BIO-3: Vegetated Filter Strip

Also known as:

- *Buffer strip*
- *Vegetated buffer*

Vegetated filter strip.
Source: http://www.wsdot.wa.gov/Environment/WaterQuality/Research/Reports.htm

Vegetated filter strips are designed to treat sheet flow runoff from adjacent impervious surfaces or intensive landscaped areas such as golf courses. Filter strips decrease runoff velocity, filter out total suspended solids and associated pollutants, and provide some infiltration into underlying soils. While some assimilation of dissolved constituents may occur, filter strips are generally more effective in trapping sediment and particulate-bound metals, nutrients, and pesticides. Filter strips are more effective when the runoff passes through the vegetation and thatch layer in the form of shallow, uniform flow. Biological and chemical processes may help break down pesticides, uptake metals, and utilize nutrients that are trapped in the filter.

Feasibility Screening Considerations

- Vegetated filter strips may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Filter strips provide an attractive and inexpensive vegetative storm water runoff BMP that can be easily incorporated into the landscape design of a site.
- Open areas are needed for vegetated filter strips, including road and highway shoulders, small parking lots, and residential, commercial, or institutional landscaped areas.
- Must be sited adjacent to impervious surfaces which can sheet flow onto filter strips.
- Shallow, evenly distributed flow across entire width of strip is recommended.
- Steep terrain and/or a large tributary area may cause concentrated, erosive flows. The site slope should not exceed 5%.
- Drainage area is ≤ 2 acres with a maximum length (in the direction of flow towards the filter strip) of 150 feet.

OC-Specific Design Criteria and Considerations

☐ For biotreatment applications, the minimum length in the flow direction is 15 feet, and the maximum length in the flow direction is 150 feet. If filter strip is used for pretreatment, the minimum filter strip length is 7.5 feet.

☐ The width of the filter strip should extend across the full width of the tributary area, with the upstream boundary of the filter strip located contiguous to the developed area.

☐ A minimum design residence time of 10 minutes is recommended for biotreatment applications, or 5 minutes for pretreatment uses.

☐ The bed slope in flow direction should be between 2 - 6%.

- [ ] The slope in the direction perpendicular to flow should not exceed 4%.
- [ ] The maximum design flow depth should be 1 inch.
- [ ] The design flow velocity should not exceed 1 ft/sec.
- [ ] Irrigated turf grass or approved equal should be used for vegetation. Grass height should be maintained between 2 – 4 inches.
- [ ] The top of the strip should be installed 2 to 5 inches below the adjacent pavement to allow for vegetation and sediment accumulation at the edge of the strip. A beveled transition is acceptable and may be required per roadside design specifications

Sizing Approach for Vegetated Filter Strip

The Design Capture Method for Flow-based BMPs should be used to determine the design flowrate for a vegetated filter strip. The user then selects the design flow depth and longitudinal slope and uses the sizing steps below to determine the length and width of the swale. The sizing steps are as follows:

Step 1: Determine Design Flowrate (Q)

Calculate the Design Flowrate (Q) using the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**). Inputs include the time of concentration of the catchment (T_c) and the capture efficiency achieved upstream by HSCs or other BMPs.

Step 2: Calculate the Minimum Filter Strip Width

$$W_{MIN} = Q / q_{A,MIN}$$

Where:

W_{MIN} = minimum width of filter strip (and tributary area), ft

Q = design flow, cfs

$q_{A,MIN}$ = minimum linear unit application rate, 0.005 cfs/ft

Step 3: Calculate the Design Flow Depth

$$d_F = 12 \times ((Q \times n_{WQ}) / (1.49 \times W_{TRIB} \times s^{0.5}))^{0.6}$$

Where:

d_F = design flow depth, in

Q = design flow, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, use 0.2 unless other information is available

W = width of strip (and tributary area), ft (should be equal or greater than W_{MIN})

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

Step 4: Calculate the Filter Strip Design Velocity

Calculate the filter strip design velocity using the following equation:

$$V_{WQ} = Q / (d_F \times W)$$

Where:

V_{WQ} = filter strip design flow velocity, fps

d_F = design flow depth, in

Q = design flow, cfs

W = width of strip (and tributary area), ft

The design flow velocity should not exceed 1 foot per second. If the velocity exceeds 1 fps, adjust the strip longitudinal slope to decrease the velocity.

Step 5: Calculate Filter Strip Length

Calculate the filter strip length required to achieve the required minimum residence time using the following equation:

$$L = 60 \times t_{HR} \times V_{WQ}$$

Where:

L = filter strip length, ft (must be 15 ft to 150 ft for biotreatment)

t_{HR} = hydraulic residence time, min (minimum 10 minutes for biotreatment)

V_{WQ} = design flow velocity, fps

Configuration for Use in a Treatment Train

- Filter strips are often used as pretreatment devices for other larger capacity BMPs such as bioretention areas and assist by filtering sediment and associated pollutants prior to entering the larger capacity BMP, preventing clogging and reducing the maintenance requirements for larger capacity BMPs.

Additional References for Design Guidance

- Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 4: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- SMC LID Manual (pp 135): http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf