Item 5Ci.
BCWMC 7-17-25

Cavanaugh Lake
2024 Water Quality Monitoring



The Bassett Creek Watershed Management Commission

Stewardship of the Ȟaȟá Wakpádaŋ/Bassett Creek Watershed
to improve ecosystem health and reduce flood risk

The Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality conditions in the watershed's 10 priority lakes since 1972. This monitoring is performed to detect changes or observe trends in water quality, inform pollution modeling and studies, and target future projects and programs. A summary of 2024 monitoring efforts on Cavanaugh Lake is provided below.

At a glance: 2024 monitoring results

In 2024, the BCWMC monitored Cavanaugh Lake (also called Sunset Pond) for the following:

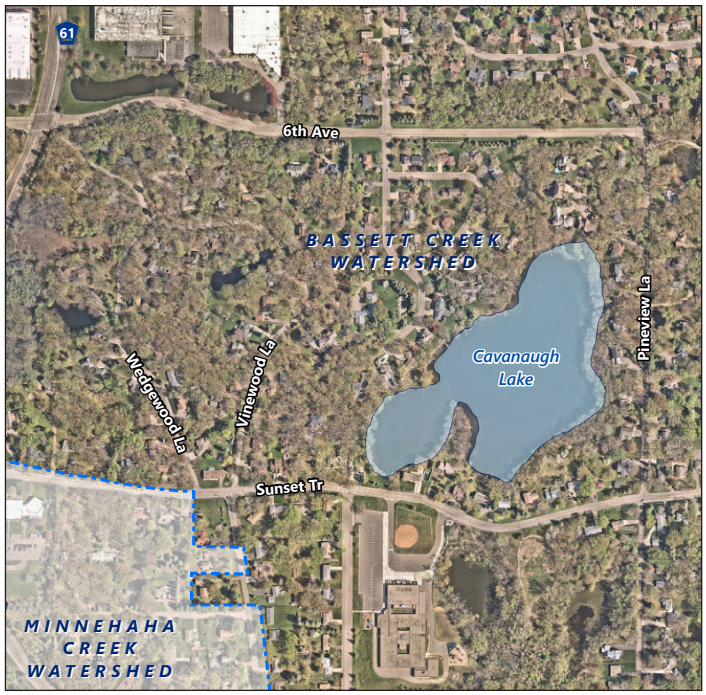
- Water chemistry (nutrients, chlorophyll *a*, chloride)
- Water clarity and dissolved oxygen
- Phytoplankton and zooplankton (microscopic plants and animals)
- Macrophytes (aquatic plants)

Results of 2024 monitoring show that Cavanaugh Lake met the applicable Minnesota Pollution Control Agency (MPCA) and BCWMC water quality standards for chlorides, Secchi disc (a measure of clarity), and total phosphorus but did not meet the MPCA and BCWMC standard for chlorophyll *a*. Other results include the following:

- The number of plant species observed in the lake was better than the Minnesota Department of Natural Resources (MNDNR) Plant Index of Biotic Integrity (IBI) threshold in June and August; the highest number of species observed in the lake by the BCWMC was during this monitoring period.
- Floristic Quality Index (FQI) values, a measure of plant species quality, were better than the MNDNR Plant IBI threshold in June and August. The June value was the highest value observed in the historical monitoring record.
- Aquatic invasive species (AIS) observed in 2024 were curly-leaf pondweed (CLP), purple loosestrife, and reed canary grass; none were at problematic levels.
- The 2024 phytoplankton summer average was lower than summer averages from 1994 to 2019.
- The reduction in phytoplankton, available food for zooplankton, and fish predation reduced zooplankton numbers. Consequently, the 2024 zooplankton summer average was lower than summer averages in 1994 and 2019 (the highest summer averages measured during the monitored period) but higher than the summer average of 1998 (the lowest summer average measured).
- The results of an AIS suitability analysis indicate that the water quality of Cavanaugh Lake meets the suitability requirements for rusty crayfish and spiny waterflea, but only partially meets the suitability requirements for Chinese mystery snail, faucet snail, zebra mussel, and starry stonewort.

About Cavanaugh Lake

BCWMC classification	Priority-2 shallow lake
Watershed area	126 acres
Lake size	13 acres
Average depth	5.3 feet
Maximum depth	10.8 feet
Downstream receiving waterbody	Plymouth Creek (during large rain events)
Location (city)	Plymouth
MPCA impairments	None
Aquatic invasive species	Curly-leaf pondweed, purple loosestrife, reed canary grass
Public access	No



Recommendations

- Continue to provide education and information to lake users to reduce the chance of AIS introduction
- Continue water quality and biological monitoring at a 5-year frequency

2024 water chemistry

2024 was a very wet year. According to data from the Minnesota Department of Natural Resources, the April through June period was the wettest on record for Minnesota. During this period, the Twin Cities received 17.3 inches of precipitation, 5.9 inches above normal. March, July, and August were also wet, with 13.5 inches of precipitation in the Twin Cities—3.4 inches above normal. As shown in the figures to the right, phosphorus and chlorophyll a concentrations in Cavanaugh Lake increased and Secchi disc depth decreased over the course of the 2024 monitoring season. Above normal precipitation in 2024 increased stormwater runoff which carried additional total phosphorus to the lake. The additional total phosphorus caused increased chlorophyll a concentrations in the lake which decreased water clarity.

Total phosphorus levels

While phosphorus is necessary for plant and algae growth, excessive phosphorus leads to excessive algae growth, decreased water clarity, and water quality impairment. Some common sources of phosphorus are fertilizers, leaves and grass clippings, atmospheric deposition, soil erosion, and aquatic plant die-off (such as CLP). Phosphorus can also be released from lake sediments when dissolved oxygen concentrations are very low.

- BCWMC/MPCA standard: Summer average of 60 micrograms per liter (µg/L) or less
- Observed range: Low of 20 µg/L in March to a high of 73 µg/L in early August (see figure at right and on page 3)
- Summer average: 57 µg/L (met BCWMC/MPCA standard)

Chlorophyll *a* levels

Chlorophyll *a* is a pigment in algae and generally reflects the amount of algae growth in a lake. Lakes that appear clear generally have chlorophyll *a* levels of less than 15 micrograms per liter (µg/L).

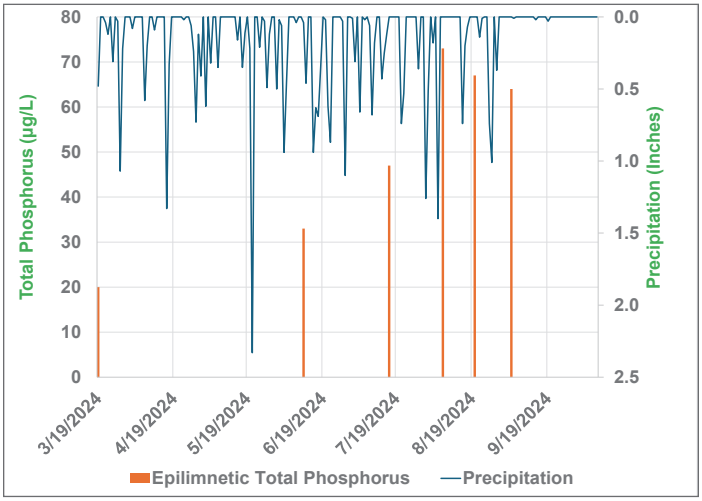
- BCWMC/MPCA standard: Summer average of 20 µg/L or less
- Observed range: Low of 4.0 µg/L in March to a high of 50.7 µg/L in early September (see figure at right and on page 3)
- Summer average: 35.3 µg/L (failed to meet BCWMC/MPCA standard)

Water clarity

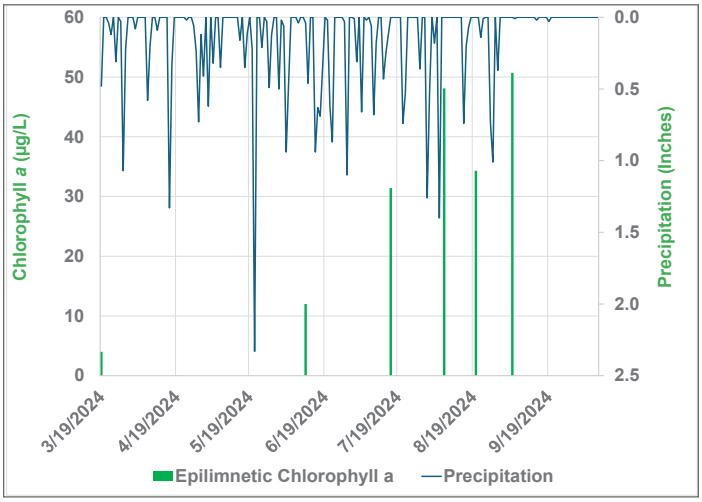
Water clarity is often affected by the number of algae or other photosynthetic organisms in a lake. It is usually measured by lowering an 8-inch “Secchi” disc into the lake; the depth at which the disc’s alternating black-and-white pattern is no longer visible is considered a measure of the water’s clarity.

- BCWMC/MPCA standard: Summer average of 1.0 meter or more
- Observed range: From a high of 2.4 meters in March to a low of 0.6 meters in early September (see figure below and on page 3)
- Summer average: 1.0 meter (met BCWMC/MPCA standard)

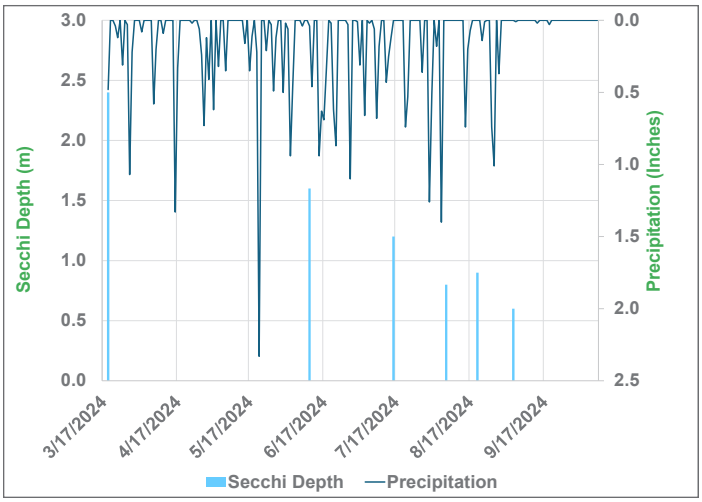
2024 precipitation and total phosphorus



2024 precipitation and chlorophyll *a*

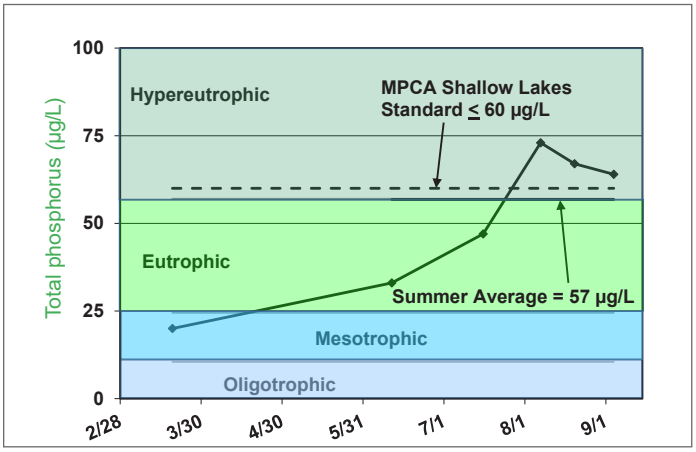


2024 precipitation and water clarity

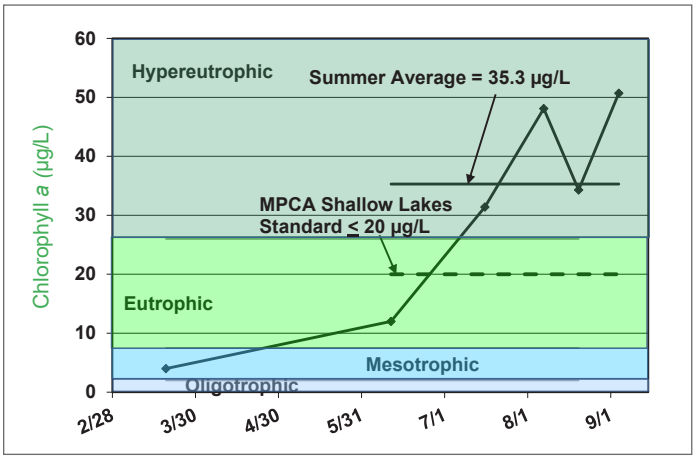


2024 water chemistry monitoring, cont.

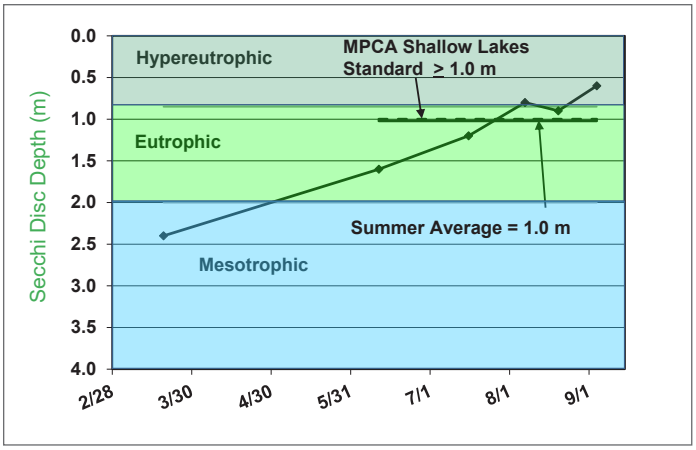
2024 total phosphorus trends



2024 chlorophyll *a* trends



2024 water clarity (Secchi depth) trends



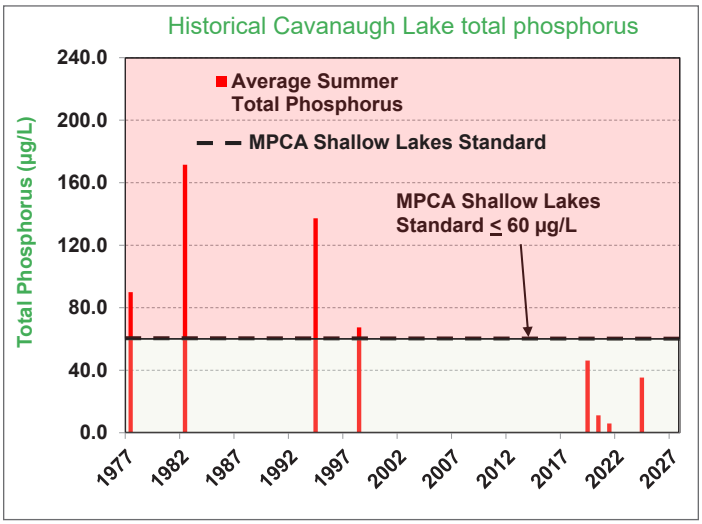
Definitions

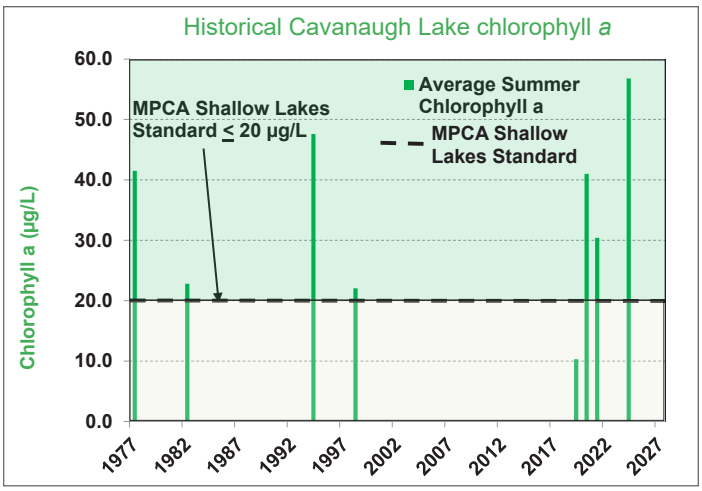
- **Hypereutrophic:** Nutrient-rich lake conditions characterized by frequent and severe algal blooms and low water clarity; excessive algae can significantly reduce lake oxygen levels
- **Eutrophic:** Lake condition characterized by abundant accumulation of nutrients supporting dense growth of algae and other organisms; decay of algae can reduce lake oxygen levels
- **Mesotrophic:** Lake condition characterized by medium levels of nutrients and clear water
- **Oligotrophic:** Lake condition characterized by a low level of dissolved nutrients, high oxygen content, sparse algae growth, and very clear water

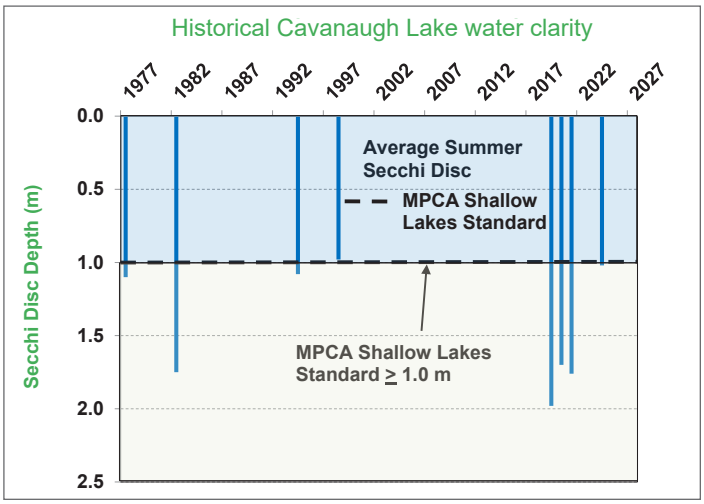


Water chemistry monitoring: 1977–2024

Summer water quality in Cavanaugh Lake has been monitored since 1977. The figures below show summer averages (June through September) of total phosphorus, chlorophyll *a*, and Secchi disc depth from 1977–2024. Summer averages for total phosphorus and chlorophyll *a* failed to meet the MPCA/BCWMC standard in 1977, 1982, 1994, and 1998, and chlorophyll *a* failed to meet the standard in 2024. Secchi disc depth met the standard in all years except 1998. In recent years chlorophyll a concentrations have increased and Secchi disc transparency has declined despite declining total phosphorus concentrations. The cause of these water quality changes is not apparent from review of the available data.





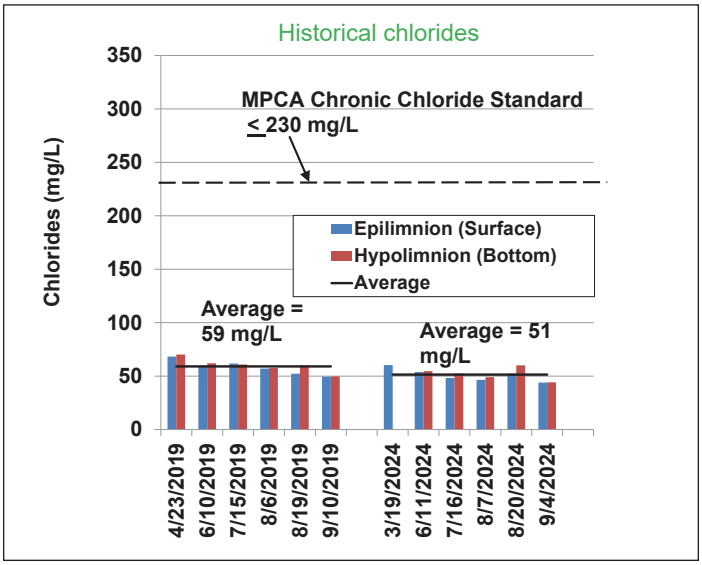


Chloride levels in 2019 and 2024

Chloride concentrations in area lakes have increased since the early 1990s, when many government agencies switched from sand or sand/salt mixtures to salt for winter road maintenance. When snow and ice melt, the salt goes with it, washing into lakes, streams, wetlands, and groundwater. It only takes 1 teaspoon of road salt to pollute 5 gallons of water so that it can no longer support freshwater life. The pollution is essentially permanent, as there is no easy or affordable way to remove chloride from water.

Because high chloride concentrations can harm fish, zooplankton, and plant life, the MPCA has established maximum and chronic chloride standards. The maximum standard is the highest concentration of chloride that aquatic organisms can be exposed to for a brief time with zero-to-slight mortality. The chronic standard is the highest chloride concentration that aquatic life can be exposed to indefinitely without causing chronic toxicity. Chronic toxicity is defined as a stimulus that lingers or continues for a long period, often one-tenth of the life span or more. Chronic effects can include mortality, reduced growth, reproduction impairment, harmful changes in behavior, and other nonlethal effects. A lake is considered impaired for chlorides if two or more measurements exceed the chronic criterion (230 mg/L) within a 3-year period or if one measurement exceeds the maximum criterion (860 mg/L).

All chloride measurements in Cavanaugh Lake in 2019 and 2024 were well below both the maximum and chronic chloride standards. The 2024 average annual chloride concentration (51 mg/L) was slightly lower than the 2019 average (59 mg/L).



Macrophytes (aquatic plants)

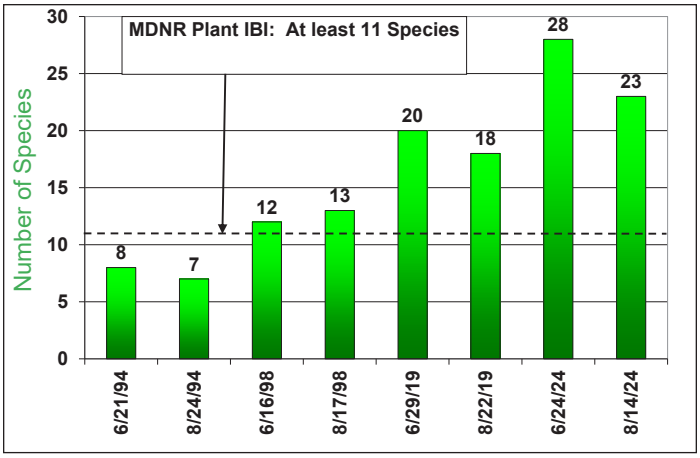
Lake Plant Eutrophication Index of Biological Integrity (IBI)

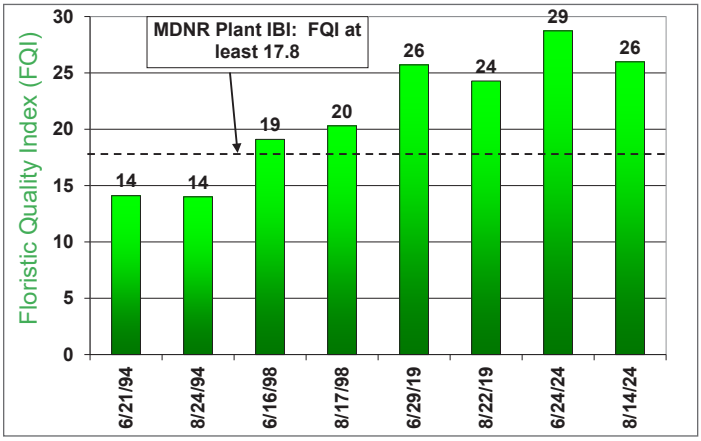
Eutrophication (excessive nutrients) can have detrimental effects on a lake, including reducing the quantity and diversity of plants. The MNDNR developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication. The Lake Plant Eutrophication IBI includes two metrics: (1) the number of species in a lake and (2) the "quality" of the species, as measured by the Floristic Quality Index (FQI). The MNDNR has determined a threshold for each metric. Lakes that score below the thresholds contain degraded plant communities and are likely stressed from anthropogenic (human-caused) eutrophication.

Cavanaugh Lake plant survey data from 1993 to 2024 were assessed to determine Plant IBI trends. The figures at right show the number of species and the FQI scores for that period compared to the MNDNR Plant IBI thresholds.

- **Number of species:** A shallow lake, such as Cavanaugh Lake, meets the MNDNR Plant IBI threshold if it has at least 11 species. During the period examined, the number of species in Cavanaugh Lake ranged from seven to 28, exceeding the MNDNR Plant IBI threshold from 1998 through 2024. Twenty-three to 28 species were observed in the lake in 2024, the highest number of the historical record.
- **FQI values (quality of species):** The MNDNR Plant IBI threshold for shallow lakes, as measured by FQI, is a minimum value of 17.8. During the period examined, FQI values in Cavanaugh Lake ranged from 14 to 29, exceeding the MNDNR Plant IBI threshold from 1998 through 2024. In 2024, FQI scores ranged from 26 in August to 29 in June, the highest score to date.







Phytoplankton and Zooplankton

Samples of phytoplankton, microscopic aquatic plants, were collected from Cavanaugh Lake to evaluate water quality and the quality of food available to zooplankton (microscopic animals). Phytoplankton numbers fluctuated over the 2024 sampling season—increasing in June, decreasing in July, increasing in August, and decreasing in September—but consistently reflected good water quality (see figure on page 6). Green algae, a good food source for the lake's zooplankton, were dominant in March, July, and September. Blue-green algae were dominant in June and August. Although blue-green algae are associated with water quality problems and can be a source of health concerns, the low numbers of blue-green algae in the lake throughout the monitored period are consistent with good water quality and no health concerns.

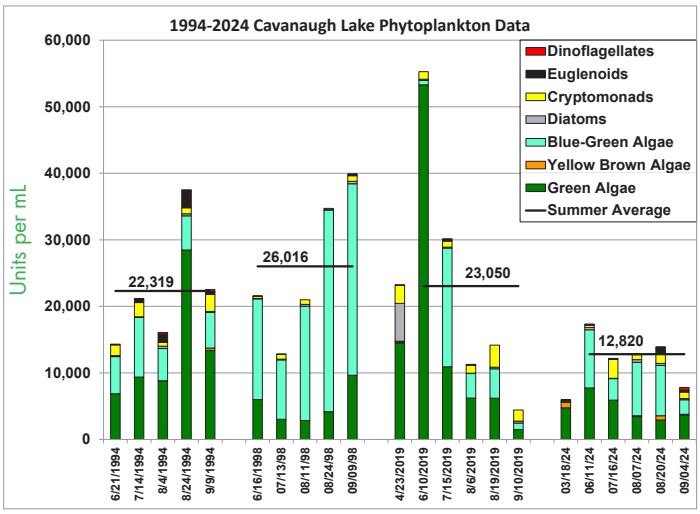
The 2024 phytoplankton summer average of 12,820 units per milliliter was lower than the summer averages from 1994 to 2019, ranging from 22,319 to 26,016 units per milliliter.

Unlike phytoplankton, zooplankton do not produce their own food. As "filter feeders," they eat millions of small algae; given the right quantity and species, they can filter the volume of an entire lake in a matter of days. They are also valuable food for planktivorous fish and other organisms.

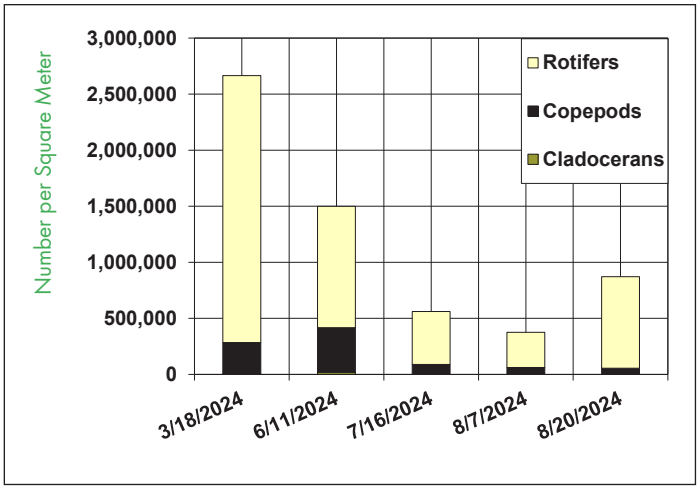
The 2024 zooplankton composition reflects the impact of fish predation on the community. Zooplankton numbers were highest in spring, before the spring hatch of fish, and declined quickly when the newly hatched fish began feeding. Small rotifers dominated the zooplankton community throughout the monitored period; copepods were consistently present, but cladocerans were not observed from July through September. The absence of cladocerans during mid-to-late summer was likely due to fish predation. Fish generally select the largest zooplankters they see and prefer cladocerans to copepods because they swim slowly and lack the copepods' ability to escape predation by jerking or jumping out of the way. Rotifers are the least preferred food for fish. Because rotifers and copepods do not graze as heavily on algae as the larger cladocerans, they generally have a limited impact on the lake's water quality. This suggests that future Cavanaugh Lake water quality improvement efforts should focus on phosphorus management to reduce the nutrients contributing to algae growth.

Zooplankton are limited by food availability and predation. Good quality food (green algae) was consistently present in 2024; however, the lower numbers of phytoplankton reduced the quantity of food available to the zooplankton (see historical phytoplankton and zooplankton figures at right). This reduction in available food and fish predation reduced zooplankton numbers in 2024. Consequently, the 2024 summer average (938,182) was lower than summer averages in 1994 (1,118,342) and 2019 (1,097,616)—the highest summer averages measured during the monitored period. However, the 2024 summer average was higher than the 1998 average (187,324), when reductions in good quality food and fish predation reduced zooplankton numbers to the lowest summer average measured during the monitored period.

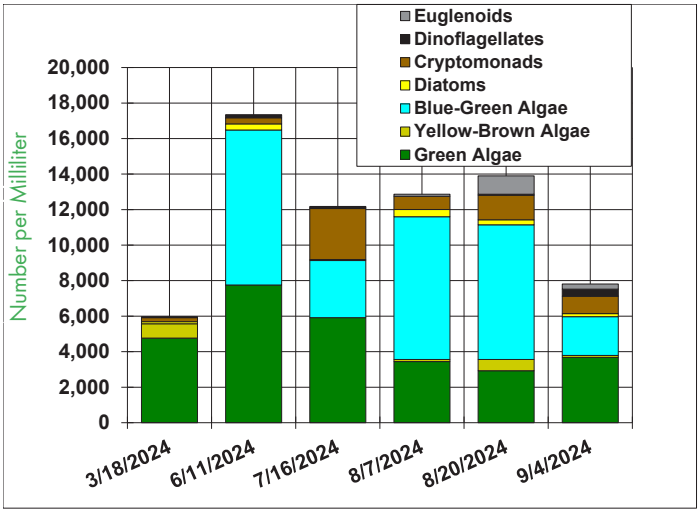
Cavanaugh Lake
historical phytoplankton



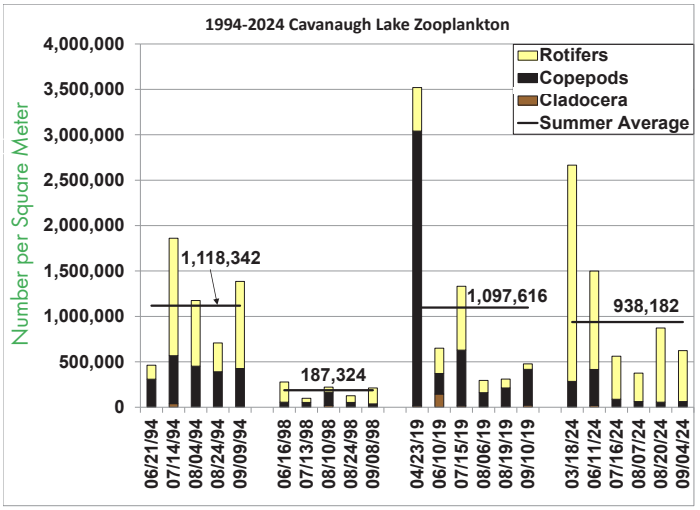
Cavanaugh Lake
2024 zooplankton



Cavanaugh Lake
2024 phytoplankton



Cavanaugh Lake
historical zooplankton





Aquatic invasive species

In 2024, three aquatic invasive species (AIS) were found to be present in Cavanaugh Lake but were not considered problematic.

- **Curly-leaf pondweed (Potamogeton crispus):** Curly-leaf pondweed (CLP) was first sighted in June 2019, when low-density growth was observed at two southwest bay sample sites. In June 2024, CLP was seen at three southwest bay sample sites. It was not problematic in 2024 because only a few scattered plants were found.
- **Purple loosestrife (Lythrum salicaria):** During a prior year's sampling in 2019, purple loosestrife was not observed in June, but was observed in a few scattered clumps along the northern shoreline in August. In June 2024, this emergent species was found at one location along the northwestern shoreline but was not observed in the August monitoring.
- **Reed canary grass (Phalaris arundinacea):** Reed canary grass was observed at a single location along the north shoreline in June and August of 2019. In 2024, reed canary grass was observed at two locations along the eastern shoreline and one in the southwest bay in June; it was observed at one location in the southwest bay in August.

Suitability of Cavanaugh Lake for other AIS

Many aquatic invasive species (AIS) in Minnesota have not yet been observed in Cavanaugh Lake, but could be introduced. For example, both zebra mussels and starry stonewort are present in nearby Medicine Lake but have not yet been observed in Cavanaugh Lake. A suitability analysis was performed to evaluate whether Cavanaugh Lake water quality would support the introduction of six AIS (starry stonewort, zebra mussels, spiny waterflea, faucet snail, Chinese mystery snail, and rusty crayfish).

The analysis compared 2024 water quality in Cavanaugh Lake with the water quality conditions required for each species, specifically evaluating total phosphorus, chlorophyll a, Secchi disc depth, trophic state index (TSI), water temperature, dissolved oxygen, specific conductance, pH, calcium, magnesium, sodium, alkalinity, hardness, and calcium carbonate. The results indicate that the water quality of Cavanaugh Lake meets the suitability requirements for rusty crayfish and spiny waterflea, but only partially meets the suitability requirements for Chinese mystery snail, faucet snail, zebra mussel, and starry stonewort. Hence, these species would likely survive but may not thrive in Cavanaugh Lake.