Filter Strip

Description: Uniformly graded section of land that is densely vegetated and is designed to treat runoff through vegetative filtering and infiltration. Water enters the filter strip along its width and runs across the length of the filter strip.

Components:

- Vegetation – provides water quality treatment through filtering and plant uptake; vegetation can be grasses or other deep-rooted plants
- Land with gradual slope – minimal slopes allow for some amount of water quality treatment through infiltration
- Level spreader – ensures runoff over the vegetated filter is in sheet flow (shallow, uniform flow length) as opposed to concentrated (channelized) flow

Advantages/Benefits:

- High community acceptance in any type of setting
- Easy to maintain once ground cover and/or trees established
- Can be used as pre-treatment for other BMPs, similar to sediment forebay
- Filter strips are easily incorporated into new construction/ development designs

Disadvantages/Limitations:

- Cannot meet the 80% total suspended solids goal without another BMP in a treatment train. Fifty foot strip is assumed to achieve 50% TSS removal, while 25 foot strip used as a pretreatment control is assumed to achieve 10% TSS removal
- Filter strip and level spreaders have limited drainage areas
- It can be difficult to construct a level lip on level spreaders

Design considerations:

- Must have slopes between 2% and 6%
- Must maintain sheet flow across entire filter strip
- Minimum 25 foot flow length; the longer the flow length, the higher the pollutant removal, if sheet flow is maintained.

Selection Criteria:

- [ ] **Water Quality 80% TSS Removal**
- [x] **Accepts Hotspot Runoff**
- [x] **Residential Subdivision**
- [ ] **High Density / Ultra Urban Use**

Maintenance:

- Maintain a dense, healthy stand of grass and other vegetation
- Repair erosion
- Periodic sediment removal
- Revegetate as needed

L	**Maintenance Burden**

L = Low M = Moderate H = High

General Description

Filter strips are uniformly graded, densely vegetated areas of land that are designed to remove pollutants from runoff through vegetative filtration and infiltration. Filter strips are suited for treating runoff from roads and highways, small parking lots, pervious areas, and roof downspouts. They are also well-suited as the outer zone of a stream buffer and as pretreatment for other structural controls. Filter strips that fulfill Metro requirements can be used as credits against the stormwater quality volume for a site (see Volume 1, Chapter 7.8).

The vegetation can be grassed or a combination of grass and woody plants. Pollutant removal efficiencies are based upon a 50-foot long strip. Filter strips with shorter flow lengths are considered to have lower removal efficiencies and should be used as coarse sediment settling areas for other structural controls. Filter strips are and considered to be an integral component of those controls, similar to sediment forebays for stormwater wet ponds (see PTP-01). Uniform sheet flow must be maintained through the filter strip to provide pollutant reduction and to avoid erosion. To obtain sheet flow when discharging runoff from a developed area, a level spreader may be required.

Components

Figure 7.1 illustrates a filter strip. Filter strips consist of the following components:

1. Sheet flow spreader that allows flow to enter the filter strip as sheet flow.
2. Uniformly graded area with 2 to 6 percent slopes, with a minimum width of 15 feet, and a minimum length (flow path) of 50 feet for a 50% TSS removal credit (Volume 4, Section 6.1) and 25 feet for a settling or pretreatment control, with a lesser credit of 10% TSS removal.
3. Dense vegetation that can withstand relatively high velocity flows.
4. Optional berm.

Site and Design Considerations

The following design and site considerations must be incorporated into the filter strip design:

1. Filter strips should be used to treat small drainage areas, ordinarily with a maximum of 75 feet for impervious surfaces, and 150 feet for pervious surfaces (CWP, 1996). For longer flow paths, special provision must be made to ensure design flows spread evenly across the filter strip. .
2. Flow must enter the filter strip as sheet flow spread out over the width of the strip, generally no deeper than 1 to 2 inches.
3. Filter strips should be integrated into site designs.
4. Filter strips should be constructed outside the natural stream buffer area whenever possible to maintain a more natural buffer along the streambank.
5. Filter strips should be designed for slopes between 2% and 6%. Greater slopes than this would encourage the formation of concentrated flow. Flatter slopes would encourage standing water.
6. Filter strips should not be used on soils that cannot sustain a dense grass cover with high retardance. Designers should choose a grass that can withstand relatively high velocity flows at the entrances, and both wet and dry periods.
7. The filter strip should be at least 15 feet long to provide filtration and contact time for water quality treatment. 25 feet is preferred, though length will normally be dictated by design method. 50 feet is necessary to achieve the 50% TSS removal credit.
8. Both the top and toe of the slope should be as flat as possible to encourage sheet flow and prevent erosion.
9. An effective flow spreader a pea gravel diaphragm located at the top of the slope (ASTM D 448 size no. 6, 1/8" to 3/8"). The pea gravel diaphragm is a small trench running along the top of the filter strip. It serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the filter strip. Second, it acts as a level spreader, maintaining sheet flow as runoff flows over the filter strip. Other types of flow spreaders include long timbers, a concrete sill, curb stops, or curb and gutter with "sawteeth" cut into it.
10. Ensure that flows in excess of design flow move across or around the strip without damaging it. Often a bypass channel or overflow spillway with protected channel section is designed to handle higher flows.
11. Maximum discharge loading per foot of filter strip width (perpendicular to flow path) is found using the Manning's equation:

$$q = \frac{0.00236}{n} Y^{\frac{5}{3}} S^{\frac{1}{2}}$$

Where: q = discharge per foot of width of filter strip (cfs/ft)
Y = allowable depth of flow (inches)
S = slope of filter strip (percent)
n = Manning's "n" roughness coefficient
(Use 0.15 for medium grass, 0.25 for dense grass, and 0.35 for very dense Bermuda-type grass)

Site and Design Considerations (Continued)

12. Using q, computed above, The minimum width of a filter strip is:

$$W_{fMIN} = \frac{Q}{q}$$

Where: W_{fMIN} = minimum filter strip width perpendicular to flow (feet)
Q = water quality flow rate (see PTP-03 Bioretention, page 5, Design Step #4).

Filter Strips without Berm

13. Size filter strip (parallel to flow path) for a contact time of 5 minutes minimum.
14. Equation for filter length is based on the SCS TR-55 travel time equation (SCS, 1986):

$$L_f = \frac{(T_t)^{1.25}(P_{2-24})^{0.625}(S)^{0.5}}{3.34n}$$

Where: L_f = length of filter strip parallel to flow path (25 ft minimum)
T_t = travel time through filter strip (5 minutes minimum)
P2-24 = 2-year, 24-hour rainfall depth (3.39 inches)
S = slope of filter strip (2-6 percent preferred)
n = Manning's "n" roughness coefficient
(Use 0.15 for medium grass, 0.25 for dense grass, and 0.35 for very dense Bermuda-type grass)

(Source for equations in items 11 through 14: Georgia Stormwater Management Manual)

Filter Strips with Berm

15. Size outlet pipes to ensure that the bermed area drains within 24 hours. Refer to PTP-01 Stormwater Wet Ponds for orifice sizing equations.
16. Specify grasses resistant to frequent inundation within the shallow ponding limit.
17. Berm material should consist of sand, gravel and sandy loam to encourage grass cover (Sand: ASTM C-33 fine aggregate concrete sand 0.02"-0.04", Gravel: AASHTO M-43 ½" to 1").
18. Size filter strip to contain the WQ_v within the wedge of water backed up behind the berm.
19. Maximum berm height is 12 inches.

Filter Strips for Pretreatment

20. A number of other structural controls, including bioretention areas and infiltration trenches, may utilize a filter strip as a pretreatment measure. The required length of the filter strip depends on the drainage area, imperviousness, and the filter strip slope. Table 7.1 provides sizing guidance for using filter strips for pretreatment. Filter strips used as pretreatment for coarse sediment for bioretention areas and infiltration trenches are not credited with removing TSS above and beyond the main treatment BMP.

Site and Design Considerations (Continued)

Table 7.1 Sizing of Filter Strips for Pretreatment Only

Parameter	Impervious Areas*				Pervious Areas (Lawns, etc)**			
Maximum inflow approach length (feet)	35		75		75		150	
Filter strip slope (max = 6%)	< 2%	> 2%	< 2%	> 2%	< 2%	> 2%	< 2%	> 2%
Filter strip minimum length (feet)***	10	15	20	25	10	12	30	36

* 75 feet maximum impervious area flow length to filter strip.
** 150 feet maximum pervious area draining to filter strip.
***At least 25 feet is *required* for minimum pretreatment credit of 10% TSS removal. Fifty feet is required for obtaining 50% TSS removal credit.
(*Adapted from Georgia Stormwater Management Manual)*

As-Built Certification Considerations

After the filter strip has been constructed, the developer must have an as-built certification of the filter strip conducted by a registered Professional Engineer. The as-built certification verifies that the BMP was installed as designed and approved.

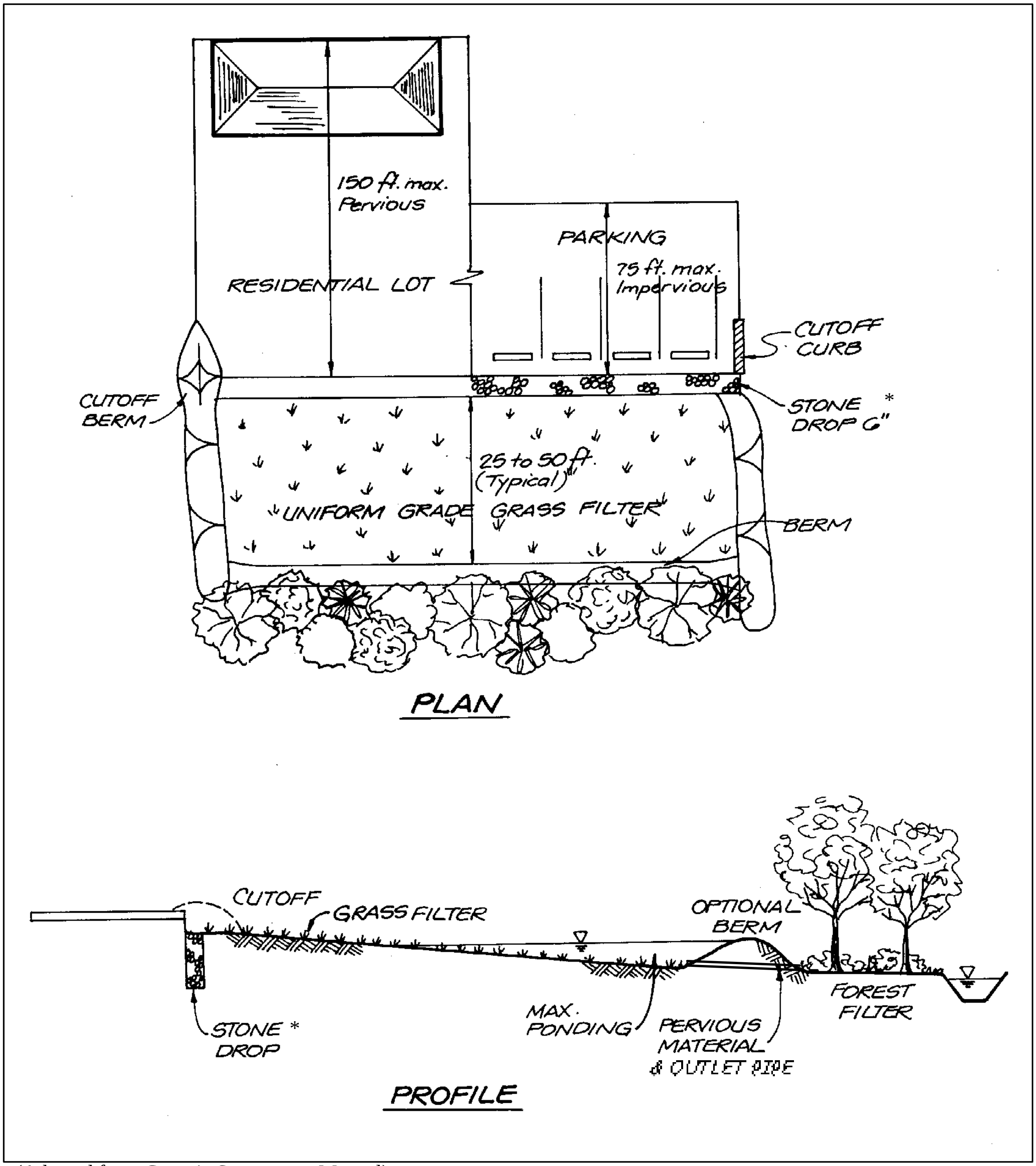
The following components must be addressed in the as-built certification:

1. Ensure design flows spread evenly across filter strip.
2. Ensure design slope is between 2% and 6%.
3. Verify dimensions of filter strip.

Maintenance

Each BMP must have an Operations and Maintenance (O&M) Agreement that is submitted to Metro for approval and is maintained and updated by the BMP owner. Refer to Volume 1 Appendix C for the Operation and Maintenance Agreement for filter strips, as well as an inspection checklist. The O&M Agreement must be completed and submitted to Metro with site plans. The O&M Agreement is to be used by the BMP owner in performing routine inspections. The developer/owner is responsible for the cost of maintenance and annual inspections. The BMP owner must maintain and update the BMP operations and maintenance plan. At a minimum, the operations and maintenance plan must address:

1. Maintain a dense, healthy stand of grass and other vegetation by frequent mowing: grass heights of 3 to 5 inches should be maintained, with a maximum grass height of 8 inches;
2. Repair erosion;
3. Periodic sediment removal; and
4. Revegetate as needed.



(Adapted from Georgia Stormwater Manual)

* Stone drop or some other acceptable type of level spreader to achieve sheet flow.

Figure 7.1 Filter Strip

References

ARC, 2001. Georgia Stormwater Management Manual Volume 2 Technical Handbook.

CDM, 2000. Metropolitan Nashville and Davidson County Stormwater Management Manual Volume 4 Best Management Practices.

Suggested Reading

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