Retrofitting Our Legacy

GREEN STRATEGIES FOR TREATING URBAN STORMWATER

The Nature Conservancy
Washington

Accelerating the Strategic Use of Green Stormwater Infrastructure to Improve Water Quality for People and Nature Across the Puget Sound Region

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EXECUTIVE SUMMARY

Each year, millions of pounds of pollution from untreated stormwater flow into Puget Sound waterways, harming aquatic and marine life and human health.

OUR WATER QUALITY CHALLENGE

Each year, millions of pounds of pollution from untreated stormwater flow into Puget Sound waterways, harming aquatic and marine life and human health. Busy highways and roads are the largest source of stormwater pollution to Puget Sound, poisoning our ecosystems with heavy metals, excessive organic materials, and toxic chemicals, including the salmon killer 6PPD. Insufficient policies and a glacially slow response leaves our aquatic systems in danger of irreversible loss.

Luckily, we know that green stormwater infrastructure effectively cleans road runoff while generating multiple benefits for people and nature. Now cities and counties, the level of government that manages stormwater infrastructure, must build green stormwater infrastructure quickly and at scale to bring benefits to water quality and beyond.

FIVE COMMONSENSE STRATEGIES

This paper proposes five broad, commonsense strategies for cities and counties to ramp-up their use of green stormwater infrastructure (GSI) and other nature-based solutions to treat road runoff. We explore these five strategies through specific examples and case studies. By implementing these strategies to treat polluted road runoff at scale, jurisdictions can do their part to restore healthy water for salmon and people in the Puget Sound region.

STRATEGY 1: GO BIG, BECAUSE HOME IS POLLUTED

Use watershed perspective to prioritize toxic hotspots and treat with regional facilities.

STRATEGY 2: MAKE GSI EASY

Make policy changes to reduce barriers and boost GSI and hybrid gray/green retrofits for water quality at city and county levels of government.

STRATEGY 3: SHOW ME THE MONEY

Incentivize investment in stormwater retrofits for roads that deploy nature-based solutions.

STRATEGY 4: MAXIMIZE IMPACT WITH MULTIPLE BENEFITS

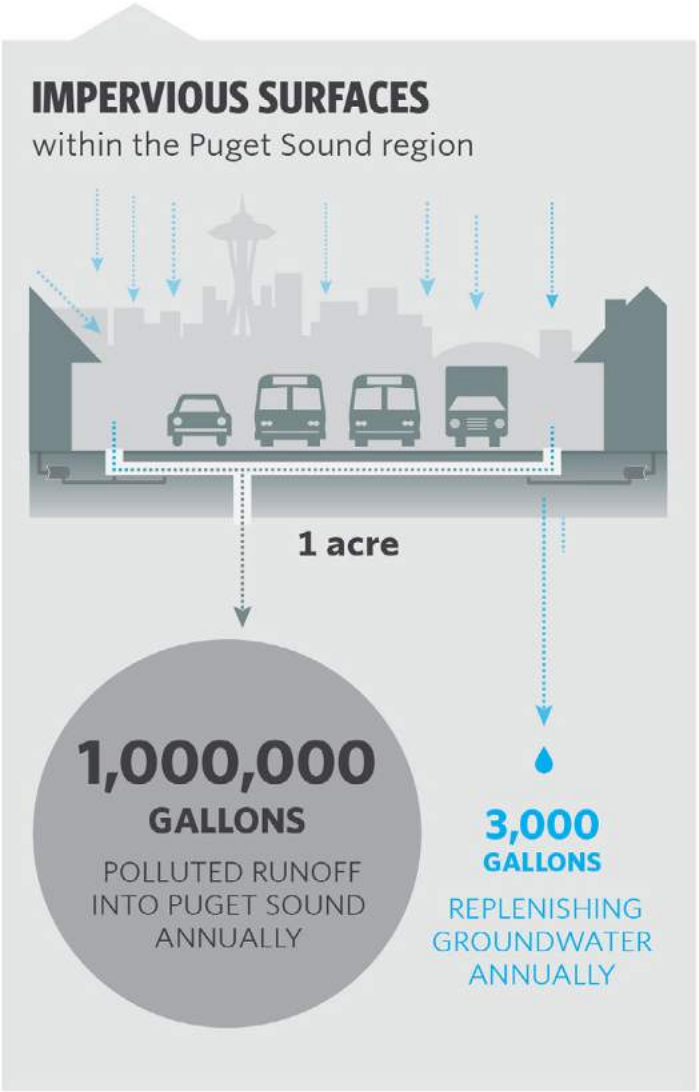
Build GSI projects that support communities in ways beyond stormwater.

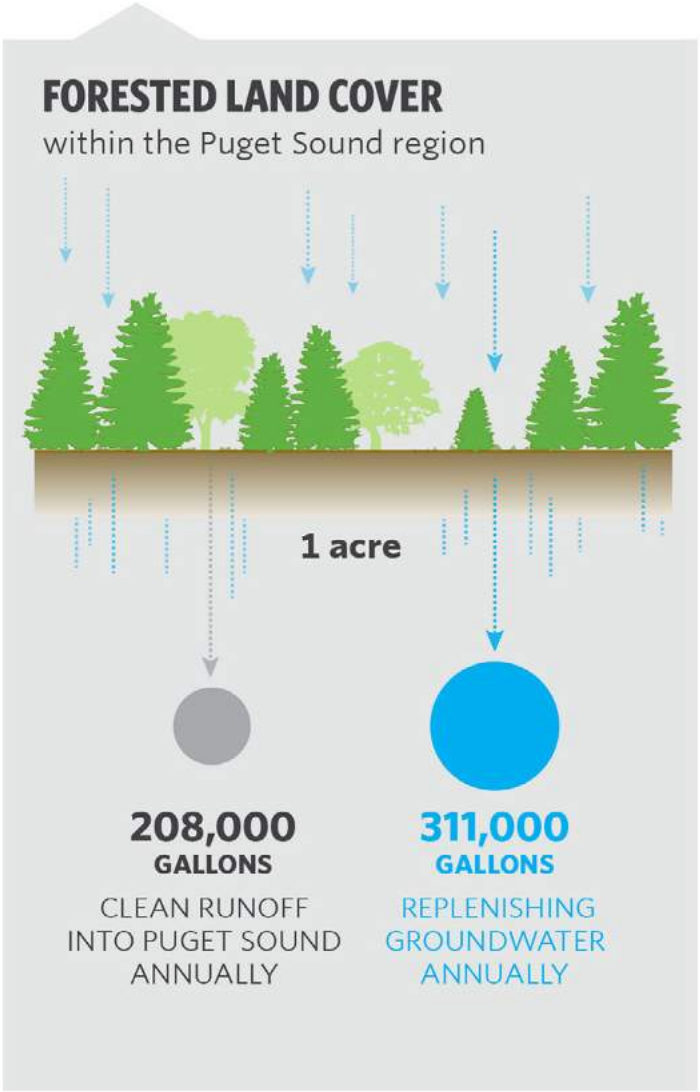
STRATEGY 5: BUILD DECISION MAKER SUPPORT

Accurately value and communicate the benefits and costs of GSI, and hybrid grey/green solutions including co-benefits.

What is the issue?

As stormwater hits the ground and washes over impervious surfaces in urban areas, it picks up pollution and rushes to creeks, lakes, and Puget Sound. In a natural setting, clean stormwater soaks into the ground and helps replenish vital groundwater. Stormwater pollution is considered the biggest water pollution problem in the urban areas of Washington State.





Data Sources: Puget Sound Fact Book - Parametrix (2010) Puget Sound Stormwater Retrofit Cost Estimate Appendix A, USGS Summary of Land Cover Trends Puget Lowland Ecoregion, WSDOT Hydraulics Manual - Runoff Coefficients for the Rational Method 10-year Frequency. All stormwater runoff volumes shown are estimates.

INTRODUCTION

Each year, millions of pounds of pollutants threaten the future of Puget Sound waterways.

THESE POLLUTANTS FLOW AS UNTREATED STORMWATER INTO OUR WATERWAYS, HARMING OUR ICONIC MARINE LIFE AND HUMAN HEALTH. Busy highways and roads are the largest source of pollution to Puget Sound, poisoning our ecosystems with heavy metals, excessive organic materials, and toxic chemicals.

Every day, scientists learn more about the specific toxins in stormwater and their deadly impact. Recent research by the University of Washington, Washington State University, and the Washington Stormwater Center has identified the tire additive 6PPD and more specifically its breakdown product 6PPD-quinone (6PPD-Q) as toxic to coho and chinook salmon, and steelhead. It is particularly toxic to coho salmon, killing up to 90% of returning coho before they can spawn in urban watersheds.[1]

Our communities are harmed too. The natural health of Puget Sound should not be considered separate from the land or the people—they are one and the same. The salmon and ecosystems that are threatened by this pollution are central to the cultures and treaty rights of indigenous peoples in the Pacific Northwest. Stormwater runoff from roads is widespread in the Puget Sound region and is especially dense in communities of color and low-income communities largely due to historical and ongoing environmental racism.

Incremental improvements in stormwater regulation and technology will not result in actual clean water for at least a century—leaving natural systems in danger of irreversible loss. We must accelerate the pace and scale of solutions that clean our road runoff and generate multiple benefits for people and nature. Despite Puget Sound being filled with people who love this place and with organizations doing meaningful work for the region, the health of Puget Sound is getting worse faster than it is getting better—and that is before accounting for the continued rapid population growth facing the region.

We don't have decades to build the political will, expertise, and support for stepwise corrective actions. Through collaborative action and a commitment to innovation, we must pursue water quality solutions that match the challenge of our giant pollution problem. This paper proposes how we can accomplish this with five overarching strategies for cities and counties to contribute to Puget Sound restoration by radically accelerating the use of green stormwater infrastructure retrofits and other nature-based solutions to treat road runoff.

Juvenile coho in a healthy stream away from urban areas © Bridget Besaw

Measuring a juvenile coho © Bridget Besaw

1 *(B. F. French, 2022)*

What Are GSI Retrofits?

NATURE-BASED SOLUTIONS

Green Stormwater Infrastructure (GSI) is a broad term that refers to a diverse set of strategies that use nature to treat stormwater before it flows to natural water bodies or combined sewers. GSI uses trees and plants, compost and organic soils, and other biological solutions engineered to mimic natural water movement through healthy ecosystems. These features can filter pollution, infiltrate water into the ground, and slow runoff before it flows into the broader natural or piped drainage system.

GSI includes a range of best management practices (BMPs) that can be implemented at a variety of scales, ranging from centralized regional facilities such as stormwater parks to roadside bioswales and small site-specific installations like rain gardens. BMPs can include more heavily engineered facilities referred to as gray/green infrastructure that may use some traditional stormwater treatment.

WORKING WITH EXISTING INFRASTRUCTURE

GSI "retrofits" refer to the treatment of runoff from existing development, including roads, using nature-based and grey/green stormwater management BMPs. Most existing impervious surfaces were built to quickly funnel water away to natural water bodies without attention to the pollution carried by road runoff nor the damage done to ecosystems by increasing stream flashiness. Retrofits address the problems caused by existing infrastructure without having to entirely rebuild that infrastructure.

FILTERS POLLUTION AND MANAGES FLOW

The benefits of GSI for road retrofits include its ability to naturally filter out pollutants and reduce stormwater flow volumes. BMPs that use infiltration and bioretention are particularly effective at removing the tire additive 6PPD.[2] Slowing the flow of stormwater runoff improves stream habitat and reduces environmental damage associated with flash flooding, combined sewer overflows, and stormwater discharges. The trees and plants in GSI also store carbon, filter air pollution, mitigate urban heat islands, and create green space and habitat.

SITE CONSIDERATIONS

It is important to note that GSI retrofits may not always be technically feasible and not every BMP is appropriate for every site. For example, areas with steep slopes, underlying bedrock or hardpan, or contaminated soil may not be appropriate for infiltration, while road runoff needs GSI that can handle high levels of sediment and pollution. Local conditions and site-specific considerations will determine which BMPs can be used. In some instances, the right fit might require treating or detaining the stormwater at a different location.

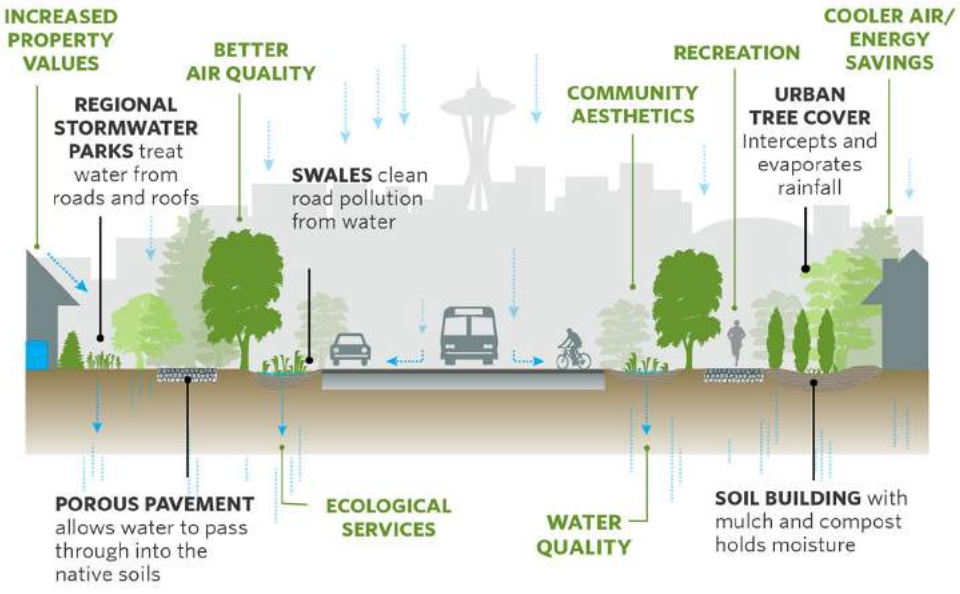
RELATED CONCEPTS

Three other terms overlap with GSI but have slightly different meanings.

Green infrastructure is used interchangeably with GSI in the stormwater context.

How are we rethinking the problem?

Re-envisioning and re-designing cities to function more like forests so water is absorbed back into the ground, in addition to treating stormwater through traditional means, will solve our region-wide stormwater problem.



GREEN & GRAY STORMWATER INFRASTRUCTURE

A study by the city of Philadelphia has shown a hybrid approach of green and gray infrastructure can get the same freshwater solutions as gray infrastructure, plus additional benefits to the community.

Data Source: City of Philadelphia Water Department

2 *(Navickis-Brasch, 2022)*

Nature-based solutions refers to the incorporation of natural systems in our response to environmental or social challenges. This includes green stormwater infrastructure, but is much broader as well, incorporating other nature-based strategies such as protecting and restoring forests for carbon sequestration.

Low Impact Development (LID) is an approach to designing a built environment that mimics the hydrology of the forests that once blanketed the Puget Sound. LID frequently uses GSI, and LID BMPs defined by the WA State Department of Ecology are used to meet stormwater requirements for redevelopment and new construction. The key difference between LID and GSI is that LID BMPs are applied on-site, while GSI strategies can be applied at any scale, from the parcel to end-of-pipe retrofits.

Why GSI Retrofits?

TRUE SOLUTIONS STOP POLLUTION AT ITS SOURCE

Optimal or true solutions are the most critical steps to improving water quality in Puget Sound. These solutions entail:

- **Reducing car dependence** and vehicle miles traveled, lowering pollution on roads.
- **Protecting open space** and preventing sprawl to minimize new stormwater impacts.
- **Protecting mature urban trees** and supporting urban forestry for stormwater mitigation.
- **Depaving and reforesting** urban areas to improve water infiltration and eliminate pollution sources.
- **Removing 6PPD** from car tires, eliminating one of the deadliest toxins in the stormwater cocktail.

CHALLENGES TO ADOPTION

All these actions are essential to meet clean water goals, however they will not happen at the pace and scale necessary to address our water quality problems. Challenges to implementing them include our dependence on cars and the lack of effective public transit options, the need for sufficient affordable housing for the existing and growing population, and the sheer expansiveness of our road infrastructure.

ALTERNATIVE STRATEGIES

Therefore, even as work to stop pollution at its source continues, we must also implement meaningful alternative strategies that mitigate the harm of stormwater pollution.

The rest of this paper will focus on green stormwater infrastructure retrofits as a core complement to these true solutions.

INVESTING IN GSI WORKFORCE

To implement GSI solutions, we need to invest in the workforce that will design, build, and maintain small and large-scale green stormwater infrastructure across the region. The existing GSI workforce is not sufficient to build out GSI to meet water quality needs and effectively respond to community priorities. By investing in this workforce, we can improve water quality and the economic well-being of local communities.

GSI workforce development efforts across the country provide models that the Puget Sound Region can draw on. Given the widespread opportunity and need for GSI and increasing regulatory pressure to act, this is a growing sector with opportunities at all employment levels.

In addition, workforce development that considers accessibility and sustainable wages can bring strong economic and equity co-benefits to communities through GSI investments. Jurisdictions should support equitable workforce development initiatives for the benefit of their water and communities.

Who Is This Paper For?

To achieve clean stormwater, people within and beyond public utilities should champion GSI and clean stormwater. While most stormwater work is currently managed by public utilities, many other professions have opportunities to incorporate GSI in their work and make transformational changes for Puget Sound.

ENGAGING NEW GSI CHAMPIONS

Transportation departments plan, build, and maintain our region's roads, the source of our worst stormwater pollution. Developers invest significant money in GSI as required by Low Impact Development standards in stormwater codes. We need champions in transportation departments, and development and architecture firms, to incorporate stormwater retrofits into their standard planning routines.

City councils and other policy makers can provide policy support to make GSI feasible and easy so that planners from different urban sectors have a policy scaffolding to build on. Finally, residents, tenants, home buyers, and especially commercial tenants can drive demand for GSI, because developers will not expand investments if they do not hear from the buyers and users of their buildings.

Five Strategies to Accelerate GSI

This paper proposes five broad, commonsense strategies for cities and counties to contribute to Puget Sound restoration using GSI and other nature-based solutions to treat road runoff. We explore these five strategies through specific examples and case studies.

Strategy 1: Go Big, Because Home is Polluted. Use watershed perspective to prioritize toxic hotspots and treat with regional facilities.

Strategy 2: Make GSI Easy. Make policy changes to reduce barriers and boost GSI and hybrid gray/green retrofits for water quality at city and county levels of government.

Strategy 3: Show Me the Money. Incentivize investment in stormwater retrofits for roads that deploy nature-based solutions.

Strategy 4: Maximize Impact with Multiple Benefits. Build GSI projects that support communities beyond stormwater.

Strategy 5: Build Decision Maker Support. Accurately value and communicate the benefits and costs of GSI, and hybrid gray/green solutions including co-benefits.

ALIGNED WITH PUGET SOUND CLEAN WATER STRATEGIES AND FUNDING

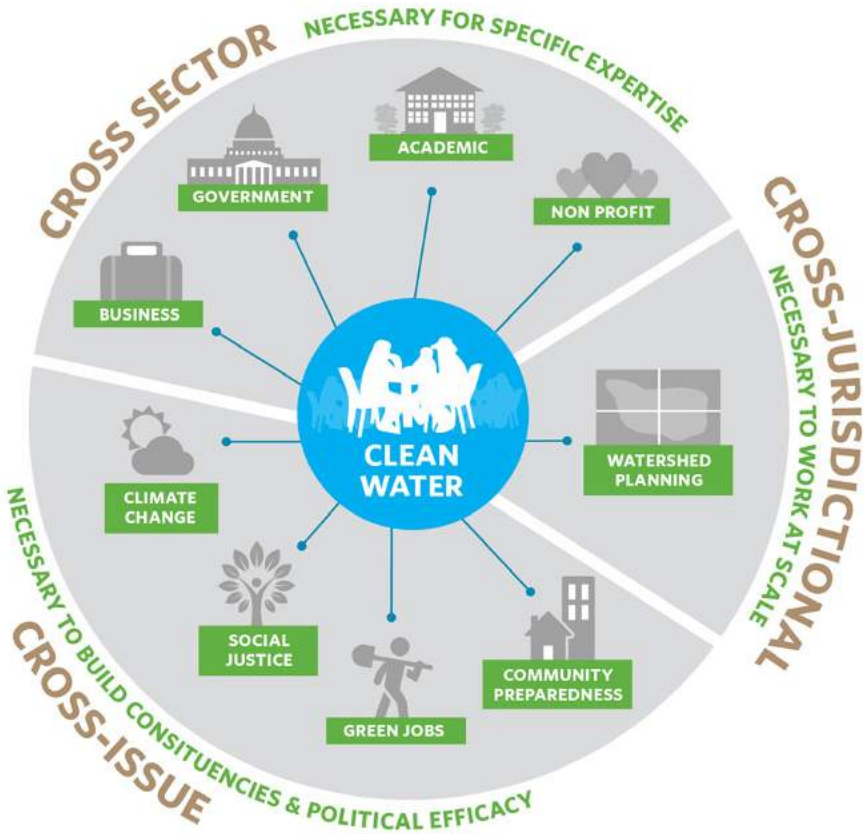
The strategies proposed in this paper are in alignment with the Stormwater Strategic Initiative Lead's Toxics in Fish Implementation Strategy: "Find and Fix Toxic Hotspots". While focused on water quality and toxic pollution, many of the strategies discussed apply to flow control aspects of stormwater as well.

The connection between the strategies in this paper and the Toxics in Fish Implementation Strategy means that jurisdictions may be eligible to seek funding to implement these strategies from Puget Sound Partnership's Stormwater Strategic Initiative Leads (SIL) as well as the Department of Ecology's Combined Water Quality Funding Program, among other sources.

In addition, the document includes three appendices. The Appendix A lists other knowledge resources for stormwater practitioners. Appendix B lists programs that can help jurisdictions find funding to support stormwater retrofits that deploy nature-based solutions. Appendix C provides a list of regional planning documents and policies that jurisdictions should consider for a comprehensive alignment of plans and policies that support GSI retrofits.

Who can help?

To build a robust coalition for collaboration, all are needed at the table.



Use a Watershed Perspective to Prioritize Toxic Hotspots and Treat with Regional Facilities

WATERSHED PERSPECTIVE IS THE NEW PARADIGM FOR STORMWATER PLANNING AND MANAGEMENT. This big picture view allows the overall health of a watershed to drive strategies, rather than focusing on visible pollution, localized flooding and erosion, and site-specific projects that provide little impact on the overall health of a watershed. As stormwater permitees told the Department of Ecology, "On our own we can each meet NPDES requirements without improving water quality in Washington State."[3]

From single creeks to large river systems, thinking about watersheds at different scales allows local jurisdictions to focus on priority sites and sub-basins, leverage regional coordination for economies of scale, and collect data in a collaborative and consistent manner.

Watershed-scale plans have the greatest impact when they prioritize retrofits and other stormwater improvements at sites with the most environmental, equity, and health benefits. By directing funding to the right locations, watershed-scale planning efficiently delivers water quality and GSI co-benefits while optimizing taxpayer resources.

1-A: Watershed Scale Planning—Collaborate Across Jurisdictions, Coordinate Projects

Plan at the watershed scale to address pollution hotspots including those that cross jurisdictional boundaries.

ECONOMIES OF SCALE

Watershed boundaries do not align with political boundaries, and the actions of one jurisdiction can impact another's water resources. For instance, upstream pollution can have significant impacts on the success of downstream jurisdictions' water quality efforts. Working across jurisdictions unlocks opportunities, as agencies can pool resources for more impact and take advantage of economies of scale when constructing GSI in jurisdictional overlap locations. Watershed-scale planning therefore requires partnerships across jurisdictions with an interest in the improved health of the watershed.

SITE-LEVEL COLLABORATION

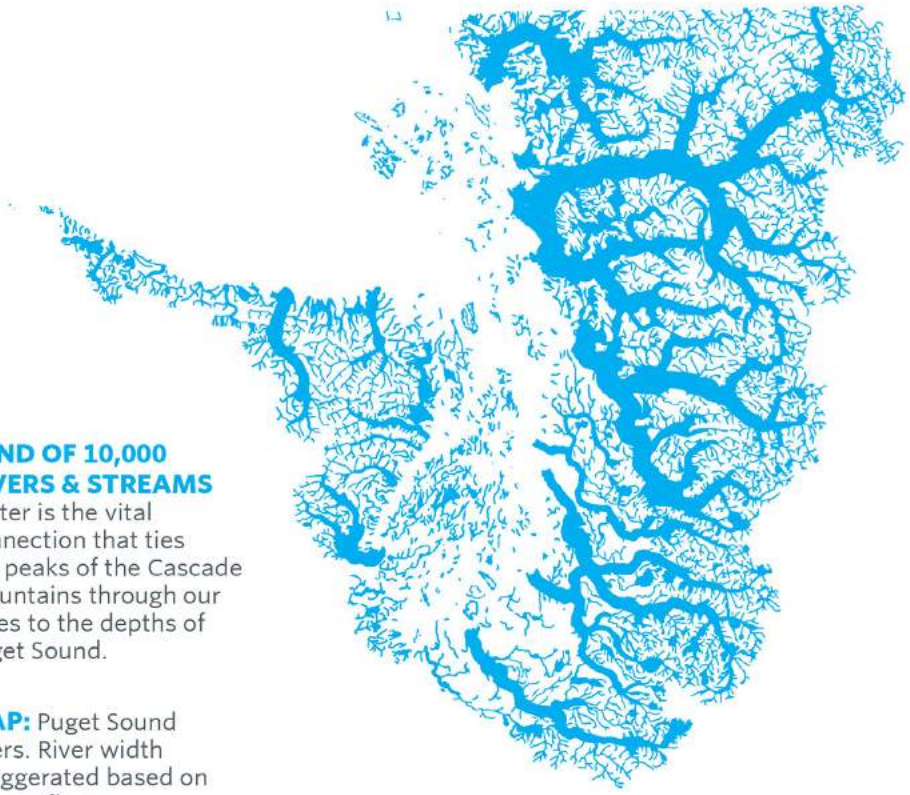
Cross-jurisdictional collaboration is important at the site and project level as well. Pollution hotspots likely to cross jurisdictions include streams crossing city boundaries, highways near busy roads where polluted runoff from Washington State Department of Transportation (WSDOT) and local jurisdictions overlap, and large outfalls and other locations where Municipal Separate Storm Sewer Systems (MS4s) collect from a broad drainage area that touches multiple jurisdictions.

Collaboration with WSDOT to treat highway and local runoff in overlapping locations may be particularly effective given WSDOT's budget of $500 million over 16 years for GSI retrofits.

WHAT IT TAKES

Effective watershed-level planning requires dedicated resources and collaboration across basins and political boundaries. Cities and counties need employees with the devoted time and skillsets to make collaboration work. It also needs shared goals and vocabulary around metrics and reporting and may require formal agreements between jurisdictions.

3 *(Blair, et al., 2022)*



LAND OF 10,000 RIVERS & STREAMS
Water is the vital connection that ties the peaks of the Cascade Mountains through our cities to the depths of Puget Sound.

MAP: Puget Sound rivers. River width exaggerated based on stream flow.

Data Sources: National Hydrography (NHD) Stream Data

Some of the barriers to effective watershed collaboration include restrictions on investment outside of a jurisdiction's boundaries and lack of staff with time devoted to collaboration. Multiple case studies in this document demonstrate how jurisdictions have overcome these barriers.

CASE STUDY:

Redmond Watershed Management Plan

Challenge: The City of Redmond wanted to be more strategic with its stormwater investments rather than respond to uncoordinated regulatory drivers for incremental change.

Solution: Redmond City Council approved the Citywide Watershed Management Plan in December 2013. The plan focuses resources and efforts into five watersheds to recover in-stream habitat within decades. Under Phase II NPDES requirements the city selected Mackey Creek for their SMAP planning using a watershed prioritization matrix. As a tributary to Bear Creek, King County's SMAP planning sub-basin, stormwater management in Mackey Creek will benefit cross-jurisdiction stormwater efforts.

Results: Watershed-scale planning maximized the overall water quality impact of the city's actions and aligned investments with those of other jurisdictions in a shared watershed. Redmond was highlighted *Building Cities in the Rain*, a document which provides guidance to local governments on how to prioritize creeks for restoration.

1-B: Think Big and Focus on Toxic Hotspots and Environmental Justice

Build multiple benefit retrofits for high traffic roads and super outfalls in communities facing environmental health disparities.

Prioritizing the overlap of these three areas will maximize the potential of retrofits for water quality and community benefits.

- **Super Outfalls and Large MS4[4] Collector Pipes** concentrate the pollution from large areas into one location where it can be efficiently treated before it creates toxic hotspots in natural water bodies. "Super outfalls" refers to outfalls with disproportionate volume and pollution load, such that cleaning the discharge would provide a disproportionately large water quality benefit compared to other potential retrofit sites.
- **High traffic roads** create toxic hotspots as the dirtiest sources of stormwater pollution. Using pollution modeling tools such as the Stormwater Heatmap, jurisdictions can prioritize the busiest roads and toxic hotspots in their watersheds.
- **Environmental justice and equity** should shape projects at each step, including site selection. By overlaying toxic stormwater hotspots with environmental justice-focused tools such as the Washington Environmental Health Disparities Map jurisdictions can prioritize retrofit investments in the communities facing the most environmental health burdens. The Equity Guide for GSI Practitioners provides in-depth guidance for incorporating equity into GSI projects and programs.

4 *(Municipal Separate Storm Sewer System (MS4). MS4s collect stormwater runoff from impervious surfaces like roads and roofs. Sanitary sewers carry human wastewater from buildings. Combined sewers carry both stormwater and human sewage, leading to combined sewer overflows (CSOs) during large storms when the total volume surpasses the capacity of wastewater treatment plants.)*

Raingarden plants waiting to grow in a raingarden at Paradise Parking Plots. © Kelly Compton

Given the close connections among traffic volume, stormwater pollution, air pollution, and environmental health disparities, GSI can address multiple sources of pollution. GSI can provide multiple benefits too, for example when nature-based treatment of road runoff leads to creating parks and usable green space, communities benefit beyond clean water.

"Most folks think of green stormwater solutions as small, distributed units like rain gardens spread throughout a drainage basin. We used GSI as a centralized, end-of-pipe facility instead."

CHRIS MAY
Kitsap County Public Works

CASE STUDY:

Paradise Parking Plots Community Garden in Kent, WA

Situation: Immigrant community members in Kent identified their needs, including building community, improved food access, and economic independence.

Solution: World Relief, with the help of over 1500 volunteers, built a community garden in an underutilized parking lot leased for free from Hillside Church. The project includes fifty garden plots, five rain gardens, five cisterns, and a flow control food forest/bioswale designed by the community.

Results: This project depaved part of a parking lot and manages 1.1 million gallons of stormwater annually. The garden provides culturally valued food for over 50 families from Kent's low-income immigrant and refugee community who garden at the site and builds community by "providing a space for people to build transformative relationships with their neighbors from around the world."[5]

1-C: Utilize Economies of Scale for Water Treatment and Planning

Regional coordination and watershed-scale planning creates opportunities for the development of larger consolidated GSI systems instead of a distributed patchwork of small, parcel-based facilities. It also allows the shared development and use of planning tools.

5 *(Paradise Parking Plots Community Garden, n.d.)*

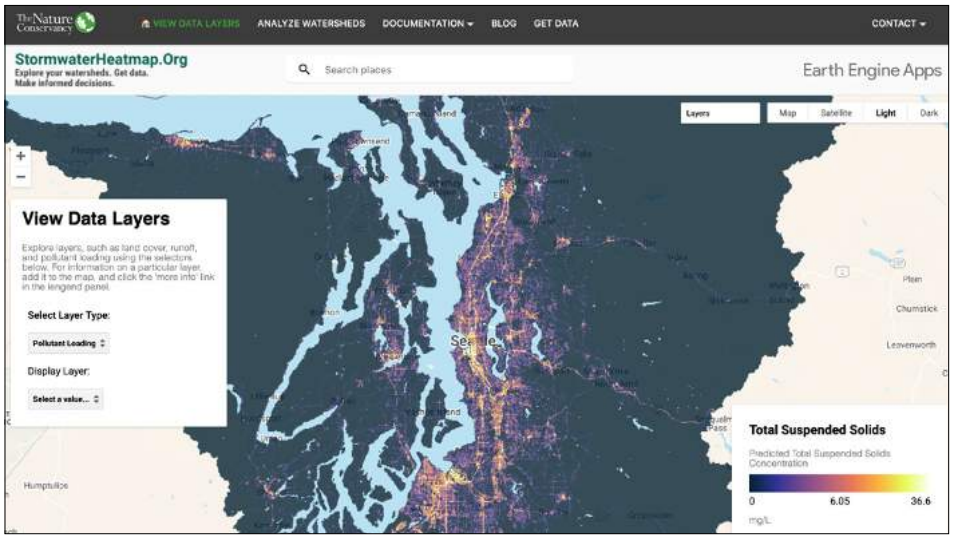
Regional Facilities—Implementing at the regional-level can be more cost-effective than smaller facilities per gallon of stormwater treatment both for construction and long-term maintenance costs.[6] WSDOT's $500 million budget for GSI retrofits from the Move Ahead Washington transportation package provides opportunities for cost-effective state and local collaboration on high-impact regional locations.

Regional Retrofit Fund—During the ad-hoc process to inform the 2024 municipal stormwater permit a group of practitioners recommended a Regional Retrofit Fund to increase funding availability and prioritize regional retrofits, which would bring economies of scale to the funding side of retrofits as well as BMP installation.

Regional Planning Tools—Jurisdictions should leverage analysis tools at the regional level for planning, rather than recreating the wheel in each city and county. This allows everyone to save money on tools and planning so limited funds go towards building BMPs.

Examples of regional-level analysis tools include:

- **Stormwater Heatmap:** Highlights the most polluted runoff. GSI siting can then be planned by overlaying pollution hotspots with high priority areas that may include salmon migration corridors, health disparity areas, and sites that are most important to the local communities. The heatmap uses a land cover mapping system capable of analyzing and classifying terrain at one-meter resolution.
- **EPA Green Infrastructure Modeling Toolkit:** A suite of tools from the EPA to plan for and model GSI and gray/green infrastructure water impacts, co-benefits, and costs.
- **The Nature Conservancy's GSI Siting Template:** A how-to guide and scope of work for jurisdictions and consultants to select optimum sites for GSI retrofits of existing urban areas.
- **King County's Water Quality Benefits Evaluation Toolkit and forthcoming GSI Retrofit Prioritization Study:** A collection of tools and models to identify pollution loading, most effective and cost-efficient BMPs for treatment, and where to site them.
- **SMAPr—Our Green Duwamish's Watershed Prioritization Tool:** A tool for cities in the Green/Duwamish Watershed to prioritize sub-basins for GSI retrofits and other stormwater activities.



I-5 Ship Canal Project Drainage Basins. The initial project will treat the blue area, and will study feasibility of treating water from the super outfall draining the Densmore Basin in red.

CASE STUDY:

I-5 Ship Canal Stormwater Pilot Project

Situation: Large volumes of the state's dirtiest water currently falls untreated from the I-5 Ship Canal bridge into a salmon migration corridor. The site is adjacent to a super outfall, the King County Densmore Outfall which drains over 2,000 acres of Seattle, including parts of I-5 and Highway 99. The area available to construct BMPs is limited to a single parcel. Seattle, King County, and WSDOT collaborating across jurisdictional boundaries is necessary to treat all the water at this high opportunity site.

Solution in Progress: The Nature Conservancy, WSDOT, and the WA Dept. of Ecology are partnering to build a multi-benefit stormwater park underneath the I-5 Ship Canal Bridge in Seattle. The goal is to demonstrate the feasibility of filtering large volumes of water on a parcel-sized footprint while creating a path for collaboration across jurisdictions.

6 *(Water Quality Benevits Evaluation - SUSTAIN Model, 2022)*

Expected Results:

- **Benefits:** Co-benefits from building this stormwater park may include connecting commuter paths, improving ADA accessibility, upgrading the TAPE facility used to test new BMPs, and educating the community about stormwater pollution and GSI.
- **Learning opportunities:**
  - » **Super Outfall Treatment**—The project presents an opportunity to demonstrate the water quality and economic value of large, end-of-pipe retrofits, as well as the feasibility of treating large volumes of water on a single parcel.
  - » **Maintenance**—A key challenge and learning opportunity for this project is creating a structure for maintenance responsibility and funding (see Strategy 3) for this multi-jurisdiction project where the utility agencies are already working at full capacity and there is not an existing permit or market incentive.

1-D: Collaborative Data Collection

Effective cross-jurisdiction data collection involves sharing metrics and reporting to create transparency and consistency that enable comparisons and cooperation.

Consistent data practices—Current metrics focus on water volume and flow control, but water quality is harder to compare across different pollutants and land uses. Consistent data practices, including developing regionally accepted water quality metrics, can help facilitate collaboration across permits.

Adult coho © Keith Lazelle

Sharing data with community and government partners—Shared data can help identify opportunities for creative partnerships. Some data layers that help with planning include maps of super outfalls and their drainage basins, downspouts off bridges/highways, and underground stormwater assets. High resolution land cover layers as well as performance monitoring of GSI are also helpful data sets. While traffic volume is a current proxy for 6PPD, the development of 6PPD data layers will also help prioritize treatment of road runoff that kills salmon.

CASE STUDY:

Western Washington Stormwater Action Monitoring (SAM)

Challenge: Efficiently monitor water quality and the impacts of stormwater management across the region without duplicating efforts.

Solution: SAM is a collaborative, Western Washington regional stormwater monitoring program funded by jurisdictions under the general municipal stormwater permits.

SAM's goal is to improve stormwater management to reduce pollution, improve water quality, and reduce flooding. SAM targets three strategic categories:

- **Effectiveness studies**—How well are required or innovative stormwater management practices working? What are the most common types of pollution in stormwater and how can we improve treatment?
- **Status and trends studies**—Are small streams and marine nearshore water quality getting better or worse?
- **Source identification projects**—What are the common sources of illicit discharges? What are some regional solutions for source control and elimination?

Results: A unique regionally funded and managed research and monitoring collaboration. All jurisdictions can benefit from SAM projects, designed to produce regionally transferable findings. All permittees implement SAM findings to protect downstream waters.[7]

7 *(Stormwater Action Monitoring, 2022)*

Policy Support for GSI Retrofits at City and County Levels of Government

GIVEN THE SCALE AND COMPLEXITY OF POLLUTING RUNOFF, improving water quality in the region will need to go beyond current best practices to 'next' practices—game-changing strategies that rapidly scale-up GSI retrofits for road runoff.

High-impact actions require looking beyond a specific road, property, or building. Changing the status quo to one where stormwater management is always a priority requires policy support and alignment across local government code and agencies.

2-A: Drive Road Retrofits with Offsite Stormwater Management Policies for Water Quality

Refocus stormwater investments from redevelopment to retrofitting, so that low-impact-development supplements a road retrofit strategy that accelerates treatment of existing pollution.

To achieve clean water within a generation, jurisdictions must frontload retrofits of roads rather than continue today's incremental path of treating stormwater only when something new gets built.

Offsite stormwater management policies allow developers, who are required to install stormwater BMPs when building, to site their flow control and/or water treatment BMPs somewhere other than the project site. They may also be able to buy into regional facilities that consolidate the required treatment from many sites.

FRONTLOADING WATER QUALITY PROGRESS

Washington's current municipal stormwater permit relies primarily on the incremental and piecemeal approach of low-impact development (LID) requirements on new and redevelopment to increase treatment. LID standards make developers install stormwater management BMPs when they rebuild or build new impervious surfaces. Given the slow rate of redevelopment, this approach will take over 60 years to bring existing urban buildings up to permit compliance while not effectively addressing road runoff, the main source of pollution.[8] Offsite stormwater management maintains the level of effort of LID, while concentrating it in regional facilities at the locations and scale needed to improve water quality in the near term.

FUNDING OFFSITE STORMWATER MANAGEMENT AT REGIONAL FACILITIES

Credit trading and in-lieu fee policies provide financial mechanisms to release developers from their water quality obligations in exchange for investment in these hotspot projects. These policies help can cover capital and maintenance costs for regional facilities. This provides a particularly effective opportunity to fund treatment of large volumes of dirty water by retrofitting busy roads and MS4 outfalls or collection pipes. For additional information on financial incentives see: Strategy 3-A.

CHALLENGES AND POTENTIAL SOLUTIONS FOR OFFSITE MANAGEMENT POLICIES

Strategies for offsite stormwater management have been successfully implemented in many jurisdictions across the country. Puget Sound can learn from the challenges and solutions found elsewhere.

8 *(Washington Dept. of Ecology, 2019 Stormwater Management Manual for Wester Washington Appendix I-E: Introduction to the Stormwater Control Transfer Program)*

Clarify the use of water quality and flow control BMPs. In some instances, it may make sense to provide offsite management for one while requiring onsite management for the other. For example, WA Department of Ecology's current guidance for offsite management is focused on flow control. However, from a toxic pollution standpoint there is a need for offsite management for water quality.

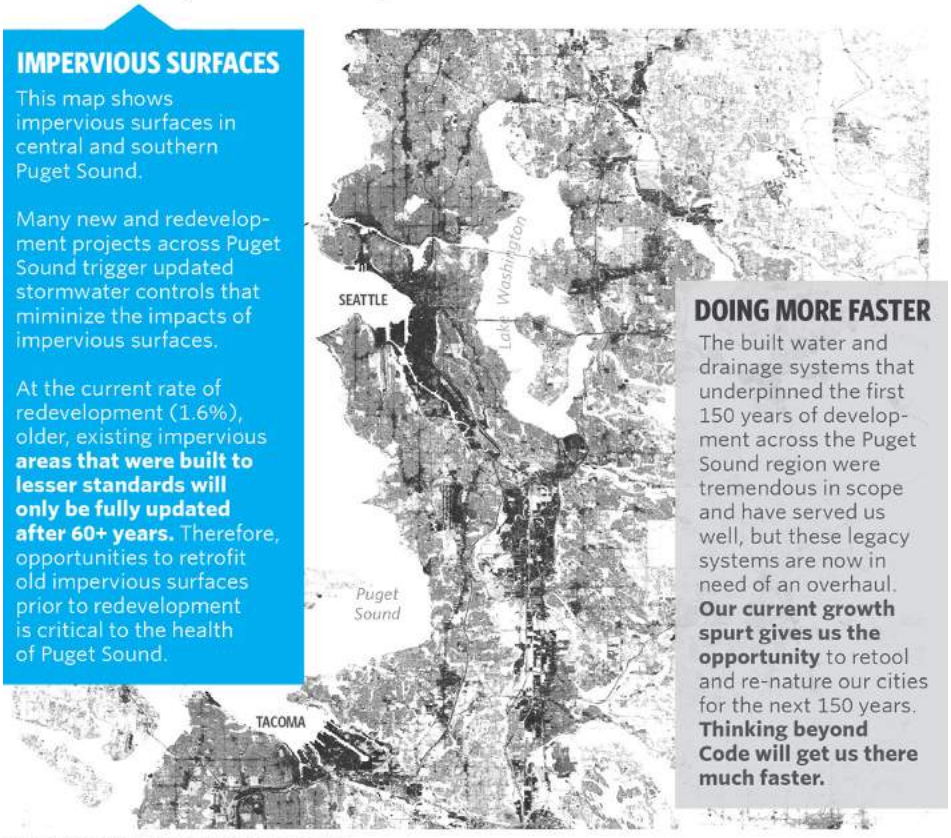
Investments in water quality BMPs are most effective when they treat our region's dirtiest water—road runoff. Flow control BMPs, on the other hand, may be similarly or more effective in distributed facilities. The necessary BMPs for any project are influenced by whether a system flows into a combined sewer or MS4, as well as whether a receiving water is flow control exempt.

Develop consistent methods for measuring outcomes. Most areas in the country using offsite stormwater management focus on flow control. Comparing water quality outcomes across different land uses and pollutants is a challenge. A gallon of runoff from an interstate and a gallon of runoff from a residential area have different pollution loads, as do areas with non-car related pollutants such as PCBs in building envelopes. The Nature Conservancy is developing a metric to compare water quality treatment across land uses and pollutants, which will allow for better offsite management.

Clarify the rules for transferring stormwater responsibility off-site and jump-start treatment. WA Dept. of Ecology identifies different rules for in-basin and out-of-basin transfers, which can be restrictive for creating trading systems. Ecology should create clear rules that allow for offsite stormwater management to encourage front-loading treatment (as opposed to waiting for LID BMPs at the snail's pace of redevelopment).

What is the scope of the problem?

The large footprint of impervious surfaces in Puget Sound was developed prior to stormwater quality controls created by the Clean Water Act.



Data Source: 2006 NOAA impervious surface data

OFFSITE STORMWATER MANAGEMENT RESOURCES:

- King County's Report on Feasibility of In-Lieu Fee, Credit Trading, and Basin Transfer Program's for Stormwater Management
- Economic Instruments For GSI—A comprehensive report on the financial mechanisms to support offsite management.
- Municipal Stormwater Permit Guidance—Washington State Department of Ecology (Refer to the guidance for "Runoff/Flow controls for development".)
- 2019SWMMWW—Stormwater Control Transfer Program from the Stormwater Management Manual for Western WA Volume 1, Appendix I-E.
- FAQ for Implementing the Flow Control Standard in Ecology's Western Washington Municipal Stormwater Permits—An FAQ document that explains the different ways the flow control standard can be implemented.

A roadside raingarden on Beacon Hill in Seattle. © Zoe van Duivenbode

2-B: Fix Road Runoff Pollution When You're Already Fixing Roads

Collaborating with transportation departments makes it cheaper to install GSI to treat road runoff.

By a large margin, cars and trucks are often the most significant source of pollution in our water and air. Collaborating with transportation departments when roads, bridges, and highways are redesigned or reconstructed is often the easiest and most economical approach to treating stormwater runoff. For example, the City of Seattle found that the lowest cost point in time to make green infrastructure investments is often when unrelated capital projects get built.

POTENTIAL FOR SIGNIFICANT COST SAVINGS

According to the City's estimates, it would be roughly three times cheaper (per gallon of water treated) for the Seattle Department of Transportation to install a roadside bioswale while doing adjacent unrelated work than to build the GSI independently. Additionally, incorporating GSI retrofits into transportation capital improvement plans will help agencies recognize and plan for opportunities to collaborate. However, legislative action may be needed to address "color of money" issues when limitations on how agencies can spend their money prevent collaboration.

CASE STUDY:

Seattle's Natural Drainage Systems

Challenge: Design and build cost-effective streets with green infrastructure to treat stormwater runoff.

Solution: Seattle's Natural Drainage Systems and Green Grid projects use bioswales and other GSI to cost-effectively treat road runoff and beautify the urban environment.

Results: Integrating stormwater retrofits when streets are being rebuilt can be the most cost-effective way to add retrofits. According to Seattle Public Utilities, street designs with green infrastructure cost up to $240,000 less per block than a traditional street and drainage improvement. For example, the rebuilding of the Broadview and Pinehurst grids, both of which incorporate GSI, were cheaper than conventional approaches to stormwater treatment.[9]

2-C: Remove Barriers for Private Investment to Fix Public Road Pollution

Maximize efficient investment by allowing and encouraging developers to clean road pollution flowing adjacent to their on-site efforts.

New and re-development projects in Puget Sound already spend lots of money on stormwater management for private

parcels as required by LID standards. However, as exemplified by the Stormwater Heatmap, the worst source of stormwater pollution comes from public roads, just across the property line from the BMPs installed for LID.

Making it easier for private developers to treat adjacent road runoff as part of their required post-construction stormwater management will reposition the state's primary stormwater solution, redevelopment, to address the primary pollution problem, road runoff.

Barriers to treating right-of-way runoff on private property include:

- Legal restrictions on treating public runoff on private property and private runoff in the right-of-way
- Difficulty working with siloed and unresponsive public agencies.
- Questions of who will hold liability in the event of flooding or other system failure.
- Lack of incentives for any entity to take on the cost and responsibility for construction or maintenance.

Overcoming these barriers will require buy-in, collaboration and incentives for developers, stormwater utilities, and transportation departments. Having coordinated a project that overcame these barriers (see Aurora Bridge case study), The Nature Conservancy is confident that this is a workable strategy to dramatically expand the impact of post-construction stormwater management.

CASE STUDY:

Aurora Bridge in Seattle

Challenge: Private developer Mark Grey wanted to treat the dirty highway runoff flowing untreated off the Aurora Bridge (State Route 99) next to his project site. The water ran off a WSDOT road and through City of Seattle infrastructure managed by multiple, siloed city agencies.

Solution: Tenacity. After a challenging process working with multiple public agencies, Mark Grey's company installed rain gardens under the bridge in the public right of way. The developer maintains the soil and vegetation in the rain garden while Seattle Public Utilities maintains the below-grade infrastructure.

Results: The project treats two million gallons of highway runoff per year and identified roadblocks that government agencies need to overcome to leverage private development for right-of-way runoff. If agencies address these barriers and incentivize private investment, the Aurora Bridge project will provide a replicable model for private beyond-code treatment of public stormwater.

Aurora Bridge Rain Garden © Courtney Baxter

9 *(Seattle Public Utilities "Natural Drainage System Program")*

Aurora Bridge Project

ROADBLOCKS	SOLUTIONS
Policy prevented treating road runoff on private parcels and parcel-side runoff in the right-of-way.	These policies should have exceptions when GSI can be intentionally engineered/sized to accept additional runoff from both sides of the property line and in cases where the parcel-side owner is public (city facility, for example, or a park). Operations and maintenance commitments need to be explicitly established during planning.
Funding voluntary retrofits was difficult even with willing partners for construction, and operations and maintenance.	Need stronger NPDES permit incentives for retrofitting roads in all jurisdictions. Leverage Structural Stormwater Controls program for retrofits.
Public agencies were unresponsive to private partners.	Government agencies should create a process and points of contact to facilitate private retrofits of public stormwater pollution.
Permitting process review timelines did not align with project needs, and GSI did not qualify for expedited permits.	The development team negotiated a variance to the 30-60-90 process that included closer to real-time access to the Street Improvement Permit reviewer. The development team felt that without the variance, the timelines for review and risk of major changes late in the design process would have been prohibitive. Note: The Philadelphia Case Study in Strategy 3-B of this paper explores how cities can use permitting to incentivize private treatment of public runoff.

2-D: Integrate GSI Solutions in Parks—in Visible and Invisible Ways

Just like collaboration with the local Department of Transportation, collaboration with the Parks Department can supercharge GSI opportunities.

Parks and open spaces are optimal locations to build GSI with multiple community benefits. Regional stormwater facilities can provide an opportunity to create new parks or be incorporated into existing parks.

Parks contribute to the attractiveness of an area and provide health benefits such as lowering stress and mental illness. Creating a stormwater park presents opportunities for community co-design or community engagement so the users get to shape their public spaces.

CASE STUDY:

Manchester Stormwater Park, Kitsap County

Challenge: Treat stormwater while also creating a beneficial space for the local community.

Solution: In 2012, Kitsap County used a holistic approach to stormwater investments at its Manchester Stormwater Park. The County used a collaborative design process to envision a multi-use facility. The design of the treatment system and park includes

innovations that make effective use of limited space.

Results: The built facility has multiple benefits. It improves water quality, alleviates flooding, and creates a park and public gathering space for the community that accrues economic benefits to surrounding businesses. Using GSI as a reason to create a park built public support.

"We have learned through public outreach that folks want a multi-functional, multi-benefit facility—they care about water quality and want to clean their runoff, but they also want park-like features that provide community amenities and recreational opportunities."

CHRIS MAY
Kitsap County Public Works

CASE STUDY:

Point Defiance Regional Stormwater Treatment Facility, Tacoma

Situation: Before the facility was built, polluted stormwater from the 754-acre watershed flowed untreated into Puget Sound near Point Defiance Marina. The polluted stormwater flowed into an area already overloaded with heavy metals from the Tacoma Asarco Smelter Plume.

Solution: In 2015, Metro Parks Tacoma and the City of Tacoma built the innovative Point Defiance Regional Stormwater Treatment Facility within Point Defiance Park to improve water quality in Puget Sound. Among the largest facilities of its kind in the world, the 5,500-square-foot project features a series of six cascading pools that channel stormwater runoff from streets and properties.

Results: Collaboration between the parks department and stormwater utility resulted in clean water benefits for Puget Sound. With a six-pool waterfall, the facility is also an amenity with a placemaking benefit.

"This project demonstrates with the power of partnerships, we can support healthy neighborhoods and a thriving Puget Sound, leaving a better Tacoma for all."

JESSICA KNICKERBOCKER
Environmental Engineer, City of Tacoma

Pt Defiance Storwmater Park in 2017 © Jessie Israel

2-E: Use Community-Based Public Private Partnerships for Maximum Benefit

A relatively recent business model, Community-Based Public Private Partnerships harness the government's public interest focus and financing abilities along with the cost efficiencies of the private sector and economies of scale.

As described by the Washington State Department of Commerce, Community-Based Public Private Partnerships (CBP3s) for GSI are a form of performance contract between a public and private entity, where the public agency provides funding and guidelines while the private organization designs, builds and maintains GSI facilities.

TNC Raingarden project at a church in Prince George's County, MD © Kahlil Kettering

ADVANTAGES OF CBP3S

This model shifts risk from public to private entities since the private partner only gets paid when they achieve the metrics in the contract. This allows the public partner to include a wide range of public benefits in the contract terms, including water quality outcomes, workforce development, equitable contracting and more. For example, CBP3s can help overcome the maintenance challenge faced by municipalities who may have capital to invest in green stormwater facilities but don't have the people power to maintain those facilities for the long term.

The CBP3 model requires the inclusion of many projects under a single contract, taking advantage of economies of scale for both public and private benefit.[10] To learn more about CBP3s, check out the CBP3 resources for municipalities funded by WA Department of Commerce, including a guide for municipal stormwater managers.

CASE STUDY:

CBP3 in Prince George's County, Maryland

Situation: Starting in 2014, Prince George's County had to significantly improve management of its stormwater to meet NPDES permit and Chesapeake Bay Total Maximum Daily Load requirements. This includes retrofitting at least 15,000 acres of impervious surface by 2025. The cost for the county to do the work alone was estimated at $1.2 billion.

Solution: The county created a CBP3 with Corvias to finance, design, build, operate and maintain (FDBOM) a massive urban stormwater green infrastructure retrofit program. This non-traditional CBP3 is purposefully designed to promote innovation and create a true partnership between the county and the private sector to:

- Share financial and legal risks
- Drive costs down through technological innovations
- Obtain greater efficiencies through market forces
- Stimulate economic development by creating new sustainable business opportunities and jobs and building community wealth[11]

Results: Corvias completed retrofits of the first 2,000 acres of impervious surface under-budget and in half the time allotted. They have now retrofitted over 4,500 acres at 215 project sites, while continuing to maintain the projects for the 30-year life of the contract. To meet the community benefit aspects of the partnership agreement, Corvias subcontracts much of the work to local, women, and minority owned businesses. To date, 77% of the workforce lives within Prince George's County.[12]

10 *(Environmental Incentives, Geosyntec Consultants, Corvias, Futurewise, 2019)*

11 *(Environmental Protection Agency, 2022)*

12 *(Corvias; Prince George's County, 2022)*

2-F: Get Everyone on the Same Page: Align Local Plans and Policies with GSI

Leverage the multitude of planning efforts to further GSI retrofits.

One of the most influential roles of government is to set policy and establish regulations. In addition to the Stormwater Management Plan required under the NPDES permit, jurisdictions can incorporate stormwater planning into other aspects of policy.

For example, permittees must incorporate LID standards into their building codes, something most jurisdictions have completed.

Other potential plans that could include GSI:

- Comprehensive plan required by the Growth Management Act
- Surface Water Comprehensive Plan
- Transportation
- Utilities
- Capital Facilities
- Climate Action
- Urban Forestry
- Parks

Like Tacoma and Portland (see case studies), jurisdictions benefit from aligning local plans and policies with the goal of using GSI retrofits to find and fix toxic hotspots. Coordinating plans and policies at a state, regional, or federal level presents additional opportunities to support GSI retrofits.

Appendix C includes a comprehensive list of plans and policies and shows potential opportunities to integrate GSI.

CASE STUDY:

Tacoma Mall Subarea Plan Stormwater Strategy

Challenge: Create neighborhood plans that incorporate green infrastructure and its many co-benefits.

Solution: In planning for the Tacoma Mall subarea, the City of Tacoma conducted technical studies including substrate investigations and urban stormwater modeling, which improved the City's understanding of soil and groundwater conditions in the subarea. This information enabled the subarea plan to achieve a high level of specificity and certainty regarding stormwater infiltration potential and identified areas best suited for green stormwater infrastructure. This work informed the development of an area-wide stormwater strategy as part of the subarea plan.

Results: Tacoma incorporated GSI early in the neighborhood planning process, ensuring infrastructure improvements serve stormwater management and other goals. Strategic leveraging of stormwater projects enables the City to fund and achieve multiple goals with individual projects, such as complete street improvements that include GSI, improved drainage, sidewalks, and greenery. [13]

CASE STUDY:

Portland Green Streets Program

Situation: The City of Portland, Oregon identified that 66% of its runoff came from streets and right-of-ways, and made the policy decision to pursue GSI retrofits to its streets.

Solution: Portland mandates Green Street retrofits in all city projects that require a stormwater permit. If project related GSI retrofits are infeasible, then an offsite retrofit is required. With a limited number of exceptions, city projects that do not trigger a stormwater permit still contribute a 1% fee into the Green Street fund. The city aligned goals for livability, sustainability, green space, transportation, and the environment in the Comprehensive Plan. Potential projects were prioritized in alignment with the Portland Department of Transportation Capital Improvement Plan.

Results: Over the last decade, Portland has retrofitted dozens of streets through its Green Streets Program. GSI retrofits are transforming a surface water problem into a community amenity with linear green spaces and protecting wellhead areas, while preserving infrastructure investments by limiting the demand on the combined sewer system. These changes also reduce costs associated with stormwater treatment. [14]

2-G: Amend the Rules to Make High-Impact and Multi-Benefit GSI Projects Easier

Jurisdictions can allow themselves to improve stormwater management.

Although communities have basic rules in place to allow GSI, amendments need to address barriers and specifically support stormwater retrofits of older facilities such as roads and highways.

Incorporate GSI into green streets. This may require use of code amend-

13, 14 (City of Tacoma, 2018)

ments to eliminate conflicts with requirements for parking, ADA accessibility, utilities clearance, curb and gutter, and oversized streets for fire and safety equipment.

Target LID requirements at road pollution. Cities can require or incentivize developers to plan for retrofits that treat road runoff adjacent to their parcel boundaries. Updated rules should clarify liability and maintenance responsibilities. Development regulations, site planning requirements, design guidelines, and related forms and checklists should specifically include provisions for road and site GSI retrofits to ensure they are considered at the beginning of the project.

Specify responsibilities for performance monitoring and maintenance. The development regulations that address issues such as utilities, roads and landscaping should also specify responsibilities for GSI performance monitoring and maintenance. The Building Green Cities guidebook can help identify BMPs and ways to incentivize developers to implement them.

Support funding streams for GSI. Add authorizing language for GSI funding streams, including stormwater transfer control programs if communities choose to pursue that. Funding streams for GSI should ensure all multi-benefit features are eligible. For example, if funding a stormwater park, make sure that the funding covers features that make the park a desirable public space in addition to the BMPs treating the water.

2-H: Offer Clarity and Support for Maintenance Responsibilities

Overcoming maintenance challenges allows more GSI projects to move forward.

Maintenance is a major barrier and knowledge gap for implementation of nature-based stormwater management strategies.[15] Governments cite maintenance as one of the biggest barriers to implementation of GSI retrofits due to uncertainties about long-term costs, enforcement on private property, and equipment and personnel needs.

The following solutions may help provide certainty for maintenance:

- More and reliable funding for maintenance, which could include a dedicated maintenance fund for GSI retrofit projects.
- Sufficient regional workforce trained in GSI maintenance
- Workforce development and a clear career path for GSI maintenance professionals.
- Sufficient agency staffing
- Ensure access to needed maintenance equipment, and use an equipment co-op or rental where several jurisdictions can share specialized equipment.
- Track maintenance and operations costs for GSI retrofits to better predict future costs.
- Utility rate discounts for property owners who maintain their own GSI facilities.
- Use CBP3s (Strategy 2-E) to lower the costs and staffing needs for GSI maintenance.
- Use Structural Stormwater Control points trading or other trading system to fund maintenance
- Update local codes to ensure clear assignment of GSI maintenance responsibility, just as codes assign responsibility for utilities, land use, transportation, and law enforcement.

15 *(Futurewise, 2016)*

Incentivize Investment in GSI Retrofits for Roads

THE CURRENT SYSTEM FOR BUILDING NEW STORMWATER TREATMENT IN WESTERN WASHINGTON relies on private developers installing stormwater infrastructure when they build to mitigate runoff from their impervious surfaces. This approach ignores existing infrastructure, especially the roads where most stormwater pollution originates. Local jurisdictions can use a range of strategies to refocus developers and private investment on public roads for water quality treatment.

CATALYZING PRIVATE INVESTMENT IN ROAD RUNOFF TREATMENT

Financial incentives to shift private money towards road and highway retrofits are particularly important since retrofits of existing roads and impervious surfaces are rarely required by regulations and NPDES permits. Incentives for the private sector can spark transformative ideas for integrating GSI retrofits of existing roads into new development. In stakeholder workshops, the Natural Resources Defense Council found that while regulations are the primary driver for private installation of GSI, financial incentives are the catalyst for GSI retrofits beyond minimum requirements.[16] Regardless of incentive type, certainty and simplicity are key to an effective incentive program.

3-A: Move the Money to the Problem: Financial Mechanisms for Offsite Stormwater Management

Redevelopment is currently the primary source of retrofitting investment in urban areas. Cities and counties with offsite stormwater management plans should create financial mechanisms to redirect money from parcel scale stormwater BMPs to regional facilities with higher impact, cost effectiveness, and community benefit.

Offsite stormwater management programs (Strategy 2-A) have the potential to accelerate water quality improvements by frontloading investments in GSI. Two common strategies used are credit trading and in-lieu fees.

Credit trading programs enable property owners who are subject to on-site stormwater requirements to meet a portion of their requirements by buying stormwater "credits" from other facilities rather than building GSI on their own property. These trading programs provide flexibility around post-construction requirements that make them attractive to property owners and potential developers.

Credits can act as incentives for existing property owners to voluntarily implement stormwater management retrofits on their properties since they can sell these credits. Credit trading schemes can thus distribute stormwater management strategies across both existing and new development. While establishing and administering a credit-trading program and market can be expensive for local governments, the cost is far lower than the utility building equivalent runoff treatment.

In-lieu fee programs allow the payment of a fee instead of on-site stormwater mitigation. The fees are typically calibrated to reflect the cost of remediation measures. A prioritization framework allows local jurisdictions to direct accumulated fee revenues toward the implementation of stormwater projects in these priority locations. This

16 *(Natural Resources Defense Council, 2015)*

is a common strategy in the wetland mitigation world, and the WA Dept. of Ecology has provided guidance on in-lieu fees for flow control.

CASE STUDY:

Tacoma In-Lieu Fee Program

Challenge: Lack of water quality treatment and flow control, with long time-horizons for redevelopment under LID requirements to significantly improve water quality.

Solution: Frontload investments in water quality and flow control to see immediate environmental benefits rather than waiting for redevelopment to improve stormwater management parcel by parcel.

The City of Tacoma instituted an in-lieu fee system for water quality in the Thea Foss Watershed and for flow control in the Flett Creek watershed. After constructing facilities that treat stormwater in these watersheds, the city allows developers to buy-in to these facilities in-lieu of installing BMPs on the property. Because each watershed only has regional facilities to address one minimum requirement, new construction still must address the other applicable minimum requirements on-site.

Results: Building regional facilities *now* accelerates water quality improvement. The in-lieu fees also lower the cost of development in the urban core and allow the city to recover capital expenses. The City of Tacoma manages maintenance to ensure that water quality benefits continue long term.

3-B: Move the Money to the Closer Problem: Post-Construction Stormwater BMPs for Roadside Runoff

When requiring BMPs on private property, have them treat runoff in the adjacent road as well.

Developers already spend significant money meeting post-construction stormwater standards for new buildings. Redirecting this money to treat adjacent road runoff will improve the value of these investments for the community. This represents the economic side of policy Strategy 2-C.

CASE STUDY:

Philadelphia's Developer Right-of-Way and Height Bonus Incentives[17]

Challenge: Unmanaged road runoff flows right past the BMPs built by developers to meet permit requirements. Cities do not have the capacity to quickly retrofit every street, and most developers will not volunteer to manage stormwater beyond their permit requirements without incentives.

Solution: These incentives provide money and increase the allowed building height for property owners who direct drainage area from the right-of-way (ROW) into their BMP. The designer includes the additional runoff in sizing the BMP and designing conveyance to the BMP while meeting all required project criteria. During construction, the development contractor constructs any on-site structures needed for this management. Philadelphia later constructs infrastructure, such as an inlet and junction box, within the ROW using separate, non-Incentive funding.

Result: Incentives lead to voluntary treatment above and beyond permit requirements for road runoff that would otherwise go untreated.

CASE STUDY:

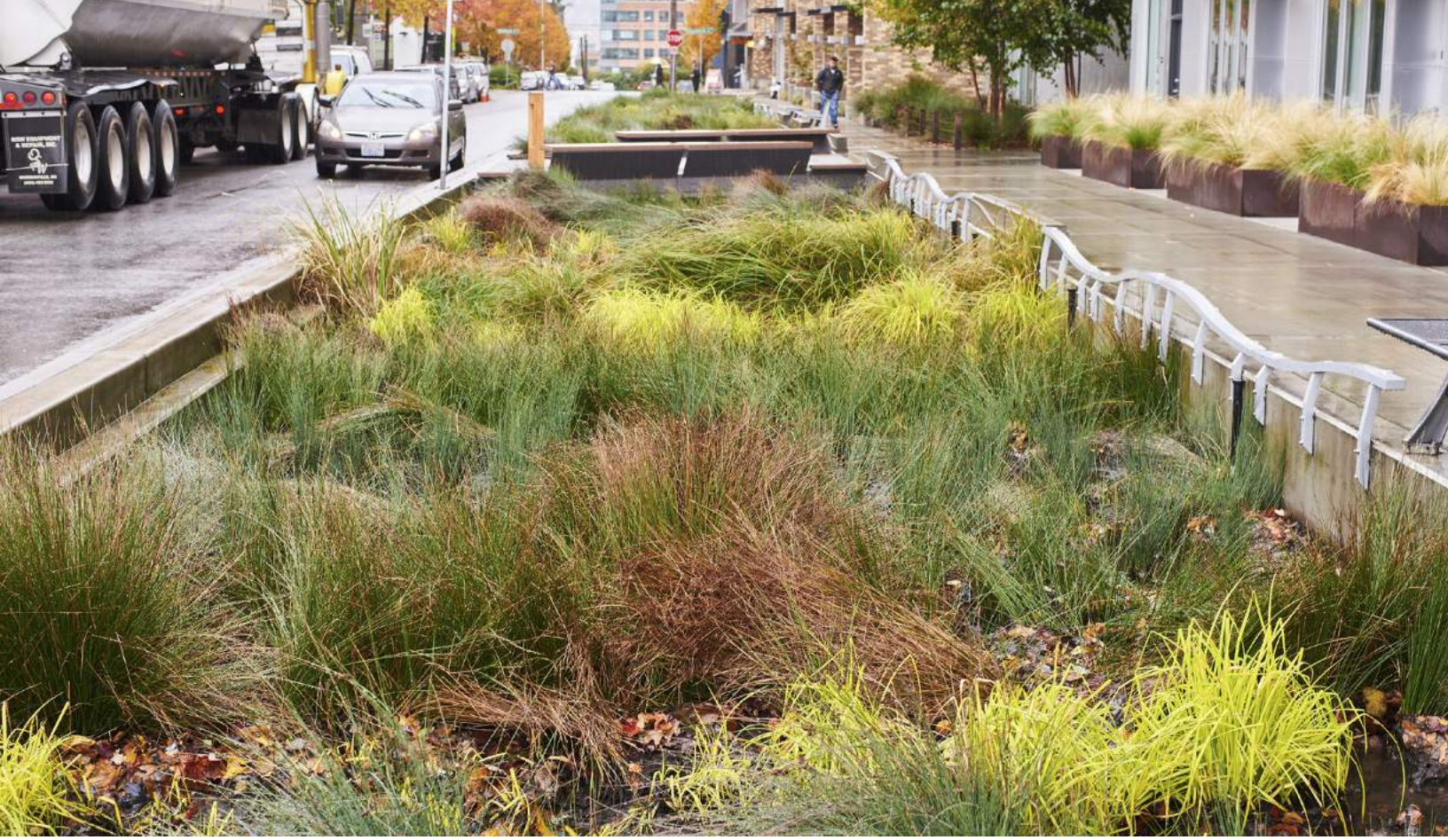
Swale on Yale, Seattle

Situation: Millions of gallons of urban runoff were running untreated from Capitol Hill into Lake Union.

Solution: Seattle Public Utilities partnered with Vulcan Real Estate in the spring of 2018 to construct a stormwater treatment system along four city blocks. The project consists of four biofiltration swales (a series of extra-wide planting areas between the sidewalk and the roadway), a pre-treatment swirl concentrator, and a diversion structure.

Results: Together, the four swales treat stormwater from 435 acres of Capitol Hill streets and sidewalks. That equates to an average of 190 million gallons of stormwater annually flowing from Capitol Hill into Lake Union. In addition to addressing stormwater treatment, the swales make the area more pedestrian-oriented

17 *(Development Incentives, n.d.)*



Swale on Yale in 2016 © Michael B. Maine

and knit together public spaces in the community. Insufficient pre-treatment means that heavy sediment loading of the BMPs requires more maintenance than anticipated. This can be prevented with properly designed pre-treatment.

3-C: Grants & Rebates: Offer Funding for GSI Retrofits to Private Parties

Grants and/or rebates are highly motivational for private property owners to install GSI retrofits even if they do not cover the full cost of the improvements.

Private property often has impervious surfaces needing retrofits. Expense, rather than space, is often the limiting factor. Grants and rebates can dramatically increase the amount of water treated by GSI while supporting local contractors and improving property values. County and local jurisdictions are encouraged to create incentives like the successful rebate programs cited here.

To meet water quality goals, TNC recommends focusing on commercial and multi-family residential areas with parking lot and road surfaces in need of GSI water quality treatment in addition to flow control.

REBATES FOR GSI RETROFITS

- Shoreline Soak It Up Rebate Program: Rebates of up to $1,600 for rain gardens or conservation landscaping on residential or commercial property.
- Kirkland Yard Smart: Site visit and consultation that evaluates private property for runoff, suggests specific retrofits, and counsels the owner on next steps. Homeowners that install a recommended retrofit can receive a 75% rebate of project costs, up to $6,000 for commercial properties.
- Seattle & King County Rainwise: Property owners located in targeted combined sewer overflow basins within the City of SEattle can receive up to 100% rebate for installing certain GSI.
- 12,000 Rain Gardens in Puget Sound: Informs people about rain gardens, offers technical advice, and connects people to resources, rebates, and grants. Developed by Stewardship Partners.

© Michael B. Maine

3-D: Stormwater Utility Fee Reductions: Offer Lower Bills Over Time

Stormwater utility fee reductions give property owners that invest in GSI retrofits a fee reduction, creating an on-going incentive to install GSI.

A study of the City of Philadelphia's fee reduction program found that stormwater utility fees were a useful incentive for property owners to reduce impervious surfaces or manage water on-site. Lower cost improvements such as downspout disconnections and swales were able to recover initial installation costs within ten years of construction, just through fee reductions alone.

A SUPPLEMENTAL APPROACH

In contrast, more expensive GSI retrofits such as rain gardens, green roofs, or porous pavements could not achieve fee payback within ten years. This indicates that while fee reductions are useful and practical, they may be most effective as part of a larger package of policies and incentives to support a full complement of GSI retrofits.[18]

Often fee reductions programs are tied to the ratio of pervious/impervious surface or other metrics related to GSI function. Some programs cap the total fee credit. For example, the Seattle Stormwater Facility Credit Program allows drainage fee reductions up to 50% of the total bill for parcels that maintain their own, fully functioning stormwater system on site.[19]

3-E: Leverage Development Permitting and Zoning Incentives

Permitting and zoning incentives for developers can be very successful in obtaining specific project benefits.

Incentives can be used to spur private developers to mitigate pollution beyond the footprint of their parcel, such as from a neighboring roadway (Strategy 2-C). NPDES permits mandate that cities and counties require LID construction for new/re-development. Therefore, encouraging developers to treat water from adjacent busy roads may be the most effective use of these permitting and zoning incentives.

OFFER INCENTIVES THAT SAVE TIME AND MONEY

In The Nature Conservancy's focus groups, developers shared that allowing code compliance flexibility or speeding up the development permit process could provide an incentive by saving developers money without a direct cost to local jurisdictions.

Examples of development and zoning incentives include:

- **Expedited permitting:** Expedited review can be an incentive for nearly any type of development and could be used as an incentive for GSI retrofit projects. However, fast track permitting requires that jurisdictions maintain adequate staffing levels and staff trained in GSI retrofits.
- **Density bonuses and/or zoning variances:** While expedited permitting can help reduce the costs of development, another set of incentives can help increase revenue. These incentives provide density bonuses or zoning variances. Density bonuses can allow developers who incorporate GSI into their projects to build at a higher density than they would otherwise be allowed, while zoning variances can allow developers to build a different land use such as denser housing or allow variations in certain requirements. Incentive systems should be crafted to provide incentives that meet developers' market demands and provide community benefit.

Typically permitting and zoning incentives are applied at the time of development or redevelopment, so their use for GSI retrofits would be limited to parcels obtaining a development permit. However, incentives have been applied in several places to spur community amenities such as open space, public art, or environmental restoration.

18 *(Natural Resources Defense Council, 2013)*

19 *(Stormwater Facilities Credit Program - Questions and Answers)*

Design Projects that Support Communities Beyond Stormwater

STRATEGIC SITING AND DESIGN CHOICES FOR GSI RETROFITS HELP ENSURE THEY DELIVER MULTIPLE BENEFITS, such as improved public health and climate resilience.

Equity—While much of this paper has focused on cleaning the dirtiest water in our urban areas, jurisdictions should also consider the multiple benefits that GSI can have for the people living in their communities. When governments that have underinvested in BIPOC and low-income communities recognize this history and prioritize these areas, GSI investments become pro-equity investments as well. As previously discussed, GSI investments are also a chance to invest in economic opportunity for under-resourced communities.

Climate Resilience—GSI can also be a pro-climate resilience investment. The saying "when it rains, it pours" is becoming a reality as global warming upends our drizzly winter weather in the Puget Sound Region. Increasingly, intense rain events lead to localized flooding, strain stormwater drains, and create hazards for public transportation. In the summers, we are experiencing scorching weather like the 2021 heat dome that killed over 650 people.[20] Many of the GSI retrofits discussed in this paper can help mitigate these growing climate-related challenges.

Public Health—In addition to mitigating heat and flooding, GSI designed for public use provides access to green space, improving mental and physical health. Cleaner air and water also lower toxic exposures.

Beautification—In addition to having significant public health and climate-related benefits, GSI can enhance the aesthetics of neighborhoods and public spaces. For example, the promenade that will be part of Seattle's new waterfront construction will provide areas to stroll and bike surrounded by native landscaping designed to manage stormwater runoff.

4-A: Consider People *and* Nature When Prioritizing Where to Act

GSI retrofits offer an opportunity to improve environmental and public health in areas with environmental inequities.

Busy roads and lack of green space are all too common environmental injustices in BIPOC and low-income communities. Knowing that GSI can create green space and incorporate trees that help improve air quality as well as water quality, prioritizing GSI in these communities can help address environmental inequities. Jurisdictions should also prioritize GSI in places where water quality is important for salmon health and tribal fishing rights, as well as urban areas where communities rely on fish for sustenance.

4-B: Meet Community Needs and Improve Equity with GSI Design and Construction

GSI provides the opportunity to create public spaces that serve the surrounding community in ways that extend beyond water runoff.

From planting trees that lower urban temperatures and clean air pollution to mitigating flooding to creating green space and parks that improve physical and mental health, GSI serves the surrounding community. When designing the site, public agencies and engineers should think beyond the BMP, creating community engagement or community co-design processes that shape the final design to meet community needs.

Additionally, designing, building, and maintaining GSI can create jobs and workforce development programs for community members. Ensuring that contracting and hiring is done with an equity and community-focused lens will magnify the economic benefits of GSI.

20 *(U.S.D.A Climate Hubs)*

A small group of Little Brook Youth Corps students examine a native tree. © Hannah Letinich

CASE STUDY:

Dirt Corps

Situation: South Seattle's Duwamish Valley is an area with many environmental injustices. Residents of the Valley's riverfront neighborhoods of Georgetown and South Park have disproportionately high environmental health burdens and risks. The neighborhoods are also relatively lower income with larger BIPOC communities than other parts of the city.

Solution: Dirt Corps implements GSI as part of its on-the-job training program in South Seattle for youth and adults ages 15 to 60, people of color, and military veterans. The program provides hands-on training with a focus on rain garden and cistern design and build, operations and maintenance, vegetation management, and ecological restoration.

Results: Dirt Corps cultivates leadership and entrepreneurial skills among youth in South Seattle, and its graduates reflect the diversity of the area. It is an effective job training program based in a historically disadvantaged neighborhood that brings economic and environmental benefits to the community.

4-C: Integrate Best Available Climate Data so GSI Retrofits Support Resilience

Ensure that GSI serves the needs of the present and future, not the past.

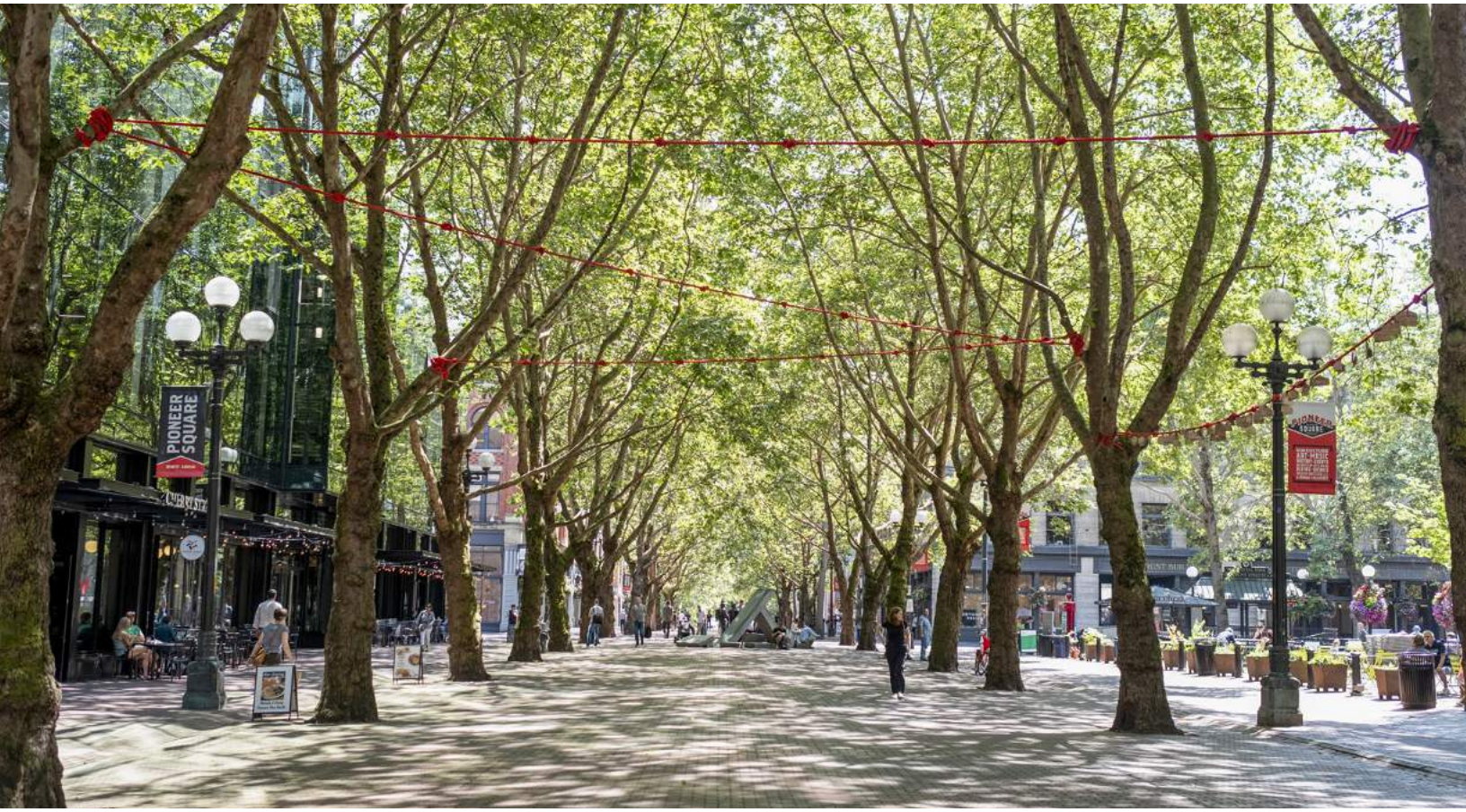
Heavy rainfall events are becoming more intense and frequent, with climate models showing that the heaviest 24-hour rain events in the Pacific Northwest will intensify by an average 22% by the 2080s. Increases in the intensity of heavy rainfall events create drainage problems and exacerbate localized flooding.

More rain increases the cost of operating, maintaining, and upgrading critical stormwater infrastructure built for a bygone climate, and can affect water quality due to increased flows, sediment, and nutrient loads. With the addition of rising sea levels, stormwater and wastewater systems are likely to experience problems with saltwater intrusion, corrosion, and flooding. The increased frequency and intensity of heavy rain will escalate flood risks to many watersheds.[21]

MODEL TWICE, BUILD ONCE

GSI retrofits are critical in helping Puget Sound adapt to climate change such as increasing rainfall. Building BMPs that provide flood control and water quality treatment can help communities manage current and future flooding while bringing a range of additional water quality and community benefits.

21 *(The Nature Concervancy, University of Washington Climate Impacts Group, 2016)*



© Kevin Lee

All BMPs should be sized for the increased intensity and duration of rainfall in our heating world so they don't need to be rebuilt shortly after installation.

4-D: Prioritize Urban Tree Canopy for Stormwater, Climate Resilience, and Equity

Trees provide a myriad of benefits, including for stormwater and water quality.

A healthy urban tree canopy reduces stormwater harm in multiple ways. Sheltering roads from precipitation directly lowers the quantity and pollutant load of road runoff. Incorporating trees into the design of bioretention infrastructure and stormwater parks strengthens their stormwater and co-benefit impacts.

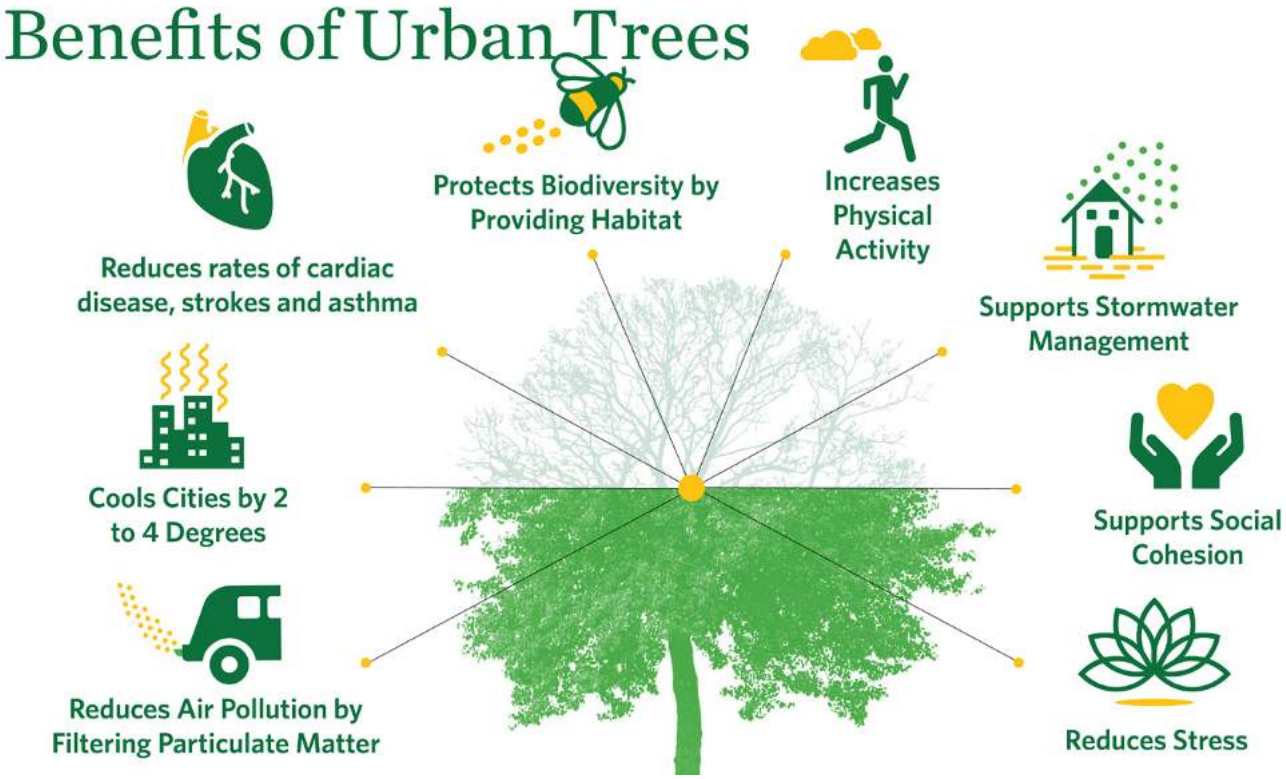
However, trees are inequitably distributed in cities across the region, contributing to racial and economic health disparities. As shown in the next infographic, mature trees build climate resilience in many ways. Preserving existing tree canopy and targeted planting and maintenance are needed to address tree equity and improve climate resilience while mitigating stormwater runoff.[22]

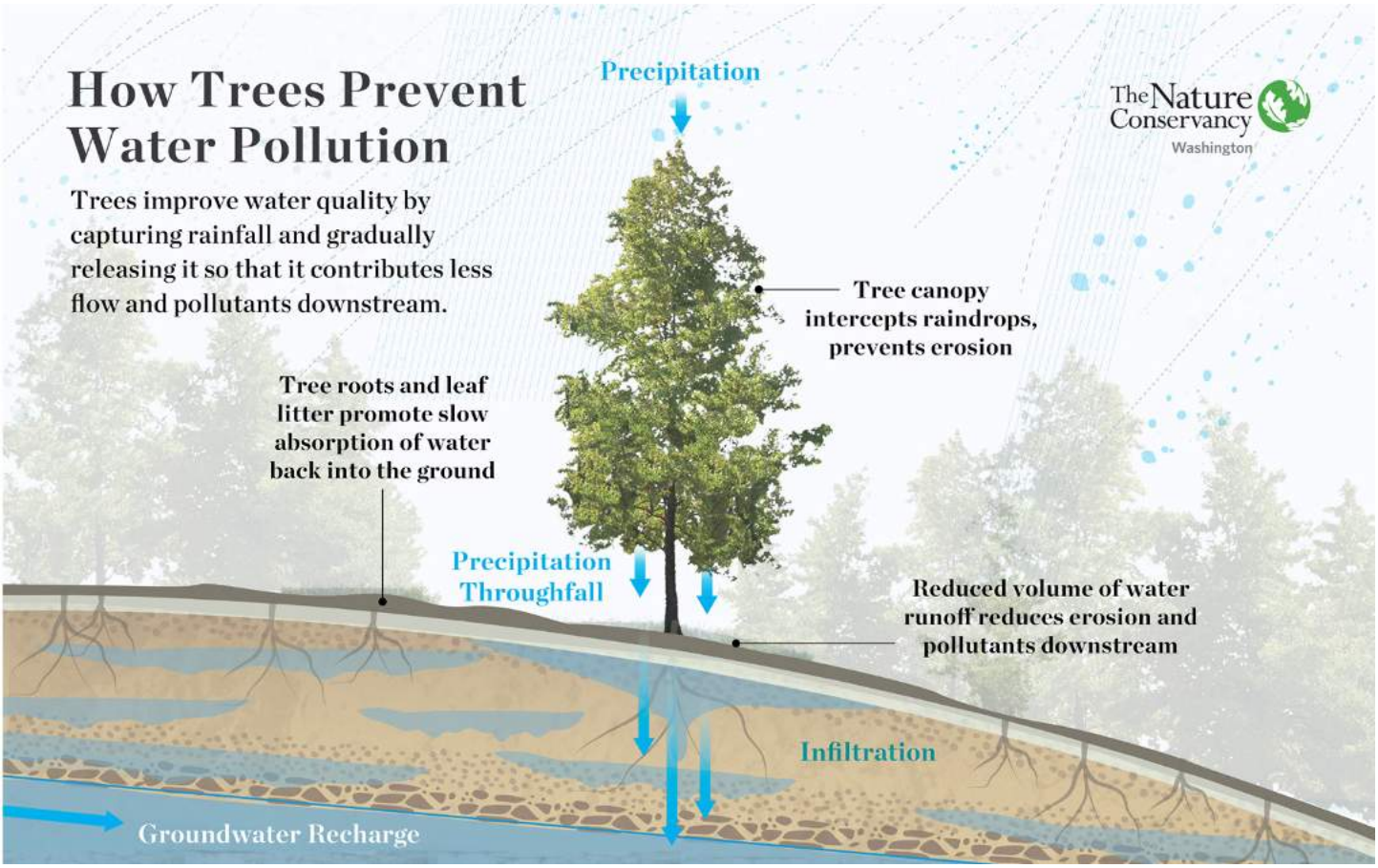
Using GSI projects to improve tree canopy within and beyond new BMPs will help these projects provide multiple benefits. Siting should consider tree equity as well as ecosystem benefits the trees will provide. The i-Tree Landscape Tool helps identify priority locations to plant for equity and ecosystem needs.

RESOURCES FOR PRACTITIONERS

- Puget Sound Urban Tree Canopy and Stormwater Management Handbook
- Urban Tree Canopy Assessment Toolkit

22 *(Carrie Asselmeier, 2019)*


Benefits of Urban Trees
Reduces rates of cardiac disease, strokes and asthma
Protects Biodiversity by Providing Habitat
Increases Physical Activity
Supports Stormwater Management
Cools Cities by 2 to 4 Degrees
Supports Social Cohesion
Reduces Air Pollution by Filtering Particulate Matter
Reduces Stress


How Trees Prevent Water Pollution
Trees improve water quality by capturing rainfall and gradually releasing it so that it contributes less flow and pollutants downstream.
Precipitation
The Nature Conservancy
Washington
Tree canopy intercepts raindrops, prevents erosion
Tree roots and leaf litter promote slow absorption of water back into the ground
Precipitation
Throughfall
Reduced volume of water runoff reduces erosion and pollutants downstream
Infiltration
Groundwater Recharge

STRATEGY 5: BUILD DECISION MAKER SUPPORT

Communicate the Benefits of GSI Retrofits.

TYPICALLY, DECISION MAKERS, FUNDERS, AND STAKEHOLDERS involved with allocating resources for GSI retrofits will not be stormwater practitioners or deeply familiar with GSI benefits. These parties include:

- Developers and landscape architects on the frontlines of LID BMP implementation.
- Decision makers such as legislators and transportation and utility planners who decide how to prioritize road runoff treatment in budgets and plans.
- Community members and groups who stand to gain the most from well-implemented GSI.

Engaging all these stakeholders to learn about and support GSI will lead to attention and funding, installation of more and better GSI, and onwards in a positive cycle.

5-A: Social Marketing and Outreach

Social marketing can raise awareness of GSI and increase alignment with the strategies in this paper.

Social marketing utilizes the communication practices of traditional marketing to change behavior for social benefit. It can build support for GSI with stakeholders, including decision makers, developers, and community members by:

- Communicating the region's stormwater problem and its impact on environmental and community health
- Clarifying the benefits and costs of GSI retrofits
- Addressing common misconceptions
- Creating focus and a sense of urgency
- Building self-efficacy so people feel empowered to act
- Incentivizing behavioral change

ENGAGING DEVELOPERS

For example, when a city uses a stormwater management fee reduction for voluntary GSI, it will see greater adoption if developers are provided clear information about the costs of retrofits needed to obtain a stormwater fee reduction, the value of the resulting reductions, and clear projections of long-term stormwater fee schedules. (See the Department of Commerce's Building Green Cities guidebook for more information about working with Developers.) Cities should invest in communicating GSI benefits and opportunities to developers and other decision makers.

RECOGNITION INCREASES PARTICIPATION

Creating recognition or certification programs related to GSI retrofits is a form of social marketing that builds on the momentum around environmentally friendly lifestyles and green building practices. Certifications like LEED, Built Green, Salmon Safe, and Green Roads provide credits for some types of GSI retrofits. Promotion of programs like these, or the creation of a program that specifically recognizes retrofits, can help incentivize private action.

5-B: Communicate Success and Learning Through Case Stories

Due to the lack of experience with GSI projects, jurisdictions see investing in retrofits as risky. Sharing success stories and lessons learned can build knowledge and lower the risk of investing in GSI.

One barrier to advancing the use of GSI retrofits is the lack of working, built examples of innovation and experimentation. Interviews from public-sector stormwater practitioners made it clear that for developers and public utilities, experimentation is a financial risk many are unwilling or unable to take.

Case stories are essential to changing perceptions about the risk of GSI by demonstrating that it has been successfully implemented with beneficial results. By building on the lessons learned (both positive and negative) from GSI projects, future projects can continue to scale up.

SHARING LESSONS LEARNED IMPROVES FUTURE PROJECTS

For example, Seattle's Swale on Yale was one of the first large-scale projects in the region and requires unexpected extra maintenance to manage high sediment loads. This experience provided a valuable lesson learned for engineers and spurred stronger analysis and better pre-treatment systems for future projects. However, lessons like this will only reach

the necessary audiences if jurisdictions and engineering firms share them openly, including both hard lessons and successes.

CASE STUDY:

Puget Sound Regional Council Stormwater Parks

Challenge: Jurisdictions lacked information about regional-scale GSI when planning and making decisions.

Solution: Puget Sound Regional Council (PSRC) created a planning guide for stormwater parks, including seven case stories from across the region. Each case story includes challenges and lessons learned from the project and general information such as site size, acres treated, and cost to build. The case stories provide links and contact information for each project so interested groups can learn more.

Results: Practitioners have access to learnings from projects across the region. The information will help PSRC provide technical assistance during planning for six new stormwater parks in the region.

5-C: Proactively Connect Decision Makers with GSI Proponents

Where "business as usual" development continues due to a lack of information or motivation, support from a knowledgeable champion can help decision makers get comfortable with GSI solutions.

GSI champions are experts that have the trust of stakeholders and can communicate the benefits of GSI to a range of audiences. GSI champions should be identified and supported as they are powerful advocates that can inform and motivate hesitant decision makers.

Inexperience with GSI, or the piloting of cutting-edge systems, can create uncertainty around lifecycle costs and benefits. GSI champions can point to resources such as case studies, examples of GSI design, and experience with difficult to measure co-benefits that help clarify the benefits and costs of GSI retrofits.

For example, developers in focus groups said they appreciated organizations that provide sustainable development expertise and guide developers to available incentives. Champions make getting assistance easy by proactively reaching out to developers, and the information they provide helps developers quickly make design decisions. Champions can also help government agencies less familiar with stormwater work, such as transportation departments, understand their opportunities to use GSI.

5-D: Show Value of Green Infrastructure

Provide decision makers with cost-benefit analysis of GSI to help them understand the value of GSI and support the most cost-effective solutions for treating stormwater.

A significant barrier to large-scale use of GSI retrofits is the lack of data and standardized ways to calculate the benefits and costs. Existing studies are theoretical or are from other areas of the country. GSI advocates need to invest in regionally tailored cost-benefit analysis that accounts for initial construction, life cycle costs and benefits, and the relative long-term maintenance and repair costs for both property owners and local jurisdictions.

These analyses should also consider the costs of inaction, as well as the cost of implementing gray infrastructure options—including the missed co-benefits that are provided with GSI.

CASE STUDY:

Philadelphia's Hybrid Approach

Challenge: The City of Philadelphia considered two options to get identical water quality benefits. One option relied solely on "gray" infrastructure, using concrete vaults and tunnels to detain water during a storm event. The second option relied on a GSI hybrid approach that was 50% gray and 50% green infrastructure with multiple community benefits. Decision makers needed to understand the costs and benefits of both options.

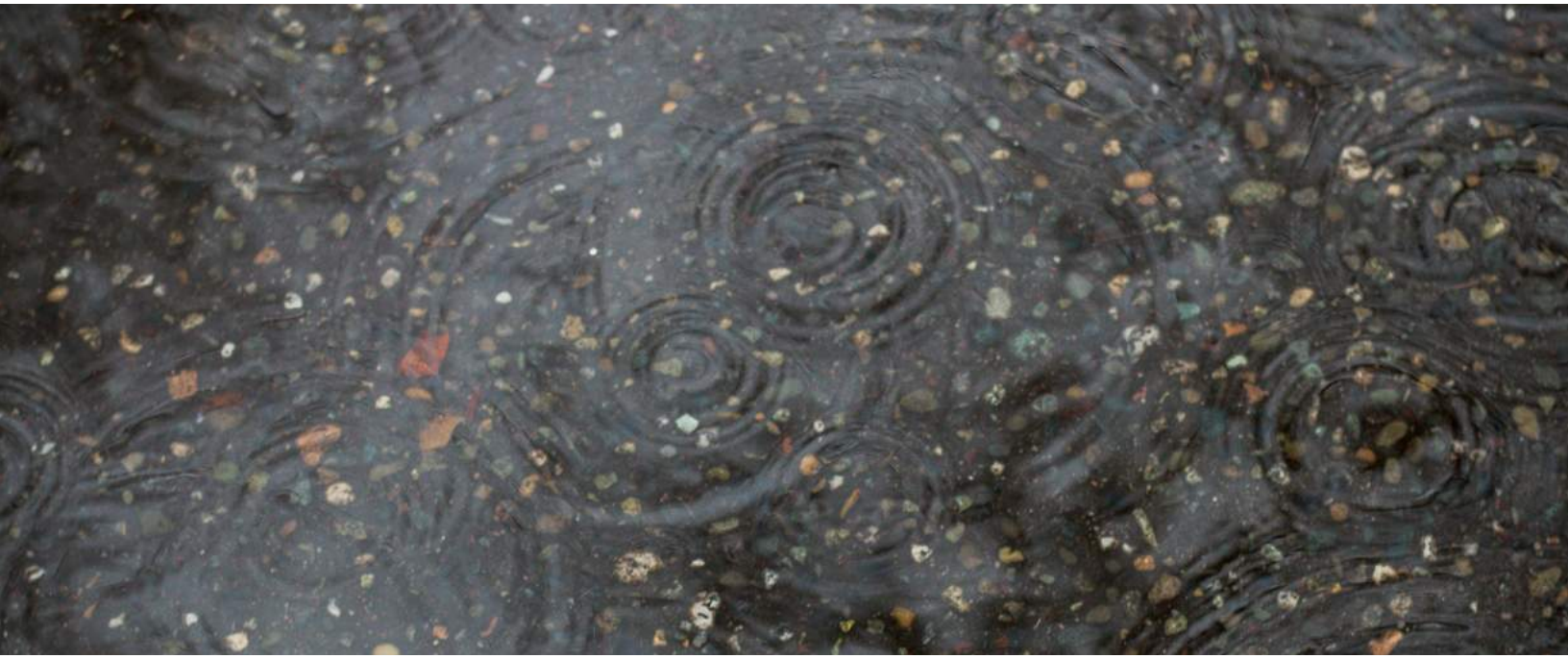
Solution: After being presented with a cost-benefit analysis, Philadelphia officials were able to choose the best performing option to treat stormwater, the GSI hybrid approach.

Results: Based on overall impacts, Philadelphia found over $2.85 billion in benefits to the community from a stormwater system that use 50% traditional "gray" infrastructure and a 50% nature-based solution. The same analysis estimated only $122 million in benefits from the use of 100% gray infrastructure.[23]

23 *(Valderrama, 2013)*

CONCLUSION

It will take a tremendous amount of effort to "re-plumb" the Puget Sound basin to treat the abundant road runoff in our region.



© Leslie Carvitto

FAILURE TO DO SO WILL LEAD TO CONTINUED DECLINES in already decimated salmon populations and worsening water quality in our freshwater and marine ecosystems. Southern Resident killer whales are on a course headed for extinction, primarily due to the destruction of Chinook salmon populations and high levels of toxic stormwater runoff affecting immune systems, health, and reproductive rates. Coho salmon face pre-spawn mortality rates as high as 90% from road runoff. The stakes are higher than a 100-year flood.

Yet the opportunity and potential payoff for retrofitting toxic hotspots in Puget Sound are high as well. Cutting edge science has identified many of the worst pollutants in our water and their sources. Innovative retrofit projects have demonstrated the capability of GSI to treat large volumes of water for 6PPD and other deadly contaminants.

The additive nature of retrofits, and their many co-benefits that strengthen communities, make GSI retrofits cost-effective, smart solutions. Bringing more nature into cities and towns with GSI not only helps us clean our water and the air we breathe, but helps communities thrive by supporting public health and building a strong, vibrant economy. To make it happen, federal legislation such as the Infrastructure Investment and Jobs Act is making more money available to kick-start putting treatment in the ground.

To actually clean our water, we need all entities engaged in stormwater, from public utilities to transportation departments and developers to property owners, prioritizing the treatment of road runoff and implementing GSI retrofits. Following the strategies and sub-strategies outlined in this paper will help us align to make the Puget Sound region thrive. Working together with determination and rapid investment in green stormwater retrofits we can restore our water, strengthen our communities, and address environmental injustices.

APPENDIX A

GSI Resources

General Information

- Encyclopedia of Puget Sound—University of Washington. A comprehensive guide to the science of Salish Sea ecosystem recovery.
- Stormwater Action Monitoring (SAM)—WA Dept. of Ecology. SAM brings together municipal stormwater permittees to collaborate on monitoring needs under the Western Washington municipal stormwater permits.
- Puget Sound Partnership Action Agenda—Puget Sound Partnership. Charts the course for Puget Sound recovery as our community's shared plan for advancing protection and restoration efforts across the region.

Regional Data and Planning Tools

- Planning Stormwater Parks—Puget Sound Regional Council. Guidance document, toolkit, model scope of work, and case studies for stormwater parks in the Puget Sound Region.
- Stormwater Heatmap—The Nature Conservancy. Data rich mapping tool that includes hydrology, land use, and pollution loading in Puget Sound.
- Washington Environmental Health Disparities Map—WA Dept. of Health.
- GSI Siting Template—The Nature Conservancy: A how-to guide and scope of work for jurisdictions and consultants to select optimum sites for GSI.
- Trees for Resilience Toolkit and Puget Sound Urban Tree Canopy and Stormwater Management Handbook—Puget Sound Conservation Districts. A compendium of local and national research, case studies, and resources specially curated to help regional decision makers, planners, and managers integrate urban forests and tree canopy into the fabric of the community for greater livability and resilience.
- Urban Tree Canopy Assessment Toolkit—The Nature Conservancy
- Green Infrastructure Modeling Toolkit—Environmental Protection Agency
- King County's Water Quality Benefits Evaluation Toolkit and forthcoming GSI Retrofit Prioritization Study: A collection of tools and models to identify pollution loading, most effective and cost-efficient BMPs for treatment, and where to site them.
- SMAPr—Our Green Duwamish's Watershed Prioritization Tool: A tool for cities in the Green/Duwamish Watershed to prioritize sub-basins for GSI retrofits and other stormwater activities.

General GSI Policy Guidance Documents and Reports

- The Equity Guide for GSI Practitioners—Greenprint Partners and the Green Infrastructure Leadership Exchange. Provides stormwater practitioners a framework, research, and tools that will help facilitate stronger partnerships between their organizations and the communities they serve.
- Building Cities in the Rain—WA Dept. of Commerce guide on watershed prioritization for stormwater retrofits.
- Nature's Scorecard—Puget Soundkeeper and Washington Conservation Action. A performance scorecard for communities using green solutions when planning for growth and preventing pollution.
- Lay of the Land: LID/GSI in King County—Futurewise.
- Expanding the Benefits of Seattle's Green Stormwater Infrastructure—Environmental Protection Agency report examining the many positive value adds and money saving aspects of GSI.
- Mapping Green Stormwater Infrastructure Careers to Improve Diversity and Inclusivity—Seattle Jobs Initiative report and recommendations.

- Building Green Cities Guidebook—WA Dept. Of Commerce. Guidance for local jurisdictions on incentivizing low-impact development beyond permit requirements
- Cascading Benefits—Designing Green Stormwater Infrastructure for Human Wellness—The Nature Conservancy.

Offsite Stormwater Management

- Alternative Site Stormwater Management | US EPA, Compendium of MS4 Permitting Approaches—Off-Site SWM (epa.gov)
- King County's Report on Feasibility of In-Lieu Fee, Credit Trading, and Basin Transfer Program's for Stormwater Management
- Economic Instruments For GSI—A comprehensive report on the financial mechanisms to support offsite management. —Willamette Partnership.
- Stormwater Control Transfer Program from the 2019 Stormwater Management Manual for Western WA Volume 1, Appendix I-E.
- Municipal Stormwater Permit Guidance—Washington State Department of Ecology (Refer to the guidance for "Runoff/Flow controls for development".)
- FAQ for Implementing the Flow Control Standard in Ecology's Western Washington Municipal Stormwater Permits—An FAQ document that explains the different ways the flow control standard can be implemented.

Community Based Public-Private Partnerships

- Financing Green Infrastructure—Is a Community-Based Public-Private Partnerships (CBP3) Right for You?—Environmental Protection Agency.
- Washington State Stormwater Community Based Public-Private Partnership Feasibility Assessment—WA Dept. Of Commerce
- The Clean Water Partnership—A CBP3 between Prince George's County, MD and Corvias.
- Aurora Bridge Public-Private Stormwater Park Roadblocks and Solutions—Case study for policy and process improvement opportunities.

Regional Resources and Case Studies

- Puget Sound Stormwater Parks Case Studies—Puget Sound Regional Council. Part of the Planning Stormwater Parks resource listed above.
- Portland Green Streets Case Studies—City of Portland
- 12,000 Rain Gardens in Puget Sound—Stewardship Partners. Informs people about rain gardens, offers technical advice, and connects people to resources, rebates, and grants. Developed by Stewardship Partners.
- 700MillionGallons—Seattle & King County's GSI website.

APPENDIX B

Funding Sources for GSI Retrofits

The following are examples of funding sources that can support local jurisdictions with GSI retrofits. This is not a comprehensive inventory.

Federal and State Sources

FEDERAL TAX CREDIT

New Markets Tax Credit
Encourages private investment in a range of project types in distressed areas (e.g., real estate or business development projects). Awards are allocated to nonprofit and private entities based on their proposals for distributing the tax benefits (e.g., awards are made to community development entities not to individuals or businesses).

GRANT AND LOAN PROGRAMS

Stormwater Strategic Initiative Lead Funding
The Stormwater Strategic Initiative Lead (SIL) has funding to support the Toxics in Fish, Benthic Index of Biotic Integrity, and Marine Water Quality Implementation Strategies. This includes Public Road Retrofits Planning by Local Jurisdictions.

Water Quality Combined Funding Program—WA Dept. of Ecology
The Washington State Department of Ecology administers an integrated funding program for projects that improve and protect water quality throughout the state. The program combines grants and loans from state and federal funding sources, including significant investments from the Infrastructure Investment and Jobs Act.[24]

Applications are managed under one process. The four primary funding sources administered by Ecology are:

- Clean Water Act Section 319 Program
- Centennial Clean Water Program
- Clean Water State Revolving Fund
- Stormwater Financial Assistance Program

Who can apply?

- Counties, cities, and towns
- Tribal governments (federally recognized)
- Special purpose districts
- Conservation districts
- Nonprofit organizations (only those qualify for section 319 grants)

Amount of funding available: Varies based on the state budget—ranges from $100 million to $200 million annually.

Eligible project types:

- Wastewater
- Stormwater
- Nonpoint
- Onsite sewage systems

WA Ecology's Municipal Stormwater Grants of Regional or Statewide Significance
Grants of Regional or Statewide Significance (GROSS) are competitive grants that assist permittees in completing projects that will benefit multiple permittees.

Who can apply: NPDES Phase 1 and Phase 2 permitees in WA.

Grant award limit: $300,000

Match required: No

FEMA Building Resilient Infrastructure and Communities (BRIC)
The FEMA BRIC program is granted through the Washington Emergency Management Division. Past awards include GSI projects. The program aims to promote a national culture of preparedness and public safety through investments that protect our communities and infrastructure and foster resilience, shifting the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. For more information on the BRIC program, visit the website or send your questions to the Hazard Mitigation Assistance all-staff email address: HMA@mil.wa.gov.

US Dept. of Transportation RAISE Grants
Previously known as Better Utilizing Investments to Leverage Development (BUILD) and Transportation Investment Generating Economic Recovery (TIGER), this competitive federal grant program for transportation can be used to manage transportation runoff. RAISE Grants fund investments in road, rail, transit, and port projects. Grants have been

24 *(Washington State Department of Ecology, 2014)*

awarded to projects that included green infrastructure components, such as the Connective Corridor project in Syracuse—the project created more bikeable and walkable streets to encourage active transportation and reduce greenhouse gas emissions, and incorporated green infrastructure elements such as tree trenches and porous pavements.

US Dept. of Transportation PROTECT Grants
Provides grants for activities that enable communities to address vulnerabilities to current and future weather events, natural disasters, and changing conditions, including sea level rise, and plan transportation improvements and emergency response strategies to address those vulnerabilities. The protect program has both formulaic and competitive funding.

US Dept. of Transprotation INFRA Grants
The INFRA grant program run by USDOT includes eligibility for resiliency. It awards competitive grants for multimodal freight and highway projects of national or regional significance to improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas.

Who can apply? All levels and coalitions of state, local, and tribal government

Funding amount: $8 billion from 2022-2026

U.S. EPA: Urban Waters Small Grants Program (UWSG)
The Urban Waters Small Grants Program provides funding to communities to improve the quality of urban waters while simultaneously stimulating neighborhood revitalization. The UWSG has a focus on underserved communities, defined as "communities with environmental justice concerns and/or susceptible populations." The Program can be used specifically for innovative or new green infrastructure practices that improve water quality. The grants are competed and awarded every two years, with individual award amounts of up to $60,000.[25]

Who can apply? State, local, and tribal governments, as well as public and private universities and colleges, public or private nonprofit institutions/organizations, intertribal consortia, and interstate agencies.

Sample project: The Duwamish River Cleanup Coalition/Technical Advisory Group (Seattle, Washington) is implementing the Healthy River/Healthy Communities project.

U.S. Housing and Urban Development: Community Development Block Grant (CDBG) Program
The Community Development Block Grant (CDBG) program is a flexible program that provides communities with resources to address a wide range of unique community development needs. Communities can use CDBG funds for stormwater and green infrastructure because these projects can create jobs, increase economic activity, and increase property values. Urban tree planting can increase economic activity in a commercial district. Additionally, green infrastructure can increase property values by mitigating flooding, improving neighborhood aesthetics, and providing other co-benefits.

Who can apply? Local governments—note: Washington State Department of Commerce administers a CDBG program for small, rural cities/towns and counties that are not entitled to receive CDBG funds directly from HUD.

Sample project: Chicago has used CDBG funding to put a new green roof on its historic Cultural Center.

U.S. Department of Agriculture: Rural Development Water and Environmental Programs (WEP)
WEP is exclusively focused on the water and waste infrastructure needs of rural communities with populations of 10,000 or less. The programs provide technical assistance and financing for development of drinking water, waste disposal, and stormwater systems in rural areas. WEP also provides funding to organizations that provide technical assistance and training to rural communities in relation to their water and waste activities. A variety of grant or loan options are available through WEP to state and local government entities, nonprofit organizations, federally recognized tribes, and academic institutions.[26]

National and Local Foundations

National Fish and Wildlife Foundation's America the Beautiful Challenge
A public-private grant program for locally led ecosystem restoration projects that invest in watershed restoration, resilience, equitable access, workforce development, corridors and connectivity, and collaborative conservation, consistent with the America the Beautiful Challenge.

Pisces Foundation
Supports GSI construction and policy through grants: "We support local efforts in cities from coast-to-coast to implement One Water approaches, like green infrastructure, that can reduce water pollution, add parks and other amenities, reduce flooding, and augment water supply. We fund leaders who are

25 *(U.S. Environmental Protection Agency Urban Waters, 2016)*
26 *(U.S. Department of Agriculture, 2017)*

bringing this new thinking and bold practice to the urgent task of ensuring safe, sufficient, and secure water, creating more resilient communities, healthier waters, and stronger economies. We support implementation of policies that stimulate investment in One Water approaches or facilitate their implementation. We fund efforts locally and nationally to reduce barriers to new policies that ensure clean, reliable water is available for all."

Local funding sources

STORMWATER UTILITIES

Some communities have created stormwater utilities that charge a fee to residential, industrial, and commercial water customers to generate funds to manage stormwater and its impacts. Stormwater utilities are similar to water, sewer, or fire districts in that they are stand-alone service units within a government that generate revenues through user fees for services related to the control and treatment of stormwater, separate from the general tax fund, and used only for those services. Three common methods used for collecting stormwater utility fees are to charge by 1) flat fee, 2) equivalent residential unit (ERU), and 3) tiered rate structure.[27]

Stormwater utilities may provide credits or rebates to property owners who install and maintain privately-owned systems that reduce stormwater flow or provide water quality treatment.[28] Seattle Public Utilities, for example, offers a credit on drainage bills to property owners with fully functioning, well-maintained stormwater systems in compliance with the City Stormwater code standards. This credit incentivizes private property owners to help lessen the impact to the City's stormwater system, creeks, lakes, and Puget Sound. Large parcels with large amounts of impervious surface being managed by a stormwater system typically benefit the most from the credits, though the program is open to everyone.[29] Single family homeowners in Seattle who live in a targeted sewer overflow basin may also be eligible for rebates to hire a trained "RainWise" contractor to install a rain garden or cistern.[30]

REGIONAL FUNDING DISTRICT

If a stormwater construction project benefits only a portion of a municipality, it can be funded by fees assessed only to those properties within that area, which is called a special assessment district. Real Estate Excise Tax (REET) fee cities and counties in Washington are authorized to collect a REET on all sales of real estate. All cities and counties are authorized to levy a 0.25% tax, REET 1; cities and counties planning under the Growth Management Act (GMA) may levy a second 0.25% tax, REET 2.[31]

- Depending on the population of the jurisdiction and whether they are planning under GMA, REET 1 revenues must be used for capital improvements identified in a capital improvements plan and local capital improvements, or the capital facilities element of the jurisdiction's comprehensive plan. REET 1 revenues may be spent on a wide variety of capital projects, including everything from street projects to parks to stormwater systems to swimming pools.
- REET 2 revenues must be used for capital projects specified in a comprehensive plan, regardless of the population of the jurisdiction. This part of the tax has more limited uses, and may only be spent on street projects, water and sewer projects, and parks projects (RCW 82.46.035).
- A limited amount of REET 1 and REET 2 revenues may be spent on operations and maintenance of existing capital projects.

PUBLIC-PRIVATE PARTNERSHIPS/PAY FOR PERFORMANCE MODEL

As an alternative to using taxes, fees, bonds, loans, and grants, communities may also consider establishing public-private partnerships. This approach involves the private sector through a contractual agreement between a public agency and private sector that allows for the private sector involvement in financing, planning, design, construction, operation, maintenance, and rehabilitation and replacement of urban retrofit facilities.[32]

Public-private partnerships can substantially expand the market for private investment in green infrastructure and help to lower the costs of construction and maintenance, accelerate implementation, access new sources of investment capital, and incentivize optimal performance by shifting performance risk to private partners where payments are tied directly to performance.[33]

27 *(U.S. Environmental Protection Agency, 2014, pp. 6-10)*
28 *(U.S. Environmental Protection Agency, 2014, p. 10)*
29 *(City of Seattle, 2016)*
30 *(City of Seattle, 2016)*
31 *(MRSC, 2016), (Washington Department of Revenue, 2010)*
32 *(U.S. Environmental Protection Agency, 2014, pp. 18-21)*
33 *(Valderrama, 2013)*

APPENDIX C

Plans and Policies for GSI Retrofit Alignment

The following table contains a list of documents that jurisdictions should consider as part of a comprehensive alignment of plans and policies to support GSI retrofits. This starts by working with the agencies, stakeholders, and the public involved in the update of these documents to identify shared goals and address barriers.

Each time a plan or policy on this list is updated there is an opportunity to build partnerships, strengthen local retrofit efforts, or develop new programs. Example jurisdictions in this table highlight communities who have used this approach to support GSI through plan and policy alignment.

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
NPDES STORMWATER GENERAL PERMITS	X	X		
Update process & schedule: In accordance with WAC 173-226-220, general permits shall be issued for fixed terms not exceeding five years from the effective date. Washington Department of Ecology issues all NPDES permits in Washington except federal facilities and permits on tribal lands (for which EPA is responsible).				
• Phase I & Phase II Municipal Stormwater Permits		X		
Update process & schedule: The current permits were issued July 1, 2019, were effective starting August 1, 2019, and expire on July 31, 2024. Ecology will be updating the Phase I and Phase II permits on August 1, 2024.				
• Industrial Stormwater General Permit		X		
Update process & schedule: The current permit went into effect on January 1, 2020, and will expire December 31, 2024.				
• Construction Stormwater General Permit		X		
Update process & schedule: The current permit went into effect on Jan. 1, 2021 and expires on Dec. 31, 2025.				
• Sand and Gravel General Permit		X		
Update process & schedule: The current permit went into effect April 1, 2021 and expires on March 31, 2026.				
• Boatyard General Permit		X		
Update process & schedule: The current permit went into effect on Sept. 1, 2022 and expires on Aug. 31, 2027.				

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
STORMWATER MANAGEMENT MANUALS FOR EASTERN AND WESTERN WASHINGTON		X		

Update process & schedule: The Stormwater Management Manuals for Eastern and Western Washington (SWMMEW and SWMMWW) are guidance documents designed for engineers and other stormwater professionals that work with Ecology permits and programs. The current versions were published in 2019 and Ecology is updating them for publication in 2024 alongside the new Municipal Stormwater Permits.

ECOLOGY WATERSHED STORMWATER PLANNING	X	X	City of Redmond City-wide Watershed Management Plan & the Bear Creek Watershed-Scale Stormwater Plan

Update process & schedule: The legislature updated the Streamflow Restoration Act in 2018. Ecology collaborated with planning groups in 15 watersheds to develop watershed plans that help enhance streams for fish and offset impacts from new domestic permit-exempt wells. Watershed planning continues for five watersheds or Water Resource Inventory Areas (WRIA), while ten watersheds have complete plans. Prior to the 2018 update a total of 44 planning units initiated Watershed Plan development with State funding between 1998 and 2012. Watershed plans were adopted by 33 planning groups. As planning efforts were completed, and no new plans were in the works, Ecology began calling this Watershed Management.

WSDOT NPDES MUNICIPAL STORMWATER PERMIT	X		

Update process & schedule: The current permit went into effect April 5, 2019, and expires April 5, 2024.

WSDOT HIGHWAY RUNOFF MANUAL	X		

Update process & schedule: the current Highway Runoff Manual was published in April 2019. Revisions to the manual are published on an as needed basis to comply with NPDES municipal stormwater permit requirements. The document was originally published in February 1995, updated in March 2004, and has subsequently been updated every 1-3 years since.

STORMWATER MANAGEMENT ACTION PLAN		X	

NPDES Municipal Stormwater permitees are required to create a Stormwater Management Action Plan that outlines the specific stormwater management actions they will take in a selected subbasin.

NATIONAL MENU OF BMPS FOR STORMWATER (EPA)	X		

Update process & schedule: This non-exhaustive list of BMPs was first released by the EPA in October 2000 and is based on the stormwater Phase II rule's six minimum control measures. Fact sheets describe the BMPs and general applicability, implementation, and effectiveness information to help municipal stormwater and construction site operators comply with the stormwater Phase II requirements. EPA is currently updating some of the factsheets.

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
ENDANGERED SPECIES ACT (ESA)	X			

Update process & schedule: The Interior Department's U.S. Fish and Wildlife Service (FWS) and the Commerce Department's National Marine Fisheries Service (NMFS, or NOAA Fisheries) administer the ESA. The FWS has primary responsibility for terrestrial and freshwater organisms, while the responsibilities of NMFS are mainly marine wildlife such as whales and anadromous fish such as salmon. Projects that are funded partially or in full by the federal government or which require a federal permit must comply with the ESA. Congress has the authority to update the law and has annually appropriated funds to the ESA since 1992.

NATIONAL ENVIRONMENTAL POLICY ACT	X			

Update process & schedule: Laws written by Congress provide the authority for EPA to write regulations to explain the technical, operational, and legal details necessary to implement NEPA. These regulations are developed on an as needed basis.

STATE ENVIRONMENTAL POLICY ACT		X		

Update process & schedule: Ecology updates SEPA rules when directed by the state legislature. Most recently, the 2022 Legislature limited appeals under SEPA for new housing construction under S.B. 5818.

VISION 2050 (PSRC)		X		

Update process & schedule: Vision 2050 is Puget Sound Regional Council's (PSRC) growth management, environmental, economic, and transportation strategy for the Central Puget Sound Region (includes King, Kitsap, Pierce and Snohomish counties and their cities and towns). Vision 2050 was adopted in 2020 and replaced Vision 2040.

REGIONAL TRANSPORTATION PLAN		X		

Update process & schedule: Puget sound Regional Council's Regional Transportation Plan (RTP) is the long-range transportation plan for the central Puget Sound region. The RTP is adopted every four years, and is designed to implement the region's growth plan, VISION 2050. The RTP meets all state and federal requirements and is based on the latest data, adopted land use assumptions, and technical tools. The current plan was adopted in 2022.

PUGET SOUND PARTNERSHIP ACTION AGENDA		X		

Update process & schedule: The Action Agenda for Puget Sound outlines regional strategies and actions needed to protect and restore Puget Sound. It is updated every four years. The 2022-2026 Action Agenda is organized into two sections, a Comprehensive Plan with long-term priorities and strategies and an Implementation Plan with detailed actions.

TOXICS IN FISH IMPLEMENTATION STRATEGY		X		

Update process & schedule: Finalized in 2021, the Toxics in Fish Implementation Strategy: 1) Describes what is currently known of the status and trends of toxic contaminants in Puget Sound, 2) Provides the context by which toxic contaminants are currently managed, and 3) Describes regional strategies that can help reduce the occurrence and impacts of these toxic contaminants.

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
BENTHIC INDEX OF BIOTIC INTEGRITY IMPLEMENTATION STRATEGY		X		

Update process & schedule: Finalized in 2021, the Benthic Index of Biotic Integrity (B-IBI) Implementation Strategy describes the interim results needed to make progress towards the Freshwater Quality Vital Sign target. The Implementation Strategy identifies four strategies: Local Capacity Strategy; Watershed Planning Strategy; Education and Incentives Strategy; and Working Lands Strategy.

SOUTHERN RESIDENT ORCA TASK FORCE FINAL RECOMMENDATION	X		

Recommendations from a state task force published in 2018 and 2019. With only 73 individuals remaining, there is no time to waste—the road to sustained Southern Resident recovery is through swift, bold, and impactful solutions. Together, these 49 recommendations provide multiple benefits that, if sustained, will lead to better water quality, a healthier ecosystem, and more robust salmon runs.

GMA COMPREHENSIVE PLANS	X	X	
ZONING AND DEVELOPMENT CODE	X	X	

Mandatory "periodic updates" of the entire comprehensive plan and development regulations are required every eight years for all "fully planning" cities and counties. In addition, all cities and counties, including those not fully planning under the Growth Management Act (GMA), must review and, if necessary, amend their critical areas and natural resource lands policies and regulations.

Counties and cities were/are required to review and revise their comprehensive plans and development regulations on or before the following dates, and every eight years thereafter:

- December 31, 2024: King, Pierce, and Snohomish counties and the cities within those counties
- June 30, 2025: Clallam, Clark, Island, Jefferson, Kitsap, Lewis, Mason, San Juan, Skagit, Thurston, and Whatcom counties and the cities within those counties
- June 30, 2026: Benton, Chelan, Cowlitz, Douglas, Franklin, Kittitas, Lewis, Skamania, Spokane, Walla Walla, and Yakima counties and the cities within those counties
- June 30, 2027: Adams, Asotin, Columbia, Ferry, Garfield, Grant, Grays Harbor, Klickitat, Lincoln, Okanogan, Pacific, Pend Oreille, Stevens, Wahkiakum, and Whitman counties and the cities within those counties

An additional two years for meeting the review and revision requirements is granted to smaller and slow growing counties and cities that meet certain criteria.

Optional annual amendments allow cities and counties, if desired, to adopt a package of changes to the comprehensive plan and development regulations no more than once per year.

CAPITAL FACILITIES PLAN	X	X	

Update process & schedule: Capital facilities plans are a 6+ year plan of capital projects with estimated costs and proposed methods of financing that are updated annually during municipal budget cycles.

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
TRANSPORTATION IMPROVEMENT PROGRAM (TIP)		X	X	

Update process & schedule: TIPs are 6-year planning documents updated annually during municipal budgets cycles – the plans show sources and amount of funding for transportation improvement projects planned for the next six years

HEALTH IMPROVEMENT PLAN	X	X	Kittitas County Public Health Department, WA (high quality CHIP identified by NACCHO)

Update process & schedule: Health Improvement Plan is a long-term, systematic effort to address public health problems based on results of community health assessment activities and community health improvement processes. A variety of tools and processes may be used to conduct a community health assessment; the essential ingredients, according to the CDC, are community engagement and collaborative participation. Community Health Improvement Plans (CHIPs) are typically updated every 3-5 years. The Washington State Health Improvement Plan (SHIP) is updated by the Department of Health every 3-5 years.

STORMWATER USER FEE AND FEE REDUCTIONS	X	X	Bellingham Surface and Stormwater Utility

Update process & schedule: a stormwater utility, operating much like an electric or water utility, may collect fees related to the control and treatment of stormwater that can be used to fund a municipal stormwater management program. Typical steps involved in creating a stormwater utility are to develop a feasibility study, create a billing system, implement a strong public information program, adopt an ordinance, provide credits/exemptions, and implement the utility. Fee rates are set by the utility and rate change requests for privately-owned water companies must be made to the Washington Utilities and Transportation Commission.

STATE/REGIONAL/LOCAL PLAN OR POLICY DOCUMENT NOT UPDATED ON A REGULAR SCHEDULE			

Update process & schedule: The following documents are not updated on a regular schedule. While the process for updating these documents varies by municipality, the process will often include a pre-draft public outreach period, a draft version of the updated plan or proposed policy change, and a public comment period (formal or informal) before final updates are adopted by the appropriate governing body (city council, county council, etc.).

• Parks, Recreation, and Open Space Plan	X	X	
• Municipal Stormwater Code and Manual	X	X	
• Transportation Plan	X	X	
• Economic Development Plan	X	X	

PLAN OR POLICY DOCUMENT	LEVEL OF GOVERNMENT			EXAMPLE JURISDICTIONS
	FEDERAL OR NATIONAL	STATE OR REGIONAL	LOCAL	
• County Public Health Operational Master Plan (PHOMP)		X		TPCHD , King County PHOMP, & King County Environmental Health Services Strategic & Operational Plan, 2010-2015
• Street Tree Management Plan and Manual			X	
• Neighborhood Plan			X	Tacoma Mall Neighborhood Subarea Plan
PLAN OR POLICY DOCUMENTS ISSUED ON A PER PROJECT BASIS				
Update process & schedule: The following documents or permits are issued for individual projects and are typically subject to the relevant municipality's stormwater codes and manuals.				
• Construction and Building Permits			X	
• Clearing and Grading Plans			X	
CERTIFICATION OR STATUS ADMINISTERED BY PRIVATE OR NON-PROFIT ENTITIES				
Update process & schedule: The following certifications or statuses are administered by private and/or non-profit entities. Certification requirements are updated periodically by the entities in response to feedback from project teams, and progress in the design, construction, and manufacturing industries.				
• LEED (U.S. Green Building Council)	X			
• Living Building Challenge and Living Community Challenge (International Living Future Institute)	X			
• Built Green (Master Builders Association of King and Snohomish Counties)		X	X	
• Salmon Safe	X	X		

GLOSSARY

BMPs Best Management Practices are standards and techniques that are used to prevent nonpoint source pollution.

CSO Combined Sewer Overflow happens when wastewater and stormwater go to the same sewage system pipes. Large storms then overwhelm the system, resulting in overflows of a mix of stormwater and raw sewage into natural waterbodies. See MS4 below for separated sewers.

GMA Authorized under RCW 36.70A, the Growth Management Act requires most cities and counties to plan for long term growth by setting policies for land use, transportation, housing, economic development, capital facilities, utilities, and parks and recreation.

GRAY INFRASTRUCTURE Traditional infrastructure comprised of drains, pipes, sewers, detention ponds, and vaults intended to move stormwater away from the built environment where it is typically discharged back into the environment at another location.

GSI Green Stormwater Infrastructure refers to engineered features designed to support the biofiltration, retention, and infiltration of stormwater at or near the location in which it falls. GSI uses plants, organic soils, and landscaped features to mimic the natural environment.

LID Low Impact Development is a general term used to describe the use or mimic of natural processes to control stormwater and protect water quality in the design and construction of the built environment.

MS4 Municipal Separate Storm Sewer System is a system that transports runoff from storm drains and roofs. It is separate from the sanitary sewer that carries wastewater from inside buildings.

NONPOINT SOURCE POLLUTION is caused by rainfall running over the ground and carrying pollutants including trash, oil and grease, and fertilizers into nearby waterways.

NPDES National Pollution Discharge Elimination System is a federal permit program that addresses the discharge of pollutants into waters of the United States. It was developed as part of the Clean Water Act. The federal Environmental Protection Agency has given authority for the management of the NPDES program in Washington to the State Department of Ecology.

STORMWATER TRANSFER CONTROL PROGRAM This is a program that allows infill development to pay a fee in-lieu of building green stormwater infrastructure. Fees are applied to a project at another location where investment in GSI is more likely to improve water quality and meet other environmental goals.

WORKS CITED

Anchor QEA. (2012). *Effectiveness of Basin-Wide Stormwater Best-Management Practices: Thea Foss Drainage Basin, City of Tacoma.* City of Tacoma Public Works Department.

B. F. French, D. H. (2022). Urban Roadway Runoff Is Lethal to Juvenile Coho, Steelhead, and Chinook Salmonids, But Not Congeneric Sockeye. *Environ. Sci. Technol. Lett. 2022, 9, 9,* 733–738, 733-738.

Balk, G. (2017, June 29). Seattle added more people last year than all of King County's suburbs combined. *The Seattle Times.*

Balk, G. (2017, May 25). Seattle once again nation's fastest-growing big city; population exceeds 700,000. *The Seattle Times.*

Blair, L., Brosnan, J., Clark, A., Deleon, D., Dettelbach, A., Hansen, S., . . . Pietzold, S. (2022). *2022 Ad Hoc Subgroup: Possible Incentives for Developing Shared Priorities Across Jurisdictional.* Washington Stormwater Center. Retrieved October 20, 2022, from https://www.wastormwatercenter.org/wp-content/uploads/Shared-Priorities-White-Paper-Final.pdf

Carrie Asselmeier, L. D. (2019). *Puget Sound Urban Tree Canopy and Stormwater Management Handbook.* Puget Sound Conservation Districts Caucus. Retrieved from https://betterground.org/wp-content/uploads/2021/10/PugetSoundTreeCanopy_web.pdf

City of Kirkland. (2017). *Yard Smart Rain Rewards.* Retrieved July 2017, from City of Kirkland: http://www.kirklandwa.gov/depart/Public_Works/Utilities/Storm___Surface_Water/Yard_Smart_Rain_Rewards.htm

City of Portland. *Green Streets.* Retrieved February 4, 2023 from Environmental Services—City of Portland: https://www.portlandoregon.gov/bes/45386

City of Seattle. (2016). *RainWise Program.* Retrieved July 2017, from Seattle Public Utilities: http://www.seattle.gov/util/EnvironmentConservation/Projects/GreenStormwaterInfrastructure/RainWise/index.htm

City of Seattle. (2016). *Stormwater Facility Credit.* Retrieved July 2017, from Seattle Public Utilities: http://www.seattle.gov/util/ForBusinesses/DrainageSewerBusinesses/StormwaterFacilityCredit/index.htm

City of Shoreline. (2017). *Soak It Up LID Rebate Program.* Retrieved July 2017, from City of Shoreline: http://www.shorelinewa.gov/government/departments/public-works/surface-water-utility/keeping-stormwater-clean/soak-it-up-lid-rebate-program

City of Tacoma. (2018). *Tacoma Mall Neighborhood Subarea Plan.* Retrieved February 4, 2023, from https://cms.cityoftacoma.org/Planning/Tacoma%20Mall%20Subarea/Tacoma%20Mall%20Subarea%20Plan%20(May%202018).pdf

Corvias; Prince George's County. (2022). Retrieved October 30, 2022, from The Clean Water Partnership: https://thecleanwaterpartnership.com/

Covert, B. (2016, February 18). Retrieved from The Nation: https://www.thenation.com/article/race-best-predicts-whether-you-live-near-pollution/

Darrell M. West, R. N. (2011). *Rebuilding America: The Role of Foreign Capital and Global Public Investors.* The Brookings Institution.

Development Incentives. (n.d.). Retrieved October 30, 2022, from Philadelphia Water Department: https://water.phila.gov/stormwater/incentives/development/

Dorfmeier, E. a. (2016). *Comparing Costs to Reduce Toxic Pollution: City of Tacoma.* Puget Sound Partnership.

Environmental Incentives, Geosyntec Consultants, Corvias, Futurewise. (2019). *Washington State Stormwater Community Based Public-Private Partnership Feasibility Assessment.* Washington State Department of Commerce.

Environmental Protection Agency. (2022, August 31). *Prince George's County Maryland Clean Water Partnership.* Retrieved October 30, 2022, from Environmental Protection Agency: https://www.epa.gov/G3/prince-georges-county-maryland-clean-water-partnership

Futurewise. (2016). *Lay of the Land Report: On the Ground Realities in King County.* Futurewise.

Green Roofs For Healthy Cities - North America. (n.d.). *How Your Community will Benefit from Adopting Green Roof Policy.* Green Roofs for Healthy Cities - North America.

Kitsap County. (2012). *Roadside Ditch and Shoulder Water Quality Enhancement Program.* Kitsap County.

Levine, L., Clements, J., St. Juliana, A., & Davis, P. (2013). *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value.* Natural Resources Defense Council. Retrieved from https://www.nrdc.org/resources/green-edge-how-commercial-property-investment-green-infrastructure-creates-value

MRSC. (2016, August 24). *Real Estate Excise Tax.* Retrieved July 2017, from MRSC Local Government Success: http://mrsc.org/Home/Explore-Topics/Finance/Revenues/Real-Estate-Excise-Tax.aspx

Murphy, e. a. (2015). *Green Infrastructure Policy Integration in Puget Sound Municipalities: An Ethnographic Perspective.* Puget Sound Partnership.

National Ocean Service. (2013). *National Coastal Population Report: Population Trends from 1970 to 2020.* National Oceanic and Atmospheric Administration.

Natural Resources Defense Council. (2013). *Creating Clean Water Cash Flows: Developing Private Markets for Green Stormwater Infrastructure in Philadelphia.* Natural Resources Defense Council.

Natural Resources Defense Council. (2015). *Getting the Green Out: Key Findings and Recommendations from NRDC Workshops on Promoting Green Stormwater Infrastructure on Private Property.* Natural Resources Defense Council.

Navickis-Brasch, A. M.-B. (2022, June). *Stormwater Treatment of Tire Contaminents Best Management Practice Effectiveness - Final Report.* Retrieved from Washington State Department of Ecology: https://fortress.wa.gov/ecy/ezshare/wq/Permits/Flare/2019SWMMWW/Content/Resources/DocsForDownload/2022_SWTreatmentOfTireContaminants-BMPEffectiveness.pdf

Paradise Parking Plots Community Garden. (n.d.). Retrieved October 30, 2022, from World Relief Western Washington: https://worldrelief.org/western-wa/our-work/resiliency/garden/

Partnership, P. S. (2017). *State of the Sound.*

Poresky, A. e. (2015). *City of Seattle: Reducing Pollution from Stormwater Runoff.* Puget Sound Partnership.

Puget Sound Institute. (2015). *Puget Sound Factbook v 3.1.* University of Washington Tacoma.

Puget Sound Partnership. (2015). *Considerations for Social Strategies.* Puget Sound Partnership.

Puget Sound Partnership. (2015). *Protection and Restoring Puget Sound Effective Action: Reducing Stormwater Pollution Seattle, WA.* Puget Sound Partnership.

Puget Sound Partnership. (2016). *Action Agenda for Puget Sound - Comprehensive Plan.* Puget Sound Partnership.

Puget Sound Partnership. (2016). *Protecting and Restoring Puget Sound Effective Action: Reducing Stormwater Pollution, Tacoma, WA.* Puget Sound Partnership.

Puget Sound Starts Here. (2017). *Puget Sound Facts.* Puget Sound Starts Here. Retrieved July 2017, from http://www.pugetsoundstartshere.org/Facts.aspx

Seattle Public Utilities. (2017). *City of Seattle.* Retrieved July 2017, from RaisWise Program: http://www.seattle.gov/util/EnvironmentConservation/Projects/GreenStormwaterInfrastructure/RainWise/index.htm

Seattle Public Utilities. (2017). *Stormwater Facility Credit.* Retrieved July 2017, from City of Seattle: http://www.seattle.gov/util/ForBusinesses/DrainageSewerBusinesses/StormwaterFacilityCredit/index.htm

Seattle Public Utilities. (n.d.). *Natural Drainage System Program.* Retrieved October 7, 2022, from https://www.seattle.gov/util/cs/groups/public/@spu/@usm/documents/webcontent/spu02_019986.pdf

Stewardship Partners and Washington State University Extension. (2017). *12,000 Rain Gardens in Puget Sound.* Retrieved June 24, 2017, from http://www.12000raingardens.org/

Stormwater Action Monitoring. (2022, October 1). Retrieved from WA Department of Ecology: https://ecology.wa.gov/Regulations-Permits/Reporting-requirements/Stormwater-monitoring/Stormwater-Action-Monitoring

Stormwater Action Monitoring. (2022, October 3). Retrieved from Washington State Department of Ecology: https://ecology.wa.gov/Regulations-Permits/Reporting-requirements/Stormwater-monitoring/Stormwater-Action-Monitoring

Stormwater Facilities Credit Program - Questions and Answers. (n.d.). Retrieved October 30, 2022, from Seattle Public Utilities: https://www.seattle.gov/utilities/your-services/discounts-and-incentives/stormwater-facility-credit/questions-and-answers

The Nature Concervancy, University of Washington Climate Impacts Group. (2016). *Adapting to Change: Climate Impacts and Innovation in Puget Sound.* Retrieved from https://www.nature.org/content/dam/tnc/nature/en/documents/adapting-to-change-report.pdf

The Nature Conservancy. (2015). *Outside Our Doors: The Benefits of Cities Where People and Nature Thrive.* The Nature Conservancy.

U.S. Department of Agriculture. (2017). *Water & Environmental Programs.* Retrieved July 2017, from Rural Development: https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs

U.S. Environmental Protection Agency. (1993). *National Estuary Program Guidance: Base Program Analysis.* EPA Office of Water.

U.S. Environmental Protection Agency. (2008). *Green Parking Lot Guide.* U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (2008). *Managing Wet Weather with Green Infrastructure Municipal Handbook.* U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (2013). *Nonpoint Source Program and Grants Guidelines for States and Territories.* U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/nps/319-grant-current-guidance

U.S. Environmental Protection Agency. (2014). *Getting to Green: Paying for Green Infrastructure.* Office of Wetlands, Oceans, and Watersheds National Estuary Program. U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities#Funding Tools

U.S. Environmental Protection Agency. (2017). *Federal and State Funding Programs - Stormwater & Green Infrastructure Projects.* U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency Urban Waters. (2016). *About the Urban Waters Small Grants Program.* U.S. Environmental Protection. Retrieved from https://www.epa.gov/urbanwaterspartners/urban-waters-small-grants-101

U.S. General Services Administration. (2011). *The Benefits and Challenges of Green Roofs on Public and Commercial Buildings.* U.S. General Services Administration.

Valderrama, A. L. (2013). *Creating Clean Water Cash Flows: Developing Private Markets for Green Stormwater Infrastructure in Philadelphia.* Washington, D.C.: Natural Resources Defense Council (NRDC). Retrieved from http://www.nrdc.org/water/stormwater/files/green-infrastructure-pa-report.pdf

Washington Department of Revenue. (2010). *Real Estate Excise Taxes Reference Guide.* Retrieved from http://mrsc.org/Home/Explore-Topics/Finance/Revenues/Real-Estate-Excise-Tax.aspx

Washington State Department of Commerce. (September 2016). *Building Cities in the Rain.* Washington State Department of Commerce.

Washington State Department of Ecology. (2014). *Funding for Water Quality Improvement and Protection.* Washington State Department of Ecology.

Washington State Department of Ecology. (2014). *Funding Guidelines State Fiscal Year 2016: Water Quality Financial Assistance.* Financial Management Section. Washington State Department of Ecology.

Washington State Department of Ecology. (2014). *Low Impact Development Code Update and Integration Toolkit.* Washington State Department of Ecology.

Washington State Department of Ecology. (2016). *Stormwater Control Transfer Program: Out of the Basin.* Washington State Department of Ecology.

Washington State Department of Ecology. (2017). *Centennial Grants.* Retrieved July 2017, from Water Quality Program Funding Opportunities: http://www.ecy.wa.gov/programs/wq/funding/fundprgms/Cent/oppCent.html

Washington State Department of Ecology. (2017). *Clean Water State Revolving Fund (CWSRF or SRF) Loans.* Retrieved July 2017, from Water Quality Program Funding Opportunities: http://www.ecy.wa.gov/programs/wq/funding/fundprgms/CWSRF/oppSRF.html

Washington State Department of Ecology. (2017). *Section 319 Grants.* Retrieved July 2017, from Water Quality Program Funding Opportunities: http://www.ecy.wa.gov/programs/wq/funding/FundPrgms/Sec319/oppSec319.html

Washington State Department of Ecology. (2017). *Stormwater Financial Assistance.* Retrieved July 2017, from Water Quality Program Funding Opportunities: http://www.ecy.wa.gov/programs/wq/funding/FundPrgms/Stormwater/oppSW.html

Washington State Department of Ecology. (2018, February). *State Fiscal Year 2018 Final Water Quality Funding Offer List and Intended Use Plan.* Retrieved June 2018, from https://fortress.wa.gov/ecy/publications/SummaryPages/1810008.html

Washington State Department of Ecology. (2018, May). *State Fiscal Year 2019 Final Water Quality Funding Offer List and Intended Use Plan.* Retrieved June 2018, from https://fortress.wa.gov/ecy/publications/SummaryPages/1810020.html

Washington Stormwater Center. (2017). Retrieved June 24, 2017, from Washington Stormwater Center: www.wastormcenter.org

Washington Stormwater Center and Herrera Environmental Consultants. (2013). *Western Washington Low Impact Development Operations and Maintenance.* Washington State Department of Ecology.

Water Environment Research Foundation. (2017). *Building a Nationally Recognized Program Through Innovation and Research.* Retrieved July 2017, from Using Rainwater to Grow Livable Cities: http://www.werf.org/liveablecommunities/studies_port_or.htm

Water Quality Benevits Evaluation - SUSTAIN Model. (2022, October 1). Retrieved from King County: https://publicinput.com/N2771#3

Wolf, K. L. (n.d.). *Nature's Riches: The Health and Financial Benefits of Nearby Nature.* The Nature Conservancy.

In addition, this white paper benefits from insights from interviews with developers, architects and private owners, on how to best engage and support them in including GSI and GSI retrofits ("Understanding The Private Sector, Green Stormwater Infrastructure, Part II," May 2018, by Aardvark Design Labs and the Nature Conservancy Cities Team for the Department of Commerce). Some key takeaways from that research are included.

Conserving the lands and waters on which all life depends.

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