RAMSEY-WASHINGTON
METRO WATERSHED DISTRICT

2024 WATER MONITORING ANNUAL REPORT

Prepared
May 2025

TABLE OF CONTENTS

TERMS

Best management practices (BMPs): Practices that protect water quality.

Chloride: Small amounts of chlorides are required for normal cell functions in plant and animal life, but chloride from de-icing and water-softener salt that gets into lakes and streams can be toxic to some aquatic life. The standard for chloride in Minnesota lakes and streams is 230 mg/L for chronic levels. That is the standard level used in this report.

Chlorophyll-*a*: Chlorophyll-*a* measures the amount of algae in a lake. Large amounts of algae, which cause green scum and odors, are a symptom of degraded water quality.

Eutrophication: Eutrophication describes a situation where a lake or other body of water has excessive nutrients and minerals, frequently due to polluted runoff. The effect of the nutrient excess can be dense plant growth and stress to animal life due to lack of oxygen.

Orthophosphate: The form of phosphorus that is readily available for use by algae and other aquatic plants for growth.

PFAS (perfluoroalkyl substances): Polluting substances used in a variety of industrial, agricultural, military, and commercial product applications.

Phosphorus: Phosphorus is a nutrient that is essential for plant life, but excessive phosphorus degrades water quality. Common sources of phosphorus in lakes are fertilizers and organic wastes from runoff and soil erosion.

Secchi disk: The clarity or transparency of water is measured by lowering a "Secchi disk" (usually black and white) into the water until it is no longer visible from the surface. The greater the "Secchi depth," the more transparent the water.

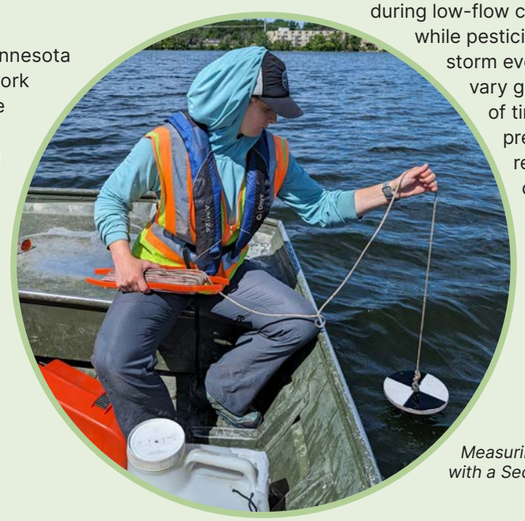
Tiered aquatic life uses (TALU): The Minnesota Pollution Control Agency's TALU framework is a significant revision to the aquatic life use classification in the state's water quality standards and is built on existing water quality standards to improve how water quality in streams and rivers are monitored and managed.

Total suspended solids: Particulate matter, including soils, metals, organic materials, and debris that are suspended in a moving body of water.

STATE STANDARDS

The following information on how Minnesota standards for water quality are determined is taken from the Minnesota Pollution Control Agency's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*.

- **Total phosphorus and chlorophyll *a* in lakes:** Data used for phosphorus and chlorophyll-*a* calculations are limited to those collected from the upper most 2 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine mean summer values for TP, corrected chlorophyll-*a*, and Secchi depth. These values are then compared to the standards, and the assessment is made.
- **Conventional pollutants (total suspended solids [TSS]):** A stream exceeds the standard for TSS if (1) the standard is exceeded more than 10% of the days of the assessment season (April through September) as determined from a data set that gives an unbiased representation of conditions over the assessment season, and (2) at least three such measurements exceed the standard.
- **Aquatic life toxicity-based standards (chlorides):** Aquatic life toxicity-based chronic water quality standards are written as four-day average concentrations. In some cases, pollutant concentrations can be quite variable over such periods, depending on factors such as the type and size of the water body, weather and flow conditions, and the source and nature of the pollutant. For example, chloride concentrations in lakes, streams, and wetlands are relatively stable during low-flow conditions over 4 days, while pesticide concentrations during storm events in small streams can vary greatly in that same amount of time. The chloride values presented in this report represent average water column concentrations.



Measuring water clarity with a Secchi disk

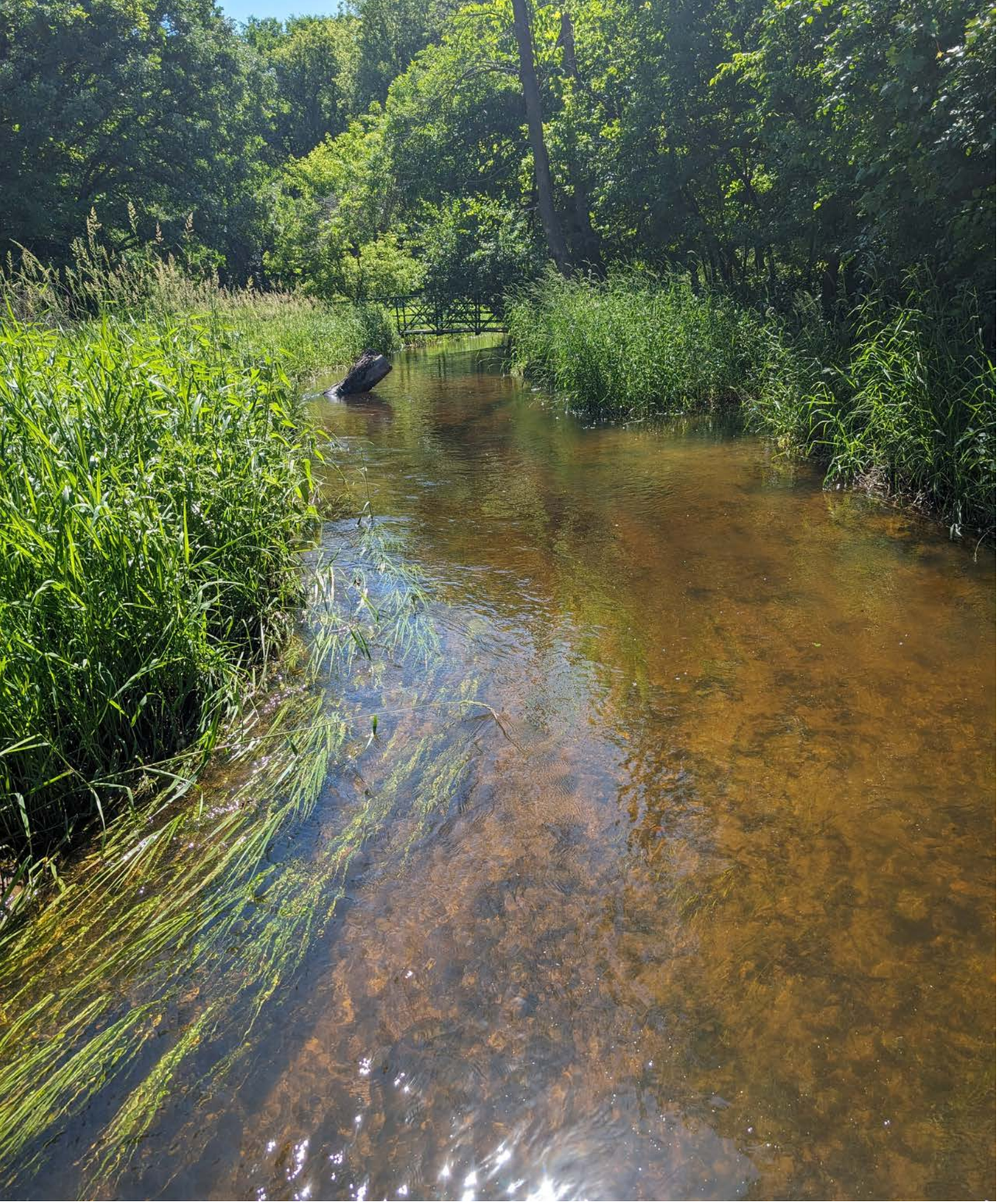
1. INTRODUCTION

This report presents annual historical monitoring data, providing an overall water quality assessment of lakes and streams within the Ramsey-Washington Metro Watershed District (RWMWD or the District). It includes an assessment of 16 lakes and ponds and five streams or conveyances, with a primary focus on total phosphorus, ortho-phosphorus, chlorophyll-*a*, Secchi disk depth (lakes only), total suspended solids, and chloride. Data also includes nitrogen in streams. Nitrogen loads contributed by streams may influence the ecological status of aquatic-plant-dominated shallow lakes, and there are many shallow lakes in the District. Chloride is also a pollutant of increasing concern as deicing salt used on impervious areas has the potential to lead to high chloride concentrations in ponds, lakes, and streams, particularly during winter and spring months.

This report includes a section on best-management practices (BMPs) constructed at various locations in the watershed. BMPs are also discussed with lake and stream assessments. Unlike ponds, which settle phosphorus attached to particulate sediment, these BMPs are designed to remove both particulate and dissolved phosphorus. While ponds are still a dominant feature in the District and remove high fractions of particulate pollutants, their phosphorus-removal performance is limited. For this reason, one of the primary BMPs installed to meet total maximum daily load (TMDL) requirements is filtration-type BMPs. Many of the filtration-type BMPs with media designed to bind dissolved phosphorus are still considered somewhat experimental; hence, an assessment of the lifespan, performance, and effectiveness of these systems is warranted. The BMP section will also cover other unique BMPs within the District, such as an alum treatment plant and a pond that received an iron filing application. The District also constructs infiltration BMPs, but due to a lack of monitoring data, they are not discussed in this report.

The report is organized by resource type or subject.

- **Chapter 3** includes the most recent and historical lake data, water quality trends, a discussion of in-lake management actions and actions in the tributary watershed, and an overall assessment.
- **Chapter 4** includes recent and historical monitoring data for streams and conveyances, an overall assessment, a discussion of water quality trends, and a description of relevant management actions.
- **Chapter 5** provides the results of various monitored BMPs throughout the District.
- **Chapter 6** discusses contaminants of emerging concern in the District, including PFAS (perfluoroalkyl), chloride, and mercury.
- **Chapters 7 and 8** describe fisheries and aquatic vegetation management strategies the District has used to help improve water quality.
- **Chapter 9** highlights recent examples of bioinfiltration basins (rain gardens) constructed to manage stormwater runoff and improve water quality.



Overall, there is a long-term trend of improving water quality for eutrophication parameters for District lakes. A qualitative review of the figures in Section 3 suggests that in 2024, water quality improved in Lake Wabasso Lake Owasso, and Wakefield Lake, while water quality was worse for Battle Creek Lake, Keller Lake, and Kohlman Lake. For monitored streams (Battle Creek, Fish Creek, Kohlman Creek, Beltline Interceptor, and Gervais Creek), there is also a long-term trend of improving water quality; however, those improvements appear to have plateaued, and trends are potentially starting to worsen again over the last 10 years. This was year ten of chloride monitoring for most waterbodies, and the following lakes have a ten-year worsening trend of chlorides: Lake Owasso, Lake Phalen, Twin Lake, Lake Wabasso, Snail Lake, Fish Creek, and Kohlman Creek.

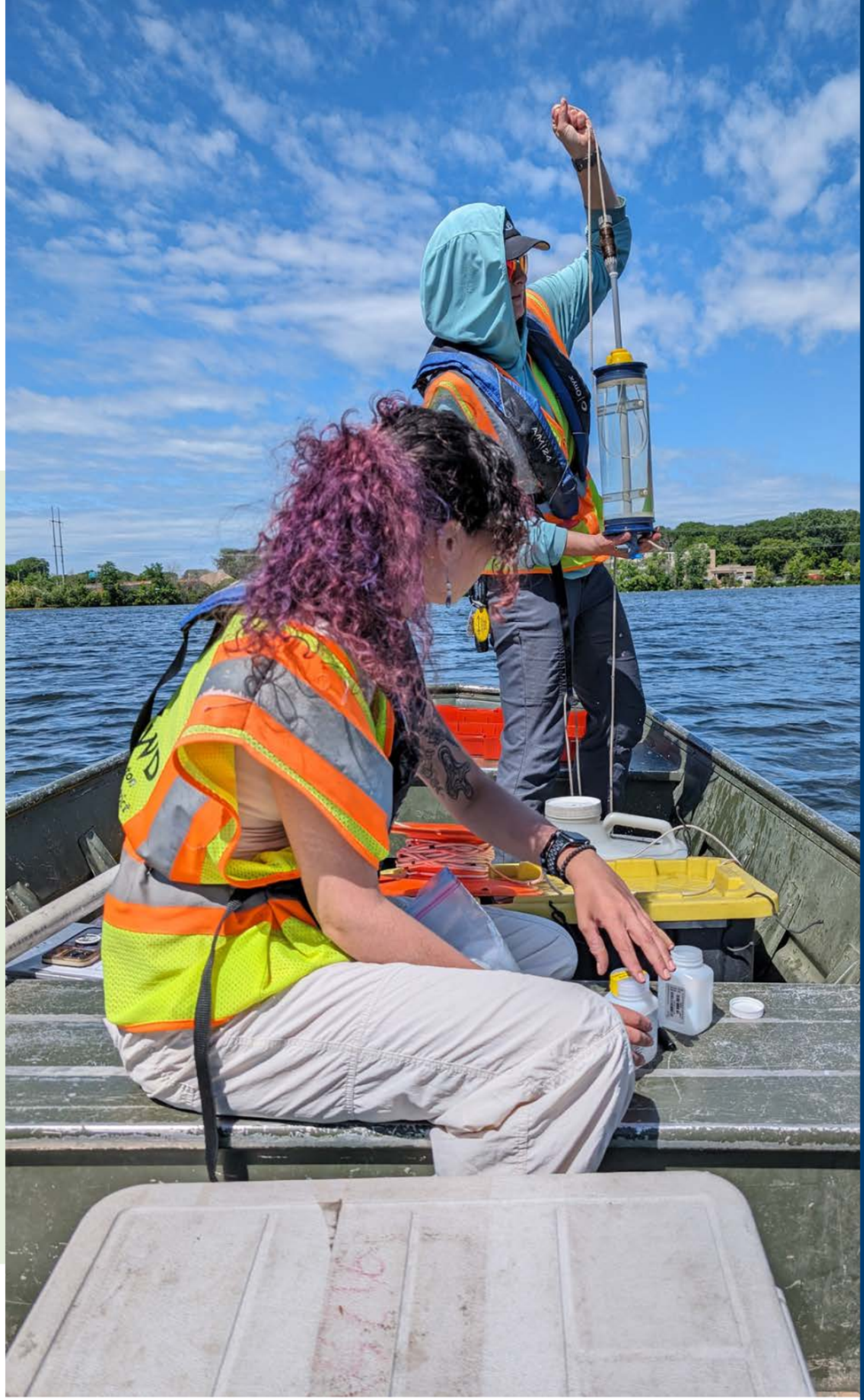
Long-term water quality improvements in District lakes and streams suggest that the implementation of numerous BMPs has been successful; however, changes in precipitation may have also contributed to improvements in the water quality of District water bodies. The next generation of BMPs has been implemented over the past two decades to begin removing dissolved phosphorus in addition to particulate phosphorus. A summary of these BMPs is below:

- The Beam Avenue filter, an iron-enhanced sand filter, was first monitored in 2009, with total phosphorus removal ranging from around 70 to 93% and ortho-phosphorus removal ranging from 10 to 80% from 2009 to 2018. Total phosphorus and ortho-phosphorus performance have been variable from 2021 to 2023. This could be due to three drought years and media replaced closest to the inlet in 2022. The Beam Avenue filter was not monitored in 2024 due to consistent performance trends over the past 10 years.
- The Woodlyn Avenue iron-enhanced sand-type vegetative filter was monitored from 2012 to 2018. During that period, total phosphorus removal ranged from 22 to 75 percent, with the most recent removal in 2018 being 75 percent. Ortho-phosphorus removal during the monitoring period was as high as 90%, but in 2018, the percent removal was 0. In 2022 and 2024, the filter has over 85% removal for total phosphorus, orthophosphate, and total suspended solids. While 2023 had 61% total phosphorus removal, 36% orthophosphate removal, and 83% total suspended solids removal. Due to the inconsistency in performance ten years after constructed, it is recommended to continue monitoring and postpone media replacement.
- Three spent-lime media filtration type BMPs have been constructed in the District. It is instructive to compare the performance of these systems to the iron-enhanced sand filters and critically evaluate them both as it is still not clear which type of media performs best; each has positive and negative attributes. The Wakefield Experimental Filter (Wakefield cell) was monitored from 2012 to 2016 and had annual average total phosphorus removal ranging from 41 to 80%, orthophosphate removal ranging from 67 to 86%, and total suspended solids removal from 0 to 77%. Influent total phosphorus, orthophosphate, and total suspended solids removal at the Frost Kennard Filter decreased from 2018 to 2021, but then removals increased in 2022 (potentially due to drought conditions). In 2023 and 2024, the filter had consistent high total phosphorus removal (50%-65%) and total suspended solids removal (over 90%), while orthophosphate has consistent low removals (Below 20%). The other spent-lime BMP, Willow Pond Continuous Monitoring and Adaptive Control (CMAC) had its first monitoring year in 2024, which included three sampling events. The average removal for CMAC during the 2024 monitoring period was 26% for total phosphorus, 13% for orthophosphate, and 36% for total suspended solids. Monitoring of the Frost Kennard Filter and CMAC will continue in 2025.
- In 2022, the Wakefield cell's spent-lime media was replaced with iron and granite sand media. The performance of the filter for phosphorus and orthophosphate was mixed with an average removal of 9% and 19%, respectively. Total suspended solids performance improved over the year, but the filter still had minimal removals, with two events releasing suspended solids. In 2023 and 2024, performance has been consistently high at to over 70% removal of total phosphorus, orthophosphate, and total suspended solids removal. One potential reason for the increased performance is that the new media was not washed properly and contained additional solids at the time of installation.

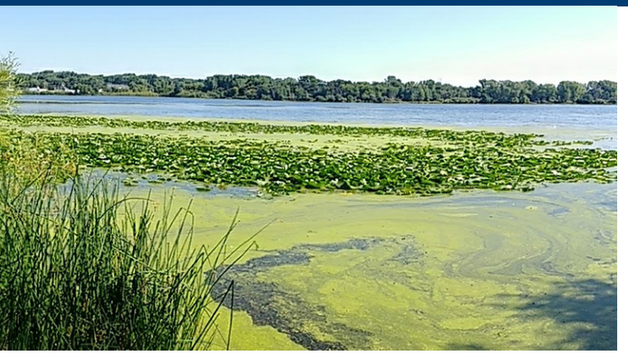
- In 2024, the **Arbogast filter** monitoring began. The total phosphorus and total suspended solids removal were constant, typically 30-45% for total phosphorus and over 85% for total suspended solids. While orthophosphate had mixed removals ranging from -35% to 30%. The filter needs to be monitored more to understand the filter's long-term performance.
- **The Tanners Lake alum treatment facility** deserves some mention as it has performed very reliably and is likely the primary reason that Tanners Lake has been taken off the impaired waters list and also why Battle Creek Lake water quality has improved notably. Since the beginning of operation in 1998, the average annual total phosphorus removal has ranged from 48 to 91%, with the removals from 2015 to 2019 ranging from 78–89%. Total phosphorus removal declined in the past 3 years from 2021 to 2023. One potential reason could be the low-flow conditions from the drought. In 2024, the total phosphorus removal was 60%.
- **The Shoreview Commons Pond** has a history of internal loading. In February 2021, iron filings were applied to the frozen lake. The application of iron on ice allows the filings to be equally distributed as the ice melts. The pond was monitored from 2019 to 2024 to evaluate the impacts of the iron-filing application. Orthophosphate and total suspended solids removal were similar pre- and post-filing. Overall, there are unclear trends in the pre- and post-filing application due to external circumstances, including wet/dry years and the installation of a fountain or aerator in the pond.

The following are monitoring recommendations for future annual reports.

1. Chloride
    a. Continue to incorporate chloride monitoring into all routine water quality monitoring.
    b. Continue annual monitoring of water bodies, including ponds, ditches, and creeks, on a rotating basis to better understand where the chloride hotspots are within the RWMWD. In 2024, ice-out chloride monitoring was continued (see Chapter 6), and monitoring in water bodies is planned to continue in 2025.
    c. Measure specific conductance when measuring chloride to develop a relationship between chloride and specific conductance. In the future, specific conductance may be used as a surrogate for chloride by developing a regression between the two parameters.
2. Streams
    a. Continue monitoring the water quality of streams (at minimum, total phosphorus, total dissolved phosphorus, ortho-phosphorus, total Kjeldahl nitrogen, nitrate plus nitrite, total suspended solids, chloride, and chlorophyll-*a*). Water quality monitoring will have value even if the flow cannot be monitored.
3. BMPs
    a. A rotating monitoring schedule for the filtration-type BMPs constructed in the District has been developed to document their performance. A rotating schedule will allow for a more widespread monitoring effort when new BMPs come online. It is important to reevaluate the BMP monitoring schedule annually.
    b. The media of the following BMPs needs further evaluation in 2025 or later (another year of monitoring may be appropriate to confirm whether these filters are performing as designed):
        i. Beam Avenue iron-enhanced sand filter
        ii. Woodlyn Avenue iron-enhanced sand filter
        iii. Willow Pond spent-lime filter
        iv. Wakefield Lake experimental iron and granite sand filter
        v. Arbogast CC17 filter

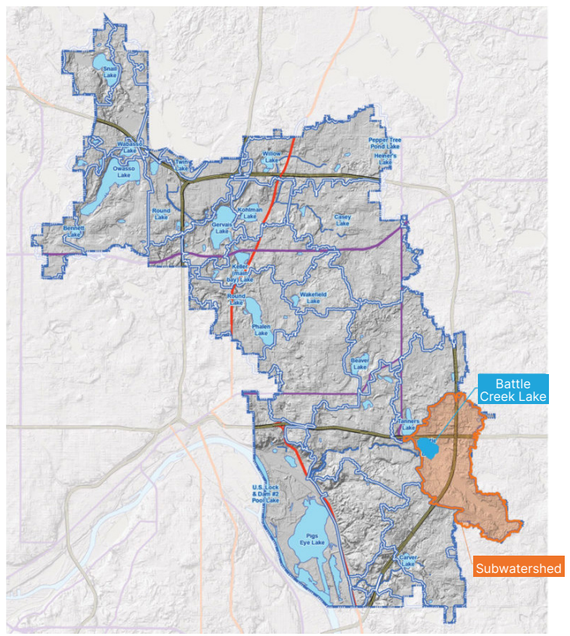


BATTLE CREEK LAKE



Minnesota Pollution Control Agency (MPCA) designations	Shallow lake; "non-support" of aquatic life (chloride)
Tributary area	2,638 acres
Surface area	103 acres
Average/maximum depth	4 feet/15 feet
RWMWD nutrient classification[1]	At risk
Accountable municipalities	Landfall, Oakdale, Woodbury, Washington County
Downstream water body	Battle Creek

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Battle Creek Lake is a shallow lake in Washington County that receives flows from Tanners Lake and outlets to Battle Creek. The lake is used for a variety of recreational purposes, including motor boating, canoeing, fishing, picnicking, and aesthetic viewing. A public boat access is located at the lake's southeast corner in Shawnee Park.

Battle Creek Lake is on the MPCA's impairment list for mercury (aquatic consumption) and chloride (aquatic life). A statewide mercury TMDL was completed in 2007, and the Twin Cities Metro Area Chloride TMDL was completed in 2016. In 2014, the lake was removed from the MPCA's Impaired Waters List for excess nutrients.

Battle Creek Lake has been monitored annually for phosphorus, chlorophyll-*a*, and Secchi disk depth from 1997 to 2024; it has been monitored annually for chloride since 2015. In 2024, the lake met Minnesota state standards for summer averages for Secchi disk depth and chloride (see table and graphs at right). The 10-year data shows a statistically significant trend of worsening total phosphorus and chlorophyll-*a* concentration.

According to the 2017 *Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 68% of the phosphorus in Battle Creek Lake comes from stormwater. Strategies to address stormwater management include implementing water-quality projects that reduce external loading to the lake and BMP cost-share programs. Plans to address chloride include improving road salt management by promoting and adopting strategies outlined in the *Twin Cities Metro Area Chloride Management Plan*.

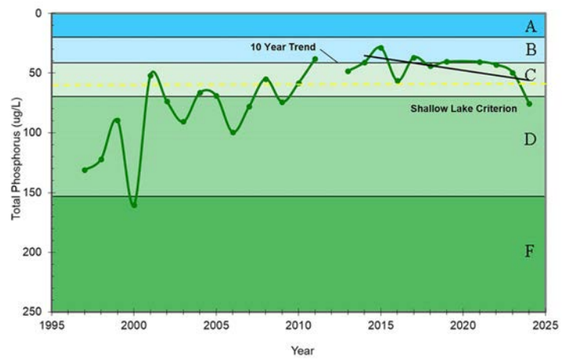
Since first establishing water quality goals for Battle Creek Lake, RWMWD has completed several projects that have contributed to improvements in water quality. Recent projects include:

- Woodbury Elementary and Middle School rain gardens (2017): This was one of six school rain garden projects funded, in part, by a $150,000 Clean Water Fund grant. Two gardens were planted at the site, providing needed pollinator habitat and reducing the volume of polluted runoff that drains to Battle Creek Lake.
- Trinity Presbyterian Church (2017): Two rain gardens were installed at this site to manage runoff from the church's parking lot. This reduces the volume of polluted rainwater draining to Battle Creek Lake.
- Woodbury Target (2024): Two biofiltration basins were installed at the Target store located in the Valley Creek Plaza in Woodbury. Water is captured from the store's parking lot via trench drains that discharge into the basins. The basins reduce the pollutants that drain to Battle Creek Lake, and include native vegetation for pollinator, bird, and insect habitat.

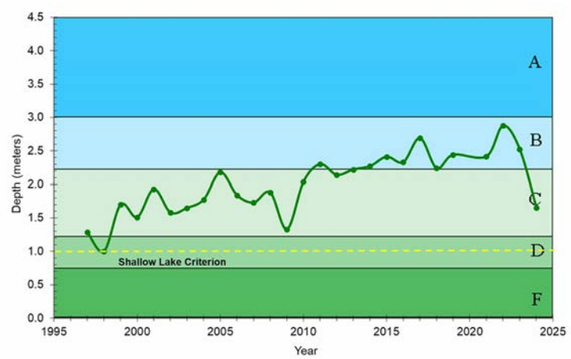
Parameter	State Standard	2024 Battle Creek Lake	10-Year Average	10-Year Trend
Phosphorus	≤ 60 µg/l	75.6 µg/l	46 µg/l	Worsening
Chlorophyll-*a*	≤ 20 µg/l	22.5 µg/l	9 µg/l	Worsening
Secchi disk transparency	> 1 meter	1.6 meters	2.4 meters	None
Chloride	≤ 230 mg/L [2]	148 mg/L	197 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

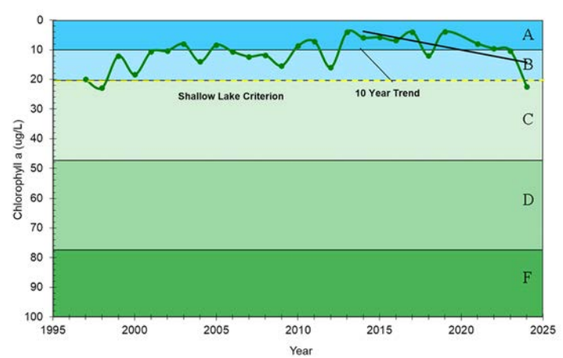
Total phosphorus (µg/l)



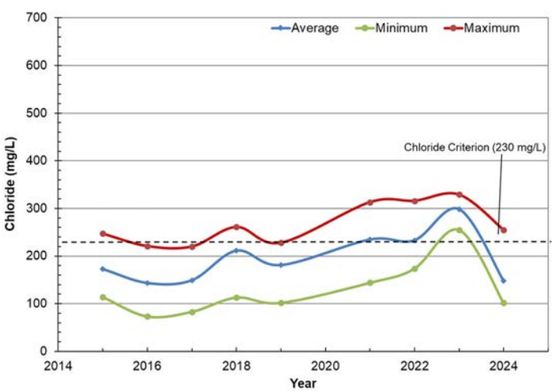
Secchi transparency (m)



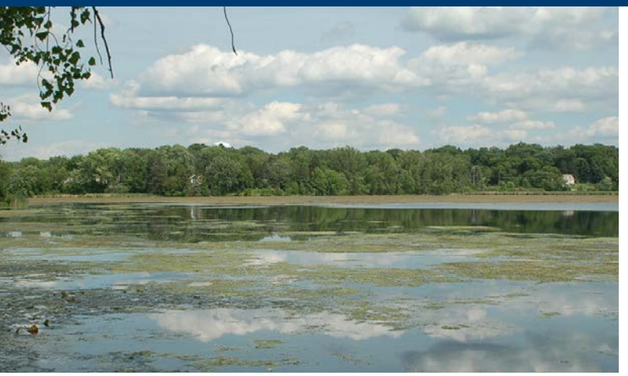
Chlorophyll-*a* (µg/l)



Chloride (mg/L)

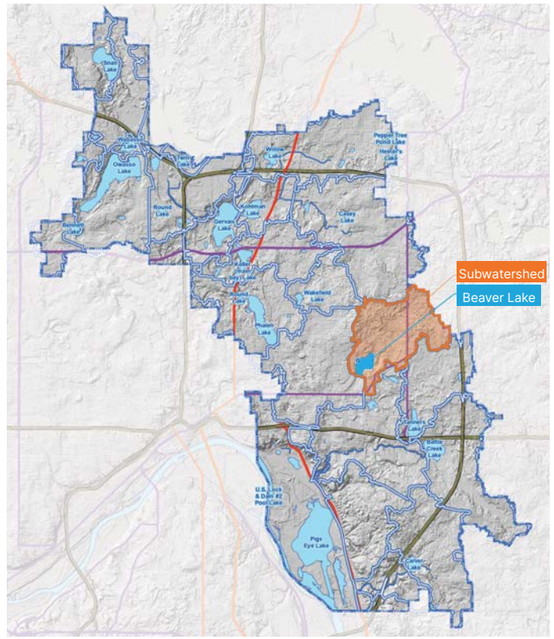


BEAVER LAKE



MPCA designation	Shallow
Tributary area	1,935 acres
Surface area	87 acres
Average/maximum depth	4/11 feet
RWMWD nutrient classification[1]	At risk
Accountable municipalities	Maplewood, St. Paul, Ramsey County, Washington County
Downstream water body	Beltline Storm Sewer and Mississippi River

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Beaver Lake is a small, shallow lake in Maplewood that drains to the Beltline storm sewer and on to the Mississippi River. A Ramsey County park occupies most of the north and west shoreline. The lake has some wildlife habitat and is primarily used for canoeing, fishing, picnicking, and aesthetic viewing. It is impaired for mercury (aquatic consumption), at risk for chlorides, and listed by the Minnesota DNR as infested with Eurasian watermilfoil. In 2012, the lake was removed from the MPCA's Impaired Waters List for excess nutrients.

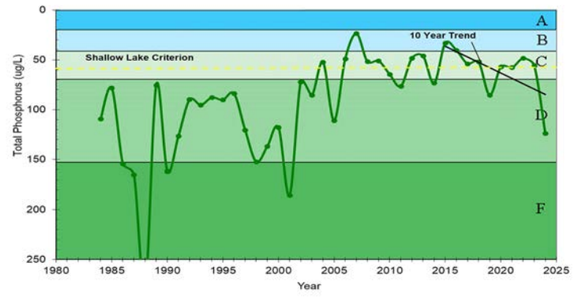
Beaver Lake has been monitored annually for phosphorus, chlorophyll-*a*, and Secchi disk depth since 1984; chloride monitoring started in 2015. In 2024, the lake did not meet summer-average state standards for total phosphorus and chlorophyll-*a* (see table and graphs at right). The 10-year data shows a statistically significant trend of worsening total phosphorus concentration.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 51% of the phosphorus in Beaver Lake comes from stormwater, and 47% comes from internal loading. Strategies to address stormwater management include implementing water-quality projects to reduce the total phosphorus load to the lake and BMP cost-share programs. Plans to reduce in-lake loading include assessing options for the inactivation of sediment release of phosphorus.

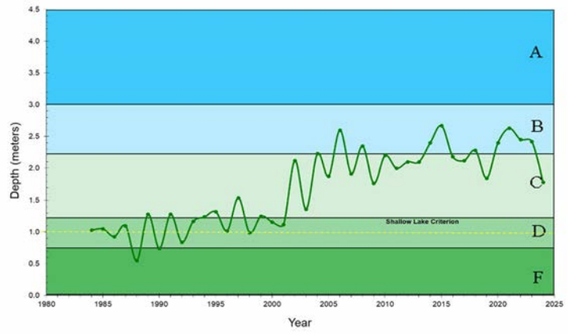
Parameter	State Standard	2024 Beaver Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 60 µg/l	123.9 µg/l	61 µg/l	Worsening
Chlorophyll-*a*	≤ 20 µg/l	53.7 µg/l	19 µg/l	None
Secchi disk transparency	> 1 meter	1.8 meters	2.3 meters	None
Chloride	≤ 230 mg/L [2]	94.0 mg/L	112 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

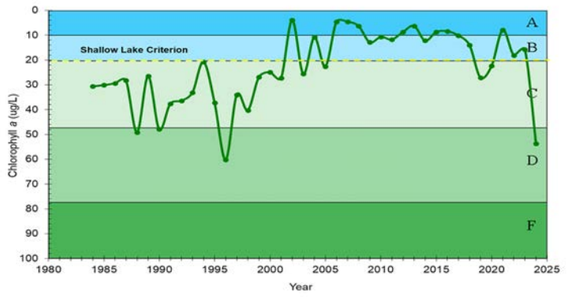
Total phosphorus (µg/l)



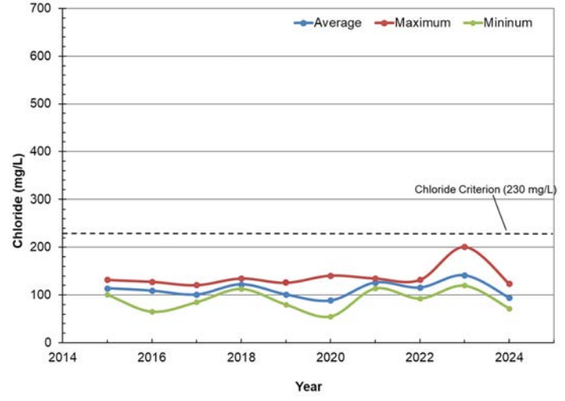
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



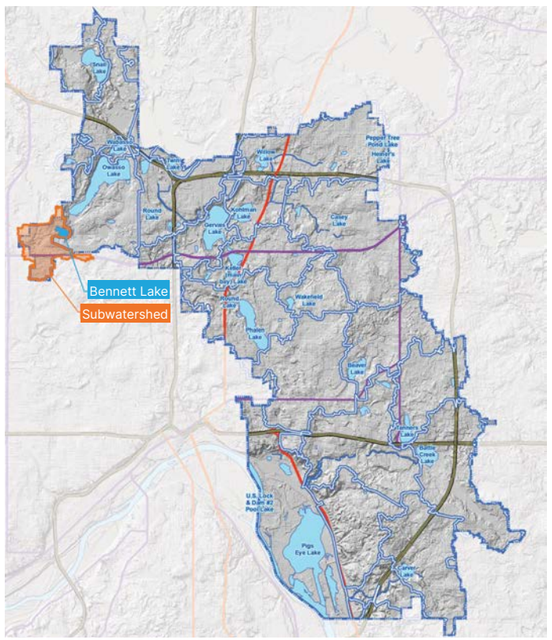
Chloride (mg/L)



BENNETT LAKE

MPCA designation	Shallow
Tributary area	721 acres
Surface area	25 acres
Average/maximum depth	9 feet
RWMWD nutrient classification[1]	Impaired
Accountable municipalities	Roseville, Ramsey County
Downstream water body	Lake Owasso

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Bennett Lake is the start of a chain of lakes that ultimately drains to Grass Lake. The City of Roseville's Central Park surrounds the lake, which has a fishing pier and provides canoeing opportunities. The Minnesota Department of Natural Resources uses Bennett Lake as a fish nursery.

Bennett Lake is considered by the MPCA to be impaired for mercury (aquatic consumption) and excess nutrients. A statewide mercury TMDL was completed in 2007, and a nutrient TMDL was completed in 2017.

Bennett Lake has been monitored annually for chlorophyll-*a* from 1984 to 2024 and for phosphorus and Secchi disk depth from 2003 to 2024. Annual chloride monitoring began in 2015. In 2024, the lake met summer-average state standards for only Secchi disk transparency and chloride (see table and graphs at right). The 10-year data shows a statistically significant trend of worsening total phosphorus concentration.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 56% of the phosphorus in Bennett Lake comes from internal loading, and 43% comes from stormwater. In 2022, a shallow lake aeration study began. The study consisted of monthly monitoring for water quality and sediment coring, as well as continuous dissolved oxygen monitoring. The objective of the study was to determine if shallow aeration could reduce phosphorus loading and improve dissolved oxygen throughout the lake. The benefits of aeration for Bennet Lake were primarily seen close to the aeration system and may have been limited due to the lack of iron. The shallow lake aeration study monitoring was continued in 2023, and report was provided to RWMWD staff and the board of managers in 2024.

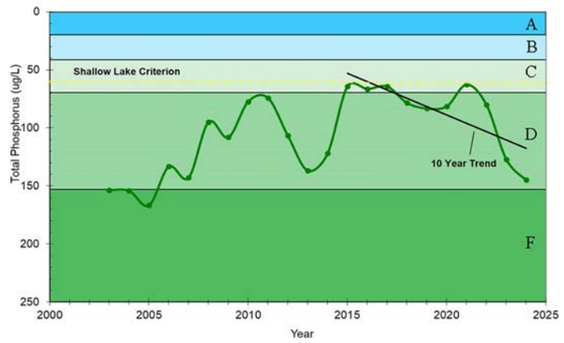
RWMWD has completed three recent projects that have contributed to the improving water quality of this lake:

- Grace Church retrofit (2015): This project involved the installation of two rain gardens and three native planting areas to intercept and filter runoff from the Grace Church parking lot, reducing the volume of polluted rainwater draining to Bennett Lake.
- Carp management (ongoing since 2017): Carp management in the Lake Owasso system of lakes (Owasso, Wabasso, Bennet, and Grass) is helping control phosphorus loading in these waters. Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of carp nurseries, and installing barriers.
- Willow Pond spent-lime filter (2018): This project involved the installation of a spent lime filter that draws water above the pond's outlet elevation off of Willow Pond. The pipe that draws water from Willow Pond can be opened and closed automatically to control the volume of water in the filter and the length of time between filling events.

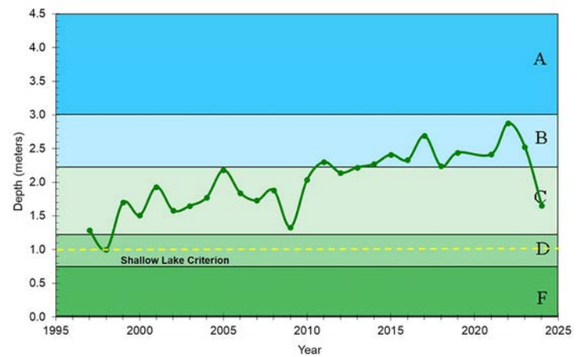
Parameter	State Standard	2024 Bennett Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 60 µg/l	144.8 µg/l	85 µg/l	Worsening
Chlorophyll-*a*	≤ 20 µg/l	42.8 µg/l	18 µg/l	None
Secchi disk transparency	> 1 meter	1.2 meters	1.6 meters	None
Chloride	≤ 230 mg/L [2]	59.7 mg/L	115 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

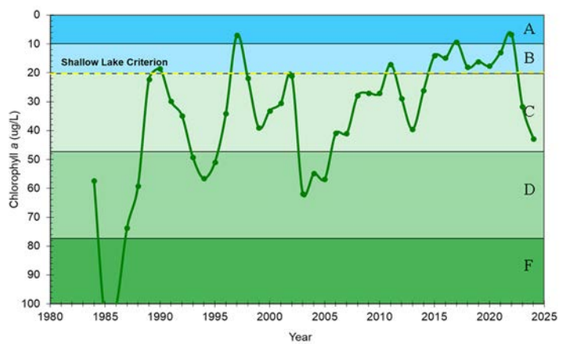
Total phosphorus (µg/l)



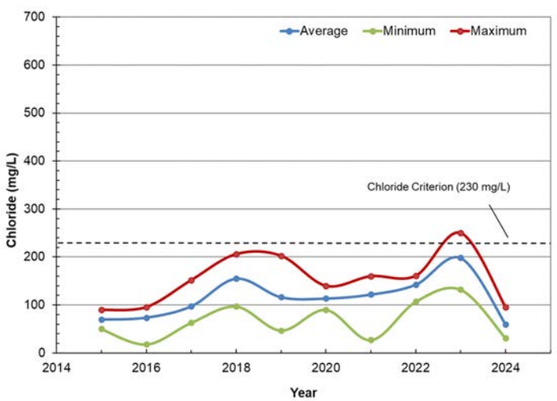
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



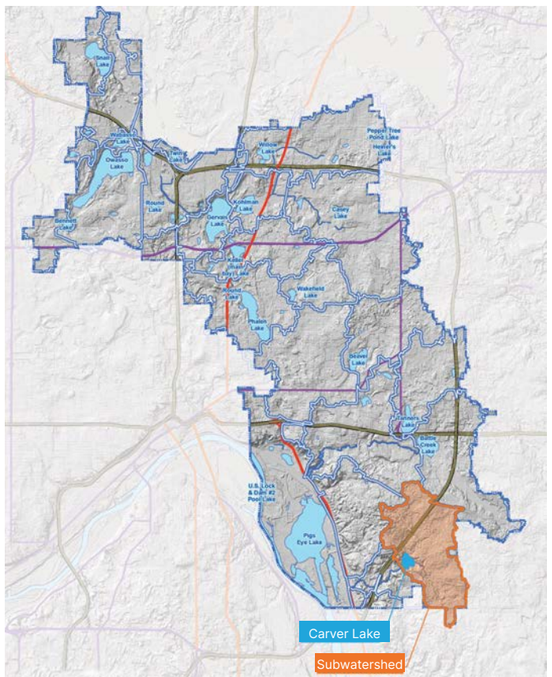
Chloride (mg/L)



CARVER LAKE

MPCA designations	Deep lake; "non-support" of aquatic life (chloride)
Tributary area	2,274 acres
Surface area	49 acres
Average/maximum depth	16/36 feet
RWMWD nutrient classification[1]	At risk
Accountable municipalities	Maplewood, Woodbury, Ramsey County, Washington County
Downstream water body	Fish Creek

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Carver Lake, which borders the popular Carver Lake Park, is used primarily for swimming and canoeing. There is a public beach located on the southeast side, along with canoe access.

Carver Lake was removed from the MPCA's impaired list for nutrients in 2012. However, it is still considered to be impaired for mercury (aquatic consumption) and chloride (aquatic life). A statewide mercury TMDL was completed in 2007, and the Twin Cities Metro Area Chloride TMDL was completed in 2016.

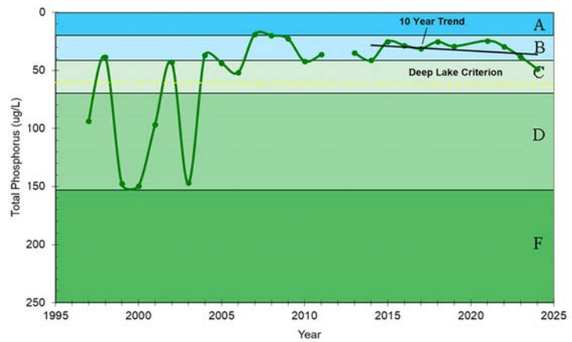
Carver Lake has been monitored annually for phosphorus, chlorophyll-*a*, and Secchi disk depth from 1997 to 2024. Annual chloride monitoring began in 2016. In 2024, the lake did not meet MPCA summer-average state standards for any monitored parameter. The 10-year trend shows a statistically significant worsening of total phosphorus concentrations (see table and graphs at right).

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 79% of the phosphorus in Carver Lake comes from stormwater, and 19% comes from internal loading. Goals for the lake include improving stormwater management by implementing a BMP cost-share program and water quality projects that decrease the phosphorus load to Carver Lake.

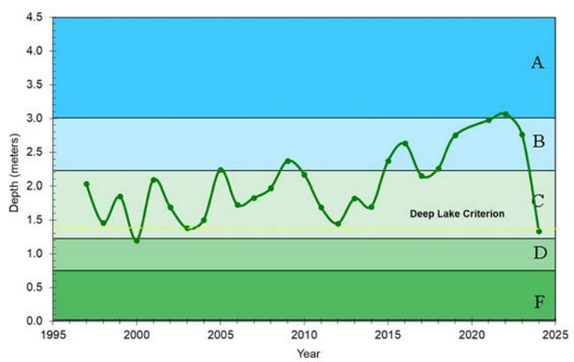
Parameter	State Standard	2024 Carver Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	48.9 µg/l	32 µg/l	Worsening
Chlorophyll-*a*	≤ 14 µg/l	33.9 µg/l	16 µg/l	None
Secchi disk transparency	> 1.4 meters	1.3 meters	2.4 meters	None
Chloride	≤ 230 mg/L [2]	342 mg/L	N/A	N/A

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

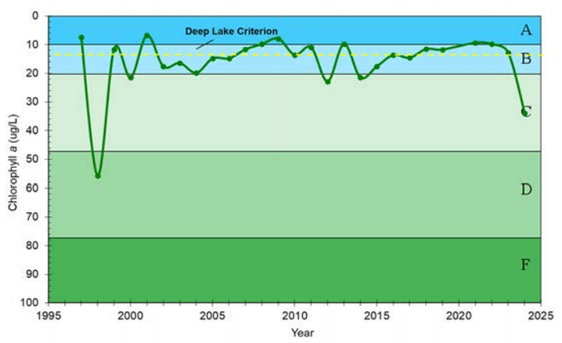
Total phosphorus (µg/l)



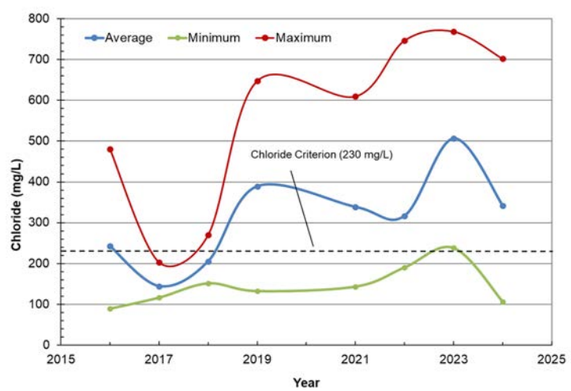
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



Chloride (mg/L)



CASEY LAKE

Casey Lake is actually a large wetland. Located in North St. Paul, it is the headwaters of Kohlman Creek.

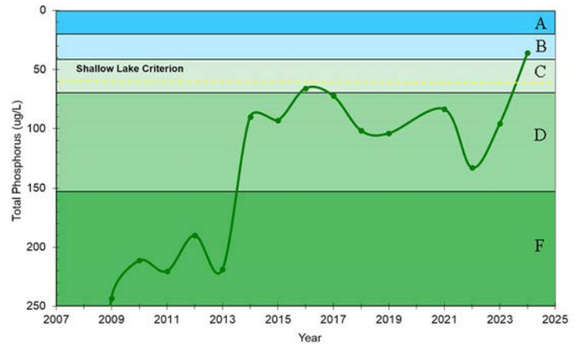
Casey Lake has been monitored annually for phosphorus, chlorophyll-*a*, and Secchi disk depth since 2008; however, as a wetland, state eutrophication standards do not apply. The 10-year data does not show a statistically significant trend in any of the monitored parameters.

In the winter of 2012–2013, a draw-down of Casey Lake was done to kill invasive carp, which used the lake as a nursery. Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. The draw-down dramatically improved the lake's water clarity (from 0.26 meters to 0.88 meters). In the spring of 2013, the DNR stocked bluegills and bass in Casey Lake to keep carp levels low.

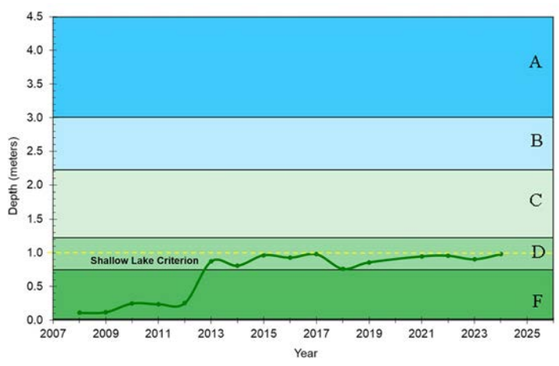
Parameter	State Standard	2024 Casey Lake	10-Year Average[1]	10-Year Trend
Phosphorus	N/A	36.0 µg/l	88 µg/l	None
Chlorophyll-*a*	N/A	6.2 µg/l	17 µg/l	None
Secchi disk transparency	N/A	0.98 meters	0.9 meters	None
Chloride	N/A	42.7 mg/L	N/A	N/A

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

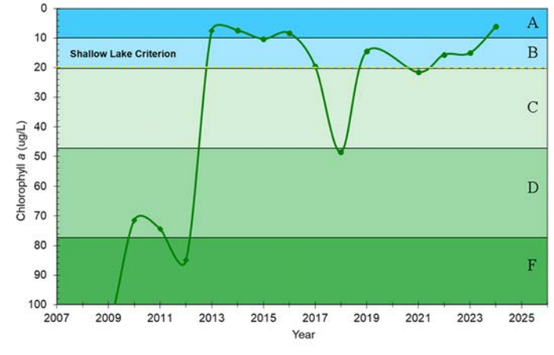
Total phosphorus (µg/l)



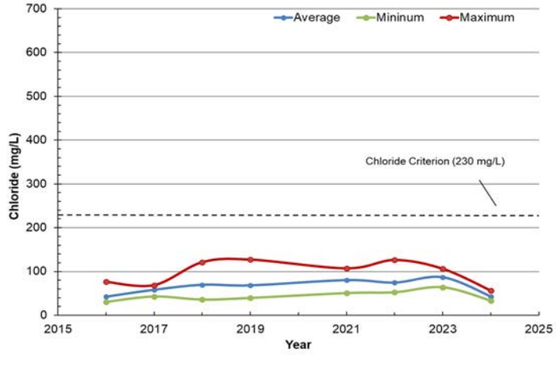
Secchi transparency (m)



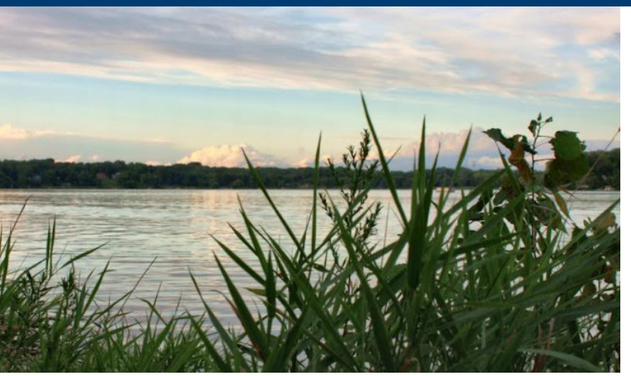
Chlorophyll-*a* (µg/l)



Chloride (mg/L)

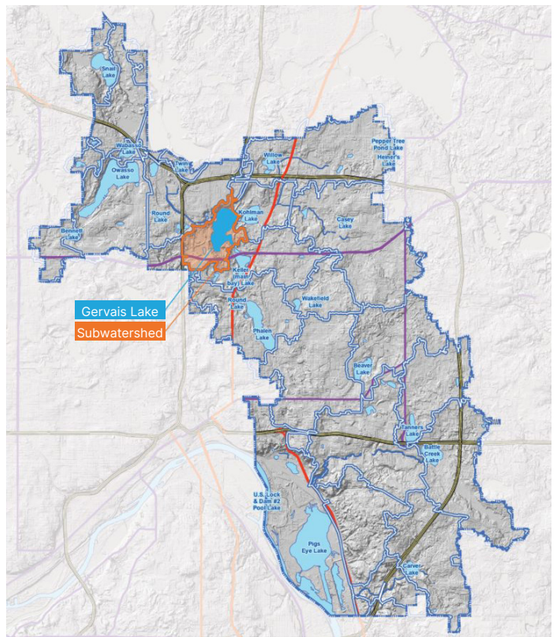


GERVAIS LAKE



MPCA designations	Deep; "non-support of aquatic life (fish and chloride)
Tributary area	893 acres
Surface area	234 acres
Average/maximum depth	22/41 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Little Canada, Maplewood, Ramsey County
Downstream water body	Keller Lake

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Gervais Lake is the second and largest lake in the Phalen Chain of Lakes. It is used primarily for swimming, skiing, and boating. There is a public boat access from Spoon Lake and a Ramsey County swimming beach and park adjacent to the lake. The lake receives flows from Gervais Creek, Kohlman Lake, and runoff from its direct tributary area.

Gervais Lake is on the MPCA's impaired waters list as impaired for mercury (aquatic consumption) and is considered to be impaired for chloride according to the MPCA's 2024 draft impaired waters list. The lake is also listed by the Minnesota DNR as infested with Eurasian watermilfoil. A statewide mercury TMDL was completed in 2007.

Annual monitoring for phosphorus, chlorophyll-*a*, and Secchi disk depth started in 1981. Annual monitoring for chloride began in 1998. In 2024, the lake met summer-average state standards for total phosphorus and chloride. The 10-year data shows no statistically significant change for any parameter.

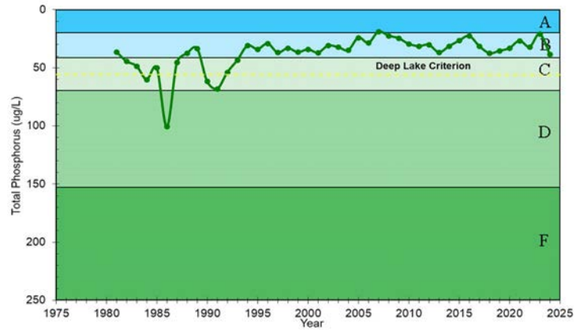
According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 24% of the phosphorus in Gervais Lake comes from stormwater, and 76% comes from upstream water bodies. Plans to address these conditions include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake.

One project that helps control phosphorus loading in the Phalen Chain of Lakes (Gervais, Lake Phalen, Lake Keller, Kohlman Lake) is carp management (ongoing since 2009). Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of nurseries, and installing barriers. Efforts have reduced carp in the Phalen Chain by over 60%.

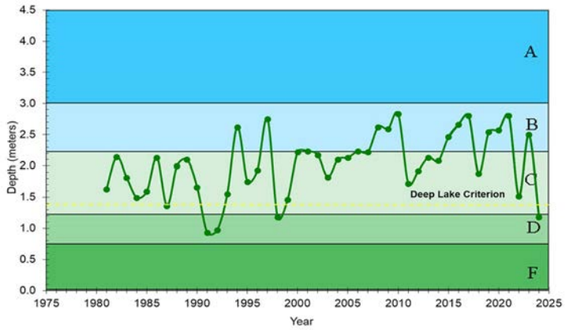
Parameter	State Standard	2024 Gervais Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	38.5 µg/l	30 µg/l	None
Chlorophyll-*a*	≤ 14 µg/l	43.2 µg/l	16 µg/l	None
Secchi disk transparency	> 1.4 meter	1.2 meters	2.3 meters	None
Chloride	≤ 230 mg/L [2]	175 mg/L	187 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

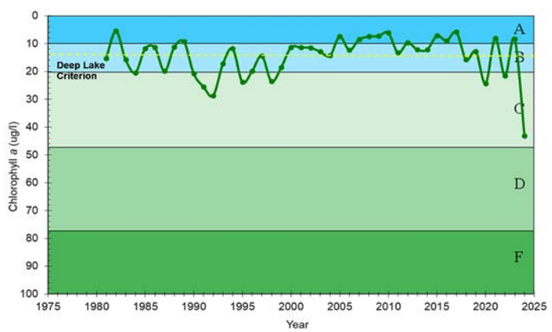
Total phosphorus (µg/l)



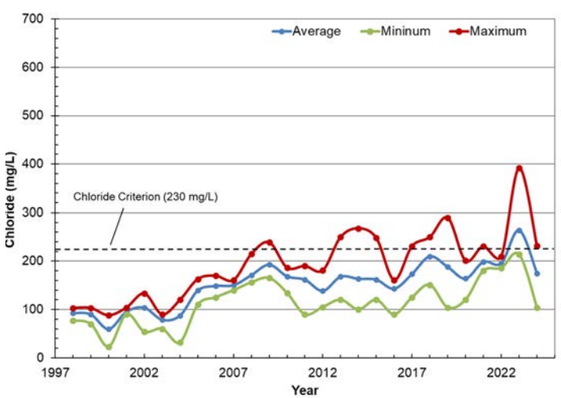
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



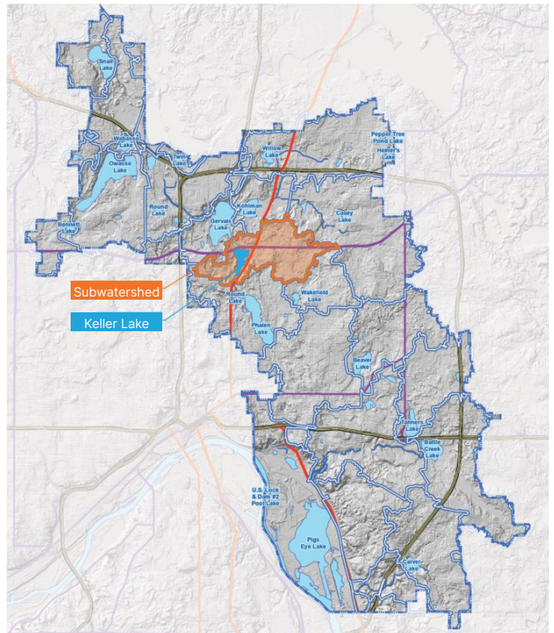
Chloride (mg/L)



KELLER LAKE

MPCA designation	Shallow
Tributary area	1,577 acres
Surface area	72 acres
Average/maximum depth	4/8 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Little Canada, Maplewood, Ramsey County
Downstream water body	Lake Phalen

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Keller Lake is the third lake in the Phalen Chain of Lakes and is used for motor boating, canoeing, fishing, picnicking, and aesthetic viewing. There is a Ramsey County Park on the lake's east shoreline. Flows to the lake are received from Gervais Lake (through Spoon Lake) and runoff from its direct tributary area.

Keller Lake was listed as impaired for excess nutrients in 2002 but was removed from the list in 2012 after meeting state standards (for shallow lakes). The lake is still at risk of impairment for chlorides. In addition, Keller Lake is listed by the Minnesota DNR as infested with Eurasian watermilfoil.

Annual monitoring for phosphorus, chlorophyll-*a*, and Secchi disk depth began in 1981; monitoring for chlorides started in 2015. In 2024, Keller Lake met summer-average state standards for all parameters except for chlorophyll a (see table and graphs at right). The 10-year data shows a statistically significant trend of worsening chlorophyll-*a* concentration and Secchi disk depth.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 42% of the phosphorus in Keller Lake comes from stormwater, 8% comes from internal loading, and 49% comes from upstream water bodies. Strategies to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake. Internal loading is being addressed by managing carp.

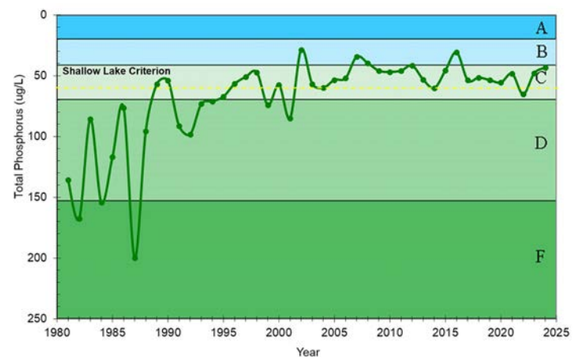
Several recent projects have helped Keller Lake meet state water-quality standards. These include:

- Carp management (ongoing since 2009): Carp management helps control phosphorus loading in the Phalen Chain of Lakes (Keller Lake, Gervais Lake, Lake Phalen, and Kohlman Lake). Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of nurseries, and installing barriers. Efforts have reduced carp in the Phalen Chain by over 60%.
- Keller Lake Shoreline (2012): This ecological restoration project treated over 2,000 feet of shoreline, helping to reduce the volume of polluted stormwater that reaches the lake. The restoration areas now support more than 75 species of native plants.
- Lakeview Lutheran (2013) is one of 12 projects to manage rainwater runoff at churches with large amounts of impervious surface. Three rain gardens were installed, as well as a native planting area that provides pollinator habitat. The gardens and planting area filter runoff from the church parking lot.

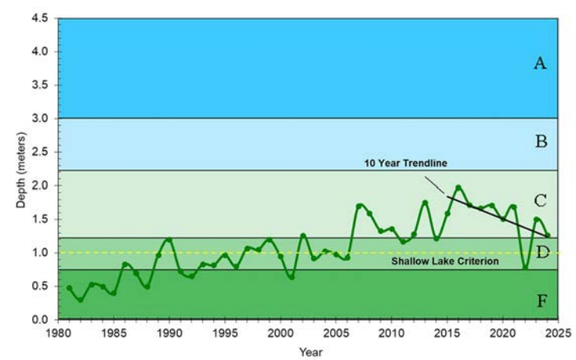
Parameter	State Standard	2024 Keller Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 60 µg/l	43.4 µg/l	50 µg/l	None
Chlorophyll-*a*	≤ 20 µg/l	27.5 µg/l	15 µg/l	Worsening
Secchi disk transparency	> 1 meter	1.3 meters	1.3 meters	Worsening
Chloride	≤ 230 mg/L [2]	142 mg/L	168 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

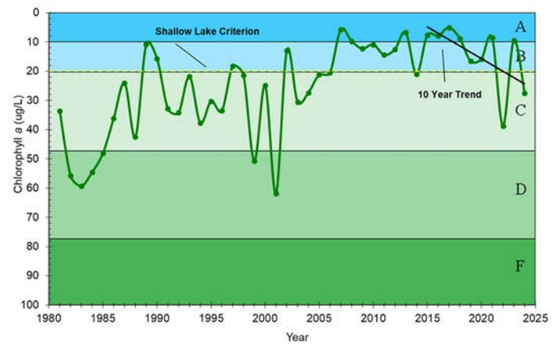
Total phosphorus (µg/l)



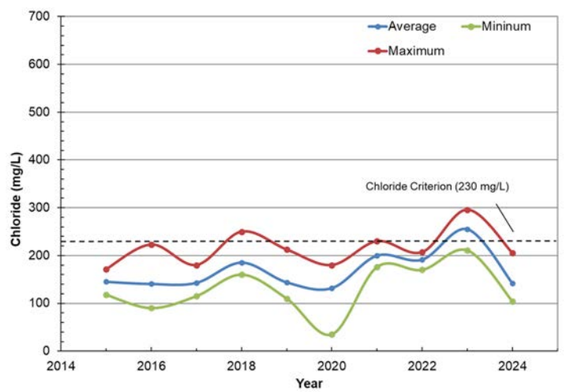
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



Chloride (mg/L)

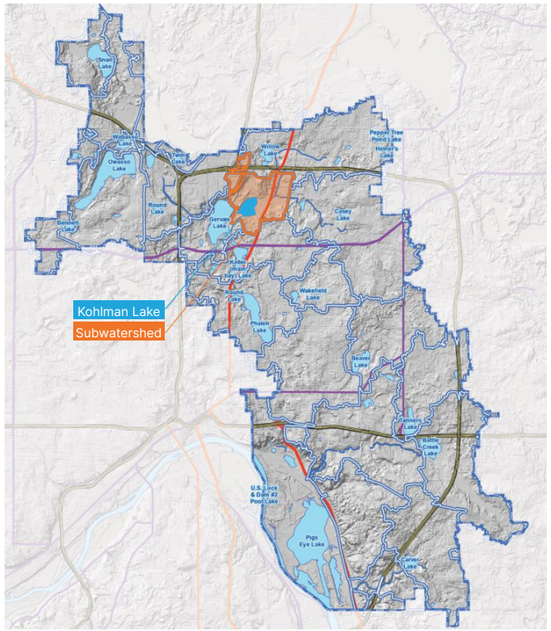


- The Highway 36/61 project (2014): This project was constructed as part of the overall Trunk Highway 36 and English Street interchange effort. It included the installation of a stormwater treatment system to prevent polluted stormwater runoff from entering Keller Lake and downstream Lake Phalen. The project treats stormwater from approximately 70 acres of commercial, residential, and highway areas by channeling it through an enhanced sand filter cell and two wetland treatment basins designed to remove phosphorus-rich sediment and other contaminants.
- Weaver Elementary School (2016) is one of six school rain garden projects to manage polluted runoff at schools in priority areas of the watershed. This project also provides needed pollinator habitat.

KOHLMAN LAKE

MPCA designations	Shallow; "non-support" of aquatic life (chloride)
Tributary area	1,009 acres
Surface area	84 acres
Average/maximum depth	4/12 feet
RWMWD nutrient classification[1]	At-risk (changed from "impaired" in 2022 MPCA assessment)
Accountable municipalities	Little Canada, Maplewood, Vadnais Heights, Ramsey County
Downstream water body	Gervais Lake

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Kohlman Lake is the first lake in the Phalen Chain of Lakes. It is used for a variety of recreational purposes, including motor boating, canoeing, fishing, picnicking, and aesthetic viewing. While the drainage area that directly reaches the lake is just over 1,000 acres, the total area connected to the lake through Kohlman and Willow Creeks is about 7,500 acres. There is no direct public boat access to Kohlman Lake, but it can be accessed from Gervais Lake.

Kohlman Lake was listed as impaired for excess nutrients in 2002 and is impaired for chloride (aquatic life). A nutrient TMDL was completed in 2010, and the Twin Cities Metro Area Chloride TMDL was completed in 2016. Kohlman Lake was delisted from the impaired waters list for excess nutrients in 2022.

Annual monitoring for phosphorus, chlorophyll-*a*, and Secchi disk depth has occurred since 1981. Annual monitoring for chlorides began in 2021. In 2024, Kohlman Lake met the summer-average state standards for Secchi disk depth and chloride. The 10-year trend shows a statistically significant trend of worsening total phosphorus concentration, chlorophyll-*a* concentration, and Secchi disk depth.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 76% of the phosphorus in Kohlman Lake comes from stormwater, and 23% comes from internal loading. Strategies to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake. Internal loading will be addressed by managing carp and curlyleaf pondweed, as needed. An initial alum treatment was completed on the lake in 2010; another alum treatment is planned in the coming years to address a rebound in internal phosphorus load in the lake.

A few projects have helped improve water quality in Kohlman Lake:

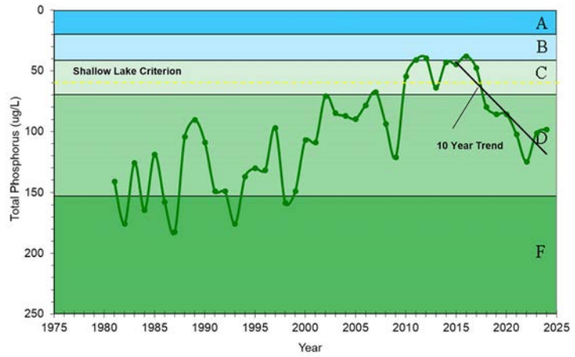
- **Beam Avenue iron-enhanced sand filter (2009):** During construction of the new Country View Lane in Maplewood, RWMWD constructed a sand filter to remove dissolved phosphorus from stormwater. Sand filters have been used for years to remove solids and some pollutants from stormwater, but elemental iron (often called zero-valent iron) was added to the sand to remove dissolved phosphorus by forming iron-phosphate complexes. RWMWD monitoring indicates this practice effectively removes about 90 percent of dissolved phosphorus in the tributary stormwater. This filter is evaluated in Section 7.
- **Carp management (ongoing since 2009):** Carp management helps control phosphorus loading in the Phalen Chain of Lakes (Kohlman Lake, Lake Phalen, Gervais Lake, Lake Keller). Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of nurseries, and installing barriers. These efforts have reduced carp in the Phalen Chain by over 60%.
- **Maplewood Mall (2012):** With 35 35 acres of asphalt pavement and concrete surfaces surrounding it, Maplewood Mall was a major source of phosphorus runoff to Kohlman Lake. But, over 4 years, the RWMWD installed a variety of stormwater management features that capture and filter 67 percent of rainwater at the mall—up from just 3 percent before the project. These features include innovative tree trenches, rain gardens, permeable pavers, and a 5,700-gallon cistern that receives runoff from the mall roof. Interpretive signage educates the public about these improvements, and a large watershed map in the entry vestibule shows how water travels from the mall all the way to the Mississippi River.

Parameter	State Standard	2024 Kohlman Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 60 µg/l	98.2 µg/l	81 µg/l	Worsening
Chlorophyll-*a*	≤ 20 µg/l	31.6 µg/l	20 µg/	Worsening
Secchi disk transparency	> 1 meter	1.1 meters	1.5 meters	Worsening
Chloride	≤ 230 mg/L [2]	94.0 mg/L	154 mg/L	None

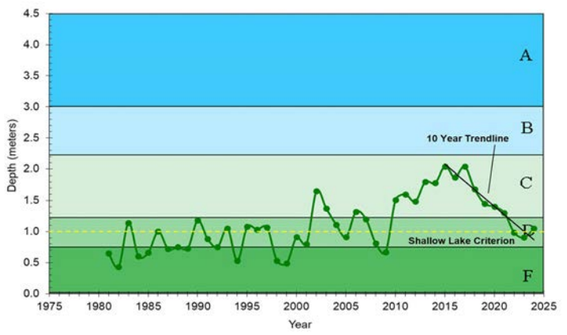
[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.

[2] State standard for chronic chloride exposure.

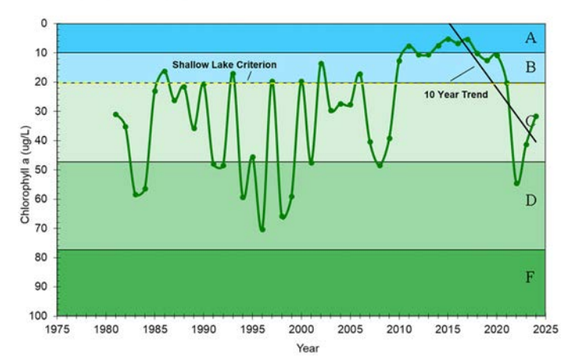
Total phosphorus (µg/l)



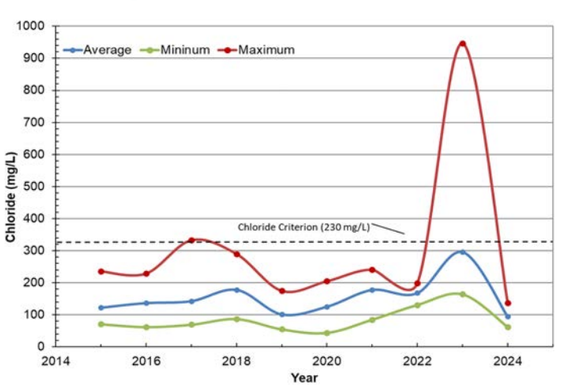
Secchi transparency (m)



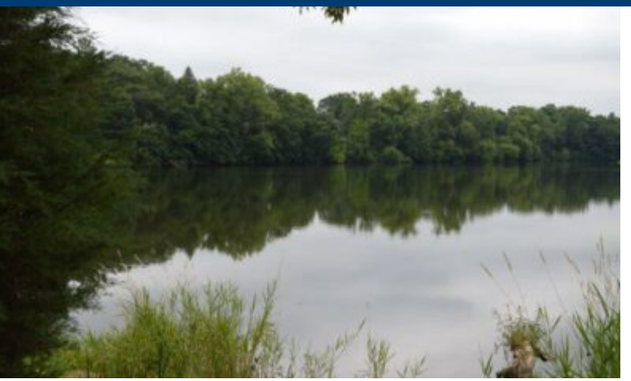
Chlorophyll-*a* (µg/l)



Chloride (mg/L)

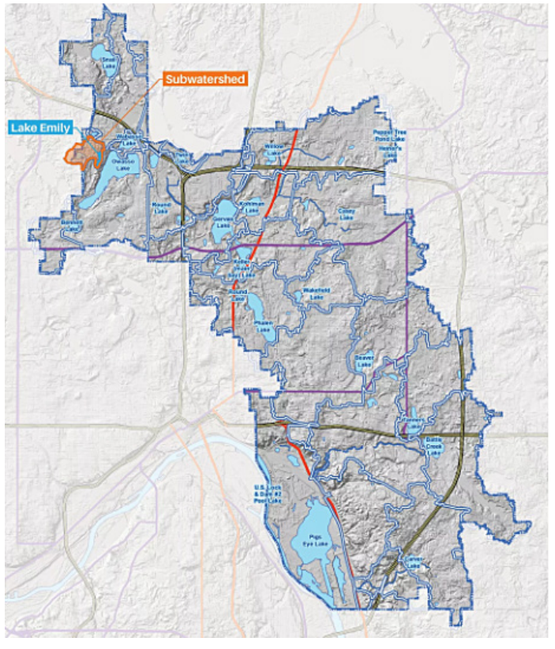


LAKE EMILY



MPCA designation	Shallow
Tributary area	244 acres
Surface area	13 acres
Average/maximum depth	7/15 feet
RWMWD nutrient classification[1]	At-risk
Accountable municipalities	Shoreview
Downstream water body	Lake Owasso

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Lake Emily is a small, shallow lake in Shoreview, within Ramsey County. The lake is part of the larger Lake Owasso watershed. Lake Emily is completely surrounded by private land, and there is no public access. Residents use the lake for fishing, canoeing, and aesthetic enjoyment.

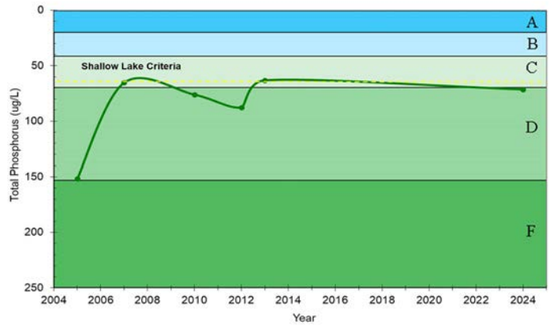
The Lake Emily subwatershed is fully developed. Land use is predominantly single-family residential, with some areas of park, recreational, or preserve land use and institutional land uses. Based on water quality modeling, approximately 42% of the nutrient load to Lake Emily comes from the lake sediments, approximately 37% comes from the direct watershed, and approximately 20% comes from the upstream Lake Judy wetland. In

The RWMWD has assigned a water quality classification of “At Risk” to Lake Emily based on water quality data that exceed the MPCA standards and RWMWD goals. RWMWD monitored Lake Emily from 2005 and 2013 and the data is included in the table below. In 2024, Lake Emily was monitored for the first time since 2013 due to the installation of the Arbogast CC17 filter. In 2024, the lake did not meet MPCA summer-average state standards for total phosphorous or chlorophyll-*a*.

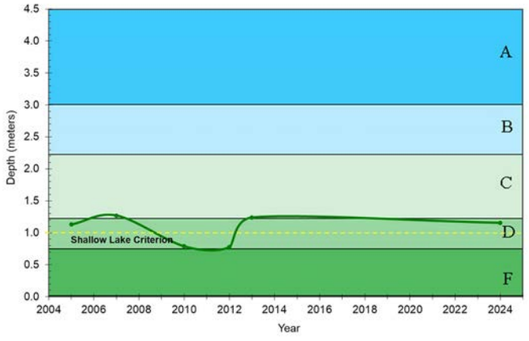
Parameter	State Standard	2024 Lake Emily	Lake Emily (2005-2013) Growing Season Average	Trend (2005-2013)
Phosphorus	≤ 60 µg/l	71.5 µg/l	98 µg/l	Worsening
Chlorophyll-*a*	≤ 20 µg/l	76.0 µg/l	34 µg/l	No Trend
Secchi disk transparency	> 1 meter	1.2 meters	1.4 meters	No Trend
Chloride	≤ 230 mg/L [2]	53.3 mg/L	N/A	N/A

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

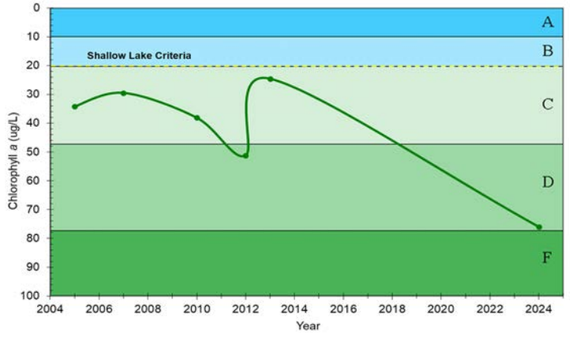
Total phosphorus (µg/l)



Secchi transparency (m)



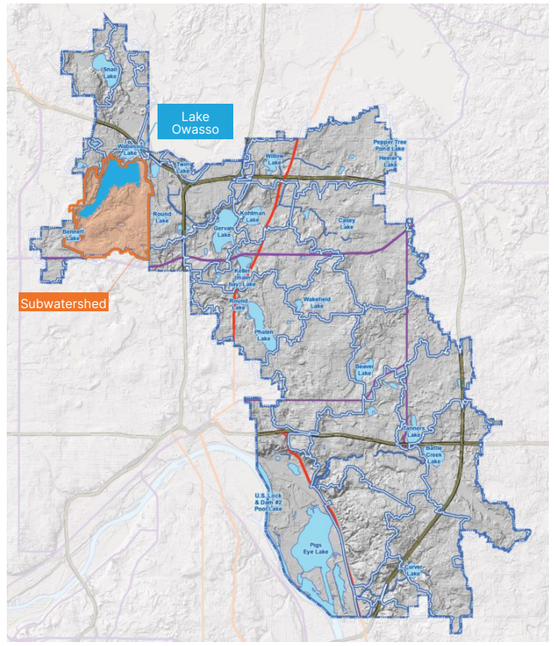
Chlorophyll-*a* (µg/l)



LAKE OWASSO

MPCA designation	Deep
Tributary area	2,175 acres
Surface area	375 acres
Average/maximum depth	11/37 feet
RWMWD nutrient classification[1]	At risk
Accountable municipalities	Roseville, Shoreview, Ramsey County
Downstream waterbody	Lake Wabasso

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Lake Owasso is the largest lake in the RWMWD and a major regional recreational resource for fishing, boating, waterskiing, and swimming. Roseville's Central Park North (along the south shore of the lake) and Owasso County Park in the city of Shoreview (on the north side) provide two public access points, including a boat launch and a public swimming beach. Lake Owasso receives water from Bennett Lake and Lake Emily.

Lake Owasso is impaired for mercury (aquatic consumption) and is also listed by the Minnesota DNR as infested with Eurasian watermilfoil. A statewide mercury TMDL was completed in 2007.

Phosphorus and Secchi disk depth have been monitored annually at Lake Owasso from 2003 to 2024. Chlorophyll-*a* has been monitored annually since 1984, and chlorides have been monitored since 2015. 2024 monitoring shows that the lake meets summer-average state standards for all four parameters. The 10-year data shows a statistically significant improvement in phosphorus concentration, chlorophyll-*a* concentration, and Secchi disk depth, but worsening of chloride concentration.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 31% of the phosphorus in Lake Owasso comes from stormwater, and 63% comes from internal loading. Plans to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake. Internal loading will be addressed by managing carp as needed. Options for the inactivation of sediment release of phosphorus will also be assessed.

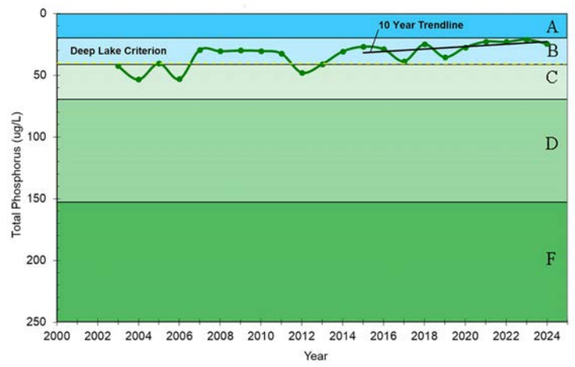
Several projects have been completed to improve water quality in Lake Owasso:

- Central Park Elementary (2017) is one of six school rain garden projects that provide needed pollinator habitats and reduce the volume of polluted runoff. RWMWD's goal was to manage rainwater runoff at schools in priority areas of the watershed while engaging local communities in a shared learning experience.
- Prince of Peace Lutheran Church (2015) and North Heights Christian Academy (2017) are two of 12 projects to manage rainwater runoff at churches with large amounts of impervious surfaces. The goal of these projects was to install rain gardens to intercept and filter polluted runoff from the church parking lots.
- Carp management (ongoing since 2017): With four interconnected lakes (Owasso, Wabasso, Bennett, and Grass) and 12 shallow ponds, the Lake Owasso system offers prime habitat for carp to potentially out-compete native game fish. As carp root for food along the lake bottom, they stir up nutrient-rich sediment, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of nurseries, and installing barriers.

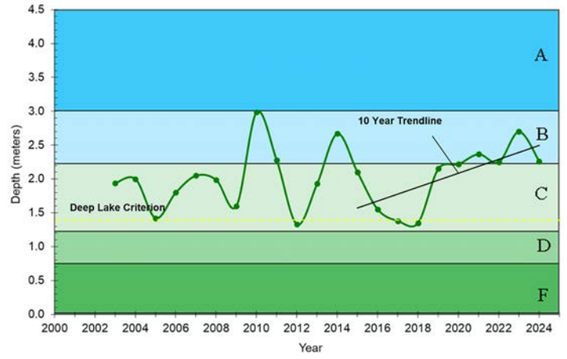
Parameter	State Standard	2024 Lake Owasso	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	24.5 µg/l	27 µg/l	Improving
Chlorophyll-*a*	≤ 14 µg/l	10.7 µg/l	12 µg/l	Improving
Secchi disk transparency	> 1.4 meter	2.3 meters	2.0 meters	Improving
Chloride	≤ 230 mg/L [2]	79.0 mg/L	63 mg/L	Worsening

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

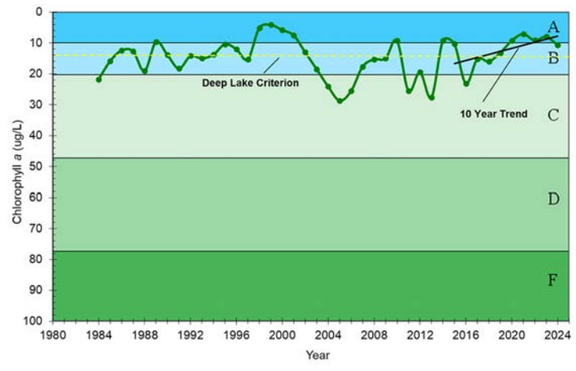
Total phosphorus (µg/l)



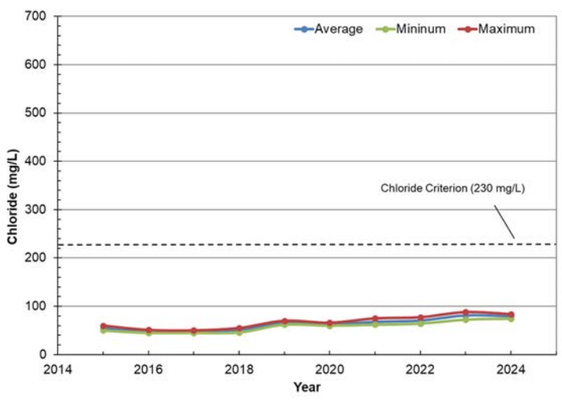
Secchi transparency (m)



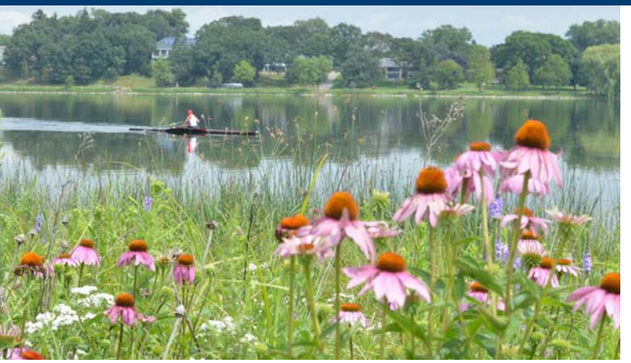
Chlorophyll-*a* (µg/l)



Chloride (mg/L)

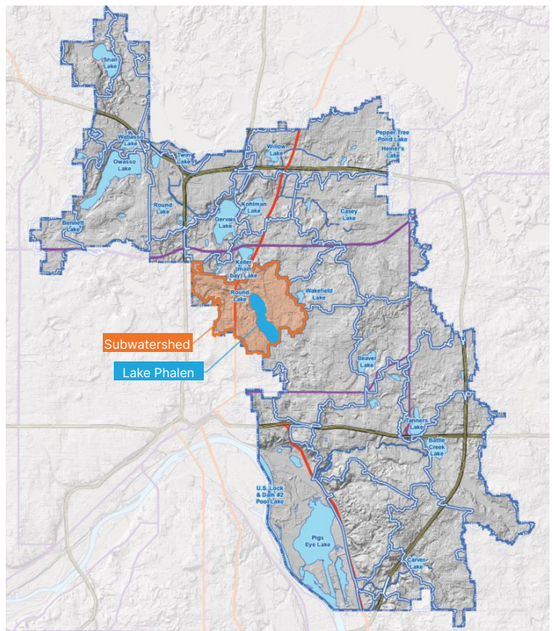


LAKE PHALEN



MPCA designation	Deep
Tributary area	1,995 acres
Surface area	200 acres
Average/maximum depth	22/95 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Maplewood, St. Paul, Ramsey County
Downstream water body	Mississippi River via the Beltline Interceptor storm sewer

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Lake Phalen, the downstream-most lake in the Phalen Chain of Lakes, is surrounded by park land that has 2 miles of restored shoreline. The lake is used primarily for swimming, fishing, paddling, picnicking, and aesthetic viewing. It has public boating access and a swimming beach. While the direct tributary area to the lake is close to 2,000 acres, the total land area that ultimately drains through Lake Phalen is closer to 15,000 acres, including the Keller Lake and Wakefield Lake subwatersheds.

Lake Phalen is impaired for mercury (aquatic consumption) and is listed by the Minnesota DNR as infested with Eurasian watermilfoil. A statewide mercury TMDL was completed in 2007.

Phosphorus, chlorophyll-*a*, and Secchi disk depth have been monitored annually since 1981. Annual chloride monitoring began in 2015. In 2024 the lakes met summer-average state standards for all parameters except for chlorophyll-*a*. The 10-year data shows a statistically significant trend for an increase in chloride concentration.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 68% of the phosphorus in Lake Phalen comes from stormwater, and 32% comes from internal loading. Plans to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake.

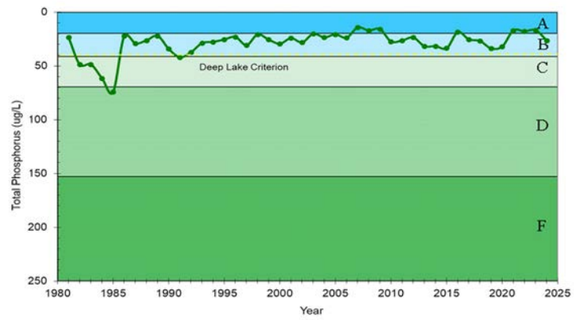
Projects that have improved water quality in Lake Phalen include:

- **Carp management (ongoing since 2009):** Carp management helps control phosphorus loading in the Phalen Chain of Lakes (Lake Phalen, Gervais Lake, Lake Keller, Kohlman Lake). Foraging carp stir up nutrient-rich sediment on the lake bottom, which, in turn, contributes to turbid water and algae blooms. Management efforts include counting carp to understand the extent of the population, tracking them with radio tags to allow efficient harvesting and identification of nurseries, and installing barriers. These efforts have reduced carp in the Phalen Chain by over 60%.
- **Phalen shoreline restoration (2010):** This project has become one of the largest lakeshore restoration efforts in Minnesota. The long-term effort involved restoring deep-rooted native plants to filter stormwater, prevent erosion, and create needed urban wildlife habitat. More than 100 native plant species have become established along the shore.

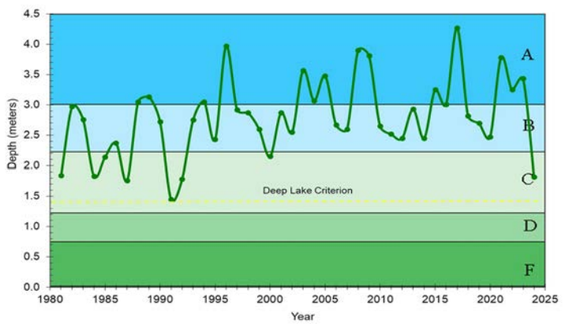
Parameter	State Standard	2024 Lake Phalen	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	26.5 µg/l	25 µg/l	None
Chlorophyll-*a*	≤ 14 µg/l	16.4 µg/l	8 µg/l	None
Secchi disk transparency	> 1.4 meters	1.8 meters	3.1 meters	None
Chloride	≤ 230 mg/L [2]	185 mg/L	152 mg/L	Worsening

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

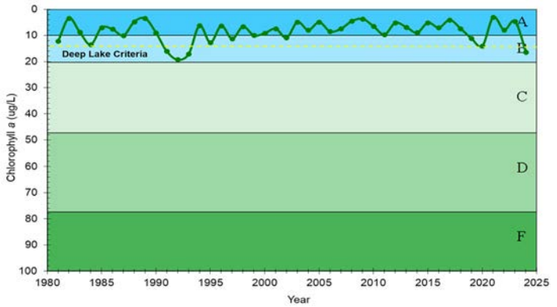
Total phosphorus (µg/l)



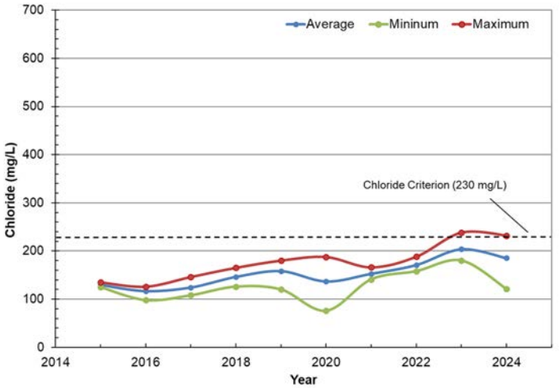
Secchi transparency (m)



Chlorophyll-*a* (µg/l)

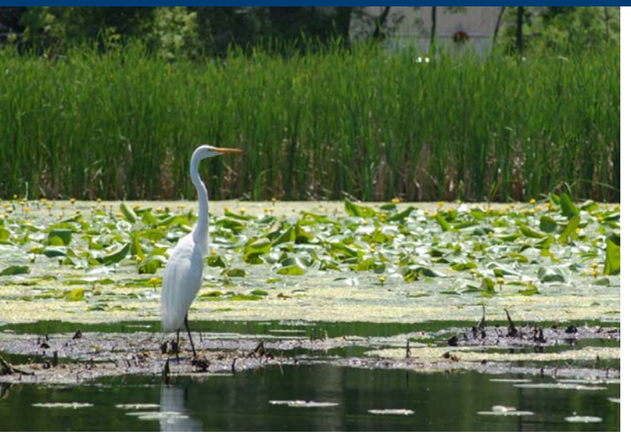


Chloride (mg/L)



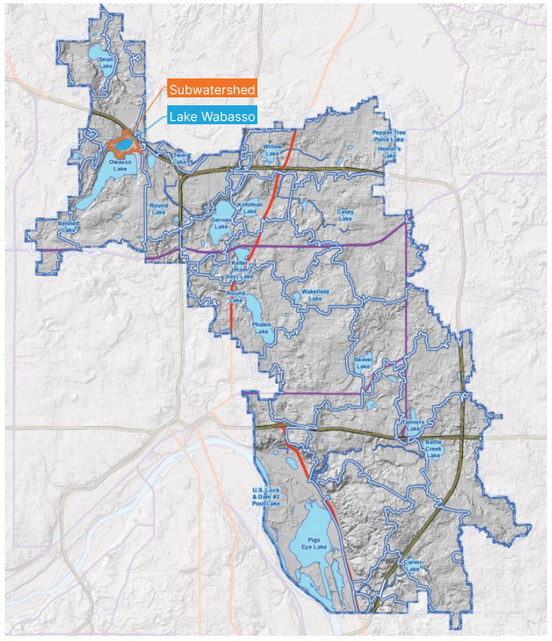
- **Keller Golf Course (2014):** Keller is a beautiful public course located just east of Lake Keller. The no-play areas on this course comprise part of the Phalen Chain of Lakes natural areas corridor, providing critical wildlife habitat and improving infiltration. This improvement project restored more than seven acres of no-play area.
- **Keller Creek buffer (2018):** The Keller Creek restoration effort restored native plant communities, removed invasive vegetation, reduced erosion, and brought significant improvements to wildlife habitat and recreation along nearly a mile of the creek.

LAKE WABASSO



MPCA designation	Deep
Tributary area	147 acres
Surface area	52 acres
Average/maximum depth	16/66 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Shoreview, Ramsey County
Downstream waterbody	Grass Lake

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Lake Wabasso is a deep lake in Shoreview that supports a healthy fish population. In addition to fishing, it is used for boating and swimming. Boat access is provided in Lake Owasso County Park on the south side. The lake is at risk of impairment for chloride; however, recent data suggest it may not be at risk. It is also listed by the Minnesota DNR as infested with Eurasian watermilfoil.

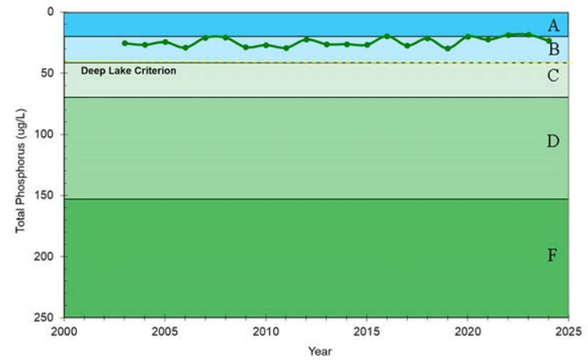
Chlorophyll-*a* has been monitored annually at Lake Wabasso since 1984. Phosphorus and Secchi disk depths have been monitored annually since 2003. Annual chloride monitoring began in 2015. In 2024, Lake Wabasso met summer-average state standards for all four parameters. The 10-year data shows a statistically significant trend of Secchi disk depth improvement.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 13% of the phosphorus in Lake Wabasso comes from stormwater, 62% comes from internal loading, and 22% comes from atmospheric deposition. Plans to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake.

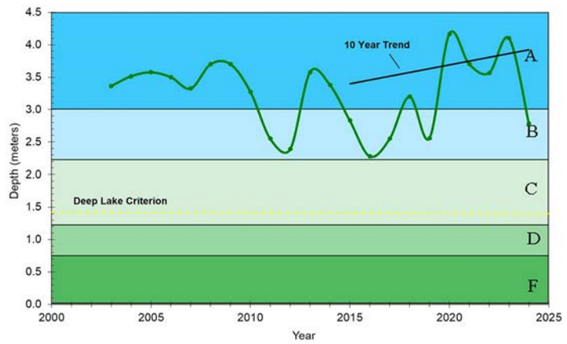
Parameter	State Standard	2024 Lake Wabasso	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	23.4 µg/l	23 µg/	None
Chlorophyll-*a*	≤ 14 µg/l	9.6 µg/L	7 µg/	None
Secchi disk transparency	> 1.4 meters	2.8 meters	3.2 meters	Improving
Chloride	≤ 230 mg/L [2]	72.4 mg/L	60 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

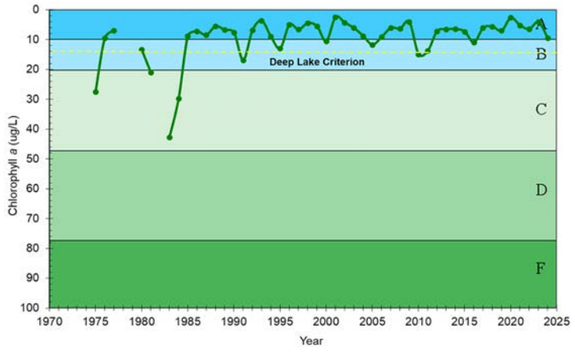
Total phosphorus (µg/l)



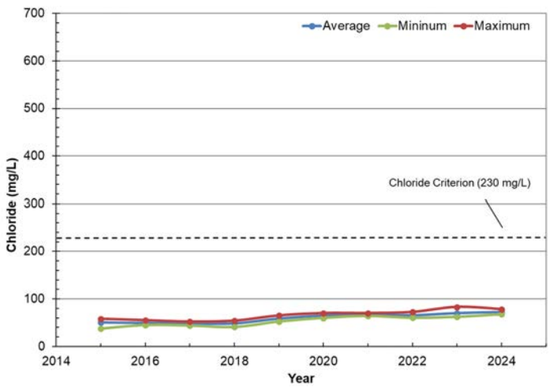
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



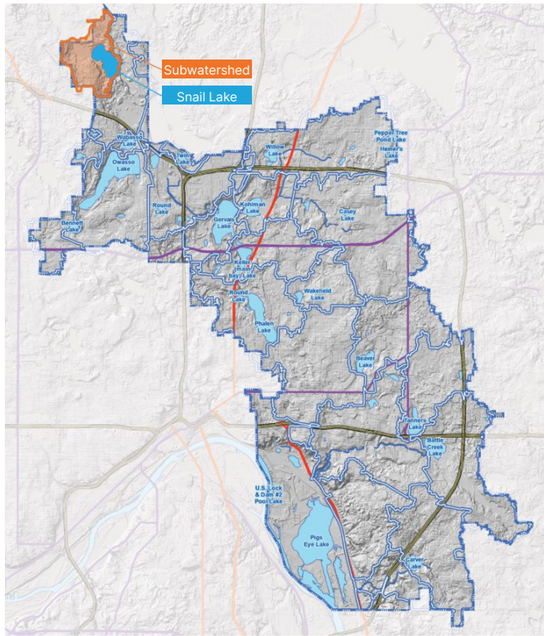
Chloride (mg/L)



SNAIL LAKE

MPCA designation	Deep
Tributary area	961 acres
Surface area	190 acres
Average/maximum depth	28 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Shoreview, Ramsey County
Downstream waterbody	Landlocked

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Snail Lake is a 190-acre landlocked lake in the city of Shoreview; a 35 acre wetland can be found on the northwest side of the lake. The lake, used for fishing, boating, and swimming, is bordered by Snail Lake Regional Park to the south. The park includes public access and a swimming beach.

Snail Lake is impaired for mercury (aquatic consumption); a statewide mercury TMDL was completed in 2007. The lake is also listed by the Minnesota DNR as infested with Eurasian watermilfoil.

Phosphorus, chlorophyll-*a*, and Secchi disk depth have been monitored annually since 2005. Annual monitoring of chloride began in 2015. In 2024, the lake met summer-average state standards for all four water-quality parameters. The 10-year data shows a statistically significant trend of chloride concentrations worsening.

According to the *2017 Ramsey Washington Metro Watershed District Watershed Restoration and Protection Strategies Report*, 30% of the phosphorus in Snail Lake comes from stormwater, 11% comes from internal loading, and 51% from upstream water bodies. Strategies to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake.

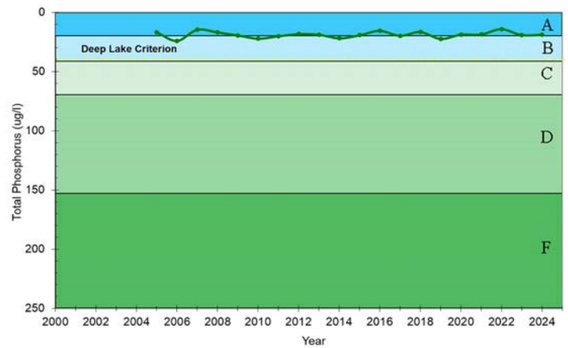
One project that has improved water quality in Snail Lake is:

- **Wetland A ecological restoration (2020 and 2021):** RWMWD partnered with Ramsey County and other organizations to conduct a 3-year ecological restoration project in the area. Between 2020 and 2021, RWMWD staff and volunteers restored 4.8 acres of shoreline that stretched approximately 4,500 feet long. Over 80 species of native plants were installed as natural buffers in place of invasive species like common buckthorn.

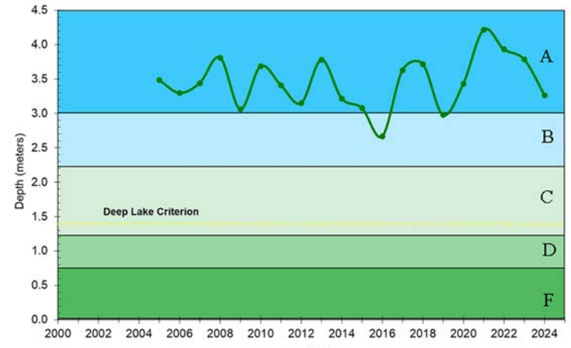
Parameter	State Standard	2024 Snail Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	18.8 µg/l	18 µg/l	None
Chlorophyll-*a*	≤ 14 µg/l	7.1 µg/l	5 µg/l	None
Secchi disk transparency	> 1.4 meters	3.3 meters	3.5 meters	None
Chloride	≤ 230 mg/L [2]	98.4 mg/L	91 mg/L	Worsening

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

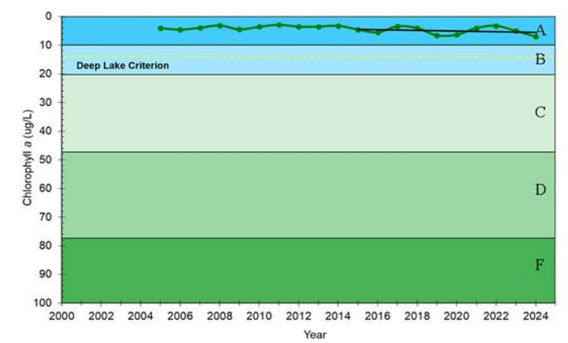
Total phosphorus (µg/l)



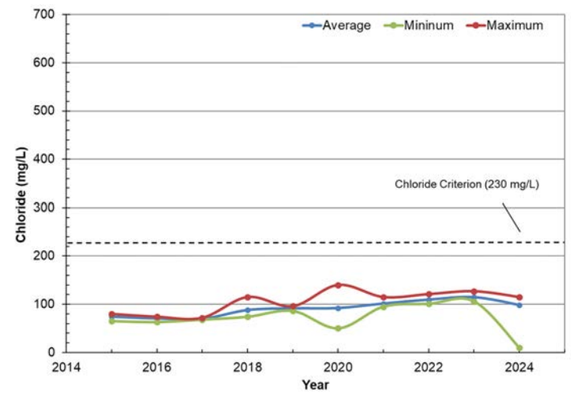
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



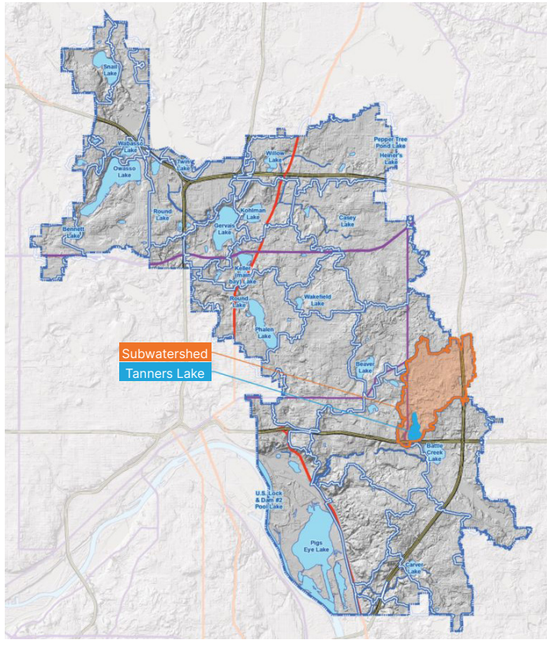
Chloride (mg/L)



TANNERS LAKE

MPCA designations	Deep; "non-support" of aquatic life (chloride)
Tributary area	1,707 acres
Surface area	74 acres
Average/maximum depth	20/46 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Landfall, Maplewood, Oakdale, Woodbury, Ramsey County, Washington County
Downstream water body	Battle Creek Lake

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Located almost entirely within the cities of Oakdale and Landfall, Tanners Lake discharges into the headwaters of Battle Creek—a tributary of the Mississippi River. The lake is used primarily for swimming, skiing, motor boating, fishing, canoeing, picnicking, and aesthetic viewing. Tanners Lake Park, which includes a beach for swimming and boat access for fishing, is located on the east shore of the lake. Facilities are also present for softball and volleyball.

Tanners Lake was listed as impaired for excess nutrients in 2002, but after meeting state standards, it was removed from the impaired waters list in 2004. It is currently impaired for mercury (aquatic consumption) and chloride (aquatic life). A statewide mercury TMDL was completed in 2007, and the Twin Cities Metro Area Chloride TMDL was completed in 2016.

RWMWD currently operates an aluminum sulfate (alum) treatment facility on the north end of Tanners Lake that treats a significant portion of watershed runoff before it enters the lake. Alum is injected into the stormwater runoff, which causes phosphorus to precipitate out and settle into a sedimentation pond.

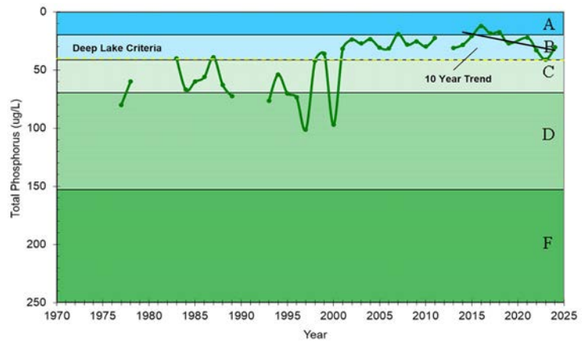
Phosphorus, chlorophyll-*a*, and Secchi disk depth have been monitored annually since 1993. Annual chloride monitoring began in 2017. In 2024, the lake met summer-average state standards for all parameters but chlorophyll-*a*. The 10-year data shows a statistically significant trend of worsening phosphorus concentration, chlorophyll-*a* concentration, and Secchi disk depth.

Strategies to address stormwater pollution include implementing the BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake. Plans to address chloride include improving road salt management by promoting and adopting strategies in the Twin Cities Metro Area Chloride Management Plan.

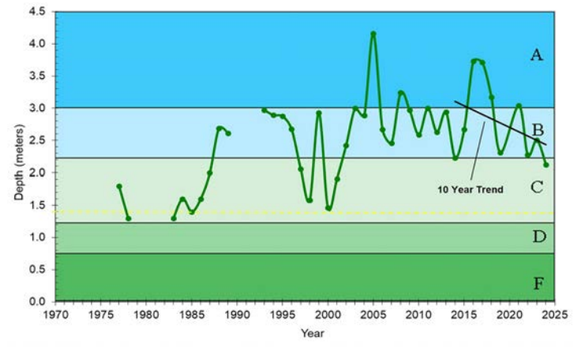
Parameter	State Standard	2024 Tanners Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	30.4 µg/l	25 µg/l	Worsening
Chlorophyll-*a*	≤ 14 µg/l	15.4 µg/l	9 µg/l	Worsening
Secchi disk transparency	> 1.4 meters	2.1 meters	2.8 meters	Worsening
Chloride	≤ 230 mg/L [2]	162 mg/L	N/A	N/A

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

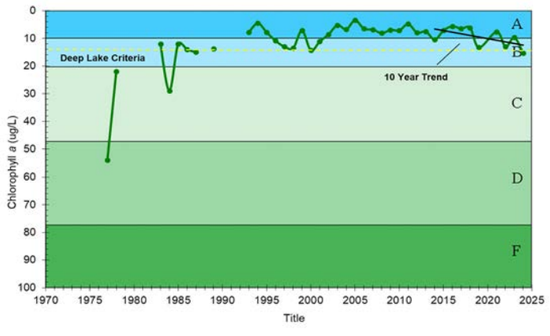
Total phosphorus (µg/l)



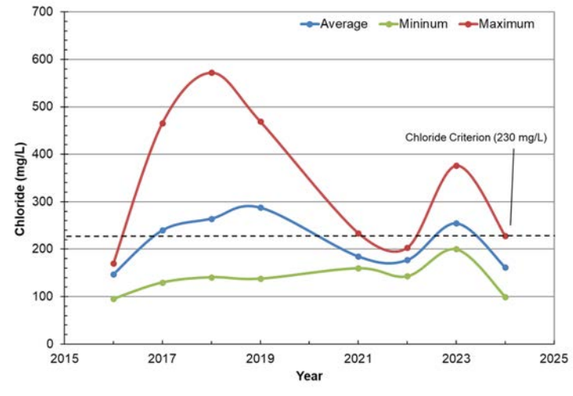
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



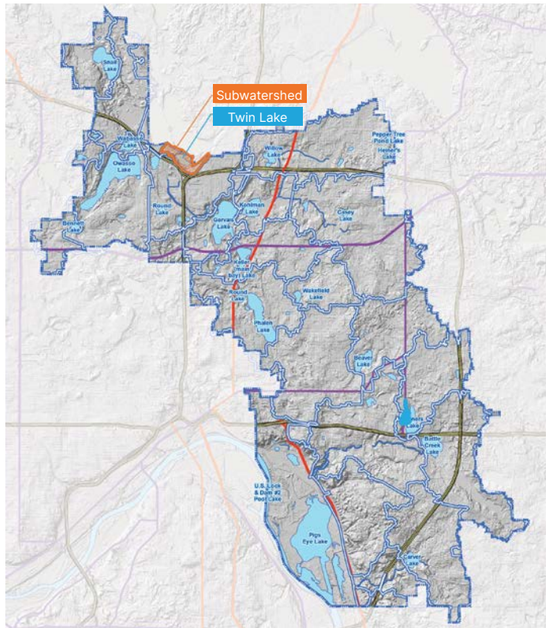
Chloride (mg/L)



TWIN LAKE

MPCA designation	Deep
Tributary area	192 acres
Surface area	35.5 acres
Average/maximum depth	33 feet
RWMWD nutrient classification[1]	Stable
Accountable municipalities	Little Canada, Vadnais Heights, Ramsey County
Downstream waterbody	Gervais Creek

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Twin Lake lies in Little Canada and Vadnais Heights. It is a small and relatively deep lake, mainly surrounded by homes. Formerly landlocked, an outlet was installed in the lake in 2020 to allow water to discharge to Gervais Creek during high water periods. Twin Lake has some wildlife habitat and is primarily used for canoeing, aesthetic viewing, fishing, and occasional jet skiing; there is no public access. The lake is not impaired.

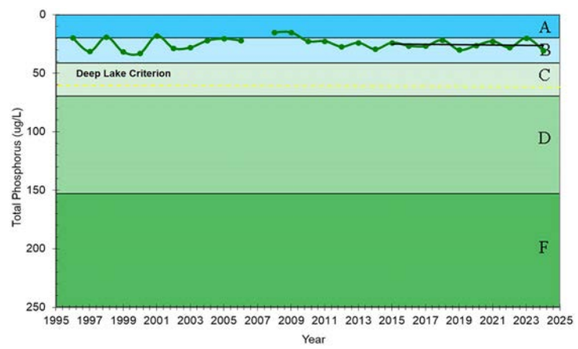
With the exception of 2007, phosphorus, chlorophyll-*a*, and Secchi disk depth have been monitored annually on Twin Lake since 1996. Annual monitoring of chloride began in 2015. In 2024, the lake did not meet the summer-average state standards for chlorophyll a. The 10-year data shows a statistically significant trend of worsening chloride concentration.

Strategies to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake.

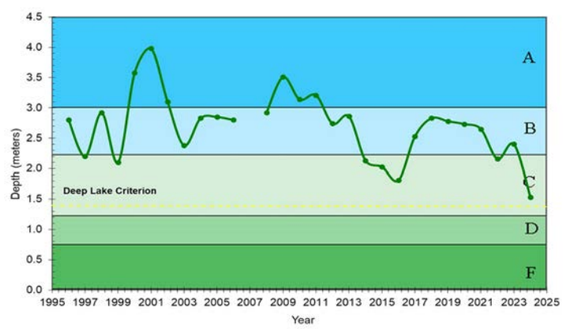
Parameter	State Standard	2024 Twin Lake	10-Year Average[1]	10-Year Trend
Phosphorus	≤ 40 µg/l	30.6 µg/l	26 µg/l	None
Chlorophyll-*a*	≤ 14 µg/l	24.9 µg/l	12.0 µg/l	None
Secchi disk transparency	> 1.4 meters	1.7 meters	2.3 meters	None
Chloride	≤ 230 mg/L [2]	61.9 mg/L	58 mg/L	Worsening

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

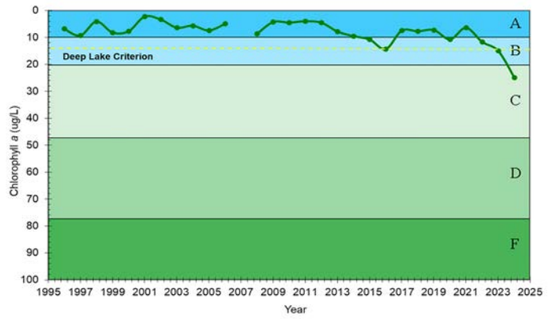
Total phosphorus (µg/l)



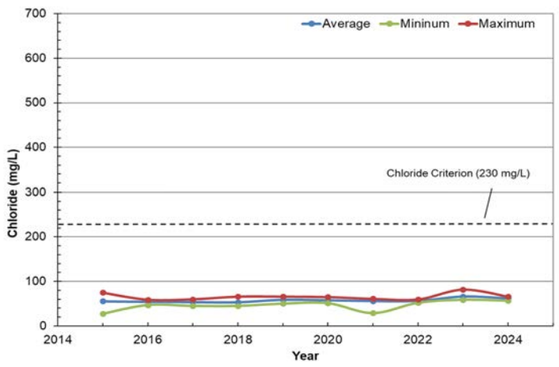
Secchi transparency (m)



Chlorophyll-*a* (µg/l)



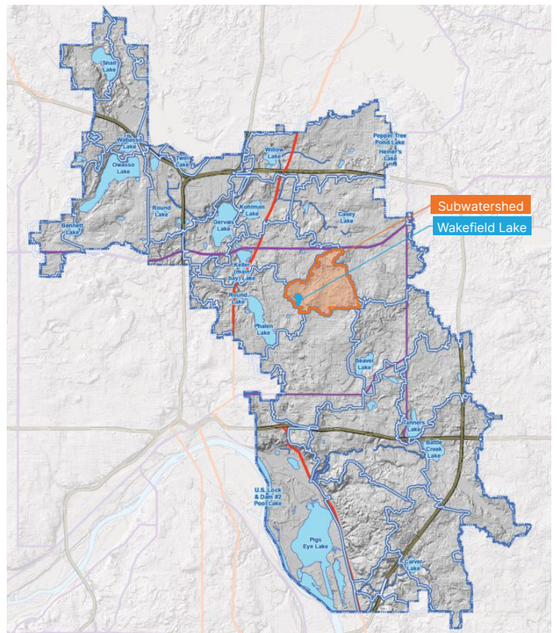
Chloride (mg/L)



WAKEFIELD LAKE

MPCA designation	Shallow
Tributary area	948 acres
Surface area	23 acres
Average/maximum depth	4.6/9 feet
RWMWD nutrient classification[1]	Impaired
Accountable municipalities	Maplewood, North St. Paul, St. Paul, Ramsey County
Downstream water body	Lake Phalen

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Wakefield Lake is located in Maplewood and is primarily used for shoreline fishing, picnicking, and aesthetic viewing. It is bordered by park land on the north and east sides of the lake. Public access is available in Wakefield Park, although there is no boat launch. Wakefield Lake was added to the MPCA's impaired waters list for excess nutrients in 2002; a nutrient TMDL was completed in 2017. Wakefield is also at risk for chloride impairment.

In 2024, RWMWD installed dissolved oxygen probes to collected continuous dissolved oxygen data in Wakefield Lake. Dissolved oxygen probes were used at three depths: surface of the lake, middle depth of the lake, and bottom of the lake. The purpose of the data collection was to evaluate if an aeration system is required in Wakefield Lake.

Phosphorus, chlorophyll-*a*, and Secchi disk depth have been monitored annually since 1984. Chloride has been measured annually since 1992. In 2024, Wakefield Lake met summer-average state standards for all parameters. The 10-year data shows a statistically significant trend of Secchi disk transparency improving.

Strategies to address stormwater pollution include implementing a BMP cost-share program and water-quality projects that decrease the total phosphorus load to the lake. Plans to reduce in-lake loading by 80% include developing a plan for macrophyte management (including curlyleaf pondweed) and assessing options for the inactivation of sediment release of phosphorus.

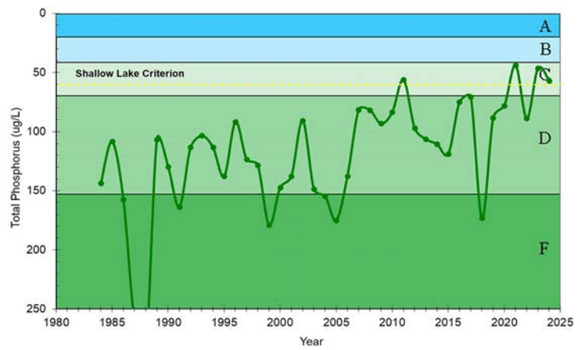
Recent projects to improve the water quality of Wakefield Lake are:

- Presentation Catholic Church (2015): Is one of 12 projects managing rainwater runoff at churches with large amounts of impervious surfaces. The goal was to install six rain gardens and one infiltration trench that intercept and filter runoff from the church parking lot. This reduces the volume of polluted rainwater draining to Wakefield Lake.
- The Wakefield spent-lime filter (2018): This project involves piping stormwater from a large portion of the 944-acre Wakefield Lake subwatershed into a large underground chamber where it interacts with spent lime. The lime material is a repurposed byproduct of municipal drinking water treatment, and it binds to phosphorus in the stormwater. Water leaving the spent lime chamber was projected to contain about 70 percent less dissolved phosphorus than when it entered. (This treatment system, during the first year of operation, is evaluated in Section 7).
- Wakefield Park stormwater improvements (2020): The goal of this project was to install two large rain gardens that intercept and filter rainwater runoff from the streets. This reduces the volume of rainwater runoff and increases the quality of runoff that drains into Wakefield Lake. This project was completed in conjunction with a City of Maplewood project to narrow Frost Avenue, which also improves the quality of runoff going into Wakefield Lake.
- Aldrich Ice Arena (2020): The goal of this project was to remove the asphalt parking lot and install 15 rain gardens. The rain gardens reduce the volume of stormwater runoff and remove pollutants from the runoff before reaching Wakefield Lake.
- Mounds Park Academy (2022): The goal of this project was to remove a section of unused parking lot to build a rain garden that could treat runoff before it enters the school's pond. The school is interested in funding an outdoor learning space alongside the rain garden.
- Woodland Hills (2024): The goal of this project was to install four rain gardens that intercept and filter runoff from the church parking lot.

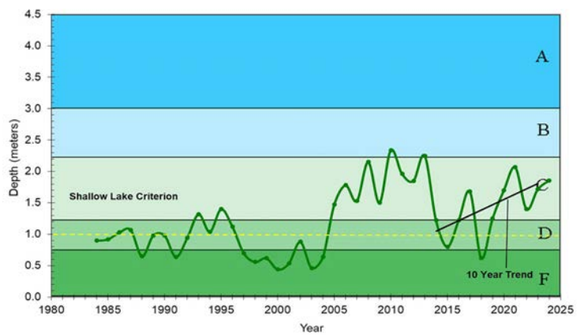
Parameter	State Standard	2024 Wakefield Lake	10-Year Average[1]	10-YearTrend
Phosphorus	≤ 60 µg/l	57.1 µg/l	84 µg/l	None
Chlorophyll-*a*	≤ 20 µg/l	12.1 µg/l	29 µg/l	None
Secchi disk transparency	> 1 meter	1.9 meters	1.4 meters	Improving
Chloride	≤ 230 mg/L [2]	65.0 mg/L	131 mg/L	None

[1] A minimum of 10 years of data were analyzed. If a year was missing within the most recent 10-year period, the period of record was extended.
[2] State standard for chronic chloride exposure.

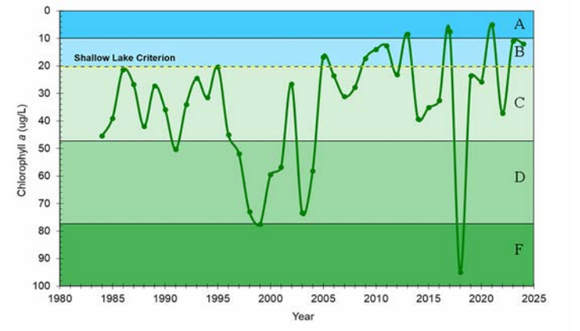
Total phosphorus (µg/l)



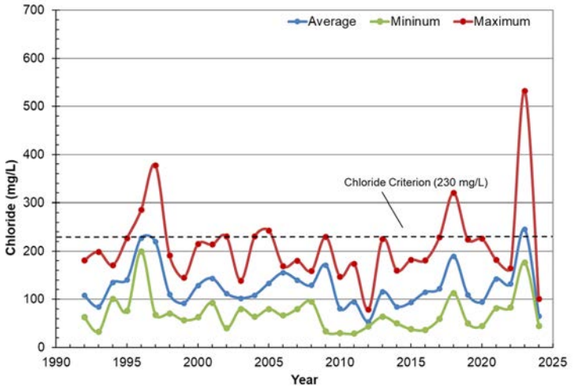
Secchi transparency (m)



Chlorophyll-*a* (µg/l)

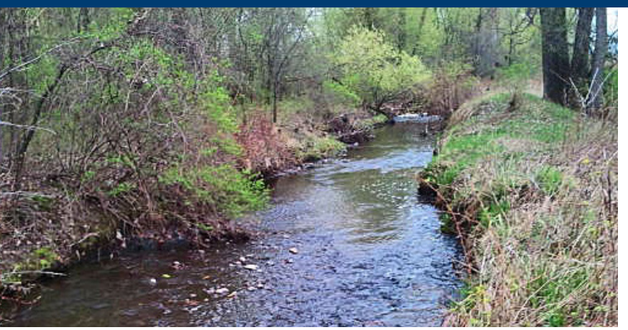


Chloride (mg/L)



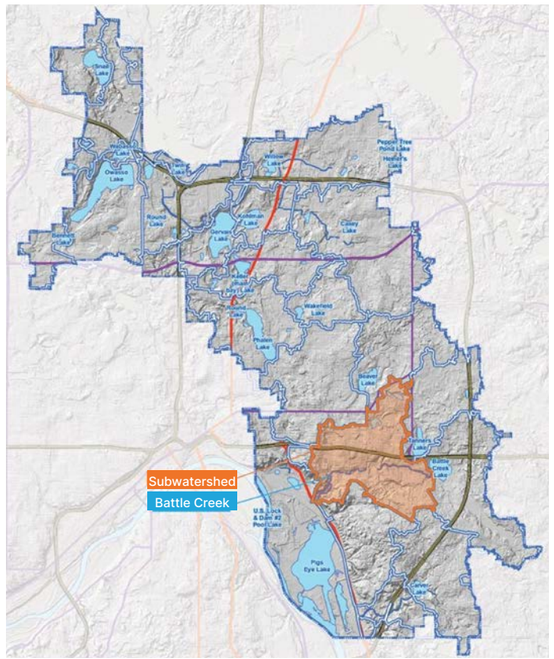
4. STREAMS

BATTLE CREEK



Tributary area	2,972 acres
Creek length	3.8 miles
Downstream waterbody	Mississippi River
MPCA designations	Impaired for "non-support" of aquatic life (chloride, fish, macroinvertebrates)
Accountable municipalities	Maplewood, St. Paul, Woodbury, Ramsey County, Washington County
RWMWD nutrient classification[1]	Impaired (TSS)

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Battle Creek is a perennial, urban stream that originates at the outlet from Battle Creek Lake in Woodbury. The creek then flows west and ultimately discharges to Pigs Eye Lake and the Mississippi River. A well-maintained regional park with trails for hiking, cross-country skiing, and cycling is situated along the creek in St. Paul.

Historically, Battle Creek has been plagued by frequent and devastating floods that caused loss of life, substantial property damage, and heavy stream erosion. The District completed a significant restoration project in 1982 and continues to conduct maintenance on the creek to sustain that project.

Battle Creek has been monitored annually for phosphorus and total suspended solids since 1996. Annual monitoring for nitrate began in 2000 and for chloride in 2002. The creek is currently impaired for chloride and was also listed in 2014 as impaired for degraded fish and macroinvertebrate biological community health. The draft 2024 impaired waters list includes E. coli as an impairment for Battle Creek. A stressor identification report was completed in 2015; chloride and total suspended solids (TSS) were found to be the primary stressors for fish and macroinvertebrates in the creek. The study identified total phosphorus as a probable secondary stressor. For that reason, the District has assigned Battle Creek a RWMWD nutrient water quality classification of "Impaired."

As seen in the chart at right, the creek failed to meet state standards for phosphorus and total suspended solids in 2024. The 10-year data shows a statistically significant trend of worsening nitrate concentrations.

Recent projects to improve the water quality of Battle Creek include:

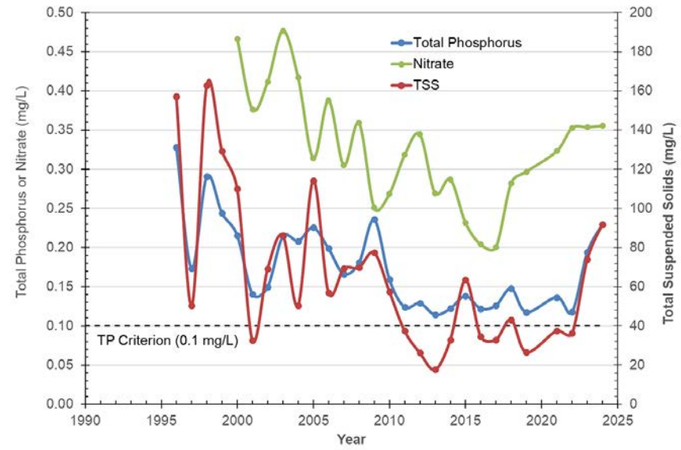
- Maplewood Living Streets (2012): The Maplewood street reconstruction project included 32 new rainwater gardens throughout the neighborhood, the addition of 120 drought-tolerant trees, and the creation of a regional infiltration basin. The rainwater gardens, trees, and infiltration basin sequester 40 tons of CO2 per year, as well as filter and infiltrate 50 percent of the stormwater runoff.
- Christ United Methodist Church (2016): Two rain gardens were installed to intercept and filter runoff from the church's parking lot—reducing the volume of polluted runoff that drains to Battle Creek.
- Slumberland Clearance Outlet Store (2016): A native planting area replacing 20,000 square feet of parking lot surface provides pollinator habitat and filters rainwater runoff before it drains to Battle Creek.

Parameter	State Standard	2024 Battle Creek	10-Year Average	10-Year Trend
Phosphorus	≤ 100 µg/l	229 µg/l	148 µg/l	None
Total suspended solids	<15 mg/L	93 mg/L	47 mg/L	None
Nitrate	N/A	0.36 mg/L	0.29 mg/L	Worsening
Chloride	≤ 230 mg/L[1]	138 mg/L	195 mg/L	None

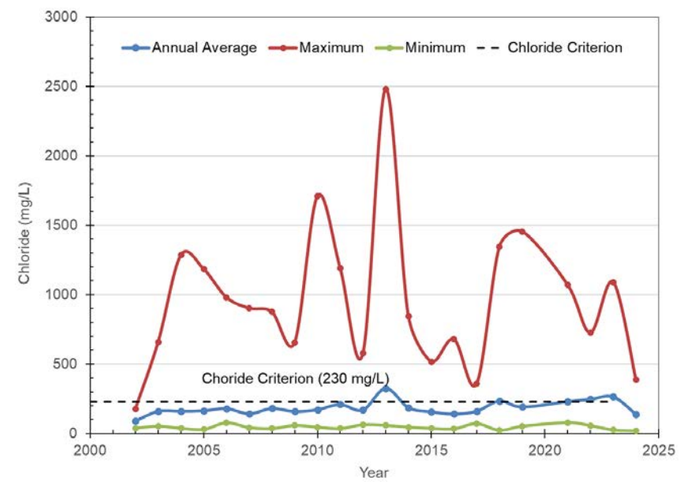
[1] State standard for chronic chloride exposure.

- Target—Suburban Avenue (2020): The project included the removal of impervious parking lot to install seven rain gardens and a linear tree trench. The installed best management practices can reduce the volume of polluted runoff that drains to Battle Creek, as well as remove pollutants such as total suspended solids and total phosphorus.
- St. Pascal Baylon Church (2022): The project included retrofitting the existing parking lot to maintain the existing grading and adding a tree trench and small rain garden. The tree trench and rain garden will remove phosphorus and sediment from stormwater that travels to Battle Creek.

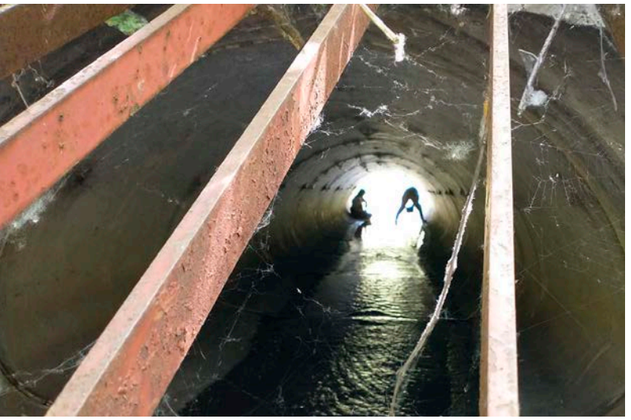
Nutrients and solids (mg/L)



Chlorides (mg/L)



BELTLINE INTERCEPTOR



The Beltline Interceptor is a large storm sewer pipe system constructed in 1920 and maintained by the RWMWD. The system is approximately 5 miles long, extending from the outlets of Lake Phalen and Beaver Lake to the Mississippi River. It collects a large percentage of stormwater runoff from St. Paul's east side and also conveys runoff from the entire Phalen Chain of Lakes subwatershed and the Beaver Lake subwatershed to the Mississippi River. The total drainage area to the Beltline Interceptor is 27. 8 square miles)—over half of the District's water.

The Beltline Interceptor has been monitored annually for phosphorus and total suspended solids since 1995. Annual monitoring for nitrates began in 2000 and for chloride in 2002. As seen in the chart below, the Beltline Interceptor met state standards for only chlorides in 2024. The 10-year data shows a statistically significant trend of worsening nitrate concentration.

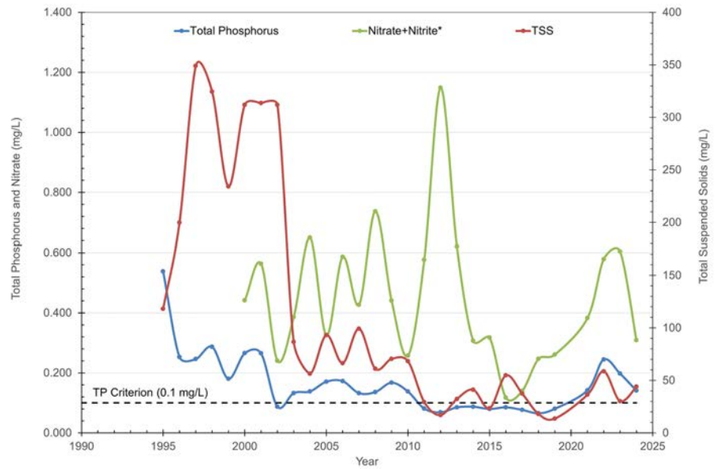
Recent projects to improve the water quality of Beltline Interceptor include:

- Saint Paul Urban Tennis Center (2020): A new infiltration basin was installed to reduce the volume of runoff to the Beltline interceptor and remove pollutants from stormwater runoff.

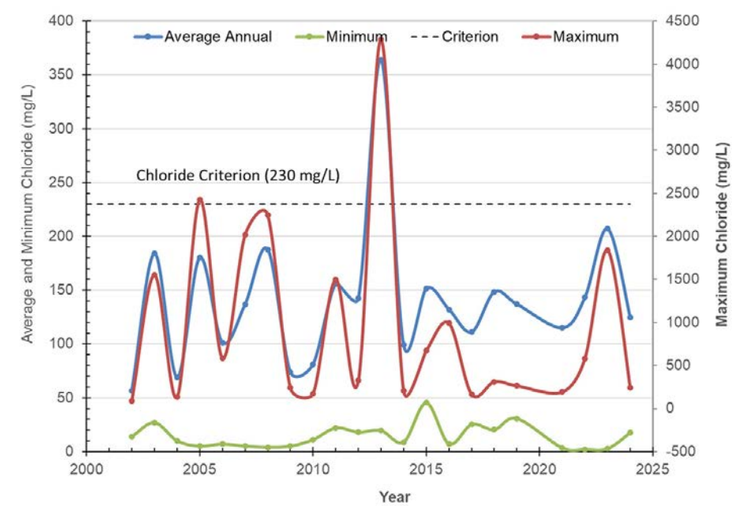
Parameter	State Standard	2024 Beltline Interceptor	10-Year Average	10-Year Trend
Phosphorus	≤ 100 µg/l	141 µg/l	124 µg/l	None
Total suspended solids	<15 mg/L	44 mg/L	35 mg/L	None
Nitrate and Nitrate[1]	N/A	0.31 mg/L	0.33 mg/L	Worsening
Chloride	≤ 230 mg/L[1]	124 mg/L	141 mg/L	None

[1] State standard for chronic chloride exposure; chloride value is average water-column concentration

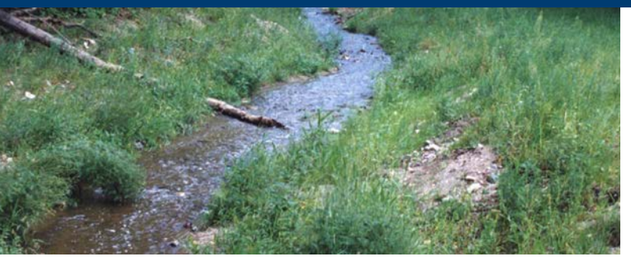
Nutrients and solids (mg/L)



Chlorides (mg/L)

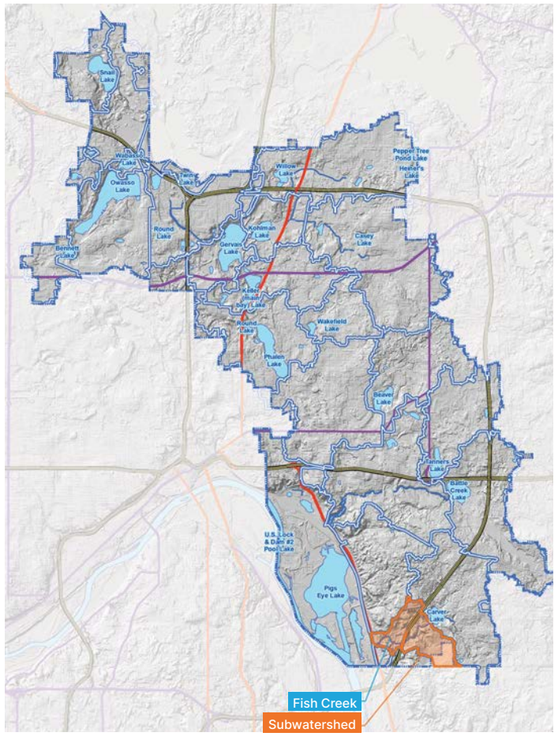


FISH CREEK



Tributary area	783 acres
Creek length	1.8 miles
Downstream waterbody	Eagle Lake
MPCA designations	"Non-support" of aquatic life (benthic macroinvertebrates); at risk for chloride; "non-support" of aquatic recreation (*E. coli*; and total suspended solids)
Accountable municipalities	Maplewood, St. Paul, Woodbury, Ramsey County, Washington County
RWMWD nutrient classification[1]	Impaired (TSS)

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Fish Creek is a perennial, urban stream that originates at Carver Lake and ultimately discharges to Eagle Lake and the Mississippi River. The majority of the Fish Creek subwatershed is located in Ramsey County and the southeastern portion of Washington County.

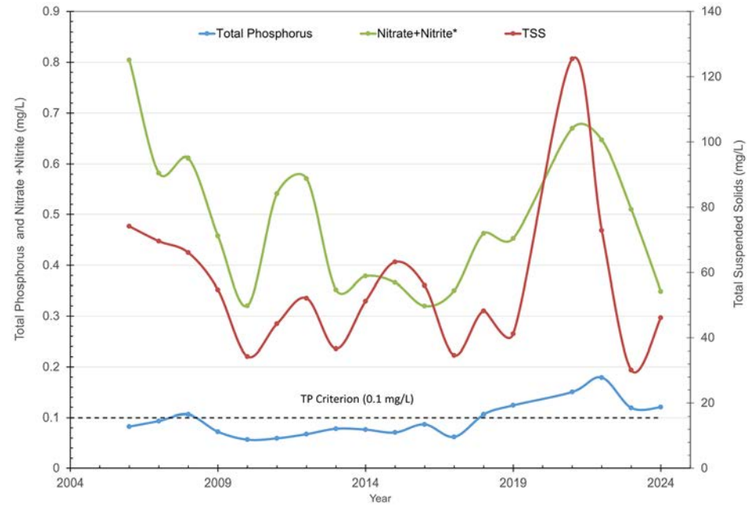
Fish Creek was placed on the 2014 303(d) impaired waters list due to elevated levels of *E. coli* bacteria. *E. coli* is used in water quality monitoring as an indicator of water that is contaminated with human or animal waste and accompanying disease-causing organisms. Bacterial abundance in excess of the water quality standards can pose a risk to human health. The draft 2024 impaired waters list includes TSS and benthic macroinvertebrates bioassessments as impairments for Fish Creek.

Fish Creek has been monitored annually for phosphorus and total suspended solids since 1995. Annual monitoring for nitrates began in 2000 and for chlorides in 2002. In 2024, Fish Creek failed to meet state standards for phosphorus and total suspended solids. The 10-year data shows a statistically significant trend of worsening total phosphorus chloride concentrations.

Parameter	State Standard	2024 Fish Creek	10-Year Average	10-Year Trend
Phosphorus	≤ 100 µg/l	120 µg/l	113 µg/L	Worsening
Total suspended solids	<15 mg/L	46 mg/L	58 mg/L	None
Nitrate and Nitrate[1]	N/A	0.35 mg/L	0.46 mg/L	None
Chloride	≤ 230 mg/L[1]	165 mg/L	163 mg/L	Worsening

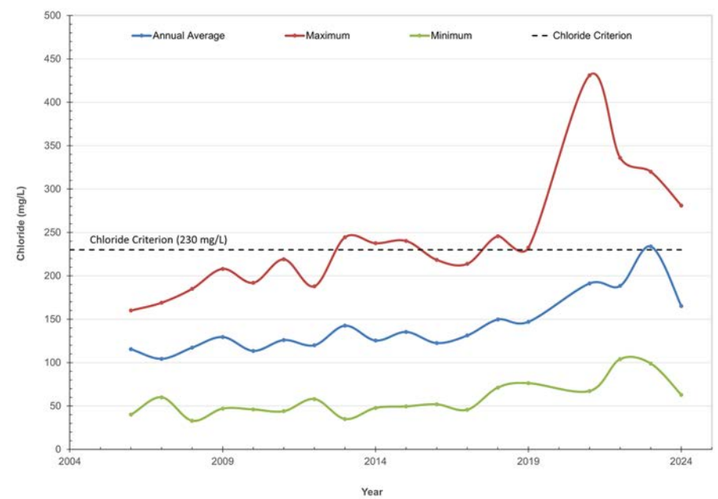
[1] State standard for chronic chloride exposure; chloride value is average water-column concentration

Nutrients and solids (mgl/l)

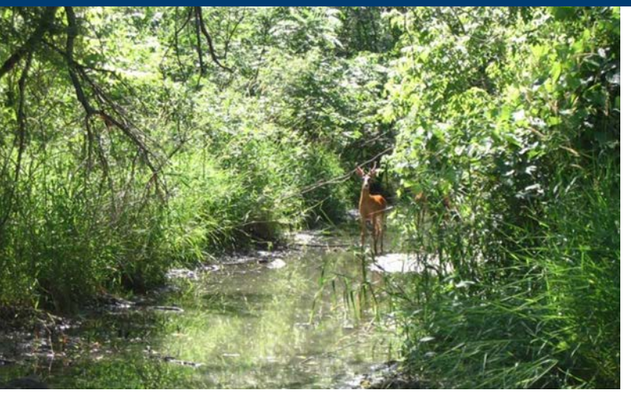


* Prior to 2021, only nitrate was measured.

Chlorides (mg/L)

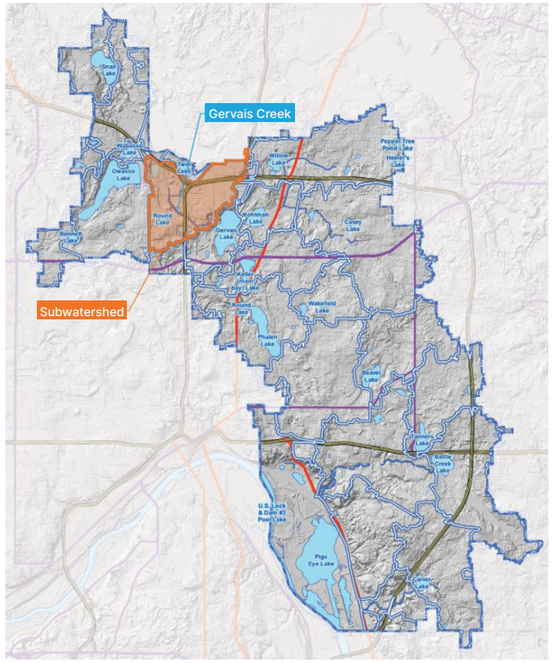


GERVAIS CREEK



Tributary area	1,847 acres
Creek length	2.2 miles
Downstream waterbody	Gervais Lake
MPCA designations	"Non-support" of aquatic life (benthic macroinvertebrates)
Accountable municipalities	Little Canada, Vadnais Heights, Ramsey County
RWMWD nutrient classification[1]	At risk

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Gervais Creek is an intermittent stream that was previously managed as a county ditch (County Ditch 16). It is now managed by the RWMWD as a stormwater system.

Gervais Creek has been monitored annually for phosphorus and total suspended solids since 2010. Annual monitoring for chlorides began in 2010 and for nitrates in 2016. In 2024, the creek met the state standard for phosphorus, total suspended solids, and chloride. The 10-year data shows no statistically significant trend for any parameter.

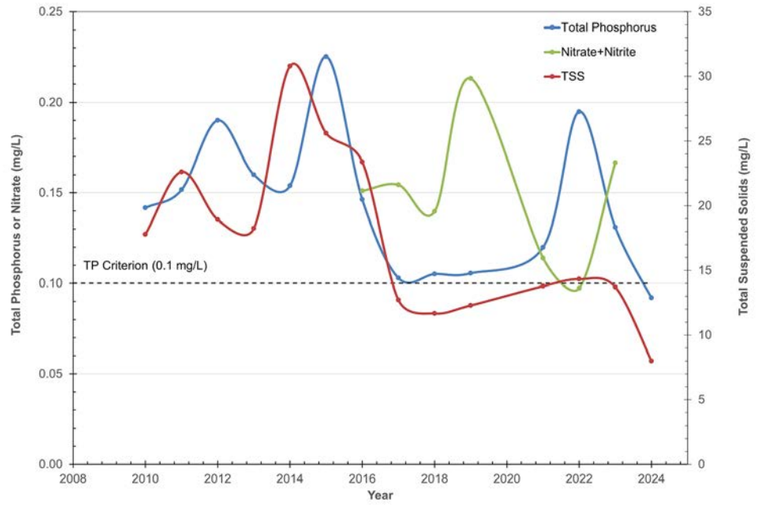
Recent projects to improve the water quality of Beltline Interceptor include:

- Pioneer Park (2024): At Pioneer Park in Little Canada, RWMWD installed a stormwater reuse system that utilizes the top one foot of water in the two existing ponds. Assuming this water is used for irrigation, is estimated that stormwater could meet 88% of the annual irrigation demand for Pioneer Park. It is estimated that this project could reduce annual TSS loads by 1,393 pounds per year and annual TP loads by 7.7 pounds per year. The stormwater reuse system includes pumping, particulate filtration and disinfection (UV). The system also utilizes the existing well system for irrigation back-up supply.

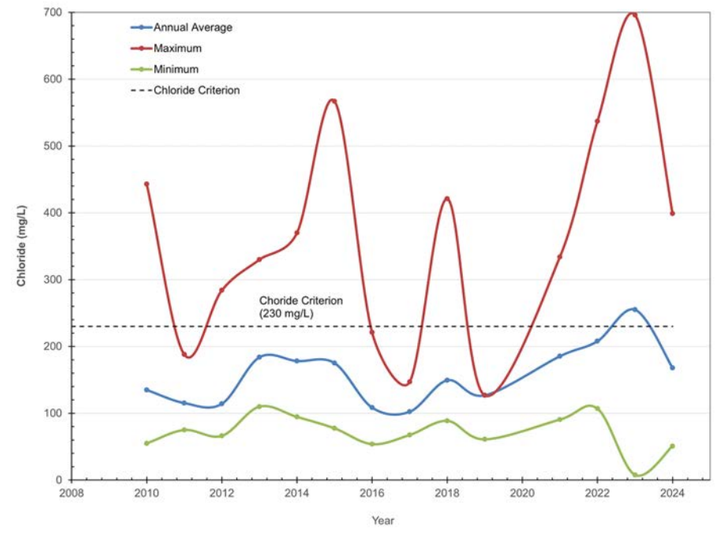
Parameter	State Standard	2024 Gervais Creek	Average	10-Year Trend
Phosphorus	≤ 100 µg/l	92 µg/l	136 µg/l (10-year average)	None
Total suspended solids	<15 mg/L	8 mg/L	15 mg/L (10-year average)	None
Nitrate	N/A	0.17 mg/L	0.15 mg/L (6-year average)	N/A
Chloride	≤ 230 mg/L[1]	168 mg/L	164 mg/L (10-year average)	None

[1] State standard for chronic chloride exposure.

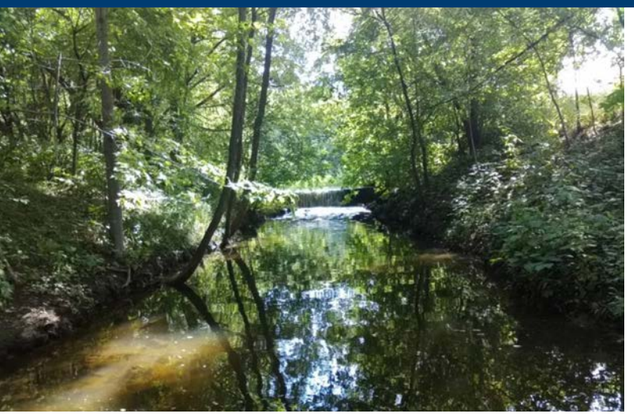
Nutrients and solids (mg/L)



Chlorides (mg/L)

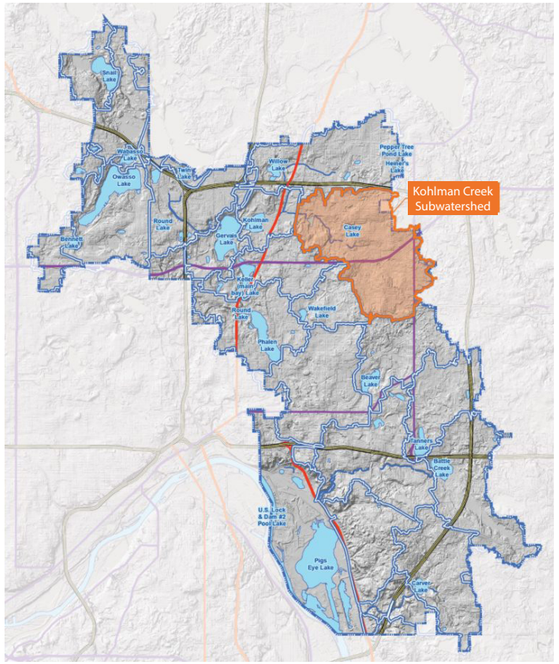


KOHLMAN CREEK



Tributary area	3,653 acres
Creek length	2.8 miles
Downstream waterbody	Kohlman Lake
Accountable municipalities	Maplewood, North St. Paul, Oakdale, Ramsey County, Washington County
RWMWD nutrient classification[1]	At risk

[1]RWMWD nutrient classifications are based on the relationship between the historical average water quality (based on phosphorus concentration alone) and the MPCA water quality (phosphorus) standards.



Kohlman Creek is an intermittent stream that was previously considered a county ditch (County Ditch 18 South). The stream generally flows from southeast to northwest and eventually discharges to the Kohlman Basin in the Kohlman Lake subwatershed. The District has managed the creek as a stormwater conveyance system. Most of the creek remains in its natural state.

Kohlman Creek has been monitored annually for phosphorus, total suspended solids, and chlorides since 2008. Annual monitoring for chlorides began in 2015. In 2024, Kohlman Creek met the state standard for all monitored parameters. The 10-year data show a statistically significant worsening of chloride concentrations.

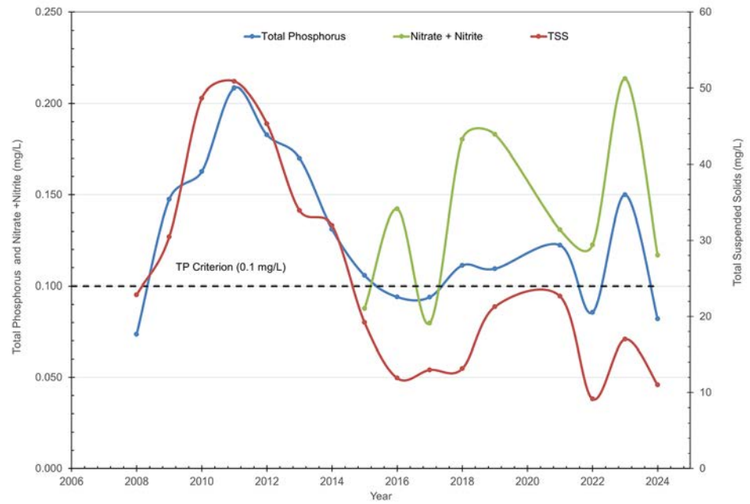
Recent projects to improve the water quality in Kohlman Creek include:

- Maplewood Mall (2012): With 35 acres of asphalt pavement and concrete surfaces surrounding it, Maplewood Mall was a major source of phosphorus runoff to Kohlman Lake and Kohlman Creek. But, over 4 years, the RWMWD installed a variety of stormwater management features that capture and filter 67 percent of rainwater at the mall—up from just 3 percent before the project. These features include innovative tree trenches, rain gardens, permeable pavers, and a 5,700-gallon cistern that receives runoff from the mall roof. Interpretive signage educates the public about these improvements, and a large watershed map in the entry vestibule shows how water travels from the mall all the way to the Mississippi River.
- Harmony Learning Center and Maplewood Middle School (2016): These school rain garden projects provide pollinator habitat and reduce the volume of polluted runoff that drains to Kohlman Creek.
- North Presbyterian Church (2017): This rain garden intercepts and filters runoff from the church parking lot, reducing the volume of polluted rainwater draining to Kohlman Creek.
- Target—North Saint Paul (2021): The project included the removal of an impervious parking lot to install 4 rain gardens and 2 linear tree trenches. The installed best management practices can reduce the volume of polluted runoff that drains to Kohlman Creek, as well as remove pollutants such as total suspended solids and total phosphorus.

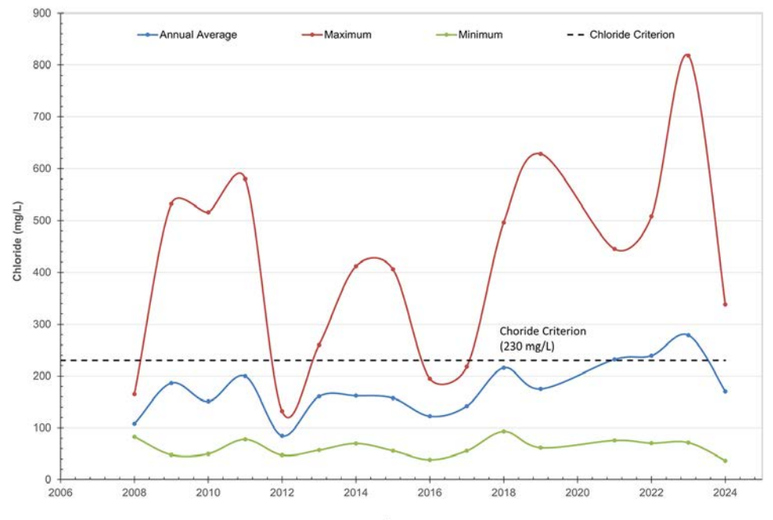
Parameter	State Standard	2024 Kohlman Creek	Average	10-Year Trend
Phosphorus	≤ 100 µg/l	82 µg/l	106 µg/l (10-year average)	None
Total suspended solids	<15 mg/L	11.0 mg/L	15 mg/L (10-year average)	None
Nitrate	N/A	0.12 mg/L	0.14 mg/L (6-year average)	N/A
Chloride	≤ 230 mg/L[1]	170 mg/L	192mg/L (10-year average)	Worsening

[1] State standard for chronic chloride exposure.

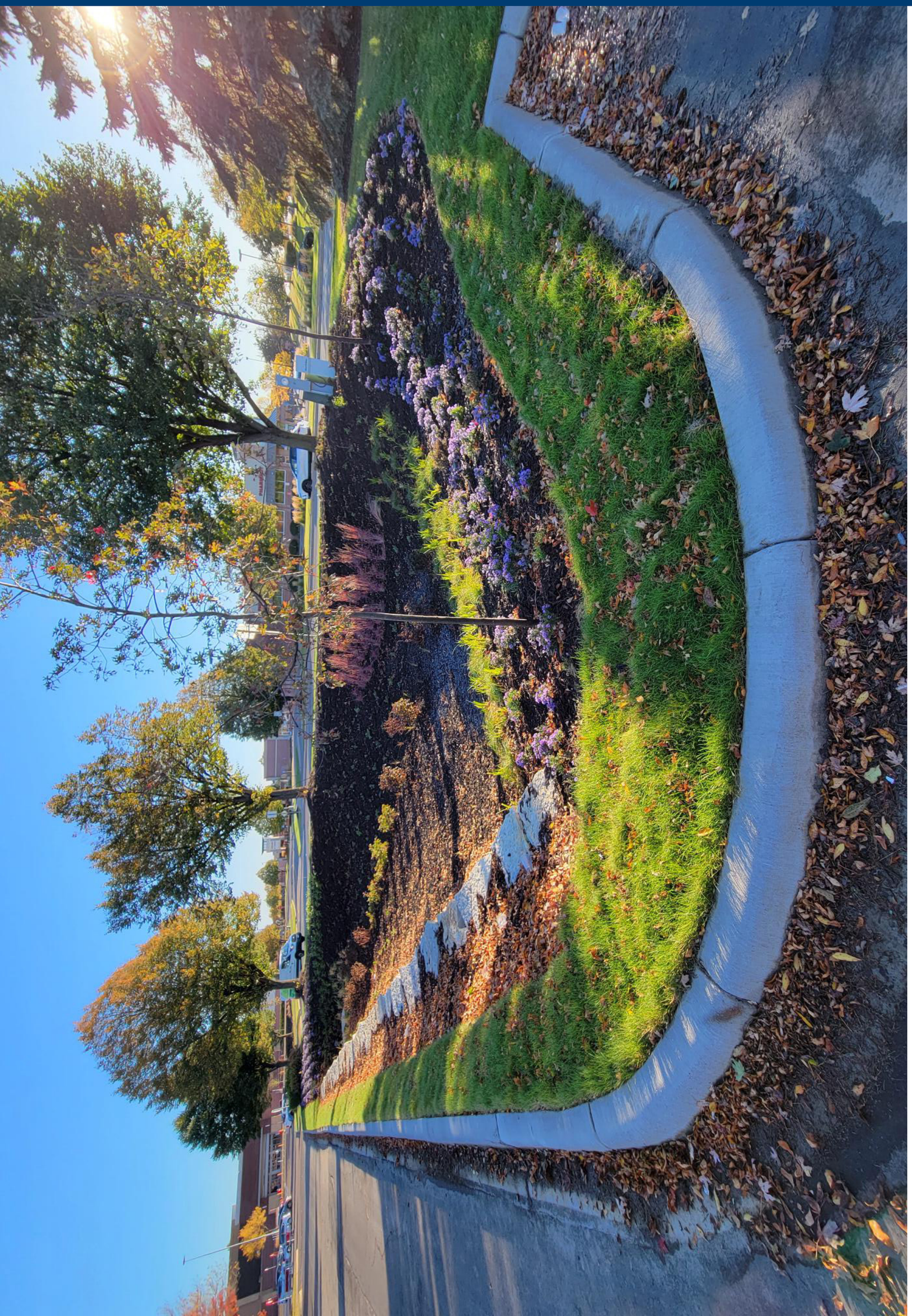
Nutrients and solids (mg/L)



Chlorides (mg/L)



5. BEST MANAGEMENT PRACTICE (BMP) WATER QUALITY REPORTS



IRON-ENHANCED SAND FILTERS

City	Maplewood
Subwatershed	Kohlman Creek
Completed	2009
Cost	$235,000
Funding Sources	District Levy Fund, Stormwater Impact Fund
Partners	City of Maplewood, University of Minnesota—St. Anthony Falls Laboratory

Beam Avenue Iron-Enhanced Sand Filter

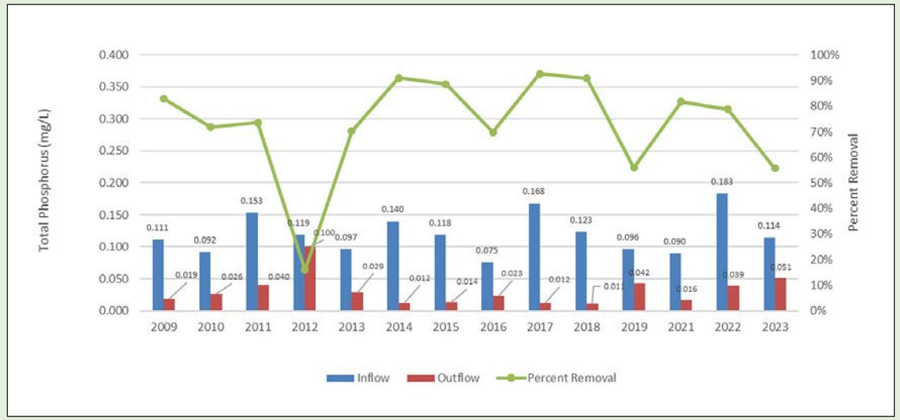
RWMWD's iron-enhanced sand filter on Beam Avenue was installed in 2009 to improve the water quality of Kohlman Lake. It was the first filter of its kind in Minnesota.

Sand filters have been used for years to remove solids and pollutants from stormwater. Newer, iron-enhanced sand filters (sand mixed with iron filings) are now being used as an efficient and cost-effective means of removing phosphorus. The filter works through a chemical process in which phosphorus molecules bind to the iron particles in the sand filter as water passes through.

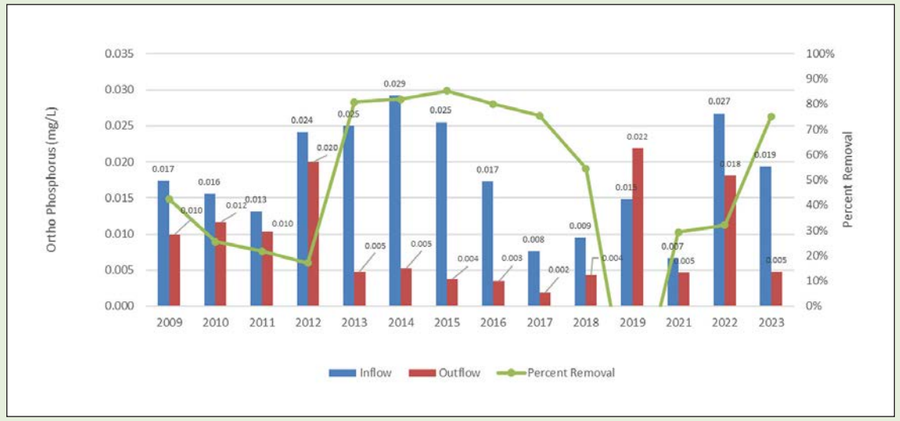
The RWMWD has monitored its iron-enhanced sand filter since 2009. Between 2009–2018, total phosphorus removal ranged from 70–93%. But, in 2019, it declined significantly (56%). For 2021 and 2022, the TP removal improved to 82% and 79%, respectively. However, in 2023, there was again a performance decrease to 56% removal. Removal of orthophosphate has declined, dropping from 70% removal in 2016 to -47% in 2019 (perhaps an indication that the filter is releasing dissolved phosphorus).

In 2021 and 2022, orthophosphate removal rates increased slightly to approximately 30%. In 2023, the removal of orthophosphate increased to roughly 75%. The increased removals between 2021 and 2023 could be because of drought conditions in the watershed but could also be attributed to the replacement of the media closest to the system's inlet in 2022. Removal of total suspended solids remains relatively steady, with average yearly removal consistently exceeding 85% for almost all monitored years. The average percent removal for the period of monitoring (2009–2023) is 73% for total phosphorus, 40% for orthophosphate, and 89% for total suspended solids.

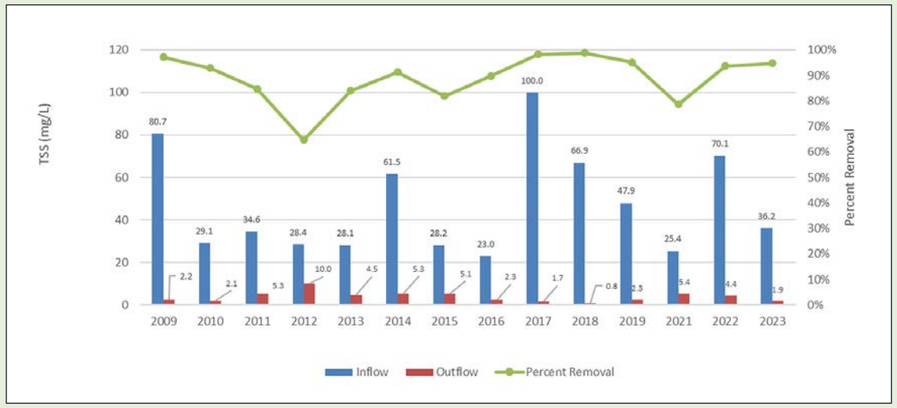
Total phosphorus removal performance



Orthophosphate removal performance



TSS removal performance



Woodlyn Rain Garden Iron-Enhanced Sand Filter

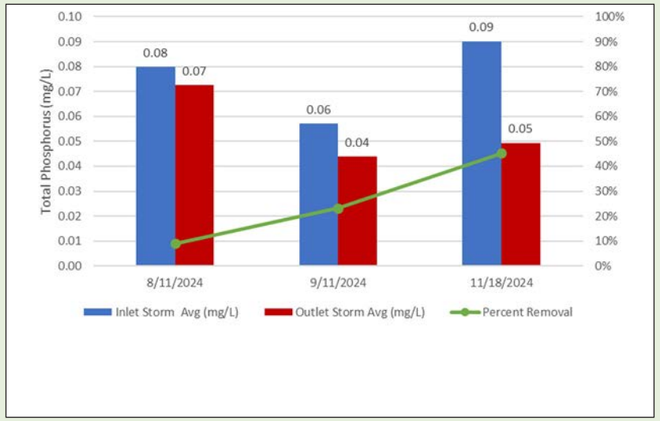
The Woodlyn iron-enhanced sand filter is part of the larger Maplewood Mall stormwater retrofit effort. The goal of that project—designed to capture and filter 67% of rainwater at the mall site—was to decrease the phosphorus runoff to nearby Kohlman Lake. Prior to the project, only 3% of the stormwater runoff from the mall was captured and filtered.

The Woodlyn iron-enhanced sand filter is a narrow strip of iron-enhanced sand beneath a rain garden. Runoff is intercepted from a parking lot and directed to the rain garden. There, the stormwater filters through the iron-enhanced sand for a period until it is treated. The average annual phosphorus removal with the filter has ranged from 3% during the first year of operation to 92% in 2022. The average annual removal of orthophosphate ranged from 0% in 2018 to 93% in 2015. The average removal for the 2012 to 2018 monitoring period was 58% for total phosphorus, 73% for orthophosphate, and 94% for total suspended solids.

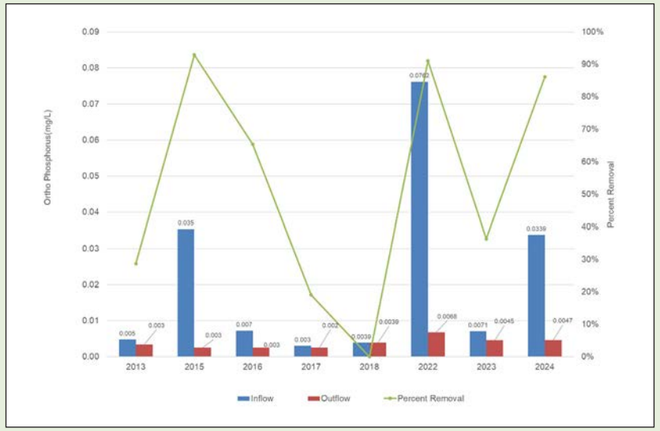
In 2022, over ten years after the construction of the filter, total phosphorus, orthophosphate, and total suspended solids removal were all over 90%—the highest yearly removal rates since monitoring began. The infrequent and small rainfall events in 2022 may account for this increased performance, as the rain washed down impervious surfaces laden with atypically high levels of accumulated sediment. Due to the improved performance in 2022, Barr recommended monitoring of Woodlyn before deciding whether filter media replacement was required. In 2023, the filter was sampled more frequently, and the total phosphorus removal dropped to 61%. Orthophosphate removal dropped to 36%, and total suspended solids removal dropped to 83%. In 2024, the filter was sampled frequently and had performance similar to 2022 with removals above 85% for the three monitored parameters. Based on the performance in 2022 and 2024, it is recommended monitor for another year and postpone media replacement.

City	Maplewood
Subwatershed	Kohlman Lake
Completed	2009
Cost	$72,900
Funding Sources	District funds
Partner	Simon Property Group, Minnesota Pollution Control Agency (monitoring)

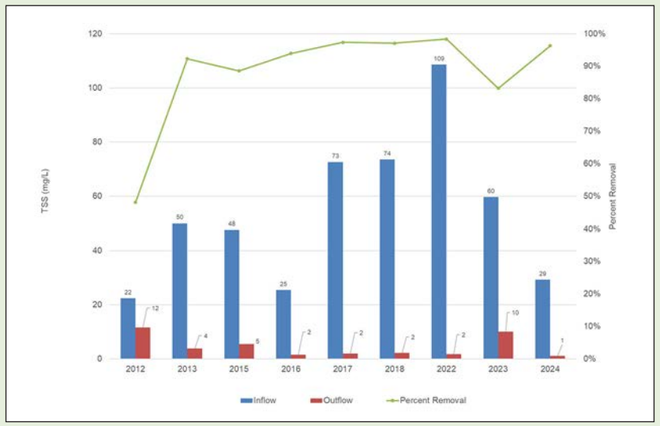
Total phosphorus removal performance



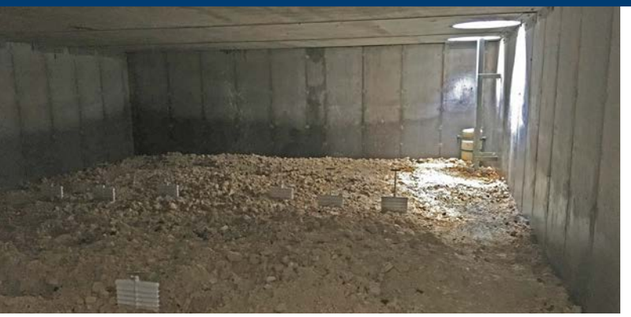
Orthophosphate removal performance



TSS removal performance



SPENT-LIME FILTERS



City	Maplewood
Subwatershed	Wakefield Lake
Completed	2018
Cost	$390,000
Funding Sources	Clean Water Fund ($300,000) and District funds
Partner	City of Maplewood

Frost and Kennard Spent-Lime Filter

This innovative stormwater filter is at the corner of Frost Avenue and Kennard Street in Maplewood, a few blocks upstream from Wakefield Lake. It is designed to capture and filter stormwater runoff from a large portion of the lake's 944-acre subwatershed.

The filter intercepts water from the storm sewer and routes it into a 20- by 36-foot underground chamber. There, the water interacts with spent lime—a chalky clay-like material consisting of calcium carbonate, which is a waste product of municipal drinking water treatment. Phosphorus in the water binds to calcium in the spent lime material, decreasing the amount of phosphorus in the water leaving the chamber.

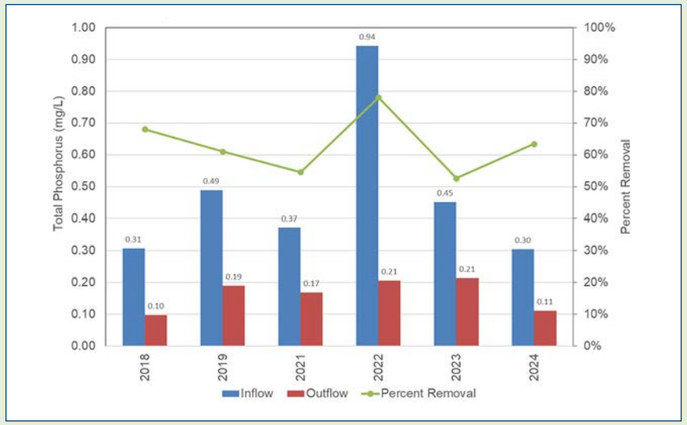
Spent lime is particularly effective in removing a form of phosphorus called orthophosphate, often found in stormwater runoff. While orthophosphate is a vital nutrient for bacteria and plants in surface waters, too much orthophosphate can promote algae growth and decrease water clarity.

Sampling equipment monitors phosphorus levels and total suspended solids as water enters and leaves the filter on its way to Wakefield Lake, which is impaired for phosphorus. The goal is to help the lake meet the state standard for phosphorus (60 micrograms per liter).

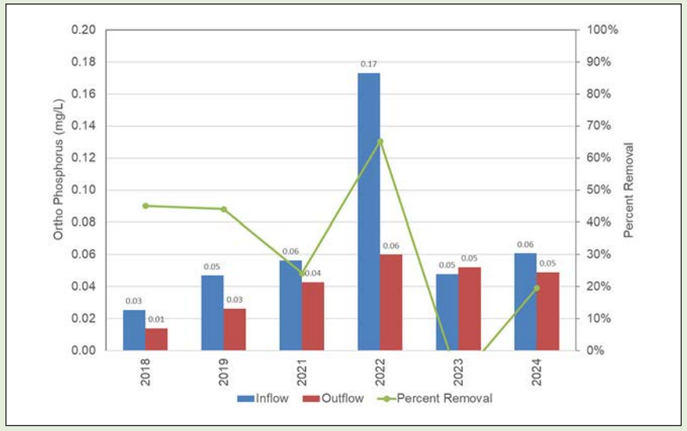
The removal performance of total phosphorus, orthophosphate, and total suspended solids all show a similar pattern. From 2018 to 2021, there was a slight decrease in removals for all parameters. For example, total phosphorus performance was 68% in 2018, 61% in 2019, and 55% in 2021. This decreasing trend would indicate that the media may need to be replaced. However, in 2022, the filter had its best removal performance, with removals of 78% for total phosphorus, 65% for orthophosphate, and 93% for total suspended solids. One potential reason for the increased performance in 2022 could be that 2022 was a drought year with typically small rainfall events. Monitoring from 2023 to 2024 indicates that total phosphorus removal is relatively constant with annual removal percentage ranging from 50 to 65%. Similarly, the annual total suspended solids removal was above 90% for both years. These results indicate that the filter has stabilized for total phosphorus and total suspended solids removals. However, orthophosphate removal remains an all-time low with the 2023 average annual removal being negative and the 2024 average annual removal being approximately 20%. Declining orthophosphate removals indicate the filter material may need to be replaced in the near future.

July 2024, RWMWD staff entered the underground chamber to inspect the filter and potential sediment buildup. The motivation for the inspection was the mixed performance of the filter over the years. The inspection found that sediment was covering the spent lime material throughout the system. The depth of sediment ranged from 0.05 feet to 0.4 feet in various locations. In addition, the forebay was approximately 50% full of sediment.

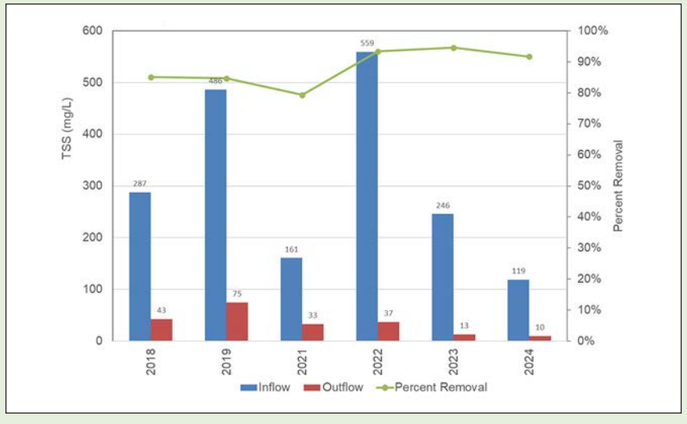
Total phosphorus removal performance



Orthophosphate removal performance



TSS removal performance



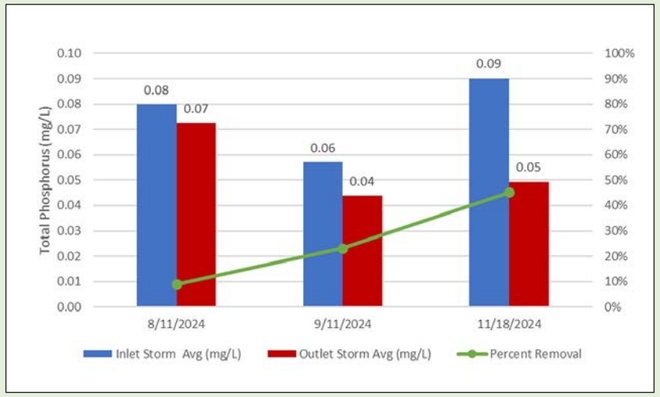
Willow Pond Continuous Monitoring and Adaptive Control (CMAC)

This innovative filter is located adjacent to Willow Pond, off Hamlin Avenue and County Road B2 West in Roseville. The filter was designed to receive intermittent flow from Willow Pond before the water travels downstream to Bennett Lake, which is impaired for excess nutrients. The system has multiple sensors that give real-time feedback to stop pumping if the water level drops below a threshold in Willow Pond. The intermittent flows pumped into the filter are treated with spent lime material. Although the system was constructed in 2019, 2024 was the first year the system was monitored. The system was not monitored until 2024 due to low water levels in Willow Pond

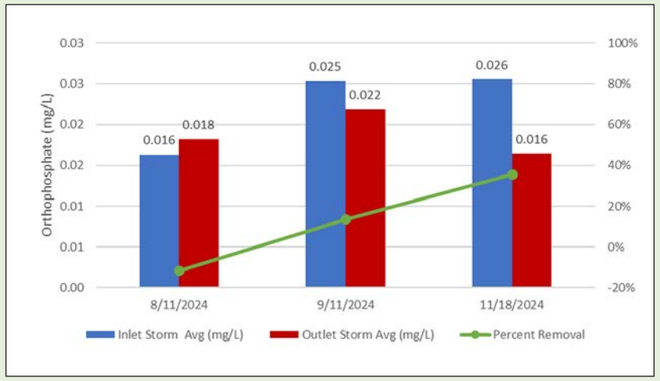
In 2024, only three storms were sampled. The sampling for the CMAC utilizes sequential/discrete sampling by collecting nine samples. The results in the figures are based on taking the average inlet and outlet sample based on the nine discrete samples taken. The average removal for the 2024 monitoring period was 26% for total phosphorus, 13% for orthophosphate, and 36% for total suspended solids. For all three parameters, the average annual removal rate increased from August to November. Due to limited sampling, no statement about the long-term performance of the filter can be made. It will be important to continue monitoring CMAC to increase the dataset and understand removal performance trends.

City	Roseville
Subwatershed	Bennett Lake
Completed	2019
Cost	$220,000
Funding Source	District funds
Partner	Roseville

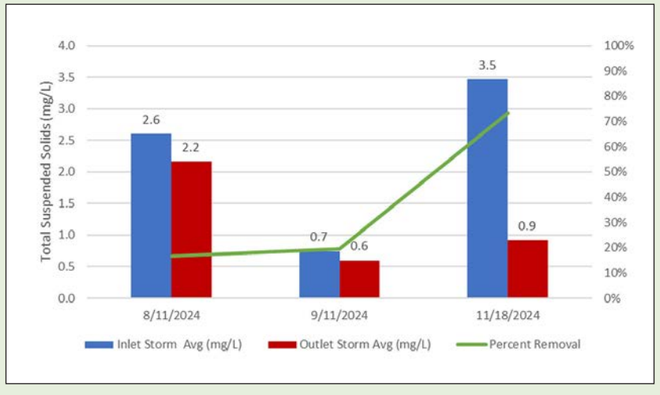
Total phosphorus removal performance

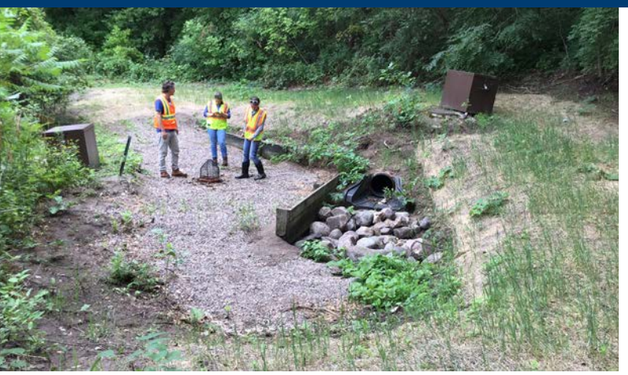


Orthophosphate removal performance



TSS removal performance





City	Maplewood
Subwatershed	Wakefield Lake
Completed	Fall 2011; filter media changed in 2022
Cost	$40,000
Funding Source	MPCA 319 Grant
Partner	City of Maplewood

Wakefield Lake Experimental Iron and Granite Sand Filter

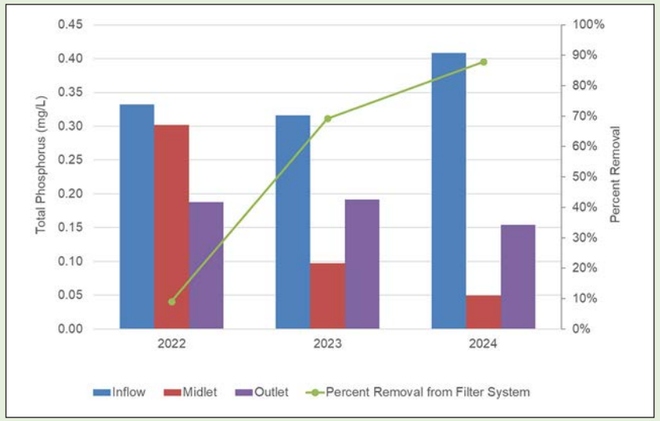
In 2022, the media in the Wakefield Lake experimental filter was replaced with iron and granite sand. Iron and granite sand were selected due to granite sand's high infiltration rate and iron's ability to remove dissolved phosphorus. The system was monitored from 2022 to 2024 in three locations: inlet, "midlet," and outlet. The inlet is the inflow location, the "midlet" is where water leaves the filter media system, and the outlet is the outflow of the pond downstream of the filter (before Wakefield Lake).

In 2022, the filter system had mixed total phosphorus removal performance. The filter removed phosphorus during some events but released it during others. From inlet to outlet, almost all events had a reduction in total phosphorus, but the majority of removals came from the downstream pond. The filter had an average total phosphorus removal (between the inlet and the "midlet") of 9%, while the pond's average removal (between the midlet and the outlet) was 38%. A similar trend was apparent for orthophosphate and total suspended solids. The average orthophosphate removal from the filter was 19%, while the average removal from the pond was 61%. The average total suspended solids removal from the filter was negative, while the pond was 91%.

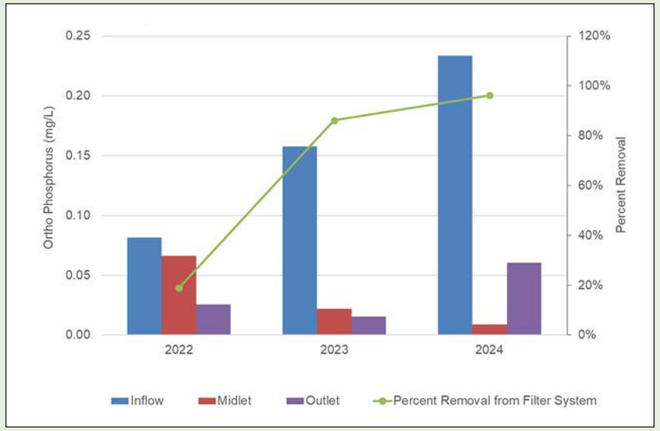
In 2023 and 2024, the performance of the filter and the pond showed different trends. Phosphorus, orthophosphate, and total suspended solids were consistently removed, but the removal came from the filter and not the pond. In 2023 and 2024, most removals were from the inlet to the midlet, and loading was from the midlet to the outlet. For example, the yearly average total phosphorus and orthophosphate removal for the filter was over 70%, while the pond was over -100% (i.e., loading). Similarly, the 2023 yearly total suspended solids removal was over 75% for the filter and -67% for the pond. It is important to note that the only change in the 2024 results is that the removals from the filter continued on an upward trend. For example, total phosphorus increased from 70% in 2023 to almost 90% in 2024. The results of 2023 and 2024 indicate that the filter is functioning as designed and is removing contaminants

It is also important to note that in 2023, the total suspended solids concentrations in the effluent have remained constant compared to the high effluent concentration in May of 2022. One potential explanation for the high midlet concentration of total suspended solids in May of 2022 is that the granite sand was not washed well enough before being installed in the filter, resulting in a pulse of suspended solids getting washed off of the new media. In 2023, the "midlet" concentration of total suspended solids ranged from 11 to 21 mg/L, which supports that the granite sand has been washed thoroughly by storm flows.

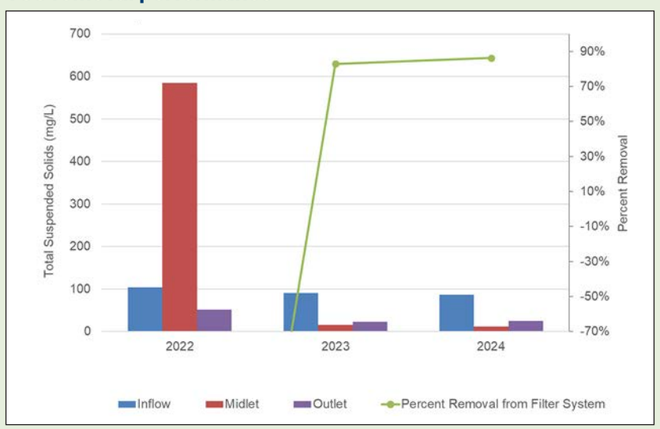
Total phosphorus removal performance



Orthophosphate removal performance



TSS removal performance



Arbogast CC17 Filter

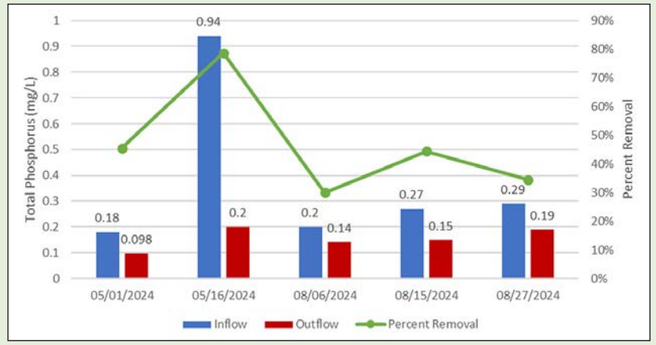
This stormwater filter is located below a paved piking/ walking path north of the intersection of Arbogast Street and Emmert Street in Shoreview. The goal of the underground filtration system is to divert low flows from the storm sewer along Arbogast Street (which conveys outflow from Lake Judy, as well as stormwater runoff from the residential drainage area to the northwest) to a subsurface treatment system before discharging back to the storm sewer and ultimately into Lake Emily.

CC17 is a form of crushed limestone used for a variety of infrastructure and agricultural purposes. In recent years, RWMWD has been experimenting with using it as a filtration media, with the aim of removing phosphorus and other pollutants. When stormwater containing phosphorus enters the CC17 filter media, the phosphorus molecules are attracted to calcium in the CC17 through a bond that is not dependent on the oxygenated state of the media (unlike a phosphorus-iron bond which can only happen in oxygenated environments). However, CC17 has a lower phosphorus removal efficiency when compared to that of iron enhanced sand. CC17 has a relatively high hydraulic conductivity rate (2264 inches per hour) and can therefore filter much higher volumes of stormwater, which makes it a viable filtration media choice in areas that receive continuous flows of stormwater.

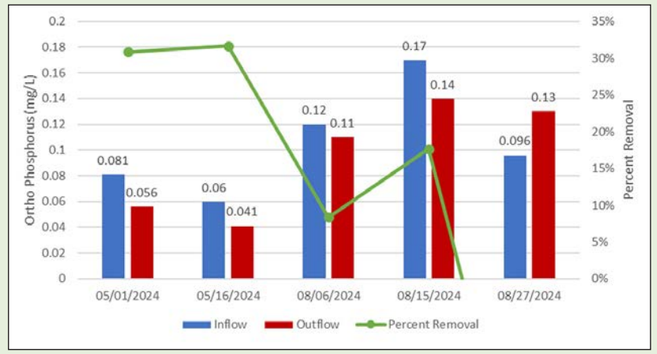
In 2024, the Arbogast filter had consistent event removals for total phosphorus (typically removed 30-45%) and total suspended solids (85% or higher). However, orthophosphate removal performance was varied throughout 2024. In May the filter removed approximately 30% of influent orthophosphate for the two monitored event. For the three events in August, the removals ranged from -35% (release of phosphorus) to 18%. It should be noted that there were difficulties with monitoring the outflow of the filter which could impact the outlet concentration and removal performance. In addition, the August 15th and 27 outlet samples were grab samples, while all other inlet and outlet samples were collected by an autosampler. It will be important to continue monitoring the Arbogast filter to increase the dataset and understand long term performance trends of the filter.

City	Shoreview
Subwatershed	Lake Emily/Owasso Lake
Completed	2023
Cost	$775,000
Funding Source	District funds
Partner	City of Shoreview

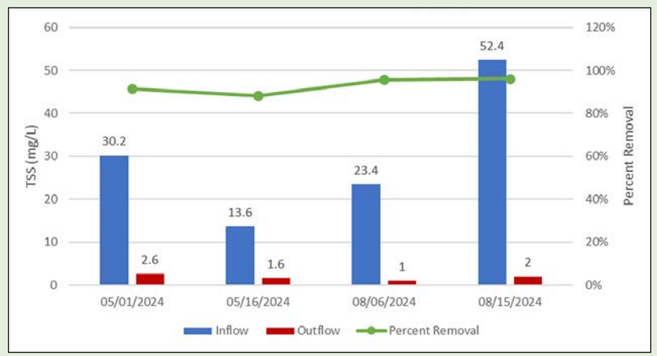
Phosphorus removal performance (mg/L)



Orthophosphate removal performance (mg/L)



Total suspended solids removal performance (mg/L)



ALUM TREATMENT SYSTEM

City	Oakdale
Subwatershed	Tanners Lake
Completed	1998
Cost	$1.9 million[1]
Funding Sources	District funds, Minnesota Pollution Control Agency State Revolving Fund Loan

[1] This cost reflects the alum facility as well as other related water quality improvements: Tanners Lake 5th Street Basin, Tanners Lake Berm, Tanners Lake Tartan High School Pond

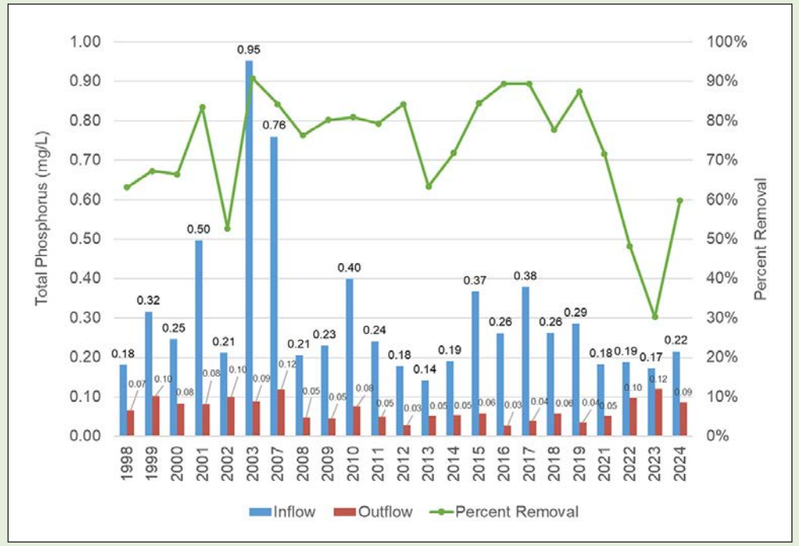
Tanners Lake Alum Treatment Facility

The Tanners Lake alum treatment facility was constructed in 1998 to reduce the amount of phosphorus reaching Tanners Lake. The facility receives stormwater runoff from a 1,246-acre watershed and injects it with aluminum sulfate (known as alum). The alum then binds with the phosphorus in the water and forms a floc that settles to the bottom of a pond upstream of Tanners Lake. The water that ultimately drains out of the pond to Tanners Lake has significantly lower phosphorus content.

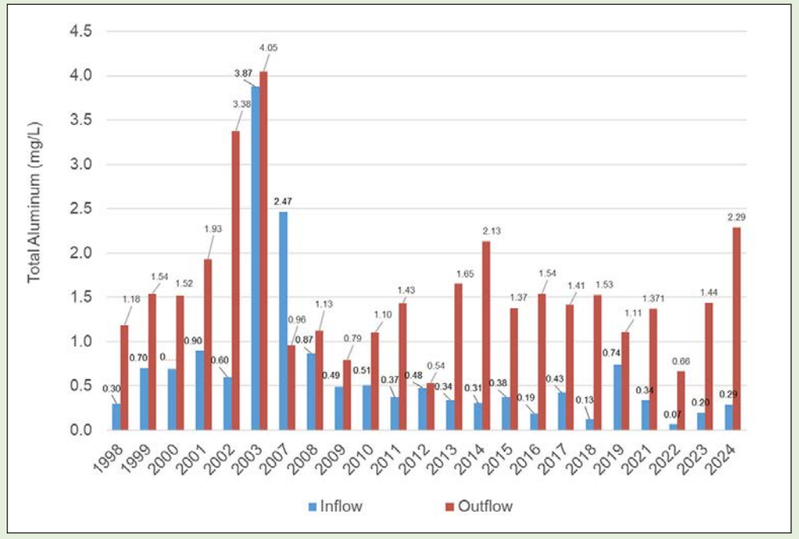
The graphs below show the effectiveness of the alum treatment system in reducing total phosphorus over the last 20-plus years of monitoring. Peak performance for phosphorus removal occurred in 2003 (91%) after improvements to the system in 2002. From 2004 to 2019, total phosphorus removal would consistently range from 72% to 89%. From 2021 to 2023, there has been a downward trend in total phosphorus removal.

In 2023, there were multiple events with phosphorus outflow concentrations that were over 0.1 mg/L from the end of May to the end of July. One potential explanation for these high concentrations is that in 2023, the alum treatment plant was shut down from May 9 to May 26 due to low-flow conditions. After the alum treatment plant was shut off, the inlet was flushed, resulting in untreated water entering the alum pond and, potentially, higher phosphorus concentrations. It will be important to continue monitoring total phosphorus removal to determine if the downward trend persists or is a byproduct of the low-flow conditions for 2021 to 2023.

Total phosphorus removal performance



Total aluminum



City	Shoreview
Subwatershed	Snail Lake
Completed	2021
Cost	$20,000
Funding Source	District funds
Partner	University of Minnesota

Shoreview Commons Pond

The Shoreview Commons Pond is north of Highway 96 in the Shoreview Commons Park. The pond has a drainage area that is approximately 144 acres (35% impervious), primarily comprising residential and institutional land. The outflow of the pond travels to Snail Lake. Shoreview Commons Park Pond has a historical trend of odor problems, low water clarity, and significant duckweed growth.

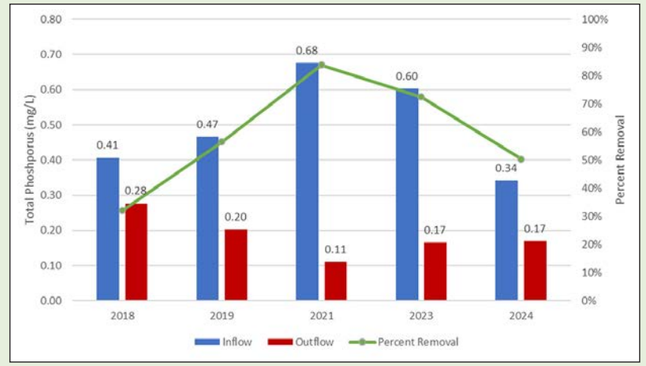
The pond was initially studied in 2018 using sediment cores, laboratory mesocosms, and in-situ water quality sampling. The 2018 study determined the baseline water quality for the pond, which was used to develop an iron filings treatment plan and dose. St. Anthony Falls Laboratory researchers chose to add iron filings to the pond to reduce internal loading and improve the pond's water quality. In February 2021, 12,000 pounds of iron filings were applied to the surface of the frozen Shoreview Commons Pond. The application of iron on ice allows the filings to be equally distributed into the pond as the ice melts.

From 2018 to 2019 (pre-iron-filing application), the annual average total phosphorus removal in the pond was 32% and 56%, respectively. From 2021 to 2024, post-application, the average annual total phosphorus removal decreased from 84% to 50%. During 2021 and 2023, there were only three monitoring events (out of 19) that resulted in negative or no total phosphorus removal, while in 2024 there were five monitoring events (out of 13). These results indicate that the filings have the potential to reduce internal phosphorus loading, but the potential might decrease with time.

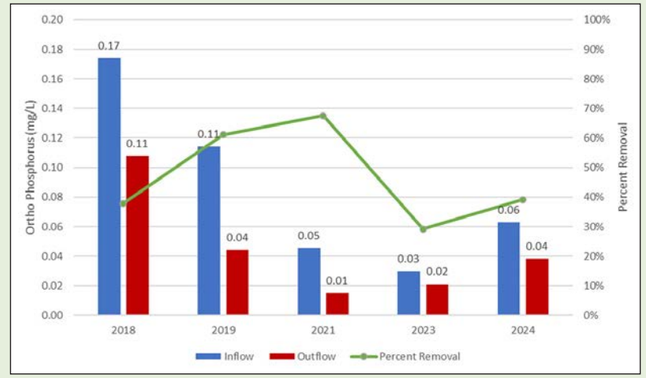
Unlike total phosphorus, there is no clear trend for orthophosphate removal. In 2018 and 2019, pre-application, the orthophosphate removal was 38% and 61%, respectively. Meanwhile, from 2021 and 2024, post-application, the average annual orthophosphate removal ranged from 29% to 68%. Therefore, it appears the iron-filing application may not impact orthophosphate removal. There is also no clear trend for total suspended solids removal; the removals pre- and post-filings have been consistent with the yearly averages, exceeding 80%.

It is difficult to draw conclusions on the Shoreview Commons Pond performance due to two important facts. First, the 2021 and 2023 data periods were drought years, while 2018 and 2019 were wet/average years for precipitation. Therefore, the years may not be very comparable because the precipitation conditions impact loading and removals for the pond. Second, the pond had a fountain (aerator) installed between October 2020 and August 2021, which may have interfered with the pond's water quality. Based on Google Earth imagery, it appears the fountain was on in 2022, 2023, and 2024.

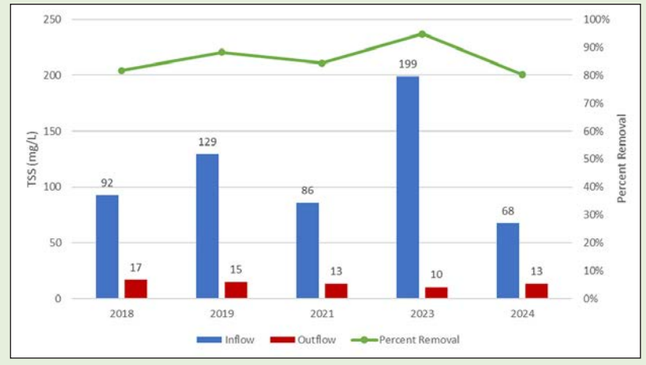
Phosphorus removal performance (mg/L)



Orthophosphate removal performance (mg/L)



Total suspended solids removal performance (mg/L)



Perfluoroalkyl substances (PFAS)

Perfluoroalkyl substances (PFAS) are also referred to as Perfluorochemicals (PFCs). PFAS are a family of manmade chemicals that have been widely used for decades. PFAS are extremely stable and do not break down in the environment. Common uses of PFAS include:

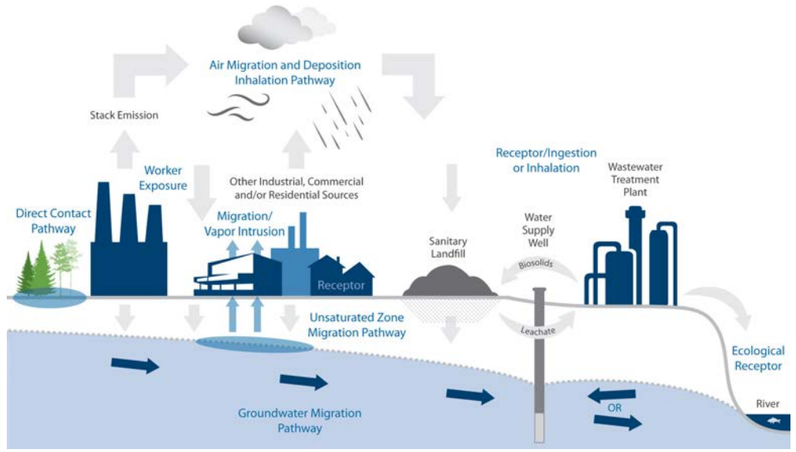
- Nonstick cookware, stain-resistant carpets and fabrics
- Coatings on some food packaging (especially microwave popcorn bags and fast food wrappers)
- Components of fire-fighting foam
- Many industrial applications

PFAS have been found in the groundwater in certain parts of Minnesota and are considered "emerging contaminants." Emerging contaminants are contaminants about which the MPCA has a new awareness or understanding of how they move in the environment or affect public health. PFAS, like other emerging contaminants, are the focus of active research and study, which means that new information is released occasionally. In recent years, various forms of PFAS (PFOS, PFOA, PFBA, PFPeA, PFPxA, PFBS, and PFHxS) were detected in surface water from both Battle Creek and Battle Creek Lake through monitoring by the MPCA. Concentrations were low, especially in Battle Creek Lake. High concentrations of PFAS (PFOS, PFOA, PFBA, PFPeA, PFPxA, PFBS, and PFHxS) were detected in samples from the surface foam on Battle Creek. Other areas in the District impacted by the 3M PFAS contamination include the eastern portion of Maplewood, North St. Paul, St. Paul, Oakdale, Landfall, and Woodbury.

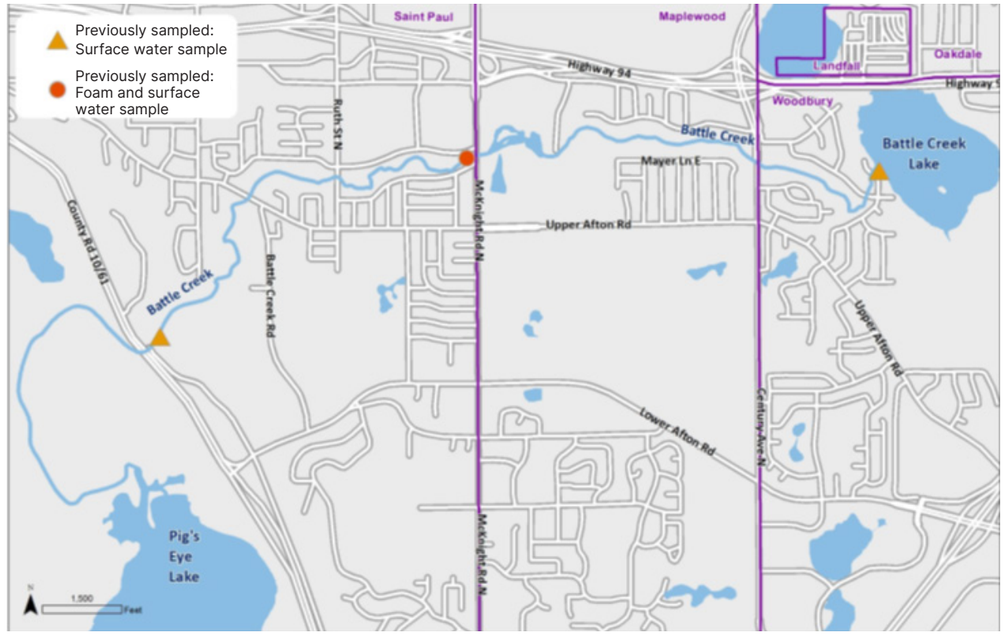
Generally, surface water foam on natural water bodies naturally occurs and does not contain PFAS. However, if PFAS-containing foam is found on surface water, MDH states that it does not pose a risk to human health if skin contact with the foam is minor and infrequent. Overall, with respect to contact with water bodies containing PFAS, MPCA recommends "when in doubt, stay out."

The Minnesota Department of Health (MDH) has guidelines for the recommended consumption of fish based on species type. The MDH has also tested fish for contaminants throughout the state to determine if guidelines should be more stringent based on contaminant concentration results and potential impacts to humans. For example, should the frequency of eating bass be reduced from once a week to once a month because bass in a given lake have a higher concentration of PFAS or mercury? The MDH has determined that the following lakes in the District should have more strict guidelines for fish consumption based on PFAS/PFOS results:

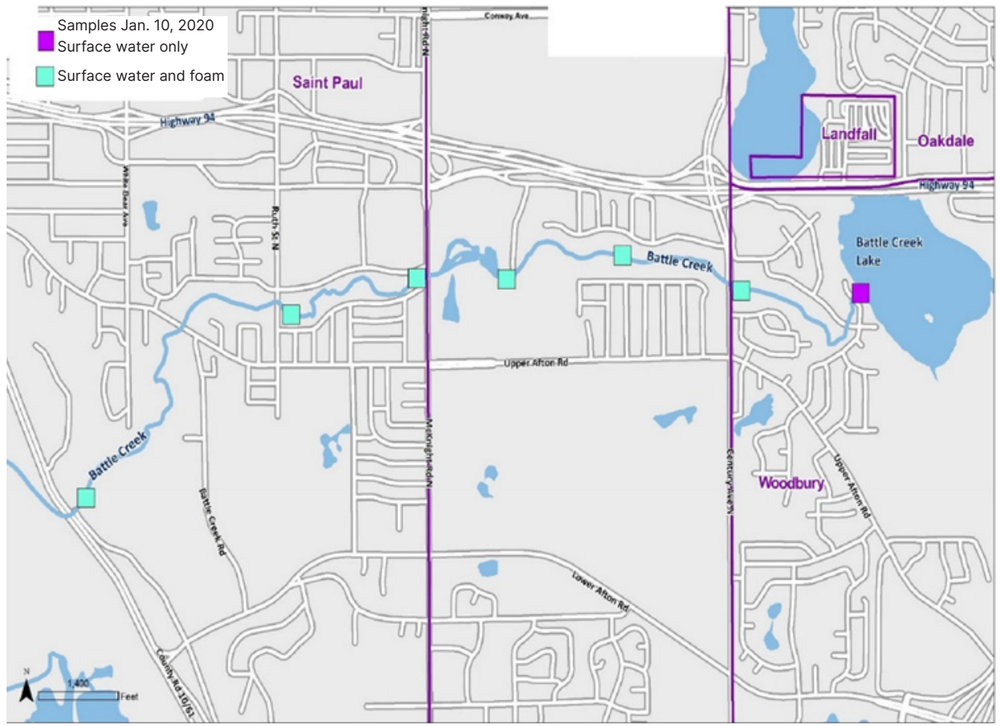
- Gervais Lake
- Keller Lake
- Lake Phalen
- Battle Creek Lake
- Tanners Lake



Traditional pathways of PFAS



MPCA's 2019 PFAS sampling locations



MPCA's 2020 PFAS sampling locations

Chloride

Chloride is a component of total dissolved solids (or total dissolved salts); chloride alone or in combination with other dissolved salts can be toxic to aquatic life. The Minnesota Pollution Control Agency's chronic chloride criteria is 230 mg/L.

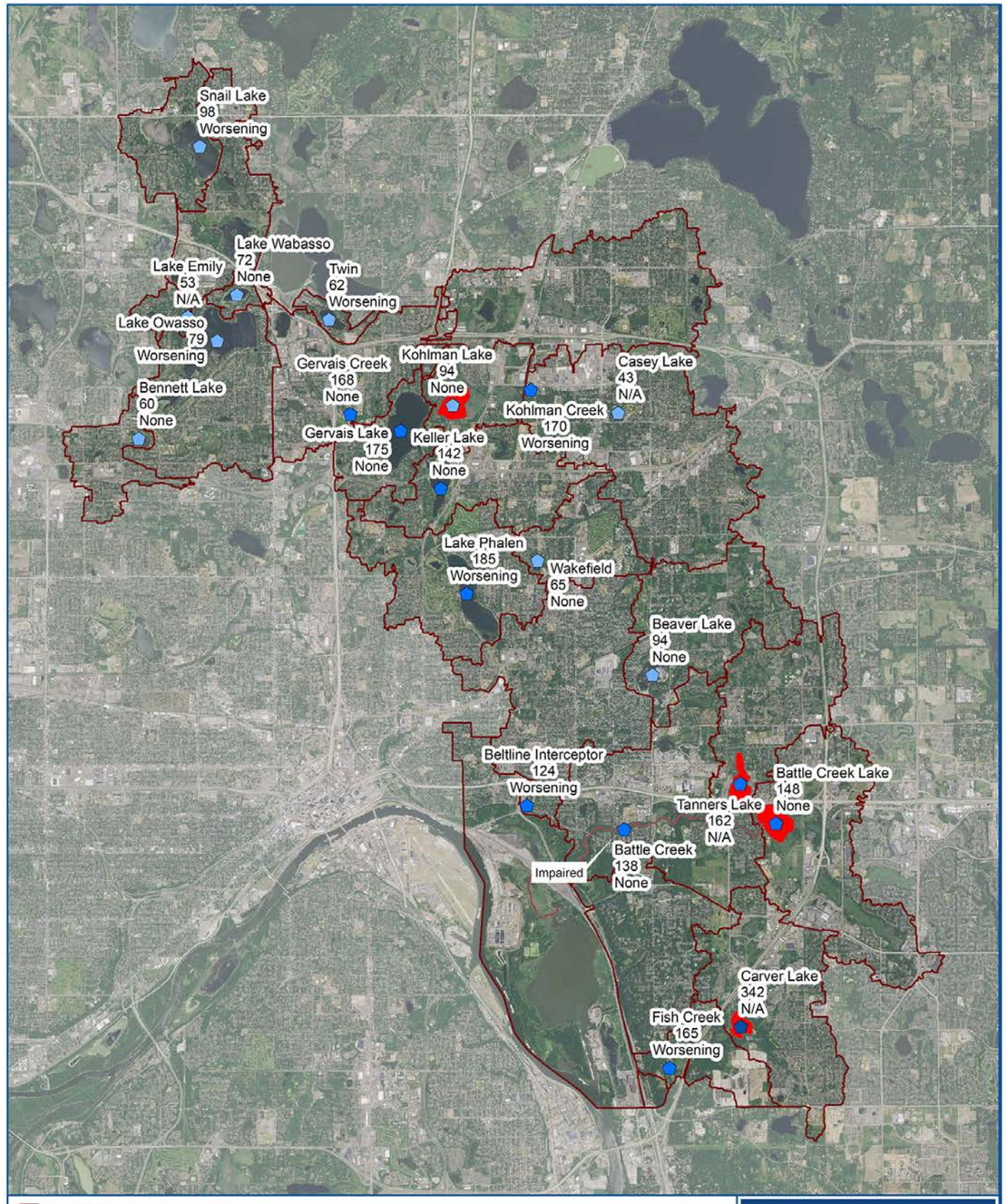
Most aquatic life criteria are based on testing with sensitive species; hence, the cumulative ecological impact of short-term or persistently high chloride is challenging to identify. Clearly, maintaining chloride below the 230 mg/L criteria will have ecological benefits by reducing overall stress on aquatic life. However, the potential ecological effect can be expected to be a function of the degree to which a given water sample exceeds criteria (e.g., how much greater than 230 mg/L), the frequency of the exceedance, and the persistence. The first step is to examine which water bodies have high chloride concentrations and consider if there are areas within the District with high concentrations ("hot spots").

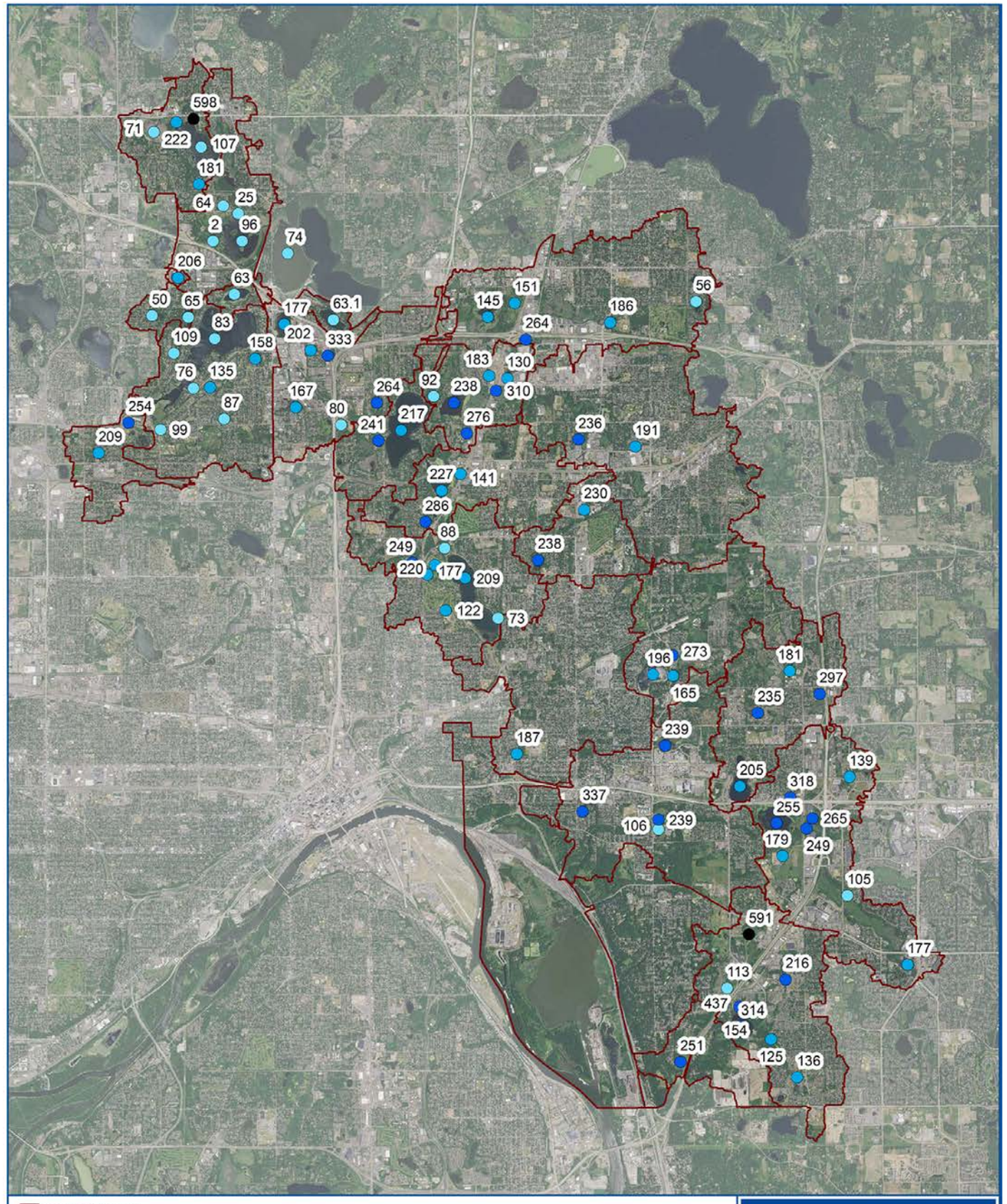
Chloride monitoring in the District has been completed with two programs: routine lake/stream sampling and ice-out monitoring. Routine lake and stream monitoring refers to sampling that occurs throughout the year (with a focus on summer monitoring), as presented in earlier sections of this report. Chloride monitoring for most of the lakes in this report began in 2015, therefore, 2024 was the tenth year of monitoring. Figure 6-1 shows the 2024 average summer chloride concentration and 10-year trend of chloride for all RWMWD lakes and streams.

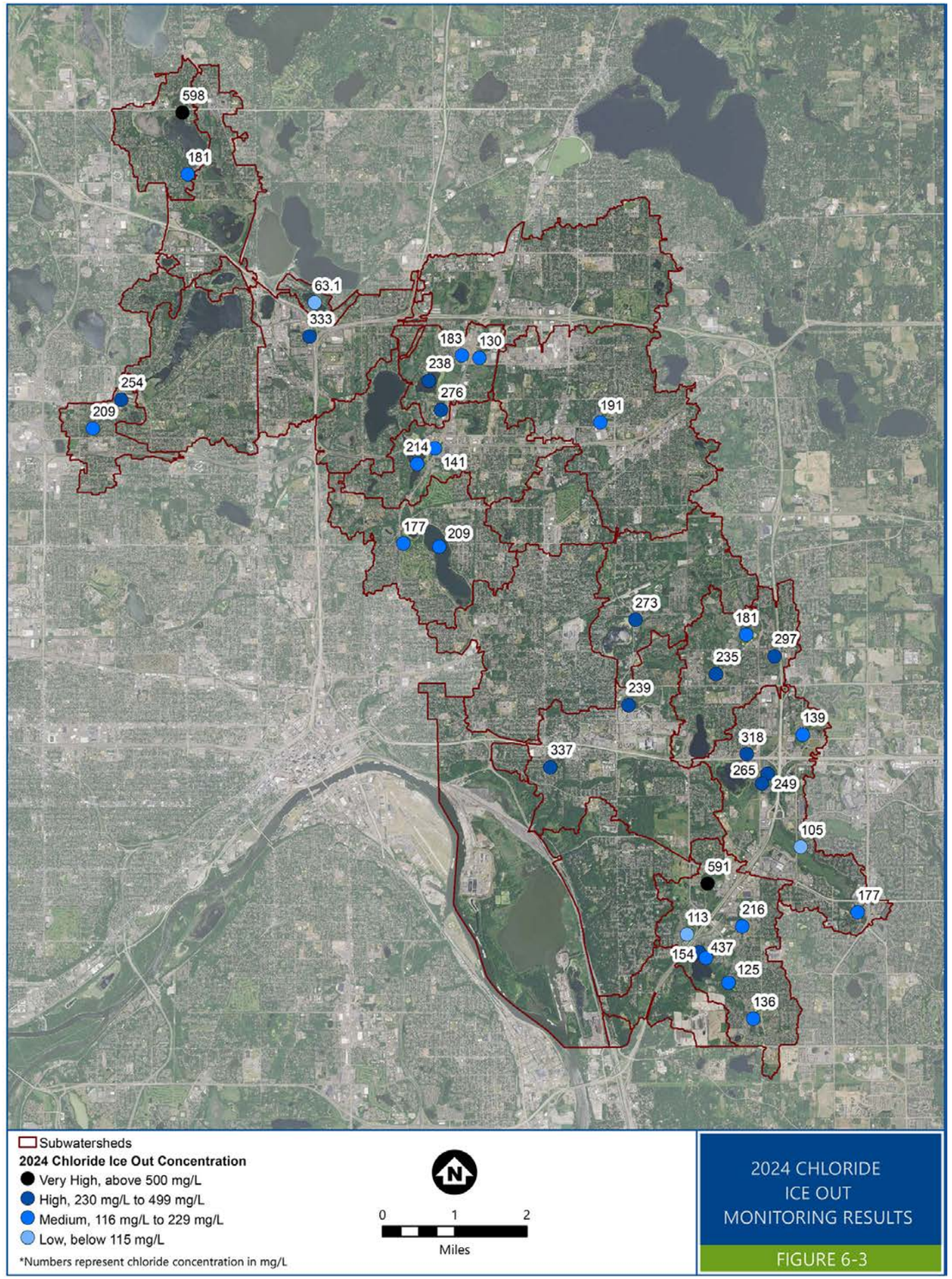
The second chloride monitoring work is chloride ice-out monitoring. Starting in 2021, the District began sampling chlorides after ice-out, typically taking place from late March to early April. The goal of ice-out chloride sampling was to understand the worst-case chloride concentrations that are a result of road salt application. The 2021 and 2022 sampling efforts focused on sampling the District areas that do not drain to Pig's Eye Lake, a public water that is in the floodplain of the Mississippi and has been impacted by industrial activities. Between 2021 and 2022, 63 samples were collected, representing approximately 80% of the District's stormwater runoff that does not enter Pig's Eye Lake. Figure 6-2 shows the most recent ice-out chloride concentration in every location that has been sampled in the District.

For 2023 and 2024, the ice-out chloride sampling protocol was shifted. Thirty sampling locations were identified; half were selected because they were in the top 50th percentile of chloride concentrations between 2021 and 2022. The primary goal of collecting samples at these locations was to understand potential annual fluctuation in chloride concentrations. The remainder of the sample locations were chosen because they are in the Tanners Lake, Battle Creek Lake, Carver Lake, or Kohlman Lake subwatershed—all of which are listed by the MPCA as impaired for chlorides. Another goal of collecting samples at these locations was to understand local hot spots in impaired water body subwatersheds. Additional samples were taken by RWMWD and Ramsey County; these were focused on larger lakes in the district and county. Results for 2024 are seen in Figure 6-3, while results for 2023 can be seen in the 2023 RWMWD Water Monitoring Annual Report.

In 2025, ice-out chloride monitoring will continue by sampling the locations sampled in 2023 and 2024. The ice-out monitoring in 2025 will mark the fifth year of ice-out monitoring. After the 2025 sample collection, it will be important to review the data to understand potential trends such as chloride concentrations related to imperviousness, land use, and more. The results of the trend analysis can be used to help with source control by identifying areas that are typically associated with high chloride concentrations.


Snail Lake
98
Worsening
Lake Wabasso
72
None
Lake Emily
53
N/A
Twin
62
Worsening
Lake Owasso
79
Worsening
Gervais Creek
168
None
Kohlman Lake
94
None
Casey Lake
43
N/A
Bennett Lake
60
None
Kohlman Creek
170
Worsening
Gervais Lake
175
None
Keller Lake
142
None
Lake Phalen
185
Worsening
Wakefield
65
None
Beaver Lake
94
None
Beltline Interceptor
124
Worsening
Battle Creek Lake
148
None
Tanners Lake
162
N/A
Battle Creek
138
None
Impaired
Carver Lake
342
N/A
Fish Creek
165
Worsening
Subwatersheds
2024 Lakes and Creeks Concentration
High, 230 mg/L to 499 mg/L
Medium, 116 mg/L to 229 mg/L
Low, below 115 mg/L
*Numbers represent chloride concentration in mg/L
**Worsening, improving, none, and N/A represent the 10-year trend
***Waterbodies in red are impaired for chloride
0
1
2
Miles
2024 RWMWD
LAKES AND STREAMS
CHLORIDE RESULTS
FIGURE 6-1


598
71
222
107
181
64
25
2
96
74
206
63
50
65
177
63.1
145
151
186
56
109
83
158
202
333
264
183
130
76
135
92
238
310
167
264
254
87
80
217
276
209
99
241
236
191
227
141
286
230
88
249
238
220
177
209
122
73
196
273
181
297
165
235
239
187
205
139
318
337
255
265
106
239
179
249
105
591
177
216
113
437
314
154
251
125
136
Subwatersheds
Chloride Ice Out Monitoring Concentration
Very High, at or above 500 mg/L
High, 230 mg/L to 499 mg/L
Medium, 116 mg/L to 229 mg/L
Low, below 115 mg/L
*Numbers represent chloride concentration in mg/L
0
1
2
Miles
MOST RECENT
CHLORIDE ICE OUT
MONITORING RESULTS
FIGURE 6-2



Mercury

In Minnesota, numerous lakes have aquatic consumption impairments due to mercury in fish tissue. These lakes are considered impaired by mercury. Mercury contamination in Minnesota is primarily due to air deposition and not from point sources. Therefore, the MPCA developed a statewide TMDL to address mercury impairment in its lakes.

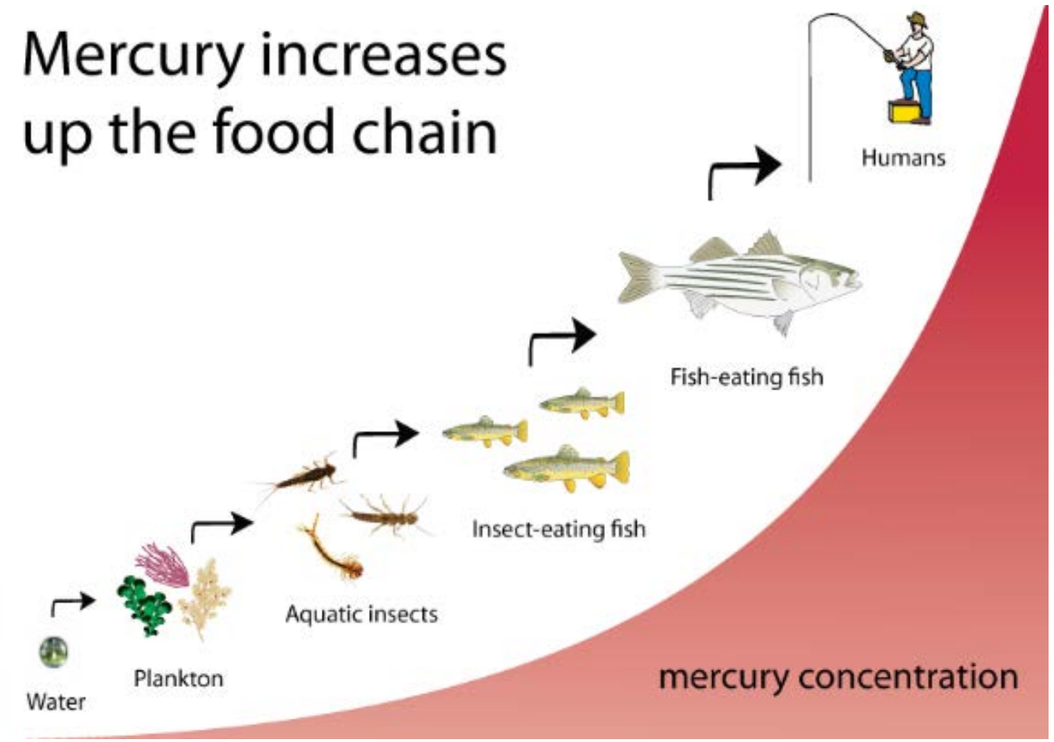
Mercury in fish tissue is problematic and dangerous for two primary reasons. First, there is no method for cooking or cleaning fish to reduce the concentration of mercury in the fish before consumption. Secondly, mercury is a compound that is prone to bioaccumulation and biomagnification in fish tissue. Bioaccumulation is the process of chemical concentrations increasing in a single fish over its life span because it consumes a chemical, and the chemical will not degrade via ingestion or other biological processes. Biomagnification is the process of chemical concentrations increasing from lower to higher on the food pyramid by animals high on the food pyramid consuming animals lower on the food pyramid.

The combination of bioaccumulation and biomagnification of mercury results in larger fish being more likely to have a high concentration of mercury in their fish tissue. Given the issues with bioaccumulation and biomagnification, the Minnesota Department of Health (MDH) has guidance on which fish can be eaten and at what frequency (i.e., if a sunfish from a give lake can be eaten as one meal a week or one meal a month, depending on the contamination levels). In addition, guidance from the MDH can be more stringent if the lake is impaired by mercury.

Currently, RWMWD has nine lakes that are designated as impaired by the MPCA for aquatic consumption due to mercury in fish tissue:

- Battle Creek Lake, listed in 2012
- Beaver Lake, listed in 2002
- Bennett Lake, listed in 2012
- Carver Lake, listed in 1998
- Gervais Lake, listed in 1998
- Lake Phalen, listed in 2012
- Snail Lake, listed in 2002

Currently, the District does not monitor for mercury in surface water or fish tissue. However, the Minnesota DNR has tested fish in all six lakes listed above. More information on fish contamination testing and results can be found for each specific lake on the Minnesota DNR LakeFinder Database.



This section describes the work the District has done managing fisheries in its water bodies to improve the water quality of its lakes. To date, efforts have been focused on carp management due to their ability to decrease water quality. Below is a summary of the carp management projects that the District has implemented.

Carp are notorious for deteriorating the water quality of lakes because they stir up sediment and sediment-bound phosphorus while searching for food in the lake bottom. Carp also tend to uproot and disturb submerged aquatic vegetation. They reproduce quickly, have long life cycles, and lack natural predators—increasing the longevity of their impact on water quality. Studies have indicated that carp biomass over 90 pounds per acre can lead to reduced lake water quality (Bajer et al., 2009). Over the past several years, RWMWD has completed significant work to quantify, track, remove, and limit the movement of carp in various waterbodies in the District. Since 2009, the District has worked to reduce carp in the Phalen Chain of Lakes with the use of fish surveys, capture events, the drawdown of Casey Lake (a major carp nursery), and the installation of carp barriers. Due to the success of this program, a similar effort was initiated on the Owasso chain of lakes and is detailed below:

- In 2017, electrofishing surveys for carp were completed on Lake Owasso, Bennett Lake, Lake Wabasso, Lake Emily, Grass Lake, and West Vadnais. Due to high catch rates, a recapture study was completed on Lake Owasso. The Lake Owasso recapture study was completed by marking over 200 carp and releasing them back to the lake, then recapturing them again later in the summer. Results of the recapture study predicted that the population of carp was roughly 15,500 adult carp with a biomass of 195 pounds per acre (double the water quality management threshold).

- From August 2017 to February 2018, 20 carp in Lake Owasso were monitored with radios to record their movements. Tracking the movement of carp can be a beneficial tool for understanding where carp spawn and potential locations to try to capture and remove them. Tracking showed that during the winter, carp move to and typically stay in the northwest bay of Lake Owasso. In February 2018, a commercial carp fishing company was hired to assist with catching the carp in the northwest bay. Unfortunately, the event was unsuccessful due to the nets breaking on submerged objects.

- In May 2018, carp barriers were installed in five locations on the Owasso chain. The barriers prevent carp from migrating in shallow channels to smaller ponds and wetlands where the carp prefer to spawn. If carp spawn in larger lakes, the spawn rate is lower due to eggs and young being eaten by native fish. To date, the carp barriers have been successful—they are seen at the barriers during checks and unable to access the small channels. Any carp found during carp barrier checks are removed. Success can also be seen by fewer young carp in the main lakes and decreasing carp biomass.

- In 2024, RWMWD staff and its hired contractor continued efforts to monitor and control the common carp population in the District. Electrofishing, Passive Integrated Equipment, temporary barriers, trap netting, and other methods were used to both remove carp and estimate carp populations from the Owasso chain of lakes and the Phalen chain of lakes. A total of 735 carp were removed from District waters, and all monitored lakes had carp population densities less than the critical threshold of 100 kg/ha.

Given the success on the Phalen Chain and Owasso Chain, an electric carp barrier was installed at the West Vadnais Lake Outlet in 2021. The barrier also has passive integrated transponder (PIT) technology. Over the years, hundreds of carp have been tagged with PIT. If a carp with a PIT sensor hits the barrier, the PIT technology will track the hit and record it. This information can be used to determine if the barrier is preventing tagged fish from traveling elsewhere. The District's management approach will be similar for future years, while also integrating goldfish monitoring and control in several waterbodies.

8. AQUATIC VEGETATION

Over the years, the District has pursued aquatic vegetation projects to help improve lake health and water quality. Below is a summary of the aquatic vegetation management projects the District has conducted over the last decade.

A healthy lake should have aquatic vegetation, which provides food and shelter to many aquatic animals. However, too much aquatic vegetation can be detrimental to water quality. Excess aquatic vegetation can store phosphorus and then release it to the water column when it dies and decays. In addition, invasive species such as Eurasian watermilfoil or curly leaf pondweed can grow densely, limiting the growth of native plants and the ability of the lake water to mix oxygen throughout the water column. In such cases, aquatic vegetation management (i.e., harvesting) may be required. The District has, on occasion, selectively employed aquatic vegetation harvesting in District lakes.

From June to August 2015, the District hired a contractor to conduct aquatic plant harvesting on Kohlman Lake. The aquatic plant harvesting occurred multiple times throughout the summer, going to a depth of 1 meter; this protected against over-harvesting. The harvesting was conducted primarily in the middle of the lake to provide open-water space for recreation. Harvesting has been regularly conducted on Casey Lake since a carp removal event in 2012. The harvesting depth in Casey Lake is set to 0.3 meters to minimize substrate disturbance. The 2013 harvesting was analyzed, determining that the phosphorus removed from harvesting was the equivalent of 53% of the total phosphorus inflow to Casey Lake.

Ramsey County performed aquatic vegetation point-intercept surveys on ten lakes in 2025 including, Carver, Eagle, Keller, Kohlman, Phalen, Round, Snail, Spoon, Tanners, and Twin. Both Keller and Kohlman Lakes were surveyed once per month from June through September. Across all lakes, two non-native species were observed: Curly-leaf pondweed (CLP) and Eurasian watermilfoil (EWM). CLP frequency of occurrence ranged from 1% to 29%, with the most abundance in Kohlman Lake. EWM frequency of occurrence ranged from 1% to 68%, with the most abundance in Snail Lake and Lake Phalen. Several native species were observed in all lakes, with varying levels of occurrence.

Additionally, RWMWD partnered with researchers at Montana State University and the University of Minnesota to conduct genetic testing of watermilfoil on three lakes: Wabasso, Owasso, and Gervais. This analysis identified several strains of watermilfoil, including some hybrid strains that have not been identified in any other lakes that are part of the genetic database maintained by the researchers. Herbicide treatments may be less effective on hybrid strains of watermilfoil.

One of the most common best management practices that gets implemented throughout the RWMWD are biofiltration or bioinfiltration basins, also commonly referred to as rain gardens. These basins play a crucial role in managing stormwater runoff and improving water quality. The systems are vegetated depressions or basins that use surface storage, vegetation, planting soil, and outlet controls to treat, detain, and retain stormwater runoff. They help reduce stormwater volume and pollution by filtering runoff through a vegetated soil medium that promotes evapotranspiration. Bioinfiltration systems remove stormwater via infiltration into the surrounding soils, while biofiltration systems attenuate runoff with flow-regulating underdrains. These practices are effective at removing pollutants and reducing the volume of runoff.

Oftentimes, these types of practices are implemented through two of the District's cost-share programs: the Stewardship Grant Program and the Targeted Retrofit Program. The Stewardship Grant Program offers support to design and construct rain gardens and other water quality BMPs. This program provides cost-share applicants with design and review services, focusing on smaller-scale projects that enhance water quality throughout the District. The Targeted Retrofit Program is designed to implement larger-scale BMP retrofit opportunities through partnerships with commercial, faith-based, and school properties to improve downstream water quality. RWMWD provides comprehensive services including design, bidding, and construction to achieve significant water quality improvements on properties. Over the past two decades, the District has financed or constructed almost 500 rain gardens, bioinfiltration, or biofiltration basins. Some recent examples of these projects are highlighted in this report.

Highlighted large basins include:

- Maplewood Mall—Woodlyn Ave rain garden
- Wakefield Park—two large biofiltration basins
- Woodland hills—large biofiltration basin
- Targets—biofiltration basins (along with tree trenches)

9. RAIN GARDENS/BIOFILTRATION BASINS HIGHLIGHT

RAMSEY-WASHINGTON
METRO WATERSHED DISTRICT

2665 Noel Drive
Little Canada, MN 55117
P: 651-792-7950
E: office@rwmwd.org