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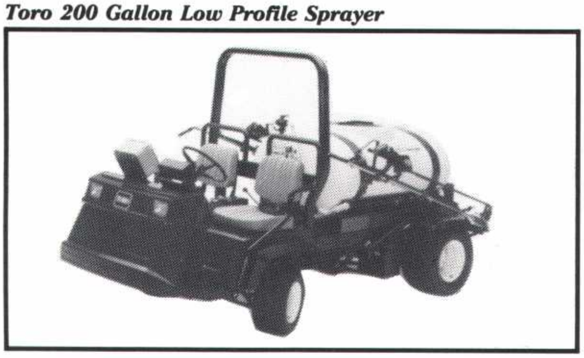

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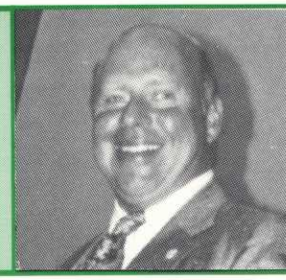
FROM THE PRESIDENT'S DESK

I Hope To See You in Mankato On April 19



Our association is investigating participation in the newly proposed MN Turf and Grounds Maintenance Foundation. Structurally, each allied organization will be represented by one member on the Board of Directors. Additional seats will be set aside for equipment and supply vendors as well as the University of Minnesota. Once the foundation is formally in place and operating, an incremental cooperation process will probably evolve to include field days, educational sessions and eventually a combined trade show. Although this vision appears appealing, much hard work, time and effort will be necessary to avoid an illusion. Just as a new golf course needs time to mature, so will this foundation.

* * * *

Howard Kaerwer, representing the USGA, has made a video tape available explaining the virtues of joining the New York State Audubon Cooperative Sanctuary Program. This tape will be available from our office on a loan basis by request.

* * * *

I am looking forward to visiting Mankato Country Club on April 19, not only for a friendly game of golf but also to honor the retirement of Boots Fuller as golf course superintendent. Boots has served this association in many capacities and we are appreciative of his fine work. We wish you many happy years in retirement, Boots. I'm sure you will be earning more frequent flyer miles on your winter escapes to southerly climes.

* * * *

SEE YOU IN MANKATO.

—Greg Hubbard, CGCS
President

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Baker National Golf Course Leachate Study

FINAL REPORT
DECEMBER 17, 1992

John M. Barten
Water Quality Manager, Hennepin Parks

(Ed. Note) This is the first portion of a two-part series report on the Baker National Leachate Study. The remainder will be published in the May issue of Hole Notes.

Introduction

Historically, a wide variety of pesticides and fertilizers have been applied to golf courses in order to maintain high-quality turf on greens and fairways. Because of the perceived heavy use of these chemicals, golf courses have been implicated as a significant source of contaminants entering surface and groundwater. The location of many golf courses adjacent to water bodies has exacerbated this problem by making lakes and streams the direct receiving body of golf course runoff. Any deterioration in water quality is at least partially blamed on the golf course. Unfortunately, accurate data regarding the type and quantity of contaminants in golf course runoff water is generally not available.

In order to assess the potential impact of golf courses on groundwater resources, Hennepin Parks and the Minnesota Golf Course Superintendents Association (MGCSA) initiated a study in 1990 with the following objectives:

1. Determine the quantity and quality of subsurface leachate through a golf course green.
2. Determine a suitable treatment system to remove contaminants from golf course green leachate water.
3. Inform golf course operators of the project results.

The collection of flow data and water samples was done by Hennepin Parks staff. Water samples were sent to a private laboratory for analysis. Analytical costs were funded by the MGCSA.

Study Site

The study was located in Baker Park Reserve on the Baker National Golf Course. Baker Park Reserve is approximately 20 miles west of Minneapolis and is one of seven reserves managed by the Suburban Hennepin Regional Park Reserve District (Hennepin Parks). The golf course contains numerous wetlands and is adjacent to Spurzem Lake, a 69-acre recreational water body.

During the renovation of the golf course in 1989, an underdrain tile system was installed in the 7,182 square-foot green on the 7th hole. The underdrain system was designed by the Hurdzan Design Group. Leachate from the green is collected by the underdrain system and discharged into an adjacent manhole (Figure 1). The manhole was constructed to act as a trap for pollutants in the leachate water. Outflow from the manhole flows into a small pond which discharges into Spurzem Lake. Leachate from the green was collected immediately upstream of the manhole.

Green 7 at the Baker National Golf Course is a terraced green with a total drop of 5 feet from the upper to the lower tier. The green was constructed with a percolation rate in excess of 16 inches/hour.

Methods

A stainless steel box equipped with an adjustable 30-degree, v-notch weir was fabricated for the project to facilitate sample and flow data collection (Figure 2). The box was installed between the green and the manhole. The sample box was constructed with attachments to connect the drainage tile line to the inlet and outlet ends of the box. Flow monitoring and water sample collection devices were installed in the box.

Flow through the weir was monitored continuously with an ISCO flow meter equipped with a pressure sensitive probe. Water height over the weir during rainstorm events was confirmed by visual observations of the sampling station. A companion ISCO sampler was installed to collect water at discreet intervals during rainfall events. The flow meter was equipped with a sample actuator which automatically started the sampler when flow through the weir began. The sampler was equipped with a stainless steel intake device, teflon tubing and glass bottles. Flow data from the meter was downloaded onto a computer and analyzed by Hennepin Parks staff.

Sample collection dates were selected randomly in 1991 by segmenting the growing season into weekly intervals. Each week from May 6 to September 23, 1991 was assigned a number. Sample collection dates were then selected by using a random number table. If a leachate producing rainfall event did not occur in the selected week, the sampler was left in place for one additional week and then removed. Applications of fertilizer and pesticides to green 7 occurred independently of sample collection dates, on the same schedule as for the rest of the course. Because only a few rainfall events produced runoff, sample collection in 1992 occurred whenever leachate events occurred.

Water samples were composited according to the flow rate, put on ice, and transported to a private laboratory. The laboratory was initially selected by competitive bid. However, in 1991 and 1992 only one facility in the Twin City metropolitan area had the capability of performing

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Leachate Study —

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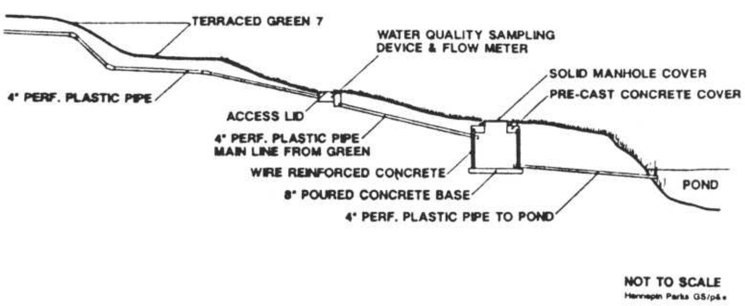
the analysis. Samples were analyzed for the phosphorus and nitrogen concentration as well as for any of the compounds listed in table 1 which had been applied to the green prior to the rainfall event. Samples of the pesticides applied to the green were provided to the laboratory and were used to calibrate the analytical procedure.

FIGURE 1

GREEN 7 LEACHATE COLLECTION AND SAMPLING SYSTEM



Rainfall volume data was collected at two gauges, one installed approximately 200 yards north of green 7 and the other installed approximately one quarter mile southwest of green 7. The gauges were read daily. In addition, in 1991 rainfall intensity data was collected with two tipping bucket rain gauges installed approximately two miles west of Baker National Golf Course. These rain gauges were installed for a different study but the intensity information was assumed to be similar to that occurring at the golf course. In 1992 one tipping bucket gauge was installed approximately 200 yards north of green 7.

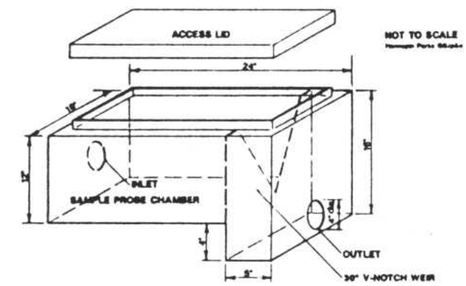
Results

The sample box/weir was installed at green 7 on June 1, 1990. Flow monitoring and sample collection began in July, 1990. Leachate samples were collected during rainfall events on July 11 and July 26, 1990. Initial sample collection in 1990 was delayed because of the condition of the green. A lack of snow cover during the winter of 1989-1990 caused dieback of the turf grass on Green 7. The green was reseeded on June 5, 1990, and applications of pesticides and fertilizer were delayed until after the turf was reestablished. Monitoring of flow and sampling of leachate was, therefore, delayed until July. In 1991 flow monitoring at Green 7 began on 29 April and continued throughout the growing season. Monitoring in 1992 began in June and ended in October.

Rainfall on Green 7 during the study season (May through September) was above average in 1990 and 1991, and below average in 1992 (Figure 3). A total of 23.3, 27.5, and 16.2 inches of rain fell on the Baker Golf Course in 1990, 1991, and 1992 respectively, as compared to the average of 20.3 inches.

FIGURE 2

GREEN 7 WATER QUALITY SAMPLING CHAMBER AND PRIMARY FLOW MEASURING DEVICE



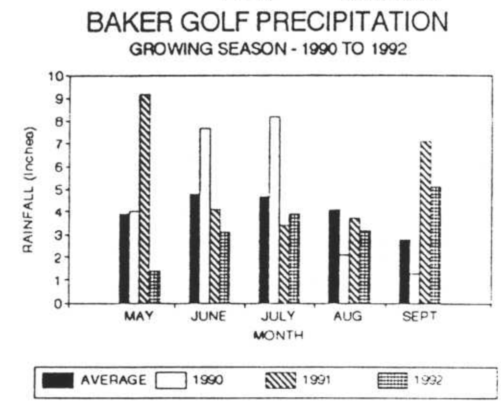


Figure 3. Baker Golf Precipitation 1990 to 1992

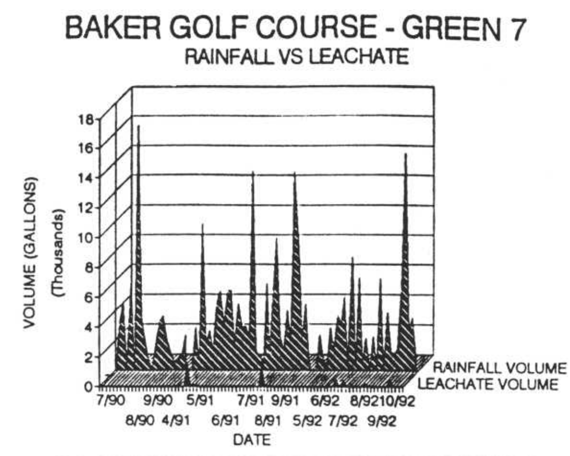


Figure 4. Total Rainfall and Resulting Leachate at Green 7 Baker Golf Course

As shown on Figure 4, only 14 of 63 monitored rainfall events which occurred during the three-year study period produced leachate. Rainfall events less than 0.50 inches did not produce leachate, and larger events produced only small quantities. The amount of water passing through green 7 was less than 5 percent of the rainfall on the green for all but two events.

There was a significant difference in the intensity of rainfall events which produced leachate and those that did not. Comparison of rainfall and leachate data shows that the intensity of the rainfall was a more critical factor than the rainfall volume in determining the amount of leachate. Figure 5 shows the intensity in inches per hour for four rain events all over one-half inch. Only the event on June

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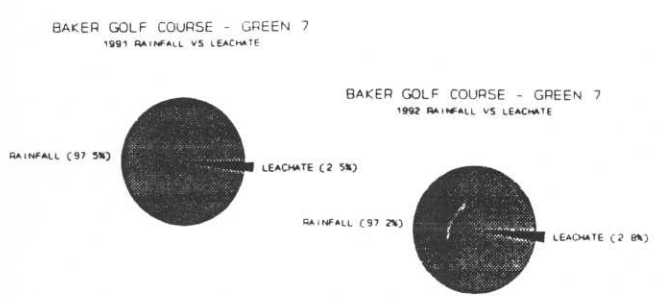
20 produced any leachate. Two events occurred on May 26, the first (0.55 inches) in the early morning. Since the rainfall intensity was low, the soil apparently absorbed the rain and no leachate resulted. A second event (0.5 inches) eight hours later was of sufficiently high intensity that no leachate occurred. Therefore, despite the fact that over an inch of rain fell on Green 7 on May 26, no leachate was generated. Data collected by the tipping bucket rain gauge shows that the intensity of most rain events during the three-year study was in excess of five inches/hour, apparently faster than the effective percolation rate of the green.

The total measured volume of leachate generated during the study was 3,439 gallons in 1991 and 1,755 gallons in 1992. This amounted to 2.5 and 2.8 percent respectively of the total rainfall volume on green 7 in 1991 and 1992 (Figure 6).



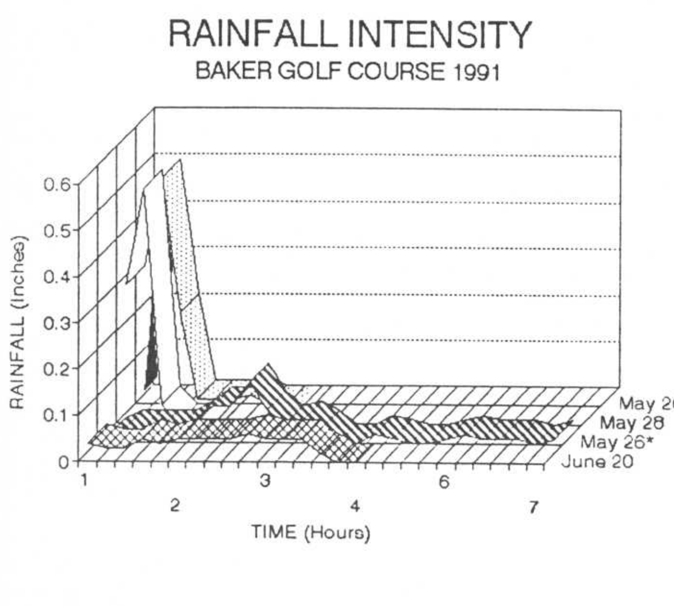


Figure 5. Intensity of Selected Rainfall Events on Baker Golf Course.

Figure 6. Leachate vs Rainfall

Flow data from 1990 is not shown because much of it was lost due to a software problem with the date logger. During the analysis of the data it was observed that the total flow volume displayed on the meter and manually recorded did not match the total flow stored in the meter memory. Since it was not possible to determine which flow was correct, the data from June and July was discarded. In August and September, the flow was manually tabulated from the meter display. The software problem was corrected in 1991.

Some additional flow data was lost in 1991 when lightning strikes near the monitoring site caused a "crash" of the data logger computer memory. Data for the rainstorm event in which the lightning occurred, as well as all previously accumulated data, was lost during these episodes. However, the sample site was visually inspected during most rainfall events and the lack of leachate recorded.

Detailed information on the amount, date, and volume of rainfall events and the resulting leachate are shown in table 2. A number of events for which samples were collected and analyzed show "no data" for the amount of leachate. The data for these events was lost through lightening strikes or improper functioning of the data logger.

The quantity and timing of fertilizer applications to Green 7 are shown on Table 3. Applications of chemicals were done independently of the sampling program and followed the same schedule as the other greens on Baker National Golf Course. Significantly more phosphorus was applied to green 7 in 1990 than in 1991 and 1992, 101.7 lbs. vs 13 and 1.2 lbs respectively. The high application rate in 1990 was due to the necessity of establishing the new turf. Nitrogen applications were similar in all three years.

Two fungicides, Daconil 2787 and Chipco 26019 were applied in all three years of the study (Table 4). Two other fungicides, Dyrene and Banner, were applied in two years. In 1991, Banner and Daconil were applied before the initial sample event and were therefore available for three sample events. Chipco 26019 was applied on July 16 and was available only for one sample event. In 1992 Daconil 2787 was applied prior to the first sample event, Chipco 26019 prior to the second event and Dyrene prior to the third.

The concentrations of measured contaminants in the leachate water for monitored rainfall events are shown on Table 5. The total phosphorus concentration ranged from 0.67 mg/l to 3.9 mg/l with an average of 2.3 mg/l. The dissolved phosphorus concentration in the leachate water was equal to the total phosphorus concentration for most rainfall events, indicating that the phosphorus was in the dissolved state, not attached to soil particles. The total nitrogen concentrations in the leachate water ranged from 1.9 mg/l to 4.8 mg/l with a mean of 2.2 mg/l during the study. ■ *End of Part I — Part II of this study will be published in the May issue of Hole Notes.*