TAHOE: STATE OF THE LAKE REPORT 2025

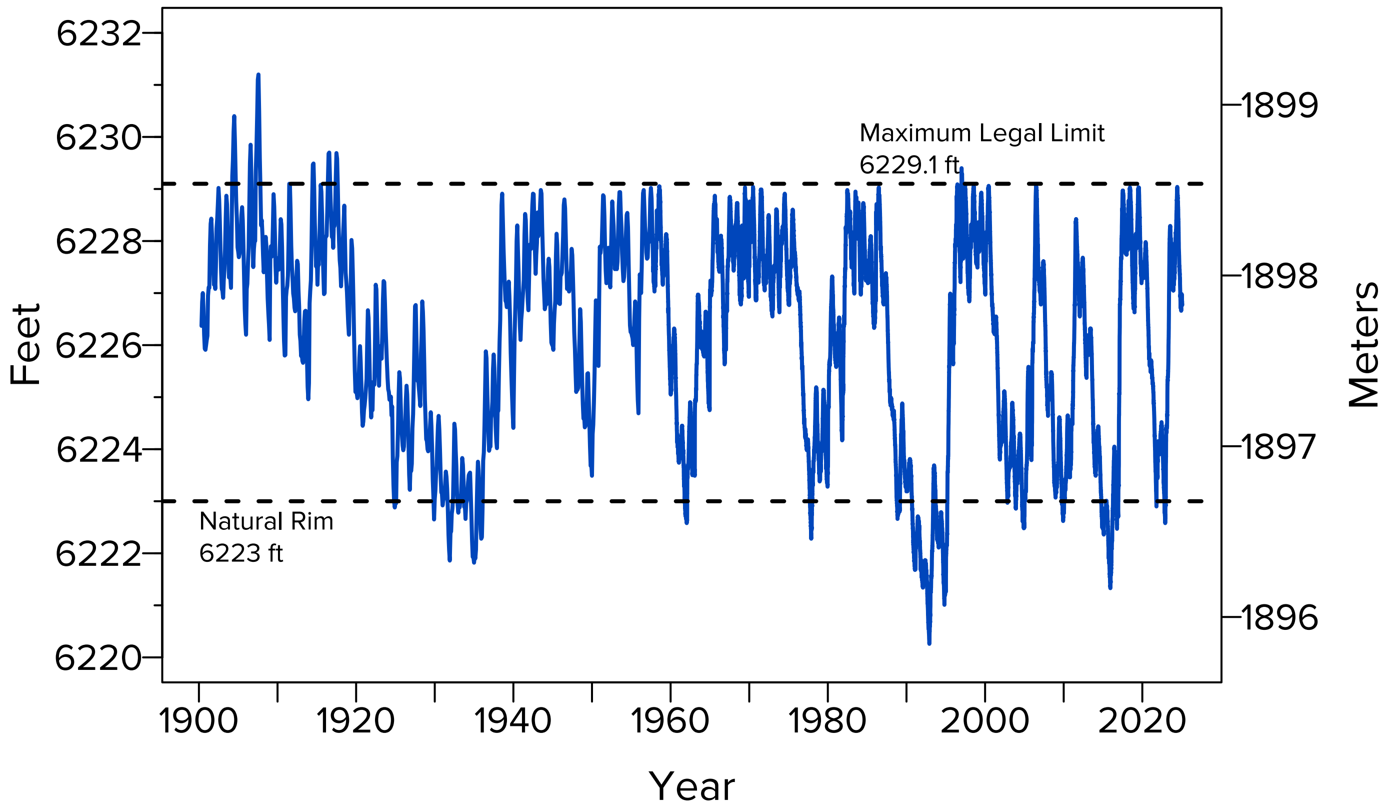
PHYSICAL PROPERTIES

Lake surface level

Daily since 1900

Lake surface levels vary throughout the year. Lake levels rise due to high stream inflow, groundwater inflow, and precipitation of rain and snow directly onto the lake surface. It falls due to evaporation, in-basin water withdrawals, groundwater outflows, and outflows via the Truckee River at Tahoe City. In 2024, the highest lake level was 6,229.04 feet on June 11, and the lowest was 6,226.66 feet on December 11, 2024, three feet higher than the natural rim of the lake. The natural rim of the lake is at an elevation of 6,223 feet. Lake Tahoe fell below its rim on October 24, 2022, but rose back above it on December 27, 2022. When the lake was below its rim, outflows via the Truckee River ceased. Several episodes of lake level falling below the natural rim are evident in the last 114 years of the record. The frequency of low water episodes appears to be increasing with four episodes observed from 1900–2000 and four episodes since 2000. The lowest lake level on record is 6,220.26 feet on November 30, 1992, 2.74 feet below the natural rim.

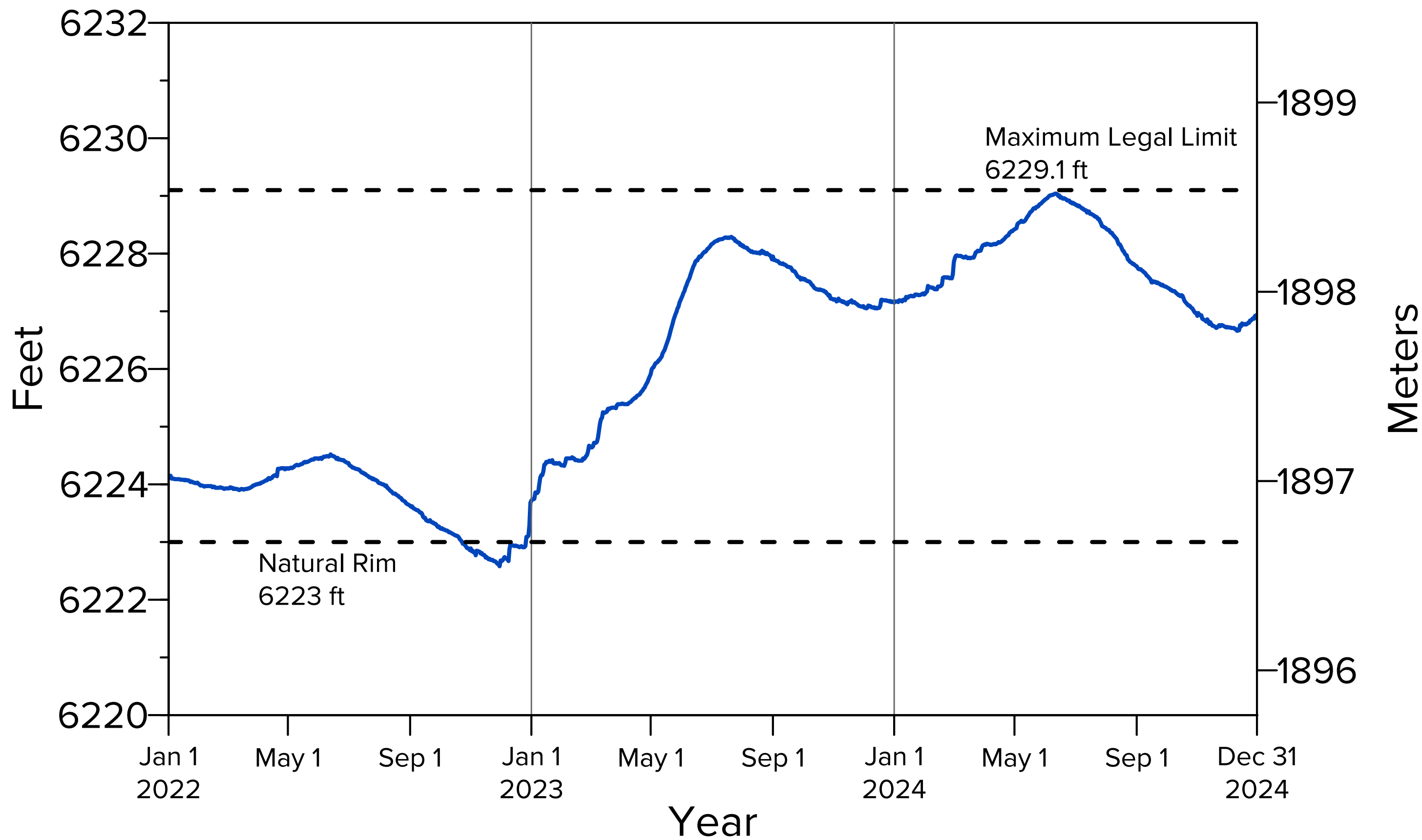
Data source: U.S. Geological Survey level recorder in Tahoe City.



Lake surface level

Daily in 2022, 2023, and 2024

The subset of lake surface data is extracted from the same data as in Fig. 8.1 for the most recent three years from 2022–2024. This more time-restricted presentation of recent lake level data better displays the annual patterns of rising and falling lake level in greater detail. For example, the rapid increases in water level directly result from storm events (e.g. spring of 2024). In 2024, on account of the typical precipitation rates, the winter and spring rises in lake level are evident and nearly reached the maximum legal limit (6,229.1 ft) of the lake. Snowmelt in spring continued the rise in lake level, but after June 11, the water level slowly fell as a result of outflow and evaporation from the lake. Increases at the end of 2024 were a result of winter precipitation.
Data source: U.S. Geological Survey level recorder in Tahoe City.



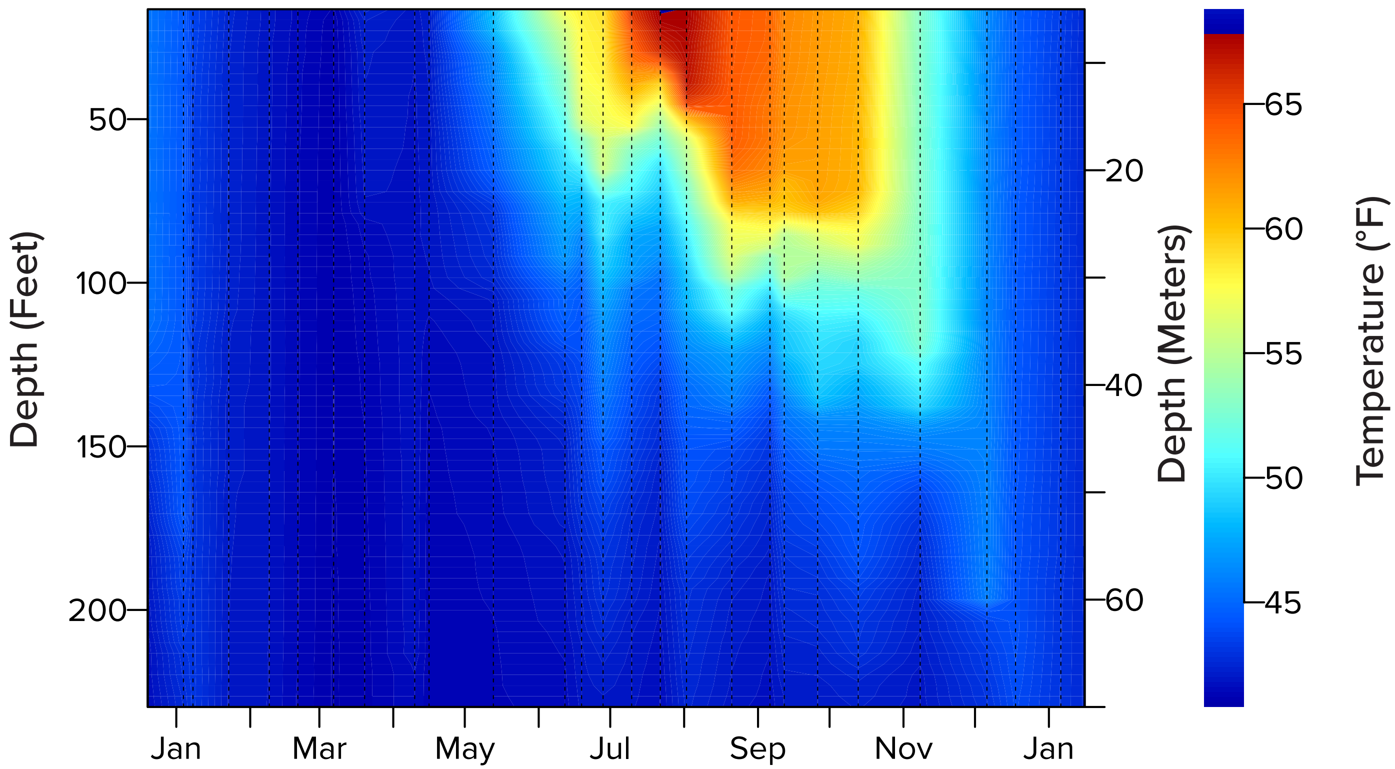
Water temperature profile

In 2024

Water temperature profiles are measured in the lake using a CTD (conductivity, temperature, depth) profiler on the days indicated by the dashed vertical lines (25 sampling events in 2024). The measured temperature is accurate to within 0.005 °F. The vertical distribution of water temperature is a very important lake attribute as it is directly related with water density within the lake.

During the summer months, the warmer, lighter water (warmer colors) remains suspended at the lake surface above the thermocline in the region known as the epilimnion. The temperature in the upper 230 feet (70 m) of Lake Tahoe is displayed as a color contour plot. In the early part of 2024, the lake temperature followed the typical seasonal pattern. In February and March, the lake surface was at its coldest, while it was at its warmest in August before fall cooling took place.

Data source: TERC lake monitoring.

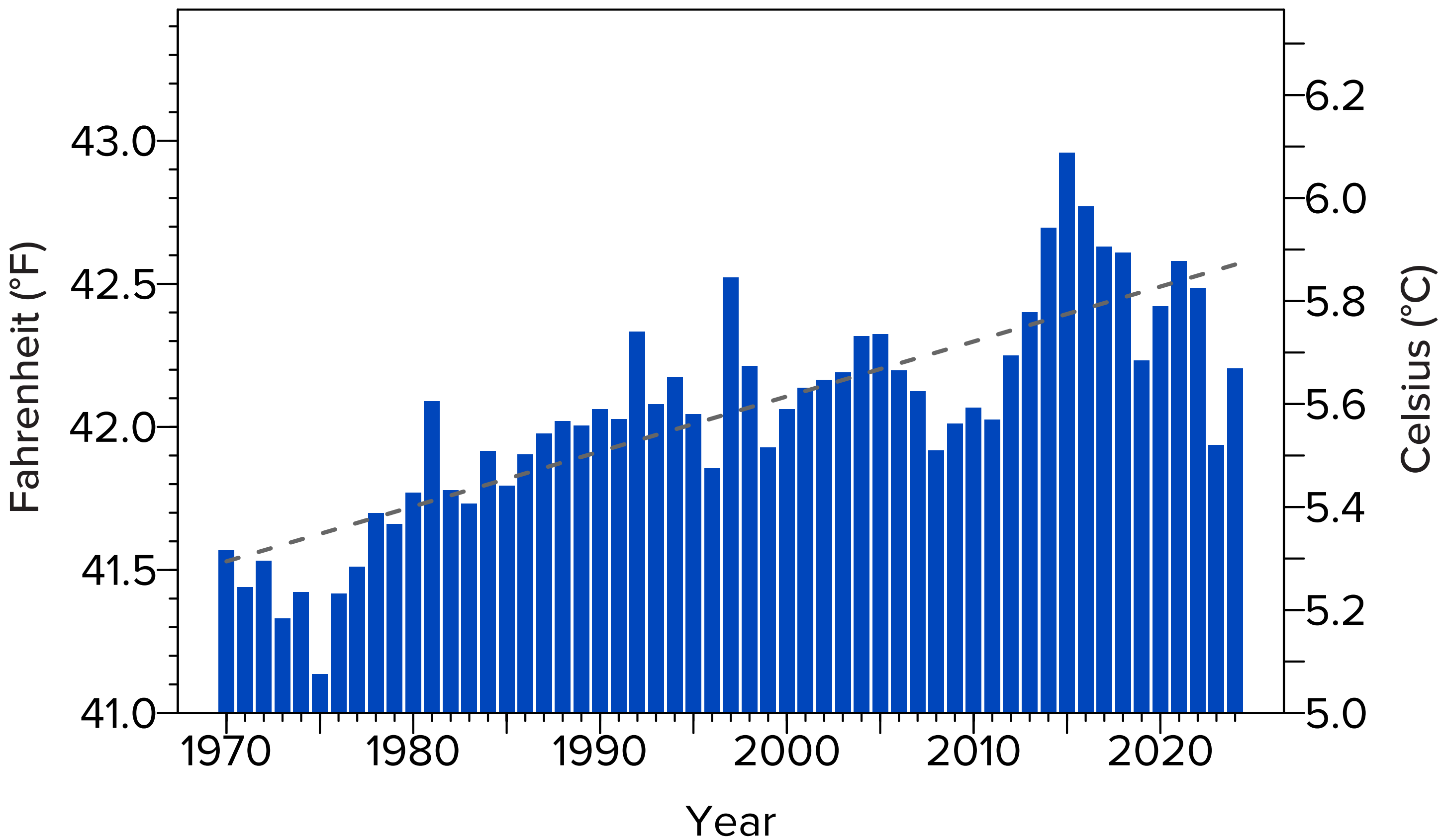


Annual average water temperature

Since 1970

The volume-averaged temperature of the lake for each year since 1970 is shown in the figure below. Under the assumption of a linear relationship, the trend line indicates that water temperature has increased by approximately 1.1 °F (0.6 °C) since 1970. The annual rate of warming is 0.21 °F/decade (0.12 °C/decade). The monthly temperature profile data from the top to the bottom of the lake has been smoothed, and any seasonal influences were removed to best show the long-term trend. The 2024 annual average water temperature of 42.2 °F (5.67 °C) was below the trendline and slightly higher than 2023 (0.3 °F or 0.15 °C).

Data source: TERC lake monitoring.

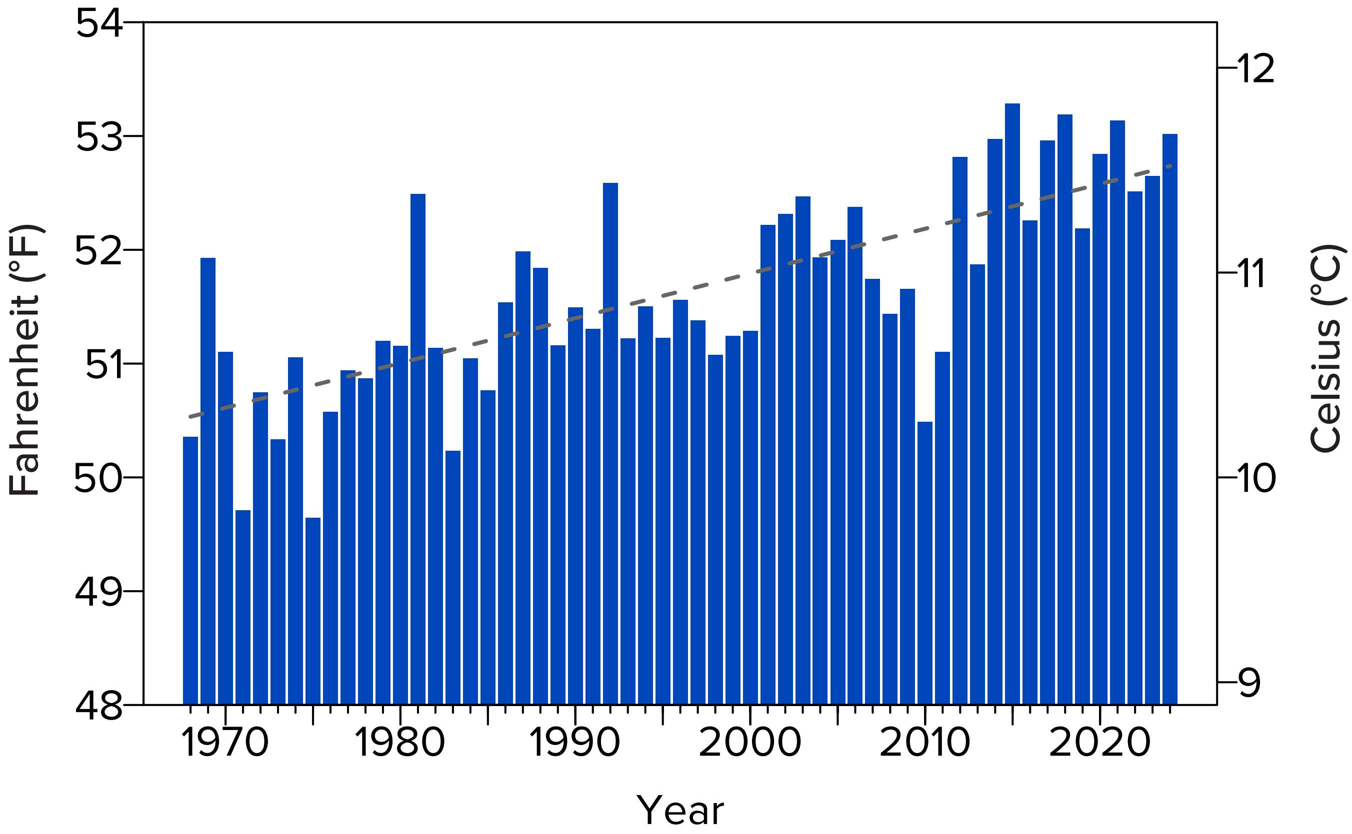


Annual surface water temperature

Yearly since 1968

Surface water temperatures (measured at a depth of 5 feet) have been recorded monthly at the Mid-lake and Index stations from TERC's research vessels since 1968 and from four research buoys since 2007. Despite year-to-year and longer cyclical variability, the annual average surface water temperatures continue to show an increasing trend, which has significant potential implications for the ecology of the lake. The average temperature in 1968 was 50.4 °F (10.2 °C). For 2024, the average surface water temperature was 53.0 °F (11.7 °C), just above the long-term trend, under the assumption of a linear regression. The overall rate of warming given from this regression of the lake surface is 0.39 °F (0.22 °C) per decade.

Data source: TERC lake monitoring.



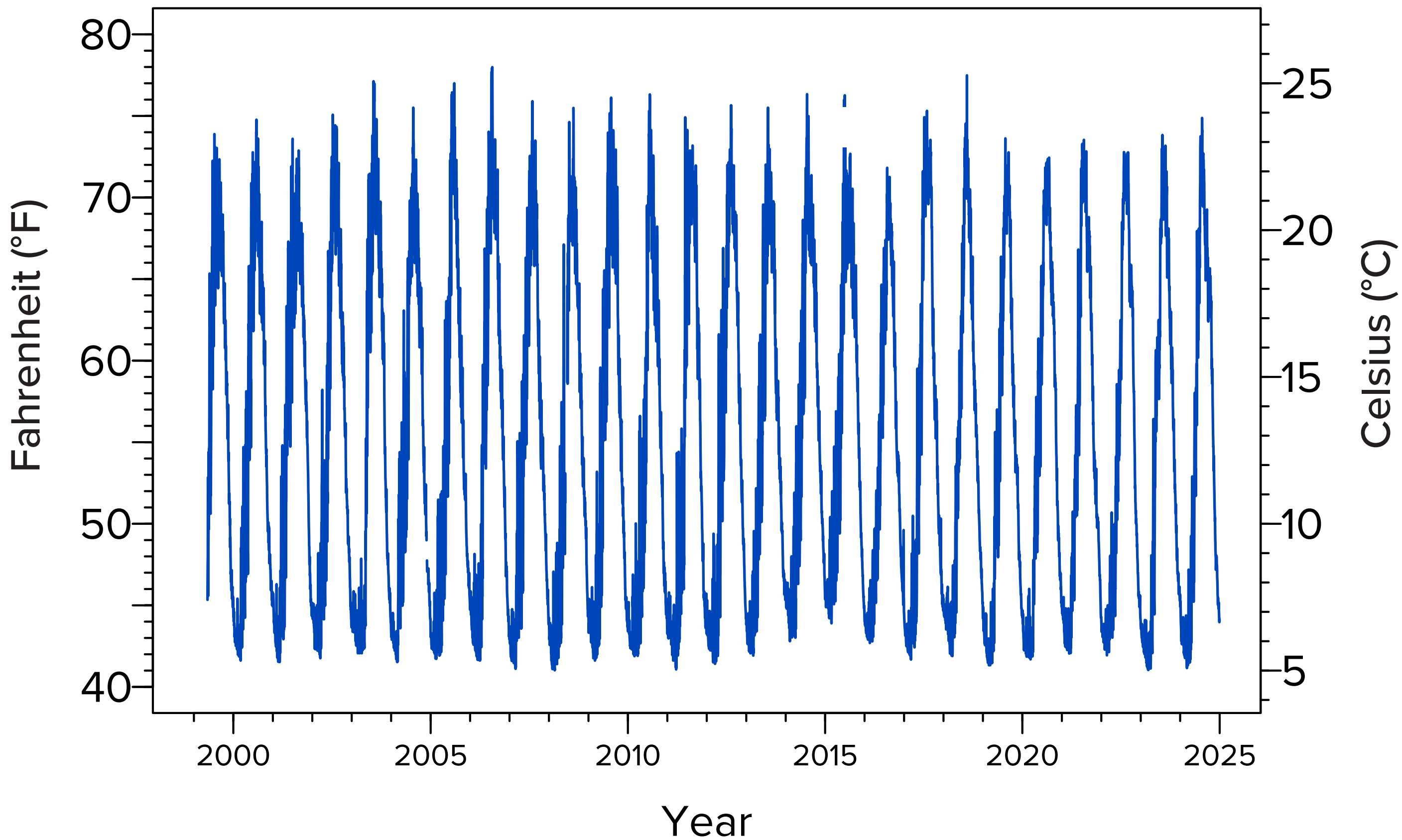
Maximum daily surface water temperature

Surface temperature measured since 1999 every 2 minutes

The maximum daily surface water temperature follows a sinusoidal pattern, with the temperature being in equilibrium with the air temperature and other meteorological variables. In 2024, the highest maximum daily surface water temperature (summer) was 74.9 °F (23.8 °C), recorded on July 22. While these are not the warmest temperatures on record, these are the highest observed values since 2019. The lowest maximum daily surface water temperature (winter) was 41.5 °F (5.1 °C), which was recorded on March 4. This was relatively warm, due in part to the absence of deep mixing.

These data are collected from thermistors at a depth of 5 feet (1.5 m) that are attached to four research buoys located over the deepest parts of the lake. The highest daily value from among the four buoys is considered as the daily maximum.

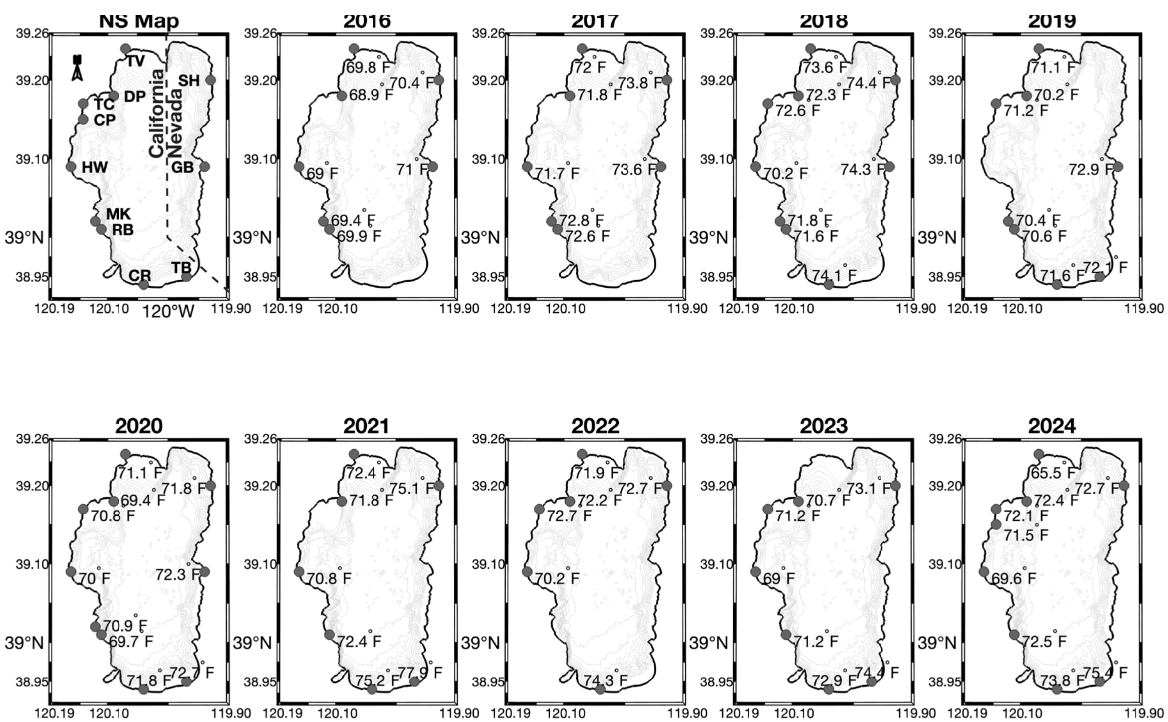
Data source: TERC lake monitoring.

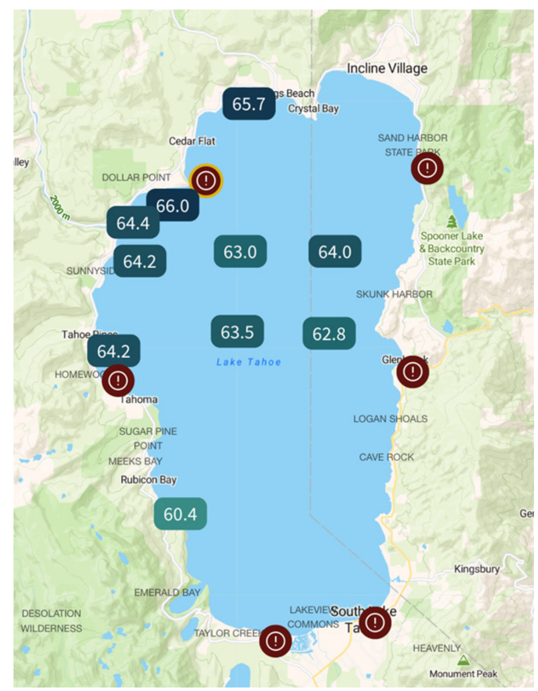


Maximum annual nearshore water temperature

Surface temperature measured by nearshore sensors

In 2014, TERC began installing a network of nearshore water quality monitoring stations around the perimeter of Lake Tahoe. The monitoring program aims to improve understanding of water quality variability in the nearshore zone. In 2024, there were 10 active stations and 1 thermistor chain in Homewood installed around Lake Tahoe, including one station on Cascade Lake, which feeds into Lake Tahoe. Each station consists of an optical instrument measuring turbidity (clarity), algal concentration, and dissolved organic matter concentrations, dissolved oxygen, along with a Conductivity Temperature Depth (CTD) sensor, measuring conductivity, water temperature, water depth, and wave height. An underwater cable connected to shore power and internet enables a real-time data feed with high resolution data every 30 seconds. Nearshore Sensor Stations (clockwise from top in the figure below): Tahoe Vista (TV), Sand Harbor (SH), Glenbrook (GB), Timbercove (TB), Camp Richardson (CR), Rubicon Bay (RB), Meeks Bay (MK), Homewood (HW), Sunnyside (SS), Tahoe City (TC), and Dollar Point (DP). Data from these stations can be viewed in real-time from (https://tahoe.ucdavis.edu/real-time-conditions). Conditions reported in the middle of the lake are from the moored buoys that also report in real-time (described in the next section). In the second figure, the stations are shown reporting in real-time. Stations shown with an exclamation mark were not reporting the day the data was retrieved (July 7, 2025). Data source: TERC lake monitoring.



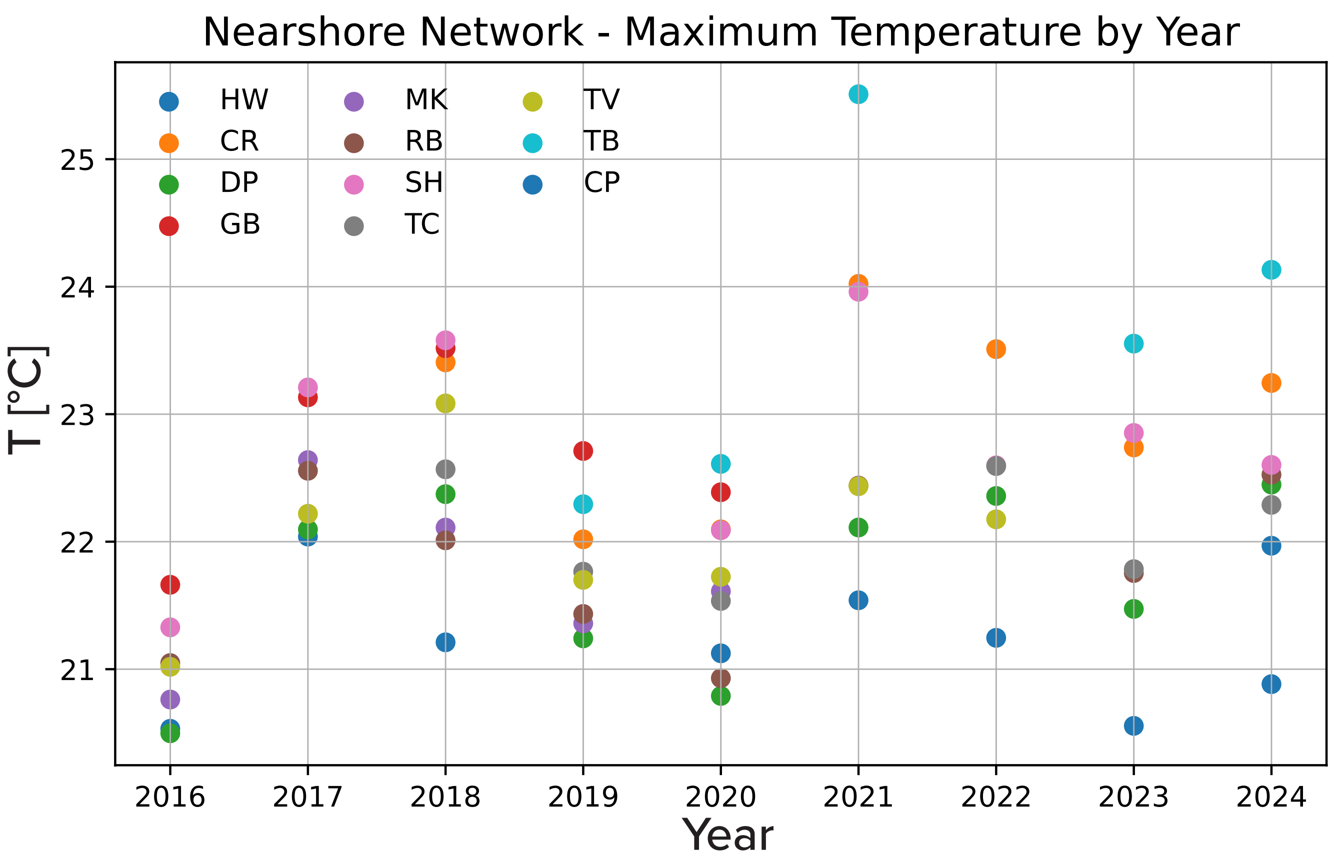


Maximum annual nearshore water temperature, continued

Surface temperature measured by nearshore sensors

The strategic locations of the nearshore sensor network allow us to characterize the spatial heterogeneity of Lake Tahoe's nearshore while identifying the lake locations that tend to exhibit warmer temperatures as well as the locations with the most striking impact from the wind. The figure below shows an evident increase in the water temperature at all sites [Tahoe Vista (TV), Sand Harbor (SH), Glenbrook (GB), Timbercove (TB), Camp Richardson (CR), Rubicon Bay (RB), Meeks Bay (MK), Homewood (HW), Sunnyside (SS), Tahoe City (TC), and Dollar Point (DP)] since 2016. The eastern shore tends to be warmer than the western shore because of the usual southwestern winds (the wind pushes the warmer surface water towards the east). The southern shore is exhibiting a rapid increase in temperature, likely due to the broad sediment shelf and shallow water column.

Data source: TERC lake monitoring.

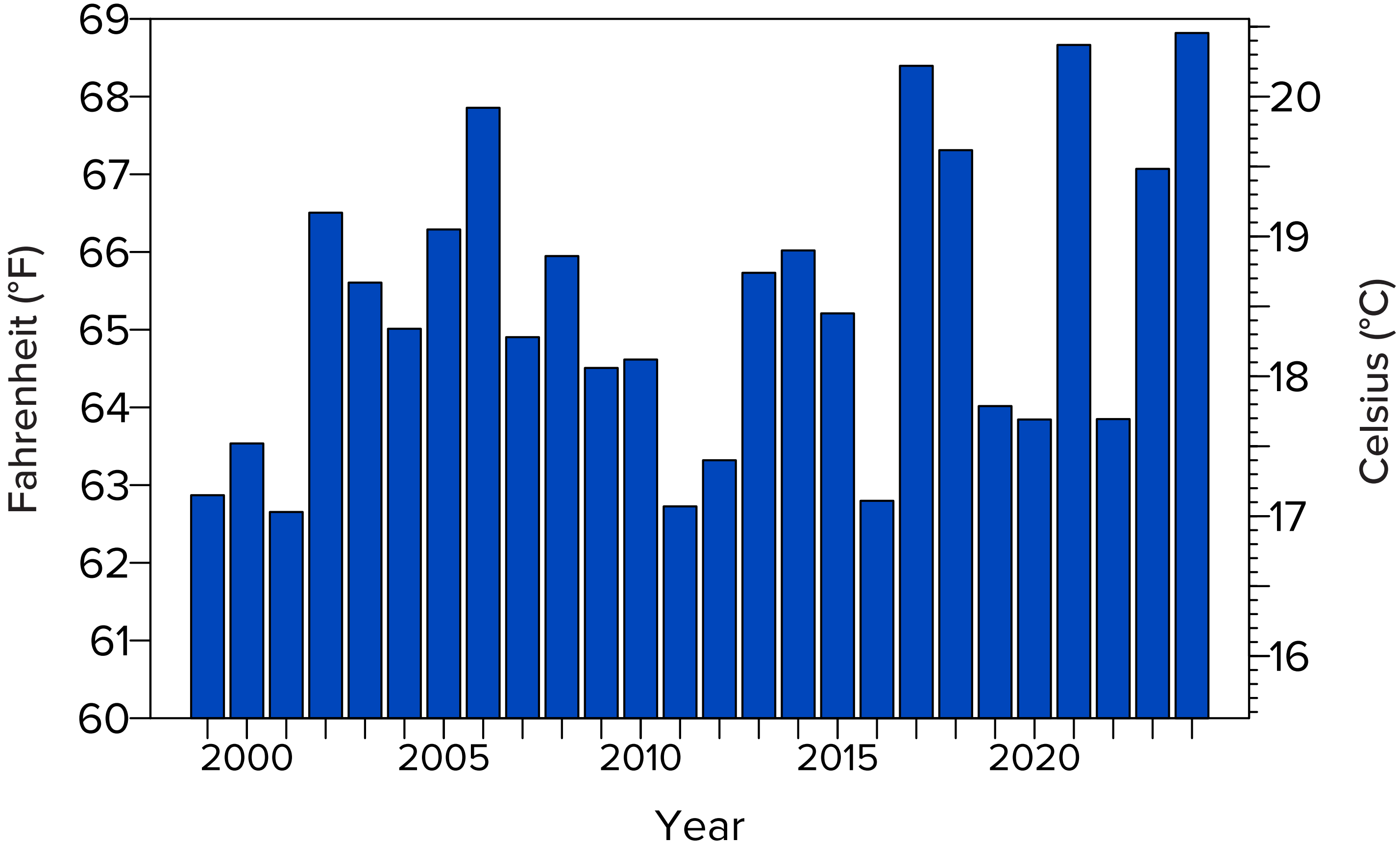


July average surface water temperature

Measured since 1999 every 2 minutes

Surface water temperature has been continuously recorded since 1999 from four NASA/UC Davis buoys in the center of the lake. Shown here are 25 years of average surface water temperatures in the month of July when water temperatures are typically at their warmest and the greatest number of people are recreating on the lake. In 2024, July surface water temperature was relatively warm. It averaged 68.8 °F (20.5 °C). This was increase over the previous year and the warmest year in our observation record. The long-term average is 65.3°F (18.5°C) for the 26-year period of record. These data are collected from thermistors at a depth of 5 feet (1.52 m) that are attached to four buoys located over the deepest portions of the lake. The data can also be accessed from our real-time data page. (https://tahoe.ucdavis.edu/real-time-conditions)

Data source: TERC lake monitoring.



Deep water temperature

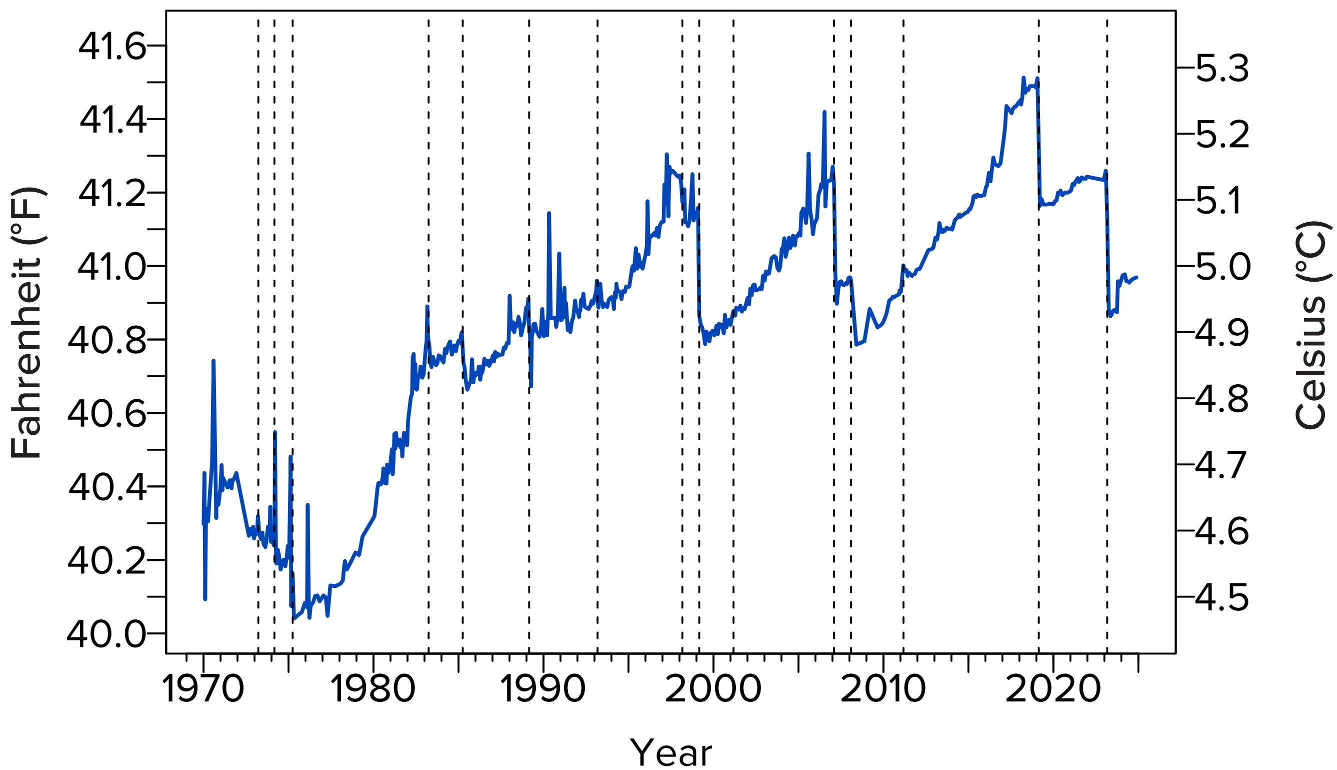
Monthly since 1970

The water temperature at a depth of 1,320 feet (400 m) is indicative of conditions in the deeper waters (hypolimnion) of Lake Tahoe. The deep-water temperatures show a complex pattern of warming and sudden cooling. During deep mixing events (the dashed vertical lines), the temperature can drop "precipitously" over a short period of time, although these drops are generally less than 0.3 °F. The last time one of these deep mixing events occurred was in 2023. The heating of the bottom water along with the fluctuations in temperature when deep mixing does not occur is an area of current research.

In general, bottom temperatures are warming. Complete vertical mixing is an event that allows a large amount of heat to escape from the lake. In 2023, there was deep mixing (see the next figure) and water temperatures dropped by 0.4 °F from 41.26 °F to 40.86 °F. Between the last two deep mixing events in 2011 and 2019, the rate of water warming was 0.07 °F/yr.

In 2024, the deep water temperature ranged from 40.95 °F to 40.98 °F (just under 5 °C).

Data source: TERC lake monitoring.



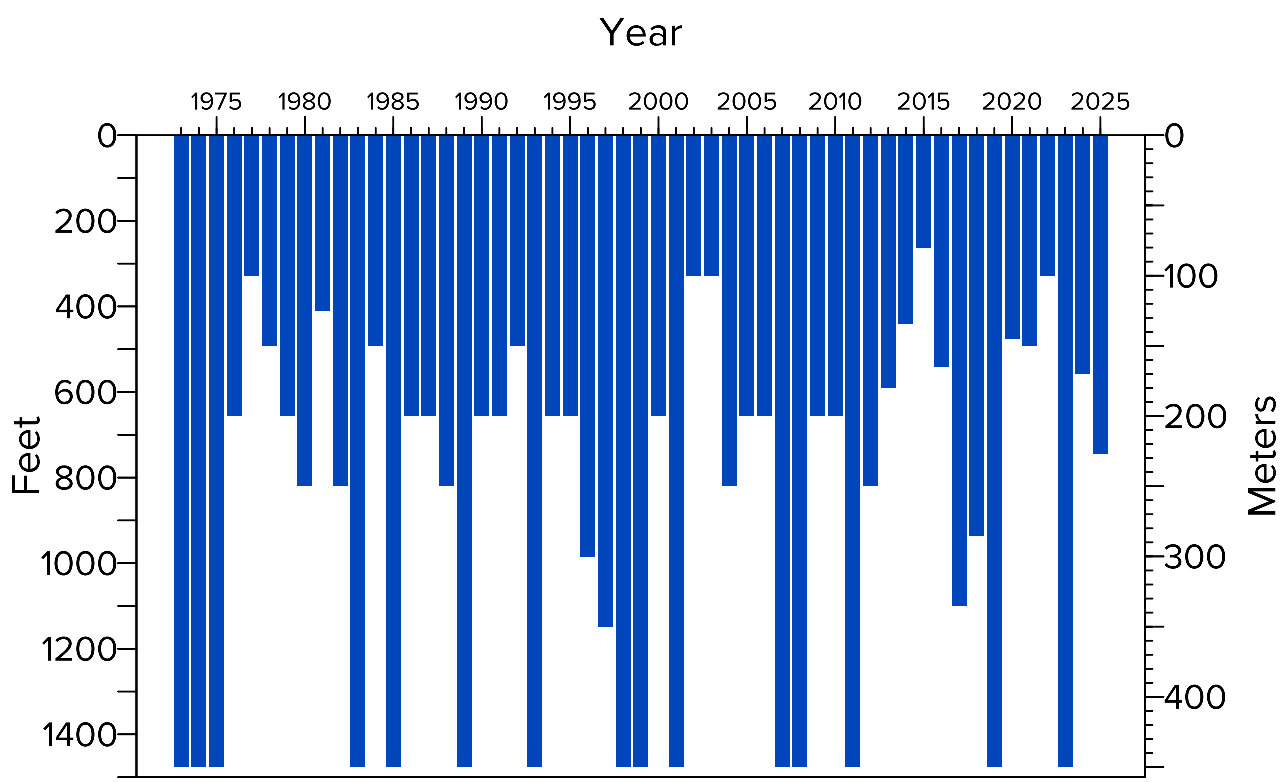
Depth of mixing

Yearly since 1973

The water of Lake Tahoe vertically mixes each winter as surface waters cool and sink downward. In a lake as deep as Tahoe, the intensity of cooling in winter determines how deep the lake mixes vertically with the full mixing event reaching the deepest areas of the lake. Mixing depth has profound impacts on lake ecology and water quality. Deep mixing brings nutrients to the surface, which promote algal growth. It also carries oxygen downward to deep waters, promoting aquatic life throughout the water column.

The deepest mixing typically occurs between February and March. Unlike 2023 when a deep mixing event occurred, 2024 only had a partial mixing event. On March 18, 2024, Lake Tahoe was observed to have mixed fully to a depth of 558 feet (170 m). Deeper mixing did not occur because there wasn't a prolonged enough episode of cooling to trigger a deep mixing event. Continuous temperature measurements off Glenbrook provided additional confirmation data.

Data source: TERC lake monitoring.

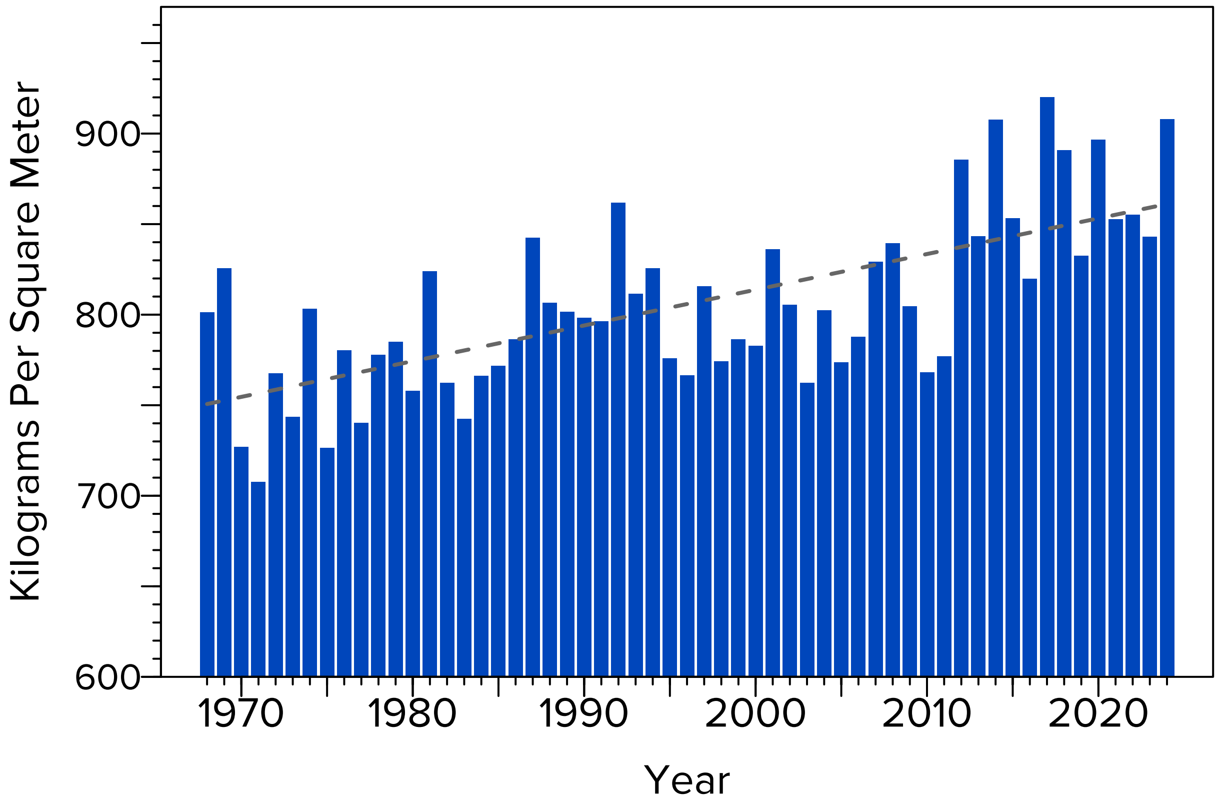


Lake stability index

Since 1968

Increasing stability poses a potential threat to all lakes. When the lake has a vertical distribution of temperature, it has a corresponding distribution of density. Warmer and lighter water remains at the surface (known as the epilimnion) above the colder and denser water below (known as the hypolimnion). As the temperature difference between top and bottom increases, the lake is said to become more stable (e.g. greater resistance to mixing). The stability index is a measure of the energy required to vertically mix the lake when it is density stratified. The average stability index for the upper 330 feet (100 m) of Lake Tahoe is plotted for the period of May through October each year. The values are derived from temperature profiles taken at the Index Station at approximately 10- to 20-day intervals. There has been an overall increase in lake stability by 13.8 percent in the last 56 years. In years where overturn does not take place, oxygen renewal to the hypolimnion will not take place. While not as high as the highest value observed on record (2017), it is the second highest observed.

Data source: TERC lake monitoring.

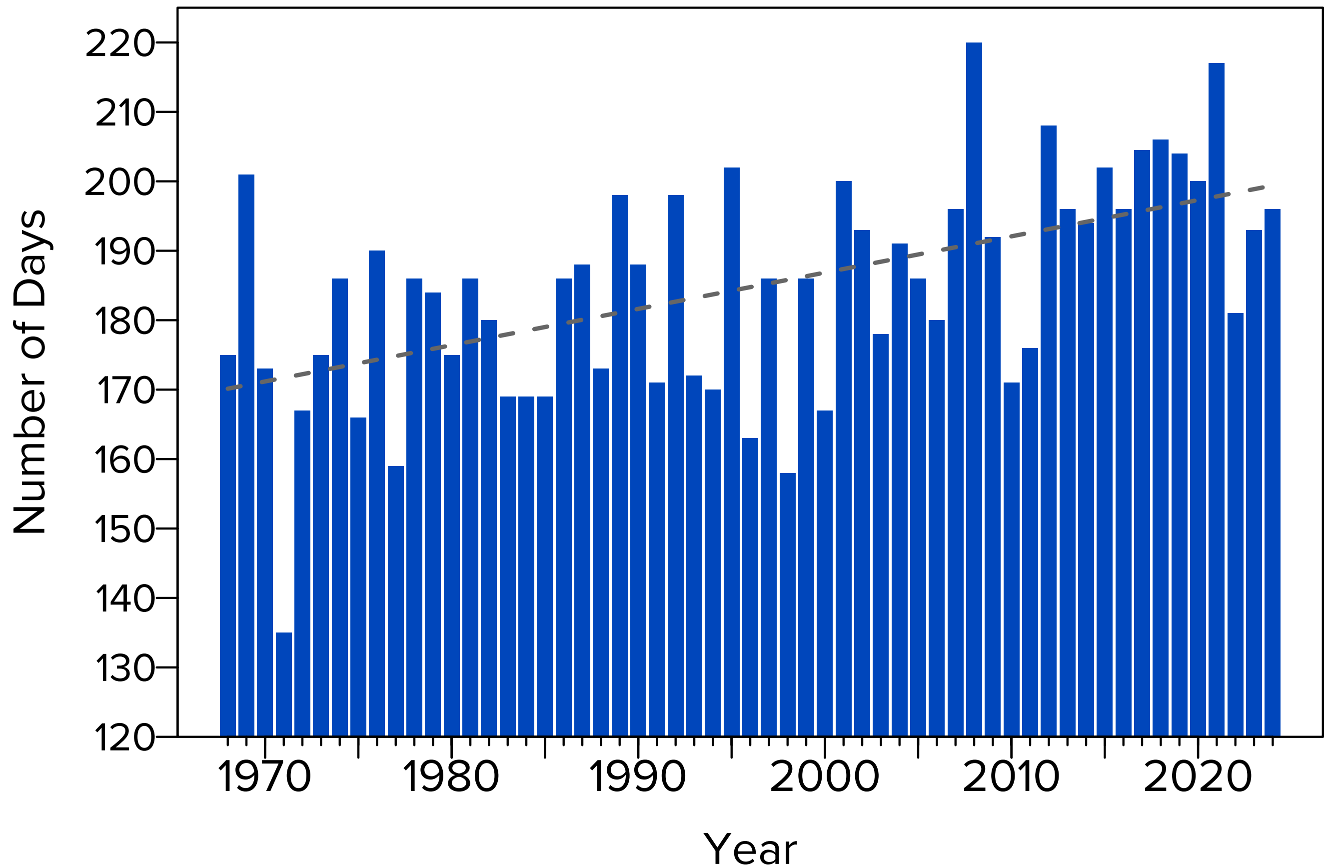


Stratified season length

Since 1968

The stability index is a measure of the energy required to vertically mix the lake that can be evaluated for every day of the year. We define the stratification season as the number of days when the stratification index exceeds a value of 600 kilograms per square meter. Since 1968, the length of the stratification season has increased by 29 days, albeit with considerable year-to-year variation. In 2024, the length of the stratified season was 196 days and just below the long-term linear regression. As the stratification season lengthens, the potential for deep mixing events decreases.

Data source: TERC lake monitoring.



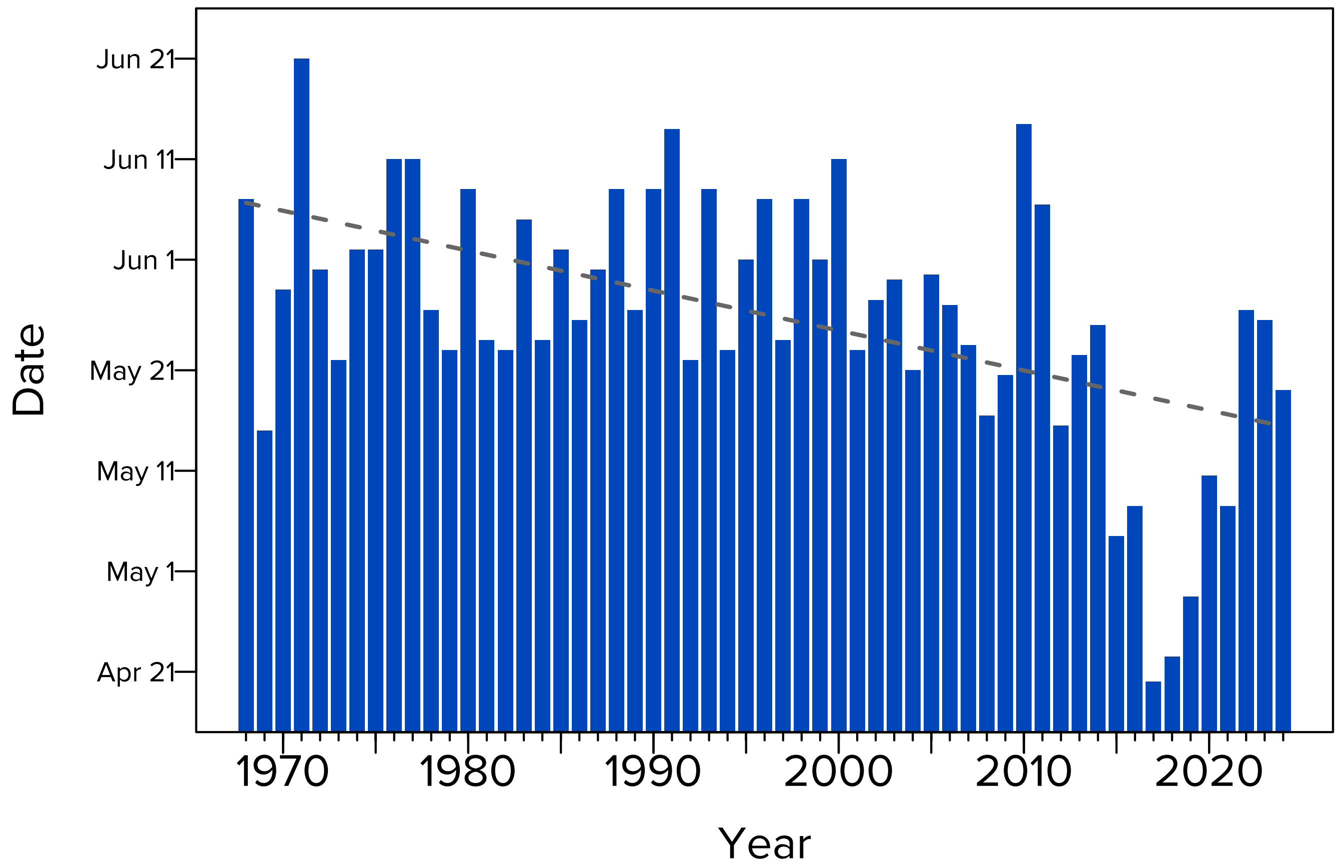
Beginning of the stratification season

Since 1968

The amount of time that Lake Tahoe is stratified has been increasing since 1968. One reason for this is the increasingly early arrival of spring as evidenced by the earlier commencement of stratification.

In 2024, the stratification commenced relatively late, on May 18 (Day 139). This was slightly later two weeks later than the long-term trend line would have suggested. The timing of the start of stratification and how it interacts with the snow melt run-off is important for the water clarity of the lake.

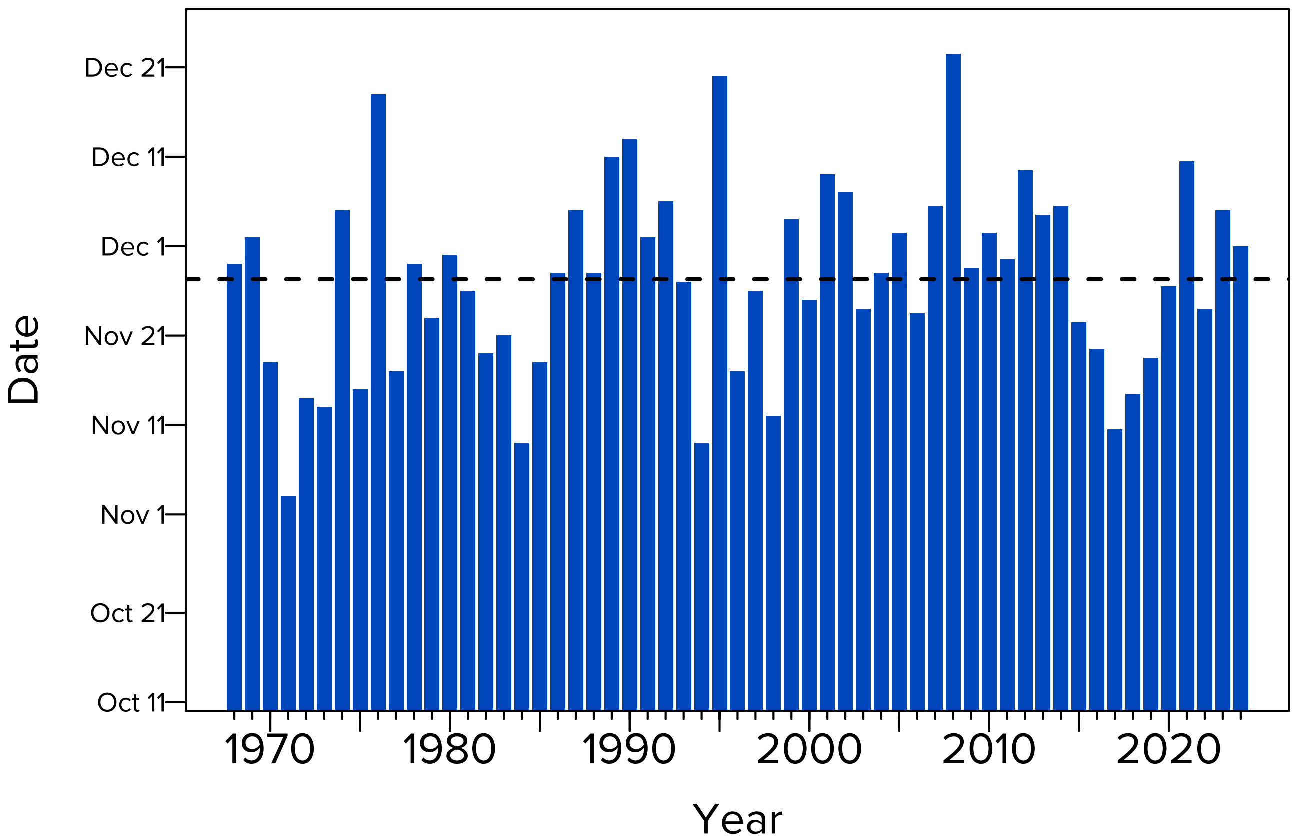
Data source: TERC lake monitoring.



End of stratification season

Since 1968

The amount of time that Lake Tahoe is stratified appears to have increased by almost a month since 1968 (described in the previous figure). The end of the stratification season has been extended, but not as much as the onset of stratification. Over the 56-year record, the end of stratification appears to have been extended by approximately one week. Although the trend is not statistically significant, extended duration of stratification can have important implications for lake mixing and water quality, such as the buildup of nitrate at the bottom of the lake and the timing of deep-water mixing events. The dashed black line indicates the long-term mean for the end of stratification date. In 2024, the end of stratification closely matched the long-term mean. Data source: TERC lake monitoring.

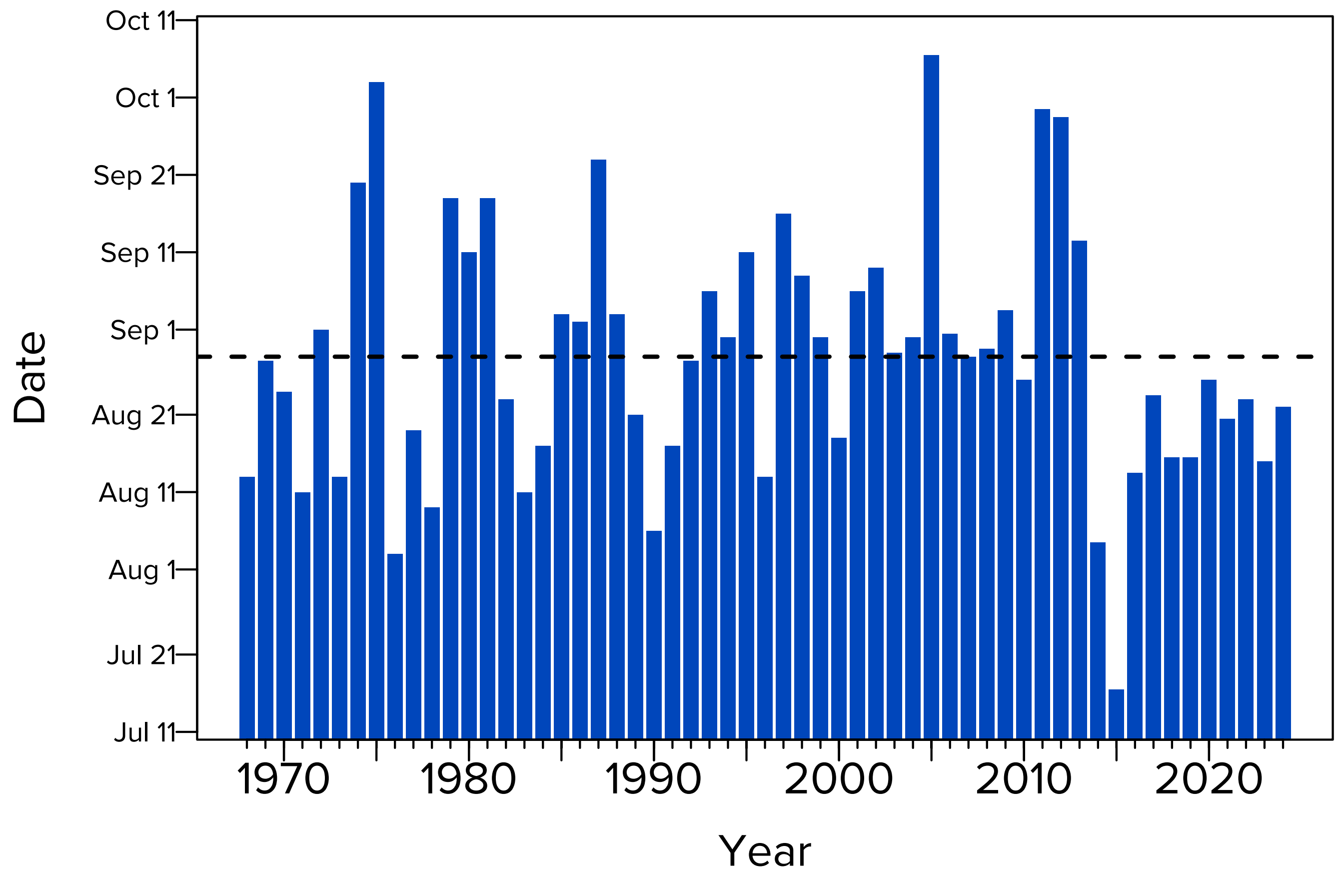


Peak of stratification season

Since 1968

Over the last eleven years the occurrence of the peak of stratification has been earlier than the long term mean date. The day of the year when lake stratification reaches its maximum value is the peak of stratification season. There is considerable year-to-year variation, but over time there has been no statistically significant change in when the peak occurs. The dashed line shows the long-term mean. In 2024, the peak occurred on August 21.

Data source: TERC lake monitoring.



Onset of snowmelt pulse

Yearly since 1961

Although the date on which the onset of snowmelt commences varies from year to year, since 1961 it has shifted earlier by an average of over 16 days. The snowmelt pulse is calculated and averaged for five streams—the Upper Truckee River, Trout Creek, Ward Creek, Blackwood Creek, and Third Creek. This shift is statistically significant and is one effect of climate change at Lake Tahoe. In 2024, the onset of snowmelt pulse occurred on April 11, twelve days after the predicted regression line. According to the regression line, since 1961, the onset of the snowmelt pulse has occurred earlier by 17 days than it did in 1961. The onset of the pulse is calculated as the mean flow for the period January 1 to July 15. In the past, the peak of the stream hydrograph was used to estimate this metric. The later snowmelt pulses arrive, the more likely the receiving water will be stratified and prevent the water from reaching the hypolimnion.

Data source: U.S. Geological Survey stream monitoring.