Article 89

Technical Note #9 from Watershed Protection Techniques. 1(1): 23

Nutrient Dynamics and Plant Diversity in Volunteer and Planted Stormwater Wetlands

The performance of two stormwater wetland systems in the coastal plain of Maryland were monitored over a two year period by Athanas and Stevenson (1991). The wetland plant community was established by planting at one site (Queen Anne) and volunteer colonization at the second (Washington Business Park).

The 0.6 acre Queen Anne stormwater wetland treated runoff from a 16 acre catchment containing the roof, parking areas, and ballfields of a high school. About 30% of the wetland's surface area was in the 0 to -12 inch depth zone, with the remaining surface area in the -12 to -24 inch depth zone. A polyliner and six inch sand layer was placed on the bottom to prevent groundwater intrusion. The wetland was planted with 4,000 plants of three species (common three square, lizards tail, and duck potato (*Saggitaria*)) at an approximate density of 0.7 plants/square foot.

The Queen Anne stormwater wetland was reasonably effectively in removing sediment, total phosphorus and total nitrogen from urban runoff (Table 1). Removable of soluble nutrient forms (ortho-P, ammonia and nitrate) were frequently above 50%, whereas removal of particulate forms was slightly negative. This pattern has been seen in many ponds and wetlands where both baseflow and stormflow performance monitoring is conducted. The current explanation is that soluble nutrient forms are taken up by algae and bacteria and are then incorporated into particulate forms. Due to intense biological activity in the wetland during the growing season there is a slight export of particulate nutrients in the outflow from the wetland.

The authors felt that overall removal rates could have been higher, but the sand substrate on the bottom of the wetland did not contain enough organic matter to provide the exchange sites to trap pollutants. The sand substrate was also impoverished with respect to aluminum and iron cations, which help to increase phosphorus binding to sediments. A review of the outflow concentrations from the wetland after the fall plant dieback did not reveal any pulse or spikes of dissolved nutrient concentrations.

The plant community in the Queen Anne stormwater wetland showed an interesting development pattern. While the planted species survived well, the emergent marsh zone was invaded by cattails and spike rush, along with other rushes, sedges (*Carex*), and boneset (*Eupatorium perfoliatum*). The cattail had spread to most of the marsh after three years, but did not crowd out the other species. They formed a kind of structural matrix that many other species appear to exploit. The mean above-ground biomass in the stormwater wetland after two years was about 350 grams dry weight per square meter. The greatest unit biomass was recorded in saturated soils not inundated (above normal pool).

A series of monitoring problems prevented the computation of pollutant removal performance at the Washington Business Park "volunteer" stormwater wetland. Based on a comparison of inflow and outflow concentrations, it did appear to be an effective facility, despite much higher sediment and nutrient inputs. The plant community was dominated by cattails and common reeds (*Phragmites*). The sedges, rushes and other emergent species found at the Queen Annes site were poorly represented at the Washington Business Park. This presumably reflects the value of intentional planting and also perhaps greater sediment deposition.

—TRS

Reference

Athanas, C. and C. Stevenson. 1991. *The Use of Artificial Wetlands in Treating Stormwater Runoff.* Prepared for the Maryland Sediment and Stormwater Administration. 66 pp.

Table 1: Pollutant Removal at the Queen Anne's Stormwater Wetland Site

Urban Pollutant	Percent Mass Reduced
Total Suspended Solids	65.0
Orthophosphorus	68.7
Total Dissolved Phosphorus	44.3
Total Organic Phosphorus	-5.7
Total Particulate Phosphorus	7.2
Total Phosphorus	39.1
Nitrate+Nitrite-Nitrogen	54.5
Ammonia-Nitrogen (NH_4)	55.8
Total Organic Nitrogen	-5.4
Total Particulate Nitrogen	-5.0
Total Nitrogen	22.8

Mass reduced for both storm and baseflow events over 23 months