RiverSmart Washington: Green Infrastructure Monitoring, Rehabilitation, and Modeling

Post-Implementation Monitoring Phase 2

Final Report

Executive Summary

RiverSmart Washington (RSW) is a long-term demonstration project of the Department of Energy & Environment (DOEE) in partnership with Department of Transportation (DDOT), DC Water, and a contractor, LimnoTech. The goal of the project was to intensely apply distributed microscale green stormwater infrastructure (GSI) practices across a pair of developed urban sewersheds, to understand the cumulative ability to capture and treat stormwater, through monitoring and modeling. Two similar-sized neighborhood-scale sewersheds were selected as experimental sewersheds: in the vicinity of MacFarland Middle School, and in the vicinity of Lafayette Recreation Center. A third sewershed was utilized as a control for the experiment where no GSI was installed. This project involved the design and construction of various GSI practices within the roadside right of way, including biorentention (raingardens) and various types of permeable and porous surfaces (permeable pavers, permeable pavement panels, porous concrete and porous asphalt). Additionally, the project installed GSI practices on private properties that volunteered to participate in the program including tree planting, rain barrels, rain gardens, and permeable pavers while also retrofitting the MacFarland School with GSI.

Initial planning and design of the project occurred from 2010-2012, with construction concluding in 2016. There were periods of pre- and post-construction monitoring which extended into 2017. In 2019, a second phase of monitoring occurred before and after maintenance and deep cleaning/rehabilitation was conducted. Monitoring efforts included end-of-the-pipe flow monitoring of the sewersheds, as well as practice-level monitoring of individual GSI locations with meters and moisture sensors in a sampling of various types of practices.

As is often the case in field experiments, it was difficult to control all the experimental variables. Factors such as rainfall, construction, equipment failures, and differences in maintenance varied between sewersheds and between monitoring years. This, along with limitations in the precision of monitoring equipment led to the sewershed level monitoring result being largely inconclusive. The RiverSmart Washington results are similar to those that both Philadelphia Water and DC Water have had in monitoring their Long Term Control Plan implementation. Contrary to predicted results, end-of-pipe flows from the experimental sewersheds may have increased after GSI was installed, though increases were less than observed in the control site. This indicates the GSI may have had led to a reduction in total flow compared to what would have been observed without the GSI (despite the conflicting results). The data also indicate that peak flow response at the sewershed scale was reduced after practices were rehabilitated.

Unlike the sewershed scale monitoring, practice-level monitoring did provide more conclusive results and indicated that practices were functioning as designed, capturing stormwater flows, and in some cases, the filtered stormwater passing quickly through practices and back into the storm sewer systems. Monitoring also showed that practices

responded well to deep cleaning and rehabilitation. There was definitive improvement in performance in most monitored practices in post-rehabilitation monitoring. However, for some permeable surfaces, the improvement in performance was short-lived as those surfaces quickly re-clogged. Bioretention practices maintained undiminished functionality for the entire post-rehabilitation monitoring period. Across the spectrum of permeable and pervious surfaces, permeable pavers demonstrated greater infiltration capacity, responded better to maintenance cleaning and retained effectiveness for longer duration in between maintenance intervals.

The District has learned many lessons through this effort, some of which have already been incorporated into new GSI installations and how existing and future GSI is maintained. In selecting types of GSI to use, the data shows that bioretention is one of the more cost-effective GSI approaches, provides high aesthetic value for communities, continues to function comparatively better than other GSI when maintenance is neglected or deferred, and is the most easily maintained with minimal disruption. Comparatively, permeable surfaces are more expensive to install, and more disruptive to the public to maintain. In considering improvements to the design of GSI, the District believes that when properly maintained, the current design of GSI is performing well at filtering out pollutants and making streets safer by reducing surface level stormflow. But GSI but may not be performing as expected in infiltrating stormwater, recharging groundwater, and reducing in-pipe stormwater flows. To increase infiltration and groundwater recharge and decrease in-pipe stormwater flows, District agencies are considering changes in GSI underdrains (pipes under GSI that transport excess water to stormwater pipes). Six-inch underdrains were standard specification in RiverSmart Washington GSI. This size was utilized for ease of cleaning, however it may be so large as to lead to quick drainage of infiltrating stormwater. District agencies are now considering using smaller-sized underdrains and/or valves on underdrains that can be adjusted to reduce or increase drainage as is needed.

Finally, it was not surprising to the District to find that GSI that is poorly maintained does not perform well at capturing stormwater and reducing pollution. Additionally, the District has learned that the distributed model of GSI maintenance, where each landowning agency is responsible for the maintenance of GSI on its lands, is not an effective model. In this model each agency needed to be experts at GSI maintenance and contract for its work. This led to higher-priced contracts and large differences in how well GSI was maintained. The District is now developing a unified model where one agency, DOEE, is charged with the maintenance of the District's GSI. Although it is just beginning this effort, the hope is that this model will lead to more stormwater being captured and treated as all GSI will be better maintained at a better price per practice.