Hydrologic and Water Quality Assessment from an Intensively Managed Watershed-scale Turfgrass System

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Objectives:

1. The primary objective of this effort is to assess the watershed-scale hydrologic and surface water quality impact from a well managed golf course.

Start Date: 2003
Project Duration: five years
Total Funding: $115,861

The primary objective of this effort is to assess the watershed scale hydrologic and surface water quality impact from a well managed golf course. Once baseline conditions are determined, we hope to change the management or introduce best management practices that will reduce the transport of nutrients and pesticides.

The study site is located on Northland Country Club (NCC) in Duluth, MN. The site is a near ideal hydrologic and water quality research area, as the study site has only one inflow location and one outflow location. The study area is located along a stream on the northeastern part of the NCC golf course. This area forms a discrete drainage area composed of six complete holes, three partial holes and unmanaged areas of mixed northern hardwoods and bedrock outcroppings. Water quality enhancement or degradation between the inflow and outflow point is contributed by the course.

The inflow to the course originates from a low-density housing and forested area comprised of approximately 80 ha. Eventually, all surface drainage on the golf course migrates toward Lake Superior. The deep to moderately deep clayey soils over bedrock have some increased risk of surface runoff. A regime of integrated management practices (mechanical, cultural, biological, and chemical) to control fertility, pests, irrigation, and turf growth conditions are used to maintain the expected level of turf quality and optimize the total use of fertilizer and pesticides. Grasses on the course are primarily creeping bentgrass (*Agrostis* stolonifera L.) and Kentucky bluegrass (*Poa pratensis* L.).

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Initiated in 2003, surface and subsurface water chemistry data have been collected during the growing season (April 15 - November 15) from a 21.8-ha subarea of the Northland Country Club Golf Course in Duluth, MN. The assessment includes analyses of hydrology, nutrients (ammonium, nitrate, total nitrogen, dissolved reactive phosphorus, and total phosphorus) and pesticides (2,4-D and chlorothalonil).

Automated collection systems with bubbler technology were installed and discharge is recorded on a 10-minute time interval during the growing season. Discharge is measured with 3-ft H-flumes located in the stream at the inlet and outlet points. For the 4-year period of record (2003-2006), the average discharge-coefficient was 0.48. Water samples are collected based on a flow proportional sampling scheme which allows both base flow and storm event sampling.

During the 2003 through 2006 growing season, a combined total of 516 samples at the inlet and 705 samples at the outlet have been collected. Nutrient load attributed to the course was 0.02 kg ha^{-1} per year NH_4-N, 0.62 kg ha^{-1} yr^{-1} NO_3-N, 0.14kg ha^{-1} yr^{-1} DRP, 3.15 kg ha^{-1} yr^{-1} TN, and 0.22 kg ha^{-1} yr^{-1} TP. Measured pesticide load was 5.0 g ha^{-1} yr^{-1} 2,4-D and 10.9 g ha^{-1} yr^{-1} chlorothalonil. Nitrogen loss was approximately 7.3% of applied N while phosphorus loss was approximately 1.1% of applied P during the same period. Less than 1.0 % of the applied chlorothalonil and 2,4-D were lost in surface flow. Roughly 30 to 50% of the nutrient and pesticide loads were cycled through the subsurface drain lines prior to entering the surface flow.

In 2007, the superintendent initiated a no-phosphorus fertilizer program. In 2008, we plan to introduce surface amendments to enrich the buffer areas around the stream and tile surface inlets to combat the phosphorus and pesticide transport.

Summary Points

- Hydrologic and water quality data have been collected at the inlet and outlet since April 2003 and from subsurface tile drainage outlets since April 2004.
- Varying degrees of nutrient concentrations have been detected in the surface and subsurface flows.
- Nitrogen and phosphorus loadings from the course are generally less than loadings reported for agriculture.
- Turfgrass pesticides exiting the course in surface flow have been detected at a range of concentrations.
- Nutrient and pesticide transport in subsurface drainage accounts for a considerable fraction of the total transported amounts.