Puget Sound National Estuary Program

BENTHIC INDEX OF BIOTIC INTEGRITY INDICATOR BASE PROGRAM ANALYSIS

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EXECUTIVE SUMMARY

The Benthic Index of Biotic Integrity (B-IBI) is a metric that uses invertebrates living in rocks and gravel along a stream bottom to measure degradation of habitat condition and water quality. B-IBI scores are grouped into five categories along a gradient of human impact, ranging from "excellent" (most natural condition) to "very poor" (most human disturbance).

In 2011, the Puget Sound Partnership selected B-IBI as one of several indicators to communicate the health of Puget Sound, gauge improvements or declines, and specify regional recovery goals. The B-IBI indicator has two recovery targets to encourage protection of the region's best remaining stream habitats and restoration of those with the most potential for recovery: (1) all Puget Sound lowland streams with baseline "excellent" scores retain those scores, and (2) the mean B-IBI scores of 30 Puget Sound lowland streams with "fair" scores improve to "good" scores.

Development of a regional recovery strategy intended to accelerate progress towards these B-IBI indicator goals began in 2017. This "Implementation Strategy" was led by the Stormwater Strategic Initiative, a partnership between the Washington Department of Ecology, Washington Department of Commerce, and Washington Stormwater Center. A volunteer "Interdisciplinary Team" of fourteen technical experts generated four strategies using a collaborative process designed by the Puget Sound Partnership. Those strategies are:

1. Local Capacity Strategy: Improve funding, staff capacity, and availability of decision support tools for local stormwater management programs.
2. Education and Incentives Strategy: Encourage stormwater retrofits, pollutant source control, and habitat restoration efforts with education and incentives.
3. Watershed Planning Strategy: Promote multi-program and cross-jurisdictional planning for water resource protection and restoration on a coordinated basin scale.
4. Working Lands Strategy: Reduce ongoing impacts of working lands on stream health and the risk of conversion to land uses with more impervious surface.

This report is one of several appendices to the B-IBI Implementation Strategy Narrative prepared by the Stormwater Strategic Initiative. It assesses ongoing programs relevant to B-IBI indicator targets and is intended to help regional partners operationalize the four strategies developed by the Interdisciplinary Team. It was developed in accordance with U.S. Environmental Protection Agency (1993) guidance for NEP base program analysis.

This report starts with a brief introduction to Puget Sound National Estuary Program recovery planning. Next is an overview of regulatory tools that can be leveraged to support implementation of the B-IBI strategies, focusing on Municipal Stormwater General Permits and the Growth Management Act. The remaining sections cover the four strategies. Each begins with a short description of the strategy and its objectives, followed by a table cataloging ongoing programs with potential to support strategy implementation. Then we provide analysis

of the specific approaches the Interdisciplinary Team recommended to help attain strategy objectives. These sub-sections include review of supporting literature; discussion of key programs, barriers, opportunities, and innovative models that could be replicated; and recommendations for implementation based on our review and analysis.

LOCAL CAPACITY STRATEGY

The primary outcome sought by this strategy is increased investment in stormwater management, particularly in smaller jurisdictions where stormwater management is most capacity limited.

The majority of Puget Sound jurisdictions charge stormwater utility fees, but the amounts and rate structures vary widely. The extent to which fee revenue is inadequate for meeting Puget Sound region stormwater program needs is unknown. The Interdisciplinary Team identified lack of political will as a barrier to increasing stormwater utility fees and recommended education as a way to mitigate political challenges associated with charging for services. This approach is supported in the literature and there are existing resources for implementation, including the Association of Washington Cities and Municipal Research and Services Center's Elected Officials Essentials Webinar Series; the Department of Commerce's Short Course on Local Planning; Stormwater Outreach for Regional Municipalities' Stormwater Messaging Toolkit; and Stormwater Action Monitoring's video series.

The Interdisciplinary Team expects increased program funding to improve local stormwater management programs in two ways: augmenting staffing and enhancing information resources. Additional personnel could provide more staff on the ground for inspections, maintenance, and enforcement. Grants are sometimes used to fund staff time for program elements that go beyond bare-minimum stormwater permit requirements, which will be likely necessary to achieve B-IBI indicator goals. However, relatively few programs provide grants to stormwater program operations and grants may not necessarily benefit smaller jurisdictions where already overcommitted staff may not have the time required to apply for and manage grants. An alternative could be providing external support via "circuit rider" technical and/or planning staff that could work with a jurisdiction for a limited time to help support stormwater permit implementation, retrofit planning, and multi-jurisdiction watershed planning processes. Developing a team of on-call regional topic specialists to step in as temporary consultants may be more efficient than trying to build expertise at 120+ jurisdictions region wide.

Several existing programs provide education resources and training for local government staff. Interdisciplinary Team members did not identify specific barriers to program access but suggested that offering professional certifications or continuing education credits, offering classes in multiple geographic areas, and offering webinars could potentially increase participation.

Recommendations for strategy implementation identified in this report include:

- There is not sufficient information to evaluate an Interdisciplinary Team recommendation to revise existing rate structures. We suggest additional research and analysis to assess the efficacy of differing rate structures and other funding mechanisms.
- Encourage regional collaboration and pooling of resources to support the utilities of smaller jurisdictions. This could include collaboration for implementation of municipal stormwater permit obligations, as has been done through Stormwater Action Monitoring and Stormwater Outreach for Regional Municipalities, and/or utility regionalization among neighboring jurisdictions via inter-local agreements or joint utility services authority.
- Explore new project delivery models to attract private capital, such as Public Private Partnerships and Environmental Impact Bonds.
- Evaluate the relative efficiency and effectiveness of the Clean Water Kitsap partnership among Kitsap County's Public Works Department and Department of Community Development, the Kitsap Public Health District, the Kitsap Conservation District, and Washington State University (WSU) Extension Kitsap to determine if this model for collaborative stormwater management program implementation should be encouraged in other counties.
- Conduct a feasibility study for development of a regional program to provide technical support to small jurisdictions. This study should assess demand for this type of program; scope the services most needed; determine the level of interest in expanding an existing program; assess preferences for public, private, or non-profit support; and identify funding sources.
- The Interdisciplinary Team identified improving coordination within jurisdictions as a desired outcome but did not identify specific mechanisms for integrating policies across core jurisdiction functions to resolve differences in departmental priorities. We suggest additional research on factors associated with strong coordination among municipal units.
- Identify barriers and motivators for stormwater staff participation in existing stormwater training programs.
- Conduct needs assessments with end-users before developing any models or tools to support local stormwater investment decisions.

EDUCATION AND INCENTIVES STRATEGY

The objective of this strategy is to develop and employ incentives that encourage private property owners to voluntarily undertake actions to remedy conditions associated with stream degradation. Target activities are (1) stormwater retrofits on properties developed prior to modern stormwater regulations; (2) pollutant source control activities; and (3) riparian, in-stream, and wetland habitat restoration.

The cost of retrofit projects is a barrier that must be overcome for incentive efforts to succeed. Financial incentives will likely be a key motivator and therefore an important part of any retrofit incentive program. Direct and focused engagement with landowners is another element of successful incentive programs.

Several existing programs provide education about pollutant source control. Areas not subject to municipal stormwater permit requirements may benefit from investments in source control awareness to prevent some geographies key to the B-IBI indicator targets from being missed by current efforts.

The Interdisciplinary Team called for increased coordination among existing habitat restoration programs and projects so that restoration investments can be concentrated in geographies or specific watersheds relevant to the B-IBI indicator targets. They also suggested there may be opportunities to incorporate habitat elements into infrastructure projects (e.g., flood control, transportation) to improve stream condition.

Recommendations for strategy implementation identified in this report include:

- Clearly identify geographies associated with B-IBI indicator targets to guide regional stormwater and habitat incentive program investments into relevant areas.
- Since this strategy was developed in 2017, the Stormwater Strategic Initiative has funded several incentive projects that begin to implement it. As these projects wrap up, there would be value in conducting a performance assessment designed to inform how additional incentive program investments should be structured, managed, and coordinated. This assessment could support formulation of a more coordinated regional strategy that addresses service delivery models, regionwide prioritization, and sustainable sources of funding.
- Develop fact sheets to communicate B-IBI Implementation Strategy priorities to habitat restoration practitioners in key B-IBI geographies.

WATERSHED PLANNING STRATEGY

This strategy aims to promote multi-program and cross-jurisdictional planning focused on protecting high quality streams and coordinating restoration actions. The primary planning focus will differ across the region depending on development patterns. In jurisdictions where new development dominates, planning for protection should be a priority. Where redevelopment is prevalent, restoration planning would take precedence. The Interdisciplinary Team prioritized planning for protection because stormwater retrofits are significantly more expensive and not a proven way to improve B-IBI scores.

A key element of this strategy is connecting land use planning and stormwater management. Watershed planning is meant to be a tool to identify lands needed to protect stream health, as well as specific regulatory and non-regulatory mechanisms available to achieve protection.

Some recent protection-focused watershed planning efforts that share some characteristics of this idealized watershed planning approach are described. The Watershed Protection and Restoration Grant Program funding was a driver for most of these projects.

Implementation of watershed plans requires codification of recommended protections in a Comprehensive Plan, zoning, Critical Areas Ordinance, and/or other development regulations. The Interdisciplinary Team acknowledged the extent of the political challenge associated with restricting development and suggested policy changes that strengthen regulations may be necessary to drive implementation of protection-oriented plans.

New Stormwater Management Action Planning requirements in the 2019 municipal stormwater permits are expected to motivate more jurisdictions to undertake protection-focused watershed planning into the future. However, jurisdictions not subject to municipal stormwater permit coverage may be important for the B-IBI indicator targets and would need another motivation to undertake this type of planning.

Continued implementation of coordinated acquisition efforts like the Puget Sound Regional Council's Regional Open Space Conservation Plan, King County's Land Conservation Initiative, and the Watershed Protection and Restoration Grant Program's Riparian Acquisition Initiative, would advance protection goals. Expansion of these models to other geographies may also support progress towards indicator goals.

This strategy seeks to develop financial and regulatory incentives that encourage mitigation of stormwater impacts at a basin scale, rather than on-site, and direct growth to areas that will not harm stream health. A number of projects that piloted market-based tools have recently wrapped up. Synthesis work currently underway will expand understanding of barriers to application of these tools and how they can be overcome. A forthcoming Base Program Analysis for the Land Development and Cover Implementation Strategy will build on this report with emergent findings.

The Interdisciplinary Team stressed the importance of consistent status and trends monitoring; watershed-scale information syntheses; tools that integrate evaluation of landscape and biological metrics; assessment of project and regulatory effectiveness; and documentation of the costs and benefits of management actions. Improving our understanding of the relationship between B-IBI scores and management actions will require continued support for existing programs and projects, including the Department of Ecology's Stormwater Action Monitoring program and Watershed Characterization Technical Assistance Team; Department of Commerce's Growth Management Services and Puget Sound Mapping Project; and Washington Department of Fish and Wildlife's High Resolution Change Detection project and Priority Habitats and Species Program.

Recommendations for strategy implementation identified in this report include:

- Continue grant support for watershed planning efforts with a focus on multi-jurisdictional projects; geographies not subject to municipal general stormwater permits; and planning to support municipal permitees in going above and beyond minimum regulatory obligations. Compared to the three other B-IBI strategies, there is a dearth of existing programs that support this type of work.
- Identify high-priority watershed protection and restoration targets that could be integrated into Growth Management Act buildable lands reporting for 2021-2022. Identifying and removing key parcels from a buildable lands inventory may help to safeguard those areas from development pressure.

WORKING LANDS STRATEGY

The objectives of this strategy are (1) to support long-term economic and ecosystem sustainability of forestry and agricultural operations by directing growth away from working lands and (2) increase the relevance and availability of technical assistance and financial incentives to support implementation of best management practices on working lands.

This strategy not as fully developed as the previous three. The Interdisciplinary Team lacked expertise in forestry issues and determined that the Implementation Strategy process was not likely to "add value" to existing forestry agreements and plans. Agricultural participants recommended developing a cross-cutting strategy for agriculture since the scope of recovery issues applicable to agricultural lands extend well beyond B-IBI indicator goals.

Input received from participants was captured and will be used as a starting point for future strategy development work, including a forthcoming update to the 2016 Land Development and Cover Implementation Strategy. The multitude of technical assistance programs for working lands catalogued in this report will be evaluated further as part of a Base Program Analysis for Land Development and Cover under development.

ACRONYMS AND ABBREVIATIONS

B-IBI	Benthic Index of Biotic Integrity
BMP	Best Management Practice
CADDIS	Causal Analysis/Diagnosis Decision Information System
Commerce	Washington Department of Commerce
CAO	Critical Area Ordinance
CWA	Clean Water Act
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Equivalent Service Unit
GIS	Geographic Information Systems
GMA	Growth Management Act
GSI	Green Stormwater Infrastructure
HCP	Habitat Conservation Plan
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer Systems
NEP	National Estuary Program
NMFS	National Marin Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTA	Near Term Action

PBRS	Public Benefits Rating System
PSP	Puget Sound Partnership
PSRC	Puget Sound Regional Council
REET	Real Estate Excise Tax
SAM	Stormwater Action Monitoring
SIAT	Stormwater Strategic Initiative Advisory Team
SMAP	Stormwater Management Action Plan
STORM	Stormwater Outreach for Regional Municipalities
SWMMWW	Stormwater Management Manual for Western Washington
TMDL	Total Maximum Daily Load
UGA	Urban Growth Area
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WSCC	Washington State Conservation Commission
WSDOT	Washington State Department of Transportation

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1. INTRODUCTION

The National Estuary Program (NEP), administered by the U.S. Environmental Protection Agency (EPA), was established to protect and restore the water quality and ecological integrity of estuaries of national significance. The Puget Sound Partnership (PSP) is a Washington State agency created in 2007 to coordinate the Puget Sound NEP by bringing together partners to mobilize action around a common agenda. PSP focuses the region's collective effort through development of a shared vision and strategy articulated in the Action Agenda for Puget Sound. This comprehensive plan helps to efficiently allocate federal, state, and local recovery investments based on a science-driven, prioritized system.

Beginning in 2010, PSP developed a portfolio of Vital Signs to track progress toward Puget Sound recovery goals. These Vital Signs represent overarching measures used to communicate the health of Puget Sound and gauge improvements or declines. Each Vital Sign has one or more specific and measurable metrics, called indicator targets, that specify regional recovery goals. These indicator targets include quantitative milestones that reflect the region's commitments to, and expectations for, significantly improving the condition of Puget Sound by 2020.[1]

1.1 FRESHWATER QUALITY VITAL SIGN AND B-IBI INDICATOR TARGETS

NOTE: This section describes Vital Sign and indicator targets in place during development of the B-IBI Implementation Strategy. An effort to revise the Vital Sign indicators for use beyond 2020 began in 2019. The following content may be out-of-date soon after publication of this report but is included to provide context for the 2017-2019 planning effort that resulted in the strategies described throughout this document.

The Freshwater Quality Vital Sign tracks the condition of streams and rivers that flow into Puget Sound. The Vital Sign has three indicators that report status and trends region-wide: Benthic Index of Biotic Integrity, Freshwater Impairments, and Water Quality Index.

Benthic Index of Biotic Integrity (B-IBI) is a well-known metric that uses invertebrates living in rocks and gravel along a stream bottom to measure degradation of habitat condition and water quality. A B-IBI score is a number that conveys the biological health of wadeable streams by integrating the cumulative impacts of physical, chemical, and biological changes in a watershed. This "bug index" is composed of ten metrics that characterize the diversity and abundance of the aquatic macroinvertebrate community (insects, crustaceans, snails, clams, and worms). When combined into a single numerical score, this value describes the condition of a stream

[1] O'Neil et al. (2018) provide a history of processes used to select and refine indicators of Puget Sound's biophysical condition, as well as early recommendations for the revision effort underway at the time of writing. Human Wellbeing Vital Signs and indicators were developed through a separate process described in Biedenweg (2014), Biedenweg et al. (2014), and Stiles et al. (2015).

segment and its upstream drainage basin. B-IBI scores are grouped into five categories along a gradient of human impact, ranging from "excellent" (most natural condition) to "very poor" (most human disturbance).

The B-IBI indicator developed by PSP in 2011 had two recovery targets:

- **Protection** – All Puget Sound lowland streams with baseline "excellent" scores retain those scores.
- **Restoration** – The mean B-IBI scores of 30 Puget Sound lowland streams with "fair" scores improve to "good" scores.

These B-IBI indicator targets were intended to represent the region's best remaining stream habitats as well as those with highest potential for recovery (Wulkan 2011). Degraded stream segments with "poor" and "very poor" scores were not addressed by the B-IBI indicator targets but would likely be addressed through the other freshwater indicators developed in 2011.

1.2 IMPLEMENTATION STRATEGIES

Progress toward meeting Vital Sign indicator targets has been mixed. Several indicators have made gains relative to baseline conditions, but many others are not showing improvement (PSP 2019). EPA, as federal lead for NEP efforts in Puget Sound, identified a need to further focus regional recovery and protection priorities. The Implementation Strategy is a planning tool developed to provide this focus.

Implementation Strategies describe outcomes necessary to accelerate progress towards individual Vital Sign indicator targets. They are intended to serve as a road map for aligning opportunities across agencies and programs, provide priorities for the Action Agenda, and guide funding decisions. The Implementation Strategies are developed collaboratively with local and regional input from experts and practitioners from multiple disciplines.

Implementation Strategy development follows a process designed by PSP (2017). A volunteer **Interdisciplinary Team** recruited through a public process provides most of the technical input on what to include, focus on, and recommend as priorities within the Implementation Strategy. This occurs in facilitated workshops where *Open Standards for the Practice of Conservation* (Conservation Measures Partnership 2013) planning tools are used to structure group discussion and develop products.

The strategies and content developed by the Interdisciplinary Team are vetted and refined during topical subgroup meetings, a **technical workshop**, and a **partner workshop**. These subgroups and review workshops broaden participation to validate and improve the draft materials before public and external science reviews occur. Participant feedback is intended to improve the accuracy of content, identify additional resources or information available, and to allow input from organizations that may bear some responsibility for implementation of the proposed strategies.

A complete Implementation Strategy contains the following elements:

- A summary narrative that identifies and prioritizes approaches for achieving targets; describes strategies, actions, programs, and policy changes associated with each approach; delineates research and monitoring needs; identifies adaptive management opportunities; and estimates strategy costs.
- Three types of *Open Standards for the Practice of Conservation* logic models:
    - A situation analysis that documents participants' common understanding of the factors contributing to problems, barriers, and opportunities. This conceptual model is used to help decide where and how to intervene.
    - Result chains that describe the cause-effect changes necessary to make progress under each identified approach. They define the sequence of steps needed to achieve specific outcomes, and document group hypotheses about how approaches are intended to address identified barriers.
    - A schematic overview depicting how the approaches selected by participants work together to drive progress towards indicator targets. Priority pathways are also indicated.
- Supporting technical reports/appendices including an analysis of ongoing programs for a Base Program Analysis (this document); a State of Knowledge report synthesizing technical information about current conditions and uncertainties; and tables that specify proposed actions to achieve outcomes identified in the results chains.

1.3 DEVELOPMENT OF THE B-IBI IMPLEMENTATION STRATEGY

An Implementation Strategy for the B-IBI indicator targets has been under development since early 2017. The process was led by the Stormwater Strategic Initiative, a partnership between the Washington Department of Ecology (Ecology), Washington Department of Commerce (Commerce), and the Washington Stormwater Center. Technical support was provided by EPA, PSP, and Puget Sound Institute.

The Interdisciplinary Team of fourteen technical experts represented several perspectives (local government, state agency, federal agency, non-governmental organization, private sector, and academia) and disciplines (entomology, ecotoxicology, conservation biology, land use/urban planning, regulatory compliance, water resource engineering, and natural resource management) developed four strategies to accelerate attainment of the B-IBI indicator targets:

1. **Local Capacity Strategy**: Improve funding, staff capacity, and availability of decision support tools for local stormwater management programs.
2. **Education and Incentives Strategy**: Encourage stormwater retrofits and habitat restoration efforts with education and incentives.
3. **Watershed Planning Strategy**: Promote multi-program and cross-jurisdictional planning for water resource protection and restoration on a coordinated basin scale.

4. **Working Lands Strategy**: Reduce ongoing impacts of working lands on stream health and the risk of conversion to land uses with more impervious surface.

Approaches and actions associated with these strategies are expected to help to protect and restore freshwater quality by preventing or reducing stormwater impacts (degradation of hydrology, water quality, habitat) as well as protecting and improving habitat (riparian, in-stream, and wetland). However, it is important to note that the magnitude and timing of B-IBI response to stressor removal or remediation has not been demonstrated (King County 2015). This is a significant uncertainty that was identified and discussed several times during the Implementation Strategy development process.

This report provides a brief overview of the strategies and priority approaches. Additional information can be found in the Implementation Strategy narrative and supporting appendices. A detailed description of the development process is provided in Appendix IVa.

1.4 SCOPE OF THIS REPORT

This report is one of several appendices to the B-IBI Implementation Strategy Narrative (Stormwater Strategic Initiative 2020). It assesses ongoing programs with potential to help regional partners operationalize the Implementation Strategy and was developed consistent with EPA (1993) guidance.

Section 2 provides an introduction to regulatory drivers relevant to implementation of the B-IBI strategies. Sections 3 – 6 provide an overview of the four strategies and existing programs relating to each. Sub-sections correspond to key "intermediate results"[2] identified on the strategy results chain and identify opportunities for specific actions as well as innovative models to support implementation of the strategies.

This report intentionally focuses on state, regional, and local tools since regional partners do not necessarily have an ability to drive changes or influence priorities for federal programs.

Recommendations provided in this document were derived from:

- Interdisciplinary Team meetings and technical/partner workshops. Expert elicitation is a key tenet of the Implementation Strategy development process. Participant views cited herein generally reflect consensus opinion.
- Review of pertinent literature. Reports associated with NEP grants awarded 2011-2016 through the Watershed Protection and Restoration Grant Program ("Watershed Grant Program") were a key resource for this evaluation. A report on management actions expected to restore and/or maintain B-IBI scores consistent with indicator targets (King County 2015) was particularly useful as a guiding framework. Commerce (2019) and Wright

[2] Intermediate results lead to long-term conservation results (i.e., the desired state of the world) per Conservation Measures Partnership (2013).

(*in prep*) Watershed Grant Program summary reports were especially helpful with respect to the awards to local jurisdictions to integrate watershed characterization modeling into comprehensive plans and stormwater management plans.

2. REGULATORY DRIVERS

This section provides a brief overview of regulatory tools that can be leveraged to support implementation of the B-IBI strategies. The focus is on stormwater management and land use because the Interdisciplinary Team identified land conversion and development as the primary pressures impacting stream condition in the Puget Sound basin.

This is supported by the scientific literature, as the B-IBI metric is strongly correlated with several measures of urbanization, including total impervious area, percent urbanization, watershed canopy cover, road density, and population (DeGasperi et al. 2018, James et al. 2020 and references cited therein).

Regulations that guide stormwater management and land use provide an opportunity protect and restore stream integrity because they can address the scale and pattern of development, which affects the type and magnitude of stressors resulting from development.

Conversion to residential, commercial, or industrial land use can be particularly damaging due to increased stormwater runoff volume, which can result in scouring high flows, excessive fine sediment, and delivery of contaminants. Regulatory requirements for Low Impact Development (LID)[3] and stormwater retrofits are meant to reduce these impacts by reducing effective impervious surfaces and/or managing damaging flows.

Hydrology and water quality impacts from forestry and agricultural production may be lower compared to more intense land uses (i.e., those with extensive impervious surface and/or high building/population density), but habitat impacts can be high. Incorporation of Best Management Practices (BMPs) driven by fish protection and water quality regulations can reduce the magnitude of such impacts.

[3] **Low Impact Development (LID)** is a stormwater and land use management strategy that strives to mimic natural hydrologic conditions by promoting infiltration, filtration, storage, evaporation, and transpiration. LID practices manage rain close to where it falls. Common LID practices include bioretention, rain gardens, permeable pavements, preservation of natural vegetation, maintaining/improving soil quality and depth, vegetated roofs, and rainwater harvesting. These practices are also called **Green Stormwater Infrastructure (GSI)**.

2.1 CLEAN WATER ACT

The federal Clean Water Act required development of programs aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The EPA delegated authority to administer Washington State's water quality program to the Department of Ecology (Ecology). Two components of Ecology's water quality program that are particularly relevant to the B-IBI indicator targets are National Pollutant Discharge Elimination System (NPDES) Municipal General Stormwater Permits and the Nonpoint Source Pollution Program.[4]

2.1.1 NPDES MUNICIPAL GENERAL STORMWATER PERMITS

Pursuant to Section 402 of the Clean Water Act, Ecology regulates the discharge of stormwater to and from municipal separate storm sewer systems (MS4s) of local jurisdictions through NPDES Municipal General Stormwater Permits.

The Phase I permit covers the two largest cities and three largest counties in Puget Sound, and the Phase II permit covers most of the smaller urban areas.[5] Additional secondary permittees covered by the Phase I and II permits include school districts, irrigation districts, and other special purpose public entities that own and operate MS4s.

See Figure 1 for a map of Municipal General Stormwater Permits in the Puget Sound region.

Ecology's NPDES Municipal General Stormwater Permits require jurisdictions to develop stormwater management programs and implement stormwater BMPs[6] to reduce pollutant concentrations, discharge volume, and flow rates.

Historically, the larger counties and municipalities have more permit requirements than the Phase II jurisdictions. As of the 2019 permit reissuance, the larger counties and municipalities and Phase II jurisdictions share most of the same permit requirements. See Table 1.

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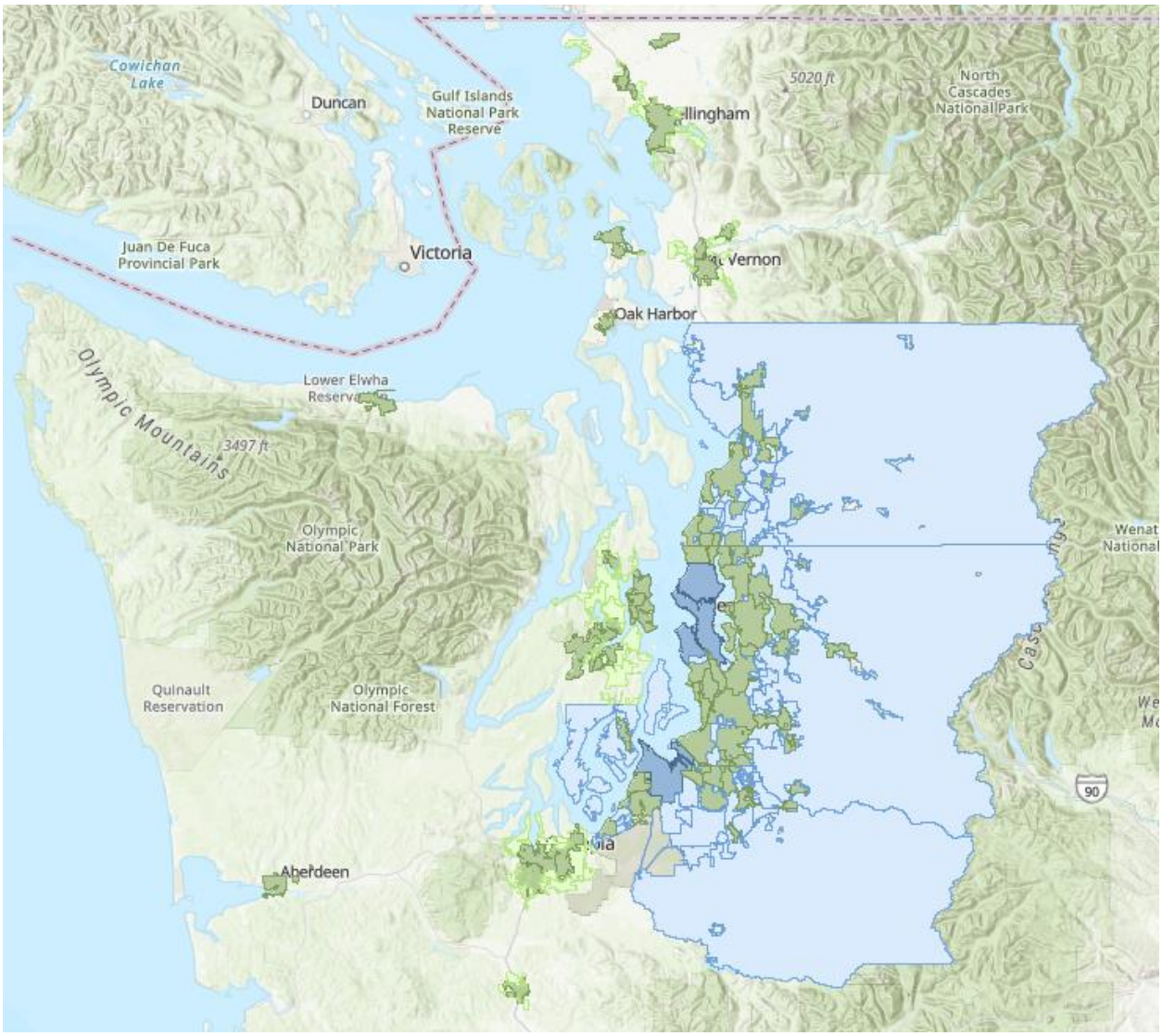
[4] Ecology has also developed Water Quality Standards for B-IBI and is working on Total Maximum Daily Load (TMDL) plans to bring impaired waters not meeting those standards into compliance in two Puget Sound watersheds. TMDLs are a powerful regulatory driver for improving stream condition. However, the B-IBI indicator targets reference "excellent" and "good" streams. Waterbodies designated as impaired are more likely to be associated with "poor" or "very poor" B-IBI scores. Therefore, recent changes to Ecology's Water Quality Assessment Policy 1-11 relating to B-IBI and the TMDL process are not included here.

[5] It is important to note that these permits only apply to areas served by MS4s and excludes areas served by combined sewers, privately owned and operated storm sewers that discharge directly to water bodies, and drywells covered under the Underground Injection Control rule (WAC 173-218).

[6] Stormwater **Best Management Practices (BMPs)** are activities, prohibitions of practices, maintenance procedures, managerial practices, or structural devices that reduce volume of stormwater flows, prevent pollution from potential sources, and treat runoff to remove sediment, oils, and other pollutants.

Figure 1. Municipal Stormwater Permit Coverage in the Puget Sound region



Source: [WAECY - Municipal Stormwater Permit Areas] dataset on the Washington Geospatial Open Data Portal.

Table 1. Comparison of Phase I and Phase II Municipal Stormwater Permits

Phase I	Phase II
Federal rules promulgated in 1990	Federal rules promulgated in 1999
Phase I general permits first issued in 1995	Phase II general permits first issued in 2007
Federal rules apply to medium and large MS4s serving cities with populations of ≥100,000 and unincorporated counties with populations >250,000 as of the 1990 census.	Federal rules apply to small MS4s serving urbanized areas as defined by the U.S. Census Bureau. Ecology extended the cities' coverage throughout the jurisdiction and the counties' coverage throughout designated Urban Growth Areas.
Regulated municipalities in the Puget Sound region include two cities (Seattle, Tacoma) and three counties (King, Pierce, Snohomish) as well as the Ports of Seattle and Tacoma.	Regulated municipalities in the Puget Sound region include 77 cities/UGAs and 4 counties.
Requires legal authority (e.g., codes, regulations, ordinances, and an enforcement program) to control discharges to and from the jurisdiction's stormwater system.	The 2019 permit added a requirement for similar legal authority.
Must submit technical standards and manuals associated with development and construction permitting to Ecology for review and approval.	Must use an equivalent approved manual. Most permittees use either Ecology' *Stormwater Management Manual for Western Washington* or a Phase I County's approved manual.
Required to develop a structural stormwater control (retrofit) program to prevent or reduce hydrologic and pollutant impacts to waters of the state. Requires prioritization and incentivizes planning.	The 2019 permit requires Stormwater Management Action Planning for a similar program.
The 2007 permit required Phase I permittees to develop a source control program for existing development to reduce pollutants in runoff.	The 2019 permit requires Phase II permittees to develop source control programs.

The Washington State Department of Transportation (WSDOT) has had its own MS4 permit since 2009. Other Ecology General Stormwater Permits cover construction operations that disturb one or more acres; sand and gravel operations; boat yards; and industrial facilities with discharges to surface water. These permits were not a focus of strategy development. However, since streams are degraded by road crossings, road runoff, and sediment mobilized by land disturbance, some participants in the Implementation Strategy development process noted that these other general stormwater permits should be evaluated in future iterations of any B-IBI strategy.

MAJOR CHANGES IN THE 2013 MUNICIPAL GENERAL STORMWATER PERMITS

NPDES permits are generally reissued every 5 years. Changes to improve controls for discharges from regulated stormwater systems occur with each reissuance. New and revised requirements in Ecology permits reflect learning from monitoring data; lessons from ongoing program implementation; Endangered Species Act listings and 4(d) rules (discussed in Section 2.3); litigation and appeals and resulting decisions of the Pollution Control Hearings Board; direction from the state legislature; and evolution of EPA guidance over time. With each reissuance, the Phase I and II permits have become more similar.

Two major permit changes that occurred during the 2013 update cycle are particularly relevant for implementation of the B-IBI strategies.

Low Impact Development

The 2013 revision required Phase I and Phase II permittees to integrate Low Impact Development (LID) provisions into local development codes for new development and redevelopment, and to remove barriers to implementing LID practices. Until recently, stormwater management focused on reducing flooding risk by quickly conveying runoff to receiving waterbodies. Traditional practices relied on installation of centralized infrastructure like pipes, vaults, and detention ponds. In contrast, LID applies methods that minimize impervious surfaces and manage stormwater runoff at its source to reduce the volume and pollutant load of runoff leaving a site. It is characterized by smaller-scale distributed controls and conservation of natural site features.

LID integration involves extensive review and complex updates to a wide variety of codes, ordinances, standards, and plans (PSP 2012, Ecology 2014). Barriers to LID implementation include requirements for certain width roads, fire lanes, parking spaces, and even sidewalks. Building effective LID regulations and removing barriers includes coordination among various departments—public works, planning, fire marshal, building, maintenance/ inspections—and can take several years to complete. Many permittees have struggled to integrate LID principles into their land development codes/ordinances (Murphy et al. 2015, Futurewise 2016, Puget Soundkeeper Alliance and Washington Environmental Council 2017), though meaningful progress has been made in several jurisdictions over the past two years (Puget Soundkeeper Alliance and Washington Environmental Council 2019).

Watershed Planning

Another new element in the 2013 Phase I permit required King, Pierce, and Snohomish Counties to each conduct one substantial watershed-scale (1 to 20 mi^2) planning process for a stream with good water quality that is in a watershed that is under development pressure. This entailed hydrologic modeling to test the performance of different stormwater strategies in multiple future build-out scenarios. The purpose of this evaluation was to identify stormwater management strategies that would result in future hydrologic and water quality conditions expected to fully support designated uses throughout the stream system. The resulting plans are discussed in Section 5 (Watershed Planning Strategy).

STORMWATER MANAGEMENT ACTION PLANS IN THE 2019 PERMITS

The 2019 permit revisions introduced another new planning process. Phase II permittees are to conduct one catchment-scale (400-600 acres) planning process to identify specific stormwater management actions to protect designated uses or improve water quality and/or habitat in a selected receiving water that will be identified through a permit-described prioritization process. The resulting Stormwater Management Action Plans (SMAPs) are intended to identify ways jurisdiction can accommodate future growth and development while preventing water quality degradation and/or improve conditions in receiving waters harmed by past development.

Phase I county permittees must produce a SMAP for either a catchment located within the watershed-scale plans developed pursuant to the 2013 Phase I permit (see above), or for a different receiving water body identified through a new planning process.

The SMAP requirement aims to expand stormwater management from the single-site/subdivision scale towards also addressing cumulative impacts of development in a watershed (Ecology 2019). SMAPs are to incorporate three types of actions:

- Strategic retrofits – Improvements to existing structural facilities and siting/construction of new facilities. BMP types and preferred locations should be included.
- Land management/development strategies – Identification of lands to protect/conserve from impervious surface conversions or native vegetation removal, and the means for providing needed protection (e.g., purchase or zoning changes). Identification of land use policy changes deemed necessary to maintain current designated uses.
- Stormwater program enhancements – Targeted, enhanced, or customized implementation of required program elements, such as focused or more frequent illicit discharge detection and elimination field screening; prioritization of source control inspections; operations and maintenance inspections or enhanced maintenance activities like line cleaning; and public education and outreach or behavior change programs to support SMAP actions.

SMAPs are to include a realistic schedule, budget, and sources of funding for implementing actions and projects identified in the plan. Ecology (2019) indicates that permittees should expect to implement the SMAP during future permit update cycles. Actions are to be categorized as short-term (to be accomplished within 6 years) or long-term (to be accomplished within 7 to 20 years). These timeframes follow the Growth Management Act capital facility planning process (discussed in Section 2.2) and are an indication of the anticipated level of effort, time, and resources expected (Ecology 2019).

The prioritization steps for selecting SMAP receiving waters are: delineate basins and identify receiving waters; assess receiving water conditions; assess stormwater management influence; develop a watershed inventory that identifies protection and/or restoration goals for potential candidate basins; and develop a receiving water prioritization process. Guidance for this prioritization process (Ecology 2019) references the three-step process described in *Building*

Cities in the Rain (Commerce 2016), a guidebook developed with NEP funding through the Watershed Grant Program. It also includes key comprehensive planning environmental checklist items (see Section 2.2 on the Growth Management Act).

Another new Phase I and II permit requirement is for cities and counties to report to Ecology how their stormwater planning is integrated into their jurisdiction's comprehensive planning. These reports will provide insight into how these tools can be better used to support advancement of local and regional stormwater management goals.

2.1.2 NONPOINT POLLUTION PROGRAM

Much of the runoff not covered under one of the stormwater general permits is addressed through the Nonpoint Pollution Program described in Ecology (2015). Pursuant to Section 319 of the Clean Water Act, Ecology's Nonpoint Pollution Program works to ensure compliance with state Water Quality Standards by supporting local water quality assessments and watershed-scale water quality planning efforts; providing financial assistance for voluntary implementation of site-scale water quality improvement projects; providing technical assistance and education/outreach; and collecting data on BMP implementation and effectiveness.

Ecology works with other state agencies (Agriculture, Health, Natural Resources) and local partners (e.g. conservation districts, city and county governments, non-profit watershed groups) to support administration of, and provide a regulatory backstop for, programs addressing non-point source pollution (e.g., Dairy Nutrient Management Program, Forest Practices Rules, On-site Sewage System programs).

The Nonpoint Pollution Program could help support B-IBI strategies involving working lands and smaller cities and counties not covered by municipal stormwater permits, where capacity might otherwise be limiting. Although the first priority of the Nonpoint Pollution Program is to correct known water quality impairments, Ecology also supports projects that protect threatened and high-quality waters (e.g., "excellent" basins) from present and future degradation (Ecology 2015). In addition, the program's emphasis on evaluating watershed data, tracking BMP implementation, and effectiveness monitoring addresses a data gap identified by the Interdisciplinary Team and supports adaptive management of B-IBI strategy implementation.

2.2 GROWTH MANAGEMENT ACT

The Growth Management Act (GMA) is the key state statute addressing land use planning. GMA aims to limit sprawl and ensure sufficient infrastructure is available to accommodate growth. It prescribes comprehensive planning requirements and directs local governments to enact development regulations consistent with their plans. GMA also requires cities and counties to identify critical environmental areas and natural resource lands then adopt regulations to protect and conserve them.[7]

Washington's Legislature established 14 goals to guide the development of local plans and development regulations: (1) encourage development in urban areas; (2) reduce sprawl; (3) encourage efficient transportation systems based on regional priorities and coordinated plans; (4) encourage availability of affordable housing and preservation of existing housing stock; (5) encourage economic development consistent with adopted plans; (6) protect the property rights of landowners; (7) process permits in a fair and timely manner; (8) encourage conservation of productive natural resource lands and discourage incompatible uses; (9) retain open space to enhance recreational opportunities and conserve fish and wildlife habitat; (10) protect the environment, including air and water quality and the availability of water; (11) encourage citizen involvement in planning and coordination between communities; (12) ensure adequate infrastructure is available at the time of development; (13) identify and encourage preservation of lands, sites, and structures that have historical or archaeological significance; and (14) protect shorelines of the state.[8]

Several types of local development regulations can be used to implement GMA requirements. They include zoning code, critical area ordinances (CAOs), clearing and grading ordinances, subdivision regulations, public works standards, and landscaping or vegetation ordinances.

The Washington State Department of Commerce (Commerce) provides technical assistance and limited financial support to help local governments comply with GMA requirements. Commerce reviews local comprehensive plans for consistency with GMA but does not formally approve them. Enforcement occurs when a local entity, organization, or citizen brings a legal challenge via a Growth Management Hearings Board.

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[7] **Critical areas** include wetlands, aquifer recharge areas, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas, per RCW 36.70A.030(5). Development regulations must preserve the functions and values of the natural environment and safeguard the public from hazards to health and safety, per WAC 365-196-830(3) et seq. **Natural resource lands** are agricultural lands, forestlands, and mining resource lands that have long-term commercial significance and were not already characterized by urban growth at the time of original designation in September 1991, per RCW 36.70A.170. Development regulations must prevent conversion to a use that removes land from resource production, per WAC 365-196-815.

[8] RCW 36.70A.020 and RCW 36.70A.480

2.2.1 URBAN GROWTH AREAS

A key tool for limiting sprawl is GMA's requirement for counties and cities to designate urban growth areas (UGAs) sufficient to accommodate the level of growth projected for the next 20 years.[9] UGAs represent a boundary outside of which growth is constrained. Adjacent and overlapping jurisdictions must coordinate to identify where growth should occur and set targets for specific areas. Within urban areas, most growth must be allocated with minimum densities of four housing units per acre. Rural areas are typically zoned for not more than one unit per five acres. Outside the UGA, cities are limited in their ability to extend utilities and other governmental services.[10]

Designated urban growth areas in the Puget Sound region are shown in Figure 2.

There are statistically significant differences in B-IBI scores within and outside of the urban growth boundary (DeGasperi et al. 2018). A recent large-scale assessment of stream condition in the Puget Sound lowlands found:

- 12% of stream length was in good condition and 82% was in poor condition inside of UGAs
- 46% of stream length was in good condition and 31% was in poor condition outside of UGAs (DeGasperi et al. 2018).

These results suggest that, in the absence of detailed geographic priorities for the B-IBI indicator, work to advance progress towards regional goals should focus on areas outside of UGA boundaries.

2.2.2 PROTECTIONS FOR CRITICAL AREAS AND NATURAL RESOURCE LANDS

GMA requires all of Washington's cities and counties to designate critical environmental areas natural resource lands then adopt development regulations to protect them. Counties and cities must (1) include the best available science in developing policies and development regulations to protect functions and values of critical areas, and (2) give special consideration to conservation and protection measures necessary to preserve or enhance anadromous fisheries.[11]

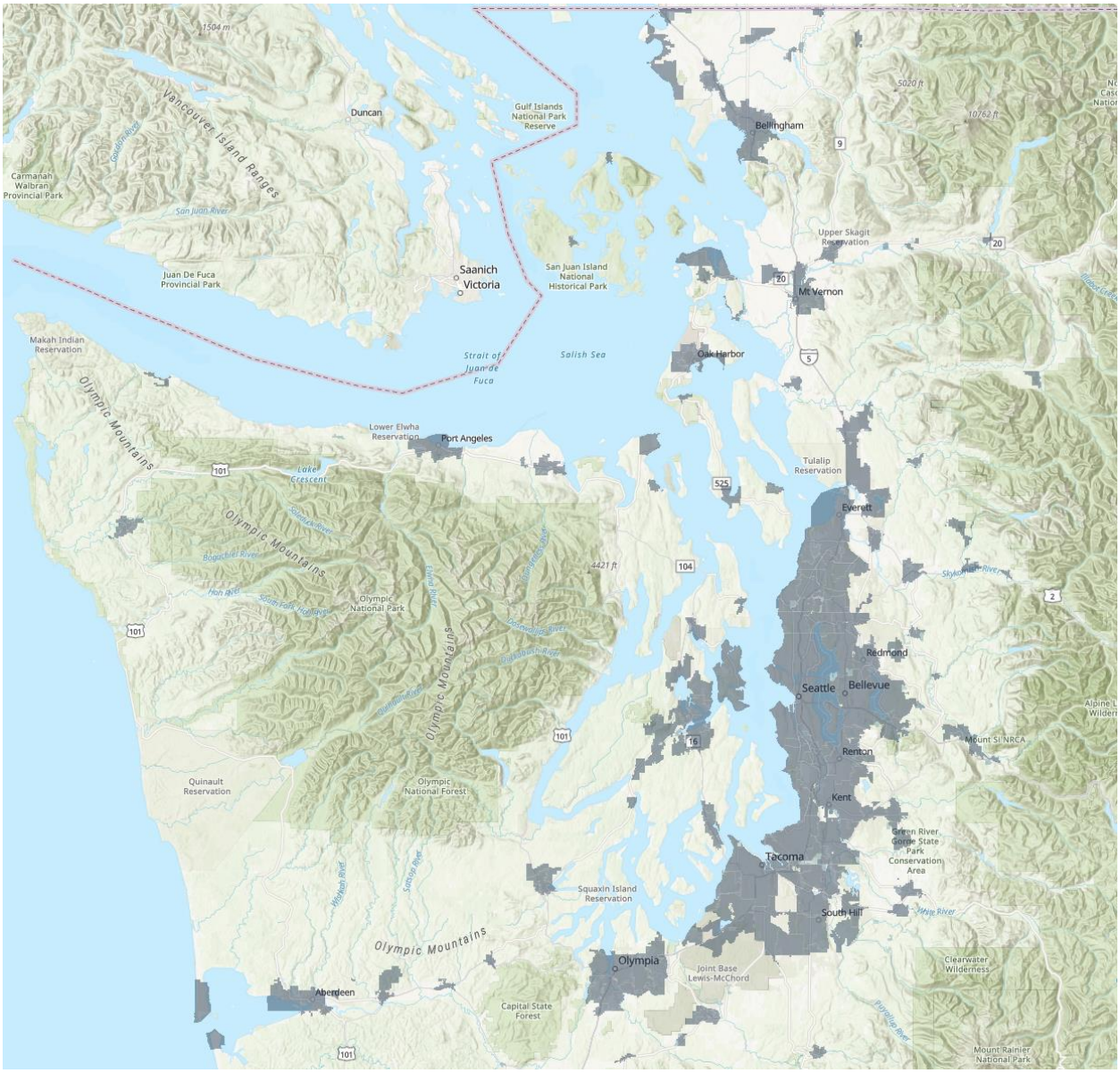
Local critical area and natural resource lands regulations adopted pursuant to GMA support B-IBI indicator goals at both the local and watershed scales. Riparian and stream habitats must be considered for classification and designation as fish and wildlife habitat conservation critical areas per WAC 365-190-135, so CAOs can limit direct habitat impacts that lower B-IBI scores. Limiting the conversion of agricultural and forest parcels (called "working lands" herein) to more intensive uses helps to maintain more natural hydrology on the watershed scale.

[9] RCW 36.70A.110(2) and WAC 365-196-310

[10] RCW 36.70A.110(4)

[11] RCW 36.70A.172(1)

Figure 2. Designated Urban Growth Areas in the Puget Sound region



Source: [Washington State City Urban Growth Areas 2019] dataset from the Washington Geospatial Open Data Portal.

However, the level of protection provided by development regulations and the degree to which they are enforced varies by jurisdiction. There is a wide range of factors influencing implementation of local regulatory programs in the region, including jurisdiction size, number of staff and their experience level, data management systems, and extent of political interference (Kinney et al. 2015). In addition, not all agricultural and forest parcels are designated as natural resource lands (see footnote 7). Other rural land use designations that allow low-density housing units may apply. Puget Sound Regional Council (2018) estimated that within King, Kitsap, Pierce, and Snohomish counties 64% of farmland and 81% of working forests are designated as such.

Voluntary Stewardship Program

The Voluntary Stewardship Program is an alternative to CAO regulations for agriculture lands that seeks to address GMA's sometimes competing goals for protection of the environment and enhancement of natural resource industries. This program was developed following several legal challenges to CAO regulations that directed farmers to remove land from production in order to meet riparian buffer requirements, which would reduce the economic viability of agricultural operations.

The Voluntary Stewardship Program promotes development of locally directed plans to balance GMA's environmental and economic goals.[12] The Washington State Conservation Commission (WSCC) administers funding to counties to engage diverse stakeholders to develop and then implement watershed work plans. Four Puget Sound counties opted into the program: San Juan, Skagit, Mason, and Thurston. As of December 2018, all work plans have been approved by WSCC and are in the implementation phase. Two-year status reports will measure progress against measurable benchmarks.

Similar to the B-IBI Watershed Planning strategy, the Voluntary Stewardship Program operates at the watershed scale rather than parcel-by-parcel. Results and lessons learned documented in upcoming status reports for the four Puget Sound county work plans can help guide implementation of the B-IBI Working Lands strategy in other counties.

2.2.3 COMPREHENSIVE PLANNING

GMA requires cities and counties above population size and growth rate thresholds to develop comprehensive plans to guide local decisions on land use, siting of essential public facilities, and capital budgeting; coordinate planning within counties and among neighboring cities and counties; ensure adequate transportation facilities are provided concurrent with growth; and protect critical areas and natural resource lands. Jurisdictions that plan under GMA must adopt development regulations to support implementation of their plan.[13] Comprehensive plans and implementing regulations must be updated every eight years.

[12] RCW 36.70A.700 et seq.

[13] All 12 Puget Sound counties are required to develop comprehensive plans. San Juan, Jefferson, and Mason could have chosen to opt-out of full planning requirements but elected not to.

Comprehensive plans are required by RCW 36.70A.070 and WAC 365-196-400 to include:

- Land use element – Designates general distribution and location of land to be used for housing, commerce, industry, timber/agriculture/mineral resources, recreation, open spaces, public utilities, and public facilities. Includes population densities, building intensities, and estimates of future population growth.
- Housing element – Inventories existing and projected housing needs, including the number of housing units necessary to manage projected growth and identification of sufficient land for housing. Some counties and cities are subject to extra review, evaluation, and reporting requirements; these are described later in this section.
- Capital facilities element – Inventories existing and forecasts future capacity needs for capital facilities including, at a minimum, water systems, sanitary sewer systems, stormwater facilities, reclaimed water facilities, schools, parks and recreation facilities, and police and fire protection facilities.[14] Includes proposed locations for expanded or new facilities and an at least six-year finance plan. Capital facility planning is discussed in more detail later in this section.
- Utilities element – Identifies the general location, proposed location, and capacity of all existing and proposed utilities including, but not limited to, electrical lines, telecommunication lines, and natural gas lines.
- Transportation element – Inventories air, water, and ground transportation facilities. Sets level of service standards for locally owned arterials and transit routes. Forecasts traffic based on adopted land use element to inform location, timing, and capacity needs of future growth. Includes a six-year street, road, or transit program with multi-year financing plan. Documents intergovernmental coordination efforts, including assessment of impacts of the plan on the transportation systems of adjacent jurisdictions. The Puget Sound Regional Council (PSRC) provides specific direction for development and evaluation of transportation elements for jurisdictions within King, Kitsap, Pierce, and Snohomish counties. Multicounty planning policies guided by PSRC are discussed later in this section.
- Rural element – Counties must establish patterns of densities and uses for lands not designated for urban growth and timber/agriculture/mineral resources. The Legislature specified a number of provisions to protect rural character in RCW 36.70A.070(5)(a)-(e).

Comprehensive plans may also include optional elements such as: conservation, parks and recreation, economic development, natural hazard reduction, historic preservation, and subarea plans.[15] GMA requires protection, but not restoration, of critical areas. Though ecosystem recovery is not a required element, nothing precludes its inclusion into a comprehensive plan (Andrade and Smith 2019).

[14] WAC 365-196-415(2)(a)(ii)

[15] RCW 36.70A.080 and WAC 365-196-445

Andrade and Smith (2019) note that stormwater issues can fall into multiple sections of a comprehensive plan. Local jurisdictions are required to consider water quality and quantity as part of the land use element, and are expected to designate appropriate land for stormwater management facilities.[16] The land use element should *provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state, including Puget Sound or waters entering Puget Sound*."[17] Stormwater management must also be addressed in the capital facilities element.

However, Interdisciplinary Team members reported that stormwater planning is not consistently integrated into comprehensive planning and is generally not done to the extent necessary to support advancement of regional stormwater management goals. It is important to note that new planning requirements in the 2019 Municipal Stormwater General Permit should impact the extent to which stormwater is considered during comprehensive planning for areas covered by the permit into the future.

Below is a more detailed discussion of elements related to comprehensive planning that could be particularly useful in supporting implementation of B-IBI strategies.

Buildable Lands Analysis and Land Capacity Analysis

King, Kitsap, Pierce, Snohomish, Thurston, and Whatcom counties are required to submit a Buildable Lands Report every 8 years.[18] This reporting requirement involves conducting an analysis to compare previous growth/development targets with actual densities achieved to determine how the current comprehensive plan is functioning (Commerce 2018).

The buildable lands analysis entails identifying lands suitable for development or redevelopment. Suitable land is all vacant, partially utilized, and under-utilized parcels that are designated for commercial, industrial, or residential uses; not intended for public use; and not constrained by regulations that prevent development from occurring. The next step is determining if urban densities targeted in the previous comprehensive plan are being achieved. If target densities are not being met, jurisdiction must identify measures to achieve them.

Buildable Lands Reports must be completed no later than two (King, Pierce, Snohomish) or three (Kitsap, Thurston, Whatcom) years prior to the deadline for review and update of comprehensive plans (Commerce 2018). The next buildable lands reporting period occurs in 2021-2022.

Land capacity analyses are required for all jurisdictions that plan under GMA. Comprehensive plans must include areas and densities sufficient to accommodate growth projected to occur for the succeeding 20-year period. The land capacity analysis is used to demonstrate that this

[16] WAC 365-196-340(1)

[17] RCW 36.70A.070(1)

[18] RCW 36.70A.215

requirement is met.[19] It is typically completed as an early step of the periodic comprehensive plan update. Commerce (2018) notes that land capacity analysis is often confused with buildable land reporting requirements and explains that the land capacity analysis is entirely forward-looking while the buildable lands analysis looks at past performance as well. The buildable land jurisdictions sometimes combine the data collection and analysis portion for these two different requirements even though the planning horizons differ (Commerce 2018).

Both of these analyses provide a discrete point of entry to incorporate recovery into the comprehensive planning process (Andrade and Smith 2019). The first step to identifying land suitable for accommodating growth is to remove designated critical areas and their buffers, open space, and public roads. This provides an opportunity to integrate high-priority watershed protection and restoration targets into local land use planning. The Watershed Planning Strategy described in Section 5 could be a vehicle to identify lands important for reaching the B-IBI targets. Removing these key parcels from inventories of areas slated to accommodate growth could help to safeguard them from development pressure (Andrade and Smith 2019).

Capital Facilities Planning

The capital facilities element helps to coordinate the land use element with budgeting policy and decisions; identify and address existing service deficiencies; prioritize projects and coordinate related projects; and apply for loan and grant opportunities (Commerce 2014). Jurisdictions are required to reassess the land use element if probable funding falls short of meeting existing needs.[20] Commerce (2014) encourages jurisdictions to consider potential increased or stricter regulatory requirements, especially for water and sewer, to ensure they can be factored in to plans.

Required fiscal analyses must show the cost of meeting adopted levels of service in order to demonstrate that jurisdiction will be able to provide adequate facilities as growth occurs. This is meant to be a "reality check" for how much it will cost and how to pay for facilities needed to serve new development (Commerce 2014).

The development of detailed cost estimates for needed stormwater facilities provides an opportunity to improve coordination between planning and surface water departments, both within and among neighboring jurisdictions. These plans could also provide data on potential funding shortfalls for needed stormwater facilities. There is a wide range of factors influencing implementation of local programs, including jurisdiction size, extent of political interference, and available resources (e.g., financial; data availability and data management systems; number of staff and their experience level).

[19] RCW 36.70A.110(2) and WAC 365-196-325

[20] WAC 365-196-415(2)(d)

Multicounty Planning Polices

PSRC's Vision 2050 Plan, on track to be adopted in May 2020, establishes multicounty planning policies for the central Puget Sound region.[21] It provides a mechanism for achieving consistency among comprehensive plans developed by King, Kitsap, Pierce, and Snohomish counties and the cities therein. Vision 2050's key goal is to guide growth to urban areas near high-capacity transit and reduce development pressure that threatens natural areas, forests, and farms. It aims to provide a common planning framework and coordinate actions across jurisdictional boundaries (PSRC 2019). As a Federal Transit Administration-designated Metropolitan Planning Organization,[22] PSRC is able to distribute federal transportation funding to support implementation of the Vision 2050 Plan.

The B-IBI Implementation Strategy is consistent with the Vision 2050 Plan, and PSRC (2019) identifies several policies that support implementation of the Local Capacity (Section 3), Watershed Planning (Section 5), and Working Lands (Section 6) strategies. Key among them are:

- Recognize and give regional funding priority to transportation facilities, infrastructure, and services that explicitly advance the development of housing in designated regional growth centers.
- Explore new and existing sources of funding for services and infrastructure, recognizing that such funding is vital if local governments are to achieve the regional vision.
- Support local and regional efforts to develop state legislation to provide new fiscal tools to support local and regional planning and to support infrastructure improvements and services.
- Promote regional and national efforts to restore Puget Sound and its watersheds, in coordination with cities, counties, federally recognized tribes, federal and state agencies, utilities, and other partners.
- Work with member jurisdictions, resource agencies, and tribes to implement the Regional Open Space Conservation Plan (PSRC 2018). This plan is discussed in the Watershed Planning strategy of this report (Section 5).

2.3 OTHER RELEVANT MANAGEMENT TOOLS

This section briefly describes five other management tools that are important for protection and restoration of stream habitat in the Puget Sound region.

The Endangered Species Act, Forest Practices Act, and Hydraulic Code are receiving less attention in this report because the strategies developed by the Interdisciplinary Team do not involve any recommended changes to their implementation.

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[21] RCW 47.80.026 and RCW 36.70A.210

[22] 49 U.S.C. §5303

The Shoreline Management Act and Aquatic Lands Leasing Program were not addressed during Implementation Strategy development because the majority of stream reaches where B-IBI monitoring currently occurs are outside of their jurisdiction.

2.3.1 ENDANGERED SPECIES ACT

The 1999 listing of Puget Sound Chinook salmon as a threatened species, and subsequent listings of other salmonids, had a profound effect on implementation of other environmental regulations and federal assistance programs in the Puget Sound region.

In 2000, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) finalized rules governing take[23] for several populations of salmon and steelhead, including Puget Sound Chinook.[24] Pursuant to Section 4(d) of the Endangered Species Act, this rule defines 13 exceptions from the Endangered Species Act's take prohibition so long as the take occurs as the result of a program that adequately protects the listed species and its habitat (NMFS 2000). These exceptions, called limits in the rule, are criteria NOAA can use to formally approve state and local regulatory programs, thereby limiting liability under the Act (i.e., protection against third-party lawsuits). Limit 12 addressed municipal, residential, commercial, and industrial development. It describes 12 evaluation considerations that NOAA will apply to determine if plans and ordinances are adequately protective of listed fish. Stormwater management programs, covered in Consideration 2, must prevent impacts on water quality and quantity to preserve or enhance stream flow so they are as close as possible to historic conditions.[25] Reducing impervious surface and maintaining forest cover and natural soils are provided as ways to accomplish this requirement. Consideration 3 covers riparian habitat protections.[26]

Local and state efforts to ensure Endangered Species Act compliance for Comprehensive Plan policies and stormwater management programs (the Tri-County Model from King, Pierce, and Snohomish counties) and Shoreline Master Program Guidelines via 4(d) exemptions were not successful. Laschever (2011) describes why the formal NOAA approval proved challenging to implement for land use planning and permitting. This leaves regulatory bodies unprotected from third-party lawsuits under the Endangered Species Act.

NMFS (2000) noted that where water quality standards or state authorizations lead to pollution levels that may cause take, they will work with the state and EPA to bring the standards and permitting programs to a point where they protect salmon.

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[23] The Endangered Species Act prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife and prohibits the transport of a listed species. The term ''take'' is defined under the ESA as ''to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct'' (16 U.S.C. 1532 (19)).

[24] 65 Fed. Reg. 132 (July 10, 2000)

[25] 50 CFR Ch. II §223.203(b)(12)(i)(B)

[26] 50 CFR Ch. II §223.203(b)(12)(i)(C)

2.3.2 FOREST PRACTICES ACT

Forest activities on non-federal public and private lands are regulated under the state Forest Practices Act.[27] Corresponding Forest Practices Rules detail requirements related to growing, harvesting, and processing timber to meet natural resource protection goals. Forest practices that are specifically covered include road construction, water crossing structures, thinning/brush control, and reforestation.

The Washington Department of Natural Resources' (WDNR) Forest Practices Program administers the Forest Practices Act.[28] The Forest Practices Program operates independent of WDNR's state land management program; activities on forested state trust lands are subject to the Forest Practices Rules and generally require forest practices permits (WDNR 2006).

Rules adopted under the Forest Practices Act are guided by multi-species Habitat Conservation Plans approved under Section 10 of the Endangered Species Act.[29] This management framework ensures that entities who conduct forest practices activities in compliance with Forest Practices Rules are also in compliance with the federal Endangered Species Act. The State Forest Trust Lands Habitat Conservation Plan and the Forest Practices Habitat Conservation Plan address elements highly relevant to B-IBI scores, such as forest roads and culverts, riparian zones, and unstable slopes. However, specific rules and requirements vary by plan (as illustrated in Table 2).

In addition, the Forest Practices Act offers some alternate plan process and harvest restrictions for small forest landowners.[30] For example, there is an exemption from riparian management requirements for parcels 20 acres or less in size, when the owner holds less than 80 acres statewide. Harvest can occur within the riparian zone on exempt parcels, provided shade and other requirements are met. During the most recent forest practices reporting period, only 148 of 3,741 approved applications involved 20-acre exemptions (WDNR 2019). WDNR has a Small Forest Landowner Office to provide technical and financial assistance to small forest landowners.

[27] Management of federal forest land is guided by the Northwest Forest Plan.

[28] The Forest Practices Act was amended in 1997 to give some cities and counties authority to exercise jurisdiction over forest practices on lands located within a UGA, lands that have been or are being converted to another use, and lands not to be reforested because of likelihood of future conversion (RCW 76.09.240). Lands on which forest practices are performed under an approved permit are subject to a 6-year development moratorium (RCW 76.09.240(7)). Conversion of forestland to other uses is governed by RCW 76.09.060.

[29] Authorizes the U.S. Fish and Wildlife Service/National Marine Fisheries Service (the "Services") and landowners to negotiate an agreement to minimize and mitigate damage to listed species and their habitat in the course of covered activities. In exchange for an incidental take permit, the landowners agree to pursue specific management protections at a landscape level.

[30] RCW 76.09.368

Table 2. Comparison of riparian buffer protections in different forest management plans (adapted from Wilhere and Quinn 2018)

	Habitat Conservation Plan for Forested State Trust Lands	Habitat Conservation Plan for Forest Practices Rules	Northwest Forest Plan
Land covered	State trust land (1.4 million acres state-wide)	Private and non-federal public land (9.3 million acres in Western WA)	Federal land (1.8 million acres in WA)
Lead agency	Washington Department of Natural Resources	Washington Department of Natural Resources	U.S. Forest Service and Bureau of Land Management
Timeline	HCP approved 1997 Incidental take permit 1999	Forest & Fish Report 1999 Rules adopted 2001 HCP approved 2006	1994
Plan goals	• ESA compliance • Maximize long-term support for trust beneficiaries	• ESA compliance • Meet CWA requirements • Support harvestable supply of fish • Economically viable timber industry	• ESA and NFMA compliance • Long-term health of late-successional ecosystems • Maximize economic benefits
Riparian buffer width	• Fish-bearing: 1 site-potential tree height (100 years old) or 100’ • Not fish-bearing: 100’ or when necessary depending on stream type	• Fish-bearing: 1 site-potential tree height (100 years old) • Not fish-bearing: 1 site-potential tree height (100 years old)	• Fish-bearing: 2 site-potential tree heights (>200 years old) or 300’ • Not fish-bearing: 1 site-potential tree heights (>200 years old) or 150’
Riparian buffer management	3 management zones: • 0-25’ – no harvest • 25-100’ – harvest ≤10% by volume • > 100’ – ≤25% by volume	3 management zones: • Core (0-50’) – no harvest • Inner – basal area must meet desired future conditions target • Outer – retain 20 trees/acre (see WAC 222-30-021)	Effectively no timber harvest

HCP – Habitat Conservation Plan
ESA – Endangered Species Act
CWA – Clean Water Act
NFMA – National Forest Management Act

2.3.3 HYDRAULIC CODE

The state Hydraulic Code[31] requires permits for any work that will use, divert, obstruct, or change the natural flow or bed of any state waters. The Washington Department of Fish and Wildlife (WDFW) issues Hydraulic Project Approvals to ensure that construction occurs in a manner that protects fish and their aquatic habitats. Hydraulic projects associated with forest practice activities are administered by WDNR.

2.3.4 SHORELINE MANAGEMENT ACT

The state Shoreline Management Act[32] requires cities and counties to develop, adopt, and implement local Shoreline Master Programs with land use designations, development standards, and regulations designed to manage shoreline modifications while protecting natural resources and allowing for responsible development.

Shoreline Management Act jurisdiction extends to marine waters, lakes larger than 20 acres, streams and rivers with an annual mean flow of more than 20 cubic feet per second,[33] and shorelands within 200 feet of these waterbodies.

The majority of B-IBI monitoring sites in the Puget Sound region are thought to be located in smaller streams/tributaries that are upstream of the reaches subject to Shoreline Management Act. A quick query of King County's geographic information system revealed that less than 20% of their B-IBI monitoring sites are located in Shoreline Management Act waterbodies (K. Macneale, personal communication, May 21, 2020). Since the Shoreline Management Act is not a tool that could be uniformly applied to advance B-IBI indicator goals, it was not a focus of the Implementation Strategy development effort.

2.3.5 AQUATIC LANDS LEASING AND LICENSING PROGRAM

The Washington Department of Natural Resources (WDNR) is responsible for managing state-owned aquatic lands. WDNR reviews applications for shoreline, over-water, and in-water projects/uses on state-owned aquatic lands. An Aquatic Use Authorization, similar to a lease, is issued when WDNR determines a project provides a balance of public benefits for Washington's citizens. Common uses include navigation infrastructure (docks, piers, mooring buoys, boat launches), aquaculture, utilities, bridges, intake systems, outfalls, dredged material disposal, log storage, and mineral recovery.

[31] RCW 77.55.021 and RCW 77.55.141

[32] RCW 90.85

[33] Per WAC 173-18-040(1)(a), the Shoreline Management Act applies to Western Washington streams "from the point at which the stream reaches a mean annual flow of twenty cubic feet per second down to the mouth of said stream or river."

The state's ownership of submerged lands is based on whether a specific water body is or was navigable[34] or influenced by tides.[35] Navigability status and state ownership is determined on a site-by-site basis (WDNR 2011), and navigability-for-title may differ from navigability-in-fact.[36] Ownership of the bedlands of non-navigable rivers/streams are usually connected in title to the abutting upland property (WDNR 2011), so no Aquatic Use Authorization would be required for projects in these streams.

It is highly unlikely that the small streams where B-IBI monitoring sites are located would be considered navigable-for-title. The U.S. Geologic Survey developed a tool to predict physical characteristics of a river reach that could indicate the navigability potential of that reach (Magirl and Olsen 2009). Their resulting threshold for "probably not navigable" was a mean annual discharge of 360 cubic feet per second or less, which is many times higher than the 20 cubic feet per second mean annual discharge threshold that determines Shoreline Management Act jurisdiction (as described in the previous section). This assumption was further corroborated by a quick review of recently approved and current applications to use aquatic lands provided on WDNR's website; all proposed freshwater projects were located on larger rivers, not small streams.

Each of the next four sections of this document cover one of the strategies developed by the Interdisciplinary Team to accelerate progress towards B-IBI indicator goals. These sections are organized as follows:

- A short description of the strategy and its primary objective(s). Details and corresponding results chains can be found in the B-IBI Implementation Strategy Narrative documents.
- A table cataloging ongoing programs with potential to support strategy implementation.
- Two to four subsections providing analysis of specific approaches the Interdisciplinary Team recommended to help attain the strategy objective. This includes review of supporting literature; discussion of key programs, barriers, opportunities, and innovative models that could be replicated; and our recommendations for implementation.

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[34] Per WAC 332-30-106(41), navigable is defined as a body of water is capable or susceptible of having been or being used for the transport of useful commerce.

[35] WDNR (2011) describes exceptions. Some shorelands and tidelands are privately owned because abutting landowners could purchase them from the state until 1971. In addition, submerged lands included in pre-statehood land patents and federal grants for tribal reservations are excluded from state ownership.

[36] See Till (2005) for discussion of case law relating to navigability-for-title (required navigability for commercial use at the time of statehood) and navigability-in-fact (a river may be navigable for public use even though the bed belongs to riparian property owner).

3. LOCAL CAPACITY STRATEGY

Implementation of stormwater regulations and critical area protections largely occurs through actions taken and decisions made by cities and counties. Interdisciplinary Team members reported that many jurisdictions lack the resources needed to effectively implement stormwater management programs, and that this deficiency is limiting our ability to address the impacts of stormwater on a regional scale.

The objective of the Local Capacity Strategy is to improve funding, increase staff, and expand the availability of decision support tools for local stormwater management programs.

The Interdisciplinary Team selected the three approaches to meet this objective:

1. Build political support to increase funding for stormwater investments.
2. Increase staff and/or provide external support.
3. Improve and increase access to technical tools and expertise.

The primary outcome sought by this strategy is increased investment in stormwater management, particularly in smaller jurisdictions where stormwater management is most capacity limited. Increased funding is expected to improve local stormwater management programs in two ways: augmenting staffing and enhancing information resources.

Table 3 inventories ongoing programs related to the Local Capacity Strategy. It includes programs that provide planning support, training, and funding for stormwater project implementation. Note that these programs also support other strategies such as the Watershed Planning strategy (Section 5).

Sections 3.1 and 3.2 provide analysis of this strategy's approaches.

3.1 STORMWATER FUNDING

The Interdisciplinary Team identified funding as a major barrier for stormwater management. This input is supported by the literature (Visitacion et al. 2009, Bissonnette and Parametrix 2010, Sightline Institute 2014, Roth and Partridge 2014, Washington State Office of Financial Management 2016, Brown and Sanneman 2018, Zhao et al. 2019). Visitacion et al. (2009) reported that stormwater programs had nearly the lowest amount of funding and the largest reported funding gap of all public works programs in Washington State.

The intent of this strategy approach is to support local jurisdictions in developing and/or expanding revenue streams for stormwater management.

Table 3. Programs with potential to support the Local Capacity Strategy

Program	Implementers and/or funders	Description
Stormwater Program Support		
Municipal Stormwater Team	Washington Department of Ecology	Develops guidance and provides technical assistance to permittees
National Estuary Program	U.S. Environmental Protection Agency and 6 state agencies	Provides funding and planning support to protect and restore the water quality and ecological integrity of estuaries of national significance
Puget Sound Regional Council	Federal Highway Administration, Federal Transit Administration, U.S. Department of Commerce Economic Development Administration, Washington State Department of Transportation, and 80+ member jurisdictions within King, Pierce, Snohomish, and Kitsap counties	Offers planning services to help ensure local plans are coordinated and meet regional/state requirements, as well as a peer networking series covering best practices and local planning implementation (among many other activities)
Rural Community Assistance Corporation	6 federal and 3 Washington agencies, among many other funders	Non-profit that provides training, technical assistance, and low interest loans to small, low-income communities in rural areas. Services include a Tribal Circuit Rider program.
Small Communities Initiative Program	Washington Departments of Commerce, Health, and Ecology	Provides technical assistance to small, rural communities that must upgrade their drinking water or wastewater systems
Stormwater Capacity Grants Program	Washington Department of Ecology	Non-competitive grants to Phase I and Phase II NPDES municipal permittees for activities and equipment necessary for permit implementation.
Washington Infrastructure Assistance Coordination Council	6 state and 5 federal agencies, plus 15 associations/boards/non-profits	Non-profit whose purpose is to improve the delivery of infrastructure assistance, both financial and technical, to local governments and tribes in Washington State.
Stormwater Project Support		
Brownfields Grants	U.S. Environmental Protection Agency	Provides grants for cleanup, investigations, and studies related to contaminated sites, as well as training for affected communities

Table 3. Programs with potential to support the Local Capacity Strategy (cont'd)

Program	Implementers and/or funders	Description
Centennial Clean Water Grants	Washington Department of Ecology, U.S. Environmental Protection Agency	Grants for nonpoint activities, on-site sewage systems, and wastewater facilities for hardship-eligible small communities
Clean Water Act Section 319 Grants	Washington Department of Ecology, U.S. Environmental Protection Agency	Grants for nonpoint source pollution control activities
Clean Water State Revolving Fund	Washington Department of Ecology, U.S. Environmental Protection Agency	Provides low-interest loans for wastewater facilities, on-site sewage systems, some stormwater facilities, and nonpoint source pollution reduction activities
Community Development Block Grant General Purpose Grants	Washington Department of Commerce, U.S. Department of Housing and Urban Development	Grants for community and economic development projects, including sewer infrastructure design/construction and planning
Community Economic Revitalization Board	Washington Department of Commerce	Provides planning grants, technical assistance, and financing for public infrastructure improvements that encourage new private business development and expansion. Eligible projects include domestic and industrial water supply, stormwater, wastewater, public buildings, telecommunications, and port facilities. Local match required.
Public Works Program	U.S. Department of Commerce Economic Development Administration	Provides grants to communities in economic decline for upgrade of critical infrastructure, including wastewater facilities
Stormwater Financial Assistance	Washington Department of Ecology, U.S. Environmental Protection Agency	Grants to retrofit existing infrastructure with stormwater facilities and activities for stormwater pollution control
Transportation Enhancement Activities	Federal Highway Administration	Provides funding for non-highway transportation projects. Mitigation of polluted highway runoff and purchase of farmland easements are eligible activities.
Urban Waters Small Grants Program	U.S. Environmental Protection Agency	Grants for activities that improve water quality while advancing community priorities, including education and monitoring

Table 3. Programs with potential to support the Local Capacity Strategy (cont'd)

Program	Implementers and/or funders	Description
Washington Public Works Board	Washington Department of Commerce	Loans for critical public infrastructure, training for local governments, and state project support staff. Revolving loan fund managed by a board of local infrastructure representatives.
Water and Waste Disposal Loan and Grant Program	U.S. Department of Agriculture Rural Development	Helps very small rural communities finance acquisition, construction, or improvement of infrastructure including sanitary sewer and stormwater systems. Offers a predevelopment planning grant program to assist communities with initial planning and development of applications for their loan programs.
WaterWorks Small Grant Program	King County Wastewater Treatment Division	Grants for green stormwater infrastructure; education and community engagement; research and monitoring; stream bank restoration
Stormwater Messaging and Education		
City Habitats Coalition	The Nature Conservancy, Stewardship Partners, Washington Environmental Council, and 80+ affiliate organizations	Cross-sector partnership working to increase nature in cities to improve human wellbeing and ecosystem health. Extensive toolkit of web resources including case studies, how-to guides, finance options, and educational materials.
Elected Officials Essentials Webinar Series	Association of Washington Cities, Municipal Research and Services Center	Online training specifically designed to help elected officials effectively operate within the law, plan for the future, secure and manage funds, and foster staff and community relationships
Stormwater Outreach for Regional Municipalities	Puget Sound Partnership, Department of Ecology, 83 municipal permittees	Regional collaboration to meet outreach requirements under the Western Washington municipal stormwater permits. Provides a platform to share outreach materials and behavior change messaging research.
Staff Training		
Low Impact Development Program	Washington Stormwater Center	Development and evaluation of stormwater technologies as well as training for local staff
Municipal Research and Services Center	Washington Department of Commerce	Nonprofit that supports local governments by providing legal and policy guidance, training, and online resources.
Municipal Resource Program	Washington Stormwater Center	Training and technical assistance for municipalities and businesses

Table 3. Programs with potential to support the Local Capacity Strategy (cont'd)

Program	Implementers and/or funders	Description
Municipal Stormwater Education Program	ECOSS	Provides training for operations and maintenance staff and other personnel who work to implement local stormwater programs
Statewide Low Impact Development Training Program	Washington Stormwater Center	Online training and certification program for municipalities and businesses
Toolbox Peer Networking Series	Puget Sound Regional Council	Work sessions focused on best practices, tools, and resources for local planning and implementation

Operation and capital funding for stormwater management comes from a mix of local, state, and federal programs. Funding mechanisms include utility fees, general and street/road fund appropriations, capital improvement bonds, special assessments, impact fees, loans, and grants (National Association of Flood and Stormwater Management Agencies 2006). However, most of the funding burden falls on local jurisdictions (Roth and Partridge 2014).

Federal financial support for municipal water infrastructure projects has decreased over time, given a policy shift in the 1987 Clean Water Act amendments from construction cost-share grants to loans that must be repaid to the Clean Water State Revolving Fund (Congressional Research Service 2006, Congressional Research Service 2019).

At the state level, the need for stormwater infrastructure funding has exceeded availability for many years (Washington Office of Financial Management 2016). However, the Washington State Legislature passed the Model Toxics Control Reform Act during the 2019 session.[37] The Act increased state funding for programs and projects related to clean water and included creation of a dedicated revenue stream for the Stormwater Financial Assistance Program.

3.1.1 STORMWATER UTILITY FEES

Stormwater utility fees are the largest local funding source for stormwater control programs in Washington (FCS Group et al. 2012). Review of stormwater/surface water fee data compiled by Futurewise (2016), Association of Washington Cities (2018), Western Kentucky University (2018), and Snohomish County Public Works (2018) indicates that most Puget Sound jurisdictions charge stormwater fees.

Table 4 shows that 89 of 112 cities (79%) had fees in 2018. All but two Puget Sound counties will have fees for at least a portion of their unincorporated area by 2020. All Phase I permittees and all but four Phase II permittees charge stormwater fees.

Fees charged by Puget Sound jurisdictions vary widely. Single-family residential ratepayers pay from $18 to $480 annually.[38] Utility rate structures also vary:

- Single family parcels may pay a flat fee, or a tiered rate based on area or percentage of impervious surface.

[37] SB 5993 was signed into law and became effective July 2019.

[38] Recent nationwide surveys indicate that these rates are comparably high. Western Kentucky University (2018) found that Washington had the highest median monthly stormwater fee at $11.70. Washington municipalities had three of the top five average rates and all Washington respondents were in the top quartile. Black & Veatch's (2018) survey found that average annual single-family rates ranged from $5.40 to $480.

Table 4. Puget Sound jurisdictions categorized by stormwater fee and NPDES permit status

Jurisdictions with stormwater fees

Phase I Permittees	Phase II Permittees				Other jurisdictions
King County	Kitsap County	Des Moines	Lakewood	Puyallup	Island County
Pierce County	Skagit County	DuPont	Lynden	Redmond	Mason County
Snohomish County	Thurston County	Duvall	Lynnwood	Renton	San Juan County
Seattle	Whatcom County*	Edgewood	Maple Valley	Sammamish	Blaine
Tacoma	Algona	Edmonds	Marysville	SeaTac	Friday Harbor
	Anacortes	Enumclaw	Mercer Island	Sedro-Woolley	La Conner
	Arlington	Everett	Mill Creek	Shelton	Langley
	Auburn	Federal Way	Milton	Shoreline	Gold Bar
	Bainbridge Island	Ferndale	Monroe	Snohomish	North Bend
	Bellevue	Fife	Mountlake Terrace	Snoqualmie	Port Townsend
	Bellingham	Fircrest	Mukilteo	Steilacoom	Roy
	Black Diamond	Gig Harbor	Newcastle	Sumner	Ruston
	Bonney Lake	Granite Falls	Normandy Park	Tukwila	Stanwood
	Bothell	Issaquah	Oak Harbor	Tumwater	Sultan
	Bremerton	Kenmore	Olympia	University Place	Sumas
	Brier	Kent	Orting	Woodinville	Wilkeson
	Buckley	Kirkland	Pacific	Woodway	Yarrow Point
	Burien	Lacey	Port Angeles		Yelm
	Burlington	Lake Forest Park	Port Orchard		
	Covington	Lake Stevens	Poulsbo		

Jurisdictions without stormwater fees

Phase II Permittees		Other jurisdictions			
Clallam County	Medina	Jefferson County	Coupeville	Hunts Point	Sequim
Clyde Hill	Mount Vernon	Beaux Arts Village	Darrington	Index	Shelton
		Bucoda	Eatonville	Lyman	Skykomish
		Carbonado	Everson	Nooksack	South Prairie
		Carnation	Hamilton	Rainier	Tenino
		Concrete			

* Fees to be phased in beginning 2020, Lake Whatcom Watershed only. Data sources: Futurewise (2016), Association of Washington Cities (2018), Western Kentucky University (2018), Snohomish County Public Works (2018), jurisdiction web pages

- Many jurisdictions express impervious surface area using an equivalent service unit (ESU) or similar metric that reflects the average amount impervious surface on a developed single-family parcel. One ESU is generally 2,500 to 4,000 ft^2 but can be as high as 10,000 ft^2.
- Commercial/industrial/institutional properties are often charged at higher rates per impervious surface area/percentage or ESU.
- Rate discounts or rebates are commonly provided for properties with flow control and treatment, and in some jurisdictions, for LID features like raingarden and conservation landscaping.

The extent to which fee revenue is inadequate to support Puget Sound regional stormwater program needs is unknown. Ideally, stormwater fees should fully recover operations, construction, and maintenance costs of stormwater programs (National Association of Flood and Stormwater Management Agencies 2006, Roth and Mazza 2017, Zhao et al. 2019). Black & Veatch (2018) surveyed stormwater operators nationwide and found that 46% of respondents indicated that fees were sufficient to cover all or most needs, while the remainder indicated that fees were completely insufficient, or would only cover urgent needs. 94% of respondents that charge stormwater fees indicated that those fees comprise over 75% of total utility revenue received.

Creating a stormwater utility and raising fees as needs grow and/or new regulatory requirements are added requires significant effort and political support. This topic is explored in the literature review provided in Appendix A.

Futurewise (2016) noted that some of the cities they surveyed had not updated their rates in 8 to 15 years. However, many increases have occurred since that report was released. Snohomish County Public Works (2018) compiled data on annual stormwater/surface water charges in 48 Puget Sound communities. Between January 2016 and January 2018, 39 of these communities had increased their rates**.** Only four of the communities had not had a rate increase since 2009.

Recommendation: Evaluate the efficacy of different stormwater utility fees in terms of revenue generated, rate structure, and sufficiency to meet program needs.

The Interdisciplinary Team indicated that stormwater fee structures don't capture the single-family residential land base adequately (i.e., single family parcels are underpaying for stormwater programs) and recommended encouraging jurisdictions to restructure stormwater utility and/or development impact fees. Stormwater utility fee data in Appendix 1 of Futurewise (2016) indicate that this may be true in some, but not all, King County jurisdictions. These jurisdictions tend to charge other types of properties increasingly higher rates as percent impervious area increases. However, in several other jurisdictions, rates per ESU are the same for single-family and non-single-family parcels.

Zhao et al. (2019) provides an alternate view when presenting a criterion to evaluate the equity (allocation of costs and benefits) of stormwater fees: perhaps commercial properties should pay more given their higher relative impact on water quality.

There is not sufficient information to evaluate the Interdisciplinary Team's recommendation to restructure existing rate structures. We suggest additional research and analysis to assess the efficacy of differing rate structures and other funding mechanisms. More data on the following attributes may enable development of more nuanced recommendations:

- Percent contribution of stormwater fee revenues and other types of financial support to overall budgets developed for jurisdictions of various sizes
- Distribution of revenues between capital and operating expenses
- Extent to which revenue is adequate to maintain and improve local stormwater programs (i.e., gap between budgets versus needs to meet minimum regulatory compliance versus needs to protect and recover B-IBI)
- Effectiveness of different types of rate structures, particularly with respect to changing ratepayer behavior (e.g., adopting BMPs)

Recommendation: Encourage regional collaboration and pooling of resources to support the utilities of smaller jurisdictions.

Local jurisdictions vary widely in their capabilities to raise funds, with smaller communities facing distinctive challenges (Congressional Research Service 2006, Roth and Partridge 2014, Futurewise 2016, Brown and Sanneman 2018). In addition to limited revenue generation, a smaller tax base may be associated with difficulties accessing public financing and seeking supplemental grants.

Several authors have noted a trend towards sharing costs for projects and programs that span multiple jurisdictions and encourage additional regional collaboration to achieve scale (National Association of Flood and Stormwater Management Agencies 2006, Roth and Partridge 2014, Roth and Mazza 2017). This could support small communities unable to raise funds themselves, be a more efficient approach than developing specialized resources in each community, and drive jurisdictions to work on a watershed scale.

Two local programs, Stormwater Action Monitoring and Stormwater Outreach for Regional Municipalities, provide an example of employing a regional collaborative approach to meeting NPDES municipal stormwater permit obligations. There may be additional opportunities to regionalize implementation of other stormwater program elements.

Another option is utility regionalization among neighboring jurisdictions via inter-local agreements[39] or joint utility services authority.[40] The Municipal Research and Service Center's web page on Intergovernmental Cooperation in Public Works provides several examples of service consolidation in Washington. Two are stormwater-specific: the Yakima Regional Stormwater Management Program and the Douglas County Stormwater Utility.

Efforts are currently underway in Rhode Island to develop a large regional stormwater management district covering 7 municipalities and the state Department of Transportation. The feasibility study and draft governance framework for this Upper Narragansett Bay Regional Stormwater Management District could provide a model process for any larger attempts at utility regionalization.

One potential barrier to this approach could be local statutes or rules requiring that taxes or fees collected by a jurisdiction may only be spent within that jurisdiction or only on certain programs. The prevalence of this type of rule should be investigated.

Recommendation: Explore new project delivery models to attract private capital.

Several authors have identified opportunities to leverage private investment capital for infrastructure funding via new procurement and finance strategies (Roth and Partridge 2014, EPA 2015). Alternative project delivery models that may warrant attention include:

- **Public Private Partnership** – Public Private Partnerships (P3s) are an alternative procurement method. The public sponsor controls each phase of the infrastructure development process (design, construction, finance, and operation/maintenance) with conventional procurements. Under a P3 approach, a single private entity or consortium assumes responsibility for more than one project development phases. P3s are common for road and water/wastewater facilities, but until recently this tool has not been used for stormwater management (EPA 2015). A topic of current conversations is how to address additional challenges and risks of working in public right-of-way.
    - EPA (2015) researched and evaluated P3s for their potential adaptation and use for green stormwater infrastructure in the Chesapeake Bay region (EPA 2015).
    - Environmental Finance Center (2017) evaluated variation in P3 delivery models for water projects implemented in 9 communities. The report assessed key financial features, financial impacts of different options, and how outcomes did or did not differ from initial expectations. Two of the projects evaluated involved stormwater system retrofits
- **Environmental Impact Bonds/Pay for Success** – Environmental Impact Bonds (EIBs) are a finance mechanism that seeks to mobilize private capital to supplement public dollars. They

[39] RCW 39.34

[40] RCW 39.106

are modeled after Social Impact Bonds[41] and sometimes referred to as Pay for Success contracts. This approach involves a government entity contracting with a private sector service provider to obtain a specific outcome. This service provider obtains capital from private commercial or philanthropic investors in exchange for a share of government payments that become available if performance targets are met. This funding strategy shifts the burden of investment risk from the government to private investors. Investors commit to financing a government program or project with the hope of receiving investment returns based on contract performance.

- In 2016, the DC Water and Sewer Authority used this approach to finance installation of green infrastructure to reduce combined sewer overflows in one District of Columbia sewershed. This project was the first time the Pay for Success (PFS) model was applied to an environmental bond, and was developed through a grant from the Social Impact Bond Technical Assistance Lab at Harvard University's Kennedy School of Government. In this case, the EIB was 30-year tax-exempt municipal bond with payments structured according to the runoff reduction rate achieved by the green infrastructure projects implemented with bond proceeds (EPA 2017). If runoff is reduced between 18.6% and 41.3% of the baseline, DC Water pays only basic principal and interest on the EIB. If runoff is reduced more than 41.3%, then DC water will make a one-time additional payment of $3.3 million to investors. If runoff is reduced less than 18.6%, the investors will make a one-time payment of $3.3 million to DC Water.

The Nature Conservancy/City Habitats proposed piloting such strategies to accelerate urban stormwater investment as part of a 2018 Near-Term Action proposal (NTA 2018-0483).[42]

3.1.2 POLITICAL WILL

The Interdisciplinary Team identified lack of political will as a barrier to increasing stormwater utility fees and recommended education as a way to mitigate political challenges associated with charging for services. Their focus was on developing and delivering meaningful messages about the need for and value of stormwater management to elected officials.

This approach is strongly supported in the literature (National Association of Flood and Stormwater Management Agencies 2006, U.S. Water Alliance 2011, Roth and Partridge 2014, Dhakal and Chevalier 2017, Western Kentucky University 2018). Futurewise (2016) noted that elected officials need to understand that stormwater permit compliance requires resources.

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[41] Social Impact Bonds (SIBs) generally involve funding for prevention-focused social programs that help address homelessness, early childhood education, etc. (EPA 2017). Traditional SIBs are not typically a debt instrument (i.e., bond) but rather a loan from private funders; to minimize confusion they are also called Pay for Success contracts (Liebman and Sellman 2013).

[42] **Near-Term Actions (NTA)** is are projects, investigations, or programs intended to advance priority recovery sub-strategies. They are the core of the Implementation Plan component of the Puget Sound Action Agenda; there were 631 NTAs included in the 2018-2022 Action Agenda. Three Strategic Initiatives disburse NEP funds to implement highly-ranked NTA proposals.

Black & Veatch (2018) reported that periodic workshops for elected officials was ranked by their respondents as the most effective outreach method, followed by public/neighborhood meetings.

Existing resources to support implementation of the education approach include:

- The Association of Washington Cities and Municipal Research and Services Center offer an Elected Officials Essentials Webinar Series that could provide a venue for reaching decision-makers.
- Commerce offers a Short Course on Local Planning geared to local officials. In addition to in-person trainings, a resource guide and short videos are provided on Commerce's website. Video topics include infill development, sustainable development, and urban forestry.
- The Stormwater Messaging Toolkit developed by Stormwater Outreach for Regional Municipalities (STORM) as part of their Puget Sound Stormwater Messaging Project. The toolkit provides audience-tested framing and messaging recommendations; photos and line drawings of stormwater concepts and pathways; and a library of fact sheets, slide decks, and other materials.
- Stormwater Action Monitoring, the regional stormwater monitoring program funded by municipal stormwater permittees, has created a series of videos appropriate for public and elected audiences. The two on bioretention and receiving waters are germane to LID.

A review of existing course content may identify opportunities to add curriculum about the impacts of development on streams and the benefits of stormwater management.

Zhao et al. (2019) associates low political support for stormwater fees with a knowledge gap between policy makers and the public, and advocates incorporating the public into stormwater utility decision-making. For example, Snohomish County Public Works (2018) incorporated an advisory panel of residential and commercial ratepayers during development of their surface water management business plan. This panel made recommendations regarding level of service, rate increases to fund new/enhanced services, and annual rate adjustments to address inflation. The Snohomish County Public Works process could be an example by which other jurisdictions utilize education-based approaches to address current and future deficiencies in stormwater utility fees.

3.2 STAFF CAPACITY

Addition of the LID requirement to Ecology's municipal stormwater permits marked a dramatic change in stormwater management. It represented a paradigm shift from "gray" (centralized infrastructure to quickly convey runoff to receiving waterbodies) to "green" (conservation of natural site features and smaller-scale distributed controls to infiltrate runoff on-site). Likewise, new watershed planning requirements should encourage jurisdictions to manage stormwater beyond the individual parcel scale. Since these regulatory shifts are expected to reduce hydrologic alteration and pollutant loads, their widespread implementation should accelerate

progress toward B-IBI indicator goals. However, operationalizing these new requirements is complex and several implementation barriers have been identified (Sightline 2014, Murphy et al. 2015, Futurewise 2016, Ecology 2019).[43]

The intent of this approach is to improve implementation of these challenging stormwater permit requirements by:

- Increasing the number of stormwater program staff and/or provide additional external support to smaller jurisdictions.
- Increasing the availability and accessibility of training and continuing education.
- Developing decision support tools for local jurisdictions and project proponents.

This overall approach is supported by the literature. Municipal staff and others interviewed by Futurewise (2016) reported that number of staff is the most significant limiting factor for effective LID implementation. U.S. Water Alliance (2011) found that insufficient technical knowledge and experience is a barrier for implementation of green stormwater projects. U.S. Water Alliance (2011) also identified a need for standardized hydrological modeling tools. Given the distributed nature of LID facilities, GIS tools are also needed (Murphy et al. 2015, Futurewise 2016).

3.2.1 STAFF SIZE AND EXTERNAL SUPPORT

Staffing issues are particularly acute for smaller jurisdictions that may have 5 or fewer full-time equivalent positions to handle permitting, planning, engineering, maintenance, and inspections (Futurewise 2016). Murphy et al. (2015) highlighted the need for more "staff on the ground" for maintenance and enforcement. Adding staff should result in improvements in these program areas. Grants are sometimes used to hire staff that allows jurisdictions to go beyond bare-minimum stormwater permit requirements.

As illustrated in Table 3 and noted in Futurewise (2016), the number of external funding sources that support stormwater capital *projects* outnumber those that provide support for operation of stormwater *programs*. This gap was a programmatic focus for the Watershed Protection and Restoration Grant Program, which funded several stormwater retrofit planning efforts to support jurisdictions in going above and beyond permit requirements. Continuing and/or expanding these types of grants is consistent with the Local Capacity strategy. However, this may not necessarily benefit smaller jurisdictions where already overcommitted staff may not have the time required to apply for and manage grants.

Participants representing municipal governments during a technical/partner workshop held for this Implementation Strategy reported that in small jurisdictions it may not be possible or desirable to hire additional staff. Alternatives to adding staff could include: (1) implementing

[43] LID implementation barriers identified in these reports were summarized in the B-IBI Implementation Strategy Starter Package (Day et al. 2017).

stormwater program components via interlocal agreements with larger neighboring jurisdictions (as mentioned in Section 3.3.1) or by engaging other local organizations and (2) providing assistance through external partners.

An example of the first alternative is the Clean Water Kitsap partnership among Kitsap County's Public Works Department and Department of Community Development, the Kitsap Public Health District, the Kitsap Conservation District, and Washington State University (WSU) Extension Kitsap. This partnership, previously called the Surface and Stormwater Management program, was formed in 1993 to coordinate funding, planning, implementation, and administration of several water quality programs (Kitsap County Public Works Department 2019). Each member organization has an identified area of responsibility and budget to meet municipal stormwater permit and TMDL requirements and address non-point source pollution. For example: Kitsap Conservation District provides agricultural assistance programs, a backyard habitat program, and a rain garden program; Kitsap Public Health District administers a Pollution Identification and Correction Program; and WSU Extension Kitsap handles public education and involvement. The interlocal agreements are updated annually with new scope of work and budget (Kitsap County Public Works Department 2019). There could be value in conducting an analysis of the relative efficiency and effectiveness of this arrangement to support ongoing program needs in order to determine if export of this governance model to other counties is recommended.

A second alternative to providing external support could take the form of "circuit rider" technical and/or planning staff that could work with a jurisdiction for a limited time to help support stormwater permit implementation and multi-jurisdiction watershed planning processes. Visiting support staff could provide short-term project help by linking jurisdictions with data resources and available tools. Developing a team of on-call regional topic specialists to step in as temporary consultants may be more efficient than trying to build expertise at 120+ jurisdictions region wide.

This type of support could be a new program or an expansion of an existing program, such as Commerce's Small Communities Initiative or the Municipal Research and Services Center.

- A potential model is the Center for Planning Excellence, a nonprofit that provides technical assistance to local jurisdictions in Louisiana. Their focus is community resilience and disaster planning best practice. Local jurisdictions pay for services, but the rate is heavily subsidized as a result of grant and donation support for the organization.
- Another model is Massachusetts' Municipal Vulnerability Preparedness Program. It provides technical and financial support via grants, an information clearinghouse, and planning guidance. The program trains then approves consultants and other organizations as certified vendors that communities can choose to assist with planning grants. Once communities have completed a planning grant, they become eligible for action grant funding.

Recommendation: Conduct a feasibility study for development of a regional program to provide technical support to small jurisdictions.

This study could assess demand for this type of program; scope the services most needed; determine the level of interest in expanding an existing program; assess preferences for public, private, or non-profit support; and identify funding sources.

Intra- and Inter-jurisdictional Coordination

Improving coordination within and among jurisdictions was another desired outcome the Results Chain for this strategy associated with increased staff capacity. Review of the literature indicates that there is less certainty about the relationship between number of staff and improved coordination. Implementation of LID occurs within a context of conflicting local priorities embedded in incongruous codes, mandates, and regulations (Murphy et al. 2015). Leadership by municipal managers and elected officials addressed through this strategy's education approach is one factor that could help improve coordination, but the literature indicates that additional factors are associated with challenges integrating activities across city government units (U.S. Water Alliance 2011, Murphy et al. 2015, Feiock et al. 2017).

Recommendation: Conduct research into factors associated with strong coordination across core jurisdiction functions.

Public administration literature on institutional collective action may be informative in identifying mechanisms to achieve policy integration and resolve differences in departmental priorities.

3.2.2 TRAINING AND CONTINUING EDUCATION

As illustrated in Table 3, there are several existing programs that provide education resources and training for local government staff. Interdisciplinary Team members did not identify specific barriers to program access but suggested that offering professional certifications or continuing education credits, offering classes in multiple geographic areas, and offering webinars could potentially increase participation.

Recommendation: Identify barriers and motivators for participation in existing stormwater training programs.

Two shoreline management regulatory effectiveness projects supported by National Estuary Program funding (through the Marine and Nearshore Lead Organization) identified a barrier that should be investigated further. In jurisdictions that rely on a fee-based funding model for permitting programs (i.e., permit review programs are financially supported by fees paid by applicants rather than a general fund), there is little budget for staff time to attend classes since it is not directly related to permit review (Johannessen 2013a, Barnhart et al. 2015).

3.2.3 DECISION SUPPORT TOOLS

Improving modeling capabilities and stormwater tools to support local stormwater investment decisions is a key element of this strategy. The Interdisciplinary Team mentioned several existing tools that could serve as models and/or be expanded; these are described in the Implementation Strategy narrative.

Recommendation: Conduct needs assessments with end-users before developing tools.

When developing or expanding these types of tools, it is critical that the needs and requirements of both end-users and regulators are considered early in the development process to ensure that tools are both useful and compatible with Ecology's *Stormwater Management Manual for Western Washington*.

4. EDUCATION AND INCENTIVES STRATEGY

The objective of this strategy is to develop and employ incentives that encourage private property owners to voluntarily undertake actions to remedy conditions associated with stream degradation. There are three types of target activities included in this strategy:

1. Stormwater retrofits on properties developed prior to modern stormwater regulations (i.e., legacy properties),
2. Pollutant source control activities, and
3. Riparian, in-stream, and wetland habitat restoration (e.g., tree planting).

This strategy was developed to address three barriers identified by the Interdisciplinary Team:

- **Knowledge** – Property owners don't understand the impacts of stormwater and harmful products like pesticides. Many do not recognize that small changes can make a big difference and are unsure of what they can do to improve conditions.
- **Lack of a regulatory driver** – Properties developed prior to the mid-1990's often lack stormwater controls. Redevelopment generally triggers retrofit requirements, but installation of stormwater BMPs should be accelerated beyond what is required by regulations.
- **Cost** – Retrofit and habitat restoration activities are expensive. Financial incentives can help motivate property owners to take action.

These barriers have also been identified in the literature. Sightline (2014) indicated that outreach and communication efforts have not created the urgency required to solve the stormwater problem on a large scale, and that efforts to keep toxic pollutants out of stormwater are underfunded and undervalued. Crisostomo et al. (2014) discuss the application of incentives to improve stormwater management on properties lacking a regulatory driver for action. Most of the stormwater incentive program case studies evaluated by Crisostomo et al. (2014) included financial incentives due to the high cost of retrofit projects; one program had a minimum cost threshold of $5,000 and another reported that projects rarely cost less than $15,000.

Table 5 inventories ongoing programs related to the Education and Incentives Strategy. It includes programs that provide stormwater and source control focused education and outreach, as well as habitat restoration and acquisition programs. Note that this table does not repeat the programs included in Table 3 that provide stormwater project funding and stormwater messaging, which are also relevant here.

Sections 4.1 - 4.3 provide analysis of target activities.

Table 5. Programs with potential to support the Education and Incentives Strategy

Program	Implementers and/or funders	Description
Education, outreach, and technical assistance		
12,000 Rain Gardens	Stewardship Partners, Washington Stormwater Center	Provides a clearinghouse for information and resources for rain garden installation in the Puget Sound region
Better Ground	Puget Sound Conservation District Caucus, Stormwater Strategic Initiative	Provides technical assistance and other incentives for property owners. Rain gardens and catchments are one area of focus. Has a Depave Puget Sound campaign and Green Stormwater Schoolyards program.
Don't Drip and Drive	Washington Department of Ecology	A behavioral change campaign reduces vehicle-born pollution through leak detection events, trainings, and repair rebates
Dump Smart	Washington Stormwater Center	An education campaign providing fact sheets with BMPs for painters, carpet cleaners, and pressure washers in multiple languages
EnviroStars	Washington Green Business Council	Provides green certification for local businesses who commit to specific best practices
Local Source Control Partnership	Washington Department of Ecology and multiple local jurisdictions	Funds staff at local levels to work directly with business owners to reduce pollution through outreach, technical assistance, and financial assistance
Orcas Love Rain Gardens	Washington Environmental Council	Raises awareness about impact of everyday actions on water quality and ways to prevent pollution, highlighting the effectiveness of bioretention and its promise to help recover the orca population.
Puget Sound Spill Kit Program	ECOSS	Provides businesses with free spill kits, customized spill kits, and spill response training in multiple languages.
Puget Sound Starts Here	Puget Sound Partnership, Department of Ecology, U.S. Environmental Protection Agency, 700+ partner organizations	Raises awareness about impact of everyday actions on water quality and ways to prevent pollution
Stormwater Action Monitoring	Washington Department of Ecology, funded by Phase I and II municipal stormwater permittees	Video, fact sheet, and story map about bioretention and what we're learning about its effectiveness and added benefits

Table 5. Programs with potential to support the Education and Incentives Strategy (cont'd)

Program	Implementers and/or funders	Description
Washington Waters	Washington Department of Ecology	Educational posters and videos on pollution prevention topics including yard care, on-site sewage systems, and managing manure
Habitat restoration and property/easement acquisition[44]		
Conservation Futures Funds	10 Puget Sound counties	In counties that have chosen to levy a property tax, these funds are used for property acquisitions to preserve lands of public interest. All Puget Sound counties except Clallam and Mason raise revenue through the conservation futures tax
Cooperative Watershed Management Grants	King County Flood Control District	Grants for implementation of WRIA 7, 8, 9, and 10 watershed forum/salmon recovery priority restoration projects and monitoring
Family Forest Fish Passage Program	Washington Department of Natural Resources	Provides financial and technical assistance for private forestland owners to remove and replace culverts or other barriers to fish passage
Fish Barrier Correction Program	Washington Department of Transportation	Replaces culverts that impede fish migration at state highway stream crossings
Land and Water Conservation Fund	U.S. Fish and Wildlife	Funds acquisition of land and conservation easements by federal agencies to protect national parks, forests, wildlife refuges, and recreation areas. Also funds 2 state grant programs to support voluntary conservation on private land: Forest Legacy Program and Cooperative Endangered Species Conservation Fund.
Puget Sound Acquisition and Restoration Fund	Puget Sound Partnership, Salmon Recovery Funding Board	State capital funding for large habitat restoration and acquisition projects. Provides state match for several federal grant programs.
Regional Fisheries Enhancement Groups	Washington Department of Fish and Wildlife, 7 non-profit regional groups	Nonprofit organizations that implement restoration projects and lead community-based stewardship activities. Supported by fishing license fees administered by WDFW.

[44] Washington State's Recreation and Conservation Office (RCO) provides fiscal and contract management support to other state agencies implementing several restoration and acquisition programs. These programs distribute a mix of state and federal funding. RCO administers federal funds from a variety of sources as well as the state funds (e.g., Aquatic Lands Enhancement Account) used to meet grant match requirements.

Table 5. Programs with potential to support the Education and Incentives Strategy (cont'd)

Program	Implementers and/or funders	Description
Salmon Recovery Grants	Washington Recreation and Conservation Office, Salmon Recovery Funding Board, National Oceanographic and Atmospheric Administration	Grants for projects to restore damaged habitat, fix fish migration barriers, and preserve pristine habitat. Some of the funding for this program comes from the federal (NOAA) Pacific Coastal Salmon Recovery Fund.
Voter-approved funding measures	Varies by jurisdiction	Proceeds from open space bonds, park levies, and real estate excise tax (REET) measures approved by voters are used to acquire property for conservation.
Washington Wildlife and Recreation Program - Habitat Conservation Account	Washington Recreation and Conservation Office	Provides funding for acquisition, restoration, and recreational facility development in categories including critical habitat, natural areas, riparian protection, state park lands, and urban wildlife habitat.
Watersheds Small Grants Program	Pierce County with watershed councils and other local organizations	Financial support for projects that improve habitat and water quality in WRIAs 10, 12, and 15

4.1 STORMWATER RETROFITS

The intent of this strategy element is to address impacts resulting from *past development* that occurred prior to modern stormwater regulations. Application of similar incentive tools to guide *future development* is included as a Watershed Planning Strategy approach (Section 5.2).

The Interdisciplinary Team recommended building on existing successful programs by using a social marketing approach to encourage more voluntary retrofits on private properties developed without modern stormwater controls. Social marketing applies traditional marketing principles to influence behavior change in target audiences. This approach differs from traditional community outreach and education programs in that it focuses on identifying and addressing specific barriers to action (PSP 2015). Formative research is a key element of social marketing. Once barriers to and motivators for desired actions are known, targeted messages and/or incentive tools can be applied to achieve specific behavior changes. Social marketing is a rigorous, evidence-based approach that has been used for decades to improve public health.

A local example of the successful application of social marketing techniques to encourage residential property owners to undertake costly stewardship projects is the Shore Friendly Program[45] which encourages waterfront homeowners to voluntarily choose alternatives to hard shoreline armor (e.g., bulkheads, seawalls). Colehour + Cohen et al. (2014) conducted formative research and systematically developed a comprehensive strategy designed to be customized for deployment by local partners. Five pilot Shore Friendly campaigns were implemented between 2014-2018; this program now has a long-term home at a state agency and no longer relies on grant funding (Kinney and Francis 2019). Other local examples include:

- Seattle Public Utilities' RainWise Program incentivized stormwater-related practices on private property.
- Washington State Department of Commerce's Building Green Cities[46] social marketing study aims to identify incentives for developers to go beyond regulatory requirements when redevelopment occurs in urban centers.

These and similar efforts outside the Puget Sound region provide a wealth of information about developing and implementing incentive programs (see Appendix B). Below is a synthesis of key findings applicable to implementation of this strategy:

- Project cost is a barrier that must be overcome for incentive efforts to succeed.
    - Environmental benefits/goals are not as effective as financial incentives when encouraging stormwater BMP adoption (Chaffin et al. 2016, Gao et al. 2018, BenDor et al. 2018).

[45] Development and pilot implementation of this program was funded by the National Estuary Program through the Marine and Nearshore Lead Organization and its successor the Habitat Strategic Initiative.

[46] Funded by the National Estuary Program through the Stormwater Strategic Initiative (NTA 2016-0053 and NTA 2018-0293).

- Low cost, low barrier actions are more likely to be implemented than high cost actions (Boulet et al. 2017).
- Four plus years of Shore Friendly implementation established that financial incentives are a key motivator for residential-scale armor removal projects (Kinney 2018, Kinney and Francis 2019).
- Future savings in the form of reduced stormwater fees or water bills were more motivating than subsidies or rebates for project implementation (Gao et al. 2018).

- Direct and focused engagement with potential project implementers is a key element of successful incentive programs.
  - Changing behavior requires face-to-face interaction (Colehour + Cohen et al. 2014).
  - There is high demand for site visits where property owners can receive site-specific management recommendations from local experts in a non-regulatory context (Johannessen 2013b).
  - A common point of entry into stormwater incentive programs is free or low-cost site visits where property owners receive individualized advice (Crisostomo et al. 2014).
  - Letter mail-outs were less effective than online surveys and door-to-door correspondence when engaging stakeholders (Brown et al 2016, Boulet et al. 2017).
  - Shore Friendly grantees reported that "hand-holding" throughout project implementation is crucial for project success, but very staff intensive (Kinney and Francis 2019).
- Education needs to come from a trusted source.
  - Landowners are suspicious of government officials and contractors trying to sell them something (Keller 2012, Johannessen 2012, Colehour + Cohen et al. 2014).
  - Brown et al. (2016) found incentive programs led by government agencies or municipalities received less interest compared to those led by other groups.
  - Engage groups that have organizational capacity to partner with and lend legitimacy (Chaffin et al. 2016). Third party entities generally play a large role in implementing programs (Crisostomo et al. 2014).
  - People want to see and hear about successes from neighbors (Colehour + Cohen et al. 2014). Adopters are more likely to beget more adopters (Crisostomo et al. 2014, Gao et al. 2018).

Since the Education and Incentives Strategy was developed by the Interdisciplinary Team in early 2017, the Stormwater Strategic Initiative has funded several projects that begin to implement elements of this strategy (Table 6).

Table 6. Incentive programs funded by the Stormwater Strategic Initiative

Project	Grantee	Year funded
Strengthening STORM NTA 2018-0658	King County	2019
Better Ground NTA 2016-0246	Puget Sound Conservation Districts Caucus	2018
Puget Sound Conservation District Stormwater Action Team NTA 2016-0292	Puget Sound Conservation Districts Caucus	2018
Technical and Financial Assistance: Private Property Low-Impact Development Retrofits NTA 2016-0232	City of Kirkland	2018
Develop a Riparian Restoration Program in Thurston County NTA 2016-0175	Thurston County	2018
Building Green Cities NTA 2016-0053 (Phase 1) and proposed NTA 2018-0293 (Phase 2)	Department of Commerce	2017
Replicable Model for Depave and LID Retrofits NTA 2016-0032	Pierce Conservation District	2017
Puget Sound Starts at My School NTA 2016-0218	Snohomish Conservation District	2017
Urban Tree and Forest Canopy Cover Toolkit NTA 2016-0343	King Conservation District	2017

Source: https://pugetsoundestuary.wa.gov/what-we-do/projects/stormwater-projects/

Recommendation: Work with existing grantees and municipal permittees to evaluate the various organizational structures used to date and develop a sustainable funding strategy for coordinated investment in stormwater incentive programs.

Table 6 shows that grants have been made to different types of organizations for both local and regional incentive projects. As these projects wrap up, there would be value in conducting a performance assessment designed to inform how additional incentive program investments should be structured, managed, and coordinated. This assessment could support formulation of a more coordinated regional strategy that addresses elements described in Faghin and von Reis Crooks (2015). Elements that may warrant additional consideration include:

- Service delivery models – Identify an oversight entity to coordinate the various service providers (non-profit organizations, Conservation Districts, local government, utilities) across the region. Identify program elements best suited to regionalization and those better handled by local service providers.
- Regionwide prioritization – Develop and apply a methodology to prioritize watersheds and sites within them, as well as tools to evaluate site feasibility.
- Additional social marketing formative research needs – This could include rigorous audience segmentation work to enable more nuanced messaging for different types of properties (e.g., residential, commercial, churches, schools); exploration of contractor training needs;

identification of the most effective incentives tools for different types of projects; and program options for a range community sizes.

- Sustainable sources of funding – Crisostomo et al. (2014) noted that most stormwater incentive programs were driven by combined sewer overflow consent decrees. This was the case for Seattle Public Utilities' RainWise Program. The fiscal benefits of developing an incentive program are not as obvious for jurisdictions lacking a consent decree (Nylen and Kiparsky 2015). It is likely that most local agencies will need some state and/or federal support or a regulatory mandate to invest in this type of work. NEP funds can help to build these programs but are not intended to provide long-term support.
- Types of projects eligible for support – "Gray" retrofits should be eligible for funding in locations where LID techniques are not viable due to factors like poor soil suitability, steep slopes, high groundwater table, and insufficient space. Traditional BMPs show positive water quality impacts (Mackenzie et al. 2018; Stormwater Action Monitoring), but some programs will not fund them due to a preference for LID infrastructure that also reduces runoff volume (Futurewise 2016).

Recommendation: Clearly identify geographies associated with B-IBI indicator targets to help guide regional stormwater and habitat incentive program investments.

Many different approaches have been used to prioritize sites for stormwater retrofits in the Puget Sound region. Mackenzie and McIntyre (2018) summarize implemented and proposed retrofit siting approaches, which ranged from prioritizing receiving waters with low/moderate levels of impairment to heavily degraded waters subject to a TMDL or 303(d) listing. The Building Cities in the Rain retrofit prioritization guidance (2016) was developed with support from the Watershed Grant Program.

Given that the B-IBI indicator was developed to focus attention on the region's "best remaining stream habitats" (Wulkan 2011), investments driven by the B-IBI indicator targets should focus on less degraded and less urban areas. However, some NTA proposals that received Stormwater Strategic Initiative funding based on alignment with B-IBI regional priorities target heavily urbanized areas with poor or very poor B-IBI scores. For example:

- The City of Kirkland was funded to develop an incentive program that provides technical and financial assistance for LID retrofits on private property. Yet data uploaded to Puget Sound Stream Benthos indicates that B-IBI scores in Kirkland streams are poor and very poor.
- Commerce's Building Green Cities social marketing study focuses on developing incentives for cities and developers to go beyond municipal stormwater permit requirements during redevelopment in regional growth centers[47] designated by the

[47] Puget Sound Regional Council has designated 29 regional growth centers in their 4-county service area. These areas are focal points for planned growth, economic development, and transportation infrastructure investments in the VISION 2040 plan. See https://www.psrc.org/centers

Puget Sound Regional Council. These geographies are heavily urbanized areas likely to have highly degraded streams.

These are valuable projects that could advance other regional recovery goals, but they would not have any impact on the B-IBI indicator targets. More detailed requests for proposals that specifically identify target-relevant geographies would likely result in projects better aligned with regional goals intended to protect and restore highest-quality stream habitat.

4.2 SOURCE CONTROL

This approach was a late Interdisciplinary Team addition to this strategy, so it is less well-developed than the other strategy elements. Education about herbicide/pesticide use and funding stability for existing source control programs were the primary topics of discussion.

Example programs include:

- Municipal stormwater permit-required business inspection source control programs. The 2019 permit update added this requirement for Phase II jurisdictions.
- Ecology's Local Source Control Partnership funds local specialists who provide one-on-one technical support to small businesses to assist them with stormwater management and chemical storage/disposal. This program received a significant portion of its funding from NEP and Puget Sound geographic funds through the Toxics and Nutrients Lead Organization between 2011-2019 (Roberts 2017). Funding for 6 local programs ended in June 2019. A proposal (NTA 2016-0177) to continue and expand this support has not been funded by the Stormwater Strategic Initiative (successor to the Lead Organization). At the time of writing, Ecology was seeking approval for a supplemental budget request to fill this funding gap (K. Zarker, Ecology, pers. comm.).
- The Stormwater Outreach for Regional Municipalities (STORM) Program is a regional collaboration that supports implementation of municipal stormwater permit requirements for education and outreach programs intended to promote awareness of stormwater issues and motivate protective behaviors. PSP, Ecology, and 83 Western Washington permittees use STORM to build capacity by sharing outreach materials and messaging research. In 2019, the Stormwater Strategic Initiative funded NTA 2018-0658 to strengthen this program with a new coordinator position intended to improve communication among members and develop new messaging and social marketing programs. Development of long-term funding strategy for this work is an explicit element of the work plan for this grant.

Some existing source control-related education and technical assistance programs like the Local Source Control Partnership and STORM are largely funded through short-term grants may not be able to maintain sufficient resources and momentum to operate stable programs. In contrast, permittees will be required to establish and sustain their new business inspection source control programs. This program element may be a good candidate for multi-jurisdiction implementation through interlocal agreements among neighboring jurisdictions.

Areas not subject to NPDES stormwater permit requirements may benefit from similar source control awareness programs to prevent some geographies key to the B-IBI indicator targets from being missed by current efforts.

This strategy element has a strong nexus with the Toxics in Fish Implementation Strategy currently being prepared by the Stormwater Strategic Initiative. Development of long-term sustainable funding strategies for source control programs should be considered as that strategy matures. Another identified need is strategic coordination among groups that develop and deliver education campaigns. Sightline (2014) highlighted the importance of a cohesive communication campaign over multiple project or program efforts.

Some NTA proposals related to this strategy approach have been linked to other Vital Signs: "Puget Sound Starts Here – A regional awareness and behavior change campaign" (NTA 2018-0540) Toxics in Fish; "Natural Yard Care behavior change campaign" (NTA 2018-0566) Land Cover and Development; and "Evaluation of current-use pesticides in King County" (NTA 2018-0235) Chinook.

4.3 HABITAT RESTORATION AND ACQUISITION

As shown in Table 5, there are many sources of federal, state, local, and quasi-governmental technical assistance and project funding available for riparian/stream habitat restoration and property or easement acquisition. This approach calls for increased coordination among these existing programs and projects so that restoration investments can be concentrated in geographies or specific watersheds relevant to the B-IBI indicator targets.

The phasing of hydrological and habitat restoration actions was noted as an important consideration for such coordination work. This is because the effectiveness and longevity of riparian or stream channel improvements can be short-lived if the altered hydrologic conditions that caused or contributed to the degraded condition are not addressed first.

The Interdisciplinary Team also suggested that there may be opportunities to incorporate restoration into infrastructure projects (e.g., flood control, transportation) to achieve benefits beyond their original scope. For example, the Washington State Department of Transportation Fish Passage Project replaces approximately 15 culverts per year, many within the Puget Sound region. These projects could be leveraged to include habitat elements to further improve stream condition.

The Interdisciplinary Team did not discuss who should take on this coordination role in different watersheds.

Recommendation: Develop fact sheets to communicate B-IBI priorities to habitat restoration practitioners.

Once geographic priorities for the B-IBI indicator are delineated, PSP or the Stormwater Strategic Initiative could develop fact sheets to communicate those priorities and encourage existing programs that provide technical assistance and financial support for riparian and stream restoration on private property (e.g., Conservation Districts, Regional Fishery Enhancement Groups, salmon Lead Entities) to consider B-IBI goals and monitoring when selecting projects for implementation.

Conservation Districts may be particularly well-suited to integrate water quality and habitat priorities and align funding within individual watersheds. They have extensive experience delivering technical and financial assistance to landowners, and the Puget Sound Conservation District Caucus has been working to build their capacity to address stormwater issues (as evidenced by the multiple projects shown in Table 6). Conservation Districts are known partners who work frequently in the rural areas.

5. WATERSHED PLANNING STRATEGY

Achieving the B-IBI indicator targets is expected to require three broad types of actions: protection (reducing development in sensitive areas), mitigation (reducing the impacts of new and future development), and restoration (addressing the impacts of existing development). Since B-IBI scores reflect the cumulative effect of both local-scale and watershed-scale stressors, identifying the most effective and efficient combination of actions to improve conditions is a challenge. The Interdisciplinary Team identified watershed planning as a way to provide a coordinated framework for decision support.

The Watershed Planning Strategy aims to promote multi-program and cross-jurisdictional planning focused on protecting high quality streams and coordinating restoration actions. The envisioned watershed planning process is expected to increase understanding of current and future watershed conditions; support informed, methodical, and integrated decision-making; and drive coordinated investments at the relevant hydrologic scale.

Three planning approaches were identified by the Interdisciplinary Team:

1. Integrate land use and water quality protection planning to protect stream health
2. Develop incentive tools to encourage mitigation at the basin scale
3. Coordinate restoration actions at the basin scale to maximize benefits

The primary planning focus will differ across the region depending on development patterns. In jurisdictions where new development dominates, planning for protection should be a priority. Where redevelopment is prevalent, restoration planning would take precedence. The Interdisciplinary Team prioritized planning for protection because, per King County (2015),

stormwater retrofits are significantly more expensive and not a proven way to improve B-IBI scores.

Two additional approaches address information needed to support watershed planning:

4. Ensure status and trends information is available and synthesized at the watershed scale
5. Evaluate project and plan outcomes to understand trends in B-IBI scores and the effectiveness of management interventions

The Watershed Planning Strategy Results Chain recognizes linkages with the B-IBI Local Capacity Strategy as well as the 2016 Land Development and Cover Implementation Strategy's Regional Support for Conservation of Ecologically Important Lands and Working Lands Strategy. The B-IBI Results Chain addresses jurisdiction motivations to engage in watershed planning and seeks to address structural barriers to watershed planning like a lack of cross-jurisdiction and intra-jurisdiction coordination/collaboration. The Land Development and Cover Strategy seeks to reduce growth in ecologically important rural lands, which is consistent with the B-IBI protection target.

Table 7 inventories ongoing programs with potential to support implementation of the Watershed Planning Strategy. Note that several programs included in Tables 3 and 5 are also relevant to the Watershed Planning Strategy.

Sections 5.1 – 5.4 describe example protection/restoration-oriented planning efforts and existing monitoring programs.

Table 7. Programs with potential to support the Watershed Planning Strategy

Program	Implementers and/or funders	Description
Financial and Technical Support		
Growth Management Services	Washington Department of Commerce	Provides technical and financial assistance to local governments to support GMA planning. Offers a "Short Course on Local Planning" for elected officials.
Stormwater Grants of Regional or Statewide Significance Program	Washington Department of Ecology	Grants that assist permittees in completing projects to benefit multiple NPDES municipal permittees
Watershed and Flood Prevention Operations Program	Natural Resources Conservation Service	Provides technical and financial assistance to states, local governments, and Tribes for planning and installing watershed projects
Watershed Characterization Technical Assistance Team	Washington Departments of Ecology, Fish and Wildlife, and Commerce, U.S. Environmental Protection Agency	Provides local jurisdictions with guidance interpreting and applying the Puget Sound Watershed Characterization in support of planning processes
Monitoring and Effectiveness Studies		
Cooperative Monitoring, Evaluation and Research Program	Washington Department of Natural Resources, Forest Practices Board	Forest practices effectiveness monitoring to meet adaptive management goals
National Rivers and Stream Assessment	U.S. Environmental Protection Agency	Collaborative national survey on ecological condition of and key stressors to rivers and streams, including wadeable streams.
National Water Quality Assessment Program	U.S. Geologic Survey	Conducts monitoring and assessment of water chemistry, hydrology, land use, stream habitat and aquatic life in 51 study units across the nation, including the Puget Sound basin
Stormwater Action Monitoring	Washington Department of Ecology and 90+ municipal stormwater permittees in western WA	Regional collaboration to satisfy monitor monitoring needs under the Western Washington municipal stormwater permits. Funds stormwater management effectiveness studies, status and trends monitoring, and source identification. Projects are designed to produce regionally transferable findings.
Watershed Health Monitoring	Washington Department of Ecology	Environmental Assessment Program's status and trends monitoring program. SAM follows many of the same protocols as this program.

NOTE: Programs in Tables 3 and 5 that build local capacity and fund water quality projects, property acquisitions, or habitat restoration are also relevant but not repeated here.

5.1 INTEGRATE LAND USE AND WATER RESOURCE PROTECTION PLANNING

King County (2015) advises that the best way to protect streams with excellent B-IBI scores is to maintain existing land cover or mitigate the effects of land conversion as they occur. They recommend a combination of mechanisms to accomplish this:

- Regulatory development restrictions (e.g., zoning, critical area protections)
- Acquisition of property, conservation easements, or development rights
- Implementation of Low Impact Development (LID) practices to reduce effective impervious surface as development occurs

The objective of this approach is to balance development demands and water quality protection by connecting land use planning and stormwater management. A first step is identifying what a receiving water needs to meet water quality standards and maintain beneficial uses under projected future growth. Next is encouraging jurisdictions to set protection goals that are consistent with ecosystem needs and direct growth away from areas necessary to maintain key watershed functions. Watershed planning is meant to be a tool to identify lands needed to protect stream health, as well as the specific regulatory and non-regulatory mechanisms available to achieve protection.

Table 8 summarizes recent protection-focused watershed planning efforts that share some characteristics of the idealized watershed planning approach described by this strategy. Key planning elements may be missing in some cases. For example, most of these plans do not span more than one jurisdiction.

Several of the plans in Table 8 used Ecology watershed characterization assessments to support the identification of high-priority areas for sustaining watershed health (Commerce 2019, Wright *in prep*).

Watershed Grant Program funding was a driver for most of these projects. New Stormwater Management Action Planning (SMAP) requirements in the 2019 municipal stormwater permits are expected to motivate more jurisdictions to conduct this type of planning in the future. Ecology (2019) specifically requires permittees to identify land management strategies in their plans. However, jurisdictions not subject to NPDES stormwater permit coverage may be important for the B-IBI indicator targets and would likely need financial and technical assistance incentives to undertake this type of planning.

Table 8. Examples of recent protection-focused watershed planning efforts

Jurisdiction(s) and watershed(s)	Driver(s)	Description	Outcomes
City of Bonney Lake Watershed Protection Plan (2018) – Fennel Creek Additional source: Sullivan 2019	Rapid growth, Watershed Grant Program funding, interest in increased regulatory flexibility	Conducted an integrated watershed protection and land use evaluation to inform GMA comp planning; provide the technical basis for a to-be-approved by Ecology Stormwater Basin Plan with basin-specific site stormwater development standards; and prioritize retrofits. Audited City's municipal code to identify areas where existing regulations may be inconsistent with watershed protection goals and land use plans then recommended specific changes to improve compatibility.	Several recommendations have been implemented: • Updated 3 existing Center Plans and added 1 new Center Plan. These plans direct new development, redevelopment, and infill to town centers with existing or proposed regional stormwater facilities. • Downzoned areas not suitable for development. • Added 20 prioritized stormwater projects, including new regional facilities and retrofits, to Capital Improvement Projects Plan. As of late 2019, the City was awaiting Ecology approval for their Basin Plan.
City of Duvall Watershed Plan (2015) – Cherry Creek, Weiss Creek, and Duvall Tributaries (Snoqualmie River) Additional sources: Booy & Stanley 2017 Commerce 2019 Wright *in prep*	Comp Plan update, urban flooding, Watershed Grant Program funding	Assessed watershed conditions using the Puget Sound Watershed Characterization Model and local data. Delineated 17 sub-basins then categorized them by 5 management groups: • Group 1: protect/restore • Group 2A: highest conservation • Group 2B: moderate conservation • Group 2C: lowest conservation • Group 3: urban development	Several recommendations have been implemented: • Comp Plan update directs growth to Groups 1 and 2A, and restoration/ conservation in Groups 3 and 2C. This will focus development on only 30-40% of the City's annexed land area. • Critical area standards allow for variable protections by management priority, such as smaller buffers in Group 3 areas. • Revised subdivision site design requirements emphasize LID features and habitat corridors. • New tree protection standards • Updated Surface and Stormwater Comp Plan with assessments to inform retrofit ranking and LID policy direction

Table 8. Examples of recent protection-focused watershed planning efforts (cont'd)

Jurisdiction(s) and watershed(s)	Driver(s)	Description	Outcomes
Island County – Fish and Wildlife Conservation Area Update and Critical Areas Ordinance Update	Comp Plan update, Watershed Grant Program funding	Conducted an audit of County critical area standards and a watershed assessment. Developed management recommendations, in collaboration with a Technical Advisory Group, to improve protections.	Fish and Wildlife Conservation Area Ordinance and associated Comp Plan amendments were adopted in 2014. Changes to Critical Areas Ordinance polices on wetland protection and mitigation, mitigation sequencing, development codes, and BMPs for agricultural areas were adopted in 2017.
Kitsap County – Little Anderson (2016) Additional sources: Commerce 2019 Wright *in prep*	Comp Plan update, Watershed Grant Program funding	Piloted a "planning by watershed" approach to use Puget Sound Watershed Characterization Model outputs to inform land use recommendations for the County Comp Plan update.	Decisions not to expand the Urban Growth Area in the Little Anderson Watershed, to keep industrial development out of sensitive areas, and to recommend stormwater BMPs to reduce erosion and increase aquifer recharge. New geo-hazard data being used in building permit review. Timing was an issue for inclusion of findings into the Comp Plan. Some analysis was not completed until after the update window had closed.
Kitsap and Pierce Counties – Minter Creek Watershed Strategies (2014)	Comp Plan updates, Watershed Grant Program funding	A watershed strategies group developed a land use vision and prioritized land use strategies across the county boundary.	Recommendations for Comp Plan updates and surface water management programs. Extent of implementation unknown.

Table 8. Examples of recent protection-focused watershed planning efforts (cont'd)

Jurisdiction(s) and watershed(s)	Driver(s)	Description	Outcomes
Thurston County – Deschutes Watershed Study (2017) Additional sources: Commerce 2019 Wright *in prep*	Comp Plan update, Watershed Grant Program funding, water quality impairments	Compiled/synthesized information about current conditions in the watershed and used the Puget Sound Watershed Characterization Model to identify areas at highest risk from future development and those where protection/restoration would best support ecological function. Developed and assessed 5 management scenarios: • Baseline management • Education and Outreach • Restoration and Conservation • Zoning Regulations (rezone to reduce number of homes in sensitive areas) • Development Regulations (reduce impervious surface limits	A Stakeholder Workgroup prioritized 18 actions (associated with the scenarios) to protect ecological functions in the watershed. Actions associated with the Education/Incentives and Restoration/Conservation scenarios received unanimous support and were ranked high priority. Workgroup support for zoning and regulatory changes was split or low priority. As a result, little code language was developed and adopted into the Comprehensive Plan update.

Recommendation: Continue grant support for watershed planning efforts with a focus on multi-jurisdictional projects; geographies not subject to NPDES municipal stormwater permits; and planning to support municipal permitees in going above and beyond minimum regulatory obligations.

Very little money is currently being directed to local governments to improve their land use plans, policies, and regulations (Commerce 2019). The majority of projects described in this section as models for watershed planning and protection were a result of NEP grants. Compared to the three other B-IBI strategies, there is a dearth of existing programs that support this type of work.

Continued grant support and multi-jurisdiction collaboration are critical to achieving Watershed Planning Strategy goals. Few watersheds are located within the boundaries of a single jurisdiction. Financial and technical assistance incentives are needed to encourage more local jurisdictions to work together on watershed planning efforts and build support from their citizenry.

5.1.1 POLITICAL WILL

The Results Chain for this strategy recognizes implementation of watershed plans as distinct from their development. Implementation requires recommended protections be codified in a Comprehensive Plan, zoning, Critical Areas Ordinance and/or other development regulations. Political will plays a critical role in achieving this strategy's objective of directing growth away from areas that will harm stream health. The tension between conservation priorities expressed in local plans and short-term attitudes about development and tax revenue is well-recognized (Dykman and Paulsen 2012). For this strategy to succeed, local government leaders will need to make difficult choices. Political support for conservation varies among jurisdictions across the region and will likely provide an advantage to some geographies and a disadvantage to others.

A key assumption articulated in the Results Chain is that decision-makers will support protection if they understand the relative costs and benefits of protection compared to restoration via stormwater retrofits. Restricting development and ensuring development includes appropriate mitigation (e.g., LID tools like minimizing site disturbance, preserving native vegetation, reducing impervious surfaces, and infiltrating stormwater onsite) is thought to be orders of magnitude less expensive than restoring impaired streams. Educating decision-makers about the cost effectiveness of integrating water resource protection into land use planning is a recommended action under this approach. Other well-documented benefits of LID that could be highlighted as part of these education efforts include stress reduction, support for physical activity, improved air quality, reduced urban heat island effects, reduced asthma and heat-related illnesses (Brown and Sanneman 2017). Control of nuisance flooding was another driver for at least one of the efforts described in Table 8.

Some Partner Workshop participants were skeptical of the idea that stormwater issues could drive land use. The Interdisciplinary Team acknowledged the extent of the political challenge

associated with restricting development and suggested policy changes that strengthen regulations may be necessary to drive implementation of protection-oriented plans.

5.1.2 POLICY CHANGES

The Interdisciplinary Team and workshop participants identified two regulatory/policy changes that would foster linkages between land use and water quality planning, and ensure watershed protections identified in plans are enacted.

The first involved having Ecology's municipal general stormwater permits require permittees to consider land use planning as a stormwater best management practice. Since the Results Chain was first developed in 2017, Ecology has issued new permits that clearly define planning as a water quality management tool. The 2019 permits build on the lessons from the watershed-scale stormwater plans developed by Phase I counties in the 2013 permit.[48]

The new planning process, Stormwater Management Action Planning, specifically directs jurisdictions to include land use policy changes deemed necessary to maintain current designated uses (Ecology 2019). Land management/development strategies are to identify lands to protect from impervious surface conversions or native vegetation removal, and the means for providing needed protection (e.g., acquisition or zoning changes).

This policy change is consistent with the evolution of regulatory approaches in at least one other estuary of national significance. In recent years, "Land Policy BMPs" have been developed as a way to earn nutrient and sediment reduction credits as part of the Chesapeake Bay TMDL (Chesapeake Bay Commission 2013). The accounting scheme of Chesapeake Watershed Model was modified in 2018 to explicitly credit conservation actions for their role in avoiding future land conversion. Default elements of the growth management BMP include metrics like increase proportion of urban versus rural growth and increase proportion of growth occurring as infill/redevelopment. The other classes of land policy BMPs address forest and farmland conversion.

The second recommended policy change involved elevating stormwater in Growth Management Act (GMA) planning requirements. Receiving water habitat has not been a priority in growth management planning to date. One desired result articulated on this strategy's Results Chain is for land use and growth management planning to be accountable for water quality standards. Two specific changes were suggested to accomplish this objective:

[48] As described in Section 2.2.1, the 2013 permit required King, Pierce, and Snohomish Counties to conduct a watershed-scale planning process to identify stormwater management strategies that fully support designated uses into the future. This required development of detailed hydrologic models to test the performance of different stormwater strategies in multiple future build-out scenarios but, with the exception of King County, failed to include changing land use designations or zoning as a management strategy to protect water quality. See Table 10 for more about these plans.

- Require jurisdictions to consider long-range attainment of water quality standards in comprehensive plans.
- Require state approval of local comprehensive plans to ensure that adequate protection and restoration are included to address stream health. This would be like the Shoreline Management Act requirement for Ecology to approve local Shoreline Master Programs.

For most jurisdictions, implementing these changes would be likely be a significant challenge in the near-term. As discussed in Section 2.2.1, GMA established multiple—and sometimes competing—goals to guide comprehensive planning and development regulations. Amendments to GMA are being discussed, but housing affordability is the primary motivator.[49]

In 2017, the Washington State Legislature funded the Ruckelshaus Center to develop a Road Map to Washington's Future and identify areas of agreement on ways to adapt Washington's growth planning framework of statutes, institutions, and policies to meet future challenges. After hearing from more than 2,500 people, the Ruckelshaus Center synthesized insights collected from participants to identify common themes and opportunities for improvement. The project's final report identified 6 areas ripe for transformational change and 25 key reforms to improve Washington's growth planning framework (Ruckelshaus Center 2019). Although these recommendations do not include elevating water resource protection above other GMA goals, several of the key reforms identified by Ruckelshaus Center (2019) are consistent with this and other B-IBI strategy approaches:

- Increase grants for cities and counties to plan under GMA.
    - Participants indicated that too much emphasis is on reviewing and updating plans instead of improving development regulations. The final report recommends state support for making updates to ordinances that correspond with developed plans. This change could advance the implementation component of this strategy. As illustrated in Table 8, successful implementation of watershed plans required auditing of local codes and translation of protections into relevant regulations.
- Fund and develop guidelines and methods for performance monitoring and measurement of comprehensive and regional plan implementation. This is similar to what the B-IBI strategy advocates in Section 5.4 (Evaluation and Effectiveness Monitoring).
- Incorporate GMA-related topics into existing required training for elected officials. For example, understanding of policies in the growth planning framework; roles of state, regional, and local governments; responsibilities of elected officials as decision makers. This relates to a recommendation made in Section 3.3.
- Support policies and programs that enhance economic and environmental viability of agriculture. Identify and develop strategies and programs that address the needs of farmers. The Working Lands strategy described in Section 6 has a similar focus.

[49] For example, more than 50 bills that would amend GMA were proposed during the 2019 legislative session. Of the 6 that were approved, 5 related to housing affordability (passed together as HB 1923).

- The Voluntary Stewardship Program was provided as an example of a preferred approach.

5.1.3 COORDINATED ACQUISITION PLANNING

Acquisition of property or conservation easements is a non-regulatory approach for protecting lands needed to maintain stream health. The voluntary nature of property acquisition limits the application of this approach, but it should be one component of a larger watershed protection effort.

Several programs that fund acquisitions are listed in Tables 5 and 10. Canty (2015) and Appendix B of Puget Sound Regional Council (2018) provide information about these programs and their application throughout in the region. King County Land Conservation Advisory Group (2017) provides an extensive analysis of traditional and new finance tools available for the purchase of land and conservation easements.

Continued implementation of the three coordinated acquisition efforts described below would advance this strategy approach. Expansion of these models to other geographies may also support progress towards indicator goals.

Watershed Grant Program Riparian Acquisition Initiative

In 2015, the Watershed Grant Program developed an initiative to protect and restore riparian zones on streams in Puget Sound agricultural communities (Canty 2015, Hume 2018). This program provides a good model for watershed-based identification of acquisition priorities. Grantees from 8 geographic focus areas were required to develop reach-scale plans that describe the local context, identify needed actions, then prioritize/sequence those actions and recruit landowners. The plans had to be completed and approved before grantees could be eligible for implementation funding.

As described in Hume (2018), Doyle (2018), Grah and Dickerson-Lange (2018), Higgins (2018), Marshall et al. (2018), and Redfern (2018), grantees applied a variety of strategies to identify/priorities actions and engage with landowners. Actions were identified via workshops, modeling, geographic and land cover analysis, and pre-existing studies like the Skokomish River General Investigation and South Fork Nooksack TMDL. Prioritization schemes included GIS analysis to score/rank reaches based on factors like potential ecological lift, threat of development, or landowner willingness; partner workshops to score based on best professional judgement; or cost estimates and real estate analyses.

Several insights shared by managers, advisors, and grantees of this program should be kept in mind as this B-IBI strategy is implemented:

- Existing watershed leaders (lead entities, tribes, land trusts, Local Integrating Organizations, other watershed organizations) are best suited to select priorities and form teams to implement protection and restoration goals (Canty 2015). The appropriate entity may vary

by watershed. Partners are needed to fill a variety of roles, such as problem solving, trust building, increased community awareness, access to funding (Doyle 2018).

- Leveraging multiple funding sources is often necessary to complete projects, but navigating different program criteria, deadlines, reporting obligations, and match requirements is an ongoing challenge (Canty 2015). Advisory group participants expressed a desire to simplify application and administration processes and recommended that granting agencies coordinate planning and priority setting.
- Time needs to be budgeted for cultivating landowner relationships, which makes short timelines for spending grant money a challenge (Doyle 2018, Hume 2018). Community outreach must include an active effort to understand landowner needs (Canty 2015).
- Consistency with existing, locally supported watershed plans and priority-setting processes is important (Canty 2015). Advisory group members indicated that salmon recovery plans are sufficiently advanced to identify priority areas, but reconciliation of salmon and water quality priorities may need attention.
- Protection planning efforts need to strike a balance between being strategic and opportunistic (Canty 2015).
- Canty (2015) contains much useful information about the mechanics of conservation easements. Only certain entities certified under federal tax code and state law can execute easement instruments. In Washington, they include 26 incorporated land trusts, state or local government agencies (including conservation districts), and federally recognized tribes. However, ongoing staff support is needed to manage/enforce easements, and this has been a challenge for state agencies in the past. Advisory group members recommended that the entity who will ultimately hold any acquired conservation easements be identified and involved early.

Puget Sound Regional Council Open Space Conservation plan

The Puget Sound Regional Council's (PSRC) Regional Open Space Conservation Plan is a significant resource for implementation of this strategy approach in King, Snohomish, Pierce, and Kitsap counties. PSRC (2018) used existing plans and datasets, as well as extensive input from numerous stakeholders, to compile a geodatabase that delineates the most important open spaces in the central Puget Sound region. The resulting regional open space network includes 6 types of open spaces—natural lands, farmland, working forest, aquatic systems, urban open space, and regional trails—grouped by watershed/WRIA. This data is intended to be used by local governments, resource agencies, conservation nonprofits, and others to plan and guide conservation actions.

The mapped network covers about 3.03 million acres of land within the 4 counties.[50] 96% of this open space network is located outside of the Urban Growth Area. PSRC (2018) estimated that ~70% has long-term protection through public ownership and conservation easement. An

[50] The maps can be viewed at: https://www.psrc.org/sites/default/files/osplan-appendixd-maps-watershed.pdf

additional 1.3 million acres of privately-owned farms and working forests—representing 64% of farmland and 81% of timberland—has some protection via zoning designations in county comprehensive plans.[51] The remaining acreage is subject to environmental regulations but may lack sufficient protection. PSRC (2018) considers 104,000 acres of farmland; 183,000 acres of working forest; and 175,000 acres of intact habitat within their regional open space network to be most at risk of conversion to developed uses.

PSRC (2018) provides 10 strategies and describes tools that address barriers to protecting these areas from development. Lack of funding was identified as the largest barrier to long-term protection. Other barriers are land availability/landowner willingness, existing regulations/cost-prohibitive permitting requirements, and public agency capacity to broker land/easement acquisition. There are significant similarities between several of PSRC's proposed strategies/actions and the approaches recommended in this B-IBI strategy. The Open Space Conservation advocates for:

- Integrating land use and infrastructure planning. The B-IBI Watershed Planning Strategy seeks to accomplish this.
- Requiring or incentivizing LID. This is a desired result of several B-IBI strategy approaches.
- Conducting watershed planning and use of watershed characterization. The B-IBI Watershed Planning Strategy is intended to encourage these approaches.
- Integrating planning across departments. The B-IBI Local Capacity Strategy (Section 3) and Watershed Planning Strategy both seek to accomplish this.
- Keeping working lands working. The Working Lands strategy described in Section 6 has a similar focus.
- Identifying the highest priority areas for restoration/retrofits. This relates to a recommendation described in Section 5.3 (Coordinate Restoration Actions).
- Advancing the use of incentive tools like Transfer of Development Rights, Land Conservation and Local Infrastructure Program, and Ecosystem Service Markets. This is similar to the approach described in Section 5.2 (Develop Incentive Tools).

King County Land Conservation Initiative

King County's Land Conservation Initiative demonstrates the extent of local analysis and political support required to implement a large-scale acquisition program. It also quantified the gap between current acquisition funding and revenue needed to meet conservation goals.

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[51] PSRC (2018) provides data on the effectiveness of working lands designations in the 4 counties. Between 2010 and 2015, lands designated for agriculture and forestry experienced much less development than areas with other designations: over 103,500 housing units were permitted in UGAs; almost 4,800 in rural areas; 82 in designated farmland and 8 in designated timberland. However, these designations are not necessarily permanent. Between 2000-2008, 6.5% of designated agricultural land (6,690 acres) was re-designated as rural residential or another use that allows additional development.

This County Executive led initiative began in 2015 with a goal of preserving all remaining high conservation lands in King County within the next 30 years. County staff has identified, mapped, priced, and prioritized 60,600 acres (5,400 parcels) of critical natural lands and green spaces. Staff also assessed each parcel to determine best preservation mechanism (purchase, conservation easement, current use tax incentive[52]).

At the 2016 pace, it would take more than 70 years to protect all of these lands. Because King County is one of the fastest-growing large counties in the nation, accelerating the acquisition schedule is a key element of the initiative. Acting quickly avoids future land value appreciation and lost opportunities as development pressure increases.

The 2019-2048 cost estimate for this initiative is $4.14 billion; the estimated funding gap is $893 million not including operations and maintenance (King County Land Conservation Advisory Group 2017). Financial modeling was used to analyze various acceleration strategies and identify options to fill the funding gap. King County Land Conservation Advisory Group (2017) described alternatives for increasing acquisition funding sources:

- Public options: raise existing Conservation Futures Tax to its maximum levy rate; lift the property tax lid; issue general obligation bonds supported by a property tax increase; and/or establish a new Real Estate Excise Tax (REET 3).[53] Some of these changes would require approval by voters or the Washington State Legislature.
- Emerging opportunities: ecosystem service payments/credits (carbon storage and stormwater), mitigation bank/in-lieu fee, conservation finance/private capital, healthcare provider "community benefit" funding.[54] Some of these tools are described further in Section 5.2 below.

The Lands Conservation initiative has been successful at increasing funding for open space acquisitions and operations/maintenance. In 2018, the King County Council approved the sale of bonds secured by the Conservation Futures Tax to raise as much as $148 million through 2022 via an ordinance that lets the County sell bonds based on 80% or Conservations Futures

[52] This and other incentive/mitigation tools mentioned here are described in Section 5.2 (Develop Incentive Tools).

[53] RCW 82.46.070 authorized counties to impose an excise tax (not to exceed 1%) on real estate sales with proceeds used for acquisition and maintenance of conservation areas. This tax must be approved by county voters. REET for Conservation Areas measures have appeared on ballots in several counties but were approved only in San Juan County. King County attempted to pass a REET measure in 1990, without success.

[54] 501.c.3 healthcare organizations and hospitals are required to deploy a certain amount of "community benefit" funding to maintain their tax-exempt status. King County Land Conservation Advisory Group (2017) suggested highlighting the connection between open space and human health in order to access "healthy lifestyle program" funding. The group provided some examples to illustrate the magnitude of funding disbursed annually (e.g. Seattle hospitals alone spent $600 million on community benefits in 2015) and how a very small percentage of this funding could be significant for conservation purposes.

revenue rather than 50%.[55] This new funding allowed 3 times more acquisitions activity relative to previous years.[56] In August 2019, King County voters approved a 6-year parks and recreation property tax with annual increases.[57]

5.2 DEVELOP INCENTIVE TOOLS

This strategy approach seeks to further develop financial and regulatory incentives that encourage mitigation of stormwater impacts at a basin scale, rather than on-site, and direct growth to areas that will not harm stream health. The focus here is on *future development*, in contrast to the Education and Incentives Strategy's retrofit element that seeks to "right past wrongs" (Section 4.1).

Builders are responsible for mitigating the hydrologic and water quality impacts of their developments. When stormwater control facilities are designed as part of an individual development, they may or may not contribute to larger watershed goals. Recognizing that small projects here and there will not be enough to achieve B-IBI goals, the Interdisciplinary Team supports the use of private investments off-site where they may have a higher benefit at a lower cost. Widespread availability of economic and regulatory incentives is expected to protect watershed function by stimulating mitigation of future land conversion impacts within hydrologic basins. Incentives should also encourage retrofits of legacy development that restore watershed function.

Table 9 describes an array of economic instruments that could accelerate progress towards this and other B-IBI strategy goals.

These market-based tools generally fall into two categories: incentive-based and mitigation or credit-based (Brown and Sanneman 2017). Incentive-based approaches motivate an entity to take desired action(s) through financial gain, cost avoidance, or non-financial benefits. Mitigation or credit-based frameworks provide flexibility in meeting regulatory obligations by allowing regulated actions to be offset at other sites or by other parties.

[55] https://kingcounty.gov/elected/executive/constantine/news/release/2018/July/30-land-conservation.aspx and https://www.seattletimes.com/seattle-news/constantine-wants-to-leverage-conservation-fund-to-buy-65000-acres-of-last-best-places/

[56] https://www.seattletimes.com/seattle-news/king-county-seeks-to-preserve-5000-acres-for-parks-open-space-by-the-end-of-2020/

[57] https://ballotpedia.org/King_County_WA_Proposition_1,_Parks_and_Recreation_Property_Tax_(August_2019)

Table 9. Summary of market-based incentive and mitigation tools with potential to support B-IBI strategies

Tool	Description	Examples and Opportunities
Builder incentives	Jurisdictions encourage applicants to go "above and beyond" code requirements by offering a fee reduction or subsidy; faster, easier, or less uncertain permit review; and/or code exceptions like density bonuses and alternative setback, height, parking requirements. These types of programs sometimes have low participation rates. Cost savings must be sufficiently attractive, marketing effective, the burden to participate low, and benefits must accrue to the developer not a future long-term property owner (Brown and Sanneman 2017).	Futurewise (2016) provides several examples, including the City of Auburn's point-based incentive program and Lake Forest Park's mini-grants for natural drainage projects. Commerce's Building Green Cities project is currently exploring optimal designs for builder incentive programs for redevelopment within urban centers.
Current use taxation	RCW 84.34 and WAC 458-30 allow counties to reduce property taxes when owners preserve or restore their land. Tax relief is provided when open space, agricultural, or timber lands are valued at "current use" rates rather than the "highest and best use" typically assessed. This can translate into a reduction in the assessed value for the portion of the property enrolled in a county's current use program (Faghin and Mateo 2014). All but three Puget Sound counties (Mason, Skagit, and Snohomish) have established a Public Benefit Rating System (PBRS) that provides standardized criteria from which the reduction in assessed value can be calculated. The higher the public benefit rating, the higher the level of tax relief awarded.	Faghin and Mateo (2014) recommended working with PBRS counties to encourage modifications to existing priority resource categories and numerical ratings to more effectively incentivize protection. This could include modifying point systems to award significant bonus points where conservation easements are in place to provide permanent protection.
Ecosystem services transactions	Properly functioning ecosystems provide essential environmental and economic benefits traditionally considered free to society. Payments for these services can occur when they are quantified as credits and a market is developed to link participating landowners with entities willing to pay for actions that protect/restore services. Entities paying for credits often have a regulatory requirement to meet or service to deliver (e.g., water treatment, drinking water, flooding protection).	The Nisqually Watershed Services Transaction Demonstration Project, which received funding from the Watershed Grant Program, resulted in a completed payment-for-watershed-services transaction to protect 36.4 acres of Lake Saint Clair shoreline to benefit the City of Olympia's drinking water supply (WDNR 2013, Wright *in prep*). In 2016, the Nisqually Land Trust and Microsoft completed Washington's first carbon credit transaction.

Table 9. Summary of market-based incentive and mitigation tools with potential to support B-IBI strategies (cont'd)

Land Conservation and Local Infrastructure Program (LCLIP)	RCW 39.018 provides a financing tool for cities in designated development rights receiving areas to invest in infrastructure. LCLIP allows cities to receive a portion of future county property tax revenue if they receive a higher percentage of their allocated share of development rights.	Eight cities have evaluated the feasibility of LCLIP (Commerce et al. 2013), but only Seattle has adopted the program (Wright *in prep*). Feasibility varies depending in zoning designations and regulations, development capacity, and projections for future growth (Commerce 2019).
Stormwater control transfers	Allows permittees to satisfy regulatory requirements for flow control, runoff treatment, and/or low impact development by directing rehabilitation efforts to priority basins within a jurisdiction where they will provide more immediate environmental benefit (Ecology 2016). This encourages planning and prioritization of stormwater control facilities at a basin scale rather than a site scale.	City of Redmond allows builders to pay an in-lieu fee instead of building required flow control or runoff treatment retrofits on-site. The City then uses this money to build retrofits in a higher-priority basin. See Table 10 for more information.
Third-party compensatory mitigation for losses of aquatic resources	Section 404 of the Clean Water Act established a program to regulate the discharge of fill material into waters of the United States (including wetlands). 73 FR 19594 authorizes two types of third-party compensatory mitigation mechanisms: mitigation banking and in-lieu fee payments. These approaches can consolidate what would otherwise be several smaller, lower-quality compensatory mitigation projects into a single project that provides greater overall environmental benefit.	Three in-lieu fee programs (King County, Hood Canal Coordinating Council, and Pierce County) and eight mitigation banks have received federal approval in the Puget Sound basin. In addition to satisfying federal 404 permit requirements, King County's Mitigation Reserves Program sells credits to mitigate critical area impacts.
Transfer of development rights (TDR)	RCW 43.362 authorizes regional TDR programs that encourage development in UGAs while funding conservation easements. A jurisdiction identifies areas to conserve ("sending areas" such as working lands or open space) and areas to direct additional growth ("receiving areas" within cities or UGAs). Landowners in sending areas can choose to sell their development rights to developers interested in gaining additional development potential in receiving areas. The sending property is protected through a conservation easement and developers get a bonus like additional building height, floor area, or increased units.	Five counties and ten cities in the Puget Sound region have adopted or conducted feasibility studies for TDR programs. Thirteen of these jurisdictions received EPA funding via Watershed Management Assistance Grants and the Watershed Grant Program to develop or enhance their programs (Commerce et al. 2013, Commerce 2019). Wright *in prep* will summarize some successes and challenges associated with these efforts and make recommendations for moving forward.

Much has been written about barriers to more widespread adoption of market-based protection and restoration tools in the Puget Sound region and elsewhere (Gockel 2011, WDNR 2013, Faghin and Mateo 2014, Willamette Partnership and Freshwater Trust 2014, Futurewise 2016, WSCC 2017, Brown and Sanneman 2017, PSRC 2018, Willamette Partnership et al. 2018).

However, limited discussion of identified barriers is provided in Table 9. This is because there are projects currently underway that will significantly expand our understanding of barriers and how they can be overcome. These include a synthesis of Watershed Grant Program investments (Wright *in prep*) and Commerce's Building Green Cities project.

A forthcoming Base Program Analysis for the Land Development and Cover Implementation Strategy will build on this report with emergent findings.

5.3 COORDINATE RESTORATION ACTIONS

King County (2015) advises that the best way to restore streams with fair B-IBI scores is to improve conditions via:

- **In-stream restoration** – add wood, add substrate, enhance sinuosity, replace culverts, and stabilize stream banks.
- **Riparian restoration** – stabilize slopes, plant vegetation, and extend buffers.
- **Stormwater BMPs** – retrofits for flow control and/or treatment, the use of green stormwater infrastructure, maintenance of existing stormwater infrastructure, street sweeping in areas with high-traffic roads, source control.

This strategy element seeks to increase the efficacy of stormwater retrofits and habitat actions through prioritization, concentration, and cross-jurisdiction collaboration. It relates to calls in the Education and Incentives Strategy (Section 4) for retrofit planning and increased coordination among existing programs/projects. The B-IBI restoration target focuses on "fair" basins, though the Interdisciplinary Team also felt it important to include "good" basins in the restoration planning process. The Interdisciplinary Team advocated for identifying opportunities for and barriers to incorporating restoration activities in coordination with other infrastructure projects in order to achieve benefits beyond the original scope which could include improved stream habitat. For example, co-locating stormwater retrofits with other public facilities (e.g., parks, streamside trails, transportation corridors). This input is supported by the literature. Roth and Partridge (2014) recommend integrating planning across infrastructure categories as a way to achieve cost efficiencies and co-benefits.

Table 10 provides examples of recent restoration-focused watershed planning efforts, some of which involved basins with "fair" B-IBI scores. Relative to the Interdisciplinary Team's intent to integrate multiple types of restoration planning, these examples are narrowly focused on stormwater retrofits.

Table 10. Examples of recent restoration-focused watershed planning efforts

Jurisdiction(s) and watershed(s)	Driver(s)	Description	Outcomes
King County – Small Stream Basin Retrofit Siting Program	Phase I Permit structural stormwater control program requirement	This landscape-level planning effort identified over 64 small streams/lakes in unincorporated King County considered to be degraded as a likely result of stormwater runoff.	A stormwater capital needs assessment was completed in 2012. Retrofits needed to achieve flow durations and peak discharges goals were identified. At least 2 retrofits have been completed.
King County, Snohomish County, Redmond, Woodinville, and WSDOT – Bear Creek Watershed Management Study (2018)	2013 Phase I Permit requirement	Assessed existing conditions to evaluate the impact of the developed watershed on water quality, habitat, and stream flow. Modeled projected impact of future growth and made 4 recommendations to protect the watershed into the future: • Upgrade and build new stormwater infrastructure on public land • Incentivize rain gardens, cisterns, and gravity wells on private land • Restore habitat along streams and wetlands • Monitoring and adaptive management	5 high-priority basins were identified. 10-year cost estimates: $51M for stormwater infrastructure; $21.7M for acquisitions; $4.7M for stream and wetland habitat restoration; and $4.2M for programs and studies. The 2019 permit requires that additional project planning occur in the near future.
King County and City of Seattle – Our Green Duwamish Watershed-wide Stormwater Management Strategy (Phase II 2017)	Identified as need by Watershed Advisory Group established in 2014	Collaboratively developed of 7 goals and 18 objectives for watershed-scale stormwater management. Objectives included: compile and centralize access to existing, available stormwater information; use existing information to prioritize actions regionally; and perform watershed-level basin planning.	Implementation plan developed. In fall 2019, a mapping tool was being developed to help Phase II cities in the watershed comply with new Stormwater Management Action Planning requirements. NTA 2018-0355 proposal to implement other early-action items has not yet been funded.

Table 10. Examples of recent restoration-focused watershed planning efforts (cont'd)

Jurisdiction(s) and watershed(s)	Driver(s)	Description	Outcomes
City of Redmond Watershed Management Plan (2013) – multiple Additional sources: Hitch and Rheaume 2017	Water quality impairments, rapid growth	Piloted application of Puget Sound Watershed Characterization Model and Building Cities in the Rain retrofit prioritization approach. Used watershed assessment data to evaluate rehabilitation potential and set goals for future desired condition. Four management strategies for basins: • Protection • Highest restoration • Restoration • Restoration development Identified indicators and developed a monitoring approach.	Operational Stormwater Control Transfer Program that directs stormwater and surface water infrastructure investments where they provide the most benefit. In lower-priority development basins, developers can opt to pay an in-lieu fee instead of improving flow control or runoff treatment on-site. The City uses the money to build retrofits in a higher-priority basin. Watershed assessment data was used to prioritize receiving basins and develop detailed plans for specific improvements. Progress towards restoration goals is being monitored as part of a SAM study.
Snohomish County – Little Bear Creek Basin Plan (2018)	2013 Phase I Permit requirement	Assessed existing and predicted future conditions under the County's existing Comp Plan. Results indicated that water quality standards for temperature, fecal coliform, and B-IBI would not be met. Stormwater BMP sequences were then modeled to identify optimum combinations of improvements to meet standards and targets.	The cost of modeled strategies was estimated at $289M: $167 M for detention, $68M for LID, $49M for filtration, and $4M for buffer restoration. The 2019 permit requires that additional project planning occur in the near future.
City of Edmonds, City of Lynwood, and Snohomish Conservation District – Perrinville Basin	Nuisance flooding and erosion, funding from Watershed Grant Program, Boeing, and Stormwater Strategic Initiative	A flow reduction study to prioritize capital retrofit projects was completed in 2015. This was followed by assessments of spatial suitability for green stormwater infrastructure (Walter et. Al 2016) and rain garden incentives (Murphey et al. 2016).	Partners began a pilot rain garden program in the basin in 2017. NTA 2016-0364, funded in 2018, will support implementation of at least two previously recommended Green Stormwater Infrastructure projects in the basin.

5.4 SYNTHESIS, EVALUATION, AND EFFECTIVENESS MONITORING

A significant portion of the Watershed Planning Strategy Results Chain addresses the collection, synthesis, and evaluation of data about stream health and the effects management interventions. The Interdisciplinary Team stressed the importance of consistent status and trends monitoring; watershed-scale information syntheses; tools that integrate evaluation of landscape and biological metrics; assessment of project and regulatory effectiveness; and documentation of the costs and benefits of management actions.

These data needs are supported in the literature. Nylen and Liparsky (2015) noted the lack of watershed-level data about the cumulative impacts of distributed stormwater infrastructure. Mackenzie and McIntyre (2018) proposed installing stormwater facilities with a measurable hypothesis that can be tested, and stressed the importance of monitoring new and existing BMPs for downstream biotic impacts.

In recent years, much has been accomplished to improve our understanding of these complex issues. Continued support for several existing program is critical to maintaining and building on this momentum. The remainder of this section catalogs key programs, existing tools, and model projects currently available to support and inspire work to implement this strategy approach.

- Ecology's Stormwater Action Monitoring (SAM) program is funded through jurisdictions under the NPDES Phase I and II western Washington municipal stormwater permits. SAM staff and contractors design, execute, and report results of effectiveness studies, status and trends monitoring, and source identification studies to provide actionable data for local jurisdictions. B-IBI is one parameter evaluated as part of Puget Lowland Streams Status and Trends Monitoring (DeGasperi et al. 2018). The Redmond Paired Watershed Retrofit Effectiveness Study includes long-term monitoring of B-IBI to evaluate progress toward restoration goals. Effectiveness studies on hydrologic performance, pollutant removal, and toxicity reduction are underway; study fact sheets and other information can be viewed on SAM's communications web page.
- Ecology's Watershed Characterization Model is a set of spatially-explicit water flow/water quality and habitat assessments that compare areas within a watershed for restoration and protection value. The main products of this model are color-coded maps that show the relative value of small watersheds throughout the Puget Sound Basin (Stanley et al. 2013). The colors reflect a matrix which describes management recommendations (high/medium/ low protect or restore) based on the watershed's level of importance versus level of degradation). This decision-support tool was developed with funding from the Watershed Grant Program. Several example applications are described in Section 5.1.
- The Watershed Characterization Technical Assistance Team was formed in 2012, with support from the Watershed Grant Program, to support Watershed Characterization Model users in developing watershed-based plans and updating comprehensive plans and critical areas ordinances. This interagency team is comprised of experts that can assist users with interpreting and integrating model outputs into planning processes. They can also help

incorporate finer-scale local data to develop targeted solutions to watershed problems. Several example projects supported by the team were described in Tables 8 and 10.

- Commerce's Puget Sound Mapping Project provides a standardized zoning layer that uses generalized land use and development intensity categories that resolve differences among all 12 counties and 113 cities in the Puget Sound region. It contains 15 land use master categories and 32 subcategories that are integrated with housing data and can be overlain with watershed characterization model outputs. These data layers can support a wide range of planning and environmental recovery efforts, including identifying locations where changes to development regulations could improve water quality and habitat protections (Commerce 2019). This GIS resources was developed with support from the Watershed Grant Program.
- The multi-stakeholder Cooperative Monitoring, Evaluation, and Research Committee managed by WDNR plans, designs, and implements research and monitoring projects conducted to meet Forest Practices Adaptive Management Program goals. The inclusion of B-IBI data could greatly expand our understanding of the impacts forest practices have on watershed health as well as the correlation between B-IBI scores and salmon.
- WDFW's Priority Habitats and Species Program provides information and technical support to local jurisdictions developing and implementing GMA land use plans and development regulations. The program recently released new management guidelines for riparian zones (WDFW 2018). The program was recently funded to evaluate the effectiveness of local critical areas protections for riparian areas (NTA 2018-0368).
- Commerce recently updated their Critical Areas Handbook with a new chapter on monitoring and adaptive management of critical areas regulations (Commerce 2018). This resource provides several local examples of program effectiveness monitoring.
- In 2008, King County and EPA began a multi-year investigation of the effectiveness of critical area, grading, and building regulations at preventing environmental degradation in rural watersheds. Lucchetti et al. (2014) describes the assessment framework and results of five years (2007-2012) of study. Results were confounded by a sharp decrease in development associated with a major economic recession that corresponded with the study period. There was no detectable effect of combined compliant and noncompliance land cover change on the environmental response variables. However, given the project's strong experimental design, the data obtained provides a robust baseline for future evaluations in King County and a model for similar work elsewhere in the region.
- EPA's Causal Analysis/Diagnosis Decision Information System (CADDIS) is used to identify which specific combinations stressors have degraded B-IBI scores in a given basin.
- WDFW tracks land use/land cover change using High Resolution Change Detection techniques applied to aerial imagery. A Watershed Grant Program application of this technique in Thurston County is described in Section 5.1.
- The Freshwater Trust's StreamBank Toolkit consists of proprietary data and technology tools to plan and quantify conservation outcomes. This toolkit includes the BasinScout

Methodology for assessing watershed and site-level conservation opportunities; the Dynamic Implementation Environment Tool to optimize multiple conservation objectives; and the StreamBank Monitoring Application and Tracking Tool assesses program progress over time.

- The Northwest Forest Plan's Aquatic Conservation Plan includes guidance for managing watersheds to maintain biotic integrity. It describes considerations for multiple scales of assessment (i.e., watershed vs. basin vs. parcel scale).

6. WORKING LANDS STRATEGY

This objective of this strategy is to prevent the conversion of forestry and agricultural areas to more intensive land uses, and to reduce ongoing impacts of working lands on stream health. The Interdisciplinary Team identified two approaches to support progress:

1. Support long-term economic and ecosystem sustainability of forestry and agricultural operations by directing growth away from working lands. This approach is similar to a strategy developed as part of the 2016 Land Development and Cover Implementation Strategy: providing regional support to reduce the conservation of working lands by improving local implementation of GMA and directing growth away from working lands via regional infrastructure planning.
2. Increase relevance and availability of technical assistance and financial incentives to support implementation of best management practices on working lands.

Table 11 lists existing programs that support these approaches.

Given the forthcoming Base Program Analysis for the Land Development and Cover Implementation Strategy, described in Section 5.2, no analysis of these programs is provided in this report.

Table 11. Programs with potential to support the Working Lands Strategy

Program	Implementers and/or funders	Description
Agricultural Land Easements	Natural Resources Conservation Service	Provides financial assistance to help landowners purchase easements to keep their land in agricultural use. Part of the Agricultural Conservation Easements Program.
Community Forest and Open Space Conservation Program	U.S. Forest Service	Supports community acquisition of forests that provide public access and recreational opportunities, protect vital water supplies and wildlife habitat, serve as demonstration sites for private forest landowners, and provide economic benefits from timber and non-timber products. Community Forests can be owned by local governments, tribal governments, and qualified nonprofit entities.
Community Forest Trust Program	Washington Department of Natural Resources	Provides funding for purchase of private forestland at high-risk of being converted to non-forest uses. Part of the Community Forest and Open Space Conservation Program.
Conservation Innovation Grants	Natural Resources Conservation Service	Intended to stimulate the development and adoption of innovative conservation approaches and technologies in agricultural production, requires a 1:1 match
Conservation of Private Grazing Land Initiative	Natural Resources Conservation Service	Technical, educational, and related assistance is provided to generate better grazing land management; reduced soil erosion; energy efficiency; water conservation; wildlife habitat; and to sustain forage and grazing plants; use plants to sequester greenhouse gases and increase soil organic matter; and to use grazing lands as a source of biomass energy and raw materials for industrial products
Conservation Partners Program	National Fish and Wildlife Foundation, National Resources Conservation Service	Grant funding to support organizations that provide staff and technical assistance to private landowners in order to place expert staff ("boots-on-the-ground") where they can maximize outreach to the private landowner
Conservation Reserves Enhancement Program	12 local Conservation Districts, U.S. Department of Agriculture	Provides enrolled participants with annual rental payments and cost-share assistance for removing sensitive lands from production for a contract period of 10-15 years. Operates as a partnership between state and federal governments.

Table 11. Programs with potential to support the Working Lands Strategy (cont'd)

Program	Implementers and/or funders	Description
Conservation Stewardship Program	Natural Resources Conservation Service	Provides technical assistance on conservation enhancing practices tailored to specific-site goals
Conservation Technical Assistance Program	Natural Resources Conservation Service	Delivers voluntary conservation technical assistance, available to any group or individual
Continuous Conservation Reserve Program	Natural Resources Conservation Service	Provides enrolled participants with annual rental payments and cost-share assistance for removing sensitive lands from production for a contract period of 10-15 years
Current Use tax programs	Multiple Puget Sound counties	Reduces property taxes for private landowners maintain their lands as open space, or working farms and forests in order to lessen the pressures to convert such lands to development
Environmental Quality Incentive Program	Natural Resources Conservation Service	Provides financial and technical assistance incentives to plan and implement conservation practices
Farm and Ranch Lands Protection Program	Natural Resources Conservation Service	Provides funds to purchase development rights on private lands
Farmland Preservation Grants	Washington Recreation and Conservation Office	Provides funding to cities, counties, non-profit organizations, and the Washington Conservation Commission to buy development rights on farmlands. Part of the Washington Wildlife and Recreation Program.
Farm to Farmer Program	PCC Farmland Trust	Land-matching program designed to connect farmers to land opportunities in Pierce, King, and Skagit counties.
Forestland Preservation Grants	Washington Recreation and Conservation Office	Provides funding to lease or buy conservation easements on working forests, as well as forest habitat restoration. Part of the Washington Wildlife and Recreation Program.
Forest Legacy Program	Washington Department of Natural Resources, U.S. Forest Service	Provides grants through state partners to protect environmentally sensitive forest lands while maintaining private ownership and working forests. A Land and Water Conservation Fund program.
Forest Stewardship Program	Washington Department of Natural Resources, U.S. Forest Service	Provides advice and assistance to help family forest owners manage their lands, including development of Forest Stewardship Plans to help landowners qualify for financial assistance and current use taxation

Table 11. Programs with potential to support the Working Lands Strategy (cont'd)

Program	Implementers and/or funders	Description
Forestry Riparian Easement Program	Washington Department of Natural Resources	Reimburses landowners for the value of the trees they are required to leave to protect fish habitat
Healthy Forests Reserve Program	Natural Resources Conservation Service	Helps landowners restore, enhance and protect forestland resources on private lands through easements and financial assistance.
Natural Resource Investments Program	Washington State Conservation Commission, 12 local Conservation Districts, U.S. Department of Agriculture	Grants and technical assistance to complete natural resource enhancement projects necessary to improve water quality in non-shellfish areas
Northwest Agricultural Business Center	U.S. Department of Agriculture, Washington Department of Commerce, Washington Department of Agriculture, and other local/foundation sponsors	Provides business training and resources to support farmers in Island, King, San Juan, Skagit, Snohomish and Whatcom counties
Puget Sound Extension Forestry Program	Washington State University Extension	Provides research-based classes and educational resources for owners of forested and wooded properties in a six-county region
Readiness and Environmental Protection Integration Program	U.S. Department of Defense	Aims to stop suburban encroachment by funding working lands conservation easements to buffer bases from residential and commercial development. Joint Base Lewis/McChord is a "sentinel landscape" given high priority by DOD and NRCS under this program
Regional Conservation Partnership Program	Natural Resources Conservation Service, Alliance for Puget Sound Natural Resources	Provides funding and technical assistance for conservation partners and agricultural producers to plan and implement conservation activities that address natural resource priorities on eligible lands
Washington Farm Link	Tilth Alliance	Provides technical assistance, educational resources, and hosts networking events to facilitate the transition of farms to the next generation and help build sustainable farming operations.
Wetlands Reserve Program	Natural Resources Conservation Service	Provides financial and technical assistance to help landowners protect, enhance, and restore wetlands on their property. Part of the Agricultural Conservation Easements Program.

7. CONSIDERATIONS FOR FUTURE STRATEGY UPDATES

During the first phase of B-IBI Implementation Strategy development, the Interdisciplinary Team identified then scored more than twenty potential strategies that could address factors contributing to declines in stream health. Five strategies were then selected for development of results chains.[58] This was consistent with Implementation Strategy development guidelines (PSP 2017), which advise narrowing the scope of possible recovery pathways to only those that are likely to have the greatest impact.

Improving regulatory compliance and enforcement was a potential strategy that scored fairly high but was not advanced for results chain development. The need to identify and address compliance issues was reiterated again and again during strategy reviews by the Stormwater Strategic Initiative Advisory Team (SIAT), topical experts that participated in the partner and technical workshops, and external peer reviewers.

Implementation Strategies are intended to be updated periodically. This section compiles insights and specific suggestions about improving permit outcomes via increased attention to compliance and enforcement. These ideas were captured during development of the B-IBI Implementation Strategy and should be considered during future updates and/or for development of other related strategies.

Multiple participants commented on a perceived lack of enforcement of NPDES Municipal Stormwater General Permit requirements. Participants in the August 2017 technical workshop identified two components of this problem: (1) Ecology ensuring local jurisdictions meet minimum standards in their codes, and (2) jurisdictions ensuring implementation of required BMPs. Understaffing was identified as the probable cause of these deficiencies. Also mentioned was a lack of incentives for jurisdictions to do a good job and a lack of consequences for doing poorly.

The Local Capacity Strategy is intended to increase resources for compliance and enforcement at the local level, but none of the B-IBI strategies address resources needed at the state level. One external reviewer made several insightful suggestions for policy changes that should be considered if an Ecology NPDES compliance strategy were to be developed in the future. Discussion of these recommendations are provided in the bullets below.

- Increase legal support for Ecology NPDES oversight and enforcement at the Attorney General's Office. It is notable that the issue of staffing levels at the Attorney General's office was also raised in other Implementation Strategies: as a factor in slowing down approvals of Model Toxics Control Act clean-up agreements (Toxics in Fish) and restricting action on Hydraulic Code/Shoreline Management Act violations (Shoreline Armoring). Increasing

[58] Two of these strategies were ultimately combined. See narrative Appendix IVa for a complete description of the Implementation Strategy development process.

capacity at the Attorney General's Office could potentially be a significant lever to accelerate progress for multiple Vital Signs.

- Fully fund WSDOT's budget for operation and maintenance of stormwater infrastructure, including a significant line item for state-of-the-art stormwater control retrofits. This reviewer commented that the Legislature's consistent failure to do so sets a poor example for local governments. An analysis of WSDOT stormwater funding needs compared to recent appropriations is needed.
- Utilize anti-degradation provisions of the Clean Water Act to create a sense of urgency for local jurisdictions to incorporate watershed-sensitive decisions into land use decisions, policies, and rules. The idea that anti-degradation provisions are a tool that has been under-utilized in the context of land use is supported in the literature (Hersh 2009).

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APPENDIX A.

Effectiveness of Stormwater Utility Fees in Funding Stormwater Management Programs

Prepared by Christopher Wally Wright (May 2019)

In a review of academic literature and nationwide stormwater utilities' annual reports on their stormwater management programs, a variety of benefits and challenges were explained. None of the studies quantified the effectiveness of fees but over 90% of the 1,681 stormwater utilities (SWUs) nationwide and the 117 in Washington State use stormwater utility fees (SUFs) to fund their stormwater management programs.

In Washington State, approximately 35 SWUs use a tiered fee system, 9 use a fixed rate utility fee, 69 use ERU (Equivalent Residential Units = square feet of impervious surface), 3 use a two level system (Residential/Commercial) and 1 was unknown. Of 75 stormwater utility employees representing 21 states surveyed by Black & Veatch Consulting in their 2018 biennial stormwater survey, 94% reported that over 75% of their percentage of utility revenue received came from fees.

The benefits of using SUFs to fund stormwater management programs include:

1) **Increased awareness and enthusiasm for a community's stormwater.** In Downers Grove, IL and for several western Massachusetts utilities (Pioneer Valley Green Infrastructure Plan 2014) it was found that if residents "understand the benefits they will receive [from managing stormwater run-off through SUFs] they are more likely to support a fee" (Pioneer Valley Green Infrastructure Plan 2014). Additionally, SUFs have the potential to lead to a change in public behavior and are an efficient use of municipal resources (Zhao 2019).
2) **Revenues from SUFs are predictable, stable and sustainable** as they are earmarked exclusively for stormwater management purposes (Zhao 2019). However, factors such as the ability to recover direct costs, the ability to keep up with inflation, and the extent of stormwater discounts and credits may challenge revenues.
3) SUFs can be more equitable than having property owners pay for stormwater using a traditional property tax approach as users pay relative to the runoff generated. However, this varies depending on implementation. For instance, charging all users a flat fee may bring less equity into the funding system (Zhao 2019). According to a nationwide survey of 75 stormwater utility employees (Black & Veatch 2018), 92% of respondents said that their SUF structure is based on calculating impervious area of a parcel and 18% said it is calculated based on gross area. 92% of respondents calculating based on impervious areas has increased from 77% and 79% in the 2016 and 2014 surveys, respectively.
4) If SUFs are calculated based on impervious area of a parcel (using the Equivalent Residential Unit or the average impervious area on a parcel), it may encourage property owners to change some of the impervious areas of their parcel to pervious (EPA 2009). SUFs can incentivize reduction of impervious area if stormwater fees are based on impervious area, thus reducing their fees. Using impervious area as a basis for SUFs is considered more equitable because "the cost is borne by the user on the basis of the user's demand placed on the drainage system" (Brisman 2002).
5) Stormwater utilities can incorporate incentives and credits which help individuals pay reduced rate. These credits encourage pro-environmental behaviors as well as foster support for SUFs because the credit can help "property owners feel as if they have more control over the utility charge" (Brisman 2002). According to the 2018 stormwater survey conducted by Black & Veatch Consulting, 53% of respondents indicated that their SWU offered a stormwater credit program with 42% saying that the maximum stormwater fee credit reduction was between 25%-50% of a ratepayer's bill. 54% of SWU respondents said that they offer BMP design assistance and site assessment incentive programs.

The challenges of using SUFs to fund stormwater management programs include:

1) **Difficulty gaining public and political approval** because the average ratepayer is "unsure of the benefits they would receive from it" (Zhao 2018).
2) **Legal challenges when implementing fees** are not uncommon for several reasons:
    a) Rate payers feel that stormwater runoff mitigation is not a "product being paid for [and] is not something concrete and measurable like electricity or water" (Black & Veatch 2018).
    b) Ratepayers don't believe stormwater utilities have "the authority to enact [fees] and [question] the legality of the mechanism". According to the Western Kentucky University 2018 stormwater utility survey, 27% of respondents surveyed reported that their utility's SUFs have faced a legal challenge. 38% of those legal challenges were regarding whether the SUF was actually a tax and not a user fee and 24% said that the utility lacked the authority to assess stormwater fees. In another survey of 92 stormwater experts representing 116 jurisdictions in the southeastern United States, 12% of respondents said that their utilities have had their SUFs face a legal challenge. 75% responded that their fee was sustained while 17% reported that a settlement was reached with the prosecuting party.
    c) Legal challenges have arisen which question whether the fee is actually a fee or whether it functions more as a tax, such as in the legal case of Gainesville v. State (Brisman 2002).
3) **There is a long lead time for failed attempts at fee implementation.** In terms of SWUs launching new SUFs and gaining ratepayer approval, a stormwater expert found that "failed stormwater utility launches usually require a 7-10 year interval (grace period) before the next attempt because [of] algorithm changes every 3-5 years." (Leinhart 2014).
4) **There is a research gap** regarding "variations in the use of SUF revenues across municipalities as well as effective SUF designs that can avoid or minimize legal challenges". As such there is little evidence of 'universal' SUF systems or fee types that work across the board (Zhao 2018).

Source	Key Findings
Village of Downers Grove, IL Stormwater Utility 2019 Update	The Village of Downers Grove, IL, in their annual SWU report, have found that there are multiple benefits to implementing a fee-based system (the town previously used property fees) including: • All properties in the Village share in the cost of operating and maintaining the stormwater system. • SUFs provide a predictable and sustainable funding source. • A heightened sense of awareness of the stormwater management system is created. • Property owners are encouraged to reduce the mount of run-off from their property by installing rain barrels, rain gardens and detention basins, and may be eligible for a credit to their stormwater fee. • Revenues generated by the fee can be allocated to the maintenance and operating costs of the stormwater infrastructure system.
White, A., Prabha Kumar, P. Black & Veatch Management Consulting, LLC. 2018 Stormwater Utility Survey.	In this consultancy's biennial stormwater utility survey, the consultants found that: • Of the utilities surveyed, 94% reported that over 75% of their percentage of revenue that their utility received came from stormwater user fees. • 87% of the utilities responded that their funding is majority cash financed versus majority debt financed (13%). Of the cash financed, 91% was from stormwater user fees, 24% from grants. For debt-financed organizations stormwater revenue bonds and general obligation tax bonds provided 13-15% of funding. • 92% of respondents said that their stormwater user fee is based on calculating impervious area of a parcel and 18% said calculated based on gross area. 92% is up from 77% and 79% in 2016 and 2014 surveys, respectively. The trend is going upwards. • 48% reported that the calculation for determing impervious area is based on aerial imagery with 32% reporting that impervious area is based on building footprint (from tax assessment systems) with 70% of utilities responding that GIS was used to update gross and impervious area billing units • 64% reported that public land is exempt from stormwater fees, 20% that their public parks area, 19% that there school districts are and 25% that there city/county/local government land is. • 27% reported that their utility's stormwater fees have faced a legal challenge in the past or currently with 38% of those legal challenges being on the baseis of the stormwater utility fee was actually a tax and not a user fee and 24% that the utility lacked the authority to assess stormwater fees. • 53% of respondents indicated that they offered a stormwater credit program with 42% saying that the maximum stormwater fee reduction was between 25%-50% • 54% of respondents said that they offer BMP design assistance and site assessment incentive programs
Pioneer Valley Planning Commission Green Infrastructure Plan (2014)	In a survey of western Massachusetts stormwater utilities, • Several offer utility fee reduction of up to 50 percent in exchange for implementation of improved stormwater management practices—such as drywells, cisterns, and rain gardens—that reduce storm flow to the City's infrastructure and local streams and rivers. • Several cities use a "financial capability assessment guidelines" to help evaluate the burden on ratepayers/households and provide a measure of how financially burdensome CSO mitigation is and price accordingly • Several SWUs are using a "watershed approach to the reduction of impervious surface" because it could "promote important collaborations across municipalities to more effectively improve the condition of surface waters" but this has not been instituted at the time of the study. • Across all western Massachusetts municipalities regarding utility fees, several offered best practices: 1. Establish outreach campaign that generates enthusiasm for the community's stormwater vision. No one wants new fees or taxes, but if residents understand the benefits they will receive they are more likely to support the fee. 2. Direct greatest costs toward those who create the most runoff, particularly commercial and industrial facilities with large areas of impervious cover. 3. Ensure the fee do not harm low-income residents using sliding fee scales, bill discounts, crisis vouchers, and zero interest loans for qualified customers are options for offsetting the burden on lower income residents.
Cousins, J. (2017). Infrastructure and institutions: Stakeholder perspectives of stormwater governance in Chicago. *Cities,* 66, 44-52.	In a stakeholder survey of stormwater infrastructure operators in Chicago (n=13), the majority viewed fees as a "feasible approach for long-term and successful stormwater management". Chicago currently use property taxes where-in stormwater fees are viewed as taking away from other service such as "recreation or emergency management" and as such Chicago has not instituted stormwater fees yet.
Brisman, A. (2002) Considerations in Establishing a Stormwater Utility, *Southern ILL. University Law Journal*, 26, 505-528.	An assessment of the legal nature of stormwater utility fees found that: • Raising funds through a stormwater utility is beneficial because property taxes are not increased which "creates stability and predictability" • Storm water utilities are equitable because "the cost is borne by the user on the basis of the user's demand placed on the drainage system." • Stormwater utilities can incorporate credits which help individuals to pay reduced rate as well as fosters support because it helps "property owners feel as if they have more control' over the utility charge" • With stormwater, ratepayers are asked to pay to prevent something they do not want-water pollution however, most residents do "not recognize or appreciate the benefits of preventing stormwater pollution and, thus, will be less willing to pay the storm water utility fee as they would a power utility fee". Legal challenges have arisen which question whether the fee is actually a fee or whether it functions more as a tax such as in the legal case of Gainesville v. State (778 So.2d 519, 526 (Fla. Dist. Ct. App. 2001) • Several cities nationwide have adopted unique ways of offering credits such as the City of Griffin which offers up to a 50% reduction in the schools' stormwater charges for teaching the Water Wise program to students
SESWA's Survey of Southeast Stormwater Utilities, 2017 Southeast Stormwater Utility Report.	In another survey of 92 stormwater experts representing 116 jurisdictions in the southeastern United States: • 88% of respondents charged SUFs and 75% used impervious area as basis for that SUF. • 67% reported that undeveloped land is exempt from fees as are government (64%) as well as school district and city/county/governmentally owned properties. • The average reduction of bill for those that received SUF credits is 25%. • 12% of respondents said that have faced a legal challenge with 75% reporting that the fee was sustained and with 17% reporting that a settlement was reached.

	• 81% reported that their utilities' operating budget is funded only by stormwater fee revenue. Of the 19% that did not use SUFs for their operating budget, 56% of those use general funding to fund their operations. • 61% reported that an organized public information/education effort is essential for the success of their SUFs • The most effective forms of communication were (ranked in order): 1) Internet 2) brochures 3) bill inserts 4) PSAs 5) public schools 6) neighborhood meetings and press releases 7) advisory groups and 8) public hearings
Zhao et al. (2019). Stormwater Utility Fees and Credits: A Funding Strategy for Sustainability. Sustainability, 11(7): 1913.	This literature review of nationwide utility fees reviewed the costs and benefits of SUFs: • SUFs have the potential to lead to a change in public behavior and efficient use of municipal resources • SUFs can be more equitable than the traditional property tax approach as users pay relative to the runoff generated. However, this varies with its implementation. For instance, charging all users a flat fee brings less equity into the funding system. In addition, it is critical to consider residents' ability to pay when establishing SUFs. • Revenues from SUFs are stable and sustainable as they are earmarked exclusively for stormwater management purposes. However, factors such as the ability to recover direct costs, the ability to keep up with inflation, and the extent of stormwater discounts and credits challenge the revenue adequacy. • "Challenges to implementation include gaining public and political approval. SUFs have high visibility due to the design and implementation costs, and often the public is unsure of the benefits they would receive from it. Other issues municipalities face when implementing SUFs are legal challenges related to the authority to enact them and the legality of the mechanism" • The study found that there is a "there is a research gap regarding variations in the use of SUF revenues across municipalities as well as effective SUF designs that can avoid or minimize legal challenges."

APPENDIX B.

Stormwater Best Management Practices and Green Infrastructure – Incentives, barriers, social marketing academic literature review

Prepared by Christopher Wally Wright (May 2019)

Literature review of nine academic articles that evaluated the various aspects of stormwater retrofits and installation. The focus of the literature review was finding literature related to:

a. Evaluating the effectiveness of incentive programs to increase number of retrofits on developed/private properties. These studies primarily involved homeowners, residential properties, small business and the financial incentives designed to encourage stormwater retrofit or green infrastructure adoption. In general, the literature reviewed tended to focus on rain barrels and rain gardens and not retrofits.
b. Identifying key barriers to widespread implementation of stormwater retrofits or green infrastructure adoption.
c. Identifying other effective means of marketing including social marketing, changing social norms, policy decisions (other than financial) that can influence adoption and result in behavior change.

Using the above as guiding tenets for the literature review, research was conducted by searching through peer-reviewed academic journals for newer, relevant articles published in the last 3-5 years. The articles consisted of:

- 2 articles that presented lessons learned from case studies of municipalities successfully and unsuccessfully installing green infrastructure and stormwater retrofits (Chaffin et al. and BenDor et al.)
- 1 article that analyzed results from an online questionnaire sent to municipal officials and professional planners on adoption of stormwater best management practices (Cettner et al.)
- 4 articles that analyzed mailers/online surveys/semi-structured interviews with residents in various urban and residential locations on green infrastructure (Gao et al., Coleman et al., Persaud et al., Brown et al.)
- 1 article that conducted its own literature review of urban stormwater challenges and associated political/policy barriers (Dhakal et al.)
- 1 article that analyzed a pre-post intervention trial of small, industrial/manufacturing businesses encouraged to adopt non-structural stormwater practices (Boulet et al.)

Aggregated Findings and Key Themes that Emerged	**Number of studies showing similar results**
Environmental benefits/goals are not as effective as financial incentives when encouraging BMP or GI adoption.	5
In general, residents and businesses were not engaged with their local river or waterway – some believing that stormwater runoff has a positive impact on local rivers and streams .	3
Future savings (in the form of reduced stormwater fees for impervious surfaces, reduced water bills, etc.) were more motivating than subsidized green infrastructure (such as discounted rain barrels).	2
Stormwater projects led by government agencies or municipalities were met with more hostility and less interest than those led by other groups (non-profits, academic institutions).	3
For businesses, low cost, low barrier actions were more likely to be implemented versus high cost actions.	1
Attitudes towards adoption of green infrastructure are dictated by the social norms of the community – in some cases rain gardens were destroyed because they had been installed at a community playfield and in another because a homeowners' association disapproved of the aesthetics of 'unkempt' rain gardens. Understand community norms before engaging.	2
Providing data (such as water quality data) can assist in encouraging stormwater BMP adoption. Use data to demonstrate waterway impairment (and improvement post-BMP installation).	2
Cognitive barriers exist for those who have not adopted stormwater management practices, so education campaigns and demonstrations can help to sway non-adopters. Adopters are more likely to beget more adopters.	2
Residents who have experienced stormwater events (flooding, runoff, erosion, or washouts of driveways/lawns/gardens) were more likely to believe stormwater runoff was a problem and install green infrastructure.	2
Residents who have installed rain barrels and rain gardens had more "protective attitudes" towards local waterways and were more educated on the issues of stormwater impairment.	2
Economic uncertainties around green infrastructure is prevalent. It is viewed as a risky investment to install on a municipal and residential level, there is a lack of knowledge of the costs and benefits (particularly a lack of marketable value in regards to ecosystem services), and high cost BMPs are not perceived to be worth the investment for vague environmental benefits.	3
Letter mail-outs were less effective than online surveys and/or door-to-door correspondence when engaging stakeholders.	3
Demonstration of BMPs in public places (such as a rain garden near a riverfront public walking path) can increase awareness and increase attachment to local rivers and waterways.	2
Integrate, reduce barriers, and encourage siloed municipal/government/political institutions to work cooperatively for stormwater retrofit projects.	2

Citation	Background	Key Findings	Recommendations	Keywords
Brown, H.L., et al. (2016). More than money: how multiple factors influence householder participation in at-source stormwater management *Journal of Environmental Planning and Management* 59, 79-97.	• This study measured engagement of an urban community in a stormwater retrofit program in Melbourne, Australia. • The program worked with 767 households that had direct stormwater drainage to the local stream with public education and financial incentives for either rainwater tank or rain garden installations. • Financial incentives were allocated via a uniform-price auction where households submitted a bid: an application identifying details of the proposed retention system and the minimum funding they would seek from the project management. • The bids were assessed for their environmental benefit and then doled out to households that received the highest environmental benefit score to install rainwater tanks or rain gardens on their property. • Following the installation and bidding process, the participants were interviewed about their experiences.	• Of 58 interviewees, 46 had a positive view of rainwater tanks and 12 had a positive view of rain gardens. 22 had negatives views of rainwater tanks and 39 had negative views of rain gardens. • Negative perceptions of rainwater tanks included concern of potential financial loss should a government levy charges on rainwater tank owners. This was fueled in part by negative experience with authorities in the past. • Negative perception of rain garden was loss of garden space, concerns with flood damage to personal or neighboring property and disruption to the household during installation. • 21 participants identified the financial incentive for rainwater tanks as their reason for participating in the project. • Future financial savings on water bills and independence from water restrictions also contributed to the financial motivation to participate and the motivation to contribute to the environmental cause tended to be secondary in importance. • 14 participants elected not to participate because of concerns about the project's authenticity, specifically engagement by a government agency or water authority because of past negative experiences with such organizations, including the perception that government authorities would be incapable of running such a project effectively. • Interviewees showed a lack of knowledge about the local stream and of the link between stormwater and the ecological degradation of waterways. • Perception of a likely return on an investment of personal time and resources influenced participation outcomes. • Residents were primarily motivated to participate in the project because of the financial incentive for a rainwater tank and the economic benefits gained. • Residents that did not own their property or did not anticipate staying there for a long time showed less interest in the program.	• Avoid the requirement of an upfront payment by the householder to reduce the perception of risk. • Project information should be disseminated via diverse communication methods and not just letter mail-outs. • Environmental goal of the project were attractive to some residents, but a disincentive for others particularly because of skepticism and distrust of environmental communications and information. • Personality of project staff and their initial contact with potential participants is an important way to secure trust. • Educate and communicate importance of local stream for community members to encourage ownership – prior to the project several residents believed stormwater had a positive impact on the local waterway. • Use the theory of planned behaviour (Madden et al. 1992) framework (a system to measure progress towards environmental goals by looking at social outcomes) to maximize householder participation by giving the householder the perception of behavioral control and reduce the uncertainties on the part of householders about the likely success of their intended actions.	theory of planned behavior; stormwater management; community participation; community trust; civic environmentalism
Boulet M et al. (2017). Behaviour change: Trialling a novel approach to reduce industrial stormwater pollution *Journal of Environmental Management* 204, 272-281.	• This study presented a behavior change trial of small- to-medium sized industrial businesses to engage them in non-structural stormwater pollution mitigation. Non-structural stormwater reduction measures are non-physical interventions like education or awareness campaigns. • The trial intervention voluntarily engaged industrial (engineering, mechanics, printers, manufacturing) businesses in an industrial estate in Melbourne, Australia. • To achieve pro-stormwater management behavior change, the intervention sent out	• The actions that were successfully achieve were generally low-cost and low-risk actions (such as pollution notice installations as opposed to sewer drain overhauls). • An independent water quality consultant measured water quality in the affected area pre- and post-intervention and found no change in water quality. • Statistically significant increases in compliance with stormwater protection was found. These compliance increases were already mostly uncommon among the businesses. • The increases in compliance were generally behaviors that were low cost and low barrier to entry. The study found that non-structural changes that were more time-consuming and costly were less likely to have occurred.	• The study suggests that a "opportunistic, door-knocking", focused intervention can lead to better business participation in the future as well as incentives to encourage the business to participate. • Low cost, low barrier actions were more likely to be implemented versus high cost. • Some business could not adopt assessor's actions because business's headquarters were elsewhere or they were only leasing the site.	Barriers, non-structural BMPs

	letters to raise awareness, offers for voluntary stormwater assessments at the businesses, a community-wide communication campaign, and random EPA inspections of several business to demonstrate regulatory support for the voluntary behavior change program. • The trial intervention began with stormwater pollution assessments to high-risk businesses to collect data on their current behavior as well as inform the businesses of the "un-planned" EPA drop-in inspections. • Businesses could opt in to participate in recommendations from the assessor. • The community-wide communication campaign included EPA "Report Pollution" signage, media releases and stormwater drain stenciling. • 823 business were identified by door-to-door assessor visits and 268 were identified as high-risk. 530 (64%) agreed to participate in an initial assessment. Of the high-risk businesses 49% agreed to take part in assessment. Follow-up of the assessed businesses showed that 80% undertook actions that they had agreed with the assessors to commit.	• The changes that were less likely to occur were also associated with the fact that the businesses leased their sites and did not own them – for several of the stormwater BMPs, the owners would need to be the implementer, not the tenant. Additionally, several businesses that were not company headquarter could not implement any actions without headquarter approval - this may have prevented certain, more substantial actions from having been undertaken. • The letter mail-out received no replies for assessment; all assessments occurred only through face-to-face interactions.		
Persaud et al. (2016). Landscaping practices, community perceptions, and social indicators for stormwater nonpoint source pollution management Sustainable Cities and Society 27, 377-385.	• This study aimed to assess relationships between regulatory and education approaches to homeowner behaviors, perceptions and knowledge of BMPs. • Study used interviews, survey and participant observation to gather data to evaluate knowledge and attitudes surrounding nonpoint source pollution management, particularly lawn care ordinances in a planned community in western Florida. • Conceptual basis for the study was the theory of planned behavior (Madden et al. 1992) – a system to measure progress towards environmental goals by looking at social outcomes • This study looks at the subjective norms to determine participants knowledge and actions towards • Study area was a planned community of 6000 homes	• Questions included whether respondents had seen any outreach material on the community's fertilizer ban (54% said no), and questions regarding the community's ponds for stormwater management. Overall responses to whether participants had seen any outreach materials for any topic was 74% saying no. • The study found that residents lacked awareness of the lawn fertilizer ban, as well as did not believe their lawn care had any impact on the local water quality. • The majority of the respondents said that they would not change behavior towards aquatic or shoreline plants, or change lawn care behavior if it resulted in view obstruction or lowered property values. • Informal communications with residents showed that future efforts should share water quality data with the residents so that they would know how their actions are affecting the local ponds and water reservoirs. • Attitudes towards natural areas (such as not allowing shoreline plants because of aesthetic reasons) at community ponds or on lawns) were dictated by the social norms of the community – specifically by the homeowner's organization that is the regulatory body for landscape practices. The HOA fined residents if in violation of certain standards	• Provide water quality data to present at stakeholder meetings and to committees to show problems in stormwater quality in order to change behavior. • Educate homeowners of the dangers of over-watering and over-fertilization of lawns. Change the social norms that were largely instilled by the Homeowners Association that dictated how lawns should be cared for. • Educate to change behaviors on aesthetically "un-pleasing" natural shoreline plants and their impact on stormwater filtration versus more aesthetically pleasing manicured, homogenous lawns.	theory of planned behavior, residential, nonpoint source pollution, shoreline plants, filtration

	• Methodology was a web-based survey, interviews, participant observation. • Questionnaire included questions on homeowner expectations of water quality, landscape and lawn maintenance, knowledge of the community's fertilizer ordinance. • Survey participation was voluntary and emailed to 3400 individuals of which responses numbered 590.	for lawn care. The HOA community is a "norm-enforcing entity" that generally told residents how they should maintain their lawns.		
Dhakal K. et al. (2017). Managing urban stormwater for urban sustainability: Barriers and policy solutions for green infrastructure application. *Journal of Environmental Management* 203, 171-181.	• This study conducted a literature review of urban stormwater challenges specifically around green infrastructure in the US and then suggested policies to overcome those barriers and proposed a policy framework to address the challenges • Barriers were grouped by: federal, state, city policy governance barriers, resources barriers (financial, human), cognitive barriers (risk aversion, perceived cost and performance challenges, (ignorance of green instrastructure, no evidence of costs and benefits of ecosystem services) and education and community attitudes	• Lack of marketable value for ecosystem services discourages management of stormwater through GI systems and lacks incentive for private home-owner to install GI • Certain cities have restricted GI due to aesthetic reasons, restriction on space, and public/private property issues (such as installation of permeable pavement not allowed city streets) • Governance barriers related to the "mismatch of hydrologic and political boundaries" meaning that different political entities control different parts of watersheds, for example. • No existing approaches were found to bring private investment into stormwater retrofit projects. • Cognitive barriers to installation include questions of reliability of GI, perceived risks/risk averse populace (arising from absence of historical data on cost performance of GI) • Focus policy efforts on awareness, education, recognition, training, coordination and engagement	***Federal, state, city policy recommendations*** • Add hydro-ecological integrity as a statutory goal of the CWA • Establish flow (or its surrogate such as impervious area) as a control measure • Enact statutory provisions to allow cities to enforce flow control regulations on private parcels • Require cities to conduct planning and development based on hydrologic features • Integrate intercoupled functions under one institutional umbrella • Establish national design, maintenance standards, guidelines for GI • Provide tax exemptions or credits for GI • Enact a nationwide development threshold that triggers SWM requirements • Audit codes and eliminate or amend conflicting and confusing provisions • Remove mandatory requirements for curb and allow curb cuts • Remove requirements for impervious pavement material in driveways • Remove requirement for minimum parking space in transit served areas • Remove requirement to route stormwater to gray system • Create GI guidance documents and manuals • Enact ordinance that requires on-site stormwater retention using GI • Allow rainwater harvesting • Adopt market-based incentives to motivate private landowners • Enact liability transfer ordinance to allow landowners to transfer maintenance liability to a third party licensed by the city ***Governance*** • Establish regional watershed level agencies to facilitate/fund research/education/data collection for ecosystem services • Establish communication and coordination mechanism for government agencies and stakeholders ***Funding mechanisms*** • Establish stormwater fee and allowance trading as revenue sources as well as incentive mechanism, allow off-site mitigation or in-lieu fee • Ensure stable policies such as year fee schedule to tackle uncertainty and motivate private financiers	Barriers, retrofit, policy, governance

			• Create municipal green bonds • Endorse quasi-market mechanism to encourage behavior (incentives, rebates, grants, tradable allowances of discharge, fees/discounts) ***Education and outreach*** • Establish programs to raise public awareness • Have programs in place to train existing staff responsible for stormwater management • Encourage universities, K-12 to offer curriculum research opportunities on GI • Establish award and recognition programs to encourage individual and social capital	
Coleman et al. (2018). From the household to watershed: A cross-scale analysis of residential intention to adopt green stormwater infrastructure. *Landscape and Urban Planning* 180, 195-206.	• The study conducted a statewide survey of Vermont residents (4000 surveys sent out, 577 survey respondents) and spatial analysis to evaluate how differing stormwater contexts, including exposure to site-level runoff, erosion or flooding, perception of neighborhood-level challenges, town-level stormwater regulation, and watershed impairment in rural and urban landscapes may influence residents to adopt GI. • Study also evaluated whether other factors influence decisions between adopting three different GIs: rain garden (bio retention), infiltration trenches and rain barrels.	• 470 survey respondents were geo-located to measure proximity to water urban zones, and residence in impaired watersheds to place decision in hydrologic and spatial locations • Of survey respondents, 54% had experienced at least one erosion, flooding, washout, or stormwater runoff problem • About 1/3 reported experiencing "runoff, erosion, or washouts of driveway or road to your house"; 1/6^{t} reported experiencing "basement flooding." 1/10 reported either "runoff, erosion, or washouts of lawns or gardens," or "flooding on property." • 85% that did not experience on-site problems also did not perceive runoff or flooding to be a problem at the neighborhood scale. • 35% of households with on-site challenges also perceived stormwater and or flooding problems at the neighborhood-scale. • 69% of households that experienced on-site challenges fell in non-urban areas. • More households experienced water-related problems in watersheds with less designated stormwater-impaired waterways. • Use of compost was positively correlated with education level and was negatively correlated to imperviousness. Barriers to adoption were noted by survey responses: • 50% of respondents reported that there was no need for any GI infrastructure • Between 30-49% of respondents reported no interest in GIs (responses varied depending on the specific GI mentioned) • 51% said permeable pavement cost too much, while 30% said rain gardens cost too much • Around 30% of respondents said not enough information to decide • Around 30% of respondents said GI was not suitable on their property • Around 20% said GI was too much maintenance • Around 10% responded that they didn't believe GI works and around 7% responded that GI doesn't look good	• Further investigate barriers to adoption. If respondents replied with "against property rules" as a reason for not adopting, determine what were the norms surrounding these rules and who were the regulatory bodies (homeowner associations, other types of property management). • Research the perceptual differences between how rural and urban households understand what qualifies as "stormwater". • Research why residence in an MS4 municipality emerged as a significant predictor of greater intention to adopt rain gardens. • Implement social marketing strategies that go beyond traditional educational interventions. • Leveraging the power of social norms including the influence of neighbors and community members can be helpful.	Norms, Social-ecological system, Infiltration trenches, Rain gardens
Chaffin et al. (2016). A tale of two rain gardens: Barriers and bridges to adaptive	• This article describes the barriers to applying green infrastructure to stormwater management in Cleveland, Ohio. • Cleveland's stormwater management (SWU) utility in partnership with community development orgs and non-	Plans were reduced due to several barriers: • Lack of single, regional entity stormwater management utility that controls stormwater governance and has jurisdictional latitude such as well as political and financial incentives. • Organizational culture differences (mismatched timeframes, jurisdictional boundaries, expertise) between the sewer district that	• Establish careful, inclusive partner development to create the necessary flexibility and legitimacy of the organizations.	Barriers, community participation, sewer districts, urban area,

management of urban stormwater in Cleveland, Ohio. *Journal of Environmental Management* 183, 431-441.	profits identified sites in downtown Cleveland to implement a larger-scale green infrastructure (GI) project on small, vacant residential parcels in the city. • Initial plans were reduced by city planners to 2 separate, small-scale projects: An SWM-led project of 3 aesthetically-pleasing rain gardens alongside major downtown streets (0.5 ha) and a Cleveland Botanical Garden-led series of 9 rain gardens in vacant residential parcels. • Problem was multiple competing projects instead of integrated partnership approach	understand below-ground sewer management infrastructure and other groups, such as the Cleveland Botanical Garden that understand urban greening and aesthetics. • Green infrastructure is considered a risky investment in vacant land when compared with traditional land uses such as residential or commercial redevelopments; specifically vague cost-benefit analyses of GIs (including ecosystem service benefits) make it difficult to compete with traditional development projects that have well–known financial benefits. • Despite multiple stakeholders working cooperatively to do community engagement for rain garden implementation, the groups did not engage individuals at the household-level: one of the parcels chosen was not well-received by local residents. A rain garden was found destroyed and it was determined that the spot was an informal community sport field for youth of the neighborhood.	• Establish agreed upon goals and a governance structure that legitimizes experimentation, monitoring and feedback into policy. • Find common objectives and incentivize partner organizations to stay engaged in light of more pressing institutional objectives; engage groups that have organizational capacity to partner with and lend legitimacy. • Engage community members to understand neighborhood-scale dynamics such as community spaces, both formally and informally defined including regarding the aesthetics of rain gardens as compared to manicured green spaces. Share information to change community members' minds if needed.	
Gao et al. (2018). Public perception towards river and water conservation practices: Opportunities for implementing urban stormwater management practices *Journal of Environmental Management* 223, 478-488.	• This study performed statistical analyses on four surveys (occurring 2006, 2009, 2014 and 2016) administered to urban residents in the Wabash River watershed in Tippecanoe County, Indiana. • The surveys were administered by Purdue University and aimed to track changes in public perceptions and experiences over time on the following issues: perceptions of water pollution sources, opinions about the environment, practices to improve water quality, attitudes towards the Wabash River, and opinions about urban stormwater management practices (SMPs). • In the region surveyed, since 2017, over 900 rain barrels and 160 rain gardens/bioswales had been installed. • The surveys were all mail surveys; with varying degrees of sample size and response rate: • 2006 survey, response rate of 38% of total surveys mailed out resulted in n=352 • 2009 n=309; response rate of 39% • 2014 n=278; response rate 27% • 2016 n=255; response rate 31.4% • Demographics of the respondents differed from the demographics of the county overall: average age of respondents across all four surveys was 58 vs. 28; 49% male vs. 51%; 49.5% vs 35% had a bachelor's or higher; and homeownership was 83.7% vs 52.5%.	• Respondents of the 2014 survey believed personal actions are important for water quality while respondents of the 2016 survey identified sources of pollution, improper disposal of lawn waste, oils and chemicals, as well as illegal littering as important. • Respondents who were currently using a rain garden on their property were more likely to disagree with the statement ""I don't know a whole lot about what the Wabash [river] provides to our community". • In addition, people who had never heard of rain barrels were more likely to agree with the statement "Even if we clean the Wabash [river], someone else will trash it". • 85% of respondents agreed that rain barrels should be integrated into public spaces and yards because of their functional benefits such as "reduce water use for gardening and landscaping" Environmental benefits such as "are a cost-effective way to manage stormwater" elicited 65% agreement. • Survey respondents who had already installed rain barrels felt they were aesthetically pleasing, were a cost-effective way to manage stormwater, increased property values, did not increase likelihood of bugs and insects and provided sufficient water quality benefits. Respondents who did not own rain barrels expressed negative perceptions of all of the above. • A majority (58%) of respondents agreed that if a user adopted a rain barrel or rain garden they should receive reduced stormwater fees (the cost of treating stormwater runoff on property based on impervious surface) vs. a reduced cost of installation (with a minority of 46% of respondents supporting). • Overall, respondents were more informed of the local watershed, stormwater issues, and individual responsibility in the 2016 survey versus all the earlier surveys. This may because of increased	• As respondents who installed rain barrels and rain garden had more "protective attitudes" towards the river, it is recommended that managers encourage public involvement and reach out to residents through newsletters, neighborhood groups, etc. • Connect residents to a local river to encourage understanding of water-related issues and engage residents in environmental stewardship activities. • Demonstration of BMPs in public places (such as a rain garden near a public walking path) is also recommended to encourage awareness and increased attachment. • The functional benefits of GI, such as economic savings, should also be emphasized as these values were perceived to be more beneficial than environmental benefits. • As respondents were more in favor of reduced stormwater fees than subsidized GI systems, recommended to reduce household stormwater fees as an incentive to promote increased adoption. • Cognitive barriers exist for those who have not adopted stormwater management practices, so education campaigns and demonstrations can help to sway non-adopters. Adopters can be leveraged as they are more likely to be engaged with the community and share that information with non-adopters.	Survey, attitudes, cognitive barriers, stormwater management practices,

		awareness of river revitalization campaigns and education outreach programs over time. • Residents perceived rain gardens to be more cost-effective than rain barrels, especially as rain garden added more aesthetic benefits than rain barrels. • Respondents who were currently using rain gardens on their property, perceived reduced basement flooding and increased property values as important benefits. • Residents who have installed SMPs are more engaged with their community (this study and Gao et al 2016).		
Cettner et al. (2014). Assessing receptivity for change in urban stormwater management and contexts for action. *Journal of Environmental Management*, 146, 29-41.	• This study administered a 28 question on-line questionnaire designed to get a picture of Swedish municipalities' receptivity for a change towards sustainable stormwater management (SWM) from traditional stormwater management. The questionnaire asked information about the respondents and their work experience, their perceptions of stormwater management in urban planning and practice, perceptions about drivers and barriers for an accelerated change process. • The questionnaire was administered to 1300 municipal officials and officials with managerial positions in April and June 2011, representing 5 municipal departments within 290 Swedish municipalities. • Of the respondents, a smaller working group (n=319) was interviewed that represented the most relevant professional backgrounds. This was comprised of 50% engineers, 30% planners and architects and 20% environmental officials.	• 73-84% of the respondents from the interest groups Implementation of SWM alternatives would be very effective or effective if stormwater was supported by a stormwater strategy and integrated into the planning process • 79% from water, 68% from planning and 63% from the environmental group indicated that they were committed to a change process around traditional stormwater but that leadership was too department-oriented to be effective. • 40-44% of the interest group respondents believe that experimenting with solutions was very important indicating a knowledge of the risk of failure. • 34-40% of working group respondents indicated that extreme events (floods or pollution from discharges) and a political decision (29-46%) were strong potential drivers that could trigger change. • 30% felt that legislation neither supported nor prevented the implementation of sustainable stormwater solutions but 27% of respondents indicated that legislation was a driver. • 36-43% of respondents felt that existing water system infrastructure was a barrier but 18-23% felt that it was neither a driver nor a barrier. • 33-41% of respondents felt that construction costs were seen as a barrier and 27-42% felt that operation and maintenance costs were. • 25-38% saw technical feasibility as a barrier • 25-45% of the respondents felt that the planning department was responsible for stormwater in the planning process, while 24-36% thought water department was. • Respondents indicated that policy, leadership, culture and simplicity of goals were significant factors associated for action.	• The study found that the professionals interviewed were professionally prepared by not practically prepared for action – they were missing level or political, organizational, scientific and community support. Providing support for professionals in this capacity was recommended. • Progress is being made in a supporting culture, consensus of key priorities for action, a vision, but an agenda to change to GI must be supported by political decisions, respondents felt. Supporting political decisions was recommended by the professionals. • Respondents felt that policies, organization, commitment and responsibility were all collectively needed for change to SWM practices – ensuring that these work cooperatively will help to change SWM practices.	Survey, municipality, stormwater planners, Sustainable urban
BenDor et al. (2018). Ecosystem services and U.S. stormwater planning: An approach for improving urban stormwater decisions *Environmental Science & Policy* 88, 92-103.	• This study proposed that ecosystem services-based evaluations can integrate a broader set of social and biophysical factors than traditional evaluations allow, can identify new opportunities and constraints for reducing storm flow volume and the delivery of contaminants to downstream ecosystems. Adopting an ecosystem services (ES) framework can be used to evaluate the value of integrating green infrastructure (GI) into existing stormwater systems. • Authors examined two case studies – one in Durham, North Carolina and one in Portland, Oregon to examine how ES can change the	• In some cases GI solutions can represent win-win outcomes for improving ecosystem services outcomes and provide net benefit to society • Economic uncertainties around GI capacity and maintenance, resistance to collaboration across city governance, increasingly inflexible financing, accounting practices that do not incorporate the multiple values of GI, and difficulties in incorporating ecological infrastructure into stormwater management are barriers to GI adoption	Instead of recommendations, this study identified research needs for ES-based assessments of GI moving forward. • Determine how networks of GI across different scales interact, particularly GI in different political boundaries that operate in the same hydrologic boundaries. • Conduct research to determine different effectiveness of GI in high-density developments vs. low-density sprawl environments. • Create methods that balance the information needs of an ES approach with the cost and capacity of stormwater managers and urban planning processes. Develop ecosystem service tradeoffs that can be readily understood and digested by practicing planners particularly through open-access online resources.	Ecosystem services, Stormwater planning,

	evaluation of benefits gained from these stormwater infrastructure scenarios. • In Durham, agencies led a participatory process and evaluated different scenarios incorporating values of communities members with the city voluntarily adopted GI. • In Portland, the city adopted a 20-year plan (in 2013) and put in place a fully integrated green- and gray-infrastructure system. The project did not involve public participation nor included community members' values as the city was forced to install improvements because of litigation regarding overflow of untreated stormwater.		• Use methods developed by economists and decision scientists and adapt for use in urban planning and make stormwater planning participatory by design and require it • Develop suite of tools to evaluate connections between biophysical service productions and community values. For example, connect flood reduction (direct community value) with GI's other benefits such as expanding green space, slowing traffic, expanding non-human habitat, and educate the community of these value adds.	