Low Impact Development strategies use careful site design and decentralized stormwater management to reduce the environmental footprint of new growth. This approach improves water quality, minimizes the need for expensive pipe-and-pond stormwater systems, and creates more attractive developments.

MASSACHUSETTS **LOW IMPACT DEVELOPMENT** TOOLKIT

FACT SHEET #3

GRASS FILTER STRIPS

Overview

Grass filter strips are low-angle vegetated slopes designed to treat sheet flow runoff from adjacent impervious areas. Filter strips (also known as vegetated filter strips and grassed filters) function by slowing runoff velocities, filtering out sediment and other pollutants, and providing some infiltration into underlying soils. Because they use sheet flow and not channelized flow, filter strips are often more effective than swales at removing suspended solids and trash from runoff. They provide good "pretreatment" of stormwater that will then be routed to another technique such as a bioretention area.

Filter strips were originally used as an agricultural treatment practice, but have recently been used in more urban and suburban locations. They differ slightly from buffer strips, which are natural vegetated areas alongside streams and lakes; buffer strips are left undisturbed for habitat protection and visual screening, while filter strips are altered areas designed primarily for stormwater management. Like many other LID techniques, vegetated filter strips can add aesthetic value to development. They cost significantly less than "hardscaped" stormwater infrastructure and also provide a convenient and effective area for snow storage and treatment.

Applications and Design Principles

Filter strips are appropriate for roadside applications and along the edge of small- to medium-sized parking lots, so long as the tributary area extends no more than 60 feet uphill from the buffer strip. They can also be used to treat roof runoff that is discharged over a level spreader. Filter strips are ideal components of the outer zone of a stream buffer, or as pretreatment to another stormwater treatment practice. They are generally require too much land area for applications in urban areas. The contributing drainage area should generally be less than five acres.

Management Objectives

- Remove suspended solids, heavy metals, trash, oil and grease.
- Reduce peak discharge rate and total runoff volume.
- Provide modest infiltration and recharge.
- Provide snow storage areas.
- Improve site landscaping.

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Filter strips work best when they are at least 20 feet long (downhill axis), though shorter strips will still provide some treatment. They should have slopes between 1% and 15%, preferably in the lower end of that range. It is critical for filter strips to be planar or convex, since any undulation in the surface or obstructions can cause concentrated flow that leads to erosion, channelization, and loss of water quality benefits.

The design should seek to keep runoff velocity in the low to moderate range (less than 2 feet per second) in order to maximize water quality benefits. This can be done by limiting the size of the contributing impervious surface. Both the top and toe of the slope should be as flat as possible to encourage sheet flow. A pea gravel or cement level spreader (with a lip) at the top of the filter strip will improve sheet flow and will capture some sediment.

Some filter strips are designed with a pervious berm at the downhill end of the filter strip, to detain water temporarily, increasing infiltration and reducing peak discharge rates. This berm can significantly enhance water quality benefits if it is designed to impound the water quality volume.

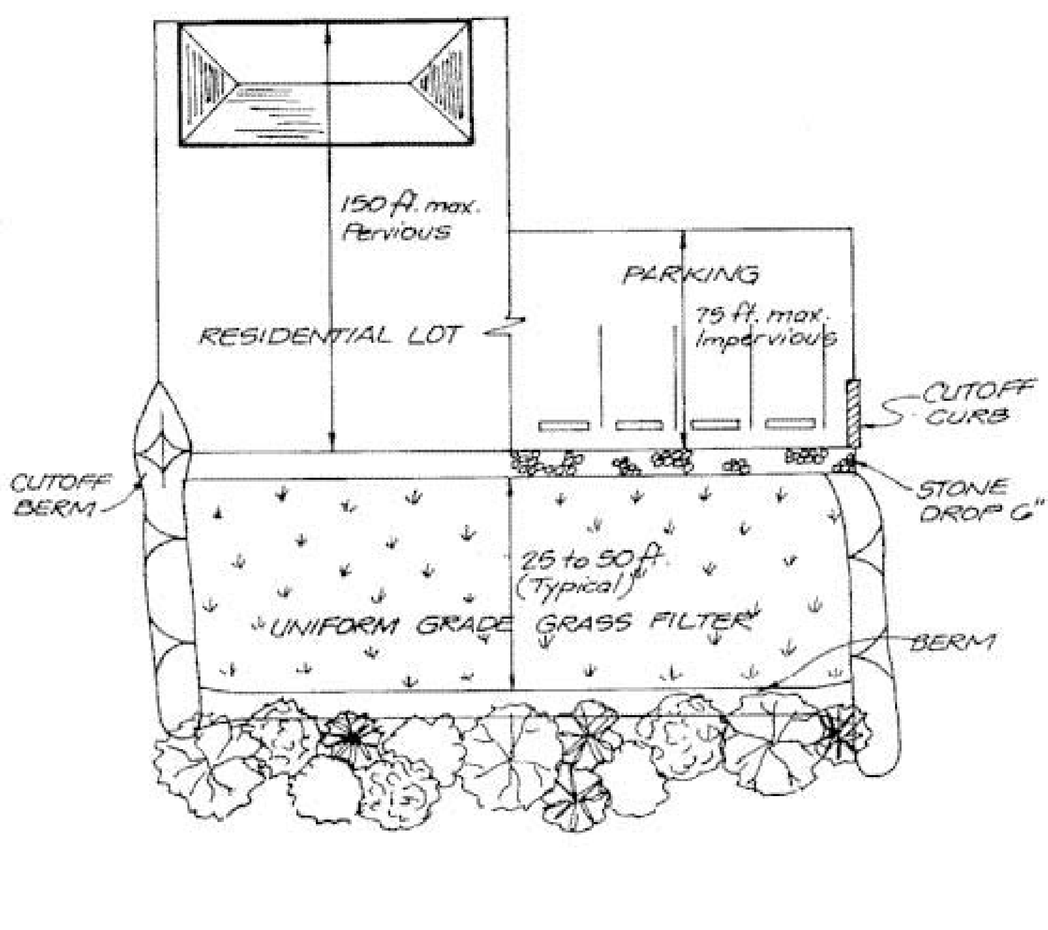
Cover, top: This 40-foot wide filter strip provides water quality pretreatment of runoff from the adjacent highway. *Photo: California Stormwater Quality Association.*

Cover, bottom: A filter strip adjacent to this filling station provides room for snow storage and can remove sediment and organics from runoff. *Photo: Steve Haubner, Atlanta Regional Commission*

Below right: A plan view of filter strips in residential and commercial settings. *Image: Center for Watershed Protection*

Benefits and Effectiveness

- Filter strips provide runoff pretreatment by trapping, filtering and infiltrating particulates and associated pollutants. TSS removal rates range from 40%-90%. Effectiveness depends largely on the quantity of water treated, the slope and length of the filter strip, the type of vegetation, and the soil infiltration rate.
- Vegetated filter strips also reduce runoff velocities and increase the time of concentration as compared to channelized flow, resulting in a reduction of peak discharge rates.
- Filter strips may provide groundwater recharge as runoff infiltrates into soil; recharge may be considerable if design incorporates a ponding area at the toe of the slope.



Above: Here a filter strip is being used as pretreatment for parking lot runoff directed to an infiltration basin. Note concrete level spreader (at right) to facilitate sheetflow across filter strip. *Photo: California Stormwater Quality Association*

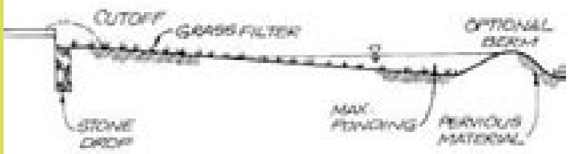
- Filter strips can serve as a location for snow storage during winter months and will also help to trap and treat the salt and sand in snow when it melts.
- Filter strips are inexpensive to construct, especially when compared to conventional curb-and-gutter systems.
- Vegetated filter strips help to accent the natural landscape by providing green space adjacent to parking lots and roadways.

Limitations

- Because filter strips infiltrate runoff to groundwater, they could be inappropriate at stormwater "hotspots" (such as gas stations) with higher potential pollutant loads. They should be combined with other BMPs to ensure adequate treatment of polluted runoff prior to discharge.
- Channelization and premature failure may result from poor design, imprecise construction, or lack of maintenance. Proper design requires a great deal of finesse, and slight problems in the construction, such as improper grading, can render the practice less effective in terms of pollutant removal.
- Filter strips have low removal rates for nutrients, so they must be used in conjunction with other best management practices.
- Filter strips often require lots of space, making them often infeasible in urban environments where land prices are high.

Maintenance

- Inspect level spreader monthly and remove built-up sediment.
- Inspect vegetation monthly for rills and gullies and correct. Fill any depressions or channels. Seed or sod bare areas.
- In the year following construction, inspect the filter strip regularly to ensure that grass has established. If not, replace with an alternative species. Allow natural succession by native grasses and shrubs if it occurs.



This diagram shows a filter strip designed with a berm to impound water, resulting in improved water quality treatment and increased infiltration. *Image: Center for Watershed Protection*

- Mow grass, as rarely as 2-3 times per year, to maintain 4" to 6" of dense grass cover. Grass clippings should be collected and composted elsewhere. Provide a minimum of fertilizer only when necessary. Mow when the soil is dry and firm to prevent rutting.
- Semi-annually, remove sediment that has accumulated to prevent berms or channels.

Cost

Filter strips cost considerably less to construct than many hardscaped stormwater management structures such as curbs, storm sewers, and ponds. The primary direct expenses are clearing, grading, and seed or sod. Additional expenses may include construction of a level spreader at the top of the strip or a berm at the toe of the slope.

The most significant cost of filter strips may be an indirect expense, which is the cost of the land, which may be very valuable in dense urban settings. In many cases, however, open spaces and buffers are required by municipal landscaping or zoning regulations, and filter strips may be used to satisfy these requirements. Established vegetated buffers may also add value a property.

Design Details

- The limiting design factor for filter strips is not total drainage area but rather the length of flow contributing to it. Because sheetflow runoff becomes concentrated flow as distance increases, the contributing area to a vegetated buffer should be no more than 60 feet for impervious surfaces, and 100 feet for pervious surfaces.
- Slopes should be between 1% and 15%, though slopes less than 5% are preferred. The top and toe of the slope should be as flat as possible.
- The filter strip should be at least 20' long (downhill length) to provide water quality treatment. Minimum width is 8' or 0.2 X length of flow over the impervious surface upstream of the filter strip.
- Depth of sheetflow should be less than 0.5" for the design storm. Depending on the pollutant removal required, residence time should be at least 5 minutes, preferably 9 minutes or more.
- Use Manning's equation to calculate velocity, assuming hydraulic radius equals depth, with n values of 0.20 for mowed grass slope and 0.24 for infrequently mowed grass slope. Normal velocity should be <1.0 feet/second for design flow, with maximum permissible velocity of 3.0 feet/second for peak discharge during 10-year storm.
- Use a cement level spreader or pea gravel diaphragm at the top of the slope.
- Filter strips can be designed with a pervious berm of sand and gravel at the toe of the slope. This feature provides an area for shallow ponding at the bottom of the filter strip. Runoff ponds behind the berm and gradually flows through outlet pipes in the berm. The volume ponded behind the berm should be equal to the water quality volume.
- Designers should choose a grass that can withstand calculated flow velocities, and both wet and dry periods. Also consider depth to groundwater and choose facultative wetland species if appropriate.
- If filter strip will be used for snow storage, use salt tolerant vegetation (e.g., creeping bentgrass.)
- During construction, divert runoff from unstabilized areas away from filter strips.
- Protect the underlying soil from compaction to the extent possible: work from outside the boundaries of the filter strip or use oversized tires and lightweight equipment.

Additional Resources

Mass Highway Department Stormwater Handbook
(www.mhd.state.ma.us/mhd/environ/publications.htm)
www.stormwatercenter.net

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