Northwood Lake 2019 water quality monitoring

Monitoring water quality in Northwood Lake

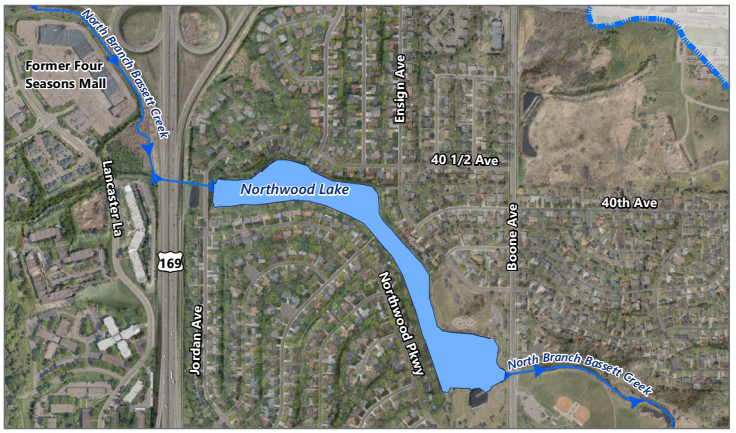
The Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality conditions in the watershed's 10 priority lakes since 1972. The purpose of this monitoring is to detect changes or trends in water quality and evaluate the effectiveness of efforts to preserve or improve water quality.

At a glance: 2019 monitoring results

In 2019, the BCWMC monitored Northwood Lake for:

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

Results of 2019 monitoring show that Northwood Lake did not meet applicable Minnesota Pollution Control Agency (MPCA) and BCWMC water quality standards for shallow lakes. Trend analyses indicate that water clarity has significantly declined over the past 20 years. In addition, the plant community did not meet the Minnesota Department of Natural Resources (MDNR) plant index of biotic integrity (IBI) standard for Floristic Quality Index (FQI), which measures the quality of the plant community (see page 4). However, the plant community has consistently improved since 2000. In 2019, the number of species in the lake met the state standard and FQI was close to meeting the standard. Curly-leaf pondweed was problematic in 2019, present at 92 percent of sample locations, with a high average density of 2.5 on a scale of 1 to 3 (increasing numbers indicate increasing density).



About Northwood Lake

BCWMC classification	Priority-1 shallow lake
Watershed area	1,294 acres
Lake size	15 acres
Average depth	2.7 feet
Maximum depth	5 feet
Ordinary high water level	885.5 feet
Normal water level	884.4 feet
Downstream receiving waterbody	North Branch Bassett Creek
Location (city)	New Hope
MPCA impairments	Nutrients
Aquatic invasive species	Curly-leaf pondweed, purple loosestrife, hybrid cattail, reed canary grass, yellow iris
Public access	Yes

Recommendations

- Continue to implement best management practices and capital improvement projects in the lake's watershed to improve the lake's water quality
- Consider management of curly-leaf pondweed to improve the lake's water quality by reducing phosphorus loading from plant die-off
- Continue water quality and biological monitoring

Water chemistry monitoring: 2019

Total phosphorus levels

While phosphorus is necessary for plant and algae growth, too much phosphorus leads to excessive algae, decreased water clarity, and water quality impairment. Some common sources of phosphorus are fertilizers, leaves and grass clippings in streets, atmospheric deposition, soil erosion, plant die-off (such as curly-leaf pondweed), and lake sediment, which can release phosphorus when oxygen concentrations are absent or very low.

- **BCWMC/MPCA standard:** 60 micrograms per liter (µg/L) or less.
- **Range:** Total phosphorus concentrations ranged from a low of 67 µg/L in June to a high of 280 µg/L in August. All concentrations were within the hypereutrophic category (very high nutrient content).
- **Summer average:** 142 µg/L (did not meet 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 which appear clear generally have chlorophyll *a* levels less than 15 micrograms per liter (µg/L).

- **BCWMC/MPCA standard:** 20 µg/L or less.
- **Range:** Chlorophyll *a* concentrations ranged from a low of 3.5 µg/L in June to a high of 52.0 µg/L in August. Concentrations were primarily in the hypereutrophic or eutrophic category, indicating poor water quality; however, there was one June sampling event when the concentration was in the mesotrophic category, indicating good water quality.
- **Summer average:** 24.3 µg/L (did not meet BCWMC/MPCA standard).

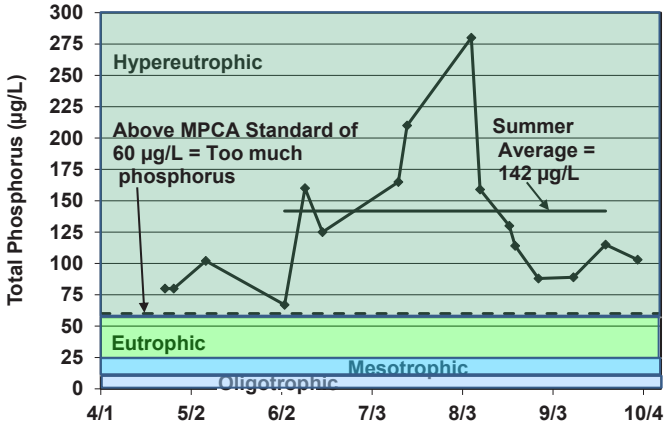
Water clarity

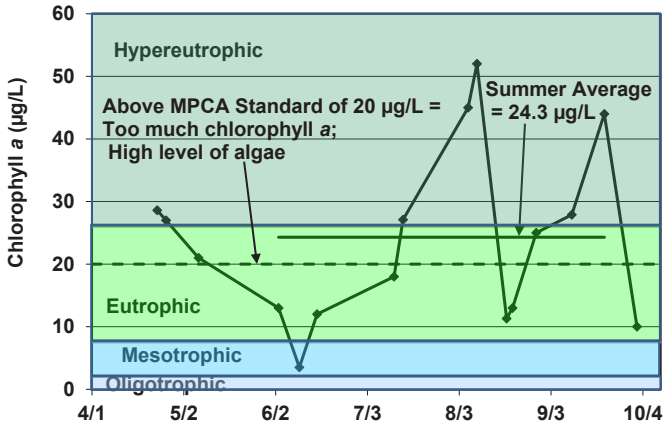
Water clarity is often affected by sediment and the amount of algae or other photosynthetic organisms in a lake. It is usually measured by lowering an 8-inch "Secchi" disc into the lake; the depth at which the disc's alternating black-and-white pattern is no longer visible is considered a measure of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

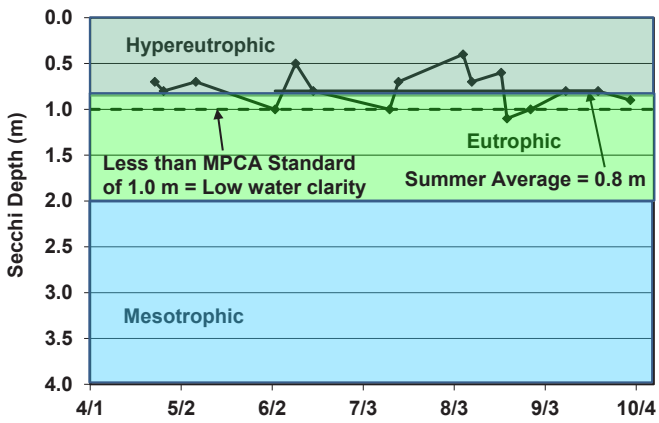
- **BCWMC/MPCA standard:** 1.0 meters or more.
- **Range:** From 0.4 meters in early August to 1.1 meters in late August. Throughout 2019, Secchi disc depths were in the hypereutrophic or eutrophic category, indicating poor water quality.
- **Summer average:** 0.8 meters (did not meet BCWMC/MPCA standard).

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 accumulation of dissolved nutrients, high oxygen content, sparse algae growth, and very clear water



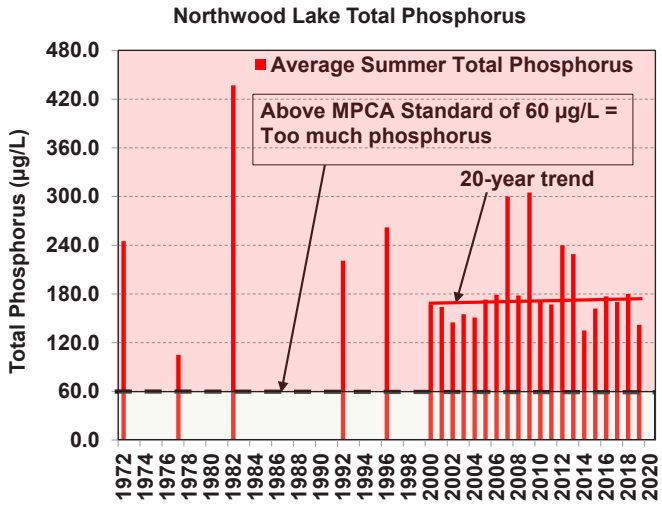


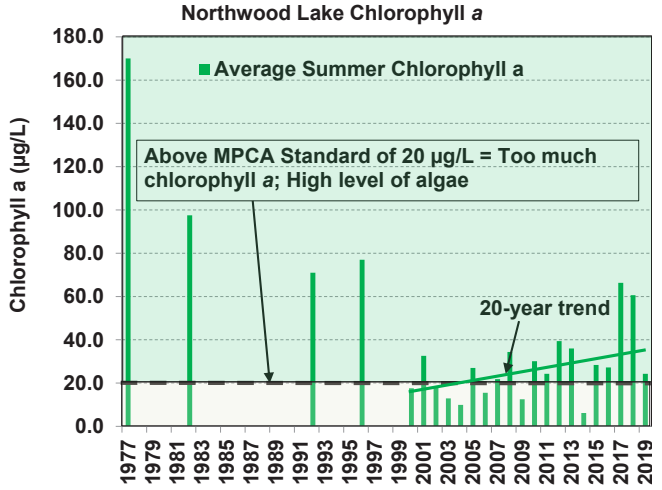


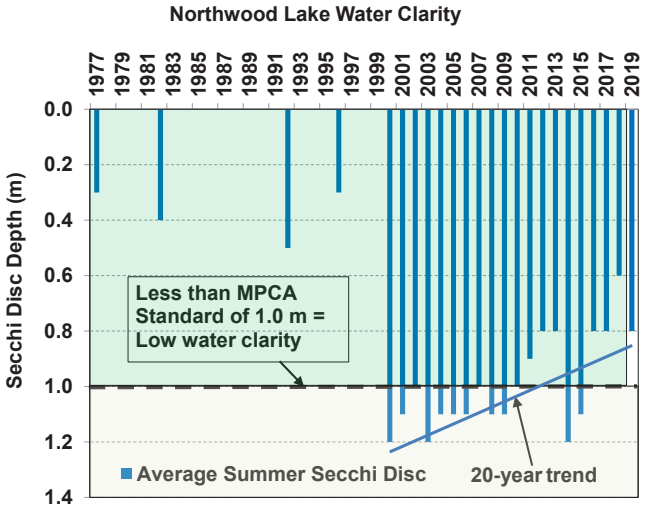
Water chemistry monitoring from 1972—2019: historical trends

Water quality in Northwood Lake has been monitored since 1972. Summer averages (June through September) of total phosphorus, chlorophyll *a*, and Secchi disc depth from 1972–2019 are shown in the figures below (left). Summer averages for phosphorus have failed to meet BCWMC/MPCA standards for the entire period of record. Chlorophyll *a* concentrations and Secchi disc depth failed to meet the standard 71 and 46 percent of the time, respectively.

Trend analyses show declining water quality with statistically significant decreases (95 percent confidence level) in water clarity (Secchi disc depth) over the last 20 years. Total phosphorus and chlorophyll *a* concentrations have also increased during this period, but not at statistically significant levels.







Chloride levels in 2019

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 melts, the salt goes with it, washing into lakes, streams, wetlands, and groundwater. It only takes 1 teaspoon of salt to permanently pollute 5 gallons of water. And, once in the water, there is no way to remove chloride.

Because high concentrations of chloride can harm fish and plant life, the MPCA established a chronic exposure chloride standard of 230 mg/l or less.

- **Range of chloride concentrations in Northwood Lake:** From a high of 195 mg/L, measured in April, to a low of 68 mg/L, measured in September. One reason the levels are staying below the standard is because the creek flows through the lake, likely carrying the chlorides downstream in early spring.
- **Average concentration:** 99 mg/L (meets MPCA standard)

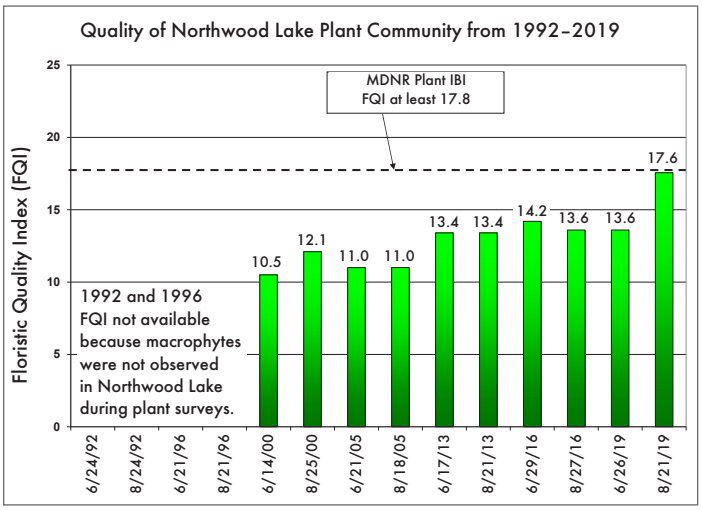
Macrophytes

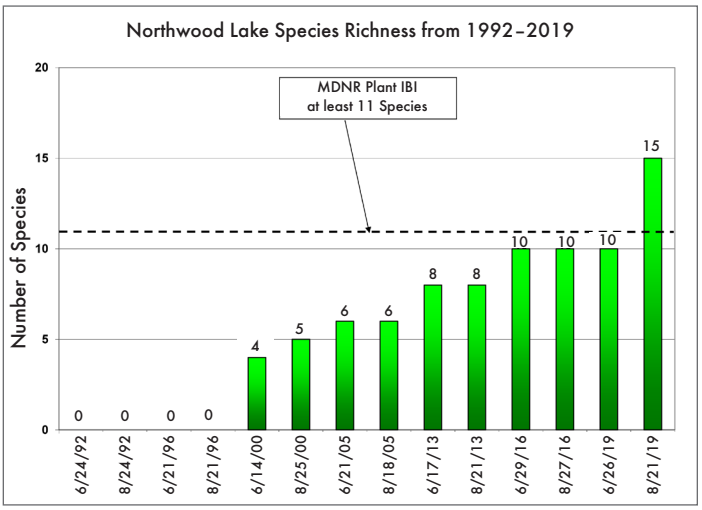
Lake Plant Eutrophication Index of Biological Integrity (IBI)

The MDNR developed metrics to determine the overall health of a lake's aquatic plant community. The Lake Plant Eutrophication Index of Biological Integrity (plant IBI) is expected to eventually be used by the MPCA to determine whether a lake is meeting the federal Clean Water Act standards, intended to protect aquatic life. The plant 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).

Plant survey data from 1992 through 2019 were assessed to determine plant IBI trends. The figures below show the Northwood Lake FQI scores and number of species for that period compared to the MDNR plant IBI standard.

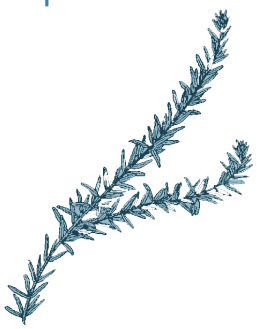
- **Number of species:** The number of species in Northwood Lake has increased from four species in 2000 to 15 species in 2019. August of 2019 was the first sample event in which the number of species observed in Northwood Lake was above the standard of 11 species. Some of the most common plants are shown below. The increase is attributed to a management technique implemented by the city of New Hope in 2000. From 2000 to 2003 the city placed barley straw at predetermined locations throughout the lake. As barley straw decays, it inhibits algal growth. This increases the water's transparency, allowing sunlight to reach the lake's bottom and aquatic plants to become established.
- **FQI values (quality of species):** The standard, as measured by FQI, is a value of 17.8 or higher. Similar to the number of species, FQI values for Northwood Lake have increased from 10.5 in 2000 to 17.6 in 2019, but still failed to meet the state standard.
- **2019 results:** Because FQI values are below the state standard, Northwood Lake may be considered impaired for aquatic plants.



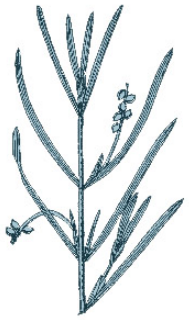


Commonly found aquatic species

Coontail
Ceratophyllum demersum
(native plant)

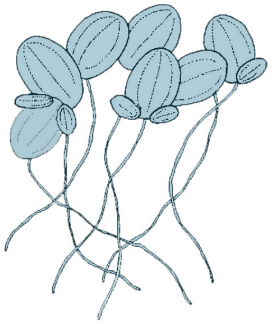


Canadian waterweed
Elodea canadensis
(native plant)



Flatstem pondweed
Potamogeton zosteriformis
(native plant)

Curly-leaf pondweed
Potamogeton crispus
(non-native invasive species)



Common duckweed
Lemna minor
(native plant)

Aquatic invasive species

In 2019, five invasive species were found in Northwood Lake.

- **Curly-leaf pondweed (*Potamogeton crispus*):** Curly-leaf pondweed has increased in extent and density since 2016. Though prevalent in 2016 (50% of sample locations in June), it coexisted with native plants at relatively low densities (average density of 1.4 out of 3) and was not problematic. Curly-leaf pondweed was problematic in June of 2019 when it was observed at 92 percent of sample locations, with an average density of 2.5. The surge and subsequent die-off of curly-leaf pondweed added phosphorus to the lake, resulting in increased algal growth and decreased water clarity.
- **Purple loosestrife (*Lythrum salicaria*):** This emergent species was observed along the shoreline at one location in June and two locations in August. Most plants had suffered damage from beetles introduced to control the purple loosestrife population, suggesting that the beetles were having the desired effect.
- **Hybrid cattail (*Typha glauca*):** Hybrid cattail was observed at two locations along the shoreline.
- **Reed canary grass (*Phalaris arundinacea*):** Reed canary grass was observed at two locations along the shoreline.
- **Yellow iris (*Iris pseudacorus*):** The first observation of yellow iris occurred in 2019 at one location. The appearance of yellow iris is concerning because it spreads rapidly and competes with native shoreland vegetation. Its root system forms a dense mat which compacts the soil and inhibits seed germination of other plants. It is recommended that BCWMC ask the landowner to remove the yellow iris. The landowner could either dig it up or spray it with glyphosate. An MDNR permit would be required for either method of removal.

Curly-leaf pondweed

Purple loosestrife

Hybrid cattail

Reed canary grass

Yellow Iris

Phytoplankton and zooplankton

Samples of phytoplankton (microscopic aquatic plants) were collected from Northwood Lake to evaluate water quality and the quality of food available to zooplankton (microscopic animals). As shown in the figure below (right), phytoplankton numbers declined in June, then increased through early August, declined again in late August and increased in September. The community was dominated by green algae and diatoms—both considered a good source of food for the lake's zooplankton. Blue-green algae, which is associated with water quality problems and can be a source of health concerns, was present in low numbers.

2019 phytoplankton numbers were within the range of numbers observed since 2005. Numbers in July and early August of 2019 were higher than numbers in July and August of 2013 and 2016. (See the graph on the following page for historical Northwood Lake phytoplankton information.) The higher numbers in 2019 are likely due, in part, to phosphorus added to the lake by curly-leaf pondweed die-off.

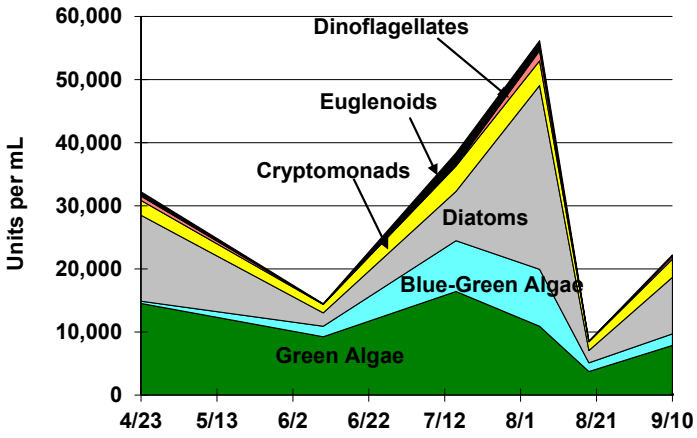
Unlike phytoplankton, zooplankton do not produce their own food. As "filter feeders," they eat millions of small algae; given the right quantities and species, they can filter the volume of an entire lake in a matter of days. They are also a valuable food source for planktivorous fish and other organisms. Fish generally select the largest zooplankters they see and prefer cladocerans to copepods because cladocerans swim slowly and lack the copepods' ability to escape predation by jerking or jumping out of the way.

The 2019 numbers and community composition of zooplankton in Northwood Lake reflect the impact of fish predation on the community. Small rotifers, the least preferred food for fish, dominated the zooplankton community. Small rotifers and copepods were prevalent throughout the summer, while cladocerans were observed in low numbers; their numbers were so low they are not generally visible on the figure at right.

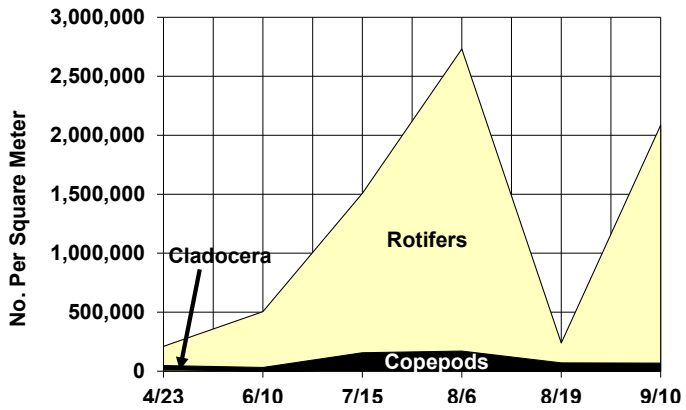
The low numbers of cladocerans are likely due to fish predation. Low numbers of cladocerans in shallow lakes are common because they have no deep water refuge to escape predation from fish. Deeper waters have sufficient oxygen for zooplankton survival, but insufficient oxygen for fish survival. Consequently, deeper lakes often have higher numbers of cladocerans than shallow lakes.

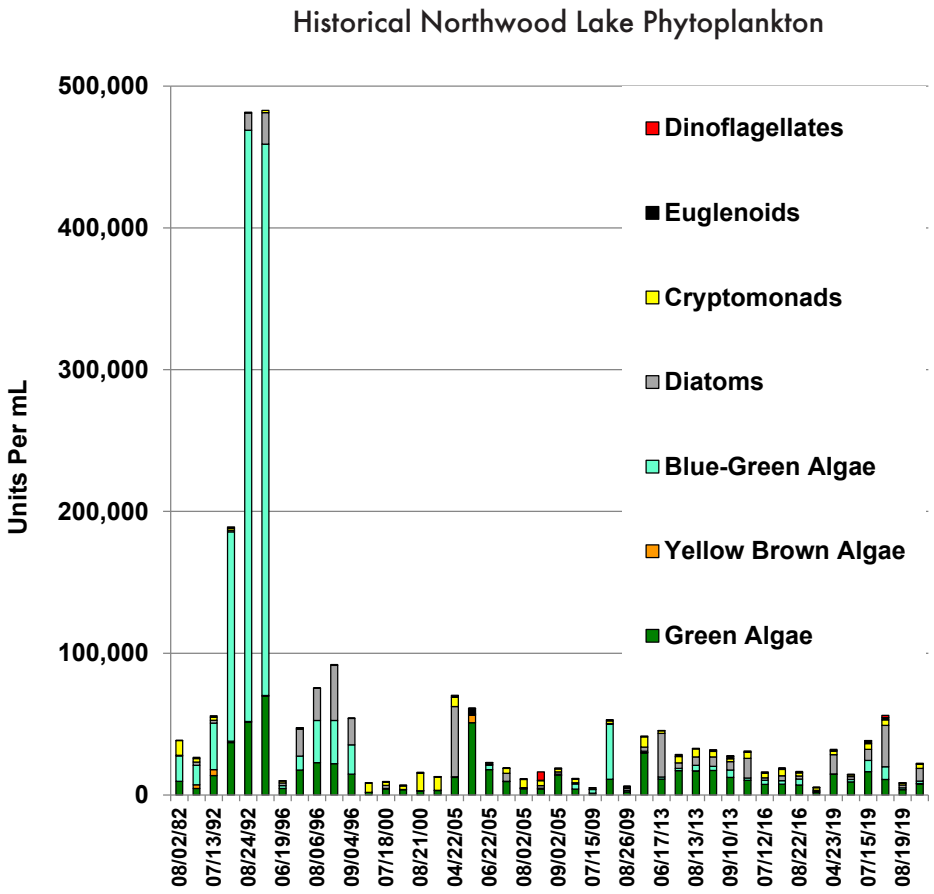
The 2019 numbers and community composition of zooplankton in Northwood Lake were within the range of numbers observed since 2013. (See the graph on the following page for historical Northwood Lake zooplankton information.) Zooplankton numbers observed from 2013 through 2019 were higher than numbers prior to 2013. The higher zooplankton numbers since 2013 are likely due to increased extent and density of aquatic plants within the lake. Aquatic plants provide hiding places for zooplankton to avoid predation by fish. Aquatic plants were not observed in Northwood Lake during plant surveys prior to 2000 and zooplankton numbers were very low. Use of barley straw to inhibit algal growth and improve water clarity in 2000 enabled plants to grow in the lake. The aquatic plant community has consistently increased in extent and density since 2000 and zooplankton numbers have also increased.

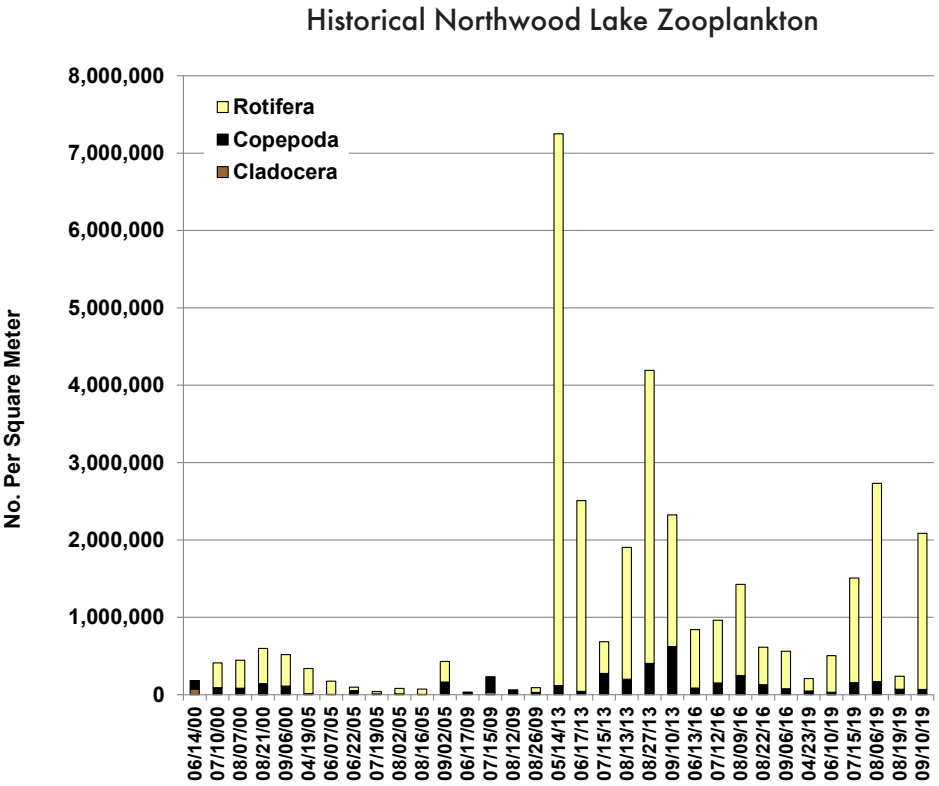
2019 Northwood Lake Phytoplankton



2019 Northwood Lake Zooplankton







Suitability of Northwood Lake for Aquatic Invasive Species (AIS)

A large number of AIS residing in Minnesota have not yet been observed in Northwood Lake, but could be introduced. For example, both zebra mussels and starry stonewort were recently found in nearby Medicine Lake. To determine whether Northwood Lake water quality would support the introduction of six AIS (starry stonewort, zebra mussels, spiny waterflea, faucet snail, Chinese mystery snail, and rusty crayfish) a suitability analysis for each species was performed.

The analyses compared 2019 lake water quality with the water quality conditions required for each species, specifically evaluating total phosphorus, chlorophyll *a*, Secchi disc depth, trophic state index, water temperature, dissolved oxygen, specific conductance, calcium, magnesium, sodium, alkalinity, hardness, and calcium carbonate. The results indicate the water quality of Northwood Lake meets the suitability requirements for rusty crayfish, faucet snail, and spiny waterflea. However, the water quality of Northwood Lake only partially meets the suitability requirements for Chinese mystery snail, zebra mussel, and starry stonewort. Hence, these species would likely survive, but may not thrive in Northwood Lake if introduced.

Bassett Creek Watershed Management Commission
bassettcreekwmo.org

Cleaner, healthier water for a growing community