LOWER MAKEFIELD TOWNSHIP

STORMWATER MANAGEMENT

MS4 PROGRAM OVERVIEW
2023 UPDATE

Presented By Township Engineer:
Andrew Pockl, PE, CFM

MS4 : Municipal Separate Storm Sewer System:

Stormwater conveyance system from impervious surfaces to local waterways

Permit Requirements
Minimum Control Measures (MCM)

- MCM 1 – Public Education and Outreach
- MCM 2 – Public Involvement and Participation
- MCM 3 – Illicit Discharge Detection and Elimination
- MCM 4 – Construction Site Runoff Control
- MCM 5 – Post Construction Stormwater Management
- MCM 6 – Pollution Prevention & Good Housekeeping
- Pollution Reduction Plan
- PCMs – Pollution Control Measures

What's New for 2023?

- MCM 1 – Township Continues to Post Stormwater Related Information on Social Media
- MCM 2 – This presentation allows us to comply with permit requirements
- MCM 3 - SWM Ordinance has been updated to be in accordance with the DEP Model Ordinance
- MCM 6 – O&M Plan Updated Annually starting in 2018

What's New for 2023?

- Permit Approved in February 2022
  - General Permit Expires 2023 – Extension Expected
  - 137 Outfalls to be Inspected in 2023
- PCMs – Pollution Control Measures
  - Investigation Ongoing – Completed by End of Year
  - Animal Waste Protection - Done

Approved Pollution Reduction Plan

- Reduction Plan to be Executed by 2027

  General Permit expires in 2023, renewal may come with increased requirements (e.g. reductions) so it is important to not delay any stormwater initiatives.

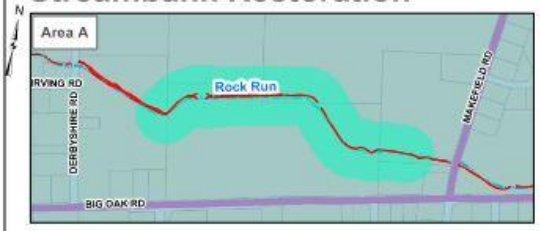
- Approved BMPs to be Implemented
  - Streambank Restoration at Charles Boehm MS
  - Porous Paving Parking Lot at 5 Mile Woods
  - Regional Detention Basin Retrofits

MS4 PRP PROPOSED BMP OPTIONS

0 375 750 1,500 Feet

1 inch = 750 feet

Charles Boehm Middle School Streambank Restoration

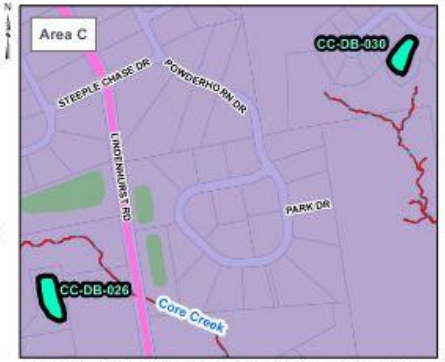


Pervious Pavement

Five Mile Woods Parking Lot

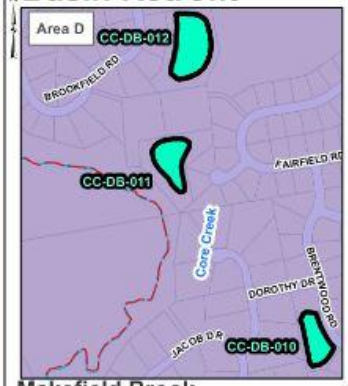
0 625 Feet

Basin Retrofit



Dolington Estates and Penn's Fields at Farmview

Basin Retrofit

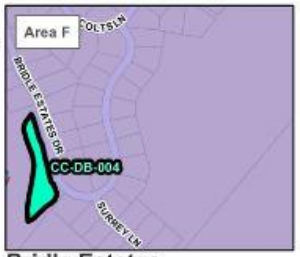


Makefield Brook

Basin Retrofit

Back of Yardley Run

Basin Retrofit



Bridle Estates

Basin Retrofit

Hidden Oaks

Basin Retrofit

Yardley Crest

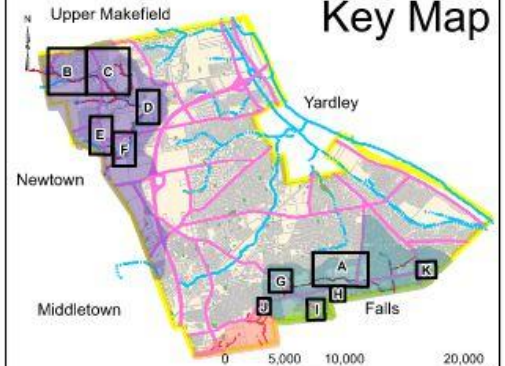
Basin Retrofit

Basin Retrofit

Basin Retrofit

Data Sources:
1. Parcel Data provided by Bucks County Planning Commision.
2. Stream data provided by Pennsylvania Spatial Data Access (PASDA).

Key Map



Lower Makefield Township
Bucks County, PA

Legend

- Rock Run Streams-Siltation Impaired
- Queen Anne Streams-Siltation Impaired
- Core Creek Streams-Siltation Impaired
- StreamBank Restore
- Proposed PRP Basins
- Proposed PRP Pervious Pavement
- Basins, Wetponds & Lakes

Impaired Watersheds

- CORE CREEK
- MARTINS CREEK
- QUEEN ANNE CREEK
- ROCK RUN
- PennDOT
- Streams
- Parcels
- Municipal Boundary

Last Revised: 1/14/2022

RVE 1901 REMINGTON & VERNICK ENGINEERS

BMP Schedule

- 2023
  - Charles Boehm Middle School Streambank Restoration - $600,000: *1.12 Acres**
  - Five Mile Woods Parking Lot Pervious Pavement - $297,312: *3.0 Acres**
- 2024
  - Hidden Oaks Basin Retrofit - $571,212: *57.43 Acres**
  - Penn's Fields at Farmview Basin Retrofit - $132,648: *59.44 Acres**
  - Yardley Crest Basin Retrofit - $ 240,208: *31.32 Acres**
- 2025
  - Makefield Brook Basin Retrofit - $767,580: *43.76 Acres**
  - Bridle Estates Basin Retrofit - $257,760: *58.63 Acres**
  - W Ferry Road Basin Retrofit - $349,440: *45.05 Acres**
- 2026
  - Dolington Estates Basin Retrofit – $169,776: *75.54 Acres**
  - Yardley Run Basin Retrofit – $513,540: *89.06 Acres**
  - Twining Road Basin Retrofit - $140,000: *24.81 Acres**

**Area Treated By BMP*

Pollution Reduction Plan Schedule

- The projects listed are within the following watersheds and will help to meet the pollution reduction requirements:
  - Core Creek Watershed
    - Dolington Estates Basin Retrofit, Penn's Fields at Farmview Basin Retrofit, Makefield Brook Basin Retrofits, Yardley Run Basin Retrofit, Twinning Road Basin Retrofit, Bridle Estates Basin Retrofit

Core Creek Watershed	Goal	2023	2024	2025	2026	Total
Sediment Reduction (10%)	78,360.16	0.00	0.00	91,167.12	Requirement Satisfied in 2025	91,167.12
Cost for Projects		$ -	$ -	$ 1,025,340.00		$ 1,025,340.00
Reduction Credits Remaining		78,360.16	78,360.16	-12,806.96		

  - Queen Anne Creek Watershed
    - Five Mile Woods Parking Lot Pervious Pavement

Queen Anne Creek Watershed	Goal	2023	2024	2025	2026	Total
Sediment Reduction (10%)	847.25	1,210.82	Requirement Satisfied in 2023			1,210.82
Cost for Projects		$ 297,312.00				$ 297,312.00
Reduction Credits Remaining		-363.57				

Pollution Reduction Plan Schedule

- The projects listed are within the following watersheds and will help to meet the pollution reduction requirements:
  - Martin's Creek Watershed
    - Yardley Crest Basin Retrofit

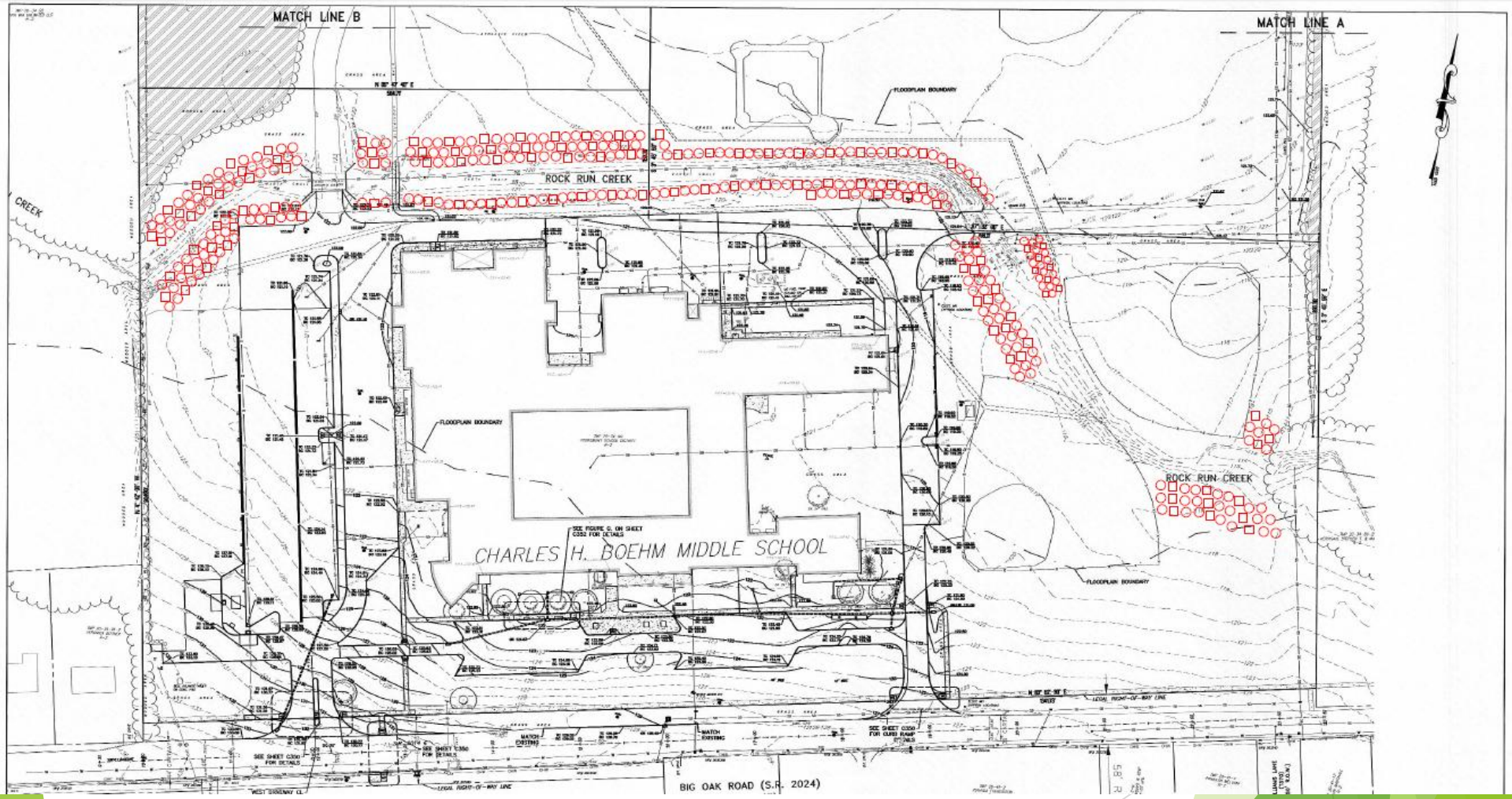
Martin's Creek Watershed	Goal	2023	2024	2025	2026	Total
Sediment Reduction (10%)	4,695.11	0.00	9,432.31	Requirement Satisfied in 2024		9,432.31
Cost for Projects		$ -	$ 240,208.00			$ 240,208.00
Reduction Credits Remaining		4,695.11	-4,737.20			

  - Rock Run Creek Watershed
    - Charles Boehm Middle School Streambank Restoration, Hidden Oaks Basin Retrofits, W Ferry Road Basin Retrofit

Rock Run Creek Watershed	Goal	2023	2024	2025	2026	Total
Sediment Reduction (10%)	70,205.85	47,124.00	20,178.62	13,303.25	Requirement Satisfied in 2025	67,302.62
Cost for Projects		$ 600,000.00	$ 571,212.00	$ 349,440.00		$ 1,520,652.00
Reduction Credits Remaining		23,081.85	2,903.23	-10,400.02		

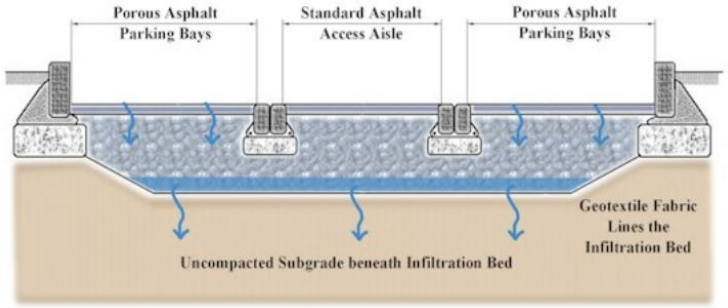
Charles Boehm Middle School Streambank Restoration

- Estimated Cost - $600,000
- Scope
  - Improve and restore streambank to help the stream channel's ability to transport sediment and maintain its natural capacity
  - Improve stream's performance during a flooding event and maintain existing aquatic environments
  - Restore stream bank with natural materials and create gentler slope to drastically reduce erosion. Plant forested buffer area around top of bank on both sides of stream to reduce maintenance, provide wildlife habitat and reduce sediment from site impervious areas being transported to stream.


MATCH LINE B
MATCH LINE A
ROCK RUN CREEK
FLOODPLAIN BOUNDARY
CHARLES H. BOEHM MIDDLE SCHOOL
BIG OAK ROAD (S.R. 2024)

Five Mile Woods Parking Lot Pervious Pavement

- Estimated Cost - $297,312
- Scope
  - Install pervious pavement to allow stormwater to drain through the surface where it is then held in the voids of the stone placed underneath and then slowly drains into the underlying, uncompacted soil mantle



Five Mile Woods Parking Lot Pervious Pavement

Figure 1: Entrance of parking lot

Figure 2: Parking lot looking towards Five Mile Woods

Figure 3: Parking lot looking towards entrance

W Ferry Road Basin Retrofit

- Estimated Cost – $349,440
- Scope
  - Retrofit the existing basin by installing native plantings to increase infiltration, removing the concrete low flow channels, maintaining the inlet and outlet structures

W Ferry Road Basin Retrofit

Figure 1: West side of basin looking downstream towards W Ferry Rd

Figure 2: Middle of basin looking downstream down low flow channel

Figure 3: Low flow channel looking upstream towards Figure 4 location

Figure 4: East side of basin looking downstream

Resources

For professional advice, contact your county conservation district or state extension office:

PACD
Pennsylvania Association of Conservation Districts, Inc.
http://pacd.org/your-district/find-your-district/

PENNSTATE
Cooperative Extension
College of Agricultural Sciences
http://extension.psu.edu/counties

Published by:

pennsylvania environmental council
215-545-4570 www.pecpa.org

Watershed Coalition of the Lehigh Valley
www.watershedcoalitionlv.org

Cover photo: Jisett/PWC

Budget Considerations

Cost is typically a major factor when considering a basin retrofit project. After identifying the project area and collecting key information, it will be easier to outline goals that fit your budget.

- **Consider the budget in general terms.** Basin retrofits range from simple plantings to complex engineering designs. Although it is difficult to estimate, here are some rough calculations:
  - Simple Landscape retrofit: $500+
  - Simple Engineering retrofits: less than $15,000
  - Moderate Engineering retrofits: $15,000 - $50,000
  - Complex Engineering retrofits: $50,000+
- **Consider using existing resources** to reduce costs. Resources can include the use of municipal labor, machinery, compost and soil materials. Volunteer efforts can also be of enormous value.
- **Include maintenance costs.** Calculate the current maintenance costs for the basin, especially mowed turf. Then calculate the proposed maintenance costs for the retrofitted basin. Often there is significant cost savings over time for reducing basin mowing. Be sure to include costs associated with managing invasive plant removal for several years.
- **Grant funding may be available.** The following list of grantors fund basin retrofit projects:
  - Growing Greener (Pennsylvania Department of Environmental Protection)
  - Exelon Schuylkill River Heritage Area Grant Program
  - TreeVitalize
  - PENNVEST

Public Outreach

Basin retrofits involve a change from manicured, turf grass to natural looking meadow grass and shrubs. Because change can be a challenge, outreach to the community can be a critical factor in project success.

Reach out to landowners and community leaders. Send letters or hold an informational meeting to explain the proposed project and gather comments. Emphasize the benefits of the project and address concerns. Not all citizens realize that stormwater is an issue that can be addressed by retrofitting existing basins.

Continue to communicate to stakeholders during each phase of the project. Let the community know that more visually appealing basin retrofit will emerge over a several year period. Adding a mowed path around the edge of the basin and bird boxes may provide an opportunity for walking, bird watching, or nature contemplation. Signs explaining project features and benefits are essential.

Public Health and Safety Concerns

The two most common concerns people have with naturalized landscapes involve the perception of increased populations of mosquitos and ticks.

West Nile Virus (WNV) is a mosquito-borne disease. Infiltration testing should be conducted during the design phase to assure that the water retained in the retrofitted basin will infiltrate into the ground (or drain) before mosquito breeding can occur. A retrofitted basin may actually reduce mosquito populations by creating a habitat with insects, birds and other animals which eat the mosquito larvae.

Lyme disease is transmitted to humans through the bite of infected deer ticks. To avoid contact with ticks, mowed paths can be established in and around stormwater basins that are used by the public.

Aesthetic Concerns

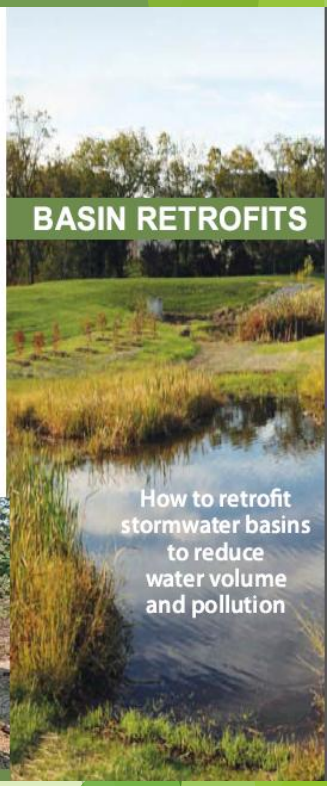
In order to manage the expectations of the public, basin owners should demonstrate that the naturalized basin is being maintained. Simple measures to indicate that the naturalized basin is intentional and not neglected may include: fencing, mowing the edge of a naturalized basin, providing mowed trails, installing interpretive signage, and removing invasive plants. The goal over time is to see well managed naturalized basins become the new landscaping norm.

Permitting

All earth disturbance activities in Pennsylvania are regulated by the Pennsylvania Code. When the ground surface is disturbed, loose soil can be carried into waterways during storm events as pollution called *sediment*. Regulations require the implementation of erosion and sediment control best management practices and may require an approved erosion and sediment plan from the County Conservation District. Contact your municipality and your local county conservation district about plan and permit requirements prior to starting the project.

Maintenance and Schedules

After a retrofit is complete, a maintenance plan must be developed and implemented. Regular maintenance will ensure that the basin continues to function as designed, complies with regulations and is aesthetically pleasing. General maintenance activites include: preventing sediment and litter accumulation, erosion control, ensuring proper drainage, regular inspections after storm events, and maintaining the native plant community.



BASIN RETROFITS

How to retrofit stormwater basins to reduce water volume and pollution

Why Retrofit?

Retrofitting existing stormwater basins offers a relatively low cost opportunity to slow down and clean the water before it reaches streams, thereby reducing flooding, erosion and water pollution.

Stormwater causes flooding, erosion, loss of stream habitat and water pollution. Hundreds of stormwater basins have been constructed in Southeastern Pennsylvania to manage runoff from development. Most basins were designed to convey smaller storms quickly through the basin, detaining only larger storm events.

In order to improve water quality and reduce volume, the smaller storms must be managed by the basins as well. The runoff from the very beginning of any storm picks up all of the surface contamination and contains more pollution than runoff from later in the storm. This is called the *first flush*. In traditional basins, this initial water passes through the basin very quickly.

The inside poster will show you how basin retrofits work.

Jisett/PWC

The Case for Basin Retrofits

- **Reduction of flooding and erosion can be costly.** Retrofits can reduce the damage at a reasonable cost.
- **Retrofits can reduce mowing costs over time.** Retrofitted basins require less frequent mowing, using less gas, fewer man hours and causing less equipment wear and tear.
- **Naturalized basins can enhance the aesthetics of engineered basins.**
- **Regulatory compliance for stormwater regulations.** Basin retrofits can help communities required to limit non-point source pollution discharges reach their new goals by slowing and filtering stormwater runoff.
- **Naturalized basin landscapes have habitat benefits** that attract birds, butterflies and beneficial insects while deterring geese.

Retrofit Basics

Gather information about basin access, size, structural features, historic design plans, current field conditions, visibility and note unique conditions of the basin. A site visit is critical.

Soil Test and Percolation/Infiltration Test

A key consideration for retrofitting a basin is how quickly water infiltrates into the ground if it is detained in the basin. Water in a dry detention basin should drain within 48 to 72 hours. Infiltration will be impeded if bed rock or the water table are at a shallow depth or if there is compaction or hard layers of soil. Check available records for the types of soil present and whether soil testing has been conducted since the basin was constructed. It is recommended that infiltration rate testing be carried out.

Survey

In order to design the retrofit, it may be necessary to collect survey information to verify the elevations of basin features such as berms, spillway, and the basin floor. Often basins will accumulate sediment over time, which can lead to changes in their holding capacity and it is important for the designer to account for the changes.

Inspection and maintenance records combined with survey information can reveal the current capacity of the basin, how much sedimentation has occurred since the basin was constructed, how much sediment can be removed to achieve original design conditions, and what the potential is to gain additional volume via a retrofit expansion.

D. Harris

Mapping

If possible, **obtain a copy of the stormwater system map or plan** that shows location of the basin itself, the inlets, ditches, pipes and other conveyance systems that direct water into and out of the basin. For more complex basin retrofit projects, the size of the land area that drains into the basin (the catchment area) will also need to be determined. Municipalities are required to develop maps of their stormwater systems. When considering a basin retrofit, first check with the municipality's engineer or manager to determine the status of basin and stormwater system mapping. Also, review your project with municipal officials to determine the need for any permits.

Jisett/PWC

Questions to Ask:

Who owns the basin and has the authority to retrofit it?

Does the basin have an impervious (e.g. concrete) low flow channel? If so, this makes the basin a good candidate for a retrofit that includes removal of the low flow channel.

Is there an opportunity to lengthen the flow path? Larger basins are likely to provide more opportunities to lengthen the flow path between the inlet and outlet structure so water has an opportunity to stay in the basin longer.

Is the vegetation in the basin mowed turf grass or a mix of grasses and woody plants? Planting diverse vegetation in a basin that is presently mown lawn can provide substantial water quality benefits.

Was the basin constructed more than ten years ago? Older basins have may lost volume capacity due to years of sediment buildup. Removal of this sediment can restore the basin's lost capacity.

Is the basin in a highly visible area where there could be public concerns? Be aware of citizens perceptions. Area residents may need to adjust to the change in landscape aesthetic from highly manicured lawn to more naturalized plantings.

Does the basin have the capacity to infiltrate water? Standing water in a basin is a sign that the bottom of the basin does not infiltrate water well. This can be due to many reasons: compaction during construction, sedimentation of the basin over time, high water table, bedrock close to the surface or high clay content soils. Restoring or improving the capacity for infiltration may involve soil amendments; however, in some cases infiltration may not be possible.

Can the basin be expanded to manage more water? Any available adjacent land can offer an opportunity to expand a basin. Basin expansion can increase water quality benefits and allow for managing additional volume.

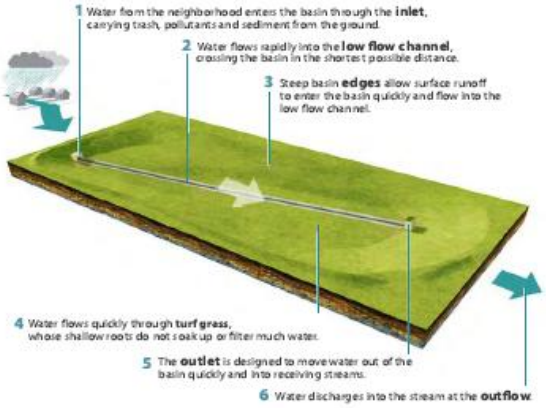
Jeffrey Beall

Jisett/PWC

How does a retrofit work?

Basin retrofits **slow**, **spread**, **soak** and **filter** water before it leaves the basin, resulting in better water quality. Water quantity is also reduced through evaporation and uptake by plants.

What Happens to Stormwater in a *Traditional* Detention Basin?



1 Water from the neighborhood enters the basin through the **inlet**, carrying trash, pollutants and sediment from the ground.

2 Water flows rapidly into the **low flow channel**, crossing the basin in the shortest possible distance.

3 Steep basin **edges** allow surface runoff to enter the basin quickly and flow into the low flow channel.

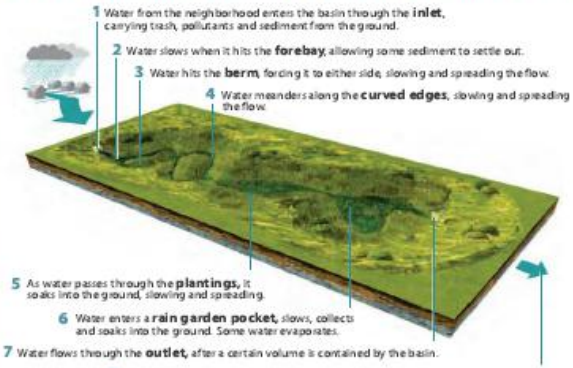
4 Water flows quickly through **turf grass**, whose shallow roots do not soak up or filter much water.

5 The **outlet** is designed to move water out of the basin quickly and into receiving streams.

6 Water discharges into the stream at the **outflow**.

Naturalized basin landscapes have habitat benefits that attract birds, butterflies and beneficial insects while also deterring geese.

What Happens to Stormwater in a *Retrofitted* Detention Basin?



1 Water from the neighborhood enters the basin through the **inlet**, carrying trash, pollutants and sediment from the ground.

2 Water slows when it hits the **forebay**, allowing some sediment to settle out.

3 Water hits the **berm**, forcing it to either side, slowing and spreading the flow.

4 Water meanders along the **curved edges**, slowing and spreading the flow.

5 As water passes through the **plantings**, it soaks into the ground, slowing and spreading.

6 Water enters a **rain garden pocket**, slows, collects and soaks into the ground. Some water evaporates.

7 Water flows through the **outlet**, after a certain volume is contained by the basin.

8 **Outflow** discharges a smaller volume of water than enters the basin, and during some small storms, no water flows out of the basin.

Basin modifications:

Basin retrofits range from naturalized basin plantings to more complicated, engineered solutions. Typically a basin naturalization retrofit involves converting the vegetation from mowed grass to a more diverse mix of native plant species with longer root systems. A simple engineering retrofit will slow the water down and retain some of it in the basin for longer periods of time. Complex engineering retrofits may alter the hydrology, flow path, and outflow characteristics of a basin.

PADEP Permit Schedule

- MCM 1 – PEOP Updated Annually starting in 2018
  - Must distribute two types of materials annually
- MCM 2 – PIPP Updated Annually starting in 2018
  - Must conduct at least one public meeting dedicated to the MS4 program by 2023.
- MCM 3 – IDD&E Program Updated Annually starting in 2018
  - Must have map of entire MS4 system, update and maintain annually (Required since 2013)
  - Dry weather inspection of every outfall at least once by 2023.
  - SWM Ordinance must be consistent with the DEP 2022 Model Ordinance by September 30, 2022.
- MCM 4 – Annual Reports on any violations
- MCM 5 – Full Inventory of PCSM BMPs with O&M Activities starting 2018 + Basin Inspection
- MCM 6 – O&M Plan Updated Annually starting in 2018
  - Must update inventory of Operations and Land Uses that may contribute to pollution in SW Runoff annually
  - Develop and annually update employee training to abide by O&M Plan.

PADEP Permit Schedule

- MCM 1 – PEOP Updated Annually starting in 2018 — **Complete**
  - Must distribute two types of materials annually
- MCM 2 – PIPP Updated Annually starting in 2018 — **Complete**
  - Must conduct at least one public meeting dedicated to the MS4 program by 2023.
- MCM 3 – IDD&E Program Updated Annually starting in 2018 — **Last Updated 2022**
  - Must have map of entire MS4 system, update and maintain annually (Required since 2013) — **Complete**
  - Dry weather inspection of every outfall at least once by 2023. — **In Progress**
  - SWM Ordinance must be consistent with the DEP 2022 Model Ordinance by September 30, 2022. — **Complete**
- MCM 4 – Annual Reports on any violations — **Last Updated 2022**
- MCM 5 – Full Inventory of PCSM BMPs with O&M Activities starting 2018 + Basin Inspection — **Complete**
- MCM 6 – O&M Plan Updated Annually starting in 2018 — **Last Updated 2022**
  - Must update inventory of Operations and Land Uses that may contribute to pollution in SW Runoff annually
  - Develop and annually update employee training to abide by O&M Plan.

Grant Opportunities

- Delaware Watershed Conservation Fund
  - $250,000 max, 1:1 match, Due March 16, 2023
- DCNR Community Conservation Partnerships Program
  - $250,000 max, 1:1 match, Due April 5, 2023
- Watershed Restoration
  - $300,000 max, 15% match, Due May 31, 2023
- Flood Mitigation
  - $500,000 max, 15% match, Due May 31, 2023
- PennVEST – Various Programs

Questions?

- Andrew Pockl – Andrew.Pockl@rve.com