

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: three years

Total Funding: \$70,861

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 sub-area 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).

The site is an ideal hydrologic and water quality research area, as the study site has only one inflow location and one outflow location. The study area forms a discrete drainage area composed of six complete holes, three partial holes, and unmanaged areas of mixed northern hardwoods and bedrock outcroppings. The drainage stream enters a natural pond located at the top of the small watershed. This stream then bisects the study area. Therefore, 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. The study area ranges in elevation from 320



During the 2003 and 2004 growing season, a combined total of 241 samples at the inlet and 378 samples at the outlet have been collected.

| | 2003 | | | | | |
|----------------|---------------|--------|---------|-----------------|--------|---------|
| | Inflow (n=88) | | | Outflow (n=141) | | |
| | mean | median | maximum | mean | median | maximum |
| 2,4-D | 1.07 | 0 | 27.1 | 0.32 | 0 | 4.76 |
| chlorothalonil | 0.04 | 0 | 1.51 | 1.22 | 0.55 | 13.1 |

| | 2004 | | | | | |
|----------------|----------------|--------|---------|-----------------|--------|---------|
| | Inflow (n=153) | | | Outflow (n=237) | | |
| | mean | median | maximum | mean | median | maximum |
| 2,4-D | 1.77 | 0.92 | 27.7 | 2.45 | 1.14 | 55.9 |
| chlorothalonil | 0.02 | 0 | 0.25 | 2.47 | 0.84 | 47.2 |

Table 1. Measured pesticide concentrations (micrograms L⁻¹) at the inflow and outflow locations

meters at the top of the subbasin to 283 meters at the bottom of the basin.

Eventually all surface drainage on the golf course migrates toward Lake Superior. The course is located on lacustrine clay deposits with moderately deep soils over bedrock. 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 (*A. stolonifera* L.) and Kentucky bluegrass (*Poa pratensis* L.). ISCO 6712 automated collection systems with bubbler technology were installed on site in April, 2003. 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 two-year period of record (2003-2004), the average runoff-coefficient was 0.24. Water samples are collected based on a flow-proportional sampling scheme. The flow-proportional scheme allows both base-flow

and storm-event sampling. During the 2003 and 2004 growing season, a combined total of 241 samples at the inlet and 378 samples at the outlet have been collected.

Nutrient load attributed to the course was 0.11 kg ha⁻¹ yr⁻¹ NH₄-N, 0.59 kg ha⁻¹ yr⁻¹ NO₃-N, 0.14 kg ha⁻¹ yr⁻¹ dissolved reactive P, 2.79 kg ha⁻¹ yr⁻¹ total N, and 0.27 kg ha⁻¹ yr⁻¹ total P. During the two-year period, various concentrations of 2,4-D and chlorothalonil have been measured in the surface flow (Table 1).

Summary Points

- Hydrologic and water quality data have been collected at the inlet and outlet since April, 2003.
- Instrumentation to measure quantity and quality of subsurface drainage on the course was established in 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.