Stormwater Action Monitoring 2024 Annual Report

This is the tenth annual report from the Washington State Department of Ecology (Ecology) on implementation of Stormwater Action Monitoring (SAM), a collaborative program funded by more than 100 Western & Eastern Washington cities and counties, the ports of Seattle and Tacoma, and the Washington State Department of Transportation (WSDOT). Ecology manages SAM's revenues, expenditures, agreements, and communication of findings.

Stormwater Action Monitoring (SAM) is the regional cooperative stormwater monitoring option in the municipal stormwater permits.

SAM is the alternative to outfall monitoring in the permits.

The SAM program funds projects to improve stormwater management, reduce pollution, improve water quality, and reduce flooding. The projects do this by measuring stormwater impacts on the environment, evaluating the effectiveness of stormwater management techniques, and suggesting changes to the stormwater manuals, local practices, and permit requirements. SAM projects also build tools, techniques, and resources for permittees.

All jurisdictions, large and small, can benefit from SAM projects by using findings to protect local lakes, rivers, streams, wetlands, and estuaies.

https://ecology.wa.gov/SAM

Highlights for 2024

The SAM Program celebrated its 10-year anniversary in 2024!

In September, Raghu Namburi was hired as the new SAM Program Coordinator & Engineer.

Ecology's permitting team reissued Municipal Separate Storm Sewer Systems (MS4) Phase 1 and 2 permits for Western Washington and Phase 2 permits for Eastern Washington. For the first time, Eastern Washington MS4 Phase 2 communities could opt into the SAM Program—19 of the 25 jurisdictions joined the SAM program.

All Western Washington permittees from the previous cycle (2019-2024) recommitted for the 2024-2029 cycle, reaffirming the program's value.

Several new best management practice effectiveness studies were contracted in 2024. Learn more about these studies and access project websites in the Effectiveness Studies section.

SAM also committed to another five years of trend monitoring in the Puget Sound and Lower Columbia River Basin.

Program Management

Stormwater Work Group (SWG)

SWG meets quarterly to implement, improve, and expand the regional stormwater monitoring program. The group strives for consensus around a cooperative program that leverages existing programs, scientific expertise, and other capacity to improve our understanding of stormwater impacts and evaluate the effectiveness of stormwater management actions.

In 2025, SWG and SAM will initiate the planning process for soliciting a fifth round of stormwater research studies. The selection process will be completed in 2026. Permittees and SWG members play a key role in this process by reviewing proposals, providing input, and helping determine which studies should receive funding. Those interested in participating are encouraged to get involved and share their perspectives.

The SWG welcomes participation on the group's subcommittees and caucuses. All meetings are open to the public. See the SWG website[1].

What is the connection between SAM and the SWG?

The SWG sets priorities and oversees the budget for SAM. All SAM projects are selected and approved by the SWG. The SWG makes recommendations to support SAM implementation and other stormwater-related monitoring.

Permittees fund SAM. Permittees, state and federal agencies, and universities all provide leadership on SAM projects. Ecology serves as the administrative entity that manages expenditures of funds to implement SAM.

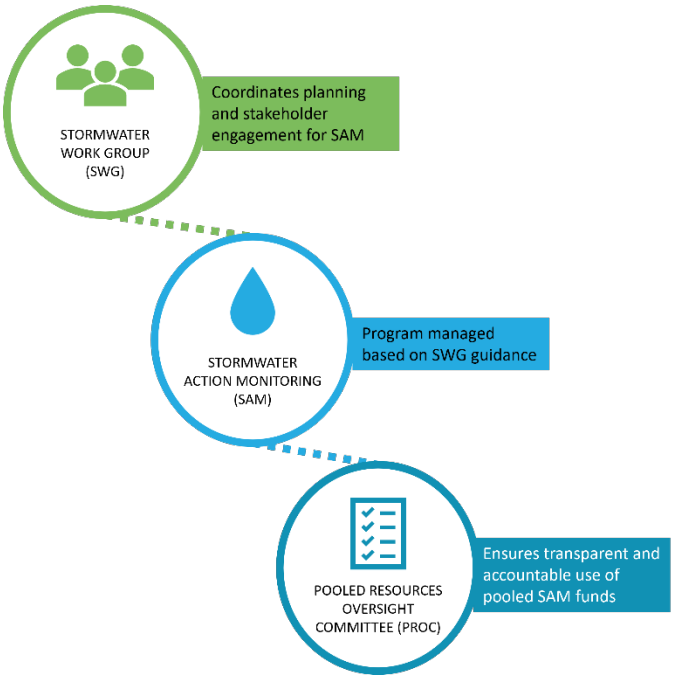
The Pooled Resources Oversight Committee (PRO-C) is a subgroup of SWG and oversees SAM project scopes, schedules, budgets, and SAM contracting decisions. PRO-C also provides review and recommendations to the SWG on Ecology's administration of the SAM. Both the SWG and PRO-C are formal committees whose members represent stakeholder groups.

Who makes up SAM?

SAM receives annual revenue from Cities, Counties, Ports, WSDOT and the US Navy via an option in the NPDES Municipal stormwater permits.

Western Cities: Aberdeen, Algona, Anacortes, Arlington, Auburn, Bainbridge Island, Battle Ground, Bellevue, Bellingham, Black Diamond, Bonney Lake, Bothell, Bremerton, Brier, Buckley, Burien, Burlington, Camas, Centralia, Clyde Hill, Covington, Des Moines, DuPont, Duvall, Edgewood, Edmonds, Enumclaw, Everett, Federal Way, Ferndale, Fife, Fircrest, Gig Harbor, Granite Falls, Issaquah, Kelso, Kenmore, Kent, Kirkland, Lacey, Lake Forest Park, Lake Stevens, Lakewood, Longview, Lynden, Lynnwood, Maple Valley, Marysville, Medina, Mercer Island, Mill Creek, Milton, Monroe, Mount Vernon, Mountlake Terrace, Mukilteo, Newcastle, Normandy Park, Oak Harbor, Olympia, Orting, Pacific, Port Angeles, Port Orchard, Poulsbo, Puyallup, Redmond, Renton, Sammamish, SeaTac, Seattle, Sedro-Woolley, Shoreline, Snohomish, Snoqualmie, Steilacoom, Sumner, Tacoma, Tukwila, Tumwater, University Place, Vancouver, Washougal, Woodinville.
Western Counties: Clark, Cowlitz, King, Kitsap, Pierce, Skagit, Snohomish, Thurston, Whatcom.
Eastern Cities: College Place, Ellensburg, Kennewick, Moses Lake, Pasco, Pullman, Richland, Selah, Shelton, Spokane, Spokane Valley, Sunnyside, Union Gap, Walla Walla, West Richland, Yakima
Eastern Counties: Spokane, Walla Walla, Yakima
Ports: Tacoma and Seattle.
Agencies: Washington Department of Transportation and the United States Navy.

In-kind funds have been received from Washington Departments of Ecology, Agriculture, and Fish and Wildlife, the United States Geological Survey, Penn Cove Shellfish, and Cedar Grove Composting.

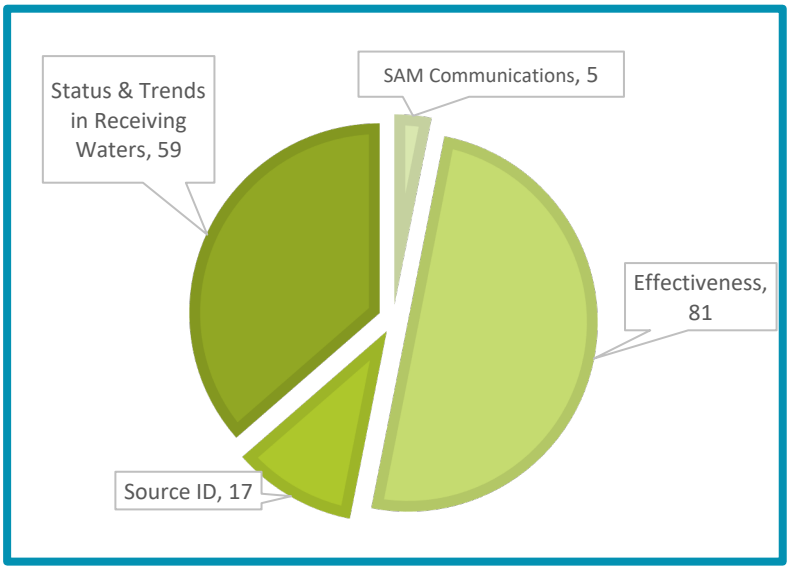


[1]https://sites.google.com/site/pugetsoundstormwaterworkgroup/

Administration

Contracts and Agreements

Since 2014, SAM staff with assistance from Ecology's fiscal, management, and contracts sections have processed about 160 contracting actions. Actions include initiating new contracts, making amendments, and closing completed contracts. In 2024, three contracts were completed and closed out, five were amended, and two new contracts were signed. We continue to build in contingencies, time to hire subcontractors, and time to incorporate review processes that are expected by technical committees and Ecology's SAM staff to minimize the high rate of amendments.



Status & Trend Studies of Receiving Waters

Are conditions in receiving waters getting better or worse?

SAM is assessing the impacts of stormwater runoff in urban and urbanizing areas in the Puget Sound and Lower Columbia River watersheds. These studies are long-term and active each year. Reports completed in 2024 are showcased in the blue boxes.

Puget Sound Basin Studies

Stormwater managers know that effective and lasting improvements to infrastructure, best management practices, and changing behaviors of Puget Sound residents takes time. Long-term monitoring of key environments help us determine if conditions are getting better in the areas adjacent to urban areas. Two receiving waters studies cover the Puget Sound watershed. Each study monitors 33 randomly selected sites from across four levels of impervious cover and two reference sites.

- **Puget Small Streams (PSS):** U.S. Geological Survey (USGS) leads the small urban streams assessment for SAM. Monitoring includes water, sediment, macroinvertebrate sampling and physical habitat assessment. Water level and temperature using sensors are monitored continuously throughout the year. The annual reports for water year 2020 was publishing in early 2024. The 2021 and 2022 reports are expected in Spring 2025. A new agreement to continue monitoring thru 2030 was signed in February 2025.
- **Puget Sound Nearshore Mussels:** Washington Department of Fish and Wildlife (WDFW) leads the biannual nearshore mussel assessment for SAM. WDFW published findings from their 2020/2021 survey in November 2024. See the blue box for details. Preparations for the next survey began in 2023 and mussel were deployed at 33 new sites from November through February. The findings from the 2023/2024 survey are expected to be published in summer 2025. A new agreement to continue monitoring thru 2030 was signed in February 2025.

Lower Columbia River Study

The Lower Columbia Urban Streams (LCUS) study monitors small urban streams in Clark and Cowlitz counties. The LCUS study design includes trend sites that will be monitored yearly and status sites that will be sampled at five-year intervals. Trend analyses will be conducted every five years.

- Clark County leads this streams assessment for SAM. Monitoring includes water, sediment, macroinvertebrate sampling and physical habitat assessment. Water level and temp erature using sensors are monitored continuously throughout the year. Clark County completed the fourth round of sampling in 2024. They also published a report of their findings from water year 2023. See the blue box below for details. The agreement was extended to continue monitoring thru 2029.

2021/22 Nearshore Mussel Monitoring Findings

Biannual Report, November 2024[2]

Like prior survey years, the most abundant organic contaminants detected in mussels of the Puget Sound nearshore are:

- polycyclic aromatic hydrocarbons (as Σ16PAH)
- polychlorinated biphenyls (as total PCBs)
- polybrominated diphenyl ethers (as Σ11PBDEs)
- dichlorodiphenyltrichloroethane and its metabolites (as Σ6DDTs).

All metals tested (arsenic, cadmium, copper, lead, mercury, zinc) continue to be frequently detected in mussels.

Estimates of the spatial extent of mussel tissue contamination in the Puget Lowland ecoregion indicate that most of the Puget Sound nearshore length (approximately 50-90%) had low concentrations of Σ16PAHs, total PCBs, Σ11PBDEs, and Σ6DDTs, and less than approximately 5% of the nearshore length had high concentrations. Similarly, for most of the metals (cadmium, copper, lead, mercury, zinc), a small proportion (approximately 0-10%) of the nearshore length had concentrations considered high.

Puget Sound's water quality is impacted by many different discharges beyond stormwater. SAM focuses on the nearshore as the most likely aspect of the marine environment for stormwater impacts to be measured and tracked, especially as the region expands existing and new development. We will continue this long-term status and trends monitoring of the marine nearshore to evaluate whether and how stormwater discharge and the stormwater management actions implemented in the region correlate to nearshore biota contaminant levels. An in-depth trend analysis is planned for 2025.

2023 Lower Columbia Urban Streams Findings

Annual Report, August 2024[3]

Clark County continued stream monitoring in the Lower Columbia River Basin for water year 2023 (October 2022–September 2023) to assess stream health using multiple indicators.
Five sites are monitored annually, while three rotate on a five-year cycle. Key findings from the eight monitored sites include:

- **Flow & Temperature:** All sites met flow criteria for salmon use, but none met temperature standards. Flow is assessed using continuous stage measurements as a surrogate.
- **Biological Health:** Benthic Index of Biotic Integrity (BIBI) scores declined in subwatersheds with more impervious surfaces and higher traffic, reinforcing previous findings that stormwater pollution from roads significantly impacts streams.
- **Sediment Quality:** Metal concentrations in stream sediments were below cleanup standards.

This long-term study will help classify streams as good, fair, or poor. Every five years, trend analyses and risk assessments will identify key stressors affecting stream health.

[2] https://wdfw.wa.gov/publications/02544

[3] https://apps.ecology.wa.gov/publications/SummaryPages/2410050.html

Source Identification Projects

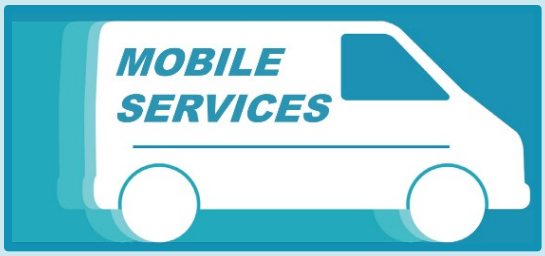
What are the common sources of illicit discharges and best ways to reduce them?

SAM Source Identification projects identify common problems and propose regional actions on source control to prevent transport of pollutants in stormwater. One project was active at the beginning of 2024 and finished in Spring 2024.

Mobile business stormwater source control and coordination

SAM Fact Sheet 32, May 2024[4]

Some mobile businesses have unique pollution prevention challenges due to their mobile nature. Stormwater permittees are faced with how to identify and inspect mobile businesses that may operate both within and outside of the permittee's jurisdiction. Good source control efforts address business activities where they occur, and this study helps expand and deepen the resources and guidance available for permittees and mobile businesses in Washington.



King County and consultants worked with the WA Department of Revenue to pull business listing information to help jurisdictions identify mobile business types from business licensing data. They developed resources for identifying and providing technical assistance to mobile businesses for stormwater source control. These resources were tested in a pilot program in southern King County.

Mobile business stormwater source control resources available include:

- Software tool for searching keywords in business licenses lists and identifying likely mobile businesses of interest to stormwater.
- Best Practices Guidance for municipal source control efforts with mobile businesses.
- Compilation of 27 existing outreach materials for mobile business types and activities from cities in Washington and other states.
- New outreach brochures developed for three mobile business types: mobile automobile repair; commercial landscaping; and pressure washing.
- Compilation of 26 best management practices (BMPs) for mobile business types and activities from leading stormwater management manuals in western Washington.

These resources are available from the project website at www.ecy.wa.gov/sam

[4] https://apps.ecology.wa.gov/publications/documents/2510032.pdf

Effectiveness Studies

How well are required or innovative stormwater management practices working?

SAM is measuring the effectiveness of BMPs and stormwater management actions to reduce negative hydrologic impacts and the discharge of pollutants to receiving waters. Bulleted studies were active in 2024 and completed SAM projects are shown in the blue boxes.

- **Paired watershed retrofit and restoration:** The City of Redmond's paired watershed study of retrofitted and restored watersheds is now in year 9 of 10. Water year 2025 will mark the final year of monitoring for this long-term study. The Annual Report for water year 2023 was published in late 2024. In 2025, results from the interim Trend Analysis Report (2016-2023) will be available. The final Trend Analysis Report, covering the full dataset from 2016-2025, is expected by the end of 2026.
- **Evaluation of BMP Maintenance:** The City of Bellevue evaluated maintenance thresholds and conditions for ponds, vaults, trenches, and tanks using a permittee survey and literature review. Preliminary findings were published in two memos in 2023. In 2025, a white paper will synthesize these findings and provide recommendations for optimizing BMP maintenance to improve environmental outcomes and meet permit requirements.
- **Longevity of bioretention soil mix for toxicity reduction:** Washington State University (WSU) continues to evaluate the effectiveness of the standard 60:40 bioretention soil mix in reducing coho salmon toxicity. Ecology extended research for three additional water years to analyze coho toxicity and quantify the emergent contaminant 6PPDQ. Findings are expected in summer 2025.
- **Bioretention effectiveness for 6PPDQ and PFAS:** King County, in collaboration with Whatcom County, launched a new study assessing a full-scale bioretention facility's ability to reduce 6PPD-quinone and PFAS in stormwater. The media in the facility is the high-performance bioretention soil mix developed in an earlier SAM study. Research will continue through 2026.
- **Characterization of Stormwater Transport of Contaminants of Emerging Concern:** The City of Tacoma, in partnership with Western Washington collaborators, initiated a study to characterize stormwater and sediment concentrations and compare results to prior Phase I permit monitoring as well as gather data on Contaminants of Emerging Concern (CEC). The study includes 16 sites spanning four land use types: Industrial, Commercial, High-Density Residential, and Low-Density Residential. This project will continue through 2027.
- **Measuring Street Sweeping 6PPDQ Whole Environment Load Reductions:** Seattle Public Utilities began a new study in 2024 to assess street sweeping's effectiveness in reducing tire wear pollutants, including 6PPD-quinone, on roadways. Findings from this research will inform permittees and Ecology on how to enhance street sweeping programs to better mitigate stormwater impacts. This project will continue through December 2028.

Hydrologic performance of the oldest bioretention

SAM Fact Sheet #33, July 2024[5]

The City of Olympia and consultants evaluated the infiltration rates of 50 older bioretention facilities in Washington State to identify key design factors and maintenance insights.

The results reinforced findings from two previous bioretention performance studies and confirmed that infiltration rates remain high over time. Underdrained sites generally exhibited higher infiltration rates than typical sites. Additionally, plant species in the facilities have shifted from those adapted to wetter conditions, as originally planned, to species better suited for drier conditions.

Maintenance staff surveys showed that most facilities were serviced 1–4 times per year, though some required more frequent upkeep (1–2 times per month). Common maintenance activities included trimming vegetation and removing debris.

These findings provide stormwater managers with evidence that early-generation bioretention facilities effectively manage runoff as intended. For future designs, site-specific infiltration data should guide planning, and plant selections should emphasize drought tolerance

Ditch Maintenance for water quality study

SAM Fact Sheet #34, July 2024[6]

Roadside ditches convey stormwater, but erosion and sediment transport can degrade water quality. Maintenance and vegetation choices offer an opportunity to stabilize ditch banks and reduce pollutant runoff.

Washington State University tested several plant mixes to quickly establish vegetation after maintenance or regrading. The ideal plants outcompete invasive species while remaining low-growing to minimize mowing and upkeep.

The study provides six recommended plant blends tailored to ditch conditions, including sun exposure, disturbance level, and soil moisture.

[5] https://apps.ecology.wa.gov/publications/documents/2510030.pdf
[6] https://apps.ecology.wa.gov/publications/documents/2510031.pdf

SAM's 2024 Communications

The SAM program website[7] serves as a central hub for project information and program administration. Each active study is granted its own project page, ensuring that detailed and up-to-date information is readily accessible. When completed, projects are concisely summarized in the website's accordion sections—find them under Effectiveness Studies, Source Identification, and Status and Trends. The SAM webpages are filled with stormwater resources, including factsheets, comprehensive final reports, educational presentations, and informative videos.

Additionally, the website hosts our regular newsletters and a compilation booklet of studies conducted between 2013-2019. We're working on the second compilation booklet for studies conducted between 2019-2024 and are excited to unveil it in 2025!

Meet our new coordinator, Raghu Namburi!

In September, we were excited to welcome Raghu Namburi as our new SAM Coordinator! A licensed engineer with experience at both the Oregon Department of Environmental Quality and the Oregon Department of Transportation, Raghu brings a strong technical background in stormwater management. He's passionate about building relationships and supporting permittees in navigating their requirements to protect water quality.

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- **STORMWATER-ACTION-MONITORING**: a newsletter announcing SAM study findings and upcoming workshops.
- **STORMWATER-WORK-GROUP**: meeting agendas, materials, summaries, and announcements related to SWG.

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[7] http://www.ecology.wa.gov/sam

[8] https://ecology.wa.gov/About-us/Who-we-are/News/Email-lists