Glen Lake NPS Monitoring 2020 Report

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Introduction

Since 2017, SUNY Adirondack has partnered with the Glen Lake Protective Association (GLPA) of Queensbury, NY, and the Warren County Soil and Water Conservation District (WCSWCD) to investigate whether residential/commercial septic systems could be a contributing factor to nonpoint source (NPS) pollution of Glen Lake.

The US Environmental Protection Agency defines nonpoint source pollution (NPS) as, "any source of water pollution that does not meet the legal definition of 'point source' in section 502(14) of the Clean Water Act." Point source water pollution is defined as follows:

> "The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture." (https://www.epa.gov/nps)

The EPA also notes, "nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, we know that these pollutants have harmful effects on drinking water supplies, recreation, fisheries and wildlife." (https://www.epa.gov/nps)

On residential lakes, septic systems are often the primary source of NPS pollutants and constitute an environmental concern. NPS pollution of surface or ground water is often related to runoff that occurs when rainfall or snowmelt moves over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, which are then depositing into lakes, wetlands, rivers, coastal waters and ground waters.

Previous research conducted by the SUNY Adirondack ESC has shown that concurrent detection of (1) hypochlorite ion or hypochlorous acid (HOCl), which are chlorine compounds in bleach and cleaning products that are not found naturally in aquatic environments; and (2) fecal bacteria, specifically *Escherichia coli* (EC) can be a reliable indicator of septic system-associated NPS pollution for monitoring water quality and identifying areas of concern.

This report is a summary of three consecutive years of NPS monitoring on Glen Lake, a small residential lake in the Southern Adirondack region of New York.

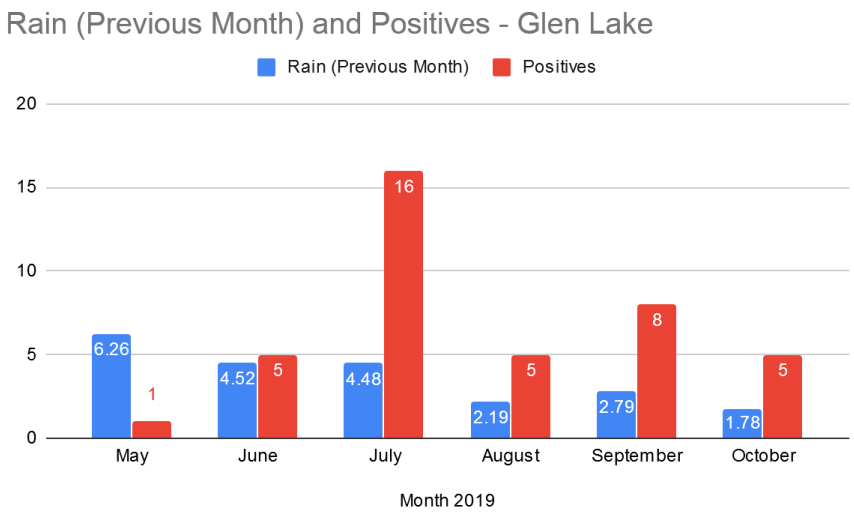
Method

Testing was conducted at selected sites around the lake once a month between May and October in 2018, 2019, and 2020. In 2019, rainfall data was accessed from the National Climatic Data Center (www.ncdc.noaa.gov) to evaluate if there was a relationship between the amount of rain and detection of the two NPS indicators, hypochlorite and *E. coli*. Each sampling location was identified using visual and GPS coordinates. Additional samples were obtained from sites in the lake's graminoid fen and inlet areas on an occasional basis.

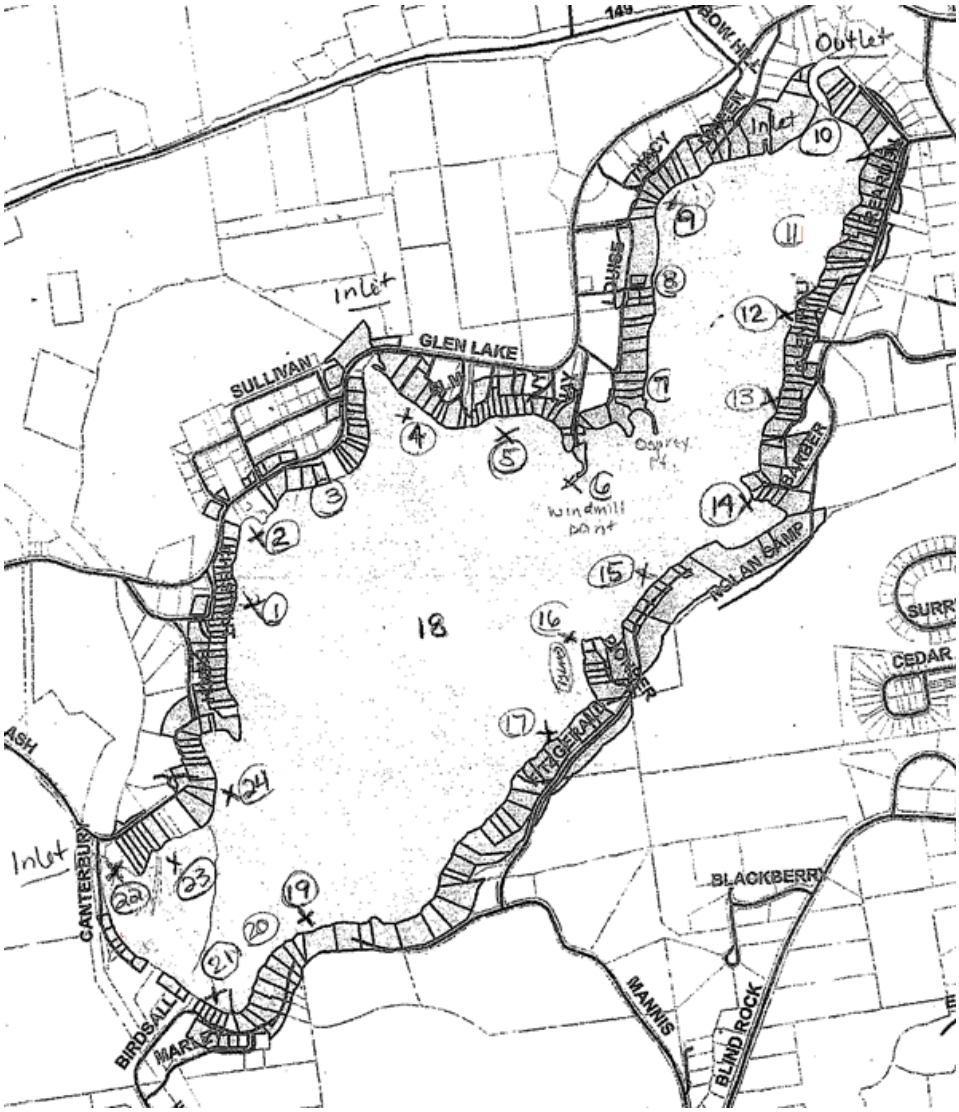
At each site, a "grab" sample was obtained approximately 10-20 cm below the surface of the water in sterile 250 ml Naglene bottles. All samples were stored in a cooler with ice and transferred to the Microbiology Research Laboratory at SUNY Adirondack where they were processed within 2 hours of collection. Each sample was tested for the presence of *Escherichia coli* (a fecal coliform bacteria) using the IDEXX Colilert testing system, which is a culture-based detection method, according to manufacturer specifications. The samples were also tested for free chlorine (hypochlorous acid and hypochlorite) using a Hach DR/800 colorimeter and HACH reagents according to manufacturer recommendations. For this study, we used the lower limit of detection (0.02 mg/L) of the assay as the positive cutoff value.

Results and Discussion

In 2019, the highest number of positive sites occurred in July and September, when 65% and 40% of the sites tested positive for both indicators. The testing dates for these months correlated with holidays associated with increased recreational lake usage (Fourth of July and Labor Day). As shown below, this increase in the number of NPS positive sites showed little correlation with monthly rainfall totals.



For the three-year period, water samples were collected from the same 24 sites along the shoreline, and tested for the NPS indicators HOCl and *E. coli*. These sites are shown on the map view of Glen Lake, below. Additional tests were completed on samples obtained from the Glen Lake fen, which is an inlet to the lake (sites not shown).



In 2018 and 2019, an increase in total NPS positive sites was noted to correlate with summer holidays, specifically in May (Memorial Day), July (Fourth of July), and September (Labor Day). Interviews with year-round lake residents revealed that recreational use of the lake in 2020 was consistently higher than usual, presumably due to the quarantine and remote workers who would normally only be in residence over weekends and on holidays. As shown in Table 1, the total NPS positive sites for each testing date remained relatively constant, with the exception of October, when 63% of the sites were positive for both NPS indicators.

Table 1: Summary of Glen Lake NPS Indicator Testing Results from May through October, 2020. Site 18 (center of lake/control) was negative on all testing dates.
(1 – Positive for both HOCl and *E. coli*. 0 – Negative for one or both indicators)

GL 2020 Composite Data								
	13-May	10-Jun	6-Jul	18-Aug	14-Sep	12-Oct		Site Pos
LAKE								
1	0	0	0	1	0	1		2
2	0	0	1	0	1	0		2
3	0	0	0	0	1	1		2
4	0	1	0	0	1	0		2
5	0	0	0	1	1	1		3
6	0	0	1	0	0	1		2
7	0	1	0	1	1	0		3
8	1	1	1	1	1	1		6
9	0	1	1	1	1	1		5
10	0	0	0	0	0	0		0
11	0	1	0	1	1	1		4
12	0	1	1	1	1	0		4
13	0	1	0	1	0	0		2
14	1	0	0	0	0	1		2
15	0	0	1	0	0	0		1
16	1	1	0	0	0	1		3
17	0	1	0	0	0	1		2
18	0	0	0	0	0	0		0
19	1	0	0	0	1	1		3
20	0	0	0	0	0	1		1
21	1	0	0	0	0	0		1
22	0	0	0	0	1	1		2
23	0	0	0	0	1	0		1
24	0	1	0	0	0	1		2
	5	10	6	8	12	15		
	21%	42%	25%	33%	50%	63%		
FEN								
25F	0	0	0	0	0	0		0
26F	0	1	1	0	1	0		3
27F	0	0	1	0	0	0		1
28F	1	1	0	0	0	0		2
29F	1	0	1	0	1	1		4
	2	2	3	0	2	2		
	40%	40%	60%	0%	40%	40%		

The combined results of NPS monitoring of Glen Lake, which began in August of 2017 and continued through October of 2020, are shown in Table 2 below. Although samples were also collected and tested in May, June, and July, not all 24 sites were monitored and therefore the data is not included.

Table 2: Results of NPS testing on Glen Lake from 2018, 2019 and 2020.

	2017	2018			2019						2020						
	8/17/2017	18-Aug	18-Sep	18-Oct	16-May	10-Jun	8-Jul	12-Aug	10-Sep	8-Oct	13-May	10-Jun	6-Jul	18-Aug	14-Sep	12-Oct	Total
	LAKE						LAKE						LAKE				
1	0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	1	5
2	0	1	0	0	1	0	0	0	1	0	0	0	1	0	1	0	5
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
4	0	1	1	0	0	0	1	0	1	0	0	1	0	0	1	0	6
5	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	5
6	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	4
7	1	1	0	0	0	0	1	0	1	1	0	1	0	1	1	0	8
8	0	1	1	0	0	0	1	1	0	0	1	1	1	1	1	1	10
9	0	1	0	0	0	0	1	0	1	0	0	1	1	1	1	1	8
10	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	1	5
11	1	1	0	0	0	1	1	0	1	0	0	1	0	1	1	1	9
12	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	5
13	0	1	1	0	0	0	1	0	1	1	0	1	0	1	0	0	7
14	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0	1	5
15	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	4
16	1	0	0	0	0	0	1	0	1	0	1	1	0	0	0	1	6
17	0	1	0	0	0	0	1	1	0	1	0	1	0	0	0	1	6
18	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
19	0	1	0	0	1	0	0	1	0	1	1	0	0	0	1	1	7
20	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	3
21	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3
22	1	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	5
23	0	1	0	0	0	1	1	0	0	1	0	0	0	0	1	0	5
24	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	1	5
	6	18	4	1	2	5	15	4	11	7	5	10	6	8	12	15	
	25%	75%	17%	4%	8%	21%	63%	17%	46%	29%	21%	42%	25%	33%	50%	63%	

Over the three-year period, a total of 16 samples were collected and tested for NPS indicators for each site. The average number of NPS positive tests per site was 5.375, approximately one-third of the 16 total sampling dates. Site 18, the center of the lake and the site considered the "control" because of its location away from any shoreline area and the depth of the lake, was negative for the duration of the 2020 testing period, and positive only once over the three-year time span. This supports the validity of the monitoring protocol to identify areas of the lake shoreline where NPS contaminants are carried into the lake.

The cumulative data shows that four sites (7, 8, 9 and 11) exceeded the average and were positive more than 50% of the time, with site 8 showing the highest total NPS positive tests (10/16 or 63%). These four sites are clustered along the northern shoreline on the east side of the lake. The grab-sample approach to sample collection does not allow identification of one specific location, but the proximity of these sites indicates NPS pollution is entering the lake in this area, and provides a focus for possible future NPS mitigation efforts.

Interestingly, the data shows that for each of the three years that sampling and testing was done on all 24 lake sites, one month showed a higher than average number of sites that were positive for both NPS indicators. (August in 2018; July in 2019; and October in 2020). No direct correlations with average rainfall or variables other than recreational lake usage could be established.

The results of testing for NPS indicators on Glen Lake in 2020 supports the conclusion from the previous years of the project, that the lake is receiving NPS pollution. Septic systems associated with lakefront properties the most probable source of the NPS indicators which reach the lake as a result of runoff. The lakefront is heavily residential, with both year-round and seasonal properties with septic systems ranging from original to the property, to recently installed. Under a law that went into effect on January 1, 2019, the town must inspect the septic system when a waterfront residential zone property is sold, and the system replaced if found non-functional.

Although the study design does not permit identification of specific waterfront properties where NPS contamination originates, the data does indicate a region along the northern shore on the east end of the lake as an area where runoff transfers NPS indicators to the lake.

This project has been an ongoing collaborative effort among SUNY Adirondack, the Glen Lake Protective Association, and the Warren County Soil and Water Conservation District, with a goal of providing information that will help guide the development of policies to protect and preserve the water quality of Glen Lake, and potentially other residential lakes.