

2H-1 General Information for Stormwater Wetlands



BENEFITS			
	Low = <30%	Medium = 30-65%	High = 65-100%
	Low	Med	High
Suspended Solids			■
Nitrogen		■	
Phosphorous	■	■	
Metals		■	■
Bacteriological		■	■
Hydrocarbons			■

Description: Stormwater wetlands are constructed wetland systems explicitly designed to incorporate the functions of natural wetlands to aid in pollutant removal from stormwater. Constructed wetlands can also provide for quantity control of stormwater by providing a significant volume of temporary water storage above the permanent pool elevation. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling and biological uptake within the practice. Wetlands are among the most effective stormwater practices in terms of pollutant removal, and also offer aesthetic value. A sediment forebay is provided for removal of coarse sediments that could degrade performance.

Typical uses:

- Larger residential developments and medium-density suburban commercial areas. Not suited for high-density/ultra urban areas due to space constraints.

Advantages/benefits:

- Very good removal of suspended and particulate pollutants.
- Biological uptake of nutrients by wetland plants.
- Reduction of peak flows and flood attenuation.
- Enhancement of vegetation diversity and wildlife habitat in urban areas.
- Relatively low maintenance costs

Disadvantages/limitations:

- Needs continuous baseflow for viable wetland vegetation – a critical design factor for smaller areas (<20 acres).
- Usually some release of nutrients in the fall and winter months.
- May act as a heat sink with discharge of warmer water to downstream reaches.
- May attract year-round population of wild geese if natural buffers not included in the wetland design.
- Relatively higher land requirements and construction costs than most other BMPs.

Maintenance requirements:

- Replacement of wetland vegetation to maintain at least 50% surface area coverage.
- Remove invasive vegetation.
- Monitor sediment accumulation and remove periodically.

A. Description

Stormwater wetlands are constructed wetland systems explicitly designed to incorporate the natural functions of wetlands to aid in pollutant removal from stormwater. Constructed wetlands can also provide for quantity control of stormwater by providing a significant volume of temporary water storage above the permanent pool elevation. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling and biological uptake within the practice. A sediment forebay is provided for removal of coarse sediments that could degrade performance. Stormwater wetlands are designed specifically for the purpose of treating stormwater runoff, and typically have less bio-diversity than natural wetlands both in terms of plant and animal life. However, as with natural wetlands, stormwater wetlands require a continuous base flow or a high water table to support aquatic vegetation.

There are several design variations of the stormwater wetland, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland. These include the shallow wetland, the extended detention shallow wetland, pond/wetland system and pocket wetland. Below are descriptions of each design variant:

1. **Shallow wetland.** In the shallow wetland design, most of the water quality treatment volume is in the relatively shallow high marsh or low marsh depths. The only deep portions of the shallow wetland design are the forebay at the inlet to the wetland, and the micro-pool at the outlet. One disadvantage of this design is that since the pool is very shallow, a relatively large amount of land is typically needed to store the water quality volume. (See Figure 2).
2. **Extended detention shallow wetland.** The extended detention (ED) shallow wetland design is the same as the shallow wetland; however, part of the water quality treatment volume is provided as extended detention above the surface of the marsh and released over a period of 24 hours. This design can treat a greater volume of stormwater in a smaller space than the shallow wetland design. In the extended detention wetland option, plants that can tolerate both wet and dry periods need to be specified in the ED zone. (See Figure 3).
3. **Pond/wetland systems.** The pond/wetland system has two separate cells: a wet pond and a shallow marsh. The wet pond traps sediments and reduces runoff velocities prior to entry into the wetland, where stormwater flows receive additional treatment. Less land is required for a pond/wetland system than for the shallow wetland or the ED shallow wetland systems. (See Figure 4).
4. **Pocket wetland.** A pocket wetland is intended for smaller drainage areas of 2-10 acres and typically requires excavation down to the water table for a reliable water source to support the wetland system. (See Figure 5).

B. Stormwater management suitability

Similar to stormwater detention systems (wet ponds), stormwater wetlands are designed to control both stormwater quantity and quality. Thus, a stormwater wetland can be used to address all of the unified stormwater sizing criteria for a given drainage area.

1. **Water quality.** Pollutants are removed from stormwater runoff in a wetland through uptake by wetland vegetation and algae, vegetative filtering, and through gravitational settling in the slow-moving marsh flow. Other pollutant removal mechanisms are also at work in a stormwater wetland, including chemical and biological decomposition, and volatilization.

2. **Channel protection.** The storage volume above the permanent pool/water surface level in a stormwater wetland is used to provide control of the channel protection volume (Cpv). This is accomplished by releasing the 1-year, 24-hour storm runoff volume over 24 hours (extended detention). It is best to do this with minimum vertical water level fluctuation, as extreme fluctuation may stress vegetation.
3. **Overbank flood protection:** A stormwater wetland can also provide storage above the permanent pool/water surface level to reduce the post-development peak flow of the 10-year storm (Qp) to pre-development levels (detention). If a wetland facility is not used for overbank flood protection, it should be designed as an off-line system to pass higher flows around rather than through the wetland system.
4. **Extreme flood protection:** In situations where it is required, stormwater wetlands can also be used to provide detention to control the 100-year storm peak flow (Qf). Where Qf peak control is not required, a stormwater wetland must be designed to safely pass extreme storm flows.

Figure 1: Stormwater wetland examples



Shallow Wetland



Shallow ED Wetland



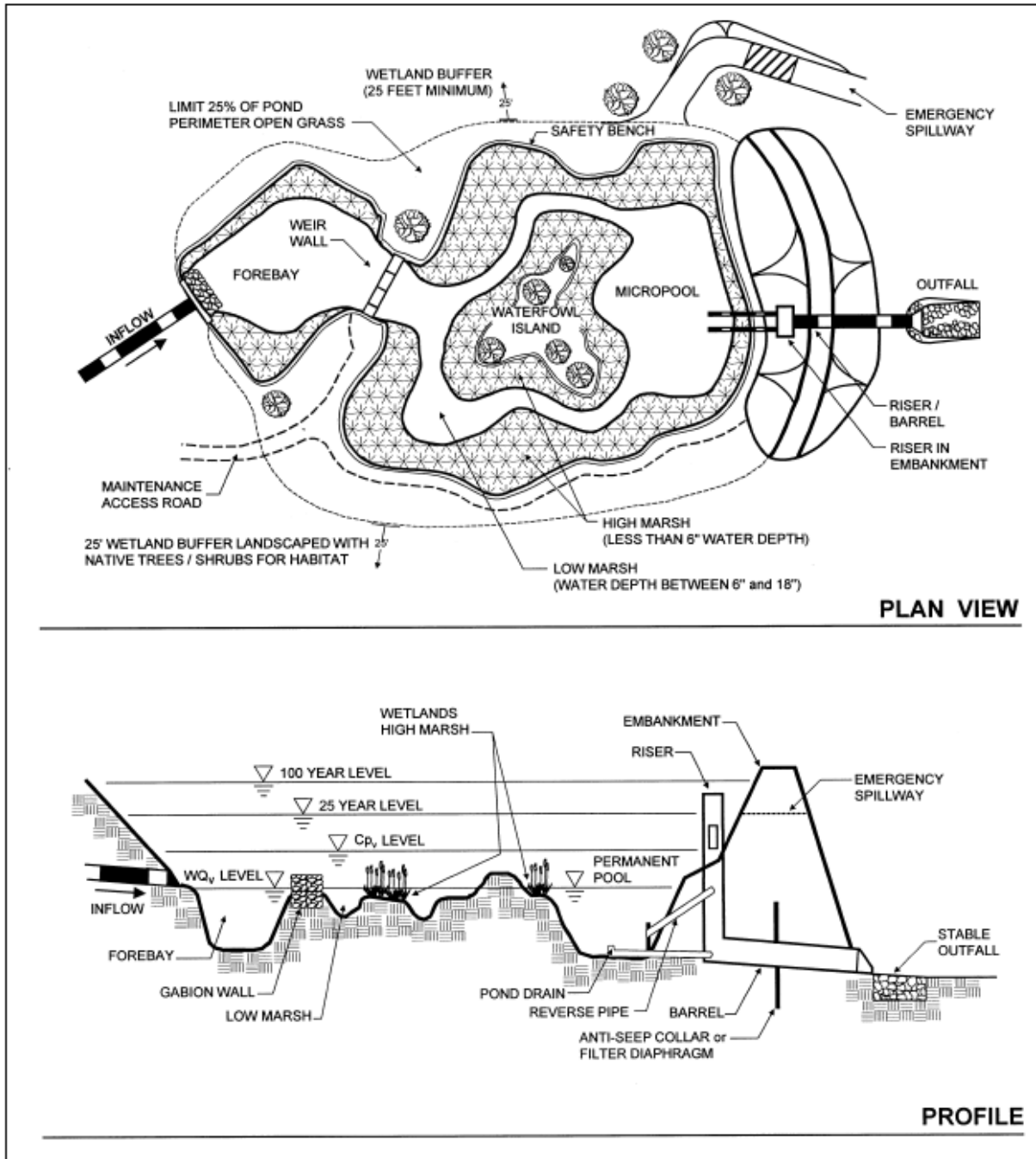
Newly Constructed Shallow Wetland



Pocket Wetland

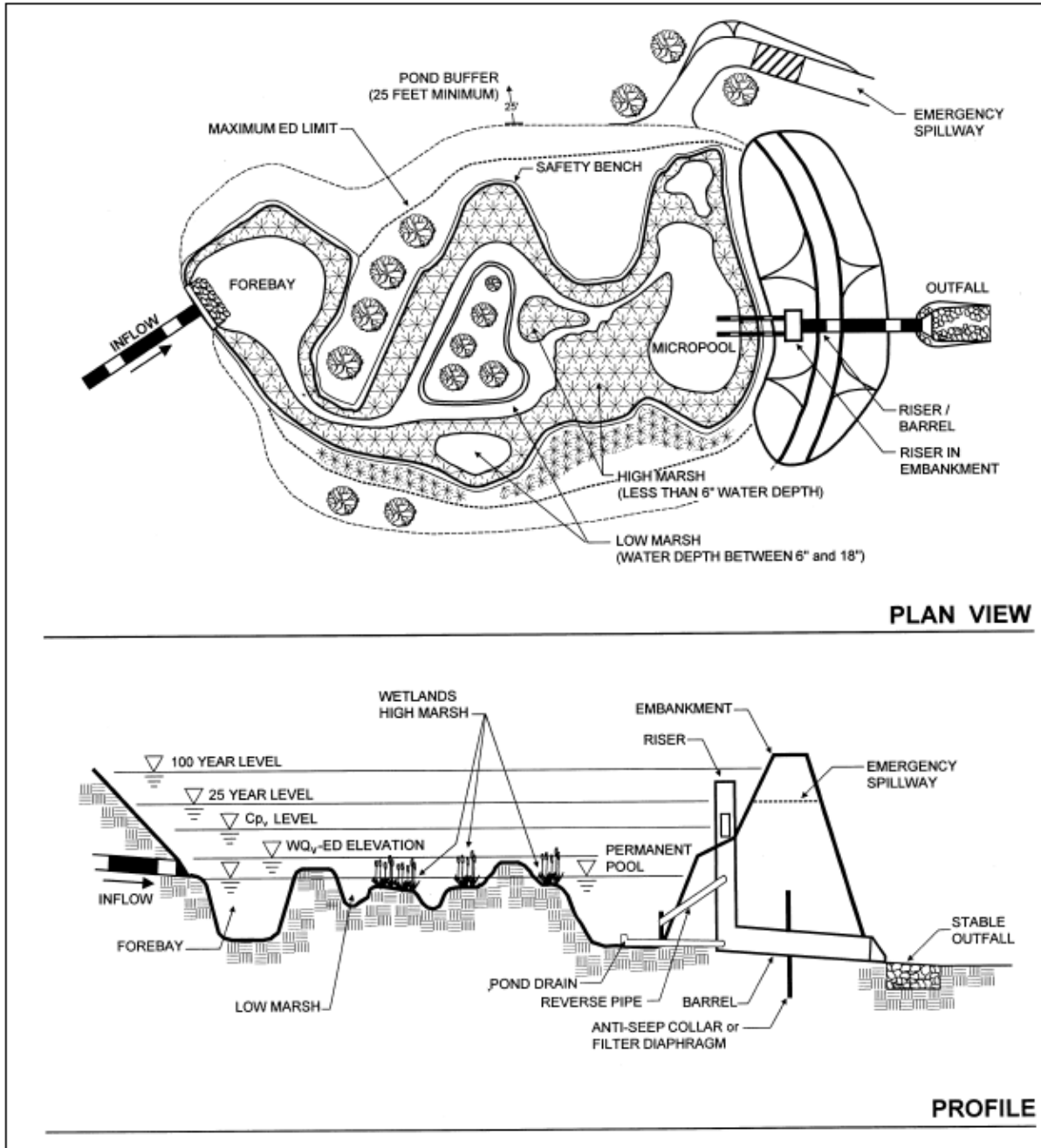
Source: Georgia Stormwater Manual, 2002

Figure 2: Shallow wetland schematic



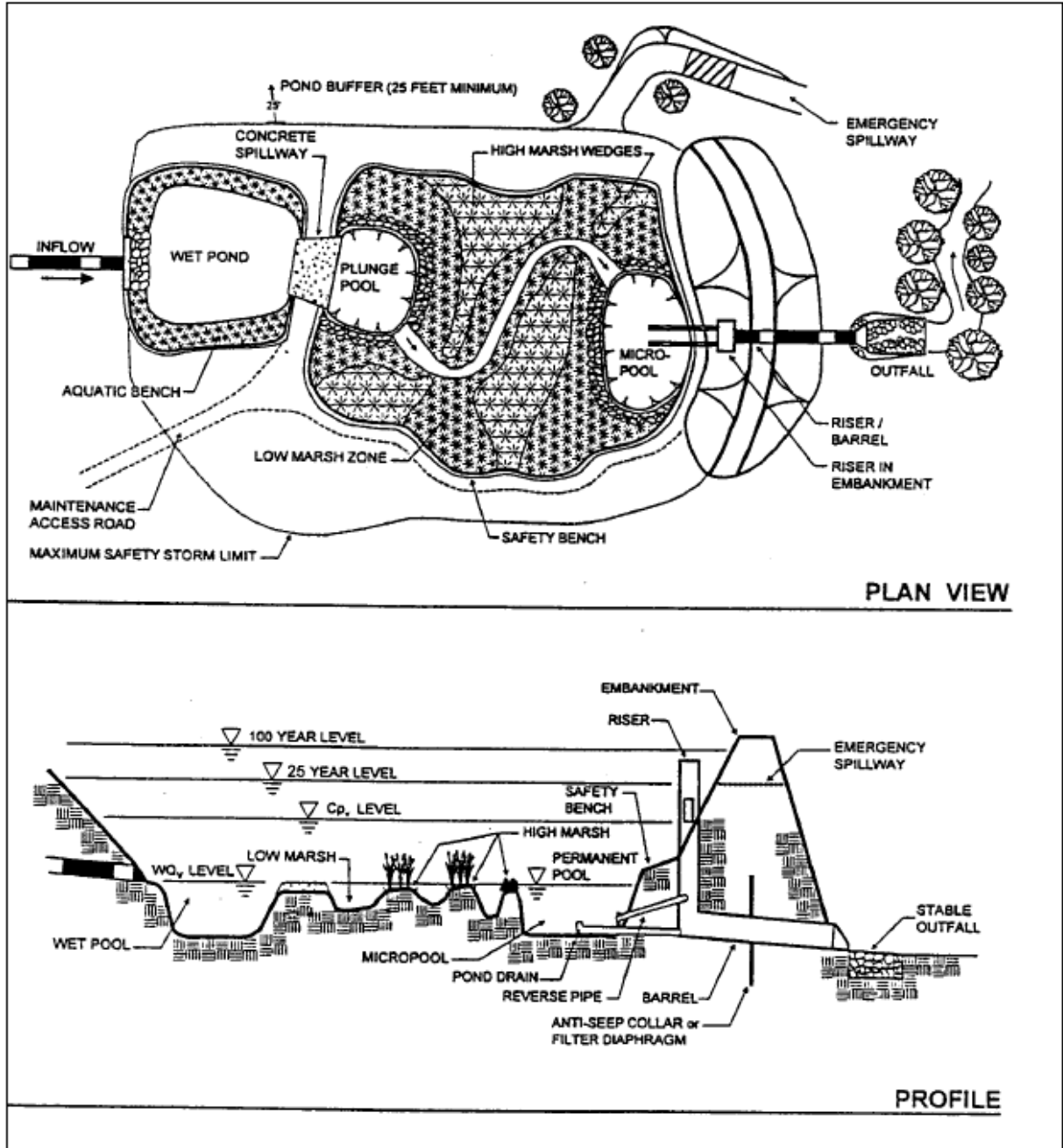
Source: Center for Watershed Protection

Figure 3: Extended detention shallow wetland schematic



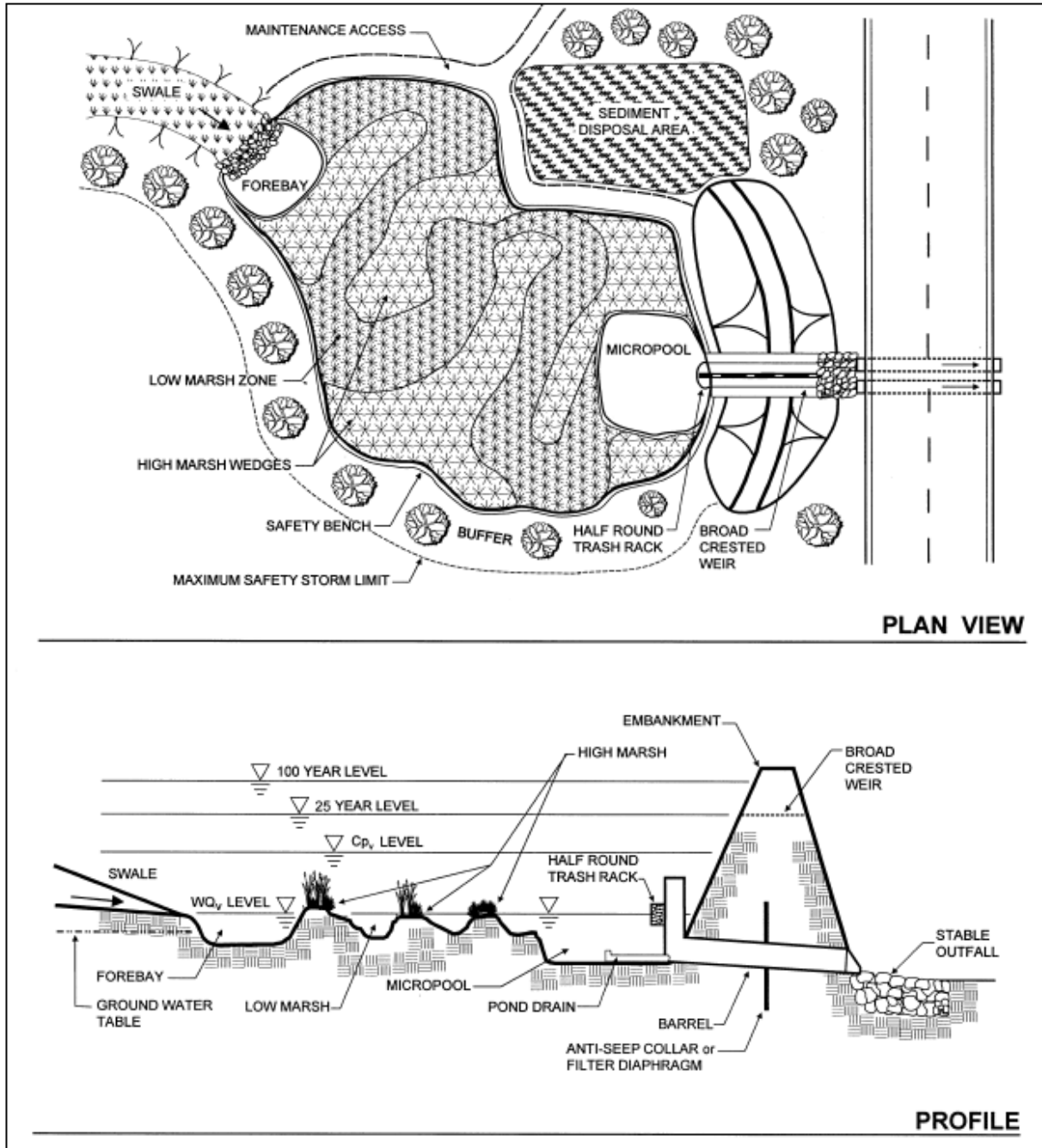
Source: Center for Watershed Protection

Figure 4: Pond/wetland system schematic



Source: Center for Watershed Protection

Figure 5: Pocket wetland system schematic



Source: Center for Watershed Protection

C. Pollutant removal capabilities

Conventional stormwater wetlands have a high pollutant removal capability, generally comparable to wet ponds. All of the stormwater wetland design variants are presumed to be able to remove 80% of the TSS load in typical urban post-development runoff when sized, designed, constructed, and maintained in accordance with the recommended specifications. Phosphorous and nitrogen removal will be more variable. Under-sized or poorly-designed wetland facilities can reduce TSS removal performance. The following design pollutant removal rates are conservative average pollutant reduction percentages for design purposes derived from previous published sampling data, modeling,

and professional judgment. In a situation where a removal rate is not deemed sufficient, additional controls may be put in place at the given site in a series or treatment train approach.

- Total suspended solids – 80%
- Total phosphorus – 40%
- Total nitrogen – 30%
- Fecal coliform – 70% (if no resident waterfowl population present)
- Heavy metals – 50%

Overall performance is greatest during the growing season and lowest during the winter months (Strecker, et al, 1990). For additional information and data on pollutant removal capabilities for stormwater wetlands, see the National Pollutant Removal Performance Database (2nd Edition) available at www.cwp.org and the National Stormwater Best Management Practices Database at www.bmpdatabase.org.

D. Application and feasibility

Stormwater wetlands are generally applicable to most types of new development and redevelopment, and can be used in both residential and non-residential areas. However, due to the large land requirements, wetlands may not be practical in higher-density areas. The following criteria should be evaluated to ensure the suitability of a stormwater wetland for meeting stormwater management objectives on a site or development.

1. General feasibility:

- Suitable for residential subdivision usage – yes (some concern for insect control)
- Suitable for high-density/ultra-urban areas – land requirements may preclude use
- Regional stormwater control – yes

2. Physical feasibility – physical constraints at project site:

- **Drainage area.** A minimum of 25 acres and a positive water balance is needed to maintain wetland conditions; 5 acres for pocket wetland.
- **Space required.** Approximately 3-5% of the tributary drainage area.
- **Site slope.** There should be no more than 8% slope across the wetland site.
- **Minimum head.** Elevation difference needed at a site from the inflow to the outflow: 3-5 feet; 2-3 feet for pocket wetland.
- **Minimum depth to water table.** If used on a site with an underlying water supply aquifer or when treating a hotspot, a separation distance of 2 feet is recommended between the bottom of the wetland and the elevation of the seasonally high water table; pocket wetland is typically below water table.
- **Soils.** Permeable soils are not well-suited for a constructed stormwater wetland without a high water table. Underlying soils of hydrologic group C or D should be adequate to maintain wetland conditions. Most HSG A soils and some B soils will require a liner. Evaluation of soils should be based upon an actual subsurface analysis and permeability tests.