FSS

Filter Strips and Swales

Description

Filter strips and swales can remove sediments and pollutants from stormwater runoff. Low velocities, combined with healthy stands of grass vegetation allow particles to settle out from stormwater runoff. Filter strips can be composed of grass or forest buffer zones if efforts are made to ensure sheet flow to the buffer zone. Generally, a maintained grass filter strip is used to treat sheet flow. A maintained vegetative filter swale is used to treat channel flow. This practice will provide a partial reduction in most types of pollutants.

A filter strip is a relatively flat area of healthy grass vegetation adjacent to or downstream from an impervious surface that may contain pollutants. Or alternatively, a wild grass or forest buffer zone may function as a filter strip.

Filter strips and swales can perform well as a First Flush BMP. For small development, they can be used to eliminate other requirement (i.e. detention pond). Filter strips and swales could also be used in combination with other stormwater treatment BMPs. Filter strips and swales should be carefully designed for high intensity rainfall events.

Filter strips and swales are best used for small-medium size development (i.e. office buildings, small shopping centers) and road projects or as a supplemental BMP for larger developments. Since thick and healthy grass vegetation is a part of every landscaped property, filter strips and swales are easy to incorporate into most BMP strategies.

Selection Criteria

Filter strips and swales are often used in conjunction with other stormwater management practices to treat runoff from paved streets and parking lots. They can also be used to reduce the amount of directly connected impervious area that drains into the storm drainage system, thus reducing peak flows. In addition to pavement areas, this approach can be used similarly for roof drainage.

Design Considerations

Filter Strips

A minimum width of 10 feet is recommended for vegetated filter strips. Widths of 20 to 30 feet are highly recommended. Typical slopes range from 2-5%. Steep slopes would require additional structures such as dikes. The length of a filter strip is typically the entire length of the adjacent parking lot, street, or building. The use of vegetation is essential in establishing a filter strip, particularly for small widths such as 10 feet. Limit the width of pavement that drains to a filter strip; typical values should be 50 to 100 feet whenever possible.

Generally curbs and gutters are not desirable for paved areas with filter strips since they tend to concentrate flows. Avoid concentrating stormwater runoff on pavements by ensuring that the pavement slopes and vegetated surface slopes are level or change very gradually. In busy parking lots, even vehicle wheels or parking curb stops may channelize flow in some instances and can only be overcome by a level spreader. Channelization will reduce the effective treatment area of the filter strip and may erode grass because of excessive velocities. A level spreader, check dam or energy dissipator may assist in returning channelized flow back into sheet flow, if designed and constructed properly.

Protect grass filter strips from vehicle traffic. This is typically done with wheel stops made of pre-cast concrete, iron or landscaping timbers. Even heavy foot traffic can compact the topsoil and trample the grass, affecting performance of a filter strip. Design and analyze problem areas of foot traffic, and provide paths and sidewalks that are compatible with the need for grass filter strips. If irregular or uneven areas appear while the vegetation is being established, repair and restore to a smooth and level appearance to prevent concentrating stormwater sheet flows.

Filter Swales

Filter swales are generally grass-lined channels that are wider than necessary for conveyance. Other materials may be incorporated into grass-lined channels, such as a gabion wall along one side of the channel or a concrete swale crossing, provided that overall flow velocities are below 1 foot per second. Typical slopes are generally 1-2 % to ensure positive drainage. The average flow depth should not be more than 1 inch, and the maximum flow depth at any point should not be more than 3 inches.

Filter swales are often constructed around parking lots and commercial centers as recessed planters for landscaping. Filter swales in these areas may also incorporate inlets raised 4 to 6 inches above the swale, which may function as first-flush retention volume for pretreatment if infiltration rates are sufficient (typically 0.2 inches per hour observed field rate). Raised inlets should be constructed in a way that a flooded median will not appear to be bad drainage design.

The typical channel shape for a filter swale is trapezoidal or parabolic, with a 3:1 or flatter side slope. The swale velocity and flow depth should be determined using Manning's equation and the design parameters included in Section 5.2 Channel Stabilization with Basic Flow calculations. Typically the velocity is checked for the mowed condition, while the flow depth and capacity are checked for the un-mowed condition. Manning's roughness coefficient 'n' depends heavily on the height of grass, so that the mowed and un-mowed conditions will yield significantly different velocities and flow depths.

For parking lot application, design considerations include width of swale, the anticipated overhang of vehicles, whether to use wheel stops, and spacing of grate inlets. In general, the grate inlets should flow to a detention basin or other stormwater treatment structure prior to being discharged to a storm drainage system or natural stream. Figure 1 shows an example of a parking lot design that shows sheet flow entering a wide swale rather than a gutter or curb inlet.

For rooftop application, drainage would typically reach ground level via gutters and downspouts. This stormwater should be conveyed at least 5 to 10 feet from the building to avoid wet basements or saturated foundations. Downspouts concentrated flow should be turned into sheet flow through filter strips whenever possible. Figure 2

shows an example of rooftop design having flow coming from rooftops and driveways.

Maintenance

Filter strips and swales should be inspected regularly during and after the establishment of vegetation. Repair or replace any damage to the sod, vegetation, or evenness of grade as needed. Look for signs of erosion, distressed vegetation or channelization of sheet flow.

Maintain vegetation between 4 to 6 inches tall. Allowing the grass to grow taller may cause it to thin and become less effective. The clippings should be bagged and removed. Mowing grass regularly promotes growth and pollutant uptake. Proper maintenance is required to maintain the health and density of grass vegetation, such as irrigation during summer droughts and adding small amounts of fertilizer or lime as needed. Keep all level spreaders or check dams even and free of debris.

Solids/Debris Removal & Disposal

The solids accumulation rate is dependent on a number of factors such as land use type, drainage area size, etc. The sediment composition should be identified before being removed and disposed. Proper disposal techniques should be used.

Limitations

The effectiveness of a grass filter strip depends heavily upon sheet flow being maintained across the grass surface. This is accomplished by level spreaders and by careful maintenance of the grass surface. Check dams generally increase the travel time within a swale and remove trash/debris.

Grass filter strips can only treat sheet flow. Curb cuts are not useful in establishing grass filter strips as a stormwater treatment BMP. Grass filter strips are effective only on gentle slopes, typically less than 2 or 6 percent.

References

Knoxville (City of). October 2007. Knoxville Stormwater Engineering Division. City of Knoxville BMP Manual. http://www.ci.knoxville.tn.us/engineering/bmp_manual/

Photo 1 Filter Swale

Figure 1 Typical Filter Strips/Swale Application for Parking Lot Stormwater Control

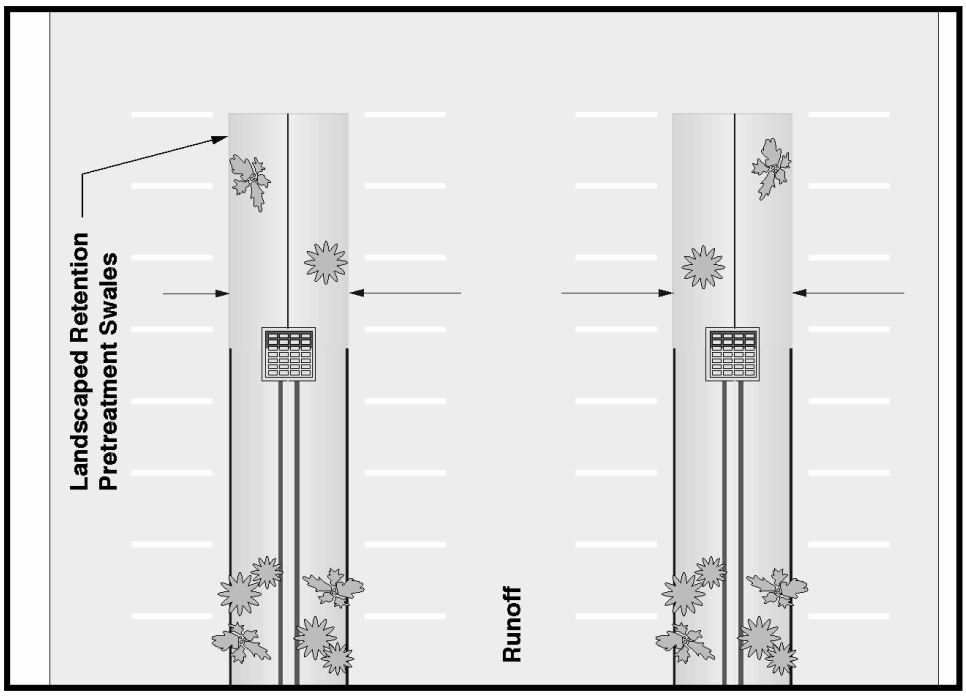

Figure 2 Illustration of Filter Strips/Swale Application for Rooftops Stormwater Control