

Vegetated Swale



Application

- Roadway shoulders and medians
- Linear open space along arterial, collector, and local roads
- Open spaces
- Pretreatment for other BMPs

Advantages

- Provides high pollutant removal and stormwater volume reduction
- Combines stormwater treatment with runoff conveyance
- Relatively low maintenance

Limitations

- Higher maintenance than conventional curb and gutter
- Not applicable for steep slopes

DESCRIPTION

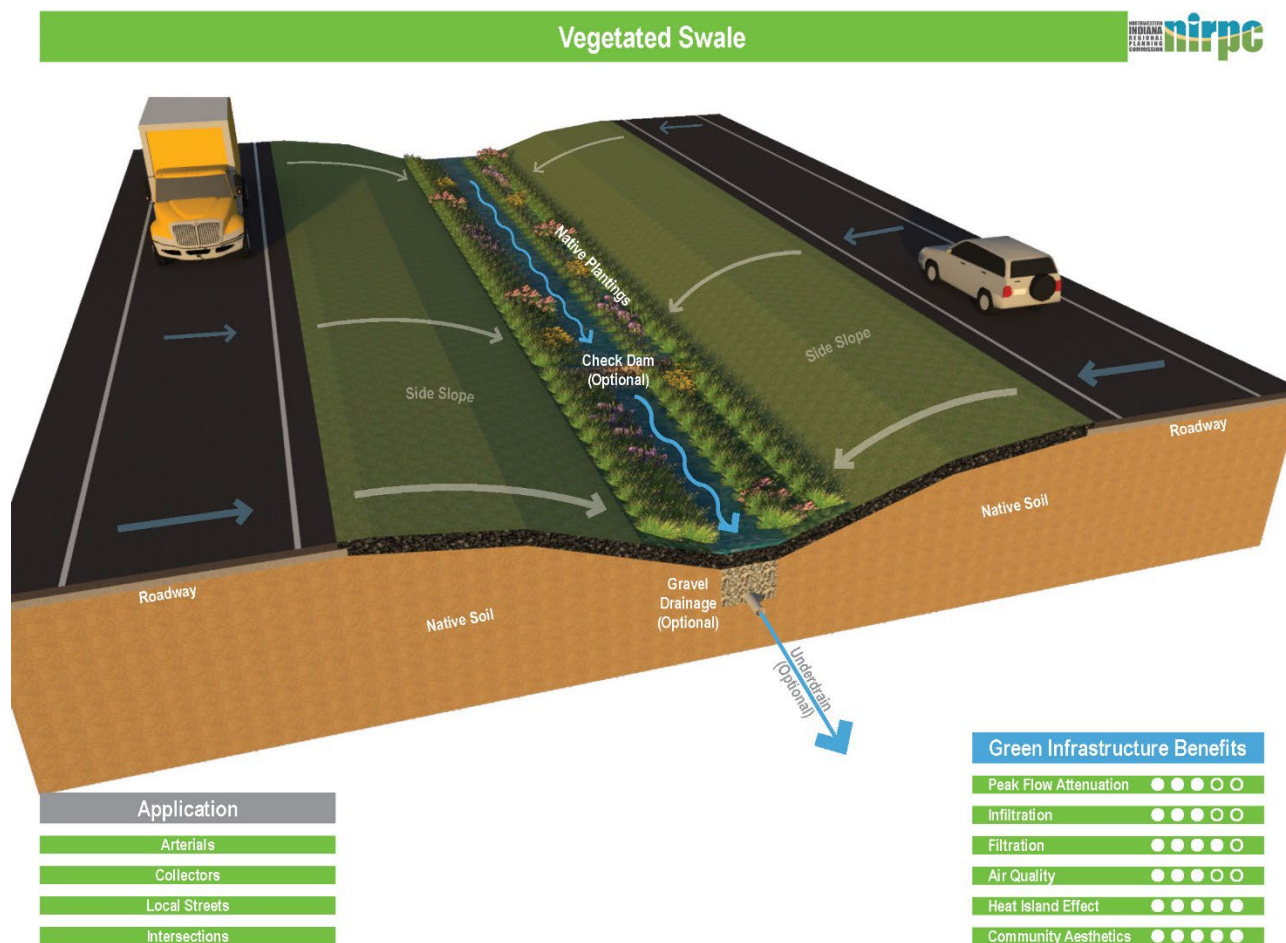
Vegetated swales are shallow, open conveyances with low-lying vegetation covering the channel that collect and slowly convey runoff to downstream discharge points. Swales remove stormwater pollutants by filtering flows through vegetation and by allowing suspended pollutants to settle due to the shallow flow depths and slow velocities in the swale. Bioswales are a swale that incorporates bioretention to promote both filtration and infiltration. Additional pollutant removal mechanisms include volume reduction through infiltration and evapotranspiration. Biochemical processes provide treatment of dissolved constituents. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a minimum 5 minute period. The vegetation in the swale including native vegetation and grass swales can vary depending desired aesthetic, maintenance requirements or maximizing water quality benefits. Use of native plant species are encouraged to maximize infiltration, pollutant removal, and vegetation survivability.

CONDITIONS WHERE PRACTICE APPLIES

Vegetated swales or bioswales have a wide range of applications and can be implemented adjacent to all roadway classifications including arterials and collectors. Vegetated swales are

well suited to treat runoff from impervious surfaces in both rural and urban settings and can be a natural buffer between impervious areas and natural drainages.

Vegetated swales are typically intended as a pre-treatment and not a standalone BMP. Swales decrease runoff velocity, filter out sediment and associated pollutants, and provide some infiltration into underlying soils. Vegetated swales can be designed and sized to convey high stormwater flows that can replace curbs, gutters, and storm drain systems. Swales should either be lined or avoided in areas where soils might be contaminated. Underdrains are recommended if there is limited infiltration capacity of underlying soils or if the longitudinal slope is less than 1.5%. Underdrains can improve the health of the vegetation and prevent the bottom of the vegetated swales from becoming soggy. Underdrains are recommended to mitigate vector (mosquito) concerns related to the formation of stagnant pools of water in poorly drained soils.



Site Suitability Considerations for Vegetated Swale Filters

Tributary Area	< 5 acres ¹
BMP Area Typically Required as Percentage of Tributary Area (%)	< 5 percent
Site Slope (%)	2 to 10 percent ^{2,3}
Hydrologic Soil Group	Any ³

1) Tributary area is the area of the site draining to the vegetated swale. Tributary areas provided here should be used as a general guideline only. Tributary areas can be larger or smaller in some instances.

2) If the longitudinal slope of the swale exceeds 4%, check dams should be provided.

3) If the vegetated swale has a longitudinal slope less than 1.5% or has poorly drained soils (hydrologic soil groups "C" or "D"), underdrains should be incorporated.

Note: The water quality design flow rate is the maximum flow rate that the swale can effectively treat. The design flow rate within the swale should have a flow depth of less than 4 inches with a velocity of less than 1 ft/sec. The designer can vary the swale width, slope, and Manning's n to achieve the desired conditions. Flow rates in excess of the water quality design flow can be routed through the swale, as in an on-line swale; however, these flows are not effectively treated.

VARIATIONS AND ENHANCEMENTS

Vegetated swales can be designed to maximize contact time, aid in trapping and securing of pollutants, or assist with volume reduction depending on the project. Structural and operational enhancements that can increase performance in vegetative filtration facilities are presented below.

- Check dams are recommended where longitudinal slopes exceed 4% to reduce velocities and dissipate erosive forces. Check dams increase sediment removal by causing stormwater to pond allowing coarse sediment to settle out.
- Amended soils provide sorption sites for the removal of dissolved and suspended pollutants and help support for plant growth. Soil amendments also help to increase evapotranspiration and infiltration by increasing storage within the soils thereby allowing the underlying native soils time for deeper infiltration.
- Vegetated swales function best under conditions of even, shallow sheet flow. Flow spreaders that distribute flow evenly across the width of a vegetated swale are recommended. Flow spreaders should be placed where point discharges, such as the outlet of a storm sewer, enter the swale.
- Flow dividers are recommended for vegetated swales when the bottom width exceeds 10 feet. Flow dividers encourage sheet flow and limit channelization along the bottom of the swale.

SIZING AND DESIGN CONSIDERATIONS

The following are recommended sizing and design considerations. Final vegetated swale designs should be based on site-specific considerations and limitations.

Green Infrastructure Fact Sheet

- The vegetated swale should be sized based on the target percent capture and estimated time of concentration.
- The design flow velocity through the swale should not exceed 1ft/sec to keep the vegetation in the swale upright.
- Size width and side-slopes to handle the design flow rate such that flow depths in the vegetated swale do not exceed a recommended depth of 4 inches. Typically flows should be at least 2 inches less than grass height.
- The recommended minimum bottom width of the vegetated swale is 2 feet and maximum bottom width is 10 feet.
- The recommended swale length is the length required to achieve a minimum hydraulic residence time of 10 minutes. The recommended minimum swale length is 100 feet.
- The recommended side slope of the swale is flat with 3:1 max slopes.
- The vegetated swale should be planted with wetland vegetation if the swale is designed to be persistently wet.
- See Plant Lists for recommendations of vegetation for Northwest Indiana.

INSPECTION AND MAINTENANCE

Routine Maintenance

Routine maintenance activities in vegetative swales should include:

- Maintain vegetation as needed to preserve aesthetics and proper function. Maintenance of vegetation could include mowing, trimming, and removal invasive species. Mowing should only be completed if swale is completely dry to avoid causing low spots.
- Remove trash and debris and visible floatables such as oil and grease.
- Remove minor sediment accumulations near inlet and outlet structures.
- Stabilize and repair eroded banks as needed. Reseed areas where soil is exposed.

Major Maintenance

Major maintenance activities in vegetated swales should include:

- Re-grade swale bottom to restore design longitudinal slope as needed.
- Aerate or scarify compacted areas to restore infiltration capacity.