

Portland Water District
Sebago Lake Monitoring Programs
Lower Bay Bacteria Monitoring
Presenting data from 1977 to 2017
Laurel Jackson

Introduction

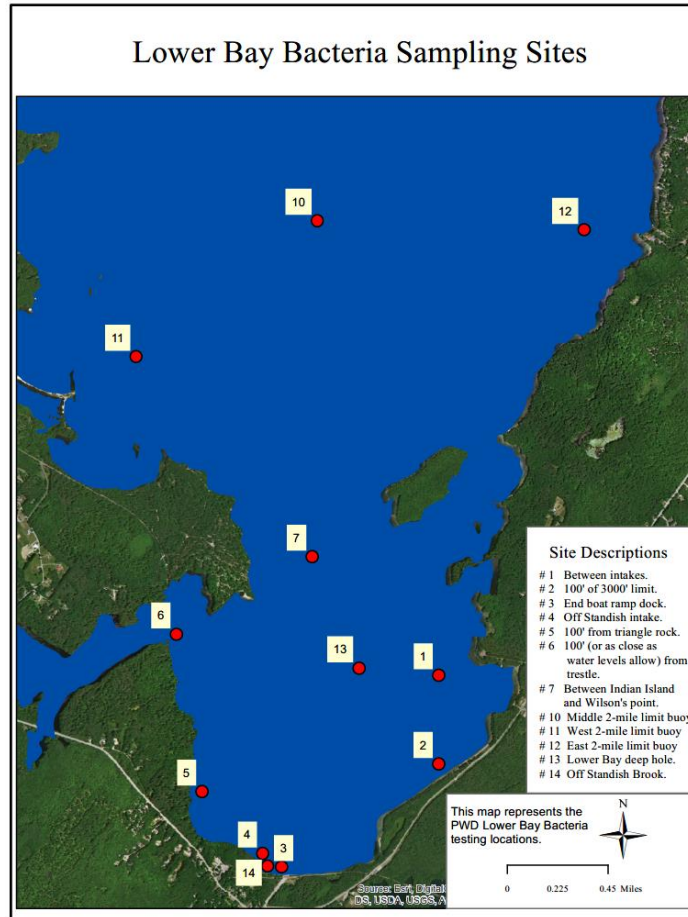
Sebago Lake is the primary drinking water supply for nearly 200,000 people in 11 Greater Portland communities. Lake water was first pumped to Portland in 1869, from an intake located in the southernmost part of the lake, referred to as Lower Bay. In 1907, the Portland Water District was chartered by the Maine Legislature to provide water and wastewater services to the region. Since its inception, the District has been actively monitoring and working to protect Sebago Lake.

In 1993, the District was granted a waiver to the filtration requirements of the federal Safe Drinking Water Act (SDWA) based in part on the purity of the water and the effectiveness of watershed protection efforts. This waiver agreement requires ongoing monitoring of lake water quality. The District maintains more than 10 monitoring and surveillance programs throughout the watershed and lake. In general, as one moves closer to the intakes, more samples are collected and tested for more parameters.

This report summarizes results of the Lower Bay Bacteria Monitoring Program. The purpose of the program is to monitor fecal coliform bacteria levels at various sites around Lower Bay, ensure levels are within historic ranges, and if not, identify possible sources of contamination.

Methods

Bacteria sampling occurs once a month from May to October. Twelve locations in Lower Bay are monitored for fecal coliform bacteria (see map for locations). Samples are taken just below the water surface with sterile gloves and sterile collection vessels. Samples are taken during “normal” lake conditions and are not designed to monitor extreme storm events or abnormal water circumstances. Samples are analyzed using the membrane filtration technique and incubated on mFC agar at 44.5 degrees Celsius for 24 hours.



Results and Discussion

Fecal coliform bacteria refer to a group of microorganisms that are present in the gastrointestinal tracts of warm-blooded animals. Fecal coliform in water bodies can indicate the presence of fecal contamination and related disease-causing microorganisms such as *Giardia*, *Cryptosporidium*, *E. coli* 0157:H7 and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. The SDWA Surface Water Treatment Rule sets a limit for raw drinking water of less than 20 fecal coliform colony forming units (CFU) per 100ml in 90% of daily samples for the previous 6 months. Raw water samples are analyzed for fecal coliform bacteria 5 days per week. Lower Bay bacteria monitoring is conducted in conjunction with these legally-required raw water samples.

The most significant sampling sites are summarized below.

Intakes

Bacteria concentrations from the sampling location above the water intakes pipes are among the lowest in Sebago Lake. The average fecal coliform concentration above the intakes from 1977 to 2017 is 0.40 cfu/100 ml. The data table (Figure 1) is a frequency distribution of all samples taken from 1977 through 2017 and the number of fecal CFU per 100 ml of lake water.

Figure 1. 81% of fecal coliform bacteria samples taken above the intakes (site #1) from 1977 to 2017 have 0 cfu/100 ml and 100% of samples are below 16 cfu/100 ml.

Fecal (cfu/mL)	Frequency	Cumulative Percent
0	275	80.6
1	43	93.2
2	14	97.3
3	5	98.7
4	1	99.0
5	0	99.0
6	0	99.0
7	0	99.0
8	0	99.0
9	0	99.0
10	2	99.6
11	1	99.9
12	0	99.9
13	0	99.9
14	0	99.9
15	1	100.2

Standish Brook Outlet

Bacteria concentrations near the outlet of Standish brook contain the highest concentrations of fecal coliform bacteria in the Lower Bay. The average fecal coliform concentration near the Standish Brook outlet from 1997 to 2017 is 3.1 cfu/100 mL. The data table below is a frequency distribution of all samples taken and the number of CFU per 100 ml of lake water.

Figure 2. 94% of fecal coliform bacteria samples taken near Standish Brook (site #14) from 1997 to 2017 have fecal concentrations between 0 and 10 CFU.

Fecal (cfu/mL)	Frequency	Cumulative Percent
0	59.0	48.7
1	24.0	67.9
2	10.0	75.9
3	10.0	83.9
4	2.0	85.5
5	3.0	87.9
6	3.0	90.3
7	1.0	91.1
8	0.0	91.1
9	2.0	92.7
10	1.0	93.5
>10	10.0	100.0

Standish Boat Ramp

Samples collected at the Standish boat ramp have historically high concentrations of fecal coliform bacteria. The average fecal coliform concentration at the Standish boat ramp is 3.5 CFU/100ml. The data table below is a frequency distribution of all samples taken and the number of fecal coliform CFU per 100 ml of lake water.

Figure 4. 99% of samples from the Standish boat ramp from 1997 to 2017 have fecal concentrations between 0 and 10 CFU.

Fecal (cfu/mL)	Frequency	Cumulative Percent
0	127	65.1
1	34	82.8
2	11	88.5
3	7	92.2
4	2	93.2
5	3	94.8
6	0	94.8
7	2	95.8
8	1	96.4
9	2	97.4
10	1	97.9
>10	2	99.0

All data from 2017 are presented below in Figure 7. There was one sampling event in 2017 that yielded fecal coliform levels at or above 10 cfu/100 ml. The sample collected from site 11 (eastern side of 2-mile limit) on 9/25/2017 had fecal coliform level of 41 cfu/100mL. Natural occurrences that may cause elevated fecal coliform levels include significant precipitation events that wash pollution from impervious surfaces and areas of development (animal feces, etc) into a water body. Site 11 (eastern side of 2-mile limit) was re-sampled on 9/27/17 and the result was 5 cfu/ 100 mL.

Figure 5. Total data set collected in 2017. Yellow values show fecal coliform concentrations greater than or equal to 1 cfu/100ml.

Sample site location	5/17/2017		6/22/2017		7/26/17		8/15/2017		9/25/2017		10/11/17	
	Fecal coliform	<i>E. coli</i>	Fecal coliform	<i>E. coli</i>	Fecal coliform	<i>E. coli</i>	Fecal coliform	<i>E. coli</i>	Fecal coliform	<i>E. coli</i>	Fecal coliform	<i>E. coli</i>
Between Intakes	0	0	0	0	1	0	0	1	1	1	3	2
100' of 3000' foot limit	0	0	0	0	0	1	0	1	0	0	1	1
End of boat ramp dock	0	0	0	0	0	3	0	1	0	0	0	0
Off Standish intake	7	10	0	0	0	3	0	1	0	0	2	1
100' off triangle rock	0	0	0	0	0	0	0	1	0	0	1	1
100' off trestle	0	0	2	6	0	2	0	0	1	1	0	0
Between II and Wilsons Pt	0	0	0	0	0	0	3	1	0	0	0	1
Middle buoy of 2 mile limit	0	0	0	0	0	0	0	0	0	1	0	0
East buoy of 2 mile limit	0	1	0	1	0	1	0	0	41	27	0	0
West buoy of 2 mile limit	0	0	1	1	0	0	0	0	1	1	0	0
Lower Bay deep hole	0	0	0	0	0	0	0	1	0	1	1	1
Off Standish Brook	0	1	1	1	0	1	0	1	1	1	2	0

Conclusion

Fecal coliform bacteria levels around Lower Bay are very low for a multi-use lake. Traditionally the two sampling locations with the highest levels of fecal coliform bacteria are the outlet to Standish Brook (sampling site #14) and the Standish boat ramp (sampling site # 6). Among all sampling locations, these sites are closest to tributary stream inputs. They are also subject to human presence while people are launching boats. Although there is no bodily contact allowed, the high amount of activity in that area may contribute to fecal coliform occurrences.

Standish Brook has an urban watershed which drains residential and commercial watershed areas. Typical bacteria sources from a developed watershed are subsurface waste water disposal systems and pet waste contamination. The outlet to Standish Brook shows bacterial levels have been known to be ten-fold higher than most sampling locations in Lower Bay.

In 2017, site 11 was the only sample site with a result above the action level of 10 cfu/100mL. As seen on the site location map, site 11 is approximately 100 feet off the shore- along the 2-mile limit arc. This site has historically had very low fecal coliform levels (95% of sample below 9 cfu/100mL). The subsequent re-sample was found to be below the action level. When the re-sample was collected, District staff noted a nearby rocky outcropping with a large flock of birds congregating on it. If the birds are habitually visiting this site, it may be the cause of high bacteria levels.

Overall, these values are considered low and comply with the maximum contaminant level for water treatment plant influent of 20 fecal coliform (cfu) per 100ml in 90% of samples. Nevertheless, it is interesting to note that locations with elevated fecal coliform bacteria levels often correspond with areas within close proximity of human activity. This correlation should be taken into account when considering appropriate activities in Lower Bay and throughout Sebago Lake.