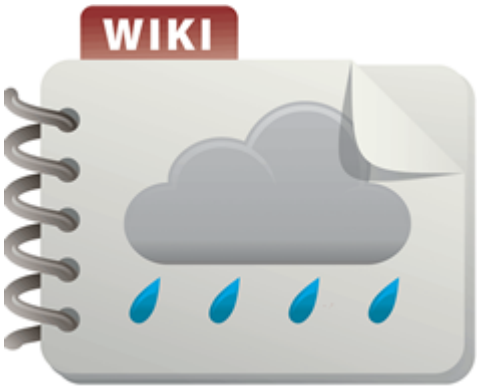

Page Content

Overview for wet swale (wetland channel)

[Download pdf]

Green Infrastructure: Swales can be an important tool for retention and detention of stormwater runoff. Depending on design and construction, swales may provide additional benefits, including cleaner air, carbon sequestration, improved biological habitat, and aesthetic value. See the section Green Infrastructure for stormwater management.

Wet swales occur when the water table is located very close to the surface or water does not readily drain out of the swale. A wet swale acts as a very long and linear shallow **biofiltration** (https://stormwater.pca.state.mn.us/index.php?title=Bioretention) or linear wetland treatment system (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_wetlands). Wet swales do not provide volume reduction and have limited treatment capability. Incorporation of **check dams** into the design allows treatment of a portion or all of the span title="The volume of water that is treated by a BMP."> **Water Quality Volume** (https://stormwater.pca.state.mn.us/index.php?title=Water_quality_criteria) within a series of cells created by the check dams. Wet swales planted with emergent wetland plant species (https://stormwater.pca.state.mn.us/index.php?title=Plants_for_swales) provide improved pollutant removal. Wet swales may be used as **pretreatment** (https://stormwater.pca.state.mn.us/index.php?title=Pretreatment) practices. Wet swales are commonly used for drainage areas less than 5 acres in size.

Contents

Photo of a wet swale. Courtesy of Limnotech.

Function within stormwter treatment train

Wet swales provide limited water quality treatment and no volume control and are not recommended practices unless options for other BMPs are limited.

Wet swales are designed primarily as in-line systems for stormwater quality and typically are used in conjunction with other structural controls in the stormwater **treatment train** (https://stormwater.pca.state.mn.us/index.php?title=Using_the_treatment_train_approach_to_BMP_selection). Wet swales may be used at various locations within a treatment train and can be used for pretreatment, conveyance, and/or primary treatment.

Typical applications

Applications of wet swales can vary extensively. Typical applications include

- individual lots for rooftop, driveway, and other on-lot impervious surface;
- shared facilities in common areas for individual lots;
- areas within loop roads or cul-de-sacs;
- landscaped parking lot islands;
- within right-of-ways along roads;
- common landscaped areas in apartment complexes or other multifamily housing designs;
- between buildings in industrial and commercial developments; and
- conveyance between detention structures and receiving waters.

Infeasibility criteria

Certain site-specific conditions may make the use of wet swales infeasible. Examples include:

- where ordinances established by the local government with jurisdiction, such as setbacks from structures, conflict with the proposed location;
- where high levels of contaminants in soil or groundwater exist (See here (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_infiltration_and_contaminated_soils_and_groundwater);
- where the only area available for siting does not allow for a safe overflow pathway to the municipal separate storm sewer system or private storm sewer system;
- where reasonable concerns about erosion, slope failure, or down gradient flooding exist and cannot be overcome by swale design modifications; and
- where there are restrictions on the proximity to building foundations.

MPCA permit applicability

One of the goals of this Manual is to facilitate understanding of and compliance with the MPCA Construction General Permit (https://stormwater.pca.state.mn.us/index.php?title=Construction_stormwater_program) (CGP), which includes design and performance standards for permanent stormwater management systems. These standards must be applied in all projects in which at least 1 acre of new impervious area is being created, and the permit stipulates certain standards for various categories of stormwater management practices.

When volume control is constrained at a site and other BMP options (e.g. [**wet pond** (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_ponds)], [**sand filter (https://stormwater.pca.state.mn.us/index.php?title=Filtration)**]) are not feasible, a wet swale with check dams provides treatment for a portion or all of the water quality volume stored behind the check dams. For regulatory purposes, wet swales that incorporate check dams into their design fall under the “Infiltration / Filtration" category described in the MPCA CGP. If used in combination with other practices, credit for combined stormwater treatment can be given. Due to the statewide prevalence of the MPCA permit, design guidance in this section is presented with the assumption that the permit does apply. Although it is expected that in many cases the wet swale will be used in combination with other practices, standards are described for the case in which it is a stand-alone practice.

The following terms are thus used in the text to distinguish various levels of wet swale design guidance:

- REQUIRED: Indicates design standards stipulated by the MPCA CGP (or other consistently applicable regulations).
- HIGHLY RECOMMENDED: Indicates design guidance that is extremely beneficial or necessary for proper functioning of the wet swale, but not specifically required by the MPCA CGP.
- RECOMMENDED: Indicates design guidance that is helpful for wet swale performance but not critical to the design.

There are situations, particularly retrofit projects, in which a wet swale is constructed without being subject to the conditions of the MPCA permit. While compliance with the permit is not required in these cases, the standards it establishes can provide valuable design guidance to the user. It is important to note that additional and potentially more stringent design requirements may apply for a particular wet swale, depending on where it is situated both jurisdictionally and within the surrounding landscape.

Retrofit suitability

The use of wet swales as a retrofit practice primarily depends on existing infrastructure and whether the invert or flowline of the wet swale outlet allow meeting design requirements.

Special receiving waters suitability

The following table provides guidance regarding the use of wet swales in areas upstream of **special receiving waters** (https://stormwater.pca.state.mn.us/index.php?title=Special_Waters_and_Impaired_Waters).

Infiltration and filtration bmp[1] design restrictions for special waters and watersheds. See also Special waters and other sensitive receiving waters.
Link to this table

BMP Group	receiving water				
	A Lakes	B Trout Waters	C Drinking Water[2]	D Wetlands	E Impaired Waters

BMP Group	A Lakes	B Trout Waters	receiving water C Drinking Water[2]	D Wetlands	E Impaired Waters
Infiltration	RECOMMENDED	RECOMMENDED	NOT RECOMMENDED if potential stormwater pollution sources evident	RECOMMENDED	RECOMMENDED unless target TMDL pollutant is a soluble nutrient or chloride
Filtration	Some variations NOT RECOMMENDED due to poor phosphorus removal, combined with other treatments	RECOMMENDED	RECOMMENDED	ACCEPTABLE	RECOMMENDED for non-nutrient impairments

[1]Filtration practices include green roofs, bmps with an underdrain, or other practices that do not infiltrate water and rely primarily on filtration for treatment.

[2] Applies to groundwater drinking water source areas only; use the lakes category to define BMP design restrictions for surface water drinking supplies

Cold climate suitability

In cold climates (https://stormwater.pca.state.mn.us/index.php?title=Cold_climate_impact_on_runoff_management), some special considerations are HIGHLY RECOMMENDED for surface systems like wet swales to ensure sustained functionality and limit the damage that freezing temperatures and snow and ice removal may cause.

For all BMPs it is HIGHLY RECOMMENDED that snow and ice removal plans including predetermined locations for stockpiling be determined prior to or during the design process. Wet swales cannot be used for significant snow storage areas as debris build-up and plant damage are likely to occur. Some snow storage is unavoidable when BMPs are adjacent to areas where snow removal is required. It is critical that the property owner and snow and ice removal contractor have identified other areas for large scale snow storage.

Plant selection is critical to ensure that the damaging effects of snow and ice removal do not severely impact plantings or seedings. Even a small amount of snow storage can break and uproot plants requiring additional maintenance in the spring. Woody trees and shrubs should be selected (https://stormwater.pca.state.mn.us/index.php?title=Minnesota_plant_lists#Salt_tolerance) that can tolerate some salt spray from plowing operations.

Water quantity treatment

Wet swales are not typically a primary practice for providing water quantity control. They are normally either designed off-line using a flow diversion or configured to safely pass large storm flows. In limited cases, wet swales may be able to accommodate the channel protection volume, V_{cp}, in either an off- or on-line configuration, and in general they can provide some (albeit limited) storage volume. Wet swales can help reduce detention requirements for a site by providing elongated flow paths and longer times of concentration, and provide very limited volumetric losses from infiltration and evapotranspiration. Generally, to meet site water quantity or peak discharge criteria, it is HIGHLY RECOMMENDED that another structural control (e.g., detention) be used.

Caution: It is HIGHLY RECOMMENDED that wet swales have a maximum slope of 1 percent.

Warning: Warning: It is REQUIRED that volume reduction practices, such as infiltration basins, are considered before filtration practices.

Water quality treatment

Wet swales provide some removal of sediment and associated pollutants through filtering and settling. Less significant processes can include evaporation, infiltration, transpiration, biological and microbiological uptake, and soil adsorption. Pollutant removal data for select parameters are shown in the adjacent table.

Water quality performance of wet swales can be diminished when plants die off in the fall and winter months as they are no longer able to uptake water and nutrients.

Median pollutant removal percentages for several stormwater BMPs. Sources (http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs#References). More detailed information and ranges of values can be found in other locations in this manual, as indicated in the table.
Link to this table

Practice	TSS	TP	PP	DP	TN	Metals[1]	Bacteria	Hydrocarbons
Infiltration (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_infiltration_Best_Management_Practices)[2]	3	3	3	3	3	3	3	3
Biofiltration and Tree trench/tree box with underdrain	80	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	50	35	95	80
Sand filter	85	50	85	0	35	50	80	80
Iron enhanced sand filter (http://stormwater.pca.state.mn.us/index.php/Iron_enhanced_sand_filter_%28Minnesota_Filter%29)	85	74	85	60[6]	35	50	80	80

Practice	TSS	TP	PP	DP	TN	Metals[1]	Bacteria	Hydrocarbons
Dry swale	68	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	link to table (http://stormwater.pca.state.mn.us/index.php/Phosphorus_credits_for_bioretention_systems_with_an_underdrain)	35	0	80	80
Wet swale	35	0	0	0			0	
Constructed wet ponds[4, 5]	84	46	84	0	30	70	60	80
Constructed wetlands	73	38	69	0	30	70	60	80
Permeable pavement	74	41	82	0				
Green roofs	85	0	0	0				

TSS=Total suspended solids, TP=Total phosphorus, PP=Particulate phosphorus, DP=Dissolved phosphorus, TN=Total nitrogen

[1]Data for metals is based on the average of data for zinc and copper

[2]BMPs designed to infiltrate stormwater runoff, such as infiltration basin/trench, bioinfiltration, permeable pavement with no underdrain, tree trenches with no underdrain, and BMPs with raised underdrains.

[3]Pollutant removal is 100 percent for the volume infiltrated, 0 for water bypassing the BMP. For filtered water, see values for other BMPs in the table.

[4]Dry ponds do not receive credit for volume or pollutant removal

[5]Removal is for Design Level 2 (https://stormwater.pca.state.mn.us/index.php?title=Requirements,_recommendations_and_information_for_using_stormwater_pond_as_a_BMP_in_the_MIDS_calculator#Pollutant_Reduction)

[6]Removal is for Tier 2 iron enhanced sand filter. Tier 1 removal is 40 percent, resulting in a TP removal of 65%

Limitations

The following general limitations should be recognized when considering installation of wet swales.

- **Nitrification** of water may occur where aerobic conditions exist
- Wet swales offer limited water quantity control
- The potential for nuisance insects (https://stormwater.pca.state.mn.us/index.php?title=Mosquito_control_and_stormwater_management) or odors exists when standing water is persistent in the wet swale
- Water quality performance can change seasonally
- Wet swales are impractical in steep areas, because maintaining a constant water surface elevation or pool becomes too difficult
- Wet swales are impractical in extremely flat areas, because the lack of gradient may cause excessive ponding and prevent positive drainage
- Vegetation must be periodically trimmed to keep woody vegetation in check
- A wet swale can erode during peak rainfall when water volume and velocity are high
- Standing water in wet swales may foster mosquitoes (https://stormwater.pca.state.mn.us/index.php?title=Mosquito_control_and_stormwater_management), so vector control is recommended

- Resuspension of sediment can occur during peak storm events
- Standing water causes water temperature to rise, which reduces oxygen in the water and negatively impacts nutrient removal

Related pages

- Terminology for swales
- Overview for wet swale (wetland channel)
- Types of filtration
- Design criteria for wet swale (wetland channel)
- Construction specifications for wet swale (wetland channel)
- Operation and maintenance of wet swale (wetland channel)
- Assessing the performance of wet swale (wetland channel)
- Plants for swales
- Check dams for stormwater swales
- Calculating credits for wet swale (wetland channel)
- Cost considerations (https://stormwater.pca.state.mn.us/index.php?title=Cost_considerations_for_dry_swale_(grass_swale))
- External resources for wet swale (wetland channel)
- References for wet swale (wetland channel)
- Requirements, recommendations and information for using wet swale in the MIDS calculator (https://stormwater.pca.state.mn.us/index.php?title=Requirements,_recommendations_and_information_for_using_wet_swale_as_a_BMP_in_the_MIDS_calculator)
- Requirements, recommendations and information for using swale side slope as a BMP in the MIDS calculator