Storm Water Wetlands

Description

Storm water wetlands remove pollutants primarily through physical filtration and settling, by biological processes of wetland plants, and bacteria in substrates. The storm water wetland is similar in design to the wet pond but has significant vegetation differences. The major difference in the wetland design is the creation of varying depth zones in the shallow marsh area of the wetland to support emergent wetland vegetation. Because consideration must be paid to creating various depth zones and establishing a plant community that can survive in the different zones, the design, construction, and maintenance of storm water wetlands is more complex than wet ponds. There are several different wetland applications including:

- Storm Water Wetland. Constructed shallow marsh system that is designed to treat both urban storm water runoff and control runoff volume. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and uptake by marsh vegetation.
- Shallow Wetland. Most of the water quality treatment takes place in the shallow high marsh or low marsh depths. The only deep sections of the wetland are the forebay and the micropool at the outlet. A disadvantage of shallow wetlands is that a relatively large amount of land is required to store the desired water quality volume.
- Extended Detention Shallow Wetland. This design is similar to the shallow wetland, but part of the water quality treatment volume is provided as extended detention above the surface of the marsh and is released over a period of 24-hours. This application can treat a greater volume of storm water in a smaller space than the shallow wetland design. Plants that can tolerate both wet and dry periods are required in the extended detention area.
- Pond/Wetland System. The system has two separate cells, a wet pond and a shallow marsh. The wet pond is designed to trap sediment and reduce runoff velocities before the runoff enters the shallow marsh. The primary water quality benefits are achieved in the shallow wetland. Less land is required for the pond/wetland system than the shallow wetland and the extended detention shallow wetland.
- Pocket Wetland. A pocket wetland is intended for smaller drainage areas of 5 to 10 acres, and requires excavation down to the water table for a reliable source of water to support the wetland vegetation.

Design Criteria

Do not convert natural wetlands to storm water wetlands. Do not remove natural wetland soils and vegetation to provide a "seedbank" for a constructed storm water wetland without the regulating approval from the US Army Corps of Engineers by obtaining a Section 404 permit. Water quantity storage can be incorporated into the vegetated wetland if the vegetation selected can withstand being submerged for the depth and duration of the water quantity storage time.

Design the wetland with a minimum 2:1 length to width ratio, with 3:1 being the preferred ratio. Maximize the distance between the storm water wetland inlet and outlet to increase the flow length. The flowpath within the wetland is increased through the use of internal berms and shelves used to create the desired varying depth zones within the wetland.

Creating varying depth zones within the wetland increases the pollutant removal efficiency. These depth zones are classified as deep-water zones, which consist of the forebay and outlet micropool, and the shallow water zone that consists of the high marsh, and low marsh area of the wetland. Designing the wetland with varying depth zones prevents the wetland from being taken over by a dominant plant species such as cattails.

Shallow Water Zones

The shallow water zone is defined as being the zones within the constructed storm water wetland that have water depths ranging from 0 to 18 inches. The shallow water zone is designed to promote the growth of emergent wetland plantings and variations in depth allow for a diversity species to survive. Design a level bottom elevation across the width of a wetland cross-section to promote sheet flow and prevent short circuiting or the creation of stagnate dead areas.

High Marsh

Design one-half (½) of the total shallow water zone as high marsh. This zone extends up from 6-inches below the permanent pool water level (6-inches deep). This zone supports a greater density and diversity of wetland species than the low marsh zone.

Low Marsh

Design one-half (½) of the total shallow water zone as low marsh. This zone extends from a depth of 18- to 6-inches below the permanent pool water level. This zone is suitable for the growth of several emergent wetland plant species.

Deep Water Zones

The deep water zones ranges from a depth of 1.5- to 6-feet and includes the forebay, low flow channels, and the outlet micropool. This zone supports little emergent wetland vegetation, but may support submerged or floating vegetation.

Forebay

Design the forebay to reduce the incoming velocities into the wetland. The forebay provides initial settling for sediments, minimizing the amount of suspended sediments that enter the constructed wetland area. Design the forebay as a level spreader distributing the flow evenly and equally across the width of the wetland area. Construct the forebay of an earthen berm no lower than the normal permanent pool depth. Design all inlets to the constructed storm water wetland to discharge to the forebay, and be protected with a properly designed Turf Reinforcement Mat.

Low Flow Channels

A minimum dry weather flowpath is required from the inlet to the outlet for storm water wetlands.

Outlet Micropool.

Design an outlet micropool allowing adequate depth for the extended detention outlet to function properly. Design a drain in the outlet micropool to drain the wetland when needed. Design the outlet micropool 4- to 6-feet deep.

Semi-Wet Zones

The semi-wet zones includes the areas above the permanent pool that will be submerged during larger storm events. This zone supports vegetation that can survive during flooding.

Wetland Planting Plan

Design a wetland planting plan and submit it as part of all constructed wetland design submittals. The selection of the proper plant species and planting locations is an integral part in designing a successful storm water wetland. Have a qualified landscape architect or wetland ecologist prepare a wetland planting plan.

Water Quality Treatment Orifice

Design a low flow orifice to slowly release the water quality volume over a period of 24-hours. Place additional orifice at outlet structures above the temporary water quality pool to provide water quantity control. Protect the water quality orifice from clogging by incorporating an appropriate trash guard.
Select a durable trash guard that extends at least 6-inches below the normal pool surface of the wetland.

Acceptable trash guards include:

- Hoods that extend 6-inches below the permanent pool water surface elevation.
- Reverse flow pipes where the outlet structure inlet is located 6-inches below the permanent pool water surface elevation.
- Trash boxes made of sturdy wire mesh.

Principle Spillway

Design the principle spillway of the constructed storm water wetland to safely pass the 2- and 10-year 24-hour storm event. Equip the spillway with a trash rack.

Emergency Spillway

Design the emergency spillway of the constructed storm water wetland to safely convey discharges resulting from the 100-year 24-hour storm event. Design the 100-year water surface elevation a minimum of 1-foot below the top of the embankment. The emergency spillway may be incorporated into the principle spillway where accommodating the emergency spillway elsewhere is not feasible for the given site characteristics.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of storm water wetlands. Maintenance responsibility for the constructed storm water wetland should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

- Maintenance requirements for constructed wetlands are particularly high while vegetation is being established. Monitoring during the first year is critical to the success of the wetland.
- Monitor wetlands after all storm events greater than 2-inches of rainfall during the first year to assess erosion, flow channelization and sediment accumulation. Inspection should be made at least once every six months during the first three years of establishment.
- Place a sediment cleanout stake in the forebay area to determine when sediment removal is required.
- Debris should be removed from the inlet and outlet structures monthly.
- Monitor wetland vegetation and replaced as necessary once every 6-months during the first three years of establishment.
- Annually inspect and maintain the depth of the zones within the wetland.
- Annually remove invasive vegetation.
- Repair all eroded or undercut areas as needed.

Average Pollutant Removal Capability

Total Suspended Solids:	66%-78%	Metals:	14%-72%
Copper:	29%-50%	Lead:	62%-76%
Zinc:	32%-52%	Total Phosphorus:	42%-53%
Total Nitrogen:	28%-39%	Pathogens/Bacteria:	58%-78%
Hydrocarbons:	80%		

Storm Water Wetland

Summary of Maintenance Requirements

Required Maintenance	Frequency
Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants.	Once every 6-months during the first three years of establishment
Clean and remove debris from inlet and outlet structures.	Frequently (3 to 4 times/year)
Mow side slopes.	Frequently (3 to 4 times/year)
Monitor wetland vegetation and perform replacement planting as necessary.	Semi-annual (every 6-months)
Examine stability of the original depth zones.	Annual
Inspect for invasive vegetation, and remove where possible.	Annual
Inspect for damage to the embankment and inlet/outlet structures.	Annual, repair as necessary
Monitor for sediment accumulation in the facility and forebay.	Annual
Inspect for operational inlet and outlet structures.	Annual
Repair undercut or eroded areas.	As needed
Harvest wetland plants that have been “choked out” by sediment buildup.	Annual
Removal of sediment from the forebay.	Per design cycle, as needed, after 50% of total forebay capacity is filled
Remove sediment accumulations in the main permanent pool.	5 to 10 year cycle, after 25% of the permanent pool volume is filled