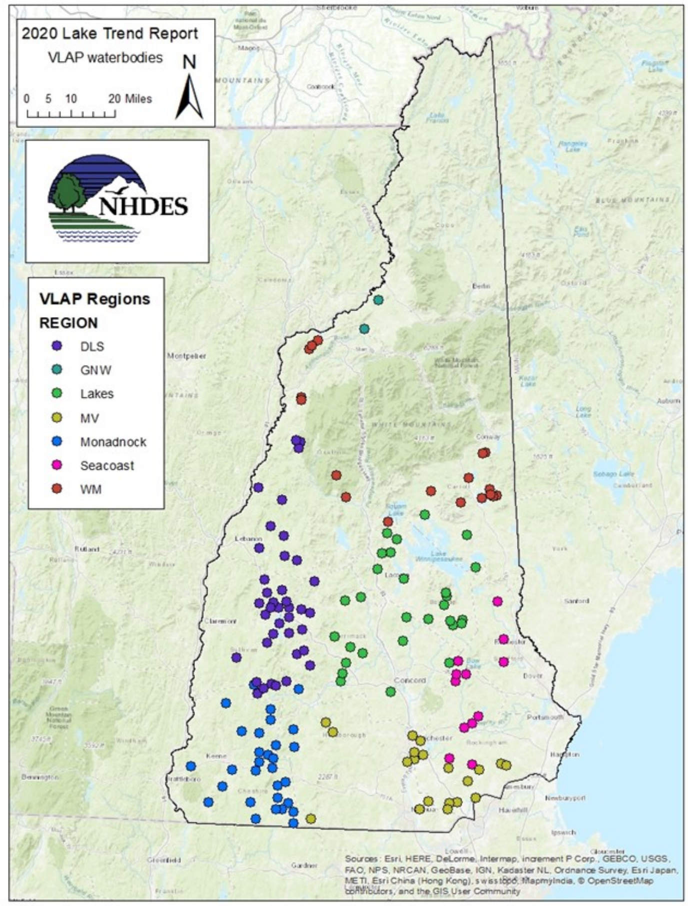
2020 Lake Trend Report

Status and Trends of New Hampshire's Water Quality Indicators

New Hampshire's surface waters are vital natural resources that provide habitat for aquatic life, recreational opportunities, tourism and economic benefits. The New Hampshire Department of Environmental Services (NHDES) is responsible for monitoring and reporting on the condition of the state's surface waters. The [Water Monitoring Strategy](), published by NHDES in 2016, details the agency's approach for monitoring the condition of the state's inland surface waters. One component of this strategy is to provide regular reports on the status and trends of water quality conditions, including the Lake Trend Report released in 2020. This document provides a brief summary of that reports' findings. Find the full [2020 Lake Trend Report]() on our website.

One-hundred-fifty lakes and ponds contributed ≥ 10 years of data from 1991 to 2018. A majority of the data were contributed by the Volunteer Lake Assessment Program (VLAP), but in some cases data from additional programs were utilized to evaluate waterbody condition. Data were analyzed to examine current conditions, long-term trends and short-term changes for individual waterbodies. Trophic class and regional trends were also examined.



Water Quality Indicators

Indicator Parameter	Parameter Description
Alkalinity	A measure of a waterbody's ability to resist acidic inputs, a.k.a. buffering capacity.
Bacteria	A measure of the concentration of E. coli, a common bacterium that is present in the fecal material of warm-blooded animals.
Chlorophyll-a	A photosynthetic pigment found in plants that serves as an measure of the abundance of suspended algae.
Cyanobacteria	Photosynthetic bacteria that are capable of producing toxic blooms. Occurs naturally in waterbodies, but can increase in abundance with excessive nutrients.
Dissolved Oxygen (1-meter below surface)	The concentration of oxygen in water used by plants and animals. Low or highly variable dissolved oxygen concentrations can result from decomposition of organic material.
Ice in/out records	Period of time a waterbody is covered in ice.
Invasive Aquatic Plants	Non-native species that are a threat to ecological, aesthetic, recreational and economic values of freshwater resources.
pH	A measure of the water's acidity.
Secchi Disk Transparency	A measure of water clarity.
Specific Conductance	A measurement of the water's ability to conduct electricity. Compounds such as road salts, fertilizers and other chemical compounds increase the specific conductance of water.
Total Phosphorus	Typically, the limiting nutrient for aquatic plants and algae in NH lakes. Total phosphorus concentration controls, in part, the amount of plant and algae growth, which relates to trophic status.
Water Temperature (1-meter below surface)	Aquatic communities are adapted to specific water temperature conditions. Water temperatures can be affected by air temperature, water clarity and global climate patterns.

Alkalinity

Long-term trends found 59% of waterbodies INCREASED and 1% DECREASED in alkalinity over time, with eutrophic and mesotrophic classes INCREASING. Short-term changes (changes in the last ten years) found 74% of waterbodies INCREASED and 0% DECREASED in alkalinity. The regions with the most increases were the Dartmouth Lake Sunapee and Monadnock regions.

The long-term increases in alkalinity in more than half the lakes are likely due to two factors. First, our lakes and ponds are recovering from acid rain. The decline in acid-causing pollutants should allow waterbodies to regain positive ions from weathering, which would increase alkalinity. However, increases in alkalinity may also be tied to road salt. Salt is composed of chloride and sodium, and sodium is a positive ion. An influx of salt, and consequently sodium, has been found to increase alkalinity. The short-term analysis found that nearly 75% of the waterbodies in this study had significant increases in alkalinity in the last ten years, which is more rapid than would be expected for acid rain recovery and coincided with increasing specific conductance.

Bacteria

The percentage of monitored beaches that were issued an E. coli advisory and the total number of days an advisory was in place INCREASED over time.

Possible explanations include warmer water temperature, more people using beaches, increased waterfowl populations or increased stormwater run-off.

Chlorophyll-a

Long-term trends found 3% of waterbodies INCREASED and 13% DECREASED in chlorophyll-a concentration over time, but there were no trends by trophic class. Short-term changes (changes in the last 10 years) found 3% of waterbodies INCREASED and 10% DECREASED in chlorophyll-a concentration. The regions with the most decreases were the Lakes and Monadnock regions.

Decreases in chlorophyll-a concentrations are generally viewed favorably because it indicates a decrease in algae. The decreases could be linked to the darker water, as less sunlight can pass through the water column.

Cyanobacteria

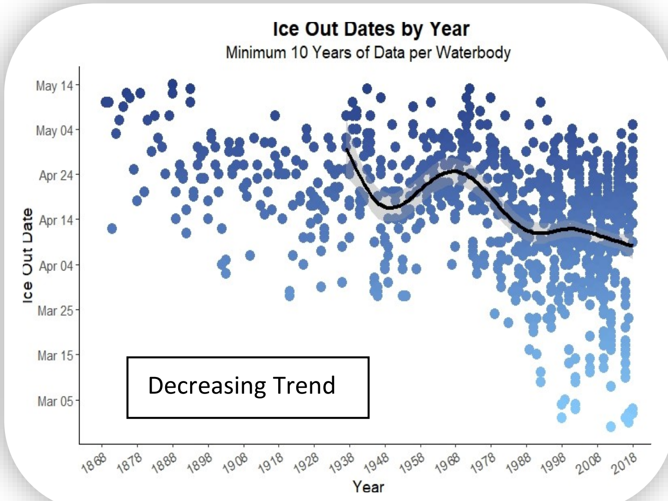
Cyanobacteria advisories have INCREASED over time, but the number of days advisories were in place shows no trend.

Increased awareness of cyanobacteria and sample effort may have led to the increase in the number of advisories issued; however, an increasing number of blooms may also be occurring. Reoccurring cyanobacteria blooms may reflect legacy nutrient loads to the waterbody, which are nutrients that entered the waterbody in year or even decades prior. Under anoxic (no oxygen) conditions at the bottom of the waterbody, these legacy nutrients can re-suspend in the water column and fuel cyanobacteria blooms.

Dissolved Oxygen

Long-term trends found 1% of waterbodies INCREASED and 16% DECREASED in dissolved oxygen at one meter depth over time, with the mesotrophic class DECREASING. Short-term changes (changes in the last ten years) found 14% of waterbodies INCREASED and 0% DECREASED. The regions with the most decreases were the Dartmouth Lake Sunapee and Monadnock regions.

Dissolved oxygen levels are influence by water temperature, algae and aquatic plant abundance, time of day, decomposition, and weather. Reductions in dissolved oxygen may be a response to increasing water temperature, as warmer water holds less dissolved oxygen, while increases may be due to increased algal production or more mixing from wind.



Ice Out

The day of ice out on our lakes and ponds has DECREASED (occurred earlier in the year) over time.

The day of ice-out is largely determined by air temperature and earlier ice-out has been found across New England. As the day of ice-out can vary drastically from year to year, long-term datasets are imperative for breaking through the "noise" to investigate trends. Earlier ice-outs dates are likely to result in hotter summer water temperatures, lower water levels, and prolonged summer lake stratification, which may promote low dissolved oxygen levels at lake bottom and cyanobacteria.

Invasive Aquatic Plants

The number of waterbodies with invasive aquatic plants have INCREASED over time. Overall, acreage and herbicide use has not changed significantly; however, the use of alternative controls (e.g. diver-assisted suction harvesting) has INCREASED.

Freshwater invasive aquatic plants have no predators or diseases, which allows them to grow quickly and dominate freshwater systems. These pests are most often spread by accident as fragments attached to boat trailers.

Variable milfoil (Myriophyllum heterophyllum) is the most common invasive aquatic plant in New Hampshire.

pH

Long-term trends found 13% of waterbodies INCREASED and 5% DECREASED in pH over time, but there were no trends by trophic class. Short-term changes (changes in the last ten years) found 23% of waterbodies INCREASED and 4% DECREASED in pH. The regions with the most increases were the Dartmouth Lake Sunapee and Monadnock regions.

A measure of a waterbody's acidity, pH is influenced by a number of variables including alkalinity, dissolved oxygen levels, carbon dioxide levels, pollutant levels, and water temperature. Vitally important to aquatic life, pH levels below 6.5 or above 8.0 are considered to have negative influences on aquatic organisms such as insects and fish. Approximately 84% of waterbodies with an increasing long-term trend and 80% of waterbodies with a short-term change in pH also had an increasing alkalinity. The greater number of waterbodies with increasing trends in pH may be partially due to decreases in acid precipitation.

Secchi Depth

Long-term trends found 2% of waterbodies INCREASED and 16% DECREASED in Secchi depth over time, with mesotrophic and oligotrophic classes DECREASING. Short-term changes (changes in the last ten years) found 6% of waterbodies INCREASED and 4% DECREASED in Secchi depth. The regions with the most decreases were the Dartmouth Lake Sunapee and White Mountain regions.

A recent phenomenon in the Northeast known as "lake browning" is thought to be causing decreases in Secchi depth. Darker lake waters have been attributed to increasing amounts of dissolved organic carbon (DOC) entering waterbodies. This increase in DOC is likely due to both recovery from acid rain and increasing severe storms and rain that the Northeast has experienced in recent decades.

Specific Conductance

Long-term trends found 41% of waterbodies INCREASED and 8% DECREASED in specific conductance over time, with eutrophic and mesotrophic classes INCREASING. Short-term changes (changes in the last ten years) found 80% of waterbodies INCREASED and 0% DECREASED in specific conductance. The regions with the most increases were the Lakes, Merrimack Valley, and Dartmouth Lake Sunapee regions.

New Hampshire's surface water tends to have low specific conductance (< 50 µS/cm). While specific conductance can be naturally high or low based on geology, the increasing long and short-term changes is alarming. The most likely driver of this change is salt – specifically road salt, and to a lesser extent, water softeners.

Excess salt used on our roads and walkways is a problem for our water! Click here to learn more.

Total Phosphorus

Long-term trends found 4% of waterbodies INCREASED and 7% DECREASED in total phosphorus over time, with the eutrophic class INCREASING. Short-term changes (changes in the last ten years) found 4% of waterbodies INCREASED and 6% DECREASED in total phosphorus. The regions with the most increases were the Merrimack Valley and Monadnock regions.

As the most common limiting nutrient in New Hampshire lakes, changes in total phosphorus concentration can have cascading effects throughout a waterbody. Changes in total phosphorus levels are waterbody-specific and reflect land use practices in each watershed. Increases are associated with stormwater run-off, impervious surfaces, fertilizers, and vegetation loss, while decreases may reflect better management practices, such as leaving vegetation buffers intact, reducing fertilizer use, or regularly pumping septic systems.

Water Temperature

Long-term trends found 18% of waterbodies INCREASED and 1% DECREASED in water temperature at one meter depth over time, with mesotrophic and oligotrophic classes INCREASING. Short-term changes (changes in the last ten years) found 5% of waterbodies INCREASED and 0% DECREASED. The regions with the most increases were the Dartmouth Lake Sunapee, Lakes, and Monadnock regions.

Water temperature can be influenced by air temperature, weather, water color, and shade. Water temperature changes have likely been driven by increases in air temperature (almost 2° F from 1895 to 2011), earlier ice-out dates which allows lake water to begin warming and stratifying earlier, and increases in water color, which darken the water and absorb more heat.