CTRF Project Report: January, 2016

Project Title: The impact of golf courses on nutrient loss and overall pollutant export from developed areas

Principal Investigator: Dr. Chris Murray, Lakehead University

Summary:

This project is aimed at quantifying the effect golf course maintenance has on the quality of runoff and groundwater, especially where nutrients, volume of flow and sediment are concerned. Testing during the second growing season has been completed and a new round of indoor testing (enabled through collaboration with a local secondary school) is underway. An examination of the effect of winter snowmelt will be conducted simultaneous to this indoor study that will continue our work on the effect of fertility on nutrients in runoff and groundwater.

Personnel:

Ms. Amanda Grant continues her M.Sc. in Biology on this subject, and is beginning her fifth semester in her program. Professor Nanda Kanavillil (Associate Professor of Biology, Lakehead University) is, along with Dr. Murray, advising Amanda and tracking her progress, and serves as co-supervisor for Amanda's M.Sc. project.

Progress since last report:

Using plot designs refined over the winter of 2014/2015, 26 separate tests were conducted in outdoor plots throughout the summer and fall of 2015 (Figure 1).

Figure 1 (left): 26 test plots located near Talbot Ontario.

The following experimental parameters were varied amongst the test plots:

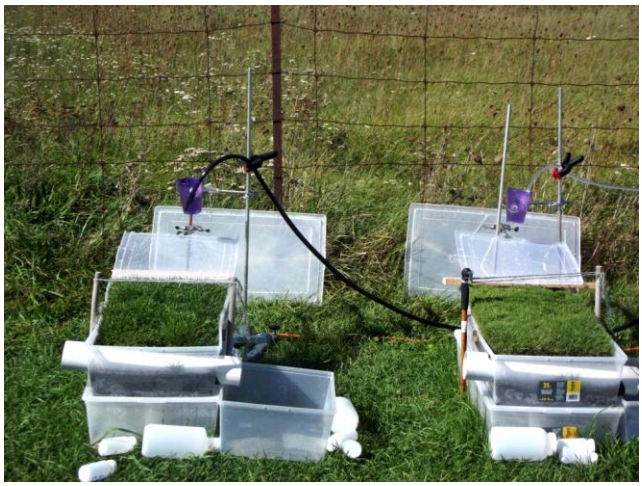
- Grass type: plots were divided between those seeded with Kentucky Bluegrass and Creeping bentgrass
- Seed density: while most plots received the same seed surface density, several plots were seeded at higher and lower seed densities with an aim to discover what, if any, the effect of shoot density might be on the nutrient export behavior.
- Fertilizer regime: subsets of plots received fertilizer (slow release, polymer-coated methylene urea in the summer, ammonium sulphate in the fall) at rates of 0.5, 1 and 2 lb Nitrogen/1000 square feet. A subset of plots also received phosphorus (through application of monoammonium phosphate) at a rate of 1 lb P/1000 square feet, and a subset of plots received no fertilization. Fertilizer samples were provided by Mr. Mark Obee of Alliance Agri-turf.

All plots were measured at a slope of 5%.

Two types of tests were conducted: simulated rain measurements in which clean water was applied over the entire surface of the plot at a constant rate (Figure 2), and simulated storms, in which water dosed with phosphate, nitrate and sediment was applied at the upper end of the plot at a variable but well controlled rate (Figure 3). For the simulated storms events, the flow rates and contaminant concentrations were chosen to be representative of the runoff from a typical impervious surface (such as a parking lot) of area much larger than the plot. In this way, this testing simulated how turf might perform as a buffer strip that received runoff from other areas of a golf course.

Figure 3 (right): storm events were simulated by applying well-defined amounts of water that had been dosed with dissolved nutrients and sediment to the upper edge of the plots.

Figure 2 (left): simulated rainfall apparatus consisted of permeable (soaker) hose that was arranged to distribute an even flow of water over the entire surface of the test plot.



For each type of measurement, the total volume of water added was measured, and the volumes that were collected as “runoff” (collected using a trough at the lower end of the plot) and “groundwater” (collected in an underdrain system beneath each plot) were measured such that the amount absorbed by the turf and soil could be calculated.

Each water sample (each test yielded groundwater samples, while some yielded both groundwater and runoff samples) was analyzed for phosphate, nitrate and TSS concentration, and a subset of samples was frozen for shipping to Thunder Bay for total P and total N measurement. Analysis of the results obtained from summer and fall measurements is now underway.

Whenever rain was expected, the outdoor plots were covered so that only the water due to the planned testing contributed to runoff and groundwater. Based on soil moisture measurements, the plots were irrigated periodically, but not enough to generate significant groundwater volumes.

Once temperatures are expected to remain below zero (within the next weeks), the plots will be left uncovered so that they can accumulate snow. As temperatures climb the plots will be monitored so that the runoff and/or groundwater that results from the snowmelt can be collected and analyzed.

While waiting for the outdoor winter tests to proceed, the research team has begun a collaborative project with Stayner Collegiate Institute that will allow indoor testing of a second round of turf plots. With the help of secondary school students in Environmental Science and Green Industries classes (Figure 4), ten plots (similar in design to the 26 used outdoors, but with improved stability) have been constructed and placed in a greenhouse at SCI.

Figure 4 (left): Ms. Amanda Grant works with a student from Stayner Collegiate Institute to prepare plots that will allow testing of turfgrass to continue in a greenhouse throughout the winter of 2016.

All plots were seeded with Kentucky Bluegrass at the end of December and we are waiting for the seedlings to come up. These plots will enable both duplication of tests conducted outdoors during the summer/fall (for verification purposes) and new tests we have not yet conducted, such as examination of possible interference between simulated storm testing and simulated rain testing. The students of SCI will continue to assist in the testing of these plots, and the Lakehead research team will be presenting guest lectures on turfgrass science and water quality to their classes at the same time (two such presentations have already been made). The support of the CTRF has been acknowledged in the signage surrounding these test plots and in the presentations being made to classes.

Next steps:

Indoor testing of turfgrass will consist of varying the fertilizer regime and testing to see if the nutrients present in the simulated storm testing are having any effect on the results of simulated rain events that might follow. As with the outdoor summer/fall testing that has been completed, each test plot enables capture of both runoff and groundwater, and the volume, nitrate, phosphate and TSS value associated with each collected sample will be measured using both simulated storm and rain events.

Snow melt samples are expected to be collected later this semester, after which a second round of outdoor testing will commence. At the same time as this spring/summer/fall 2016 testing, Ms. Grant will be consolidating her results into a M.Sc. thesis that she will defend during the summer or fall semester. The research team will also be working to present these results in at least one peer-reviewed journal article, and will continue to present its results through outreach aimed at secondary school students.