

Stormwater Action Monitoring

2021 Annual Report

June 2022



This is the seventh annual report from the Washington State Department of Ecology (Ecology) on implementation of Stormwater Action Monitoring (SAM), a collaborative program funded by more than 90 Western 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 Puget Sound.

<https://ecology.wa.gov/SAM>

Highlights for 2021:

While continuing to work remotely, we were able to begin work on many of the Stormwater Work Group (SWG) approved SAM projects that came out of the Round 3 Study selection process in 2020.

Many active SAM projects contracts were modified to add time for completion due to delays from the global pandemic.

Field work was still accomplished but more slowly this year for the streams, mussels, and few of the effectiveness studies. Laboratory analyses were delayed for projects with samples, which in turn delayed analysis of results. Most of the contracts needed time extensions to complete the project. Some of the effectiveness studies were able to adapt to remote work, such as those conducting surveys, workshops and trainings last year were able to use virtual platforms.

New SAM projects from the Round 3 workshops started.

By the year's end, we contracted for five of the new SWG approved projects. Each active SAM project gets its own webpage so that Permittees can easily follow along their own progress and use deliverables for their own jurisdictions updates or discuss in regional meetings. Each new project is discussed in this report.

Looking ahead.

Next year, we will reach the midway point of the permit cycle and will need to begin planning for the Round 4 study solicitation, conduct our mid-cycle performance audit (also known as the report card) with the Pooled Resources Oversight Committee (PRO-C).

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Program Management

Stormwater Work Group

The Stormwater Work Group (SWG) scale is larger, but participates in the Puget Sound Ecosystem Monitoring Program (PSEMP). SWG is a coalition of representatives of local, state, and federal governments, environmental and business organizations, public ports, tribes, and agriculture. SWG formed in 2008 to develop a strategic, coordinated, and integrated approach for monitoring municipal stormwater in Western Washington and evaluating effectiveness of stormwater practices and management activities.

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

<https://sites.google.com/site/pugetsoundstormwaterworkgroup/>

What is the connection between SAM and the SWG?

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

Permittees, state and federal agencies, and university faculty provide funding and/or leadership on SAM projects. Ecology serves as the administrative entity that manages SAM funds and executes SAM contracts.

The Pooled Resources Oversight Committee (PRO-C), a subgroup of SWG, oversees Ecology's administration of SAM. The PRO-C approves all SAM contracting decisions and spending and also reviews each project scopes of work and amendments. Both the SWG and PRO-C are formal committees whose members represent stakeholder groups.

Communications

SAM funded projects were featured at MuniCon, Green Stormwater Infrastructure Summit, local, APWA stormwater managers meetings, PSEMP Freshwater and Toxics workgroup and other meetings in 2021.

Ecology is now using GovDelivery as our mass emailing software for the SAM newsletter as well as SWG email lists. All contacts were transferred from Listserv. See back page of updated subscription information.

Ecology maintains approximately 20 webpages for SAM communication and transparency. Individual project pages exist for each of the active SAM studies. Completed projects are summarized, in the accordions, under Effectiveness Studies Source Identification and Status and Trends. SAM communication includes factsheets, SAM newsletters, SAM booklet of completed studies in 2013-2019 and multiple SAM educational videos.

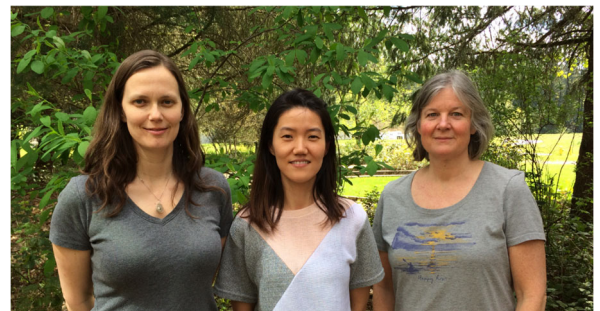
Special accommodations

To request materials in a format for the visually impaired, visit <https://ecology.wa.gov/accessibility>, or call Ecology at (360) 407-6600, Relay Service 711, or TTY (877) 833-6341.

Staff

Ecology is committed to the success of SAM and continues to fund staff for the SWG to ensure a forum for stakeholder input on monitoring, and a process to work together to set priorities for SAM studies as part of the municipal stormwater general permits.

SAM staff (Brandi and Keunyea) manage the program at Ecology and work with project leads to develop detailed scopes of work, review deliverables, approve project invoices, and maintain the website for transparency to permittees and stakeholders. SWG staff (Karen) manage the SWG processes and subgroups.



Brandi Lubliner, SAM Coordinator; Keunyea Song, SAM Scientist; and Karen Dinicola, SWG Project Manager. Not pictured Emma Trewwhitt, SWG Coordinator

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Administration

Contracting timeline for new SAM Projects

In November 2020, Ecology received the following eight new SWG approved SAM Effectiveness Studies and Source ID projects from the Round 3 Study Solicitation. Progress was made on five of them in 2021.

Two new [SAM Source Identification Projects](#)

- Developing and refining source control inspection programs for businesses
- Mobile businesses, illicit discharges, and multi-jurisdiction coordination

Three new [SAM Effectiveness Studies](#)

- Guidance for evaluating the effectiveness of public education and outreach programs
- The role of ditches in pollutant management and how cleaning impacts their biogeochemical function
- Stormwater BMPs maintenance conditions evaluation

Remaining Round 3 projects start in 2022 as SAM staff capacity is available

- Tools and strategies to determine the most effective BMP depending on pollutant type and source
- Evaluation of the influence of bioretention soil infiltration performance rate and safety factors on facility sizing and maintenance
- Replacement and lifecycle costs of permeable pavements compared with conventional pavements

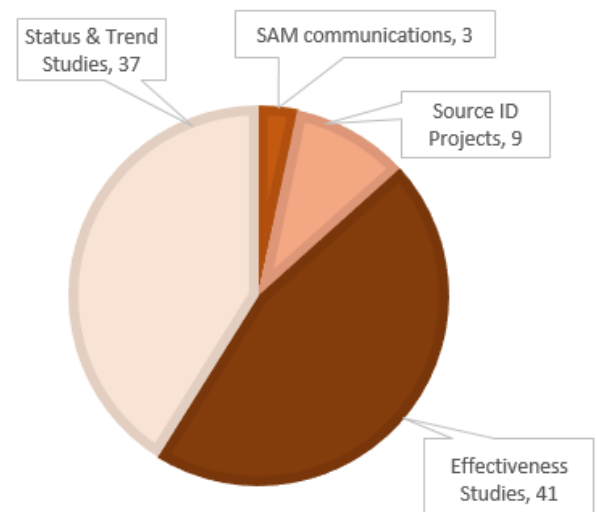
Contracts and Agreements

By the close of 2021, a total of 52 unique contracts have been made to accomplish SAM funded work. Adding to this number the amendments brings the total number of contracting actions for SAM projects since 2014 to 90, as shown in the pie chart.

Many of SAM's contracts seek amendments. Sampling projects often have delays due to weather or site conditions. We are learning that the study leads need assistance early on to understand where to build in contingencies, time to hire sub-contractors, and time to incorporate review processes that are expected by technical committees and Ecology's SAM staff.

Also as noted earlier, the global COVID pandemic also caused many interruptions, delays, or we simply needed to change the contracted projects deliverables, particularly in 2020 and 2021.

**NUMBER OF CONTRACTING ACTIONS
SINCE 2014**

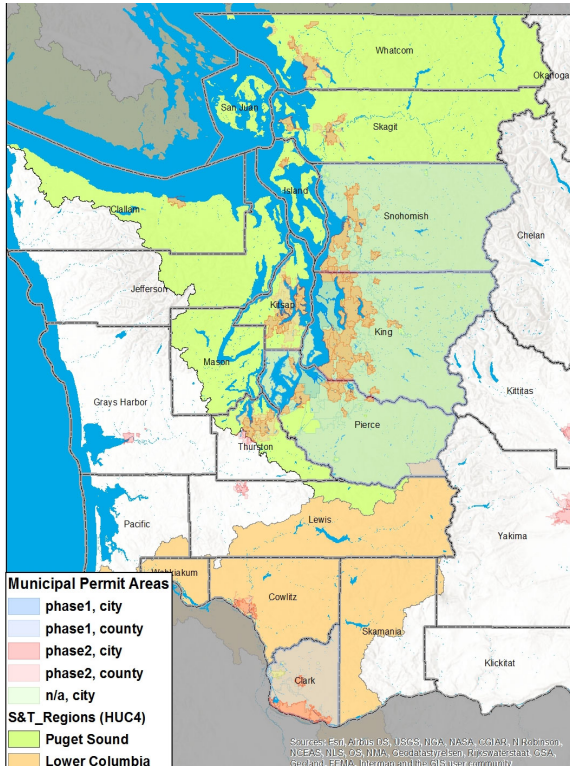
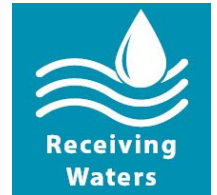


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Receiving Water Status & Trends

Are conditions in receiving waters getting better or worse?

SAM is monitoring and assessing the impacts of stormwater runoff in urban and urbanizing areas in the Puget Sound nearshore and small stream environments in both Puget Sound and Lower



Two receiving water status and trends monitoring regions: Watersheds of Puget Sound and Lower Columbia River

Puget Sound Study Design

Both long-term studies are now operating under the updated study designs. Improvements monitoring efficiency and statistical power.

Key study design details include:

- 1) the study frame to be the entire Puget Lowland watershed for both streams and nearshore studies,
- 2) stratification of sites by percent impervious cover of sub-watershed into four categories,
- 3) sampling at 33 randomly selected sites and two reference sites, and
- 4) annual sampling for streams and biannual for nearshore study.

◆ Puget Small Streams (PSS)

U.S. Geological Survey (USGS) successfully completed summer field monitoring at 33 urban gradient sites and two reference (least-disturbed) sites suc-



cessfully. This was the second year using the updated study design.

Monitoring includes water, sediment, macroinvertebrate sampling and physical habitat assessment. Water level and temperature using sensors were monitored continuously throughout the year. As PSS sampling is done annually, reconnaissance of sites for next water year sampling was completed in fall. Restrictions related to the pandemic continued to impact field work, chemical analysis, and reporting. The annual report for water year 2020 due in November 2021 will now likely be published in mid-2022.



◆ Puget Sound Nearshore Mussels

Washington Department of Fish and Wildlife (WDFW) continues to lead the study to assess chemical contamination using caged mussels in Puget Sound nearshore.

WDFW successfully transitioned this year to implement the updated study design, and completed cage deployment in November 2021. The deployed cages will be retrieved in February of 2022.

The final report summarizing trends of last three sampling events using the old design and the annual status deliverable have been delayed due to slowed laboratory analysis. They are both anticipated in mid-2022.

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Lower Columbia River Study Design

The Lower Columbia Urban Streams (LCUS) study to sample annually at 22 urban streams in the Phase I and II permittee jurisdictions in the county. Five sites visited annually and the remaining 17 sites are monitored once within five year cycle under a rotating panel design. Continuous measurements of water conductivity, temperature and water level are made. Samples for sediment chemistry, macroinvertebrate sampling and physical habitat assessment are collected only during the summer following the watershed health protocols.

Clark county leads the study in partnership with Cowlitz Counties, Cities of Battle Ground, Camas, Kelso, Longview, Vancouver, and Washougal, and the Washington State Department of Transportation.

♦ Lower Columbia Urban Streams (LCUS)

Clark County completed the first summer sampling in 2021 successfully. As LCUS sampling is done annually, reconnaissance of sites and sensors deployment for next water year sampling was completed in fall. The first annual report is due in winter 2022.



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. The following studies were active in 2021. Completed SAM projects are shown in the blue boxes. Two effectiveness studies were completed in 2021. All final reports, scopes of work, and other key deliverables are available on the SAM websites under completed studies. SAM staff and the study lead co-author a two-page fact sheet for each final report.



- ♦ **Longevity of bioretention soil mix for toxicity reduction:** WSC is evaluating how long the default 60:40 bioretention soil media can prevent acute toxicity to coho salmon. The original contract with USFWS was terminated in December 2020, and WSC (former subcontractor) continues the study under a new contract approved in 2021.

Stormwater runoff is collected from a busy urban road site and applied to the experimental columns containing three different media depths (6, 12, and 18 inch) of bioretention soil media. Runoff is applied at an accelerated rate to simulate 10 water years in only three calendar years. Juvenile coho salmon are exposed to the treated effluent and impacts assessed. To date all three depths are preventing toxicity.

In 2021, the contract was amended to test for 6PPD-quinone as one of water quality parameters in the runoff influent and effluent of bioretention media in the column study. Analysis of all the frozen water samples for 6PPD-quinone and the final report are expected in 2022.



Photos: Stormwater runoff is pumped from a 250-gallon stainless steel tank to the experimental bioretention columns. After the 24-h dosing period, influent and effluent waters are subsampled for analyses (up). Juvenile coho salmon are exposed to stormwater and bioretention-treated effluent for toxicity test (down). The photos taken by Jason Berg at WSC.

Effectiveness Studies (cont'd)

Oyster Shell Retrofits for Water Quality

SAM Fact Sheet #24, June 2021

King County partnered with the City of Mercer Island and Port of Seattle to evaluate whether oyster shells retrofitted into stormwater catch basins can decrease dissolved metal concentrations and reduce runoff toxicity. Previous studies showed success with using oyster shell at a parking lot and individual building site scale. This study aimed to test this same approach but at a larger scale with more flow.

Water quality of runoff from two catch basins each fitted with two cubic feet of oyster shells was compared to two control catch basins without oyster shells. The oyster shell fitted catch basins did not improve water quality in this study, and the study was halted. The authors reasoned there was insufficient oyster shell material in the catch basin to treat larger amount of stormwater flows.



The ratio was 12 gallon per minute (gpm) of runoff/1ft³ oyster-shells for this study which was substantially higher than the previous study's ratio of 3 gpm runoff/1ft³ oyster-shell. The higher flows are believed to overwhelm the oyster-shell media. Oyster-shells are still believed to be effective for metal reduction if a sufficient volume of treatment media to stormwater flow ratio is used.

♦ ***Hydrologic benefit of individual trees:***

Washington Department of Natural Resources and Washington Stormwater Center (WSC) are quantifying the hydrologic benefits of retaining trees during development. Sensors are monitoring water transpired, through fall, and other hydrologic components of individual native evergreen and deciduous trees at two locations in Western Washington.

First phase of the study monitored 64 mature trees (Douglas fir, western red cedar, big leaf maple and red alder). They presented results to SWG in November, the two evergreen species can transpire and intercept over half the total rainfall. The final report will be published in early 2022.



The second phase of the study monitoring younger trees was approved by SWG in November. This will be managed as a new contract in Ecology.

♦ ***Orifice control of bioretention for water quality treatment:***

Washington State University (WSU) is evaluating the impacts of small orifice as part of a bioretention underdrain system on water quality and quantity performance improvements.

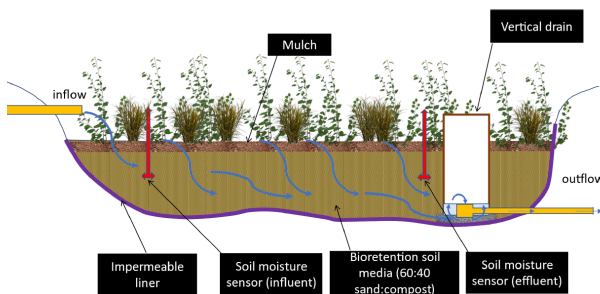


First phase of the study focusing on monitoring was completed and presented to SWG this year. In second phase, stage-storage-discharge (SSD) relationships will be developed for bioretention with small orifice in WWHM and used to assess long term runoff volume reduction and to estimate pollutant loading reductions. The report is expected in December 2022.

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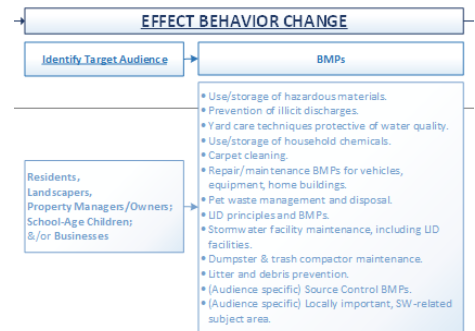
Effectiveness Studies (cont'd)

- ♦ **Watershed scale retrofit and restoration:** The City of Redmond paired watershed study is in year 6 of 10. Annual status reports are completed for this BMP effectiveness study.
- ♦ **Mulch choices for bioretention:** WSC is wrapping up the study on 3 types of mulch (2 kinds of bark and wood chips) to provide better water retention, contaminant capture, and weed prevention in bioretention facilities. The final report is anticipated mid-2021.



- ♦ **Guidance for evaluating the effectiveness of public education and outreach programs:**

WSU will determine what types of stormwater problems are amenable to, and best addressed by, behavior change efforts. A decision support tool, and guidance to evaluate effectiveness will be developed.



- ♦ **Ditch Maintenance for Water Quality Study:** WSU will conduct a study in roadside ditches on the effectiveness of different reshaping techniques and planting plans to reduce long-term costs associated with maintenance, water quality, and storm flow conveyance.

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. The following studies were active in 2020. Completed studies are shown in the blue boxes.

- ♦ **Mobile Business:** King County will lead a two year effort to identify mobile businesses and methods to conduct inspections and outreach for the purposes of stormwater source control and pollution prevention. New tools and best practices guidance will be developed informed by a pilot source control effort and coordinating source control among jurisdictions.
- ♦ **Business Source Control:** Washington Stormwater Center (WSC) is leading this two year effort to expand the business inspection reference guide, as well as prepare an online manual for permittees to use for stormwater program development. Business inspection trainings are planned for late Fall 2022.

2020 Spill hotline Feasibility

SAM Fact Sheet #22, March 2021

King County partnered with Herrera and Hardwick Research to assess the feasibility of a regional or statewide "hotline" (reporting system) for citizens and municipal staff in Washington state to report spills and environmental incidents. While they determined that implementing a regional spill reporting system is feasible with key benefits that are not addressed by the current system of disparate local hotlines, they found overall low support from jurisdictions to implement a new regional system. Despite this, recommendations can apply at smaller scales for individual jurisdictions or several jurisdictions working together



Administration (cont'd)

SAM Budget - Mid-permit cycle

The NAVY joined SAM in 2021. The EPA-issued MS4 permits for Naval Base Kitsap (WAS026646), Naval Station Everett (WAS026620), and Naval Air Station Whidbey Island (WAS026611) provides the Navy with the option to participate in the SAM network to satisfy requirements for monitoring. Their first year, 2021, was prorated for \$8,936 into SAM's Effectiveness Studies and Status and Trends accounts. Each year thereafter will be \$15,318 for the remainder of their permit cycle.

SAM revenue gathered in 2022 and 2023 will be enough for new Effectiveness Studies and Source Identification projects, and extend monitoring for the long-term Status and Trends studies. With oversight by SWG, a Round 4 solicitation process will begin in 2022.

Ecology continues to manage permittees' annual funding receipts in PARIS: <https://apps.ecology.wa.gov/paris>.

SAM Staff Capacity

Staff turnover in SAM projects as well as at Ecology continued to occur, and SAM Coordinator and Scientist continue to spend time covering more duties, therefore administration charges to the SAM accounts were much lower in 2021 and some duties such as quarterly reports are running later than normal. In 2022 we anticipate the SAM Scientists will be very involved with the USGS, LCUS, and PS Mussels leads to provide training and curate the spatial design data analysis and statistical work.

STAY INVOLVED AND UP TO DATE!

In early 2022 Ecology began using a new mass email software and the active subscribers were migrated to GovDelivery. New subscribers go to our [GovDelivery Subscriber Preferences Page](#). Enter your email address, click to add subscriptions, and navigate to the Water Quality Program list to subscribe to:

STORMWATER-ACTION-MONITORING: a newsletter announcing SAM study findings and upcoming workshops.

SWG-REPORTER: four issues per year to hear about study findings and the process for selecting studies.

STORMWATER-WORK-GROUP: meeting agendas, materials, summaries, and announcements related to our work.

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SAM is annually funded by Cities, Counties, Ports, and US Navy; has received in-kind funds from cities, business and agencies:

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. **Counties:** Clark, Cowlitz, King, Kitsap, Pierce, Skagit, Snohomish, Thurston, Whatcom. **Ports:** Tacoma and Seattle. **State:** Washington Department of Transportation, Washington Department of Ecology, Washington Department of Agriculture, Washington Department of Fish and Wildlife. **Federal:** United States Geological Survey **Business:** Penn Cove Shellfish, Cedar Grove. United States Navy.