

**American Water Resources Association**  
**2009 ANNUAL WATER RESOURCES CONFERENCE**  
**November 9-12, 2009**  
Seattle, WA

**Monday, Nov. 9**  
**3:30 PM – 5:00 PM**  
**SESSION 14: Design Details**

**Vegetation Growth and Success as a Function of Soil Moisture Conditions in Bioretention Cells - Jennifer Reiners, CH2M Hill, Chicago, IL (co-author: Richard R. Horner)**

Vegetation has an important role in the hydrologic, hydraulic and pollutant removal processes that reduce the quantity and improve the quality of stormwater runoff in bioretention cells. However, few, if any, studies exist evaluating the effects of bioretention conditions on survivorship and success of vegetation in the field. A study was conducted for one year to evaluate the success of plant communities under two soil moisture conditions in four bioretention cells in the Pinehurst Green Grid area in Seattle, WA. Fourteen species were evaluated, including two woody species and 12 herbaceous species. Success was based on key physiological and descriptive variables including plant coverage, density, height, erectness and other symptomatic characteristics, such as necrosis, chlorosis and brittleness. Recommendations for bioretention plant selection were made to Seattle Public Utilities based on the success of the species and ability of the plants to provide water quality benefits during the dormant season. This study also provided information for the design and maintenance of future bioretention projects in Seattle and the Pacific Northwest.

**2D Modeling of Engineered Logs Jams in the Anastomosing Lower Elwha River, WA – Tim Abbe, ENTRIX, Seattle, WA (co-authors: Aaron Kopp, Mike McHenry)**

Engineered log jams and dam removal are critical components of salmonid restoration in the lower Elwha River. Restoration of anastomosing river systems requires a strategic layout of ELJs to control flow into side channel habitats, backwater habitats, and distributaries. It is through the large woody debris jams and channel migration processes that we can hope to return the salmon to the lower Elwha River. The strategic placement of 5 ELJs in fall of 2008 have acted to increase water surface elevations and back water through islands cutoffs and increase floodplain forest connectivity. The engineered log jams placement and push-up dike removal was analyzed with a River 2D two dimensional hydraulic model. Preliminary results after first flood season show increased velocities in side channels, scour pools in the main channel, and lower velocities in ELJ depositional zones. ELJ placement and anastomosing river hydraulics are sustainable in the same way that natural large woody debris serves to create anastomosing river processes. This is a necessary means to facilitate the return of anastomosing channel processes and form given the impending release of 14 million cubic meters of sediment upon removal of the Glines and Elwha dams.

**Urban Roof Runoff: Green Roofs, Blue Roofs, and Wind Roofs - Charles Wisdom, Parametrix, Bellevue, WA**

Reducing urban roof runoff can decrease receiving environment peak flows, combined sewer overflows, municipal infrastructure needs and can help improve NPDES permit compliance. Currently, much interest is being expressed in the application of green roofs as a best management practice to achieve roof runoff reduction. While no performance standards are currently in place for green roofs, a general goal of reducing 50% of intercepted annual rainfall has been suggested in the Puget Sound LID Guidance Manual. However, an examination of the physical factors controlled water movement through the atmosphere, canopy, soil, and roots confirms earlier studies that evapotranspiration in the Puget Sound Lowland area will be insufficient to consistently achieve these levels of runoff reduction. Part of the reason for this is the pattern of rainfall in the Puget Sound Lowland area, with approximately 60-70% of precipitation occurring between October and March, while the bulk of the evapotranspirative demand

occurs between April and September of a water year. Modeling of evaporation using a combined estimation of the Energy Balance and Aerodynamic Methods indicated that evaporation could, on average, reduce the amount of typical runoff from roofs except for the month of November. However, the amount of water generated by the Washington State water quality design storm (2" of rain in a 24-hour period for the Seattle area) would exceed the average evaporative demand by six-fold (6,000 cf of runoff generated versus 1,500 cf of runoff evaporated from a standard 1 acre roof). A mathematical examination of the physical factors that can be realistically manipulated in an urban roof setting - wind speed, surface area, and roughness – demonstrated the potential to achieve complete reduction of the 2-inch, 24-hour design storm using an enhanced evaporation BMP – a “wind roof”. The utility of this BMP and its role in achieving Low Impact Development goals, particularly the use of natural processes to mimic pre-development hydrology, will be discussed.

**The Effectiveness of Different Low Impact Development BMPs on the West Coast - Douglas Beyerlein, Clear Creek Solutions, Inc., Mill Creek, WA**

Low Impact Development (LID) BMPs, such as, green roofs, bioretention swales, rainwater cisterns, rain gardens, impervious runoff dispersion, and permeable pavement can be used to reduce stormwater runoff. The effectiveness of different LIDs to reduce stormwater runoff depends on the individual LID facility, the native soil, and the local climate. On the West Coast of the United States there are three very different climates: Pacific Northwest marine, Northern California Mediterranean, and Southern California semi-arid. Clear Creek Solutions used continuous simulation hydrologic computer modeling of LIDs to evaluate the effectiveness of different LIDs for these three different climates. The LID modeling was based on HSPF using the WWHM interface. Results are presented in terms of the percent reduction in mean annual stormwater runoff for each LID BMP with each major soil type in each of the three climatic zones. In addition to quantifying the percent reduction in mean annual stormwater runoff, the LID stormwater modeling results demonstrate the feasibility and limitations of using LIDs to reduce the impact of increased runoff from new land use development. They also show the value of retrofitting LIDs in existing urban areas to reduce existing stormwater runoff for the three different West Coast climates. Results from the LID modeling quantitatively identify the important considerations that must be kept in mind when designing LID practices for an urban environment and the practical effectiveness of implementing these practices to protect private property and public resources.