



Portland Water District

Sebago Lake Watershed Monitoring Programs Tributary Monitoring - 2022

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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 water pollution problems exist on the land that drains to the lake, one would expect to see water quality declines 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, Crooked River (site name: State Park), 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 (site name: St. Joe's). 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 PWD’s Crooked River monitoring 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. Due to laboratory staffing changes, samples were not analyzed for total phosphorus in August and October of 2022.

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.

In 2022, the tributaries were sampled for an expanded set of water quality parameters to compare to historical baseline data. The sampling occurred in June, and is referred to as the “expanded” tributary run in this report. The parameters included: temperature, dissolved oxygen (DO), pH, conductivity, alkalinity, total dissolved solids (TDS), total suspended solids (TSS), color, nitrate, hardness, iron, and chloride. Temperature, dissolved oxygen, pH, conductivity, and total dissolved solids were measured using field meters. Alkalinity, total suspended solids, hardness, iron, and nitrate were analyzed in the PWD laboratory. Color was analyzed by A&L Laboratory and chloride was analyzed by Maine Environmental Laboratory.



Figure 1: Tributary sampling sites location map for 2022.

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 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 2022, the total phosphorus level was above the 35 ppb action level in St. Joe’s stream during the June sampling event (Table 1).

Table 1: Total phosphorus (ppb) results for 2022. 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
4/12/22	15.0	15.0	7.3	6.3	7.8	7.5	13.0	13.0	14.0	15.0
6/6/22	Low flow	37.0	10.0	5.8	12.0	13.0	23.0	18.0	Flow reversed	12.0

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 this sampling event. Total phosphorus sampling has been conducted on St. Joe’s stream since 2017 and data indicate that the typical range of total phosphorus values is higher than in the other tributaries. For this reason, starting with the 2023 sampling season, the action level for St. Joe’s stream will be increased to 60 ppb.

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 turbidity 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 2022, the turbidity results were above the action level of 4 NTU in Panther Run during the January sampling event and in 1952 Brook in the May sampling event (see Table 2).

Table 2: Turbidity (ntu) results for 2022. 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
1/26/22	frozen	0.5	30.2	0.7	frozen	0.7	1.2	1.0	frozen	frozen
2/14/22	frozen	0.5	1.2	0.7	frozen	frozen	0.8	0.6	frozen	frozen
3/23/22	0.7	0.3	0.7	0.7	0.4	0.4	0.4	0.4	0.4	0.5
4/12/22	1.0	0.6	1.1	0.7	0.7	0.6	0.7	1.0	0.9	1.5
5/23/22	6.9	0.3	1.2	0.5	0.7	0.6	0.8	1.0	flow reversed	2.0
6/6/22	low flow	1.3	0.9	0.8	0.6	0.5	0.7	0.7	flow reversed	1.7
7/18/22	Dry	0.2	1.9	0.6	0.4	0.3	1.0	1.6	1.3	Dry
8/8/22	Dry	Stagnant	1.5	0.6	0.7	0.4	1.0	1.4	1.1	Dry
9/15/22	Dry	Stagnant	1.7	0.4	0.7	0.6	1.0	1.6	1.7	No flow to lake
10/18/22	0.8	0.9	1.4	0.7	1.0	1.2	1.8	2.1	1.2	1.7
11/7/22	2.7	0.7	0.9	0.5	0.7	0.4	0.7	0.9	0.9	1.4
12/27/22	0.7	0.6	0.7	0.8	0.7	0.8	0.4	0.5	0.6	0.6

The turbidity was high in Panther Run during the January sampling event. The very likely cause was a large number (40+) of waterfowl upstream from the sampling site. The site was visibly turbid during sampling (noted by sampler).

The turbidity was high in 1952 Brook during the May sampling event. The very likely cause was the presence of iron bacteria (noted by sampler).

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 dry or 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 (i.e., animal feces) and eroded soils into the tributaries. A small percentage of fecal bacteria is associated with soil.

The District's action level for *E. coli* is 235 Most Probable 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 2022, Northwest River exceeded the action level during the May sampling event, Panther Run exceeded the action level during the June sampling event, Smith Mill exceeded the action level during the

September sampling event, and Rich Mill and Standish Brook exceeded the action level during the October sampling event. (Table 3).

Table 3: *E. coli* (MPN/100mL) data for 2022. Results at or 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
1/26/22	frozen	0	11	1	frozen	1	0	33	frozen	frozen
2/14/22	frozen	5	4	0	frozen	frozen	0	17	frozen	frozen
3/23/22	2	2	1	0	8	6	9	17	5	1
4/20/22	5	3	1	3	53	18	12	73	42	93
5/23/22	8	6	105	68	69	920	5	109	flow reversed	105
5/24/22						18				
6/6/22	low flow	50	579	86	7	26	29	93	flow reversed	54
6/8/22			866							
6/9/22			770							
6/14/22			1120							
7/18/22	Dry	12	172	214	6	15	105	101	0	Dry
8/8/22	Dry	Stagnant	93	179	31	21	22	102	1	Dry
9/15/22	Dry	Stagnant	113	102	22	43	91	411	29	No flow to lake
9/19/22								1300		
9/21/22								<i>111</i>		
10/18/22	124	228	63	43	65	53	238	219	40	613
10/19/22								<i>16</i>		
11/7/22	5	0	8	5	7	4	6	6	2	187
12/27/22	11	45	6	1	19	22	6	29	15	24

The *E. coli* level was high in Northwest River during the May sampling event. There were rain events in the days preceding the day of sampling which may be the likely cause of the high result, though, no other site experienced high results. 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. Often, results above the action level are due to precipitation events prior to sampling, but there was no major precipitation event in the days preceding sampling. The *E. coli* level did not fall below the action level upon initial resampling, and subsequent resampling occurred during and after heavy rain events, which may have been the likely cause of those high *E. coli* results. However, June high *E. coli* numbers have become a pattern which, in the past, were associated with large numbers of geese and ducks along the river. During these sampling events, large waterfowl numbers were not observed. A definitive cause of the *E. coli* pollution could not be determined. The *E. coli* levels were below the action level in Panther Run during the July sampling event. We are evaluating the effectiveness of microbial source tracking tools for determining the cause of high *E. coli* results and may use these tools if results are high at Panther Run in the future.

The *E. coli* level was high at Smith Mill during the September sampling event. Often, results above the action level are due to weather events prior to sampling but there was no precipitation in the days preceding sampling. Resampling produced another high *E. coli* result, but resampling occurred during and after a heavy precipitation event. The cause of the initial high result is unknown. The *E. coli* level fell below the action level upon subsequent resampling.

The *E. coli* level was high at Rich Mill and Standish Brook during the October sampling event. There was a rain event the day of sampling which is the likely cause of the high results. The *E. coli* level fell below the action level in both tributaries upon resampling.

Expanded Tributary Run

Historically, the expanded set of parameters (listed in the Methods section of this report) was analyzed on every sampling event. PWD determined, however, that these parameters were not needed as indicators of stream health monthly because they did not vary much over time and regular sampling discontinued after 1997. Since then, the expanded set of parameters has been monitored in 2001, 2002, 2010, 2017 and 2022 for comparison to historical data to determine whether the water quality has changed.

In 2022, samples were not collected at 1952 Brook and Sticky River due to low flow and reversed flow (the lake water is flowing into the river), respectively. Chloride samples were analyzed by an outside lab which used a new method for analysis. Because of the method change, we cannot compare 2022 chloride data to historical data. Other results from the 2022 expanded sampling fell within the historical range for all parameters except conductivity results were high at Songo River, Muddy River, and Northwest River and the nitrate levels were high at Muddy River. The results of the 2022 expanded sampling can be found below in Table 4.

Table 4: Results of expanded Tributary run sampling on 6/6/2022. Results outside of the historical range are indicated by bolded text

	1952 Brook	St. Joe's	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
Temperature (°C)		12.6	19.1	19.7	15.6	16.5	17.9	17.8		14.0
DO (mg/L)		8.6	8.8	8.9	9.6	9.5	8.0	7.5		9.0
pH		6.56	6.91	6.93	7.02	6.84	6.60	6.46		6.82
Alkalinity (mg/L)		16.4	10.3	7.1	9.1	6.1	9.5	6.6		20.8
Conductivity (µS)		112.3	97.5	80.0	66.6	78.1	76.3	38.7		359.0
TSS (mg/L)		<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5		<2.5
TDS (mg/L)		56.5	48.8	39.2	33.3	39.1	38.2	77.8		183.0
Color (SPU)		50	5	15	40	65	65	75		15
Nitrate (mg/L)		0.5	0.0	0.1	0.3	0.2	0.1	0.1		0.8
Chloride (mg/L)		20.0	16.0	13.0	11.0	17.0	14.0	15.0		87.0
Hardness (mg/L)		22.4	16.4	11.9	12.2	9.8	11.8	12.1		34.1
Iron (mg/L)		0.05	0.02	0.01	0.31	0.17	0.24	0.33		0.32

The 2022 conductivity levels were higher than the historical data for the Songo River (80.0 µS), Muddy River (66.6 µS), and Northwest River (78.1 µS) sites. However, these results still fall within the typical range for streams and rivers.

The 2022 nitrate result of 0.3 mg/L for the Muddy River site is higher than the historical data for that site. However, this is still well below the EPA established Maximum Contaminant Level for drinking water, which is 10 mg/L.

We cannot compare the chloride results to historical data. However, the highest chloride result in 2022 of 87 mg/L found at Standish Brook is well below the EPA and State of Maine recommended limit for drinking water of 250 mg/L.

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 2022, weather and other events were the most likely causes of exceedances of action levels in some tributaries. The number of exceedances in 2022 were within the normal range and the overall water quality in the tributaries remained high during the sampling events in 2022. 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.