Stormwater Action Monitoring

Project Title

Regional Stormwater Facility Retrofit Study in Federal Way, Washington

Effectiveness Study

Lead Entity

King County

Partners

Federal Way

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? Send an email to SAMinfo@ecy.wa.gov

Study goals

This study evaluated effectiveness of stormwater treatment facilities built as part of an expansion and retrofit of a regional stormwater detention facility in Federal Way. The overall goal was to evaluate two new bioretention facilities, an expanded and new combined detention stormwater treatment wetlands (wetland complex), and the regional facility as a whole, for their ability to improve water quality and to reduce peak flows of stormwater runoff.

Stormwater management problem

Stormwater managers across the region are updating old stormwater detention facilities and other outdated infrastructure. Effectiveness monitoring is needed to evaluate whether new technologies are achieving the intended water quality and flow control goals. This study was designed to address data gaps regarding the effectiveness of stormwater treatment technologies when built as retrofits. Stormwater managers want to know how much they can expect to reduce the impacts of stormwater on aquatic ecosystems with similar retrofit projects.

Project findings

Eighteen storms between March 2016 and April 2017 were sampled using compositors. Flows were measured continuously. Both bioretention facilities, the expanded wetland complex, and the system as a whole reliably attenuated stormwater flows by reducing and delaying the timing of peak flows. The bioretention facilities and the wetland complex had mixed water quality treatment results, they were able to treat some targeted pollutants but not others. The system as a whole reduced total suspended solids (TSS), polycyclic aromatic hydrocarbons (PAHs), polychlorinated bi-phenyls (PCBs), and total metals (zinc, lead, copper and cadmium). However, the system increased concentrations of nutrients and dissolved lead. The bioretention facilities were a source of nutrients.

The bioretention facilities were newly constructed with 30 inches of the default bioretention soil media (BSM), based on old guidance in the 2012 SWMMWW

that more soil mix would provide better nutrient treatment. Instead, they contributed nearly 80% of the total phosphorus leaving the system, despite receiving less than 10% of the runoff to the system.

Water quality and benthic community data from the North Fork of West Hylebos Creek were collected downstream of the retrofit and expansion before and after the project to assess overall performance of the system. Turbidity improved, though the data are not yet significant. Changes in the benthic community were not observed, though it is likely too early to detect a change. More time is needed to determine any long term recovery of the benthic communities in the creek.

Recommendations

The nutrient export observed from bioretention is consistent with prior studies on the default BSM. Designers and stormwater managers should carefully consider designs and siting arrangements that will reduce the impacts of nutrient export. Managers should avoid designs that may facilitate or exacerbate nutrient export, such as more compost or delayed drainage of the bioretention – both conditions in this project.

Siting, designing, and monitoring stormwater treatment facilities is complex and should consider the potential for groundwater to affect flows of water and pollutants into and out of the facilities. To measure effectiveness, all inlets and outlets need to be accessible and easy to instrument with necessary monitoring equipment.

Why does this study matter?

Standard design criteria bioretention contains flexibility for site considerations. BMPs in retrofit situations are given further flexibility to accommodate space constraints and other limitations. Studies like this help us understand how modified BMPs perform in retrofit projects. This study identified some benefits and limitations of large bioretention facilities and a treatment wetland complex in one particular situation. The wetland complex successfully reduced nutrients, and in a different scenario could follow the bioretention. We are still learning whether and to what extent individual projects result in improvements in biological communities in the receiving water.

What should we do with this information?

Yet-to-be-built bioretention facilities designed according to the 2012 recommendation for 24" or more soil depth should be constructed with 18" soil depth instead, to help control nutrient export. Stormwater engineers and managers can use the findings from this study to help inform their decisions and expectations regarding site selection, design and monitoring of regional stormwater treatment facilities and retrofits, particularly in space-constrained situations. At a site where nutrients are a concern and a wetland complex is feasible, that approach may be preferable to and provide better overall treatment than a large bioretention facility. Bioretention facilities attenuate flows, but the reduction in pollutants is mixed: toxics such as PAHs and total metals are effectively removed, but if nutrient export is a concern for the receiving water, treatment trains or polishing should be added to the site design.

What will Ecology do with this information?

Ecology will continue to fund retrofits to improve stormwater quality opportunistically. Bioretention soil media mixes that release fewer nutrients and metals are being pursued. Ecology changed language in the SWMMWW to recommend against additional soil media depths due to the export of nutrients (plant growth and survival appears to depend more on hardiness and suitability of the dry climate of a bioretention cell in summer). Ecology continues to support the bioretention guidance within the 2014 and upcoming 2019 SWMMWW that advises against use of bioretention within one-quarter mile of a phosphorus-sensitive waterbody without further treatment, suitable soils, or when an underdrain would be routed to the receiving water.

For more information

For more information: See ecology.wa.gov/SAM and search for SAM Federal Way.