Utilities Systems Assessment

The City of Big Lake's public utilities systems exist to ensure the safe and efficient delivery of drinking water, the treatment and disposal of waste water, and the management of surface water.

The role of the public utilities element in the Comprehensive Plan is to

- Ensure that these systems can properly accommodate the forecast growth
- Promote cost-effective engineering and spending decisions
- Help protect public health and property.

Figures

Major Utility Systems Issues

Sanitary Sewer Issues

1. **Growth Locations**: Where are the most suitable locations to expand the sanitary waste system (and the city) based on cost, engineering feasibility, and environmental effects?
2. **High-Demand Users:** Should system improvements be made to accommodate the high demand of a very small number of industrial users? How will this decision affect the city's economic development strategy?

Water Supply and Distribution Issues

1. **Growth Locations**: Where are the most logical locations to expand the sanitary waste system based on cost, engineering feasibility, and environmental impacts?
2. **System Improvements**: What enhancements to the existing water treatment and supply system would be required to serve all areas of the city today and/or future areas of the city as it grows with additional residential, commercial, industrial, or institutional land uses?

Surface Water Management Issues

1. **Planning:** Should the city prepare a comprehensive surface water management plan?

Sanitary Sewer System

The city's sanitary sewer and treatment system consists of:

Gravity Collection Lines. Wastewater from residences, businesses, industrial parks and other land uses is collected by 60 miles of gravity collection pipes, including 7.5 miles of force (pumped) main. Figure 7-1 illustrates that nearly every building in the city is served.

Lift Stations. The collected waste water flows by gravity to collection points where 14 lift stations (pumps) with over 7.5 miles of force-main piping help to move the wastewater toward the wastewater treatment plant, which is located along the Mississippi River. These pumps are needed to compensate for low areas or old, shallow pipes that cannot be effectively drained by gravity. The flat landscape of the city worsens this situation. All of the wastewater eventually reaches a point at the southern end of the city, where it is pumped south to the treatment plant along the river.

Wastewater Treatment Plant. Sewage treatment is the process of removing contaminants from wastewater, primarily from household sewage but also industrial wastewater. It includes physical, chemical, and biological processes to remove contaminants and produce water that is environmentally safe to discharge to a stream.

The treatment plant was constructed in 1981 and updated in 1996 and 1999. The upgrades were completed because the 1981 facility did not have the capacity to meet demand associated with anticipated growth. Because of the economic recession, the growth that was anticipated in 1996 and 1999 has not yet fully occurred.

There is some remaining capacity in the City's existing system but additional investments will likely be needed depending on the level of growth that occurs.

Please refer to the City's Website for a description of improvements made to the City's wastewater treatment plant in the past ten years.

Some industries treat their wastewater before emptying it into the sewer system in order to reduce the pollutant load before industrial effluent mixes with household sewage and arrives at the treatment plant.

A few industries (in Big Lake and other cities) produce so much wastewater that the city has to negotiate a limit in order to protect the system, or else design the system to accommodate those high flows.

Extending the City's Sanitary Sewer System

At this time, it appears that city growth will not cause problems for either the wastewater collection or the treatment system.

The major wastewater collection lines all have sufficient unused capacity, and secondary lines have been stubbed to the perimeter of the city in all directions. These and other sizing decisions were based on a system plan sketched in 1999 by the City's engineering consultant. Therefore, it should be feasible to accommodate city growth into logical perimeter locations without excessive costs. An exception to this would be growth to the extreme eastern or western ends of the city along Highway 10.

For example, the collection system for Sweetwater Bend (in the northwestern corner of the city) was sized for a development is only partially complete. The open area north of Glenwood Avenue is a logical growth area where the sanitary sewer system is appropriately sized. Likewise, the area east of Hudson Woods is supplied with a system that was sized for district growth.

Another area that is not as favorable for growth is near the Mississippi River at Highway 25 where an annexation agreement is in place. It is anticipated that major upgrades to the sewage collection system would be required to serve that location.

On-Site Wastewater Systems

There are 40 to 50 such on-site wastewater systems left in the city. Most are north of the school campus, but there are a few other locations, also. These buildings will be required to hook-up to the City's sewer system when a sewer line is constructed in front of each property.

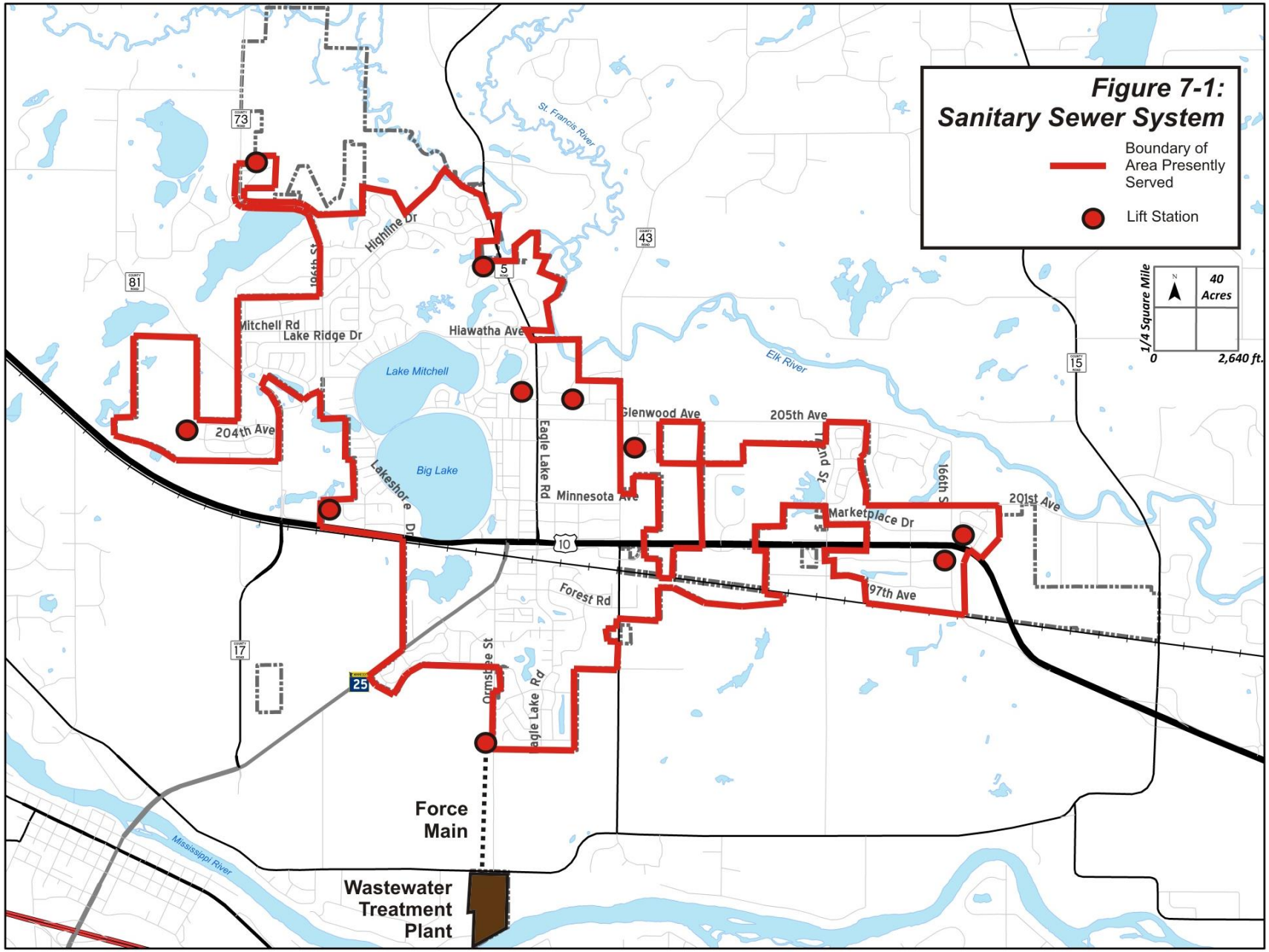
Figure 7-1:
Sanitary Sewer System
Boundary of Area Presently Served
Lift Station
1/4 Square Mile
40 Acres
0
2,640 ft.
St. Francis River
Elk River
Lake Mitchell
Big Lake
Highline Dr
Mitchell Rd
Lake Ridge Dr
Hiawatha Ave
204th Ave
Lakeshore Dr
Eagle Lake Rd
Glenwood Ave
Minnesota Ave
205th Ave
Marketplace Dr
201st Ave
97th Ave
Forest Rd
Force Main
Wastewater Treatment Plant
Mississippi River

Water Supply and Distribution

Water Source

The city gets its drinking water from seven wells that tap an aquifer that lies under parts of Sherburne, Benton, Stearns and Wright Counties.

Usage records show that the demand for water continues to grow from urban and agricultural users. Based on a 2013 study by the US Geological Survey, the study area's aquifer could support additional withdrawals but caution should be exercised. The study cautioned that lowering ground-water levels will have a domino effect on lake levels and stream flows, and in some locations within the study area, aquifer dewatering would reduce individual well yields.

In some areas the aquifer is shallow, 50 to 80 feet thick. It consists of unconsolidated sand enclosed by layers of limestone, sandstone or clay, and the water can be extracted for agricultural and urban use. Being shallow, these areas of the aquifer are susceptible to contamination from the surface.

The portion of the aquifer the city relies on for drinking water is referred to as the Hinckley - Mt. Simon Aquifer, which is a deep aquifer. The city's seven wells extend to a depth of 178 feet to 297 feet, and, at these depths, threats from surface contamination are comparatively low.

As with other cities that rely on groundwater, the City of Big Lake must document its need for additional wells and steps it is taking to conserve water use before it is granted permission to extract more water. The Department of Natural Resources is the regulatory agency that approves wells for municipalities.

Big Lake has adopted a water use conservation plan that focuses on: user fees; education; and ensuring that its water collection, storage, and distributions systems are operating at a high level of efficiency. For example, the City of Big Lake focuses some of its resources on fixing leaks in the system in order to ensure that water is conserved and not wasted.

Water Filtration and Supply Plant

The city must follow all federal and state regulations to supply safe drinking water.

For examples, the city must remove the radionuclides present in the aquifer. Radionuclides are carcinogens that are regulated by the US Environmental Protection Agency and the Minnesota Pollution Control Agency.

In addition, the City's water supply has concentrations of iron and manganese higher than allowable limits. It was, therefore, determined that an iron and manganese removal plant should be constructed and the radionuclides removed with the oxidized manganese, thereby meeting the necessary treatment standards. The plant has been thus improved. The filtration plant is located south of Glenwood Avenue and east of County Road 43.

Please refer to the City's Website for an informational video about the City's water filtration plant.

Distribution, Storage and Pressure

Potable water is pumped from the treatment plant to main distribution lines, which fill the city's three water towers. Secondary lines, usually located under streets and ranging in size from 6 to 12 inches, deliver water from the water towers to districts and neighborhoods. Supply lines (called laterals) run from the main lines to individual properties.

Neighborhoods and districts on the periphery of the city have been built with stubs for extending the system.

The filtration plant has an average design capacity of 4.8 million gallons per day and a maximum capacity of 5.7 million gallons per day. Figure 7-2 illustrates that nearly every building in the city and some undeveloped properties are served by city water.

Expansion Potential

There are no immediate limitations on the expansion of the water system to accommodate forecast growth in housing or businesses. There are sizable supply lines stubbed in all directions, and the filtration plant has ample unused capacity.

Normal caution should be exercised when serving very large industrial users.

The long-term health of the aquifer should be monitored on a regional basis. Alternative water sources include the Mississippi and Elk Rivers, so supply should not be a problem even if there are additional costs to convert from wells.

Figure 7-2 on the following page illustrates the Big Lake drinking water system and pinpoints the locations of the city's seven wells, three water towers, and water treatment plant. Figure 7-2 shows the boundary which defines areas of the community that are served by the system.

The City's water filtration plant

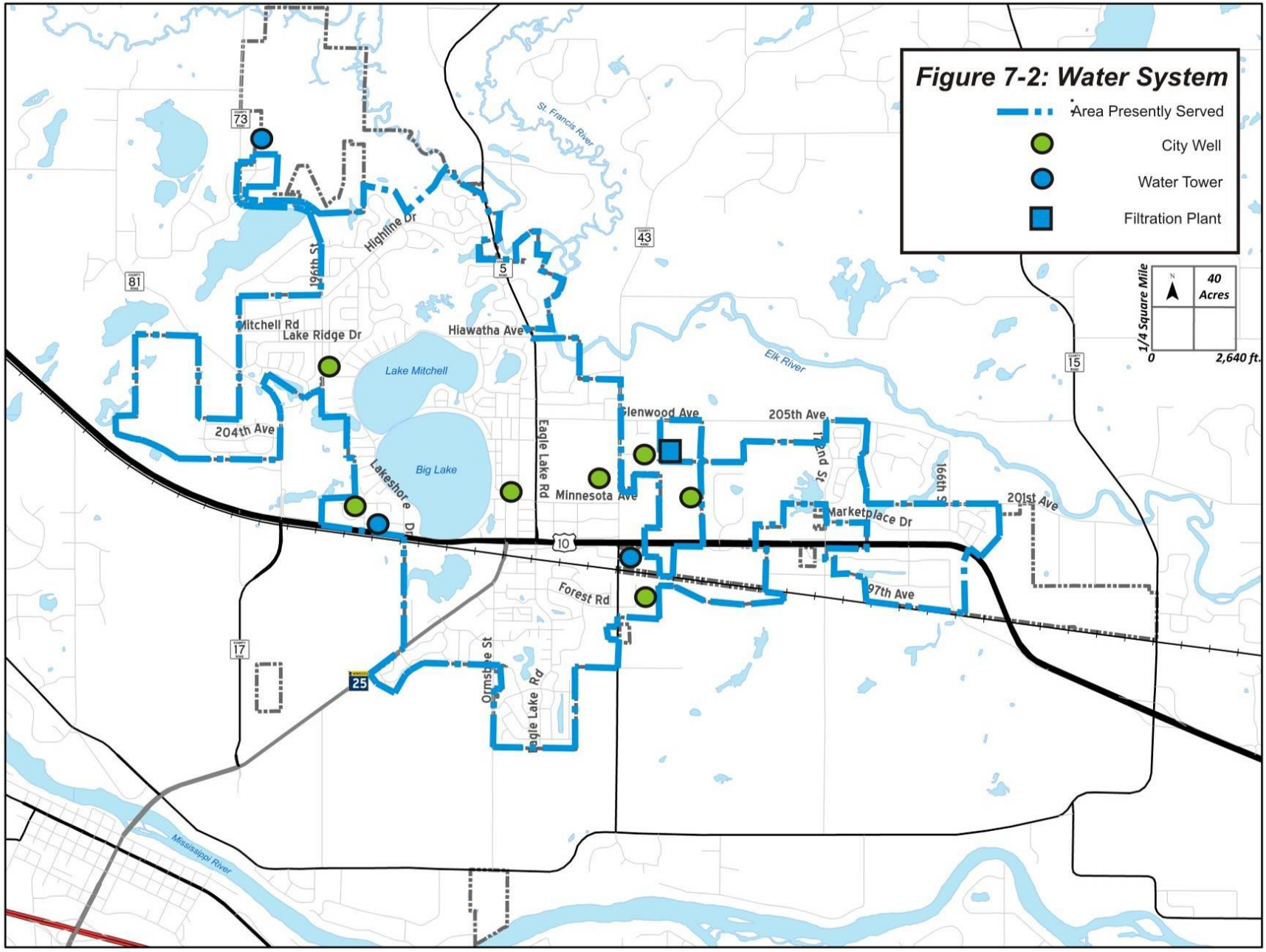
Figure 7-2: Water System
Area Presently Served
City Well
Water Tower
Filtration Plant
1/4 Square Mile
40 Acres
0
2,640 ft.
St. Francis River
Elk River
Lake Mitchell
Big Lake
Mississippi River
Highline Dr
196th St
Mitchell Rd
Lake Ridge Dr
Hiawatha Ave
204th Ave
Lakeshore Dr
Eagle Lake Rd
Glenwood Ave
205th Ave
Minnesota Ave
Marketplace Dr
201st Ave
97th Ave
Forest Rd
Ormsbee St
73
81
5
43
15
10
17
25

Surface Water Management

Big Lake is responsible for storm water management and has studied various management options. However, the city has not yet adopted a comprehensive storm water management plan. Instead, specific problems are managed case-by-case.

The Big Lake System

Surface water management in Big Lake consists primarily of a network of pipes, usually located under streets, that convey runoff to many lakes, ponds, wetlands, and the Elk River. In a few locations, more natural means such as swales or ditches are used to convey water. Man-made ponds have been introduced in recent decades to cleanse water before it gets to a natural water body. The man-made ponds cleanse water by letting it soak into the ground where it is filtered before it finds its way to larger water bodies. The sandy soils of the region readily accommodate such infiltration. Consequently, the ponds do not have water standing in them at all times.

The overall approach to surface water management in Big Lake (and across the nation) has evolved from piping water away as fast as possible to hybrid systems that combine short runs of pipe and overland conveyance, in combination with infiltrating surface water near its source.

Big Lake and Mitchell Lake serve as the primary retention ponds. Both are land-locked, meaning that they do not have natural outlets, and have small watersheds of approximately 938 combined acres, as illustrated by Figure 7-4. The primary inlets to these lakes are 20 storm sewers that capture water from the surrounding area, including Highway 10 and the surrounding city streets. These two lakes have a man-made outlet that drains from Mitchell to Beaudry Lake and ultimately to the Elk River.

To minimize costs and improve water quality, Big Lake has been using alternative measures such as infiltration, swales, narrower streets, street sweeping and “rain gardens.” Where natural controls are insufficient, problems are addressed during (re)development or street work.

As the community continues to develop, careful attention to storm water management will be needed to prevent problems before they occur and to fix those that exist. The goal of storm water management planning should be to minimize the pollution reaching the lakes and to minimize the flooding.

Water Quality in Big and Mitchell Lakes

Recent studies have found that the water quality of Big and Mitchell Lakes is good compared to other lakes in the region.

However, these are "seepage lakes," which are sensitive to changes in their small watersheds (catchment areas). They also tend to retain most of phosphorus that enters them. Therefore; it is essential to minimize the use of phosphorus in those watersheds. The City can help with this through public improvements, regulations and education.

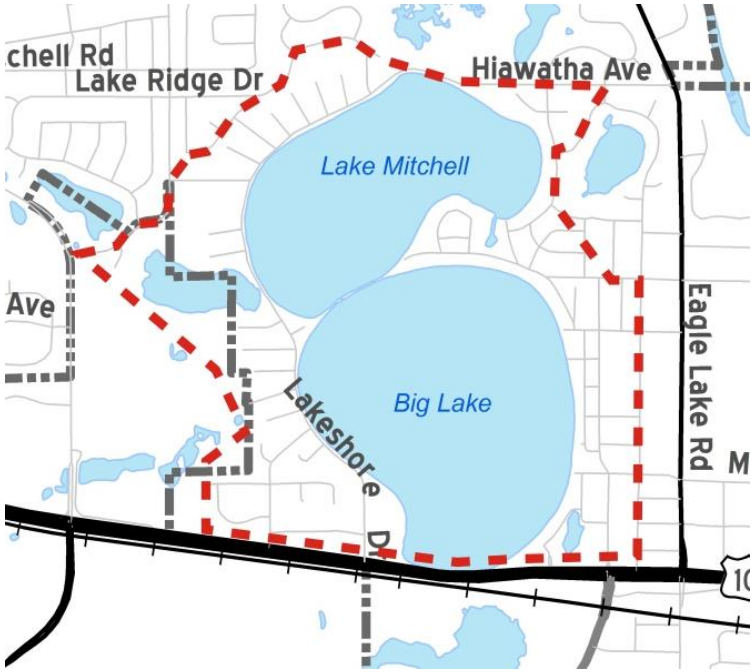

Figure 7-3: Approximate Boundary of the Watershed of Big and Mitchell Lakes

Periodic Flooding

Today, flooding is very isolated in the City of Big Lake and usually occurs in only in a handful of specific areas in the spring. These isolated areas are along roads that do not have storm sewers. There is no flooding in the cottage neighborhoods around Big Lake and Mitchell Lake, but basements may be wet if sump pumps are not used.

The city's lakes and ponds were high in 2017 because of recurrent rains, causing some encroachments and erosion, and some nearby storm sewers were partially filled with lake water. The man-made outlet built in 1986 for Big Lake and Mitchell Lake has overflowed because of heavy rainfall.

There is no overflow system to direct storm water to the Mississippi River on the southern end of the city.

The northern parts of the city drain to the Elk River at several locations.

Each of the city's newer neighborhoods has one or more storm water ponds or swales that hold water and allow it to infiltrate into the soil.

The Challenges of Surface Water Management

Surface water management consists of flood and urban runoff control and water quality management. Surface water is generated from rain and snow that flows over land or impervious surfaces, such as paved streets, parking lots and building rooftops, and does not soak into the ground. The runoff picks up pollutants such as trash, chemicals and soil that can harm streams and lakes.

To protect natural resources, controls called best management practices (BMPs) are used to filter pollutants or prevent pollution by controlling it at its source.

Urban development is a major generator of water pollution and affects the volume and rate of runoff. It can result in habitat change or loss, increased flooding, decreased biological diversity, increased sediment and erosion.

The benefits of effective storm water runoff management include:

- Protection of wetlands and aquatic ecosystems
- Improved quality of receiving water bodies
- Conservation of water resources
- Protection of public health, and
- Flood control.

Storm water management is a regional as well as a local issue. Approximately 90 percent of Sherburne County is drained by the Elk River, St. Francis River and their tributaries. These rivers enter Sherburne County from the north, flow southeastward, and empty into the Mississippi River near Elk River. Regionally, ground water moves toward the Mississippi River; locally it moves toward tributary streams and lakes.