Stormwater Action Monitoring

Redmond Paired Watershed Study – Interim Findings

Effectiveness Study

Lead Entity

City of Redmond

Partners

King County

Herrera Environmental Consultants, Inc.

Collectively improving stormwater management

Stormwater Action Monitoring (SAM) is a collaborative, regional stormwater monitoring program that is funded by more than 90 Western 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 to reduce pollution, improve water quality, and reduce flooding. We do this by measuring stormwater impacts on the environment and evaluating the effectiveness of stormwater management actions.

Questions about SAM?
See ecology.wa.gov/SAM

Study goals

The goal of the Redmond Paired Watershed Study (RPWS) is to evaluate the effectiveness of the following rehabilitation efforts for improving receiving water conditions at the watershed scale:

- Stormwater management retrofits in upland areas that include installation of best management practices (BMPs) for onsite stormwater runoff treatment and flow control.
- Riparian and in-stream habitat improvements.
- Programmatic practices for stormwater management (e.g., more frequent street sweeping).

For more background on the RPWS, see SAM Fact Sheet #6: Redmond Paired Watershed Study – Status Update.

Stormwater management problem

In theory, if all developed land in a watershed were equipped with nonstructural and structural stormwater controls, the receiving water would be protected from hydrologic and water quality impacts caused by urbanization. While the effectiveness of nonstructural and structural controls has been well documented at the site and parcel scale, limited data exist on the effectiveness of these controls in aggregate at the watershed scale to stop degradation and improve conditions in receiving waters.

Redmond's 2014 Citywide Watershed Management Plan (WMP) coordinates stormwater management efforts under the Phase II Municipal Stormwater Permit, Section 303(d) of the Clean Water Act, and salmon recovery efforts to support a watershed approach to improving receiving water conditions. The WMP allows Redmond to focus BMPs in a subset of priority watersheds moderately impacted by urbanization and expected to respond more quickly to rehabilitation efforts. This approach provides a unique opportunity to study the effectiveness of stormwater BMPs for improving receiving water conditions on an accelerated time frame and at a watershed scale.

Project findings

The RPWS experimental design involves routine and continuous measurements of various hydrologic, chemical, physical habitat, and biological indicators of stream health over an extended time frame to quantify improvements in receiving water conditions in response to watershed rehabilitation efforts. Using a "paired watershed" experimental design, these measurements are collected in seven watersheds categorized as follows:

- Three "Application" watersheds with streams that are moderately impacted by urbanization and prioritized for rehabilitation efforts: Evans, Monticello, and Tosh watersheds.
- Two "Reference" watersheds with relatively pristine streams that do not require rehabilitation: Colin and Seidel watersheds.
- Two "Control" watersheds with streams that are significantly impacted by urbanization and not currently prioritized for rehabilitation: Country and Tyler's watersheds.

Monitoring for the study began in 2016 and is anticipated to continue for a 10-year timeframe. In study years 4, 6, 8, and 10, trend analyses reports will summarize analyses to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. The first trend analysis report (for year 4) of RPWS implementation was recently completed. Major conclusions from annual monitoring and the trend report are as follows:

- Few consistent trends have been detected in the data for each indicator because rehabilitation efforts have been relatively modest in the Application watersheds thus far. Redmond will be constructing projects in the Application watersheds in 2021 that can now be assessed over multiple years of operation and varied climatic conditions relative to an extremely robust data set for baseline conditions.
- An interannual hydrologic trend was detected in the rainfall runoff response across most stations located in the Application, Reference, and Control watersheds. This trend was traced to climate-related changes over the four years. Specifically, progressively drier water years from 2017 to 2019 likely resulted in less saturation of the landscape, increased evapotranspiration, and reduced interflow and overland flow. This confounding trend from the first four years of this 10-year study will need to be accounted for in future analyses to reliably detect trends driven by hydrologic controls installed in the Application watersheds.
- Two detention vaults constructed in the Evans Creek watershed appeared to provide no measurable flow control benefit based on analyses of the rainfall runoff response in the creek before and after the vaults became operational. The likely explanation is that these two vaults are not treating a sufficient amount of the watershed area to have a detectable impact on flows.
- Total suspended solids (TSS) and total copper (Cu) concentrations consistently and significantly decreased in the Monticello Creek watershed, indicating that the increase in street sweeping frequency (from once to twice per month) on all public roads in the watershed benefitted water quality. These results are also consistent with a street sweeping study that was implemented by Seattle Public Utilities circa 2018.

Recommendations

The RPWS is less than halfway completed. These early findings suggest that to detect changes in receiving water peak flows in any given watershed, a meaningful threshold of flow control implementation is needed. This study aims to quantify these thresholds. Street sweeping should receive increased emphasis as an effective practice for improving receiving water quality.

Why does this study matter?

Ecological function in Puget Sound lowland streams is impaired to a large degree by outdated development practices and a lack of adequate post-construction controls for preventing adverse impacts from stormwater runoff. Information on the level of stormwater retrofit and stream rehabilitation required to restore ecological function in these areas is essential for guiding policies and programs on stormwater and receiving water management.

What will Ecology do with this information?

Ecology will continue to fund infrastructure improvements and maintenance activities, like street sweeping, for Washington's cities and counties to improve stormwater management and protect receiving water quality.

What should we do with this information?

Based on these early project findings, stormwater managers aiming to control TSS and Cu should consider increasing street sweeping. This study helps manage expectations of the public and elected officials at the planning stage by highlighting the time it takes for benefits of retrofits to become measurable. Stormwater managers may also need to identify additional indicators of project impacts or success.

For more information

Visit the SAM website at www.ecology.wa.gov/SAM and search for "paired watershed."