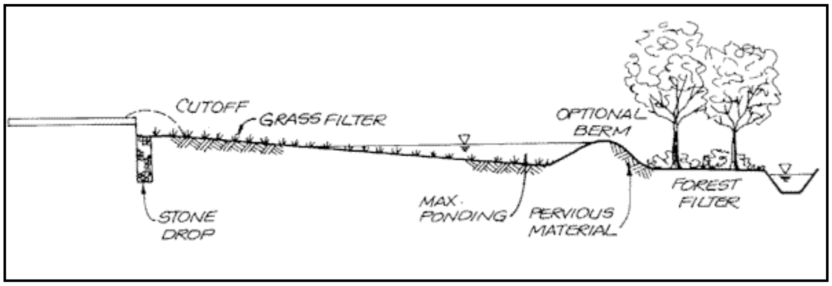
Filter Strips



Description

Filter strips (also known as vegetated filter strips, grass filter strips and grassed filters) are densely vegetated, uniformly graded areas that treat sheet flow from adjacent impervious surfaces. Filter strips function by slowing runoff velocities, trapping sediment and other pollutants and providing some infiltration. While frequently planted with turf grass, filter strips may also employ native vegetation, such as meadow or prairie, which may be more effective in treating nutrients. In addition, trees and shrubs may be incorporated into portions of the strip to create visual screening as well as a physical barrier. (See Figure 1.)

Filter strips are best suited to treating runoff from roads and highways, roof downspouts and small parking lots, and they are ideal components of the "outer zone" of a stream buffer. In addition, filter strips are frequently used as a pretreatment system for stormwater destined for other BMPs such as filters or bioretention systems.

A challenge associated with filter strips is the difficulty of maintaining sheet flow. Urban filter strips are often short-circuited by concentrated flows, which results in little or no treatment of stormwater runoff. To avoid this problem, filter strip design can incorporate a level spreader to distribute concentrated flow along the width of the strip.

Filter strips were originally used as an agricultural treatment practice and have more recently evolved into an urban practice. Studies in agricultural areas indicate that a 15-foot wide grass buffer can achieve a 50 percent removal rate of nitrogen, phosphorus and sediment and that a 100-foot buffer can remove 70 percent of these constituents. Urban runoff studies suggest a minimum removal rate of 35 percent of solids and 40 percent of nutrients. This assumes a filter strip that is properly designed, constructed and maintained.

Purpose

Water Quantity

Flow attenuation	◧
Runoff volume reduction	◧

Water Quality

Pollution prevention	
Soil erosion	□
Sediment control	◧
Nutrient loading	◧
Pollutant removal	
Total suspended sediment (TSS)	◧
Total phosphorus (P)	□
Nitrogen (N)	□
Heavy metals	□
Floatables	◧
Oil and grease	◧
Other	
Fecal coliform	□
Biochemical oxygen demand (BOD)	□

■ Primary design benefit
◧ Secondary design benefit
□ Little or no design benefit

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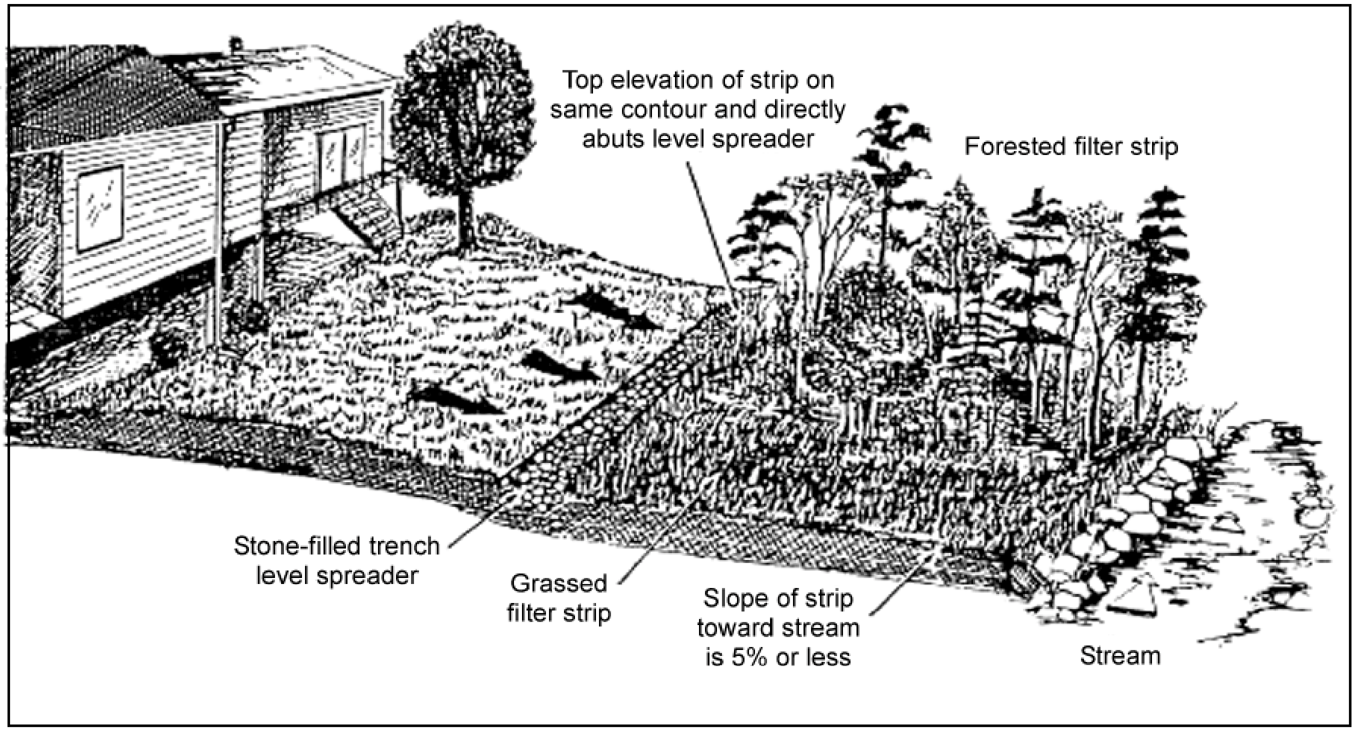

Figure 1: Filter Strip Combining Grassed and Wooded Areas
Source: Claytor, 1996

Advantages

- Filter strips help remove sediment and associated insoluble contaminants from runoff.
- They allow increased infiltration opportunity for soluble nutrients and pesticides to drain into the soil.
- Filter strips work well in residential areas, where they provide open space for recreation activities, help maintain riparian zones along streams, reduce streambank erosion and provide animal habitat. (See Figure 2)
- Since they do not pond water on the surface for long periods, filter strips help maintain temperature norms of the water, thereby protecting or providing habitat for aquatic life.
- Filter strips can be useful as sediment filters during construction. In some settings, this may only require preservation of an appropriately located area of existing vegetation. (See Design section for details.)
- Filter strips with taller, denser vegetation can help provide a visual barrier from such areas as roads, factories or recreation sites.
- Filter strips with dense native vegetation can trap dust blowing off a construction site.
- They are relatively simple and inexpensive to install, employing only planting and perhaps some earthwork.
- Filter strips are relatively low-maintenance practices.

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- They tend to be low-cost as well, since their plantings and maintenance often overlap with what would be done on the site regardless of stormwater management practices.

Limitations

- They are not appropriate for hilly or intensively paved areas due to high-velocity runoff.
- These systems are difficult to monitor, and thus there is less available data on their effectiveness for pollutant removal.
- Use of filter strips tend to be impractical in watersheds where open land is scarce and/or expensive.
- In general, filter strips should not accept highly contaminated "hotspot" runoff, since infiltration could result in groundwater pollution and damage to vegetation..
- Filter strips tend to be poor retrofit options since they consume a relatively large amount of space and cannot treat large drainage areas.
- Improper grading can render the practice ineffective.
- Since filter strips cannot provide enough storage or infiltration to significantly reduce peak discharge or volume of runoff, the practice may be best implemented as one of a series of stormwater BMPs.
- Filter strips are only effective if sheet flow can be maintained through the filter strip.

Requirements

Design

- Ordinarily, forests and other natural areas should not be destroyed to create a filter-strip system. Such areas may already be functional or may only need to be enhanced (with, for example, level spreaders or repair to eroded spots) to function properly as treatment systems.
- The design of filter strips must be specific to the site; widths, for example, vary greatly depending on proximity of streams or lakes.
- Filter strips must be at least 15 feet wide in the direction of flow in order to be effective, however greater widths will enhance treatment. The steeper the slope, the wider the strip should be.
- The Natural Resources Conservation Service (NRCS) recommends a minimum of 150 feet of filtering buffer between a land disturbance activity and a water body. Depending on soil types and slopes, the width may need to be even greater.
- The length of the filter strip should stretch the entire length of the impervious surface from which stormwater originates, and when adjacent to a natural water body, they should stretch the entire length of the property or shoreline.
- If soil and vegetation within designated buffer areas or zones are disturbed as part of the site work, they should be designed to act as filter strips. Disturbance of native vegetation in buffer areas should be avoided whenever possible.

Filter Strips

Requirements

Design (continued)

- In general, filter strip slopes should be no less than 1 or 2 percent and no greater than 6 percent. Greater slopes will encourage concentrated flow and flatter slopes may result in ponding.
- Top and toe of slope should be as flat as possible to encourage sheet flow and prevent erosion.
- The area immediately upslope from the filter strip may also need to be shaped and graded to ensure sheet flow.
- Concentrated flow should not be discharged into filter strips. If flows are concentrated, a level spreader should be included to spread the flow out over the entire length of the filter strip.

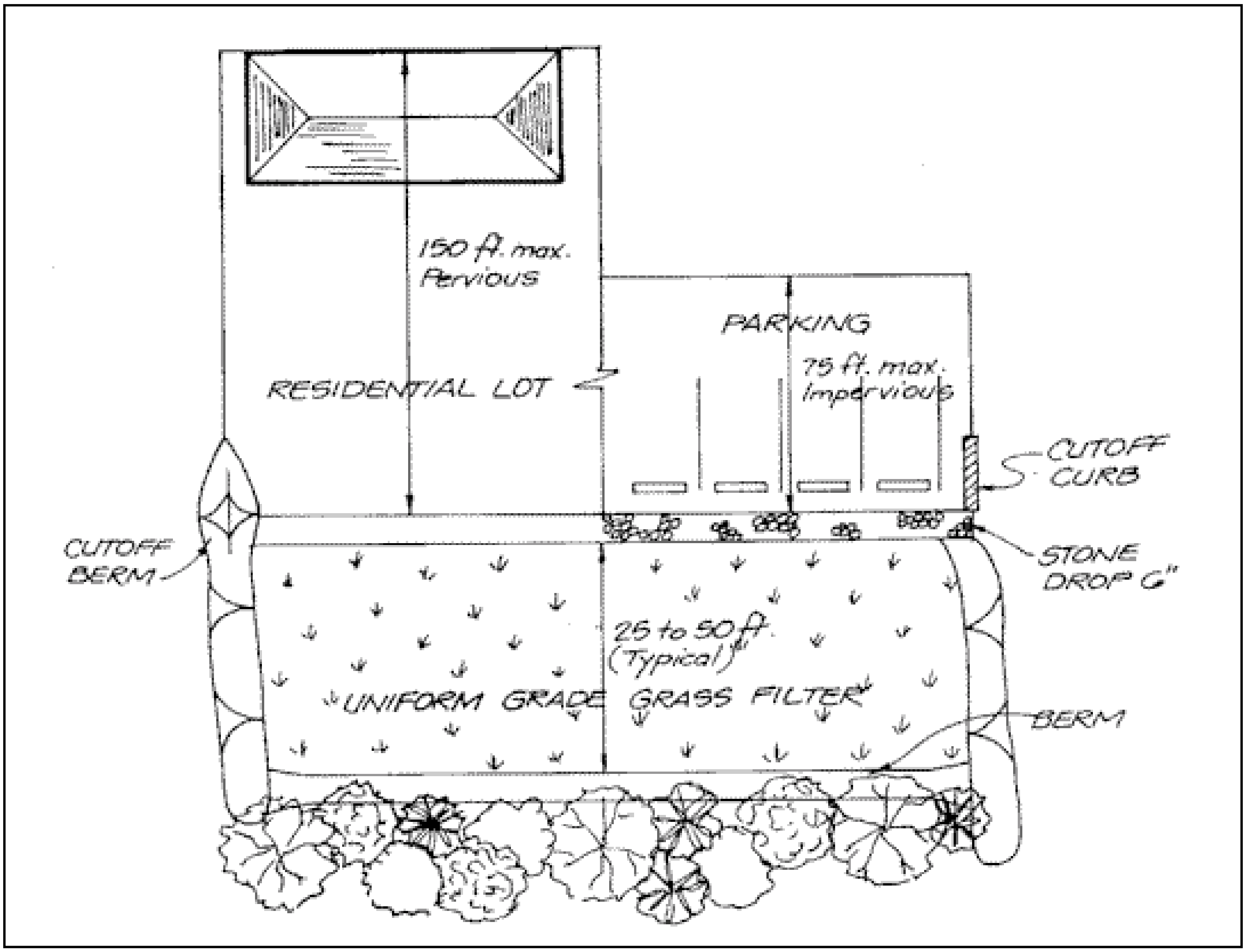

Figure 2: Filter Strip Plan
Source: Center for Watershed Protection, 2000

- Level spreaders can take on many configurations. Level spreaders must take concentrated flow and spread it out into sheet flow upstream of the filter strip. This can be accomplished in many different ways. The key is that there must be a long, continuous and level overflow elevation. This can be a curb, a concrete weir or a level trench (12 inches wide by 24 inches deep), filled with pea gravel or crushed stone.

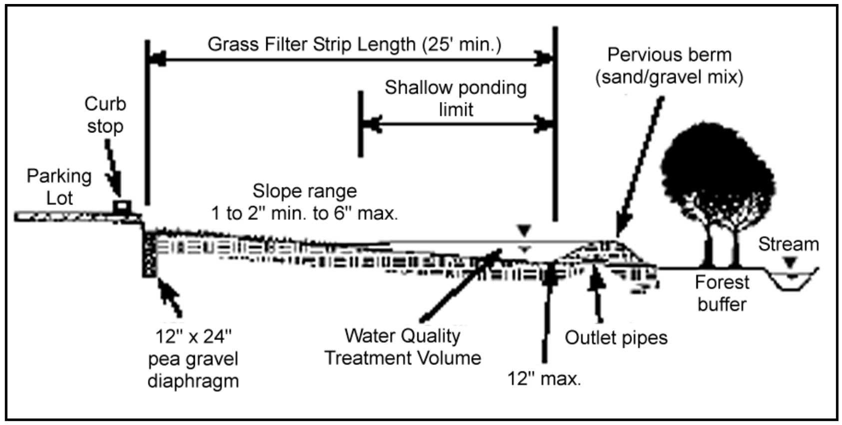

Figure 3: Filter Strip Profile
Source: Claytor & Schueler, 1996.

- To enhance the effectiveness of the filter strip, install a pervious berm of sand and gravel (see Fig. 3) at the toe of the slope. This could also include outlet pipes flowing through it or an overflow weir. This provides an area for temporary shallow ponding to accommodate a portion or all of the water quality volume.
- Select plants that are able to withstand flowing water and both wet and dry periods. See On-Lot Infiltration BMP for plant lists.
- When a filter strip is used during construction, its design should be incorporated into the final post-construction landscape. This may mean selecting vegetation that will reach an appropriate height at maturity and offer an attractive appearance.
- Depending on adjacent land use and traffic, filter strips may require fencing to control destructive access by vehicles, pedestrians and animals.
- Filter strips are typically designed to handle flows from the 1 to 2 year storms and are unable to reduce flow rates of large storm events. Depending on slope and vegetation, the flows from larger storms could damage filter strips. If this is the case, the design should incorporate a bypass system into supplementary BMPs.

Requirements

Construction

- Accurate grading is essential, since even small departures from design slopes can eliminate sheet flow and decrease effectiveness.
- All filter strips should use appropriate soil-stabilization methods, such as mulch (at a minimum), or preferably mats or erosion control blankets (see other BMP sections).
- If a filter strip must be interrupted by construction entrances, resulting in removal of natural vegetation, artificial buffer techniques must be installed: for example, vehicle tracking pads or silt fences.

With minimal maintenance, filter strips can be effective indefinitely. Those that are not maintained properly may

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Maintenance

quickly become nonfunctional. Maintenance basically involves normal grass or shrub-growing activities such as mowing, trimming, removal of invasive species, and replanting when necessary.

Filter strips require more tending as the volume of sediment increases. Periodically, strips used for sediment removal may require regrading and reseeding of their upslope edge. When used during construction activities, and if a high volume of sediment builds up, the strip may need to be reworked and replanted. The same would be necessary if concentrated flow erodes a channel through the strip.

Annual

(Semiannual in Year 1)

- Inspect pea gravel diaphragm/level spreader for clogging and effectiveness and remove built-up sediment.
- Inspect for rills and gullies. Immediately fill with topsoil, install erosion control blanket and seed or sod.
- Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.

Regular, Frequent

- Mow turf grass with low ground pressure equipment to a three- or four-inch height. Cut only when soil is dry to prevent tracking damage to vegetation, soil compaction and flow concentrations.

Regular, Infrequent

- Remove sediment and replant in areas of buildup.
- Limit fertilizer applications based on plant vigor and soil test results.

Filter Strips

Sources

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