Sebago Lake, Maine, and the Water Quality Index

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A Method for Subwatershed Prioritization

Introduction

Sebago Lake is the drinking water supply for the greater Portland region of Maine. Approximately 200,000 people, one-sixth of Maine's population, rely on Sebago Lake for drinking water that is treated and distributed by the Portland Water District (PWD). The lake is also an important recreational, residential, and economic resource for the region. It is surrounded by thousands of summer and year-round homes, supports important freshwater fisheries, is popular with boaters, provides the setting for dozens of boys and girls camps and campgrounds, and supports many valuable lake-oriented businesses.

The lake is 30,000 acres in size, is over 300 feet deep at its deepest point, averages 100 feet in depth, and holds nearly one trillion gallons of water. With an average Secchi transparency reading of 10.6 meters in the Lower Bay of the lake since 1975, the water quality of Sebago Lake can be classified as outstanding and very stable. Because of this high water quality, in 1993 the PWD was granted a waiver to the filtration requirements of the federal Safe Drinking Water Act, so the lake water is treated but not filtered before it is delivered to customers. Maintaining and protecting Sebago Lake's water quality is important to the Portland Water District, as well as the residents who live around the lake, those who enjoy it for recreation, and those whose businesses depend on it (see Figure 1).

Figure 1. Aerial image of Sebago Lake.

A large component of protecting Sebago Lake is maintaining the forested land in the 450-square-mile watershed that includes all or parts of 23 towns and over 50 lakes and ponds. While the watershed is more than 80 percent forested, 90 percent of the land is privately owned and could be developed over time. Because the forest helps to absorb, filter, and clean the water that runs across the landscape, reductions in forested land in the watershed could lead to declines in water quality over time.

The size of the lake and its watershed, as well as the number of lakes that drain to Sebago Lake, provide challenges for protecting Sebago Lake's high water quality. In 2014, Portland Water District, Cumberland County Soil and Water Conservation District, Lakes Environmental Association, the University of Southern Maine, and the Maine Department of Environmental Protection (DEP) partnered on a project to identify areas of the watershed where future erosion control work would most benefit the water quality of Sebago Lake. The results will also be used to engage watershed residents and to help organizations within the watershed prioritize nonpoint source issues.

About EPA's Non-Point Source Grants Program

One of the primary sources of funding for non-point source planning and mitigation is the Nonpoint Source Management Program established by the Environmental Protection Agency

(EPA) under Sections 604(b) and 319 of the Clean Water Act. In Maine, this competitive program is administered by the DEP and over a 20-year period has been used to fund more than 30 projects in the Sebago Lake watershed. These efforts have been well-received and generally successful, judging from the continued good water quality of the lakes within the watershed.

Beginning in 2014, DEP began requiring watershed-based plans as a prerequisite for awarding 319 implementation funds in unimpaired water bodies. For impaired waters, EPA guidance provides a framework for developing a nine-element watershed-based management plan that includes extensive characterization of non-point source pollution sources and a public involvement process. For unimpaired waterbodies DEP has issued guidance that streamlines the EPA process and results in a Watershed-based Protection Plan (WBPP). In 2014 the Cumberland County Soil and Water Conservation District, partnering with PWD, the Town of Standish, and Maine Forest Service, received a 604(b) planning grant to support developing a watershed-based protection plan for Sebago Lake. The total funding (including grant and match) was approximately $75,000.

Sebago Lake is an unimpaired waterbody but the DEP guidance was not easily applied to its 450-square-mile watershed. Furthermore, it would have been cost-prohibitive to develop a nine-element watershed-based management plan following the EPA guidance. The project team therefore developed a revised method that utilized almost exclusively data that were publicly available. The goal of this revised method was to divide the Sebago Lake watershed into parts (subwatersheds), evaluate and rank each subwatershed based on its condition, and assess its relative importance to the overall water quality of Sebago Lake. In an effort to make the results useful and a catalyst for action, the project also involved developing a simple means of communicating the results to the public. There were five steps in this process: (1) defining the subwatersheds, (2) compiling existing data, (3) assessing each subwatershed, (4) completing a sensitivity analysis, and (5) communicating the results.

Step 1: Defining the subwatersheds

The state of Maine maintains an online database of spatial data, including watershed boundaries, for lakes in the state. For this project, the Maine Drainage Divide GIS shapefile was obtained from the MEGIS website. The file contains watershed boundaries for ponds and rivers in Maine, based on the United State Geological Survey 1:24,000 scale topography. The Maine Drainage Divide GIS shapefile broke some lake watersheds in the study area into multiple polygons. As part of the subwatershed definition, these polygons were merged to create one watershed polygon per lake. Additionally, a few polygons contained no bodies of water and were merged with adjacent subwatershed polygons based on topography. Ultimately, the Sebago Lake watershed was divided into 60 subwatersheds (see Figure 2).

Step 2: Compiling existing data

Typically, watershed protection planning involves completing a non-point source survey and identifying erosion sites and project partners who can support mitigation of the sites. It was clear from the start that Sebago Lake's total watershed protection planning funds would not be adequate to collect new environmental data to support the watershed-based protection plan. Therefore, the team explored existing environmental data that were

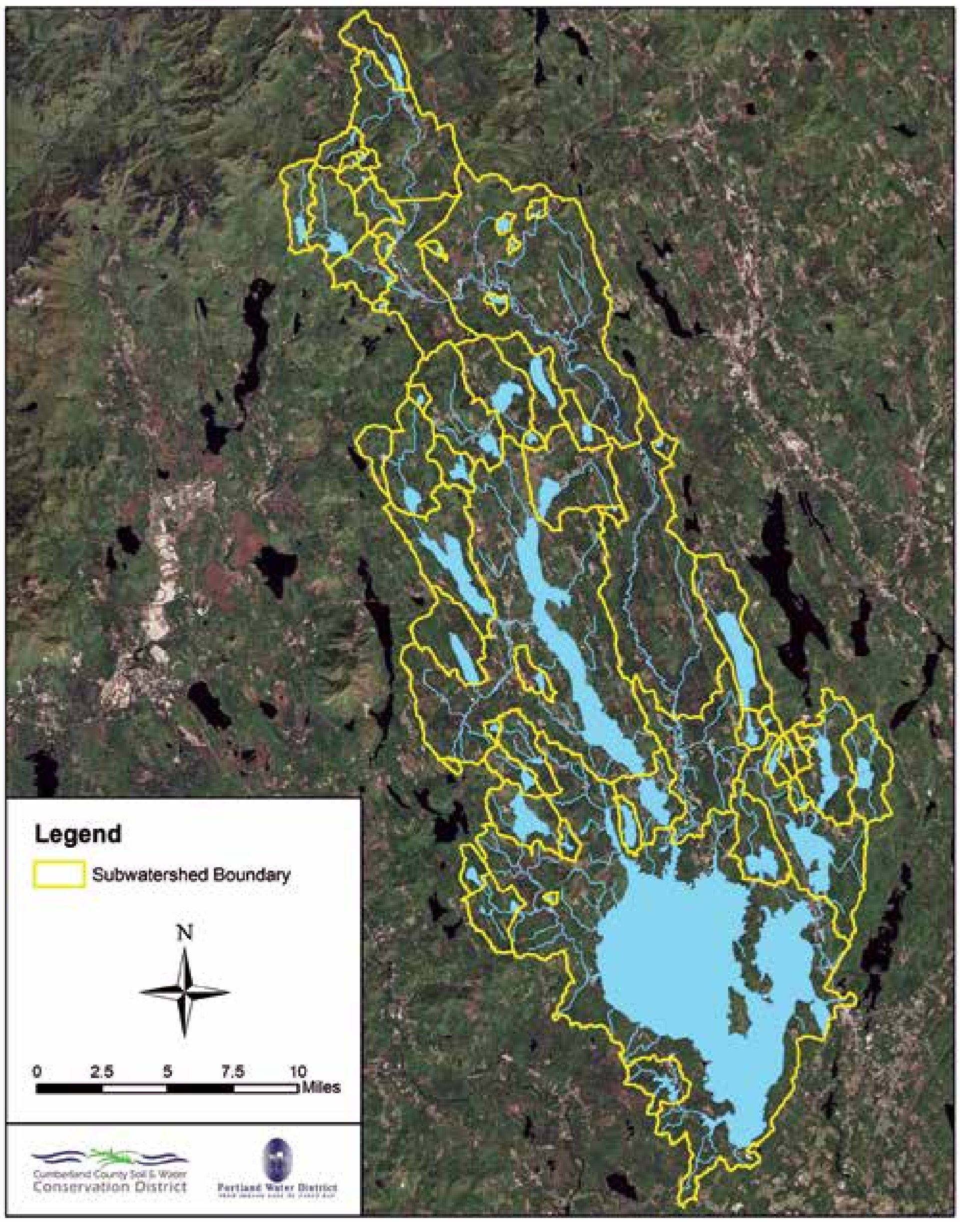


Figure 2. Subwatersheds of Sebago Lake.

publicly available and could help assess the condition of each subwatershed. Ultimately, three types of data were used: water quality data, land cover data, and information about known potential partners. These data were then used to rank the subwatersheds in Step 3.

Step 3: Assessing each subwatershed

The concept behind the Water Quality Index (WQI) is to use environmental indicators to evaluate each subwatershed and convey its present condition and favorability for effective non-point source work. The WQI can then be used to prioritize non-point source work within the greater watershed. For the Sebago Lake WQI, the team selected the following indicators: current water quality, recent trends in water quality, land cover change over the last 25 years, and the extent and success of recent collaborative lake protection work.

Indicator 1: Current Water Quality Condition. Current water quality provides a strong indication of the need for immediate intervention to protect a lake from non-point source pollution. Lakes with higher water quality likely need less attention than those with lower water quality. The current water quality condition assessment was based on the Maine Trophic State Index (TSI) for each lake. The TSI assigns a numerical value to the trophic conditions of a lake based on either water transparency as determined using a Secchi disk (transparency), total phosphorus concentration (Total P), or chlorophyll-*a (*Chl-*a)* concentration. The Maine TSI is calculated using slight adaptations to the methodology described in Carlson (1977). These adaptations reflect the range of trophic conditions observed in Maine lakes (Maine DEP 1981). All the water quality data used for this assessment are publicly available, and partners at Maine DEP compiled and prepared the analysis for the WQI.

The amount of water quality data for the many lakes in the Sebago Lake watershed varies. For some lakes there are multiple stations with many years of transparency, Total P, and Chl-*a* data. For others the data are more limited. A TSI was only calculated for lakes with the following data:

- Samples must have been taken from open water.
- There must have been at least five months of data in a given year.
- It is not permissible to miss any two consecutive months in the period of record.
- Water samples must have been taken as cores (depth-integrated epilimnetic samples).
- There must be at least five years of data.
- Only data since 1995 were used, and there must have been at least one year of data since 2008.

The parameter used to calculate TSI for any lake was prioritized by length of the dataset and in decreasing order of reliability: (1) Chl-*a* (highest because it is a direct measure of algal abundance); (2) Total P; (3) transparency. For example, if a lake had four years of Chl-*a* data but eight years of Total P data, the Total P data were used. Of the 60 subwatersheds initially evaluated, 26 had adequate data to calculate TSI.

Once TSI values were determined, the lakes were ordered from lowest TSI (highest water quality) to highest TSI (lowest water quality). The lakes were given a ranking that compared them to one another: The lakes were divided into quintiles based on their TSI calculations. Those with the lowest TSI were assigned a 5 score. Those with the highest TSI values were assigned a 1 score. Twenty-one of the 26 lakes have a current TSI under 44.

Indicator 2: Water Quality Trend. The water quality trends were evaluated using Mann-Kendall trend analysis based on Chl-*a* or transparency median values for July, August, and September for each year. Only lakes with a minimum of ten years of data were evaluated.

The trend data complements the current condition assessment by evaluating stability of the lake's TSI. A lake with a relatively high TSI that hasn't changed in many years or shows an improving trend might be of lesser concern even though the current condition data might suggest that the lake is potentially impacted by non-point source pollution. A relatively high but stable or improving TSI could either reflect a lake that is naturally high in nutrients or a subwatershed where conditions contributing to lake water quality are improving. Similarly, a lake with relatively low current TSI and a worsening trend may be in need of more immediate attention before the lake becomes impaired.

Lakes with adequate data for a trend analysis were given a score from 1 (significantly increasing TSI or declining water quality) to 5 (significantly decreasing TSI or improving water quality). Twenty-two of 26 lakes evaluated had stable to decreasing TSI. Since all of these lakes eventually empty into Sebago Lake, this fact is a positive leading indicator of the likely trend of water quality in Sebago Lake in the coming years.

Indicator 3: Land Cover Change. Land cover change is the third indicator in the WQI. A subwatershed that has seen a significant percentage of land conversion from undeveloped to developed might be a good candidate to invest in non-point source mitigation or to advocate for land conservation or planning. Land cover change could be a leading indicator of the potential for future declining water quality not yet evident in the lake monitoring data.

Thirty-meter resolution Landsat imagery from 1987 was compared with imagery from 2013 to assess the degree to which "undeveloped vegetated land" had been converted to "developed land" (or vice versa) during this time period. These data are publicly available and were processed and checked for accuracy for the purpose of this study by faculty and students at the University of Southern Maine. Though 30-meter resolution cannot detect all development details, overall trends can be detected. Figure 3 shows the imagery for one part of the watershed for 1987 and 2013. The light-colored pixels are interpreted as developed land. Note the changes detectable in the circled area.

Researchers at the University of Southern Maine determined the percent land conversion from undeveloped to developed between 1987 and 2013 in 60 subwatersheds. As with the water quality data, subwatersheds compared to one another by dividing them into

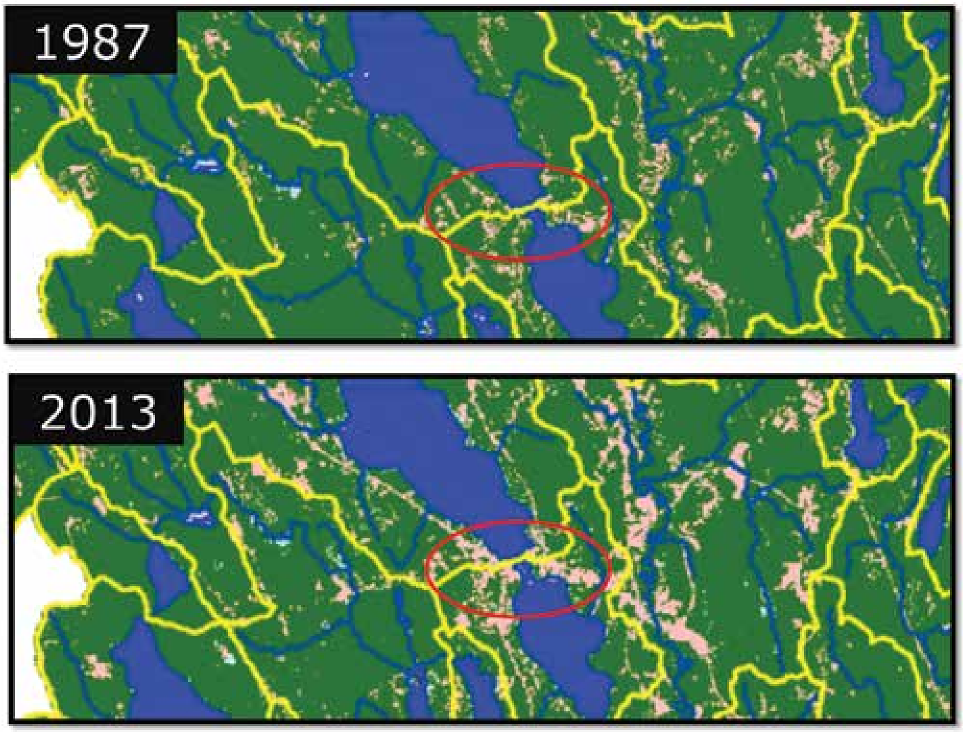


Figure 3, Comparison of 1987 and 2013 land cover – detail.

quintiles and scoring the quintiles from 1 to 5. A score of 1 indicates the most conversion and a 5 the least (see Figure 4).

The 1987 and 2013 land cover data indicate a net change of 1.65 percent for the watershed as a whole. The subwatersheds closer to Sebago Lake generally saw more change than those that are further from Sebago Lake. At this rate of land cover conversion, it would take about 150 years to convert 10 percent of the land in the watershed from undeveloped to developed.

Indicator 4: Partnerships. A lake watershed or subwatershed does not belong to any individual. Maine lakes are legally "owned" by the state and the land around them is a patchwork of parcels that are owned by many different individuals, families, and organizations. For this reason, addressing non-point source issues in a lake watershed can only be successful with the cooperation of many partners. Work should be prioritized, at least in part, to those places where committed partners can help ensure success.

The last indicator that makes up the WQI is an estimate of the likelihood of finding successful partners with whom to work on lake protection efforts. This estimate is based on two things: (1) evidence of past successful partnerships in the subwatershed and, (2) the existence of groundwork that could aid a potential 319 project work such as a prior non-point source survey, an approved watershed-based protection plan, and/or a likely source of in-kind or cash match for a non-point source grant.

Subwatersheds were scored from 1 (low likelihood of successful partnership) to 5 (high likelihood of successful partnership). The history of successful 319 projects in the watershed is reflected in the scores. More than half of the subwatersheds have at least a medium ranking.

Each subwatershed was assessed using the four criteria described in Step 3, resulting in a WQI score. A healthy subwatershed generally has high current water quality, a positive water quality trend, little recent land cover change, and known, engaged lake protection partners. The WQI score for a healthy subwatershed would approach 20 (four criteria with a maximum of 5 points for each). A less healthy subwatershed would score lower for one or more of the criteria and would receive a lower score. Therefore the subwatersheds with lower scores are a higher priority for nonpoint source mitigation work. The WQI provides the subwatershed residents with an overall indication of the health of their own waterbody and allows regulators and watershed partners to have an

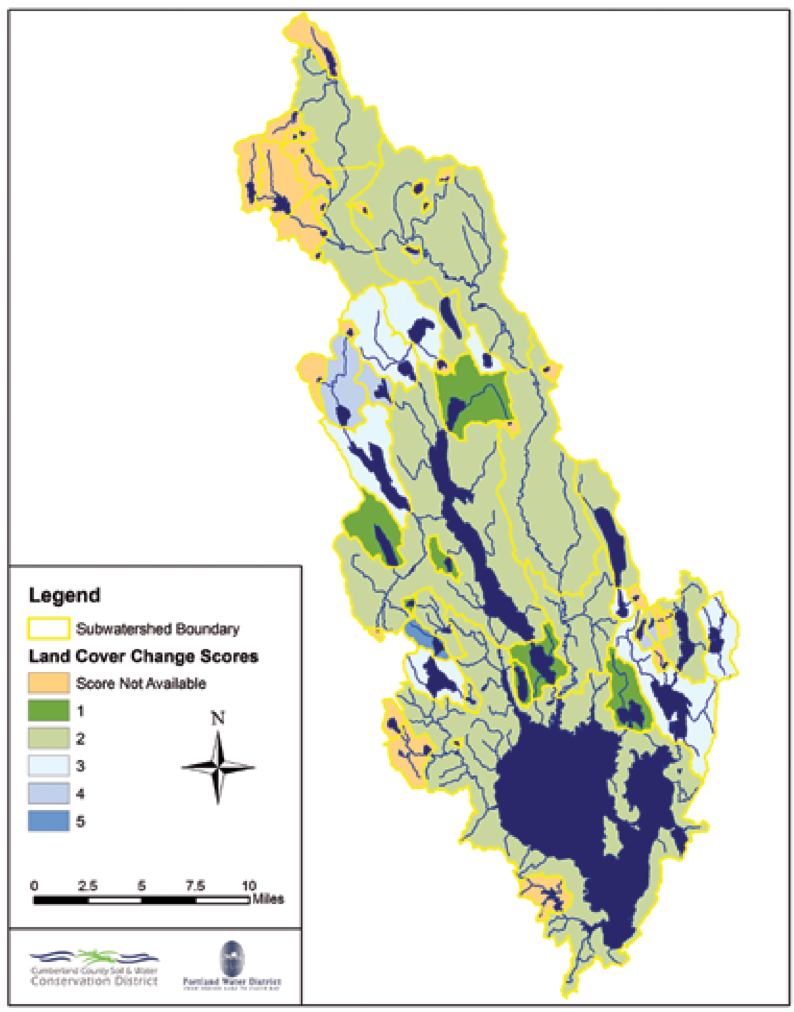


Figure 4. Land cover change scores.

informed starting point for conversations to strengthen watershed protection initiatives.

Step 4: Completing a Sensitivity Analysis. The WQI did not take into account the amount of phosphorus that each subwatershed contributes to Sebago Lake. Therefore it does not provide adequate information to prioritize nonpoint source work that will reduce nutrient input into Sebago Lake. The team recognized that the subwatersheds are not equally important to Sebago Lake's overall health. For example, some subwatersheds have a small annual output of Total P compared to the total annual phosphorus load into Sebago Lake. Therefore, even if the quality of that subwatershed declines dramatically, it may have little overall effect on the water quality of Sebago Lake. By contrast, a decline in the water quality of a lake with a larger Total P contribution may have a greater negative impact on Sebago Lake.

A sensitivity analysis was completed that used a mass balance process based on the work of Vollenweider (1968, 1976) to rank the subwatersheds based on their annual phosphorus contribution to Sebago Lake. In general, a subwatershed with a direct connection to Sebago Lake has little or no opportunity for attenuation of phosphorus. By contrast, a subwatershed that is part of a chain of lakes will contribute less of its load of phosphorus to Sebago since some phosphorus will be bound in the sediments of the intervening lakes (Table 1).

Not surprisingly, most of the annual phosphorus input to Sebago Lake comes from its direct watershed (including the Crooked River watershed). For the purposes of this modelling effort, the Crooked River is assumed to act as a direct conduit of water and nutrients to Sebago Lake (i.e., no attenuation occurs). Though the direct watershed accounts for only about half of the total watershed area, it contributes two-thirds of the annual load of phosphorus. This sensitivity ranking highlights the importance of protecting the health of the direct watershed of the lake and also identifies which subwatersheds are most directly connected to Sebago Lake and thus are the ones to which Sebago Lake is most sensitive to change (Figure 5).

Table 1. Ten Highest Priority Subwatersheds Based on Annual Phosphorus Contribution to Sebago Lake.

Subwatershed	*Subwatershed Area (acres)*	*Percent of Overall Watershed Area*	*Annual Contribution (kg P)*	*Percent of Annual P Input to Sebago*
Sebago Lake and Crooked River (direct watershed)	143,396	50.9	5493	68
Long Lake	38,664	13.7	812	10
Brandy Pond	3,033	1.1	234	2.9
Panther Pond	8,954	3.2	184	2.3
Holt Pond	2,159	0.8	108	1.3
McWain Pond	2,950	1.0	105	1.3
Crystal Lake	5,791	2.1	89	1.1
Bear Pond	5,581	2.0	79	1.0
Highland Lake	6,511	2.3	77	1.0
Crescent Lake	4,748	1.7	61	0.7

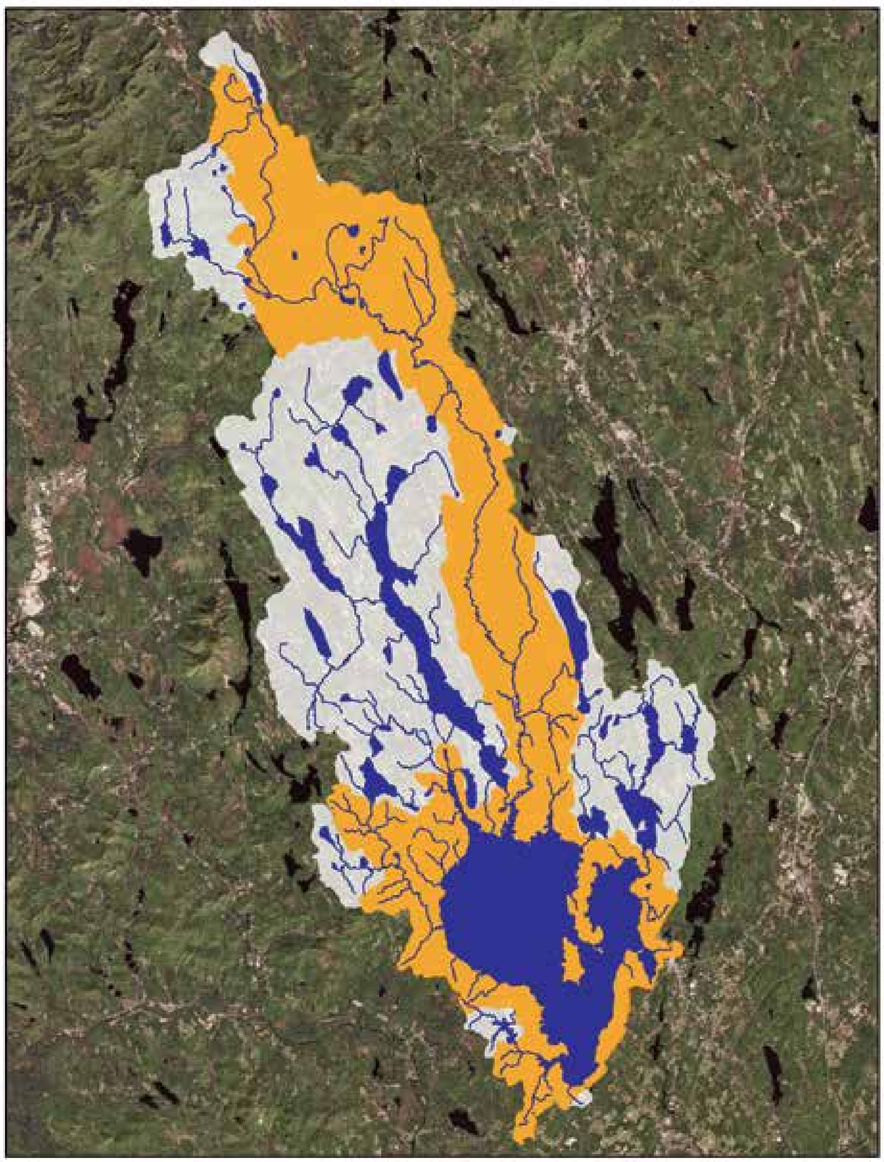


Figure 5. Direct watershed of Sebago Lake.

The sensitivity analysis enables Sebago Lake's environmental stewards to prioritize protection efforts. In the past, lake protection work has been first-come, first-served. However, now there are data to support investing more Sebago Lake protection resources into the lakes that are responsible for a greater percentage of the annual Total P load into Sebago Lake.

*Step 5: Communicating the Results***.** One of the challenges with lake protection is that the science behind the health of a lake is often poorly understood by the individuals who live and work around the lake and whose behavior is most directly linked to the water quality of the lake. Just as legal terms are confusing to people who haven't studied law, limnology terminology can be difficult for non-scientists. Communicating science requires a balance between language that is technically precise and complete, and language that is easy to understand and can be used to motivate community action.

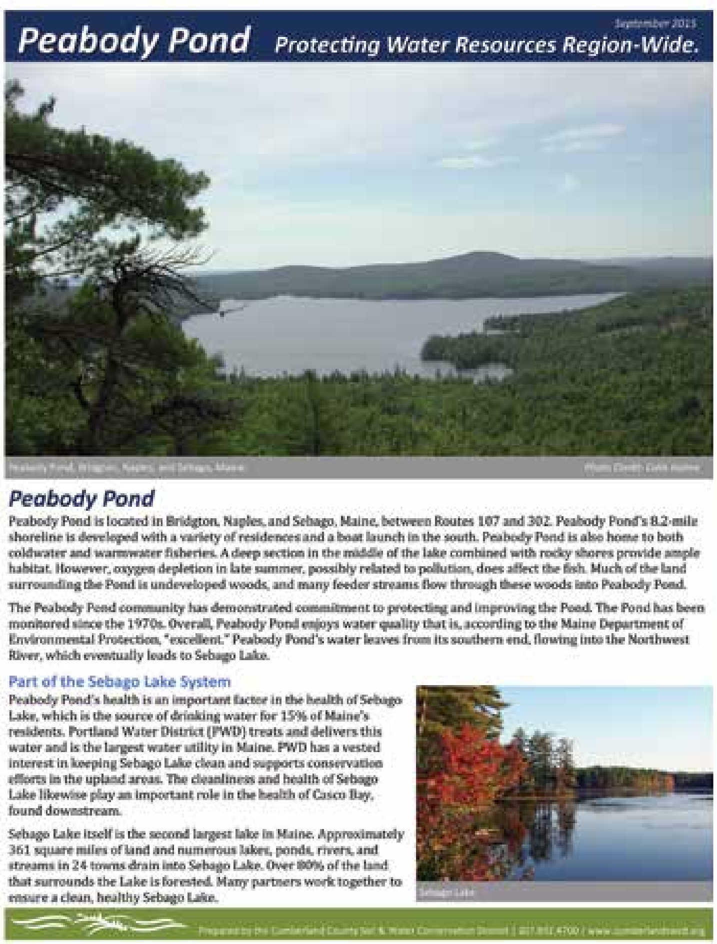
For this reason the last step of this assessment was a consideration of the clearest, most complete way to depict the results for sharing with the residents of the watershed. Ultimately, face-to-face meetings of various types will be organized in the coming years to meet with residents, talk with them about the assessment, and hear their questions and concerns. The basic tool to initiate these discussions will be a series of subwatershed fact sheets. These are essentially report cards summarizing how the subwatershed was scored and what actions are recommended to address any low scores.

A total of 22 fact sheets were prepared, a customized report of results for each subwatershed for which sufficient information was available (Figures 6 through 9). A great deal of effort went into using as little jargon as possible and trying to explain concepts using terms that are familiar to non-scientists.

Summary

This project to assess the Sebago Lake watershed for the purposes of prioritizing future work was triggered by a change by the EPA to the eligibility requirements for 319 grant funds. The methodology for a WBPP detailed by the Maine DEP to meet this requirement was not easily adapted to the 450-square-mile Sebago Lake watershed. Therefore, a team of lake professionals developed a method for evaluating subwatersheds to provide a data-driven methodology to prioritize nonpoint source work both to protect the subwatershed lakes themselves and to positively influence the water quality of Sebago Lake.

The evaluation of each subwatershed, known as the Water Quality Index, took into account current and recent trends in water quality, extent of change in land cover since 1987, and the likelihood of a successful collaborative partnership with recently active local groups. In addition, an analysis based on connectedness to Sebago Lake was used to estimate the



September 2015

Peabody Pond Protecting Water Resources Region-Wide.

Peabody Pond, Bridgton, Naples, and Sebago, Maine

Peabody Pond

Peabody Pond is located in Bridgton, Naples, and Sebago, Maine, between Routes 107 and 302. Peabody Pond's 8.2-mile shoreline is developed with a variety of residences and a boat launch in the south. Peabody Pond is also home to both coldwater and warmwater fisheries. A deep section in the middle of the lake combined with rocky shores provide ample habitat. However, oxygen depletion in late summer, possibly related to pollution, does affect the fish. Much of the land surrounding the Pond is undeveloped woods, and many feeder streams flow through these woods into Peabody Pond.

The Peabody Pond community has demonstrated commitment to protecting and improving the Pond. The Pond has been monitored since the 1970s. Overall, Peabody Pond enjoys water quality that is, according to the Maine Department of Environmental Protection, "excellent." Peabody Pond's water leaves from its southern end, flowing into the Northwest River, which eventually leads to Sebago Lake.

Part of the Sebago Lake System

Peabody Pond's health is an important factor in the health of Sebago Lake, which is the source of drinking water for 15% of Maine's residents. Portland Water District (PWD) treats and delivers this water and is the largest water utility in Maine. PWD has a vested interest in keeping Sebago Lake clean and supports conservation efforts in the upland areas. The cleanliness and health of Sebago Lake likewise play an important role in the health of Casco Bay, found downstream.

Sebago Lake itself is the second largest lake in Maine. Approximately 361 square miles of land and numerous lakes, ponds, rivers, and streams in 24 towns drain into Sebago Lake. Over 80% of the land that surrounds the Lake is forested. Many partners work together to ensure a clean, healthy Sebago Lake.

Sebago Lake

Prepared by the Cumberland County Soil & Water Conservation District | 207.892.4700 | www.cumberlandswcd.org

Figure 6. Fact sheet page 1.

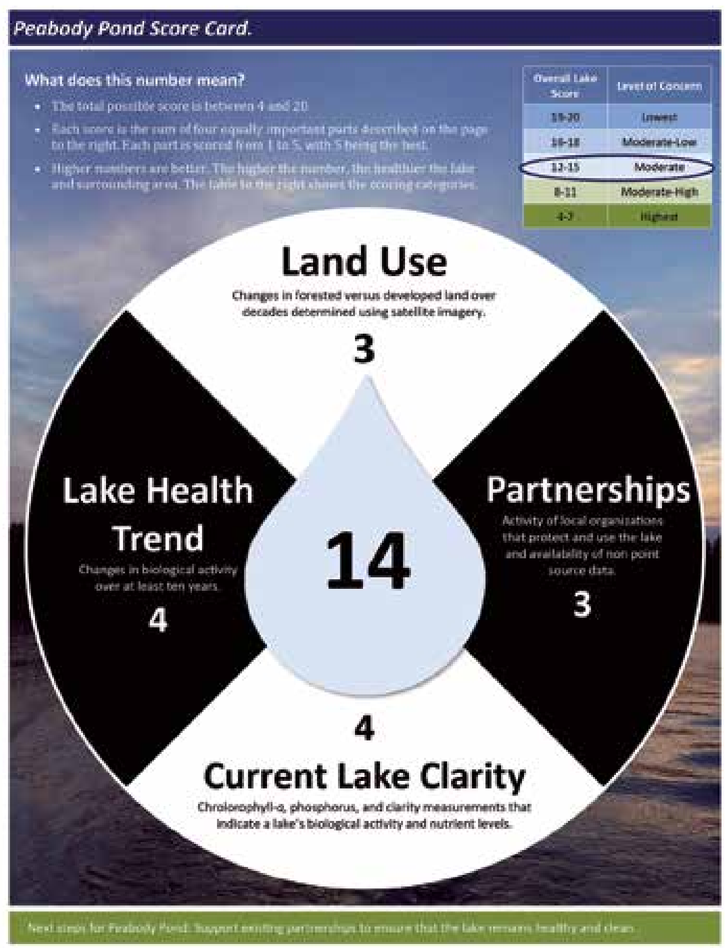


Figure 7. Fact sheet page 2.

How Healthy is Peabody Pond?

Land Use (scored 3 out of 5)
Most of the land that drains into Peabody Pond is woods, enabling soil to filter pollution. The overall % of woods and vegetated land has not changed much over the past quarter century. However, road erosion and yard care chemicals are common pollution sources in the region.

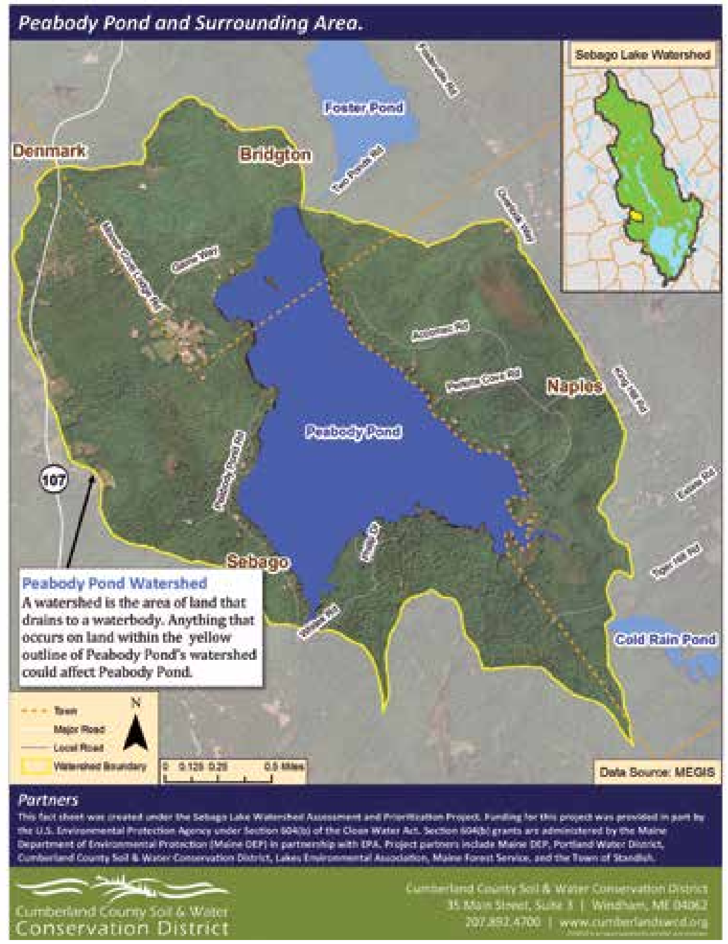
Partnerships (scored 3 out of 5)
The Peabody Pond community has a few active partners who are committed to protecting the lake. Though partners can provide in-kind support, external financial support would help facilitate projects. An updated land survey would be needed to apply for federal funding.

Lake Health Trend (scored 4 out of 5)
Biological activity, as monitored over the past decade, indicates that Peabody Pond is healthy! The clean water trend has persisted even as many waterbodies in the area suffer from pollution washed off of the land. Residents can anticipate future years of clean water for recreation.

Current Lake Clarity (scored 4 out of 5)
Clean, clear water is found in Peabody Pond. Aquatic plants and animals are able to thrive and local residents benefit from clear swimming water and healthy fish populations. The current clear conditions could change if there are increases in area soil erosion or polluted surface runoff.

For More Information
To learn more about your local waterbody, resources for property owners, or the Sebago Lake Watershed Assessment and Prioritization Project:
Visit: www.cumberlandswcd.org
Call: Cumberland County Soil & Water Conservation District (207) 892-4700

Figure 8. Fact sheet page 3.



Peabody Pond and Surrounding Area.

Peabody Pond Watershed
A watershed is the area of land that drains to a waterbody. Anything that occurs on land within the yellow outline of Peabody Pond's watershed could affect Peabody Pond.

Partners
This fact sheet was created under the Sebago Lake Watershed Assessment and Prioritization Project. Funding for this project was provided in part by the U.S. Environmental Protection Agency under Section 604(b) of the Clean Water Act. Section 604(b) grants are administered by the Maine Department of Environmental Protection (Maine DEP) in partnership with EPA. Project partners include Maine DEP, Portland Water District, Cumberland County Soil & Water Conservation District, Lakes Environmental Association, Maine Forest Service, and the Town of Standish.

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Figure 9. Fact sheet page 4.

sensitivity of Sebago Lake to changes in water quality for each subwatershed. This work relied almost exclusively on previously compiled, publicly available data. Twenty-two fact sheets were prepared as a tool to be used for outreach and to initiate local discussions and, ultimately, action.

Because the assessment evaluated each subwatershed in five ways, there are many different approaches that could be used to take action using these results. For example, a subwatershed that had a low score in one or the other of the water quality-related criteria are good candidates for a nonpoint source survey to identify potential sources of nutrients (Figure 10).

The land cover change indicator provides a second lens through which to view the results and to guide outreach efforts. Sharing the land cover data with a town that contains a subwatershed with significant conversion to developed land could help inform future planning efforts (Figure 11).

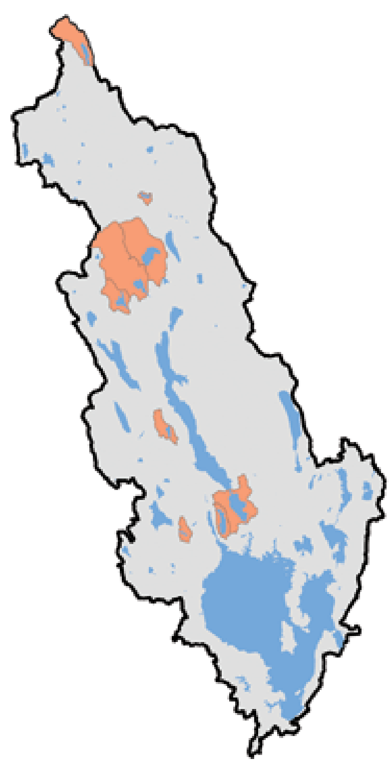

Figure 10. Subwatersheds with low water quality scores highlighted.

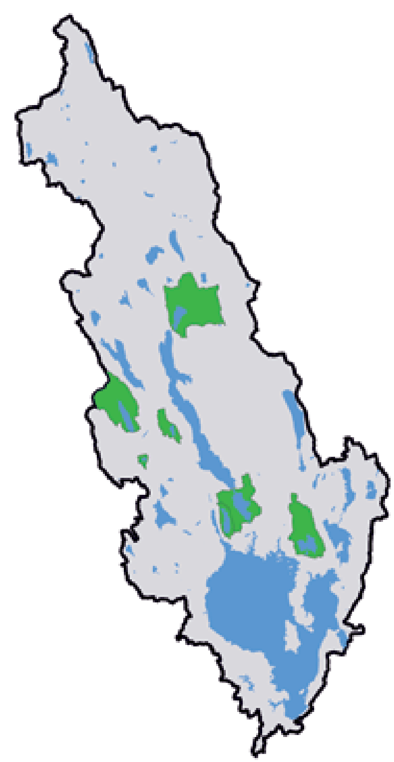

Figure 11. Subwatersheds with low land cover scores highlighted.

A third approach to outreach is suggested by the partnership indicator. Subwatersheds that scored low for that criterion either have not done nonpoint source work and/or have not recently completed a watershed survey. Reaching out to a subwatershed with a low partnership score could lead to collaborative lake protection efforts in the future (Figure 12).

The sensitivity analysis points to the fact that two-thirds of the phosphorus load to Sebago Lake originates in the direct watershed of the lake and the Crooked River, its primary contributing tributary. For this reason, any effort to safeguard the water quality of Sebago Lake into the future has to include a focus on that portion of the 450-square-mile watershed.

Conclusions

Several findings of this work point to a favorable water quality trend for at least the near future of Sebago Lake. These include:

- Twenty-one of the 26 lakes within the Sebago Lake watershed that were evaluated have a current TSI under 44.
- Twenty-two of the 26 lakes within the Sebago Lake watershed that were evaluated had a stable to decreasing TSI. Since all of these lakes eventually empty into Sebago Lake, this fact is a positive leading indicator of the likely trend of water quality in Sebago Lake in the coming years.
- Over a 26-year period, just 1.65 percent of the land in the Sebago Lake watershed was converted from undeveloped to developed.
- More than half of the subwatersheds have at least a medium partnership score, reflecting the presence of active and interested residents and successful groundwork for successful nonpoint mitigation work.

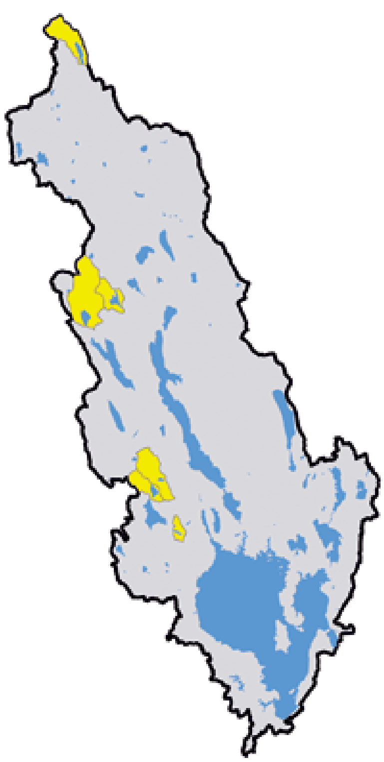

Figure 12. Subwatersheds with low partnership scores highlighted.

Environmental projects often involve many public and private partners with differing levels of interest in the work and unequal resources to contribute. It is not uncommon to participate in a planning project and find that little is asked of some members, and once completed, the results of the work do not get used. This can leave some team members dissatisfied or with a feeling of irrelevance to the work. This project was considered a success by all of the contributing partners for several reasons, including:

- The data were almost all publicly available and preexisting. For this reason the team focused on how to use and interpret data with which they were already familiar rather than how to collect new data.
- Every partner played a key role. The product would have been diminished if any one of the partners were not included. This made the work go faster and more smoothly and kept all team members engaged.
- A great deal of time was spent considering how to use the results. The fact sheets were designed to try to make the results accessible and understandable to the widest possible audience.
- The project was designed to be an assessment to identify priorities. This work has helped to lay out a direction for outreach and non-point source work for years to come. The Water Quality Index as displayed in the fact sheets can help potential partners see why the work should be a priority and what specific things could improve the health of their lake.

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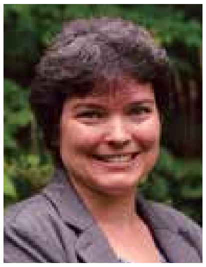
Paul Thomas Hunt is the environmental manager for the Portland Water District, Maine's largest water and wastewater utility. In that role he administers the Watershed Control Program for Sebago Lake, one of only about 50 unfiltered surface water supplies in the United States. The major

elements of the program are monitoring, security, inspection and direct actions, education and outreach, and land conservation. Paul is a Maine Certified Geologist and licensed water and wastewater operator.



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Kirsten Ness is a water resources specialist for the Portland Water District. She is involved in all aspects of the protection of Sebago Lake – monitoring, inspection, laboratory analysis, security and outreach. She is also a Maine Master Gardener, a licensed water operator, and chairs the Public Awareness Committee of the Maine Water Utilities Association.

Next Issue – Winter 2016-17 *LakeLine*

Many people believe that the heyday of public funding of lake management activities is over. In our next issue, we check in with several state and provincial lake management programs to learn how and what they are doing.

(OSGOOD, continued from p. 8 . . .)

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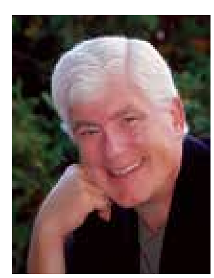

Dick Osgood, co-founder of of Lake Advocates, has 38 years of experience working with lakes, the people that use and love them, and the organizations that manage them. He is a co-instructor of the Alum Workshop offered at NALMS Annual Symposia. Dick is a Certified Lake Manager and is trained and experienced as a lake scientist, planner, policy analyst, facilitator, mediator, expert witness, and educator. Dick is NALMS Past President and recipient of NALMS Secchi Disk Award. For more information, contact Dick at: Dick@DickOsgood.com.