Overview for stormwater wetlands

This section provides an overview of stormwater wetlands. It includes a discussion of permit applicability, function within the treatment train, cold climate and retrofit suitability, and role in water quality and quantity treatment.

Contents

Example of a stormwater wetland in a suburban area.

Function within stormwater treatment train

Stormwater wetlands (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_wetlands) are typically installed at the downstream end of the **treatment train** (https://stormwater.pca.state.mn.us/index.php?title=Using_the_treatment_train_approach_to_BMP_selection) (they are considered an end-of-pipe **best management practice** (BMP)). Stormwater wetland size and outflow regulation requirements can be significantly reduced with the use of additional upstream BMPs. However, when a stormwater wetland is constructed, it is likely to be the only management practice employed at a site, and therefore must be designed to provide adequate water quality and water quantity treatment for all regulated storms.

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 one acre of new impervious area is being created, and the permit stipulates certain standards for various categories of stormwater management practices.

For regulatory purposes, stormwater wetlands currently fall under the "Wet Sedimentation Basin" category described in the permit. If used in combination with other practices, **credit (stormwater credit)** (https://stormwater.pca.state.mn.us/index.php?title=Overview_of_stormwater_credits) 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. Also, although it is expected that in many cases the wetland will be used in combination with other practices, standards are described for the case in which it is a stand-alone practice. Of note, the MPCA will evaluate the need to keep stormwater wetlands under the "wet sedimentation basin" category in future CGP revisions and consider it as a **bioretention practice** instead.

The following terms are used throughout this Manual to distinguish various levels of stormwater wetland design guidance:

Required:Indicates design standards stipulated by the MPCA Permit (or other consistently applicable regulations).

Highly recommended:Indicates design guidance that is extremely beneficial or necessary for proper functioning of the wetland, but not specifically required by the MPCA permit.

Recommended:Indicates design guidance that is helpful for stormwater wetland performance but not critical to the design.

Of course, there are situations, particularly retrofit projects, in which a stormwater pond is constructed without being subject to the conditions of the 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 also important to note that additional and potentially more stringent design requirements may apply for a particular stormwater wetland, depending on where it is situated both jurisdictionally and within the surrounding landscape.

Retrofit suitability

As a retrofit, stormwater wetlands have the advantage of providing both educational and habitat value. One disadvantage of wetlands, however, is the difficulty in storing large amounts of runoff without consuming a large amount of land. Therefore, the most common type of wetland retrofit involves the modification of an existing dry or **wet pond** (https://stormwater.pca.state.mn.us/index.php?title=Stormwater_ponds).

Special receiving waters suitability

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

Design restrictions for special waters - constructed ponds and wetlands
Link to this table

BMP	Watershed Management Category				
	A Lakes	**B** Trout Waters	**C** Drinking Water*	**D** Wetlands	**E** Impaired Waters

BMP	Watershed Management Category				
Constructed wetlands	Some variations NOT RECOMMENDED due to poor P removal, combined with other treatments.	NOT RECOMMENDED except for wooded wetlands	RECOMMENDED	RECOMMENDED but no use of natural wetlands	RECOMMENDED
Wet Extended Detention Pond	RECOMMENDED	Some variations NOT RECOMMENDED due to pool and stream warming concerns	RECOMMENDED	RECOMMENDED (alteration of natural wetlands as stormwater wetlands not allowed)	RECOMMENDED

*Applies to groundwater drinking source areas only; use the sensitive lakes category to define BMP Design restrictions for surface water drinking supplies

Cold climate suitability

Wetland performance can be diminished in spring months when large volumes of runoff occur in a relatively short time and carries the accumulated pollutant load from the winter months. Because stormwater wetlands are relatively shallow, freezing of the shallow pool can occur. Also, freezing of inlet and outlet structures can occur, which will reduce performance of the stormwater wetland. To avoid these problems, the Center for Watershed Protection (Caraco and Claytor, 1997) made some general design suggestions, which are adapted as follows.

- Inlet pipes should not be submerged, since this can result in freezing and upstream damage or flooding.
- Burying all pipes below the frost line can prevent frost heave and pipe freezing. Wind protection can also be an important consideration for pipes above the frost line. In these cases, designs modifications that have pipes “turn the corner” are helpful.
- Increase the slope of inlet pipes to a minimum of 1 percent to prevent standing water in the pipe, reducing the potential for ice formation. This design may be difficult to achieve at sites with flat local slopes.
- If perforated riser pipes are used at the outlet, the minimum opening diameter should be ½ inch. In addition, the pipe should have a minimum 6 inch diameter.
- When a standard **weir** is used, the minimum slot width should be 3 inches, especially when the slot is tall.
- Baffle weirs can prevent ice reformation during the spring melt near the outlet by preventing surface ice from blocking the outlet structure.
- Alternative outlet designs that have been successful include using a pipe encased in a gravel jacket set at the elevation of the aquatic bench as the control for water quality events. This practice was both avoids stream warming and is also a non-freezing outlet.
- Trash racks should be installed at a shallow angle to prevent ice formation.

Water quantity treatment

Stormwater wetlands are well-suited to provide channel protection and **overbank flood protection (http://stormwater.pca.state.mn.us/index.php/Overbank_flood_protection_criteria_%28Vp10%29)**. As in ponds, this is accomplished with **live storage** (extended detention) above the permanent pool.

Information: It is *highly recommended* that when providing water quantity control in stormwater wetlands, the smallest possible bounce (vertical water level fluctuation) be designed for in order to limit the amount of stress on the vegetation.

Water quality treatment

Pollutants are removed from stormwater runoff in a wetland through uptake by wetland vegetation and biota (algae, bacterial), vegetative filtering, soil adsorption, and gravitational settling in the slow moving marsh flow. **Volatilization** and chemical activity can also occur, breaking down and assimilating a number of other stormwater contaminants such as hydrocarbons.

Pollutant removal efficiencies and optimum effluent concentrations for selected parameters are provided in following two tables.

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%

Typical BMP best attainable effluent concentrations. Values from ASCE BMP database and Winer 2000
Link to this table

Practice	TSS (mg/l)	TP (mg/l)	TN (mg/l)	Cu (ug/l)	Zn (ug/l)
Wetlands	6	0.2	1.7	3.0	50

Limitations

The following general limitations should be recognized when considering installation of stormwater wetlands.

- They require more land than other practices
- They requires careful design and planning to ensure wetland hydrology is maintained
- Water quality behavior can change seasonally

Related pages

- Overview for stormwater wetlands
- Types of stormwater wetlands
- Design criteria for stormwater wetlands
- Construction specifications for stormwater wetlands
- Assessing the performance of stormwater wetlands
- Operation and maintenance of stormwater wetlands
- Cost-benefit considerations for stormwater wetlands
- Calculating credits for stormwater wetlands
- References for stormwater wetlands
- Requirements, recommendations and information for using stormwater wetland as a BMP in the MIDS calculator.