REPORT SUMMARY

Birch Island Lake Water Quality Study

January 2024

Prepared for
Nine Mile Creek
Watershed District

9 MILE CREEK WATERSHED DISTRICT

REPORT SUMMARY CONTENTS

- Water Quality Goals to Protect and Enhance Our Lakes
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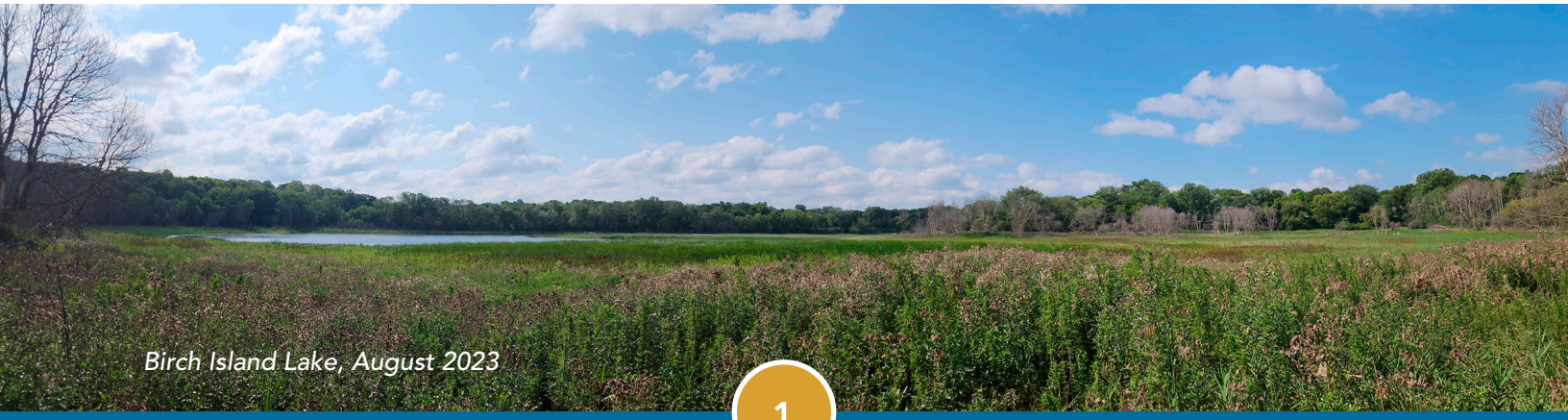
Water Quality Goals to Protect and Enhance Our Lakes

Birch Island Lake is a shallow, urban lake located in the northern portion of the city of Eden Prairie, south of County Road 62 and west of Highway 494. Monitoring data collected in the past 5 years indicates degrading water quality conditions. The Nine Mile Creek Watershed District (NMCWD), a local unit of government that works to address water-related problems, conducted a study of Birch Island Lake in 2022–2023 to evaluate current water quality and identify protection and improvement strategies. The study incorporated additional data and advanced modeling and analysis methods to confirm the findings of a 2000 NMCWD study. Additional information on the current lake conditions, water quality challenges, and recommended management strategies, including implementation timelines, are summarized in this project overview.

Protecting and enhancing the water quality of the lakes within the Nine Mile Creek watershed is one of the primary goals of the Nine Mile Creek Watershed District. The NMCWD's lake management program includes data collection (monitoring), assessment (e.g., studies), and implementation of projects and programs to protect and improve water quality and ecosystem health. Using monitoring data collected in recent years (2019 and 2020), the objectives of this study were to assess or "diagnose" the lake's water quality problems, understand the cause or sources of the problems, and recommend management strategies to improve the water quality and overall health of the lake.



Birch Island Lake, August 2023

Birch Island Lake, June 2015

Lake Management Goals

When assessing the ecological health of a lake, it is important to take a holistic approach, considering factors such as in-lake water quality (e.g., phosphorus and nitrogen concentrations), the health and quality of the aquatic communities, and water quantity (see Figure 1). How recreation and wildlife habitat affect and are affected by overall lake health are also considered. Numerical goals exist for some of these factors, such as state water quality standards. However, other factors are assessed relative to narrative criteria that describe the desired condition and do not have strict numerical goals. For this study, the primary goals are to achieve the water quality standards for shallow lakes; attain a diverse, native macrophyte (aquatic plant) population; and support a healthy, balanced aquatic ecosystem.

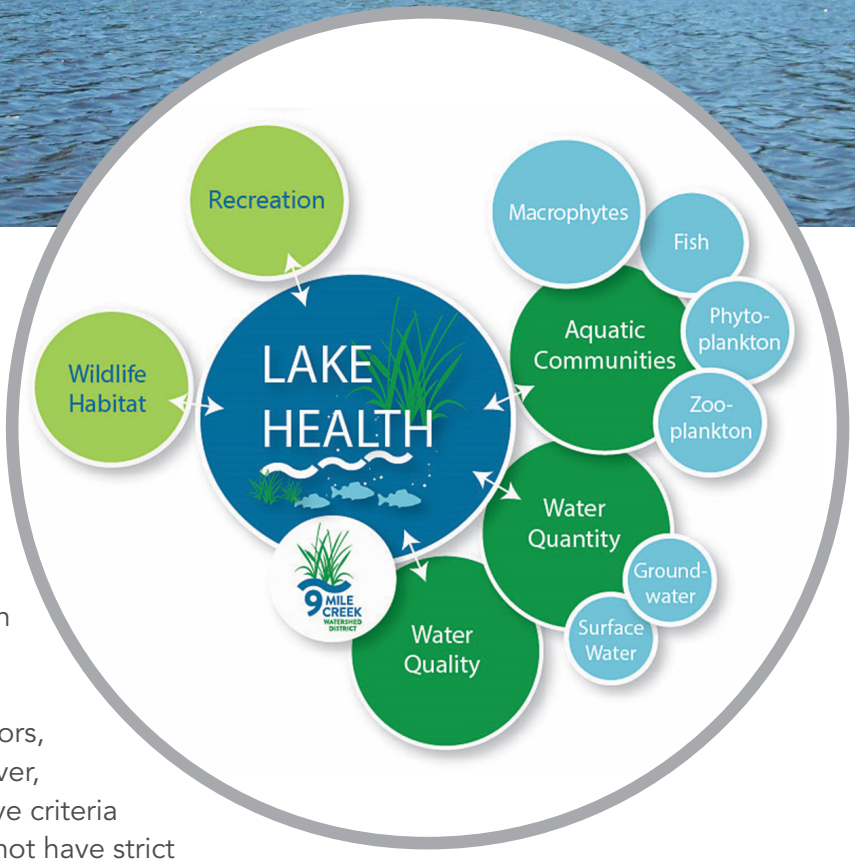


Figure 1
NMCWD Holistic Lake Health Assessment Factors

For this study, the primary goals are to achieve the water quality standards for shallow lakes; attain a diverse, native aquatic plant population; and support a healthy, balanced aquatic ecosystem.

9 MILE CREEK WATERSHED DISTRICT

Birch Island Lake, October 2022

Current Lake Conditions

Currently, the state of Minnesota uses three parameters to indicate lake health and help track and quantify water quality changes. These three parameters include:

1) Total Phosphorus, which is a nutrient that can fuel algae and plant growth (Figure 2)

2) Chlorophyll-*a*, which is a measurement of algae growth (Figure 3)

3) Secchi disk transparency depth, which is a measurement of lake clarity. (Figure 4)

Recent monitoring data indicate that Birch Island Lake is not meeting Minnesota's water quality standards for shallow lakes in the Twin Cities. The observed summer average (June 1 - Sept 30) total phosphorus and chlorophyll-*a* concentrations exceeded Minnesota's shallow lake water quality standards (60 µg/L total phosphorus and 20 µg/L chlorophyll-*a*) in the two most recent monitoring years, 2020 and 2021. Lake water clarity was also poor in 2020 and 2021 with summer average transparency depths below the shallow lake standard of 1 meter. The degrading water quality is primarily due to excess nutrients in the lake, which fuels algal growth and decreases water clarity.

Example blue-green algae bloom

Blue-green algae, or cyanobacteria, have historically been found in Birch Island Lake since monitoring began, with a notable increase in abundance in 2015. Blue-green algae are associated with water quality problems and can be a source of health concerns not only for humans that use the lake, but for wildlife.

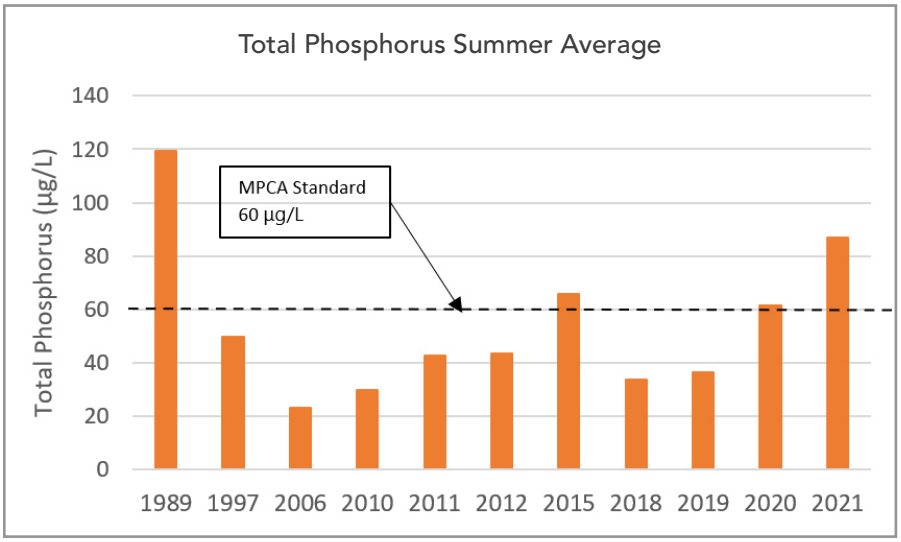


Figure 2
Summer average total phosphorus concentrations measured in Birch Island Lake between 1989 and 2021

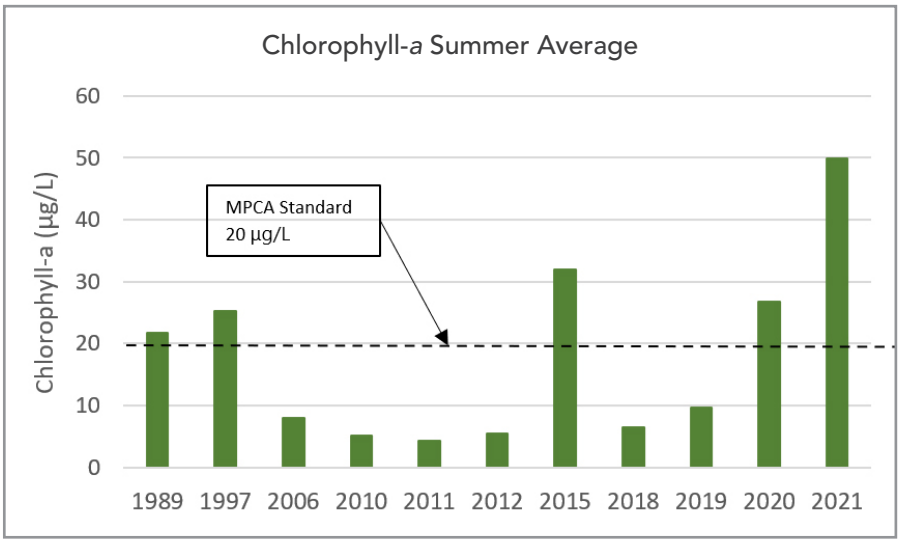


Figure 3
Summer average chlorophyll-a concentrations measured in Birch Island Lake between 1989 and 2021

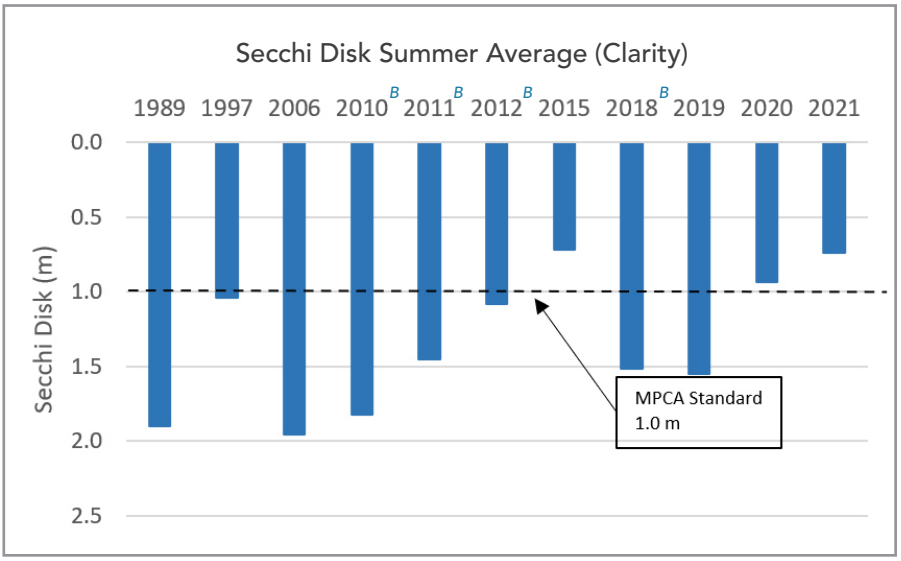


Figure 4
Summer average Secchi disk transparency depths (clarity) measured in Birch Island Lake between 1989 and 2021

B = Some SD readings measured at lake bottom at sampling location during these monitoring years.

Healthy Shallow Lakes Have...Plants!

Shallow lakes are unique ecosystems that differ from deeper lakes. These lakes have depths that allow for light to reach the lake bottom throughout most or all of the lake (often less than 10 feet deep). Shallow lakes also tend to be more nutrient-rich than deeper lakes, especially in an urban setting where they receive nutrients (e.g., phosphorus and nitrogen) from stormwater. A healthy, shallow, urban lake will have an abundance of aquatic plants growing throughout the entire lake due to the shallowness and higher amounts of nutrients. Aquatic plants, such as coontail, native pondweed, and water lily, can provide excellent habitat for insects, zooplankton, fish, waterfowl, and other wildlife. The plants can also help to take phosphorus and nitrogen from the lake water, reducing the amount of nutrients available for algae growth. However, if nutrients are high enough, excess nutrients can lead to an overabundance of algal growth that creates turbid (murky-looking, low clarity) water. Lake water with low clarity can limit or prevent aquatic plant growth, which can lead to an unhealthy plant community.

To help define the health of a lake's plant community, the Minnesota Department of Natural Resources (MNDNR) has developed an index of biological integrity (IBI), which is a score that compares the types and numbers of plants observed in a lake to what is expected for a healthy lake. Observing 11 or more species in a shallow lake is an indication of a healthier plant community. The plant surveys completed on Birch Island Lake from 1997 through 2021, summarized in Figure 5, indicate that species diversity is likely correlated with water levels. The number of species observed during years with lower water levels ranged from 3 to 5, while the number of species observed during years with higher lake water levels ranged from 6 to 11 species.

In the past decade, the difference between the lowest and highest observed water level in Birch Island Lake is approximately 13.3 feet. The lowest observed water level in 2013 corresponds to an open water area of only 3 acres. The highest observed water level in 2019 corresponds to an open water area of almost 44 acres. This substantial difference in open water area, as shown in Figures 6 and 7, can have a notable influence on long-term health of submerged and emergent plants.

Monitoring data indicate that the number of species observed in Birch Island Lake is likely correlated to water levels with the highest diversity of species observed during years with higher water levels.

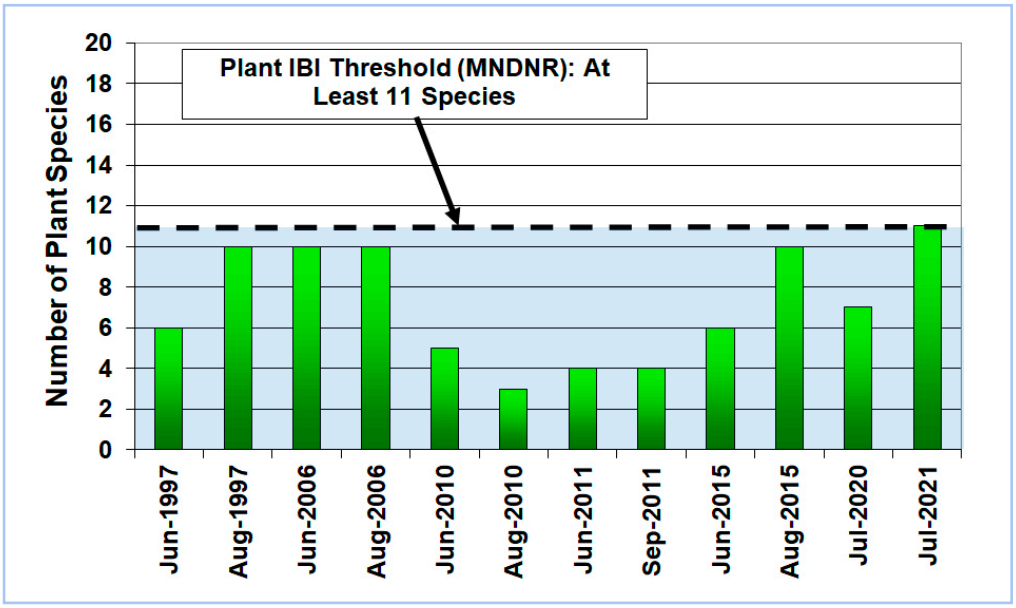


Figure 5 *Birch Island Lake Plant Species Richness compared with MNDNR Plant IBI score, which is an indication of plant health*

Fluctuating Water Levels

Birch Island Lake is generally considered landlocked. A high-level outlet has historically been referenced, but the location has not been confirmed. Given that the lake is generally landlocked, the water level in the lake depends on weather conditions (snowmelt, rainfall, evaporation) and groundwater flow. Birch Island Lake has experienced significant fluctuations in water levels in recent decades, which can pose challenges for water quality and ecosystem health.

Since the construction of County Road 62 in the mid and late 1980s, the normal water level of Birch Island Lake dropped notably lower than what was observed pre-construction. A pipe bypass system was installed in 2007 to help convey stormwater runoff draining north of County Road 62 directly to Birch Island Lake. The effectiveness of the bypass pipe in increasing water levels in Birch Island Lake has been variable, primarily due to frequent clogging of the bypass system from sediment build up.

Sediment clogging of the bypass pipe system is not the only reason for observed fluctuations in lake water levels. High water levels were observed in 2019 and early 2020 because 2019 was the wettest year on record in the Twin Cities metro area (>43 inches of precipitation). However, since 2021, the Twin Cities has experienced significantly lower than average precipitation, especially during the growing season (June–September). For example, from June–September 2022, less than 7 inches of rain fell as shown in Figure 8. Low precipitation coupled with higher evaporation rates during the 2021–2023 growing seasons have resulted in notable water level decreases in many lakes within the Twin Cities metro area.

Figure 6 *September 2013 water levels*

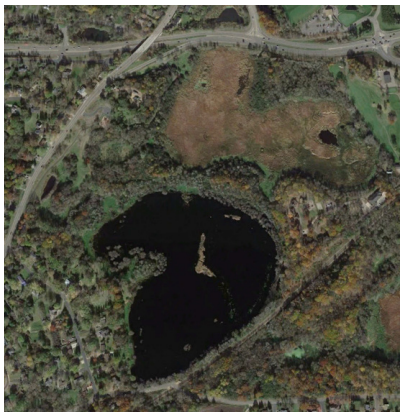


Figure 7 *October 2019 water levels*

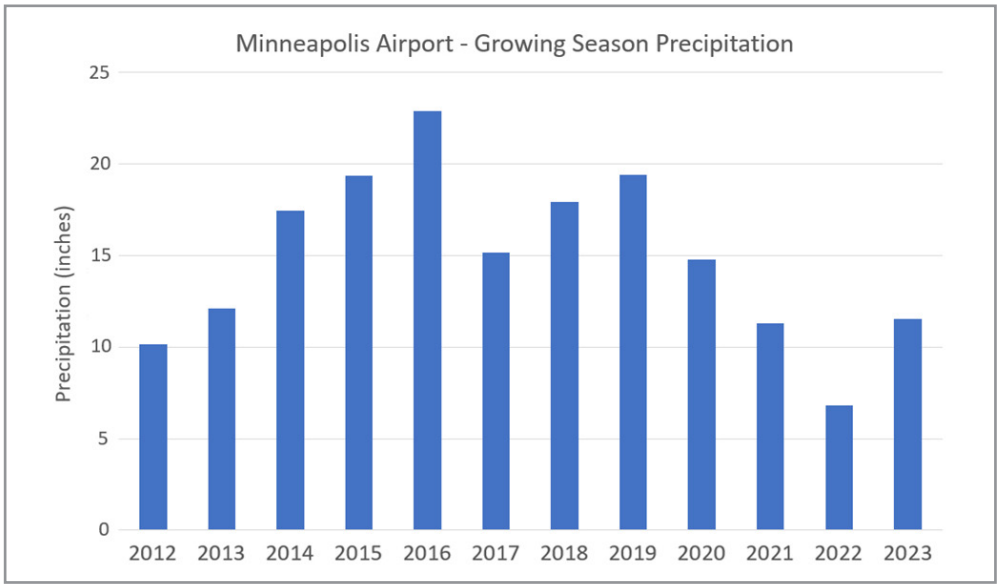


Figure 8 *Precipitation totals at the Minneapolis Airport between 2012 and 2023 during the growing season (June–September)*

Urban Watersheds Transfer Pollutants to Lakes

A lake watershed is all the land area that drains to the lake through overland flow, channels, and storm pipes. Land use practices within a lake's watershed impact the lake and its water quality by altering the amount of stormwater runoff, sediment, and nutrients that reaches the lake. Each type of land use contributes a different amount of runoff and pollutants to the lake, thereby impacting the lake's water quality differently. Land use within the highly developed Birch Island Lake watershed is primarily single family residential. The watershed also includes open water, open space, golf course and public streets/ right-of-way, and to a lesser extent multi-family residential, major highway, railroad, trails, undeveloped/ rural, and institutional (school) land uses.

Birch Island Lake generally has two tributary watershed types where runoff is either (1) tributary via the bypass pipe system where discharge to the lake is dependent on pipe clogging conditions (green watershed in Figure 9) or (2) tributary via non-bypass pipe system routes (e.g., through surface drainage, channels, or other storm sewer networks) (pink watershed in Figure 9).

In recent years, the City of Eden Prairie has increased the inspection and maintenance frequency of the bypass pipe system. The city typically cleans a critical manhole sump 3–4 times a year to remove sediment and reduce pipe clogging. In fall 2022, the city also jetted a portion of the bypass storm sewer pipes to remove sediment and restore flow capacity.

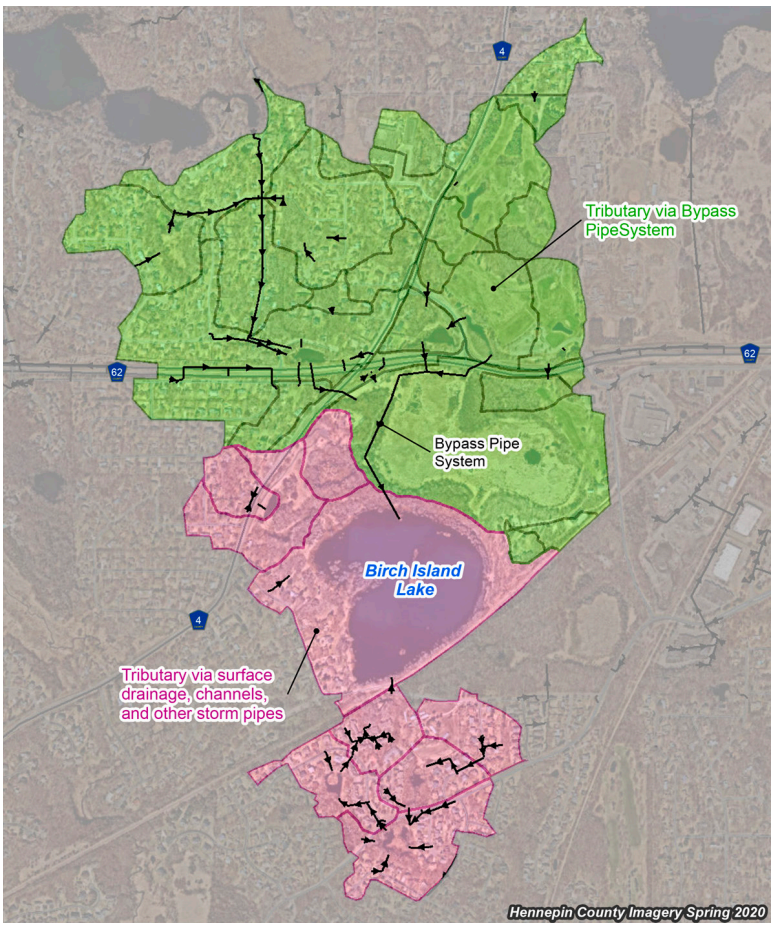


Figure 9 *Map showing the Birch Island Lake watershed*

Sources of Nutrients

Nutrients (phosphorus and nitrogen) are a food source for algae. An overabundance of these nutrients in a lake can result in nuisance algal blooms and threaten the health of the aquatic plant community. In Minnesota, phosphorus is most commonly the "limiting nutrient," although nitrogen can also be limiting for portions of the growing season. The "limiting nutrient" means the available quantity of this nutrient tends to control the amount of algae and aquatic plants produced. The three primary sources of phosphorus are summarized on page 8. The amount of nutrients coming into the lake from each source can vary from year to year as demonstrated by the pie charts for 2019 and 2020. Water quality modeling showed that phosphorus coming from the watershed can vary annually primarily due to the amount of precipitation that falls and how much runoff reaches the lake through the bypass pipe system. Simiarly, phosphorus from lake bottom sediment can vary annually due to changes in the area of sediment covered by water and variation in lake physical and chemical conditions such as the amount of lake mixing, higher temperatures and/or lower oxygen levels.

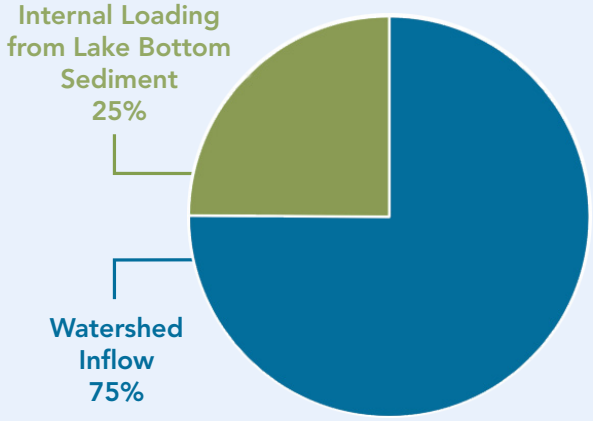
Where are the nutrients in Birch Island Lake coming from?

- **Phosphorus and nitrogen in stormwater runoff from the direct watershed—**Stormwater runoff conveys phosphorus and nitrogen from streets, lawns, driveways and parking lots within the tributary watersheds to Birch Island Lake via a series of drainage channels and storm pipes. This study confirmed that stormwater runoff is a contributor of phosphorus and nitrogen to Birch Island Lake.

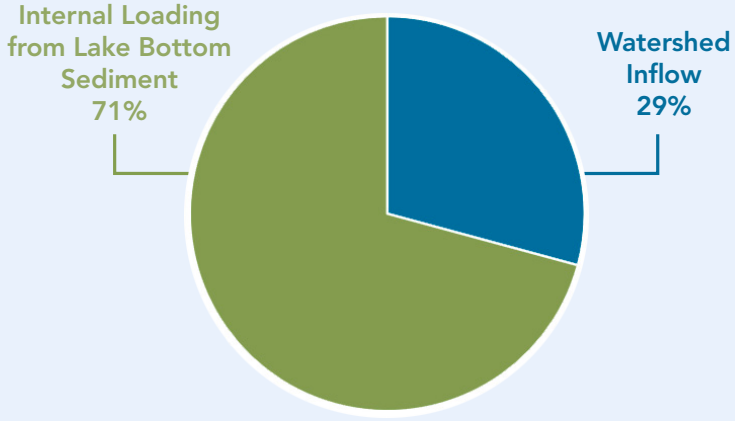
- **Nutrient-rich sediment—**Phosphorus builds up over time in lake bottom sediments as a result of sedimentation and die-off of vegetation and algae. When certain environmental conditions are met, such as low oxygen and/or higher temperatures, phosphorus can release back into the water column from the sediment. This study confirmed that phosphorus release from lake bottom sediments, typically termed "internal loading," is a contributor of phosphorus to Birch Island Lake.

- **Inflow from upstream lakes—**During precipitation and snowmelt events, water levels rise as stormwater runoff discharges from tributary watersheds. When lake levels are high enough, water, along with in-lake nutrients and pollutants, will discharge from upstream lakes and flow towards water bodies further downstream. Three lakes in the City of Minnetonka are upstream of Birch Island Lake (Holiday, Wing, and Rose Lakes). Lake Holiday discharges via pumping to Wing Lake, which then discharges by gravity to Lake Rose. When water levels are high enough, water discharges from Lake Rose via gravity to a stormwater pond located north of County Road 62. If conditions allow, the stormwater pond north of County Road 62 will discharge to the bypass pipe system and ultimately reach Birch Island Lake. Water from Lake Rose has minimally impacted Birch Island Lake in the last two decades because either (1) water levels in Lake Rose have been too low to discharge from the outlet or (2) the bypass pipe has been clogged resulting in flow from Lake Rose entering the wetland north of Birch Island Lake.

Birch Island Lake 2019
Total Phosphorus Sources



Birch Island Lake 2020
Total Phosphorus Sources



Birch Island Lake, August 2015

Lake Management Alternatives

Water quality monitoring in Birch Island Lake indicates degrading characteristics and shows that the lake currently does not meet water quality standards and ecological health goals. Given this, future management efforts should focus on improving lake water quality and ecosystem health, monitoring for changes, and continuing water quality and ecosystem health protection measures as improvements are achieved. The recommended management and protection strategies for Birch Island Lake are summarized on the next page.

Planning-level opinions of probable cost were developed for several new management alternatives evaluated as part of this study. These opinions of cost are intended to provide assistance in evaluating and comparing alternatives and should not be considered as absolute values. All estimated costs are presented in 2023 dollars and include costs for engineering and project administration.

- Lake Bottom Sediment Alum Treatment: $96,000
- Soil Sampling Program for Resident Fertilization Assessment: $22,000

Management/Protection Action		Basis	Estimated Timeline
Address Internal Bottom Sediment Phosphorus Loading	Alum Treatment	Reduce sediment phosphorus load	2025–2029*
	Sediment Release and Water Quality Monitoring	Assess management effectiveness and determine if additional sediment treatment(s) needed	2026–2034+
Address External Watershed Loading	Fertilizer Management Program	Reduce nitrogen sources from excess fertilizer use	2024/2025 (Planning begins)
	Address Channel and Slope Erosion (in Coordination with Hennepin County)	Reduce sediment loading from upland erosion	2024/2025 (Planning begins)
	Enhanced Street Sweeping Program	Reduce pollutant loading from stormwater	Reconsider in the future
	Chloride Monitoring	Continue to identify/track chloride levels from winter salt use	As part of continued lake monitoring program
	Promote NMCWD Cost-Share Grants to Watershed Residents	In a fully developed watershed, opportunities for largescale BMPs are limited	2024+
Manage Aquatic Plants (Macrophytes)	Invasive Species Management	Continue to monitor invasive species growth and manage as needed	2024+
	Promote Native Aquatic Plant Growth	Encourage native plant re-establishment to promote clear water conditions and competition with algae	2024+
Address Lake Level Stabilization	Conduct Lake Level Stabilization and Flood Management Evaluation	Increase runoff volume to lake and/or reduce extreme fluctuations in water levels	2024–2025
	Continue Frequent Inspection and Maintenance of the Bypass Pipes and Structure	Maintain flow capacity to Birch Island Lake and improve water level stability as part of Eden Prairie maintenance program	2024+
Assess Fisheries	Fisheries Management	Promote food web balance by reducing fish predation on zooplankton	2024/2025 (Planning begins)

* Estimated timeline is dependent on several factors, including lake water levels for safe access and results of the feasibility study.

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