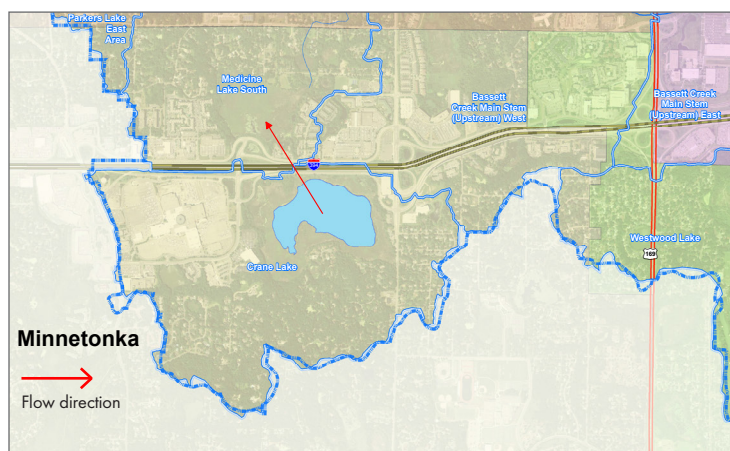


# Crane Lake 2016 water quality monitoring

Item 6B.  
BCWMC 2-16-17



## Monitoring water quality in Crane Lake

The Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality conditions in the watershed's 10 priority lakes and six ponds 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 2016 monitoring efforts on Crane Lake is provided below; more comprehensive information can be found on pages 2-7.

## At a glance: 2016 monitoring results

In 2016, the BCWMC monitored Crane 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 Crane Lake does not meet applicable Minnesota Pollution Control Agency (MPCA) water quality standards for chlorides. However, Crane Lake does meet MPCA and BCWMC water quality standards for total phosphorus and chlorophyll *a*; trend analyses show no significant changes in these parameters or Secchi disc depth (measure of clarity) over the past 20 years. According to the Minnesota Department of Natural Resources (MDNR) plant IBI, the lake's plant community is not impaired.

## Recommendations

- Work with cities, businesses, and Hennepin County to improve winter maintenance practices and reduce the chloride load conveyed to Crane Lake from streets and parking lots in its watershed.
- Continue water quality and biological monitoring.

## About Crane Lake

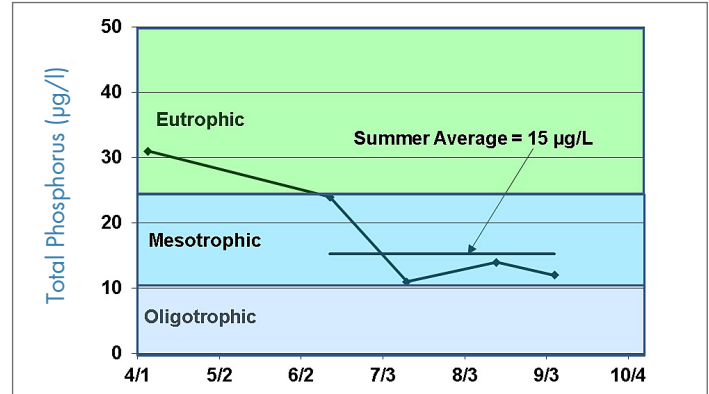
BCWMC classification	Priority-2 shallow lake
Watershed area	591 acres
Lake size	30 acres
Average depth	3.3 feet
Maximum depth	5 feet
Ordinary high water level	920.5 feet
Normal water level	917.1 feet
Downstream receiving waterbody	Medicine Lake
Location (city)	Minnetonka
MPCA impairments	None
Aquatic invasive species	Curly-leaf pondweed, purple loosestrife, hybrid cattail
Public access	No

# Water chemistry monitoring: 2016

## 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.

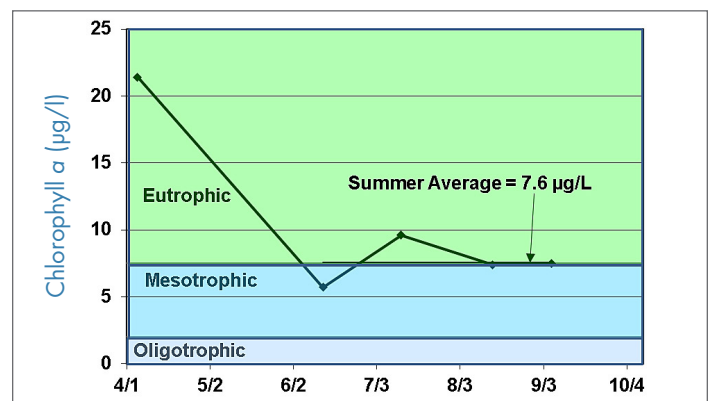
- BCWMC/MPCA standard: 60 micrograms per liter ( $\mu\text{g/L}$ ) or less.
- Range: Total phosphorus concentrations ranged from a low of 11  $\mu\text{g/L}$  in July to a high of 31  $\mu\text{g/L}$  in April.
- Summer average: 15  $\mu\text{g/L}$  (met BCWMC/MPCA standard)



## Chlorophyll a levels

Chlorophyll a is a pigment in algae and generally reflects the amount of algae growth in a lake. Lakes which appear clear generally have chlorophyll a levels less than 15 micrograms per liter ( $\mu\text{g/L}$ ).

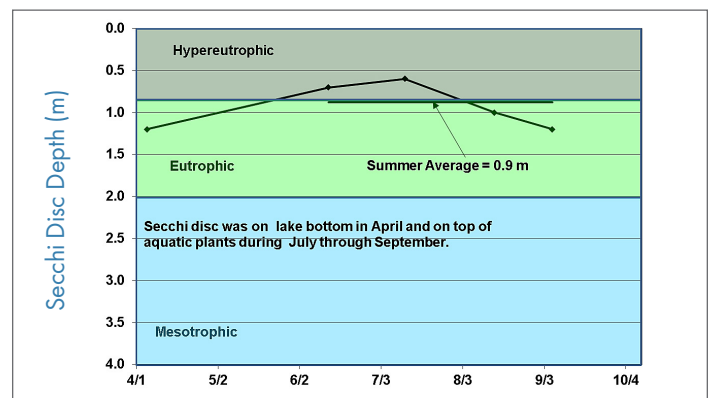
- BCWMC/MPCA standard: 20  $\mu\text{g/L}$  or less.
- Range: Chlorophyll a concentrations ranged from a low of 6  $\mu\text{g/L}$  in June to a high of 21  $\mu\text{g/L}$  in April.
- Summer average: 7.6  $\mu\text{g/L}$  (met BCWMC/MPCA standard).



## 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; 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 1.2 meters (down to the lake bottom) in April to 0.6 meters in July.
- Summer average: 0.9 meters; did not meet BCWMC/MPCA standards; however, clarity was limited by dense aquatic plant growth rather than poor water quality.



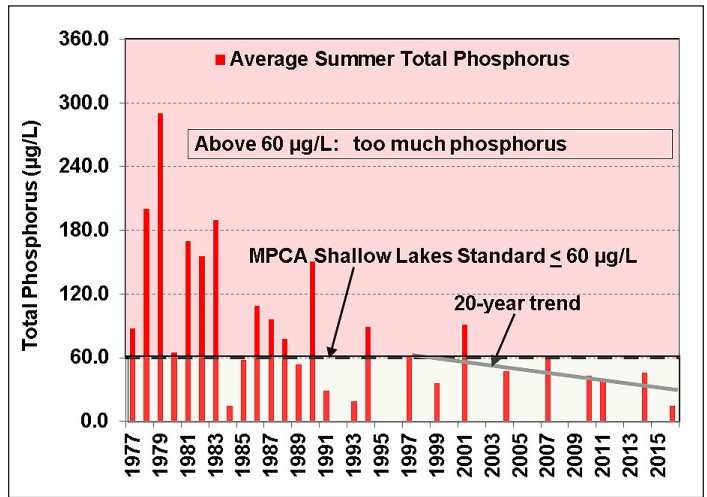
## Definitions

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





## Total phosphorus trends

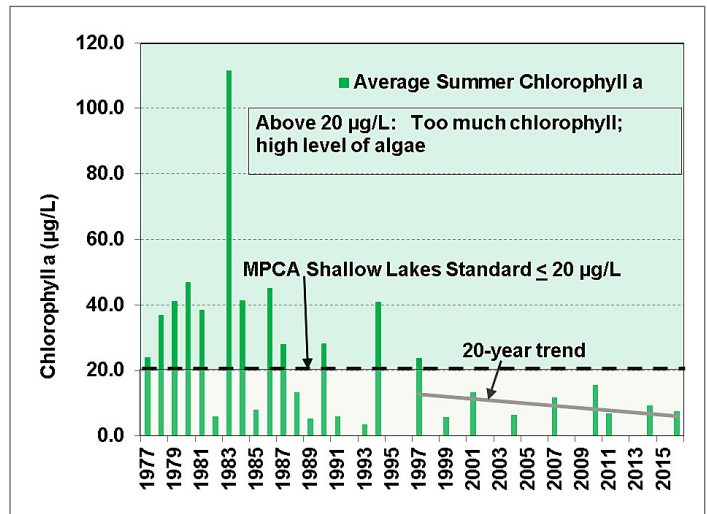


## Water chemistry monitoring from 1977–2016: historical trends

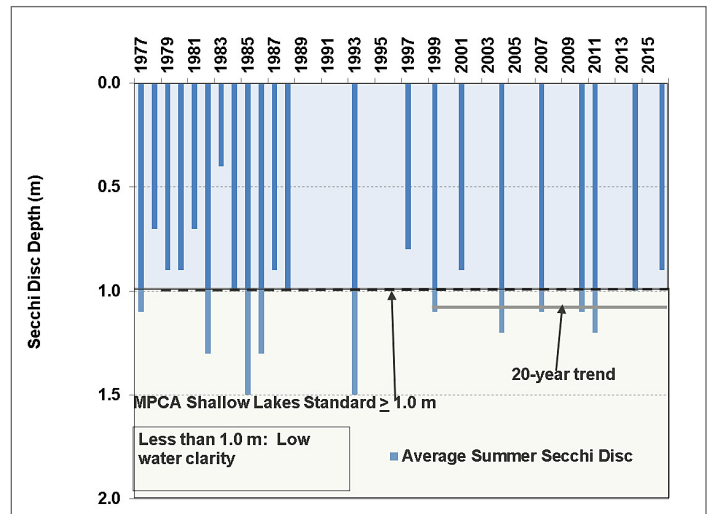
Water quality in Crane Lake has been monitored since 1977. Summer averages (June through September) of total phosphorus, chlorophyll *a*, and Secchi disc depth from 1977–2016 are shown in the figures at right. From 1977–2001 these averages regularly failed to meet BCWMC/MPCA standards, but have generally met standards since 2004. Total phosphorus and chlorophyll *a* concentrations have met the standard each year since 2004. Water clarity, measured by Secchi disc depth, has met the standard all years since 2004—except 2016 when dense plants restricted Secchi disc visibility.

In summary, trend analyses show improvements in water quality over the last 20 years as measured by decreases in summer average total phosphorus and chlorophyll *a* concentrations; these, however, are not statistically significant (95 percent confidence level). There has been no change in Secchi disc depth. Chloride concentrations, which may impact the lake’s zooplankton, have increased (see page 6).

## 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 1993 through 2016 were assessed to determine plant IBI trends. The figures below show the Crane Lake FQI scores and number of species for that period compared to the MDNR plant IBI impairment threshold.

- **Number of species:** A shallow lake is considered impaired when it has fewer than 11 species. During the period examined, the number of species in Crane Lake ranged from 5 to 15, exceeding the impairment threshold half of the time.
- **FQI values (quality of species):** The impairment threshold for shallow lakes, as measured by FQI, is a minimum value of 17.8. During the period examined, FQI values ranged from 10.7 to 20.3, exceeding the threshold 42 percent of the time.
- **2016 results:** Both the number of species in the lake and FQI values exceeded the minimum IBI thresholds that define impairment. As such, the waters are not currently considered impaired for aquatic plants.

### Commonly found aquatic species



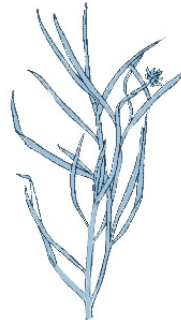
Coontail  
*Ceratophyllum demersum*



Star duckweed  
*Lemna triscula*



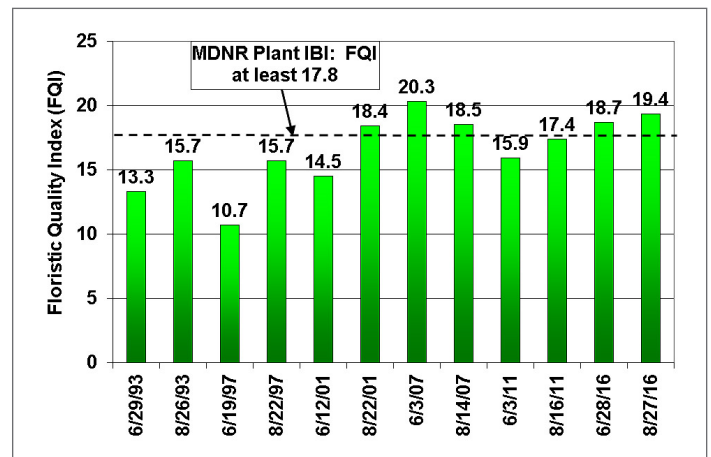
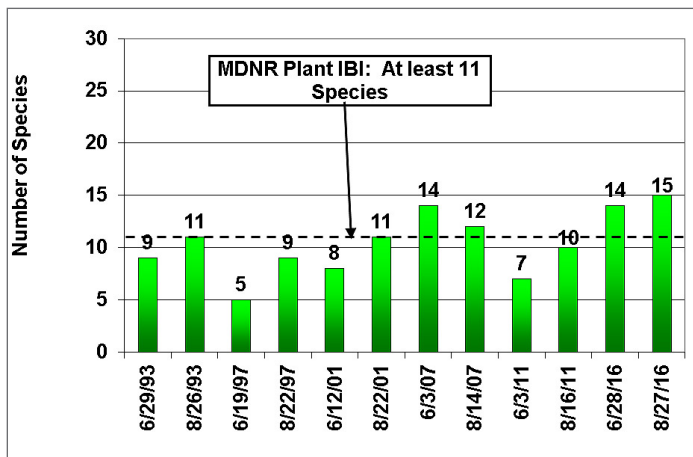
Flatstem pondweed  
*Potamogeton zosteriformis*



Water stargrass  
*Heteranthera dubia*



Fries' pondweed  
*Potamogeton friesii*





## Bearded stonewort in Crane Lake

In 2016, *Lychnothamnus barbatus* (bearded stonewort), a desirable plant, was observed in Crane Lake for the first time. This plant was observed in nearby Westwood Lake (and Minnesota) for the first time in 2015. Bearded stonewort is in the family *Characeae*, an algae that resembles rooted aquatic plants. This species was not seen in North America until 2012 and few populations have been documented in the world. Bearded stonewort obtains all of its nutrients from the water. This nutrient absorber can reduce phosphorus concentrations and improve water quality.

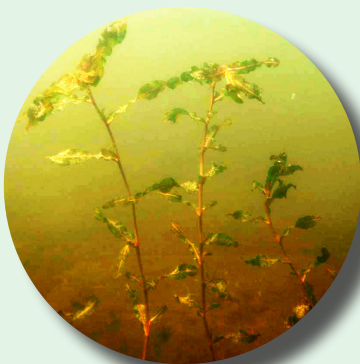
In 2016, bearded stonewort grew densely throughout the lake, dominating the lake's plant community. Nonetheless, the lake supported a diverse plant community that met plant IBI standards. Because bearded stonewort obtains all of its nutrients from the water, the dense growth in Crane Lake removed substantial quantities of nutrients and improved water quality. Phosphorus and chlorophyll a concentrations were lower in 2016 than 2011. However, the dense plant growth restricted Secchi disc depth to the top of the plants.



Bearded stonewort

## Aquatic invasive species

In 2016, three aquatic invasive species were known to be present in Crane Lake: Curly-leaf pondweed (*Potamogeton crispus*), purple loosestrife (*Lythrum salicaria*), and hybrid cattail (*Typha glauca*). No species was considered problematic.



Curly-leaf pondweed



Purple loosestrife



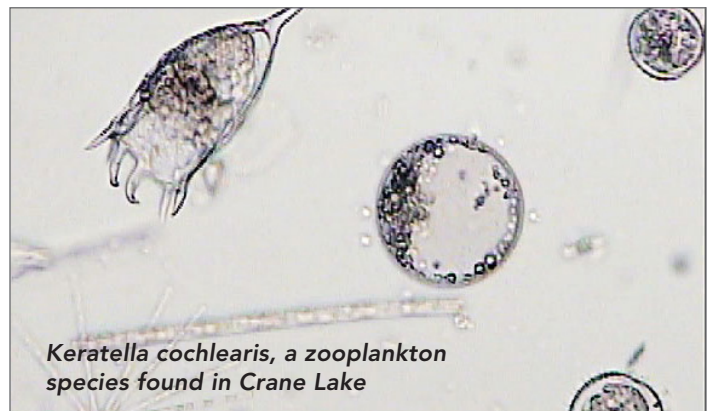
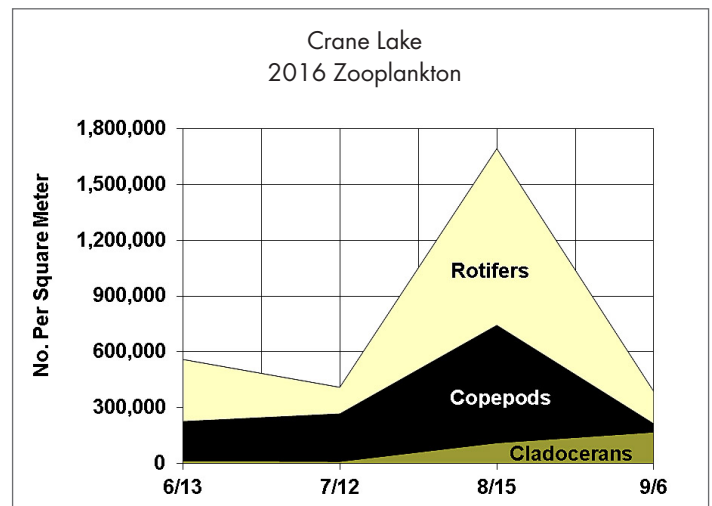
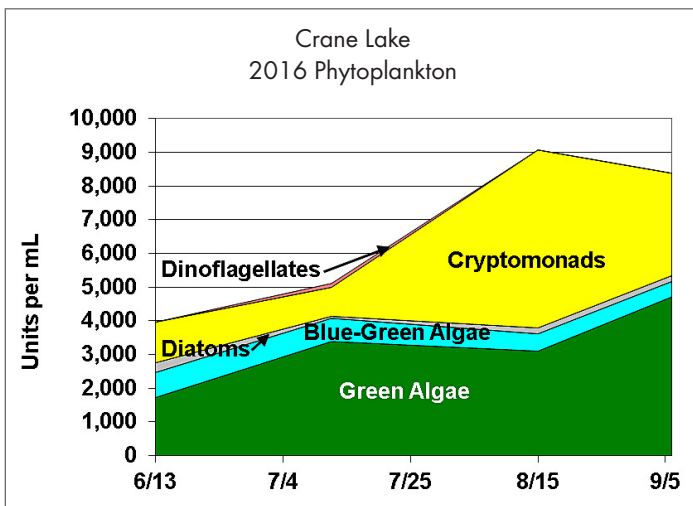
Hybrid cattail

## Phytoplankton and zooplankton

Samples of phytoplankton, microscopic aquatic plants, were collected from Crane 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 reflecting good water quality. These numbers increased between June and August, then decreased slightly in September, as shown in the figure below. Cryptomonads and green algae, good sources of food for the lake's zooplankton, were dominant throughout the summer. Blue-green algae, which is associated with water quality problems and can be a source of health concerns, was present in very low numbers.

The number of zooplankton species found in Crane Lake has decreased since 1980. This corresponds to increased chloride concentrations in lake water (see page 7). Because elevated chloride has been linked to decreased biodiversity in Minnesota lakes, the MPCA has established a chronic exposure chloride standard of 230 mg/l or less. The 2016 summer average for Crane Lake was 314 mg/L, well above the standard. Continued monitoring and assessment of the zooplankton community will help assess the impacts of high chloride concentrations on the lake's food web.

The composition of the 2016 zooplankton community was consistent with recent years. All three groups of zooplankton (rotifers, copepods, and cladocerans) were represented (see figure below). Small rotifers and copepods have generally 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 Crane Lake water quality efforts should focus on phosphorus management to reduce the nutrients that contribute to algae growth.







Increased use of chloride for road maintenance has had an impact on chloride levels in Twin Cities metro area lakes, including Crane Lake.

## Chloride and biodiversity in Crane Lake

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. Ultimately, chloride applied to streets is conveyed to water bodies by snowmelt and rainfall runoff. Because increased chloride concentrations have been linked to decreased biodiversity in Minnesota lakes, the MPCA has established a chronic exposure chloride standard of 230 mg/l or less.

Chloride concentrations in Crane Lake have increased between 1980 and 2016. While this matches a pattern seen in 38 other Twin Cities metro area lakes<sup>1</sup>, as shown in Figure 1, the 2016 chloride concentrations in Crane Lake are more than three times higher than the average of the other metro-area lakes. From April through August of 2016, Crane Lake chloride concentrations ranged from 317 mg/L to 379 mg/L, well above the MPCA standard. Concentrations did decrease to 198 mg/L in September, but the 2016 average of 314 mg/L was still above the standard.

Zooplankton data collected in Crane Lake since 1980 were compiled and analyzed to assess whether elevated chloride concentrations were negatively impacting aquatic life. The total number of species detected during three sampling periods in each year was calculated and plotted against the average chloride concentration recorded during sampling. As shown in Figure 2, the number of zooplankton species detected has decreased since 1980, as chloride concentrations have increased. A low of six species was recorded in 2011; seven species were documented in 2016.

<sup>1</sup>Novotny, E.V., Murphy D., Stefan, H.G. 2008. Increase of Urban Lake Salinity by Road Deicing Salt. Science of the Total Environment. 406, 131 - 144.

Based on this data, increased chloride concentrations may be influencing the zooplankton in Crane Lake. However, the decrease in total number of species preceded the increase in chloride concentrations, suggesting there may be other factors contributing to the overall decrease in the lake's biodiversity.

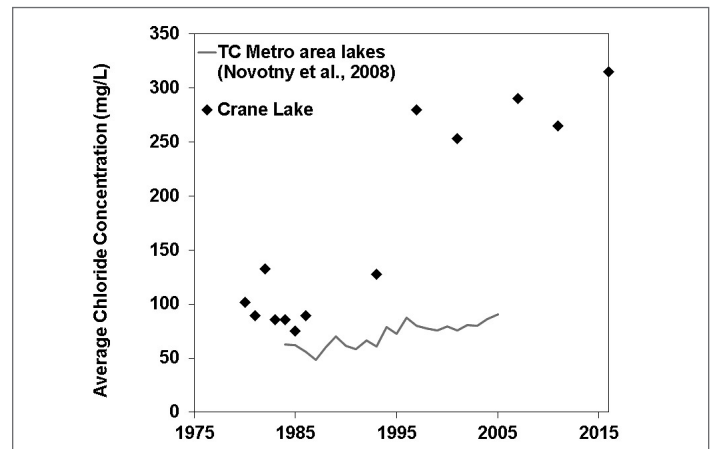


Figure 1

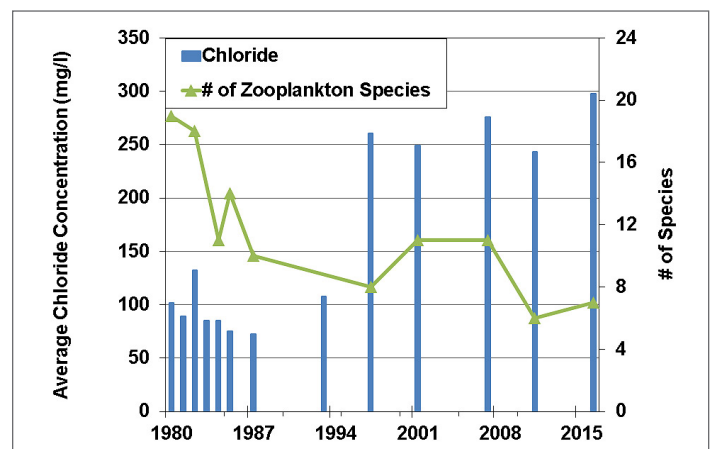
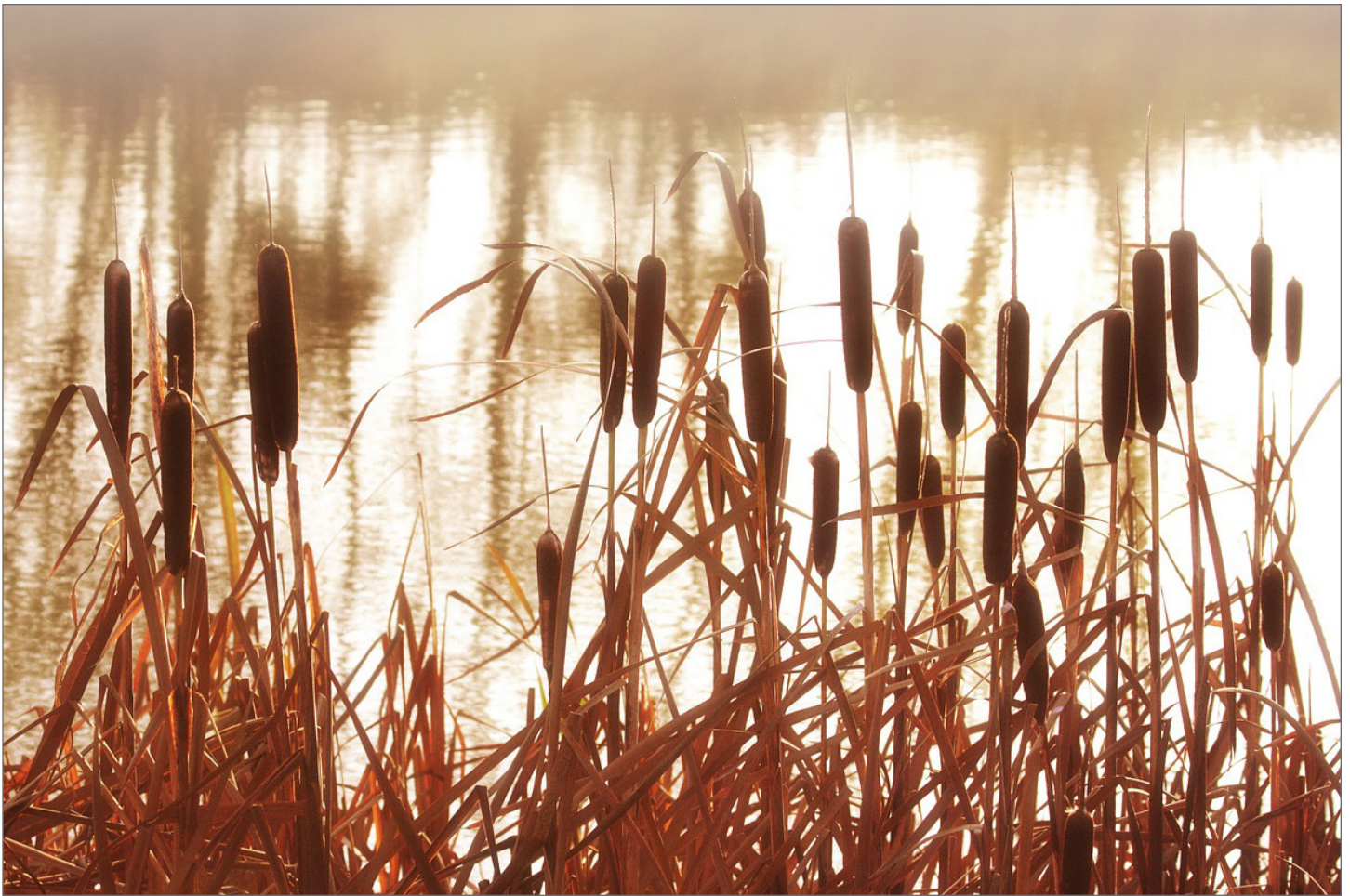


Figure 2





Bassett Creek Watershed Management Commission  
952.270.1990  
[bassettcreekwmo.org](http://bassettcreekwmo.org)



Cleaner, healthier water for a growing community

