Chapter 19

StormTreat System Installation at Elm Street, Kingston, Massachusetts

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In October of 1994, four StormTreat Systems (STS) tanks were installed at Elm Street in Kingston, Massachusetts (see Figures 19.1 and 19.2). This site was identified as a significant stormwater pollution site by the Jones River Watershed Association. Prior to the STS installation, stormwater discharged directly to the Jones River from a 850 foot (259 m) length of road surface (Elm Street) and associated parking area at the Kingston Water Department building. This drainage area is estimated to contain 18,700 square feet, or 0.43 acres (1740 m²), of pavement. The StormTreat System is designed to capture and treat the first 0.5 inches (12.7 mm) of runoff, i.e. the “first flush”.

19.1 Procedure and Analysis

The four STS tanks were installed by the Kingston Highway Department, connecting to an existing catch basin with PVC piping. Four individual effluent lines constructed of 1.5 inch (38 mm) PVC were installed, and discharge at an average rate of 0.25 gallons/minute (3.97 Liters/s), into a small rip-rapped area adjacent to the Jones River. Four effluent lines were installed at the site for research purposes (testing alternative conditions in each tank). Normal STS installations utilize one effluent line serving the entire cluster of tanks at each location.

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Figure 19.1 Elm Street StormTreat system site plan.

Figure 19.2 Storm Treat Systems tank.

Water quality sampling of six independent storm events has been conducted over the past 24 months. A total of 643 analyses have been completed on 41 samples. Sampling was conducted during and following storm events by members of the Jones River Watershed Association under the supervision of its Executive Director. According to our quality assurance plan (QAP), the Field Captain determines the likelihood of a one-half inch event using local weather forecasts and notifies samplers to report to the Elm Street location. No sampling is conducted without a minimum of 3 days of preceding dry weather.

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 5 days following the storm event. They are obtained at the sampling ports (A6, B6, C6 and D6) where the effluent pipes discharge.

Water samples are obtained using laboratory-prepared sampling bottles by taking grab samples and measuring flow rates. Samples for dissolved nutrients are filtered in the field using 0.45-micron filter paper and filtering syringe. Following the storm event the first flush samples are composited immediately (by flow-weighting method).

Samples are packed in iced coolers and shipped to the analytical laboratories with chain of custody forms. Water quality analyses are conducted by three laboratories:

- 1. Woods Hole Oceanographic Institution [WHOI], (nutrients)
- 2. Barnstable County Health & Environmental Department [BCHED], (bacteria, TSS, metals, COD)
- 3. Analytical Balance Corp. [ABC], (bacteria, TSS, metals, COD)

Woods Hole Oceanographic Institution has been certified by the U.S. Environmental Protection Agency. The other two laboratories are certified by the Commonwealth of Massachusetts Department of Environmental Protection. Specific laboratory methods are shown in Table 19.1.

Table 19.1 Laboratory analytical methods.

Parameter	Analysis
TN-part	Elemental analysis
TN-diss	Persulfate digestion
NO3, N	Cadmium reduction
NH3-N	Indophenol
TP	Persulfate digestion
O-P	Molybdenum blue
FC	Membrane filter procedure
TSS	Standard methods 2540D
Cr, Pb, Ni, Zn	Atomic absorption spectrophotometry

Our quality assurance plan requires a minimum of 5% of samples as duplicates. This is accomplished by splitting samples between two certified laboratories and by providing them with blind duplicates.

19.2 Results

To date we have successfully sampled five stormwater events at the Elm Street installation. The results are summarized below in Table 19.2 and Figure 19.3. At the time of printing, not all of the analytical results had been received from the laboratories.

Table 19.2 - Summary of water quality monitoring results of the StormTreat system - Kingston, Massachusetts.

Pollutant	Stormwater influent	Treated effluent	Percentage removed
FC (orgs/100 ml)	690	20	97
TSS (mg/liter)	93	1.3	99
COD (mg/liter)	95	17	82
TDN (micrograms/liter)	3569	520	77
TP (micrograms/liter)	300	26.5	89
TPH (mg/liter)	3.4	0.34	90
Pb (micrograms/liter)	6.5	1.5	77
Cr (micrograms/liter)	60	1	98
Zn (micrograms/liter)	590	58	90

Figure 19.3 Water quality monitoring results of the Storm Treat system - Kingston, Massachusetts (1994-1996)

The laboratory results of six rounds of samples from four stormwater events: 11/11/94, 11/28/94, 12/5/94, 2/17/95, 10/9/95, and 10/1/96 have been averaged. We are evaluating system performance by calculating the percentage removal of each parameter by comparing the influent with the average of the effluent samples. We are not directly comparing the effluent results with those in chamber A1 because we believe that resuspension of sediments within this chamber significantly alters the quality of the incoming stormwater.

These 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 (TSS) and 90% of total petroleum hydrocarbons is removed. Preliminary nutrient results suggest a removal rate of 77% for total dissolved nitrogen (TDN) and 89% for total phosphorus. We expect that the nitrogen removal rate will improve during the growing season when the wetland plants are more active. Removal rates for metals are as follows: lead - 77%, chromium - 98%, and zinc - 90%.