



Portland Water District

Sebago Lake Watershed Monitoring Programs Tributary Monitoring - 2021

Carina Brown

Introduction

Sebago Lake is the primary drinking water supply for the greater Portland area. The Portland Water District (PWD) treats and delivers drinking water to over 200,000 people in 11 communities. PWD has a waiver from the filtration requirements of the federal Safe Drinking Water Act. There are many criteria for obtaining and keeping the waiver, but one of the largest factors is the continued excellent water quality of Sebago Lake and PWD's watershed protection efforts. This waiver agreement requires ongoing monitoring of lake water quality.

PWD monitors Sebago Lake and the rivers and streams that drain to it through more than 10 monitoring and surveillance programs. In general, more samples are collected and tested for more parameters the closer one moves to the intake pipes, located in Lower Bay.

The water quality of Sebago Lake is influenced by many factors, one of which is the condition of the watershed. A watershed is the land area that drains to a water body. In the case of Sebago Lake, the watershed includes part or all of 24 towns from Standish to Bethel. The majority of the watershed is forested, and because forests act as a natural filter, the water quality of the lake is excellent.

The tributary monitoring program was created to be an indicator of conditions in the watershed. If problems arise on the land that drains to the lake, one would expect to see it in the tributaries first.

This report covers the Tributary Monitoring Program which includes 11 tributaries that drain to Sebago Lake. The Tributary Monitoring Program began in 1977 with the purpose of monitoring the health of the watershed.

Methods

Eleven tributaries to Sebago Lake are sampled at one location each for three parameters: total phosphorus, turbidity, and *Escherichia coli* (*E. coli*) bacteria (Figure 1). The tributaries include: 1952 Brook, Panther Run, State Park (Crooked River), Songo River, Muddy River, Northwest River, Rich Mill Outlet, Smith Mill, Sticky River, Standish Brook, and an un-named stream near St. Joseph's College (St. Joe's Stream). The State Park site is located on the Crooked River and is also part of the Crooked River

Monitoring Program. Results for that site are discussed in the Crooked River report. The other ten tributaries will be discussed here.

Tributary sampling occurs monthly with a hand grab or by using a “dipper” that lowers sample bottles into the water, usually from a bridge over the tributary. *E. coli* and turbidity samples are collected monthly in sterile sample bottles. Total phosphorus samples are collected four times per year (April, June, August, and October) in acid-washed glass flasks.

Total phosphorous samples are analyzed using the ascorbic acid method and a spectrophotometer in the Portland Water District’s Water Quality Lab.

Turbidity is analyzed using a laboratory benchtop Hach TU5200 Turbidimeter.

E. coli samples are analyzed using the IDEXX Colilert method and are incubated at 35 degrees Celsius for 24 hours.

Sebago Lake Tributary Monitoring Sites



Figure 1: Tributary sampling sites location map for 2021.

Results and Discussion

Total Phosphorus

PWD measures phosphorus in the tributaries because it is an important nutrient for plant growth. In lakes, the amount of the phosphorus in the water often limits the growth of algae. Increases in phosphorus in the water can lead to more algae growth and declines in water quality of a lake. Phosphorus levels tend to be higher in the tributaries than the lake but become diluted once the tributary waters reach Sebago Lake.

There are many forms of phosphorus in the environment. PWD measures total phosphorus, which includes both phosphates attached to sediment and dissolved forms of phosphorus. It is measured in parts per billion (ppb) or micrograms per liter (ug/L), and a reading of 35 ppb is the action level established by PWD. Sampling events that result in total phosphorus levels above 35 ppb are reviewed and appropriate corrective measures are taken, if possible.

In 2021, the total phosphorus level was at or above the 35 ppb action level in St. Joe's stream during the August and October sampling events (Table 1).

Table 1: Total phosphorus (ppb) results for 2021. Results at or above the action level are indicated by bolded text.

	1952 Brook	St. Joe's Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
4/28/21	17.0	16.0	7.3	8.9	9.8	7.8	13.0	14.0	Flowing backwards	11.0
6/14/21	Dry	31.0	13.0	5.2	16.0	13.0	23.0	21.0	32.0	Not reaching lake
8/18/21	Dry	35.0	12.0	4.0	12.0	11.0	19.0	Flowing backwards	34.0	Not reaching lake
10/19/21	30.0	45.0	10.0	8.5	14.0	13.0	12.0	22.0	34.0	20.0

The cause of the high total phosphorus value in the St. Joe's stream is unknown. Often results above the action level are due to rain events but there was not a significant storm prior to these sampling events. Because total phosphorus sampling has only been conducted on St. Joe's stream since 2017, there are not enough data to determine the typical range of values one might expect in the stream. The stream may have higher total phosphorus levels than the other tributaries.

Turbidity

Turbidity is the amount of suspended particulate matter in the water. In streams, the three major types of suspended particulates that contribute to turbidity are algae, detritus (dead organic material), and silt (inorganic or mineral suspended sediment). High turbidity decreases light penetration and facilitates eutrophication of lakes. Particulates also provide attachment sites for heavy metals such as cadmium, mercury and lead, many toxic organic contaminants such as PCBs, and many pesticides.

PWD measures turbidity using a turbidimeter, which is an instrument that passes a beam of light through a water sample and measures the light output on the other side. The greater the amount of suspended particulate matter in the water, the more the light beam is refracted and blocked, and the higher the turbidity reading. Turbidity is measured in NTU (nephelometric units). Generally, readings below 1 NTU

indicate water that appears “clear” to the naked eye. Readings greater than 4 NTU indicate water that would appear cloudy or murky.

A reading of 4 NTU or greater is the action level established by the District. Values that exceed 4 NTU are reviewed and appropriate corrective measures taken if possible.

In 2021, no sampling events exceeded the action level of 4 NTU (see Table 2).

Table 2: Turbidity (ntu) results for 2021. Results above the action level are indicated by bolded text, and resampling results are indicated by italicized text.

	1952 Brook	St. Joe's Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
1/21/21	0.6	0.4	0.6	0.9	0.3	0.8	0.9	0.8	0.3	0.9
2/8/21	Frozen	0.6	0.8	1.4	Frozen	0.4	0.6	0.9	Frozen	Frozen
3/18/21	0.4	1.2	0.5	0.5	0.5	0.3	0.6	0.9	0.4	0.7
4/28/21	0.8	0.6	0.9	1.4	0.8	0.5	0.6	0.8	Flowing backwards	0.7
5/10/21	1.0	0.3	0.5	0.6	0.5	0.4	0.6	0.7	Flowing backwards	0.7
6/14/21	Dry	1.3	1.6	0.5	0.8	0.5	0.7	0.9	1.1	Not reaching lake
7/7/21	Dry	0.3	1.1	0.6	0.7	0.4	0.7	1.4	1.4	Dry
8/18/21	Dry	0.3	1.7	0.6	0.8	0.4	0.8	Flowing backwards	1.2	Not reaching lake
9/27/21	Dry	0.6	Flowing backwards	0.6	2.4	0.7	0.6	1.6	Flowing backwards	3.1
10/19/21	2.7	0.5	1.1	0.6	0.8	0.4	0.6	0.8	1.5	2.0
11/8/21	0.9	0.6	0.6	0.6	0.8	0.7	0.7	1.0	0.8	1.2
12/14/21	0.8	0.3	2.0	1.0	0.3	0.3	0.4	0.5	0.4	1.1

In past years, we have seen high turbidity in 1952 Brook and Standish Brook during summer months. We did not collect samples at these sites during this time frame due to low flow conditions.

Escherichia coli Bacteria

E. coli is a type of fecal coliform bacteria that is found in the guts of warm-blooded animals and is used by water utilities as an indicator of possible contamination and pathogens in the water. *E. coli* is used as an indicator organism because it has been shown to be a reliable indicator of contamination, and it is not practical to test every sample for all the pathogens that could be present in water.

E. coli levels tend to be higher in the tributaries than the lake, but the levels become diluted once the tributary water enters the lake. Natural occurrences can cause elevated *E. coli* levels. Examples include significant precipitation events that wash pollution from impervious surfaces and developed areas (animal feces, etc.) into the river and soil erosion into the river since a small percentage of fecal bacteria is associated with soil.

The District's action level for *E. coli* is 235 Most Probably Number (MPN) per 100mL in accordance with the recommended level for beach closure under the Maine Healthy Beaches Program. Sampling events that result in *E. coli* levels above 235 MPN/100mL are reviewed or re-sampled if the cause is unknown.

In 2021, Panther Run exceeded the action level during the June sampling event, Smith mill exceeded the action level during the May and July sampling event, and Standish Brook exceeded the action level during the September sampling event. (Table 3).

Table 3: *E. coli* (MPN/100mL) data for 2021. Results above the action level are indicated by bolded text, and resampling results are indicated by italicized text.

	1952 Brook	St. Joe's Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
1/21/21	5	10	6	3	2	13	11	11	24	12
2/8/21	Frozen	2	6	0	Frozen	27	6	30	Frozen	Frozen
3/18/21	0	11	20	0	4	11	2	7	9	3
4/28/21	0	15	9	3	20	22	30	23	Flowing backwards	13
5/10/21	62	2	56	1	20	17	35	236	Flowing backwards	225
5/12/21								<i>187</i>		
6/14/21	Dry	5	548	153	25	27	86	69	5	Not reaching lake
6/16/21			866							
7/7/21	Dry	35	81	64	54	37	87	326	6	Dry
7/12/21								<i>157</i>		
8/18/21	Dry	18	141	50	52	12	72	Flowing backwards	1	Not reaching lake
9/27/21	Dry	56	Flowing backwards	76	13	11	78	104	Flowing backwards	980
9/28/21										980
9/30/21										387
10/4/21										179
10/19/21	47	9	46	56	47	20	96	102	46	166
11/8/21	12	7	8	5	29	5	4	179	13	19
12/14/21	12	9	29	48	33	32	20	74	10	10

The *E. coli* level was high in Standish Brook during the September sampling event. Often, results above the action level are due to weather events prior to sampling, but there was no major precipitation even in the days preceding sampling. Because the *E. coli* level did not fall below the action level upon initial resampling, a field investigation of the stream was conducted. No issues were observed during the field investigation. A combination of hot weather and persistent low water levels in the brook were determined to be the likely cause of the high *E. coli* level.

The *E. coli* level was high at Smith Mill during the May and July sampling events. Often, results above the action level are due to weather events prior to sampling but there was no precipitation in the days preceding sampling. The cause of the high result is unknown, and the *E. coli* level fell below the action level upon resampling.

The *E. coli* level was high in Panther Run during the June sampling event. There was a rain event the day of sampling which is the likely cause of the high result. Resampling produced another high *E. coli* result.

During resampling, waterfowl were spotted upstream, unlike the original sampling event, which is the likely cause of high *E. coli* numbers. The *E. coli* levels were below the action level in Panther Run during the July sampling event.

Conclusion

This sampling program provides a “snapshot” determination of the health of the major tributaries to Sebago Lake. Samples that exceed established action limits are investigated and re-sampled if necessary. Because sampling occurs on a monthly basis, it is difficult to determine a continuous water quality trend from the data. Rather, this program reflects the variability of water quality in response to both environmental and human factors.

In 2021, weather and other events were the most likely causes of exceedances of action levels in some tributaries. The number of exceedances in 2021 were within the normal range and the overall water quality in the tributaries remained high during the sampling events in 2021. However, continued monitoring of the tributaries is necessary. The tributaries empty directly into Sebago Lake, and reductions in water quality in these streams could affect the health of the lake.