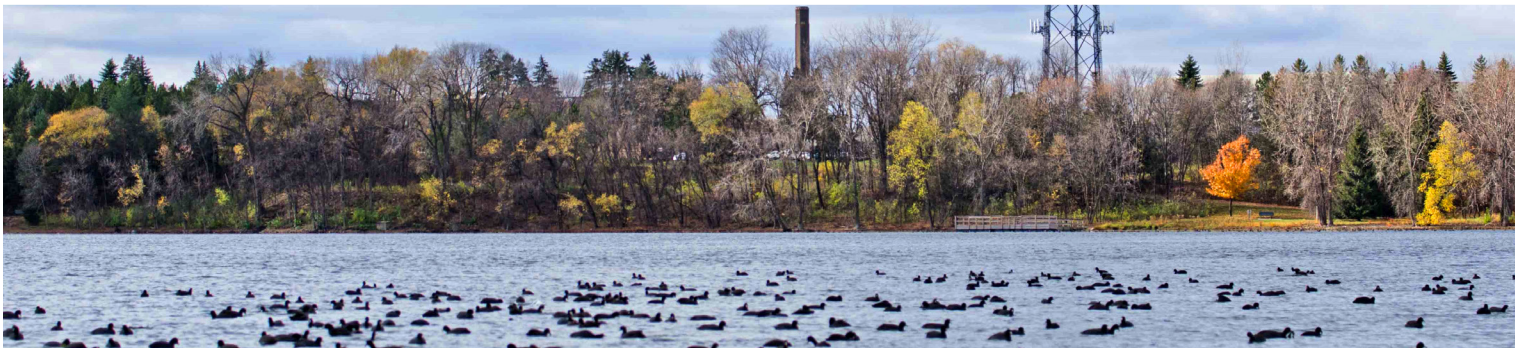
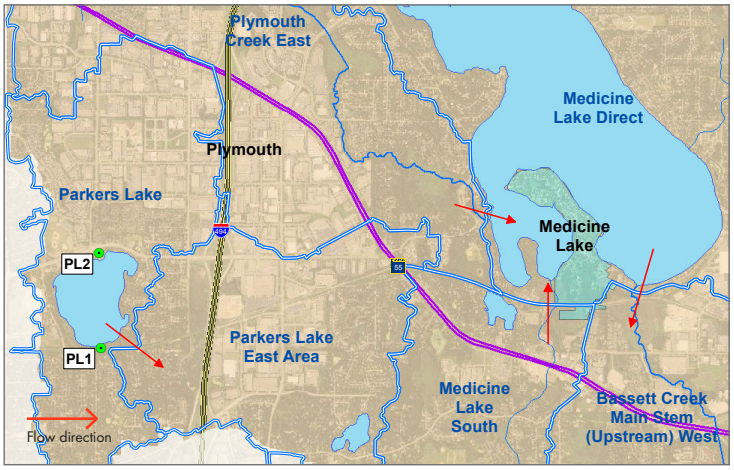
Parkers Lake 2018 water quality monitoring





About Parkers Lake

BCWMC classification	Priority-1 deep lake
Watershed area	1,065 acres
Lake size	97 acres
Average depth	12 feet
Maximum depth	37 feet
Ordinary high water level	935.9 feet (NGVD29)
Normal water level	934.2 feet (NAVD88)
Downstream receiving waterbody	Medicine Lake
Location (city)	Plymouth
MPCA impairments	Chloride, mercury in fish tissue
Aquatic invasive species	Eurasian watermilfoil, curly-leaf pondweed
Public access	Yes (boat launch)

Monitoring water quality in Parkers Lake

The Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality conditions in the watershed's 10 priority lakes since 1972. This monitoring is done to detect changes or trends in water quality and evaluate the effectiveness of efforts to preserve or improve water quality. A summary of 2018 monitoring efforts on Parkers Lake is provided below; more comprehensive information can be found on pages 2–7.

At a glance: 2018 monitoring results

In 2018, the BCWMC monitored Parkers 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 indicate that Parkers Lake meets Minnesota Pollution Control Agency (MPCA) and BCWMC water quality standards for Secchi disc (measure of clarity), total phosphorus, and chlorophyll *a*. The lake failed to meet water quality standards for chloride. According to the Minnesota Department of Natural Resources (MDNR) plant IBI, a measure of aquatic plant health, the lake's plant community did not meet standards in August 2018.

Recommendations

- Identify management measures to reduce chloride runoff from the lake's watershed, particularly on the north side of the lake
- Identify management measures to improve the quality of the lake's plant community and survey vegetation annually to facilitate early detection of aquatic invasive species
- Continue water quality and biological monitoring at a 3-year frequency

Water chemistry monitoring: 2018

Total phosphorus levels

While phosphorus is necessary for plant and algae growth, excessive phosphorus leads to excessive growth, decreased water clarity, and water quality impairment.

- **BCWMC/MPCA standard:** 40 micrograms per liter (µg/L) or less.
- **Range:** Total phosphorus concentrations ranged from a low of 17 µg/L in late August to a high of 39 µg/L in early September.
- **Summer average:** 28 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. Clear lakes generally have chlorophyll *a* levels less than 15 micrograms per liter (µg/L).
- **BCWMC/MPCA standard:** 14 µg/L or less.
- **Range:** Chlorophyll *a* concentrations ranged from a low of 0.5 µg/L in mid-May to a high of 15 µg/L in July and October.
- **Summer average:** 11.8 µg/L (met BCWMC/MPCA standard.

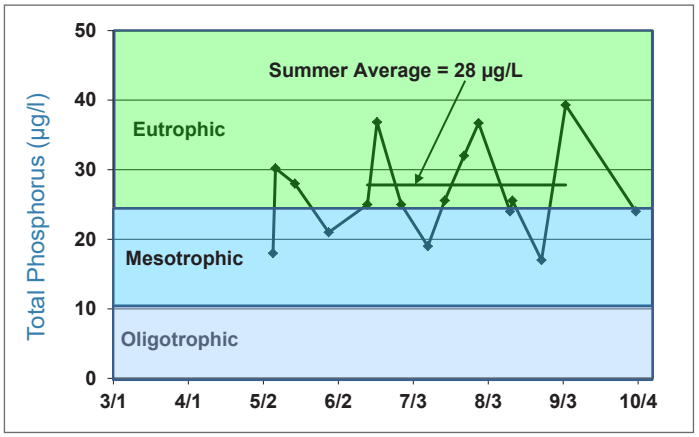
Water clarity

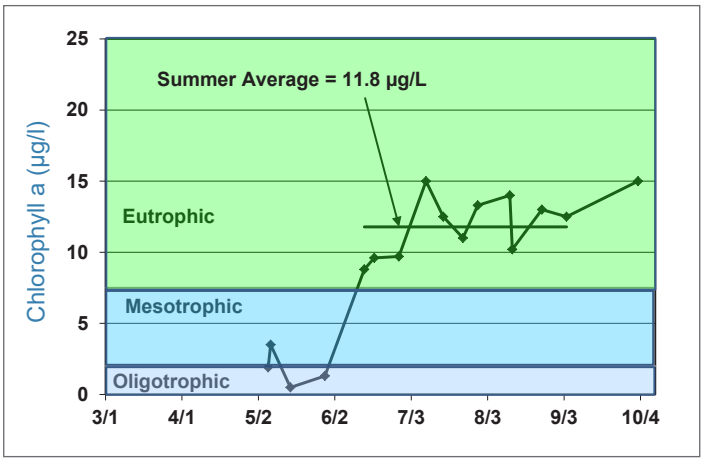
Water clarity is often affected by the amount of algae or other photosynthetic organisms in a lake. It is usually measured by lowering an 8-inch "Secchi" disc into the lake (see bottom photo); the depth at which the disc's alternating black-and-white pattern is no longer visible is considered a measure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

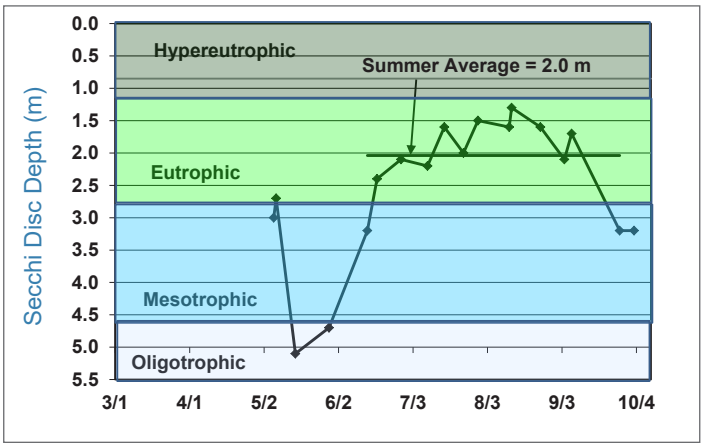
- **BCWMC/MPCA standard:** 1.4 meters or more.
- **Range:** From 5.1 meters in mid-May to 1.3 meters in mid-August.
- **Summer average:** 2.0 meters (met BCWMC/MPCA standard).

Definitions

- **Hypereutrophic:** Nutrient-rich lake conditions characterized by frequent and severe algal blooms and low transparency
- **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, and sparse algae growth







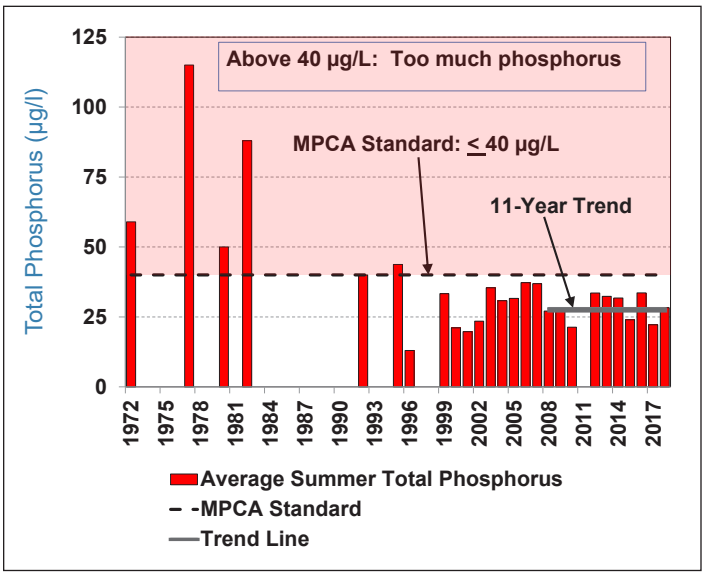
Water chemistry monitoring from 1972–2018: historical trends

Water quality in Parkers Lake has been monitored since 1972. Data includes information collected through the Citizen Assisted Monitoring Program (CAMP). Summer averages (June through September) of total phosphorus, chlorophyll a, and Secchi disc depth from 1972–2018 are shown in the figures at right. At least one of these parameters failed to meet BCWMC/MPCA standards from 1972 through 1999. Since 2000, summer average total phosphorus and Secchi disc values have met the BCWMC/MPCA standard. Summer average chlorophyll a concentrations failed to meet the standard in 2003, 2005, 2007, 2014, and 2015.

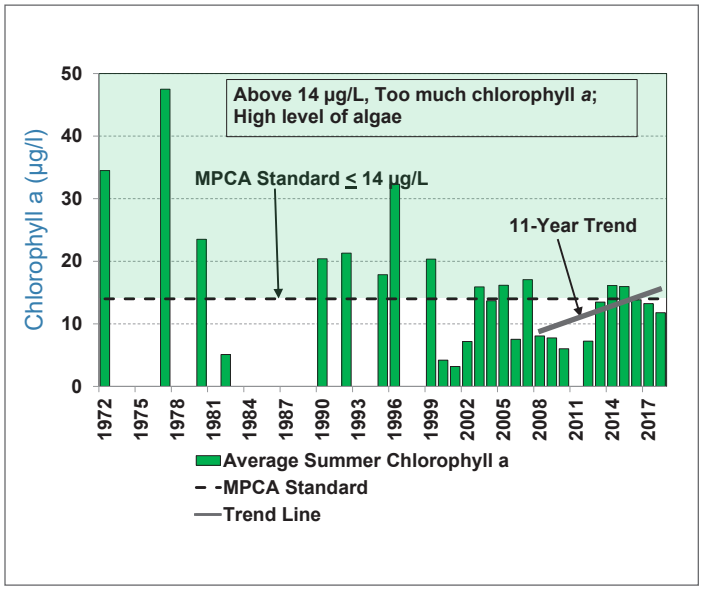
Overall, from 1972 through 2018, 94 percent of summer average Secchi disc depth and 81 and 52 percent of summer average concentrations of total phosphorus and chlorophyll a, respectively, met the BCWMC/MPCA standards. Summer averages of all three parameters met the BCWMC/MPCA standards in 2018.

In summary, trend analyses show no statistically significant change in water quality over the last 11 years as measured by an analysis of changes in summer average total phosphorus, chlorophyll *a*, and Secchi disc depth. While chlorophyll *a* has increased over the past 11 years at an annual rate of about 0.7 µg/L, this increase is not significant at the 95 percent confidence level.

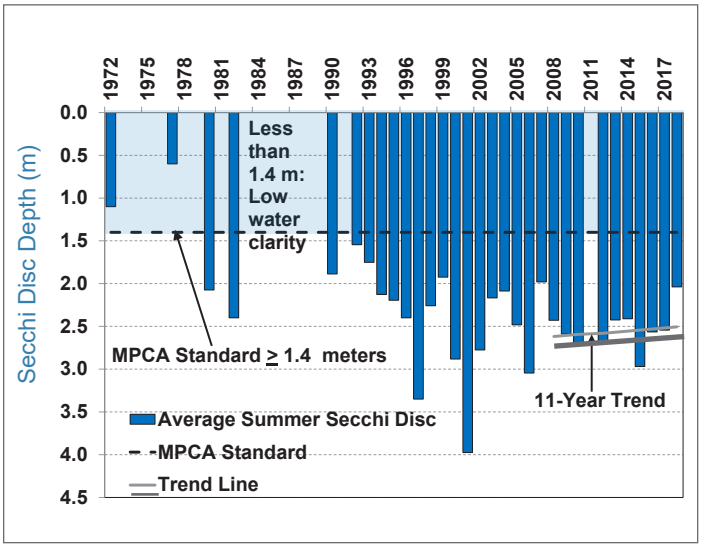
Total phosphorus trends



Chlorophyll *a* trends



Water clarity trends



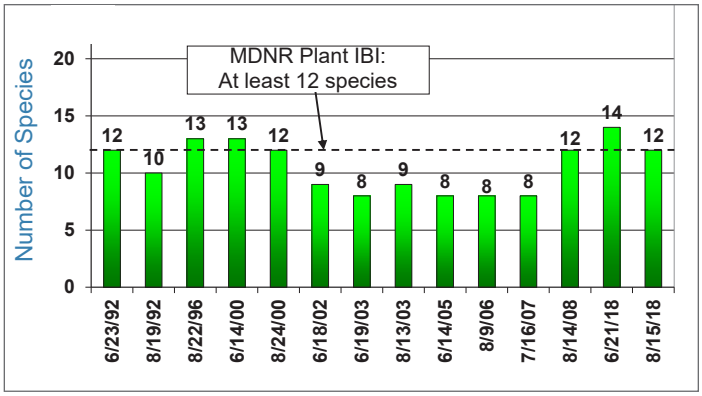
Macrophytes (aquatic plants)

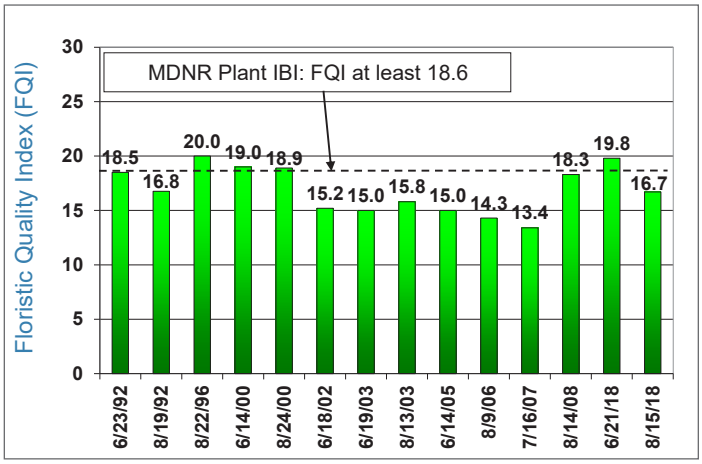
Lake Plant Eutrophication Index of Biological Integrity (IBI)

The MDNR recently developed metrics to determine the overall health of a lake's aquatic plant community. The Lake Plant Eutrophication Index of Biological Integrity (IBI) is 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 2018 were assessed to determine plant IBI trends. The figures at right show the Parkers Lake number of species and FQI scores for that period compared to the MDNR plant IBI impairment threshold.

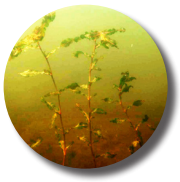
- **Number of species:** A deeper water lake, such as Parkers Lake, is considered impaired when it has fewer than 12 species. During the period examined, the number of species in Parkers Lake ranged from 8 to 14, meeting or exceeding the impairment threshold in June of 1992, August of 1996, both June and August of 2000, August of 2008, and both June and August of 2018. Fewer species were present from 2002 through 2007.
- **FQI values (quality of species):** The impairment threshold for deeper water lakes, as measured by FQI, is a minimum value of 18.6. During the period examined, FQI values ranged from 13.4 to 20.0, exceeding the impairment threshold in August of 1996, both June and August of 2000, and June of 2018. The lake's plant community was of poorer quality between 2002 and 2007.
- **2018 results:** In June both the number of species in the lake and FQI values met or exceeded the minimum IBI thresholds that define impairment. However, in August, the number of species met the minimum IBI threshold, but the FQI value failed to meet the minimum. As such, the waters would be considered impaired for aquatic plants.





Aquatic invasive species

In 2018, two aquatic invasive species were known to be present in Parkers Lake.



Curly-leaf pondweed (*Potamogeton crispus*): In 2018, curly-leaf pondweed (CLP) was found at 39 percent of sample points in June and 4 percent of sample points in August. The frequency reduction in August was due to a natural die-off which generally occurs in late June. In June, 76 percent of the sample points with CLP had a low density of plants (i.e., a density of 1 on a scale of 1–5); the remaining sample points were medium density (i.e., 2–3 on a scale of 1–5). In August, all sample points with CLP were low density. As a result, CLP did not cause problematic conditions for recreational lake users in 2018. However, when CLP dies off in June, it's decay adds phosphorus to the lake, which typically increases algae growth. This is evident in the graphs on page 2.

Eurasian watermilfoil (*Myriophyllum spicatum*): In 2018, Eurasian watermilfoil (EWM) was found at 61 percent of sample points in June and 71 percent of sample points in August. While EWM extent increased between June and August,

the number of sample points with a high EWM density declined. Nearly 20 percent of sample points with EWM in June had a high density of plants (i.e., a density of 4–5 on a scale of 1–5) compared with 10 percent in August. Most areas with EWM were low-to-medium density in both June and August. A medium density of plants (i.e., a density of 2–3 on a scale of 1–5) was observed at 45 percent of points with EWM in June and 49 percent in August. Low density (i.e., a density of 1 on a scale of 1–5) was observed at 38 percent of points with EWM in June and 42 percent in August. Thus, while some areas of the lake had problematic EWM conditions in both June and August, the majority of areas did not cause problematic conditions for recreational lake users.

Suitability of Parkers Lake for aquatic invasive species (AIS)

A large number of AIS currently residing in Minnesota have not, yet, been observed in Parkers Lake, but could be introduced in the future. For example, both zebra mussels and starry stonewort were recently found in nearby Medicine Lake. The risk of inadvertent transport of zebra mussels and starry stonewort from Medicine Lake to Parkers Lake is perceived to be high. To determine whether the water quality of Parkers Lake 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 2018 water quality in Parkers Lake with the unique 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, calcium, magnesium, sodium, alkalinity, hardness, and calcium carbonate.

The results indicate the water quality of Parkers Lake meets the suitability requirements for five of the species: starry stonewort, zebra mussels, rusty crayfish, spiny waterflea, and faucet snail. If these five species were introduced to Parkers Lake, they would be expected to both survive and thrive. The water quality of Parkers Lake partially meets the requirements for the Chinese mystery snail. However, the sodium and specific conductance levels in the lake are too high to be suitable. From the analysis, it appears that if the Chinese mystery snail were introduced to Parkers Lake, it would either not survive or not thrive.

Phosphorus loading from sediment

The release of phosphorus stored in lake-bottom sediments when oxygen levels are low is described as internal phosphorus loading from sediment. Parkers Lake data indicate low oxygen levels (<2 mg/L) were found at depths from about 7 meters to the bottom throughout the 2018 monitoring period (Figure 1). Internal phosphorus loading from sediment during this period caused near-bottom phosphorus concentrations to increase consistently (Figure 2). Because the lake remained stratified (separated into layers) throughout the monitoring period, the high phosphorus concentrations were confined to the bottom of the lake. The surface water phosphorus concentrations remained within a range indicating good water quality and met the MPCA standard throughout the monitoring period.

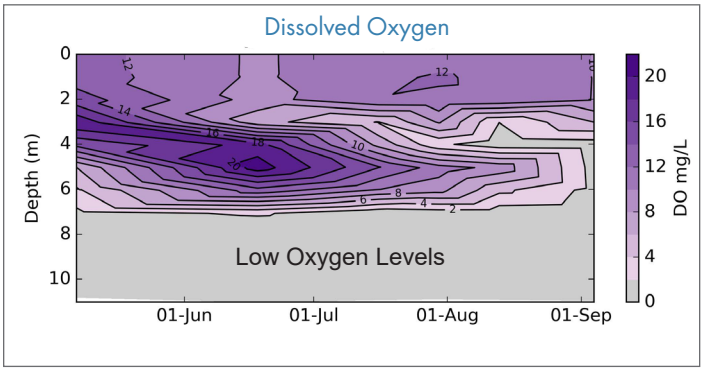


Figure 1

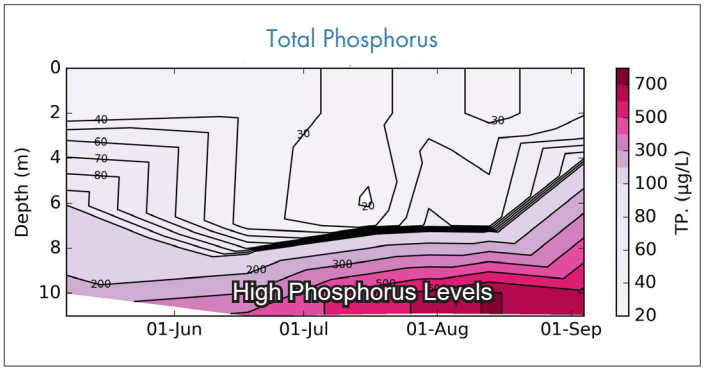


Figure 2

Phytoplankton and Zooplankton

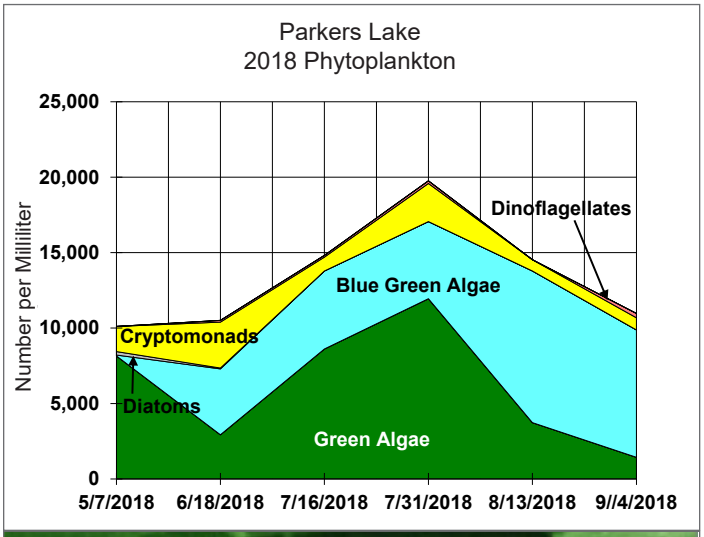
Samples of phytoplankton, microscopic aquatic plants, were collected from Parkers Lake to evaluate water quality and the quality of food available to zooplankton (microscopic animals). Phytoplankton numbers followed a pattern similar to chlorophyll *a*, both showing increases through mid-summer and decreases in late summer, reflecting the lake's good water quality. Cryptomonads and green algae, good sources of food for the lake's zooplankton, were present throughout the monitoring period and were dominant through mid-summer (see figure at right).

Blue-green algae, which are associated with water quality problems and can be a source of health concerns, were present throughout the monitoring period and were dominant in late summer. The World Health Organization (WHO) has established the following guidelines for assessing the risk posed to lake users by exposure to blue-green algae.

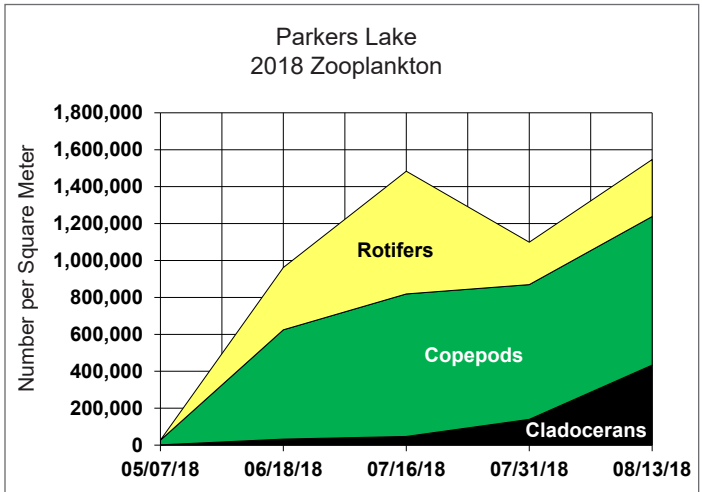
- Lakes with blue-green algae densities less than 20,000 cells per milliliter pose no risk to the health of humans or pets.
- Exposure to lakes with blue-green algae density levels between 20,000 and 100,000 cells per milliliter poses a low risk of adverse health impacts (i.e., skin irritation or allergenic effects such as watery eyes).
- Exposure to lakes with blue-green algae densities greater than 100,000 cells per milliliter poses a moderate health risk (i.e., long-term illness from algal toxins is possible).

In 2018, blue-green algae numbers were always within the no-risk category.

All three groups of zooplankton (rotifers, copepods, and cladocerans) were represented in 2018 (see figure at right). Small rotifers and copepods dominated the community. Because they do not graze as heavily on algae as the larger cladocerans, they generally have limited impact on the lake's water quality. This suggests that future Parkers Lake water quality efforts should focus on phosphorus management to reduce the nutrients that contribute to algae growth.



Chlamydomonas, a type of green algae found Parkers Lake



Keratella quadrata, a rotifer found in Parkers Lake

Chloride Levels

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 road salt to permanently pollute 5 gallons of water. And, once in the water, there is no way to remove chloride. High levels of chloride are toxic to sensitive organisms and disrupt natural lake mixing, causing lower dissolved oxygen in bottom waters and associated impacts on benthic organisms and nutrient cycling.

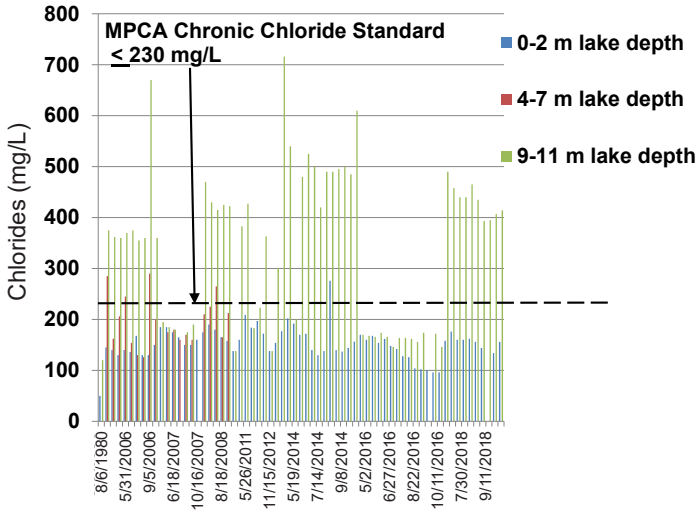
Because high concentrations of chloride can harm fish and plant life, the MPCA has established a chronic exposure chloride standard of 230 mg/L or less.

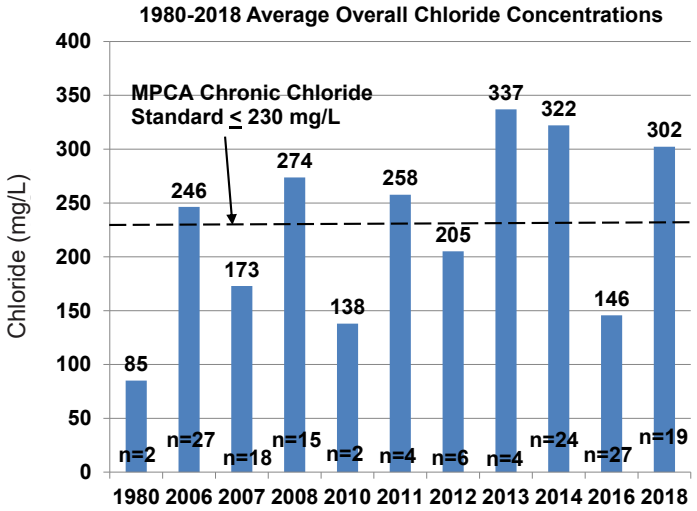
Chloride levels in 2018

- **Range of chloride concentrations in Parkers Lake:** The surface waters ranged from a high of 176 mg/L, measured in June, to a low of 156 mg/L, measured in September. The bottom waters ranged from a high of 490 mg/L in May to a low of 435 mg/L in September
- **Average concentration:** The average surface water concentration was 162 mg/L (meets MPCA chronic exposure standard); the average bottom water concentration was 455 mg/L (does not meet MPCA chronic exposure standard). The average chloride concentration for the entire lake was 302 mg/L, which does not meet the MPCA chronic exposure standard. Thus, Parkers Lake was impaired for chlorides.

Parkers Lake has been listed as impaired for chlorides since 2014. As shown in the figures at right, chloride concentrations in the lake's bottom waters (9–11 meter depths) have failed to meet the MPCA standard the majority of years from 2006 through 2018. When chloride concentrations in the deeper waters have exceeded the MPCA standard, annual chloride averages for the entire lake have also exceeded the MPCA standard. Exceptions occurred in 2007, 2010, 2012, and 2016 when lower chloride concentrations in the lake met the MPCA standard.

A study by the City of Plymouth[1] found that lower watershed chloride loading (or runoff) to Parkers Lake was correlated with lower chloride concentrations in the lake. The study focused on two of the lake's subwatersheds, PL2 in the north and PL1 in the south. The study found that chloride loading was significantly higher from PL2 than from PL1 (see table at right). Land use in PL2 consists primarily of multi-family residential and industrial areas, and 49% of the land is covered with impervious surfaces. These hard surfaces are typically roads and parking lots that receive salt applications in the winter, and the melting snow and rain run quickly off into storm sewers that reach the lake. Conversely, the area in PL1 consists mostly of single-family homes and only 19% of the land is covered with impervious surfaces. Methods should be sought to reduce the use of chlorides throughout the Parkers Lake watershed—particularly to the north.





	PL1		PL2	
Year	Chloride Loading (lbs/year)	Chloride Loading (lbs/acre)	Chloride Loading (lbs/year)	Chloride Loading (lbs/acre)
2013	3,239	12.6	105,991	561
2014	1,158	4.5	55,650	294
2015	1,052	4.1	161,814	856
2016	1,797	7.0	66,855	354
2017	4,904	19.0	122,460	648

[1] Timm, Amy, Justin Valenty, Jonathan Hess, and Brian Vlach. 2017. 2017 Water Quality Report. Prepared for the City of Plymouth by Three Rivers Park District.

A Thank You to Our Volunteers

Each year volunteers from across the watershed participate in the Citizen Assisted Monitoring Program (CAMP) coordinated and funded by the Metropolitan Council with assistance and additional funding from the BCWMC. These volunteers spend hours on their lakes collecting water samples and data that augment data collected through BCWMC routine monitoring. Their work is an important piece of the overall BCWMC monitoring program and their time and dedication are greatly appreciated!

Bassett Creek Watershed Management Commission
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Cleaner, healthier water for a growing community