Detection of Septic Derived Non-Point Source Pollution in Residential Lakes

Lake Luzerne 2024 Report

Introduction

Since 2015, the Environmental Studies Collaborative at SUNY Adirondack (ESC) has collaborated with the Warren County Soil and Water Conservation District (WCSWCD) and local lake associations to detect septic system-derived non-point source pollution (NPSP). NPSP is an environmental concern for lakes, because it can lead to short and long-term changes in overall water chemistry, with potential negative impacts on lake ecosystems. Therefore, the data provided by the ESC may be used to better understand where and how NPSP is entering the lake, and develop strategies to address resulting environmental and ecological concerns.

Research studies by the SUNY Adirondack ESC have previously shown that the concurrent detection of thermotolerant *Escherichia coli* (TEC) and the ionic form of chlorine (HOCl) found in bleach and other cleaning agents (hypochlorous or hypochlorite ions, referred to as “free” chlorine) in lake water samples may be used to indicate general locations where septic system derived pollutants may be entering the lake through run-off. Thermotolerant *E. coli* (TEC) is a bacterium that is widely used as an indicator of fecal contamination. For example, detection of TEC at public beaches on lakes in New York State at levels above 1 cfu/ml will result in the temporary closure of the beach. However, because these bacteria live in the colon of both humans and other animals, including birds, TEC is relatively non-specific in terms of the source of the contamination since it is difficult to differentiate between species that derive from human vs. animal sources.

Free chlorine (HOCl) is a form of chlorine found in bleach and cleaning products, and is also used for water purification in municipal and private water systems. There are no natural sources of this form of chlorine, thus HOCl is more specific for human-associated activity. Thus, detection of both TEC and HOCl provides a more reliable indicator of septic system-derived NPSP entering the lake water.

Method

Sampling sites and dates were determined based on discussions with lake association members, lake usage patterns, visual evidence of changes in growth patterns of native or invasive aquatic plant species, and other observations. Once the number and location of testing sites was determined, each site location was mapped using GPS coordinates. Water samples are generally taken at each site over a six-month period (May – October), averaging once per

month. Testing dates are established based on lake usage and the availability of lake association volunteers.

At each site, parameters including pH, dissolved oxygen, and others were measured in real time with a YSI PRO DSS instrument. Near shore water samples are then collected in sterile 250 mL Nalgene bottles, and placed in a cooler with ice. Samples are transported to the laboratory at SUNY Adirondack, where testing for TEC and HOCl is performed, generally within 4 hours of collection.

TEC were identified using the R-Card E. coli system available from Roth Biosciences (https://www.rothbioscience.com/collections/r-card-ecoli). This test is a quantitative measure of *E. coli* cells (colony forming unit or cfu), which are indicated by the formation of visible and discreet bacterial colonies on the test card surface. Briefly, 1 mL of water is pipetted onto the R-Card and covered with a plastic shield. Cards are incubated at 37°C for 24 hours. The growth of blue colonies on the card indicates thermotolerant *E. coli* are present in the water. Each blue colony is counted as a colony forming unit (cfu) of TEC. For this study, TEC ≥ 2 cfu/mL is considered positive for thermotolerant *E. coli*, which are fecal bacteria from a human or animal source.

HOCl (free chlorine) is measured using chemical reagents, colorimeter, and other supplies obtained from Hach (https://www.hach.com/p-dr300-colorimeters-parameter/LPV445.97.00110?promo=promosuper15). Briefly, a powdered reagent packet is added to 10 mL of water in a glass cuvette. If HOCl is present in the sample, a chemical reaction with the reagent occurs resulting in a color change to pink which is detected by the colorimeter. For this study, HOCl ≥ 0.02 mg/L was considered significant.

A testing site is reported as NPSP positive if BOTH TEC and HOCl are detected at levels above the determined cutoff value.

What does it mean if a site is positive for NPSP using this method?

Concurrent detection of TEC and HOCl in near-shore water samples is an indication that septic system effluent may be entering the lake at or near the sampling site as a result of runoff. It is not possible to identify specific septic systems involved using this approach, since the route of runoff flow through the ground to the lake is dependent on a large number of variables, including the soil composition, elevation, landscaping, ground water levels, and other factors.

Results

Table 1: Results of tests for TEC and HOCl as indicators of NPSP are shown in the table below. Key for abbreviations: Cl – free chlorine or HOCL (mg/L); TEC – thermotolerant E. coli (cfu/mL); NPS – both TEC and HOCl detected above cutoff values; TP – cumulative positives. Sites where the HOCl concentration exceeded 0.1 mg/L are highlighted in yellow, indicating human-associated, but not necessarily septic system-associated NPSP.

	6.3.2024			7.10.2024			8.14.2024			9.6.2024			
Site	Cl	TEC	NPS	Cl	TEC	NPS	Cl	TEC	NPS	Cl	TEC	NPS	**T P**
1	0.02	0	-	0.04	0	-	0.02	0	-	0.01	0	-	0
2	0.02	0	-	0.01	0	-	0.00	0	-	0.02	0	-	0
3	0.03	0	-	0.01	0	-	0.06	0	-	0.03	0	-	0
4	0.04	0	-	0.00	1	-	0.00	0	-	0.02	0	-	0
5	0.02	0	-	0.02	0	-	0.01	0	-	0.00	0	-	0
6	0.03	1	-	0.03	0	-	0.02	0	-	0.02	0	-	0
7	0.04	1	-	0.03	1	-	0.00	0	-	0.02	0	-	0
8	0.02	0	-	0.01	0	-	0.03	0	-	0.01	0	-	0
9	0.03	0	-	0.02	0	-	0.02	0	-	0.02	0	-	0
10	0.04	3	Pos	0.03	0	-	0.00	0	-	0.07	0	-	1
11	0.03	0	-	0.00	0	-	0.13	0	-	0.00	0	-	0
12	0.03	0	-	0.01	0	-	0.03	0	-	0.01	0	-	0
13	0.02	0	-	0.27	0	-	0.02	0	-	0.02	0	-	0
14	0.02	0	-	0.02	0	-	0.02	0	-	0.11	0	-	0
15	0.01	0	-	0.02	0	-	0.02	0	-	0.01	0	-	0
16	0.02	0	-	0.02	0	-	0.02	0	-	0.00	0	-	0
17	0.04	1	-	0.05	0	-	0.02	0	-	0.00	0	-	0
18	0.03	0	-	0.01	1	-	0.02	0	-	0.04	0	-	0
19	0.00	0	-	0.13	2	Pos	0.02	0	-	0.01	0	-	1
20	0.02	0	-	0.01	0	-	0.05	0	-	0.00	0	-	0
21	0.04	0	-	0.09	0	-	0.02	0	-	0.01	0	-	0
22	0.05	0	-	0.08	2	Pos	0.02	0	-	0.00	0	-	1
23	0.00	0	-	0.00	0	-	0.05	0	-	0.00	0	-	0
24	0.02	2	Pos	0.01	0	-	0.00	0	-	0.05	0	-	1
25	0.00	0	-	0.03	0	-	0.01	0	-	0.02	0	-	0
T P			2			2			0			0	

Significant findings: A total of 4 of the 25 lake testing sites were positive for NPSP at least once in 2024. An elevated concentration (> 0.1 mg/L) of free chlorine only was detected at a total of four sites; 2 sites in July, and 1 site each in August and September.