BIORETENTION HYDROLOGIC PERFORMANCE ACROSS WESTERN WASHINGTON

OVERVIEW – WHAT ARE WE DOING? AND WHY?
The Bioretention Hydrologic Performance (BHP) Project, funded by Ecology and sponsored by Bellwether, is measuring actual hydrologic performance of constructed bioretention facilities throughout Puget Sound.
The intended benefits of this project are to provide policy and implementation feedback across the Puget Sound Basin, including:
1. Design and construction guidance for jurisdiction site-plan reviewers and the engineering community so that constructed conditions meet expectations,
2. Optimize design size and select appropriate safety factors relative to flow control goals (designs not undersized or substantially oversized), and
3. Help ensure beneficial improvements for instream flow and water quality protection.

HYDROLOGIC MONITORING METHODS
A hydrologic mass balance data set is being collected from September 2016 - June 2017 through the continuous measurement of:
- inflow and outflow using pressure transducers and Thelmar Weirs,
- rainfall using tipping bucket rain gauges,
- ponding depth using pressure transducers, and
- shallow groundwater levels using pressure transducers.
All monitoring stations are maintained and downloaded every two weeks.

SITE LOCATIONS
This study conducted in-field reviews of over 70 cells and selected ten bioretention cells for intensive field study and performance monitoring (see Figure 1). Of the ten cells, nine cells do not have underdrains that discharge to surface water, so that stormwater must reliably infiltrate through the native geologic unit underlying the imported soil for the system to properly function.

HYDROGEOLOGIC AND GEOTECHNICAL ASSESSMENT
Initial hydrogeologic/geotechnical field surveys conducted prior to hydrologic monitoring.

Step 1: Document Review - Regional geologic/hydrogeologic setting, geology and soils maps, and design documents, including geotech reports and grading plans where available.

Step 2: Field Investigation - Site specific exploration and testing including:
- multiple shallow hand borings
- shallow wall points
- geotechnical soil T-probe
- laboratory testing (grain sizes, organic matter)
- controlled field infiltration testing

INITIAL FINDINGS
High-performing: 6 cells situated in glacial outwash, will meet or exceed design targets.

Unknown performance:
- Cell in glacial till with underdrain, likely lacks intended flow control due to ‘short-cutting’ of flow to underdrain (pending review of monitoring data). Short-cutting is a function of inlet location adjacent to outlet, very little retention in bioretention soil - quick access to underdrain, and very low permeability geologic unit.
- Two cells in weathered till: TBD if design targets are met - likely due to lateral flow which can connect to adjacent porous pavement reservoir.
- Cell situated in recent alluvium with very shallow ground water: TBD if design targets are met.

Imported bioretention soils will vary significantly.
- Size: well drained, higher infiltration rate than design infiltration rate in all cells, not considered a controlling factor in hydrologic performance relative to design. High rate due to low fines.
- Sizing: 2 cells likely oversized by a factor of 10+ due to required restrictions on allowable bioretention soil infiltration rate at the time of design.
- Design: 2 cells had field infiltration tests similar to the Ecology Pilot Infiltration Test allowing for optimized bioretention sizing.

IMPLICATIONS
- Site characterization is critical, it forms the basis for sizing.
- Design review education and training is needed.
- Construction observation is important to verify basis of design.
- Local variability is a wildcard, site specific data is needed.

WHAT'S NEXT?
- Monitoring is ongoing through June 2017
- Compare field tested infiltration rates to variable infiltration performance from monitoring and shallow groundwater response.
- Compare reduction in infiltration rates due to ground water mounding.
- Clear Creek Solutions will compare design flow control to actual flow control using WWHM.