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technical
INFORMATION
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INFILTRATING AND FILTRATING SURFACES IN STORMWATER FACILITIES

By Susan Giannantonio, P.E., CPESC, NTM Engineering, Inc.

Updates to federal, state, and local stormwater management regulations over the last 20 years have resulted in the widespread implementation of infiltration and filtration in stormwater management facilities to improve quality and decrease net volume of stormwater runoff. Proper construction and service life care of these areas is essential to ensure proper function of the facilities. There are many types of stormwater management facilities which were previously collectively referred to as "BMPs" and more recently with the draft PA Post Construction Stormwater Management (PCSM) Manual, are referred to as stormwater control measures, or "SCMs." Understanding what infiltration and filtration are and which SCMs contain these surfaces is an integral part of improving construction and service life care techniques.

Infiltration and filtration: Defined

Both infiltration and filtration involve collected stormwater soaking into or through a soil or engineered soil media. Engineered soil, also called engineered media or similar is an intentionally developed and placed layer of material used as the filtration material in filtration SCMs. The media incorporates a specific mix of soil grain sizes and types (sand, silt, etc.) and often includes organic material. It may be mixed on site during construction using on-site soils when suitable or may be delivered already prepared to the construction site. The soil media layer varies in depth, from six to 24 inches or more. Infiltration SCMs may have a layer of engineered material or may use the existing native (in-situ) soil material if natural permeability rates are appropriate.

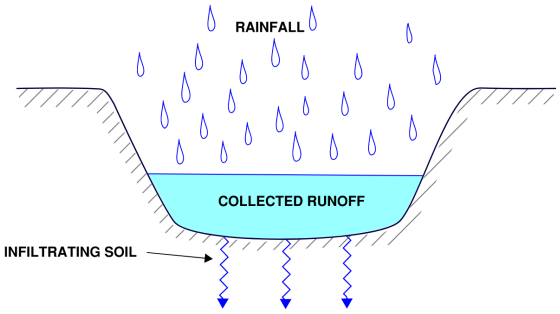

Figure 1: In infiltrating SCMs, collected stormwater runoff soaks into the native (in-situ) soils below the SCM, promoting water quality, reducing surface runoff volume and recharging ground water.

While infiltration and filtration are similar, the key difference surrounds runoff volume reduction. Specifically, infiltration occurs when runoff soaks into the ground below the SCM, reducing the surface discharge volume and providing water quality benefits simultaneously. The runoff enters the in-situ soils below the SCM, providing ground water recharge. Filtration occurs when runoff soaks into and through an engineered soil layer to a perforated pipe located below the ground surface. The water is discharged out of the SCM to a downstream drainage system, providing water quality improvement but does not substantially decrease the total surface water discharge volume.

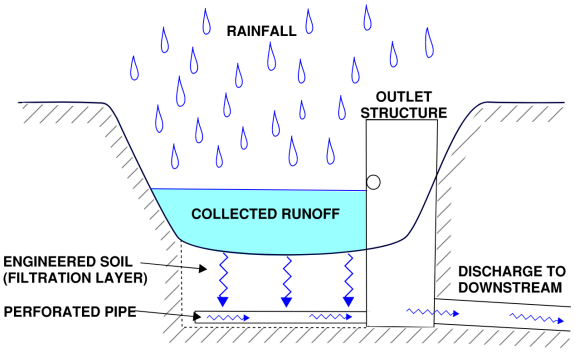

Figure 2: In filtrating SCMs, collected stormwater soaks through an engineered soil media into a perforated pipe, draining to downstream surface systems. This media filters pollutants from the surface water, improving water quality.

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400 North Street, 6th Floor
Harrisburg, PA 17120
1-800-FOR-LTAP • FAX (717) 783-9152
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Figures 1 and 2 illustrate the different water flow paths in an infiltration and filtration SCM.

Which SCMs have Infiltration and Filtration?

Many but not all SCMs have an infiltration or filtration surface. Table 1 lists the most common SCM types, indicating when an infiltrating or filtrating surface may occur. Because each design is unique to the site, the below table includes a "possible" column. Some SCMs may or may not have an infiltration/filtration (i/f) surface based on its own unique design. In these cases, the original SCM design plans must be reviewed to confirm the presence or absence of an i/f surface.

Where in the facility do they occur?

To understand where the i/f surface is located, SCMs can be broadly classified into three general shapes: bowl, swale, surface.

Bowl-shaped SCMs include: Dry Detention Basins, Managed Release Basins, Infiltration Basins (surface), Bioinfiltration SCMs and Bioretention SCMs. The i/f part of a "bowl" shaped SCM is limited to the bottom surface (floor) of the storage area (Figure 3). Side slopes and tops of berms are not part of the i/f surface.

Many bowl-shaped SCMs have a pretreatment area called a forebay. These are specifically designed to collect large amounts of sediment. However, forebays constructed with a vegetated or gravel surface are also part of the i/f surface requiring protection from compaction.

Vegetated swales are SCMs that may or may not have an i/f surface while vegetated swales with check dams do contain i/f surfaces. Review the design plans and permit documentation to confirm the presence of i/f surfaces. The i/f surface of a trapezoidal Vegetated Swale, both with or without check dams, is the bottom surface as outlined in Figure 4. In V-shaped channels, it is normally the bottom one-to two feet of channel depth, but it can also be approximated by the typical water carrying depth of the channel. The side slopes of a trapezoidal channel and slopes above the water depth of V-channels are not considered part of the infiltrating/ filtrating surface.

Surface SCMs are those whose entire surface is the treatment i/f surface (Figure 5). These include vegetated filter strips, infiltration trenches (with rock or soil surface) and similar.

Table 1: SCMs with Infiltration or Filtration Surfaces

SCM Name	Infiltrating or Filtrating Surface		
	Yes	Possible	No
Bioinfiltration	X		
Bioretention	X		
Dry Detention Basin			X
Engineered Stormwater Wetland			X
Infiltration Basin (surface)	X		
Managed Release Basin	X		
Manufactured Treatment Devices			X
Pervious Pavement, Asphalt			X
Pervious Pavement, Concrete			X
Pervious Pavement, Pavers		X	
Subsurface Infiltration/ Detention Basin			X
Subsurface Infiltration Trench	X		
Vegetated Filter Strip	X		
Vegetated Swale		X	
Vegetated Swale w/ Check Dams	X		
Wet Basin			X

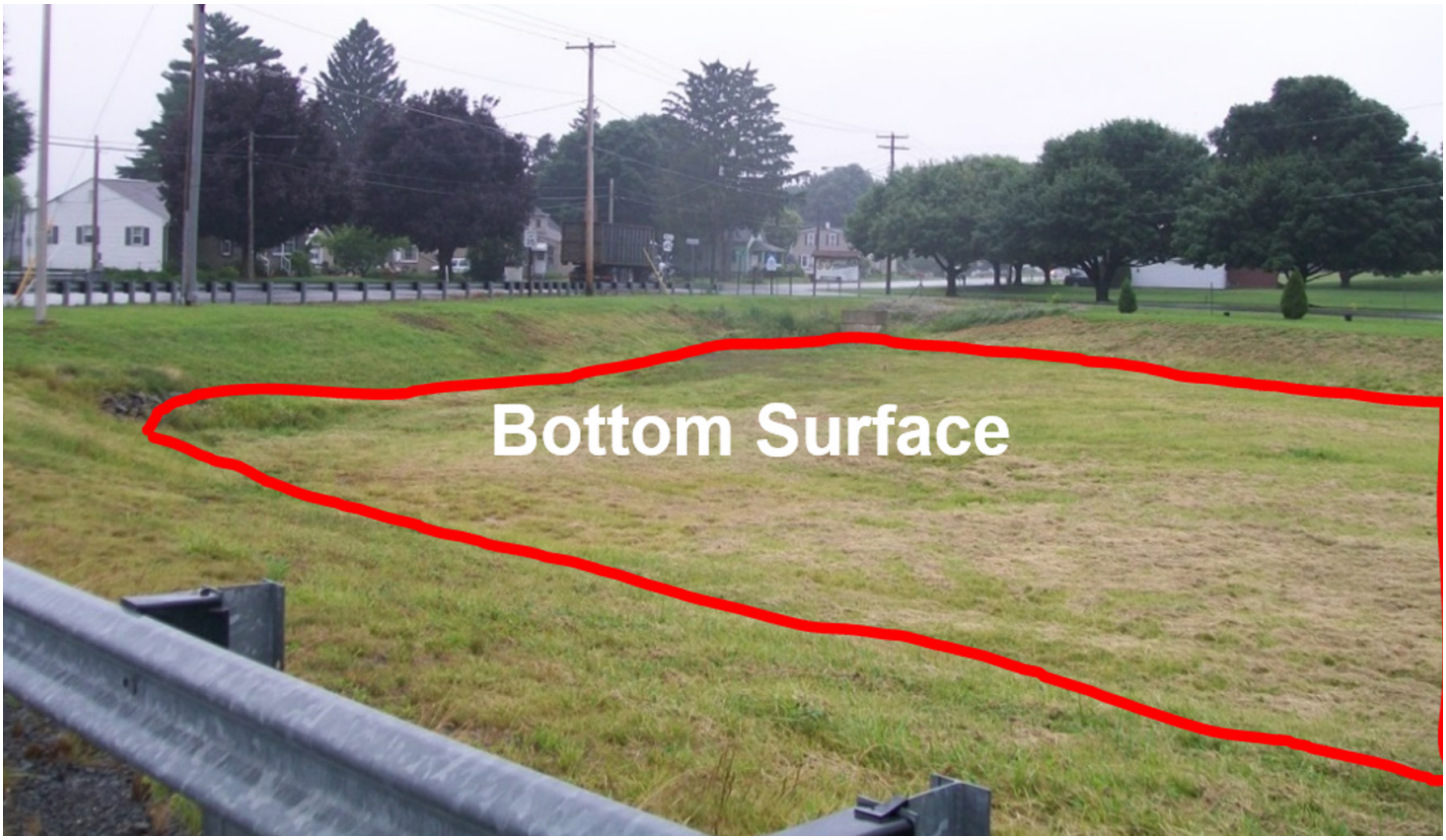

Figure 3: The i/f surface of bowl-shaped SCMs occur on the surface (floor) of the storage area.

Figure 4: Vegetative swales may have i/f surface; Vegetated swales with check dams do have i/f areas. In these SCMs, the bottom surface of the channel (bottom one to two feet in V-shape) is the i/f surface.

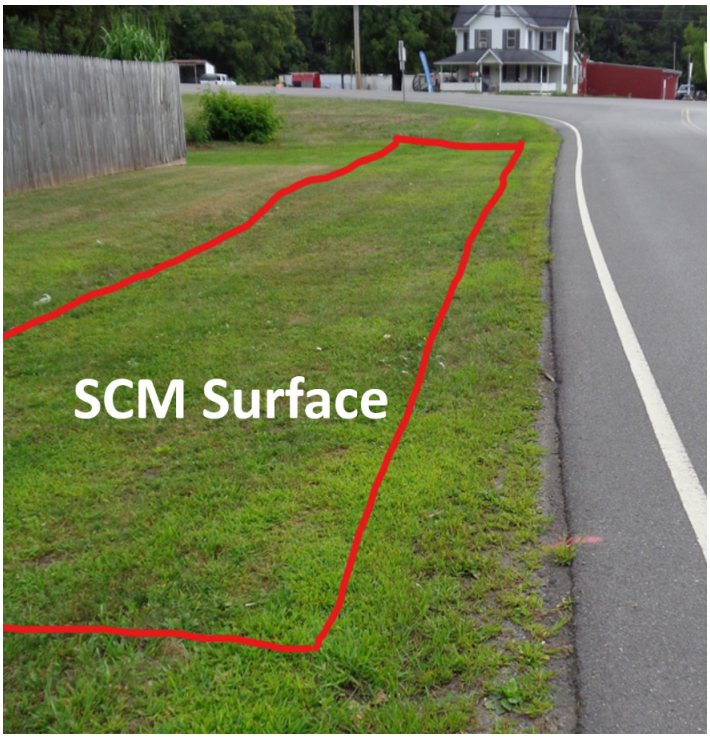

Figure 5: The entire surface of SCMs like vegetated filter strip shown here are part of the i/f surface requiring special protection.

How are they protected?

One of the most common partial and complete SCM failures seen is due to i/f issues. These surfaces are critical to the SCMs containing them and require some simple but important protection methods to ensure function. Although infiltration and filtration are two distinct processes, they require the same basic considerations to protect them. These considerations are similar for both construction and service life phase. The two primary failure modes of i/f surfaces are surface clogging and compaction. Each of these can occur due to the different root causes described below:

Surface clogging: In most i/f SCMs, the primary means of runoff entering the soil is through the visible ground surface of the main ponding (or conveyance) area of the SCM. Surface clogging occurs when this ground surface becomes nearly or totally impermeable due to foreign material filling in the void spaces.

The most common cause of this is dirty water; silt and ***sediment laden inflows*** carry significant amounts of fine material. To minimize sediment laden inflows, the area draining to the SCM must not contain any areas of bare soil or erosion conditions called unstabilized or disturbed areas. Disturbed areas occur during construction and can also been seen during the service life when other repairs or work occurs in the SCMs drainage area. Proper Erosion and Sedimentation Control Pollution measures are key to preventing silted surfaces (see Tech Sheet #204: Preventing Pollution With Sediment Barriers).

Vegetation debris comes from mowing activities in the SCMs drainage area as well as natural leaf and foliage dropping cycles. In both cases, some minor build up is natural but any amount that causes smothering of the living vegetation is sufficient to clog the i/f surface over time. Remove grass clippings and leaf debris from the SCM when accumulation threatens vegetation. Occasional vegetation thatching may also be performed.

Compaction: I/f surfaces function because of their porosity or ability for water to soak in. These areas must be protected from many types of compaction as follows: ***Heavy equipment*** should not drive over the i/f surface of an SCM because they lead to impaired i/f capacity. ***Materials storage*** such as soil, mulch or snow piling can cause compaction over large areas of the SCM i/f surface. ***Mowing*** in the same pattern leads to localized area of compaction and decrease i/f capacity. Equipment of any type ***entering an SCM when not dry*** results in compaction and ***localized rutting***, impairing i/f function. See tech sheet #225: Stormwater Facility Low Ground Pressure Maintenance Techniques for additional information on appropriate practices to minimize SCM damage.