



### Subsurface Gravel Wetland

Subsurface gravel wetlands, also called "submerged gravel wetlands" are a type of stormwater wetland. Instead of a permanent shallow water surface like traditional wetlands, the water level in this wetland is below a layer of crushed rock. Because there is a permanent water level, this BMP can also support wetland plants. Stormwater flows through the root zone of the gravel wetland where pollutant removal takes place. **How deep do you think the water level is below the surface? How is it maintained at that depth?**



### Stormwater Diversion Hump (Speed Bump)

This stormwater diversion hump, sometimes called a "water bar," is a simple device that intercepts stormwater flowing down this steep driveway and diverts it into a stable vegetated swale. This helps to slow down the water velocity, prevent erosion, and carry the stormwater into a wetland where it will be treated before flowing offsite. **Can you follow the path of water after it flows into this stormwater diversion hump?**



### Stormwater Wetland

Stormwater wetlands are constructed wetlands that incorporate wetland plants in a shallow pool. As stormwater runoff flows through the wetland, pollutants settle to the bottom and are absorbed by the plants. Stormwater wetlands are among the most effective stormwater BMPs in terms of pollutant removal. They also provide a habitat type that is less common in our mountain region. This wetland was constructed with a 12-inch compacted clay liner to ensure that it holds water. **There were 10 different species of wetland plants planted here, including various rushes and reeds. How many different types of wetland plants can you identify here today?**



### Level Spreader

Level spreaders are BMPs that are designed to uniformly spread a concentrated water flow over a larger vegetated area. They are constructed at a virtually zero percent grade. Level spreaders effectively filter and slow runoff as concentrated flow is turned into sheet flow. Pollutants are removed through settling and filtration. There are many level spreader design options available. This simple level spreader consists of lumber and a gravel apron on the downstream side. **Can you tell where the flow is concentrated and where it becomes sheet flow? Where is the flow fastest and slowest? Where would the pollutants settle out the most and why?**



### Rain Garden (Bioretention Cell)

This is the smallest of the three rain gardens on site. However, it is the second deepest at a depth of 4.5 feet. It includes gravel, sand, soil and mulch layers as well as an underdrain pipe system. There were 9 species of rain garden plants planted here, including grasses, sedges, rushes and flowers which attract beneficial insects. **How many different types of insects can you find living in this rain garden? Can you think of a location in your yard for a rain garden?**



### Infiltration Trench

Infiltration trenches are narrow subsurface basins filled with gravel or crushed stone that capture, filter, and infiltrate stormwater runoff. They can be used on sites with limited space for managing stormwater. Infiltration trenches effectively remove pollutants such as suspended solids, pathogens, nutrients and metals. This infiltration trench contains a rock layer that is 4 feet deep. **Where does the water go after entering this infiltration trench? What types of plants do you see growing here? Why are there so few plants?**



### Mushroom Mycelia Filter Strip

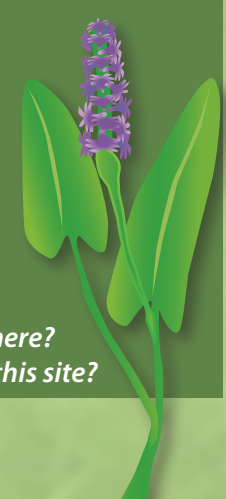
Mycelia are the thread-like body of a fungus which live below ground, while the mushrooms we see are just the small visible fruit of the fungus. Mushrooms "bloom" much like flowers do, during certain times of the year when the conditions are right. Mushroom mycelia can effectively remove pollutants from stormwater, including pathogens (protozoa, bacteria, viruses), silt and sediment, and chemical toxins (including petroleum hydrocarbons). This mushroom mycelia filter strip consists of burlap sacks filled with wood chips and inoculated with oyster mushroom spores. As the mycelia grow and eat the wood chips, they also intercept and remove pollutants from the parking lot runoff. **Can you see any mycelia? Can you find any mushrooms? What type of pollutants would you expect from the parking lot runoff?**

### Native Plants

One goal of this project was to create a diverse native habitat for many plant, insect and other animal species. The project involved planting 87 different plant species, including:

- 21 tree species
- 18 shrub species
- 19 wetland plant species
- 29 native perennials and grasses
- 31 of 87 species with secondary benefits as food, medicine, spice, etc.

**How many different plants can you identify here? How do they help to manage stormwater at this site?**



## Bringing the Message Home

Now is your chance to take what you've learned and apply it! Many of the stormwater practices demonstrated at this site can be applied on a smaller scale at our homes, schools and neighborhoods. Rain barrels, rain gardens and wetlands are some of the many techniques used by homeowners in our region and beyond. Not only do they help protect and improve our water resources, but they can reduce costs for watering landscapes and increase the enjoyment, and even the value of your property.

You can call the Madison County Soil and Water Conservation District for more information at 828.649.3313 x3

### Want to learn more?

North Carolina Stormwater Page  
[www.ncstormwater.org](http://www.ncstormwater.org)

Center for Watershed Protection  
[www.cwp.org](http://www.cwp.org)

U.S. Environmental Protection Agency  
[water.epa.gov](http://water.epa.gov)

Build your own rain garden  
[www.bae.ncsu.edu/topic/raingarden/Building.htm](http://www.bae.ncsu.edu/topic/raingarden/Building.htm)

### PROJECT PARTNERS

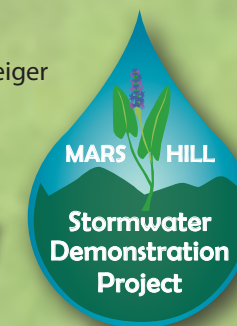
Town of Mars Hill, Madison County Soil and Water Conservation District, Mars Hill Housing Authority, Mountain Valleys RC&D, Mars Hill University, HydroCycle Engineering

### PROJECT FUNDING AND DONATIONS

NC Division of Water Resources, Pigeon River Fund, EPA 319, Town of Mars Hill, Madison County SWCD, Mars Hill Housing Authority, HydroCycle Engineering, Mary Weber Landscape Architecture, Stalite PermaTill, Hedrick Quarries, Klingstone Inc.

### DESIGN AND CONSTRUCTION TEAM

Project Manager: Bailey Mundy, Madison County SWCD  
Engineer: Tim Ormond, P.E., HydroCycle Engineering  
Landscape Architect: Mary Weber Landscape Architecture  
Watershed Coordinator: Sara Nichols, Madison County SWCD  
Permaculture Consultant: Zev Friedman  
Mycelium Consultant: Asheville Fungi  
Interpretative Signs and Brochure: Tony Geiger  
Construction: CLS Inc.  
Landscaping: Hawks Landscaping



## Thanks for visiting!

## Welcome to The Mars Hill Stormwater Demonstration Project

### Sustainable Stormwater Management in the Mountains of Western North Carolina



This stormwater demonstration project was created in an effort to improve water quality and advance stormwater management practices in our region.

### This project helps to:

- Capture and treat over 90% of all stormwater on site
- Improve water quality on site and in the Ivy River Watershed
- Reduce downstream flooding and erosion
- Establish native vegetation
- Provide habitat for wildlife
- Recharge groundwater
- Reduce water usage for landscaping
- Provide learning opportunities for students of all ages
- Demonstrate stormwater practices that can be applied at your own home

**We invite you to tour this site and learn more about the importance of stormwater and how we can all better manage it together.**

Follow the numbered trail and discover the many stormwater Best Management Practices (BMPs) that were constructed on this site!



### What is stormwater?

Stormwater is water that originates from rainfall or snowmelt. When stormwater flows over impervious surfaces like driveways, sidewalks, streets, parking lots and roofs, it is unable to soak into the ground. Stormwater can pick up and transport trash and debris as well as pollutants such as pathogens, nutrients, sediments, heavy metals and chemicals. This polluted water reaches our creeks, rivers, ponds, and lakes and can eventually make its way into our ground water.

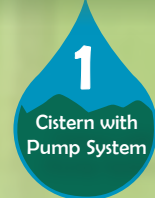
### Did you know?

Almost two-thirds of water pollution in North Carolina is caused by polluted stormwater runoff.

### A healthy water supply is vital to our overall quality of life!

Not only do we rely on water for drinking; we also need clean water to grow food, provide wildlife habitat, and for recreation like swimming and fishing.

On average, this 1.25-acre site receives about 40 inches of rain annually, which results in over 1 million gallons of stormwater runoff every year! As you walk around this site, think about what happens here when it rains. How might these stormwater BMPs help?



Cistern with Pump System

The cistern consists of underground plastic tanks which collect rainfall from the roof of the town hall building through a series of gutters, downspouts and buried pipes. The tanks hold up to 3,000 gallons of roof runoff. A pump system allows this water to be used for landscaping all around the town hall. Notice the three *access hatches* at the toe of the slope. Rain barrels are a similar, but smaller, technique that can be installed at your home to collect rain for watering your garden and landscaping. **How else could you use rain water?**



Arbor with Green Roof

This arbor was constructed from black locust, a native tree resistant to rotting. The green roof includes a waterproof membrane, a root barrier and a lightweight growing media, 4 inches deep. Hardy, low-growing, drought-resistant plants capture 65 to 100% of roof runoff. Green roofs can last 30 years or more, help to reduce heating and cooling costs, improve air quality and aesthetics. This installation was done by Living Roofs, Inc., a local company. **Can you think of any other benefits of green roofs?**



Permeable Walking Trail

Roads, driveways, parking lots and other paved surfaces are major contributors to polluted stormwater runoff. Various permeable pavement technologies have been developed to allow stormwater to percolate through the paved surface and to minimize runoff. This permeable walking trail consists of a 2-inch gravel base layer and a 3-inch washed gravel surface layer. A product called "Klingstone Paths" was applied to the washed gravel layer as a binder. The resulting walking trail allows stormwater to filter through the trail into the ground below. **Can you think of any other uses for permeable pavement?**



Eco-Lawn with Native Grasses

Maintenance of conventional lawns can take up time and energy and generate greenhouse gases through mowing. The application of chemical fertilizers and pesticides can contaminate stormwater runoff and pollute our creeks and rivers downstream. Eco-Lawn, a seed mix blend of seven fescue grasses, was developed to reduce the maintenance needs of lawns. It grows in both sunny and shady conditions, is drought-tolerant, and requires less fertilizing and mowing, saving time and expense. When left to grow longer, Eco-Lawn can act as an even more effective filter for stormwater and reduce the amount of runoff. **Can you find the stormwater flow path through this Eco-Lawn?**



Infiltration Garden with On-contour Swales

**Infiltration Garden with On-Contour Swales**  
A "swale" is a long, shallow depression in the ground, designed to collect or redirect water. "On-contour swales" are dug along level contour lines to capture stormwater runoff as it flows downhill. These swales hold the water in place and allow it to infiltrate into the ground to provide water for plants on the adjacent soil berms. Water-loving plant species such as elderberry were planted in the soil berms. **Can you think of any sloped ground at your home that could benefit from this on-contour swale technique?**



Bioretention Cell (Rain Garden)

**Bioretention Cell (Rain Garden)**  
Bioretention cells, often called "rain gardens," 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. Together, the soil, plants and microbes capture and treat stormwater to remove pollutants. Bioretention cells are usually designed to allow temporary ponding to a depth of 6-9 inches and include an overflow outlet to prevent flooding. Since the soils at this site are dense clay with slow infiltration rates, this bioretention cell has a perforated pipe underdrain system to allow an additional escape point for the treated water. This cell is over 4 feet deep, with an 8" gravel layer, a 4" sand layer, a 24" soil layer, a 3" mulch layer, and a 9" ponding layer. Nine different native plant species, including species that attract butterflies and other beneficial insects, were planted here. **How many different stormwater pathways can you see in this rain garden?**



Vegetated Swale

**Vegetated Swale**  
Vegetated swales, sometimes called "bioswales," are broad, shallow channels with a dense stand of vegetation covering the side slopes and bottom. They are designed to remove pollutants as the stormwater flows through. Unlike the on-contour swales (#5) which capture stormwater, this vegetated swale is designed to direct stormwater downhill. This particular swale has a mesh matting you might see if you look closely. The matting is there to prevent soil erosion in the fast-moving stormwater. **Can you find the 4 other vegetated swales on this site?**



Deep Bioretention Cell (Rain Garden)

**Deep Bioretention Cell**  
Like the Bioretention Cell in #6, this bioretention cell is comprised of stacked layers of gravel, sand, soil and mulch. But this one is 12 inches deeper and contains a different sandy soil mixture in order to test the pollutant removal effectiveness of different types of soil. **Can you notice any other differences between this cell and #6?**