



Portland Water District

Sebago Lake Watershed Monitoring Programs Crooked River 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 Crooked River run 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 Crooked River Monitoring Program. The Crooked River originates at the southern end of Songo Pond in Bethel and meanders southward for approximately 38 miles to its junction with the Songo River near the State Park in Naples, Maine. The two rivers then wind two more miles to their outlet in the northernmost part of Sebago Lake. The District has monitored the Crooked River for over 40 years. Since the Crooked contributes nearly 40% of the surface inflow to the lake, it is the most important tributary we monitor.

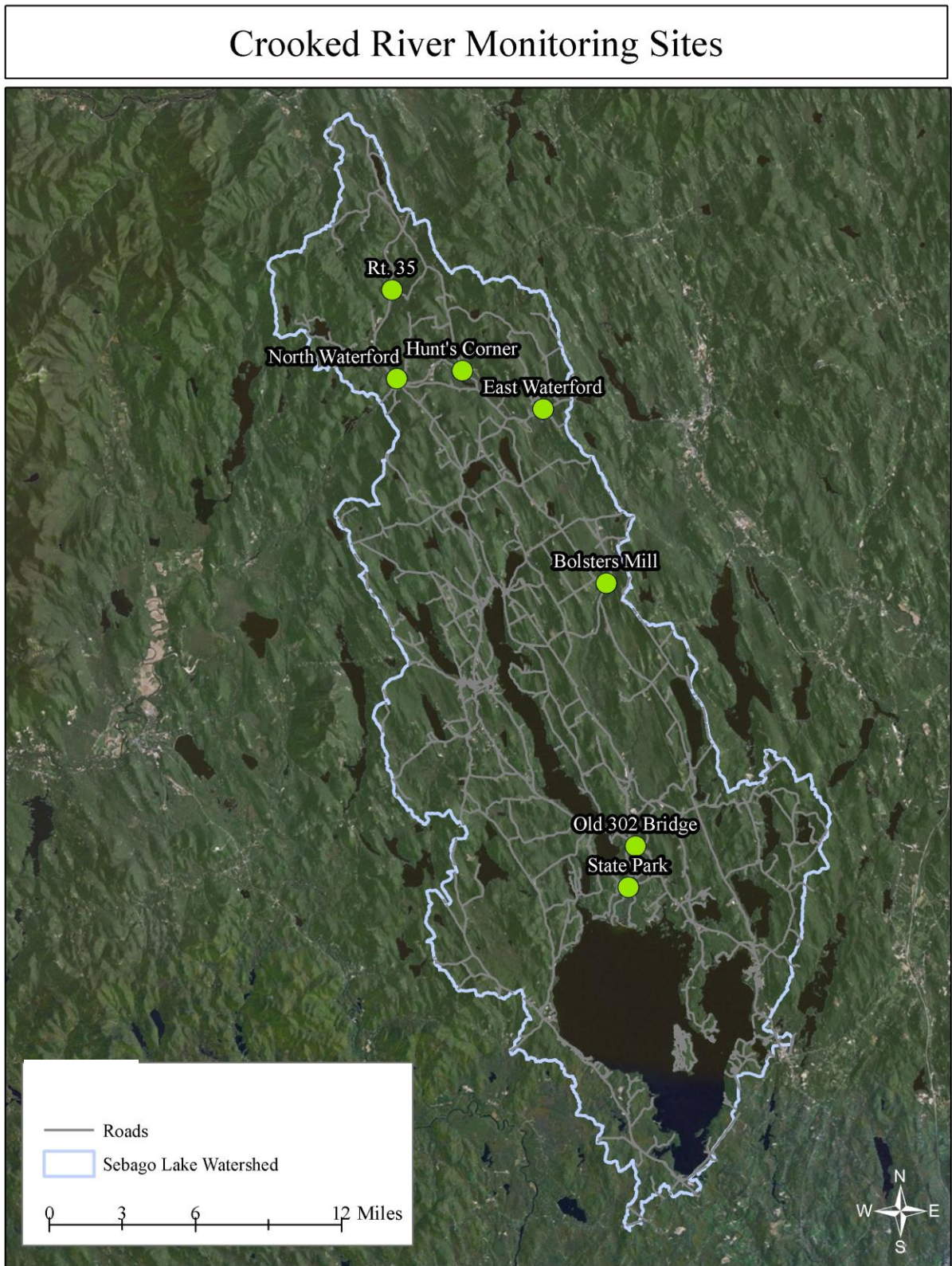
Methods

The Crooked River is monitored four times a year from the Sebago Lake State Park in Naples to a bridge on Rt. 35 in Albany Township for the following analytes: turbidity, total phosphorus, and *E. coli* bacteria. A total of seven sites are monitored as part of the program. These sites listed from North to South are as follows: Route 35, North Waterford, Hunt's Corner, East Waterford, Bolster's Mills, Old 302 Bridge, and State Park (see Figure 1). Of these sites, the southern-most sampling point (State Park) has been monitored for the longest period of time, and at the highest frequency. This is due in part to the fact that this site is also included in the Tributary Monitoring Program (see the 2022 Tributary Monitoring Report).

For the purposes of this report, data from the State Park site will be used to characterize the Crooked River's overall contribution to Sebago Lake. All data collected from this site are presented.

Sampling is performed using a "dipper" to lower acid-washed total phosphorus collection flasks and sterilized bacteria collection bottles into the water, usually from a bridge over the river. Total phosphorous samples are analyzed using the ascorbic acid method and a spectrophotometer in the District's water quality laboratory. *E. coli* samples are analyzed using the IDEXX Colilert method and are incubated at 35 degrees Celsius for 24 hours. Turbidity is analyzed using a laboratory benchtop turbidimeter. In 2019, the Hach 2100N Turbidimeter was replaced with a Hach TU5200 Turbidimeter. Data presented in this report pertain to data collected at the State Park sample site as a measure of the overall contribution of total phosphorus, *E. coli* bacteria, and turbidity from the Crooked River to Sebago Lake. Data from all seven sample sites for 2022 are included in the appendix of this report.

Figure 1.



Results and Discussion

Total Phosphorus

Phosphorus is one of the major nutrients needed for plant growth. It is generally present in relatively small amounts in temperate lakes. Phosphorous is often the limiting nutrient for algal growth in the system, meaning that as phosphorus increases, the amount of algae also increases. Phosphorus levels are generally higher in flowing tributaries than in a lake. When tributary water enters a lake, phosphorus becomes diluted and sediments with phosphorus attached settle out on the lake bottom. Total phosphorus includes phosphates attached to sediment as well as dissolved forms of phosphorus and is measured in parts per billion (ppb). A reading of 35 ppb is the action level established by the District. Sampling events that result in total phosphorus levels above 35 ppb are reviewed and appropriate corrective measures are taken if possible.

Total phosphorus has been monitored at the State Park sampling site since 1977, at Bolster's Mills, East Waterford, Hunt's Corner, North Waterford, and Route 35 since 1993, and at the Old 302 Bridge site since 1995.

No total phosphorus concentrations exceeded the action level at the State Park or any other site in 2022. Due staffing shortages in the District's Sebago Lake Laboratory, total phosphorus sampling in the Crooked River was suspended after June in 2022. This resulted in Crooked River phosphorus samples only being collected in April and June. During the time period of 1977 to 2022, total phosphorus levels at the State Park ranged from 5 ppb to 126 ppb. In 2022 State Park total phosphorus levels ranged from 7 ppb to 19 ppb (Table 1), and remained within the historical range.

Table 1. 2022 Total phosphorus (ppb) results for the State Park site on the Crooked River, Naples, ME. No total phosphorus samples exceeded the action level in 2022.

4/11/2022	19.0
4/12/2022	15.0
6/6/2022	13.0
6/27/2022	15.1

***Escherichia coli* Bacteria**

E. coli bacteria is a type of fecal coliform bacteria found in the gastrointestinal tracts of warm-blooded animals. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may also contain many other types of disease-causing organisms such as Giardia, Cryptosporidium, typhoid, viral and bacterial gastroenteritis, and hepatitis A. Natural occurrences can also cause elevated *E. coli* levels. Examples include significant precipitation events that wash pollution from impervious surfaces and areas of development (animal feces, etc.) into the river, and the erosion of soil into the river since a small percentage of fecal bacteria is associated with soil. *E. coli* levels tend to be higher in the tributaries but become diluted when the tributary water enters the lake. The District's action level for *E. coli* is 235 MPN/100 mL in accordance with 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.

E. coli levels did not exceed the action level at the State Park in 2022. During the time period of 2009-2022 *E. coli* levels ranged from 2 MPN/100 mL to 613 MPN/100 mL at the State Park. In 2022, *E. coli* levels ranged from 8 MPN/100 mL to 140 MPN/100 mL at the State Park (Table 2). The Hunt's Corner site exceeded the action level on June 27th with a reading of 387 MPN/100 mL. On June 29th the site was re-sampled and the result had fallen below the action level to 210 MPN/100 mL. On August 9th the Hunt's

Corner site exceeded the action level again with a reading of 411 MPN/100 mL. The site was resampled on August 11th with a result 435 MPN/100 mL and on August 15th with a result of 206 MPN/100ml. Often results above the action level are due to rain events but there was not a significant storm prior to the June sampling event. While almost half an inch of rain fell within 24 hours prior to the August sampling event, the cause of the high readings is uncertain. One possible cause is the beaver activity observed a short distance upstream of the sample site at Hunt's Corner where a beaver dam was observed in August. Since high *E. coli* readings have become somewhat common during the summer months at the Hunt's Corner site, and investigation of the area upstream prior to 2022 did not revealed a possible cause of contamination, we are prepared to collect samples for microbial source tracking in 2023, should this site exceed the action level again.

Table 2. 2022 *E. coli* (MPN/100 mL) results for the State Park site on the Crooked River, Naples, ME. No *E. coli* samples from the State Park exceeded the action level in 2022.

1/26/2022	Frozen
2/14/2022	Frozen
3/23/2022	8
4/11/2022	16
4/20/2022	28
5/23/2022	41
6/6/2022	39
6/27/2022	99
7/18/2022	120
8/8/2022	109
8/9/2022	121
9/15/2022	140
10/18/2022	65
10/24/2022	17
11/7/2022	9
12/27/2022	40

Turbidity

Turbidity refers to the amount of suspended particulate matter in the water. Turbidity measurements are performed through the use of a turbidimeter, in which a beam of light is passed through a water sample and the light output is measured 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. 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 rivers and lakes. Particulates also provide attachment sites for heavy metals such as cadmium, mercury and lead, and many toxic organic contaminants such as PCBs and many pesticides. 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 4.0 NTU or greater is the action level determined by the District’s Environmental Services Department. Values of 4.0 NTU or higher are reviewed, the site is resampled, and appropriate corrective measures are taken if possible.

No turbidity readings exceeded the action level at the State Park or any other site in 2022. During the time period of 2019 - 2021 turbidity values ranged from 0.5 NTU to 6.3 NTU at the State Park site. In 2022 turbidity values ranged from 0.7 NTU to 2.4 NTU at the State Park (Table 3).

Table 3. 2022 Turbidity (NTU) results for the State Park site on the Crooked River, Naples, ME. No turbidity samples from the State Park exceeded the action level in 2022.

1/26/2022	Frozen
2/8/2022	Frozen
3/23/2022	2.1
4/11/2022	1.7
4/12/2022	1.5
5/23/2022	1.0
6/6/2022	1.1
6/27/2022	1.0
7/18/2022	0.7
8/8/2022	1.4
8/9/2022	1.4
9/15/2022	1.3
10/18/2022	2.4
10/24/2022	0.7
11/7/2022	1.0
12/27/2022	1.6

Conclusion:

This sampling program provides a “snapshot” determination of the health of the Crooked River. Samples that exceed established action levels are re-sampled and investigated if necessary. Because sampling occurs four times a year, 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.

The total phosphorus levels in 2022 remained consistent with historical data, with no readings above the 35 ppb action at any sites.

E. coli bacteria levels obtained at the State Park in 2022 remained consistent with historical data, with no readings above the 235 MPN/100 mL action level. Hunt’s Corner had two samples and one re-sample above the action level. This is a site to watch. The use of microbial source tracking is being evaluated as a method for determining the source of high summer readings if the site exceeds the action level in the future.

Turbidity levels in the Crooked River in 2022 remained within the historical range. No turbidity readings at any site on the river exceeded the action level.

Overall, the Crooked River appears to have generally stable water quality. Continued monitoring of the river is necessary as the Crooked River contributes more surface inflow to Sebago Lake than any other tributary and a reduction in water quality in the Crooked River could reduce water quality in the lake.

Appendix: Crooked River Data 2022

Sample Date	Site	<i>E. coli</i> (MPN/100mL)	Turbidity (NTU)	Total Phosphorus (ppb)
1/26/2022	State Park	Frozen	Frozen	Frozen
2/14/2022	State Park	Frozen	Frozen	Frozen
3/23/2022	State Park	8	2.1	
4/11/2022	State Park	16	1.7	19.0
4/11/2022	Bolster's Mill	14	1.0	12.0
4/11/2022	E. Waterford	17	0.7	10.0
4/11/2022	Hunt's Corner	23	0.8	8.7
4/11/2022	N. Waterford	23	0.4	7.0
4/11/2022	Rte. 35	10	0.4	7.0
4/12/2022	State Park		1.5	15.0
4/20/2022	State Park	28		
5/23/2022	State Park	41	1.0	
6/6/2022	State Park	39	1.1	13.0
6/27/2022	State Park	99	1.0	15.1
6/27/2022	Old 302 Bridge	157	1.1	14.9
6/27/2022	Bolster's Mill	26	1.2	13.2
6/27/2022	E. Waterford	124	1.3	14.8
6/27/2022	Hunt's Corner	387	1.3	15.0
6/27/2022	N. Waterford	112	1.5	17.8
6/27/2022	Rte. 35	61	1.2	16.4
6/29/2022	Hunt's Corner	210		
7/18/2022	State Park	120	0.7	

8/8/2022	State Park	109	1.4	
8/9/2022	State Park	121	1.4	
8/9/2022	Old 302 Bridge	145	1.2	
8/9/2022	Bolster's Mill	50	1.1	
8/9/2022	E. Waterford	118	1.4	
8/9/2022	Hunt's Corner	411	1.2	
8/9/2022	N. Waterford	80	1.2	
8/9/2022	Rte. 35	27	1.4	
8/11/2022	Hunt's Corner	435		
8/15/2022	Hunt's Corner	206		
9/15/2022	State Park	140	1.3	
10/18/2022	State Park	65	2.4	
10/24/2022	State Park	17	0.7	
10/24/2022	Old 302 Bridge	20	0.7	
10/24/2022	Bolster's Mill	10	0.7	
10/24/2022	E. Waterford	5	0.7	
10/24/2022	Hunt's Corner	14	0.6	
10/24/2022	N. Waterford	9	0.6	
10/24/2022	Rte. 35	70	0.5	
11/7/2021	State Park	9	1.0	
12/27/2021	State Park	40	1.6	