



Mirror Lake 2021 Water Quality Update

Mirror Lake is an iconic Adirondack waterbody adjacent to the Village of Lake Placid.

Mirror Lake hosts a wide range of summer activities including recreational paddling, swimming, fishing, and the annual IRONMAN triathlon. In winter, ice skating, hockey tournaments, tobogganing, and dog sled rides are popular pastimes. Visitors and residents enjoy Mirror Lake’s beautiful waters and shore year-round. There’s little doubt that a healthy Mirror Lake is an essential social and economic resource for the village and the wider region.

Situated in western Essex County and bordered by the Town of North Elba and Village of Lake Placid, Mirror Lake (Figure 1) has a surface area of 50 hectares (124 acres) and watershed area of 301 hectares (741 acres). Of the total watershed area, 51% is forest, 27% is developed, 20% is surface water, and 2% is wetland (Wiltse et al. 2019). Much of this developed land area in the Mirror Lake watershed is covered by impervious surfaces, which do not allow fluids to pass. Indeed, Mirror Lake has over twice the percentage of developed land compared to any other lake studied in the Adirondack Lake Assessment Program (Laxson et al. 2016). This makes Mirror Lake one of the most developed

lakes in the Adirondack Park. The headwaters of the watershed, draining from the ridge between Mt. Whitney and Cobble Hill, create Echo Lake which sits 1.5 km (0.9 miles) east of Mirror Lake. A small brook trout stream travels from Echo Lake, under Mirror Lake Drive through a small underground pipe into the north bay of Mirror Lake. This upstream portion of the watershed is mostly forested. Downstream, in the areas surrounding Mirror Lake, much of the land is developed (Figure 1). The lake drains to the south, through another underground pipe, into the Chubb River which flows into the West Branch Ausable River.



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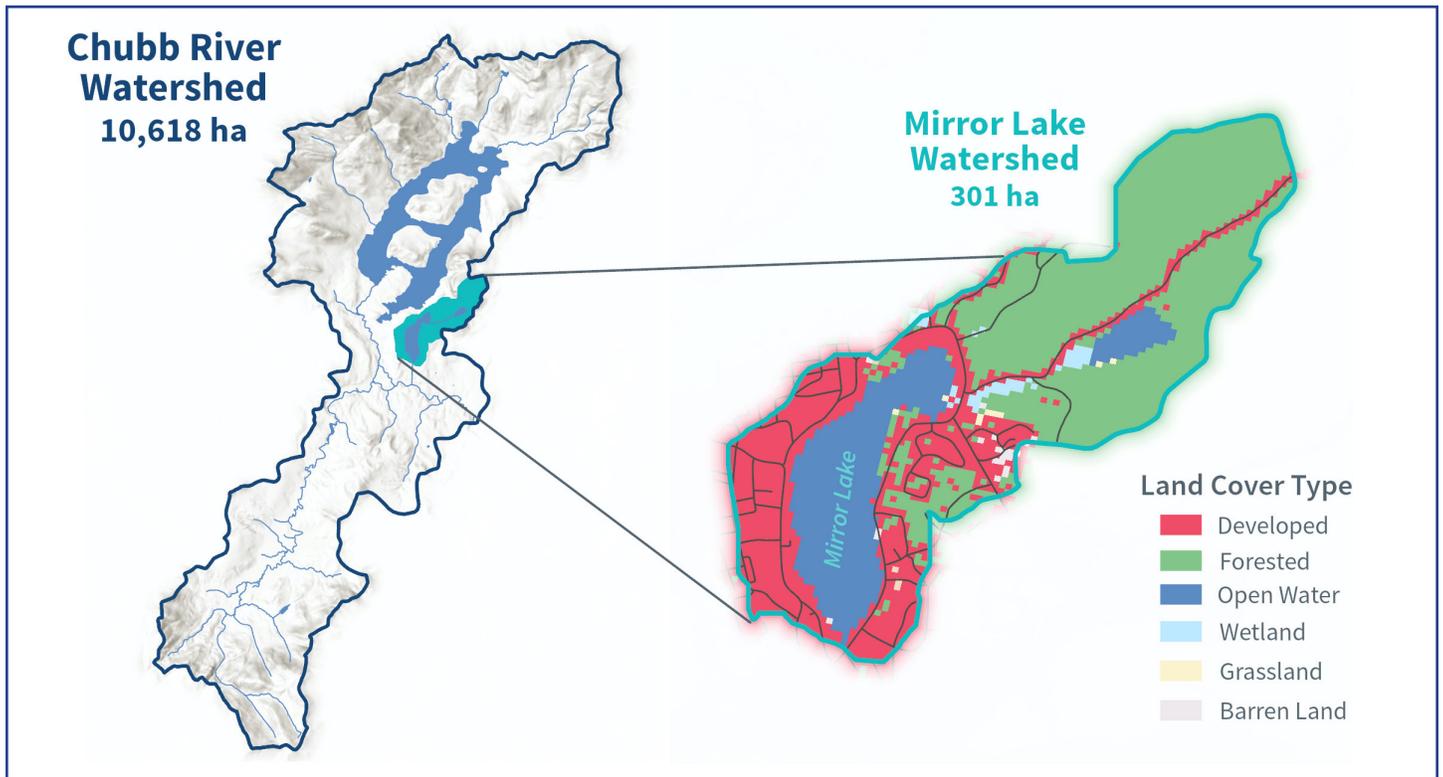


Figure 1. The Mirror Lake watershed (right) shown as part of the Chubb River watershed (left) with the distribution of land cover and road types within the Mirror Lake watershed. With 27% of land developed, there is a high proportion of impervious surfaces in the watershed. Stormwater runoff from roads, driveways, parking lots, rooftops, and other impervious surfaces collects and moves quickly, eroding soils and picking up sediment, debris, and pollutants as it makes its way to Mirror Lake. National Land Cover Database (NLCD) 2019.

OVERVIEW OF FINDINGS

The Ausable River Association and its partner the Adirondack Watershed Institute continue to monitor and sample Mirror Lake year-round to protect this fragile system from anthropogenic influences. In 2021, chloride concentrations in Mirror Lake were lower than in the past four years of monitoring. Nevertheless, the lake was unable to completely turnover in the spring of 2021. Although concentrations were lower, the water quality of Mirror Lake will remain impaired by winter salt use applications until a natural mixing regime is achieved.

METHODS

Field data were collected bi-weekly during the open-water season from a canoe anchored over the deepest location of the lake. In winter months, when the lake was covered with ice of sufficient thickness for access by foot, field data was collected bi-weekly from a hole drilled in the ice. During each sample visit, a surface water sample, hypolimnetic, or bottom sample, and profiles of temperature, dissolved oxygen, specific conductance, and pH were collected. The surface water samples were collected from a depth of 0 to 2 meters with an integrated tube sampler. The tube sampler, which allows for collection of an integrated sample of the top 2 meters of the water column, was then emptied into a field rinsed 1L sample bottle. A portion was poured off into an acid-washed and field-rinsed sample bottle for laboratory analysis and 250ml was filtered through a 0.45µm cellulose membrane filter. The filter was folded in half twice, wrapped in foil, and stored on ice for chlorophyll-a

analysis. Hypolimnetic samples were collected using a 1.5L Kemmerer bottle from approximately 1 meter above the bottom. This sample was immediately transferred to an acid-washed and field-rinsed sample bottle and stored on ice. All water samples and the chlorophyll-a sample were transported on ice until they could be frozen before being transported to the Adirondack Watershed Institute. Samples were analyzed for pH, conductivity, alkalinity, total phosphorus, nitrate, ammonium, total nitrogen, chlorophyll-a, chloride, sodium, and calcium at the Adirondack Watershed Institute Environmental Research Lab. Transparency was measured during the ice-free period using a 20cm black and white Secchi disk from the shady side of the boat. Profiles of temperature, dissolved oxygen, specific conductance, and pH were collected at 1m intervals from the surface to 17m using a YSI EXO2 sonde.

Temperature and Dissolved Oxygen Profile

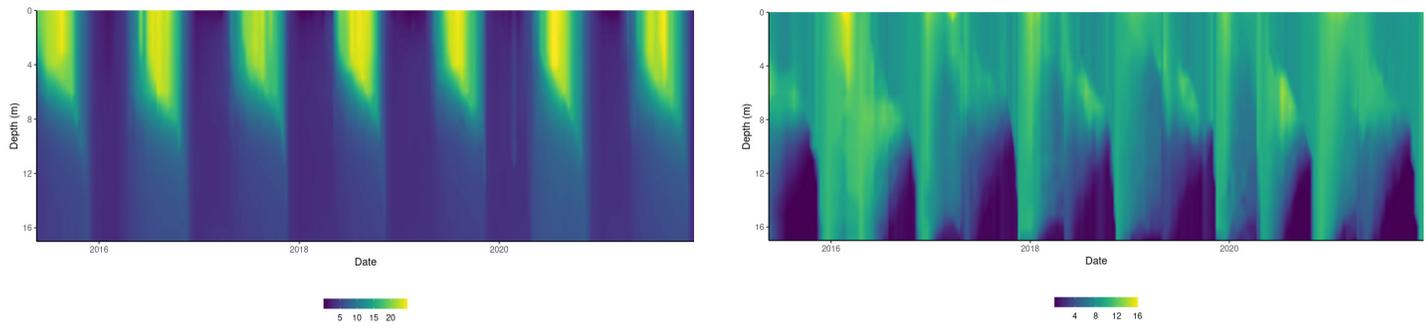


Figure 2. Temperature (°C) (left) and dissolved oxygen (mg/L) (right) from vertical profiles collected at 1m intervals at the deepest part of the lake from 5/18/2015 – 12/31/2021. Lighter colors denote higher temperatures or dissolved oxygen.

RESULTS

Mirror Lake experienced hypoxic conditions (low oxygen levels, a dissolved oxygen reading of <2 milligrams per liter, or mg/L) in the hypolimnion, or lower lake waters, during each summer from 2015-2021 (Figure 2). Low dissolved oxygen reduces habitat for lake trout and other aquatic organisms essential to lake health and integral to the economic value of the lake. Mirror Lake is oligotrophic, meaning low nutrient content, and had relatively low phosphorus concentrations throughout 2021.

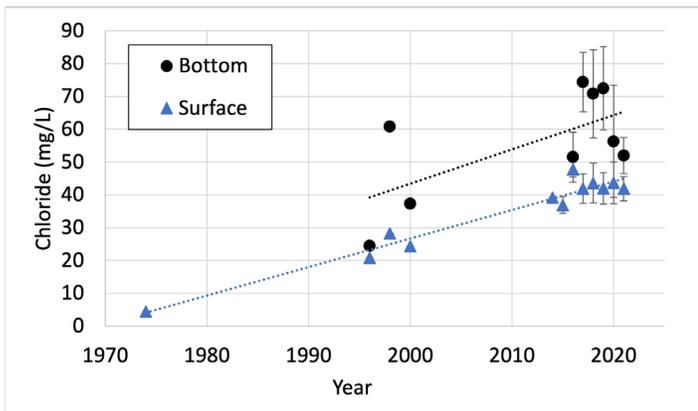


Figure 3. Annual average chloride (mg/L) concentrations from 1974-2021. Bottom samples are shown in black circles and surface samples are shown in blue triangles. Vertical bars represent one standard deviation of the mean.

Lake trout seek out optimal areas where temperatures are cool (<15 °C) and are well oxygenated (>6 mg/L dissolved oxygen, Plumb and Blanchfield, 2009). When these conditions are not met, fish are forced into a narrow range of lake depths. For much of the summer and into the fall of 2021, these conditions were not achieved, and lake trout were likely forced into depths between 8 and 12 meters, and in some instances a smaller range (Figure 2).

Minimally impacted Adirondack lakes have average chloride concentrations of 0.2 mg/L (Kelting et al. 2012). Road runoff is a major source of chloride in regions where rock salt is used as

a road and sidewalk deicer in winter. New York has one of the highest road salt application rates per lane mile in the United States (Kelting & Laxson 2010). Within the Village of Lake Placid, road salt is applied to roads, parking lots, and sidewalks around Mirror Lake. With 27% developed land in the watershed, a high proportion of surfaces are impervious, increasing potential application area and facilitating movement of pollutants into nearby waterbodies. In 2021, work began in the Village of Lake Placid to upgrade the stormwater system including three stormwater management basins. These changes are still being studied but have altered the amount and route of water entering Mirror Lake, the Chubb River, and beyond.

Lower levels of chloride were seen in the hypolimnion in 2021 compared to years prior (Figure 3). This may be attributed to the combination of a mild winter in 2021, changes to the stormwater system in the Village of Lake Placid, and the Salt Use Reduction Initiative that has been working to reduce road salt applications into Mirror Lake. The average hypolimnion chloride concentration for 2021 was 52 mg/L. The highest chloride concentration recorded in the hypolimnion layer in Mirror Lake in 2021 was 65 mg/L. In years prior, chloride concentrations were recorded as high as 125 mg/L (Figure 3). The highest concentrations of chloride were observed from January to April. After April, more uniform conditions were seen with the partial mixing of the water column (Figure 3).

Although the recorded chloride concentrations were lower in 2021, they still are not in the range of our water quality targets. Our short-term goals include achieving concentrations less than 40 mg/L of chloride, and our long-term goals aim to record chloride concentrations less than 10 mg/L, or close to the records from the 1970s.



Commission, the New York State Department of State, Mirror Lake Watershed Association, the North Elba Local Enhancement and Advancement Fund (LEAF), Adirondack Foundation-Nancy Adams Sweet Family Fund and Holderied Family Community Fund, Cloudsplitter Foundation, the Village of Lake Placid, and Town of North Elba. The ongoing work on Mirror Lake would not be possible without the support of businesses and residents of the watershed.

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CITATIONS

- Kelting, D.L. & Laxson, C.L. 2010. *Review of Effects and Costs of Road De-icing with Recommendation for Winter Road management in the Adirondack Park.* AWI Report 2010-1.
- Kelting, D.L., Laxson, C.L., & Yerger, E.C. 2012. *A regional analysis of the effect of paved roads on sodium and chloride in lakes.* Water Research, 46(8): 2749-2758.
- Laxson, C.L., Yerger, E.C., Regalado, S.A., & Kelting, D.L. 2016. *Adirondack Lake Assessment Program: 2015 Report. Paul Smith's College Adirondack Watershed Institute.* Report No. PSCAWI 2016-04. 181p.
- Plumb, J.M., & Blanchfield, P.J.,. 2009. Performance of temperature and dissolved oxygen criteria to predict habitat use by lake trout (*Salvelinus namaycush*). *Can J Fish Aquat Sci.* 66(11): 2011–2023
- Wiltse, B., Yerger, E.C., & Laxson, C.L., 2019. *A Reduction in Spring Mixing Due to Road Salt Runoff Entering Mirror Lake (Lake Placid, NY),* Lake and Reservoir Management, 36:1, 109-121.

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CONCLUSIONS

Although Mirror Lake's chloride levels were lower in 2021 than in years prior, road salt continues to be a major concern. It inhibits natural turnover and reduces lake trout habitat (Wiltse et al. 2019). In 2022, water quality monitoring continues, and the Ausable River Association will continue working with the Village of Lake Placid, the Town of North Elba, our science partners, business owners, and residents in our efforts to reduce the use of road salt applications.

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