WHAT IS STORMWATER RUNOFF?

Runoff is the portion of rainfall that is not absorbed by the land surface and runs overland to storm sewers or streams. Natural ground, or soil, allows rain to be absorbed by the earth. The soil surface is referred to as "pervious" because it allows rain to infiltrate. When rainfall amounts exceed the soil's ability to absorb all the water, it begins to run over land. When the natural surface of the land is replaced with hard surfaces such as paved roads, parking lots and rooftops, the amount of runoff increases because these "impervious" surfaces do not allow rain to infiltrate.

WHAT PROBLEMS ARE ASSOCIATED WITH INCREASED RUNOFF?

Three major changes occur as the amount of runoff increases:

1. More water is delivered to streams more frequently.
2. Less water infiltrates the soil to replenish groundwater supply.
3. Runoff washes a wide variety of pollutants into streams. Pollutants such as oil, gas, coolants, heavy metals such as zinc and lead, detergents, bacteria, pesticides, fertilizer and sediment laying on the surface may be picked up by runoff and carried into streams.

These changes cause a wide variety of problems in watersheds and streams including:

- Bank erosion and in-stream sediment deposits
- Increased nuisance flooding and property damage
- Increased public cost to maintain infrastructure
- Decreased groundwater levels for supplying streams during periods of dry weather
- Depleted groundwater levels for supplying wells
- Damage to aquatic habitat and aquatic life
- Decreased aesthetic value of the stream
- Decreased recreational value for swimming, fishing or boating
- Decreased value as a water source and increased cost to treat water

SO...WHAT'S THE SOLUTION?

Better management of runoff will minimize or eliminate the problems listed above. Two of the most effective ways to manage runoff are:

1) rethinking how development is regulated through local ordinances and revising local development ordinances to require and allow improved site design focusing on stormwater management; and
2) utilizing Best Management Practices (BMPs).

BEST MANAGEMENT PRACTICES (BMPs)

BMPs are practices, structures and techniques that minimize the adverse affects of increased runoff. Although a wide variety of BMPs exist, they can be generally categorized as either detention, infiltration or filtration BMPs. Some BMPs fulfill all these functions, however most are designed with a primary function. Selection of particular BMPs is based on site conditions and goals.

Infiltration BMPs provide a greater opportunity for runoff to be absorbed into the earth's surface. Infiltrating rain water reduces the amount of runoff and increases the amount of water available for groundwater recharge. This is done by:
- directing water to holding areas designed to allow infiltration
- routing stormwater over pervious areas that allow infiltration

Filtration BMPs filter runoff before it reaches streams by:
- directing runoff to areas where the runoff is slowed down, allowing suspended particles to settle out
- providing a medium through which runoff drains to filter pollutants

BMP WALKING TOUR

This site has been retrofit with a variety of BMPs. The purpose of the site is to demonstrate how BMPs work in order to inform contractors, design professionals, government agencies, municipal decision makers, watershed organizations and the general public about their use. A map detailing the location of each BMP along with a brief description is included on the opposite side. Fact sheets that include more detailed information about each BMP are located in the sign box adjacent to it. Please help yourself to the fact sheets; they are also located on the DCCD website at www.dauphincd.org.

As you visit each BMP and read its description, keep the following points in mind:

- Each BMP has a certain application and should be carefully selected based on the site conditions and purpose for using a BMP
- Misapplication or poor design of BMPs may cause significant problems
- BMPs can be used alone or combined to achieve the desired goals
- Although BMPs on this site were primarily installed for demonstration purposes, they are all fully functional stormwater management BMPs.

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PACD Pennsylvania Association of Conservation Districts, Inc.

Dauphin County Conservation District

Dauphin County Conservation District
Stormwater Best Management Practices Tour Map

Project Vendors

BMP Installation

B.R. Kreider & Son, Inc.
Excavating, Paving and Utility Contractors
63 Kreider Lane Manheim, PA 17545 Phone: 717-898-7651

www.brkreider.com

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1- FILTER STRIP

Filter strips treat runoff draining from impervious surfaces such as pavement and rooftops. Vegetation planted in the strip slows runoff entering as sheet flow from an impervious area. As runoff passes over the undelying soil, sediment and pollutants are filtered from the runoff. Due to their effectiveness at filtering pollutants from runoff, filter strips make effective buffers between impervious areas and pervious areas, storm sewer systems or streams.

In this demonstration, the filter strip receives runoff from a pipe connected to the roof downspout and the pavement adjacent to the filter strip.

2-INFILTRATION TANK

The tank displayed at this site is the same version as the one installed under-ground just in front of the pad you are standing on. The underground infiltration tank is attached to downspout piping in order to collect and temporarily store rooftop runoff. Small holes in the tank allow runoff to drain initially to a stone bed surround-ing the tank, then into the ground for infiltration. Because the tank does not remove pollutants from runoff prior to infiltration, it is best used for receiving runoff from areas with few or no pollut-ants or sediment.

3-BIORETENTION AREA

Bioretention areas are designed to capture and treat the "first flush" or initial wave of runoff which carries the majority of pollutants laying on the surface. These pollutants include oil, grease and sediment.

In this demonstration, runoff is directed into the swale-shaped bioretention area from the parking lot adjacent to it on the left. The surface layer of rock slows the speed of runoff. An underlying layer of soil mix provides filtering of particles and removal of some dissolved pollutants from runoff. Geotextile material placed between the soil mix layer and soil subbase keeps the soil mix in place. An underdrain collects treated runoff and routs it to the storm sewer system. The drain in the forefront of the picture allows excess runoff which contains less pollutants to be transported directly to the storm sewer system.

4-POROUS ASPHALT & BLOCK PAVERS

The parking area to your right displays two types of permeable paving, both designed to allow runoff to penetrate the surface and pass through into an underlying stone reservoir for storage and infiltration into the groundwater supply.

Porous asphalt is mixed with similar materials as conventional asphalt; however, no fine particles are added to the mix. Removing the fines creates void space in the pavement for stormwater to pass through.

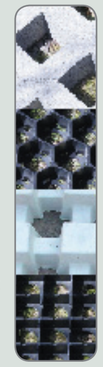
Permeable block pavers have been installed in parking spaces. While the pavers themselves are not porous, the shape of the pavers creates a void space that is filled with gravel to allow runoff to pass through to the underlying stone bed.

5-GRASS SWALE & CHECK DAM

A grassed swale can be used in place of a storm sewer pipe to convey runoff from an area. Vegetation planted in the swale enhances infiltration of runoff into the soil and aids with slowing runoff which allows particles to settle out. Swales may be constructed with a subsoil mix that improves infiltration. The swale at this site incorporates such a mix.

This swale is fitted with a wooden check dam named for its function of "checking" or slowing runoff as it courses through the swale. The water held back by the dam forms a small ponding area that allows particles to settle out of runoff.

6-TURF PAVERS



The four types of turf pavers displayed at this site have been incorporated into the overflow parking spaces directly in front of you. Turf pavers are an alternative to impervious paved surfaces and are well-suited to areas that receive light vehicular traffic such as overflow parking or fire lanes.

Turf pavers are grid structures made of concrete or plastic designed with a void space that is filled with soil and grass. Runoff flowing to the pavers passes through the vegetation and the hole in the base of each cell to infiltrate the underlying soil. The paver grid provides support to prevent the grass from being destroyed by tires.

A stone reservoir can be installed under the grids to provide additional temporary storage of runoff. This demonstration does not feature a reservoir bed.

16-RAIN BARREL

One of the most user-friendly BMPs from an installation standpoint, rain barrels can be implemented at any type of site and are a practical way for individual homeowners to practice water conservation. The barrel is connected to a downspout for capturing roof runoff. Runoff is stored in the barrel for later use. A garden hose can be connected to the spigot at the base of the barrel. In doing so, roof runoff can be used for watering lawns and gardens. Using water saved in a rain barrel saves money while it also reduces water consumption.

7-DETENTION BASIN

Detention basins hold runoff temporarily then allow it to drain at a predetermined rate, which reduces the peak rate of runoff discharged to storm sewers or waterways.

This design uses a riser outlet structure to regulate the amount of runoff leaving the basin. Several holes are located along the height of the riser. When the water level reaches the height of an outlet it is discharged from the basin. By sizing and locating the outflow orifices properly, the basin may be designed to control peak discharges from a variety of different rainfall amounts to allow sediment and other particles to settle out and to protect the receiv-ing stream channel from erosion.

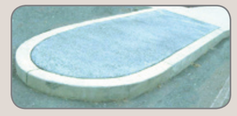
Placing stone near the pipe that discharges to the basin reduces the energy of the flow and prevents erosion of the basin. This technique is known as stone stabilization.

15-POROUS BLOCK PAVERS

This site demonstrates another version of permeable block paver, different in look but similar in function to those installed in the parking lot. Void space created by the paver's interlocking design allows stormwater to pass through and infiltrate the ground to recharge the groundwater supply. The paver also provides an aesthetically pleasing alternative to brick or concrete paving for driveways and patio areas around the home.

Also, a close look at the mulched area by the light post reveals that this mulch is made from recycled tires. Benefits of rubber mulch include: it improves infiltration and air flow to the underlying soil; it does not serve as a food source for most insects; it does not float; and most seeds dehydrate before weeds can establish themselves.

8. POROUS CONCRETE



The end segment of sidewalk has been poured with porous concrete. Porous concrete is another form of permeable paving that functions similarly to porous asphalt. Fine particles are removed from the concrete mix to allow water to pass through the material for infiltration into the ground. A stone bed beneath the paved surface serves as a reservoir to hold water prior to infiltration into the groundwater supply.

Note the difference in appearance between porous concrete and conventional concrete. This is due to porous concrete's void space of approximately 22% compared to 3-5% void space for conventional concrete.

14-INFILTRATION TRENCH

A peek into the observation pipe at this site shows the depth of water contained in the underground infiltration system that is installed to the left of the display pad.

The infiltration trench featured here is filled with plastic containers that resermble milk crates. During installation, the containers are stacked and placed side by side, then wrapped with geotextile material to keep soil from entering the storage area. Runoff from the roof downspouts is diverted to the trench, and is stored in the fabric-wrapped containers. Over time, water seeps through the fabric into the ground to recharge the groundwater supply.

13-RAIN GARDEN

Rain gardens are small, vegetated bioretention areas. A special subsoil mix of varying layers of stone, mixed aggregate and soil enhances filtration and infiltration. Runoff is directed to the rain garden, where it is stored while it awaits infiltration into the ground below. Vegetation in the rain garden aids with filtering pollutants and evapotranspiration of water. Organisms living in the plants' root structure aid in breaking down pollutants.

Rain gardens are well-suited for placement in residential areas due to their small size and aesthetics. They also provide habitat for small wildlife, such as birds and butterflies.

12-INLET PROTECTION

Inlet devices are available in many designs, and have the capability to address different needs. This inlet has been retrofit with a device for treating the first flush of runoff. Runoff entering the inlet passes into a chamber where sedi-ment settles out from water. Next, water seeps through a series of filters designed to remove par-ticles, hydrocarbons and other chemical pollutants. The treated runoff flows into a bottom drain where it is released to the storm sewer system.

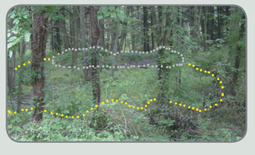
11-VEGETATIVE STABILIZATION

Few stormwater management practices are as effective as natural vegetation. An alternative to clearing a site in preparation for construction, the practice of preserving existing vegetation reduces the amount of soil exposed to the erosive forces of wind and water. Vegetation and root systems help to keep soil in place and reduce the velocity of runoff leaving a site. Preserved vegetation also provides habitat for wildlife and is aesthetically pleasing.

Sites should be assessed prior to the start of construction to determine any areas that can be preserved. Protective measures must be taken to prevent damage to mature trees and their root systems.

10-VEGETATED DETENTION BASIN

This detention basin functions similar to the basin featured at #7, but also allows for infiltration of runoff and is designed to blend with its surrounding natural landscape. In the photo below, yellow dots mark the boundary of the basin's depression (shaded area on map). Runoff enters the basin after it has passed through the stormwater treatment unit at #9. Stone stabilization protects the basin from erosion by dissipating the energy of runoff entering the basin. Amidst the trees,a small berm is visible (outlined by gray dots), which forms the outer boundary of the basin. Existing vegetation absorbs water from the basin.



9-STORMWATER TREATMENT

What appears to be a manhole is actually a stormwater treatment unit. Units such as this one use a settling tank to filter contaminants from runoff. Runoff is piped into an upper chamber and is then diverted to a lower settling chamber, where sediment settles to the bottom, and floatable pollutants, such as oil and grease, rise to the top of the chamber. After contaminants are separated from runoff, water is displaced up through a riser pipe and is discharged to the storm sewer system.

The upper chamber allows high velocity flows to bypass the treatment chamber to avoid resuspending pollutants.