REPORT SUMMARY

Lake Smetana Water Quality Study

Use Attainability Analysis Update for Lake Smetana (2019)

9 MILE CREEK WATERSHED DISTRICT

Prepared for
Nine Mile Creek Watershed District

February 2020

MANAGING LAKE SMETANA WATER QUALITY

WORKING TO MEET DISTRICT GOALS

Lake Smetana is a shallow, 56-acre lake within the "Golden Triangle" area of Eden Prairie, an industrial park surrounded by Interstate 494 and U.S. Highways 212 and 169. The lake is situated along the South Fork of Nine Mile Creek, approximately 1.3 stream miles downstream of Bryant Lake within the Nine Mile Creek watershed. With an average depth of 3 feet and maximum depth of 10 feet, the lake's shallow nature and urbanized watershed pose water quality challenges. Although improved in recent years, water quality in Lake Smetana has historically been moderate to poor. The Nine Mile Creek Watershed District (NMCWD), a local unit of government that works to solve and prevent water-related problems, conducted a study of Lake Smetana in 2019 to evaluate current water quality and identify protection and improvement strategies. Additional information on the current lake conditions, water quality challenges, and recommended management strategies 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 aquatic habitat. Utilizing monitoring data collected by NMCWD in recent years (2016 and 2018), 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.

LAKE MANAGEMENT GOALS

When assessing the ecological health of a lake, it is important to take a holistic approach, considering factors such as chemical water quality (e.g., phosphorus 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 (e.g., state water quality standards), however, other ecological lake health factors are assessed relative to narrative criteria (e.g., criteria that describe the desired condition) without strict numerical goals. For this study, the primary goals are to achieve the water quality standards for shallow lakes, maintain a diverse, native macrophyte (aquatic plant) population, and maintain a healthy, balanced fishery.

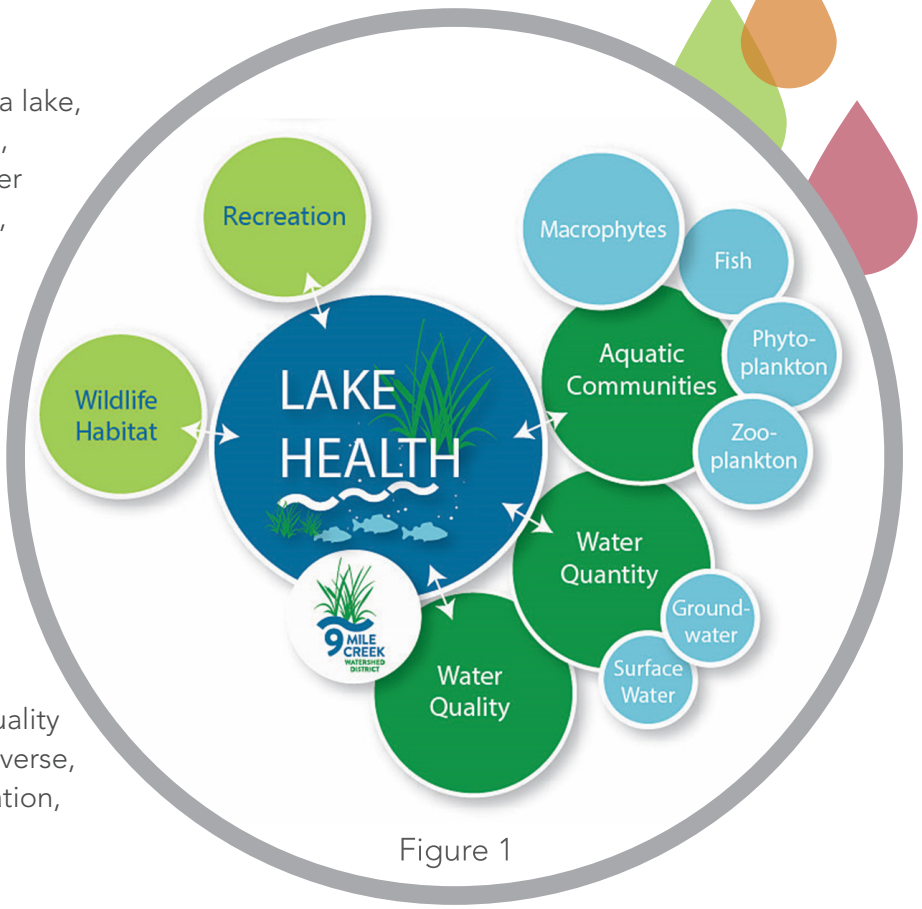


Figure 1

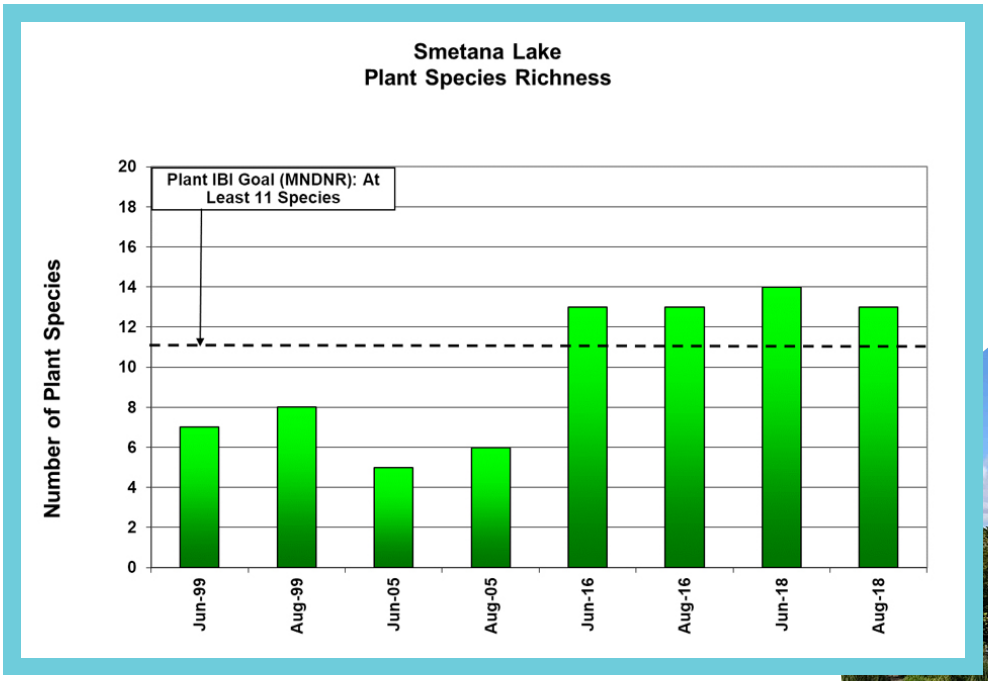
AN IN-DEPTH LOOK

HEALTHY SHALLOW LAKES

Lake Smetana can be classified as a shallow lake ecosystem. Shallow 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). These lakes also tend to be more nutrient-rich than other deeper lakes, especially in an urban setting where they receive nutrients (e.g., phosphorus and nitrogen) from stormwater. A healthy shallow lake will have abundant aquatic plant growth due to the shallowness and nutrients. However, excess nutrients can lead to algal growth that creates turbid water and limits or prevents aquatic plant growth.

Aquatic plants are good for shallow lake ecosystems. Healthy shallow lakes have plants growing throughout the entire lake, with a variety of species such as coontail, native pondweed, and water lily. The plants take phosphorus and nitrogen from the lake water, reducing the amount of nutrients available for algae. Aquatic plants also provide excellent habitat for insects, zooplankton, fish, waterfowl and other wildlife.

One measure of a lake's health is the community of plants, fish and aquatic life it sustains. Certain species can't survive without clean water and a healthy habitat while other species are tolerant of degraded conditions. These species are considered "indicators" of the health of a lake. For aquatic plants, the Minnesota Department of Natural Resources 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. As shown below, the number of plant species in Lake Smetana in recent years exceeds the DNR's goal of at least 11 species for a healthy lake.



Smetana Lake has surpassed the MN DNR goal for number of plant species in the lake since 2016.

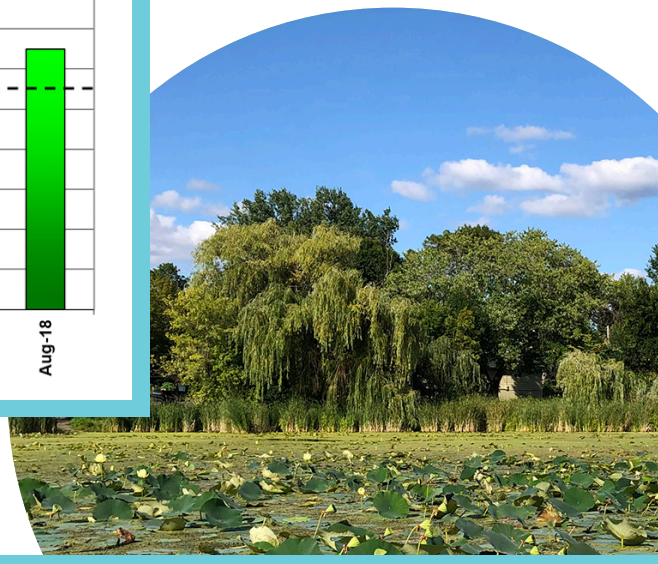
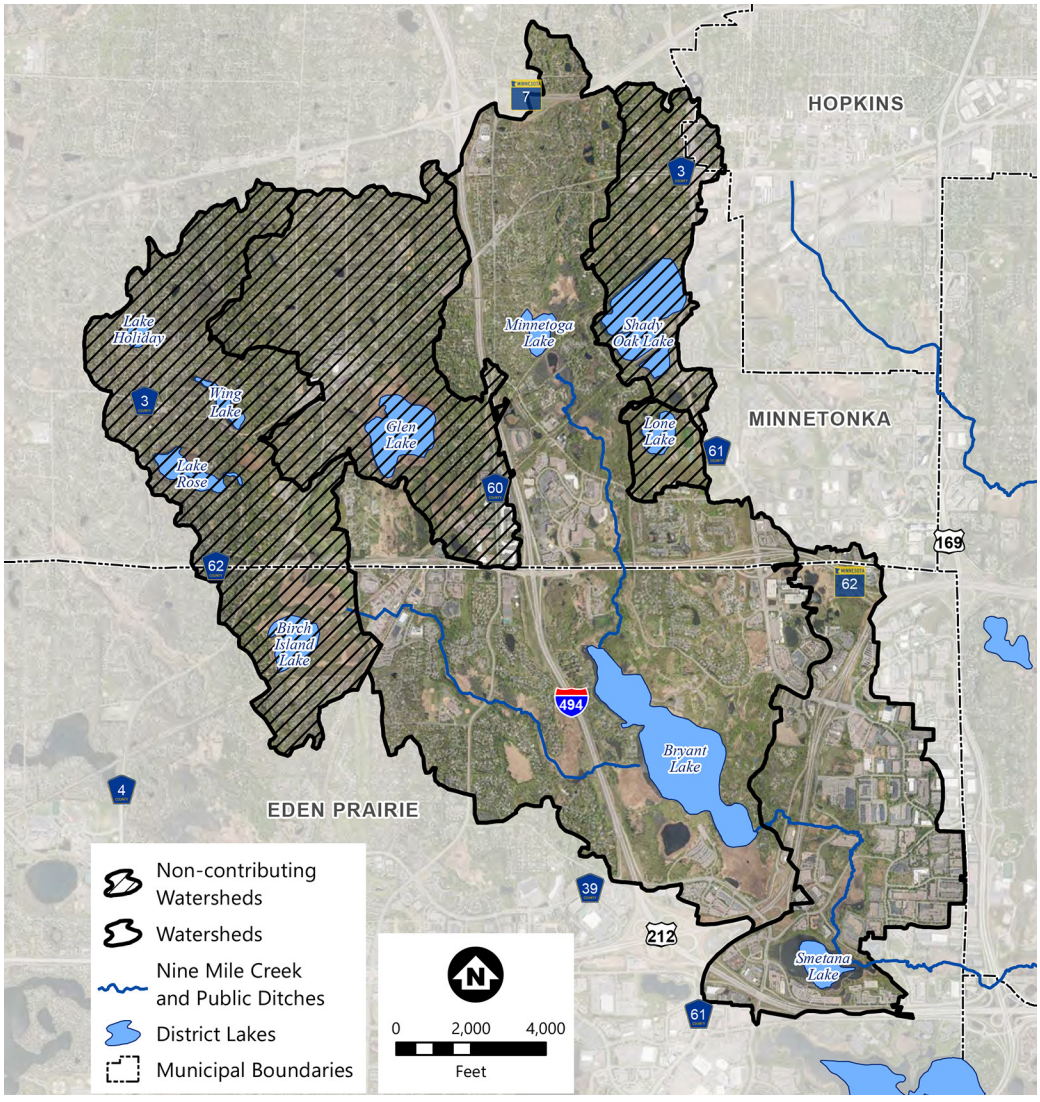


Photo source: Matthew Berg, Endangered Resource Services, LLC

LAKE SMETANA WATERSHED

Located along the South Fork of Nine Mile Creek, Lake Smetana receives inflows from a large contributing area. The watershed extends north of State Highway 7 in Minnetonka and includes both Minnetoga Lake (Minnetonka) and Bryant Lake in Eden Prairie (see figure below). The watershed tributary to Lake Smetana also includes approximately 1,000 acres downstream of Bryant Lake (see figure below). Runoff from the watershed enters Lake Smetana through overland flow, discharge from the South Fork of Nine Mile Creek, and from several storm sewer outfalls at various points along the lakeshore.

Land use practices within a lake's watershed impact the lake and its water quality by altering the amount of stormwater runoff, sediment load, and nutrient load (namely phosphorus) that reaches the lake from the lake's watershed. Each land use contributes a different amount of runoff and phosphorus to the lake, thereby impacting the lake's water quality differently. Land use within the highly developed Lake Smetana watershed is primarily industrial, highway, office/commercial, and public open space, with smaller areas of residential (low-density and high-density) and church/cemetery.

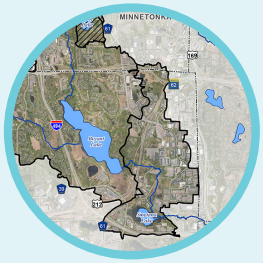


Watershed map showing the drainage area to Bryant Lake and the direct watershed to Lake Smetana. Hatched areas are watersheds that are generally land-locked or discharge infrequently.

SOURCES OF PHOSPHORUS TO LAKE SMETANA

An overabundance of nutrients (phosphorus and nitrogen) 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," meaning the available quantity of this nutrient tends to control the amount of algae and aquatic plants produced. As part of the 2019 water quality study, watershed and in-lake computer models were used to estimate the amount and sources of phosphorus to Lake Smetana during the evaluated years (2016 and 2018). The results of the analysis are summarized below.

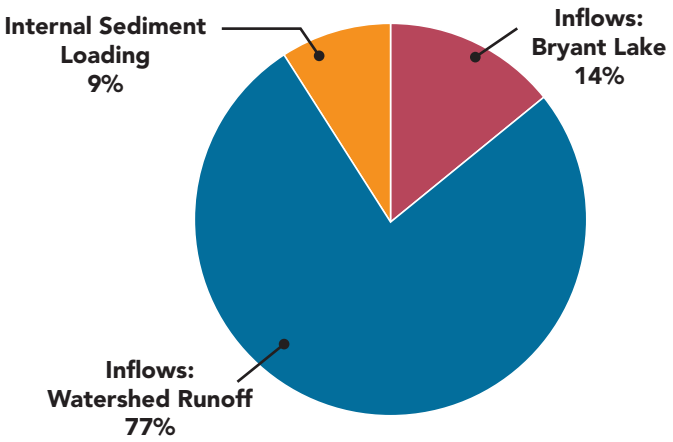
Phosphorus in stormwater runoff from the direct watershed — Stormwater runoff conveys phosphorus from streets, lawns, and parking lots within the direct watershed to Lake Smetana via a series of storm drain pipes or the South Fork of Nine Mile Creek. Computer models indicate that stormwater runoff is the major contributor of phosphorus to Lake Smetana, contributing 77% and 63% of the annual phosphorus load to the lake in 2016 and 2018, respectively.



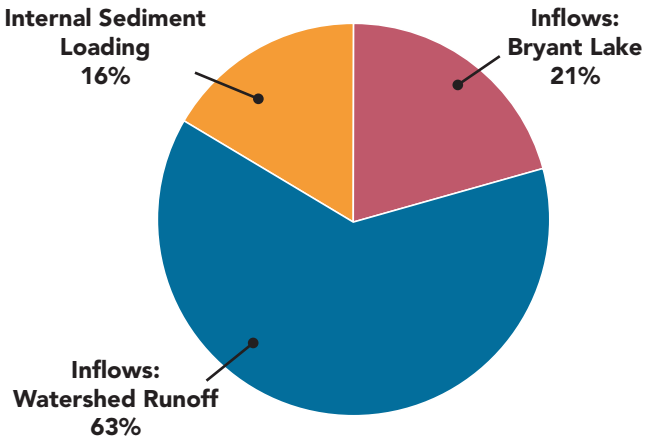
Phosphorus from Bryant Lake discharge — Lake Smetana is located along the South Fork of Nine Mile Creek, approximately 1.3 stream miles downstream of Bryant Lake. Modeling results indicate that flows from Bryant Lake accounted for approximately 14% and 21% of the annual phosphorus load to Lake Smetana in 2016 and 2018, respectively.

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 oxygen levels are low at the lake bottom (typically periodically throughout the summer), some of the phosphorus is released from the sediment into the water column, contributing to poor water quality conditions. Modeling results indicate that phosphorus release from lake bottom sediments accounts for 9% and 16% of the annual phosphorus load to Lake Smetana in 2016 and 2018, respectively. While this represents a notable portion of the loading, other internal process in the lake are helping to balance the effects of loading from the sediments, including frequent and rapid flushing from high inflows and significant uptake of phosphorus from aquatic plant growth.

2016 TOTAL PHOSPHORUS SOURCES



2018 TOTAL PHOSPHORUS SOURCES

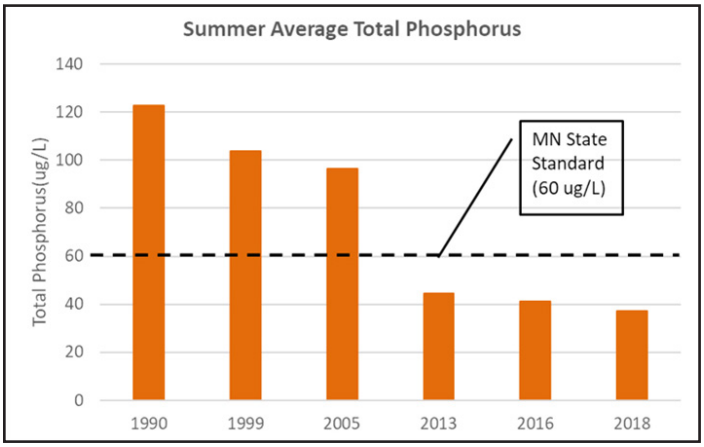


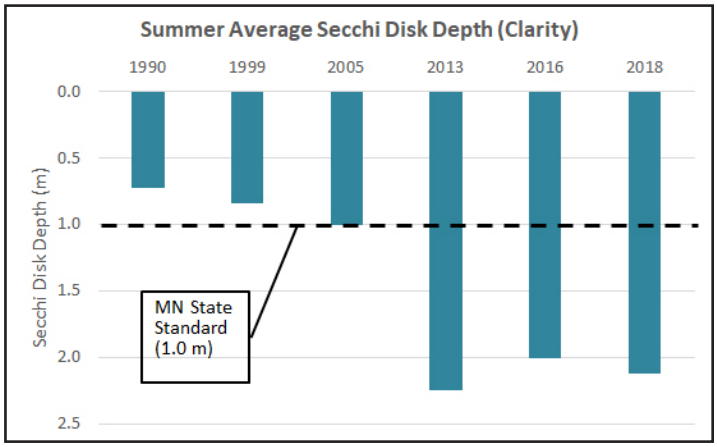
IMPROVED WATER QUALITY IN LAKE SMETANA

Water quality in Lake Smetana has seen a noticeable improvement in the past decade. Prior to 2009, water quality in the lake was moderate to poor, consistently failing to meet state standards for nutrients in shallow lakes, as measured by water clarity, total phosphorus and chlorophyll *a* (an indicator of algae). What caused the improvement in Lake Smetana water quality? While the marked improvement can be attributed to several management programs and activities implemented by the Nine Mile Creek Watershed District in recent decades, the alum treatment of upstream Bryant Lake in the fall of 2008 led to the most pronounced improvements in both Bryant Lake and downstream Lake Smetana. The alum, distributed throughout the lake by a barge (see photo at right), settles to the bottom of the lake, removing phosphorus from the water column and binding (or immobilizing) the phosphorus in lake bottom sediments, minimizing its release into the water column. Other management activities and programs that have helped to improve Lake Smetana water quality include a 2008 wetland restoration project upstream of Bryant Lake (just west of Interstate 494) and implementation of the NMCWD's permitting program that requires construction of stormwater best management practices when land is developed or re-developed.

Alum treatment of upstream Bryant Lake led to improvements in Lake Smetana water quality.

The graphs below show the historic summer-average concentrations of phosphorus and chlorophyll *a* in Lake Smetana for the years monitored by NMCWD. As can be seen in the graphs, water quality after the 2008 alum treatment in upstream Bryant Lake has consistently met the state standard for shallow lakes in this area of the state (60 ug/L).





Too much salt — Observed chloride concentrations in Lake Smetana in May and June of 2018 were high, exceeding the MPCA standard of 230 mg/L (244 mg/L on May 14, 2018 and 264 mg/L on June 12, 2018). While chloride occurs naturally in lakes and streams, too much chloride can be harmful to fish and other aquatic life. The primary source of chlorides in our lakes and streams is road salt, which is commonly used in the winter to minimize the amount of ice on our roadways, parking lots, and sidewalks. With Lake Smetana receiving stormwater runoff from several highways, local roadways and an area of densely-developed commercial, industrial, and residential properties, the lake is especially vulnerable to chloride pollution. NMCWD should continue periodic monitoring of chloride concentrations in Lake Smetana and seek opportunities to work with property owners, property management companies, and private applicators within the Lake Smetana watershed to reduce winter salt usage.

MANAGEMENT STRATEGIES TO PROTECT AND IMPROVE LAKE SMETANA

Water quality in Lake Smetana has improved in the past decade and the lake currently meets water quality and ecological health goals. Given this, future management efforts should be focused on protecting lake water quality, monitoring for changes, and improving water quality and ecosystem health as partnership opportunities arise. The recommended management and protection strategies for Lake Smetana are summarized below.

Maintain Bryant Lake Water Quality

The water quality improvements observed in Lake Smetana in the past decade are in large part due to the water quality projects implemented in upstream Bryant Lake, most markedly the 2008 alum treatment to reduce the release of phosphorus from the lake bottom sediments. The reduction in internal phosphorus loading to Bryant Lake resulted in significant improvements to Bryant Lake and Lake Smetana water quality, highlighting the importance of maintaining good water quality in upstream Bryant Lake. Although the longevity of alum treatments can vary widely depending on several lake and watershed characteristics, treatments typically have an effective life of 10 – 15 years. The NMCWD and partners will continue to monitor Bryant Lake nutrient and dissolved oxygen concentrations to identify changes in internal loading and assess the need for another alum treatment to avoid degrading water quality conditions in Lake Smetana.

Reduce Pollutant Loading from Stormwater Runoff

Study results indicate that the greatest source of phosphorus to Lake Smetana is stormwater runoff from the direct watershed. The following watershed management strategies are recommended to protect and improve Lake Smetana water quality.

Seek opportunities to improve water quality during development and redevelopment — NMCWD requires stormwater management and erosion control for development and redevelopment sites as part of its regulatory program. As portions of the Golden Triangle area redevelop in upcoming years with the construction of the Southwest Light Rail (SWLRT) transit system, the NMCWD will seek opportunities to partner with land owners to construct additional stormwater best management practices or expand existing practices.

Reduce erosion through partnership opportunities — Residents and lake users have noted areas of erosion along portions of the Lake Smetana shoreline and upstream slopes. NMCWD implements a cost-share grant program available to residents, associations, nonprofits, schools, businesses, and cities for projects that protect and improve water quality. NMCWD will partner with public and private entities through its cost share grant program as opportunities arise to address erosion issues that have the the potential to degrade Lake Smetana water quality.

Continue to Monitor Lake Smetana

NMCWD will continue periodic monitoring of water quality and the health of the aquatic communities in Lake Smetana to identify changes and plan for future management needs. NMCWD will also work with MDNR and other partners to collect additional fishery information.

Prepared by Barr Engineering Co.
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