Puget Sound Small Streams & Nearshore Study Design

Lead Entity

Stormwater Action Monitoring Staff

Partners

U.S. Environmental Protection Agency
U.S. Geological Survey
Washington State Department of Fish and Wildlife
Washington State Department of Natural Resources
Washington State Department of Ecology
Puget Sound Partnership
King County

Collectively improving stormwater management

Stormwater Action Monitoring (SAM) is a collaborative, regional stormwater monitoring program that is funded by more than 90 Washington cities and counties, the ports of Seattle and Tacoma, and the Washington State Department of Transportation.

SAM's goal is to improve stormwater management by measuring stormwater impacts on the environment and evaluating the effectiveness of stormwater management actions.

Project purpose

SAM is monitoring small stream and nearshore marine waters over time to see if they are getting better or worse in urban and urbanizing areas of Puget Sound. We monitor water quality, sediment, and macroinvertebrate health in small urban streams. In the nearshore we assess bioaccumulation of pollutants from the water column using caged mussels.

A group of scientists spent two years reviewing previous monitoring study findings and other literature to recommend adjustments to the study design. The revised design improves statistical robustness, monitoring efficiency, and captures year-to-year climate variations.

Stormwater management problem

To prevent stormwater from harming streams and the Puget Sound, we need to know which management approaches are effective and which ones aren't. While SAM studies on the effectiveness of specific stormwater management methods provide valuable insights, we also need regional-scale monitoring to assess whether overall stormwater management efforts are achieving their goals of protecting and restoring water quality. Stormwater managers need information at all levels, from individual sites to entire regions.

The revised Puget Sound monitoring study design

The first set of SAM status & trend studies randomly selected sites located within Puget Sound urban growth areas or along urban growth area shorelines. These areas were presumed to be most affected by stormwater runoff. In the streams study, sites within urban growth areas were compared to Puget Sound sites outside these boundaries. At the conclusion of the first round, our partners recommended that SAM revise the study design to use a gradient of urban development that reflects the landscape, rather than the binary inside or outside an urban growth area.

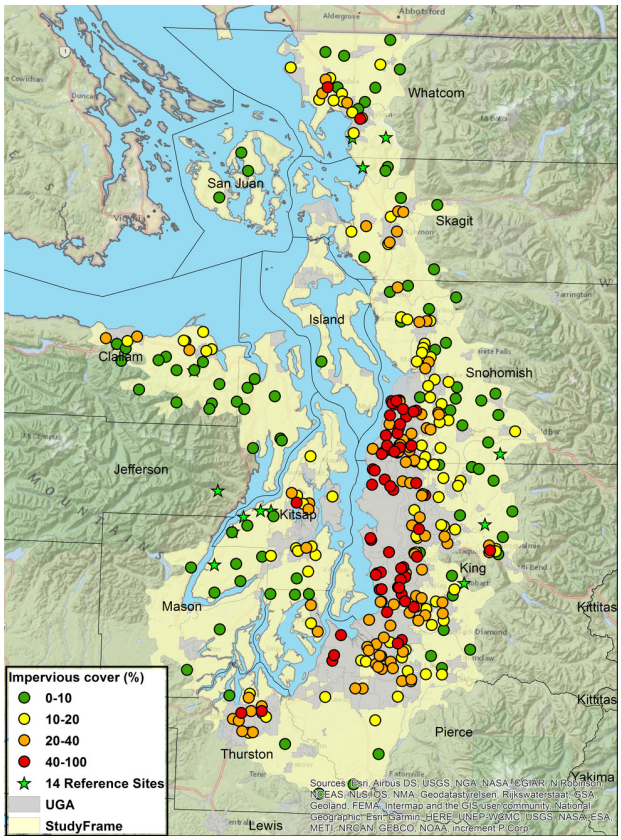

Figure. 1 Sampling sites in next 20 years, grouped by category of total impervious cover (TIC) of the watershed draining to each site.

After two years of review and discussion, a group of scientists proposed a revised study design for long-term monitoring of Puget Sound streams and nearshore that:

- improves statistical robustness and trend detection power,
- better captures annual climate variability, and is
- less expensive to implement than the 2015 study design.

We first selected candidate streams and nearshore sites most likely to show the impact of stormwater runoff. Each stream candidate site is a perennial, wadable stream with contributing watershed size between 0.5-70 km2 (0.2-27 mi2). The nearshore candidate sites are all located adjacent to watersheds less than 70 km2 (27 mi2) in size and away from single entity industrial sources of pollutants, such as marinas.

Employing a probabilistic survey design approach, sampling sites were then meticulously chosen from the candidate site lists to ensure a representative collection of sites, effectively mirroring the entire Puget Sound region. We used the Generalized Random Tessellation Stratified spatial survey design tool to select sites from four groups based on the percentage of total impervious cover (TIC) in the contributing watersheds:

- least developed areas (0-10% TIC),
- low urbanized areas (10-20% TIC),
- medium urbanized areas (20-40% TIC), and
- highly urbanized areas (40-100% TIC).

We launched the revised study design in 2020. Each year we visit 33 stream sites and two least-disturbed reference stream sites. Every other year, we deploy caged mussels at 33 nearshore sites and three least-disturbed reference nearshore sites. Some of the sites from the previous studies were included in the redesign. To improve trend detection power, we return to each site two more times at five- or six-year intervals.

In the revised design, we strategically selected parameters for sampling based on their frequency of detection and the extent of their variation across urban development patterns observed in previous studies.

In the streams study we are sampling:

- sediment chemistry including metals (total arsenic, cadmium, chromium, copper, lead, and zinc) and organics (polycyclic aromatic hydrocarbons, polybrominated diphenyl ethers, and phthalates);
- biotic indices including macroinvertebrates, periphyton, and physical habitat;
- water quality including temperature, dissolved oxygen, total suspended solids, nutrients, metals (total and dissolved arsenic, cadmium, chromium, copper, lead, and zinc), chlorophyll-a, and bacteria (fecal coliform and E. coli).

Continuous water level is monitored at each stream site for a full water year to improve our understanding of stream hydrology.

In the nearshore study we are sampling mussel tissue for:

- 110 organics compounds including 42 polycyclic aromatic hydrocarbons (PAHs), 41 polychlorinated biphenyls (PCBs), 11 polybrominated diphenyl ether (PBDE) flame-retardants, and 17 pesticides
- 6 metals including total mercury, total arsenic, cadmium, copper, zinc, and lead

We are also sampling field conditions at each mussel cage site such as tidal stage, site location, habitat, and anthropogenic structures at shoreline.

Annual (for streams) and bi-annual (for nearshore areas) reports characterize the projected status of all stream and nearshore miles in the Puget Sound. Approximately every five years, trends analyses and risk assessments are conducted to identify the key stressors causing poor conditions in the region.

What will Ecology do with this information?

Ecology will use this study to track progress in reducing stormwater impacts on streams and evaluate overall and long-term effectiveness of municipal stormwater permits.

What should we do with this information?

As we continue to track regional conditions and identify key stressors and pollutants impairing stream health, local officials and stormwater managers will be able to compare their stream conditions with others in the region and prioritize and focus their management practices. State and local agencies can use this information to develop regional protection and restoration strategies and evaluate the effectiveness of those programs.