future wise

Low Impact Development/Green Stormwater Infrastructure

Lay of the Land Report

On-the-ground realities in King County

Heather Trim and Cailin Mackenzie
February 2016

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Findings

Stormwater staff from all jurisdictions in King County, as well as development professionals, provided their insights about the *lay of the land* of low impact development/green stormwater infrastructure (LID/GSI) and other related stormwater issues such as education, filter systems and street sweeping.

Barriers

Five major themes emerged as knowledge gaps and barriers to implementation:

- Maintenance
- Research
- Education
- Prioritization
- Funding

Recommendations

Recommendations from staff are found at the end of each section in the report (organized by topic) and are organized by barriers below:

Maintenance

- ***Fund maintenance.*** Funding for maintenance of LID/GSI facilities is a great need at the local level. Providing a funding source at the state level, such as block grants from Ecology, could greatly improve maintenance at the local level.
- ***Create an equipment rental system or co-op.*** King County could create a co-op for equipment rental or sharing, possibly modeled after tool library programs. This would include vactor trucks, regenerative air sweepers, permeable pavement cleaners, video inspection vans and more.
- ***Develop maintenance equipment for permeable pavement, including sidewalks.**** In order to facilitate effective and cost efficient cleaning of permeable pavement, R & D is needed by manufacturers to create new equipment. This is needed both for roadways and parking lots as well as sidewalks (which have additional challenges related to width and obstacles). Suitable equipment has not yet been developed, even though staff have requested it from manufacturers.

Research

- ***Create better soil and geology maps.*** Better mapping of soils and geology is needed to understand conditions across the county. King County could potentially coordinate regional mapping, if funded by Ecology or another source.
- ***Develop cost analysis.*** Now that a large number of LID/GSI projects have been constructed in the Puget Sound region, staff would like a report (and factsheets) which develops cost-per-lifetime of different LID/GSI measures. To date, the few existing studies are primarily theoretical or are from other areas of the country. This study should include long term maintenance and repair costs for both the landowner and the municipality in relation to other forms of stormwater management.
- ***Study LID/GSI effectiveness.**** A study of the effectiveness of on-the-ground LID/GSI projects after 5, 10, and 15 years would be a useful resource.
- ***Study LID/GSI outcomes on larger scales.*** It would be helpful to conduct a study comparing areas with impervious surface with and without LID/GSI on cluster development to determine if LID/GSI requirements and incentives actually increases total impervious surface and, if so, the impact on stormwater flow and quality.
- ***Study of LID/GSI for redevelopment and retrofits.*** A study is needed on how well stormwater (and zoning, building) rules are working on redevelopment and retrofits as compared to new development.

- ***Assess overflow scenario.*** A regional or watershed-scale study is needed to determine if the impact of overflow from distributed LID/GSI facilities in major storms negates the benefits gained in streams during the rest of the year. The study should include scenarios with traditional infrastructure-only, LID/GSI-only, and a combination of traditional and LID/GSI and consider different soil infiltration variables. This study is especially important given the increased intensity storms predicted as a result of climate change.
- ***Study permeable pavement***.** A number of studies are needed to answer the following questions related to permeable pavement: What is the full life cycle for permeable pavement? How does permeable pavement fare in Pacific Northwest winter conditions (icing, longevity)? Does permeable pavement provide water quality treatment and should Ecology provide a treatment credit? Does permeable pavement hold water long enough to make a difference for flow control? Is moss a problem in terms of infiltration function? Do different media mixes inhibit moss growth? What are the impacts of winter efforts like sanding and salting? How long can permeable pavement go without sweeping and what drives the frequency?
- ***Develop permeable pavement installation standards for the Pacific Northwest.**** Uncertainty and installation variability of permeable pavement is a big concern among staff. A standard needs to be developed and accepted for mixes and installation methods for the Pacific Northwest.
- ***Study green roof function.*** Now that there are a large number of existing green roofs in a variety of both urban and rural settings in the county, staff would like a broader study to see how well roofs function for stormwater management in the Pacific Northwest. There is also a need to assess the potential for toxic leachate from underlying roof membranes and/or planting mixtures.
- ***Study local filter cartridge treatment installations.*** Staff would like a comprehensive summary report of local cities' experience with proprietary filter cartridge systems, including how well the systems are working in the field. Many of the presentations to date have been provided by the manufacturers.
- ***Study bioretention***.* More research is needed on the following: proper media mixes; nutrient leaching from compost; sources of copper, other metals, and other currently unregulated pollutants in compost; how weeds affect function; whether facilities are protecting water quality region-wide; and if different feedstocks work better than others (and does that impact what pollutants to monitor).
- ***Study ditches.**** Determining the functionality of existing ditches and enhanced ditches (ditches that have been retrofitted for bioretention), including testing water quality at ditch outfalls, would provide local cost-benefit information to inform jurisdictions of the value of enhancements as well as prioritization for enhancements.
- ***Study street sweeping***. Conduct studies to answer the following questions: What is the actual dollar savings and effectiveness of street sweeping versus catchment basin cleaning (in a variety of conditions)? How well does street sweeping work in a variety of seasons and conditions including urban, suburban and industrial? Does intensive sweeping on rural roads provide the same return as it does on urban roads?
- ***Research ideal tree mix for stormwater management.**** Most staff did not know the source of the recommended tree lists in their city code nor did they have a good idea of what would be the ideal tree mix for Pacific Northwest stormwater benefits. The ideal tree mix for the Puget Sound region, especially for street trees, needs to be well researched and defined, including consideration of long-term maintenance as well as associated maintenance issues such as leaf litter on permeable pavement and drains.
- ***Study the benefit of preserving versus planting trees on disturbed sites.*** Some staff suggest that redevelopment is an opportunity to put in healthy trees in disturbed sites rather than preserving many of the potentially vulnerable trees during construction. A study is needed to assess the long-term benefits (15 years plus) of both approaches.
- ***Research groundwater impacts, including interflow.*** Staff feel that most LID-related calculations assume that the bulk of the stormwater is going into deep infiltration, but their experience is that a large portion is moving laterally in interflow and causing local problems. Another issue is whether collective mounding from wholesale LID placement raises seasonal high groundwater levels, diminishing the distance between seasonal high groundwater and the bottom of the LID/GSI facility. There is also concern about toxic chemicals moving into groundwater and feeling that adequate study has not yet occurred. A groundwater impact study related to

implementation of the new LID requirements, specifically in terms of water quality and hydrology, would be useful.

Education and Communication

- ***Conduct social science research.**** Social science research (focus groups, surveys) is needed to determine the best terms for public comprehension of stormwater and LID/GSI. Currently used terminology is jargon-rich and difficult to comprehend by the public. In addition, it would be helpful to assess cultural nuances and whether it would be more effective to use market saturation or cycled messaging in order to maintain a high level of awareness and cooperation.
- ***Create outreach resources.**** Customizable, well researched factsheets, sample presentations and other outreach materials on key stormwater topics would be helpful for staff at the local level to use to educate their communities. Resources are needed in multiple languages and may need to be varied according to cultural context. These educational pieces need to be tested to ensure efficacy.
- ***Improve Puget Sound Starts Here.**** The Puget Sound Starts Here campaign is valued but needs to provide more information and materials that cities can use to promote BMPs and practical strategies for residents.
- ***Beef up school programs.*** There is a need to develop and enhance formal public school education curricula that educates kids about stormwater and is universally implemented in all schools across the region. There is existing curricula already being used in various jurisdictions which can be built upon.
- ***Provide resources for staff to educate decision-makers.**** Staff need customizable fact sheets, sample power points, and training to be better able to write staff reports, justify utility rate increases, and give effective council-level presentations about stormwater topics including LID/GSI.
- ***Provide stormwater utility rate justification materials.*** For cities to introduce stormwater utility fees, or increase existing ones, staff need materials to educate decision-makers and citizens about the benefit of stormwater projects and the need for robust funding.
- ***Provide maintenance education/training for the public.*** Most cities do not have the capacity to do educational programming regarding maintenance. An outside agency which could be contracted to conduct demonstrations/trainings related to maintenance of rain gardens and other LID/GSI facilities would be well received.
- ***Create LID/GSI materials for developers.*** Cities need customizable LID/GSI materials for developers that are compelling and readable (which would help planners as well).
- ***Create a fact sheet on street sweeping benefits***. An easy-to-read factsheet is needed to help staff make the case for purchasing high quality equipment and justifying staff time or contracts for running the machines frequently.
- ***Provide educational materials regarding trees.**** Staff need high quality materials to educate the public about the value of trees, the specific benefits/drawbacks of different species relative to stormwater, and guidance on installation and maintenance.

Prioritization

- ***Prioritize on a region-wide scale.*** Rather than prioritization at the local scale, a region-wide prioritization (going the next step beyond Watershed Characterizations**) that identifies the most important places for salmon and ecosystem recovery could better guide the best placement of retrofits and other proactive efforts to address stormwater problems. In doing this, a distinction needs to be made between rural and urban areas, as one size does not fit all. As the population grows we need to know what is critical to protect and what must be restored.
- ***Address highest priorities through grant programs.*** Some grant programs need restructuring to address highest priorities after doing a region-wide prioritization. Many staff pointed out that the polarization between "gray and green" solutions needs to be reduced and the focus should be on the solution that works best in each situation, which is not always LID/GSI.

Funding

- ***Continue and expand grant funding.*** Stormwater grants should be continued and expanded. Municipalities rely heavily on these grants to go above and beyond permit requirements.
- ***Simplify grant applications, lengthen grant cycle time and/or allow grant spending to bridge state fiscal periods.*** Current applications are cumbersome, especially for small cities, and the grant cycle does not work well with city budgeting timelines and construction windows. Creating an easier application process, lengthening grant cycle time, and reducing potential for funding gaps would be helpful.
- ***Broaden project eligibility.*** High priority projects that are well justified and are not LID/GSI should be eligible for stormwater grant funding. Many staff would like to address their highest priority water quality problems and LID/GSI is not always the appropriate solution.
- ***Make sure grant programs have a reliable funding source.*** Grant funding sources need to be reliable so that local governments have assurance that significant upfront investment, including planning and setting aside grant match, is a viable use of utility rate funds.
- ***Advertise King County Flood Control District grants***. This grant program, which is focused on improving failing infrastructure, can be very beneficial for addressing the repair/replacement of existing facilities, and should be better advertised to local cities.

Training

- ***Create customized trainings taught by people with on-the-ground experience.*** Ecology should offer a larger number of specific LID/GSI trainings that are customized to different audiences (maintenance staff, inspectors, permit writers) which are taught by people in those fields who have on-the-ground experience and who can offer "real life" information about what works and what doesn't work.
- ***Provide convenient trainings.*** Trainings should be offered in many locations to be more convenient for local staff. Some topics (full trainings) should be presented by webinar.
- ***Offer technical program.*** A technical program for stormwater technicians (which is more comprehensive than the current UW certificate program), including topics such as proper sampling techniques, background science, field studies, CESCL, and IDDE, could be offered at community colleges and benefit both job seekers and existing city staff.
- ***Require regional contractor training.*** Staff feel that more training is needed for construction contractors. Specific training for contractors and construction personnel could be taught by contractors and would be well attended if mandatory under the NPDES permit.
- ***Create training for upper management.*** Inspectors, especially in smaller jurisdictions, need more support from upper management for enforcement of construction stormwater requirements. Developers know which cities have less management support – thus training and education for upper management could help level the playing field.
- ***Advertise trainings broadly and in a more timely manner.*** Trainings should be marketed well in advance (especially for sequenced trainings) and to a larger number of people, including local jurisdiction management and elected officials (especially in small cities).

Policy

- ***Distinguish rural and urban conditions in guidance.*** It would be helpful if technique guidelines better distinguished rural and urban implementation.
- ***Distinguish between different scales of responsibility.*** Some stormwater management responsibilities need to be at the jurisdictional level while others can and should be done at the watershed or regional level.
- ***Develop interflow guidelines.*** Interflow (lateral movement of water due to hardpan or aquitards) is causing significant problems on neighbors' properties and municipal infrastructure. This challenge needs to be better defined and addressed in both policy and implementation of LID/GSI techniques.

- ***Develop utility trench guidelines.*** LID/GSI discharge to utility trenches as paths of least resistance has been identified as a potential problem both for intent of the stormwater facility, fate of infiltrated water, and damaging to trenched utilities. This issue needs to be addressed in both policy and implementation of LID/GSI techniques.
- ***Incorporate consideration of maintenance into TAPE program.*** TAPE (Ecology's treatment technology certification program) should consider local experience of operations and maintenance in certifications of stormwater treatment technologies.
- ***Improve rain garden standards.*** According to staff, many rain gardens are not functioning properly due to underlying soils. Improved percolation tests need to be required.
- ***Standardize treatment filter cartridges.*** Each proprietary filtration system has unique replacement cartridges. It is challenging for cities to maintain an inventory of replacements for all filter types in their city because they inherit systems from private developers. It would be desirable to incentivize use of one standardized filter cartridge.
- ***Consider banning treatment filters in some uses.*** It might be helpful to ban some proprietary systems in some uses (such as rights-of-ways) because they clog too fast for municipal maintenance schedules or require upgraded maintenance technology.
- ***Reduce toxics at the source.*** Staff at the local level are looking to the State to enact legislation to improve source control to prevent pollutants from entering the stormwater pathway. Many staff pointed out that it would be less costly if toxic chemicals were not present in the stormwater pathway and thus treatment would not be required. There also was concern that the LID/GSI approach does not remove pollutants from the system but rather, in many cases, loads them into the soil which may have to be cleaned up later.

Resources

- ***Develop a third party inspector system for bioretention facilities.*** Because of the specialized nature of bioretention facilities and the need to ensure that they are property constructed, a third party inspector system may be desirable.
- ***Increase Ecology support for enforcement.*** Staff suggested Ecology needs to play a larger role in enforcing construction permit requirements and assisting smaller jurisdictions who have trouble with non-complying contractors.
- ***Develop tracking tool***. An elegant, user-friendly tracking system for LID/GSI implementation and inspection would be helpful.
- ***Convene a green roof summit.*** Because of the breadth of local experience, it appears that a summit on green roofs to share experiences and technical improvements would be useful. Many green roofs are failing due to poor installation and maintenance (mainly in the first three years), and knowledge exchange could be helpful.
- ***Create local soil banks.*** For locations where developers are not required to stockpile soil onsite, there may be value in creating a soil bank to preserve high quality material for top soil use.

**** Near Term Action submitted.*** *Coincidently, concurrent to the development of this report, the Puget Sound Partnership solicited proposals for Near Term Actions as part of their 2016 Action Agenda update process. Thus local jurisdictions and/or Futurewise submitted proposals, as this process represents a potential opportunity for funding to implement key solutions. Appearance in the Action Agenda, which will be adopted in June 2016, does not guarantee funding.*

*****Currently being studied.*** *This project is currently funded as a study in the Regional Stormwater Management Program (see page 20).*

Thank You

We would like to gratefully acknowledge the following individuals for their assistance and expertise. As a note: We thank many people here rather than reference them in the text in order to preserve confidentiality of our interviews. While we reflect individual opinions in specific segments of the guide, the persons listed below do not necessarily support the views, findings, or recommendations of this entire document.

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Phil Messina, City of Carnation
Jim Morgan, City of Pacific
Doug Navetski, King County
Lance Newkirk, City of Pacific
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Lydia Reynolds-Jones, King County
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Kerry Ritland, City of Issaquah
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Table of Contents

List of Tables

List of Callout Boxes

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Cover photos. *Front:* Bioretention facility draining roadway. Credit: Cailin Mackenzie. Back: Parking lot at Urban Waters Center (Puget Sound Partnership headquarters), Tacoma. Credit: Heather Trim.

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1. Introduction

"Habitat restoration, salmon restoration, and stormwater retrofits all occurring concurrently and cooperatively within the same footprint will get to cleaner water faster."
- Staff from medium sized city

Stormwater management has gradually ramped up in the past decades. Clean water, under Stormwater National Pollutant Discharge Elimination System (NPDES) permits, and salmon recovery, under the federal Endangered Species Act, are the primary drivers for stormwater management in Puget Sound.

Pollutant loading and excessive flows continue to cause adverse impacts to Puget Sound ecosystems. Washington State Department of Ecology (Ecology) compiled data from the 2009-2013 Western Washington Stormwater NPDES Phase I reports. Data from 597 different storm events showed that stormwater from residential areas had the highest dissolved nutrient concentrations whereas commercial and industrial areas had relatively higher levels and more frequent detections of metals, hydrocarbons, phthalates, total nitrogen and phosphorus, pentachlorophenol, and polychlorinated biphenyls (PCBs). Across all land uses and in a large proportion of samples, copper (58% of samples), total PCBs (41%), zinc (40%), dissolved lead (28%), and mercury (17%) were present at levels that exceeded water quality criteria (WA Ecology, 2015). "Flashy" stream flows, in which surges of water enter streams and then recede quickly, have been correlated with poor ecological health of those streams (DeGasperi et al., 2009).

Low impact development (LID), alternatively referred to as green stormwater infrastructure (GSI) or natural drainage, is a technique that mimics nature by slowing and filtering stormwater. Effective LID/GSI projects help protect water quality in streams, rivers, lakes, and Puget Sound, and also help reduce flooding and combined sewer overflows. When these projects are constructed in the right places, they have been found to work well, save money, and provide aesthetic and other community benefits.

LID/GSI is poised to be universally launched in the region as municipalities meet permit requirements to update their codes to incorporate these techniques by the end of 2016.[1] Over the past 20 years, jurisdictions have begun to implement a variety of LID/GSI techniques by proactively changing municipal code, building demonstration projects, and supporting proactive developers. Staff at the local level, therefore, have experience both in use of traditional approaches and evolving LID/GSI technologies to manage stormwater.

With support from the Surdna Foundation, Futurewise interviewed staff from King County and all cities[2] within King County and others to find out the *lay of the land* of stormwater management and local experiences implementing LID/GSI techniques.

In the politically charged arena of stormwater regulations, many cities do not want to be the first to implement policy changes. It is hard for jurisdictions to be public pioneers: when everyone is moving together political

[1] All western Washington Phase I jurisdictions (i.e., 6 larger jurisdictions) were required to implement the minimum requirements, thresholds, and definitions in Appendix 1 of their permit (or an equivalent, approved program) by June 30, 2015. These requirements are derived from Ecology's Stormwater Management Manual for Western Washington (SWMMWW) as amended in 2014 (SWMMWW). Phase II (i.e., smaller jurisdictions) were required to adopt Appendix 1 or an equivalent Phase I program by December 31, 2016. Some of these dates have been modified and all must complete implementation by various dates, the last of which is December 31, 2016. The 2014 SWMMWW includes a LID Performance Standard, which requires post-developed runoff discharge durations for qualifying projects to match pre-developed durations for the range of pre-developed discharge rates from 8 percent of the 2-year peak flow to 50 percent of the 2-year peak flow. The developer can select the first *feasible* BMP from an ordered list of BMPs for site design or model an alternative approach which meets the performance standard. Ecology reviews and approves Phase I development/redevelopment programs if they chose to write their own. In the Phase II permit, permit holders have to adopt the minimum requirements, thresholds, and definitions in Appendix 1 or an equivalent, Ecology approved, program one of the Phase I's developed. In King County, some Phase II permit holders adopt King County's program.

[2] A few cities chose to answer our questions via email due to staff time constraints.

backlash can be avoided. We found, however, that all of the cities we interviewed were innovators in one way or another. Furthermore, while staff had varying degrees of support for LID/GSI, everyone said that they want to do the right thing for their city and the environment. Flow control (i.e., reduction of stormwater "flashy" flows) and runoff treatment (i.e., reduction of pollutant loading) were recognized as imperative for salmon recovery.

Staff are also grappling with the continuing need to address increasing population growth in the Puget Sound region, which brings a strong pressure for development and redevelopment. Under the State's Growth Management Act, the goal is to direct development to urbanized areas in order to protect natural resources, agricultural lands and more. Often this infill development and densification result in removal of vegetation and increase in impervious surface which limits the range of LID/GSI options. Staff in local jurisdictions are working to make it all work together for the benefit of the environment and their municipalities.

While the focus of this report is on LID/GSI, we also discuss related stormwater management issues and best management practices (BMPs) including public education, proprietary filter cartridge systems, construction BMPs, street sweeping, and tree ordinances. These issues complete a picture of what is working well and what needs improvement for local LID/GSI integration.

Methods

This report is designed to reflect the "voice" of staff at King County and the 39 cities in King County. From September 2015 through January 2016, we interviewed staff at each jurisdiction (please see acknowledgement page), although in a few cases, staff were unable to be interviewed and instead they filled out the questions electronically. We also interviewed building professionals in order to gain additional perspective. The comprehensive results of these interviews were drafted and circulated among interviewees to ensure that the findings were accurate and the recommendations were representative of staff experience. The report is organized by topic. In each section, we highlight the on-the-ground experience of King County jurisdictions and conclude each section with recommendations which reflect the opinions of local staff. These recommendations have been organized by barrier in the Findings section in the beginning of the report.

2. Resources

This section addresses staffing, training, guidance, and funding issues.

Staffing

"You don't have a lot of time to spare if you're a small city."
- Small city staff member

We found that the range of staffing for different sized jurisdictions, including staff equivalents for all functions (permitting, planning, engineering, maintenance, and inspection) was:

- Very small cities (200 to 2,000 population): 0.0 to 0.5 full time equivalent (FTE)
- Small cities (3,000 to 8,000 population): 0.5 to 5.0 FTE
- Medium cities (10,000-50,000 population): 1.5 to 12.0 FTE
- Large cities (50,000 to 140,000 population)[3]: 8.0 to 24.0 FTE

[3] In places in the report where we report ranges, we omit Seattle and King County because of their vast difference in scale and resources relative to the smaller cities.

Most cities tend to staff all functions internally, while a few contract engineering or seasonal maintenance services. The smallest jurisdictions tended to contract consultant services. Many jurisdictions contract for street sweeping services. In one small city, staff is worried that their P.E. licenses won't cover LID/GSI and they think that they will probably hire a consultant to cover LID/GSI work in the future.

Almost all respondents, especially those from smaller cities, said staff size as one of their most limiting factors in effective LID/GSI implementation, especially for adequate inspection and maintenance. We noted that there does seem to be a fair amount of turnover of staff. Many staff mentioned their previous work in other local jurisdictions which helped provide more background to their perspectives.

LID/GSI Training

"Hire trainers that actually do the work."

- A shared perspective

In almost all jurisdictions, at least some staff have attended LID/GSI training, primarily through the Ecology program at the Washington Stormwater Center in Puyallup, and also through other sources. In a few cities, staff have only had Certified Erosion and Sediment Control Lead (CESCL) certification.

While most staff had favorable comments about the Ecology/Stormwater Center trainings, there were quite a few suggestions for improvement, and a few jurisdictions said that the trainings at this time weren't worthwhile enough to warrant staff time.

Praise included:

- Trainings were helpful because staff have been thrown into LID/GSI work and it was useful to get the needed overview and design information.
- Trainings were useful and fairly comprehensive.
- Trainings had good science behind them.
- Topic-specific trainings have been helpful – for example, a training on erosion control, including a spray-on compost presentation, worked well.

Suggestions included:

- ***Content.***
    - Trainings need to be honest about pros and cons of LID/GSI, explaining where techniques work and where they don't.
    - Ecology tends to overwhelm people.
    - Trainings need to be about real life situations, rather than theoretical ones.
    - Trainings need to be matched to the right audiences (i.e., design staff should attend the existing WSU training)
    - Trainings can be sales pitches. For example, there has been "training after training on porous pavement that push techniques as opposed to real trainings about what really works."
- ***Class size.*** Some trainings fill up too fast for staff to participate. Even the basic and prerequisite classes fill early. It would be helpful to make full trainings available via webinar.
- ***Q&A.*** While content was adequate in the training module, pitfalls came up in the Q&A: trainers often couldn't answer all the questions such as "How do you maintain? What's the lifespan? How do we schedule repair and replacement? What are the funding techniques?"
- ***Advance notice.*** For sequential trainings, more lead time about the schedule is needed so that staff can plan out their year accordingly.

- ***Announcements.*** Management staff including mayors of small cities need more information on trainings available in their area.
- ***Convenience***. Staff need convenient, local opportunities for trainings. The current training location in Puyallup is convenient for southern county cities but is difficult for others. One suggestion is to host some of the trainings via webinar so that staff do not have to use up a whole day for training.
- ***Trainers.*** It would be desirable to have "a little bit of local flavor" (i.e., trainings taught by local trainers with regional expertise would be desirable).
- ***Specialized training.***
    - *Development review.* These staff have a steeper learning curve and need specialized training that answer questions like: How do you verify that what developers are proposing is meeting LID/GSI standards? How do you apply the new manual(s) in the development review process?
    - *Inspector.* Inspector trainings by WSDOT are infrequent and fill up too fast for many city staff to get in. Specific trainings on how to tell if different LID/GSI are working or not in the field is critical to ensure performance.
    - *Maintenance.* Training is needed on new techniques. Trainers experienced in LID/GSI maintenance could provide straight-forward information on "what works and what doesn't" as well as "the tricks of the trade." There was a strong feeling that the training should be taught be someone who has field experience using equipment, chemicals, and tools that have worked to maintain LID/GSI facilities.
    - *Office staff.* Training is needed for topics such as state and federal legal requirements and tools to help staff educate their decision makers.
    - *High level management.* Training is needed for upper level staff and elected officials to understand that NPDES compliance needs resources. The existing Ecology presentation designed for elected officials is lengthy, text-heavy, and doesn't effectively connect LID/GSI to salmon and Puget Sound recovery (www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/Resources/Elected BriefingsWWApresentation.pdf).
- ***Advanced program.*** A program comparable to existing Water and Sewer technical programs which would provide a strong technical and science background is desirable. Such a program could include proper sampling techniques, background science, field studies, CESCL, and IDDE, and could be offered at community colleges. Evening classes could provide career advancement opportunities for current public works staff. The proposed program would be more comprehensive than the University of Washington Professional and Continuing Education Program (www.pce.uw.edu/certificates/green-stormwater-infrastructure.html).
- ***Hands-on training.*** One city said that they would be willing to pay for "feet on-the-ground, what to look for, check your boxes" training conducted for their staff in their city.

For some, there is a feeling that the LID/GSI trainings came out too early and too much time has passed between training and the need to use the knowledge. There is a big need to train staff in 2016 before jurisdictions will be fully implementing LID/GSI per the NPDES Phase II permittee deadlines. Several cities have had to re-train their staff and do follow-up work, while other cities do not have the resources to re-train.

Many staff particularly emphasized the need for maintenance staff training. There are a large number of long-term staff (10-15 years+) who are trained and comfortable with maintenance of traditional stormwater infrastructure and who have not easily transitioned to LID/GSI approaches. There were a number of comments that field staff don't take the NPDES permit seriously.

Unique Need: Education for decision-makers

Staff need resources that they can use to help educate their decision-makers. It is difficult for local staff to pull together the components they need for staff reports and council presentations about stormwater. As noted by staff the "biggest challenge is justification …[and]…how do you tell council that you need to narrow roads?" Staff

need help justifying raising rates and addressing liability concerns. A specific suggestion was a sample PowerPoint presentation.

Staff receive these types of questions from council about topics such as reducing impervious area, including changing required widths of roads and sidewalks:

- What is it based on?
- What criteria are you looking for?
- Is it going to work?
- How do we know it will work?
- Who's liable if it doesn't work?

Making stormwater information easier to use

Following the model of the Department of Health's drinking water factsheets and online presence, there was a suggestion that stormwater information (regulations, guidelines, manuals, training information, and phone numbers for staff to answer different questions) be presented in a similar way by Ecology.

Along those lines, another suggestion is to create a "permits for dummies" that is scannable, easy to read and gives information about "here is what I have to do." Additionally, a field reference version would be helpful, without all of the detail and jargon.

Recommendations:

- ***Create customized trainings taught by people with on-the-ground experience.*** Ecology should offer a larger number of specific LID/GSI trainings that are customized to different audiences (maintenance, inspectors, permit writers) which are taught by people in those fields who have on-the-ground experience and who can offer "real life" information about what works and what doesn't work.
- ***Advertise trainings broadly and in more timely manner.*** Trainings should be marketed well in advance (especially for sequenced trainings) and to a larger number of people, including local jurisdiction management and elected officials (especially in small cities).
- ***Provide convenient trainings.*** Trainings should be offered in many locations to be more convenient for local staff. Some topics (full trainings) should be presented by webinar.
- ***Offer technical program.*** A technical program (which is more comprehensive than the current UW certificate program) for stormwater technicians, including topics such as proper sampling techniques, background science, field studies, CESCL, and IDDE, could be offered at community colleges and benefit both job seekers and existing city staff.
- ***Provide resources for staff to educate decision-makers.**** Staff need customizable fact sheets, sample power points, and training to be better able to write staff reports, justify utility rate increases, and give effective council-level presentations about stormwater topics including LID/GSI.

** Near Term Action submitted for the Puget Sound Partnership Action Agenda June 2016 update.*

Stormwater Funding

> ***"If we had funding we "would love to do LID everywhere and do it right."***
>
> \- ***Small city staff person***

We determined that county and local jurisdictions in King County spend approximately $302 million annually on stormwater management including operations, capital and grants. This total includes the City of Seattle whose budget is $110 million which includes CSO management and construction.

There is a wide range of operation and capital stormwater funding (including fees, grants, general funds) in King County cities:

- Very small cities (200 to 2,000 population): <$10,000 to $100,000
- Small cities (3,000 to 8,000 population): $100,000 to $3,500,000
- Medium cities (10,000 to 50,000 population): $700,000 to $8,500,000
- Large cities (50,000 to 140,000 population)[4]: $6,000,000 to $42,000,000

Thirty-two of King County's 39 cities support their stormwater program with utility rates or stormwater fees (see Appendix 1 for a compilation of 2016 rates: *2016 Utility fees for King County jurisdictions*). For single-family parcels, flat rates range from $7.26 to $19.73 per parcel. Some cities bill single-family parcels by impervious surface coverage, and their monthly rates range from $2.98 to $40.95 depending on impervious coverage and billing units. Most nonresidential rates bill based on impervious surface coverage, and monthly rates range from $2.98 to $275.75, depending on impervious coverage and billing units. A few cities bill nonresidential parcels with flat rates. Some cities have rates that promote onsite treatment, minimization of impervious surface and LID/GSI techniques (For an example see Callout Box for Redmond).

Redmond: *Utility rates promote minimization of impervious surface, flow control, and water treatment*

In the City of Redmond, stormwater utility rates encourage impervious surface minimization. The annual rates (per 2,000 square feet impervious) for non-single family land uses are:

- $198.72 – >0-29% impervious
- $218.64 – 30%-39%
- $238.44 – 40%-49%
- $258.36 – 50%-59%
- $278.16 – 60%-69%
- $298.08 – 70%-79%
- $318.00 – 80%-89%
- $337.80 – 90%-100%

Rates are discounted significantly for flow control and water quality treatment.

More info: www.redmond.gov/Government/FinancesandBudget/UtilityBilling/GeneralRates/

Some cities have not updated their rates in 8 to 15 years. Staff reported that when their cities have raised their rates they used comparable existing rates in other jurisdictions as justification.

For cities without stormwater fees, several staff mentioned that there have been efforts to establish fees, as it is a challenge to have street and stormwater funds integrated rather than separated out.

For wealthier small cities, stormwater is funded from general operating budgets and sometimes partially from street funds. One of these cities has a robust capital program from real estate excise taxes.

Incentives built into the fees

In addition to encouraging pervious over impervious coverage of lots, the fees include a number of additional incentives, such as:

- Rebates for use of stormwater BMPs including detention and flow control with demonstrated *maintenance*.
- Discounts for infiltration facilities.
- Discounts for water quality treatment facilities.
- Discounts for approved LID/GSI facilities.
- Discounts for detention/retention based on capacity size LID/GSI.

Stormwater fees don't tell the whole story

Some cities are significantly better funded because of high commercial presence, robust grant funding, short-term priority projects, and other factors.

[4] In places in the report where we report ranges, we omit King County and Seattle because of their vast difference in scale and resources relative to cities.

Supplemental funding

Some cities rely heavily on Ecology grants to supplement their fee. Quite a few people mentioned that King County Flood Control grants have become a useful source of funding. In at least one jurisdiction, Federal Community Development Block Grant (through King County) for sidewalks and stormwater have been significant for retrofits.

Recommendations:

- ***Provide stormwater utility rate justification materials.*** For cities to introduce stormwater utility fees, or increase existing ones, staff need materials to educate decision-makers and citizens about the benefit of stormwater projects and the need for robust funding.

Pros and Cons of Ecology versus King County Manual

"Competition between manuals is good – it makes for better product."
- Small city staff member

About half of King County Phase II cities reference Ecology's *Stormwater Management Manual for Western Washington* and about half reference King County's equivalent manual. Many staff are satisfied with their manual but some told us that they inherited the use of one or the other and it is too difficult to switch to what they consider the better manual. One staff person said that they "wish they could use the Ecology manual for better consistency with permit requirements." While another staff person said "The layout of the Ecology manual makes following the requirements very difficult."

The reported advantages of the Ecology manual include:

- Ability to "cherry pick" techniques that work best.
- Ease of permit compliance without worry about "acceptance of the most current manual."
- Greater flexibility and "more options to create a system that functions with the site."[5]

The reported advantages of the King County manual include:

- It is more up-to-date.
- On-the-ground realities that are better reflected.
- It is more readable and more layperson-oriented.

There were a number of comments by staff of small cities that a better distinction needs to be made between urban and rural conditions in guidance.

Recommendations:

- ***Distinguish rural and urban conditions in guidance.*** It would be helpful if technique guidelines better distinguished rural and urban implementation.

[5] King County staff report that they have been aware of these concerns and have worked to make the revised (2016) King County manual more oriented towards providing flexibility in meeting the LID/BMP requirements of Ecology stating that "We provide a more cafeteria approach where permeable pavement, bioretention, and limited infiltration are equal choices. We provide a list approach alternative to Ecology's requirement to model the LID Performance standard on large, rural lots."

Ecology Grants

"Without Department of Ecology grants, our city would be able to meet permit requirements but not do anything proactive."

- Small city staff person

Many staff spoke of how appreciative they are for the Ecology grants for capacity support, retrofit work, equipment purchases, and education. There were, however some suggestions as to how the grant program could work better for local jurisdictions, especially small cities:

- ***Relax requirements for terminology.*** Some find that the limitation "to use convoluted terminology in grant requirements" is inappropriate as they would like to use clearer terminology with the public, developers and contractors.
- ***Revise grant cycles.*** The grant cycle is not synced with the local budgeting cycles and would be more accessible with 3-4 year funding windows and the removal of gaps, especially for small cities. One city, for example, missed a whole year of funding due to timing issues. Their capacity grant, used to fund street sweeping, shifted from a biennium schedule to a fiscal year schedule, which cut off funding six months earlier and greatly limited street sweeping capacity during the wet season.
- ***Increase funding for operations.*** According to staff, capital grants almost always get the bulk of the funding. There is a great need to support both operations and capital projects.
- ***Improve cumbersome application system.*** Staff said that Ecology grants are difficult paper-work wise, especially for smaller cities, and that the EAGL system in particular is not user friendly.
- ***Clarify funding confusion.*** Some staff are not sure how much can be reimbursed on what schedule.
- ***Fund non-LID/GSI retrofits.*** Some staff feel that while LID/GSI is appropriate in many places, there are high priority retrofit situations from an ecosystem perspective and a non-LID/GSI retrofit is a better solution - yet "Ecology says retrofits have to be LID/GSI."
- ***Make filters eligible.*** Staff wonder why Ecology is not willing to pay for filters even though they are included in their specifications.
- ***Offer block grants.*** One suggestion is that Ecology provide block grants to jurisdictions for certain activities each year (not replacing utility fees). This is desired because the average cost to apply for a capital projects grant is $10,000 in staff and consultant time due to the requirement of 10% predesign and having to fulfill a large number of requirements. This cost of application artificially recuses smaller jurisdictions from applying. With a block grant, cities could send a report at the end to qualify for another round instead of applying.

Recommendations:

- ***Continue and expand grant funding.*** Stormwater grants should be continued and expanded. Municipalities rely heavily on these grants to go above and beyond permit requirements.
- ***Simplify grant applications, lengthen grant cycle time and/or allow grant spending to bridge state fiscal periods.*** Current applications are cumbersome, especially for small cities, and the grant cycle does not work well with city budgeting timelines and construction windows. Creating an easier application process, lengthening grant cycle time, and reducing potential for funding gaps would be helpful.
- ***Broaden project eligibility.*** High priority projects that are well justified and are <u>not</u> LID/GSI should be eligible for stormwater grant funding. Many staff would like to address their highest priority water quality problems and LID/GSI is not always the appropriate solution.
- ***Make sure grant programs have a reliable funding source.*** Grant funding sources need to be reliable so that local governments have assurance that significant upfront investment in planning and setting aside grant match is a viable use of utility rate funds.

- ***Advertise King County Flood Control District grants***. This grant program, which is focused on improving failing infrastructure, can be very beneficial for addressing the repair/replacement of existing facilities, and should be better advertised to local cities.

3. Talking about stormwater

"We try to use plainspeak that people can visualize"
- Medium city staff person

Almost universally, we found that staff lack good terminology for talking with the public about stormwater issues and LID/GSI techniques. Staff agreed that social science research is needed to develop jargon-free wording that is accessible.

There was a feeling that public understanding about stormwater management is increasing. On the other hand, one staff person mentioned that he had been asked "can you please speak English?" while discussing stormwater at a public meeting. Stormwater communication appears to still be in its infancy.

Terms and concepts that staff use now include:

For stormwater:

- Terms:
  - *Runoff*
  - *Drainage*
  - *Erosion* – for the city that suggested this term, sediment is the number one pollutant and people understand and relate to erosion.
  - *Flooding* – a motivating term that grabs people's attention.
  - *Rain* – accompanied by an explanation of where it goes and how it picks up pollution on its way through the storm system.
  - *Surface water* - people hear stormwater and automatically think sewer. Surface water can be better in some circles.
  - *Stormwater pollution* or *polluted stormwater runoff* – emphasizes that action is needed.

- Concepts:
  - "Where do you think this water comes from? What happens when it rains really hard?"
  - Educate people on how they affect stormwater with their lifestyles.
  - "Keep clean water clean, reduce dirty water as much as possible to reduce downstream impacts."
  - "Only rain down the drain."
  - "Everything that's on your lawn and on your car and on your street ends up in the stormwater."
  - What the rain picks up: oils on the road, dog poop on the lawn.
  - And finally, "Damn, I have water in my basement!"

For LID/GSI and Best Management Practices (BMPs):

- Terms:
  - *Rain garden* - more accessible than *bioretention* and people understand what they are
  - Conversely: Avoid *rain garden* because every constructed one has failed due to improper maintenance. This staff person preferred the terms *bioretention* and *bioinfiltration* which he explains as a grassed area with enough soil underneath it to treat water before it drains.

    - *Green techniques* or *environmentally friendly techniques*
    - *Infiltration* – more understandable than LID/GSI to the general public.
    - *Permeable pavement* – most people understand it and other concepts are harder to describe.
    - *Green Infrastructure* – a snappy term.
    - *Conservation landscaping* – term from Maryland that people understand with explanation (amending soils, planting natives).
    - *Swales*
- Concepts:
    - "Mimic nature to infiltrate water."
    - Message of LID/GSI has been lost in just installing more rain gardens.
    - LID/GSI treats and disposes (discharges) stormwater close to the point where the rain falls.
    - "Would you rather have ditches for drainage or giant puddles?" – to address concerns people have about installation of ditches which are perceived as taking away parking along the streets.
    - Distinguish how water moves horizontally when it hits roofs and asphalts versus vertically when it hits the ground and goes down into it.
    - "Trying to protect streams and recover salmon by managing impacts of development."
    - LID/GSI is "mimicking mother nature."
    - "Using the ground as a sponge."
    - "Working to make sure that when it rains, all the rain stays pretty close to where it lands."
    - "Helps manage stormwater so it is clean when it reaches Puget Sound and doesn't hurt anybody along the way (people, fish, property)."

Social science research is needed

Overall, staff felt that we need to do a better job of telling the story. One person commented, "Water quality, habitat restoration, and salmon recovery need to be upfront all the time" when we discuss stormwater. There was a specific suggestion that foundational research for messaging is necessary and that focus group research would be a good pairing with the STORM group (STormwater Outreach for Regional Municipalities). STORM appears to be filling important needs but has not had the resources to conduct messaging research. Seattle did conduct some focus groups a few years back that led to their use of the term "natural drainage solutions."

As a note, smaller city staff said that they appreciate collaborating with bigger cities on education/outreach efforts.

Improved educational factsheets and outreach materials are needed. While there are some compelling examples – US Environmental Protection Agency (EPA) has developed a relatively attractive set of fact sheets entitled Barrier Busters which are designed for decision makers (www.epa.gov/polluted-runoff-nonpoint-source-pollution/urban-runoff-low-impact-development) - zippy, memorable pieces with slogans such as "Don't Mess with Texas" and "Save the Crabs, Then Eat 'Em" (Chesapeake Bay) are missing for most stormwater topics.

Figure 1. Puget Sound Starts Here plaque on catchment basin

There are also needs to be more of an effort to investigate cultural nuances in communication; messaging may need to be varied and nuanced. Outreach and educational materials are needed in multiple languages.

Critically, educational pieces need to be tested to make sure they are effective before distribution.

Puget Sound Starts Here Campaign

While staff were appreciative that this broad public awareness campaign – the Puget Sound Starts Here media campaign – has been established, there are concerns that the campaign needs improvement to be more usable by local jurisdictions. The website is not as effective as desired and needs less focus on lifestyle and more focus on BMPs and practical strategies. The Puget Sound Starts Here campaign has suffered recently from a lack of funding.

An unanswered question for broadcast messaging such as the Puget Sound Starts Here Campaign and its component campaigns is whether it is better to saturate the market on an ongoing basis or to create cycles of messaging in order to maintain a high level of awareness and cooperation by the public about stormwater issues.

Vigorous school programs

Many people commented that schools are a potent way to build public awareness about stormwater issues and that stronger school programs would be a great asset and a good investment. Some cities offer robust education programs in their local schools (See Callout Box for Federal Way). One city said that they have considered buying the American Public Works Association's curricula for elementary school kids.

Federal Way: *Storming the Sound with Salmon education program*

Federal Way's *Storming the Sound with Salmon* program links salmon to stormwater in elementary and middle school classrooms. The program has been implemented in 26 schools, reaching thousands of children. Curricula includes:

- Designing rain gardens
- Aquariums in classrooms to raise fry
- Salmon release events

More info: http://wa-federalway.civicplus.com/DocumentCenter/View/4505

It is surprising that after more than two decades of environmental education work by agencies and nonprofit organizations there appears to be a deficit of a universal school program/curricula in Washington related to stormwater issues that is implemented for all students. There are isolated programs in some jurisdictions. One idea involved Ecology presenters visiting all schools in the region. Another idea involved the *Puget Sound Starts Here* campaign taking on regional stormwater education in a significant way, building on the Drain Ranger curriculum (www.pugetsoundstartshere.org/drain-rangers) and other sources.

One city suggested that gauging efficacy of current education and outreach would be valuable but would need to be conducted regionally as it would be too expensive for one city alone to do a study that is statistically viable.

Workshops

Several cities regularly offer workshops for residents, taught by guest speakers, on topics such as using rain barrels and building rain gardens.

Role of nonprofit organizations in shaping stormwater awareness culture

Some staff feel that nonprofit organizations can help create demand and appreciation for stormwater management and LID/GSI techniques by doing cultural shaping and social marketing work. Presentations to homeowner groups, media advertising, public awareness campaigns and other strategies could help develop a needed ethic of environmental care that translates to property owner responsibility. We need to help let people know that their property is a piece of a whole landscape and decisions on their property affect everyone. The current "how little can I do?" feeling by some could shift more to a culture of "What do I need to do to make sure my development won't be an issue?"

Incentives for homeowners

A few cities offer rebate programs and other voluntary incentives for homeowners (See Callout Box for Shoreline, Kirkland and Seattle examples).

Shoreline: *Soak It Up rebate program for rain gardens and native vegetation landscaping*

The City of Shoreline's *Soak It Up* rebate program provides funding for LID/GSI retrofits including rain gardens and native vegetation landscaping on private property. Rebates are $2 per square foot of contributing area treated and/or hard surface converted, min. 400 sf. And mx. 800 sf., up to $1,600 per property. Requirements to receive a rebate include:

- Initial site visit
- Design and installation criteria compliance
- Signed covenant
- Final inspection

More info: www.shorelinewa.gov/SoakItUp

Kirkland: *Yard Smart Rain Rewards site visit and rebate incentive program*

The City of Kirkland, in an effort to reduce runoff from single-family homes, offers an incentive program for homeowners. Selected homeowners receive a free site visit that measures how much runoff a property produces, recommendations for reducing runoff, and sizing/location guidance for potential LID/GSI. Homeowners that receive a site visit are eligible for a retrofit rebate for installation of these approved practices (recommended by the site visit for the specific site):

- Downspout disconnection
- Tree planting
- Soil amendments
- Pavement removal
- Conservation landscaping
- Permeable pavers
- Cisterns
- Rain garden

Seattle: *RainWise rebate incentive*

The City of Seattle's *RainWise* rebate program provides education materials for homeowners as well as rebates averaging $4,000 for rain gardens or cisterns in targeted sewer overflow basins.

More info: www.seattle.gov/util/rainwise

Education and communication resources

Staff suggested specific resources that would be helpful:

- A factsheet with new data about effectiveness of impervious surfaces.
- Information to justify LID/GSI and stormwater BMPs and requirements. LID/GSI is more difficult to justify than other requirements like ADA.
- LID/GSI cost-benefit data. Staff get asked "What numbers are you talking about? What is the benefit? What design standards are people using to get different benefits?"
- Presentations by Ecology or Puget Sound Partnership. Regional speakers are needed to present to local council members about the NPDES program.

Rain gardens as a communication tool: Hate 'em or Love 'em

Some staff were highly enthusiastic about the use of rain gardens as a way to communicate to the public about stormwater. Others emphatically disliked the use of the term at all and felt that it misleads people or that there is too much of a singular focus on rain gardens in outreach messaging to the detriment of other concepts and techniques.

One staff person told us that an Ecology grant required the use of the term "biofiltration," but his City leans towards using the term "rain garden" as a more understandable term for the public.

Recommendations:

- ***Conduct social science research.**** Social science research (focus groups, surveys) is needed to determine the best terms for public comprehension of stormwater and LID/GSI. Currently used terminology is jargon-rich and difficult to comprehend by the public. In addition, it would be helpful to assess cultural nuances and whether it would be more effective to use market saturation or cycled messaging in order to maintain a high level of awareness and cooperation.

- ***Create outreach resources.**** Customizable, well researched factsheets, sample presentations and other outreach materials on key stormwater topics would be helpful for staff at the local level to use to educate their communities. Resources are needed in multiple languages and may need to be varied according to cultural context. These educational pieces need to be tested to ensure efficacy.
- ***Improve Puget Sound Starts Here.**** The Puget Sound Starts Here campaign is valued but needs to provide more information and materials that cities can use to promote BMPs and practical strategies for residents.
- ***Beef up school programs.*** There is a need to develop and enhance formal public school education curricula that educates kids about stormwater and is universally implemented in all schools across the region. There is existing curricula already being used in various jurisdictions which can be built upon.

** Near Term Action submitted for the Puget Sound Partnership Action Agenda June 2016 update.*

4. Communication between cities

"Collaboration is key in the stormwater industry."
- Appreciative small city staff member

Generally, staff feel they have good channels for communication with staff at other cities about stormwater issues. Many people said other local jurisdictions have been helpful and supportive.

There were a large number of ongoing coordination and collaboration meetings mentioned by staff. These meetings are at various levels – some at staff level, some at elected official level. Many focus on stormwater while others occasionally include stormwater-related issues on their agendas. The mentioned meetings included:

- American Public Works Association (APWA) Public Works Director meetings
- American Public Works Association (APWA) Surface Water Manager meetings
- Central Permit Coordinators meetings
- East Side Jurisdictions Planning Director meetings
- King County Climate Change Collaborative (K4C) (climate change)
- King County Flood Control District meetings
- King County Sustainable Cities Roundtable
- North Sound Coordinators Forum
- Phase 1 Permit Coordinators meeting
- Puget Sound Ecosystem Monitoring Program (PSEMP) Stormwater Work Group meetings
- Puget Sound Partnership ECO Net meetings
- Puget Sound Regional Council (PSRC) meetings (Transportation and Environmental)
- ROAD MAP (Regional Operations and Maintenance Program) forums
- Salmon Recovery Council
- Snoqualmie Valley Cities City Manager meetings
- Snoqualmie Watershed forum
- SOGGIES - South King Stormwater Outreach Group
- SOGGIES - North King County Stormwater Outreach Group
- Sound Cities Association
- South King County Public Works Director meetings
- South Sound Phase II Coordinator's Group
- Stormwater Inspectors Group
- Stormwater Outreach for Regional Municipalities (STORM) meetings
- WRIA 7 meetings
- WRIA 8 meetings
- WRIA 9 meetings

Short term or ephemeral meetings mentioned include:

- Advisory Council for Cedar River Corridor Plan
- Basin planning meetings in some specific areas
- Bioretention Seminar
- Puget Sound Regional Council (PSRC) Federal funding forum (related to transportation)
- Green River System Wide Improvement Framework (SWIF) Technical Advisory Committee
- Ecology and US EPA Green-Duwamish Watershed Pollutant Loading Assessment meeting
- Puget Sound Partnership Stormwater Strategic Initiative meetings
- Puget Sound Partnership/Dept. of Commerce "Building Cities in the Rain" meetings
- Total Maximum Daily Load (TMDL) meetings in some specific areas

Small cities have different needs.

In smaller cities, staff have many roles and are well rounded in their knowledge. For example, "The smaller the city, the more informed the Public Works Director is on 'in the weeds' issues." Critically, staff of small cities don't have time to go to regional coordination meetings as they are too overloaded with day-to-day operations. Many of these staff said that they attend meetings on an as-needed basis and find summaries and minutes helpful if they are unable to attend.

Some cities have the burden of being two-county cities with two sets of meetings.

How useful are the meetings?

Some staff say that they used to participate frequently in some regional meetings but feel that they are "not helpful anymore, not productive because they became a complaint sounding board." Overall, though, staff spoke highly of the coordination and educational function of the meetings and said that they try to attend as often as possible.

5. The challenge of infiltration in Western Washington

"Existing maps are horrific."

- Medium sized city staff person

The complex geology of the area means that soils and underlying formations vary significantly over short distances. As a result, the infiltration characteristics of soils have huge variety, sometimes on scales as small as single parcels. Some cities have gravel and sand outwash sediments with excellent infiltration properties, while others have mostly glacial till with poor infiltration. Others have silt and clay rich formations, such as that formed by the historic Osceola mudflow in south King County, which occur at or near the surface and act as highly effective aquitards with little or no infiltration, creating the potential for significant lateral movement of water.

Most King County cities have mixed infiltration potential, with just a few cities reporting good infiltration across their entire jurisdiction. A few cities reported virtually no infiltrative areas. Some of these cities have high groundwater with frequent ponding at the surface. Others are coastal cities with steep slopes that already have major problems with water flooding into down gradient properties. Some cities have areas which are constantly seeping with groundwater outletting to the surface in continuous flow onto some streets.

Lack of maps.

Staff expressed a need for better maps. Currently, there is a lack of detailed, fine resolution maps that show soil characteristics for King County. Most cities rely on older United States Geologic Survey (USGS) maps. One city estimated that it would cost $350,000 for a detailed map in their 16-square mile jurisdiction that showed geology,

slopes, lithology, and feasibility of LID/GSI and infiltration. One idea for a regional map involved compiling existing data from site-level geotechnical reports, septic system installation reports, and well logs.

Several people asked if such mapping would allow cities to declare LID/GSI to be infeasible in areas of their cities and thus remove the requirement for developers to perform geotechnical assessments in those areas.

Seattle has developed an "areas unsuitable for infiltration" map layer as an aggregation of relevant GIS layers, including underlying bedrock, contaminated soils, steep slopes and set-backs from steep slopes. Developers do not need a geotechnical report to eliminate infiltrating onsite BMPs in these areas. Non-infiltrating BMPs such as biofiltration, bioretention with an underdrain and liner, stormwater cisterns, green roofs, and tree planting are still permitted and promoted in these areas (Seattle, 2015).

In addition to maps, it was pointed out that on-the-ground experience should be better tapped and specifically that one should, "listen and acknowledge 'local knowledge.' People who have resided in neighborhoods or areas have a surprisingly in-depth knowledge about the geology, hydrology, and soils of the area."

Interflow challenge

One major concern is that aquitards (hard clay-rich layers, also called 'hardpan") in some areas tend to catch infiltrating water which then moves laterally and surfacing - creating wet spots – or causing flooding in adjacent basements that didn't have previous problems. This "interflow" movement of groundwater is not a problem if it is deep enough or in large lot areas, but in denser urban areas or areas with hilly terrain, interflow can be a significant challenge.

Current geotechnical tests do not necessarily include sufficient lateral observations or include soil cores that go deep enough to fully investigate potential lateral interflow problems. Geotechnical professionals generally look at property and surface flowpath but don't look at adjacent properties, partly because there is a legal barrier to entering neighboring properties.

One staff person pointed out that in urbanizing areas, water that used to evapotranspirate through trees, vegetation and surface soils may now be transported by LID/GSI into lateral interflow conditions. Extra scrutiny is necessary to consider movement of water to adjacent properties in densifying areas that incorporate LID/GSI techniques.

Staff expressed hope that the new manuals will recognize this problem and will require more consideration of site-specific conditions such as aquitards and potential for lateral problems, including investigation of neighboring properties. Current feasibility standards, which require less than 5% slope and infiltration rate greater than 0.3 inches per hour, do not currently incorporate potential downstream/down gradient problems related to interflow conditions.

The 2014 Ecology manual and the draft 2016 King County manual (King County 2016) address interflow primarily as a significant potential occurrence in glacial till soils to be added as a factor into modeling calculations. The manuals also mention concerns about development negatively impacting interflow. In terms of assessing the potential impact of LID/GSI facilities to increase interflow, the only requirement is:

> If onsite infiltration may result in shallow lateral flow (interflow), the conveyance and possible locations where that interflow may re-emerge should be assessed by a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. This will likely require placement of ground water monitoring wells to determine existing ground water gradients and flow. In general, a minimum of three wells associated with three hydraulically connected surface or ground water features, are needed to determine the direction of flow and gradient (Ecology, 2012).

There is no mention of the requirement or need to conduct offsite investigations.

The *Puget Sound Partnership LID Manual*, on the other hand, does have a more robust discussion of negative impacts of increased interflow on neighboring properties. The manual addresses interflow for projects required to meet NPDES minimum requirements 1 through 9 but does not specify in detail how this should be assessed. It states: "If on-site infiltration might result in shallow lateral flow (interflow, the conveyance and possible locations where that interflow may re-emerge should be assessed by a certified soils professional. This will likely require placement of groundwater monitoring wells to determine existing groundwater gradients and flow" (PSP, 2012). As with the Ecology and King County manuals, no offsite investigations are explicitly required.

Elsewhere in the LID Manual, required technical assessments as part of Stormwater Site Plans are described. The description of this assessment focuses on depth to groundwater and other site characteristics but offsite features only relate to flooding, steep slopes, aquifer and wellhead protection areas (PSP, 2012).

The rain garden handbook (WSU, 2013) contains recommendations for siting rain gardens and testing soil but does not address the issue of potential interflow.

A key question is "Does LID/GSI work on hard pan?" The answer appears, in part, to depend on development density.

Utility Trenches

LID/GSI discharge to utility trenches as paths of least resistance has been identified as a potential problem for the intent of the LID/GSI facility, the fate of infiltrated water hydraulically, and potential damage to trenched utilities. This issue needs to be addressed in both policy and implementation of LID/GSI techniques.

Cumulative impact on groundwater mounding

In addition to interflow, staff expressed concerns about whether there may be collective mounding from wholesale LID/GSI placement which raises seasonal high groundwater levels, diminishing the distance between seasonal high groundwater and the bottom of the LID facility. That is, is post-LID/GSI distance to seasonal high groundwater less than distance to pre-LID/GSI seasonal high groundwater, and what are the ramifications for groundwater protection? This needs to be studied.

Recommendations:

- ***Create better soil and geology maps.*** Better mapping of soils and geology is needed to understand conditions across the county. King County could potentially coordinate regional mapping, if funded by Ecology or another source.
- ***Research groundwater impacts, including interflow.*** Staff feel that most LID-related calculations assume that the bulk of the stormwater is going into deep infiltration, but their experience is that a large portion is moving laterally in interflow and causing local problems. Another issue is whether collective mounding from wholesale LID placement raises seasonal high groundwater levels, diminishing the distance between seasonal high groundwater and the bottom of the LID/GSI facility. There is also concern about toxic chemicals moving into groundwater and feeling that adequate study has not yet occurred. A groundwater impact study related to implementation of the new LID requirements, specifically in terms of water quality and hydrology, would be useful.
- ***Develop interflow guidelines.*** Interflow (lateral movement of water due to hardpan or aquitards) is causing significant problems on neighbors' properties and municipal infrastructure. This challenge needs to be better defined and addressed in both policy and implementation of LID/GSI techniques.

- ***Develop Utility Trench Guidelines.*** LID/GSI discharge to utility trenches as paths of least resistance has been identified as a potential problem both for intent of the stormwater facility, fate of infiltrated water hydraulically, and potential damage to trenched utilities. This issue needs to be addressed in both policy and implementation of LID/GSI techniques.

6. LID/GSI big picture issues

"LID/GSI is finding the solution that uses the fewest resources and has the best long-term outcome."
-A small city staff person

LID/GSI techniques have been gradually introduced over two decades and will be implemented regionally in about a year. This report is intended to assess the current *lay of the land* of LID/GSI and related stormwater management approaches from the point of view of local staff. The picture is mixed.

A fair number of cities have embraced LID/GSI, installing many project sites and encouraging or requiring developers to implement LID/GSI techniques. Other cities require infiltration where soil conditions allow, but are not calling it LID/GSI (and are shying away from the use of the term LID/GSI, partly for political reasons). A few cities have done demonstration projects but do not have any private development that has used LID/GSI. A few cities feel negatively about LID/GSI and believe the required techniques will not succeed in their community.

City versus county priorities

Most of the staff we talked with from cities had a primary focus on water quality and thus on treatment. By contrast, the county (with a large rural land base) and other more rural jurisdictions had a primary focus on controlling water flow. A few suburban cities also shared the hydrology focus. These different priorities lead to different technique preferences. The King County manual, however, does seem to approach all techniques evenly.

Overflow scenario

We heard comments about regulations creating a "doubling up" situation. Generally, if a property owner wants to do LID/GSI on their site and there is discharge into a stream, they are still required to build a detention system and are only allowed a reduction in detention size. Landowners have to build two separate facilities instead of one and may have to spend more money (and vault size reduction isn't that much of an incentive). Thus there is not much motivation to construct the LID/GSI component. In one city, staff explained that the threshold for detention is at a single lot level (500 square feet), which is different from Ecology's level. As a largely residential city, if they didn't have single lot level requirements there would be no flow control.

This point of view is echoed by developers: "Most jurisdictions are layering LID/GSI on top of doing traditional detention systems and increasing costs. On infill city lots, it always costs more to do LID/GSI; for one thing, they require tie-ins for overflow."

King County modeling supports this approach for situations in which flow control is important for fish protection, to avoid flashiness in streams. According to staff, multiple modeling studies have shown that one cannot achieve flow control standards with just one approach and that both traditional and LID/GSI approaches are needed. BMPs only address a certain set/size of storms and when the onsite control capacity is exceeded, a more traditional system backing up LID that takes care of larger storms, especially in the context of climate change and larger storms, is needed. Basically, flow control BMPs and detention facilities address two different flow regimes. BMPs don't address the larger flow that has a big impact on fish due to flashiness.

A significant question is whether when the distributed LID/GSI facilities all "overflow" in major storms, the impacts in streams essentially wipe out the ongoing benefits realized in smaller storms. A study is needed to determine if this overflow scenario will have adverse effects, especially with predicted increased intensity storms with climate change. The study should consider LID/GSI-only, traditional-only, and combination scenarios.

Why do private developers use LID/GSI?

Other than in the few cities where LID/GSI is already significantly integrated in code (including Seattle and King County to meet Phase I permit requirements), the primary motivation for developers to use LID/GSI is the opportunity to market properties as green. In addition, existing motivators in the Ecology and King County manuals spur the use of LID/GSI by allowing reduced size of required vaults and other detention features (one staff person referred to them as "super-sized" ponds) which saves money, depending on location. Other cities currently offer other LID/GSI incentives like density bonuses or allowed height increases. Many cities had examples of subdivision developers who installed narrower streets, permeable pavement, bioswales and other techniques in order to reduce or eliminate a required pond or vault.

Communicating the change

Many staff said that there is strong resistance to change from developers: they tend to be comfortable doing things the way they have or they have little drive for innovation. On the other hand, some developers are just saying "tell us what we can do," but city staff don't have time to describe all of the science. Staff have limited time to work on each project and suggested that it would be helpful to have compelling, readable LID/GSI materials for developers – these materials would help planners as well.

In one city, most land is in a critical area (due to slopes), and so their Critical Areas Ordinance already requires LID/GSI (keep water on site). Homeowners say "If my home wasn't designed this way originally, why do I have to do it now?" Helping developers and residents understand what this means and how it works is a big struggle.

What the market demands

Staff noted that:

- Builders generally envision a product that requires 70% of the lot to be covered.
- People generally want large houses, small backyards, 2-car garages, and large driveways.
- Multigenerational families in same house thus desiring larger homes.

Cost motivators

While developers of subdivisions are not motivated by reduced stormwater fees for homeowners, implementing LID/GSI techniques can save costs in some areas. Staff pointed out that even in areas with bad infiltration, increasing storage volume by adding more rock is still cheaper than building huge vaults.

In other, often more urbanized areas, stronger financial motivators may be needed in addition to updated regulations. One example of this approach is the general capacity charge put in place by the City of Sammamish (See Callout Box for Sammamish).

Sammamish: *General capacity charges for development*

The City of Sammamish collects surface water system development charges:

- $1,491 for new residential dwelling units or commercial buildings with ≤2,500 sq. ft. impervious coverage
- $149.10 for other structures or additions with ≤250 sq. ft. impervious coverage
- $149.10 for each additional 250 sq. ft. impervious coverage in both categories.

These general capacity charges motivate developers to minimize impervious surface

More info:
www.codepublishing.com/WA/Sammamish/mobile/?pg=Sammamish13/Sammamish1315.html

Other motivators

In 2008, one city updated zoning code for mixed use and residential use. A new section provided opportunities for flexible alternatives, including LID/GSI for developers using incentives. LID/GSI Incentives included expedited

processing and density bonuses. To date, no one has taken advantage of this LID/GSI incentive. Staff felt that that the incentive program was not successful and perhaps it didn't make sense to developers.

According to one staff person with experience in Snohomish County, expedited review there is worth a lot to developers. Time is money, and faster permitting can be very motivating for the developer. In small cities, however, "there is no such thing as expedited review. We need city staff trained in LID/GSI to have expedited review."

King County integrates LID/GSI and other stormwater improvements into its Sustainable Infrastructure Scorecard, a holistic approach to making county capital projects more green (See Callout Box for King County).

Tracking lacking

Most cities do not have a good system to track locations of LID/GSI and associated stormwater features in their cities on private properties. Staff don't know what's in their city if they're not notified. Only some cities have solid numbers. In addition, not all jurisdictions have clear procedures for inspection and it is not always clear in the permit about when maintenance is required. Staff recommended the development of an elegant tracking system for LID/GSI implementation and inspection.

King County: *Sustainable Infrastructure Scorecard*

King County uses a point-based system for its own capital projects to fulfill their Green Building and Sustainable Development Ordinance, rewarding categories related to stormwater including:

- LID techniques
- Rainwater harvesting
- Green roofs and vegetated areas
- Erosion control BMPs
- Long-term maintenance plan
- Minimizing development footprint
- Preserving native vegetation
- Reusing native soils
- Increasing social equity

More info:
http://your.kingcounty.gov/solidwaste/greenbuilding/scorecard.asp

Variability of stormwater credits

Different jurisdictions currently offer different stormwater credits, creating a mosaic for developers who work across the region. While this variability will be reduced with new manuals, staff believe that good regional standards have to be developed from the bottom up. Cities need to buy in to the approach. In addition, there are differences in political leadership and development pressures which reinforce the variability.

What is the best bang for the buck?

Staff suggested that if one really wants to improve water quality, it would be best to address low hanging fruit in priority ecosystem areas. For different cities catch basin cleaning, street sweeping, filter vaults or LID/GSI had the most cost-effective impact on water quality. More discussion on prioritization is on page 56.

Liability, access, and criteria issues related to inspection

There are concerns about some LID/GSI techniques regarding inspection. For example, if someone puts in a green roof, staff need a right of entry to inspect it. Other staff raised the question of inspection on private property and lack of ability to see into back yards. One solution is access easements.

What if LID/GSI doesn't work?

There is a feeling among some staff that projects are being done with good intentions, but without knowledge about what makes LID/GSI successful and without protections if projects fail. Staff concerns include: "What happens if the engineered design doesn't work? Does the City need to require a bond?"

One staff person thought monitoring the effectiveness of LID/GSI on private properties was critical for widespread success. He "would be surprised if any LID/GSI on private property worked after a period of time due to lack of maintenance, unless it is a commercial property where they have money to make sure systems are maintained."

To help answer some of these questions, the Regional Stormwater Monitoring Program (RSMP), in conjunction with the Puget Sound Ecosystem Monitoring Program (PSEMP) Stormwater Work Group, is monitoring the effectiveness of some LID/GSI techniques (www.ecy.wa.gov/programs/wq/stormwater/municipal/rsmp/effective.html). The current studies include:

- Effectiveness of bioretention soil mix to remove toxicity from highway runoff (WSU Stormwater Center).
- Effectiveness of individual and collective BMPs (bioretention planter boxes, Filterra units, and detention tanks) to treat highway runoff discharging to Echo Lake (King County).
- Effectiveness of large scale retrofits in seven watersheds (three "application" watersheds, two "reference" watersheds (normal development) and two "control" watersheds (no development)) including monitoring streams for hydrologic, chemical physical habitat, and biological indicators (City of Redmond).
- Effectiveness of a complex retrofit (including two large bioretention stormwater treatment facilities and a major stormwater detention pond/engineered wetland restoration) in the City of Federal Way to stream conditions including water quality and benthic macroinvertebrates in NF West Hylebos Creek (King County).
- Effectiveness of bioretention facilities for flow reduction, including monitoring and modelling of hydrologic performance evaluation at selected sites (City of Bellingham).
- Effectiveness of source control activities for small business and commercial property owners, including impediments to control pollution sources. In addition, study includes an analysis of source identification and illicit discharge data from permittees' incident tracking reports (City of Lakewood).
- Effectiveness of street sweeping, quantifying the direct effects of street sweeping on stormwater quality using a before/after-control/impact study design (City of Seattle).
- Effectiveness of permeable pavement and maintenance impacts to BMPs performance (Clark County).

Figure 2. Permeable pavement tests at WSU Stormwater Center in Puyallip.

LID/GSI success largely hinges on inspections and maintenance

A corollary concern related to success of LID/GSI is the reliance on proper installation, inspections and maintenance. As expressed by one staff person: "As for BMPs/LID that are supposed to be distributed across the landscape, often on private property, training can only go so far. Inspection efforts are underfunded and difficult to enforce on private property politically and otherwise. A better approach is to construct a BMP/LID approach that emphasizes simple techniques that are low maintenance, low risk of failure. Basic dispersion, disconnected downspouts, limited infiltration (drywells, etc.) are examples that require very little homeowner attention and are hard to 'bury' or pave over like bioretention and permeable pavements. Ecology's list approach puts these 'easier to maintain,' 'low enforcement,' 'homeowner friendly' BMPs down the list and puts high risk, high maintenance, unknown maintenance BMPs at the top because , initially, they may infiltrate better. Then we all hope that someone else can make it so ongoing (and require training and inspection and enforcement)." Should more emphasis be placed on techniques that don't require as much ongoing maintenance?

Permit focus on new development, not redevelopment

Staff pointed out that the rules are primarily oriented towards new development, not redevelopment. One suggestion: conduct a study of how well stormwater, zoning, and building codes are working on redevelopment.

Community goals: growth management and loss of green

With strong pressure to accommodate the region's growing population within already developed areas, there are conflicts between promoting density and universally using of LID/GSI to manage stormwater, especially in suburban cities. As a specific example, if you save trees you don't get as much development. The *LID manual* explicitly recognizes the value of infill in urban areas and the protection of rural undeveloped lands from conversion (PSP, 2012).

Staff have a difficult time convincing decision-makers to reduce existing impervious coverage in order to provide stormwater benefits as it is 180 degrees away from their comprehensive plan goals and policies. They hear back: "What are you talking about?"

On the other hand, people get upset when they see trees come down. One staff person said, "Many cities in the county have a 'country feel' that residents want to maintain. Community members are upset because traffic is horrible. Upholding quality of life has not succeeded."

Some staff pointed out that increased density should be considered as LID/GSI techniques because they are "replacing parking lots with rooftops" thus replacing polluting surfaces with clean surfaces.

A contrasting staff perspective is that the LID/GSI approach is not working because jurisdictions tend to offer bonuses for LID/GSI. Bonuses are usually an increase in density, resulting in more buildings. They make up for LID/GSI by building more homes with a net result for stormwater quality and flow that is not all that different from traditional approaches. "Higher density is not a bad thing from a growth management perspective but it is self-defeating from a stormwater infiltration perspective." From this viewpoint, requiring a minimum area of natural condition or vegetated land would be preferable to impervious coverage limits. Another option would be to allow height increases rather than more homes. This staff person thinks an assessment is needed to test if LID/GSI is being used as a means to increase density of development instead of to decrease runoff and increase infiltration.

Finally, another respondent commented on the "density" mania, pointing out that "Less intense development might be a better scale to manage stormwater – every impervious surface could manage itself with green approaches with reduced density (dispersal)," but that that is not possible at this time due to our need for density because of our auto-dominated transportation system.

Spreading the burden

One suggestion from a developer was to increase the number of retrofit projects that reduce stormwater impacts by creating an incentive-based program that gives a property tax break or similar financial relief. This idea is modeled after the program that Ecology implemented in the 1980s requiring all commercial properties to remove or replace all fuel tanks within ten years. In other words, a side by side program that addresses existing development would spread the burden of fixing stormwater problems more equally between new and existing development because "To expect builders to compensate for everything that's wrong with the environment won't solve the problem."

Developers' staff knowledge

In one city with a more traditional housing market, BMPs are only used when developers are forced to use them according to staff. They feel that engineers at some of the development firms don't know understand LID/GSI techniques and don't know what bioretention means. Staff thinks LID/GSI training should be required for developers *and* engineers. They don't know "How do I route this? How do I model this?" Staff have a big barrier in trying to convince developers that LID/GSI works and that it's cheaper. They say that even in areas with good infiltration, the developers and engineers want to just copy designs from areas with poor infiltration. Staff would be helped by a LID/GSI cheat sheet for public facing staff.

Another city staff lamented the lack of trained contractors in LID/GSI types of projects, those who know the stormwater standards.

Toxic chemicals loading into the soil

Quite a few staff expressed concern about the loading of toxic chemicals into soil and potentially into the groundwater with widespread installation of LID/GSI. Staff look to the state, including the need for legislative action, to address source control to prevent toxic chemicals from entering the stormwater pathway in the first place.

Specific source control issues raised include exterior use materials such as roofing materials and components (e.g. gutters, downspouts, flashing, 'moss strips', gutter leaf excluders, and HVAC) and exterior paints and sealants which have leachable or erodible constituents such as heavy metals, organic biocides, and fire retardants, and pathogens (avian and rodent deposition).

Other issues raised about LID/GSI

Other big picture issues that were raised included:

- ***Scale of responsibility.*** Staff pointed out that some stormwater management responsibilities need to be at the jurisdictional level while others can and should be done at the watershed or regional level.
- ***Drought pressures.*** Some areas are pushing for less greenery due to drought conditions.
- ***Resistance by staff.*** Staff mentioned that in some cities, public works or other staff are not fans of new stormwater techniques. For Public Works, BMPs mean that "I can't do it the way I want to do it."
- ***Added staff strain.*** According to one city, LID/GSI administration requires a full time staff member.

Recommendations:

- ***Distinguish between different scales of responsibility.*** Some stormwater management responsibilities need to be at the jurisdictional level while others can and should be done at the watershed or regional level.
- ***Create LID/GSI materials for developers.*** Cities need customizable LID/GSI materials for developers that are compelling and readable (which would help planners as well).
- ***Develop cost analysis.*** Now that a large number of LID/GSI projects have been constructed in the Puget Sound region, staff would like a report (and factsheets) which develops cost-per-lifetime of different LID/GSI measures. To date, the few existing studies are primarily theoretical or are from other areas of the country.

This study should include long term maintenance and repair costs for both the landowner and the municipality in relation to other forms of stormwater management.

- ***Develop tracking tool***. An elegant, user-friendly tracking system for LID/GSI implementation and inspection would be helpful.
- ***Study LID/GSI effectiveness.*** ** A study of the effectiveness of on-the-ground LID/GSI projects after 5, 10, and 15 years would be a useful resource.
- ***Study LID/GSI outcomes on larger scales.*** It would be helpful to conduct a study comparing areas with impervious surface with and without LID/GSI on cluster development to determine if LID/GSI requirements and incentives actually increases total impervious surface and, if so, the impact on stormwater flow and quality
- ***Study of LID/GSI for redevelopment and retrofits.*** A study is needed on how well stormwater (and zoning, building) rules are working on redevelopment and retrofits as compared to new development.
- ***Assess overflow scenario.*** A regional or watershed-scale study is needed to determine if the impact of overflow from distributed LID/GSI facilities in major storms negates the benefits gained in streams during the rest of the year. The study should include scenarios with traditional infrastructure-only, LID/GSI-only, and a combination of traditional and LID/GSI and consider different soil infiltration variables. This study is especially important given the increased intensity storms predicted as a result of climate change.
- ***Reduce toxics at the source.*** Staff at the local level are looking to the State to enact legislation to improve source control to prevent pollutants from entering the stormwater pathway. Many staff pointed out that it would be less costly if toxic chemicals were not present in the stormwater pathway and thus treatment would not be required. There also was concern that the LID/GSI approach does not remove pollutants from the system but rather, in many cases, into the soil which may have to be cleaned up later.

***Currently being studied. This project is currently funded as a study in the Regional Stormwater Management Program (see page 20).*

Maintenance

"We have sent field staff out with equipment that doesn't work."
- Large city staff member

Maintenance of LID/GSI facilities appears to be the number one challenge from the staff perspective. Changing regulations have made it difficult for those who have been trained for the older techniques. For example, staff feel that they can't go out and clean out ditches in the efficient way that they have in the past. The new facilities are considered more difficult to maintain.

One city said that they don't like LID/GSI as a whole because it requires more maintenance and would need a larger staff to meet maintenance requirements.

Bonding and agreements to take on maintenance

How much maintenance liability cities take is a concern for staff. Many cities require a two-year maintenance bond, but some feel that two years does not guarantee LID/GSI function in the future, especially for permeable pavement projects. Also, some cities lack the staff necessary to adequately inspect required-developer maintenance during the bonded 2-year period (which sometimes involves quarterly inspections).

In most cities, property owners are required to maintain stormwater facilities for commercial properties. For subdivisions however, there is a surprisingly wide variety of approaches:

- The city takes over responsibility for maintenance of the facilities after two years.
- Cities require that the tract with the stormwater facility be deeded to the city.
- Homeowner associations retain responsibility for maintenance.
- City takes over maintenance immediately after construction.
- City takes over residential drainage tracks and other tracks are maintained by homeowner associations.
- Maintenance stays private, and the city inspects with either city staff or contracted King County staff.
- If homeowner associations fail to maintain facilities, the city does the maintenance and charges the homeowner association (See Callout Box for Bothell and North Bend).
- All private development is required to maintain their systems, including catch basins and pipes.

Bothell: *HOA inspection access via easement*

The City of Bothell requires the establishment of a homeowners' association for all subdivisions to be responsible for stormwater facility maintenance. On one plat that installed multiple rain gardens, the city required an easement around each one so the city can inspect HOA maintenance.
More info:
www.codepublishing.com/WA/Bothell/mobile/?pg=Bothell15/Bothell1516.html

North Bend: *LID maintenance by HOAs, with education packets*

The City of North Bend's *Design and Construction Standards for Streets* requires homeowner associations (HOAs) to maintain LID/GSI in rights-of-way. The city requires LID/GSI techniques in rights-of-way when soil conditions support function. HOAs are required to:

- Submit a long-term maintenance plan
- Include a note on each final plat detailing required maintenance
- Provide an educational packet to all existing and new homeowners.

More info:
www.codepublishing.com/WA/NorthBend/html/NorthBend19/NorthBend1905.html

According to staff, cities that take over maintenance do so because they experienced homeowner associations tending to disappear from city communication and maintenance being forgotten.

In some cities, like Covington, Duvall, and Pacific, the stormwater utility fee is discounted if a property owner can demonstrate stormwater facility maintenance. (See Callout Box for Pacific).

Pacific: *Treatment facilities that are maintained with annual proof receive utility discount*

In the City of Pacific, owners of *Approved stormwater facilities* which receive a significant utility rate discount are required to:

- Provide both treatment and retention
- Maintain annually to city standards
- Provide verification of operations and maintenance compliance to receive discount.

Rates are discounted significantly for flow control and water quality treatment.
More info:
www.codepublishing.com/WA/Pacific/html/Pacific24/Pacific2416.html

Equipment for maintenance.

Also discussed below for specific techniques is the issue of whether a city should own their own equipment or contract out the service was a major discussion point. One staff member said that it was important to own equipment because without it "regular routine maintenance wouldn't happen as often."

Recommendations:

- ***Fund maintenance.*** Funding for maintenance of LID/GSI facilities is a great need at the local level. Providing a funding source at the state level, such as block grants from Ecology, could greatly improve maintenance at the local level.
- ***Create an equipment rental system or co-op.*** King County could create a co-op for equipment rental or sharing, possibly modeled after tool library programs. This would include vactor trucks, regenerative air sweepers, permeable pavement cleaners, video inspection vans and more.

7. Technique-Specific Discussion

During the interviews, we asked which techniques have been implemented by jurisdictions to date as demonstration projects or new capital projects on public land. Table 2 summarizes these responses.

There is strong correlation between stormwater budget and number of techniques tried, and somewhat weaker correlation between jurisdictional population and techniques tried. Cities without stormwater utility fees generally have lower budgets and build fewer city projects. There are some cities, however, with similar budgets that have tried larger number of techniques than others.

The most popular techniques that have been tried in King County jurisdictions are bioretention (72% of cities have a facility on public lands), permeable pavement (66%) and out-of-the-box proprietary products (60%). Green roofs, preserving vegetation, and minimizing impervious surface were the least implemented, and only two jurisdictions have cisterns managing stormwater in projects on public lands.

At this time, at least some LID/GSI techniques have been installed by almost every city - the performance of these existing facilities can inform future code revisions, installation, monitoring, and maintenance.

Table 1. LID/GSI techniques implemented on public lands in King County jurisdictions

Municipality	Minimize impervious	Pervious Pavement	Green roofs	Bioretention	Filters	Rain gardens	Preserving veg/soils	Dispersion/ downspout disconnect	Cisterns
Algona		✓		✓					
Auburn	✓	✓		✓	✓		✓		
Beaux Arts									
Bellevue		✓	✓		✓		✓	✓	
Black Diamond				✓	✓				
Bothell		✓		✓	✓	✓			
Burien	✓	✓		✓	✓	✓			P
Carnation	P			P					
Clyde Hill		P			P				
Covington			P	✓	✓		✓		
Des Moines				✓	✓			✓	
Duvall	✓	✓	✓	✓			✓		
Enumclaw	✓				✓	✓			
Federal Way	P	✓	P	✓	✓	✓			
Hunts Point								✓	
Issaquah		✓		✓			✓	✓	
Kenmore	✓	✓	✓		✓				
Kent	✓	✓	✓	✓	✓	✓	✓	✓	
King County		✓		✓			✓	✓	
Kirkland		✓		✓	✓	✓	✓	✓	✓
Lake Forest Park		✓		✓	✓		✓	✓	
Maple Valley		✓						✓	
Medina				✓					
Mercer Island		✓	✓	✓	✓	✓			
Milton		P		✓		P		✓	
Newcastle	✓	✓		✓	✓	✓	✓	✓	
Normandy Park		P				P		✓	
North Bend		✓		✓	P			✓	
Pacific		✓		✓	✓				
Redmond		✓	✓	✓	✓	✓			
Renton		✓		✓	✓	✓			
Sammamish	✓	✓	✓	✓	✓			✓	
SeaTac		✓		✓					
Seattle	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shoreline	✓	✓		✓	✓	✓	✓	✓	
Skykomish								✓	
Snoqualmie				✓	✓	✓			
Tukwila		✓		✓		✓		✓	
Woodinville	✓				✓			✓	
Yarrow Point								✓	

✓=technique has been implemented **P**=technique is planned for coming year

Minimizing impervious surfaces

"LID is perceived by the public as taking away parking along the streets."
- Small city staff member

Minimizing impervious surfaces is a generally well-liked technique that is incentivized (but not everywhere) by the structure of stormwater fees, rarely for single-family and often for commercial, multi-family etc. (see Appendix 2). Some jurisdictions also offer the incentive of requiring smaller or no detention if impervious coverage is below a certain threshold. During construction of recent road projects, many cities have made a multiple-benefit effort to minimize impervious surfaces and add community amenities like multiuse trails.

Some cities are in the process of updating their code to include maximum impervious coverage. At this time a number of cities do not have maximum impervious surface limits in their codes. We did not investigate current code limits but the lowest limit we learned about was a maximum of 20% impervious lot coverage.

In unincorporated King County and in more rural cities, minimizing impervious surfaces is a relatively common stormwater technique. In urbanized cities and in high value land locations, this technique is not cost-effective, feasible or easily implemented.

Barriers for minimizing impervious surface include:

- ***Sidewalks.*** In many cities sidewalks are required on both sides of the right of way. Some cities are now allowing sidewalks to be waived on one side. A few cities do not have sidewalks in residential areas.
- ***Density.*** Cities' growth management density standards.
- ***Land value.*** Land is high value in many cities which creates intense pressure for developers to maximize their footprint. The small monthly stormwater fee is not an effective incentive for reducing impervious surface. As one staff person put it, there is an ethic of "maximum build out" in development.
- ***Safety requirements.*** Safety, fire, emergency vehicle, and ADA requirements generally push for wider rights-of-way. For example, fire engines and apparatus keep getting bigger. Outbreakers (which stabilize the truck) have to have unobstructed travel path where they can be set up. Narrower streets require fire marshal approval. There is also the challenge of being able to turn large emergency vehicles.
- Parking.
    - Single family homeowners expect street parking.
    - More affluent residents have more cars.
    - Developers like abundant parking for marketing purposes.
    - Parking regulations can include a minimum number of stalls. Multifamily buildings and commercial buildings often have other non-stormwater-related code requirements for number of stalls.
- ***Commercial footprints.*** Commercial facilities are currently allowed large impervious thresholds but then are required to plan for 100-year storm events, which creates conflict.
- ***Driveways.*** "Single families want beautiful, wide driveways." Some cities solve this by encouraging pervious pavers for driveways.
- ***Road and highway standards.*** When state highways cut through cities, cities have limited authority to promote LID/GSI highway retrofits. In addition, Annual Daily Traffic Volume standards conflict with narrowing roads.

Additional concerns expressed by staff include:

- ***Future homeowners making changes.*** New owners may replace grass with hard surfaces, like a sport court.

- ***Use of impermeable pavers.*** In some cases, people are using traditional pavers laid in sand to qualify for impervious surface (city standard is that the material has to have equivalent porosity or better than underlying soils).

Covington: *Maximum parking*

For downtown development, the number of parking spaces can be no more than 50% greater than the minimum parking required unless provided above/below grade or approved by the City of Covington. Large developments have already limited their footprint due to this requirement.
More info:
www.codepublishing.com/WA/Covington/html/Covington18/Covington1831.html

Incentives and motivators

Cities currently provide motivators such as reduced stormwater utility rates and infiltration credits. Infiltration credits or getting a break on stormwater fee, however, doesn't enter into a developer's equation for penciling out their project costs. Staff commented, "If you are serious, you just have to write it into the code." Some suggest that a capital facilities charge or similar fee is needed to charge developers for impervious surface.

For some cities where LID/GSI (or LID/GSI techniques with another label) is being promoted, development review staff encourages impervious reduction in preapplication reviews.

Some cities have already changed their codes or provide incentives to promote LID/GSI. Examples include:

- Changing street standards, including alleys. One city used to require minimum 20 foot wide alleys and now allow 18 feet.
- Allowing greater building height.
- Requiring a maximum number of parking stalls (See Callout box for Covington)
- Providing financial incentives for retrofits such as making a patio impervious ($500-1000) (See Callout box for Lake Forest Park).
- Allowing reduced lot sizes if a certain number of LID/GSI techniques are used together to preserve green space. Developers are increasingly using recreation for property value, marketing developments as "back to nature."
- Allowing narrower streets without on-street parking in subdivisions (which allows for larger lots).
- Promoting clustering by increasing lot coverage requirements if developers save open space via clustering.
- Expedited development review (See Callout Box for Auburn).

Lake Forest Park: *Mini grants for natural drainage projects*

The City of Lake Forest Park provides 50% reimbursement through min-grants with a simple application:

- Up to $500 for single family non-rain garden projects
- Up to $1,500 for community organizations or multiple property owner non-rain garden projects
- Up to $1,000 for single family rain garden installations
- Up to $2,000 for community organization rain garden installations.

The program can be used for installation of permeable pavement patios.
More info: www.cityoflfp.com/index.aspx?nid=355

Auburn: *Code Incentives for flexible development*

The City of Auburn's current code lays out a point-based incentive program for alternative development techniques to encourage developers to go "above and beyond" the requirements. LID/GSI are each worth 5 points, and water quality, habitat, and natural vegetation also provide points. Development projects that have 100 points can have:

- Alternate lot dimensions (required setbacks, frontages)
- Alternate parking lot landscaping
- Alternate engineering design
- Expedited permitting process
- Increased density
- Other bonuses including increased impervious and increased maximum height.

More info:
www.codepublishing.com/WA/Auburn/?auburn18/auburn1849.html

Increasing frontage to allow for LID/GSI

To encourage stormwater retrofits in rights-of-way, some staff suggested allowing expanded frontage to incentivize incorporation of LID/GSI. A standard design would be necessary.

Permeable pavement

"The porous pavement scenario is improving, maintenance concerns are dwindling."
- One staff perspective

There were significantly mixed feelings among staff about permeable pavement. In a few cities, the technique has functioned well. Even jurisdictions with steep slopes and groundwater seepage problems have seen developers install permeable pavement and it seems to be working. In many cities, however, there have been bad experiences, ranging from poor installation, maintenance challenges, and difficulty in finding locations where it will work. Many permeable pavement (especially many sidewalk projects) have been grant funded.

The biggest concerns are related to clogging, cost-effective maintenance, structural integrity, and pavement lifespan. On the other hand, staff say that these concerns are beginning to be addressed and future installations will improve. One big plus: permeable pavement is one of the few BMPs that doesn't require acreage.

According to local staff, City of Tacoma has been using the technique extensively for residential roads. Their projects have worked very well and that they have saved huge amounts of money over traditional stormwater controls.

In installations that have worked well, staff have experienced:

- The project is holding up as well as regular asphalting.
- The ability to do sweeping/cleaning on the regular street sweeping schedule.
- Have not seen freezing up in the winter.
- Ability to save significant funds because traditional approaches for roads require large facilities thus increasing cost of road construction and cost of buying additional land for the facilities.

Figure 3. Pervmeable pavement (left) staying relatively drier during a rain event next to sheeting water on regular pavement.

Barriers expressed (these are discussed in more detail below) are that permeable pavement:

- Is more expensive.
- Is challenging on slopes.
- Has weight-bearing limits and is not strong enough for traffic.
- Requires extensive future maintenance.
- Is difficult to cut and patch.
- Is more difficult to install.
- Develops moss growth.
- Don't fare well under tree canopy (leaf litter).
- Is difficult to know if it's working or if it's constructed correctly.
- The basic concept of introducing water into a road structure ("building a bathtub facility") goes counter to the basic tenet of building structurally sound engineered roadways. Staff are worried about life expectancy of the facilities.

Staff perceive that Ecology encourages permeable pavement "anywhere and everywhere." They also perceive that "smarter engineers are trying to use permeable and LID/GSI more."

Staff have concerns that permeable pavement facilities can't handle capacity during large rain events, resulting in ponding on pavement and on adjacent paved surfaces. Cities don't have the capacity to inspect permeable installations during storms.

Overall lifetime concerns:

- Lifetime cost is much higher than standard materials.
- Installation cost.
- Frequency and cost of replacement.
- Inability to overlay.
- Maintenance cost (special sweepers, pressure washers etc.).
- Shorter replacement window.

Clogging on roadways

There is evidence that vehicular traffic embeds sediment and particulates into permeable pavement roadways, resulting in clogging of the current mix. The pressure from wheels, especially during rain events, creates a large amount of hydraulic pressure. Sanding streets also introduces sediment which also gets compressed into the voids (See Figure 4 for photos of particulate matter in voids of pavement).

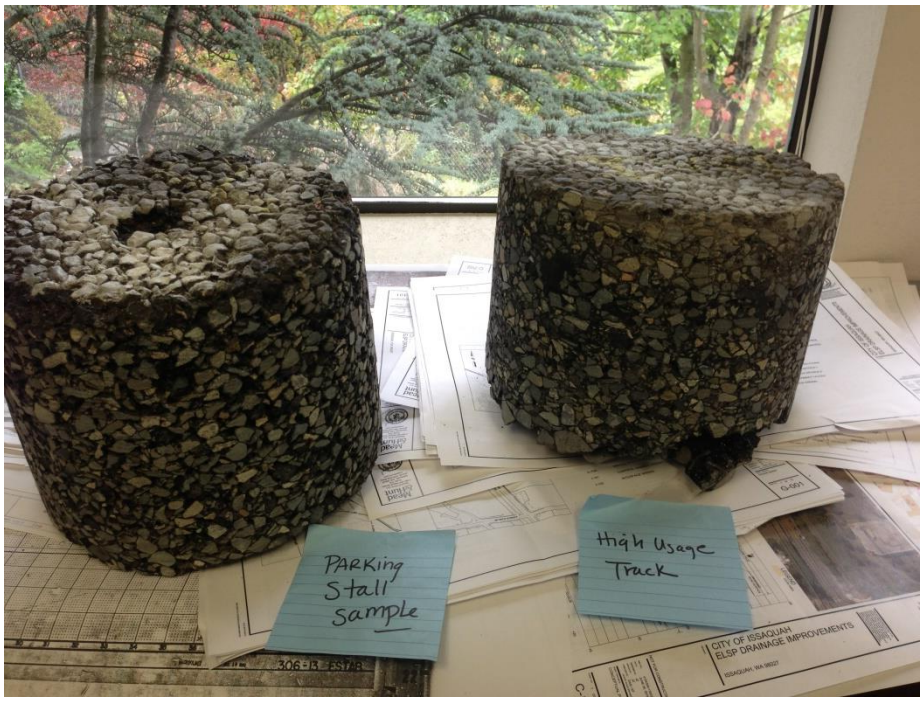


Figure 4. Cores from permeable pavement installations in Kirkland. Core on left is from a parking stall. Core on right is from roadway with heavy usage. More particulate matter is imbedded in the voids in the heavy usage core.

Lack of standards

Currently there is a lack of formal installation standards for permeable pavement which has led to a great deal of concern about durability and reliability. The cities of Tacoma and Redmond and others are working to develop regional standards that can be adopted by the industry. There is a need to find the ideal mix for the Pacific Northwest climate so that roads will be able to bear the needed weight without compaction.

This concern is magnified because private developers are installing permeable pavement that then either becomes a public responsibility for cities or is privately maintained, often without long-term assurance of reliability.

Does permeable pavement work better or worse in freezing conditions?

The jury appears to still be out on the issue of freezing conditions related to permeable pavement. We heard observations of less ice than regular pavement due to increased drainage, leading to the potential for reduced use of de-icing chemicals or sand. We also heard opinions that increased voids allowing for potential for more damage and breakdown in harsh conditions. A study is needed to assess the on-the-ground realities of the effect of freezing on permeable pavement in Pacific Northwest conditions.

Does permeable pavement count as impermeable coverage?

Some cities allow permeable pavement on private property, but still count it as impermeable in order to eliminate the possibility of failure due to bad maintenance. In one city, permeable pavement is counted as lot coverage but permeable patios and paths narrower than five feet wide are allowed and don't count as coverage.

Lack of data about treatment capability

Some cities do not allow permeable pavement in areas that would infiltrate pollution. At this time, there is limited data available about the treatment capability of permeable pavement – a local comprehensive study is needed so that it can be considered a water treatment technology. Staff suggested that if Ecology would give a water quality treatment credit, that would be a strong motivator.

Maintenance and repair concerns

Small jurisdictions are particularly concerned about extra costs to maintain permeable pavement. They do not have budgets to purchase equipment and do not have sidewalk sweeping contracts.

There is concern that the projects may function properly at first if the site has infiltrating soils, but that over time they will clog and cease to function. According to staff, permeable concrete can be unclogged more easily than permeable asphalt because it can be pressure treated to clear pores and restore function. When asphalt pores get clogged, however, little can be done to restore 100% function, necessitating removal and replacement.

When repairs are needed for permeable pavement, staff believe it will often need to be rebuilt from the bottom up, not overlain with new layers similar to traditional pavement. Staff are also worried that homeowners could destroy their permeable system trying to repair or during underground utility replacement.

Another challenge is that it is difficult to get permeable asphalt in small batches. Manufacturers have to stop production to switch from impermeable production to permeable production and only do so when they have large permeable orders. This makes it difficult to do patching and small projects.

Lifecycle analysis not available

For regular pavement, every 25-30 years an overlay is required. By doing overlays, one can avoid letting the road deteriorate to the point of needing complete replacement. It is not clear whether overlays will be possible with permeable pavement and some staff believe it will not be possible.

Thus a major concern is the lack of information about permeable pavement's lifespan. This lack of predictability makes transportation staff nervous about life expectancy: "you can't put something in that needs to be redone in ten years."

Where to use permeable pavement?

Ecology guidance and most roads departments agree that permeable pavement does not belong in roadways. Better applications are paved areas with less traffic. Cities in King County have experimented with turn lanes, shoulders, driveways, alleys, and parking lots. There is also a question as to whether it makes sense to install permeable sidewalks or trails in areas where there is significant vegetation on one or both sides; the sidewalk could simply be slightly sloped to guide runoff to the sides.

Similarly, in most of King County and in rural areas of some cities – areas that are lightly developed - staff say most roads have woods on either side. In these locations, dispersion may make more sense than a permeable shoulder (i.e., there is may be no water quality benefit to adding permeable pavement in these rural areas). Even in less rural areas, staff point out that there may be many good reasons to avoid directing water under a road due to the installation of permeable pavement "when infiltration trenches alongside roads or part of piped conveyance trenches or bioretention ditches are equivalent solutions" for stormwater management.

Figure 5. Closeup of moss growing on permable pavement sidewalk.

Moss on sidewalks

The most frequent complaint we heard about permeable pavement was significant moss growth on public sidewalks. Cities have tried a variety of maintenance approaches for removing the moss and none have worked. It is difficult to keep the permeable sidewalks up to community standards aesthetically, and also not create liability in terms of slippage on moss, and in some cases on ponded water.

Moss questions that arose in our interviews included:

- ***Is shade the culprit?*** Staff directed us to examples of moss on sidewalks that are located in full shade and full sun, so lack of sunlight does not seem to be the only cause of the growth.
- ***Is moss a functionality problem?*** Other than slippage issues, it is unclear whether moss inhibits the functionality of the porous pavement. This is another area that needs study.
- ***How to remove moss?*** Ecology's LID maintenance manual provides this recommendation for cleaning permeable pavement sidewalks: "Sidewalks: Use a stiff broom to remove moss in the summer when it is dry" (Ecology, 2013). This has not been adequate for municipalities. Staff at some jurisdictions try pressure washing their permeable sidewalks, but there are concerns that this will degrade the sidewalks. There is also a worry that increased pressure washing may just push the moss further into pores. Some cities have applied herbicides to control the moss which is contrary to the purpose of the pavement in the first place.

Figure 6. Top photos: Moss on permeable pavement sidewalks showing contrast with regular pavement. Bottom photo: Moss on regular (aged) pavement sidewalk. Photo credit for top right photo: Ross Freeman, City of Mercer Island.

New maintenance equipment needed

Suitable maintenance equipment is needed for roadways, parking lots and driveways and also for sidewalks. An effective machine for maintaining permeable pavement has not yet been developed, even though staff have requested this from manufacturers. One existing type of machine doesn't effectively remove the moss and lacks the storage capacity to hold all the goop that gets sucked up. Another type of equipment uses hot (boiling) water and pulls material out effectively but it clogs every twenty minutes. A third rotating head power washer with high vacuum cleaner is so powerful that it takes the top layer of permeable asphalt or concrete off. Another machine has a vacuum rotating head and is attached to a vactor truck but it is like using a push mower and is extremely time consuming and thus too labor intensive to be effective.

Jurisdictions would like a regenerative air, washing, and vacuuming machine that does it all. According to staff, washing combined with vacuuming would be the best solution. Pressure washing can be problematic because it can push material down into the voids in the pavement. Vacuuming would be an ideal solution but the challenge is getting a good enough seal to get the material out effectively.

Sidewalks present additional challenges. Moss appears more likely to grow on sidewalks than on more traveled roadways and parking lots. Sidewalks also are narrower and often have obstructions such as sign posts and cutouts, thus necessitating more portable or maneuverable, narrower machines.

Trees and permeable pavement

Many staff mentioned the conflict between street trees (and their leaf and debris drop) and the need to keep permeable pavement surfaces clean. The leaf drop could accelerate moss development as well as pore clogging.

Does putting in underdrains make sense?

Developers are required to use thick layers of gravel or underdrains if the site is located on poorly infiltrating soils. Some staff have questioned the point of permeable pavement if an underdrain is used, and others say that the storage capacity, a small amount of infiltration and evaporation make the facilities functional even with an underdrain. Other staff say that it is an open question: does permeable pavement hold water long enough to make a difference for flow control?

Certification

Another suggestion is that certification may be needed for installers.

Recommendations:

- ***Study permeable pavement***.** A number of studies are needed to answer the following questions related to permeable pavement: What is the full life cycle for permeable pavement? How does permeable pavement fare in Pacific Northwest winter conditions (icing, longevity)? Does permeable pavement provide water quality treatment and should Ecology provide a treatment credit? Does permeable pavement hold water long enough to make a difference for flow control? Is moss a problem in terms of infiltration function? Do different media mixes inhibit moss growth? What are the impacts of winter efforts like sanding and salting? How long can permeable pavement go without sweeping and what drives the frequency?
- ***Develop permeable pavement installation standards for the Pacific Northwest.**** Uncertainty and installation variability of permeable pavement is a big concern among staff. A standard needs to be developed and accepted for mixes and installation methods for the Pacific Northwest.
- ***Develop maintenance equipment for permeable pavement, including sidewalks.**** In order to facilitate effective and cost efficient cleaning of permeable pavement, R & D is needed by manufacturers to create new equipment. This is needed both for roadways and parking lots as well as sidewalks which have additional challenges related to width and obstacles. Suitable equipment has not yet been developed, even though staff have requested it from manufacturers.

** Near Term Action submitted to Puget Sound Partnership Action Agenda update. ** Research ongoing at WSU Stormwater Center.*

Green Roofs

"Green roofs are fine but don't get to the real problem: clean water is hitting a clean surface, as roofs are not a major source of pollution."

- Smaller town staff person

There are few green roofs in King County outside of Seattle. Many cities have no green roofs on either public or private properties. While most staff agree that they are aesthetically pleasing and have a variety of benefits, there was significant skepticism about green roofs as a stormwater management technique in the Pacific Northwest due to the timing of our large storms and our dry summers. The challenge: the amount of water that can be retained is not large enough in most cases with 3-4 inch deep soils to make a large enough difference for flow control. In addition, windy conditions in core urban settings can create dry roof conditions.

There also were concerns that for the cost, other techniques work better and provide more stormwater benefit with one person noting, "I would rather get an Ecology grant to do something else than pay the astronomical cost for small green roof." Another comment about green roofs: "A hard sell even for a demonstration" due to expense. In areas with larger lots, there is a lot of undisturbed land around homes, and staff in those locations don't see a big role for green roofs.

Seattle Public Utilities and the City of Seattle's Office of Sustainability and Environment commissioned a study to assess green roofs using a mass balance approach to measure hydrologic (water quantity) performance. Up to three years of data were collected for three separate green roofs and two conventional (control) roofs. They found that for the three green roofs the runoff percentages increased during the wetter seasons approaching 100% and decreased during the dryer seasons to approximately 30% or lower due to factors such as relatively thin soil profiles (6 inches or less), reduced evapotranspiration and direct connection of the underlying drainage layer to the roof drain system. In wet weather, meaningful flow reduction benefits were seen because flows from green roofs were slowed relative to conventional roofs and even a few hours of drying out between storms had an impact. Thus peak runoff rate reduction for intermittent rainfall events was found to be significant year-round (Seattle, 2012).

Specific barriers mentioned by staff include:

- Competition for roof space with solar facilities.
- Higher structural load required, which raises maximum roof elevation.
- Expense of creating a deep soil green roof (deeper would allow more retention and have more stormwater benefit).
- Weed seed gets blown onto roofs and weeds crowd out plants.
- Vegetation establishment is difficult and young roofs require maintenance.
- Saturation from November until the dry season.
- Access for fire department, which needs the ability to cut vent holes.

On the other hand, some cities have had good experiences. One comment was that the green roof on a new apartment building is "aesthetically pleasing," does a good job of dealing with rainfall, and "overflow goes into storm system."

Positive comments related specifically to stormwater benefit included that green roofs:

- Don't take additional footprint. They work well with density goals.
- Might be good for summer storms.

Are roofs being installed correctly?

Staff told many stories of green roofs that dried out, became weedy, or leaked. A few respondents with significant green roof experience told us that most of the problems result from inadequate design and maintenance during the first three years. They say that incorrect plants are often used and roofs are not well maintained.

A staff person with extensive green roof experience is a big fan: Green roofs are "one of the best things you can do as far as insulating property and managing on site water. After the first three years they're virtually maintenance free. Weeding has to be part of this maintenance, allowing sedum to expand. Sedum acts as a thick carpet without space for advantageous seeds. Once you get full coverage there won't be any weeds. And supplemental watering can be done with camelbacks."

Another respondent notes that installers often use the wrong type of drainage mat. This person has used coconut or coir matting with success.

It was recommended that there be a summit on green roofs to share experiences and changes that work better.

Green roofs as a credited LID/GSI technique

Not all cities are giving credit for green roofs at this time. Cities are concerned that property owners will fail to suitably maintain their roof. One city outlined maintenance in the permit agreement of the development. In terms of inspection, it is difficult for cities to see if the maintenance is being done – rooftop access is required and legally difficult. In one city, the only proposed green roof to date was withdrawn due to privacy concerns once the homeowners learned of the city's inspection requirements. The owners did not want city crews on their property.

Safe access is also a barrier to proper maintenance and inspection. One staff person suggested that railings or tie-in points be required to make access safer.

New studies needed

Overall, many staff feel that the jury is still out on green roof viability related to stormwater management in Puget Sound. There have been a few early studies but staff would like data on how green roofs like the Gates Foundation and others are functioning after they have become well established. A few staff are curious about the potential of blue roofs, which are basically rooftop vaults and have more storage capacity that green roofs and have been implemented in Europe. In addition, specific suggestions from Seattle's green roof study included:

- Produce hydrologic model calibrations for each of their green roof data sets (data already collected).
- Apply calibrated green roof hydrologic models in evaluating the usefulness of green roof systems in reducing basin specific combined sewer overflow occurrences.
- Use data and models to optimize green roof design parameters including size, shape, slope, soil depth, and drainage layer medium.
- Investigate the use of automated irrigation triggered by real time soil moisture monitoring (Seattle, 2012).

Recommendations:

- ***Convene a green roof summit.*** Because of the breadth of local experience, it appears that a summit on green roofs to share experiences and technical improvements would be useful. Many green roofs are failing due to poor installation and maintenance (mainly in the first three years), and knowledge exchange could be helpful.
- ***Study green roof function.*** Now that there are a large number of existing green roofs in a variety of both urban and rural settings in the county, staff would like a broader study to see how well roofs function for stormwater management in the Pacific Northwest. There is also a need to assess the potential for toxic leachate from underlying roof membranes and/or planting mixtures.

Out-of-the-box proprietary systems

"How quickly will [the filter] clog? What are their expectations of sediment removal and are they consistent with what a jurisdiction can actually do?"

- Large sized city staffer

Generally, staff have positive feelings about out-of-the-box proprietary systems such as Filterra, Stormceptor, and other brands. Filterra was described by one person as a "wetland in a box."

Figure 7. Filterra ® system installed along high-traffic roadway.

Most King County cities have proprietary filter systems in place, mostly in transportation and commercial projects. In some cases, they have been installed in mega-mansions.

The primary motivators for using filter systems is that they take up much less room and they are plug and play in concept. One comment is that they provide "bang for your buck for pollution removal." They are particularly useful for improving water quality (i.e., treatment) of current infrastructure. Developers like filters because they reduce upfront costs.

Cities that have favorable feelings towards them feel that they work well and predictably. They also provide a good way to retrofit areas with little space. Transportation departments particularly like these systems because they easily fit into existing roadways. Another advantage is that these systems meet both landscaping and stormwater treatment requirements at once.

One staff person commented that he likes filter systems because once the system is "out of sight he doesn't get complaints." He gets many complaints about open ponds regarding mosquitos, weeds, ugly plants and trash.

Need study of city experience and field function

Staff would like a summary report of local cities' experience with proprietary systems, focusing how well the systems are working in the field, the ease of maintenance, and the frequency of replacement. Many of the presentations to date have been by the manufacturers and there has not been a comprehensive assessment across the region of effectiveness, problems and opportunities.

Maintenance of filter systems

Often staff inherit responsibility for filter systems from developers whose projects get turned over to cities for maintenance. According to staff, they can be "horrible to maintain. They clog much more quickly than vendors say." Municipal monitoring is usually on an annual schedule but they clog faster (See Callout Box for Seattle). In addition, the products are difficult for homeowners to maintain because they are heavy

Seattle: *Filters sized to annual maintenance*

The City of Seattle requires proprietary technologies, such as filters, to be sized to accommodate solids loading with annual maintenance.

More info:
www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2358283.pdf

(hundreds of pounds). Another problem is that sometimes people damage filters during rain events - they puncture filters to prevent runoff back up. One recommendation is to ban filter cartridges in some locations, such as rights-of-way, because they clog so fast. Several cities currently do not allow filter systems in subdivisions because of maintenance concerns.

One solution in one city is to operate an aggressive street sweeping program. For them, this has eliminated clogging problems for their roadway-related filter systems.

Cost of maintaining filters

One challenge mentioned by several staff was the cost of replacing filters on a regular basis. Another one was the complexity and expense of cities being responsible for maintaining several different brands. If developers are allowed to install different brands and the city handles maintenance, some staff were concerned about having to maintain a stock of many different brands of replacement cartridges. Treatment devices are patented for one certain kind of filter. A potential solution would for manufacturer to evolve to more universal cartridges that allow for generic updates/generics and simplified maintenance. Some small cities would rather not see filters due to cost of maintenance.

Lack of inspection/replacement requirements

Not all cities have requirements for inspecting functionality of filter systems, nor requirements to replace filters.

Ecology's TAPE program not adequately considering operations and maintenance

Ecology certifies stormwater treatment technologies through the Technology Assessment Protocol (TAPE) program. Two issues regarding TAPE were raised by staff. First, the manuals do not include all of the TAPE approved technologies. Second, there is feeling that TAPE should take operation and maintenance experience by local jurisdictions more into consideration when approving proprietary technologies.

We also heard suggestions from staff to use Ecology's TAPE protocols to evaluate LID effectiveness and to expand Ecology's TAPE protocols to evaluate removal of currently unregulated pollutants, e.g. phthalates and pathogens.

Recommendations:

- ***Standardize treatment filter cartridges.*** Each proprietary filtration system has unique replacement cartridges. It is challenging for cities to maintain an inventory of replacements for all filter types in their city because they inherit systems from private developers. It would be desirable to incentivize use of one standardized filter cartridge.
- ***Consider banning treatment filters in some uses.*** It might be helpful to ban some proprietary systems in some uses (such as rights-of-ways) because they clog too fast for municipal maintenance schedules or require upgraded maintenance technology.
- ***Study local filter cartridge treatment installations.*** Staff would like a comprehensive summary report of local cities' experience with proprietary filter cartridge systems, including how well the systems are working in the field. Many of the presentations to date have been provided by the manufacturers.
- ***Incorporate consideration of maintenance into TAPE program.*** TAPE (Ecology's treatment technology certification program) should consider local experience of operations and maintenance in certifications of stormwater treatment technologies.

Bioretention facilities

"This is a cool landform technique that adds interest to boring areas and is generally low maintenance."

- *Medium-sized city staff person*

The use of *bioretention facilities* was mentioned by many staff as their preferred technique in locations where soils support infiltration. These facilities are relatively easy to install and maintain and generally work well. They also add community amenities and integrate well into public space. They are easy to inspect with a drive-by.

Recent research from Jennifer McIntyre at Washington Stormwater Center and others demonstrated the effectiveness of soil filter systems such as those in constructed bioretention systems and rain gardens. In field tests, pure stormwater runoff from Highway 520 killed all juvenile Coho salmon within 12 hours whereas all salmon survived if the stormwater was first filtered through a 14 inch diameter, 2-foot column containing 60 percent sand, 15 percent compost, 15 percent shredded bark and 10 percent drinking-water treatment residuals. Metals, PAHs and other contaminants were reduced significantly through filtering in the columns. In addition, the soil filtration prevented reproductive damage to cladocerans (*C. dubia*) and death of mayfly nymphs, an insect that salmon eat (McIntyre et al., 2015).

Concerns raised by staff include:

- Compost/media mix problems.
- Lack of clear standards for facilities.
- Maintenance.
- Infiltration on slopes.
- Pollutants from Weed and Feed products.
- Lack of contractor experience.
- Expense of bioretention installation.
- Bioretention takes up space from the traditional landscaping that sells homes. Community wants grassy areas; bioretention only sells to certain audiences.
- People like on-street parking and sidewalks on both sides of the street. They are not willing to give up pedestrian access for infiltrative facilities.
- Failed older projects have diminished public acceptance.
- Space conflicts with pipes, utilities, and street trees

Some staff said that they have been impressed with function of bioretention facilities, even in areas with less than ideal soils. In cities with poor infiltrating soils, staff told us that detention will probably always be required.

Getting developers onboard

One staff person (from a city with traditional housing) told us that developers get onboard with bioretention once they visit a demonstration site, and more and more developers are accepting of the technique. His experience is that engineers haven't wanted to do the technique and developers haven't wanted to try something new – they don't want to be the guinea pig. His city requires pre-design meetings and these have been extremely helpful for steering traditional-approach developers towards LID/GSI and to use of correct installation requirements.

Construction and installation challenges

- One city told us of challenges with contractor practices. For example, a contractor caused siltation by driving over a bioswale. This was resolved by requiring a bond.
- One city said that their experience is that the first stormwater event often uproots the plants and that the facilities tend to clog.

- Some jurisdictions have had problems with bioswales. They need be built perfectly in terms of gradients otherwise they erode and start to contribute sediment.
- A final problem is that plants may not survive summer droughts without supplemental irrigation, which is often not installed.

Maintenance and inspection issues

Problems highlighted by staff include:

- ***New skill set.*** Staff pointed out that it takes a different skill set for city staff to maintain LID/GSI compared to traditional techniques. For example, staff need to be trained in identifying weeds rather than just suctioning dirt. It has taken effort to get people who want to do it and who have interests in plants and who are willing to do hand weeding rather than faster work operating big equipment. Bioretention maintenance requires a different knowledge base and the traditional public works maxim is "If you can't get it done in one pass you're wasting time." Bioretention maintenance defies this maxim.
- ***Plants.*** One city said that maintenance of right-of-way bioswales is a big problem for them. They have an unwritten policy that they will maintain the structures but not the plants. They don't want staff mowing the plants, so they currently don't use much bioretention in rights-of-way. In Covington, staff has tried to improve maintenance efficiency with mowable bioretention designs (See Callout Box for Covington).
- ***More expensive.*** Maintenance is more expensive. These facilities cost more to maintain than pipes, and more and more projects coming online increases costs.
- ***Less is more.*** Another point is that a few big ponds are easier to maintain than many small ones.

Covington: *Mowable Bioretention*

The City of Covington encourages bioretention facilities that:

- Have 5:1 slopes
- Are seeded with grass from the LID manual
- Can be inspected with a driveby
- Are garden installations

These facilities don't require fencing and are more easily and often maintained by Public Works and property owners, especially when grass clippings are removed to prevent nitrogen export.

More info: www.wastormwatercenter.org/4422-bioretention-components

Storm system capacity

Retrofitting for stormwater management in King County is going to be expensive. King County's 2014 study of the 278 square miles of the Green-Duwamish (WRIA 9) watershed assessed stream flow and water quality, and modeled watershed hydrology and water quality to determine needed stormwater facilities such as roadside bioretention, cisterns, detention ponds and rain gardens. Current storage manages about 0.5 inches of stormwater runoff generated from developed areas. Modeling indicated that stormwater treatment facilities providing an average of 2.5 inches of storage are needed. This estimate includes an additional 10% storage needed to accommodate impacts from climate change. Upscaling storage to this degree equates to a capital cost of about $210 million per year over 30 years (2013 dollars). Operating costs would be even larger if maintenance is publically funded. An alternative scenario included strengthening regulations so that developers assume a larger proportion of capital cost and focusing public dollars on retrofitting highways and areas that are not redeveloped (King Co., 2014).

Cost of maintenance

As the new LID requirements come in, operations and maintenance (O&M) must be considered in cost projections for residential development – often these costs fall to municipalities. A 2013 study by the City of Puyallup assessed the cost differential for new development under Ecology's 2012 *Stormwater Management Manual for Western Washington* compared to its 2005 manual for 14 potential scenarios, including costs for stormwater management on residential sites using LID/GSI principles. They calculated that construction costs were less for development in 2012 versus 2005 manual standards for all scenarios except residential without LID/GSI. Ongoing maintenance for residential development, however, was higher for 2012 versus 2005 (both with and without LID). The main cause of this increase is the cost of O&M for permeable sidewalks and bioretention installations. In their calculations, for

small commercial facilities, significantly lower costs for both construction and long-term O&M are realized if bioretention is installed instead of centralized treatment and flow control facilities. For large commercial, installing permeable pavement instead of traditional runoff treatment and flow control components significantly reduces both construction and ongoing O&M costs (Puyallup, 2013).

Staff in at least one city disagrees with these results because of their experience that, in many cases, these types of LID/GSI facilities will need to be completely reconstructed, and that should be counted as a long-term maintenance cost.

Are weeds acceptable?

Staff are not sure if weeds affect function of bioretention facilities. Other than concerns about aesthetics and noxious weeds, there appears to be little research on whether weeds, or other alternative plant pallets, impact stormwater features. Research is needed about how weeds affect bioretention.

Roadside ditches

According to staff, roadside ditches are a rich opportunity for stormwater attenuation, treatment, and conveyance. Cities like ditches because it keeps water off the roads. Well vegetated, stable ditches that aren't contributing sediment are not standardized.

Some cities still have extensive ditching on one side of roads, but residents want to fill and pipe the ditches because it is highly desirable to walk along the roads. In one city, they still have more than 50% of ditches which poses a huge maintenance problem for their three public works employees. They would love funding to do infiltration projects in their existing ditch areas. Another staff person "dreams of making bioretention facilities out of all the ditches."

Kitsap County developed a roadside ditch enhancement plan to provide guidance and recommendations for retrofit measures to improve water quality of runoff from county-owned roads and right-of-way areas. The authors researched existing literature/studies to put together six retrofit project types to enhance conventional ditches to bioretention function (Kitsap Co., 2012).

Figure 8. Roadside ditch during a rain event.

Throughout the region, however, there is a need to go to the next step and conduct a study of the functionality of both existing ditches and enhanced ditches (i.e., those that have been retrofitted for bioretention), including water quality testing at ditch outfalls. This study would provide local cost-benefit information to inform jurisdictions of the value of enhancements as well as prioritization.

Media mixes still not nailed down

There is a great deal of staff concern that the correct media mix (soil/compost blend) has not yet been determined successfully for bioretention facilities. Redmond (in partnership with other jurisdictions) tested different media mixes for different receiving waterbodies related to treatment. Other studies are ongoing. Staff would like to have some solid answers on the best mixes backed by science.

Compost questions

A major challenge for these facilities is that new studies have shown that phosphate, copper, nitrogen, and other and other currently unregulated pollutants have elevated concentrations in commercially available compost (Redmond, 2015). It is likely that copper is coming from yard waste rather than food waste in the feedstock for the compost. Concerns have also been raised about the use of wastewater treatment plant biosolids or agricultural manure as feedstock for compost which may include contaminants such as personal care products and industrial chemicals, pharmaceuticals and antibiotic resistance factors. Currently compost is required to be used in bioretention facilities and yet this compost is causing contamination. Thus some cities are reluctant to promote bioretention until the compost issue is resolved.

Another question is whether a layer of compost in the bottom of the pit is needed. One perspective is that the bacteria needed to do treatment is plentiful enough that it will quickly get established and that a rock layer will work just as well.

Nonfunctioning bioswales and bioretention facilities

Some staff commented that bioswales and similar features have been installed but are not working well. In one jurisdiction with a high groundwater table, bioswales are always full of water.

One suggestion is that guidance needs to be "stricter" about facilities built over hard pan. In these locations, facilities could still be effective if their storage basin was required to be thicker.

Inherited King County ponds

Quite a few cities have had challenges with old, sometimes failing, King County detention ponds. Some cities are turning them into bioretention facilities.

In some cities, this means that they have some ponds they maintain and some that they require homeowner associations to maintain – King County required deeding of ponds and vaults to the county. This has created a "difficult mish mash situation" in which the city is responsible for some facilities and not others. Furthermore, the same storm fee is charged for one owner that is having to maintain and one that isn't.

Some staff feel that it is in their city's interest to reduce the number of vaults and inherited wet ponds.

To fence or not to fence?

One city does not require fences around ponds. This saves money and provides marketing value as a community amenity. This site has gentle slopes that are easy to mow and maintain. In other cities, fences are required for public safety.

Are facilities being installed correctly? Are they working?

Staff pointed out that construction inspectors are only able to look at the specs; they are not able to test materials or ensure that the correct mix is installed in the field. In addition, inspectors are not trained how to tell if materials, plants, and other components of bioretention facilities are installed properly and functioning.

Cities tend to oversee installation of facilities during construction but then move on to the next project. They lack the time and authority to see if facilities are working down the road. Staff suggested that they need more follow-up monitoring region-wide by other entities to see how well facilities function long-term.

Another recommendation is the development of a third party inspector system to ensure that construction of these facilities is being done correctly. Small cities, especially, do not have capacity for intensive inspections and a third party system would help reduce the need for specialized training related to this evolving technology.

Recommendations:

- ***Study bioretention***.* More research is needed on the following: proper media mixes, nutrient leaching from compost, sources of copper other metals and other currently unregulated pollutants in compost, how weeds affect function, assessment (region-wide) as to whether facilities are protecting water quality, if different feedstocks work better than others (and does that impact what pollutants to monitor).
- ***Study ditches.**** Determining the functionality of existing ditches and enhanced ditches (ditches that have been retrofitted for bioretention), including testing water quality at ditch outfalls, would provide local cost-benefit information to inform jurisdictions of the value of enhancements as well as prioritization for enhancements.
- ***Develop a third party inspector system for bioretention facilities.*** Because of the specialized nature of bioretention facilities and the need to ensure that they are property constructed, a third party inspector system may be desirable.

** Near Term Action submitted for the Puget Sound Partnership Action Agenda June 2016 update.*

Rain gardens

"Rain gardens are great as long as they're dealing with dirty water."
- Staff perspective

Currently, only a few cities offer rain garden incentives to single family homeowners. While practically all staff agreed that rain gardens provide educational value to the public, there were quite a few staff who felt that gardens are being poorly sited (inadequate percolation testing), cause basement flooding of the homeowner or their neighbor, and are not well maintained.

Specific opinions include:

- ***Poor installation and maintenance.*** Many rain gardens have been incorrectly installed and/or poorly maintained. A comment from one city (with good infiltration): "every one that has been constructed fails due to improper maintenance."
- ***Better for driveway runoff.*** Some staff feel that rain gardens are better if they are designed to address driveway runoff, not just roof runoff. "Why worry about clean roof runoff?"
- ***Underdrains.*** Some of the demonstration rain gardens have underdrains. Thus these facilities have more of an aesthetic/educational function. One staff member pointed out that a local facility is advertised as a rain garden but it's actually a decorative planting on top of a giant infiltration gallery, fed underneath by pipes.
- ***Lack of engineering.*** Rain gardens are often installed by landscapers and are not engineered.

Motivators include:

- In some projects rain gardens are required as part of the stormwater calculation.
- Rain gardens allow the opportunity to co-locate landscaping requirements with drainage requirements.
- Rain gardens that don't get stormwater credit can only have positive impact as long as they don't cause flooding.
- In urban areas, the installation of rain gardens as a distributed retrofit strategy provides a bonus amount of function where that function would not have otherwise occurred. For significant stormwater management needs, a larger facility would be required.

Poor construction

According to staff, many rain gardens are not functioning properly. They felt percolation tests were inadequate and recommended that improved tests be required.

Enforcement issues

For rain gardens which are installed for stormwater credit, city staff often don't have permission (easily) to inspect rain gardens. It is a big problem for inspectors to contact several homeowners versus one homeowner association. Also, there is a question of what happens with homeowner turnover. Some cities have solved this problem by requiring that the rain garden be recorded on the plat and an inspection easement maintained. Some cities require homeowners to reapply for stormwater credit after property sales.

The homeowner association in one development filled in their rain garden and replaced it with grass. In one city, private property owners are required to have a maintenance plans, two-year bonds, and allow city inspection annually after two years. Staff characterized ensuring maintenance as a "nightmare, especially with future homeowner change."

Educational value

In some cities, rain garden programs have had large value for educating residents about stormwater. They have held well-attended workshops. One city also does maintenance tutorials and provides a rain garden maintenance manual.

Maintenance

Long term maintenance is a big concern for staff, who worry about weeds, overgrown vegetation and sedimentation. Overflow systems need maintenance on a regular basis. The primary challenge is educating homeowners, especially new homeowners when properties change hands. Staff believe that without an education component, a rain garden program doesn't work. Most cities do not have the capacity to do educational programming about maintenance and feel that an outside agency doing rain garden demonstrations would be well received.

One staff person suggested that we should investigate the potential for "grass holes" or mowable rain gardens to overcome some maintenance issues.

Recommendations:

- ***Improve rain garden standards.*** According to staff, many rain gardens are not functioning properly due to underlying soils. Improved percolation tests need to be required.
- ***Provide maintenance education/training for the public.*** Most cities do not have the capacity to do educational programming regarding maintenance. An outside agency which could be contracted to conduct demonstrations/trainings related to maintenance of rain gardens and other LID/GSI facilities would be well received.

Preserving soil and vegetation onsite

> ***"If you don't create impervious area, you don't have to treat the area."***
>
> \- ***Medium city staff member***

Staff generally favor preserving soil and vegetation onsite as one of the best LID/GSI techniques because of the ability to preserve soil function for stormwater infiltration. Staff also find that it is one of the least used techniques because of the intense pressure to fully develop lots. In most cases, the places where this technique is used is where a city is building a park facility or a developer has other incentives to retain natural features. The major challenge is often that lot configuration doesn't blend well with locations of the existing trees.

Some urban cities require amending existing soils due to poor widespread quality. Another city said that most existing open areas are vegetated with noxious weeds. In these jurisdictions, preserving soils and vegetation is not a beneficial technique.

Furthermore, in hilly cities, the "minute you touch the property, the top soil is basically gone during grading."

A few cities require that soil and vegetation be preserved in subdivisions. An area of concern is how grading permits are managed to encourage (or discourage) soil preservation.

The primary motivators for preserving soils and vegetation are:

- High end homeowners want more greenery and vegetation.
- If developers protect soils then they don't have to spend money do soil depth replacement BMPs (but this latter incentive does not appear to be a high enough motivator as they usually scrape off the parcel and at the end bring in poor quality soil).
- Opportunity for reduced lot size. One city, for example, allowed reduced lot size for maintaining wetland buffer.
- Privacy barriers are desired in some communities.

Stockpiling soil

Some King County cities require stockpiling of organic soils (see Callout Box for Newcastle), but this is not a common technique in urban settings due to lack of space to stockpile soil on-site. Stockpiled soil can also be filled weeds. Developers can make money selling soil elsewhere. People come up to development sites wanting to buy soil as fill (though this is usually prohibited in code).

Newcastle: *Soil stockpiling*

In the City of Newcastle, native topsoil and the duff layer are required to be preserved undisturbed on development sites to the maximum extent possible. Where infeasible, stockpiling in a designated, controlled area is required.
More info:
www.codepublishing.com/WA/Newcastle/html/Newcastle14/Newcastle1415.html

Challenges removing trees

One city requires maintaining a certain percentage of tree canopy during development. They have noted that many trees become hazard trees when the rest of the site is cleared because they are unable to survive in windstorms. Loss of some trees exposes the remaining trees.

Enforcement

Only a few cities say that they enforce site disturbance thoroughly on the building inspector's side.

King County inspects sites because this strategy replaces formal stormwater controls to satisfy permit requirements #6 and #7. The county has to keep an aerial photo record to see if the builder pushes outside of their development envelopment. Enforcement is delicate.

Recommendations:

- ***Create local soil banks.*** For locations where developers are not required to stockpile soil onsite, there may be value in creating a soil bank to preserve high quality material for top soil use.

Dispersal and disconnected downspouts

"You need enough land to achieve dispersal,
otherwise you're dumping your problem on someone else."
- Medium city staff member

Figure 9. New development with a large suite of LID/GSI techniques including infiltration and permeable pavement (along with conventional pavement).

Dispersal and downspout disconnections (including infiltration trenches and similar) have historically been the norm in many King County cities with larger lots and adequate infiltration. In some cities, this technique has only been used in areas where there is no existing stormdrain system – otherwise homes are tight-lined. In one city, all new houses were required to be connected to the storm system but now the city has started letting people route driveway drainage to lawn areas.

In areas with high groundwater or steep slopes, many cities generally require that homes tight-line their roof runoff because of impacts to downgradient neighbors.

In rural areas, this technique is popular, inexpensive and can work even in locations with limited infiltration.

Barriers to the use of this technique include:

- Poorly draining soils.
- Proximity to property lines. For example, in urbanizing areas that are promoting density, houses are only 5 feet apart.
- Proximity to septic drainfields.
- Creating soggy yards - people don't want them.

Dispersion used in poor soil conditions

Several cities view this technique as an acceptable approach for areas with poor soils/high water table and require dispersion trenches in poor soil areas. In some cities, dispersion trenches are required to have overflows connected to the storm system in locations with poor infiltration. Another city requires single family properties to preserve downspouts on site in infiltration trench or dispersal, even in poorly draining areas.

Higher elevation cities have snow issues

In higher elevation cities, most houses don't have gutters because of snow load. Runoff goes into yards and into the ground.

Does dispersion really work?

There is some concern that dispersion trenches don't really work outside rural areas and that existing guidelines are inaccurate. Inevitably, runoff quickly comes back together within twenty feet because you can't grade downstream flow path. To address this, requirements need to reflect different densities.

One city has a new development requirement hierarchy:

- Infiltration
- If not infiltration, dispersal
- If not dispersal, detention

Street Sweeping

> ***"One of the most important and effective techniques: picking up materials and pollutants where they fall."***
>
> ***- Urban city staff member***

Street sweeping has become recognized in the region as an important piece in a city water quality toolkit, if done with the right equipment at a high frequency at the right time.

In our interviews with staff we asked about street sweeping equipment, frequency of operation, and source of funding. Almost all cities in King County currently has a street sweeping program. The type of machines and the frequency of street sweeping varies significantly from city to city. Regenerative air and vacuum vehicles are mostly used, with some cities using broom sweepers. Frequency of arterial sweeping ranges from weekly to biannually, and city-wide frequency ranges from every 1-2 weeks to every 2 years. Some cities sweep on an as-needed basis.

Street sweeping has been shown to be highly effective in reducing pollutant loading as demonstrated by City of Seattle data collection. Starting in 2011, Seattle began a stormwater-based sweeping program using regenerative air sweepers. The program removes approximately 1.5 times the load removed by all Seattle Public Utilities-maintained water quality treatment facilities. Seattle is now doubling their street sweeping as part of their Protect Seattle's Waterways Plan which will result in removing an 40 additional tons of fine particulate matter and attached toxic chemicals from streets annually over a five-year period (SPU 2009, 2015; Kidwell-Ross 2015).

For cities that have more frequent sweeping programs, they tend to sweep the commercial and downtown areas most frequently, followed by arterials, followed by residential areas (if at all).

Generally, staff would like to do more sweeping. The major barrier is cost. High quality trucks cost hundreds of thousands of dollars. In addition to tight budgets, not all cities have funds to pay for staff or contracts to operate the trucks.

Ideally, cities are using high efficiency vehicles. If not, it may be necessary to do tandem sweeping for maximum benefit. Regenerative air street sweepers are not high efficiency and don't pick up big debris – thus you need a broom sweeper to go ahead to break up hard surface to make debris mobile before it is vacuumed.

How street sweeping is funded

Funding street sweeping is a bit of a hot button issue due to the question: is sweeping more important for stormwater function or aesthetics/road maintenance? Of the 22 cities who provided information about their street sweeping funding source, nine are funded from their stormwater utility, six from general fund or a combination of street and utility, and five from their street fund. Two cities receive state agency funding for street sweeping. Several cities told us they vary their use from either their street and stormwater budgets, depending on which budget has extra funds each year

Acceptance by residents

Respondents said that public works staff really like street sweeping because it is one of the few jobs where residents can see a direct benefit. They can connect the dots between their stormwater fee and cleaner streets.

One challenge, though, is that for effective results cars may need to be off the street, although this is not certain (Seattle, 2009). This is why street sweeping usually occurs at night in commercial districts. Few cities have requirements for cars to be moved. Most cities don't actively enforce parking limits until they get neighborhood complaints. It will be a politically sensitive issue to require towing of cars that are parked on the street during street sweeping days.

One city told us that their primary motivation for street sweeping, combined with an aggressive catch basin cleaning program, is to reduce flooding. By ramping up their program, they have virtually eliminated flood-related complaints.

How effective and cost efficient is street sweeping relative to catch basin cleaning?

A key question for some staff is the actual dollar savings and effectiveness of street sweeping versus catchment basin cleaning. In one jurisdiction, they completely switched their budget for annual catchment basin cleaning to street sweeping because they felt sweeping was a much more effective technique. A comprehensive study is needed to clarify this tradeoff in a variety of seasons and land uses including urban, suburban and industrial.

How effective and cost efficient is street sweeping for water quality treatment?

Another key question which does not appear to be answered in some staff's minds is how well sweeping works for treatment. Seattle's study (SPU, 2009) looked at reducing frequency of catch basin cleaning but did not test net pollution load reduction through the system. Seattle has also examined the issue of seasonal variation in their studies. Some staff believe that sweeping needs to be done weekly in order to be effective for water quality treatment. A comprehensive study is needed to determine this potential benefit in a variety of seasons and land uses including urban, suburban and industrial. In addition, staff suggested that a cheat sheet is needed about sweeping benefits in order to help justify funding from upper management and councils.

In 2015, the Seattle "Street Sweeping for Water Quality Program" removed 1,046 dry tons of street solids, which contained 235 dry tons of particulate matter less than 250 microns in diameter (PM250), and 137 tons of fine particulate matter (PMWO – particulate matter wash off). They report the PMWO as an equivalent Total Suspended Solids (TSS) for comparison with stormwater best management practices. Their working model, however, indicates that other than the material blown off the street and permanently stored on the land, all material picked up by the street sweeper would ultimately be deposited in receiving waters if not removed by a catch basin and/or a stormwater treatment BMP. Staff suggest that a next step to develop and verify a model that estimates the true receiving water benefit from street sweeping would be valuable to the region would be valuable.

Where does waste go?

While the leaves are generally not contaminated, the particles and debris contain the toxic contaminants which are the target of street sweeping for water quality purposes. Currently, cities separate the leaves and send them to composting facilities. The particulates go to landfills or are used for fill mixes. Some cities serve as hubs for other cities providing the separation service. Auburn, for example, has a decomposition facility that other cities pay to use. The particulate fraction is tested regularly.

Contracting and equipment

We found that about half of the cities contract out their street sweeping and that most of these contractors are using regenerative air or vacuum sweepers. For cities that own and run their own equipment, fuel, personnel, and vehicle maintenance and replacement costs have to be balanced against contracting. Two cities share equipment. One city contracts another city for sweeping service. For cities that own their own equipment, a key issue is adequate staff capacity to operate machines. One city contracted for monthly sweeping in the past but can't afford it anymore and now has an as-needed schedule. One city rents a truck twice a year. Two cities share a joint contract. Two cities share a truck.

Does street sweeping hold back genuine source control efforts?

One staff person offered a different perspective about street sweeping. While their city does use a street sweeper on a relatively frequent basis, there is concern that sweeping is just a "band aid technique" which removes some sediments and pollutants but perpetuates the approach of placing chemicals and sand on roads because it can just be swept up. Sweeping does not address the sources of pollutants.

Recommendations:

- ***Create a fact sheet on street sweeping benefits***. An easy-to-read factsheet is needed to help staff make the case for purchasing high quality equipment and justifying staff time or contracts for running the machines frequently.
- ***Study street sweeping***. Conduct studies to answer the following questions: What is actual dollar savings and effectiveness of street sweeping versus catchment basin cleaning (in a variety of conditions)? How well does street sweeping work in a variety of seasons and conditions including urban, suburban and industrial? Does intensive sweeping on rural roads provide the same return as it does on urban roads?

8. Trees

"Trees are important for our city's identity."

- Small city staff member

Trees are part of the Pacific Northwest ethos. Some cities in King County go even further and consider trees to be a key part of their core values – they conduct Arbor Day activities, include trees in their city logos, qualify as Tree Cities, and strongly promote tree planting and protections. Abundant research has shown that trees provide impressive stormwater benefits.

Tree preservation, however, is a hot button political issue, due to view blocking concerns, maintenance issues, and desire to maximize lot coverage. Tree protection and replacement ordinances have primarily been put into place for aesthetic and historical purposes. Trees are now being promoted for stormwater benefits.

Tree ordinances have been seen by some as a violation of private property rights. Several years ago, one city's efforts to strengthen existing weak regulations failed at the ballot.

King County cities generally have a tree-related requirements distributed in different sections of city codes; a few have pulled them together into single locations. In Appendix 2 (*Tree regulations in King County jurisdictions*), we have compiled current tree regulations from municipal codes for all jurisdictions in King County. There is a wide spectrum of tree protections. For example protection of "Significant trees" range from no requirement to rigorous retention standards of 30-100%. Tree replacement regulations range from no requirement to 8:1 ratios, often based on the size of the tree removed. Cities like Sammamish, Newcastle, Burien, and Redmond have strict tree ordinances or promote tree retention with innovative incentives (See Callout Box for Sammamish).

Sammamish: *Tree retention incentive rewards with reduction of required recreation space*

The City of Sammamish incentivizes tree retention based on tree diameter, rewarding retention thresholds with reduction in required recreation space.
More info:
www.codepublishing.com/WA/Sammamish/html/Sammamish21A/Sammamish21A37.html

Some cities have tree funds into which developers can pay a fee instead of planting trees onsite. One medium-sized city said that 50% of the developers choose this option.

Tree ordinances are too lax or not well enforced

Several staff mentioned that existing tree ordinances are not well enforced. One staff said, "tree replacement standards are too lax and penalties are not motivating" in their jurisdiction. It should be noted that there are differences in types of tree ordinances in different cities, which may contribute to the perception that ordinances are lax, as pointed out by one staff person. Some cities have tree preservation ordinances while others have street tree ordinances (details for each city are shown in Appendix 2).

Some tree ordinances don't require maintenance of replacement trees. In one city, for example, replacement trees have to be kept alive for two years, after which "they can do whatever they want." If the tree is removed "nothing is serving a stormwater function" if the tree was receiving stormwater credit.

Tree challenges for utilities

Beyond political issues, we were told that while planners love trees, "public works staff have to maintain them." Problems include:

- Leaves clogging stormdrains.
- Trees obstructing street sweeping.
- Roots breaking sewer pipes.
- Roots cracking sidewalks.

Trees for stormwater credit

The King County manual does not count trees as LID/GSI because of the difficulty of calculating the benefit and the issue of follow-up to ensure tree survival.

There is strong anecdotal evidence that trees help with water management problems. One staff person told us that "whenever someone calls in a drainage complaint, 80% of the time a tree was taken out. Neighbors got a permit to remove mature trees and caused flooding next door." In some situations, however, proactively planting trees to address stormwater can be a problem in areas where the water table is high as high groundwater limits successful establishment of planted trees.

Potential drawbacks and challenges to allowing trees for stormwater credit cited by staff include:

- Removal of mature trees for which property owner is receiving detention credit.
- Lack of resources to inspect trees. Furthermore, staff do not relish becoming "tree police" given the politically charged nature of trees.

- If trees are calculated into retention and are removed, the resulting retention capacity for the site is undersized.

New tree stormwater code being written

A group of cities have joined together - Normandy Park, Sammamish, Burien, and Snoqualmie - with King Conservation District to write a stormwater code that includes trees as a stormwater management tool. The effort is called the King County-Cities Climate Collaboration (K4C) (http://kingcd.org/programs-urban-forest.htm).

Ideal tree mix for stormwater management

When queried, most staff did not know the source of the recommended tree lists in their city code nor did they have a good idea of what would be the ideal tree mix for stormwater management. It was recommended by staff at some cities that research needs to be done to find the ideal tree matrix for different areas and conditions found in the Pacific Northwest, including consideration of maintenance, leaf drop and other impacts to stormwater LID/GSI features or drains. Other environmental benefits such as desire for south-facing buildings to gain solar gain in the winter (i.e., use of deciduous trees might be desired) and safe-zone spacing from rooftop-mounted solar panel arrays could also be factored in. One existing local study related to stormwater benefits is primarily a literature compilation of the sparse available data (Seattle, 2008). In the *LID Manual*, there is only a general recommendation that evergreen trees and larger trees are better for stormwater management and that local experience should be considered.

Using USDA Forest Service's i-Tree Eco tool combined with field observations, from 2010-2012, the Green Cities Research Alliance led an analysis of the current extent and condition of Seattle's urban forest. The assessment quantified ecosystem values by looking at tree and shrub size and species information and determined that an estimated 2 million metric tons of carbon dioxide equivalent is stored in Seattle's urban forest and that it annually removes 725 metric tons of pollution from the environment. This comprehensive study provided a baseline against which further updates can be assessed. One recommendation from the report, however, is that research is needed to calibrate existing stormwater models to Pacific NW continuous storm data (Green Cities Research Alliance, 2012).

Is redevelopment an opportunity to put in healthy trees?

There is a question of how best to manage trees on disturbed sites. Older trees can get damaged in wind storms and can develop root rot issues. The *LID manual* recognizes that that some trees should be retained in groups: trees originally in dense stands may not survive as single trees as they might break (PSP, 2012).

Some species have well-defined lifespans. Big leaf maples and cottonwoods, for example, get to a certain size and will tend to fall apart. Some existing trees have been neglected and are in bad shape. Another issue is that even if trees are being saved on a site, construction activities without adequate protection can stress them too much to survive. One perspective we heard is that creating high quality LID/GSI features and replanting trees after construction was more effective than tree retention.

Based on these issues, some staff suggest that redevelopment of already disturbed sites is an opportunity to restore healthy trees. A study is needed to assess the benefits of both approaches – preserving trees and replanting trees – in terms of long-term benefit.

Incentivizing street trees

Some cities have programs to proactively replace trees. Tukwila tried an approach to encourage street trees with easements with success.

Education needed

Staff described challenges in educating residents about the value of trees in general and the value of specific types of trees. For example, some people don't like cottonwoods for a variety of reasons including their short lifespan, but they provide good water management benefit. In one city, some people wanted to cut all the cottonwoods down. Staff had to educate citizens that "cottonwoods are a great stormwater control and can help mitigate steep slopes and prevent landslides." Educational materials are needed about tree benefits.

Recommendations:

- ***Provide educational materials regarding trees.**** Staff need high quality materials to educate the public about the value of trees, the specific benefits/drawbacks of different species relative to stormwater, and guidance on installation and maintenance
- ***Research ideal tree mix for stormwater management.**** Most staff did not know the source of the recommended tree lists in their city code nor did they have a good idea of what would be the ideal tree mix for Pacific Northwest stormwater benefits. The ideal tree mix for the Puget Sound region, especially for street trees, needs to be well researched and defined, including consideration of long term maintenance as well as associated maintenance issues such as leaf litter on permeable pavement and drains.
- ***Study the benefit of preserving versus planting trees on disturbed sites.*** Some staff suggest that redevelopment is an opportunity to put in healthy trees in disturbed sites rather than preserving many of the potentially vulnerable trees during construction. A study is needed to assess the long-term benefits (15 years plus) of both approaches.

** Near Term Action submitted for the Puget Sound Partnership Action Agenda June 2016 update.*

9. What options developers typically choose

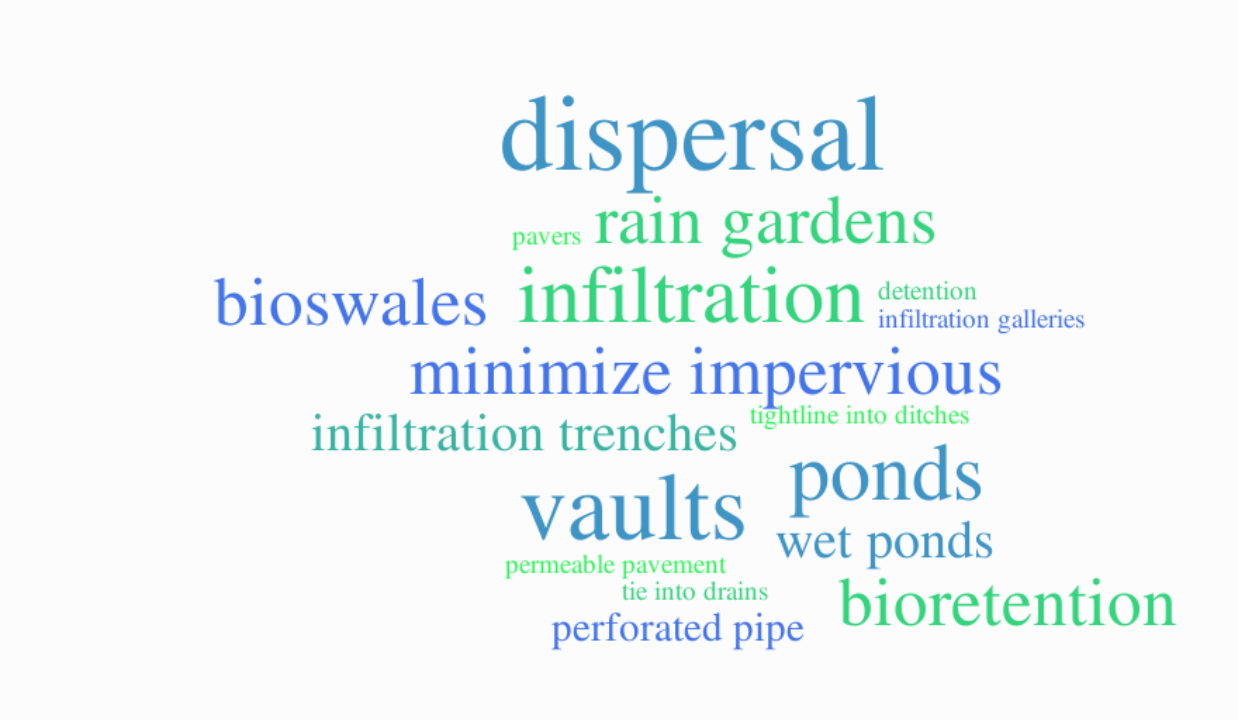
"Developers pick cheapest option that meets requirements."

- *Small city staff member*

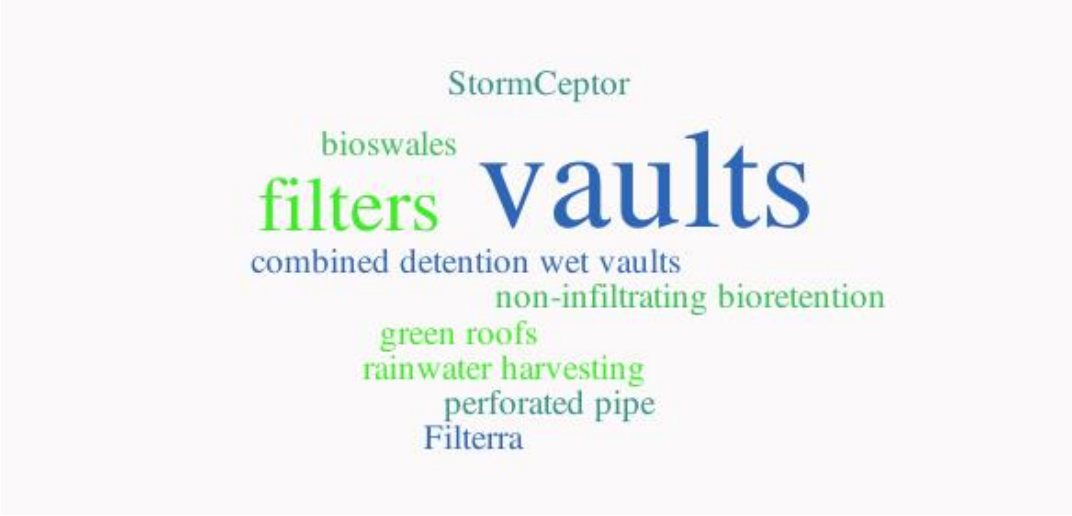
For now, developers are mostly picking tried and true grey infrastructure techniques. In some locations, LID/GSI usage is slowly picking up as developers use them to add market value or get incentives.
Options that are most favored (which reflect the land use, water table, geomorphology of the various cities) are shown below.

Word cloud of responses from staff as to which techniques developer pick in their jurisdiction for:

Residential Development



Commercial Development



10. Compliance during Construction

"The city has to ride the contractors, even on City projects, to ensure erosion control measures are in place."

- Staff from small city

In many locations cities feel that contractors are not doing a good job of meeting stormwater requirements during construction. In other cities, contractors are doing a pretty good job of controlling erosion on building sites.

Contractor stormwater problems

In addition to inadequate erosion control features and negligence in cleaning out socks, the biggest problem in several cities was dirt track-out: "Track-out requirements are violated a lot. It is difficult to get developers to comply. They have so many trucks and installed systems are not maintained." Staff feel that it is probably less expensive to maintain the track-out systems than to contract a street sweeper to clean up afterwards.

Extent of the problem

Staff feel that they basically have to stay on top of the contractors. One comment was "If you let contractors forget about stormwater pollution prevention they will.

According to staff, the challenge is changing the paradigm in the construction world. Margins are tight for contractors and they want to keep doing same thing. In addition, learning to implement new techniques is challenging and time is money.

In many cities there is a distinction between larger more established contractors are more likely to comply than uninformed contractors, often from other areas, who give significant push back to city inspectors. One staff person said that in their experience "Most problems are with little contractor companies." In contrast, another respondent said, "larger companies have worked in Bellevue and Seattle - they know that installing BMPs and complying with requirements are cheaper than a shut down."

Figure 10. Silt fencing at construction site.

Cities that have had fewer compliance problems have strong enforcement mechanisms. For example, one city staff person told us that they do shut projects down if there are repeated violations, which includes repeated failures to follow erosion control measures.

Inspectors role

Many cities said that they have inadequate funding for inspectors. Another challenge, according to staff, is that "inspectors walk a tight line – can't tell contractors what to do, only inform of code violation."

In small cities, staff feel that inspectors are generally well versed because staff have to wear many different hats and thus are well informed about all aspects of development.

The view of one staffer (from a medium sized city) is that building inspector purview is limited to 5 feet around buildings. No one is inspecting the area outside of this perimeter.

Erosion control and stormwater are not always priorities for inspectors. Some staff suggest that training for inspectors would be helpful so that they could look at entire disturbed areas and recognize stormwater issues.

Ecology's role

Some staff feel that Ecology should play a larger role in local enforcement, while others said that Ecology is overstretched and it is "hard for a state agency to take the lead on something this in-the-weeds." Overall, it was recommended that Ecology needs more staff to enforce permit requirements.

Improving compliance

Staff in some cities say that at least 50% of inspections find violations. To improve compliance staff suggested providing educational materials (i.e., LID/GSI references specifically for contractors), requiring training for contractors, and increasing enforcement action. One city tried offering a contractor training but it was poorly attended. They feel that a permit requirement or financial incentive would be necessary to boost attendance. One staff person suggested that contractors would earn a spot on an approved list if they attended a training (this is beyond CESL).

The City of Lake Forest Park has improved compliance by issuing a fine if a second inspection for erosion control is needed. The cities of Kenmore and Pacific inspect private development annually and send out an annual reminder letter to increase compliance. The City of Medina requires construction mitigation plans to increase compliance due to enhanced public notification (See Callout Box for Lake Forest Park, Kenmore, Pacific, and Medina examples).

Another staff person pointed out that "division of labor makes communication challenging" – some inspectors are well trained the technical and scientific topics while others do not receive this training.

Another perspective was that the inspectors are well trained but do not receive enough management support. Thus this person recommends educating upper management about stormwater issues in order to work towards consistency across the county. According to staff, developers know which cities have management support and which don't, and thus know where they can be less compliant and less responsive to inspectors. There is a feeling that Ecology needs to do more to support small jurisdictions whose inspectors are having difficulties with noncomplying contractors.

Lake Forest Park: *Re-inspection fees*

In the City of Lake Forest Park, when construction compliance is not met during the first inspection, a re-inspection fee is charged for follow-up inspection(s).
More info: www.codepublishing.com/WA/LakeForestPark/mobile/?pg=LakeForestPark15/LakeForestPark1506.html

Kenmore & Pacific: *Compliance reminder letters*

The cities of Kenmore and Pacific send out letters to all active construction site managers before the wet season, including reminders about more rigorous BMPs required in wet weather such as stock pile management, track out maintenance etc. Pacific has received thank you responses from contractors for this service.

Medina: *Construction compliance*

The City of Medina has significantly increased contractor compliance by creating innovative thresholds for public notification and establishing strong tools for proactive enforcement, including stop work orders for track out violations , the. A tailored construction mitigation plan is required for projects based on size and location. This program aims to minimize construction impacts. It also helps them with dirt being tracked onto the roadway because they can issue stop work orders if they don't rectify the situation quickly. They have a consultant who does go out and check sites in preparation for the winter months to make sure erosion control measures are proper for the season. The applicants pay for this through pass-through fees and permit fees.
More info: www.codepublishing.com/WA/Medina/html/Medina15/Medina1520.ht

It is not clear whether the existing requirement of CESCL trained site leads on projects over an acre in size is enforced. It appears that companies are sending unqualified people just so they can say they have a CESCL onsite.

A final point is that the manuals and regulatory requirements should support ensuring that the BMPs are working. As one staff member said, "it doesn't matter if you've implemented BMPs, it matters if they work." This person supports giving inspectors discretionary authority to say if something is not working as "Inspectors are happy to work with contactors to find cheapest alternatives that still meet the requirements."

Recommendations:

- ***Require regional contractor training.*** Staff feel that more training is needed for construction contractors. Specific training for contractors and construction personnel could be taught by contractors and would be well attended if mandatory under the NPDES permit.
- ***Create training for upper management.*** Inspectors, especially in smaller jurisdictions, need more support of upper management for enforcement of construction stormwater requirements. Developers know which cities have less management support and thus training and education for upper management could help level the playing field.
- ***Increase Ecology support for enforcement.*** Staff suggested Ecology needs to play a larger role in enforcing construction permit requirements and assisting smaller jurisdictions who have trouble with non-complying contractors.

11. Prioritization efforts/Planning

"Prioritization helped get projects funded."

- Medium city staff member

A few cities have done full-blown stormwater retrofit plans and most have done various other types of studies, including stormwater comprehensive plans. Some cities have done no prioritization effort to date. One staff person said, "We have not done a watershed plan to know where exactly pollutants are coming from and how to address them" and that this has also not been done regionally.

A few cities have engaged in formal watershed basin planning with King County under the Phase I requirement to partner with local jurisdictions in several watersheds. This has netted quality projects but are limited in scope.

Some cities used their Comprehensive Plan update to address flooding and erosion issues. A few cities plan to create stormwater comprehensive plans in the near future, often with Ecology grant support.

Prioritization Plans

Ecology and other funding sources have supported plans in some King County cities. Cities that have done prioritization projects have developed a number of approaches which break their jurisdictions into basins, prioritize based on water quality and habitat goals, and develop lists of capital projects. Based on a cost-benefit analysis, one city's plan found that bioswales should be the focus.

Local prioritization largely focuses on asset management

Cities that have not yet created prioritization plans tend to use their Capital Improvement Plan (CIP) process to identify high priority retrofits and low hanging fruit. These are generally focused on fixing existing known problems and capacity issues.

One city prioritizes their capital improvements based on severity of erosion, size of upstream drainage, and proximity to private property. This approach was initiated because of complaints by residents who live on ravines and complain about erosion.

Asset management is a big focus because the ages of assets have often surpassed their lifespans. Thus the biggest demand on funding is repair and replacement of existing assets. This replacement prioritization has surmounted the financial ability of cities to do proactive LID/GSI retrofits.

Consider a new model, based on salmon recovery approach

Several staff spoke about the need to change the paradigm to a regional prioritization approach. One person specifically recommended that Ecology shift to a model with more centralized prioritized actions, similar to the salmon recovery approach. In other words, create a regional water quality district that prioritizes sites and actions at a watershed and Puget Sound level and awards funding based on these priorities. He also thinks that innovation should be encouraged through grants.

Another staff person noted that permit and grant systems are currently oriented towards smaller projects that have minimal benefit. "With the current stormwater grant program, jurisdictions do easy projects but are not really addressing larger infrastructure issues."

One issue is that current grants generally do not cover planning as they are more oriented towards measurable results. Cities don't have time or money or expertise to determine retrofit needs. Capital planning is needed at least by basin, if not by watershed, for retrofits, building on and going beyond Ecology's recent Watershed Characterization effort. According to staff, prioritizing watershed benefit projects (in addition to what jurisdictions are doing individually) would create buy-in from cities, especially with a collaborative approach. In addition, concurrent planning for stormwater and habitat restoration would get to cleaner water faster as one staff person commented: "Go ahead and try to restore your salmon without my stormwater."

Recommendations:

- ***Prioritize on a region-wide scale.*** Rather than prioritization at the local scale, a region-wide prioritization (going the next step beyond Watershed Characterizations) that identifies the most important places for salmon and ecosystem recovery could better guide the best placement of retrofits and other proactive efforts to address stormwater problems. In doing this, a distinction needs to be made between rural and urban areas, as one size does not fit all. As the population grows we need to know what is critical to protect and what must be restored.
- ***Address highest priorities through grant programs.*** Restructure some grant programs to address highest priorities after doing a region-wide prioritization. Many staff pointed out that the polarization between "gray and green" solutions needs to be reduced and the focus should be on the solutions that work best in each situation, which is not always LID/GSI.

12. Comparison of findings with other recent reports

A number of recent efforts to assess barriers and successes of implementation of stormwater management and LID/GSI techniques have shown similar results to this report, with different emphasis.

Green Infrastructure: Lessons from Science and Practice (National)

A Syracuse University team recently conducted a literature and database review to analyze water quantity and quality performance data for LID/GSI technologies, and administered a survey to municipal officials in 23 communities on factors that may affect decisions related to LID/GSI adoption across the nation.

The data review from 121 sites showed:

- Average stormwater retention performance is influenced more by site characteristics than by storm events for a given technology. Cold weather can diminish water retention performance (except for permeable pavement).

- Almost all technologies remove suspended solids, lead, and cadmium.
- Some technologies only retain nutrients in minimal quantities.

Interviews and surveys with local stormwater managers found key factors that influence successful adoption of LID/GSI programs are:

- Strong local leadership and entrepreneurship.
- Collaboration with multiple and diverse community groups and stakeholders.
- Learning from the experiences of other LID/GSI-adopting communities.
- Consideration of social benefits related to LID/GSI technologies.

Significant barriers to implementation are:

- Concern about cost-effectiveness (including O&M costs).
- Lack of interdepartmental coordination and funding (Driscoll, et al., 2015).

Similarities/differences from this study

The Syracuse assessment highlights two of the same barriers that we found: maintenance and funding. They did not find as much concern at the national level as we did at the local level regarding the need for education, prioritization, and policy changes. They found a major lack of interdepartmental coordination, which we did not hear as a concern among the staff of King County jurisdictions.

2009 NPDES Reports and Ethnographic Perspective Assessment (Western WA)

The Puget Sound Partnership hired Thomas Murphy and team to conduct a study of LID implementation barriers. The team conducted 54 interviews and surveys of stormwater professionals (with 216 survey responses) and compared these responses to barriers identified by Phase II jurisdictions in 2009 annual NPDES reports. Their study especially focused on the differences between jurisdictions of different sizes as well as distinctions of perspective between staff of different departments.

From the 2009 NPDES reports, the top most frequently mentioned physical/technical barriers were (from most to least mentioned): soil suitability, high groundwater table, “built out” space, steep slopes, high maintenance, cookie cutter, and setbacks. The top legal/policy barriers were conflicting codes and regulations, fire/ADA conflict, lack definition, need design/manuals, permitting process, Ecology model and code enforcement. The top financial barriers were project costs, risk/liability, lack data on cost and maintenance requirements, and lack incentives. Top community and institutional barriers were lack of public demand, need staff training, insufficient staff time, internal resistance, ownership/responsibility, elected officials, conflicting priorities, external resistance, and lack of skilled contractors. The interviews generally supported these barriers with the addition of: Local flexibility, long-term cost benefits, internal communication, private property and upper management. The top five barriers identified in the survey are difficulty for public agency to ensure maintenance on private properties, maintenance and durability, uncertainties in performance and cost, legacy infrastructure that does not comply with present standards, and project cost.

Top solutions from the 2009 NPDES reports and interviews included: evaluating site by site, mapping suitability test, rewriting codes and regulations, considering stormwater design at the outset of project, design standards, cost/performance analysis, more financial incentives, grants for staff and green infrastructure, public education and social marketing, more staff training, improved internal communication, interjurisdictional collaboration, and upper municipal management support.

Top solutions from the survey were: considering stormwater design at the outset of project, incentives for retrofits, use LID designs that do not require infiltration on unsuitable soils, maps showing soil suitability for various LID techniques, and bring staff together to address communication challenges.

In summary, the major barriers identified were:

- Maintenance, especially when public agencies need to ensure that it is occurring on private property.
- Uncertainties in cost and performance increase risk and liability, driving up project costs.
- Retrofitting legacy infrastructure.
- Communication across municipal divisions, especially those dividing public works from planning and community development. This was noted as less of a problem in smaller jurisdictions.

Top recommendations from the study were:

- Clearer analysis and measures of cost and performance are needed.
- Ecosystems services analysis would be helpful and may reduce perceptions of higher costs.
- Public education and social marketing are needed so private property owners have knowledge, skills and ability to properly maintain systems.
- Developers should be responsible for environmental damage through better enforcement.
- Internal and external communications for municipalities need improvement.
- Grants and financial assistance for retrofitting legacy infrastructure, staff training, and LID/GSI projects need to be increased (PSP 2015; Murphey et al., 2015).

Similarities/differences from this study

The Murphy study found that maintenance, and especially assurance of maintenance on private property, is the number one concern across the region, mirroring our results. Other barriers and recommendations were similar, though with more focus on internal communications and ecosystem services analysis. Additionally, we found that staff have specific research needs that if addressed may make staff more confident in promoting LID/GSI techniques and are interested in targeted trainings and support for their education needs.

NRDC Getting the Green Out: Commercial Perspective (National)

In 2014 and 2015, the National Resources Defense Council (NRDC) convened two workshops with stormwater and commercial development experts – one on the east coast and one on the west coast – to discuss barriers and solutions related to LID/GSI in commercial properties. They found that many developers were aware of LID/GSI but were not knowledgeable about it and that there is a need to educate project proponents "before the pen hits the paper." While many developers implement LID/GSI because of regulations, many others do so out of desire to do the right thing, enhance property values, or gain tax benefits. Participants were concerned about inflexibility in regulations, uncertainty about how well LID/GSI works, and lack of understanding of maintenance costs.
The west coast workshop produced recommendations related to four key areas:

- "Adopt or revise stormwater regulations that allow for creative, cost-effective design to meet volume-based performance standards.
- Develop tools to capture all benefits and assess 'total' (i.e., aggregate) value, including how to quantify (where possible) and accurately characterize all values.
- Develop and widely disseminate a diverse set of case studies and stories, based on actual projects and data, showing GSI benefits for property owners and tenants. Case studies should highlight both immediate and lifecycle benefits and costs
- Educate appraisers on the benefits of GSI, and learn to speak their language." (NRDC 2015).

Similarities/differences from this study

The NRDC study focused on commercial development and highlighted the need for financial information and cost-effective approaches. Similar to what we heard from jurisdictional staff, developers are lacking in knowledge about LID/GSI and need educational material, including cost-benefit analyses. They also found, as did we, that there is a desire for more flexibility in how to meet performance standards.

The Russell Family Foundation: Strategic funding opportunities to reduce polluted runoff (Western WA)

The Russell Family Foundation commissioned the Sightline Institute in 2013 to identify strategic opportunities for private funders to reduce polluted runoff. The Foundation was interested in this topic because their environmental sustainability program focuses on reducing polluted runoff in four categories - research, outreach, pilot projects, and policy – and they wanted to ensure their investments were effective and well aligned. Sightline interviewed or surveyed 49 grantees and individuals with experience in various aspects of stormwater. Through this process, the barriers identified to reducing polluted runoff included:

- "Costs to fix outdated stormwater infrastructure are high and funding is inadequate.
- Groups working to reduce polluted runoff are not well coordinated and do not work towards clear or common goals.
- Municipalities need technical and policy assistance on green stormwater practices.
- Pollution prevention solutions are essential, yet they are undervalued.
- Incentives to voluntarily install green infrastructure on private property are lacking.
- Efforts to build public support for polluted runoff solutions and investments have not been effective as they need to be.
- Knowledge gaps can limit the effectiveness of green infrastructure and invite skepticism."

From the assessment, the primary recommendations for funders were:

- "Help secure a permanent and stable funding source for Puget Sound cleanup.
- Promote coordination among groups that do not work toward shared objectives."

Secondary recommendations were:

- "Fund teams of technical and policy experts who could be "on call" to help municipalities design and install green infrastructure, brief elected city leaders, embed low-impact development (LID) practices into codes, and share how other municipalities are solving problems.
- Consider other models to help cities implement and finance green stormwater infrastructure.
- Pick one (or several) major pollutants and build a coordinated, multi-year strategy around reducing it in Puget Sound.
- Support advocacy that would grant the Department of Ecology the authority to ban priority Puget Sound pollutants after identifying acceptable alternatives.
- Investigate the local feasibility of innovative financing methods, incentives, and stormwater pricing strategies to entice landowners to voluntarily install green infrastructure.
- Invest in public education/polling/messaging research/outreach, but only in service of a focused campaign and goal.
- Investigate alternative outreach tools that have worked well in campaigns elsewhere.
- Ensure that education efforts resonate with the region's diverse population.
- Invest in basic research to improve the effectiveness of green infrastructure and LID" (The Russell Family Foundation).

Similarities/differences from this study

This assessment's purpose was focused primarily on where to get the most 'bang for the buck" in the Foundation's grant program and thus included a large component related to advocacy as well as activities that would occur at the state level such as toxics reduction. These recommendations occupy a different sphere of work than this study's area of inquiry but found some strong similarities. The major emphasis on need for funding, for example, matches our findings as well as the gaps we found in education, research and technical assistance.

13. Conclusion

"Everything needs to be studied to make sure it's the proper solution in this location, this is a basic tenant of engineering."

- A common staff perspective

The *lay of the land* of LID/GSI in King County encompasses widespread interest in the possibilities low impact stormwater techniques hold for improving quality of life and restoring waterways in Puget Sound. Almost every city has proactively constructed a LID/GSI facility on public land. Some have proactively required low impact practices in private development before NPDES requirement deadlines. With LID/GSI set to be a more prominent component of stormwater management in the coming years, the experience and knowledge gained from the ample variety of projects in King County will bolster current local code updates, inform the next NPDES permit update, cultivate strong collaboration between state and local jurisdictions, and restore ecosystem health on an impactful scale.

In our interviews with local staff, five primary concerns emerged:

- ***Maintenance.*** Every single staff person voiced concern about maintaining LID/GSI facilities, especially as the number of projects expands significantly. Staff are uneasy about the efficacy of current maintenance technology, the required frequency of LID/GSI maintenance, and the lack of resources to fund and staff rigorous maintenance programs. A funding source needs to be identified because local funds are not sufficient. Cost-effective cleaning equipment is needed. LID/GSI-related maintenance training should be significantly improved. Like maintenance of the roof of your home, maintenance of gray infrastructure can be delayed. On the other hand, like brushing your teeth, maintenance of green techniques is constantly required because of the biological nature of some facilities and the tendency to clog for others.
- ***Research.*** Is LID/GSI working? Major questions need answering for LID/GSI to successfully benefit both flow control and water quality treatment. A significant question is: When the distributed LID/GSI facilities all "overflow" in major storms, do the impacts in streams essentially wipe out the ongoing benefits realized in smaller storms? The most requested additional areas of study were related to stormwater function, cost-benefit over time, and standards for permeable pavement, bioretention, street sweeping, and trees. Cost-per-lifetime analysis for all BMPs is needed to inform public works budgets, motivate developers, and create assurance in the minds of staff.
- ***Education.*** Current stormwater outreach has failed to cultivate an ethic of personal action and environmental responsibility on private property. Messaging needs improvement to effectively inform the general public, and inexpensive social science research could make major strides in outreach efficacy. Outreach materials need to be tested to make sure they are effective. Educational pieces are also necessary to train pertinent staff, inspire decision-makers, and empower developers.
- ***Prioritization.*** Rather than prioritization at the local scale, a region-wide prioritization that identifies the most important places for salmon and ecosystem recovery could better guide where to do retrofits and put the most proactive efforts to address stormwater problems. A distinction needs to be made between rural and urban areas, as one size does not fit all. As the population grows we need to know what is critical to protect and what must be restored.
- ***Funding.*** Grant programs have made a big difference for local jurisdictions. More funding is needed! It would be desirable if grant programs could have simpler applications, broadened eligibility and longer timing cycles. Block grants would be especially helpful.

Cost-effective maintenance, vigorous research, accessible education, and funding support will make the LID/GSI transition more productive for municipalities and watersheds alike. Stormwater management is becoming more closely linked with salmon recovery and local staff are keenly aware of their role in securing Puget Sound ecosystem recovery.

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Appendices

Appendix 1. 2016 Utility fees for King County jurisdictions

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Algona	3,090	1/1/16	2,000.00	$7.50/ERU	$90.00/ERU	2,000.00	$7.50	$90.00	✓	✓		
Auburn	74,630	1/1/16	Flat fee	$19.73 /parcel	$236.76 /parcel	2,600.00	$12.27+$15.71 /ERU	$147.24+$188.52 /ERU	✓			Water quality treatment, detention, retention
Beaux Arts Village	295	No stormwater utility										
Bellevue	134,400	1/1/16	2,000.00	$2.55 plus: 0% impervious - $0.43 >0%-20% - $3.08 >20%-40% - $3.86 >40%-70% - $5.78 >70% - $7.68	$30.60 plus: 0% impervious - $5.16 >0%-20% - $36.96 >20%-40% - $46.32 >40%-70% - $69.36 >70% - $92.16	2,000.00	$2.55 plus: 0% impervious - $0.43 >0%-20% - $3.08 >20%-40% - $3.86 >40%-70% - $5.78 >70% - $7.68	$30.60 plus: 0% impervious - $5.16 >0%-20% - $36.96 >20%-40% - $46.32 >40%-70% - $69.36 >70% - $92.16	✓	✓	✓	
Black Diamond	4,180	1/1/14	Flat fee	$16.00 /parcel	$192.00/parcel	3,000.00	$16.00/ERU	$192.00/ERU			✓	Detention/retention based on size of storage

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Bothell	41,630	1/1/15	Flat fee	$13.46 /parcel	$161.52 /parcel	% impervious	>0-10% impervious - $13.46/parcel 10-20% - $31.40/acre 20-45% - $65.13/acre 45%-65% - $125.78/acre 65%-85% - $159.42/acre 85% + - $209.00/acre	>0-10% impervious - $161.52/parcel 10-20% - $376.80/acre 20-45% - $781.56/acre 45%-65% - $1,509.36/acre 65%-85% - $1,913.04/acre 85% + - $2,508.00/acre	✓			
Burien	48,240	1/1/14 Service rates only	Flat fee	$12.79 /parcel	$153.48 /parcel	% impervious	>0-10% impervious - $12.79/parcel 10-20% - $31.96/acre 20-45% - $68.87/acre 45%-65% - $115.85/acre 65%-85% - $157.11/acre 85% + - $200.19/acre	>0-10% impervious - $153.48/parcel 10-20% - $383.52/acre 20-45% - $826.44acre 45%-65% - $1,390.20/acre 65%-85% - $1,885.32/acre 85% + - $2,402.28/acre	✓			
Carnation	1,790	No stormwater utility										
Clyde Hill	2,995	No stormwater utility										
Covington	18,480	1/1/16 + 5% every year	Flat fee	$15.37 /parcel	$184.44 /parcel	% impervious	>0-10% impervious - $15.37/parcel 10-20% - $37.94/acre 20-45% - $80.56/acre 45%-65% - $135.82/acre 65%-85% - $187.17/acre 85% + -	>0-10% impervious - $184.44/parcel 10-20% - $455.28/acre 20-45% - $966.72/acre 45%-65% - $1,629.84/acre 65%-85% - $2,246.04/acre 85% + -				

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
							$236.11/acre	$2,833.32/acre				
Des Moines	30,030	11/2/15	3,450.00	500-2,800 square feet impervious: $14.24 2,800-4,350 sq. ft: $18.65 4,350-7,500 sq. ft: $26.60 7,500+ sq ft: $18.65 /ERU	500-2,800 square feet impervious: $170.88 2,800-4,350 sq. ft: $223.80 4,350-7,500 sq. ft: $319.20 7,500+ sq. ft: $223.80/ERU	3,450.00	$18.65/ERU	$223.80/ERU	✓	✓		
Duvall	7,325	1/1/16 (increas-ing every year)	Flat fee	$19.21 /parcel	$230.52/parcel	3,000.00	$19.21	$230.52/ERU			✓	
Enumclaw	11,110	No stormwater utility, fee adoption is being considered in 2016										

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Federal Way	90,150	1/1/14	Flat fee	$7.38 /parcel	$88.56/parcel	% impervious	>0-10% impervious - $7.38/parcel 10-20% - $16.71/acre 20-45% - $34.20/acre 45%-65% - $65.98/acre 65%-85% - $83.18/acre 85% + - $108.83/acre	>0-10% impervious - $88.56/parcel 10-20% - $200.52/acre 20-45% - $410.40/acre 45%-65% - $791.76/acre 65%-85% - $998.16/acre 85% + - $1,305.96/acre	✓			
Hunts Point	405	No stormwater utility										
Issaquah	32,880	6/1/08	Flat fee	$14.08 /parcel	$168.96 /parcel	2,000.00	Undeveloped: $7.04 Non-residential developed: $14.08/ERU	Undeveloped: $84.48 Non-residential developed: $168.96/ERU	✓			
Kenmore	21,370	1/1/12	Flat fee	$13.95 /parcel	$167.40/parcel	% impervious	>0-10% impervious - $13.95/parcel 10-20% - $32.55/acre 20-45% - $67.43/acre 45%-65% - $130.21acre 65%-85% - $165.09/acre 85% + - $216.25/acre	>0-10% impervious - $167.40/parcel 10-20% - $390.64/acre 20-45% - $809.20/acre 45%-65% - $1,562.56/acre 65%-85% - $1,981.08/acre 85% + - $2,594.96/acre	✓			
Kent	121,400	1/1/15	Flat fee	$12.22 /parcel	$146.64/parcel	2,500.00	1-40% impervious - $12.22/ERU 41-60% - $14.66/ERU 61-80% - $17.11/ERU 81%-100% -	1-40% impervious - $146.64/ERU 41-60% - $175.92/ERU 61-80% - $205.32/ERU 81%-100% -	✓	✓	✓	

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
							$19.55/ERU	$234.60/ERU				
King County	2,079,967 total; 214,000 in unincorporated	1/1/2014	Flat fee	$14.29 /parcel	$171.50/parcel	% impervious	>0-10% impervious - $14.29/parcel 10-20% - $34.45/acre 20-45% - $75.49/acre 45%-65% - $128.86/acre 65%-85% - $176.40/acre 85% + - $219.91acre	>0-10% impervious - $171.50/parcel 10-20% - $413.38/acre 20-45% - $905.91/acre 45%-65% - $1,546.40/acre 65%-85% - $2,116.79/acre 85% + - $2,638.96/acre	✓	✓		Runoff mitigation, stormwater facility, impervious surface cost-share
Kirkland	82,590	1/1/14	Flat fee	$16.22 /parcel	$194.64/parcel	2,600.00	$16.22/ERU	$194.64/ERU	✓			
Lake Forest Park	12,750	1/1/16	Flat fee	$16.00 /parcel	$191.98/parcel	% impervious	>0-10% impervious - $16.00/parcel 10-20% - $38.45/acre 20-45% - $77.34/acre 45%-65% - $149.34/acre 65%-85% - $189.34/acre 85% + - $248.01/acre	>0-10% impervious - $191.98/parcel 10-20% - $461.45/acre 20-45% - $928.06/acre 45%-65% - $1,792.08/acre 65%-85% - $2,272.07/acre 85% + - $2,976.11/acre				

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Maple Valley	24,230	1/1/16 (3% increase per year)	Flat fee	$9.93 /parcel	$119.20/parcel	% impervious	>0-10% impervious - $9.93/parcel 10-20% - $23.18/acre 20-45% - $48.02/acre 45%-65% - $92.72/acre 65%-85% - $117.55/acre 85% + - $153.98/acre	>0-10% impervious - $119.20/parcel 10-20% - $278.15/acre 20-45% - $576.19/acre 45%-65% - $1,112.63/acre 65%-85% - $1,410.63/acre 85% + - $1,847.75/acre				
Medina	3,055	No stormwater utility										
Mercer Island	23,310	1/1/16	Flat fee	$15.94 /parcel	$191.28/parcel	3,471.00	$15.94/ERU	$191.28/ERU			✓	
Milton	7,265	6/4/07	2,800.00	$15.50 /ERU	$186.00/ERU	2,800.00	$15.50/ERU for all developed and $5.10 flat for all undeveloped	$186.00/ERU for all developed and $16.20 flat for all undeveloped	✓	✓		
Newcastle	10,850	1/1/15	Flat fee	$13.28 /parcel	$159.36/parcel	% impervious	>0-10% impervious - $16.29/parcel 10-20% - $38.00/acre 20-45% - $78.72/acre 45%-65% - $152.01/acre 65%-85% - $192.73/acre 85% + - $252.45/acre	>0-10% impervious - $195.48/parcel 10-20% - $456.00/acre 20-45% - $944.64/acre 45%-65% - $1,824.12/acre 65%-85% - $2,312.76/acre 85% + - $3,029.40/acre	✓			
Normandy Park	6,375	1/1/10	Flat fee	$16.00 /parcel	$192.00/parcel	3,100.00	$16.00/ERU	$192.00/ERU				

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
North Bend	6,280	5/1/01	2,920	$9.86/ERU	$118.32/ERU	2,920	$9.86/ERU	$118.32/ERU	✓	✓		
Pacific	6,830	4/1/14	2,500.00	$13.25 /ERU	$159.00/ERU	2,500.00	$16.32 for the first ERU plus: $5.87 for all other ERUs for properties with approved stormwater facilities; $16.32 for all other ERUs for properties without approved facilities.	$195.84 for the first ERU plus: $70.44 for all other ERUs for properties with approved stormwater facilities; $195.84 for all other ERUs for properties without approved facilities.	✓	✓		Discount for approved stormwater facility
Redmond	57,700	1/1/07	2,000.00	>0-29% impervious surface: $16.56 /ERU 30%-39%: $18.22 40%-49%: $19.87 50%-59%: $21.53 60%-69%: $23.18 70%-79%: $24.84 80%-89%: $26.50 >90%: $28.15	>0-29% impervious surface: $198.72/ERU 30%-39%: $218.64 40%-49%: $238.44 50%-59%: $258.36 60%-69%: $278.16 70%-79%: $298.08 80%-89%: $318.00 >90%: $337.80	2,000.00	>0-29% impervious surface: $16.56/ERU 30%-39%: $18.22 40%-49%: $19.87 50%-59%: $21.53 60%-69%: $23.18 70%-79%: $24.84 80%-89%: $26.50 >90%: $28.15	>0-29% impervious surface: $198.72/ERU 30%-39%: $218.64 40%-49%: $238.44 50%-59%: $258.36 60%-69%: $278.16 70%-79%: $298.08 80%-89%: $318.00 >90%: $337.80	✓	✓		Rate reductions are offered for flow control and treatment function, based on size of storm retained/treated

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Renton	98,404	1/1/16	Flat fee	$13.73 /parcel	$164.76/parcel	% impervious	0.5 acres or less: 0%-50% impervious: $33.99 51%-80%: $49.17 >80%: $63.39 Greater than 0.5 acres: 0%-50%: $67.98/acre 51-80%: $98.28/acre >80%: $126.78/acre	0.5 acres or less: 0%-50% impervious: $407.88 51%-80%: $590.04 >80%: $760.68 Greater than 0.5 acres: 0%-50%: $815.76/acre 51-80%: $1,179.36/acre >80%: $1,521.36/acre	✓	✓		
Sammamish	49,260	1/1/16	Flat fee	$17.83 /parcel	$213.96/parcel	% impervious	>0-10% impervious - $17.83/parcel 10-20% - $41.58/acre 20-45% - $86.17/acre 45%-65% - $164.50/acre 65%-85% - $210.33/acre 85% + - $275.75/acre	>0-10% impervious - $213.96/parcel 10-20% - $498.96/acre 20-45% - $1,034.04/acre 45%-65% - $1,974.00/acre 65%-85% - $2,523.96/acre 85% + - $3,309/acre	✓			
SeaTac	27,620	1/1/15 scheduled increase in 2017)	Flat fee	$11.18 /parcel	$134.15/parcel	% impervious	>0-10% impervious - $6.68/acre 10-20% - $22.75/acre 20-45% - $47.12/acre 45%-65% - $91.00/acre 65%-85% - $115.43/acre 85% + - $151.21/acre	>0-10% impervious - $80.20/acre 10-20% - $273.00/acre 20-45% - $565.44/acre 45%-65% - $1,091.98/acre 65%-85% - $1,385.20/acre 85% + - $1,814.57/acre	✓	✓		

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Seattle	640,500	1/1/16	Square feet impervious	<2000 sq ft: $10.32 2000-2999 sq ft: $17.24 3000-4999 sq ft: $23.89 5000-6999 sq ft: $32.50 7000-9999 sq ft: $40.95	<2000 sq ft: $123.84 2000-2999 sq ft: $206.88 3000-4999 sq ft: $286.68 5000-6999 sq ft: $390.00 7000-9999 sq ft: $491.40	1,000.00	Regular: 0-15% impervious: $2.60/ERU 16%-35% impervious: $4.04 36-65% impervious: $5.89 66-85% impervious: $7.80 86-100% impervious: $9.37 LID: 0-15% impervious:$1.55 16%-35% impervious: $3.19 36-65% impervious: $4.77	Regular: 0-15% impervious: $31.20/ERU 16%-35% impervious: $48.48 36-65% impervious: $70.68 66-85% impervious: $93.60 86-100% impervious: $112.44 LID: 0-15% impervious:$18.60 16%-35% impervious: $38.28 36-65% impervious: $57.24			✓	LID
Shoreline	55,174	1/1/16	Flat fee	$12.64 /parcel	$151.67/parcel	% impervious	>0%-10% impervious - $12.64/parcel 10%-20% - $29.36/acre 20%-45% - $60.65/acre 45%-65% - $117.62/acre 65%-85% - $149.01/acre 85% + - $195.19/acre	>0%-10% impervious - $151.67/parcel 10%-20% - $352.32/acre 20%-45% - $727.80/acre 45%-65% - $1,411.44/acre 65%-85% - $1,788.12/acre 85% < - $2,342.28/acre	✓	✓	✓	raingarden and conservation landscaping rebate
Skykomish	200	No stormwater utility										
Snoqualmie	12,130	1/1/16	2,600.00	$19.36 /ERU	$232.32/ERU	2,600.00	$19.36/ERU	$232.32/ERU			✓	

Municipality	2014 Population (est)	Date current stormwater rates became effective	Fee method (single family): - Flat fee per parcel or - Number of square feet impervious per ERU	Single-family monthly stormwater charge per unit	Single-family annual stormwater charge per unit	Fee method (non-single family): - Flat fee per parcel - Number of square feet impervious per ERU - % impervious	Non-single family monthly stormwater charge per unit	Non-single family annual stormwater charge per unit	Rate discounts for senior low income	Rate discounts for disabled low income	Rate discounts for general low income	Other rate discounts
Tukwila	19,210	1/1/16	Flat fee	$11.83 /parcel	$141.96/parcel	% impervious	Natural: $16.35/acre 0%-20% impervious - $35.56/acre 21%-50% - $65.18/acre 51%-70% - $97.27/acre 71%-85% - $117.18/acre 85%-100% - $136.69/acre	Natural: $196.28/acre 0%-20% impervious - $426.76/acre 21%-50% - $782.20/acre 51%-70% - $1,167.18/acre 71%-85% - $1,406.12/acre 85%-100% - $1,640.26/acre	✓	✓		
Woodinville	11,240	1/1/14	Flat fee	$7.26 /parcel	$87.12/parcel	% impervious	>0-10% impervious - $7.26/parcel 10-20% - $16.95/acre 20-45% - $35.10/acre 45%-65% - $67.78/acre 65%-85% - $85.94/acre 85% < - $112.57/acre	>0-10% impervious - $87.12/parcel 10-20% - $203.40/acre 20-45% - $421.20/acre 45%-65% - $813.36/acre 65%-85% - $1,031.28/acre 85% < - $1,350.84/acre				
Yarrow Point	1,015	1/1/13	Flat fee (for developed parcels)	$13.10 /parcel	$157.20/parcel	Flat fee for all developed parcels	$13.10/parcel	$157.20/parcel				

Notes:

ERU = equivalent residential unit (sometimes referred to as ESU, equivalent service unit)

Appendix 2. Tree regulations in King County jurisdictions

City: Algona

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions: • On a public right‐of‐way • In a critical area • A permit may be issued only when the tree constitutes a fire, safety and/or health hazard as defined in this chapter	**Grading and clearing requirements:** not found **Seasonal restrictions:** not found
Landscaping requirements: • 1 tree at least 6 feet tall every 100 square feet or less • Parking: • 1 tree every 200 square feet in landscaped parking areas	**Right of way limitations:** • Permit required to cut trees in ROW
Protection of trees during construction: • Marking clearing limits around buffers and trees is required before land disturbing activities.	**Pruning requirements:** • Tree cutting shall be limited to pruning and crown thinning. Where pruning or crown thinning is not sufficient to address the hazard, trees should be removed or converted to wildlife snags.

Tree protection

Definition of significant trees: • Evergreen: diameter of 6"+ at 4' above grade • Deciduous: diameter of 4"+ at 4' above grade	**Heritage trees are specifically protected?** No **Tree retention incentives:** not found
Protection of significant trees: • Pathways through wetlands should avoid significant trees.	**Tree replacement requirements:** • 2:1 if planting evergreens over 6' or deciduous with 1" diameter at breast height • 5:1 if planting seedlings

Comments:

High groundwater limits successful establishment of planted trees

City: Auburn

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** 2003

Permit is required for tree removal in these conditions:

- Permit required for all removal except:
- Removal of dead or diseased trees
- Removal associated with continuous agricultural uses
- Removal of up to six trees per lot/acre within any 12-month period
- Removal for the construction and maintenance of public facilities
- Removal in emergencies (immediate danger to life/property)
- Routine landscape maintenance and minor repair
- Removal consistent with an approved surface mining permit.
- Removal in residential zones that endangers a permanent structure.

Landscaping requirements:

- Tree spacing within the perimeter planters along streets and abutting residential property shall be planted no further apart on center than the mature diameter of the proposed species.
- All required planting areas shall be covered with a mixture of trees, shrubs, and groundcover plants.
- Required visual screens shall contain evergreen trees or tall shrubs, a minimum of six feet in height at the time of planting, which will provide a 100 percent sight-obscuring screen within three years from the time of planting is required; or a combination of evergreen trees or deciduous trees, planted 20 feet on center with no more than 30 percent being deciduous and backed by a 100 percent sight-obscuring fence.

Parking lots 13 stalls or more: Trees shall be provided at the rate of a minimum of one per planter and/or one per 100 square feet of planter.

Grading and clearing requirements:

- A dry rock wall or well is required around trees if altering grade will endanger the viability of a tree. The diameter of this wall or well must be capable of protecting the tree.

Pruning requirements:

Pruning which results in the removal of at least half of the live crown will be considered tree removal.

Allowable Pruning:

- Removal of dead wood and diseased, crowded, and weakly attached trunks and branches that create a hazard to property and citizens;
- Providing adequate clearance and visibility for safe use of parking stalls, travel ways and walkways for the passage of persons/vehicles;
- Eliminating traffic sign visibility obstructions;
- Providing adequate visibility for security patrols;
- Repairing split trees/limbs to save a tree and its appearance;
- Removing/severing tree roots causing damage to property;
- Providing visibility for merchant signs and increasing parking lot lighting only when the aesthetics of the tree will not be reduced.
- Tree topping is prohibited:
  - Branches interfering with utility lines;
  - Significant canopy dieback has occurred;

Storm damage or prior incorrect pruning requires correction.

Right of way limitations:

- An Urban Tree Board tasked with improving street trees and trees in parks and rights-of-way.

No trees or shrubs shall be planted in or removed from rights-of-way without permission from the city engineer.

Seasonal restrictions:

The city engineer shall determine the time frame when the land disturbing activity shall commence, when the project is to be completed, designated haul routes, seasonal and weather restrictions, and hours of operation.

Protection of trees during construction:

- All significant trees that are to be retained must be protected during construction by installation of a protective barricade or fence. This will require preliminary identification of the proposed area of disturbance for staff inspection and approval, then installation of a protective barricade or fence before major excavation with heavy equipment begins.
- A dry rock wall or well is required around trees if altering grade will endanger the viability of a tree. The diameter of this wall or well must be capable of protecting the tree.
- Areas devoted to driveways, curb cuts, and sight distance requirements, utilities and storm drainage facilities may be exempted from this requirement.
- No construction activities shall take place within the dripline of a tree to be retained without extra precautions as recommended by a certified arborist. The applicant may install impervious or compactable surface within the area defined by the dripline when a qualified arborist determines that such activities will not endanger the tree or trees.

Tree protection

Definition of significant trees:

- Evergreen: 6"+ diameter at 4' above grade
- Deciduous: 4"+ diameter at 4' above grade.
- Alders and cottonwoods are excluded from this definition.

Heritage trees are specifically protected? No

Tree retention incentives:

not found

Protection of significant trees:

- In the required perimeter landscaping area, applicants shall retain all significant trees.
- Areas devoted to driveways, curb cuts, and sight distance requirements, utilities and storm drainage facilities may be exempted from this requirement.
- The planning director may authorize modification of the landscape requirements.

Tree replacement requirements:

- Planting size: A minimum of 1.5” dbh at the time of planting. Evergreen trees a minimum of 4-6’ in height at the time of planting
- 1.5:1 for replacement in required landscaping
- 2:1 for replacement due to excessive pruning
- The plants shall be of the same or similar species to those plants being replaced.

City: Beaux Arts

Year of most recent tree ordinance update: 2013 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:

- Required for the removal of any protected tree.
- All property owners shall be allowed to remove any protected tree located within the building footprint of a proposed building associated with a building permit, including those tree(s) outside of the footprint which would become hazardous by the construction of the permitted building.
- All property owners shall be allowed to remove up to 20 percent of the protected tree units on their lot within any 12-month period.
- •Hazardous trees are exempt from the 20 percent limitation. At a minimum, one protected tree may be removed per each 12-month period.

Grading and clearing requirements: not found

Landscaping requirements: not found

Pruning requirements: not found

Seasonal restrictions: not found

Right of way limitations:

- Removal or intentional destruction of any tree in the right-of-way without the prior approval of the council is strictly prohibited.

Protection of trees during construction:

- All protected trees on a construction site, on the adjacent and otherwise affected town rights-of-way, and on adjacent properties impacted by site development or construction must be protected during construction.
- The property owner shall submit a report prepared by a qualified professional that evaluates the protected trees on site, on the adjacent and otherwise affected town rights-of-way, and adjacent properties and establishes tree protection requirements.
- The requirement for a report may be waived by the town when requested by the project owner and approved by the town arborist when it is determined that the scope of the proposed construction project will not likely impact protected trees. Any necessary tree protection requirements deemed appropriate by the town arborist must be included on the permit documents prior to permit approval.
- A stop work order will be issued by the building official if site tree protection guidelines are not followed.

Tree protection

Definition of significant trees:

- Any living coniferous, evergreen, madrone, oak, or big leaf maple tree having a diameter 12"-36"; or any tree planted as mitigation.
- Greater than 36" diameter is a landmark tree.

Heritage trees are specifically protected? Yes

Tree retention incentives:

not found

Protection of significant trees:

- A landmark tree or significant tree may only be removed if:
- The tree is determined to be hazardous
- The tree is within the footprint of a proposed building for which a building permit has been issued
- The tree would become hazardous by the construction of the permitted building
- The removal complies with the 20% limitation

Tree replacement requirements:

- Whenever a protected tree will be legally removed pursuant to a valid tree removal permit, the applicant shall demonstrate that, after the removal of the tree(s), the lot will meet the 20% limitation. Should the lot fail to meet this requirement, the applicant must provide a tree mitigation plan.
- Planting size: Mitigation trees shall be a minimum of 8' tall, have a full, well-developed crown of foliage, and count as a minimum of one tree unit.
- Mitigation requirements must be met within six months of the tree removal. In the case of concurrent new construction, mitigation requirements must be met before final inspection. Trees planted as mitigation must be maintained with adequate water and care to survive a three-year warranty period or be replaced.
- Mitigation trees are protected trees.
- Mitigation trees shall be one of the protected tree species, or other native tree, as agreed upon by the town.

City: Bellevue

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** 1991

Permit is required for tree removal in these conditions:

- Tree removal results in > 1,000 sq. ft. of ground disturbance.
- In a critical area or buffer.
- In a native growth protection area or a retained vegetation area.
- On the city's right of way
- In Bridle Trails

Grading and clearing requirements:

- For landscaping plans submitted with Clearing and Grading Permits, detailed irrigation plans are required.
- A clearing and grading permit must be obtained from the City prior to the removal of any significant tree from any lot in the R-1 Land Use District in the Bridle Trails Subarea.

Landscaping requirements:

- Type I:
  - Two rows of evergreen trees, a minimum of 6' in height and planted at intervals of no greater than 20' on center. The trees must be backed by a sight-obscuring fence, a minimum of five feet high or the required width of the planting area must be increased by 10'
  - Alternatively, the trees and shrubs may be planted on an earthen berm at least 15' wide and an average of 5' high along its midline.
- Type II: Evergreen and deciduous trees, with no more than 30% being deciduous, a minimum of 6' in height, and planted at intervals no greater than 20' on center.
- Type III: Evergreen and deciduous trees, with no more than 50% being deciduous, a minimum of 6' in height, and planted at intervals no greater than 30' on center; unless shorter screens are required.
- Type IV: - Trees are permitted if the trunk is branch-free below 6' in height.
- Parking: Each area of landscaping must contain at least 100 sq. ft. of area and must be at least 4' in any direction exclusive of vehicle overhang. The area must contain at least one tree at least 6' in height and with a minimum size of 1.5" in caliper if deciduous. Up to 100% of the trees proposed for the parking area may be deciduous.

Right of way limitations:

Except to abate a nuisance, no person shall damage, destroy or mutilate any tree, shrub or plant in a public parking strip or any other public place, or attach or place any rope or wire, sign, poster, handbill or other thing on any tree growing in a public place, or cause or permit any wire charged with electricity to come in contact with any such tree, or allow any gaseous, liquid or solid substance which is harmful to such trees to come in contact with their roots or leaves.

Protection of trees during construction:

- The applicant shall utilize tree protection techniques approved by the Director during land alteration and construction in order to provide for the continual healthy life of retained significant trees.

Pruning requirements:

- "Clearing" includes disturbance of over 1,000 square feet at grade due to removal or pruning of trees;
- Topping of street trees and other pruning that does not conform to industry standards is a civil violation

Seasonal restrictions:

From Oct. 1st through Apr. 30th, clearing and grading activities may only be authorized by the city if silt-laden runoff will be prevented from leaving the site through compliance.

Tree protection

Protection of significant trees:

- Landscape requirements can be altered to increase retention of significant trees and naturally occurring undergrowth.
- In Subdivisions, Short Subdivisions, Planned Unit Development, Change in Lot Coverage, or Change in Parking and Circulation (not Downtown):
  - 100% In the required perimeter landscaping area
  - 15% of diameter inches in areas of the site other than the required perimeter landscaping area.
  - 30% on total site area.
- Bridle Trails subarea:
  - 100% in the first 20' adjacent to property lines.
  - 25% of the cumulative diameter inches of existing significant trees must be retained in addition to the perimeter requirements
- Single Family:
  - 30% of the diameter inches
- Significant tree priorities:
  - Healthy significant trees over 60 feet in height;
  - Significant trees which form a continuous canopy;
  - Significant trees which contribute to the character of the environment, and do not constitute a safety hazard;
  - Significant trees which provide winter wind protection or summer shade;
  - Groups of significant trees which create a distinctive skyline
  - Significant trees in areas of steep slopes or adjacent to watercourses or wetlands.
  - Significant trees located within the first 20 feet adjacent to a property line.

Definition of significant trees:

Any tree with 8"+ eight diameter at 4' above existing grade. Significant alder and cottonwood trees are discounted by 0.5 (diamter inches) in tree calculations.

Heritage trees are specifically protected?

No

Tree retention incentives:

- If the landscape plan incorporates the retention of significant trees above requirements, the Director may approve a reduction of up to 10 percent of the required number of parking spaces if adequate parking will remain on the subject property, and if land area for the required number of spaces remains available for future development on the subject property.

Tree replacement requirements:

- 1:1 - in Bridle Hills Subarea lots with eight or fewer significant trees.
- Trees must be a minimum of six feet in height at planting.
- Modification of significant tree regulations needs to incorporate the retention or replacement of significant trees equal in equivalent diameter inches or incorporates the increased retention or replacement of significant trees and naturally occurring undergrowth to what would otherwise be required.

City: Black Diamond

Year of most recent tree ordinance update: 2011 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:

- Required for the removal of significant trees except for:
- Emergency removal of hazard trees necessary to remedy an imminent threat to persons or property;
- Removal within or adjacent to public rights-of-way or easements, at the direction of the city, for the protection of the public safety.
- Removal of Obviously Dead or Diseased Trees.
- Removal of 6 or fewer significant trees under 16" dbh by the owner during thirty-six consecutive months, as long as 2 significant trees remain.
- Christmas trees or commercial landscaping materials.
- Harvesting with a Class II or Class III or Class IV WDNR forest practices permit.

Right of way limitations: not found

Seasonal restrictions: not found

Grading and clearing requirements:

- The grade shall not be changed nor shall impervious surface be installed within five feet of the drip line of heritage trees and significant trees to be preserved.

Landscaping requirements:

Parking:

- All parking areas for multi-family and non-residential uses shall include a minimum 6' wide perimeter of landscaping, including trees, planted at no more than 25' intervals.
- The interior of all parking lots with 12+ stalls shall include landscape islands comprising not less than 10% in area of the total parking lot exclusive of required perimeter landscaping. Individual islands shall not be less than 150 sq. ft. in area and not separated by more than 120' in any direction from another island. Landscaping of these islands shall consist of trees, shrubs and groundcovers.

Pruning requirements:

- Pruning and maintenance of heritage trees and significant trees shall be consistent with best management practices in the field of arboriculture and further the long-term health of the tree.
- Pruning shall mean the selective removal of portions of branches from a tree so as to modify the tree(s) shape or profile or alter the tree's appearance.
- Heritage trees and significant shall not be topped. Topping is defined as the severe cutting back of limbs to stubs larger than three inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree.

Protection of trees during construction:

- During land alteration and construction, these best management practices for tree protection (as set forth in the Best Management Practices Guidebook for the Pacific Northwest published by Oregon State University) are required unless alternates are approved:
- An area of prohibited disturbance, generally corresponding to the critical root zone, shall be identified prior to the construction stage.
- Tree protective fencing shall be a minimum of 4' high and be highly visible. Signs must be posted on the fence reading "tree protection area."
- Trees to be retained shall be watered appropriately during and immediately after construction and shall be protected from erosion and sedimentation.
- The grade shall not be changed nor shall impervious surface be installed within five feet of the drip line of heritage trees and significant trees to be preserved.
- Directional felling shall be used to avoid damaging any heritage trees or significant trees designated for protection.

Tree protection

Definition of significant trees:

- Any tree 6"+ dbh (diameter at breast height) except Black locust, Cottonwood, Native alder, Native willow, and Lombardy poplar.
- Any tree that is planted to fulfill requirements of this chapter shall be considered significant, regardless of size or species.

Heritage trees are specifically protected? Yes

Tree retention incentives:

not found

Protection of significant trees:

- No person, corporation, agency or other entity shall remove any significant tree, as defined in this chapter, without first obtaining a tree removal permit pursuant to this chapter; provided that, a permit shall not be required for situations specifically exempted by this chapter.
- All significant trees within any required perimeter planting area, sensitive area, wetland, buffer, designated primary or secondary open space, or native growth protection area shall be retained, except for driveways, lanes, or streets necessary for access as approved by the city.
- In all other areas, site improvement design should integrate significant trees into required landscaping.

Tree replacement requirements:

- Each tree removal permit shall require a tree replacement plan.
- 1:1 for each significant tree removed (except for relocated trees)
- Planting requirements:
  - Native trees are preferred over non-native trees;
  - New trees shall meet or exceed current American Nursery and Landscape Association or equivalent organization's standards for nursery stock;
  - New trees shall be marked and planted in locations appropriate to the species' growth habit and horticultural requirements;
  - New trees must be located away from damage prone areas;
  - Deciduous replacement trees shall be a minimum of 1.5" in caliper, evergreen trees shall be a minimum of 6' in height;
  - Trees shall be watered as necessary to ensure survival and growth during their first two growing seasons after planting. Dead trees shall be replaced within 2 planting periods to ensure survival.

City: Bothell

Year of most recent tree ordinance update: 2012 **Tree City USA (year Joined):** 2000

Permit is required for tree removal in these conditions:
- New development
- Forest services
- Critical areas
- Public rights-of-way

Grading and clearing requirements:
- A tree designated for retention shall not have the soil grade altered within its dripline or within 15' of its trunk, whichever is greater, unless an alternative tree retention method is approved by the city.

Landscaping requirements:
- Type I: Two offset rows of coniferous trees at an average spacing of 10 feet.
- Type II:Trees planted at average spacing of 20 feet, max 30% deciduous
- Type III: Trees planted at an average spacing of 25 feet, max 75% deciduous
- Type IV: At least one deciduous tree for each 150 square feet of landscaped area, at average spacing of 30 feet
- Type V: At least one tree for every 500 square feet of landscaping
- Type VI: A mixture of coniferous trees which shall range from one to six feet at installation. Deciduous trees shall range from "whips" to one and one- half-inch caliper at installation.
- Parking lots: At least one interior landscape island for every 10 parking stalls shall be distributed throughout the parking lot; At least one tree shall be provided in each landscape island peninsula;

Right of way limitations:
- All deciduous and coniferous trees installed within traffic medians or islands shall be selected from the Bothell boulevard median tree list.
- Any public utility required to trim or remove trees shall ensure that their tree trimming activities protect the appearance, integrity and health of the trees, maintaining a tree trimming schedule to ensure compliance with this provision.

Protection of trees during construction:
- Protection techniques during construction are required, including but not limited to use of an air shovel to locate the root zone, five-foot-high chainlink or plastic-net fencing around tree driplines and/or root zones, tunneling instead of trenching, stump grinding instead of stump pulling and routing of traffic to prevent excessive soil compaction.
- A disturbance-free area beyond the tree dripline shall be indicated. A tree designated for retention shall not have the soil grade altered within its dripline or within 15' of its trunk, whichever is greater, unless an alternative tree retention method is submitted by a tree specialist acceptable to the city, and said alternative method is approved by the city.

Pruning requirements:
- Tree cutting shall be limited to pruning and crown thinning, unless otherwise justified by a qualified professional.
- Where pruning or crown thinning is not sufficient to address the hazard, trees should be removed or converted to wildlife snags;
- All vegetation cut (tree stems, branches, etc.) shall be left within the critical area or buffer unless removal is warranted due to the potential for disease, re-vegetation by invasive species, or pest transmittal to other healthy vegetation.

Seasonal restrictions:
- Clearing shall be allowed only from May 1st to October 1st of each year.
- The city may extend or shorten the dry season on a case-by-case basis depending on actual weather conditions.

Tree protection

Definition of significant trees: Any tree 8"+ diameter at 4' above grade (excluding alders and cottonwoods)

Heritage trees are specifically protected? No

Tree retention incentives:
- The community development director shall require a tree retention bond or other surety be submitted to the city of Bothell to ensure retention of existing trees and plant material during construction. In the event any trees designated by the city to be retained are removed, the city shall have the option of enforcing any bond posted.

Protection of significant trees:
- All significant trees located within any required perimeter landscaping area which are not dead, dying, diseased, and do not pose a significant safety hazard as determined by the community development director shall be retained;
- At least 10% of the total in diameter inches of the significant trees on the subject property shall be retained;

Tree replacement requirements:
- 2:1 for hazard trees removed.
- 3:1 for significant trees removed according to a tree retention plan. For each additional two inches of diameter over eight inches on the dead, damaged or removed tree, one new tree shall be planted.
- Replacement trees shall be species that are native and indigenous to the site and 1"+ dbh for deciduous trees and 6'+ in height for evergreen trees as measured from the top of the root ball;

City: Burien

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** 2001

Permit is required for tree removal in these conditions:
- For undeveloped/vacant lots, tree removal is not allowed until time of development.
- For developed, private lots, tree removal and pruning require a permit if the property is located within a critical area.

Right of way limitations:
- No person shall perform pruning/removal in right-of-way without an approved tree permit, with some exceptions.

Seasonal restrictions: not found

Grading and clearing requirements:
- The applicant shall submit a tree retention plan concurrent with a grading permit application.
- A rock well shall be constructed if the grade level around the tree is to be raised by more than one foot. The inside diameter of the well shall be equal to the diameter of the dripline of the tree;
- The grade level shall not be lowered within the drip line of the tree or an area around the tree equal to 1' diameter for each inch of tree trunk diameter measured 4' above the ground, whichever is greater.

Landscaping requirements:
- Type I: At least 70% evergreen
- Type II: At least 50% deciduous and at least 30% evergreen
- Type III and IV: At least 70% deciduous, evergreens spaced no more than 25' apart
- Parking: Evergreen or canopy-type deciduous trees shall be provided and distributed throughout the parking area at a rate of:
  - One tree for every 10 parking stalls for a use requiring landscape category C or D (see "Protection of significant trees")
  - One tree for every five parking stalls for a use requiring landscape category A or B

Pruning requirements:
- T he owner of property adjacent to an improved or unimproved right-of-way may prune trees within the owner's maintenance area; provided, that the best practices, policies, techniques and methods for pruning trees established by the International Society of Arboriculture are followed.
- Crown topping is not permissible.
- The city shall prepare and distribute educational materials describing best practices, policies, techniques, methods and procedures for pruning trees.

Protection of trees during construction:
- No clearing shall be allowed on a site until approval of tree retention and landscape plans;
- An area of prohibited disturbance, generally corresponding to the drip line of the significant tree shall be protected during construction with a temporary five-foot-high chainlink or plastic net fence. The fencing shall be installed prior to issuance of development permits for the site;
- No impervious surfaces, fill, excavation, or storage of construction materials shall be permitted within the area defined by such fencing;

Tree protection

Definition of significant trees: Evergreen: diameter of 8"+ measured at 4' above grade
Deciduous: diameter of 12"+ measured at 4' above grade

Heritage trees are specifically protected? No

Tree replacement requirements:
- When the required number of significant trees cannot be retained, the required number of significant trees that are removed shall be replaced with:
  - 1:1 Transplanted significant trees
  - 1.5:1 New trees measuring 3" caliper or more for every 1" diameter of the removed significant tree
- 2:1 New trees measuring less than 3"caliper for every one inch diameter of the removed significant tree.

Protection of significant trees:
- Significant trees shall be retained as follows:
- All significant trees on an undeveloped lot shall be retained.
- Landscape category A: 30% of the significant trees located on the site, excluding critical areas or their buffers.
- Landscape category B: 10% of the significant trees located on the site, excluding critical areas or their buffers.
- Landscape categories C and D: 5% of the significant trees located on the site, excluding critical areas or their buffers.
- If significant trees were previously located in a closed, forested situation, an adequate area of smaller trees shall be retained or replaced on the fringe of such significant trees;
- A grouping of 3+ existing trees with canopies that touch or overlap, may be substituted for each required significant tree, provided each tree has a diameter of at least 3" when measured 4' above grade;

Retained significant trees shall not include trees that are damaged, diseased, or safety hazards, unless deemed important wildlife habitat.

Tree retention incentives:
- The width of required perimeter landscaping may be reduced up to 25% where a development retains an additional 10% of significant trees or an additional 10 significant trees per acre on-site whichever is greater.
- Each significant tree that is retained may be credited as two trees for complying with the retention requirements, provided it meets one or more of the following criteria:
  - The tree exceeds 60' in height, or 24" in diameter for evergreen trees or 30" for deciduous trees;
  - The tree is located in a grouping of at least five trees with canopies that touch or overlap;
  - The tree provides energy savings through winter wind protection or summer shading as a result of its location relative to buildings;
  - The tree belongs to a unique or unusual species;
  - The tree is located within 25' of any critical area or required critical area buffer; and
- The tree is 18" or greater and is identified as providing valuable wildlife habitat.

City: Carnation

Year of most recent tree ordinance update: 2010 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:
- In critical areas

Pruning requirements: not found

Seasonal restrictions: not found

Grading and clearing requirements:
- All required tree protection measures shown on site grading plan.
- The city planner may allow construction limits or an alteration of grades within the root protection zone, if a certified arborist say that construction will not reduce the long-term viability of the tree.

Landscaping requirements:
- Type A:
  - 10-15' wide: At least 1 row of trees with 10’ maximum separation.
  - >15' wide: A minimum of 1 tree at least 8' tall for every 150 sq. ft. arranged in a manner to obstruct views into the property.
- Type B:
  - <15' wide: Evergreen and/or deciduous trees at least 2" caliper at 4' from the root ball), spaced at an average of 20’ on-center.
  - >15' wide: At least 1 tree per 300 sq. ft. of landscaped area;
- Type C:
  - 5-25' wide: Trees at 20’ on-center (minimum 2" caliper at 4' from the root ball) that reach a mature height of 25-40’
  - >25' wide: At least one tree per 300 sq. ft. of landscaped area or 25’ separation (on average).
- Parking:
  - Canopy trees should be utilized within parking areas.
  - There shall be no more than 8 parking spaces in a row without a landscaping bed containing a tree, shrubs and ground cover.
  - At least 1 tree for every 6 spaces excluding required perimeter

Right of way limitations:
- Street trees on all public streets shall be cut or pruned only by the city of Carnation public works department, or under the supervision of, or with the approval of, the city of Carnation public works department.
- If required by this title or by the city of Carnation street and storm sewer standards, or if the street to be newly created, widened or improved is classified as a local access or neighborhood access roadway in the city of Carnation street and storm sewer standards, the developer shall either plant or retain sufficient trees so that within the right-of-way there is for every thirty feet of street frontage at least an average of one deciduous tree of two inches d.b.h. (diameter breast height) at the time of planting and with a canopy that starts at least eight feet above finished grade and has or will have when fully mature a trunk at least twelve inches in diameter. Root deflectors shall be provided for all street trees. When trees are planted by the developer pursuant to this section, the developer shall choose trees that meet the standards set forth by the city of Carnation street and storm sewer system standards.

Protection of trees during construction:
- All minimum required tree protection measures shall be shown on the landscape plan and the site grading plan.
- All construction activities shall be prohibited within the root protection zone (determined by a certified arborist) of a protected tree.
- The construction limit line for a structure, utility, or roadway shall be located no closer than the root protection zone of a protected tree.
- No proposed structure, utility, or roadway shall be located in the root protection zone, except where structures are raised above the ground.
- Sidewalks and utilities may be located within the dripline of a protected tree, provided that construction methods and materials used will result in minimal disruption of the tree's roots, and that additional measures for tree protection are used.
- Prior to land disturbance, tree protection barriers shall completely surround the root protection zone of protected significant trees.
- Tree protection barriers shall be a minimum of 4' high chain link or polyethylene laminar safety fencing or similar material, subject to approval by the city planner. "Tree protection area" signs shall be posted visibly on all sides of the fenced areas.
- Preventative Measures: Pruning of visible deadwood on protected trees; Fertilizer application for stressed trees; Use of soil amendments and soil aeration in tree protection areas; Mulching on dripline ares; and irrigation for tree roots during and immediately after construction.

Tree protection

Definition of significant trees:
- Any tree 12"+ caliper at 4.5' from the ground, except: Black Locust, Black cottonwood, Cottonwood, Native alder, Native willow, and Lombardy poplar

Heritage trees are specifically protected? No

Tree retention incentives:
- Reduction of parking requirement to preserve significant trees.
- If space that would otherwise be devoted to parking cannot be so used because of tree requirements, the number of required spaces may be reduced by up to a maximum of 15% of the required spaces.

Protection of significant trees:
- Significant tree retention requirements by zoning:
  - MU (not Tolt Avenue): 1 significant tree per 2,500 square feet
  - MU (Tolt Avenue): No requirement
  - UR5: 1 significant tree per 5,000 square feet
  - UR7.5: 1 significant tree per 7,500 square feet
  - UR10.8: 2 significant tree per 10,800 square feet
  - SR12.5: 2 significant tree per 12,500 square feet
  - MFR: 1 tree per 2,500 square feet
  - CBD No requirement
  - SC No requirement
  - HC: 8 significant trees per acre 3 to 1
  - PU: 1 significant tree per 5,000 sq. ft. where PU abuts R
  - PR: 8 trees per acre for parks or areas of parks with passive recreation uses (not active ie. baseball fields).

Tree replacement requirements:
- Significant tree required replacement ratios by zoning code:
  - MU (not Tolt Avenue): 1 to 1
  - UR5: 2 to 1
  - UR7.5: 3 to 1
  - UR10.8: 3 to 1
  - SR12.5: 3 to 1
  - MFR: 1 to 1
  - CBD: no requirement
  - SC: no requirement
  - HC 3 to 1
  - PU: no requirement
  - PR: no requirement
  - Replacement trees shall be a minimum of 2" caliper for deciduous trees and 6' minimum height for evergreen trees.

City: Clyde Hill

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** 1993

Permit is required for tree removal in these conditions: • In view dispute cases • In public rights-of-way	**Grading and clearing requirements:** not found **Protection of trees during construction:** not found **Seasonal restrictions:** not found
Landscaping requirements: • As owners of trees, residents in the city of Clyde Hill should make every effort to recognize the zone in which they live according to the Citizen's Guide to Urban Forest Management in the City of Clyde Hill and plant and maintain appropriate species of trees that will preserve views as described in the Guide.	**Right of way limitations:** • A tree board is responsible for trees in rights-of-way. • Trees or shrubs may be planted on planting strips by the owner of property adjacent to the right-of-way meeting these specs: • Trees on acceptable planting list in the right-of-way, which do not have aggressive root systems which could cause damage to streets, sidewalks and underground utilities. • All costs of planting, pruning and maintenance of any trees and/or shrubs shall be the responsibility of the abutting property owner. • Only plant in those areas approved by the city as allowing a clear line of sight for traffic in intersections and driveways. • Public Nuisance. Any street tree or shrub planted in violation of this chapter is declared to be a public nuisance, •
Pruning requirements: • If a significant amount of pruning is required, where over a quarter to a third of a tree canopy is removed, the tree has outgrown its place and replacement of the tree is suggested. • Topping, or making a heading cut on the trunk or major branches is not an acceptable way to reduce the crown of a tree.	

Tree protection

Definition of significant trees: not found	**Heritage trees are specifically protected?** Yes
	Tree retention incentives: • not found
Protection of significant trees: • not found	**Tree replacement requirements:** • Tree removal as approved during view disputes may be accompanied by replacement plantings or appropriate plant materials to restore the maximum level of benefits lost due to tree removal. The replacement tree shall be chosen by the tree owner from a list of trees established by the city which will be less likely to cause a reoccurrence of the unreasonable obstruction.

Comments:

- City of Clyde Hill has a formal mediation program to resolve view disputes.
- Chapter 15.10.090 allows city staff to require tree retention to promote low impact development on a case by case basis.
- There are substantial recommendations in the Citizen's Gui

City: Covington

Year of most recent tree ordinance update: 2010 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions:

- On any residentially zoned parcel of land 1-2 acres in size which has >20 significant trees and is undeveloped or to be subdivided.
- On any parcel of land 2+ acres in size which contains 20 significant trees and is undeveloped or to be subdivided.
- In critical areas

Grading and clearing requirements:

- Major tree clearing permits involve removal of trees, clearing and grading of land on 2+ acre sites with trees, shrubs, or ground cover.
- For all grading permits, tree retention plans are required.
- A protected tree shall not have the soil grade altered within its critical root zone or within 6' of its trunk, whichever is greater.

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs spaced throughout the landscape strip and spaced to form a continuous screen;
  - 70-90% evergreen trees;
- Type II:
  - A mix of evergreen and deciduous trees and shrubs spaced throughout the landscape strip spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30% evergreen trees;
- Type III:
  - A mix of evergreen and deciduous trees spaced throughout the landscape strip, spaced to create continuous canopy;
  - At least 70% deciduous trees;

Right of way limitations:

- For all development, trees shall be planted at the rate of 1 tree for every 35' of frontage along all public/private streets;

Pruning requirements:

- No topping of trees is allowed as part of any regulated activity.

The Director shall prepare and distribute educational materials describing any required, recommended, or accepted tree maintenance and tree care standards for any tree tracts, preservation or enhancement trees, or replacement trees required under this chapter and any best pruning practices, policies, techniques, and procedures for any trees required under this chapter.

Seasonal restrictions: not found

Protection of trees during construction:

- An area of prohibited disturbance (generally the critical root zone of a significant tree) shall be identified during the construction stage, and temporary fencing shall be established prior to any tree clearing/grading and remain throughout construction. If any sign of disturbance is observed by the City within the tree protection area, a stop work order may be issued until corrections are made and damage is restored.
- No impervious surfaces, fill, excavation, or storage of construction materials are permitted within tree protection zones.
- A tree designated for preservation shall not have the soil grade altered within its critical root zone or within six feet of its trunk, whichever is greater. The grade may be lowered if a certified arborist with the concurrence of the Director determines the impact of lowering the grade within the area described in this subsection will not adversely affect the health of the tree;

Tree protection

Protection of significant trees:

- For all residential zoned lands on sites greater than one acre in size:
- When subdivided, if at least 20 significant trees exist on the site prior to subdivision, trees shall be preserved in tree tract(s) and subject to a tree preservation plan, prepared by a certified arborist, landscape architect, or forester, and approved as part of a minor tree removal permit or a major tree clearing permit. As many significant trees as practical shall be preserved and identified in the required tree preservation plan.
- When proposed for development, redevelopment, construction or demolition, if at least 20 significant trees exist on the site prior to development, trees outside of any proposed building footprint or partially exempted tree removal area shall be preserved and protected with a tree conservation easement filed with the County.
- Minimum tree tract size by lot size:
- - 1-5 acres - 5% of total land, minimum size of 2,178 square feet.
- - 5-30 acres - 7% of total land, minimum size of 7,000 square feet.
- - 30+ acres - 9% of total land, minimum size of 15,000 square feet.
- -Or alternative tree canopy plan as approved.
- - The tree tract or easement boundary shall be at least 5' from the critical root zone of any trees to be protected and preserved within the tract or easement. Locations of tracts are prioritized in code.
- For all commercial and industrial sites greater than 2acres in size:
  - A tree enhancement plan is required which combines preservation of existing trees and tree replanting that will best provide tree enhancement within and/or surrounding any proposed commercial and industrial development. Up to 15% of the existing significant trees on site prior to development should be retained within the tree enhancement plan, or they shall be replanted at a 2 to 1 ratio.

Definition of significant trees: Any healthy tree of 6"+ dbh.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- A one percent reduction in the percent requirements for land devoted to tree tracts may be granted if the required tree tract contains at least 10 native coniferous trees greater than 12" dbh. Such trees must be documented as healthy and likely to resist "blowdowns" in a wind storm by a certified arborist as part of the tree plans submitted with any subdivision or development application.

Tree replacement requirements:

- 2:1 - Any residential site >1 acre in size, or commercial/industrial site greater than two acres in size, shall be required to supplement any existing significant trees with new plantings of trees up to the required significant tree minimum.
- Tree species for new tree plantings shall be selected from a list of Pacific Northwest native trees published by the City. At least 60% must be coniferous. All trees shall be at least 2" in caliper.
- Replanting of trees to bring a tree tract up to the 20 tree minimum shall be at a ratio of 2 to 1 for the deficient number of significant trees less than the required 20 tree minimum.

City: Des Moines

Year of most recent tree ordinance update: 2014 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions: • Trees located within a critical area or shoreline area, or associated buffers; • Trees located within a required landscaping area; • Trees located on a private developed, partially developed, or undeveloped lot where the total area to be cleared is 2,000 sq ft or greater; • Trees located on City-owned property; • Trees located on City right-of-way.	**Grading and clearing requirements:** • Removal, cutting, or pruning of trees that results in a total area of disturbance greater than 2,000 sq. ft. shall be reviewed in accordance with the land clearing, grading, and filling provisions.
Landscaping requirements: • Parking: 1 tree for every 50 sq. ft. of parking	**Right of way limitations:** • Pruning may not remove more than 25% of a tree's total leaf area in rights-of-way.
Protection of trees during construction: • Clearing and grading shall take place outside the drip line of those trees to be retained; provided, that the Planning, Building and Public Works Department may approve hand clearing within the drip line if it can be demonstrated that such grading can occur without damaging the tree. • If the roots are damaged, the Planning, Building and Public Works Department may require restoration measures such as the application of phosphate or potash.	
Pruning requirements: • In critical areas, tree pruning shall conform to the International Society of Arboriculture standards or other standards approved by the DNR and/or Ecology.	**Seasonal restrictions:** • Tree cutting is prohibited within geologically hazardous areas or protected slope areas between October 1 and April 1 unless a waiver has been granted or the cutting is necessary due to an emergency situation involving immediate danger to life or property.

Tree protection

Definition of significant trees: • Evergreen: diameter of 6"+ at 54" above the ground • Deciduous: diameter of 8"+ at 54" above the ground (excluding alders, European ashes, cottonwoods, and willows)	**Heritage trees are specifically protected?** No **Tree retention incentives:** not found
Protection of significant trees: • Significant trees shall be retained to the extent feasible within landscape areas. The Planning, Building and Public Works Department shall designate trees to be retained prior to issuance of a land clearing, grading, and filling permit.	**Tree replacement requirements:** • 3:1 for any tree identified to be retained that is removed, destroyed or damaged. • 5:1 for any tree identified to be retained that is destroyed or damaged during construction. • Replacement trees shall be a minimum size of 8' in height for evergreen trees, and 2" in caliper for deciduous. • These trees shall be provided in addition to any street trees required.

City: Duvall

Year of most recent tree ordinance update: 2007 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions:
- In native growth protection areas
- In critical area
- Shown on an approved tree plan as to be retained
- The last one or two trees on the lot

Grading and clearing requirements:
- All minimum required tree protection measures shall be shown on the tree plan and the site grading plan.

Right of way limitations:
- Street trees shall be planted along roadway corridors and street frontages 25-40 feet on center, depending on tree type.

Seasonal restrictions: not found

Pruning requirements:
- Protected trees shall not be topped.
- Pruning and maintenance of protected trees shall be consistent with best management practices in the field of arboriculture and further the long-term health of the tree.

Landscaping requirements:
- Type I:
  - Evergreen trees at least 6' tall at planting, and evergreen shrubs providing an 80% sight-obscuring screen at planting;
  - Or a combination of trees and shrubs (both 60% evergreen/40% deciduous) backed by 100% sight-obscuring wall or fence.
  - Landscape strips 15’ or less in width—1 tree required for every 15-20’ depending on the type of tree proposed.
  - Landscape strips >15’—1 tree for every 150 sq. ft.
- Type II:
  - Planting shall include a minimum of 60% evergreen trees and evergreen shrubs. The width shall generally be at least 5-15’.
  - Landscape strips 15’ or less in width—Trees required an average of 20-30’ on center depending on the type of tree proposed.
  - Landscape strips >15’—1 tree for every 300 sq. ft.
- Parking:
  - All parking lots shall be planted with trees so that within 10 years, 50% of the surface area of the lot is shaded. Trees shall be planted in vehicle use landscape areas at a minimum of 1 tree for every 4 parking stalls. No more than 8 stalls between landscape islands.
- All plants shall have the following minimum size at installation:
  - Street trees—deciduous only, 2.5-3” caliper at breast height.
  - Other deciduous trees—2” caliper at breast height.
  - Evergreen trees: 8-10’ minimum height range.
- Vine maples/other multi-stemmed trees: 6-8’ minimum range.

Protection of trees during construction:
- All construction activities shall be prohibited within the root protection zone of a protected trees.
- Tree protection barriers shall be installed along the outer edge and completely surround the root protection zone of significant trees to be protected prior to any land disturbance.
- Preventative measures: Pruning of visible deadwood on trees to be protected or relocated; Application of fertilizer to enhance the vigor of stressed trees; Use of soil amendments and soil aeration in tree protection and planting areas; Mulching over tree dripline areas; and ensuring proper water availability during and immediately after construction.
- No proposed structure, utility, or roadway shall be located in the root protection zone of a protected tree, except where such structure is raised above the ground's surface so as not to disrupt the tree's roots.
- If such trees are damaged and/or removed, the applicant shall be responsible for paying a fine of $1,000.00 per tree plus installing replacement trees and/or paying an in-lieu fee.

Tree protection

Definition of significant trees:
- Any tree at least 16" caliper at 4.5' above the ground.

Heritage trees are specifically protected? Yes

Tree retention incentives:
- not found

Protection of significant trees:
- 35% retention is required for significant trees.

Tree replacement requirements:
- 3:1 for any protected tree irreparably damaged, severely stressed or dying if it is part of the required 35% requirement
- 1:1 for any protected tree irreparably damaged, severely stressed or dying if in excess of 35% but counted towards overall tree number.

City: Enumclaw

Year of most recent tree ordinance update: 1992 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions: • On City property • On City right-of-way • In a critical area	**Grading and clearing requirements:** not found **Seasonal restrictions:** not found **Protection of trees during construction:** not found
Landscaping requirements: In rights-of-way: • Landscaping required via development permits shall be deemed to satisfy the Street Trees section. The spacing and selection of street trees will be in accordance with the recommended street tree list. No trees may be planted closer together than the following: - small trees: 20' - medium trees: 30' - large trees: 40' • Provide a planted area between each individual garage at least 20 sq. ft. in area, with no dimension less than 4'. Provide a combination of shrubs or groundcover and a street tree. • Cluster planting area and trees adjacent to or along the alley area provided there is an average of one tree and at least 20 sq. ft. of landscaped area per individual garage. Parking: • At least 1 tree and 10 shrubs are required for every 100 sq. ft. of interior planting. • Parking spaces shall be no further than 50' from the trunk of a shade tree, or further than 75' from the trunks of 2 or more shade trees.	**Right of way limitations:** • Except for routine care, maintenance, or stump removal, no person shall plant, remove or otherwise disturb any tree or shrub located within or overhanging any public right-of-way within the city without first filing an application for and procuring a permit from the municipal arborist. **Pruning requirements:** • Every owner of any tree overhanging any street or public right-of-way within the city shall prune the branches so that such branches shall not obstruct the light from any street lamp or obstruct the view of any street intersection and so that there shall be a clear space of eight feet above the sidewalk and 14 feet above the street. The owners shall remove all dead, diseased or dangerous trees, or broken or decayed limbs which constitute a menace to the safety of the public.

Tree protection

Definition of significant trees: • Evergreen: 6"+ dbh • Deciduous: 8"+ dbh	**Heritage trees are specifically protected?** No **Tree retention incentives:** not found
Protection of significant trees: • Replacement is required in critical areas.	**Tree replacement requirements:** • 2:1 in critical areas unless otherwise directed by the administrator within one year in accordance with an approved restoration plan.

City: Federal Way

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:

- In critical areas
- Removing vegetation required to be retained during development
- Where tree and vegetation removal changes the points where the stormwater or groundwater enters or exits the subject property, or changes the quality, or velocity of stormwater or groundwater.
- Trees >6" dbh under minimum tree units (see tree protection)

Grading and clearing requirements:

- No clearing, grading, or vegetation removal shall be approved until any associated landscaping or tree retention plans are approved.
- If the grade level around the tree is to be raised by more than 1', a rock well shall be constructed (with diameter of tree trunk plus 10').
- The grade level shall not be lowered within the larger of the drip line of the tree(s) or the critical root zone of the tree(s).

Landscaping requirements:

- Minimum tree density requirements for vacant/redeveloping sites:
  - BC, BN, CE, OP, PO - 20 tree units/acre
  - SF Residential zones - 25 tree units/acre
  - RM 1800, RM 2400, RM 3600 - 30 tree units/acre

Right of way limitations:

- No person may top any street tree located in public rights-of-way.
- Any person wishing to perform any vegetation work in a public right-of-way must file a right-of-way application with the city and obtain a right-of-way permit prior to commencing any work.

Protection of trees during construction:

- No clearing shall be allowed on a proposed development site until the tree retention and landscape plans have been approved.
- A no disturbance area shall be established for each tree to be protected. The no disturbance zone shall be equal to the critical root zone which is defined as 12" radius for every 1" of tree diameter measured at 4.5' above ground.
- The no disturbance zone shall be marked during construction with a temporary 5' chain-link fence, with signage which reads "TREE PROTECTION FENCE – No soil disturbance, parking, storage, dumping, or burning of materials is allowed within the Tree Protection Fence."
- No soil disturbance, parking, storage, dumping, burning of materials, impervious surfaces, fill, excavation, or storage of construction materials shall be permitted within the no disturbance area.
- Proper drainage, and irrigation if necessary, shall be provided in all rock wells.
- The grade level shall not be lowered within the larger of the drip line of the tree(s) or the critical root zone of the tree(s).
- No trenching is allowed in any critical tree root zone areas.
- No installation of any impervious surfaces is allowed in critical root zones. Where road or sidewalk surfaces are needed within critical root zones, unmortared porous pavers or flagstone may be used. Boardwalks or bridging may span root zones without harming the tree roots.
- Tree protection areas (i.e., critical root zone) must be prepared to better withstand the stresses of the construction phase by, if necessary, fertilizing, pruning, and mulching around them well in advance of beginning any construction activities.

Pruning requirements:

- Protected trees shall not be topped.
- Street trees shall be maintained in a healthy condition by the adjacent property owner and shall only be cut or pruned with the permission of the city of Federal Way public works department.
- Pruning and maintenance of protected trees shall be consistent with arboricultural BMPs and further the long-term health of the tree.
- Excessive pruning is only allowed to protect life/property.

Seasonal restrictions:

- Development sites shall be revegetated and landscaped as soon as practical after completion of clearing and grading work:
- Where permanent revegetation measures are not in place within 7 days in the dry season and 2 days in the wet season, the applicant shall provide temporary revegetation or stabilization measures in accordance with the latest edition of ecology's stormwater management manual for Western Washington.

Tree protection

Definition of significant trees: n/a - Tree standards use a tree credit system which credits existing trees higher than replacement trees to meet tree density requirements. Larger trees count for more tree credits.

Heritage trees are specifically protected? No

Tree retention incentives:
not found

Protection of significant trees:

- Under tree credit system:
  - Existing Tree 1" to 6" d.b.h. - 1.0 tree units per tree retained
  - Existing Tree > 6" to 12" d.b.h. - 1.5 tree units per tree retained
  - Existing Tree > 12" to 18" d.b.h. - 2.0 tree units per tree retained
  - Existing Tree > 18" to 24" d.b.h. - 2.5 tree units per tree retained
  - Existing Tree > 24" d.b.h. - 3.0 tree units per tree retained

- A stop work order can be issued for tree or vegetation removal occurring without a required permit.

Tree replacement requirements:

- Under tree unit credit system:
  - Replacement Tree, Small Canopy Species (Mature canopy area < 450 SF) - .50 tree units per tree planted
  - Replacement Tree, Medium Canopy Species (Mature canopy area 450 to 1,250 SF) - 1.0 tree units per tree planted
  - Replacement Tree, Large Canopy Species (Mature canopy area > 1,250 SF) - 1.5 tree units per tree planted
- For expansion of existing uses: A minimum of 3.0 tree units shall be provided for each tree unit removed, up to 25 tree units per acre.
- For new or redevelopment, replacement trees must meet this density depending on zoning:
  - BC, BN, CE, OP, PO - 20 tree units/acre
  - SF Residential zones - 25 tree units/acre
  - RM 1800, RM 2400, RM 3600 - 30 tree units/acre
- Where a tree replacement fee is utilized, a tree replacement fee paid into the city's urban forestry account may be approved.
- Planting size:
  - Evergreen at least 6'in height, Deciduous trees at least 2" caliper.

Comments: Tree retention and maintenance requirements are protected by a bond.

City: Hunts Point

Year of most recent tree ordinance update: 2010 **Tree City USA (year Joined):** 1992

Permit is required for tree removal in these conditions:
- Significant trees

Right of way limitations: not found

Seasonal restrictions: not found

Landscaping requirements:
- Only for wireless service/telecommunication facitilities.

Grading and clearing requirements:
- No person shall begin excavation, filling or grading, install site utilities, or do any site development work that will remove, destroy, or impair the viability of regulated vegetation or trees, without first obtaining a tree removal permit and/or site development permit from the building official, with exemptions.

Protection of trees during construction:
- Tree protection fencing or other barriers shall be installed along all clearing limits just outside of a tree's root protection zone (RPZ). A moveable panel or gate should be part of the fencing or barrier to allow access to the RPZ.
- All tree protection fencing shall be installed and its location approved by the town arborist prior to the commencement of work on site.
- A 2-4" layer of arborist woodchip mulch shall be placed over the soil in the RPZ.
- No parking, dumping, burning, changing grade, nor storing debris or construction materials is allowed within this protected area.
- Work within the RPZ areas will be hand work only; no heavy equipment.
- When removing trees outside of the RPZ determined to be unacceptable for retention, use methods such as directional felling to avoid damage to trees and other valuable vegetation being retained. Small trees and other native vegetation should be carefully preserved.
- Where construction or utility trenches are required in the rights-of-way, side property setbacks, and RPZs; it is required to tunnel under or around roots by drilling, auger boring, pipe jacking or hand digging.
- Tree stumps that are within a RPZ or immediately adjacent to the RPZ of a preserved tree or other vegetation shall be removed by grinding.
- Where roots of a significant tree are encountered during excavation or grading, a certified arborist shall be on site to supervise any root pruning and to assess the potential impact of such pruning. Roots cut shall be immediately covered with soil or mulch and kept moist.
- Where access for machinery or any vehicle is required within the RPZ of any significant tree, the soil should be protected from compaction. Acceptable methods may include 18 inches of wood chips or hog fuel, plywood, or steel sheets.
- Landscaping specified within the RPZ shall limit disturbance of surface soils and preserved vegetation. No root pruning is permitted.
- Supplemental irrigation for all protected trees is required during summer months/prolonged dry periods as determined by a professional.
- All significant, preserved, and replacement trees shall be maintained for a period of three years after site development or mitigation.

Pruning requirements:
- A permit shall not be required for pruning that complies with American National Standards Institute (ANSI) A300 standards.
- Where it has been determined that roots of a significant tree may be encountered during excavation or grading, a certified arborist shall be on site to supervise any root pruning and to assess the potential impact of such pruning.
- Any trees adjacent to high traffic areas or building envelopes shall be pruned by an International Society of Arboriculture certified arborist using ANSI A300 American Standards for pruning to remove dead wood, provide clearance, and cabling or bracing.

Tree protection

Protection of significant trees:
- A tree removal permit will be issued only when consistent with code and reasonably necessary for one or more of the following:
  - The tree is dead;
  - The tree is hazardous;
  - To accommodate the building of new construction or additions to existing structures which cannot be located without such tree removal;
  - A new driveway of customary and reasonable width cannot be reasonably located without such tree removal or an existing driveway cannot be reasonably utilized due to the proximity of the tree to the driveway or actual or imminent damage to a residential structure or foundation will occur, determined by the town arborist;
  - The avoidance of a substantial risk of damage to an existing residential structure, garage or electrical, telephone or other utility line; provided, no permit shall be issued if said risk may reasonably be avoided by pruning, trimming or any other operation without the complete removal of the tree or the creation of a snag;
  - The installation and maintenance of public utilities or public streets by the town or its contractors cannot be reasonably accomplished without such tree removal.

Definition of significant trees:
- Any evergreen tree, and some deciduous trees (Oak, Madrona, Dogwood) with a 10"+ trunk diameter at 4.5' above grade
- Any tree that meets the criteria of grove trees

Any tree planted as mitigation under the Tree Code.

Heritage trees are specifically protected? No

Tree retention incentives:
- not found

Tree replacement requirements:
- 2:1 whenever a significant tree is removed or destroyed.
- Replacement trees should be of the same species or such species as recommended by the town arborist.
- Replacement planting sizes:
- -Evergreen trees shall be a minimum height of 10' tall and have a full, well-developed crown of foliage.
- - Deciduous trees shall be 3" in caliper.

City: Issaquah

Year of most recent tree ordinance update: 2011 **Tree City USA (year Joined):** 1993

Permit is required for tree removal in these conditions:

- A tree removal form is required for all removal.
- For single family properties an allotted number of significant trees are allowed to be removed within a year or five year period without a permit (see significant tree protection)
- Landmark trees (30+" dbh)
- In greenbelts
- In critical areas
- In Native Growth Protection Areas
- In required landscaping
- In rights-of-way
- Replacement trees

Grading and clearing requirements:

- Tree plans are required for any clearing and grading permit.
- The grade level around any tree to be retained may not be lowered by more than two-thirds of the area defined by the critical root zone of the tree. If the grade level around a tree to be retained is to be raised, the applicant shall construct a dry rock wall or rock well around the tree with a diameter equal to the tree's dripline.

Seasonal restrictions:

Vegetation shall be restored on disturbed areas which are not covered by permanent impervious surface within 7 days of the completion of grading or clearing, unless seasonal or weather conditions are unfavorable. In this case, temporary erosion control measures shall be installed and maintained until restoration can be completed.

Landscaping requirements:

- Type 1:
  - Minimum 90% evergreen
  - Rows spaced an average of 30' on center depending on species with a minimum of 4 trees per 5,000 sq. ft.
  - A minimum of 6-8' high for conifers and 2.5" caliper for deciduous and evergreen broad-leaf trees when planted
- Type 2:
  - Minimum 50% evergreen
  - Medium trees spaced an average of 25-30' on center depending on species, with a minimum of 4 trees per 5,000 sq. ft.
  - Minimum of 6-8' for conifers and 2" caliper for deciduous and evergreen broad-leaf trees when planted
- Type 3:
  - Minimum 30% evergreen
  - Small to medium trees spaced an average of 20' on center depending on species with a minimum of 4 trees per 5,000 sq. ft.
  - A minimum of 6-8' for conifers and 1.5" caliper for deciduous and evergreen broad-leaf trees when planted
- Parking:
  - 1 tree for every 6 parking spaces – a minimum of 10' high and 2" caliper when planted. The trees shall be 100% large broad-leaf canopy trees.
  - Planting islands with trees shall be at the ends of each row and located midway between the ends.
  - 1 tree shall be provided for each 1,000 sq. ft. of landscaped area.

Right of way limitations:

- Street trees when planted shall be a minimum of 2" caliper regardless of ultimate size.
- Permission by the City shall be required before any plant may be planted or removed from City property or public right-of-way.
- Street trees shall have a minimum overhead clearance of 7' over pedestrian pathways and 14' over streets at maturity.
- Street trees shall be centered a minimum of 3' from curbs and 2' from sidewalks or as otherwise approved by the City.
- Street trees shall be planted in a planting strip with a minimum of 5' between the sidewalk and the back of the curb. Permanent or temporary irrigation shall be required for a minimum of 3 years.
- Trees under overhead utility wires shall be of a small variety.

Pruning requirements:

- All pruning shall be done to the most recent National Arborist Association Standards. It is recommended that all pruning be done to Class I (Fine Pruning), Class II (Standard Pruning), or Class III (Hazard Pruning) standards. Class IV (Crown Reduction Pruning) shall only be done for the following reasons:
- Branches interfering with utility lines.
- Significant crown dieback has occurred.
- Storm damage or prior incorrect pruning requires correction.
- In no case is topping (the severe reduction of branches without consideration of the specifications for cutting back) allowed.

No more than 25% of the total canopy may be removed unless approved by the City Horticulturist.

Protection of trees during construction:

- For significant trees, tree stands and existing vegetation:
- The applicant shall not fill, excavate, stack or store any equipment or compact the earth in any way within the area defined by the dripline of any tree to be retained.
- The applicant shall construct a temporary but immovable 4' high sturdy fence around each tree or native vegetated area to be retained generally corresponding to the critical root zone of the trees.
- The applicant may not install impervious surface material within the area defined by the dripline of any trees to be retained unless specifically approved by the Planning Director/Manager.
- The grade level around any tree to be retained may not be lowered by more than two-thirds (2/3) of the area defined by the critical root zone of the tree. If the grade level around a tree to be retained is to be raised, the applicant shall construct a dry rock wall or rock well around the tree. The diameter of this wall or well must be equal to the diameter of the tree's dripline.

Tree protection

Definition of significant trees:

Any tree at least 6"+ dbh or an alder or cottonwood tree 8"+ dbh. Any trees that are listed on the King County complete weed list shall not be considered significant.

Heritage trees are specifically protected?

Yes

Tree retention incentives:

not found

Protection of significant trees:

- Required tree density:
- Multifamily Developments: 4 significant or replacement trees per 5,000 sq. ft.
- Commercial, Retail & Facilities: 4 significant or replacement trees per 5,000 sq. ft.
- Single Family Lots: 2 significant or replacement trees per 5,000 sq.ft.
- Maximum Tree Removal:
- Single family properties can remove without a permit (based on lot size):
- - <10,000 sq.ft. – 2 trees in one year and 4 in five years
- - 10,001-20,000 sq.ft. – 4 trees in one year and 8 in five years
- - >20,001 sq.ft. – 6 trees in one year and 12 in five years
- Tree removal requests for non-single family lots shall be required to meet the minimum tree density requirements and maintenance requirements.
- Tree retention requirements (outside Urban Village):
- Single family, duplex, short plats, or subdivision development: 30% of the total caliper (dbh) of all significant trees in developable site area
- Commercial and multifamily development: 25% of the total caliper (dbh) of all significant trees in developable site area
- Priority of Tree Retention Requirements:
- Priority One: Significant trees which form a continuous canopy; Significant trees on slopes greater than 20%; Significant trees adjacent to critical areas and their associated buffers; Significant trees over 60' in height or 18"+ dbh.
- Priority Two: Healthy tree groupings whose associated undergrowth can be preserved; Other significant native evergreen or deciduous trees; Other significant nonnative trees.
- Priority Three: Alders and cottonwoods shall be retained when all other trees have been evaluated for retention and are not able to be retained except where adjacent to open space, wetlands or creek buffers.
- Tree removal prohibited: Protected Trees, Vacant Lots, Demolitions, critical areas and in all natural growth protection easements, with exemptions.

Tree replacement requirements:

- For commercial or multifamily: replacement may be calculated based on meeting the landscape plan purpose and intent.
- For all other tree removal: 1 replacement tree for every 6" caliper dbh of trees removed if remaining tree density is below the minimum requirements.
- All replacement trees shall be:
- - A minimum of 2" caliper for deciduous trees and 7-8' tall for conifers for multifamily and commercial lots;

- A minimum of 5 gallon for existing single family lots.

City: Kenmore

Year of most recent tree ordinance update: 2011 **Tree City USA (year Joined):** n/a

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs spaced throughout the landscape strip and spaced to form a continuous screen;
  - Between 70-90% evergreen trees;
- - Trees provided at the rate of one per 10' of landscape strip and spaced no more than 30' apart on center;
- Type II:
  - A mix of evergreen and deciduous trees and shrubs generally interspersed throughout the landscape strip spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30% evergreen trees;
  - Trees provided at the rate of 1 per 20' of landscape strip and spaced no more than 30' apart on center;
- Type III:
  - A mix of evergreen and deciduous trees spaced throughout the landscape strip and spaced to create a continuous canopy;
  - At least 70% deciduous trees;
  - Trees provided at the rate of one per 25' of landscape strip and spaced no more than 30' apart on center;
- Parking:
  - 1 tree for every 3 stalls for commercial or industrial development
  - 1 tree for every 5 stalls for residential or institutional development

Permit is required for tree removal in these conditions:

- In critical areas
- In Native Growth Protection Areas
- In Wildlife Protection Zones
- On a tract or area designated for protection
- On vacant land
- On commercial property
- Removing more than maximum allowed on single-family (see protection of significant trees)

Grading and clearing requirements:

- Tree protection plan required in grading and clearing permits.
- The grade shall not be filled or cut within the critical root zone of any tree designated to remain.
- Trees and other vegetation to be retained shall be protected from erosion and sedimentation.

Right of way limitations:

- Trees shall be planted at the rate of 1 tree for every 40' of frontage along a neighborhood collector street or arterial street;

Pruning requirements:

- All trees shall be maintained in accordance with International Society of Arboriculture guidelines and standards.

Seasonal restrictions: not found

Protection of trees during construction:

- The Critical Root Zone (CRZ) of protected tree areas shall include no less than the area of a 1' radius every inch of trunk d.b.h., or the area from a tree's trunk to a point no less than the end of a tree's longest branch, whichever is greater.
- Before development, the applicant shall: (1) place 3" of composted woodchips over the CRZ of all retained trees to retain moisture, increase organic matter, and visually establish the CRZ; (2) erect and maintain readily visible protective tree fencing a minimum of 3' beyond the outer edge of the CRZ for all protected tree areas. Fencing shall completely surround the required tree protection area. Fencing shall be a minimum of 4' high and may be higher if needed to ensure clear visual delineation; (3) keep the protective fencing in place until the City authorizes the removal or issues a final certificate of occupancy, whichever occurs first; (4) ensure that any landscaping done within the root protection zone subsequent to the removal of the fence shall not disturb existing trees including roots within the CRZ.
- During development, no individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, or agency of any governmental unit, however designated, may conduct any activity within a required tree protection fence.
- During development, no individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, or agency of any governmental unit, however designated, shall attach any object to any tree designated for protection.
- Grade: The grade shall not be filled or cut within the CRZ of any tree designated to remain without prior review by a qualified tree protection professional and advance city approval. The applicant shall not install impervious surface within the protective barrier of any protected tree without the advance city authorization. To the greatest extent practical, utility trenches shall be located outside of the root protection zone of trees to be retained. Boring or tunneling under the CRZ may be considered an alternative, but shall require the advance approval of the city.

Tree protection

Definition of significant trees:

- Evergreen: 8"+ at 4.5' above grade (except hazard trees)
- Deciduous: 12"+ at 4.5' above grade (except hazard trees)

Heritage trees are specifically protected? No

Tree retention incentives: not found

Protection of significant trees:

Maximum Tree Removal:

- Single family properties can remove without a permit (based on lot size):
  - <10,000 sq. ft. – 2 trees per year
  - 10,000-20,000 sq. ft. – 4 trees per year
  - 20,000-30,000 sq. ft. – 6 trees per year
  - >30,000 sq. ft. – 8 trees per year
- The minimum tree density required for each site is 30 tree units per acre of net buildable area. (there is a table in the code to convert dbh to tree units).

Tree replacement requirements:

- Minimum density may be achieved by tree replacement if retention is infeasible or does not add to 30. There is a table in the code to convert caliper inch measurements of replacements into tree units.
- Replacement trees should be planted in areas with soil, climate, exposure, and moisture conditions appropriate to the replacement tree species.
- Replacement trees should be planted by these following priorities:
- - On-site (designated tracts, perimeter landscaping, landscaping above and beyond requirements)
- - Off-site (the applicant may propose to the City payment of a fee in lieu for installation of trees in a public park or other public space)

Comments: View issues can be contentious.

City: Kent

Year of most recent tree ordinance update: 2007 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions:
- In critical areas
- In public rights-of-way

Grading and clearing requirements: not found
Pruning requirements: not found

Landscaping requirements:
- Type I:
  - Evergreen trees or tall shrubs with a minimum height of 6' at planting, which will provide a 100% sight-obscuring screen within 3 years from the time of planting;
  - Or a combination of evergreen and deciduous trees and shrubs backed by 100% sight-obscuring fence.
- Type II:
  - Evergreen or a mixture of evergreen and deciduous trees with large shrubs and ground cover interspersed with the trees.
- Type III:
  - Evergreen and deciduous trees planted not more than 30' on center interspersed with large shrubs and ground cover. Where used to separate parking from streets, plantings must create a visual barrier of at least 42" in height at time of planting and form a solid screen 3 years after planting.
- Type IV:
  - A mixture of evergreen and deciduous shrubs and ground cover, to provide solid covering of the entire landscaping area within 3 years of planting and to be held to a maximum height of 3.5'.
- Type V:
  - Trees planted with supporting shrubs or ground cover.
- Planting size:
  - In parking area landscaping and in street rights-of-way: Deciduous trees shall have a minimum caliper of 1.75" and a height of 10', Coniferous and broadleaf evergreens shall be at least 5' in height;
  - In all other required landscape areas: Deciduous trees shall have a minimum caliper of 1.5" and a height of 10', Coniferous and broadleaf evergreen trees shall be at least 5' in height.
  - Multiple-stemmed must be at least 6' in height, and are not allowed within street rights-of-way;

Right of way limitations:
- No person shall, without a written permit from the director, plant, remove, trim, prune or cut any tree between the property line and the curb.
- No person shall wilfully injure or destroy any tree on the street or public planting areas of the city by any means.

Protection of trees during construction:
- Trees to be retained pursuant to this section shall be marked by encircling the tree with a stripe of nontoxic paint of a color and type sufficient to remain visible during onsite construction activity.
- Trees to be retained shall be protected during construction, and the dripline shall be delineated with boundary markers. No grade changes or storage of materials shall be allowed within the tree dripline. Drainage patterns shall not be significantly altered that may be detrimental to the subject trees.

Seasonal restrictions:
- Between January 1st and July 31st, no clearing, grading, or land disturbing activity shall be allowed within the Great Blue Heron Rookery buffer unless otherwise approved by the city and the Washington Department of Fish and Wildlife.

Tree protection

Protection of significant trees:
- On all undeveloped property in the city, all significant trees shall be retained on the property where they are growing.
- Where it is not feasible to retain all trees on the site due to the proposed development, a site specific tree plan, drawn to scale, shall be prepared.
- In the required perimeter landscaping areas, the applicant shall retain all significant trees which will not constitute a safety hazard.
- In areas of the site other than the required perimeter landscape area, the applicant shall retain a minimum 15% of the diameter inches of the significant trees existing in this area; provided, that alder and cottonwood trees diameter inches shall be discounted by a factor of 0.5.
- Priority of preservation: (1) Healthy significant trees over sixty (60) feet in height; (2) Significant trees which form a continuous canopy; (3) Significant trees which contribute to the character of the environment, and do not constitute a safety hazard; (4) Significant trees which provide winter wind protection or summer shade; (5) Groups of significant trees which create a distinctive skyline feature; and (6) Significant trees in areas of steep slopes or adjacent to watercourses or wetlands.

Definition of significant trees:
All trees of a 6"caliper or greater

Heritage trees are specifically protected? No

Tree retention incentives:
not found

Tree replacement requirements:
- Trees removed illegally from undeveloped land or trees designated for retention which are damaged or destroyed shall be replaced as follows:
  - 2:1 for every tree of 6" diameter removed.
  - 1:1 for each addition 3" of diameter removed.
  - 8:1 maximum replacement requirement.
- Planting size:
  - Deciduous trees shall be at least 2" in diameter at the time of planting.
  - Evergreen trees shall be at least 6-8' in height.

Jurisdiction: King County

Year of most recent tree ordinance update: 2004 **Tree City USA (year Joined):** n/a

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs spaced throughout the landscape strip and spaced to form a continuous screen;
  - 70-90% evergreen trees;
  - Trees provided at the rate of one per 10' of landscape strip and spaced no more than 30' apart on center;
- Type II:
  - A mix of evergreen and deciduous trees and shrubs spaced throughout the landscape strip spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30%evergreen trees;
  - Trees provided at the rate of one per 20' of landscape strip and spaced no more than 30' apart on center;
- Type III:
  - A mix of evergreen and deciduous trees spaced throughout the landscape strip and spaced to create a continuous canopy;
  - At least 70% deciduous trees;
  - Trees provided at the rate of one per 25' of landscape strip and spaced no more than 30' apart on center;
- Parking:
  - 1 tree for every 3 stalls for commercial or industrial development;
  - 1 tree for every 5 stalls for residential or institutional development;

Seasonal restrictions:

Between April 1 and October 31, clearing, grading, or outdoor construction is prohibited within 400' of active/potential nest trees.

Permit is required for tree removal in these conditions:

- In critical areas

Grading and clearing requirements:

- A detailed tree retention plan shall be submitted before or with submittal of permit applications incorporating grading. This plan shall identify the exact location, size, species and condition of the significant trees proposed to be retained, transplanted or replaced.

Right of way limitations:

- In street frontage trees shall be:
  - Located within the street right-of-way if permitted;
  - No more than 20' from street right-of-way linea if located in a lot;
  - Maintained by adjacent owner unless maintained by the county;
  - A species approved by the county;

- The trees may be spaced at irregular intervals to accommodate sight distance requirements for driveways and intersections.

Pruning requirements:

All significant trees shall be pruned and trimmed to maintain a healthy growing condition or to prevent primary limb failure. This requirement shall not be interpreted to allow: topping of primary stems; pruning that results in the loss of 20% of vegetative mass; and cutting of major roots, except in preparation for transplantation or as deemed necessary or acceptable by a certified arborist.

Protection of trees during construction:

- Tree removal for a project action shall not be allowed before county approval;
- Before clearing for a project action, trees to be retained shall be flagged;
- Before grading and throughout construction, a temporary fence shall be used to identify the protected area of any significant tree designated for retention. The size of the protected area shall be equal to 1’ diameter for each inch of tree trunk diameter measured 4’ above the ground;
- Impervious surfaces, fill, excavation, storage of construction materials, or grade level changes shall never occur within the critical root zone.

Tree protection

Definition of significant trees:

- Evergreen: 8"+ at 4.5' above grade (except hazard trees)
- Deciduous: 12"+ at 4.5' above grade (except hazard trees)

Heritage trees are specifically protected? Yes

Protection of significant trees:

Except when replacement trees are used, significant trees shall be at a minimum retained as follows:

- Within perimeter landscape areas (exclusive of the area required for site access by vehicles, pedestrians, or utility infrastructure):
  - 100% for the interior perimeters.
  - 75% for the street perimeter, 50% for retail commercial developments if approved
- In residential subdivision in UR or R-1 zones, including critical areas/buffers: 20 trees/acre or 10% of the trees, whichever is greater
- In an apartment or townhouse development, excluding critical areas/buffers: 10 trees/acre or 5% of the trees, whichever is greater
- In commercial or industrial development or a residential subdivision in the R-4 through R-48 zones, excluding critical areas/buffers: 10 trees/acre or 5% of the trees, whichever is greater;
- In institutional developments, excluding critical areas/buffers and recreational facilities: 10 trees/acre or 5% of the trees, whichever is greater;
- Utility developments and mineral extraction operations are exempt from retention requirements
- Project sites with 25%+ of the total gross site area in critical areas/buffers and other required undisturbed areas shall be exempt from retention requirements (other than CAO)

Tree retention incentives:

- A significant tree may be credited as two trees when it:
  - is 18"+ in diameter;
  - is located in a grouping of at least 5 trees with canopies that touch;
  - provides energy savings (winter wind protection/summer shading);
  - belongs to a unique or unusual species;
  - located within 25' of any critical area/required critical area buffers;
  - is listed on a historical register.

Tree replacement requirements:

- If the required number of significant trees cannot be retained, then nonsignificant-sized trees may be retained or new trees may be planted to meet significant tree requirements. A significant tree to be replaced by the new or existing replacement tree shall be assigned a diameter of 12”. 1:2 when using replacement trees measuring 3"+ caliper diameter; 1:1 when using replacement trees measuring less than 3" caliper diameter

City: Kirkland

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions:

- To remove 1 or both of the last 2 significant trees on the property.
- On a property that has a new residence built within the last 5 years.
- In a Native Growth Protection Easement (NGPE).
- Within 100' of a critical area.
- On a property containing subdivision restrictions listed on deed or plat map.
- Along the shoreline of Lake Washington.
- Within the Holmes Point Overlay

Grading and clearing requirements:

- The grade shall not be changed within the critical root zone of trees to be preserved without authorization from a qualified professional.
- Coverage of up to 50% of the area of the tree's critical root zone with light soils (no clay) to the minimum depth may be allowed, if it will not imperil the survival of the tree. Aeration devices may be required to ensure the tree's survival.
- If the grade adjacent to a preserved tree is raised such that it could slough or erode into the tree's critical root zone, it shall be permanently stabilized to prevent suffocation of the roots.

Landscaping requirements:

- At minimum, 1 tree for each 1,000 sq. ft. of area to be landscaped.
- Planting size: At the time of planting, deciduous trees must be at least 2" in caliper and coniferous trees must be at least 5' in height.
- Parking: 25 sq. ft. of landscaped area per parking stall planted as follows:
  - The applicant shall arrange the required landscaping throughout the parking lot to provide landscape islands or peninsulas to separate groups of parking spaces (generally every 8 stalls) from one another and each row of spaces from any adjacent driveway that runs perpendicular to the row. This island or peninsula must be surrounded by a 6" high vertical curb and be of similar dimensions as the adjacent parking stalls. Gaps in curbs are allowed for stormwater runoff.
  - Landscaping shall have at least 1 deciduous tree, 2" in caliper, or a coniferous tree 5' in height.

Right of way limitations:

- Permit required for removal.
- It is the responsibility of the abutting property owner to maintain street trees abutting their property, which may include pruning, watering, and mulching.
- In order to prune, trim, modify, or alter a street tree, the abutting property owner shall apply for a permit by filing a written application with the City.

Seasonal restrictions: not found

Protection of trees during construction:

- Placing Materials near Trees: No person may conduct any activity within the protected area of any tree designated to remain, including, but not limited to, operating or parking equipment, placing solvents, storing building material or soil deposits, or dumping concrete washout or other chemicals. During construction, no person shall attach any object to any tree designated for protection.
- Protective Barrier. Before development, land clearing, filling or any land alteration, the applicant shall:
  - Erect and maintain readily visible temporary protective tree fencing along the limits of disturbance which completely surrounds the protected area of all retained trees or groups of trees. Fences shall be 6'+ chain link.
  - Install highly visible signs spaced every <15' along the entire protective tree fence. The sign includes at a minimum "Tree Protection Area, Entrance Prohibited" and provide the City phone number for code enforcement to report violations.
  - Prohibit excavation or compaction of earth or other potentially damaging activities within the barriers.
  - Maintain the protective barriers in place for the duration of the project until removal is authorized.
  - Any approved landscaping done in the protected zone is done with light machinery or hand labor after barrier removal.
  - In addition to the above, the Planning Official may require the following: (1) mulch the critical root zone to a depth of at least 6" or with plywood or similar material in order to protect roots from damage caused by heavy equipment. (2) minimize root damage by excavating a 2' deep trench, at edge of critical root zone, to cleanly sever the roots of trees to be retained. (3) Corrective pruning performed on protected trees in order to avoid damage from machinery or building activity. (4) Maintenance of trees throughout construction period by watering and fertilizing.
- The applicant shall not install an impervious surface within the critical root zone of any tree to be retained without the authorization, and may be required to use specific construction methods and/or use of aeration devices to ensure the tree's survival and to minimize the potential for root-induced damage to the impervious surface.
- To the greatest extent practical, utility trenches shall be located outside of the critical root zone of trees to be retained.
- Trees and other vegetation to be retained shall be protected from erosion and sedimentation. Clearing operations shall be conducted so as to expose the smallest practical area of soil to erosion for the least possible time. To control erosion, it is encouraged that shrubs, ground cover and stumps be maintained on the individual lots, where feasible.

Pruning requirements:

- Street trees: It is the responsibility of the abutting property owner to maintain street trees abutting their property, which may include pruning, watering, and mulching.
- Pruning in rights-of-way shall conform to the most recent version of the American National Standards Institute A300 Part 1 – 2001 pruning standards or as outlined in an approved Utility Vegetation Management Plan.
- Tree Pruning on Private Property: A permit is not required to prune trees on private property. Pruning which results in the removal of at least half of the live crown will be considered tree removal.

Tree topping is not allowed. If a tree required by this chapter is smaller than 6" in diameter and is topped, it must be replaced. If a tree 6"+ in diameter is topped, the owner must have a qualified professional develop and implement a 5 yr. restoration pruning program.

Tree protection

Definition of significant trees:

- A tree that is 6"+ dbh as measured at 4.5' from the ground.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- not found

Protection of significant trees:

- Required minimum tree density: 30 tree credits. Measurements of onsite trees dbh convert to tree units according to the code.
- Tree Retention. For single-family homes, cottages, carriage units, two/three-unit homes, 2 trees shall be required to remain on the subject property.
- For sites and activities requiring a minimum tree density and where the existing trees to be retained do not meet the minimum tree density requirement, supplemental trees shall be planted to achieve the required minimum tree density.
- Tree location prority:
  - On-Site: (1) In preserved groves, critical areas or their buffers; (2) Adjacent to storm water facilities as approved by Public Works; (3) Entrance landscaping, traffic islands and other common areas in residential subdivisions; (4) Site perimeter – The area of the subject property that is within 10 ft. from the property line; (5) On individual residential building lots.
  - Off-Site: When room is unavailable for planting the required trees on site, then they may be planted at another approved location in the City.
  - City Forestry Account: When the Planning Official determines on-site and off-site locations are unavailable, then the applicant shall pay an amount of money approximating the current market value of the supplemental trees into the City forestry account.
- Holmes Point Overlay Zone:
  - Viable trees at a tree density of 150 tree credits per acre within the PNA
  - All significant trees outside the PNA shall be maintained in perpetuity, and tree removal will be allowed only for hazardous and nuisance trees.

Tree replacement requirements:

- For sites and activities requiring a minimum tree density and where the existing trees to be retained do not meet the minimum tree density requirement, supplemental trees shall be planted to achieve the required minimum tree density.
  - For every significant tree that is removed and is not required to remain, the City encourages the planting of a tree that is appropriate to the site.
  - 1:1 to remove 1 or both of the trees required to remain.
  - For all other uses , a tree removal permit is required and the required tree replacement will be based on the tree credit system in the required landscaping standards.
- Planting size: The required minimum size of the supplemental tree worth 1 tree credit shall be 6' tall for a conifer and 2" caliper for deciduous or broad-leaf evergreen tree. Additional credits may be awarded for larger supplemental trees.

City: Lake Forest Park

Year of most recent tree ordinance update: 2010 **Tree City USA (year Joined):** 1993

Permit is required for tree removal in these conditions:
- Critical Areas
- Landmark trees
- Significant trees

Seasonal restrictions: not found

Grading and clearing requirements:
- All grading and clearing activities shall be conducted so as to minimize potential adverse effects on significant trees.
- When establishing permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compac-tion of native soils except as needed for building purposes.

Landscaping requirements:
- At least 1 tree shall be required for every 250 sq. ft. of landscaping.
- A minimum of 30% of the landscaping and trees shall consist of evergreen/conifer species.

Right of way limitations:
- A utility must have an approved right-of-way permit for maintenance-related tree removal,.
- Street trees shall be pruned only under public works supervision.

Protection of trees during construction:
- All required tree protection measures shall be shown on the demolition, grading, and tree protection plan along with a timeline for tree protection activity.
- All construction activities, including staging and traffic areas, shall be prohibited within 5' of the dripline of protected trees.
- Tree protective fencing shall be installed at the limits of disturbance and completely around trees to be protected prior to any land disturbance unless otherwise delineated by the qualified tree professional.
- Tree protective fencing shall be a minimum of 4' high, constructed of chain link or polyethylene laminar safety fencing or similar material, subject to approval by the city. The fence must be constructed on steel posts with a minimum spacing of 8' on center. “Tree Protection Area – Keep Out” signs shall be posted visibly on all sides of the fenced areas.
- Where tree protection areas are remote from areas of land disturbance, and where approved by the city, alternative forms of tree protection may be used provided that the critical root zones of protected trees or stands of trees are clearly delineated with continuous rope or flagging and accompanied by “Tree Protection Area – Keep Out” signs.

Pruning requirements:
- Significant and other protected trees shall not be topped.
- Street trees shall be pruned only under the supervision of the Lake Forest Park public works department.
- Pruning and maintenance of protected trees shall be consistent with the ANSI A300 standards for proper pruning. Hazard trees should be pruned or removed as necessary to protect people and property.

Tree protection

Definition of significant trees: Any healthy 6"+ dbh.

Heritage trees are specifically protected? Yes

Protection of significant trees:
- Based on canopy coverage (current size for retention and 30 yr. size for replacement)
  - Single-family lots <10,000 sq. ft.: 28%
  - Single-family lots 10,000 – 15,000 sq. ft.: 39%
  - Single-family lots >15,000 sq. ft.: 58%
  - Multifamily and Commercial: 15%
- Protection priority:
  - Landmark trees;
  - Specimen trees or other high quality open-grown, windfirm trees;
  - Trees in critical area buffers, or adjacent to critical area buffers:
  - Trees that are interdependent with and critical to the integrity of stands of other protected trees;
  - Existing healthy trees in groups or stands;
  - Other trees that will be windfirm, high quality trees if retained;
  - Other trees that provide wildlife or riparian habitat, screening, buffering or other amenities;
  - Trees that help to protect neighbors’ trees from windthrow, or other trees within required yard setbacks or on the perimeter;
  - Trees next to parks or other open space areas.

Tree retention incentives:
- To incentivize tree retention, the administrator may grant reductions or adjustments to other site development standards if doing so will allow retention of a sufficient number of existing, healthy significant trees and tree canopy coverage in excess of requirements.

Tree replacement requirements:
- Replacement tree species shall be selected from the Lake Forest Park general tree list, which is maintained by the city.
- Where the lot on which tree removal occurs is below the canopy coverage goal prior to tree removal, the owner shall implement a tree replacement plan that brings canopy coverage to the percentage that existed prior to the proposed tree removal (when the replacement trees reach 30 yrs. of age).

Comments: The administrator may require other measures designed to mitigate tree loss, such as requiring the restoration of all or parts of the forest landscape and its associated benefits, including: Creation of wildlife snags from trees which would otherwise be removed; Replacement of ornamental trees with native shrubs and groundcover; Replacement of hazardous or short-lived trees with healthy new trees more likely to survive; Restoration of stream corridors with native vegetation; or Protection of nonsignificant trees to provide for the successional stages of forest development.

City: Maple Valley

Year of most recent tree ordinance update: 2014 **Tree City USA (year Joined):**

Grading and clearing requirements:

- All development or redevelopment proposals subject to tree retention requirements must include a Tree Retention Plan at the time of application, including applications for design review, land-use reveiew, site development and final plat.

Pruning requirements: not found

Seasonal restrictions: not found

Landscaping requirements:

- Type I:
  - Evergreen trees planted no more than 20' on center in a triangular pattern; or a combination of 75 % evergreen and 25% deciduous trees planted no more than 20' on center in a triangular pattern.
- Type II:
  - Evergreen or a combination of approximately 60% evergreen and 40 % deciduous trees, with an allowable 5% variance, planted no more than 20' on center in a triangular pattern.
- Type III:
  - A mixture of evergreen and deciduous trees planted no more than 30' on center in a triangular pattern.
- Type IV:
  - Trees planted, the lowest tree branches shall be pruned to keep an approximate 8' clearance from the ground.
- Parking:
  - Landscape islands shall be a minimum size of 100 sq. ft., with a minimum width of 6' at the narrowest point. At least 1 tree shall be planted in each landscape island. Deciduous trees are preferred for landscape islands within interior vehicle use areas.
- Planting size:
  - Deciduous trees shall have a caliper of at least 2 in. at the time of planting measured 4.5 ft. above the root ball or root.
  - Evergreen trees shall be a minimum 6 ft. in height measured from treetop to the ground at the time of planting.

Permit is required for tree removal in these conditions:

- A permit is required for cutting or removal of any significant tree except:
  - Cutting or removal on existing single-family lots of 2 acres or less of trees not subject to a Tree Retention Plan or Tree Protection Area.
  - Removal of any tree with obvious flaws or disease, or one that is judged to be hazardous by a qualified professional.
  - Removal of any tree during storm conditions when imminent danger exists from trees falling on structures, children's play areas, or where clear hazard to life is apparent.
  - On existing single-family lots: removal of any existing hazard tree or any tree within 1.5 tree lengths of an existing or proposed permitted building. A replacement significant tree may be required.
- - Removal of any tree in violation of City regulations is subject to a fine of $1,000 per tree in addition to required mitigation.

Right of way limitations:

- For public and private road construction and maintenance within the right-of-way or grading easements, no tree retention requirements apply; provided, retained trees within and along the right-of-way of Maple Valley Highway SR-169, Kent-Kangley Road SR-516, and Witte Road arterial corridors must be accommodated and provided as a requirement of the design engineering for and maintenance of the road.
- For installation or maintenance of major overhead and major underground utilities, such as electrical transmission lines, water or sewer mains or stormwater lines, no tree retention or planting requirements shall be imposed within the easement or right-of-way area.

Protection of trees during construction:

- All trees retained and planted to meet tree canopy coverage requirements must be located in tree protection areas (TPAs). TPAs for planted trees are marked at a radius of seven feet, measured from the point the tree is planted. TPAs for retained trees are marked at two thirds of the dripline area measured from the trunk.
- In order to qualify for canopy coverage credit, planted and retained trees must have TPAs that are contained entirely inside the subject property boundaries and entirely outside the limits of clearing and grading.
- Prior to commencing any site work, all tree protection areas must be fenced with orange plastic mesh fencing or approved equivalent, and all trees to be retained for canopy coverage credit must be marked with orange flagging.
- Tree protection details, dripline fencing, and no disturbance areas must be part of all construction plans issued for permit.
- All dripline areas of retained trees shall be located in the field and confirmed by a City Inspector prior to commencement of construction.
- Work within dripline areas specifically authorized by approved construction plans shall be done separately from mechanized mass clearing and grading of the site and shall be fenced to exclude the area from mechanized clearing or grading. Methods for work within such areas shall be detailed on the clearing and grading plans, civil engineering plans, utility plans and landscape plans as may be needed to clarify the methods and responsibilities for construction within the dripline area.

Tree protection

Definition of significant trees:

- Any evergreen or deciduous tree (excluding cottonwoods and alders) in good health, at least 12" in diameter at 4.5' above grade.
- Landmark significant trees are any significant tree that is at least 24” in diameter at 4.5’ from grade or of specimen quality.
- Retained trees are existing tree sdesignated for retention (excluding cottonwood and alders) that are < 12” in diameter but >6’ tall if evergreen or 2” in diameter if deciduous.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- For any retained landmark tree, the actual dripline area of the tree may be credited toward open space or recreational space requirements; or
- For retained significant trees in excess of 15% canopy coverage, one additional dwelling unit is permitted for each additional 10 retained significant trees; or
- Additional building height of 10' is permitted up to a maximum height of 45' provided that trees must be retained proximate to the proposed building location(s).
- If any tree that is saved in conjunction with these bonus provisions is lost in the future for whatever reason, it shall be replaced.

Protection of significant trees:

- Tree retention requirements are expressed in square feet of canopy coverage, an arbitrary amount of canopy per retained or planted tree based on tree DBH.
- A landmark tree (≥ 24 inches DBH) retained to meet canopy coverage requirements has an assigned canopy value of 1,650 square feet, a significant tree (≥12 and ≤ 23 inches DBH) 1,100 square feet and a retained tree (≤ 11 inches DBH) 900 square feet.
- Trees planted to meet canopy coverage requirements have have an assigned canopy value of 300 square feet of
- The aggregate canopy coverage requirement, the total of the canopy coverage credit for all retained and planted trees on a site, for most commercial development is equal to 10 percent of the gross development site.
- For all other development, the canopy coverage requirement is equal to 20 percent of the gross development site, less the area of any major overhead or underground utilities.

Tree replacement requirements:

- 1:1 for the loss of any retained tree due to wind, disease, or other natural causes.
- Damage to a retained landmark tree shall be documented by a qualified professional at the expense of the owner, and the recommendations of the qualified professional regarding repair or replacement shall be followed.

Comments:

- The only city to require field testing for actual location of dripline.

City: Medina

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** 2006

Permit is required for tree removal in these conditions:

- Permit exempt:
  - Trees less than 6" dbh unless the tree satisfies code requirements;
  - Normal and routine trimming and pruning on private property following current ANSI standards;
  - Emergency tree removal or hazard pruning for any tree posing imminent threat to life/property with city notification and evidence.
  - Trimming and pruning performed by the city or a contractor within rights-of-way or city-owned parkland;
  - Removal of trees by city or contractor to install/maintain utilities;
  - The removal of a tree that died from naturally occurring causes.

Grading and clearing requirements:

- Grading that over a 4 consecutive year period totals 2,000 cubic yds. or more requires a tree permit.

Landscaping requirements:

- Requirements for schools, utilities, and telecommunications only.

Pruning requirements:

- Routine pruning does not require a permit. Pruning can be required instead of removal for some hazard trees. Pruning in the ROW requires a permit.

Seasonal restrictions: not found

Right of way limitations:

- All trees planted by current or previous property owners in rights-of-way have to be maintained by adjoining property owner.
- An administrative tree activity permit is required for:
  - Land designated under development
  - Removal of any significant tree associated with the SR 520 highway;
  - Removal of any nonsignificant tree associated with the SR 520 highway that is located within 200 ' of Lake Washington.
  - Removal or pruning of any tree that is: significant in rights-of-way, designated a hazard tree pursuant.
- An administrative right-of-way tree activity permit is required for removal/pruning of any significant tree in rights-of-way, excluding hazards.

Protection of trees during construction:

- Establish tree protection zones and install protective fencing at the drip line or other barriers that are at least 4' in height, except where tree protection zones are remote from areas of land disturbance, and where approved by the director, alternative forms of tree protection may be used in lieu of tree protective fencing; provided that the critical root zones of protected trees are clearly delineated and protected;
- Limit grading levels around subject trees to not raise or lower grades within the larger of the following areas: the drip line area of the tree; or an area around the tree equal to 1' in diameter for each inch of tree diameter dbh;
- Installation of a tree well, but only where necessary and only with pre-approval of the city;
- Designation of areas on site for parking, material and equipment storage, construction ingress and egress, and similar designated areas that do not negatively impact significant trees;
- Locate utility trenches to minimize negative effects on the tree root structure and fill proximate trenches with suitable growing medium;
- Employ measures to protect critical root systems from smothering and compaction;
- Implement a tree care program during construction to include watering, fertilizing, pruning and pest control; and
- Measures for the disposal of potentially harmful items such as excess concrete, polluted water runoff, and other toxic materials.

Tree protection

Definition of significant trees:

- A tree of at least 6" dbh and of a species identified on the “City of Medina List of Suitable Tree Species”

Heritage trees are specifically protected? Yes

Tree retention incentives:

not found

Protection of significant trees:

- Developed sites need to meet tree density requirements dependent on zoning:
  - Residential - 0.35 - Schools - 0.15
  - Golf Course - 0.15 - Parks - 0.42
  - Nonresidential other than specifically listed - 0.25
- Where land is designated as under development, trees within the boundaries of the lot shall be retained in accordance with any one of the following:
  - Preserve at least 50 % of the existing significant trees that are of a native species eligible for credit on private property as set forth in the “City of Medina List of Suitable Tree Species”;
  - Preserve at least 40 % of the existing significant trees, half of which are 10"+ dbh of a native species eligible for credit on private property according to “City of Medina List of Suitable Tree Species”;
  - Preserve at least 35% of the existing significant trees - half these shall have:10"+ dbh and 40% of these shall be 24"+dbh of a native species eligible for credit on private property as set forth in the “City of Medina List of Suitable Tree Species”;
  - Preserve at least 25% of the existing significant trees, 75% of which are 24"+ dbh of a native species eligible for credit on private property according to “City of Medina List of Suitable Tree Species.”

Tree replacement requirements:

- Tree replacement may be required if preserved significant trees do not meet tree density requirements.
- Replacement ratio is dependent on dbh of removed tree:
  - 1:1 for 6-<24"dbh
  - 2:1 for >24" dbh
- If the site is not a development, replacement is still required for removal:
  - 1:1 for 6-10" dbh removed tree
  - 2:1 for >10"-<24" dbh
  - 3:1 for >24 " dbh
  - 1:1 for hazard trees >10"
- Legacy trees - See MMC 20.52.120
- Planting size: Each supplemental tree shall have a minimum caliper of 2" or, if the tree is coniferous, it shall have a minimum height of 6' at the time of final inspection by the city; and must be selected from the appropriate list set forth in the “City of Medina List of Suitable Tree Species.”
- Property owners can plant offsite or contribute to the Medina tree fund as approved.

City: Mercer Island

Year of most recent tree ordinance update: 2002 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:
- Construction work
- Landmark tree/grove
- Critical area
- Commercial zone
- Emergency (private property, immediate danger to life or property)
- Public tree
- Private utility company

Grading and clearing requirements:
- An application covering a tree to be cut as a result of construction work shall include a plot plan with topography indicated by contours at a minimum of 5' intervals, and the grading by dashed contour lines for existing grades and by solid contour lines for existing grades to be changed.

Landscaping requirements:
- Out of town center:
  - Full Screen: the number of trees provided shall be proportionate to 1 tree for every 10' of landscape perimeter length.
  - Partial Screen: the number of trees provided shall be proportionate to 1 tree for every 20' of landscape perimeter length.
- Parking: Surface parking lots not located adjacent to public rights-of-way should provide 1 tree for every 6 parking stalls. Surface parking lots located in the front of buildings or adjacent to public rights-of-way should provide 1 tree for every 4 parking stalls. Trees should be at least 6' high at the time of planting. All lots should have planting areas at the end of parking aisles.
- Parking (Town Center):
  - A ratio of 1 tree for every 6 parking spaces should be provided throughout any surface parking lot.
  - Of the total number of trees required, 50% shall be a minimum of 24" box in size, and 50% shall be a minimum of 15 gal. in size.

Right of way limitations:
- No private property owner may cut or prune a public tree.
- An annual tree permit will be issued to the city to cut any public trees necessary for public safety, removal of hazardous trees, removal of diseased or dead trees, as part of the city's forest management program or regular tree maintenance program or for construction work on public property.

Pruning requirements:
- The city arborist shall prepare and distribute educational materials describing the best practices, policies, techniques, methods and procedures for pruning trees.

Seasonal restrictions:
- No cutting of trees located in geologic hazard areas or protected slope areas is allowed between October 1 and April 1 unless: (i) an administrative waiver has been granted; or (ii) it is required due to an emergency situation involving immediate danger to life or property.

Protection of trees during construction:
- An application covering a tree to be cut as a result of construction work shall include the following:
  - A plan for protecting trees that are not intended to be cut
  - A plan for conducting all construction work in accordance with best construction practices
  - A plan for erosion control and restoration of land during and immediately following the construction period

Tree protection

Definition of significant trees:
Tree chapter does not use the term significant tree but regulates removal of:
Conifer trees that are 6'+ in height
Deciduous trees 6"+ dbh

Heritage trees are specifically protected?
Yes

Tree retention incentives:
not found

Protection of significant trees:
- When a tree permit is required to cut a tree on private property, the tree permit will only be granted if it meets any of the following criteria:
  - It is necessary for public safety, removal of hazardous trees, or removal of diseased or dead trees.
  - It is necessary to enable construction work on the property to proceed and the owner has used reasonable best efforts to design and locate any improvements and perform the construction work.
  - It is necessary to enable any person to satisfy the terms and conditions of any covenant, condition, view easement or other easement, or other restriction encumbering the lot that was recorded on or before July 31, 2001.
  - It is part of the city's forest management program or regular tree maintenance program and the city is the applicant.
  - The permit seeks to cut 1 of the following common, short-lived "weedy" tree species: Alder, Bitter Cherry, or Black Cottonwood.
  - It is desirable for the enhancement of the ecosystem or slope stability based upon professional reports in form and content acceptable to the city arborist.

Tree replacement requirements:
- Any trees that are cut pursuant to a tree permit shall be replaced on the subject property.
- In making a determination regarding the number of replacement trees required, the city arborist shall apply a replacement ratio based on a sliding scale of 0:1 up to 4:1, depending upon the criteria in the following priority order:
  1. Percentage of slope, slope stability, topography and general soil conditions;
  2. Trunk size and canopy of tree to be cut and trunk size and canopy of replacement tree;
  3. Size and shape of lot and area available to be replanted; and
  4. Proximity to any critical tree area and/or the existence and retention of vegetative cover in any critical tree area.
- Planting size: All replacement trees shall be at least 6' tall, unless a smaller size tree or shrub is approved by the city arborist.

Comments: Replacement trees have to be kept alive for only 2 years - there is no assurance of continued stormwater function.

City: Milton

Year of most recent tree ordinance update: 2013 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:
- Trees on existing 1-family and 2-family lots are exempt from the significant tree and tree topping provisions of this section.
- Some consulting required in critical areas.

Grading and clearing requirements:
- When establishing permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes.
- Permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by the director shall be delineated on the site plans and the development site.

Landscaping requirements:
- Trees shall be planted on a spacing approximating 30' on-center.
- Parking:
  - Landscape islands shall be placed to occur every 9 spaces or less.
  - Each planting island shall have a minimum of 1 tree, shrubs planted 3' on center, and the rest shall be vegetative groundcover or unit pavers that permit water infiltration.
  - A minimum of 70% required parking area trees shall be deciduous, except, if existing trees are retained, the percentage of deciduous trees can be decreased accordingly.
  - Perimeter landscape areas shall be no more than 50% evergreen.
- Planting size for required landscape areas:
  - Deciduous trees shall be a minimum 2" caliper dbh.
  - Evergreen trees shall be at least 8' high at the time of planting.

Right of way limitations:
- Trees and landscaping within the right-of-way to the edge of the right-of-way shall be required in planting strips.
- Maintenance responsibilities are the abutting property owner's unless the city of Milton has taken maintenance responsibility.
- Trees shall be planted approximately every 30'.
- To accomodate overhead wiring, two lists of trees have been developed to pick from depending on the existence of the overhead wiring.
- Street trees shall be planted according to a chart in the city code. Areas not listed do not require trees to be planted.

Protection of trees during construction:
- Prior to beginning land disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within construction areas should be clearly marked in the field and on the plans to prevent damage and off-site impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.

Pruning requirements:
- Significant trees which are not exempt from this chapter shall not be topped without prior approval of the director.
- Tree topping performed by a public utility to preserve essential services is allowed.

Seasonal restrictions:
- From October 1st through April 30th, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the director that silt-laden runoff will be prevented from leaving the construction site.

Tree protection

Definition of significant trees:
- Deciduous: 6"+ dbh
- Evergreen: 10'+ in height.

Heritage trees are specifically protected? No

Tree retention incentives:
not found

Protection of significant trees:
- For development subject to the provisions of this section, site design and construction shall retain as many significant trees and groves as can be reasonably retained.
- Significant trees and/or groves of trees located in proposed landscaping areas which do not interfere with the proposed development shall be retained.

Tree replacement requirements:
- Ratio is based on the size of significant tree removed:
  - 3:1 for deciduous 6" – 9" dbh removed
  - 5:1 for deciduous 9" – 12" dbh removed
  - 7:1 for deciduous > 12" dbh
  - 1:1 for evergreens 10' – 15' tall
  - 2:1 for evergreen > 15' tall
- Planting size:
  - Deciduous: 2" caliper, at least 6' tall
  - Evergreen: 1-10' tall tree or 2 6-9' tall trees for every required replacement.

Comments: Updated tree ordinance coming in 2016

City: Newcastle

Year of most recent tree ordinance update: 2014 **Tree City USA (year Joined):** 2007

Permit is required for tree removal in these conditions:

- In a Native Growth Protection Easement
- (NGPE)
- In aritical area
- In part of an approved significant tree retention plan.
- In a tract dedicated to a HOA
- On City property

Right of way limitations:

- Permit required for removal

Grading and clearing requirements:

- A rock well shall be constructed if the grade level around the tree is to be raised by more than 1'.
- The grade level shall not be lowered within the dripline or an area around the tree equal to 1' diameter for each inch of tree trunk diameter whichever is greater.
- Grading and clearing permit required for tree removal except:
  - Emergency tree removal to prevent imminent danger or hazard to persons or property;
  - Removal of trees outside of critical areas; provided, that trees to be removed are not located in an area designated to be preserved as part of an approved tree retention plan;
  - Where a forest practices application is not required by the WDNR.

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs placed to form a continuous screen;
  - At least 70% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Broadleaf deciduous trees spaced no more than 2' on center;
- Type II:
  - A mix of evergreen and broadleaf deciduous trees and shrubs spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Deciduous trees spaced no more than 20' on center;
- Type III:
  - A mix of evergreen and/or deciduous trees spaced to create a continuous canopy;
  - At least 70% deciduous trees;
  - Trees spaced no more than 2' on center;
- Type IV (Parking):
  - Canopy-type deciduous or evergreen trees, evergreen shrubs and groundcovers planted in islands or strips;
  - At least 90% of the trees shall be deciduous
  - Trees per Stall: Commercial or Industrial - 1:5; Residential or Institutional - 1:5 in CBC Overlay Zone, 1:10 in all other zones
- Planting Size:
  - Deciduous trees shall have a caliper of at least 2" at the time of planting. If native species are used the caliper shall be at least 6";
  - Evergreen trees shall be at least 6' in height measured from treetop to the ground at the time of planting;

Protection of trees during construction:

- No clearing shall be allowed on a site until approval of tree retention and landscape plans;
- An area of prohibited disturbance, generally corresponding to 2' outside the drip line of the significant tree, shall be identified during the construction stage with a temporary 6' high chainlink fence;
- No impervious surfaces, fill, excavation, or storage of construction materials shall be permitted within the area defined by such fencing;
- A rock well shall be constructed if the grade level around the tree is to be raised by more than 1'. The inside diameter of the well shall be equal to the diameter of the dripline of the tree;
- The grade level shall not be lowered within the drip line of the tree(s) or an area around the tree equal to 1' diameter for each inch of tree trunk diameter measured 4' above the ground, whichever is greater.
- Alternative protection methods may be used if determined by the director to provide equal or greater tree protection.
- Protection. Where the dripline of a tree overlaps a construction line, this shall be indicated on the survey and the following tree protection measures shall be employed:
  - The applicant may not fill, excavate, stack or store any equipment, or compact the earth in any way within the area defined by the dripline of any tree to be retained.
  - The applicant shall erect and maintain a temporary 6' high chain-link fence. In addition, the applicant shall provide supervision whenever equipment or trucks are moving near trees.
  - The applicant may not install ground level impervious surface material within the area defined by the dripline of any tree to be retained.
  - The grade level around any tree to be retained may not be lowered within the greater of the following areas: (1) the area defined by the dripline of the tree, or (2) an area around the tree equal to 1' in diameter for each 1" of tree caliper.
  - The applicant may prune branches and roots, fertilize and water as horticulturally appropriate for any trees which are to be retained.

Pruning requirements:

- All significant trees shall be maintained for the life of the project;

Seasonal restrictions:

- Clearing and grading shall be prohibited from October 1st to April

• All landscape materials and significant trees shall be pruned and trimmed as necessary to maintain a healthy growing condition or to prevent primary limb failure	30th, the "wet season," unless otherwise approved by the director.

Tree protection

Definition of significant trees: Evergreen: 8"+ diameter at 4' above grade Deciduous: 12"+ diameter at 4' above grade	**Heritage trees are specifically protected?** No
Protection of significant trees: • All significant trees located within any required perimeter landscaping area shall be retained; • 25% of the significant trees located in the interior of the lot, excluding sensitive areas or their buffers, shall be retained in a residential or institutional development; • 5% of the significant trees located in the interior of the lot, excluding sensitive areas or their buffers, shall be retained in commercial or industrial developments; • Utility developments and mineral extraction operations shall be exempt from the significant tree retention requirements of this chapter; • If significant trees were previously located in a closed, forested situation, an adequate buffer of smaller trees shall be retained or replaced on the fringe of such significant trees; • A grouping of 3 or more existing trees with canopies that touch or overlap, may be substituted for each required significant tree, provided each tree has a diameter of at least 3" when measured 4' above grade; • Significant trees to be retained shall not include significant trees that are damaged, diseased, or safety hazards due to potential root, trunk or primary limb failure, or exposure of mature trees which have grown in a closed, forested situation. At the discretion of the city, however, damaged or diseased or standing dead trees may be retained and counted toward the significant tree requirement if demonstrated that such trees will provide important wildlife habitat and are not classified as danger trees.	**Tree retention incentives:** • Each significant tree that is located outside of the area for perimeter landscaping and is retained may be credited as 2 trees for complying with the retention requirements provided it meets one or more of the following criteria: - The tree exceeds 60' in height, or 24" in diameter for evergreen trees or 30" for broadleaf trees; - The tree is located in a grouping of at least 5 trees with canopies that touch or overlap; - The tree provides energy savings through winter wind protection or summer shading as a result of its location relative to buildings; - The tree belongs to a unique or unusual species; - The tree is located within 25' of any sensitive area or required sensitive area buffers; and - The tree is 18"+ in diameter and is identified as providing valuable wildlife habitat. **Tree replacement requirements:** • When the required number of significant trees cannot be retained, significant trees that are removed shall be replaced with: - Transplanted significant trees; or - New trees measuring 2" caliper or more, at a replacement rate of 2" diameter for every 1" diameter of the removed significant tree. • When a tree that is part of an approved tree retention plan cannot be retained, mitigation may be required. • If significant trees cannot be retained or replaced on site, the applicant shall pay a fee in lieu of retained or replaced trees. The fee in lieu may be used to satisfy all or part of the significant tree retention or replacement requirements.

Comments:

- LID stormwater management facilities may be incorporated into required landscaping; provided, that site and soil conditions make LID feasible, where approved by the city engineer, based on review of material prepared and submitted by the applicant, and th

City: Normandy Park

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions: • In critical areas	**Right of way limitations:** not found **Protection of trees during construction:** not found **Seasonal restrictions:** not found
Landscaping requirements: • On pedestrian oriented streets: city-approved street trees placed 30' on center. • On nonmotorized corridors: the planting strip bordering any single-family residential zone shall serve as a buffer, including 15' tall trees (minimum height at time of planting), spaced no more than 30' apart.	**Grading and clearing requirements:** • Permit required for over 1,000 sq. ft. of land-disturbing activity including clearing trees and brush, surface grading, or filling and excavating. **Pruning requirements:** Topping of trees is not permitted in critical areas.

Tree protection

Definition of significant trees: not found	**Heritage trees are specifically protected?** No **Tree retention incentives:** not found
Protection of significant trees: • not found	**Tree replacement requirements:** • Trees removed in critical areas shall be replaced; • In critical areas, replacement ratios based on size of tree removed: - 3:1 for 4" to 6" dbh (single trunk) or 2" (any one trunk of a multiple trunk tree) - 4:1 for 6" to 8" dbh - 6:1 for 8" to 20" dbh - 8:1 for >20" dbh • Planing size of each replacement tree shall be a 5gal. container for deciduous trees, 6 to 8' in height for coniferous and broadleaf evergreen trees.

Comments:

- In the process of updating tree regulations.

City: North Bend

Year of most recent tree ordinance update: 2009 **Tree City USA (year Joined):** 2011

Permit is required for tree removal in these conditions:

- Permit required for all significant tree removal except:
- Dead or diseased trees,
- Nonsignificant trees
- Hazard trees and ground cover in emergency situations involving immediate danger to life, property or substantial fire hazard;
- Normal maintenance of trees and ground cover;
- Licensed commercial nurseries or tree farms.

Pruning requirements: not found

Seasonal restrictions: not found

Grading and clearing requirements:

- A clearing and grading permit is required for the removal of any significant tree(s).
- A significant tree inventory is required in the permit application for the removal of more than 8 significant trees.
- A replanting plan shall be approved prior to significant tree removal.

Landscaping requirements:

- At a minimum, the front yard of all new lots and any side yard abutting a street shall be sodded or seeded with grass or otherwise landscaped and shall include a minimum of 1 deciduous tree.
- Type 1:
  - At least 75% evergreen trees spaced no more than 15' on center. Deciduous trees shall be spaced no more than 20' on center. The number of required trees shall equal the length of the planting area divided by 15 and shall be staggered to mimic natural growth patterns, not planted in a row.
- Type 2:
  - Up to 30% deciduous trees, spaced no more than 20' on center. Evergreen trees shall be spaced no more than 15' on center. The number of required trees shall equal the length of the landscaped area divided by 20 and shall be staggered to mimic natural growth patterns, not planted in a row.
- Type 3:
  - A combination of evergreen trees and deciduous trees. At least 70% deciduous trees, spaced no more than 20' on center. Evergreen trees shall be spaced no more than 15' on center. The number of required trees shall equal the length of the landscaped area divided by 50 and shall be staggered to mimic natural growth patterns (not planted in a row).
- Parking:
  -At least 1 tree per planter area and/or one per 100 sq. ft. of planter area whichever is greater.

Right of way limitations:

- Landscaped strips and sidewalks in the right-of-way shall be maintained by the adjacent landowner, or homeowners' association in the case of low-impact development (LID) residential streets designed per the provisions under subsection V of this section.
- If no trees exist in the landscape strip, the landowner may plant trees that meet requirements of the city
- Street tree species shall be chosen from "Approved Street Tree Varieties" and shall be evenly spaced within planter strips in accordance with the spacing requirements.
- The minimum street tree size shall be 2" minimum caliper measured 6" above the root flare and conform to the most recent ANSI 260.1 American Standard for Nursery Stock.

Protection of trees during construction:

- The size of landscape or buffer areas shall be increased to protect the root zones of all trees that are to be preserved.
- Land clearing machinery shall be kept outside of the root zone of any trees designated for retention.
- Damaging of trees designed for retention by scarring, backfilling of trees with heavy soil or compaction of soil over the root zone or any other activities that may cause damage of roots, trunks or surrounding ground cover shall be considered code violations.

If any existing vegetation is to be saved, a plan shall be provided for the protection of said vegetation during construction activity, including fencing and other protective measures deemed necessary by the director.

Tree protection

Definition of significant trees:

- Evergreen: 15"+ dbh
- Deciduous: 12"+ dbh except red alder, holly, poplar, cottonwood and other invasive trees of any size.

Heritage trees are specifically protected? No

Tree retention incentives:

- not found

Protection of significant trees:

- Retention requirements based on zoning:
- Single-family, duplex, short plats, or subdivision development - 30% of all significant trees in developable area. (20% with justification)
- Cottage and multifamily development - 20% (10% with justification)
- Commercial - 15% (5% per with justification)
- Significant trees shall be retained in the following priority order:
  - Priority One - Significant trees which form a continuous canopy; Significant trees on slopes greater than 20%; Significant trees adjacent to critical areas/buffers; Significant trees over 60' in height or greater than 18" dbh; Significant trees along Cedar Falls Way and North Bend Way in the CR zone within 15' of the right-of-way.
  - Priority Two - Healthy tree groupings whose associated undergrowth can be preserved; Other significant native evergreen or deciduous trees; and other significant nonnative trees.

Tree replacement requirements:

- On-Site Replacement:The applicant shall replant as many trees on-site as feasible and must replace the tree according to the following ratio, at the applicant's choice:
  - 2:1 replacement with trees not less than 4' in height.
  - 3:1 replacement with native and/or drought-tolerant potted trees in 1 gal. size pots.
- Off-Site Replacement. Off-site replacement at a 2:1 ratio may be allowed when approved by the CED director. The applicant shall pay costs associated with the replacement of said trees.
- The priority off-site replacement locations are as follows: (1) street trees, (2) parks, and (3) other public open spaces.
- Replacement trees shall be native drought-tolerant species, 75% of which shall be an evergreen species.

Comments: North Bend is currently working on a tree ordinance for 2016

City: Pacific

Year of most recent tree ordinance update: 2001 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions: • In critical areas	**Grading and clearing requirements:** not found **Pruning requirements:** not found
Right of way limitations: • No trees or shrubs shall hereafter be planted in or removed from any public parking strip or other public place in the city without permission from the street superintendent.	**Seasonal restrictions:** • Limitation on clearing during the rainy season, generally from October 1st to May 1st in critical areas.

Landscaping requirements:

- Each individual landscaped area between 40 sq. ft. and 100 sq. ft. or less shall include at least 1 tree a minimum of 6' in height.
- Type I:
  - A solid wall of trees and/or dense hedge with a mix of deciduous and evergreen trees placed to form a continuous screen within five years, with a minimum depth of 10'.
  - At least 70% evergreen plants.
  - Coniferous and broadleaf trees may include a mixture of sizes but shall not be less then 4' in height at time of planting. Maximum mature height shall be 10'. Evergreen trees shall be spaced no more than 15' on center.
  - Deciduous trees may include a mixture of sizes but shall be fully branched, have a minimum caliper of 2"and a minimum height of 8' at time of planting. Minimum mature height shall be 10'. Deciduous trees shall be spaced no more than 20' on center.
- Type II:
  - A mix of evergreen and deciduous trees and shrubs spaced to create a filtered screen within 3 years;
  - At least 50% deciduous trees and at least 30% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Deciduous trees spaced no more than 20' on center;
- Type III:
  - A mix of evergreen and deciduous trees spaced to create a continuous canopy within 10 years;
  - At least 50% deciduous trees and no more than 65%;
  - Trees spaced no more than 25' on center;
- Type IV (Parking):
  - Canopy-type deciduous trees or broadleaf evergreen trees, evergreen shrubs and a mix of evergreen and deciduous ground covers planted in wells or strips;

Protection of trees during construction:

To provide the best protection for significant trees, applicants:

- Shall provide during the construction stage either:
  - A temporary 5'-high fence; or
  - A line of 5'-high, orange colored, two-by-four stakes placed no more than 10' apart.
- Shall place the fence or stakes in a line generally corresponding to the drip line of any significant tree(s) to be retained.
- Shall construct a rock well if the grade level around the tree is to be raised by more than 1'. The diameter of the well shall be equal to the diameter of the trunk plus 5'.
- Shall not install impervious surfaces, excavate, store, or drive equipment within the area defined by such fencing or stakes.
- Shall not lower the grade level within the larger of the two areas defined as follows:
  - The drip line of the tree(s); or
  - An area around the tree equal to 1' diameter for each inch of tree trunk diameter measured 4'above the ground.
- May use alternative protection methods if determined by the city to provide equal or greater tree protection.

Tree protection

Definition of significant trees: • No definition given	**Heritage trees are specifically protected?** No **Tree retention incentives:** • not found
Protection of significant trees: • not found	**Tree replacement requirements:** • Significant trees which would otherwise be retained, but which were damaged or destroyed by fault of the applicant shall be replaced in a manner determined by the director.

City: Redmond

Year of most recent tree ordinance update: 1998 **Tree City USA (year Joined):** 1999

Permit is required for tree removal in these conditions:

- A Tree Removal Permit is required for removal of any significant tree within the City of Redmond regardless of the condition of the tree (must be assessed by a Certified arborist) Permit not required for routine maintenance(selective pruning of a tree)

Grading and clearing requirements:

- A clearing, grading or stormwater management permit is required for Removal of 11 or more trees that are 6" diameter or larger. The tree diameter is measured 4' from the ground.
- Removal of 10 or fewer trees is regulated in Redmond Zoning Code.

Landscaping requirements:

- Type I:
  - Planting shall consist of evergreen trees and evergreen shrubs with a minimum height of 5' at planting, which will provide an 80% sight-obscuring screen at the time of planting;
  - Or a combination of evergreen and deciduous trees and shrubs backed by 100% sight-obscuring, decorative wall or fence.
  - Deciduous trees shall have a minimum height of 10' at planting.
- Type II:
  - Planting shall be evergreen or a mixture of evergreen and deciduous trees with large shrubs and groundcover interspersed with the trees, and/or a decorative wall or fence.
  - A minimum of 60% evergreen trees and evergreen shrubs.
- Parking:
  - Screening for parking structures shall consist of a maximum of 40% evergreen plantings in order to allow light to penetrate to the interior of the garages
  - Up to 100% of the trees proposed for a parking area may be deciduous.
  - Cluster interior parking lot landscaping when possible to conserve significant portions of existing tree cover as an amenity to the site.
  - Trees shall be planted in vehicle use landscape areas at a minimum of 1 per 4 parking stalls.

Right of way limitations:

- Street trees on the Recommended Street Tree List may be planted on local access streets by property owners, who are then responsible for maintenance of the trees in the street right-of-way.
- Removal of street trees without approval may be penalized.
- The average spacing for street trees may be adjusted to allow for sight lines, utilities, traffic signs, light standards, driveways etc.
- Street shall be installed within the right-of-way as follows:
  - Deciduous trees shall be planted at least 4' from the face of curb to center of tree in tree pits that measure 4' by 4' feet.
  - Coniferous trees shall be planted at least 7'+ from curbs.
  - Trees should have a clear trunk to a height of 6' above the ground.
- No person shall top any public tree.

Pruning requirements:

- Owners of property bordering on any city street, alley or right-of-way shall prune trees growing on their property in such manner that the trees and shrubs will not block or shade the light from street lights, interfere with passage of vehicles or pedestrians, obstruct the vision of traffic signs or obstruct the view of any intersection.
- Topping is defined as an inappropriate technique to reduce tree size; cutting a stem more than 2yrs. old at an indiscriminate location or back to a lateral branch too small to keep the cut stem vital (typically less than 1/3 the diameter of the cut stem); a type of pruning cut that destroys tree architecture and serves to initiate discoloration and perhaps decay in the cut stem.

Seasonal restrictions:

- The Administrator may specify conditions for work necessary to ensure the proposal's compliance with requirements of this division, including seasons within which work may be conducted.

Protection of trees during construction:

- To ensure long-term viability of trees and stands identified for protection, permit plans and construction activities shall comply with the following minimum required tree protection:
- All minimum required tree protection measures shall be shown on the tree protection and replacement plan.
- All construction activities, including staging and traffic areas, shall be prohibited within 5' of the dripline of protected trees.
- Tree protection barriers shall be installed 5' beyond the dripline of significant trees to be protected prior to any land disturbance.
- Tree protection barriers shall be a minimum of 4' high, constructed of chain link, or polyethylene laminar safety fencing or similar material, subject to approval by the Administrator. On large or multiple-project sites, the Administrator may also require that signs requesting subcontractor cooperation and compliance with tree protection standards be posted at site entrances.
- Where tree protection areas are remote from areas of land disturbance, and where approved by the Administrator, alternative forms of tree protection may be used in lieu of tree protection barriers, provided that protected trees are completely surrounded with continuous rope or flagging and are accompanied by "Tree Save Area – Keep Out" signs.

Tree protection

Definition of significant trees: Any healthy tree 6"+ dbh

Any tree 4" dbh, that after considering its age, height, value, or function, is determined to be significant.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- The Administrator may grant adjustments to site development standards for developments on which 10 or more healthy significant trees per exist acre.
- Developments that preserve 40% or more of the healthy significant trees shall be entitled to the Administrative Design Flexibility

	provisions for residential or commercial properties.
Protection of significant trees: • For single family properties, the maximum number of healthy significant trees allowed to be removed per calendar year is based upon lot size: - Up to 10,000 sq.ft. - 2 significant trees - 10,001– 20,000 sq.ft. – 4 significant trees - 20,001 – 30,000 sq.ft. – 6 significant trees - 30,001 sq.ft. or larger – 8 significant trees • For new single-family construction or single-family additions, a minimum of 35% of the existing healthy significant trees on the site must be retained. • For multifamily residential, commercial and industrial properties, the maximum number of health trees removed per calendar year is 5 per acre. • Landmark trees (greater than 30" in diameter at 4.5' above the ground), protected trees, and trees within a critical area (i.e. Native Growth Protection Easement or a wetland/stream buffer etc) cannot be removed unless they are determined to be hazardous, dead, diseased, dying or structurally unsound. • Site improvements shall be designed to protect trees with the following characteristics, functions, or location, with priority given to protection according to the following items, arranged from most important to least important: - (i) Existing stands of healthy trees; - (ii) Trees providing habitat value, such as riparian habitat; - (iii) Trees having a significant land stability function; - (iv) Trees adjacent to public parks and open space. - (v) Trees within the required yard setbacks or around the site perimeter; and - (vi) Trees that have a screening function or provide relief from glare, blight, commercial or industrial harshness;	**Tree replacement requirements:** • With removal permit: - 1:1 for significant trees removed - 3:1 for landmark trees removed • Planting Size: - 2.5" caliper dbh for deciduous trees; - 6' in height for evergreen trees. • Any person who removes a tree in violation of the conditions of a tree removal permit or in violation of this division shall be subject to remedial measures based on size of tree removed: - 2:1 - 6" dbh - 3:1 - 6'' – 9'' dbh - 4:1 - 9'' – 12'' dbh - 5:1 - 12'' – 16'' dbh - 6:1- >16'' • Remedial eplacement trees shall be: - Deciduous 3" dbh - Evergreen 12' in height • Replacement can be done off site or by contributing to the tree fund as approved.

City: Renton

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** 2008

Permit is required for tree removal in these conditions:

- Landmark trees
- Protected trees under a Land Development Permit
- In critical areas
- On protected slopes
- In Native Growth Protection Easements
- Tree topping
- Permit not required:
  -Certified hazard tree
  - 10,000 sq.' or less in area: Up to 2 trees may be removed in any 12 mon. period. No more than 4 trees may be removed in any 5 yr. period from a property.
  - 10,001-20,000 sq.' in area: Up to 3 trees in any 12 mon. period. No more than 6 trees in any 5 yr. period from a property.
  - >20,000 sq.' in area: No more than 6 trees in any 12 mon. period. No more than 12 trees in any 5yr. period.

Grading and clearing requirements:

- All tree removal activities shall comply with Grading, Excavation, and Mining Regulations, and shall:
- Not create or contribute to landslides, accelerated soil creep, settlement and subsidence or hazards.
- Not create or contribute to flooding, erosion, or increased turbidity, siltation or other form of pollution in a watercourse.
- Maintain or provide visual screening and buffering between land uses of differing intensity.
- Expose the smallest practical area of soil to erosion for the least possible time.
- Be consistent with CAO.
- Not create or contribute to a hazardous condition as the result of blowdown, insect or pest infestation, disease, or other problems.
- Preserve landmark trees

Landscaping requirements:

- Where there is insufficient right-of-way space or no public frontage, street trees are required in the front yard subject to approval of the Administrator. Front yard trees are not required in the RC and R-1 zones. A minimum of 2 trees are to be located in the front yard prior to final inspection.
- Parking:
  - Perimeter: Trees shall be 2" dbh for multi-family, commercial, and industrial uses at an average minimum rate of 1 tree per 30' of street frontage.
  - Interior: Trees shall be 2" dbh for multi-family, commercial, and industrial uses. At least 1 tree for every 6 parking spaces within the lot interior shall be planted.
- Planting Size: Broadleaf trees at the time of planting must be fully branched and no smaller than 1.5" dbh. Broadleaf trees planted in residential zones must be a minimum of 1.5" dbh. Broadleaf trees planted in all other zones must be a minimum of 2"dbh. Conifer trees at the time of planting must be fully branched and a minimum of 6' in height.

Right of way limitations:

- It shall be unlawful for any person, without prior written approval of the City to remove, destroy, cut, break, or injure any street tree that is planted or growing in or upon any street right-of-way.
- Street tree spacing standards shall be as stipulated by the Department of Community and Economic Development, provided there shall be a minimum of 1 street tree planted per address.
- Any additional undeveloped right-of-way areas shall be landscaped unless otherwise determined by the Administrator. Refer to the City's Approved Tree List and spacing standards available through the Department of Community and Economic Development and on the City's website.

Seasonal restrictions:

- From October 1st through April 30th, which is the seasonal limitation period, clearing and grading shall only be permitted if shown to the satisfaction of the Director that runoff leaving the construction site will comply with the erosion and sediment control measures and performance criteria and implementation requirements in the Surface Water Design Manual.

Protection of trees during construction:

- Construction Storage Prohibited: The applicant may not fill, excavate, stack or store any equipment, dispose of any materials, supplies or fluids, operate any equipment, install impervious surfaces, or compact the earth in any way within the area defined by the drip line of any tree to be retained.
- Fenced Protection Area Required: Prior to development activities, the applicant shall erect and maintain 6' high chain link temporary construction fencing around the drip lines of all retained trees or at a distance surrounding the tree equal to (1.25' for every 1" of trunk caliper, whichever is greater, or along the perimeter of a tree protection tract. Placards shall be placed on fencing every 50' indicating the words, "NO TRESPASSING – Protected Trees," or on each side of the fencing if less than50'. Site access to individually protected trees or groups of trees shall be fenced and signed. Individual trees shall be fenced on 4 sides. In addition, the applicant shall provide supervision whenever equipment or trucks are moving near trees.
- Protection from Grade Changes: If the grade level adjoining to a tree to be retained is to be raised, the applicant shall construct a dry rock wall or rock well around the tree. The diameter of this wall or well must be equal to the tree's drip line.
- Impervious Surfaces Prohibited within the Drip Line: The applicant may not install impervious surface material within the area defined by the drip line of any tree to be retained.
- Restrictions on Grading within the Drip Lines of Retained Trees: The grade level around any tree to be retained may not be lowered within the greater of the following areas: (i) the area defined by the drip line of the tree, or (ii) an area around the tree equal to 1-1/2' in diameter for each 1" of tree caliper. A larger tree protection zone based on tree size, species, soil, or other conditions may be required. (Ord. 5676, 12-3-2012)
- Mulch Layer Required: All areas within the required fencing shall be covered completely and evenly with a minimum of 3" of bark mulch prior to installation of the protective fencing. Exceptions may be approved if the mulch will adversely affect protected ground cover plants. (Ord. 5676, 12-3-2012)

- Monitoring Required during Construction: The applicant shall retain a certified arborist or licensed landscape architect to ensure trees are protected from development activities and/or to prune branches and roots, fertilize, and water as appropriate for any trees and ground cover that are to be retained.
- Alternative Protection: Alternative safeguards may be used if determined to provide equal or greater tree protection.

Tree protection

Definition of significant trees:

- A tree 6"+ in caliper (or an alder or cottonwood tree 8"+ in caliper).
- Trees qualified as dangerous shall not be considered significant.
- Trees planted within the most recent 10 years shall qualify as significant trees, regardless of the actual caliper.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- not found

Protection of significant trees:

- Minimum on site trees:
  - Detached single-family development: 2 significant trees for every 5,000 sq. ft. of lot area
  - Multi-family development (attached dwellings): 4 significant trees for every 5,000 sq. ft. of lot area
- Properties subject to an active Land Development Permit or building permit shall retain the following percentages of significant trees based on the property's zone. Trees within critical areas and proposed public rights-of-way shall not contribute to the number of significant trees required to be retained:
  - C, R-1, R-4, R-6 and R-8 Zones: At least 30% of the significant trees shall be retained in a residential or institutional development.
  - R-10, R-14, RMF and RMH: At least 20% of the significant trees shall be retained in a residential or institutional development.
  - All Other Zones: At least 10% of the significant trees shall be considered protected and retained in commercial or industrial developments.
  - Utility Uses and Mineral Extraction Uses: Such operations shall be exempt from tree retention requirements if the applicant can justify the exemption in writing to the Administrator's satisfaction.
- Priority of Tree Retention Requirements:
  - Priority One: Landmark trees; Significant trees that form a continuous canopy; Significant trees on slopes greater than 20%; Significant trees adjacent to critical areas and their associated buffers; and Significant trees over 60' in height or greater than 18" caliper.
  - Priority Two: Healthy tree groupings whose associated undergrowth can be preserved; Other significant native evergreen or deciduous trees; and Other significant non-native trees.
  - Priority Three: Alders and cottonwoods shall be retained when all other trees have been evaluated for retention and are not able to be retained, unless the alders and/or cottonwoods are used as part of an approved enhancement project within a critical area or its buffer.

Tree replacement requirements:

- When the required number of protected trees cannot be retained , replacement trees with at least a 2" calipter or an evergreen at least 6' tall shall be planted at a rate of 12 caliper inches of new trees to replace each protected tree removed.
- Up to 50% of trees required in landscaping code may contribute to replacement trees.
- The City may require a surety or bond to ensure the survival of replacement trees.
- Planting Size: Broadleaf trees at the time of planting must be fully branched and no smaller than 1.5"dbh. Broadleaf trees planted in residential zones must be a minimum of 1.5" dbh. Broadleaf trees planted in all other zones must be a minimum of 2" dbh. Conifer trees at the time of planting must be fully branched and a minimum of 6' in height.

City: Sammamish

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:

- Any person who desires to cut down or remove any significant tree or who desires to conduct grading activities on a site that will result in the removal of any significant tree, must first obtain approval.
- Approval may take the form of a tree removal permit or it may be included in conjunction with another land use approval such as a preliminary plat grading permit.
- Exempt: Emergency removal necessary to remedy an imminent danger, and removal in public easements and public rights-of-way by the City.

Grading and clearing requirements:

- All tree removal requires a clearing and grading permit except:
- Emergency tree removal to prevent imminent danger or hazard to persons or property;
- The cutting and removal of any coniferous tree of less than 8" dbh or any deciduous tree of less than 12" dbh when not located within a critical area or buffer;
- The pruning, limbing, and general maintenance of trees outside of environmentally critical areas and buffers;

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs generally interspersed throughout the landscape strip and spaced to form a continuous screen;
  - Between 70% and 90% evergreen trees;
  - Trees provided, one per 10' of landscape strip and spaced no more than 20' apart on center;
- Type II:
  - A mix of evergreen and deciduous trees and shrubs generally interspersed throughout the landscape strip spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30& evergreen trees;
  - Trees provided, one per 20' of landscape strip and spaced no more than 30' apart on center;
- Type III:
  - A mix of evergreen and deciduous trees generally interspersed throughout the landscape strip and spaced to create a continuous canopy;
  - At least 70% deciduous trees;
  - Trees provided, one per linear 25' of landscape strip and spaced no more than 30' apart on center;
- Parking:
  - 1 tree for every 5 parking stalls for a commercial or industrial;
  - 1 tree for every 10 parking stalls for residential or institutional;
  - Parking area landscaping shall consist of: Canopy-type deciduous trees, evergreen trees, evergreen shrubs and groundcovers planted in islands or strips; At least 70% of trees are deciduous.

Right of way limitations:

- All internal walkways along pedestrian-oriented building fronts and walkways on the edge of parking areas shall feature at least 1 street tree (on average) for every 30' of walk.
- Each required street tree planted on site shall receive a 50% credit and each street tree planted on site in excess of the minimum requirement shall receive a 100 % credit toward the tree replacement requirement.

Pruning requirements:

- Significant trees shall not be topped;
- Excessive pruning shall not be allowed unless necessary to protect life and property;

Seasonal restrictions:

- From October 1st through March 31st: clearing and grading shall only be permitted if shown to the satisfaction of the director that silt-laden runoff exceeding standards will be prevented from leaving the construction site through a combination of the following:
  - Site conditions including vegetative coverage, slope, soil type and proximity to receiving waters;
  - Limitations on activities and the extent of disturbed areas; and
  - Proposed erosion and sedimentation control measures.
- Clearing and grading will be allowed only if there is installation and maintenance of an erosion and sedimentation control plan approved by the department that shall define any limits on clearing and grading or specific erosion and sediment control measures required during this period.

Protection of trees during construction:

- All minimum required tree protection measures shall be shown on the tree protection and replacement plan.
- Tree protection barriers shall be installed 5' beyond the drip line of significant trees to be protected prior to any land disturbance.
- Tree protection barriers shall be a minimum of 4' high, constructed of chain link, or polyethylene laminar safety fencing or other material, subject to approval by the director. On large or multiple-project sites, the director may also require that signs requesting subcontractor cooperation and compliance with tree protection standards be posted at site entrances.
- Where tree protection areas are remote from areas of land disturbance, and where approved by the director, alternative forms of tree protection may be used in lieu of tree protection barriers, provided that protected trees are completely surrounded with continuous rope or flagging and are accompanied by “Tree Save Area – Keep Out” signs.
- Native understory trees, shrubs and other vegetation shall be protected within the designated tree protection area.

Tree protection

Definition of significant trees:

- A tree that is in a healthy condition and is a noninvasive species:
  - Evergreen: 8"+ dbh
  - Deciduous 12"+ dbh
- Heritage tree: 22"+ dbh
- Landmark tree: 32"+ dbh

Heritage trees are specifically protected? Yes

Protection of significant trees:

Maximum significant tree removal based on lot size in R-1, R-4 and R-6 zones:

- < 1/4 acre: 50% allowed to be removed every 10 yrs. 2 allowed to be removed per yr. 6 allowed to be removed per rolling 10r. period.
- 1/4 ac – 1/2 ac: 40%, 4 per yr., 12 per 10yrs.
- 1/2 ac – 1 ac: 30%, 6 per yr., 18 per 10-yrs.
- 1 ac – 2 ac: 20%, 8 per yr., 24 per 10yrs.
- > 2 ac: 10%, 10 per year, 30 per 10yrs.

In R-8, R-12, R-18, O, NB and CB Zones:

- A permit shall be granted for the removal of not more than 4 significant trees per year with a limit of 8 significant trees every 5 yrs.
- Retention is higher in critical areas.

Retention priorities:

- Significant trees part of a continuous canopy adjacent to an environmentally critical area and associated buffer;
- Significant trees part of a continuous canopy adjacent to a public park and/or other protected open space;
- Significant trees part of any other on-site and/or off-site continuous canopy;
- Significant trees providing relief from identified environmental impacts;
- Significant trees providing perimeter connectivity and/or off-site screening;
- Significant trees able to be incorporated into required landscaping;
- An isolated cluster of significant trees;
- Individual significant trees.

Tree retention incentives:

- (a) Landmark trees preservation shall receive retention credit as follows:
- (i) 200% in conjunction with subsections (1)(a) through (c) of this section.
- (ii) 150% credit in conjunction with subsections (1)(d) through (f) of this section.
- (b) Heritage tree preservation shall receive retention credit as follows:
- (i) 175% credit in conjunction with subsections (1)(a) through (c) of this section.
- (ii) 125% credit in conjunction with subsections (1)(d) through (f) of this section.
- (c) New subdivisions and short plats proposing a minimum 45% permanent preservation of significant trees in conjunction with subsections (1)(a) through (c) of this section shall receive a 50% reduction of required on-site recreation space.
- (d) New subdivisions and short plats proposing a minimum 40 % permanent preservation of significant trees in conjunction with subsections
- (1)(a) through (c) of this section shall receive a 25% reduction of required on-site recreation space.
- To qualify for any of these incentives, all landmark trees proposed for permanent preservation shall be outside of any environmentally critical area and associated buffer.

Tree replacement requirements:

- 3:1 for landmark trees
- 2:1 for heritage trees
- 1:1 for significant trees
- Planting size: Coniferous - 8'+ in height; Deciduous 2.5"+ dbh
- Replacement trees shall be primarily native species to Washington in order to restore and enhance a site as nearly as practicable to its pre-removal character and function.
- Replacement trees should be planted to reestablish or enhance tree clusters where they previously existed;
- Where possible, replacement trees should be planted within environmentally critical areas and associated buffers. Replacement trees may be planted within a designated open space tract or environmentally critical area tract, where it is determined that such planting enhances and complements existing vegetation and environmental functions;
- Replacement trees shall be planted in locations appropriate to the species' growth habit and horticultural requirements;
- Replacement trees shall be located away from areas where damage is likely;
- Replacement trees shall be planted in areas that connect or are adjacent to a designated open space tract or environmentally critical area tract or other open space, where appropriate;
- Offsite and restoration plantings can offset onsite replacement if approved.

Comments:

- Tree retention provides credits in the LID code

City: SeaTac

Year of most recent tree ordinance update: 2015 **Tree City USA (year Joined):** 2009

Permit is required for tree removal in these conditions:
- Commercial cutting of trees 8" in diameter or more
- In critical areas

Grading and clearing requirements:
- For 7,000 sq. ft.+ of land disturbing activity or in a critical area.
- Permit-exempt projects still need to implement water quality BMPs.

Landscaping requirements:
- Type I:
  - A solid wall of trees and/or a dense hedge with a mix of deciduous and evergreen trees placed to form a continuous screen within 3 years;
  - At least70% evergreen trees;
  - Evergreen trees spaced no more than 15'; Deciduous trees spaced no more than 20' on center;
- Type II:
  - A mix of evergreen and deciduous trees and shrubs spaced to create a filtered screen within 3 yrs;
  - At least 50% deciduous trees and at least 30% evergreen trees;
  - Evergreen trees spaced no more than 15'; Deciduous trees spaced no more than 20' on center;
- Type III:
  - A mix of evergreen and deciduous trees spaced to create a continuous canopy within 10 yrs;
- Type IV:
  - Canopy-type deciduous trees or broadleaf evergreen trees, evergreen shrubs and a mix of evergreen and deciduous groundcovers planted in wells or strips;
  - Planting wells or strips which each contain at least 1 tree;
  - At least 70% deciduous trees; spaced no more than 25' on center;
- Parking:
  - At least 10% of the interior surface parking area shall have landscaping when the total number exceeds 20 parking stalls, including a minimum of 1 tree for every 7 parking stalls to be distributed between rows and/or stalls throughout the parking lot.
- Planting Size: Deciduous trees 2" in caliper measured 4' above the ground at the time of planting. Evergreen trees 8'+ in height measured from treetop to the ground at the time of planting.

Right of way limitations:
- In the Streetfront Pedestrian Zone: A minimum 4' wide street landscaping zone shall be required adjacent to the street curb, consisting of a combination of trees, landscaping, light poles, and street furniture in a manner to be approved by the Director.

Protection of trees during construction:
- Applicants shall provide during the construction stage either:
  - A temporary 5' high fence; or
  - A line of 5' high, orange, 2x4 stakes no more than 10' apart.
- Applicants shall place the fence or stakes in a line corresponding to the drip line of any significant tree(s) to be retained.
- Applicants shall construct a rock well if the grade level around the tree is to be raised by more than 1'. The diameter of the well shall be equal to the diameter of the trunk plus 5'.
- Applicants shall not install impervious surfaces, excavate, store, or drive equipment within the area defined by such fencing or stakes.
- Applicants shall not lower the grade level within the larger of the 2 areas defined as follows:
  - The drip line of the tree(s); or
  - An area around the tree equal to 1' diameter for each inch of tree trunk diameter measured 4' above the ground.
- Applicants may use alternative protection methods if determined by the Director to provide equalor greater tree protection.

Pruning requirements:
- All required landscaped areas shall be maintained, pruned, trimmed, and watered to create and a healthy growing condition.

Seasonal restrictions:
- Clearing on an erosion hazard area is allowed only from April 1st to September 1st, except that up to 15,000 sq.' may be cleared on any lot, subject to any other requirement for vegetation retention and subject to any clearing and grading permit.

Tree protection

Definition of significant trees:
An existing healthy tree which has a
diameter of:
Evergreen: 8"+ at 3' above grade
Deciduous: 12"+ at 3' above grade (excluding poplar trees).

Heritage trees are specifically protected? No

Tree retention incentives:
- not found

Protection of significant trees:
- In single-family zones, 2 significant trees saved in each new lot
- A minimum number of trees per lot within new proposed short plats and long subdivisions shall be required:
  - 2 significant trees; 1 significant tree + 2 new trees; or 4 new trees.
- In other zones, 3 significant trees, or 12% of onsite significant trees, whichever number is greater, shall be saved in new development.
- No significant trees shall be removed from multi-family, commercial, or industrial zones without a “Tree Clearing Permit.”
- The property owner shall demonstrate at least one of the following criteria in order to obtain a “Tree Clearing Permit”:
  - A tree constitutes a safety hazard to structures on the property or on adjacent properties as determined by the City’s arborist; or
  - A tree is dead; or
  - The tree is diseased and will die according to City’s arborist; or
  - The property owner has an approved building permit.

Tree replacement requirements:
- 2:1 in single family zones
- 3:1 in other zones
- All trees required to be replanted as mitigation shall be replanted prior to occupancy.
- Any trees replanted for mitigation purposes shall be in addition to any required landscaping for the proposed project.
- Planting Size:
  - Deciduous: 2"+ in caliper at 4' from its base at the time of planting
  - Evergreen: height of 8'+, not including growth leaders

Comments: An Advisory Tree Board oversees public tree education and trees in public spaces including rights-of-way

City: Seattle

Year of most recent tree ordinance update: 2011 **Tree City USA (year Joined):** 1985

Permit is required for tree removal in these conditions:

- In critical areas
- Significant trees on undeveloped land
- More than 3 significant trees on developed land
- On developing land
- In public rights-of-way

Grading and clearing requirements:

- Grading and clearing plans are required to show existing tree and maximize tree retention.

Landscaping requirements:

- Landscaping is required to meet a "Green Factor" score by adding up square footages of different elements. Trees are weighted higher than all other vegetation: small trees are weighted at 0.3, larges trees at 0.4, and existing significant trees at 0.8.
- Landscaping that achieves a Green Factor score of .30 or greater is required for any lot zoned Mixed Use or Industrial Commercial with:
  - Development containing more than 4 new dwelling units; or
  - Development, either a new structure or an addition to an existing structure, containing >4,000 sq. ft. of non-residential uses; or
  - Any parking lot containing > 20 new parking spaces
- Landscaping that achieves a Green Factor score of 0.6 or greater is required for any lot within a LR zone if development is proposed that has more than one dwelling unit, or a congregate residence.
- Landscaping that achieves a Green Factor score of 0.5 or greater is required for any lot within a MR or HR zone if development is proposed that has more than 1 dwelling unit.
- In Urban Plazas in the North Lake Overlay Zone, a minimum ratio of 1 tree per 700 sq. ft. of plaza area is required.
- Parking:
  - Multi-Family: One tree per every five parking spaces is required.
  - Commercial: One tree is required for every ten parking spaces.
  - Downtown: One tree per every five parking spaces is required.
- Landscaping code rigorously emphasizes street trees in all land uses:
  - Street trees shall be provided in all planting strips. Existing street trees may count toward meeting requirement. Street trees shall not be required for an expansion of less than 2,500 sq. ft.. 2 street trees shall be required for each additional 1,000 sq. ft. of expansion.

Right of way limitations:

- Private property owners that plant trees in rights-of-way are responsible for:
  - Maintaining street trees and other vegetation in abutting public places;
  - Pruning street trees in abutting public places and trees on private property so that the trees do not obstruct street lights, traffic signs or signals, and views of streets or intersections;
  - Removing or relocating improperly or inappropriately planted street trees in abutting public places when requested to do so;
  - Abating nuisance trees in abutting public places.
- No person shall plant, remove, or perform major pruning on any street tree without first obtaining a Street Use permit.

Pruning requirements:

- Topping is regulated as removal.

Seasonal restrictions:

- A permit may be granted with or without conditions including restricting grading work to specific seasons, months or weather conditions.

Protection of trees during construction:

- The basic tree protection area shall be the area within the drip line of the tree. The tree protection area may be reduced if approved by the Director according to a plan prepared by a tree care professional. Such reduction shall be limited to one-third of the area within the outer half of the area within the drip line. In no case shall the reduction occur within the inner root zone.
- The Director may establish conditions for protecting the tree during construction within the feeder root zone.
- The Director may condition Master Use Permits or Building Permits to include measures to protect tree(s) during construction, including within the feeder root zone.
- If development standards have been modified to avoid development within a designated tree protection area, that area shall remain undeveloped for the remainder of the life of the building, and a permanent covenant stating this requirement shall be recorded in the King County Office of Records and Elections.
- The Director may require a tree protection report by a tree care professional that provides the following information:
  - Tree evaluation with respect to its general health, damage, danger of falling, proximity to existing or proposed structures and or utility services;
  - Evaluation of the anticipated effects of proposed construction on the viability of the tree;
  - A hazardous tree assessment, if applicable;
  - Plans for supervising, and/or monitoring implementation of any required tree protection or replacement measures; and
  - Plans for conducting post-construction site inspection and evaluation.

In Single-family and Residential Small Lot zones:

- Tree removal permitted only if: (1) The maximum lot coverage cannot be achieved without extending into the tree protection area or into a required front and/or rear yard; (2) Avoiding development in the tree protection area would result in a portion of the house being less than 15' in width.
- Permitted extension into front or rear yards shall be limited to an area equal to the tree protection area not located within required yards.
- In order to protect trees 2'+ in diameter an applicant may modify their development proposal to extend into front and/or rear yards.

In Lowrise zones:

- The Director may permit exceptional trees to be removed only if the total floor area (within the maximum permitted FAR) and height limits cannot be achieved while avoiding the tree protection area through the following: (1) Development standard adjustments; (2) An increase in the permitted height.
- In order to preserve an exceptional tree, for a principal structure that is subject to pitched roof provisions, the Director may permit the ridge of a pitched roof to accommodate, on an additional story, the amount of floor area lost by avoiding development within the tree protection area.
- A reduction in required parking may be permitted to protect an exceptional tree if the reduction would avoid the tree protection area.
- In order to protect trees over 2 feet in diameter an applicant may request and the Director may allow modification of development standards in the same manner and to the same extent as provided for exceptional trees.

In Midrise and Commercial Zones:

- The Director may permit an exceptional tree to be removed only if the applicant demonstrates that protecting the tree by avoiding development in the tree protection area could not be achieved through the development standard adjustments, a reduction in the parking requirements,, and/or a reduction in parking space standards.
- In order to protect trees over 2' in diameter an applicant may request and the Director may permit modification of development standards in the same manner and to the same extent as provided for exceptional trees.

Tree protection

Definition of significant trees:

- All trees 6"+ in diameter at 4.5' above the ground.
- The code regulates "exceptional trees" more strictly, which are a tree or group of trees that because of its unique historical, ecological, or aesthetic value constitutes an important community resource.

Heritage trees are specifically protected? Yes

Tree retention incentives:

- "Green Factor" scores for required landscaping heavily incentivize tree retention: Significant existing trees are weighted higher than another other element.

Protection of significant trees:

- No more than three significant trees may be removed in any one-year period on lots in Lowrise, Midrise and Commercial zones or on lots 5,000 sq. ft. or greater in a Single-family or Residential Small Lot zone, except when the tree removal is required for the construction of a new structure, retaining wall, rockery or other similar improvement that is approved as part of an issued building or grading permit.
- Tree removal or topping is prohibited, except for hazard trees, grading or building permits, street trees, and park projects, as follows: (1) Significant trees and exception trees on undeveloped lots; (2) Exceptional trees on lots in Lowrise, Midrise and Commercial zones or on lots 5,000 sq. ft. or greater in a Single-family or Residential Small Lot zone.

Tree replacement requirements:

For non-hazardous trees removed during development:

- 1:1 for each exceptional tree and tree over 2'+in diameter that is removed in association with development in all zones, the size and species of which shall be determined by the Director
- The tree replacement required shall be designed to result, upon maturity, in a canopy cover that is at least equal to the canopy cover prior to tree removal.
- Preference shall be given to on-site replacement.
- When on-site replacement cannot be achieved, or is not appropriate as determined by the Director, preference for off-site replacement shall be on public property.

City: Shoreline

Year of most recent tree ordinance update: 2012 **Tree City USA (year Joined):** 2012

Permit is required for tree removal in these conditions:

- The removal of trees on properties zoned Neighborhood Business, Community Business, Mixed Business, Town Center 1, 2, and 3, and Mixed-Use Residential 70' is exempt from tree regulations unless the trees are located within a critical area or its buffer.
- Unless located in a critical area or buffer, removal of the following number of significant trees is exempt from permit based on parcel size in square feet (excluding trees with dbh greater than 30"):
  - <7,200 - 3 trees
  - 7,201-14,400 - 4 trees
  - 14,401-21,780 - 5 trees
  - 21,781< - 6 trees
- Unless located in a critical area or buffer, or clearing greater than 3,000 sq. ft. of land area, any number of non-significant (smaller) trees may be removed without a permit.
- Removal of active or imminent hazardous trees is allowed, such as tree limbs or trunks that are demonstrably cracked, leaning toward overhead utility lines or structures, or are uprooted by flooding, heavy winds or storm events. After the tree removal, the City will need photographic proof or other documentation and the appropriate application approval, if any.
- Removal of trees located in critical areas or buffers which are hazardous but not active or imminent, such as suspected tree rot or diseased trees or less obvious structural wind damage to limbs or trunks, requires a permit exemption request form signed by the property owner and a tree evaluation form prepared by a qualified professional arborist to be submitted and subject to City approval.
- Permit required for removal in the right-of-way.

Grading and clearing requirements:

- A Clearing Grading Permit is required if more than 3,000 sq.' of land area is to be cleared.
- Permit required for removal of trees greater than 30" dbh and/or if more than the maximum number of exempt trees are to be removed.
- Pre-application meeting and permit required for removal of any non-hazardous tree(s) in critical areas or buffers, along with applicable critical area report(s).

Right of way limitations:

- A Tree Board recommends policy on trees in the right-of-way and city property.
- A right-of-way use permit shall be required and issued by the director of the parks, recreation and cultural services department (hereafter "director") for planting street trees in rights-of-way adjacent to the applicant's property.
- A right-of-way use permit shall be required and shall only be issued by the director for the nonexempt pruning or removal of trees in rights-of-way adjacent to the applicant's property

Seasonal restrictions:

not found

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs generally interspersed throughout the landscaped strip and spaced to form a continuous screen.
  - 80% of trees and shrubs shall be evergreen.
  - Trees planted at 10' in height, at the rate of one tree per 10' of landscaped strip and spaced no more than 15' apart.
- Type II:
  - Trees generally interspersed throughout the landscaped strip and spaced to create a continuous canopy.
  - Provide a mix of deciduous and evergreen trees and shrubs.
  - Trees planted at 1.5" caliper, at the rate of one per 25' of landscaped strip and spaced no more than 30' apart on center.
- Parking:
  - Trees shall be provided and distributed throughout the parking area at a rate of 1 tree for every 10 parking stalls.

Pruning requirements:

- Pruning of trees not in critical areas or buffers or otherwise protected is allowed.
- Minor pruning in critical areas or buffers is considered permit exempt if BMPs for pruning are utilized consistent with SMC 20.50.350(E). Protected trees may be pruned to enhance views using methods such as windowing, interlimbing, or skirting up, when completed by a qualified professional arborist and consistent with BMPs.
- Excessive pruning, including topping, stripping, imbalances, or coppicing shall not be allowed unless necessary to protect life and property.

Protection of trees during construction:

- All required tree protection measures shall be shown on the tree protection and replacement plan, clearing and grading plan, or other plan submitted to meet the requirements of this subchapter.
- Tree dripline areas shall be protected. No fill, excavation, construction materials, or equipment staging or traffic shall be allowed in the dripline areas of trees that are to be retained.
- Prior to any land disturbance, temporary construction fences must be placed around the dripline of trees to be preserved. If a cluster of trees is proposed for retention, the barrier shall be placed around the edge formed by the drip lines of the trees.
- Tree protection barriers shall be a minimum of 4' high, constructed of chain link, or polyethylene laminar safety fencing or similar material, subject to approval by the Director. "Tree Protection Area" signs shall be posted visibly on all sides of the fenced areas. On large or multiple-project sites, the Director may also require that signs requesting subcontractor cooperation and compliance with tree protection standards be posted at site entrances.
- Where tree protection areas are remote from areas of land disturbance, and where approved by the Director, alternative forms of tree

protection may be used in lieu of tree protection barriers; provided, that protected trees are completely surrounded with continuous rope or flagging and are accompanied by "Tree Leave Area – Keep Out" signs.

- Rock walls shall be constructed around the tree, equal to the dripline, when existing grade levels are lowered or raised by the proposed grading.
- Retain small trees, bushes and understory plants within the tree protection zone to the maximum extent practicable.
- Preventative Measures. In addition to the above minimum tree protection measures, the applicant should support tree protection efforts by employing, as appropriate, the following preventative measures, consistent with best management practices for maintaining the health of the tree:
  - Pruning of visible deadwood on trees to be protected or relocated;
  - Application of fertilizer to enhance the vigor of stressed trees;
  - Use of soil amendments and soil aeration in tree protection and planting areas;
  - Mulching over tree drip line areas; and
  - Ensuring proper watering during and immediately after construction and throughout the first growing season after construction.

Tree protection

Definition of significant trees:

- Evergreen: 8"+ dbh
- Deciduous: 12"+ dbh

Heritage trees are specifically protected? Yes

Protection of significant trees:

- Sites must minimally retain 20% of existing non-exempt significant trees excluding critical areas and buffers, or minimally retain 30% of significant trees including all significant trees in critical areas and buffers.
- Trees retained as a condition of a development plan must be protected and maintained for at least 3 yrs.
- Site improvements shall be designed to give priority to protection of trees with the following characteristics, functions, or location:
  - Existing stands of healthy trees that have a reasonable chance of survival once the site is developed, are well shaped to withstand the wind and maintain stability over the long term, and will not pose a threat to life or property.
  - Trees which exceed 50' in height.
  - Trees and tree clusters which form a continuous canopy.
  - Trees that create a distinctive skyline feature.
  - Trees that have a screening function or provide relief from glare, blight, commercial or industrial harshness.
  - Trees providing habitat value, particularly riparian habitat.
  - Trees within the required yard setbacks or around the perimeter of the proposed development.
  - Trees having a significant land stability function.
  - Trees adjacent to public parks, open space, and critical area buffers.
  - Trees having a significant water-retention function.

Tree retention incentives:

- The Director may grant reductions or adjustments to other site development standards if the protection levels are exceeded. On a case-by-case review, the Director shall determine the balance between tree protection that exceeds the established minimum percentage and variations to site development requirements. If the Director grants adjustments or reductions to site development standards under this provision, then tree protection requirements shall be recorded on the face of the plat, as a notice to title, or on some other legal document that runs with the property. Adjustments that may be considered are:
- Reductions or variations of the area, width, or composition of required open space and/or landscaping;
- Variations in parking lot design and/or any access driveway requirements;
- Variations in building setback requirements;
- Variations of grading and stormwater requirements.

Tree replacement requirements:

- Trees removed under partial exemption may be removed per parcel with no replacement of trees required.
- Any significant tree proposed for removal beyond this limit should be replaced as follows:
- - One existing significant tree of eight inches in diameter at breast height for conifers or 12" in diameter at breast height for all others equals 1 new tree.
- - Each additional 3" in diameter at breast height equals 1 additional new tree, up to 3 trees per significant tree removed.
- Planting size: deciduous trees shall be at least 1.5' in caliper and evergreens 6' in height.

City: Skykomish

Year of most recent tree ordinance update: 2004 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions: • In critical areas • In city parks	**Grading and clearing requirements:** not found **Landscaping requirements:** not found **Protection of trees during construction:** not found **Seasonal restrictions:** not found
Right of way limitations: • The superintendent is authorized to cause the removal of any trees and shrubs from any public area, or the roots of any trees and shrubs which extend into any public area when such trees and shrubs or the roots thereof are causing damage to or are liable to cause damage to any town water or sewer system component or appurtenance.	**Pruning requirements:** • Normal nondestructive pruning and trimming for maintenance purposes, or thinning of limbs of individual trees to provide a view corridor, shall not be subject to these buffer requirements. • Enhancement of a view corridor shall not be construed to mean excessive removal of trees or vegetation that impairs views. • Removal or destruction of trees with a caliper width greater than 6" at 4' above the ground shall be considered destructive pruning and is prohibited.

Tree protection

Definition of significant trees: • not found	**Heritage trees are specifically protected?** No **Tree retention incentives:** • not found
Protection of significant trees: • Wherever possible, preserve existing trees on private property and in the public right-of-way.	**Tree replacement requirements:** • Removed tree or vegetation in critical areas shall be replaced with like species at least 1 month prior to the end of the growing season.

City: Snoqualmie

Year of most recent tree ordinance update: 2011 **Tree City USA (year Joined):** n/a

Permit is required for tree removal in these conditions:
- A permit is required except:
- Emergency tree removal
- Normal and routine horticultural activities associated with existing commercial orchards, nurseries or Christmas tree farms.

Grading and clearing requirements:
- Grading permit applications identify any significant trees to be cut, and/or amounts of vegetation to be removed.
- Grading within the drip line of significant trees that are to be retained shall be prohibited to prevent damage to significant trees.

Landscaping requirements:
- Type I:
  - A mix of primarily evergreen trees and shrubs placed to form a continuous screen;
  - At least 70% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Deciduous trees spaced no more than 20' on center;
- Type II:
- - A mix of evergreen and deciduous trees and shrubs spaced to create a filtered screen;
  - At least 50% deciduous trees and at least 30% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Deciduous trees spaced no more than 20' on center;
- Type III:
  - A mix of evergreen and deciduous trees spaces to create a continuous canopy;
  - At least 70% deciduous trees;
  - Trees spaced no more than 25' on center;
- Type IV (Parking):
  - Canopy-type deciduous trees or broadleaf evergreen trees;
  - At least 70% of the required trees shall be deciduous
  - Shade trees at the rate of a minimum of 1per planter and/or 1 per 100 sq. ft. of planter.
  - For parking lots with 10 to 30 stalls, seven percent of the vehicle use area shall be landscaped.
  - For parking lots with 31 or more stalls, 10 percent of the vehicle use area shall be landscaped.
- Minimum sizes at installation are as follows:
  - 1.75" caliper street trees;
  - 1.5" caliper other deciduous trees;
  - 8'+ height vine maples and other multi-stemmed trees;
  - 6'+ height evergreen trees;

Right of way limitations:
- Any person negligently damaging or deforming a city tree shall be liable to the city for the cost of replacement of the tree, including the cost of nursery stock in close as size to the damaged or deformed tree as is feasible and the city's costs for soil preparation, planting and actual or estimated costs of establishment.
- Trees shall be provided along all public streets as follows:
  - Trees shall be spaced no more than 40' apart on arterials.
  - Trees shall be spaced no more than 50' apart on collector and local access streets.

Protection of trees during construction:
- The director may require protection techniques for significant trees including, without limitation, restrictions on excavations, fills and impervious surfaces within the drip line and the requirement of temporary construction fencing around the drip line.

Pruning requirements:
- Restricted in critical areas and rights-of-way

Seasonal restrictions:
- The plan shall clearly indicate the construction sequence for establishment of all erosion control work, both temporary and permanent, for the drier season and wetter winter months.

Tree protection

Definition of significant trees:
- Evergreen: 15"+ at 4' from ground surface
- Deciduous: 12" + at 4' from ground surface (other than red alder and cottonwood trees)

Heritage trees are specifically protected? Yes

Tree retention incentives:
not found

Protection of significant trees:
- In the grading and clearing permit review process:
- In general, all significant trees shall be preserved in areas designated for open space, setbacks or landscaping.
- The placement of structures and impervious surfaces in development projects shall be designed to maximize the number of significant trees that can and will be preserved on the site.
- Grading within the drip line of significant trees that are to be retained shall be prohibited to prevent damage to significant trees.

Tree replacement requirements:
- The director may require the applicant to plant replacement trees of a size and species to be approved by the director if significant trees are removed by the applicant as part of the development proposal.

City: Tukwila

Year of most recent tree ordinance update: 1995 **Tree City USA (year Joined):** 2002

Permit is required for tree removal in these conditions:
- In sensitive (critical) areas
- In required landscaping areas.
- On the Green/Duwamish Shoreline.
- In rights-of-way
- Hazard tree removal does not require a permit but requires proof of hazard, and replanting is still required in sensitive areas.

Grading and clearing requirements: not found

Pruning requirements: not found

Seasonal restrictions:
- The timing and methods to be used in any proposed vegetation removal shall be such that impacts to protected vegetation, wildlife, fisheries, and the surrounding environment are minimized.

Landscaping requirements:
- MDR & HDR: 40% horizontal tree coverage in 10 yrs. only in
- MDR/HDR, Office/ Mixed Use Office, Urban Ctr, Tuk S., Commercial Light Industrial, Residential Commercial: 1 tree each 30 '
- Light & Heavy Industrial, MIC, Neighborhood commercial: 1 tree each 20 '
- Parking lots: 1 tree per landscaped island, no stall more than 10 stalls or 110 ' from a landscaped area.

Right of way limitations:
- Public Works permit required for tree removal in the ROW.
- Topping in the ROW is considered removal.

Protection of trees during construction:
- Tree removal proposals shall include tree protection measures which meet or exceed best management practices and current standards of professional aboriculture, and which are sufficient to ensure the viability of protected trees and other vegetation identified for retention, and shall incldue measures sufficient to protect any Sensitive Area, its Buffer and vegetation within the shoreline Low-Impact Environment.
- During clearing and/or construction activities, all protected vegetation shall be surround by protective fencing whcih prevents adverse impacts associated with clearing from intruding into areas of protected vegetation.

Tree protection

Definition of significant trees:
- Diameter of 4"+ measured at 4' above the ground

Heritage trees are specifically protected? No

Tree retention incentives:
- not found

Protection of significant trees:
- See tree replacement

Tree replacement requirements:
- Replacement ratios in sensitive areas (based on diameter of tree removed):
  - 1:1 – 4-8" diameter
  - 2:1 – 8-12" diameter
  - 4:1 – 12-18" diameter
  - 6:1 – 18-24" diameter
  - 8:1 – 24"+ diameter
- In wetlands, watercourses, and their buffers replacement plants may be between 1 and 5 gal. potted plants.
- In landscaped areas - 1:1 replacement that will attain a similar size and canopy coverage at maturity as the removed tree would have attained.
- Planting size:
  - Deciduous: 2.5"+ caliper,
  - Evergreen: 6'-8' in height

City: Woodinville

Year of most recent tree ordinance update: 2013 **Tree City USA (year Joined):** 1996

Permit is required for tree removal in these conditions:

Permit required for removal except:

- Emergency Tree Removal - with City notification within 7 days Any tree on private, developed property that poses an imminent threat to life or property. The party removing the tree will contact the City within seven days of removal to provide documentation of threat for approval of exemption. If the City Tree Official determines that the emergency tree removal was not warranted, he or she may require that the party obtain a permit and/or require that replacement trees and vegetation be replanted as mitigation, in accordance with WMC 21.15.120(8)(b).
- (2) Utility Management. Trees may be removed by the City or utility provider in situations involving immediate danger to life or property, or interruption of services provided by a utility.
- (3) Commercial Nurseries or Tree Farms. A nursery or tree farm owner may remove trees that are being grown to be sold as Christmas or landscape trees.
- (4) Removal of nonsignificant trees with a diameter-at-breast-height of less than two".
- (5) Trees within the public right-of-way, and trees removed as part of a City construction project, shall be subject to the requirements of Chapter 2.24 WMC.

Seasonal restrictions:

- In critical areas, clearing shall be allowed only from May 1st to October 1st of each year; provided, that the Development Services Director may extend or shorten the dry season on a case-by-case basis depending on actual weather conditions, except that timber harvest, not including brush clearing or stump removal, may be allowed pursuant to an approved forest practice permit issued by the City or the Department of Natural Resources.

Grading and clearing requirements:

- (i) The grade shall not be elevated or reduced within the critical root zone of trees to be preserved without the City Tree Official's authorization based on recommendations from a qualified tree professional. The City Tree Official may allow coverage of up to one-half of the area of the tree's critical root zone with light soils (no clay) to the minimum depth necessary to carry out grading or landscaping plans, if it will not imperil the survival of the tree. Aeration devices may be required to ensure the tree's survival.
- (ii) If the grade adjacent to a preserved tree is raised such that it could slough or erode into the tree's critical root zone, it shall be permanently stabilized to prevent suffocation of the roots.
- (iii) The applicant shall not install an impervious surface within the critical root zone of any tree to be retained without the authorization of the City Tree Official. Alternatives to installing impervious surface within the critical root zone, such as a meandered sidewalk or shifting improvements, shall be considered prior to approval of installation of impervious surface within the critical root zone. The City Tree Official may require specific construction methods and/or use of aeration devices to ensure the tree's survival and to minimize the potential for root-induced damage to the impervious surface.
- (iv) Utility trenches should be located outside of the critical root zone of Type 1 trees. If utilities must be placed within the critical root zone, the applicant's qualified tree professional shall establish to the satisfaction of the City Tree Official that the design will adequately support the long-term viability of the trees.
- (v) Trees and other vegetation to be retained shall be protected from erosion and sedimentation. Clearing operations shall be conducted so as to expose the smallest practical area of soil to erosion for the least possible time. To control erosion, it is encouraged that shrubs, ground cover and stumps be maintained on the individual lots, where feasible.

Landscaping requirements:

- Type I:
  - A mix of primarily evergreen trees and shrubs placed to form a continuous screen;
  - At least 70% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Broadleaf trees spaced no more than 20' on center;
- Type II:
  - A mix of evergreen and broadleaf trees and shrubs spaced to create a filtered screen;
  - At least 50% broadleaf trees and at least 30% evergreen trees;
  - Evergreen trees spaced no more than 15' on center;
  - Broadleaf trees spaced no more than 20' on center;
- Type III:
  - A mix of evergreen and/or broadleaf trees spaced to create a continuous canopy;
  - At least 70% broadleaf trees;
  - Trees spaced no more than 25% on center;
- Type IV (Parking):
  - Canopy-type broadleaf or evergreen trees, evergreen shrubs and groundcovers planted in islands or strips;
  - At least 90% of the trees shall be broadleaf.

Right of way limitations:

- Street trees within the right-of-way shall be spaced at an average 25' on center, with no less than 15' on center and no more than 35' on center.
- The City shall have the right to regulate the species, installation method, and relative condition of trees located in the City rights-of-way and City-owned property.
- Trees and plants shall be considered for preservation and planting in all City construction and/or land use projects.
- Tree planting and protection shall be in accordance with the tree care standards manual.
- Private parties may plant trees on property owned by the City with written permission.
- Any planting of public trees that fails to comply with the standards established in the tree care standards manualmay be declared a public nuisance.

Protection of trees during construction:

A meeting onsite between the City Tree Official and the contractor shall determine that these standards are met prior to site disturbance:

- Protected Area. A protected area shall be established including the area five feet beyond the dripline of retained trees.

- Placing Materials Near Trees. No person may conduct any activity within the protected area of any tree designated to remain, including but not limited to equipment, solvents, building material or soil deposits, orconcrete washout or other chemicals. During construction, no person shall attach any object to any tree designated for protection.
- Protective Barrier. Prior to any development, land clearing, filling or any land alteration, the applicant shall:
  - Erect and maintain readily visible temporary protective fencing which completely surrounds the protected area of all retained trees or groups of trees and their understory. Fences shall be constructed of chain link and be at least 4' high.
  - Install highly visible signs spaced no further than 15' along the entirety of the protective tree fence. Said sign must be approved by the City Tree Official and shall state at a minimum “Tree Protection Area, Entrance Prohibited” and provide the City phone number for code enforcement to report violations.
  - Prohibit excavation or compaction of earth or other potentially damaging activities within the barriers; such activities may be approved by and under the supervision of a qualified tree professional retained.
  - Maintain the protective barriers in place until the City Tree Official authorizes their removal, which shall not be prior to completion of major site development.
  - Ensure that any approved landscaping done in the protected area subsequent to the removal of the barriers shall be accomplished with light machinery or hand labor.
- In addition to the above, the City Tree Official may require the following as site conditions require:
  - If equipment is authorized to operate within the critical root zone, the areas adjoining the critical root zone shall be mulched to a depth of at least 6", or with plywood, metal or similar material to protect roots from damage.
  - Minimize root damage by excavating a two-foot-deep trench, at edge of critical root zone, to cleanly sever the roots of trees to be retained.
  - Corrective pruning performed on protected trees in order to avoid damage from machinery or building activity.
  - Maintenance of trees throughout construction period by watering.

Pruning requirements:

- All required trees shall be maintained throughout the life of the development.
- Topping or pruning to the extent that would constitute tree removal is not allowed.
- If a required tree smaller than 6" dbh is topped, it must be replaced.
- If a tree 6"+ dbh is topped, the property owner may be subject to enforcement actions.
- Trees may be windowed or limbed up using best management practices. The following techniques for healthy pruning shall be used.
  - Crown Cleaning – removing dead, dying, diseased, crowded, weakly attached, or low-vigor branches, not reducing the canopy.
  - Crown Thinning – selective removal of branches throughout the crown of the tree to improve interior light and air. Remaining branches should be well-distributed and balanced.
  - Crown Raising – removal of the lower branches of the tree to provide height clearance, typically 8 feet for pedestrians and 16' for vehicles.
  - Windowing – removing several branches symmetrically within an area of the tree’s crown to enhance views.

Tree protection

Definition of significant trees:

- An existing healthy tree with 6"+ dbh.

Heritage trees are specifically protected? Yes

Tree retention incentives: not found

Protection of significant trees:

- A tree density calculation, using tree credits, is mandated in code. More credit is given trees with larger diameters.
- Any new development or redevelopment that results in an addition, alteration or repair that adds square footage equal to or greater than 25% of the existing square footage, or has construction costs of an amount equal to or greater than 25% of the assessed value, of the structures on-site, shall fully comply with the tree density requirements.
- Undeveloped sites and developed sites subject to the tree density requirements shall meet the required minimum tree density as follows:
  - 60 tree credits per acre
  - 30 tree credits per acre for single-family residential lots less than 7,200 sq. ft. and lots in the Central Business District.
- Priority trees to be retained are viable, healthy, windfirm trees that are: (a) Heritage trees; (b) Specimen trees; (c) Tree groves and associated vegetation that are to be set aside as preserved groves;(d) Wildlife habitat; (e) Trees in geologically hazardous areas; (f) Trees that are more than 75 yrs. old or have a diameter-at-breast-height of at least 20"; or (g) Trees that are a part of a grove that extends into abutting property, such as in a public park, open space, sensitive area buffer or otherwise preserved group of trees on adjacent private property. If significant trees must be removed in these situations, an adequate buffer of trees may be required to be retained or planted on the edge of the remaining grove to help stabilize the remaining trees.

Tree replacement requirements:

- 1:1 for sites and activities requiring a minimum tree density and where the existing trees to be retained do not meet the minimum tree density requirement, supplemental trees shall be planted to achieve the required minimum tree density.
- Tree location priorities:
  - On-Site: (1) In preserved groves, critical areas or their buffers; (2) Adjacent to storm water facilities as approved by the Public Works Director; (3) Entrance landscaping, traffic islands and other common areas in residential subdivisions that have enough area to support a mature tree of that species, as listed in the City of Woodinville Plant Species List; (4) Site perimeter; (5)On individual residential building lots.
  - Off-Site. When room is unavailable for planting the required trees on-site, or planting on-site would create nuisance or hazard trees, then they may be planted at another City Tree Official approved location in the City. The site chosen shall be in the same neighborhood, as designated in the Comprehensive Plan, as the subject site whenever possible.
  - City Tree Fund. When the City Tree Official determines on-site and off-site locations are unavailable, then the applicant shall pay an amount of money approximating the current market value of the supplemental trees plus an additional 50 percent for maintenance, into the City tree fund.
- Planting size: 2" dbh

City: Yarrow Point

Year of most recent tree ordinance update: 2010 **Tree City USA (year Joined):** 2010

Permit is required for tree removal in these conditions:	Grading and clearing requirements: not found Landscaping requirements: not found Protection of trees during construction: not found Pruning requirements: not found Seasonal restrictions: not found
• On City property • On City right-of-way	

Right of way limitations:

- The town shall have the right to plant, prune, maintain, and remove trees, shrubs, and plants within all town-owned rights-of-way and other public property as may be necessary to ensure public safety.
- Any person or entity found to have removed a protected tree within any town right-of-way, without the written permission of the town, shall be in violation of this code.

Tree protection

Definition of significant trees:	Heritage trees are specifically protected? No
• not found	Tree retention incentives: • not found
Protection of significant trees: • not found	**Tree replacement requirements:** • not found

Comments:

- A Tree Board manages public trees and evaluates requests for maintenance and/or removal.

816 Second Avenue, Suite 200
Seattle WA, 98104
www.futurewise.org

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