Reducing Watershed-Scale Phosphorus Export through Integrated Management Practices

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Objectives:

Demonstrate and quantify the watershed-scale benefits of implementing filter socks and application setbacks from surface inlet structures, limiting phosphorus application to rates less than or equal to soil test phosphorus recommendations, and using the two practices in tandem.

Start Date: 2011
Project Duration: 3 years
Total Funding: $60,000

Hypoxic and anoxic areas in coastal marine and freshwater bodies worldwide result from excess nutrients and continue to be a major environmental concern. Excess nutrients exacerbate the development of phytoplankton, creating algal blooms. In freshwater systems, excess phosphorus has generally been identified as the problem nutrient. In the urban landscape, golf courses are the most intensively managed landuse. Phosphorus losses from managed turf are comparable to export coefficients reported for forests, urban/suburban, and crop production agriculture watersheds.

The experimental site is located on Northland Country Club (NCC) golf course located in Duluth, MN. Specifically, the study area is a 21.8 ha subarea of the golf course that contained 7 greens (0.3 ha), 8 tees (0.5 ha), 10.5 fairways (3.95 ha), grass roughs (8.1 ha), and 8.95 ha of unmanaged mixed northern hardwoods. The course is characterized by several micro-depressions or 'potholes.' In order to facilitate drainage, these potholes are often drained by tapping into the existing subsurface drainage network. A surface inlet is placed at the bottom of the pothole to rapidly remove water that collects in the depression.

Discharge and water quality samples are collected by a combination of grab samples and automated sample collection. In summer of 2002, two three-foot H-flumes with stilling wells and approach sections were installed in the stream that bisects the study area. One flume was positioned at the inflow while another was placed at the outflow. The H-flumes are instrumented with Isco 4230 bubblers programmed to record stage on 10-minute intervals. In the spring of 2004, two tile lines responsible for draining the majority of the study area were instrumented with compound weirs and bubbler flow meters to determine flow rate. All sites are equipped with Isco 6712 automated samplers and programmed to collect discrete flow proportional samples.

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Hydrology and water samples have been collected at both subsurface sites and at the and outlet stream locations on the course. To date, the chemical analyses have been conducted, but no interpretation of those results has been completed. We anticipate that the amount of phosphorus being transported through the tile line draining the area of the course where socks were installed will be reduced. In 2012, we plan to remove the socks and use a reduced rate or no application of phosphorus on that area of the course.

The findings should provide much needed information on both cultural and physical practices that can be implemented to address offsite nutrient transport.

Summary Points

- Filter socks containing 75% steel slag, 2.5% cement kiln dust, and 22.5% silica sand were placed around all surface inlets draining the eastern portion of the course.
- Hydrology, dissolved reactive phosphorus, and total phosphorus data on one drainage outlet with the filters and one drainage outlet without the filter socks have been collected.
- The findings should provide an assessment of both cultural and physical approaches to reduce phosphorus export from managed turf systems.