

# ANNUAL REPORT State of Water Quality in Raymond Lakes





# **About This Report**

Raymond Waterways created this report for Raymond residents and visitors who want to understand the health of our lakes and ponds and learn what they can do to protect this most important natural resource.

A dedicated group of volunteers, supported by the lake associations, collect a variety of data relevant to lake health, some of which we present in this report. These individuals are your neighbors, and you may have seen them out on your lake peering into the water or lowering instruments to the deepest spots. As a team, they are committed to taking your lake's vital signs as many as 10 times each season.

This report brings the findings of our volunteers to the Raymond public in a way that we hope will make it easy to understand what we know about lake health and the human factors that influence it now and in the future. We expect to make this an annual tradition to promote communication among lake associations and encourage all residents and visitors to be good stewards of Raymond's waters.

# **About the Author**



This report was written by Steve Craine, the Environmental Officer for Raymond Waterways. He has a master's degree in conservation biology from Tufts University, where he did research on the effects of flooding on rare plants on Cape Cod pond shores. For ten years he has owned a camp on Raymond Pond, where he can be seen canoing, paddleboarding, and sailing.

# Acknowledgments

We'd like to recognize the many local volunteers who monitor the water quality of our lakes and inspect for invasive species. Their dedication is invaluable to preserving the quality of life here in Raymond. The Crescent Lake Watershed Association, Panther Pond Association, and Thomas Pond Improvement Association are instrumental in keeping these volunteer efforts going through the years. Data in this report are taken from the Maine Department of Environmental Protection and Lake Stewards of Maine, a nonprofit organization that trains volunteer monitors and compiles data from across the state.

# **About Raymond Waterways**



RAYMOND WATERWAYS For the past 50+ years, Raymond Waterways has worked tirelessly to preserve and protect lakes, streams, and ponds in the Town of Raymond. We are a volunteer organization that works closely with lake associations, residents, shoreline property owners, visitors, and state and local agencies to address watershed issues of concern.

Over the years, Raymond Waterways has addressed lake contamination due to septic leakage, acid rain, non-point source pollution from erosion and runoff, and invasive plants. We remain vigilant in detecting and addressing threats to our waterways and educating the public and local officials about these issues. If you are interested in preserving our lakes, please join our cause! Contact us at **info@raymondwaterways.org.** 

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# **Executive Summary**

The town of Raymond is blessed with many beautiful lakes, ponds, and streams that beckon people to settle on their shores and attract visitors from near and far. As critical natural resources, our lakes and ponds deserve regular check-ups to ensure that they remain in pristine condition for generations to come. Local volunteers have been monitoring physical characteristics of our lakes and ponds and patrolling them for new invasives for many years. This report summarizes a portion of the findings of their outstanding work.

### **Good News**

The good news is that the data show Raymond's lakes are generally healthy. In fact, they are among the best in the state, and few show any significant declines in quality. Some key points we will cover in detail:

- Water clarity: Our lakes and ponds all have above average water clarity compared with over 1000 other lakes in Maine; only two of our waterbodies show a 30-year trend toward less clarity.
- Algal blooms: None of our lakes has had an algal bloom for at least 30 years.
- **Dissolved phosphorus:** Most of our lakes are below the state average in phosphorus concentration.
- **Chlorophyll:** Readings in our lakes are higher than they should be, but generally below the levels indicating high risk for algal blooms.
- **Invasive aquatic species:** Variable milfoil has infested Sebago Lake for at least 50 years but is being held in check in Raymond waters; our other lakes are invasive-free.

Each of these factors is an indicator of lake health, and no one measure gives the whole picture.

#### **Vigilance Needed**

Despite the good news, the data also show that some lakes in Raymond need more consistent attention. Raymond Pond and Notched Pond have not been surveyed for invasives in about five years. Raymond Pond and Sebago Lake have experienced significant declines in water clarity.

We hope this report provides clarity about the state of our lakes and inspires Raymond residents and visitors to increase their efforts to care for and protect these invaluable natural resources now and in the future. We anticipate that this report and subsequent annual reports will encourage that work.

# Water Clarity

### Significance of Water Clarity

Water clarity is a key indicator of lake health. It is measured as Secchi disk transparency (SDT), which denotes the maximum depth at which a black and white Secchi disk can be seen from the surface. The greater the depth, the clearer the water. Clarity is also easily observable to anyone who uses the lake for swimming, fishing, or boating—a clear lake is a beautiful sight.

The main cause of reduced water clarity is suspended algae. Algae, in turn, are an indication of excess nutrients—especially phosphorus—in the water. When algae die in huge numbers at the end of the season, they decompose—a process that consumes available oxygen, leaving less oxygen for fish. Thus, changes in Secchi disk transparency can expose underlying threats such as excess phosphorus and algae, as well as oxygen depletion.

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### **Eutrophication**

For most lakes, natural processes lead to a progression over many decades or centuries from high clarity, low nutrients, and low algae (a healthy stage known as "oligotrophic") to an intermediate

### The Process of Lake Eutrophication



#### Anthropogenic or "Man-Made" Eutrophication



**Decades** Urban Runoff Industrial Discharge Fertilizers and Pesticides Erosion and Sedimentation Nonpoint Source Pollution



#### Oligotrophic

- Low nutrients
- Little plant or algal life
- High oxygen
- Clear water

#### Mesotrophic

- More nutrients (including pollution)
- More plants and algae
- Decayed vegetation on lake bottom
- Water less clear

#### Eutrophic

- Still more nutrients
- Live and dead plants and algae
- Reduced oxygen in water
- Unhealthy for fish
- Murky or green water

Source: Francine Matte Savard/Ministere du Development durable de l'Environnement et des Parcs, 2005.

stage ("mesotrophic"), to a high-nutrient stage ("eutrophic"—a dying lake that is choked with plants and algae and low in oxygen). The whole process of lake aging is known as eutrophication, and water clarity is a key indicator. Over the past 30 years or more, Secchi disk transparency has been one of the most consistently measured indicators of lake health. All Raymond's lakes and ponds, except Nubble Pond, have adequate data to evaluate a 30-year trend.

### How Clear Are Raymond's Ponds and Lakes?

In the figure below, the white diamonds represent the average Secchi disk value for each lake for the most recent year available (2022, unless noted). Values to the right (higher numbers and more in the blue zone) denote clearer water.



### Secchi Disk Transparency in Raymond Lakes (2022 Averages)

### How Does the Clarity of Our Lakes Compare with Other Lakes in Maine?

Now that we have seen a rough comparison of water clarity among Raymond's lakes and ponds, we would like to put these numbers in the context of other lakes in Maine. Fortunately, volunteers and state DEP staff collected SDT data for more than 1,000 lakes in the state in 2022. We have plotted the readings for Raymond's lakes on a histogram that shows the distribution of Secchi readings state-wide. (See figure on page 7.)

To understand this graph, think of the height of each bar as showing the percentage of lakes that fall below the number to it's right. For example, the first bar on the left represents the portion of lakes with average Secchi depth readings of less than 1 meter, which is extremely murky! Fortunately, only about 1 percent of Maine lakes registered such a poor reading in 2022. The most common Secchi disk reading that year (as shown by the tallest bar) was 4 meters or more and less than 5 meters, representing over 20% of all lakes. Vertical lines indicate results for our lakes using the same data from the previous graph. Examining this we can visualize our standing in relation to the rest of the surveyed lakes. For example, we can conclude that Sebago Lake was clearer than all but around 6 percent of Maine lakes, with average SDT readings in 2010 of 8.8 meters. Another way to say the same thing is that Sebago Lake was at the 94th percentile of all Maine lakes in terms of clarity.



### Water Clarity in Raymond Lakes\*

### What Is the Trend for Water Clarity in Each of Our Lakes?

So far, we have been looking at only a snapshot of water clarity in our lakes and in lakes statewide. But to understand the health of a lake it is very important to look at trends. Some basic characteristics that affect clarity are not going to change. These include size and depth, mineral composition of the surrounding land, and the rate of inflow and outflow. So if these sorts of factors are more or less constant, when clarity decreases, it is a warning to look for causes such as increased lakeshore development, erosion, nutrient loading (e.g. fertilizer and septic system failure), algae growth, and stormwater runoff.

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The following figures show changes in Secchi disk transparency over about 30 years. Since readings are typically taken several times per year, the graph records annual averages.

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When you look at the annual data points (green dots) in these graphs—and even considering the curved moving average line—it may be difficult to discern a trend. That's because, as with most natural data, there are always random fluctuations. The Maine Dept of Environmental Protection uses a statistical technique to determine whether the variability is statistically significant or likely the result of random fluctuations.<sup>1</sup>

Under each figure is a description of the statistical significance of the trend. For most purposes, we can consider statistically stable levels of water clarity over 30 years to be a positive sign of lake health. In these graphs, the dots represent how deep the Secchi disk can be seen. Thus, higher SDT values (representing greater transparency) are nearer the top.



<sup>1</sup> A statistical conclusion is significant if there is a less than 5% chance that it could have appeared from random variation rather than due to a real phenomenon. Significance is expressed in "p-value," For example, p <0.05 (less than 5%) indicates significance, and results with p >0.05 are nonsignificant.

#### **Notched Pond**



### **Panther Pond**





#### **Thomas Pond**



Notice that Secchi disk transparency in Notched Pond has been increasing significantly, but in absolute terms is lower (less clear) than any of our other lakes. On the other hand, Sebago Lake—at least at station 1—has become less clear over the years but is still much clearer than the others. This illustrates why it is important to look at trends, as well as one-time numbers.

## **Algal Blooms**

The presence of some algae in lake water is normal and healthy. In fact, algae form the base of the food chain for many animals from clams and snails to fish, and ultimately to top predators like loons and eagles, who eat those fish. As mentioned, algal concentration generally increases from spring to autumn but normally doesn't interfere with human or animal use of the lake. However, an algal bloom—usually a result of excess phosphorus—turns the water green and smelly and sometimes toxic. A bloom is defined as the presence of enough algae to reduce Secchi disk transparency to less than 2 meters.

Question: Which lakes in Raymond have had algal blooms in the past 30 years?

Answer: (Drum roll, please) Not one!

This is a record we want to maintain.

# **Phosphorus Levels**

### Why Is Phosphorus in Lake Water Important?

Phosphorus is a naturally occurring element that is essential to all plant and animal life. In fact, it is a necessary component of every molecule of DNA and other vital components of every living cell. Phosphorus is the "limiting nutrient" in lakes in our region. That means algae generally have sufficient other necessities for growth but are limited by the availability of this key nutrient. When phosphorus increases, algal blooms may occur, turning water green, depleting dissolved oxygen, and killing fish and other animal life.

### "When phosphorus increases, algal blooms may occur, turning water green, depleting dissolved oxygen, and killing fish and other animal life."

A little phosphorus goes a long way! In our area, a lake with 0 to 5 parts per billion is considered healthy, but a level as low as 10 to 15 parts per billion creates the potential for algal blooms. Human activity close to the lake may increase phosphorus in the water beyond natural levels. Rushing streams of stormwater running off buildings and roads can carry phosphorus all the way to the lake. Animal waste, failing septic systems, and the use of phosphorus-based fertilizers on the adjacent land also increase phosphorus loading. We monitor phosphorus levels in Raymond's lakes and ponds because excess phosphorus promotes eutrophication and possible future algal blooms.

### "Stormwater run-off from buildings and roads can add phosphorus to the lake as can animal waste and the use of phosphorus-based fertilizers on the adjacent land."

### How Is Phosphorus Concentration Measured?

Phosphorus monitoring is more complicated than Secchi disk readings. Water samples need to be taken at various depths, including at the bottom, and preferably several times each year. Phosphorus concentrations may be based on samples taken from the surface of the lake, from discrete samples taken at specific depths, or from an integrated water column (known as an epilimnetic core). These samples must be handled carefully to avoid contamination and sent to a central laboratory for analysis. Since samples are taken at various depths using various techniques, it is often difficult to make direct lake-to-lake or year-to-year comparisons. Low phosphorus for lakes in Maine (indicating oligotrophic conditions) is considered anything below 4.5 parts per billion (ppb). From 4.5 to 20 ppb is defined as moderate, or mesotrophic.

### What Are Phosphorus Levels in Our Lakes and How Do They Compare with Other Maine Lakes?

Since phosphorus measurements tend to be taken less frequently than Secchi disk readings, we have fewer data points to allow meaningful analysis of a single year. The bar graph on the next page shows the distribution of multi-year phosphorus averages for 903 lakes in

Maine. As with the graph of state-wide Secchi disk transparency, each gray bar represents the percentage of lakes with phosphorus lower than the number noted below it.

The first bar on the left is for those lakes with average phosphorus of less than 2 parts per billion (ppb), which is very good. As you can see, very few lakes met this high standard—less than 1 percent. The greatest number of lakes fell between 6ppb and 8ppb—about 20 percent. Remember, an oligotrophic (most healthy) lake has phosphorus less than 4.5 parts per billion. It is interesting to note that, unfortunately, quite a few Maine lakes have phosphorus concentrations of 30 parts per billion or more.

### "Sebago Lake, with 4 parts per billion, had less phosphorus than all but about 3 percent of Maine lakes. The rest of our lakes and ponds fall in the lower (better) end of the moderate range for dissolved phosphorus, in the top 30 percent or so of lakes statewide."

The lines indicate results for our lakes. Again, unlike with the water clarity data, these numbers are averages over several years, usually around 10 years. Examining this we can estimate our standing in relation to the rest of the surveyed lakes. For example, Sebago Lake, with 4 parts per billion, had less phosphorus than all but about 3 percent of Maine lakes. The rest of our lakes and ponds fall in the lower (better) end of the moderate range for dissolved phosphorus, in the top 30 percent or so of lakes statewide.

#### Phosphorus Levels in Raymond Lakes\*

Percentage of Lakes



# **Chlorophyll Levels**

### Why Is Chlorophyll in Lake Water Important?

Chlorophyll is the green pigment found in most plants and algae that harnesses the Sun's energy to build sugar molecules from water and carbon dioxide. The concentration of chlorophyll in water samples is used to estimate algal biomass in lakes, so this is another way to measure changes in trophic status and the results of excess nutrients in the lake. Less than 1.5 parts chlorophyll per billion is considered a low concentration and a sign of a healthy (oligotrophic) lake. Moderate amounts of chlorophyll start at 1.5 ppb and go up to 7 ppb.

### How Is Chlorophyll Concentration Measured?

Samples for chlorophyll analysis are taken with a device known as a Van Dorn water sampler. The Van Dorn is a tube open at both ends, with water-tight caps that are held in the open position until the device is lowered on a cable to the desired depth. Then the operator drops a weight down the cable, where it triggers the closure of both caps, capturing a sample, which can be raised to the surface. As with phosphorus, chlorophyll samples a must be handled carefully and sent to a lab for analysis.

### What Are Chlorophyll Levels in Our Lakes and How Do They Compare with Other Maine Lakes?

The bar graph below shows the distribution of multi-year chlorophyll averages for 866 lakes in Maine. Again, each vertical bar represents the percentage of lakes that fall below



#### Chlorophyll Levels in Maine and Raymond Lakes\*

the concentration specified under it. The lakes with the best readings for chlorophyll are represented in the first bar on the left: less than 1 part per billion, and about 12 percent of lakes.

All our Raymond lakes and ponds fall within the "moderate" range for chlorophyll, as described above. The average chlorophyll concentration in Sebago Lake in recent years has been a bit above 1.5 parts per billion, putting it just above the "low" range. Raymond Pond is at the other extreme of our lakes at 3.9 ppb. These levels of chlorophyll are higher than we would like, but still below concentrations that indicate substantial risk for algal blooms.

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# **Invasive Aquatic Species**

Raymond is fortunate to have outstanding teams of invasive plant patrollers (IPPers), who have been examining our lakes and ponds for signs of emerging infestations. Some of our IPPers play leading roles in statewide efforts to detect invasives before they spread. Most of our lakes have been thoroughly surveyed every year for decades, but Raymond Pond and Notched Pond are due for updated surveys.

### "Sebago Lake has had significant infestations of variable leaf milfoil since the early 1970s."

### Sebago Lake

Sebago Lake has had significant infestations of variable leaf milfoil—the most common aquatic invasive in the state—since the early 1970s. Milfoil sites are scattered among the coves and shallow areas around the lake. The Town of Raymond hires and organizes crews to remove invasive milfoil in bays, coves, and streams in our town. This effort continues work begun by Raymond Waterways more than 20 years ago and helps keep variable leaf milfoil in check. Total eradication is unlikely, so this remains an ongoing campaign to avoid further spread.

### **Other Raymond Lakes and Ponds**

Raymond's other lakes and ponds are considered at high risk for future infestations because they are near infested lakes like Sebago, Little Sebago, Long Lake, and Thompson Lake, and most have public boat ramps. The only exception is Notched Pond, which is rated by the Maine DEP at moderate risk.

### "Raymond's other lakes and ponds are considered at high risk for future infestations because they are near infested lakes like Sebago, Little Sebago, Long Lake, and Thompson Lake, and most have public boat ramps."

Fortunately, all our waterbodies other than Sebago Lake remain free of variable leaf milfoil or any other invasive species. Our IPPers are determined to catch any future invasions before the plants can spread too far to be easily removed. Credit for keeping these lakes free of invasives also goes to our program of courtesy boat inspections, which educates boaters to inspect their boats, trailers, and gear for hitchhiking plant fragments whenever launching or removing a boat at any of the four public boat ramps in town.

The primary way invasive aquatic species spread from out of state and from lake to lake in Maine is when a boat moved from an infested water body to a non-infested one carries plant parts that are capable of growing and reproducing in the new location. Many of the state's worst invasives are able to propagate from even a small stem or leaf fragment.

# **Conclusion: Vigilance Required to Preserve Our Lakes!**

This report shows that the health of our lakes and ponds is good. Moreover, thanks to many years of active monitoring, it demonstrates clearly that conditions here have been among the best in Maine for many years.

Raymond residents are lucky that water quality in our lakes and ponds has historically been very good. We are also fortunate to have a strong culture of defending our waterways. This is reflected by the very active role that volunteers have taken in monitoring water quality factors, searching out invasive plants before they become difficult to eradicate, and educating neighbors and visitors to prevent the spread of invasives from other lakes.

Starting this year, Raymond Waterways is initiating a new tradition of reporting to the public annually on the health status of our lakes. Future reports will build on the information in this inaugural issue, with up-to-date data and new features. This report was produced mainly with publicly available data, but in future years, and with wider participation of Raymond volunteers, we plan to tailor these reports to issues of most concern to town residents and visitors.

# What You Can Do

There are many ways for you to take an active role in maintaining the health of Raymond lakes. See the links below for specific ways to get involved that relate to the components of lake health that are discussed here.

### Water Quality

The regular collection of good data is essential to understanding the condition of lakes. Volunteer lake monitors collect these data. If you are interested in becoming a volunteer lake monitor, contact Raymond Waterways or your lake association. See the Lake Stewards of Maine website, which is the main source of the data in this report, for more about statewide monitoring efforts and how monitors are trained. Volunteers are especially needed for Raymond Pond and Notched Pond.

### **Shoreland & Habitat**

Good stewardship of your lake begins with a healthy shoreland area. Discontinuing the use of fertilizers, reducing stormwater runoff, properly maintaining septic systems, and planting more native species can make a big difference. LakeSmart is a state-wide program working with landowners to make these sorts of changes to promote healthy lake shorelands that protect water quality and habitat. Contact Raymond Waterways to schedule a free, voluntary, non-regulatory, evaluation of your lakeshore property. Learn more about this program at the Maine Lakes website.

### "Discontinuing the use of fertilizers, reducing stormwater runoff, properly maintaining septic systems, and planting more native species can make a big difference."

#### **Invasive Plants**

Prevention of infestation and early detection of any invasive plants are key to managing the spread of aquatic invasive species in lakes. This is intensive work and is best conducted with many hands. See the links below from Raymond Waterways, Maine DEP, Lakes Environmental Association, and Lake Stewards of Maine for information about invasive aquatic plant management on your lake:

- Learn about Boat Inspections
- Assist with the Raymond Waterways courtesy boat inspection program
- Learn about invasive aquatic plant identification and becoming a certified invasive plant patroller (IPPer)
- Contact Raymond Waterways or your lake association to be put in touch with other IPPers

#### **Financial and Volunteer Support**

Raymond Waterways and your local lake associations need volunteers and funds to do the good work of protecting our lakes and educating the public about waterway issues. If you are interested in volunteering in any capacity or donating money, please visit one or more of the following websites for more information and links to donate:

- Raymond Waterways
- Crescent Lake Improvement Association
- Panther Pond Association
- Thomas Pond Improvement Association

#### Notes


#### Notes




# **About Raymond Waterways**

For the past 50+ years, Raymond Waterways has worked tirelessly to preserve and protect lakes, streams, and ponds in the Town of Raymond. We are a volunteer organization that works closely with lake associations, residents, shoreline property owners, visitors, and state and local agencies to address watershed issues of concern.

Over the years, Raymond Waterways has addressed lake contamination due to septic leakage, acid rain, non-point source pollution from erosion and runoff, and invasive plants. We remain vigilant in detecting and addressing threats to our waterways and educating the public and local officials about these issues.

### Today, our core programs are:

- 1. Courtesy Boat Inspections (CBI). We run the Courtesy Boat Inspection program which educates boaters about how to inspect their boats for invasive species at public boat ramps.
- **2. LakeSmart.** We provide free onsite assessments to shoreline residents who are interested in improving their properties to minimize erosion and runoff into the lakes.
- **3. Water Quality Monitoring.** We train and coordinate volunteers who monitor water quality on lakes, ponds, rivers, and streams; we provide funds to lake associations to purchase water quality monitoring equipment; and we publish water quality monitoring reports.
- **4. Watershed Stewardship.** We assist lake associations and individuals in conducting watershed surveys and implementing lake protection projects to document and control erosion and polluted runoff.
- 5. Education & Outreach. We develop outreach and education programs to promote public awareness of water quality and watershed issues; we also foster working partnerships with state and local officials and watershed protection groups.

Raymond Waterways couldn't do its work without the generous donations of time and money by countless residents and visitors to Raymond. To all of you who have contributed, we give you our heartfelt thanks!



**Volunteer with Raymond Waterways:** email info@raymondwaterways.org or visit our website at http://www.raymondwaterways.org.



**Donate to Raymond Waterways:** email treasurer@raymondwaterways.org or visit our website at http://www.raymondwaterways.org.