

Measuring Nutrient Losses via Runoff from an Established Golf Course

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Objectives:

1. Compare nutrient loading via surface water runoff from a new golf course versus 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 operations.

Start Date: 2003 (current cycle)

Project Duration: three years

Total Funding: \$90,000

Kansas State University in cooperation with Jim Colbert, PGA TOUR, GCSAA, and various alumni has built a 27-hole championship golf course, Colbert Hills Golf Course, near Manhattan, Kansas. The golf course was built on land that has a prairie-woodland mix that is typical of the Flint Hills Region. The only previous land use was occasional grazing for beef cattle. The construction and operation of the golf course could possibly impact the surface water quality of nearby streams. Sediment washed away from the construction site would eventually flow into rivers and lakes and cause ecological damage. Excessive concentration of nutrients in rivers, lakes, and reservoirs can accelerate the growth of algae and other aquatic plants causing problems such as clogged pipelines, fishkill, and restricted recreation.

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 nutrients and sediment can be analyzed.

We continued our previous nutrient runoff research by collecting more samples and analyzing data. An average amount of precipitation enabled us to collect over 120 total samples from inlet and outlet sites this year. We divided the data set into three subsets, namely pre-construction (native conditions), during construction, and during operation. At the main stream leaving the golf course, 28, 138, and 264 surface water samples were collected for the three periods.

Data analysis showed that golf course construction has the greatest impacts on surface water quality with average concentrations of 3.94 mg/L, 0.93 mg/L, and 2,955 mg/L for total N (TN), total P (TP), and sediment (TSS) respectively, compared with 1.18 mg/L, 0.39 mg/L, and 477 mg/L for the pre-construction period.



Researchers have set up four monitoring stations on Little Kitten Creek and its tributaries to collect water samples and measure runoff discharges.

During operation, sediment content was brought down significantly to an average of 550 mg/L, slightly higher than that of the native prairie condition. The average concentrations of TN and TP were 2.02 mg/L and 0.49 mg/L, respectively, much lower than those in the construction period, but still over 70 and 25 percent higher than those in the native prairie condition, respectively.

Sources of nutrients in streams under native prairie condition and during construction are thought to be from the input of rainfall and sediment eroded from fertile topsoils. During golf course operation, fertilizer application is another source of nutrients in streams, in addition to those mentioned above. Further analysis shows that there are direct connections between fertilizer application and concentration of TN and TP in streams. There are cases that clearly indicate the amount and timing of fertilizer application are to be blamed. This is the case when a good amount of fertiliz-

er is applied over a large area and significant rainfall comes shortly after the application.

Less sediment in streams during operation is a contribution of golf courses to the environment. Higher concentration of TN and TP than that under native prairie condition is expectable. However, only a few samples have TN great than 10 mg/L, a drinking water standard. We therefore believe that golf course operation, as a whole does not pose an immediate threat to the aquatic system.

Using preliminary stream flow relationships, we were able to determine the surface water runoff amounts and the mass amounts of nutrient transported off-site. 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 that under native conditions, which was consistent with the estimation of sediment yields.

Summary Points

- Golf course construction has the greatest impacts on surface water quality with average concentrations of 3.94 mg/L, 0.93 mg/L, and 2,955 mg/L for total N (TN), total P (TP), and sediment (TSS) respectively, compared with 1.18 mg/L, 0.39 mg/L, and 477 mg/L for the pre-construction period.
- During operation, sediment content was brought down significantly to an average of 550 mg/L, slightly higher than that of the native prairie condition.
- The average concentrations of TN and TP were 2.02 mg/L and 0.49 mg/L, much lower than those in the construction period, but still over 70 and 25 percent higher than those in the native prairie condition, respectively.
- There are cases that clearly indicate the amount and timing of fertilizer application are to be blamed.