Crawford County Stormwater Management

Guide to Best Management Practices (BMPs) in the Meadville Area

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Introduction

Best Management Practices (BMP) are techniques used to control stormwater runoff, sediment control and soil stabilization, as well as management decisions to prevent or reduce nonpoint source pollution. These examples of BMPs are acceptable methods of stormwater management in a municipal storm sewer system (MS4). Meadville operates under a MS4. Since 2002, Meadville has been in compliance with the National Pollution Discharge Elimination System (NPDES) MS4s. A MS4 is a conveyance or system of conveyances that are designed or used for collecting or conveying stormwater. The system is not meant for combining sewage. Also, it is not part of a publicly owned treatment works.

The goal of this stormwater management best practices booklet is to provide municipal and elected officials, board and committee members, planners, engineers, planning commission members, students, and the general public with information that will enable them to preserve water resources and better manage stormwater runoff within their community.

The Crawford County Planning Commission, in partnership with the Crawford County Conservation District, the Northwest Office of the Pennsylvania Environmental Council, the Meadville Area Water Authority, and the Center for Economic and Environmental Development (CEED) at Allegheny College have developed this booklet and walking tour to showcase best management practices (BMPs) designed to protect Crawford County's watersheds from impacts of non-point source (NPS) pollution. At each location, tour attendees can learn about various best management practices and gain information about the design, implementation, and maintenance issues associated with each.

This guide was developed as a result of a multi-year planning process to develop a County-wide Stormwater Management Plan. Through this planning process it was determined that this type of educational tool was needed so as to provide the elected officials and public of region with information about what can be done to improve the environment and quality of life for their communities while following the recommendations of the County's ACT 167 Plan.

What is Act 167? Pennsylvania's Storm Water Management Act (Act 167) was enacted in 1978. This Act was in response to the impacts of accelerated stormwater runoff resulting from land development in the state. It requires counties to prepare and adopt watershed based stormwater management plans. It also requires municipalities to adopt and implement ordinances to regulate development consistent with these plans.

In June of 2010 the Crawford County Commissioners approved a County-wide Act 167 that is intended to enable all municipalities in the county to meet the following objectives:

- Manage stormwater runoff created by new development activities taking into account the cumulative basin-wide stormwater impacts from peak runoff rates and runoff volume.
- Maintain existing water quality by preventing additional loading of various stormwater runoff pollutants into the stream network.
- Maximize the use of stormwater management practices that provide groundwater recharge in an attempt to maintain the existing hydrologic regime.
- Preserve the existing natural drainage ways and water courses and provide for proper maintenance of all stormwater management facilities.

This plan was approved by the Pennsylvania Department of Environmental Protection in October of 2010.

Our goal is to educate the public about the importance of watershed protection and how to improve or remediate a watershed from the impacts of non-point source (NPS) pollution. We hope our efforts will prompt people to action with regard to natural resources protection.

Copies of this brochure are available by contacting the Crawford County Planning Office.

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Storm Water Management Glossary

Basics

Stormwater Runoff and storm sewer discharges are the second most significant cause of water pollution in the nation's estuaries. Stormwater runoff is increased by human activities through construction, paving, soil compaction or changes in the vegetation growing on the land. As runoff increases, flooding often follows and can cause streambank erosion and degradation to stream channels and aquatic habitats. Runoff moving across the ground after a rainfall carries pollutants, excess nutrients, and soil to nearby streams, rivers, lakes and estuaries. These substances degrade water quality and can have serious impacts on drinking water and aquatic life.

Increased stormwater runoff is also related to reduced groundwater infiltration. Some portion of annual rainfall needs to infiltrate into the ground to replenish water that humans have drawn out of the ground. Without this recharge, groundwater supplies will continue to decrease, creating shortages for individual drinking water wells and other public supplies that rely on public wells.

Current stormwater regulations in Pennsylvania are aimed at reducing the impacts of stormwater runoff, increasing recharge to public and private water supplies, improving stream corridor habitats, and restoring the overall environmental integrity of the watershed.

Stormwater is a part of the natural hydrologic cycle of precipitation, infiltration, evaporation and groundwater discharge. In undisturbed landscapes, the natural environment maintains an equilibrium by accepting and absorbing rainfall. Healthy vegetation and soil, with its organic matter, porosity, and microorganisms, use and absorb rainwater in their living processes. Excess water infiltrates into groundwater to discharge slowly and steadily into streams and wetlands, supporting essential aquatic ecosystems during dry weather.

Glossary of Terms

Aquifer- A geologic formation that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formation capable of yielding water in sufficient quantity to constitute a usable supply for human use.

Base Flow- Sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by groundwater discharges.

Condensation- The process of water vapor in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water.

Discharge- The volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Evaporation- The process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces. See transpiration.

Evapotranspiration- The sum of evaporation and transpiration.

Flood- An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two characteristics; the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean.

Flood, 100-year- A 100-year flood does not refer to a flood that occurs once every 100 years, but to a flood level with a 1 percent chance of being equaled or exceeded in any given year.

Floodplain- A strip of relatively flat and normally dry land alongside a stream, river, or lake covered by water during a flood.

Groundwater- (1) Water that flows or seeps downward and saturates soil or rock supplying springs and wells. The upper surface of the saturated zone is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that in the Earth's crust.

Groundwater Recharge- (1) Inflow of water to a groundwater reservoir from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. (2) Volume of water added by this process.

Hydrologic Cycle- The cyclic transfer of water vapor from the Earth's surface via evapotranspiration into the atmosphere, from the atmosphere via precipitation back to Earth, and through runoff into streams, rivers, and lakes, and ultimately into the oceans.

Infiltration- Flow of water from the land surface into the subsurface

Million Gallons Per Day (MGD)- A rate of flow of water equal to 133,680.56 cubic feet per day, or 1.5472 cubic feet per second, or 3.0689 acre feet per day. A flow of one million gallons per day for one year equals 1,120 acre feet (365 million gallons).

Nonpoint Source Pollution (NPS)- Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substance originating from land-use activities, which are carried to lakes and streams by surface runoff. Nonpoint source pollution is contamination that occurs when rainwater, snowmelt, or irrigation washes off plowed fields, city streets, or suburban backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants, such as nutrients and pesticides.

Percolation- (1) The movement of water through the openings in rock or soil. (2) The entrance of a portion of the streamflow into the channel materials, contributing to the groundwater supply.

Permeability- The ability of a material to allow the passage of a liquid such as water through rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas impermeable material, such as clay, do not allow water to flow freely.

Point-source Pollution- Water pollution coming from a single point.

Precipitation- Rain, snow, hail, sleet, dew and frost.

River- A natural stream of water of considerable volume, larger than a brook or creek.

Runoff- (1) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or groundwater runoff. (2) The total discharge described above, during a specified period of time. (3) Also defined as the depth which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

Sediment– Material in suspension in water or recently deposited from suspension. In the plural the word is applied to all deposits from the waters of streams, lakes, or seas.

Stormwater- A term used to describe water that originates during precipitation events. It may also be used to apply to water that originates with snowmelt or runoff water from overwatering that enters the stormwater system. Stormwater that does not soak into the ground becomes surface runoff, which either flows into surface waterways or is channeled into storm sewers. Stormwater is of concern for two main issues: one related to the volume and timing of runoff water (flood control and water supplies) and the other related to potential contaminants that the water is carrying.

Storm sewer- A sewer that carries only surface runoff, street wash, and snow melt from the land. In a separate sewer system, storm sewers are completely separate from those that carry domestic and commercial wastewater (sanitary sewers).

Streamflow- The water discharge that occurs in a natural channel. A more general term than runoff, streamflow is applied to discharge whether or not it is affected by diversion or regulation.

Subsidence– Dropping land surface, a result of groundwater being withdrawn in large amounts.

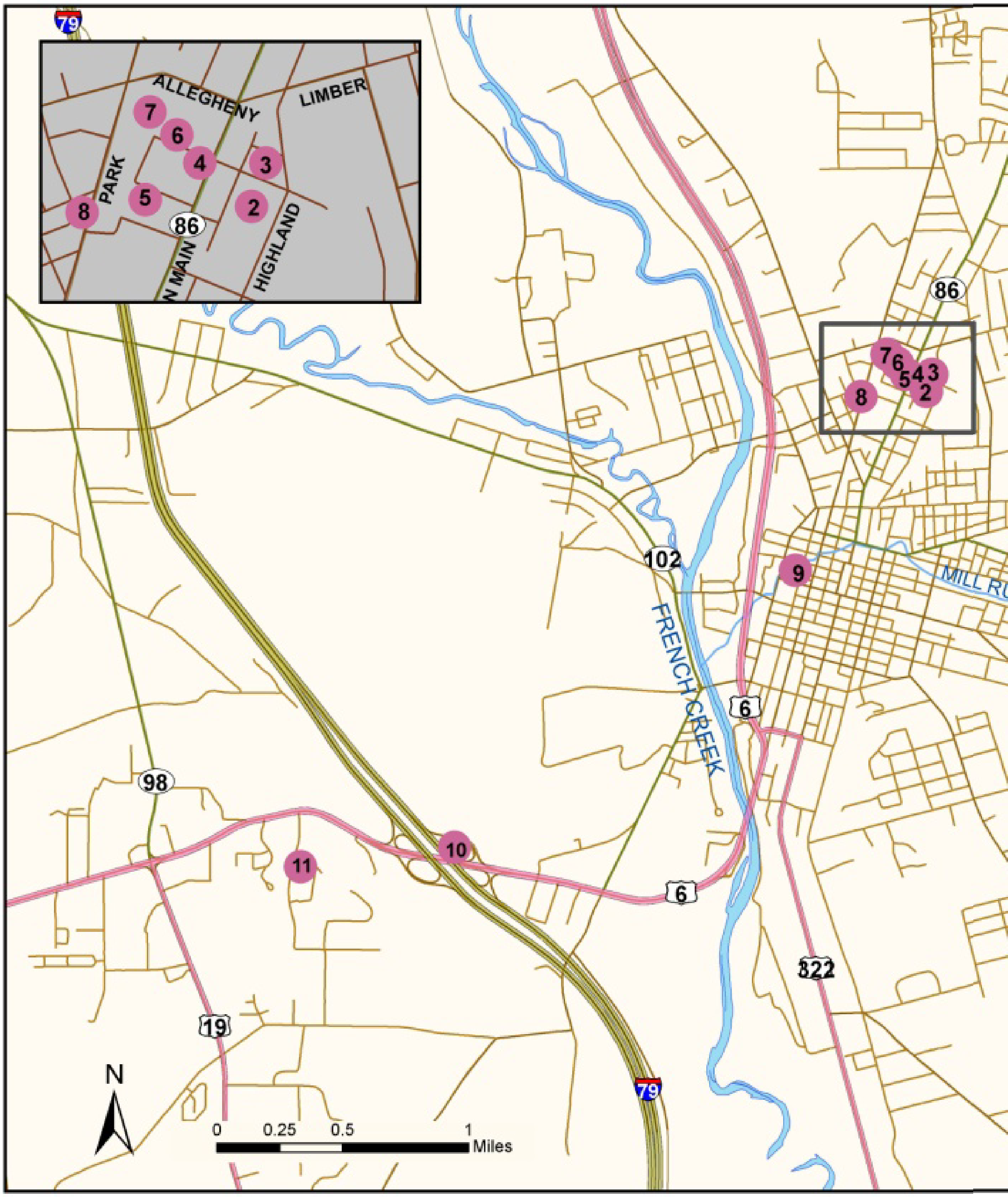
Surface Water- Water that is on the Earth's surface, such as in a stream, river, lake, or reservoir.

Transpiration- Process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, such as leaf pores. See Evapotranspiration.

Water Cycle- The circuit of water movement from the oceans to the atmosphere and to the Earth and returning to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation and transpiration.

Water Table- The top of the water surface in the saturated part of an aquifer.

Watershed- The land area that drains water to a particular stream, river or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map. Large watersheds, like the Delaware River basin contain many smaller watersheds.



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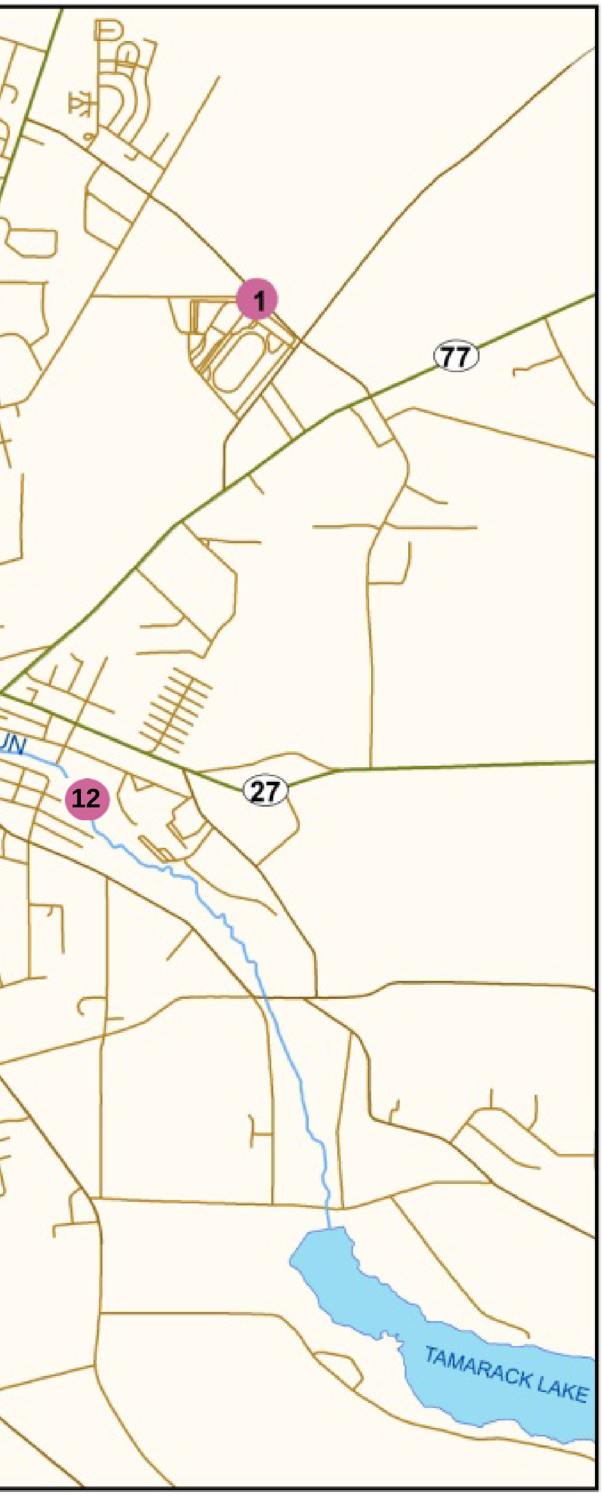

Community Assets

Innovative Stormwater Project

This Map identifies the locations of all the Innovative Stormwater Projects in Meadville.

Best Management Practices

1. Crawford County Fairground
2. Vukovich Center Green Roof
3. North Village Parking Lot (gravel parking lot)
4. Admissions Building (permeable pavers)
5. Allegheny College (rain garden)
6. Oddfellows Parking Lot
7. Ernst Meadow Mix restoration
8. Park Avenue Parking Lot
9. Market House Rain Garden
10. I-79 Interchange
11. Hampton Inn
12. Shadybrook Park

BMP Locations

- *Crawford County Fair Grounds*
  Rain Garden
- *Allegheny College*
  Rain Garden, Permeable Pavers,
  Green Roof, Native Plant Restoration
- *Market House Square*
  Rain Garden
- *Hampton Inn*
  Rain Garden
- *I-79 Interchange*
  Stormwater Management Design
- *Shadybrook Park*
  Stormwater Filtration System
- *Conneaut Lake*
  Rain Barrels
- *Riparian Buffers*
  Stormwater Management Design

Crawford County Fairgrounds

In 2008 the Crawford County Fair Board's Dairy Committee had a new dairy barn constructed at the Crawford County Fairgrounds. This 38,400 square foot structure required the installation of a rain garden as the primary stormwater control mechanism.

1

(1) Looking out over the lower of the two rain gardens. An overflow pipe on the upper rain garden to prevent the overflow of water. (2) An outflow drainage pipe leading into the lower garden. (3) Close-up of the drainage pipe (4) An outflow drainage pipe leading into the lower garden.

Designed by: Crawford County Conservation district. Maintained by: Crawford County.

Vukovich Center Green Roof

The Vukovich Center for Communication Arts on the Allegheny College Campus was opened in the spring of 2009. The Vukovich Center features a green roof, or "garden roof", of grass, ground cover, and trees. This contributes not only to the beauty of the building but also to making it a highly energy efficient structure.

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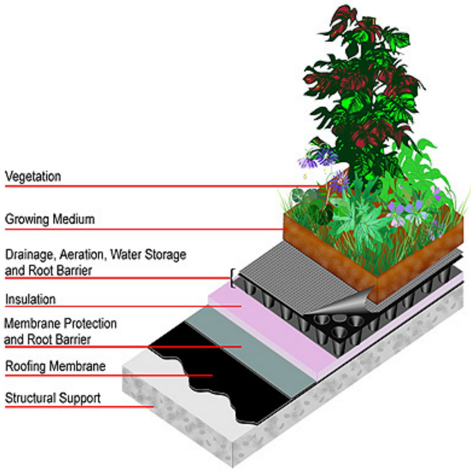


(1) Looking down a walkway towards the front of the building. On the left, roof fans and air systems are enclosed by a wooden frame. (2) A walkway leading to the top floor entrance of the building. On the right and in the rock garden, raised sky windows look down into the building. To the left, a grass plot with plants lining the walkway. (3) Trees line the front of the garden along with benches and plants on the walkway.

Designed by: Ennead Architects LLP (New York, NY).
Maintained by: Allegheny College

North Village Parking Lot

3

The gravel parking lot is an effective way to prevent stormwater runoff but meets difficulties in the winter season. The lot is difficult to plow adequately after snowfall due to the gravel and geowebbing. As a result, some surface gravel is plowed along with the snow which then collects in areas where the snow is pushed. Since the lot cannot be plowed as effectively as pavement, drivers become stuck in the snow and require towing.

(1) A mound of gravel that has been built up by plowing over the winter and now exposed after the snow has melted. (2) Exposed geowebbing underneath the gravel. (3) The parking strips of the lot are made of recycled rubber and are flexible, as a result, over time the strips have a tendency to warp, resulting in some parking strips being worked out of the gravel.

Designed by: Porter Consulting Engineers (Meadville, PA). Maintained by: Allegheny College.

Admissions Building

The Allegheny Admissions Building permeable pavement parking lot is located uphill from the two Admissions Building rain gardens. The lot is made up of an upper layer of brick, underneath of which is stone gravel. The parking lot captures water flowing from the roadway and directs it through pipes into the two rain gardens. Project completed by Trace Landscaping following a manufacturer's detail.

4

(1) Looking uphill, the Admission parking lot. (2) Close-up of the permeable brick showing gravel underneath.

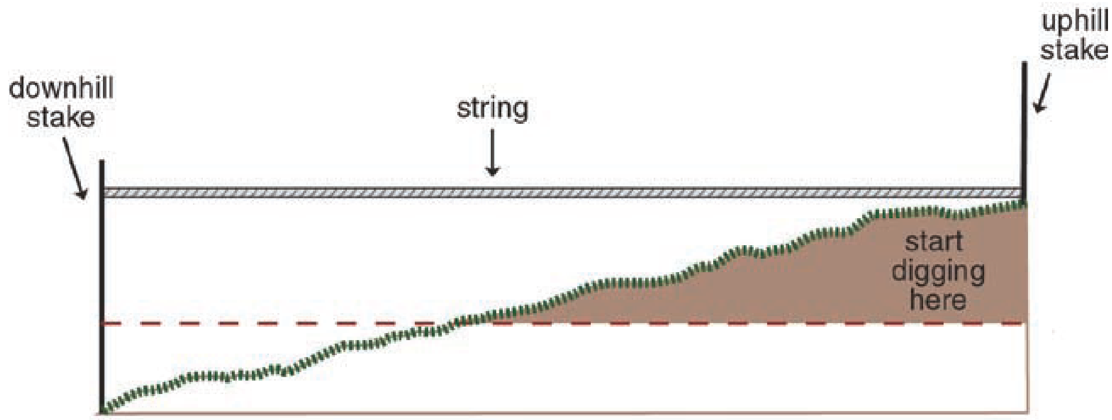
Designed by: Derck & Edson Associates (Lititz, PA). Maintained by: Allegheny College.

The Allegheny Admissions building rain garden is designed to catch water runoff from the sloping yard behind the building, water absorbed by the permeable paver parking lot along the roadway, and from the 4,000-5,000 square foot roof via underground piping.

5

(1 - 2) The rain gardens behind the Admissions Building at Allegheny College.

Designed by: Derck & Edson Associates (Lititz, PA). Maintained by: Allegheny College.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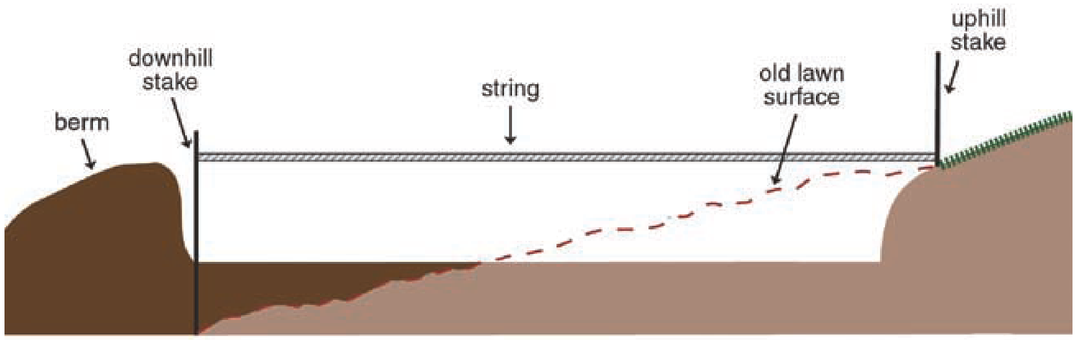
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Oddfellows Parking Lot

The Oddfellows Parking Lot contains a five foot deep stone gravel drainage system on the perimeter of the lot designed to catch water runoff from the surface. Beneath the gravel layer is a pipe which holds water to slowly percolate into the ground.

6

(1-3) The stone gravel drainage basin at the edge of the lot.

Designed by: Quality Engineering Solutions (Conneaut Lake, PA). Maintained by: Allegheny College.

Meadow Restoration

7

(1) Wildflowers planted from Ernst Seed in the foreground. Beyond is the two-level Oddfellows parking lot. (2-3) Photos looking up towards the second level of the parking lot. The sloping wild grassy areas were planted with Ernst Seed Meadow Mix.

Designed by: Ernst Seed (Meadville, PA).
Maintained by: Allegheny College

The Ernst meadow mix restoration can be found surrounding the Oddfellows parking lot and extending below the lower lot to create an open recreational space. The planting helps to prevent soil erosion, and the bright blooms are eye-catching. The lower field of planted seed mix (ERNMX 153) is a variety of twenty-three different species including Little Bluestem 'Camper,' Virginia Wild Rye, PA Ecotype, Side Oats Grama, 'Trailway' Indiangrass, 'Prairie View', Tall White Beard Tongue, PA Ecotype, and Black Eyed Susans (pictured above). The seed mix (ERNMX-140) planted on the sloping hill of the lot is a mix of twenty different plants including Riverbank Wild Rye, Bottlebrush Grass, Little Bluestem, Tall White Beard Tongue, Deer Tongue, Black Eyed Susan, Golden Alexanders, and Partridge Pea.

- Things to keep in mind when considering a wildflower planting:
- Native wildflower plots take time to develop. It is important to recognize that it can take three to five growing seasons for the full array of species to develop.
- Prior to planting a wildflower mix, it is critical to control the existing vegetation because many native wildflower species are not as aggressive as common problematic weed species. This can be done via chemical and non-chemical means.
- Select a wildflower seed mix that is interesting and diverse and that includes long-lived perennials.
- The ideal planting time for native wildflowers is late October through early May.

7

(1-3) Woodchip walkway through the Meadow Mix flowers.

Park Avenue Parking Lot

The Park Avenue parking lot includes a grass infiltration system along the Western end of the parking lot which handles rain water runoff from the asphalt. Water flows from the parking lot and into the drainage trench whereby it pools and sits for a day or more to leech back into the ground. The storm drain is a Quality Engineering Solutions Inc. design that was installed by the Kebert Construction Company.

8

(1) The grass drainage ditch to the left of the pavement captures stormwater runoff. (2) The drainage ditch to the right of the pavement on the lower parking lot.

Designed by: Quality Engineering Solutions (Conneaut Lake, PA). Maintained by: Allegheny College.

Market House Rain Garden

With support from Allegheny College and Keep Pennsylvania Beautiful (KPB), the Market House rain garden was completed during the summer of 2007. In collaboration with the Redevelopment Authority and the city of Meadville, a stormwater garden was designed and built to mitigate stormwater overflows during heavy rains. The garden was built on a vacant lot adjacent to the new municipal parking garage in the Market House Square area. The garden consists of two stone gravel swales that spiral around a brick walkway which connects the parking garage with the side walk and cross walk.

9

Courtesy of Bill Owen

(1) The rain garden viewed from the top level of the parking garage. The garden connects the parking garage at left and the Market House in the upper right via a brick walkway.

Designed by: The Center for Economic and Environmental Development (Meadville, PA). Maintained by: CEED and the Redevelopment Authority.

Drawing by Arial Duncan and Amara Geffen

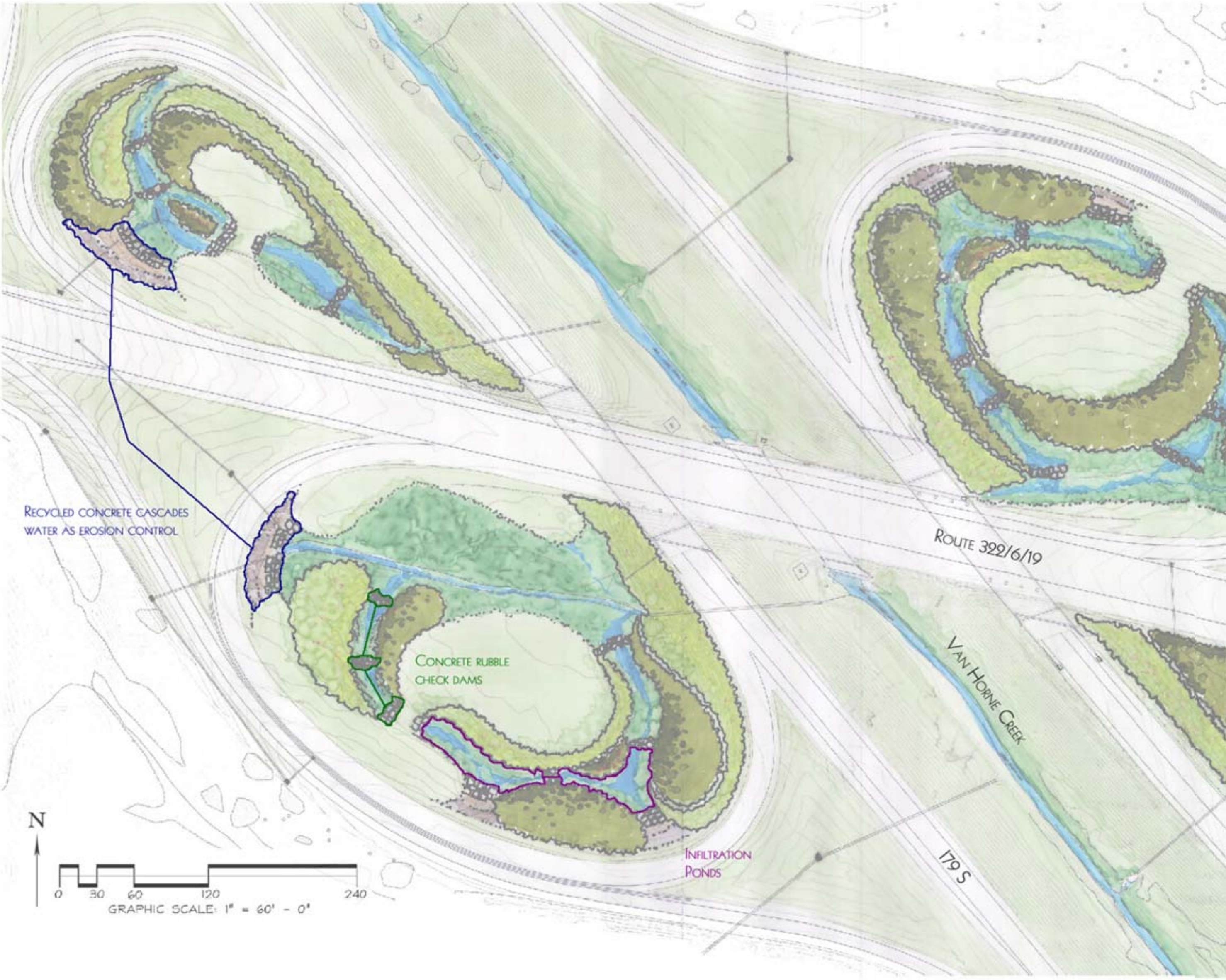
9

All photos this page courtesy of Bill Owen

With a depth of three feet, the gravel swales capture storm water runoff from the parking garage roof and allow it to percolate into the ground. This design has proven successful in preventing flooding of the Market House Square area. The garden was constructed through a combination of volunteer and contracted work. Some materials, such as the brick, were acquired from other sites and installed here as a walkway. The trees were donated by the Plant Place, reducing the cost of the garden. The garden was built on a lot which was previously the location of a building. As such, concrete slabs had to be removed from the site before the installation of sections of the gravel swales. The garden requires basic landscaping maintenance throughout the year. The Market House rain garden exemplifies the use of aesthetics to beautify a space which also serves a functional purpose. Rain gardens can become a recreational addition to a community through good design and management.

I-79 Interchange

Allegheny College's Center for Economic and Environmental Development's (CEED) Arts & Environment Initiative was awarded a contract to design an innovative solution to stormwater runoff at the I-79 interchange in Meadville. Both aesthetic and functional solutions will be addressed through the project, which will serve as a national model for handling stormwater and improving water quality on federal highways. Construction started in the Spring of 2008.

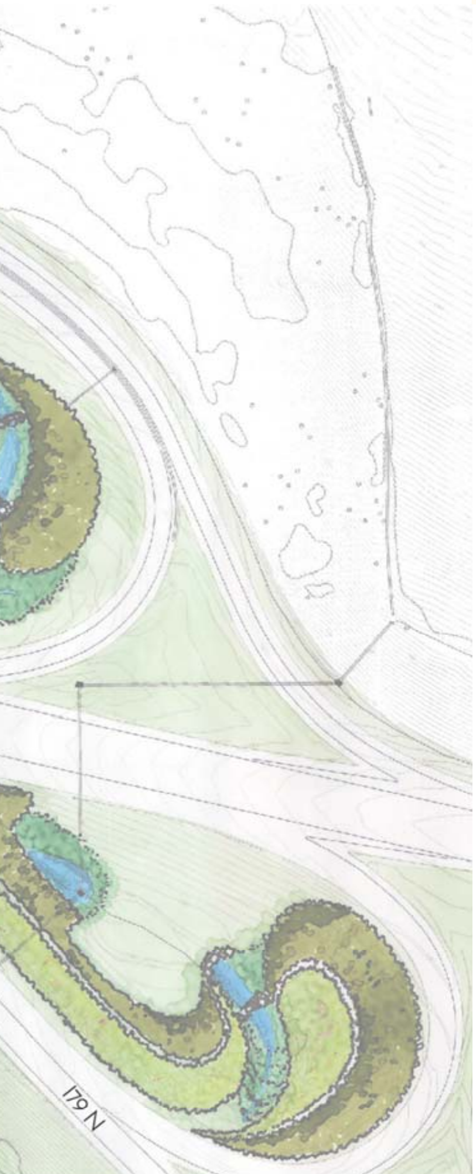


Pictured here is the four leaf clover design which connects Route 6 with Interstate 79.
Rain gardens are constructed in the center of the four interchanges to capture stormwater.

Designed by: CEED (Team members: artists Amara Geffen and Angelo Ciotti, Steve Halmi of Deiss and Halmi Engineering and Chris Brown of Derck & Edson Associates)
Maintained by: PennDOT

The mounds direct the flow of water coming off the cloverleaf. Instead of simply running off the roadway and into Van Horn Creek, which runs between the north and southbound lanes of I-79 and feeds directly into French Creek, the water has a chance to percolate and purify in the raingarden before eventually making its way into Van Horn Creek.

10



The purpose of the I-79 project was to develop creative solutions to enhance the planned improvements to the I-79 interchange at the Meadville/Conneaut Lake exits. Specifically, CEED's design team collaborated with Sucevic, Piccolomini, and Kuchar Engineering, Inc. and PennDOT to develop innovative solutions for capturing stormwater along federal highways. By directing run off from the new bridge and adjacent roadway into the cloverleafs, where it was filtered through sculptural landscaping designed to reuse concrete road rubble, create water purification systems, and minimize maintenance, we have demonstrated alternatives to sheet flow that are aesthetically pleasing and functional. The resulting remediation and beautification designs are consistent with PennDOT's Context Sensitive Design (CSD) solutions initiative, and apply such designs to stormwater best management practices (BMPs) while meeting Pennsylvania Department of Environmental Protection (DEP) requirements. The project also models best practices for Context Sensitive Design solutions for bridge parapets, abutments, and bridge fascia beam color.

10

Hampton Inn

The Hampton Inn, located on Rt. 322 in Vernon Township, was constructed in 2010 and features a parking lot with cut curbs that allow drainage from the parking lot into large rain gardens.

11

(1) Cuts in the curb of the parking lot allow water to flow down off the pavement and into the rain garden to hold and release stormwater. (2) An overflow pipe in the rain garden prevents water from rising higher into the garden. (3) A stone path directs water off of the pavement and into the far end of the garden. (4) Garden within the lot.

Designed by: Porter Consulting Engineers (Meadville, PA).
Maintained by: Hampton Inn

Shadybrook Park

12

Designed by: Deiss & Halmi, Derck & Edson Associates, and Amara Geffen.
Maintained by: The City of Meadville

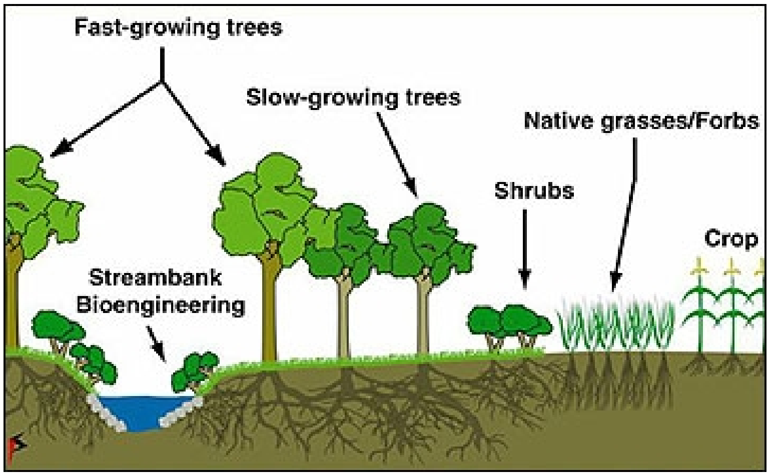
An estimated 19 acres of stormwater runs directly into Shadybrook Park from the surrounding area. A result of impervious surfaces, this runoff is contaminated with fertilizers, road salts, gas and oil, and eroded soils, all of which flowed directly into Mill Run. A stormwater management project addressing this problem was designed an implemented in 2010 as a collaboration between the city of Meadville and Allegheny College students and faculty. Project engineering and design consultation was provided by Deiss & Halmi Engineering, Derck & Edson, and artist Amara Geffen. In a multi-step process, excess stormwater from the surrounding area is directed into a forebay pool where it is temporarily retained and directed into the filtration system where it is filtered. The system ensures that water that flows to Mill Run is purified and also stimulates recharging of ground water systems. The forebay pool collects the heaviest of the sediment and holds excess water until it is directed into the filtration system. The filtration system captures the polluted stormwater, where it passes through a layer of vegetation into a mixture of sand and other filter media that capture sediments, metals, hydrocarbons, and other pollutants. The filtration systems is planted with wetland meadow plants that also aid in the filtration process. A low sculptural berm was holds excess water back ensuring that the stormwater moves through the filtration system before flowing into Mill Run.

Conneaut Lake Rain Barrels

Rain barrels are used to collect rain water from the gutter and store it so that it can be used later as a source of garden water. In the photo to your left you see a lady who has set up a rain barrel at the end of the spout of her gutter. This allows the water that runs off the roof and into the gutter to be collected. On the bottom of the barrel there is a spout. This spout could be turned on or off and a hose could be connected for easy reach other parts of the garden. This helps reduce the amount of runoff from the rooftop into storm sewers and waterways.

Installed by: The City of Conneaut Lake
Maintained by: Residence

A program coordinated by the Crawford County Conservation District and funded by the DEP Growing Greener program to provide rain barrels at low cost to resident within the Conneaut Lake watershed. Residents were offered commercial rain barrels and professional installation for a nominal cost share. The program was limited to 100 barrels within the Conneaut Lake watershed, and will expire in June of 2011. Residents who participated in the program were required to attend a short informational session on stormwater management before they could enroll in the program. The purpose of the program was to provide storage for up to 5,500 gallons of stormwater per rain event. In addition to this extra storage capacity, the program was designed to promote the use of simple stormwater management techniques within the Conneaut Lake area. Conneaut Lake was chosen because it is now listed as an impaired waterway. Conneaut Lake has also historically suffered from stormwater problems.



A riparian buffer consists of planting grasses, shrubs and trees in a specific order along a stream reach. These plantings do a number of things to help a stream stay healthy. The installation of fencing along the stream will keep cattle out of the stream thus eliminating erosion caused by cattle walking in and out of the water. Without cattle in the water course excess nutrients from manure will also be reduced. Keeping cattle out of a stream not only has environmental benefits, but can also have benefits to the dairy herd. Cattle will be healthier and vet bills should be reduced if they are no longer forced to drink from potentially contaminated water sources. Healthier cattle will produce more milk and will be more profitable.

The creation of a riparian buffer will have dramatic effects on water quality and the organisms using the buffer area along the stream. Trees and shrubs along the stream corridor will provide shade for the stream thus keeping the water cooler in the summer. Cooler water means more oxygen for the fish and Macroinvertebrates (aquatic insects and crustaceans) living in the stream. Also, some species of fish cannot survive in water that is to warm. Leaves and twigs falling from the trees and shrubs along the stream will provide a food source for macroinvertebrates, thus providing the first link in the food chain. Trees and grasses planted along the stream will also take up excess nutrients and slow down water running off the land. Tree roots will also hold soil in place along the streambank, stabilizing the stream and reducing lateral stream channel movement. The forested riparian buffer will also intercept soil running off the uplands preventing excess sediment from entering the stream and choking out aquatic life. Excess sediment can also bury rocks and gravel, which are necessary habitat for stream life.

References

Water Resources Education Network:
www.wren.palwv.org/

Department of Environmental Protection Watershed Management:
www.depweb.state.pa.us/watershedmgmt/cwp/view.asp?a=1437&Q=518682&PM=1

Environmental Protection Agency Nonpoint Source Tool Outreach Toolbox:
www.epa.gov/nps/toolbox/index.html

PA's NPS Management Homepage:
www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/Nonpointsourcepollution/defaultnew.html

What is Nonpoint Source Pollution?:
www.epa.gov/owow/nps/qa.html

Nonpoint Source News-Notes:
www.epa.gov/OWOW/info/NewsNotes

Photographs of Best Management Practices (BMP's):
www.epa.gov/owowwtr1/NPS/ex-bmps.html

Wastewater Education Materials:
www.cfpub.epa.gov/npdes/wastewatermonth.cfm#other

Nonpoint Education for Municipal Officials (NEMO):
www.nemo.uconn.edu/

National Management Measures to Control Nonpoint Source Pollution from Urban Areas:
www.epa.gov/owow/nps/urbanmm/

Stream-A-Syst: A Tool to Help You Examine Stream Conditions on Your Property:
www.eesc.orst.edu/agcomwebfile/edmat/html/em/em8761/em8761.html

NPS Unified Watershed Assessment:
www.dep.state.pa.us/dep/deputate/watermgt/WC/Subjects/NonpointSourcePollution/Initiatives/WRASLISTINFO/UniWshed-Tbl-A.htm#Table-1

Perkiomen Watershed Conservancy Stormwater Management Glossary:
www.perkiomenwatershed.org/Stormwater/stormwater_management_glossary.aspx

Stormwater Manager's Resource Center:
www.stormwatercenter.net/

Environmental Guidelines for Responsible LawnCare and Landscaping:
www.epa.gov/pesticides/grants/lei/draft_guidelines.pdf

Rain Gardens A How-to Manual for Homeowners:
www.dnr.wi.gov/runoff/rg/rgmanual.pdf

A Homeowner's Guide to Stormwater Management:
www.greentreks.org/eacnetwork/pdf/
PWDFinalHomeownerBMPManual11006.pdf

Landowner Guide to Buffer Success:
www.creppa.org/pdf/landowner%20guide%
20revised%2030oct07.pdf

Using Natural Landscaping for Water Quality &Esthetics:
www.cleanwater.uwex.edu/pubs/pdf/storm.basins.pdf

Sponsors

Water Resources Education Network (WREN)

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