## *4.4. Filter Strips*

Filter Strips are densely vegetated lands that treat sheet flow storm water from adjacent pervious and impervious areas. They function by slowing runoff, trapping sediment and pollutants, and in some cases infiltrating a portion of the runoff into the ground. To be effective, they require the presence of sheet flow across the entire strip. Since they can be incorporated into landscaped areas, filter strips can provide dual functionality to satisfy storm water pre-treatment and landscape requirements in one location. Filter strips are a sensible and cost-effective storm water management pretreatment option applicable to a variety of development sties including roads and highways.


Pennsylvania Stormwater BMP Manual

**Key elements :**

**Filter Strips must be designed within parameters required by the Fort Wayne's Development Standards/Criteria Manual.**

- Filters strips are only considered a viable pretreatment option for other BMPs and do not provide adequate pollutant removal benefits to act as a stand-alone BMP.
- Sheet flow across the vegetated filter strip is mandatory for proper filter strip function.
- Filter strip length is a function of slope, vegetation type, soil type, drainage area, and desired amount of pretreatment. See Table 4.4.2 for filter strip length criteria, as common terminology for filter strips uses the word 'length' for what would normally be considered the width as well as the length. A unit width of filter strip is assumed, with the length being the dimension parallel to the flow path. The length dimension is specified with respect to the flow path in both parallel and perpendicular directions.
- Level spreading devices are recommended to provide uniform sheet flow conditions at the interface of the filter strip and the adjacent land cover.
- The longest flow path to a filter strip, without the installation of energy dissipaters and/ or flow spreaders, is 75 feet for impervious ground covers and 150 feet for pervious ground covers.
- Filter strip slope should never exceed 8%. Slopes less than 5% are generally preferred. Slopes greater than 1% are recommended to promote positive drainage flow to and through the filter strip.
- Maximum contributing drainage area is less than 5 acres, and should also never exceed a drainage area to filter strip area ratio of 6:1.
- Maximum contributing drainage area slope is generally recommended to be less than 5%, unless energy dissipation and/or flow spreaders are provided.

- Construction of filter strips shall entail as little disturbance to existing vegetation at the site as possible.

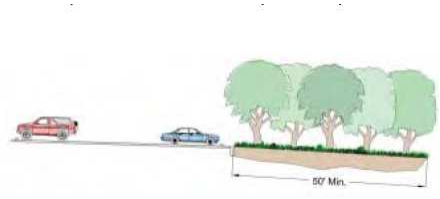
- Use of native plants within filter strips can serve to stabilize soils to prevent erosion. This is most beneficial in areas along stream banks and shorelines.

**Table 4.4.1: Filter Strips Potential Application and Storm Water Regulation**

| Potential applications | | | Storm water regulations | | |
|---|---|---|---|---|---|
| | | | | Infiltration | No Infiltration |
| Residential Subdivision: | Yes | | Water Quality Benefit | No | Yes |
| Commercial: | Yes* | | Volume Reduction | No | No |
| Ultra Urban: | Limited* | | Attenuation Benefit | No | No |
| Industrial: | Limited* | | | | |
| Retrofit: | Yes | | | | |
| Highway Road: | Yes | | | | |

### Acceptable forms of pre-treatment
N/A

### Filter Strips in the Urban Landscape
Filter strips are effective at slowing runoff velocities, removing pollutant loads, and promoting infiltration of runoff produced by both impervious and pervious areas. Filter strips are suitable for many types of development projects. Filter strips can be used as pretreatment facilities for other BMPs in residential, commercial, and light industrial development; roads and highways; and parking lots.




**FILTER STRIP IN FORESTED AREA**

Filter strips are recommended for use as a pretreatment component of other BMPs including but not limited to: bioretention, constructed wetlands, detention, filters, ponds/wet basins, porous pavement, and vegetated swales. The use of a properly maintained filter strip extends the life of the associated BMPs and decreases its hydraulic residence time. It also increases the amount of time before these structures need maintenance.

# Components of a Filter Strip System

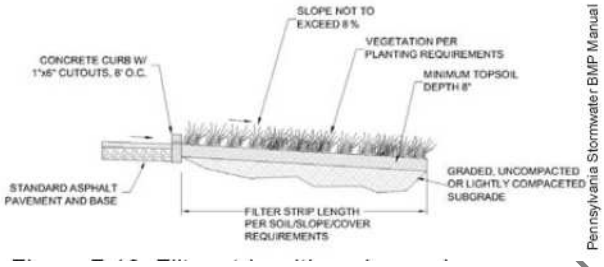
## Inlet Control
Filter strips are typically combined with a level spreader or flow control device. A flow control device functions to lessen the flow energy of storm water prior to entering the filter strip area. Filter strips function best when flows are evenly distributed over their width. Concentrated flows can have an erosive effect that can damage the filter strip by short circuiting it and rendering the strip ineffective. Curb openings combined with a gravel level spreader are a common type of flow control. See Section 4.9: Inlet and Outlet Controls for more information. Slotted or depressed curbs installed at

**FILTER STRIP PROVIDING PRETREATMENT FROM A PARKING LOT TO A BIORETENTION SYTEM**

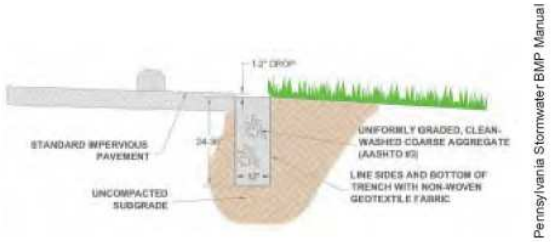
a level grade at the edge of the impervious area should ensure a well distributed flow to the filter strip. These slotted openings should be spaced along the length of the curb.

## Vegetation

The vegetation for filter strips may be comprised of turf grasses, meadow grasses, shrubs, and native vegetation. It can include trees or indigenous areas of woods and vegetation. Vegetation adds aesthetic value as well as water quality benefits. The use of indigenous vegetated areas that have surface features that disperse runoff is encouraged, as the use of these areas will also reduce overall site disturbance and soil compaction. Native vegetation also helps to minimize erosion by stabilizing the soil with the deep root structure common in native plants. The use of turf grasses will increase the required length of the filter strip compared to other vegetation options. See Chapter 5: Storm Water Landscape Guidance.




**FILTER STRIP WITH CURB OPENING**




**FILTER STRIP WITH GRAVEL TRENCH LEVEL SPREADER**

## Retentive Grading

Filter strip effectiveness may be enhanced by installing retentive grading perpendicular to the flow path. A pervious berm allows for a greater reduction in both runoff velocity and volume, thus improving pollutant removal capabilities by providing a temporary (very shallow) ponded area. The berm should be constructed according to the design provided in Section 4.6: Berms and Retentive Grading.

## Check Dams

Filter strips with slopes that exceed 6% should implement check dams to encourage ponding and prevent scour and erosion of the filter strip area. More information on check dams is available in Section 4.9: Inlet and Outlet Controls.


**CHECK DAMS: NOTE CHANNEL STORAGE CAPACITY CREATED BY CHECK DAMS. NOTCHED CENTER ALLOWS SAFE OVERFLOW WITHOUT SCOUR AROUND SIDES**

## Recommended Design Procedure

- Determine the Water Quality and Quantity requirements for the site per the Stormwater Design and Specification Manual.

- Create a Conceptual Site Plan for the entire site and determine what portion of the sizing requirements filter strips will accommodate (for pretreatment purposes).

- Investigate the feasibility of infiltration according to soil and vegetative conditions in the area proposed for the filter strip. If infiltration is feasible, determine the saturated vertical infiltration rate.

- Examine size and slope of the drainage area. The maximum contributing drainage area to a filter strip area shall never exceed 5 acres, and should also never exceed a drainage area to filter strip area ratio of 6:1.

- If the slope of the filter strip parallel to the proposed flow path is ≥ 5%, energy dissipater and/or flow spreaders must be installed.

- Design an inlet control to meet energy dissipation requirements. See Section 4.9: Inlet and Outlet Controls.

- A flow spreader which stretches the entire length (perpendicular to flow path) of the contributing drainage area should be designed to limit flow velocity to prevent erosion and to spread the flow equally across the filter strip. If necessary, a bypass should be installed to prevent excessive, damaging flows.

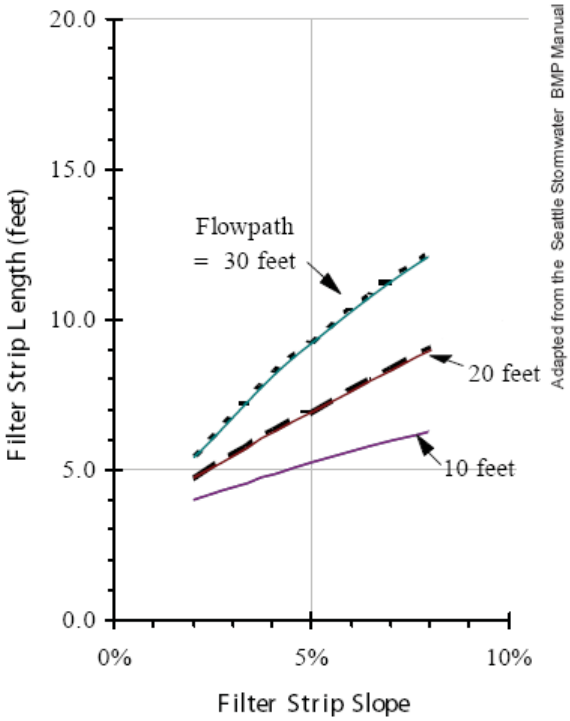
- Create a conceptual design for the pretreatment filter strip.

| **Table 4.4.2: Suggested Starting Design Values for Filter Strip Length** | |
|---|---|
| Strip Length Perpendicular to Flow Path | Largest feasible on site |
| Strip Length Parallel to Flow Path | 4* - 150 feet |
| *The minimum pretreatment filter strip value is based on the length of the receiving flow path. The graph below shows how the minimum length requirement changes as both flow path and filter strip slope change. | |

- Determine the longest flow path length for the contributing drainage area.

- For contributing drainage areas with flow paths < 30 feet use the following graph to help determine the filter strip length parallel to the flow path.

- For filter strips with contributing flow paths > 30 feet, use the suggested flow characteristics for maximum velocity and depth as design restrictions. When choosing an initial filter strip length (parallel to flow), the suggested minimum starting design value is 10 feet.




| Table 4.4.3: Suggested Maximum Velocities and Water Depths for Filter Strip Area | |
|---|---|
| Maximum Velocity (ft/s) | 1.0, Less than 0.5 preferred |
| Maximum Water Depth (in.) | 1.0, Less than 0.5 preferred |
| The values for both maximum Velocity and Water depth were taken from the US DOT Stormwater Best Management Practices (BMPs) in an Ultra-Urban Setting: Selection and Monitoring and the Seattle BMP Manual. | |



- Adjust filter strip design characteristics to provide desired amount of pretreatment.

- When considering retentive grading, use the infiltration area and the saturated vertical infiltration rate of the native soil to estimate how long the surface ponding will take to drain. The maximum drain down time for the ponded volume is 72 hours, but a drain down time of 24 - 48 hours is recommended. If ponded water does not drain in the time allowed, adjust water surface depth, soil depth, and/or surface area. Adjust the design until the volume and drainage time constraints are met.

- All retentive grading techniques should encourage soil stabilization and erosion control with vegetative growth. See Section 4.6: Berms and Retentive Grading.

- Choose plants and trees appropriate and compatible with the site conditions and local landscape requirements. See Chapter 5: Storm Water Landscape Guidance.

- Filter strips may not be used in high use areas unless precautions are taken to minimize disturbance (i.e. signage, placement of sidewalks or paths to minimize disturbance of the filter strip). Educational signage is encouraged and may be required in the Operations & Maintenance manual to ensure that the owner understands the purpose of the filter strip (to avoid future mowing and removal).

- Determine final contours of the filter strip.

- Complete construction plans and specifications.

## Materials

- Recommendations for plant materials and soils can be found in Chapter 5: Storm Water Landscape Guidance.

## Construction Guidelines

- Areas for filter strips shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.

- In areas where soil is compacted, tilling to depths of 12-18 inches is necessary. A minimum of 6 inches of top soil must be added into the tilled soil column, and small trees and shrubs with capabilities for deep root penetrations should be introduced to maximize the soil infiltrative capacity. Chapter 5: Storm Water Landscape Guidance, for more specification on soil types and preferred plantings.

- Provide erosion and sedimentation control protection on the site such that construction runoff is directed away from the proposed filter strip location.

- Complete site elevation and retentive grading, if proposed. Stabilize the soil disturbed within the limit of earth disturbance.

- Install energy dissipaters and flow spreaders. Refer to Section 4.9 Inlet and Outlet Controls for more detailed construction information.

- The slope (parallel to the flow path) of the top of the filter strip, after the flow spreading device, should be very small (less than 1 %) and gradually increase to designed value to protect from erosion and undermining of the control device.

- Construct inlet protection as specified in the design.

- Seed and plant vegetation (plants, shrubs, and trees) as indicated on the plans and specifications listed in Chapter 5: Storm Water Landscape Guidance.

- Once site vegetation is stabilized, remove erosion and sediment control protection.

## Maintenance Guidelines

All areas of the filter strip should be inspected after significant storm events for ponding that exceeds maximum depth and duration guidelines. Corrective measures should be taken when excessive ponding occurs. An Operations & Maintenance Manual should be included in the design documents to instruct the owner/operator of the maintenance required to maintain the filter strip functioning in accordance with the design.

**Table 4.4.4: Filter Strips Maintenance Guidelines**

| | Activity | Schedule |
|---|---|---|
| | Mowing and/or trimming of vegetation (not applicable to all filter strips). Filter strips that need mowing are to be cut to a height no less than 4 inches. Greater than 5 inches is preferred. | As needed |
| | Inspect all vegetated strip components expected to receive and/or trap debris and sediment for clogging and excessive debris and sediment accumulation; remove sediment during dry periods. | Quarterly |
| | Vegetated areas should be inspected for erosion, scour, and unwanted growth. This should be removed with minimum disruption to the planting soil bed and remaining vegetation.<br><br>Inspect all level spreading devices for trapped sediment and flow spreading abilities. Remove sediment and correct grading and flow channels during dry periods. | Biannually |
| | Maintain records of all inspections and maintenance activity. | Ongoing |

- When correcting grading of a flow spreading device, use proper erosion and sediment control precautions in the concentrated area of disturbance to ensure protection of the remaining potion of the filter.

- Disturbance to filter strips should be minimal during maintenance. At no time should any vehicle be driven on the filter strip. In addition, foot traffic should be kept to a minimum.

- If the filter strip is of the type that needs mowing (i.e., turf grass and possibly other native grasses), the lightest possible mowing equipment (i.e., push mowers, not riding mowers) should be used. The filter strip should be mowed perpendicular to the flow path (however not exactly the same path every mowing) to prevent any erosion and scour due to channeling of flow in the maintenance depressions.

- When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. For more information on vegetative maintenance, refer to Chapter 5: Storm Water Landscape Guidance.

- Bi-weekly inspections of erosion control and flow spreading devices should be performed until soil settlement and vegetative establishment has occurred.

**Note:**
Design of filter strips are not limited to the examples shown within this text. Successful storm water management plans will combine appropriate materials and designs specific to each site

### 4.4.1. Filter Strip Designer/Reviewer Checklist

| Item | Yes | No | N/A | Notes |
|---|---|---|---|---|
| Sheet flow provided? | | | | |
| Recommended slope ranges followed? | | | | |
| Appropriate length for soil, vegetation, and slope? | | | | |
| Slope of drainage area below five percent? | | | | |
| If not, is energy dissipation provided? | | | | |
| Length/area of incoming drainage appropriately limited? | | | | |
| Receiving vegetation considered? | | | | |
| Located in undisturbed virgin soil? | | | | |
| If not, will soil be properly compacted and stabilized? | | | | |
| Appropriate vegetation selected for stabilization? | | | | |
| Feasible construction process and sequence? | | | | |
| Soil compaction avoided or mitigated? | | | | |
| Erosion and sedimentation control provided to protect filter strip. | | | | |

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