

# **Water Quality and Watershed Analysis of Pattee Pond Executive Summary**

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The Colby Environmental Assessment Team (CEAT) investigated the impact of land use patterns on the water quality of Pattee Pond in Winslow, Maine during the summer and fall of 2008. Physical, chemical, and biological characteristics of water quality were analyzed to evaluate the current health of the lake. Data collected were compared with previous studies conducted by the Maine Department of Environmental Protection (DEP) and CEAT to examine changes in water quality and land use over time. Trends in Pattee Pond water quality suggest an improvement since the 1970s. However, the lake is still experiencing algal blooms resulting from phosphorus concentrations over 12 to 15 ppb. Furthermore, Pattee Pond is on the Chapter 502 Maine DEP List of Lakes Most at Risk from New Development and the Maine DEP Nonpoint Source Priority Watershed List. In addition to water quality analyses, a macrophyte study was performed to document the aquatic plant community and search for invasive species. CEAT studied the development patterns in the watershed, examining subsurface wastewater disposal systems and zoning regulations. A buffer strip survey was also conducted to identify potential sources of phosphorus loading along the shoreline. Historical and current aerial photographs were used to investigate and quantify land use changes throughout the watershed over the last 40 years and to estimate the impact of these changes on phosphorus loading. Findings from demographic research were used to make projections for future development and the related potential changes in phosphorus inputs to the lake.

The following is a brief summary of findings from the study of Pattee Pond and its watershed carried out by the Colby Environmental Assessment Team:

## **Lake Characteristics:**

- Pattee Pond is a relatively shallow, dimictic lake. The lake and its watershed have surface areas of 211 ha (522 acres) and 3,339 ha (8,250 acres), respectively. The lake has a mean depth of 4.6 m (15 ft), with a maximum depth of 8.8 m (29 ft).
- The flushing rate of the lake, including the input from Mud Pond, is 2.72 flushes per year. Consequently, if non-point source nutrient loading can be reduced, nutrients accumulated in the lake could be flushed out over time, improving water quality. Almost 80% of the water entering the lake annually comes from watershed runoff, suggesting land use patterns in the watershed strongly affect water quality.
- Water transparency in Pattee Pond, as measured using a Secchi disk, has gradually improved over the last 40 years. CEAT recorded Secchi depth of 3.5 m in early June. Depths then increased to 4.5 to 5.0 m through the summer. Secchi disk readings dropped rapidly beginning in early August as a result of an algal bloom caused by the fall turnover.

- Historic total phosphorus (TP) levels are variable, but have recently shown a declining trend. The mean epilimnetic phosphorus concentration from the Characterization Site (Site 1) was 12.5 ppb. Beginning in early June and extending to late August, the water column was stratified. Anoxia developed below 6.0 to 6.5 m. The anoxic zone covered almost 30% of the lake. Total phosphorus concentrations from bottom samples taken at Site 1 reached a peak at 293 ppb in early August. This spike indicates that phosphorus is being released from the sediments during the anoxic period. Approximately 18% of the phosphorus concentration in Pattee Pond is from internal recycling.
- Farber Brook is a significant source of sediment loading into Pattee Pond. Water runoff from the stream after major rain events contributes large amounts of phosphorus and sediments. Remediation specifically for this stream and the surrounding land is recommended.
- A lake remediation technique suitable for Pattee Pond is the introduction of alewives into the lake. These fish will accumulate nutrients as they feed and grow, and then remove these nutrients from the lake when they leave to spawn. This technique will help provide inexpensive, in-lake management of phosphorus loading. However, because non-point source runoff contributes the majority of phosphorus loading into the lake, remediation techniques that focus on reducing external phosphorus loading should be a top priority.
- The most common macrophytes found in Pattee Pond were common rush (*Juncus effuses*) and pickerelweed (*Pontederia cordata*). Purple Loosestrife (*Lythrum salicaria*) was the only invasive plant species found along the Pattee Pond shoreline and was localized to four points in the lake. It was not dominant at any site, and could be easily be removed by hand. Areas in the lake with depths less than 16 ft (45% of the lake) are at risk for invasive species colonization because invasives prefer shallow water.

### **Land Use and Development**

- Land use in the Pattee Pond watershed has undergone numerous changes between 1965 and 2007. The maturation of existing forests and the decrease in agricultural land have reduced potential phosphorus loading in the watershed. Land uses likely to promote phosphorus loading including residential and commercial development, recreational areas, and roads have also increased in the watershed. These increases tended to be close to roads, the shoreline, and inlets to Pattee Pond. Wetland area, particularly close to the lake and its inlets, was found to have declined.
- The three main anthropogenic sources of phosphorus in the watershed are residential development (20%), septic systems (16%), and roads (14%). Seventy percent of the phosphorus loading from roads comes specifically from camp roads. Although these sources do not have large areas, they have disproportionate effects on phosphorus loading.
- The lakeshore of Pattee Pond is densely developed with seasonal residences located on small lots along sections of the west and east shores of the lake. There are 105 seasonal and 5 year-round residences along the shoreline (less than 250 ft from the lake). There are 20 seasonal and 361 year-round residences in the remainder of the watershed. The current zoning codes stipulate a minimum lot size of two acres, with

additional restrictions for lot frontages and setbacks. The State of Maine and Town of Winslow have also adopted Shoreland Zoning rules that govern development within 250 ft of water bodies. Many of the homes in the Pattee Pond watershed were built before implementation of restrictive zoning began in 1974 and are considered legally non-conforming.

- Owners of small, legally non-conforming homes on lots close to the lake should implement best management practices (BMP) to mitigate impacts of runoff from their lots. Manuals describing different types of BMP methods are available from the Maine DEP among other sources. Individual landowners can play a major role in helping to solve erosion problems that cause sediment and phosphorus loading into the lake.
- The buffer strip survey indicated that 69 percent of shoreline properties had fair or poor quality buffers that need improvement. The properties that fell into the smallest shoreline frontage category (grandfathered under current zoning restrictions) had the highest percentage of poor buffers. The quality of buffers depends on individual property owners, who are responsible for their upkeep and improvement.
- 94.5% of the non-shoreline properties have septic systems. Shoreline properties have either holding tanks (49.3%) or septic systems (37.3%). The overall condition of subsurface wastewater disposal systems is good because of strong code enforcement, but continued periodic inspections of legally non-conforming systems to check for system failures should occur.
- Almost one half of the camp road surface around Pattee Pond requires substantial repair to reduce runoff into the lake. Whitefish Lane and Pickerel Point Road are two camp roads of particular concern. Whitefish Lane has many steep driveways leading straight down to the lake that would benefit from the installation of water diversions. Pickerel Point Road lacks adequate crowning, ditching, and water diversions on the steep section. These repairs are critical to mitigating phosphorus loading because 22% of the erosion sites that contribute significant amounts sediment to the lake are associated with private roads (Pattee's Pond Association report).
- Although the population of Winslow is stable, the mean household size is decreasing. This suggests that residential development may continue. Development is likely to occur along existing roads and close to the lake. The proposed 2008 Winslow Comprehensive Plan outlines a new zoning strategy that includes a Conservation District designed encourage growth in the town center and to limit development in the Pattee Pond watershed. The Winslow Comprehensive Planning Committee is keeping environmental concerns a top priority by promoting the plan to help protect the water quality of Pattee Pond.

Although Pattee Pond has shown improvements in water quality since the 1970s, the lake still experiences algal blooms. The trophic status of Pattee Pond is eutrophic, but appears to be improving based on historical and current data. Pattee Pond is expected to respond rapidly to mitigation techniques for phosphorus loading because of its high flushing rate. Efforts should be made to follow best management practices, to implement appropriate land use mitigation techniques, and to regulate new development within the watershed. The recommendations presented in this report all have the ultimate goal of reducing the frequency of algal blooms and restoring lake water quality.

# RECOMMENDATIONS

Pattee Pond has a history of impaired water quality, but recent improvements have been observed. This restoration of water quality is largely due to the efforts of the Pattee's Pond Association, the Town of Winslow, and local residents who have worked to reduce sediment and phosphorus loading into the lake. However, Pattee Pond still experiences algal blooms and more work is necessary to limit nutrient loading. The Colby Environmental Assessment Team (CEAT) suggests the following actions to maintain momentum in improving the water quality and general health of Pattee Pond.

## *IN-LAKE MANAGEMENT*

### **Invasive Species Monitoring and Prevention**

Invasive plants are undesirable because they compete with and often exclude native species from an area. Invasive species can also negatively alter the habitat for fish and other animals in the lake. It is important to be vigilant to ensure that invasive macrophytes are not accidentally introduced into the lake.

- Boat launches increase the potential for the introduction of invasive species because plants may hitchhike on boats and trailers being moved from infested lakes. All boats should be carefully checked for invasive macrophytes before launching.
- A courtesy boat inspector could be stationed at the Giordano's Market and Campground public boat launch to check for invasive plants and spread awareness. Educational signs should also be installed at this site. Because Giordano's is the only public boat launch, it is a likely entrance point for invasive species.
- Partnerships with the Volunteer Lake Monitoring Program or a similar organization should be established to help educate residents about invasive plants.
- Encourage regular monitoring for invasive species by local residents and lake users.

### **Alewives**

There are many possible remediation techniques available to help reduce in-lake phosphorus concentrations, but most are expensive. Sediment release of phosphorus contributes a relatively small percentage of the total phosphorus loading into Pattee Pond. For this reason, stocking alewives is the only in-lake remediation technique that CEAT recommends. Alewives are a migratory species that return to the ocean after spawning in freshwater lakes. When they return to the ocean, the phosphorus that they have bioaccumulated is removed from the lake.

## *WATERSHED MANAGEMENT*

### **Land Use Considerations**

CEAT recommends that watershed residents focus on techniques that target eliminating erosion from non-point source runoff because most phosphorus entering the lake comes from external sources. Mitigation techniques that target problematic land uses will likely have longer-lasting impacts on the water quality of Pattee Pond than in-lake strategies that may only be effective for a few years. The Pattee's Pond Association has identified erosion as the primary source of phosphorus loading into the lake. CEAT agrees with this assessment.

- Wetlands act as natural filters and are crucial to maintaining the health of Pattee Pond, and should be protected. Any areas that were historically wetlands but

converted to other uses should be restored or buffered to reduce sediment and nutrient loading.

- Erosion along the steeper slopes of the west side of the lake is a major source of phosphorus loading. Further efforts to mitigate this problem are necessary.
- Farber Brook is a major avenue for sediment and phosphorus loading into the lake. Erosion mitigation efforts should be specifically focused on Farber Brook and the adjacent land to reduce nutrient and sediment loading.
- Protection of the wetlands surrounding Bellows Stream should also be a mitigation goal because intact wetlands can serve to trap sediment and phosphorus and prevent them from entering the lake.

### **Residential Lots**

Mitigating erosion from residential lots, especially those on the shoreline, can help reduce phosphorus loading into the lake. The Pattee's Pond Association conducted a study of erosion sites and found 65 percent of the sites were located on residential land. Applying best management practices for sediment-control to these sites, and to residential lots in general, is an inexpensive way to improve lake water quality.

- Improve or remove private boat launches. Mitigate camp roads, driveways, and other avenues that may enable sediment carrying phosphorus to enter the lake.
- Add rain gardens or other runoff-trapping features to properties, especially around buildings.
- Consult publications describing best management practices for ideas to reduce the erosion potential of residential lots.

### **Buffer Strips and Erosion Prevention**

Adequate buffer strips are crucial on every property along the shoreline as a last line of defense to help prevent sediment and nutrients from entering the lake.

- A good buffer should integrate native species in a progression from inland areas towards the water. Trees and tall shrubs should be planted farthest from the shore, followed by lower shrubs and water-tolerant grasses along the shoreline. Buffers should extend as far inland as possible, ideally up to 100 ft.
- Impervious surfaces should be minimized throughout the lot.
- Specific erosion sites or potential pathways for sediment loading into the lake, such as private boat launches, should be mitigated or eliminated.
- Pathways to docks or the water's edge should be winding and constructed with mulch, grass, or gravel to intercept and slow water entering the lake.

### **Camp Roads**

Camp roads are a major source of phosphorus loading because they are located in close proximity to the Pattee Pond shoreline and typically have dirt or gravel surfaces. Routine maintenance of unpaved, camp roads will help mitigate erosion.

- Camp roads that are closest to the lake and have the most potential for erosion should be targeted for immediate repairs. A Pattee's Pond Association study of the watershed found that 22% of the erosion sites identified were associated with camp roads. CEAT has identified Pickerel Point Road and Whitefish Lane as camp roads that require urgent attention.

- Form road associations to facilitate regular monitoring and maintenance of camp roads.
- Maintain proper crowning of camp roads, keep culverts clear of debris, and plant shrubs and grasses in ditches and along roadsides to slow water flow during rain events. When road repair is necessary use materials not likely to erode, if possible.
- Add water diversions to steep driveways near the lake, especially along the west shore of Pattee Pond. Grade the driveway at the camp road interface to encourage water to not flow down the driveway toward the lake.

### **Subsurface Wastewater Disposal Systems**

Properly functioning wastewater disposal systems are important throughout the watershed, especially near the lakeshore because of their high potential for nutrient loading. Maintenance and proper functioning are crucial because system failures can quickly add nutrients to the lake. Regular pumping of holding tanks is essential to prevent nutrient release. Older holding tanks should also be inspected to ensure that they are watertight. Any system in the watershed not currently in compliance should be updated as soon as possible to comply with the Maine Subsurface Wastewater Disposal Rules.

- Inspect legally non-conforming systems regularly. Replace each legally non-conforming system as necessary, preferably before it fails.
- Educate residents about the importance of properly maintaining their wastewater disposal system.
- Ensure that gray water from residences around the lake is being properly treated, either by being pumped into a septic system or holding tank. Improper handling of gray water can result in phosphorus loading into the lake.

### **Future Development**

New development in the Pattee Pond watershed should be regulated to protect the water quality in the lake. Strict adherence to zoning ordinances should continue. Erosion control best management practices related to erosion prevention must be implemented during all construction and on newly landscaped properties to mitigate sediment loading.

- Septic system remediation should be considered when installing new systems on the central section of the eastern shoreline, the western shoreline, or along Bellows Stream because these areas are more prone to phosphorus loading from septic installation.
- Owners of shoreline homes should implement best management practices to control sediment runoff. This is especially crucial on the steep lots along the western shore of the lake.
- CEAT supports the proposed Winslow Conservation Zoning District described in the 2008 Winslow Comprehensive Plan draft. The proposed Conservation District includes the Pattee Pond watershed. This zoning district change is expected to help improve lake water quality.
- Design any new development plans to minimize additional road construction.

### ***COMMUNITY AWARENESS AND EDUCATION***

The Pattee's Pond Association, working with the Town of Winslow and the Maine DEP, has made significant efforts to improve lake water quality. Continued improvement in water

quality can only happen if local residents persist in their efforts to protect the lake. The actions of individual property owners can make a difference. Community education is the most effective way to spread awareness about the factors that affect the water quality of Pattee Pond.

- Design community workshops to inform local residents about lake ecology and protection strategies.
- Include relevant information in local school curricula to help teach children about the importance of protecting lake water quality.
- Regular monitoring by trained volunteers to assess lake water transparency and to search for invasive plants is recommended.
- The Pattee's Pond Association should continue their efforts to protect the lake and present their assessment of the status of Pattee Pond annually to the Town of Winslow.
- Local residents throughout the watershed are encouraged to join the Pattee's Pond Association and learn how they can help protect the lake.