

Comparing Nutrient Losses via Runoff from a New Golf Course and the Golf Course Site's Previous Native Condition

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Objectives:

1. Compare the nutrient loading, by way of surface water runoff, from a new golf course, and the site's previous native prairie condition.
2. Investigate the new golf course's impact on surface water quality during construction and during golf course operation.

To achieve the stated objectives, we have set up four monitoring stations on Little Kitten Creek (the major stream) and its tributaries to collect water samples, measure runoff discharges, and collect precipitation data. Water samples were tested for total nitrogen, total phosphorus, and sediment concentrations. Surface water runoff amounts were studied so that mass transport of nutrient and sediment can be analyzed.

Construction of Colbert Hills Golf Course started in July 1998 and completed in May 2000. Beginning in early 1998 and running into year 2002, this water quality monitoring program enabled us to study the impacts of construction and operation of the golf course on surface water quality. Up to date, more than 750 water samples have been collected and tested.

Nutrients Concentrations. We divided the data set into three subsets, namely pre-construction (native conditions), during construction, and during operation. Significant impacts were seen during construction and operation (Table 1). In samples of surface water leaving course (SLK, Fig. 1) during construction, the average nitrogen concentration was 4.52 mg L⁻¹ with a minimum of 0.70 mg L⁻¹ and maximum of 33.00 mg L⁻¹, and the average phosphorus concentration was 1.12 mg L⁻¹ with a minimum of 0.04 mg L⁻¹ and maximum of 8.36 mg L⁻¹. This was mainly due to the destruction of native land covers that caused heavy soil erosion. During operation, average nitrogen concentration was 2.61 mg L⁻¹ and phosphorus was 1.12 mg L⁻¹ compared with 1.18 mg L⁻¹ and 0.55 mg L⁻¹ under native conditions, respectively. The impact of operation of the golf course was less than that of the construction; this can be attributed to the good golf course operation management practices.

Nutrients Transport. Using preliminary stream flow relationships, we were able to determine the surface water runoff amounts and the mass amounts of nutrient transported offsite (Table 2). The determined rates of nutrient transport for native conditions were similar with those in the adjacent Konza Prairie Research Area. The rate of nutrient transport during construction was 3 to 4 times of that under native conditions, which was consistent with the estimation of sediment yields. These two columns were comparable since they were both developed under average rainfall conditions. On the other hand, the third column showing the rate of nutrients transport during operation was seemingly not comparable, because we have experienced an extremely dry year for 2000. More data needs to be collected before we can have a comfortable conclusion.

Sediment Yields Modeling. We also studied the sediment yields using AGNPS 98, a non-point source pollution model. Figure 1 shows the layout of Little Kitten Creek watershed and locations of our monitoring stations. Modeling results indicated a sediment yield of 2.4 tons ha⁻¹ yr⁻¹

under native conditions. During construction, however, sediment yield was 4.7 tons ha⁻¹ yr⁻¹ at SLK, about 2 times the pre-construction amount; 9.15 tons ha⁻¹ yr⁻¹ at CLV, about 4 times the pre-construction amount. The great amount of sediment at CLV was mainly due to the larger area of disturbance. Sediment yields are expected to return to pre-construction level during operation.

We are pleased with the progress we have made on our project. We will continue to collect surface water samples in order to have a better understanding of the impacts of golf course operation on surface water quality. We will need more measurements before we can develop satisfactory rating curves. We will also explore the relationships between sediment concentration and nutrients concentration, and between fertilizer application and nutrients concentrations.

Table 1. Nutrients concentrations in major inflow and outflow at three different phases: native conditions, during construction, and during golf course operation.

Phase	Major Inflow*			Major Outflow**		
	Mean	Min.	Max.	Mean	Min.	Max.
Nitrogen (ppm)						
Native conditions	1.43	0.20	3.30	1.18	0.30	4.80
During construction	1.40	0.20	2.80	4.52	0.70	33.00
During operation	1.60	1.27	2.45	2.61	0.24	11.21
Phosphorus (ppm)						
Native conditions	0.51	0.02	1.50	0.55	0.02	1.70
During construction	0.37	0.08	0.84	1.12	0.04	8.36
During operation	0.58	0.08	0.82	1.03	0.07	2.65

* Streams entering into the golf course (N16, N14)

** Streams leaving the golf course (SLK, CLV)

Table 2. Comparison of nutrients losses through surface runoff water for the three phases: native conditions, during construction, and during golf course operation. (kg ha⁻¹ yr⁻¹)

	Native conditions	During construction	During operation***
Nitrogen	0.85	2.94	0.34
Phosphorus	0.30	1.23	0.08

*** Not representative since dry year.

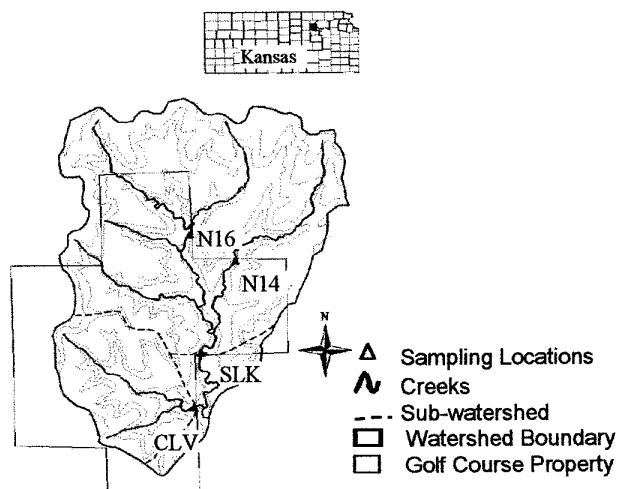


Figure 1. Layout of Little Kitten Creek watershed. Four monitoring stations were setup.