FRESHWATER
Scientific Services, LLC

www.freshwatersci.com
18029 83rd Avenue North
Maple Grove, MN 55311
mail@freshwatersci.com
(651) 336-8696

2006 Lawn Runoff Monitoring Report: Weaver Lake

Prepared for Weaver Lake Conservation Association
December 2006
by James A. Johnson
Freshwater Scientific Services, LLC

Introduction

Algae growth in Minnesota lakes is generally limited by the availability of the nutrient phosphorus. As a result, increased phosphorus inputs from internal and external sources can lead to excessive algae growth and water quality degradation. Identifying these sources of phosphorus to a lake is an important first step in developing and effective algae management plan. Determining the relative contribution of nutrients from each of the suspected sources allows for better allocation of funds and effort to maximize nutrient reductions while reducing the chance that funds will be wasted on ineffective strategies.

The Weaver Lake Conservation Association (WLCA) has been interested in nutrient management for many years, but recent noxious filamentous algae blooms have created renewed interest in monitoring the stormwater runoff entering Weaver Lake. As of 1999, the 400-acre Weaver Lake watershed was roughly 60% residential land use with the remaining 40% maintained as park and natural open areas (Weaver Lake Management Plan, 1999). Additional development over the past six years has likely shifted these percentages to include more residential and less natural area. Nearly half of the watershed is currently maintained as turf grass, and most of the rooftops drain directly to lawns, so lawn runoff is likely an important external source of runoff and nutrients to Weaver Lake. A study conducted by staff from the United States Geological Survey in 1996 found that while direct runoff from near-shore areas contributed only 4% of the annual water inflow but that small volume of water contained over half of the total annual phosphorus inflow from all sources (Garn et al., 1996).

In 2006, the WLCA initiated a monitoring program to assess lawn runoff from properties immediately adjacent to Weaver Lake. The objective of this monitoring was to explore the potential for using simple lawn runoff sampling to determine the concentration of phosphorus and nitrogen in lawn runoff entering Weaver Lake. The results of this monitoring will be used to guide any additional lawn runoff monitoring in 2007 and may serve as a foundation for future watershed runoff modeling as a part of the Weaver Lake Management Plan. In addition, the WLCA plans to use the information gained to develop educational materials that promote responsible lawn care practices and clarify the link between watershed activities and the water quality of Weaver Lake.

Figure 1. Approximate boundaries of Weaver Lake Watershed.

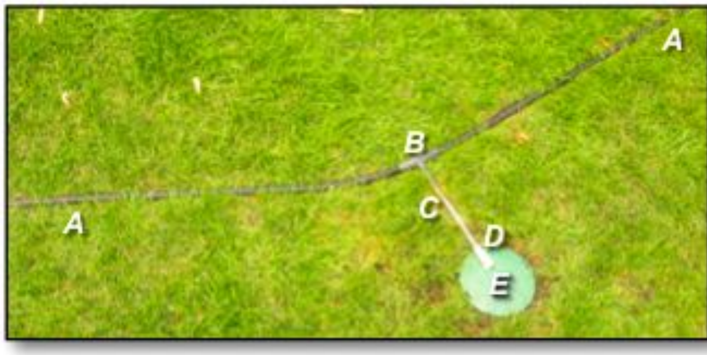
Watershed Area	340 acres
Lake Surface Area	148 acres
Residential Land Use	60%
Park/Natural Land Use	40%
Lake Volume	3182 acre-ft

Table 1. Characteristics of Weaver Lake (27-0117) and its watershed (Weaver Lake Management Plan, 1999)

Equipment and Methods

Samplers

The design of the lawn runoff samplers used in this project was a modification of similar samplers described by Waschbush, Selbig, and Bannerman (1999) and Garn (2002). The modified design incorporated the use of lawn edging installed just below grade, angled 1mm slots to collect surface runoff, a clear section of tubing to allow for easy inspections, and a buried lawn box to house a large sample bottle (Figures 2 and 3). Additional sampler design information is available from Freshwater Scientific Services.



A - Black plastic tubing
B - Gray T-shaped fitting
C - Clear tubing
D - White 90° elbow
E - Green lid (covers bottle)

Figure 2. Photo of an installed lawn runoff sampler.

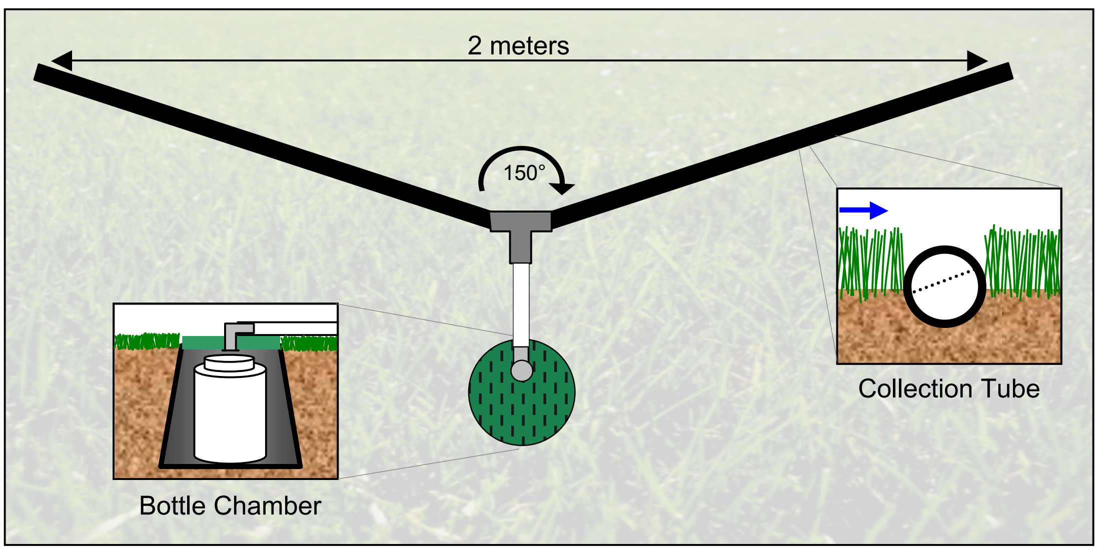


Figure 3. Diagram of modified lawn sampler design. Modifications include: perforated lawn edging collection tubes, inset of tubing level just below grade, angled orientation of perforations indicated by dotted line, 1mm perforations in collection tubes, sealed tubing ends, and a larger sample bottle capacity (1/2 gallon).

Sampler Maintenance

After each lawn sampler was installed, the homeowners for each site were given detailed maintenance instructions (Appendix-A) and a supply kit that included sample bottles, a field log, and all of the materials needed to perform routine maintenance on the sampler. Freshwater Scientific Services also routinely checked samplers to assess sampler performance and sample quality after large rain events. Each sampler was inspected after any rain event and weekly during dry periods. After retrieving any collected sample, the inside of the sample bottle was scrubbed with a brush to loosen any dirt and debris, and then rinsed with distilled water prior to placing back into the bottle chamber. In addition, the collection tubing was inspected to verify that a negative slope was maintained to promote proper drainage, the clear section of tubing was inspected for debris, and the black collection tubes were rinsed out with a hose if suspected of being clogged or dirty.

Site Descriptions

The samplers were installed to collect surface runoff from an area 2-meters wide with a minimum of 20 feet of uphill slope. All sites were in areas of open lawn with no tree canopy. Three of the samplers were installed at the bottom of backyard slopes that drained directly to Weaver Lake, while the third sampler was installed immediately adjacent to the curb on the street side of the property to monitor lawn runoff flowing onto the street and into the nearby stormwater catch basin (Figure 4).

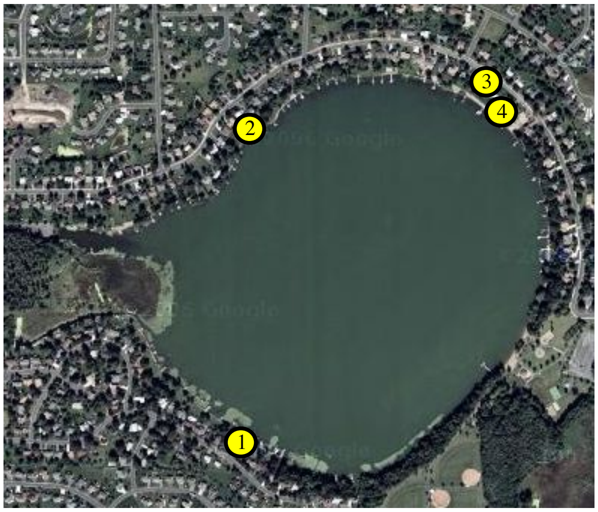


Figure 4. Location of the four monitored locations. Sites 1,2, and 4 are backyard locations, and site 3 is along the curb on the street side of the chosen property.

Site details

1 – Very flat, poorly drained backyard slope with wet sandy soils and dense turf. Sampler placed to intercept observed channelized flow to beach area. (< 30:1 slope)

2 – Steep, well drained backyard slope with dense turf. (~ 4:1 slope)

3 – Relatively flat, well drained, front yard slope with compacted areas and some roof drainage. (~ 12:1 slope)

4 – Relatively steep, well drained backyard slope with sandy soils (~8:1). (This site was accidentally destroyed during landscaping.)

Results

Sample Analysis

Sample volume, color, and presence of debris were noted at the time of collection. Very little debris was observed in any of the samples, indicating that the narrow slots effectively excluded grass clippings, soil, insects, and earthworms from the sample. All collected samples were labeled and stored frozen until delivered to the contracted lab for analysis of total phosphorus (TP) and total nitrogen (TN). All sample analyses were completed by Instrumental Research Incorporated in Fridley, MN ~~(Appendix-B)~~.

Nutrient Concentrations

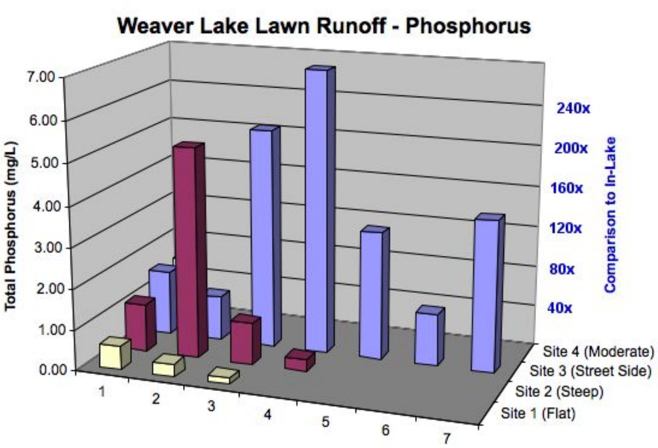
Nutrient concentrations in runoff can be affected by factors such as rainfall total and intensity, soil characteristics, turf condition, fertilizer application, and biological activity. Because of this, nutrient concentrations can be extremely variable. Table 2 summarizes typical lawn runoff concentrations for TP and TN based upon a study conducted by Herb Garn of the United States Geological Survey in 2003. Determining typical nutrient concentrations in runoff requires many samples collected from a wide range of rainfall events and site conditions in the area of interest. Measuring all of these factors is beyond the scope of this pilot project, but the largest factor, rainfall, can be somewhat accounted for by considering the storm characteristics associated with each runoff event. Simple rain gauges were used to track rainfall in 2006, so we can only report rain event totals (no rainfall intensity data) along with our sample results (Table 3 and Figure 5).

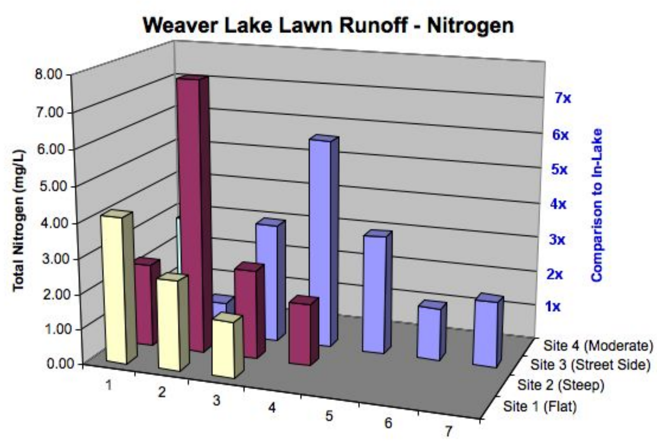
	TP *(mg/L)*	**TN** *(mg/L)*
Typical Concentration	2 - 3	5 - 6
Typical Range (IQR)	1 - 5	2 - 18
Maximum	23	55

Table 2. Summary of typical lawn runoff nutrient concentrations from fertilized and unfertilized lawns (Garn, 2003).

Date	Event	Rain *(in)*	Site #	TP *(mg/L)*	TN *(mg/L)*
8/1/06	1	1.26	1	0.58	4.15
8/1/06	1	1.26	3	1.59	1.14
8/1/06	1	1.26	4	1.52	2.86
8/2/06	2	1.34	1	0.31	2.54
8/6/06	2	1.34	2	1.17	2.36
8/2/06	2	1.34	3	1.10	0.94
8/15/06	3	0.63	2	5.17	7.70
8/14/06	3	0.63	3	5.41	3.39
8/23/06	4	0.80	3	6.93	5.93
8/26/06	5	0.52	2	1.02	2.53
8/24/06	5	0.52	3	3.15	3.37
9/4/06	6	3.32	1	0.15	1.58
9/4/06	6	3.32	2	0.30	1.76
9/5/06	6	3.32	3	1.28	1.49
9/13/06	7	0.15	3	3.71	1.85

Table 3. Summary of lab results for total phosphorus (TP) and total nitrogen (TN) along with the associated site numbers and rainfall data for collected samples.





Figures 5 and 6. Graphical summary of lab results for total phosphorus (TP) and total nitrogen (TN) for each of the 7 rain events sampled in 2006. The blue text along the right margin of each graph relates the measured runoff concentrations to the average in-lake concentrations for both TP and TN.

Discussion of Results

It is difficult to make any solid conclusions from the small data set collected in 2006, but it does appear that the measured concentrations for TP and TN generally fall within the typical ranges given in table 2, with the exception of site 1 which appears to be consistently low in TP in all three of the collected samples. Characterizing runoff from more lawns over a wider range of dates and rain event characteristics would help to clarify any trends and patterns in lawn runoff and would be a valuable addition to the overall Weaver Lake management plan.

References

Garn, H.S., Olson, D.L., Seidel, T.L., and Rose, W.J., 1996, Hydrology and water quality of Lauderdale Lakes, Walworth County, Wisconsin, 1993–94: U.S. Geological Survey Water-Resources Investigations Report 96-4235, 29 p.

Garn, H.S. 2002, Effects of lawn fertilizer on nutrient concentrations in runoff from lakeshore lawns, Lauderdale Lakes, Wisconsin. U.S. Geological Survey Water-Resources Investigations Report 02-4130.

Waschbusch, R.J., Selbig, W.R., and Bannerman, R.T., 1999, Sources of phosphorus in stormwater and street dirt from two urban residential basins in Madison, Wisconsin, 1994–95: U.S. Geological Survey. Water-Resources Investigations Report 99-4021, 47 p.

Weaver Lake Management Plan – Maple Grove, Minnesota. 1999. City of Maple Grove, MN.