Article 96

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The StormTreat System: A New Stormwater Runoff Treatment

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Frequently, stormwater runoff from various land uses—such as roadways, lawns, gas stations—is combined in a drainage ditch or stormwater pipe, which ultimately discharges to receiving waters. However, the pollutants from these different sources are diverse in their composition and quantity. Stormwater management is best accomplished by techniques that treat each area within the watershed independently as opposed to the more conventional "big pipe" solution, where a large detention/pond is constructed at the bottom of a watershed in an attempt to catch and treat all of the stormwater generated by the watershed. The big pipe approach is land-intensive and costly.

A Self-Contained, On-Site System

A new stormwater technology, StormTreat System, has been designed to capture and treat the first flush of runoff by being positioned high in the watershed and *near the pollution sources*. StormTreat incorporates sedimentation, filtration, and constructed wetlands into a modular, unitary 9.5-foot diameter structure. The number of units at each location is determined by the design storm, the size of the sub-drainage area, and the detention volume within the drainage infrastructure.

The StormTreat System is significantly smaller (usually five to 10% of the treated area) when compared with conventional stormwater ponds or wetlands. Where land costs are high or difficult site constrains exist, this size efficiency can represent significant cost savings. Discharge from the system is slow enough for either surface or groundwater discharge and so can be located in low-permeability soils with a high water table. StormTreat does not have standing water, which is common in conventional stormwater ponds and can be unsightly, unsafe, or encourage mosquito breeding (see article 100).

The StormTreat System consists of a series of 9.5-foot diameter recycled polyethylene tanks (Figure 1), resistant enough for brackish environments and self-anchored to compensate for high groundwater conditions. The tanks connect directly to existing drainage structures, most commonly the catch basins. While designed to intercept the first flush - typically half an inch of rain - the system can be sized to accommodate any size storm event. Any surplus runoff bypasses the system. Inlet pipes may be adapted to fit existing storm drainage pipes, paved swales, and other settings.

Operation

The internal sedimentation chambers contain a series of bulkheads fitted with filter screens (Figure 2). A series of "skimmers" are also utilized to selectively decant the upper portions of the stormwater in the sedimentation basins, leaving behind the more turbid lower waters. After moving through these internal chambers, the partially treated stormwater passes into the surrounding constructed wetland through a series of slotted PVC pipes. The wetland is comprised of a sand and gravel substrate planted with cattails, bulrushes, and burreeds. An outlet control valve provides a five-day holding time within the system. The valve can be shut off in the event of a hazardous waste spill. It can also be closed at the end of the rainy season in arid zones to preserve the mini-wetlands. Unlike most constructed

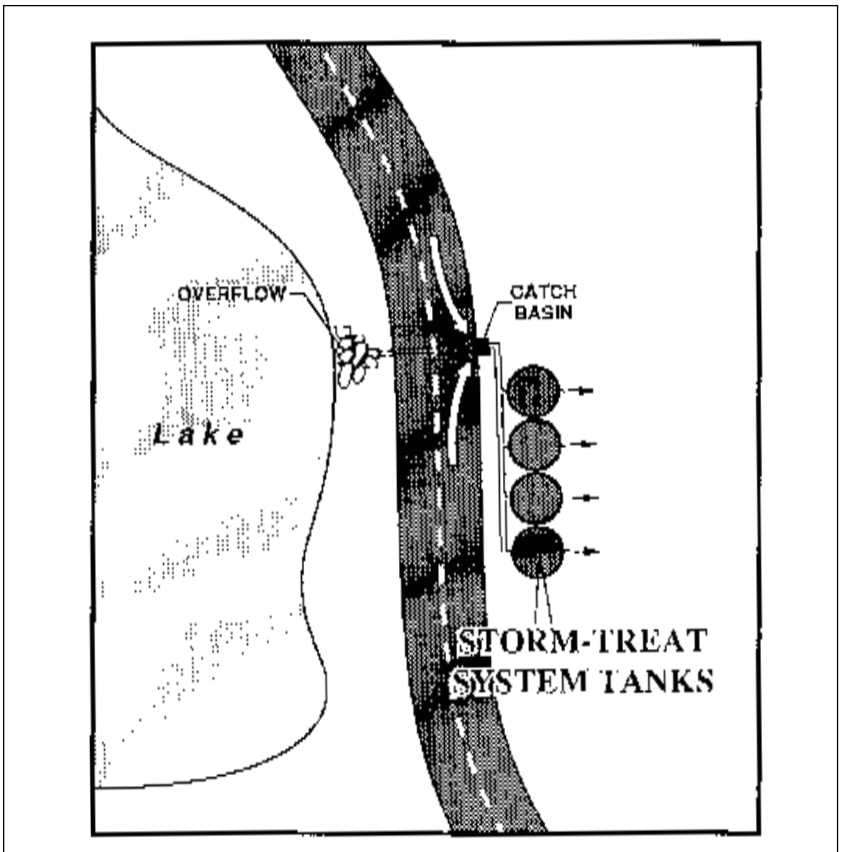

Figure 1: Typical Layout of StormTreat System

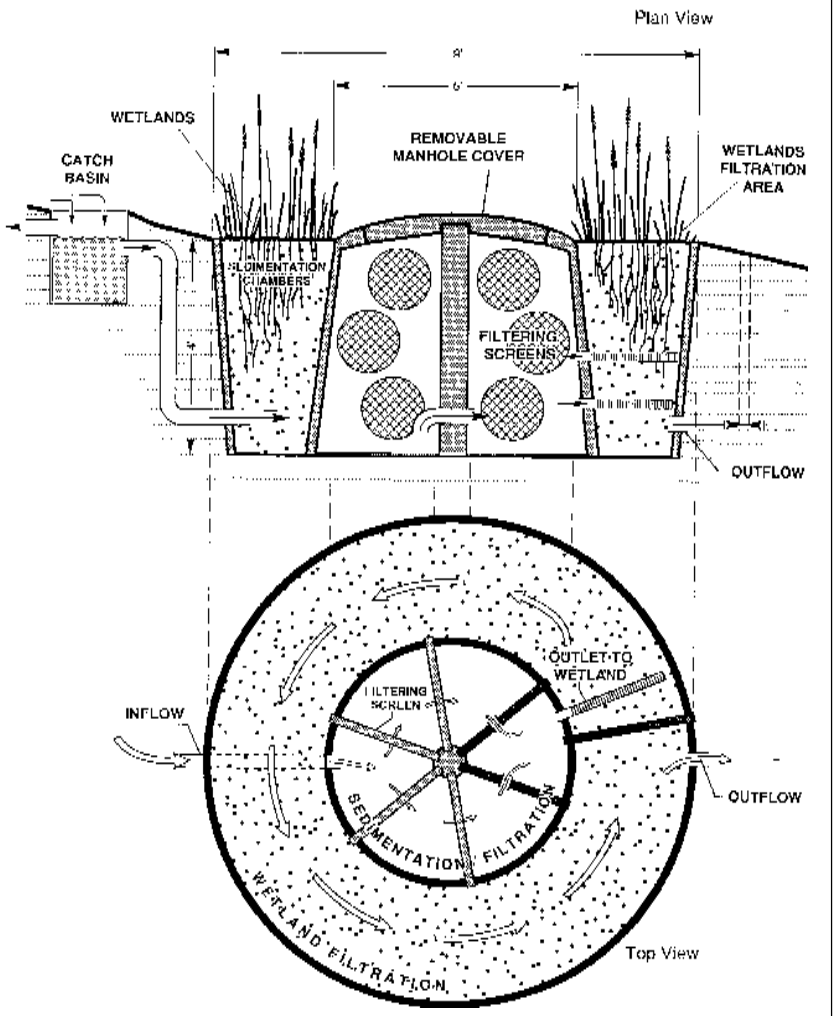

Figure 2: Cross-Section and Plan View of StormTreat System

wetlands, stormwater in the StormTreat System flows subsurface through the root zone of the constructed wetland, providing for greater pollutant removal.

Maintenance

The StormTreat System requires minimal maintenance. The only regular maintenance requirement is sediment cleanout by suction pump once every three to five years, depending on local soil characteristics and catch basin maintenance practices. Annual inspections (and cleanings if necessary) of the screens and skimmers is also recommended. The cleaning of the screens is easily done by reaching into the manhole opening, unclipping the screens, and backwashing them with a garden hose. Inspection and cleaning of screens requires about 15 minutes per tank.

Performance

To date, five storm events have been successfully sampled at the Kingston, MA installation (Table 1). First flush stormwater samples are taken at the entry point to the STS tanks by opening the manhole cover. Effluent samples are taken during the five days following the storm event. (Samples are obtained at the sampling ports where the effluent pipes discharge at ground surface.) The quality of the sampled effluent is compared with first flush runoff.

Removal of bacteria and pollutants is shown in Table 1. Testing results indicate that an average of 94% of the total coliform bacteria and 97% of the fecal coliform bacteria, 99% of the total suspended solids, and 90% of the total petroleum hydrocarbons are removed from the stormwater. Preliminary nutrient sampling suggests a removal rate of 44% for total dissolved nitrogen and 89% for total phosphorous. Higher nitrogen removal rates are expected during the growing

Table 1: Sampling Results From StormTreat System Treating 850-Foot Road Plus Parking Lot (Drainage Area 0.43 Acres Paved)

Pollutant	Stormwater influent	Treated discharge	Percentage removed (%)
Fecal coliform (no./100 ml)	690	20	97
Total suspended solids (mg/l)	93	1.3	99
Chemical oxygen demand (mg/l)	95	17	82
Total dissolved N (µg/l)	1,638	922	44
Total Petro HC (mg/l)	3.4	0.34	90
Lead (µg/l)	6.5	1.5	77
Chromium (µg/l)	60	1	98
Phosphorus (µg/l)	300	26.5	89
Zinc (µg/l)	590	58	90

StormTreat System

- *Components:* sedimentation filters in combination with mini-wetlands in self-contained tanks
- *Size*: Each tank is 4 ft. high, 9.5 ft in diam, 5-10% of treatment area.
- *Capacity*: Number of tanks needed depends on storm design, impervious area, detention volume of accompanying collection basin.
- *Placement*: At site of runoff, e.g. in a series by roadside. Self-anchoring, suitable for coastal areas, adaptable to existing drainage pipes.

season when the wetland plants are more active. Removal rates for metals are as follows: lead, 77%; chromium, 98%; zinc, 90%.

Summary

In many ways, the StormTreat System can be considered an adaptation of the gravel-based wetland technique. However, the promising pollutant-removal performance observed for the system needs to be discounted somewhat, since runoff greater than the first flush is bypassed around the unit, and receives no treatment.