Stormwater Action Monitoring

Project Title

Bioretention Capture Efficacy of PCBs from Stormwater

Effectiveness Study

Lead Entity

King County Department of Natural Resources and Parks

Partners

Washington State University

United States Fish and Wildlife Service

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

Bioretention is a widely applicable and flexible best management practice (BMP) in western Washington and the fate of organic pollutants such as polychlorinated biphenyls (PCBs) in bioretention facilities has not been studied much historically. The goal of this study was to improve our understanding of the fate and transport of PCBs in the most commonly used bioretention BMP soil mixture (60% sand and 40% compost; the 60:40 mix). The study examined:

1) Does the bioretention soil mix effectively sequester PCBs from stormwater?
2) Are PCBs lost from the bioretention soil mix in the dry season?
3) Do PCBs accumulate in the bioretention soil mix?

Stormwater management problem

PCBs have caused impairments and fish consumption advisories in Washington State's freshwaters and in Puget Sound. Many PCB sources contribute to widespread distribution through urban air deposition and wash off of impervious surfaces. Despite their intentional manufacture being banned decades ago, PCBs continue to be created as byproducts of other manufacturing processes and are inadvertently used in the urban landscape. Reducing ongoing loads of PCBs is important to reduce and prevent adverse impacts on waterbodies. The potential for successful treatment and removal of PCBs from stormwater runoff by bioretention was largely unknown prior to this study.

Project findings

This two-year monitoring project installed six experimental bioretention soil mesocosms in 55-gallon drums in a Seattle neighborhood and applied stormwater gathered from 30 acres of the Interstate-5 highway and associated grassy medians and rights-of-way. Influent, effluent, and the bioretention soil mix were sampled quarterly.

We found over the course of the study that:

1) On average, effluent concentrations of PCBs were approximately 90% lower than the stormwater influents when filtered through the 60:40 bioretention soil mix. Including plantings in the mesocosms did not significantly change capture effectiveness compared to those with no plantings.
2) There was no seasonal pattern detected in PCB concentrations in bioretention soils.
3) PCBs did not accumulate in bioretention soils. No special soil management practices need be considered in the short term (years) with regard to accumulated PCBs. Overall, PCB concentrations in the bioretention soil went down slightly over the two-year period.

4) Loadings from stormwater to soil were modest in this study and bioretention soils are biologically active. Thus, PCBs are probably degrading at a rate comparable to their input, but this requires confirmation.

Recommendations

The long-term efficacy of bioretention for removing PCBs remains unknown. Establishing an annual or semi-annual bioretention monitoring program which includes persistent organic compounds including PCBs would be a valuable contribution. Conducting bench-scale studies of labelled PCBs in bioretention soil mix would help conclusively determine their fate.

Why does this study matter?

Bioretention soils are highly effective at removing PCBs from stormwater. Widespread application of BMPs incorporating bioretention could make significant progress towards reducing the impacts of PCBs on receiving waters and related fish consumption advisories.

There were no direct or known sources of PCBs to the study site and the concentrations were relatively low, presumably typical to stormwater from atmospheric deposition and low-level dispersed sources. The lack of buildup in the bioretention soils provides some assurances for stormwater managers that bioretention facilities in typical residential and roadway settings will not accumulate PCBs in the 60:40 soil mix.

What should we do with this information?

Stormwater managers should continue to utilize bioretention based BMPs with the 60:40 soil mix wherever practicable. Typical urban watersheds with high concentrations of PCBs in stormwater will benefit the most from bioretention retrofits to reduce PCB discharges to receiving waters. However, more study is needed to understand the fate and transport of PCBs in bioretention facilities in areas with the highest concentrations of PCBs.

What will Ecology do with this information?

Ecology will continue to encourage, support, and fund installation of bioretention facilities using the 60:40 mix to treat stormwater across the state. This study provides much needed information about the successful treatment and removal of PCBs in stormwater. Finding no buildup of PCBs in the soil matrix is promising. Ecology would welcome continued study to determine an upper treatment threshold of organic contaminants by established bioretention facilities and alternative bioretention soil mixes.

Want more information?

Visit the SAM website at ecology.wa.gov/SAM, search for "Bioretention PCB Capture"