Surface and Subsurface Water Quality Data Collection and Model Development for a Watershed Scale Turfgrass System

Kevin W. King, R. Daren Harmel, and James C. Balogh
USDA-ARS and Spectrum Research, Inc.

The primary objectives of this project are to: 1) collect, evaluate, and quantify surface and lateral water quality specifically nitrate, ammonia, and phosphate from a golf course using a watershed approach, 2) evaluate the water quality impact of transitioning from potable to reclaimed water for irrigation, and 3) develop a computer model designed specifically for turfgrass systems based on an existing watershed scale water quality model.

A watershed scale water quality monitoring and analysis program was initiated in the spring of 1998 to quantify the amount and quality of water exiting a golf course in central Texas. A section of Morris Williams Municipal Golf Course in Austin, TX, managed by the City of Austin Parks and Recreation Department (PARD), was selected as the study site for the project. The selected section of the course is ideal for studying surface water, as the section has only one inlet and one outlet for runoff, thus the boundary conditions are easily monitored. The topography is such that the contributing area (29 ha) contains 10 greens (0.73 ha), 7 fairways (8.23 ha) and 7 tees (0.30 ha). The managed areas (greens, fairways, and tees) represent 32% of the total area are managed at a moderate level, typical of most municipal courses in the U.S. The contributing area also contains approximately 6.5 ha of reduced-management rough, with the remainder comprised of unmanaged trees and shrubs.

Baseflow water samples are collected on a near weekly basis while storm flow samples are collected during high flow. Current collected data from this research site suggest significant contributions of nitrate in the surface runoff from this course. Based on the collected data (Table 1), the system contributed statistically significant ($p<0.05$) increases in median NO_3+NO_2-N concentrations (+0.25 mg L^{-1}) and PO_4-P concentrations (+0.03 mg L^{-1}), decreases in NH_4-N concentrations (-0.01 mg L^{-1}).

Based on grab sample data, the golf course contributes a significantly increased concentration of NO_3+NO_2-N to baseflow exiting the course (Table 1). Baseflow through the course reduced NH_4-N concentrations, and the course had little effect on PO_4-P concentrations (Table 1). These results were similar and consistent with storm flow concentration contributions. Seasonal trends of NO_3+NO_2-N in the baseflow were observed. NO_3+NO_2-N levels in baseflow at the downstream site were consistently higher than at the upstream site, with differences being greater from fall to spring (period of turf dormancy). PO_4-P concentrations were similar at both sites and steady throughout the year. It is premature to draw any conclusions from the lateral flow data collected to date.

Current advances in model development for turfgrass include the ability to simulate: 1) hydrology on a subdaily time-step, 2) slow release fertilizers, and 3) thatch growth and decay. Enhancements are continually being developed and incorporated into the modeling framework. Research plans for the next 2.5 years include continued water quantity and quality collection and analysis and model development. The course is scheduled to receive reclaimed water from the city in summer of 2001. At that time evaluation of transitioning to reclaimed water for irrigation will begin.

Table 1. Statistical analysis† of nutrient concentrations (mg L^{-1}) in storm flow and baseflow.

	Storm Flow Concentrations (mg L^{-1}) (n = 450 for site 1,inflow; n = 425 for site 2, outflow)					
	NO_3+NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.29	0.59	0.13	0.07	0.12	0.13
Median	0.21 a	0.46 b	0.06 a	0.05 b	0.09 a	0.12 b
Maximum	2.25	3.52	4.04	1.74	0.90	0.43

	Baseflow Concentrations (mg L^{-1}) (n = 93)					
	NO_3+NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.38	0.98	0.12	0.03	0.11	0.09
Median	0.41 a	0.93 b	0.09 a	0.02 b	0.10 a	0.10 a
Maximum	0.99	2.35	0.69	0.17	0.37	0.20

† Medians for each constituent followed by the same letter are not significantly different ($p < 0.05$).