STORMWATER

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POSTER SESSION

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An Overview of the PennDOT I-95 Research Sites
Farnum, A.; McPheter, C.; Erben, J.; Lutz, C.; Kuncken, A. - Villanova University

Villanova University and Temple University are performing research on several stormwater control practices installed during I-95's reconstruction. This poster outlines a map of the various research sites, monitoring details, and research goals of the project.

Establishing the Threshold of Rehabilitation Post-Clogging for SCM Soil Media
Lutz, C., and Erben, J. - Villanova University

Despite evidence of sediment buildup in a rain garden located in Fishtown, PA known as SMP A, field infiltration tests have remained constant, and soil cores taken at multiple locations revealed no change in particle size distribution over the last five years – suggesting the soil media performed as an effective graded filter to the sediment by retaining fine particles near the surface. A laboratory study combined with field data was performed to determine if well-graded loamy sand commonly used in bioinfiltration systems can be rehabilitated easier post-clogging of sediments varying in particle size and plasticity, to extend the lifespan of the GSI and reduce time-intensive and costly maintenance.

Quantifying GSI Performance Using Deep Neural Network Model
Mehedi, A. A.; McGauley, M.; Amur, A.; Metcalf, J. - Villanova University

The performance of GSI is dynamic with respect to time due to natural, anthropogenic, and climatic processes that are not well represented by traditional numerical and hydrologic models, which are calibrated against only a few historical observations. Deep learning based predictive models, such as the Long Short-Term Memory (LSTM) neural network, are used to quantify the performance of a rain garden, Bioinfiltration Traffic Island (BTI), accounting for the highly dynamic and constantly evolving nature of influencing factors by leveraging advancements in observational data.

Assessment Of Flooding By Varying Extreme Weather Events
Starkey, R. - Villanova University

Defining the hydrological drivers that most impact a transportation network during different extreme flood events, accomplished through a spatial regression analysis

How Urban Sediments Influx to GSI Influences the Surface Sediment Advection Across GSI Surface
Akatu, W. and Erben, J. - Villanova University

In most cases of natural watercourses, due to the complex flow pattern and uneven sediment distribution and concentration, part of the sediment moves by the water (suspended sediment), while the rest is moving just over the bed (bed-load). Modeling the complex processes of sediment dynamics and transport, and riverbed changes require independent analysis of all involved processes (moving of suspended particles, erosion, deposition, bed load movement, riverbed deformation, and particle exchange between the layers of the riverbed), and their interaction. Besides, to obtain the most realistic insight into the processes involved, the natural sediment mixture, in most of the cases characterized by very uneven particle distribution, needs to be broken down into particular sediment-size classes. This study aims to investigate how urban sediment influx into green stormwater infrastructure (GSI) influences fines advection within these systems. In accordance with this, the movement of sediments within GSI has been modeled using a 2D HEC-RAS model. Several sampling activities have been carried out in the study area, and the particle size distribution information from the surface samples collected is compared to the simulated results from the HEC-RAS model. The identification of fine sediment deposition areas in GSI will help inform maintenance decisions leading to the longevity of the system.

DEI x Water Resources Engineering: Inspiring Future Engineers
DEI x VCRWS Reading Seminar Group - Villanova University

A diverse team of faculty, staff, and graduate students discusses diversity, equity, and inclusion (DEI) in the context of water resources engineering and associated design and solution considerations.

Monitoring Subsurface Hydrology Using Soil Moisture Conceptual Framework
Shakya, M. - Villanova University

The soil moisture profile, which is the varying water availability over time, needs to be better quantitatively understood as it allows us to have a detailed knowledge of the water dynamics within the soil that is a function of design choices, system maintenance success, and local site conditions. A novel conceptual framework of soil moisture behavior under pre-, during-, and post-storm conditions is presented. While this framework includes the full storm cycle, emphasis is placed on the saturation, volume storage, recession period, infiltration, and evapotranspiration of the soil moisture profile as these are the primary indicator of system health and demonstrates system recovery. This framework uses soil moisture sensors that respond to the input of stormwater runoff and the subsequent drying as water is infiltrated deep into the soil or the underdrain collection system. The soil moisture trends are identified to interpret the soil moisture content over the short-term (during and immediately after an event) and over season, which can indicate the impact on runoff generation, plant growth, or soil erosion. The framework methodology identifies critical soil moisture points for a rainfall event that are based on the change in slope of soil moisture with respect to the change in water availability. A year-long field experiment demonstrates the usefulness of the framework to establish system response and recovery, including the consistency with which a system responds to a storm event and the transferability of the trends to different sites.

Linking History, Society, and Flood Dynamics: A Tale of Two Philadelphia Neighborhoods

Amur, A., Devlin, E., Moore L., Mehedi, A., Smith,V., Ph.D, Wadzuk, B., Ph.D. Villanova Dept. of Civil and Env. Eng.
Homet, K., Kremer, P. Ph.D. Villanova Dept. of Geography and the Environment

Philadelphia, Pennsylvania, is prone to flooding due to a highly impervious landscape coupled with buried rivers, coastal effects, and use of combined sewer overflow systems (CSO). Often the neighborhoods located in areas most vulnerable to flooding were "redlined" (a discriminatory practice where neighborhoods were classified as 'hazardous' to investment). In the past two decades there have been ten major flood events, which have major impacts to the city's residents and infrastructure, placing disproportionate strain on previously redlined neighborhoods.

An Overview of the Villanova Research Sites for the Delaware River Watershed Initiative

Baghalian, S., Burns, M., Khosravi, S., Bilotta, E. - Villanova University

Bringing together over 50 organizations that span municipalities, non-profits, and academic institutions, the Delaware River Watershed Initiative aims to conserve and maintain clean waters for 15 million people across state lines. Villanova's role in research and collaboration is discussed, focusing on the monitoring of three unique sites in the Delaware River Basin.

A Seasonal Evaluation of SCMs in Series: Capture Volumes, Infiltration Rates, and Maintenance at the Treatment Train

Hernandez, F. - Villanova University

The application of several stormwater control measures (SCMs) in series as a treatment train has become popular over the implementation of a single treatment measure. The stormwater control measures (SCMs) in series, known as the Villanova Treatment Train, were constructed in October 2011. The treatment train includes a vegetated swale, two rain gardens, an infiltration trench, and a cistern. The concept of using multiple treatment processes to improve results is a long-standing remediation strategy in the water and wastewater fields. As for stormwater management, the reasons for using a series of treatments are to maximize and diversify performance by increasing the volume retained, improve outflow quality, increase longevity, and prevent total system failure. To evaluate the dynamic, seasonal performance of the infiltration trench and the cistern, a period of five years of continuous rainfall, temperature, and water level data from the infiltration trench and the cistern at Villanova University, was analyzed. Seasonal variability of recession rates in the infiltration trench was demonstrated under contrasting temperatures (recession rate is inversely proportional to temperature) and water level depth (low head dependency). The higher recession rates were attributed to warmer months and low recession rates were attributed to colder months. To develop a dynamic system (real-time control), a seasonal rainfall analysis and continuous monitoring days of the cistern's performance were done to take standard decisions for different forecasted rainfalls. Developing a dynamic system helps to adjust the treatment train to different forecasted rainfall and increases the pre-treatment of runoff stormwater before the water goes to the Infiltration trench and increases the longevity and the performance of the system by avoiding overflow of the system.

Salt Transport in a Bioretention Basin after Roadway Deicing Applications

Fischer, C.[1], Clark, S.[2], McPhillips, L.[3], Wu, H.[4], Gotsch,S.[5]

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Highlights

- Even in sandy loam bioretention soils, salt buildup occurs throughout the winter.
- Small rain volumes can create high conductivities because the salt is not diluted and is transported easily.
- A minimum of 60 days was necessary to return soil conductivity measurements to background in the sandy loam bioretention soil.

Modeling the Impacts of Storm Intensities and Rainfall Intervals on Flooding at Penn State Harrisburg

Fischer,J.[1], Clark, S.[1], McPhillips, L.[2]

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[2]Department of Civil and Environmental Engineering, Penn State University

Highlights

- In small urban watersheds, drainage times can approach 5 – 15 minutes.
- To accurately model behavior in small urban watersheds, rainfall data in 1- to 5-minute time increments will be vital.

Long-Term Effectiveness of Multiple Restoration Projects in streams of the Lititz Run Watershed

Raifsnider[1], E., Dimova, A.[2], Clark, S.[1], Sliko,J[1]

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[2]Arcadis

Highlights

- Streambank armoring prevents degradation and concurrent sediment and nutrient releases.
- Floodplain and vegetative reconnection is necessary to reduce concentrations of in-stream nutrients, especially nitrogen.
- Stream restoration's ability to reduce nutrient concentrations may be overwhelmed in areas with substantial groundwater pollution.