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Tuesday, Nov. 10
8:30 AM – 10:00 AM
SESSION 18: BMP Practices

Modeling Stormwater Basin Outlets for Potential Retrofit Designs - Ryan Headley, Rowan University, Glassboro, NJ (co-author: Josh Wyrick)

Outflow structures for stormwater detention basins can vary widely within a single watershed. The designs are often left to the whim of the local engineer. Often the outflow calculations rely on generic weir coefficients, which may not be applicable in all situations. This research attempts to (1) discern the performance and efficiency of various typical and atypical weir shapes, and (2) determine more accurate weir coefficients for all types and combinations of outlet weir configurations. To accomplish this task, a scale model of a stormwater detention basin was constructed with removable outlet weirs. The physical model was calibrated using typical weir structures (e.g. rectangular, V-notch, submerged orifice, etc.) in which accepted numerical models exist to calculate outflow discharge. Empirical stage-discharge relationships were then calculated for the atypical weir structures (e.g. stepped notch, combinations of typical shapes, etc.). These results were compared with theoretical hand calculations and numerical outputs from common commercial software. The atypical weirs simulated herein represent the range of outlet structure designs located in the Upper Mantua Creek watershed, Gloucester County, New Jersey. This area of New Jersey has experienced large urban growth in the past 40 years, and many of the existing basins were not designed for the current runoff volumes they experience. Within this 7.3 square mile watershed, there are currently 61 stormwater basins and more than 50 different outlet structure designs. The ability of each stormwater basin to pass or detain a given flow event can now be determined empirically. From these data, appropriate retrofit designs and management strategies can be implemented.

Effectiveness of High Efficiency Street Sweeping in Seattle - Rob Zisette, Herrera Environmental Consultants, Seattle, WA (co-authors: Beth Schmoyer, Shelly Basketfield, Terry Martin)

A pilot study was conducted by Seattle Public Utilities to evaluate whether high efficiency street sweeping reduces the amount of sediment and associated pollutants discharged to receiving waters, and reduces the need for catch basin cleaning. The study measured the amount and characteristics of dirt present on the streets, sediment accumulation in catch basins, and materials removed by the sweeper. Sediments were monitored on a monthly basis over a one-year period (July 2006 to June 2007) at swept and unswept (control) sites located in two residential areas and one industrial area of Seattle. Data collected for this study clearly show that sweeping each side of the street every other week is very effective in reducing the amount of sediment and associated pollutants discharged from city streets. Among the three study areas, street sweeping reduced the amount of dirt on the streets by 50 to 90 percent, and the average rate of waste removed by street sweeping was 2,700 pounds/street acre/year (4,900 pounds/curb mile/year). Street sweeping removed between 4 and 10 times more sediment than was captured by catch basins. There was little difference between the rate of sediment accumulation in catch basins between the swept and unswept test sites, which indicates that sweeping streets every two weeks does not reduce the need for catch basin maintenance. Mass removal rates were adjusted to include only those particles that would like be transported in suspension (i.e., less than 250 microns in size) to enable comparison with conventional stormwater treatment projects in Seattle. Street sweeping was estimated to remove 39 to 61 percent of the total suspended solids (TSS) loading and 66 to 112 percent of the total copper loading predicted by a stormwater

model. On a life-cycle basis, the cost of street sweeping ($5/kg TSS removed) is about 15 to 50 percent of the cost for a regional-scale structural BMP ($10 to $30/kg TSS removed) and may b in the 5 to 10 percent range when compared to small scale BMP facilities. Thus, street sweeping is a very cost effective strategy for removing sediment and its associated pollutants from roadways.

Evaluating Paired BMP Influent and Effluent Data using Running Bootstrap Medians - Marc Leisenring, Geosyntec Consultants, Portland, OR (co-authors: Aaron Poresky, Eric Strecker, Marcus Quigley)

The International Stormwater Best Management Practices (BMP) Database (www.bmpdatabase.org) contains event mean concentrations (EMCs) for several BMP types and constituents. Much of the influent and effluent data are paired (i.e., influent and effluent sampled during same storm event). As the data contained in the database have increased, the ability to detect statistically significant differences between influent and effluent averages has improved; however large variability has prevented traditional analysis methods (e.g. scatter plots, linear correlations, ANOVA, etc.) from indicating strong relationships between influent and effluent EMCs. As a much larger set of influent-effluent pairs have become available in the BMP Database, positive statistically significant monotonic correlations between influent and effluent concentrations for many constituents and BMPs can be found. If we can meaningfully and objectively quantify these correlations, we may be able to advance our understanding of the relationships between BMP design, unit processes, and treatment trains, as well as the interrelationships between structural and source control BMPs. Further, through an evaluation of influent-effluent relationships, the minimum treatment threshold or “irreducible effluent concentration” may be identified through methods that are resistant to potential bias resulting from low influent concentrations. To facilitate analyses of influent-effluent data pairs, a non-linear statistical smoothing procedure was developed and tested. Statistical smoothing is a process of separating a sequence of data points {yi} into a smooth sequence {zi = Sm(yi)} and a residual sequence {ri = zi-yi}, where the smooth function, Sm, is typically a moving average or median. The procedure developed for this study is based on the odd-span running median coupled with bootstrapped confidence intervals, and is intended to be an objective method of handling paired datasets of any size or variance while preserving the underlying variability of the dataset. Results of this research indicate that significant monotonic correlations between influent and effluent concentrations exist for many BMPs and constituents, and some data sets tend to approach an asymptotical effluent concentration. The results also indicate that estimates of achievable effluent concentrations for some BMPs and constituents may be biased low due to the inclusion of effluent concentrations that simply equal influent concentrations.

Filterra® System Performance Monitoring in Washington State: Expanding our Toolbox for Enhanced Treatment and Reducing Irreducible Pollutant Concentrations - Rebecca Dugopolski, Herrera Environmental Consultants, Seattle, WA (co-authors: Mindy Ruby, John Lenth)

A Technology Evaluation Report (TER) for the Filterra® Bioretention Filtration System was submitted to the Washington State Department of Ecology for approval through the Technology Assessment Protocol – Ecology (TAPE) in the summer of 2009. The Filterra® system was tested at the Port of Tacoma in Tacoma, Washington from May 2008 through May 2009. The Filterra® system is a self-contained stormwater treatment system manufactured by Americast, Inc. The technology packages soil media, plants, and drainage infrastructure found in typical bioretention best management practices (BMPs) into a pre-fabricated concrete housing. The Filterra® system is a flow-through stormwater treatment device intended for removal of suspended sediments, nutrients, heavy metals, and oil and grease from stormwater flows within small-scale catchments such as parking lots and streetscapes. During the 2008-2009 monitoring period, a total of 27 storm events were sampled to characterize the stormwater treatment performance of two Filterra® test systems at the Port of Tacoma. During the 2008-2009 monitoring period, the Filterra® test systems at the Port of Tacoma demonstrated significant reductions in total

suspended solids (TSS), dissolved zinc, dissolved copper, and total petroleum hydrocarbons (TPH). TSS removal ranged from 79 to 90 percent for influent TSS concentrations of 20 milligrams per liter (mg/L) or greater. The irreducible TSS concentration is commonly considered to be 20-40 mg/L TSS; however, the sampling conducted at the Port of Tacoma demonstrated that TSS reductions beyond this threshold are possible with effluent TSS concentrations from the monitored systems ranging from 2.0 to 7.8 mg/L. Dissolved zinc removal ranged from 42 to 94 percent with a median removal of 54 percent. Dissolved copper removal ranged from 24 to 74 percent with a median removal of 44 percent. TPH removal ranged from 70 to 99 percent with a median removal of 97 percent. This presentation will focus on the pollutant removal performance data obtained during this study and will also provide an update on the status of the TAPE submittal for basic and enhanced stormwater treatment in Washington State.