The Steep Slope Bioretention Pilot Project

Innovative Stormwater Research for Mountain Regions

Managing Stormwater in the Mountains

Stormwater runoff is the primary source of water pollution throughout North Carolina. Steep slope development and related stormwater management is a significant challenge in the mountain region of North Carolina. When heavy rain falls on steep slopes, the resulting stormwater runoff can flow at high speed and cause severe erosion and flooding downhill. This innovative stormwater research project, funded by the North Carolina Clean Water Management Trust Fund, was undertaken to develop and test stormwater management measures that effectively reduce stormwater runoff and improve water quality in steep slope environments.

How does it work? Just follow the water path to find out!

Stormwater runoff from the **Town Hall roof and parking lot (#1)** is directed to a **storm drain inlet (#2)**, which then flows through an 8" diameter pipe and into a **flow distribution trench (#3)**. **V-notch weirs (#4)** in the trench help to distribute the flow evenly between the two bioretention systems. This is also where the inflow samples are taken before the stormwater is treated by the bioretention systems. As water flows into the **first bioretention cell terrace (#5)**, it percolates into the soil where it is filtered and cleaned or taken up by plants. During heavier rainfall events, water can overflow onto the **lower terraces (#6)**. Filtered water is then piped through an underdrain which flows into a **weir box (#7)**, where outflow samples are taken.

The changes in water quality between the inflow (#4) and outflow (#7) provide useful information for evaluating the effectiveness of these bioretention systems. Approximately 0.3 acre of mostly impervious area drains through these bioretention systems, which were constructed on slopes ranging from 30 to 50%!

Bioretention

Bioretention systems have been shown to remove metals, nutrients, sediment, bacteria, and other pollutants. Sometimes called "rain gardens," bioretention systems are living ecological systems that act as natural filters for stormwater. They are typically shallow depressions filled with sandy soil, topped with mulch, and planted with dense vegetation. As stormwater runoff infiltrates, pollutants are removed through a variety of mechanisms including adsorption, microbial activity, plant uptake, sedimentation, and filtration.

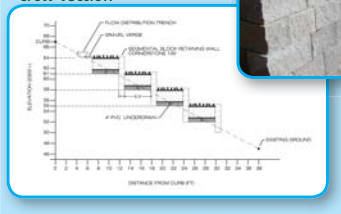
Two Different Bioretention System Designs

This project features two different bioretention systems, each with four "stair-stepped" terraces. One system uses a segmental block retaining wall and the other a gabion weep wall design. Notice both the similarities and the differences between the two systems.

Segmental Block Retaining Wall System

Segmental block retaining wall units are stacked without mortar. The blocks are hollow and filled with crushed stone. Because they are segmented, these walls can generally tolerate minor earth movement. Some segmental block systems can be permeable to minimize hydrostatic pressure.

cross-section



Gabion Weep Wall System

Gabion retaining walls are comprised of rectangular wire baskets filled with stone and stacked on one another. Gabions can conform to ground movement and are highly permeable. Additionally, silt and vegetation can fill the interstitial voids and reinforce the wall.

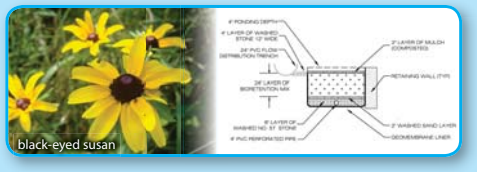
cross-section

Plants...and More!

Plants are an integral part of a bioretention system's pollutant removal and water filtration processes. Plants at this site were selected for their ability to survive during periods of extended wet or dry conditions. The different species also have different bloom times to enhance aesthetics throughout the growing season. Plants include butterfly weed, false blue indigo, lanceleaf tickseed, moss pinks (*Phlox*), black-eyed susan (*Rudbeckia*) as well as prairie dropseed grass. Additionally, mushroom species known to remove pollutants have been added to the mulch layer. These mushroom species include King Stropharia, Elm Oyster, Blue Oyster, and Shaggy Mane.

Beneath the Plants

The soil media for a bioretention system is essential to ensure adequate drainage, reduce pollutant loads, and support plant growth. Below is a cross-section of the layers beneath the plants.



Project Partners
Madison County Soil and Water Conservation District
Town of Mars Hill
Mars Hill University
HydroCycle Engineering

Project Funding and Donations
Clean Water Management Trust Fund
Town of Mars Hill
Madison County Soil and Water Conservation District
HydroCycle Engineering
Stalite PermaTill

Design and Construction Team
Project Manager: Bailey Mundy, Madison County SWCD
Engineer: Tim Ormond, P.E., HydroCycle Engineering
Mycelium Consultant: Asheville Fungi
Interpretative Signage: Tony Geiger
Construction: CLS Inc.