Reducing Watershed Scale Phosphorus Export through Integrated Management Practices

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Objectives:

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

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 land use. 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 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. In 2009, a commercialized end–of–tile filter was installed on the outlet of the east drain. All sites are equipped with Isco 6712 automated samplers and programmed to collect discrete flow proportional samples.

Figure 1. Filter socks were installed around drain inlets but had no impact on monthly soluble or total phosphorus concentrations.

In March of 2011, we initiated a paired study with the east and west drains and installed filter socks around each inlet within the eastern drainage area. The filter socks were filled with 75% steel slag, 2.5% cement kiln dust (CKD), and 22.5% silica sand by volume. Data collected in 2011 indicate that the implementation of the filter socks had no impact on monthly soluble or total phosphorus concentrations and loadings in the east drain. Annual concentrations and loadings following the filter sock implementation are not available because we only have one year of post practice implementation. However, we have three years with the end–of–tile filter system. Like the filter socks, no discernible differences in monthly loadings or concentrations were

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Figure 2. The inclusion of an end–of–tile filter system did produce a downward shift in annual phosphorus concentrations and loadings.

measured following the implementation of the filter system. However, when evaluated on an annual basis, a downward shift in both phosphorus concentrations and loadings was detected when compared to the period with no treatment. In 2012, phosphorus application in the eastern drainage area was limited. To date, the chemical analyses from those samples have been conducted but no interpretation of those results has been completed.

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

Summary

- A paired approach was designed and implemented at NCC to assess the impacts of different physical and cultural practices to reduce phosphorus transport
- In 2011, 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 were collected.
- The findings indicate that the installation of filter socks around surface inlets had no beneficial impact at reducing phosphorus concentrations in the tile drainage.
- The inclusion of an end–of–tile filter system did produce a downward shift in annual phosphorus concentrations and loadings.

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