VLAWMO

Vadnais Lake Area Water Management Organization

Gem Lake Review,
Ramsey County, MN

2024

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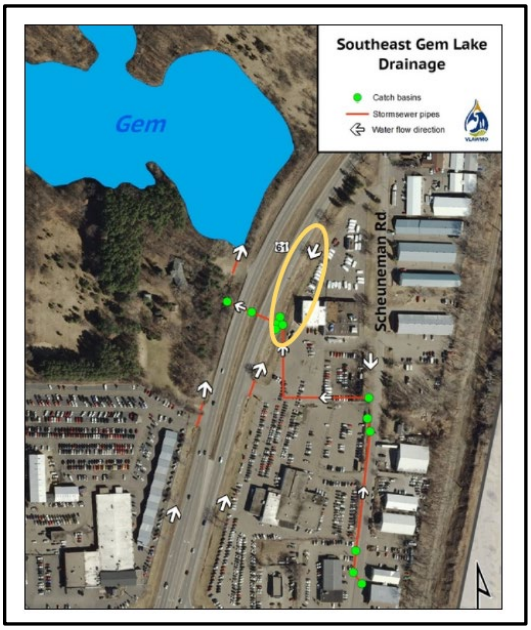
1 INTRODUCTION

1.1 INTRODUCTION

This lake review includes monitoring, surveys, planning, projects, and partnerships for Gem Lake in the city of Gem Lake. Information was originally compiled in 2015 and updated in 2023 to provide a synthesis of knowledge to date. Gem Lake was assessed in 2009 as not meeting the standards for nutrients for aquatic recreation. Gem Lake nutrient levels had the highest annual average recorded by VLAWMO in 2009. The lake was included on the MPCA's Impaired Waters List in 2010. A Total Maximum Daily Load (TMDL) report was developed including Gem Lake in 2013. In 2011, road reconstruction was completed on Hwy 61 by the Minnesota Department of Transportation (MnDOT). That work included improved grading and sediment removal, replaced and improved storm sewer infrastructure, ditch block installed to slow stormwater and increase infiltration before reaching Gem Lake, and the addition of a bioswale. In years that followed, water quality in Gem Lake improved. Total phosphorus levels decreased to nearly half the MPCA's standard of 60 µg/L for shallow lakes, and that reduction has been maintained. Chlorophyll-a levels were similarly reduced. The MPCA standard for shallow lakes is 20 µg/L. The average level of Chl-a from May 2010 to August 2017, was 15 µg/L. In August of 2017, VLAWMO requested delisting for Gem Lake. The MPCA approved the delisting. Gem Lake was removed from the Impaired Waters List in 2018.

Gem Lake has good water quality and a healthy native plant community. No invasive aquatic plant species have been detected on vegetation surveys. Gem Lake was recommended by the Minnesota Department of Natural Resources (MN DNR) in 2019 as a potential source lake within the watershed for transplanting native plants to other lakes to help reestablish native plants following water quality improvement. No transplanting has been conducted to date. Additional collaboration with MN DNR would be needed if such an effort were to proceed. In preparation for possible source lake use, an aquatic macrophyte survey was completed in 2022.

Figure 1: Stormwater swale and catch basins treating stormwater from Hwy 61. This was included in the VLAWMO press release in 2018 announcing the delisting of Gem Lake.



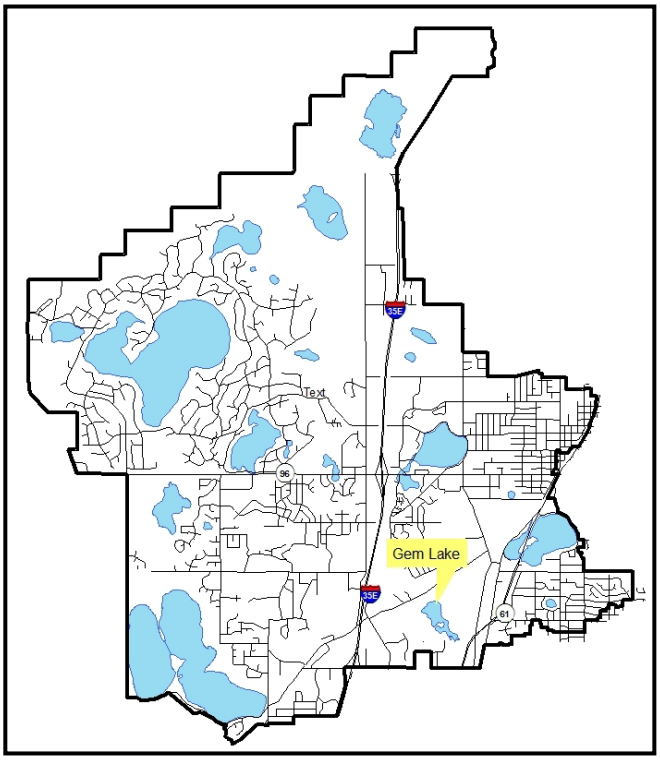
1 INTRODUCTION

Gem Lake is located in the City of Gem Lake, Ramsey County, and is within the Vadnais Lake Area Watershed. Gem Lake is a 48-acre shallow lake at maximum extent; the acreage of this lake has been reported at a variety of values depending upon the southern wetland area extent that was included (VLAWMO GIS layer). The lake has a maximum depth of 15 feet and an average depth of 7 feet (during the 2022 survey). The lake has no public access. It is surrounded by private, residential development, mostly on large, wooded lots. The City of Gem Lake has ordinances in effect which prohibit the use of motorized watercraft on the lake and regulations regarding the clearing of vegetation along the shoreline.

Gem Lake has a subwatershed size of 376 acres.

Gem Lake was listed on the State of Minnesota's 303(d) Impaired Waters List in 2010 due to high levels of nutrients (phosphorus), which inhibit aquatic recreation. It was delisted in 2018, and water quality improvements have been maintained.

Figure 2: Gem Lake, location in the watershed

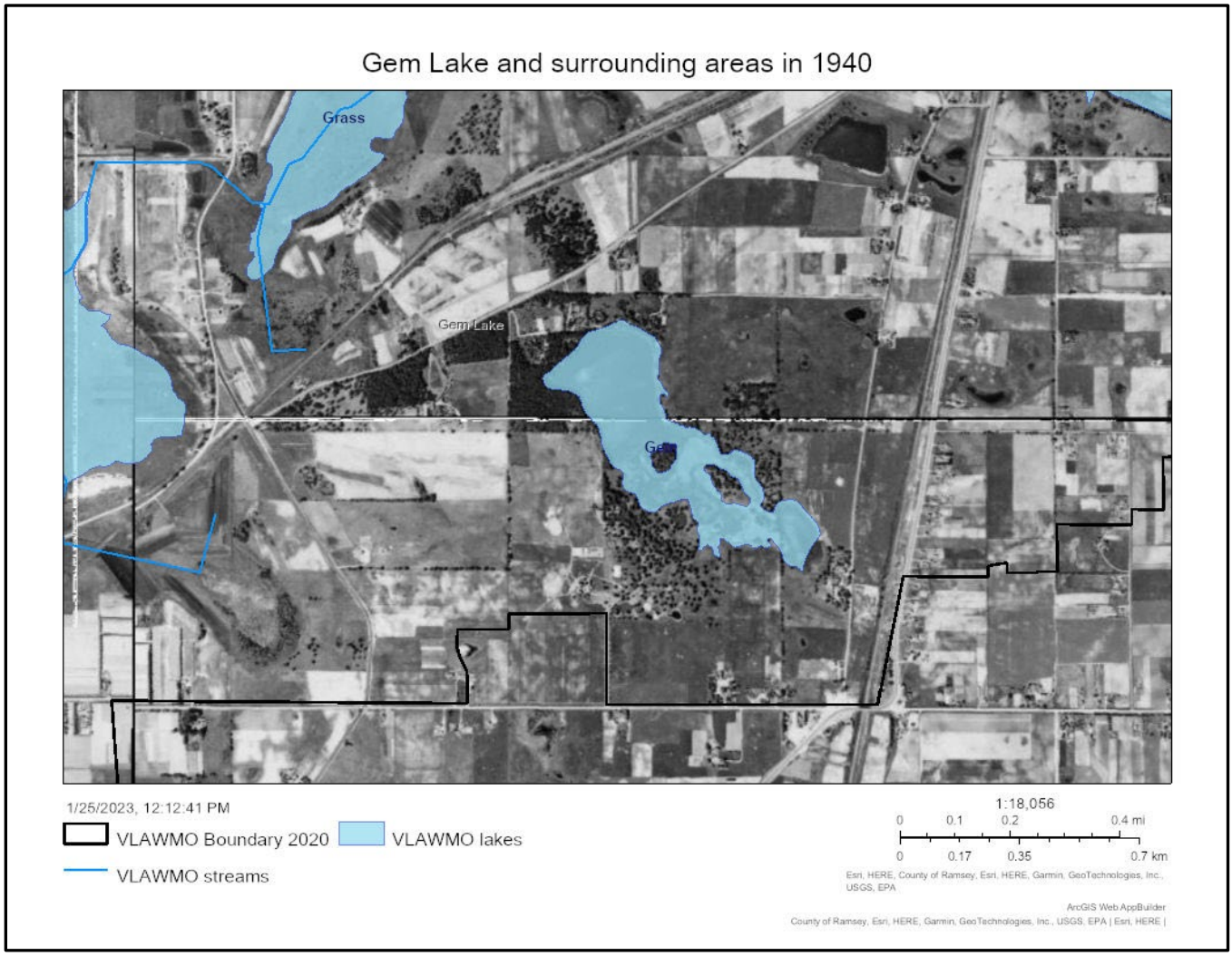


2 WATERSHED FEATURES

2.1 AERIAL PHOTO HISTORY

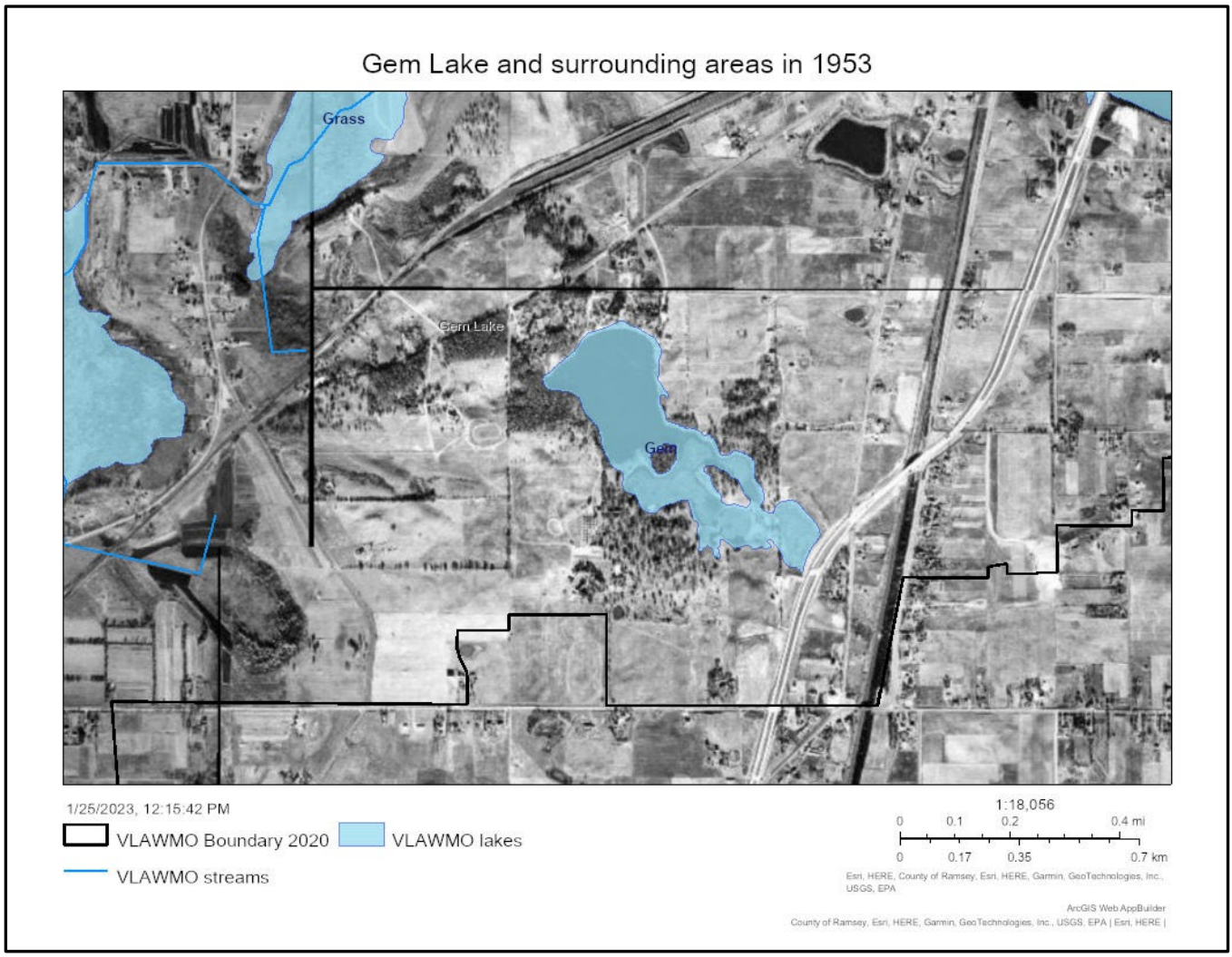
The City of Gem Lake became incorporated in 1959. Prior to that, it was considered part of the Town of White Bear. A detailed history is found in Farms & Fox Hunts, A History of the City of Gem Lake, Minnesota, 2005, written by James A. Lindner. According to this document, the land around Gem Lake was first settled in the mid to late 1800s by affluent families looking for a more secluded place to relax. as opposed to building homes on White Bear Lake, which was more of a tourist attraction. The document states that people settled there not necessarily for the lake but to have land for horses and to conduct fox hunts.

Figure 3: 1940 aerial photo of Gem Lake



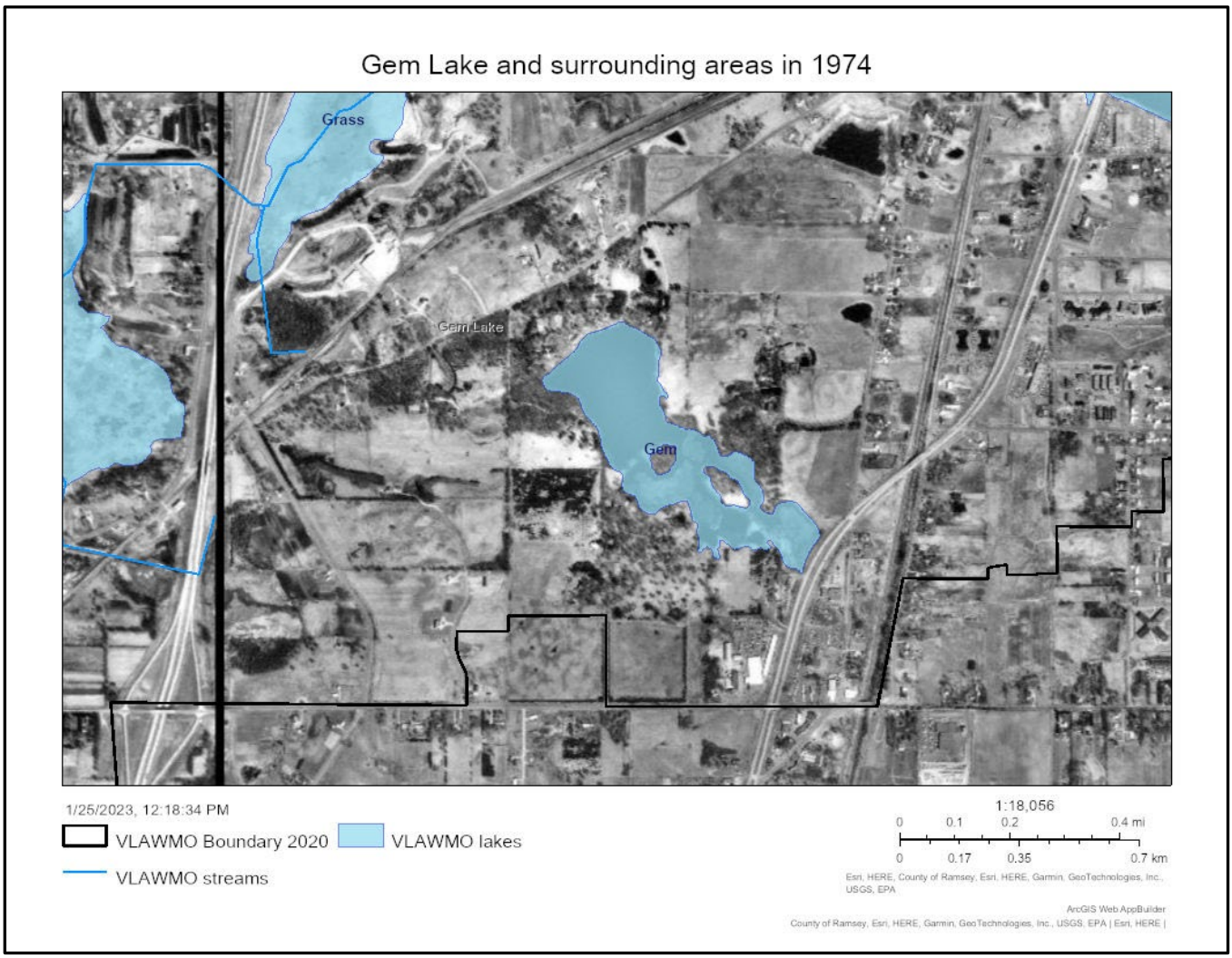
The aerial photo from 1940 shows a few homes near the lake and some agriculture. What is now Hoffman Road is on the eastern side of the photo, with homes built off the east side of the road. The railroad that runs parallel to Hoffman Road is also visible.

Figure 4: 1953 aerial photo of Gem Lake



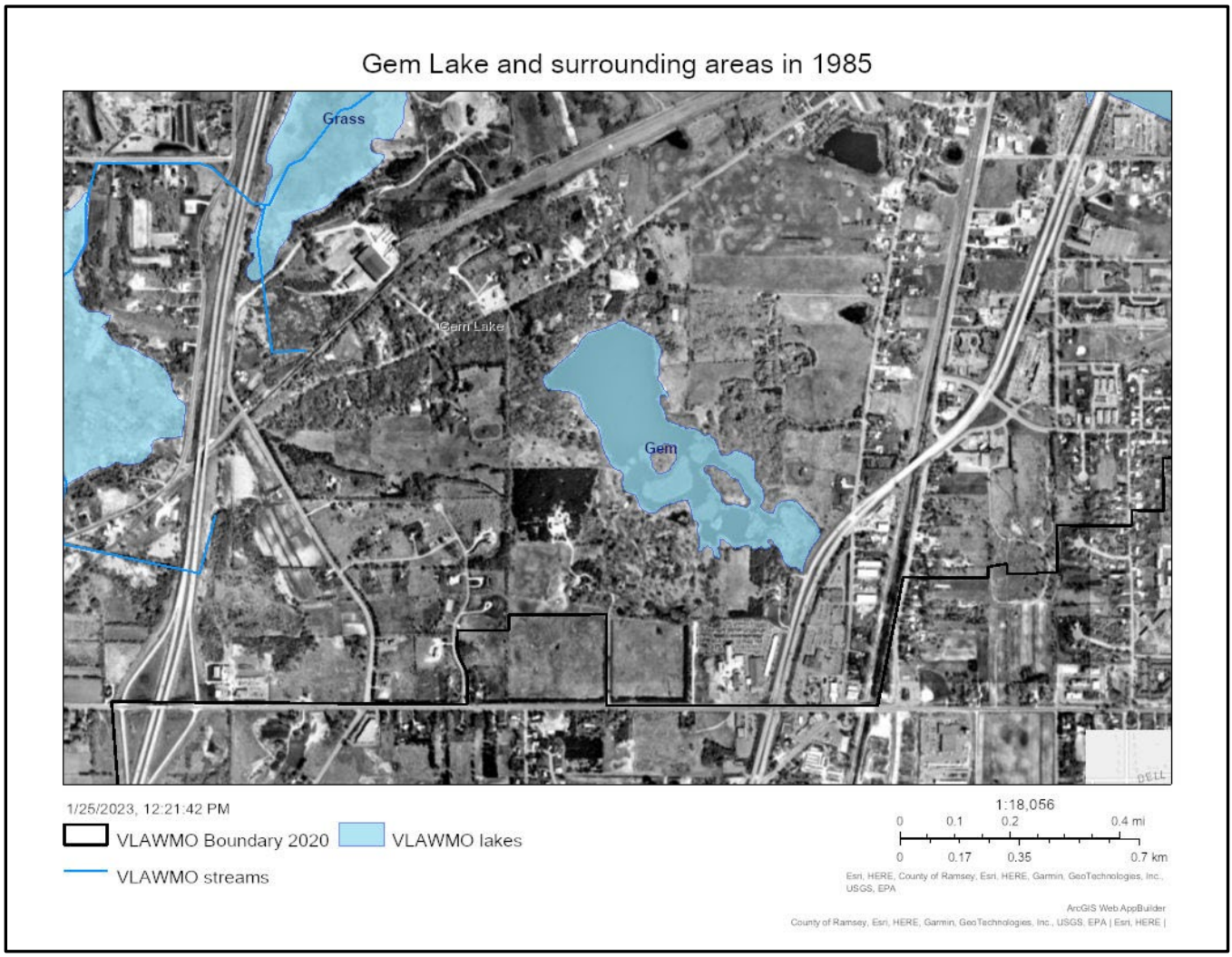
In 1953, a few more homes were present. Highway 61 had been built, and some development was occurring on the eastern side of the intersection of what is now County Road E and Highway 61.

Figure 5: 1974 aerial photo of Gem Lake



By 1974, commercial development was completed at the intersection of Highway 61 and County Road E, along with more residential development along Scheuneman Road. What is now Interstate 35E had been built.

Figure 6: 1985 aerial photo of Gem Lake

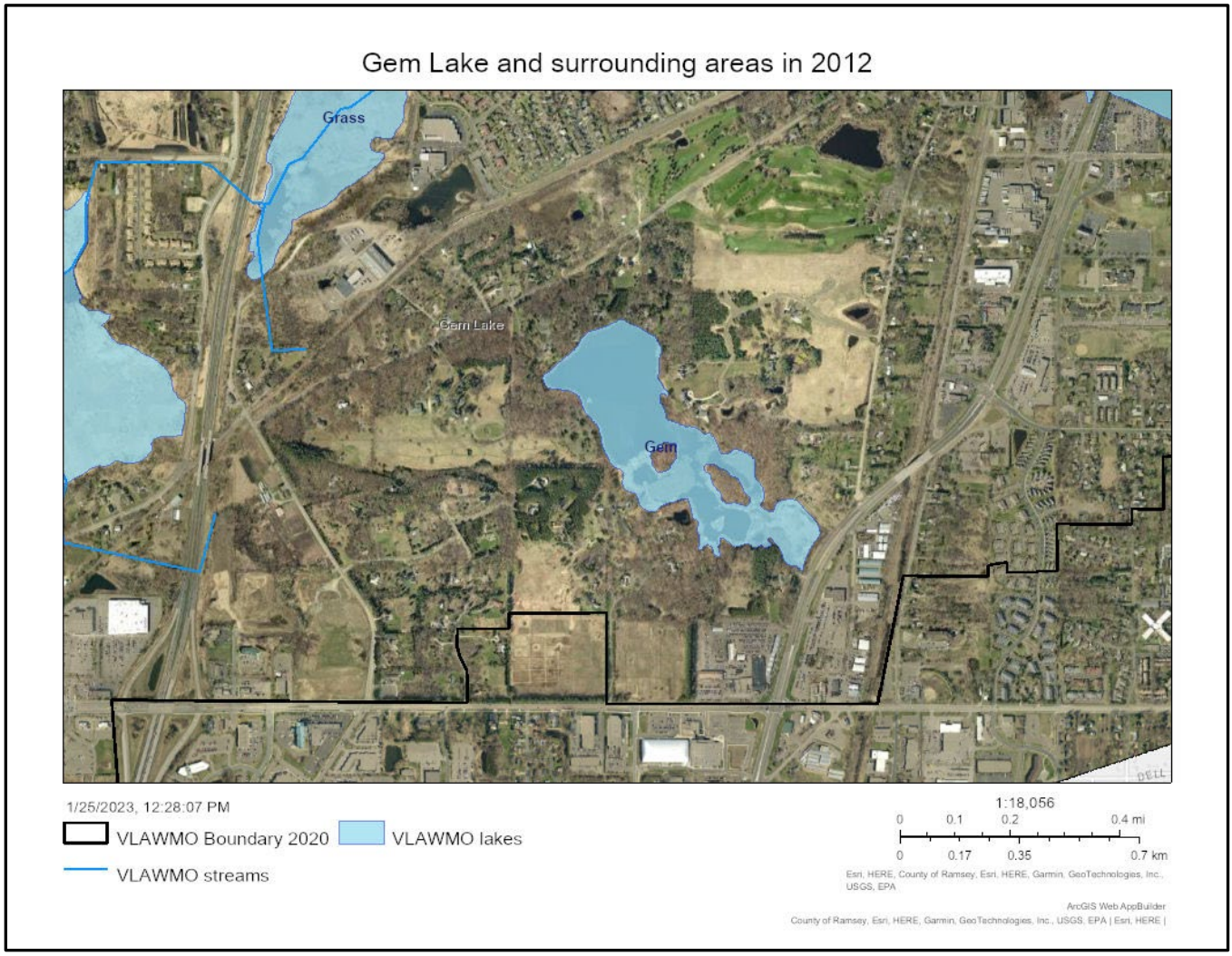


By 1985, more development was built, especially between Scheuneman Road and the railroad tracks. Residential developments around Daniels Farm Road and Big Fox Road are visible.

Figure 7: 2006 aerial photo of Gem Lake

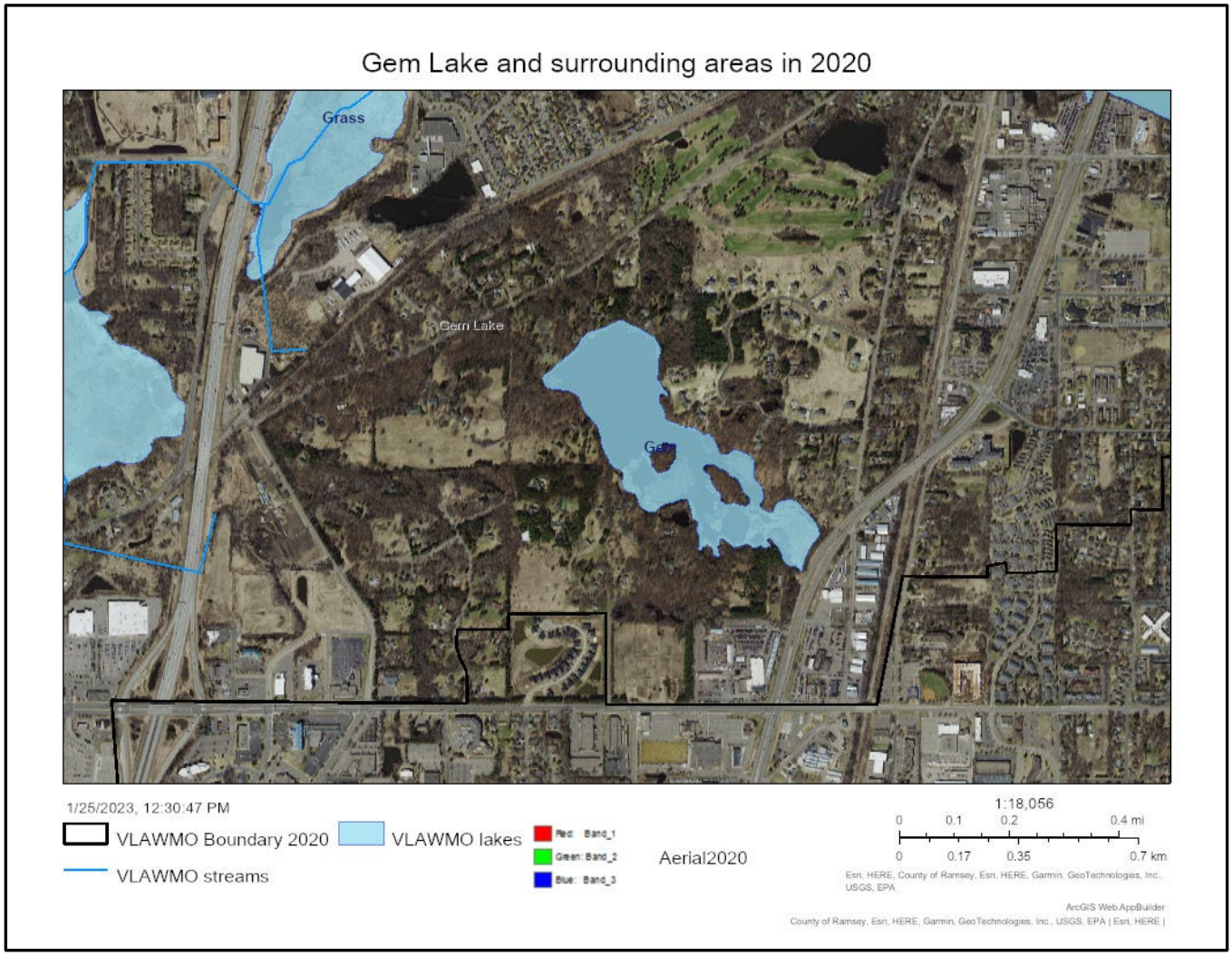
In 2006, the Hillary Farm residential area construction had begun, and the Gem Lake Golf Club had been built.

Figure 8: 2012 aerial photo of Gem Lake



By 2012, more homes were built in the Hillary Farm area. More homes were also planned for the Hillary Farm development.

Figure 9: 2020 aerial photo of Gem Lake

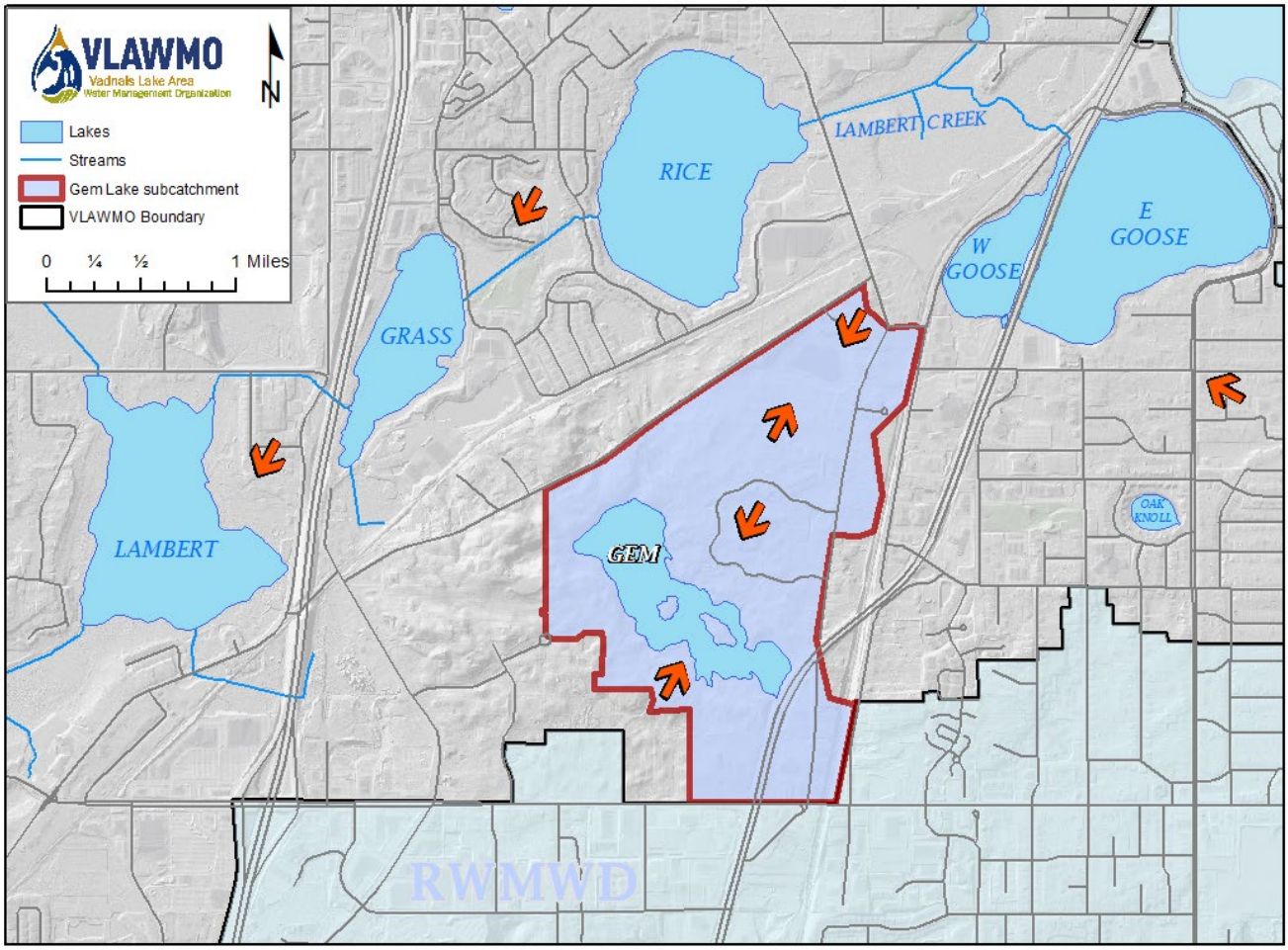


In 2020, current land uses and development extent are shown.

2.2 GEM LAKE DRAINAGE AREA

Gem Lake receives water from various sources. The subwatershed is shown in the purple area outlined in red on the map below and is 376 acres. The subwatershed area is about 15 times larger than the surface area of the lake. This is relatively small for a subwatershed. A positive aspect of a small subwatershed area is that there is not a lot of land contributing to stormwater runoff into the lake. The land use within the subwatershed is primarily residential. A large source of possible stormwater runoff comes from Highway 61. Gem Lake is slightly unusual in that water doesn't flow out of the subwatershed area.

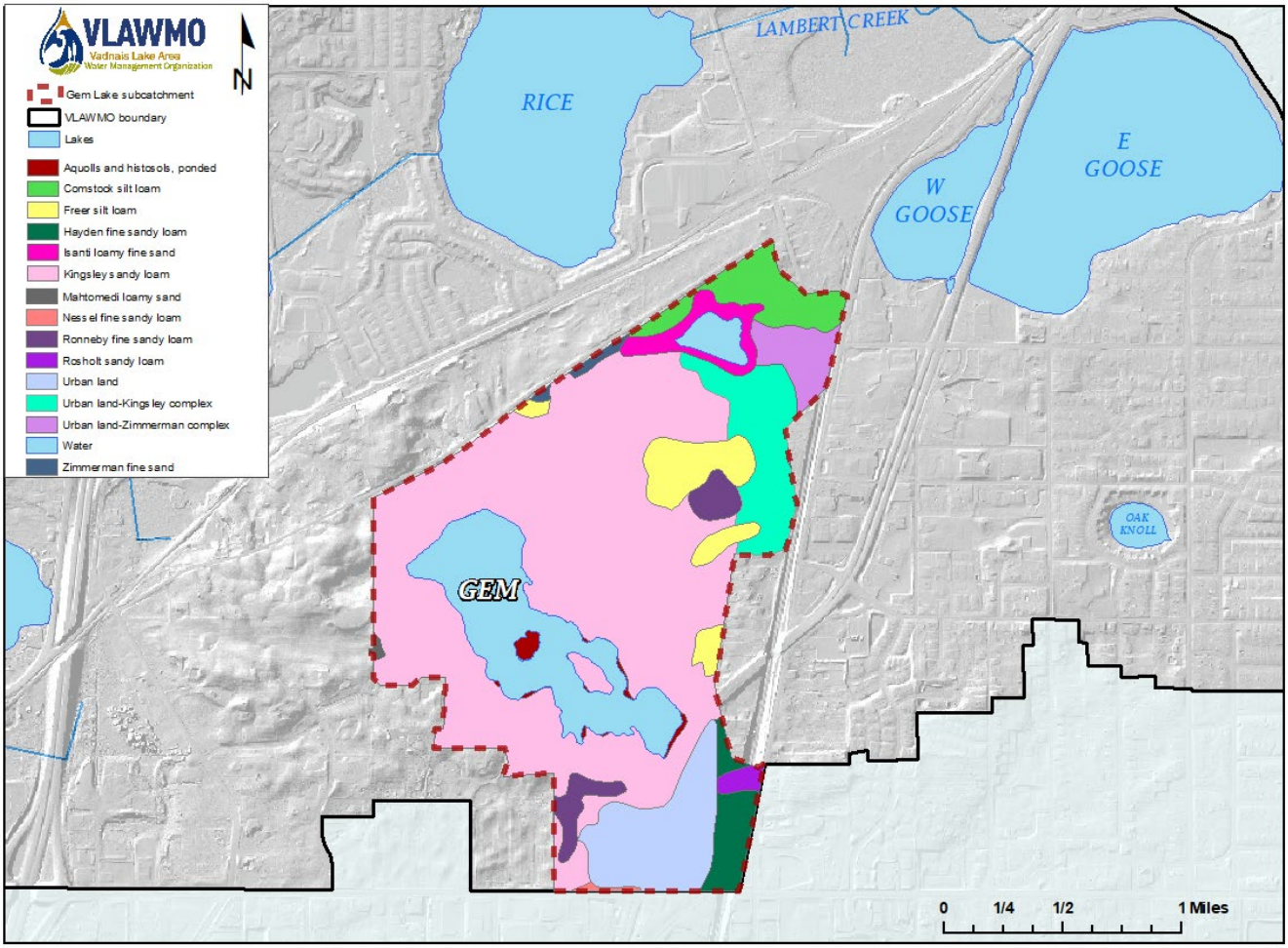
Figure 10: Gem Lake Subwatershed



2.3 GEM LAKE SOILS

The soils under and near Gem Lake are ponded aquolls and histosols, which are hydric soils that experience frequent ponding. The soils near the lake are mainly Kingsley sandy loam and urban land soils. Kingsley sandy loam tend to drain easily and are well suited for agriculture and home sites.

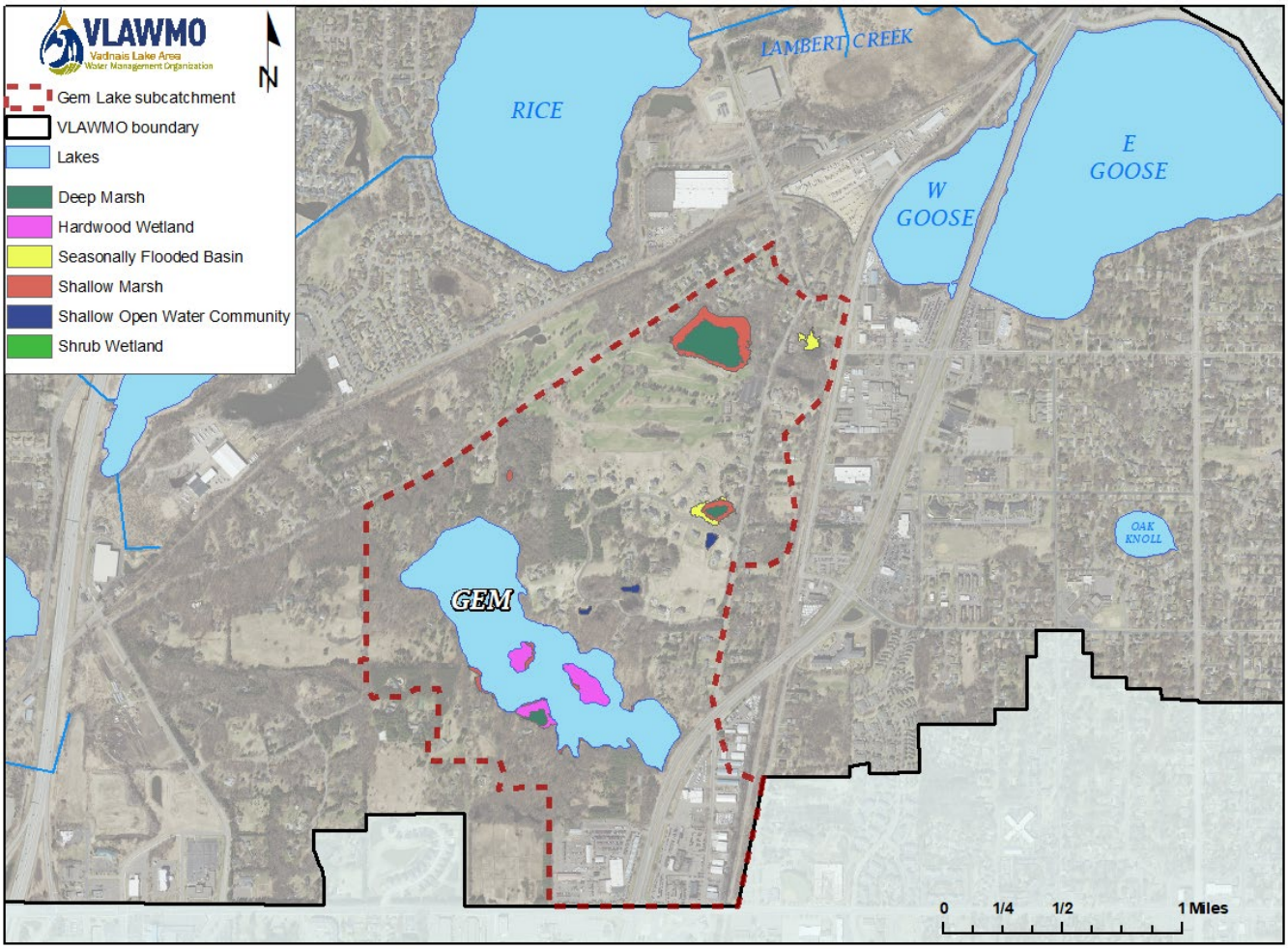
Figure 11: Gem Lake area soils



2.4 GEM LAKE WETLANDS

Gem Lake, and the marsh surrounding it, is largely classified as a Type 3/5 according to the Wetland U.S. Fish & Wildlife Circular 39 classification system. In Type 3 shallow marsh wetlands, the soil is usually waterlogged in the spring and often covered with more than 6 inches of water. A Type 5 wetland is a shallow open water wetland. Water is usually less than 6 feet deep and typically surrounded with vegetation. Both wetland types provide habitat for fish, birds, and other wildlife. They also retain floodwater and protect water quality.

Figure 12: National Wetland Inventory (2015) wetland areas in and around Gem Lake, Circular 39 Classification System



3 LAKE FEATURES

LAKE FEATURES

The land surrounding Gem Lake is low-density residential. Homes are situated on large lots. A City shoreland zoning ordinance restricts the clearing of shoreline vegetation. There are currently no signs of active shoreline erosion.

3.1 LAKE LEVELS, DEPTH, AND BOTTOM HARDNESS

Minnesota Department of Natural Resources (MN DNR) has baseline depth information available from historical monitoring. Gem's Lake ID number is 62003700.

This information was obtained from the MN DNR Lake Finder website.

Water Level Data was checked 23 times between 08/28/2006 to 03/30/2012:

Highest recorded: 947.21 ft (09/26/2011)
Lowest recorded: 944.86 ft (07/24/2009)
Recorded range: 2.35 ft
Last reading: 946.76 ft (03/30/2012)
Ordinary High Water Level (OHW) elevation: 946.8 ft
Datum: NGVD 29 (ft)

A bathymetry survey was completed by RCSWCD on August 9, 2022, to develop a map of the bottom and determine lake depths. The deepest location detected by sonar was 4.5 m (15 ft), and the average was 2.0 m (7.0 ft). Bottom hardness is represented as soft, medium, or hard; with soft bottoms characterized as muck, loose silt or sand, and medium to harder bottoms characterized as compacted sand, gravel, or rock. Gem Lake has a primarily medium lake bottom with variability.

Figure 13: North Gem Lake depths with 0.3-meter contours (top) and southern wetland area of Gem Lake (bottom)

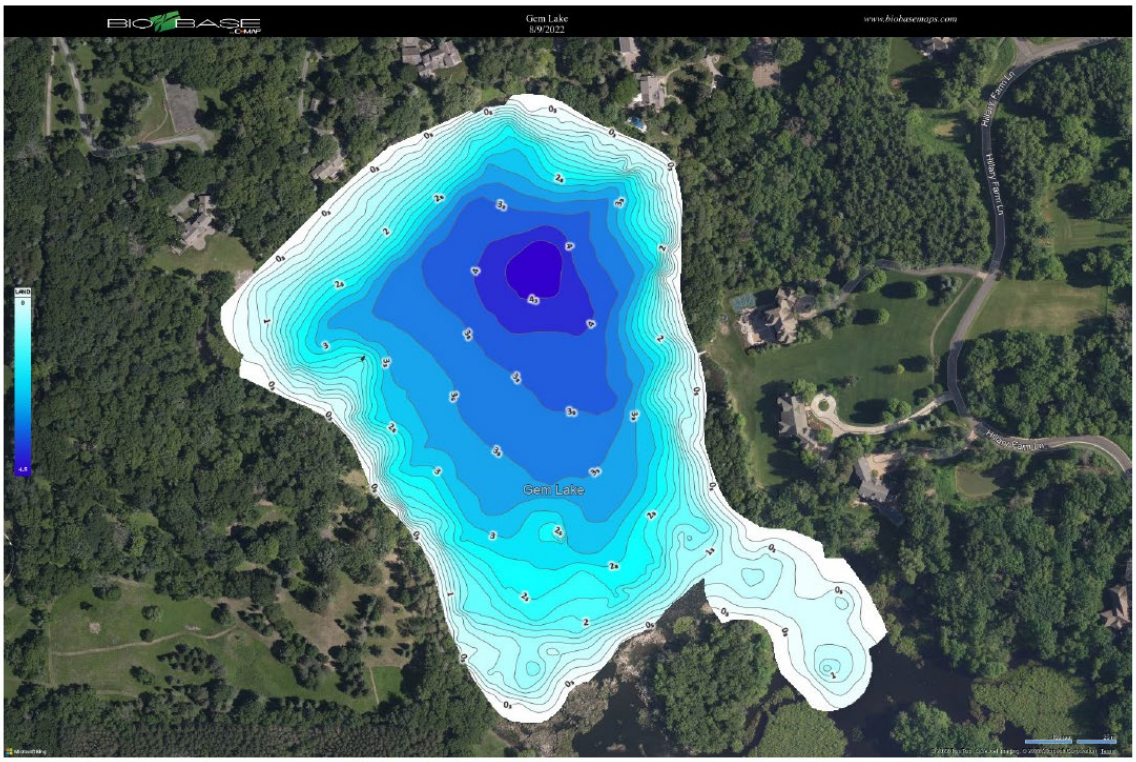


Figure 5. North Gem Lake 0.3-m contours with depth in meters taken on August 9, 2022.

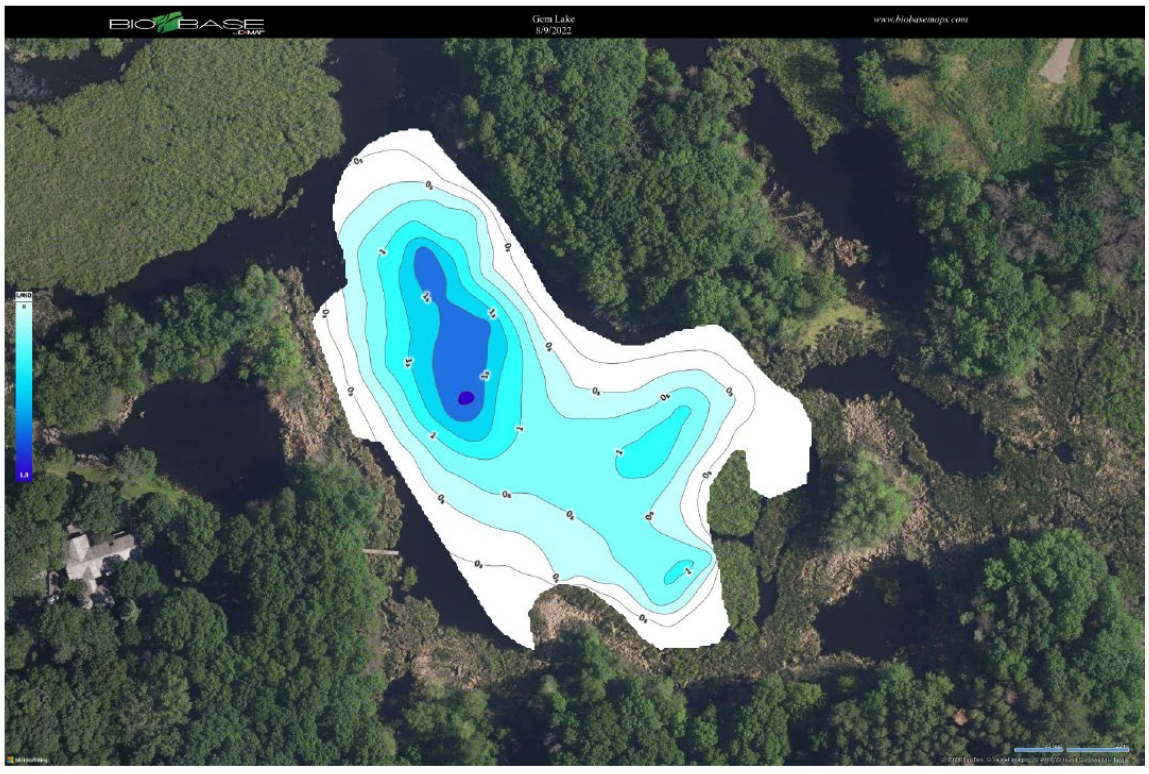


Figure 6. South Gem Lake 0.3-m contours with depth in meters taken on August 9, 2022.

Figure 14: North Gem Lake (top) and southern wetland area of Gem Lake (bottom) bottom hardness

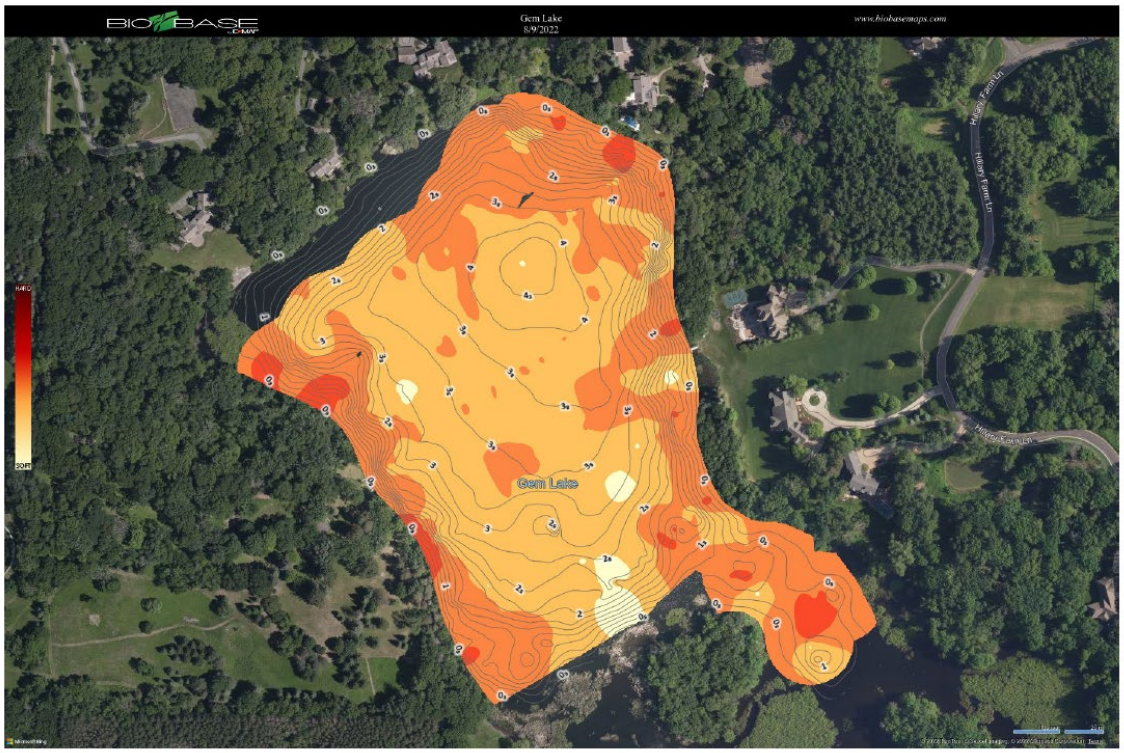


Figure 9. North Gem Lake bottom composition values with 0.3-m contours taken on August 9, 2022.

Figure 10. South Gem Lake bottom composition values with 0.3-m contours taken on August 9, 2022.

3.2 BIOVOLUME AND AQUATIC VEGETATION

Biovolume and Aquatic Vegetation (2010 and 2022)

VLAWMO staff conducted an aquatic vegetation survey on June 30, 2010. Due to Gem's depth, plant life was only found around the perimeter of the lake. Generally, sufficient sunlight does not penetrate through the water column past 4 feet to support plant life. Seven native plants species were detected as part of this survey; no invasive plant species were detected. The 3 most abundant plant species found were Clasping-leaf Pondweed, Pickerelweed, and White Waterlily.

Figure 15: Aquatic Vegetation Survey Points (2010)

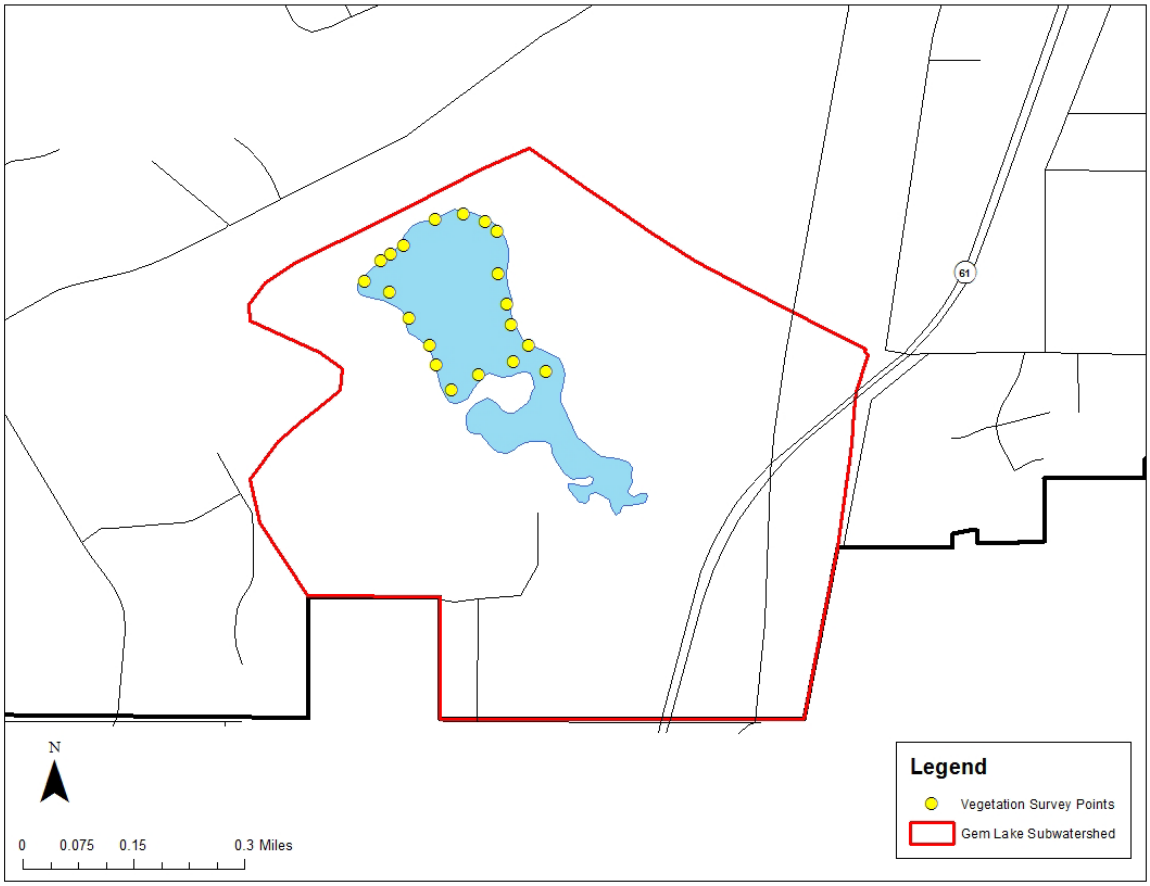


Table 1: Aquatic vegetation survey results (2010)

Gem Lake aquatic plant survey 6/30/2010							
GPS Points	Prevalence on a Scale of (1-5)						
	Bushy Pondweeds and Naiads (*Najas* spp.)	Large-leaf pondweed	Clasping-leaf pondweed	Coontail	Pickerelweed	Yellow pond lily (*Nuphar variegatum*)	White Waterlily (*Nymphaea odorata*)
106	1	0	0	0	4	0	2
107	0	0	0	0	4	0	2
108	0	1	0	1	3	0	2
109	0	0	3	0	0	0	0
110	0	0	0	0	0	0	0
111	0	0	0	0	1	0	1
112	0	3	2	1	0	0	3
113	0	3	3	0	0	0	1
114	0	0	0	0	0	0	0
115	0	2	2	0	0	0	0
116	0	0	0	0	0	0	0
117	0	0	0	0	2	5	0
118	0	0	4	0	0	0	5
119	0	0	3	0	0	0	5
120	0	0	2	1	5	3	0
121	1	0	2	3	0	0	0
122	2	2	1	2	0	0	0
123	0	0	1	0	0	0	2
124	0	0	0	0	0	0	0
125	0	0	0	1	0	0	0
TOTALS	**4**	**11**	**23**	**9**	**19**	**8**	**23**

2022

RCSWCD conducted a biovolume and aquatic vegetation survey on August 9, 2022, in Gem Lake. Biovolume measures the density of plant life within the lake. Blue signifies 0% plant life, and red signifies 100% plant life. At depths greater than 4-6 feet, there is commonly no plant life in Minnesota lakes. Plant growth is limited because the sun does not penetrate into the water column below those depths enough to allow photosynthesis to occur.

For the aquatic macrophyte survey, 65 evenly spaced (50 m) georeferenced points were surveyed using the metal portion of a rake/tines tied to a rope. Aquatic macrophytes were found at 25 of 65 points surveyed. A total of 13 species were detected. Species included: Coontail (*Ceratophyllum demersum*), Naiad (*Najas* spp.), Large leaf pondweed (*Potamogeton amplifolius*), Leafy pondweed (*Potamogeton foliosus*), Robbin's pondweed (*Potamogeton robbinsii*), Flatstem pondweed (*Potamogeton zosteriformis*), Bladderwort (*Utricularia macrorhiza*), Hornwort (*Certatyphylum echinatum*), White waterlily (*Nymphaea odorata*), Wild Celery (*Vallisneria americana*), Duckweed (*Lemna* major and minor), Filamentous algae (*Spirogyra/Cladophora* spp.). The three most common species found on Gem Lake were Large leaf pondweed (*Potamogeton amplifolius*), Hornwort (*Certatyphylum echinatum*), and Coontail (*Ceratophyllum demersum*). The Naiad species appeared to be Southern naiad (*Najas guadalupensis*), but further verification is needed. Spatterdock (*Nuphar variegatum*) was visible near point 33 but was not detected on the rake. Due to low water levels points 1-5, 37-38, 40-48, 51-53, and 66-75 were inaccessible and not able to be surveyed. No aquatic invasive plant species were detected.

Figure 16: Macrophyte sampling with RCSWCD and VLAWMO staff.

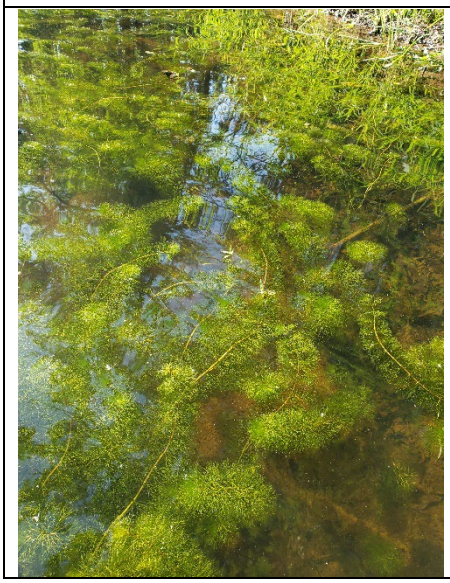
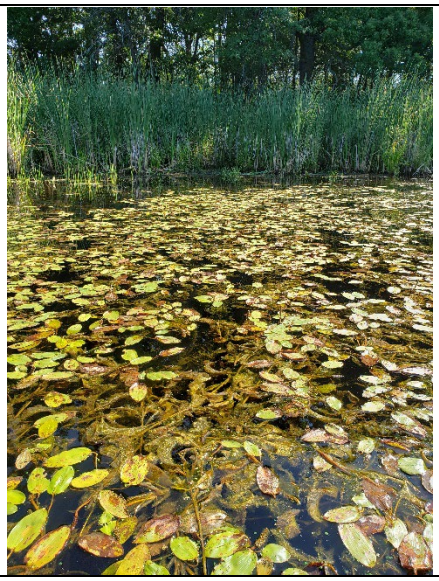
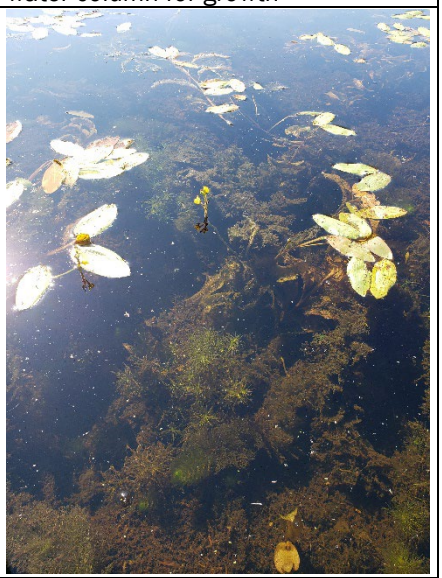
Hornwort at Gem Lake	Large-leaf pondweed at Gem Lake	Native plants (Large-leaf pondweed and Naiad shown here) help support clear water by using nutrients in the water column for growth
		

Figure 17: Gem Lake survey points with depths

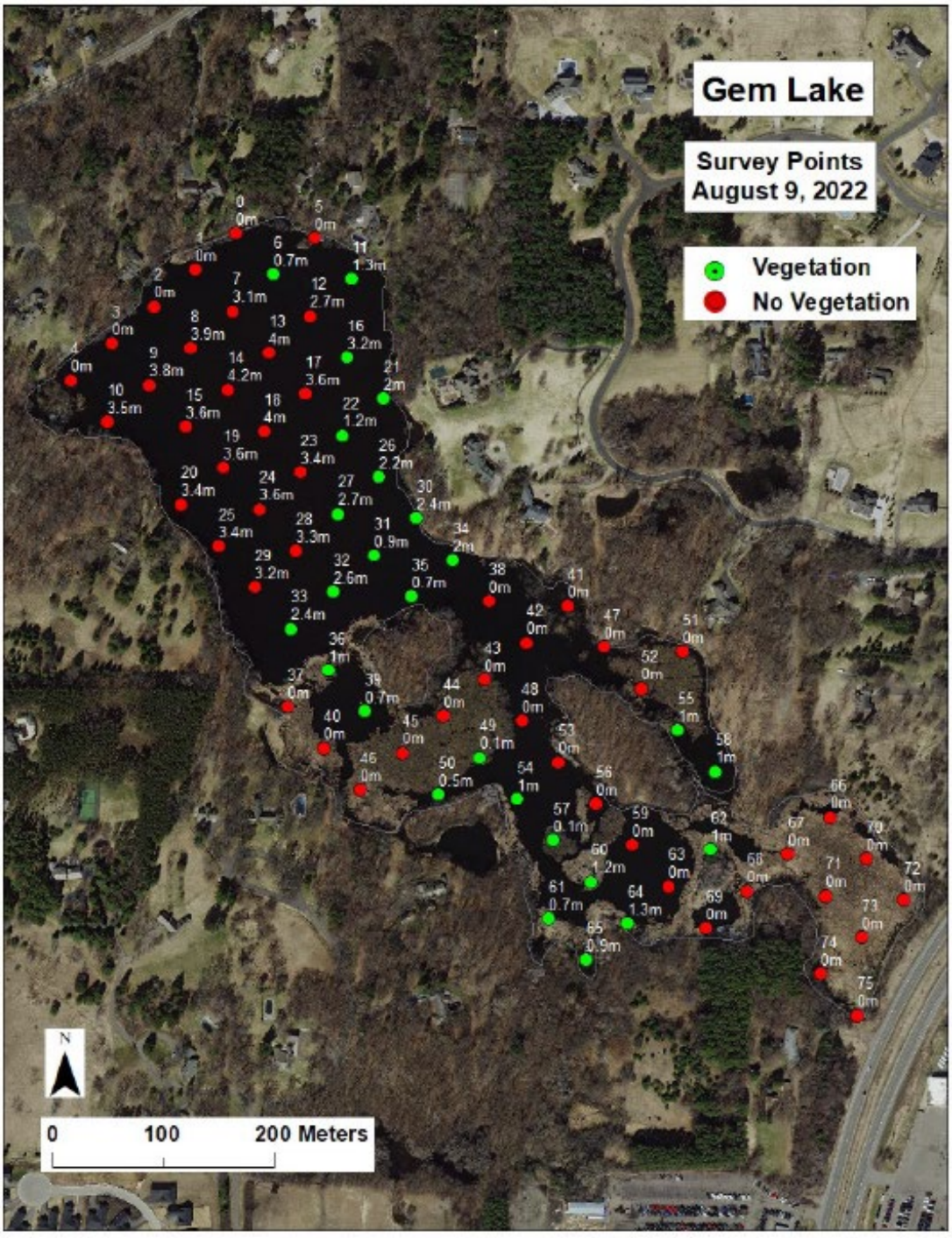


Figure 2. Gem Lake vegetation point intercept survey locations. N=75.
Note: Due to low water levels points 1-5, 37-38, 40-48, 51-53, and 66-75 were inaccessible and not able to be surveyed.

Figure 18: North Gem Lake (top) and southern wetland area of Gem Lake (bottom) biovolume

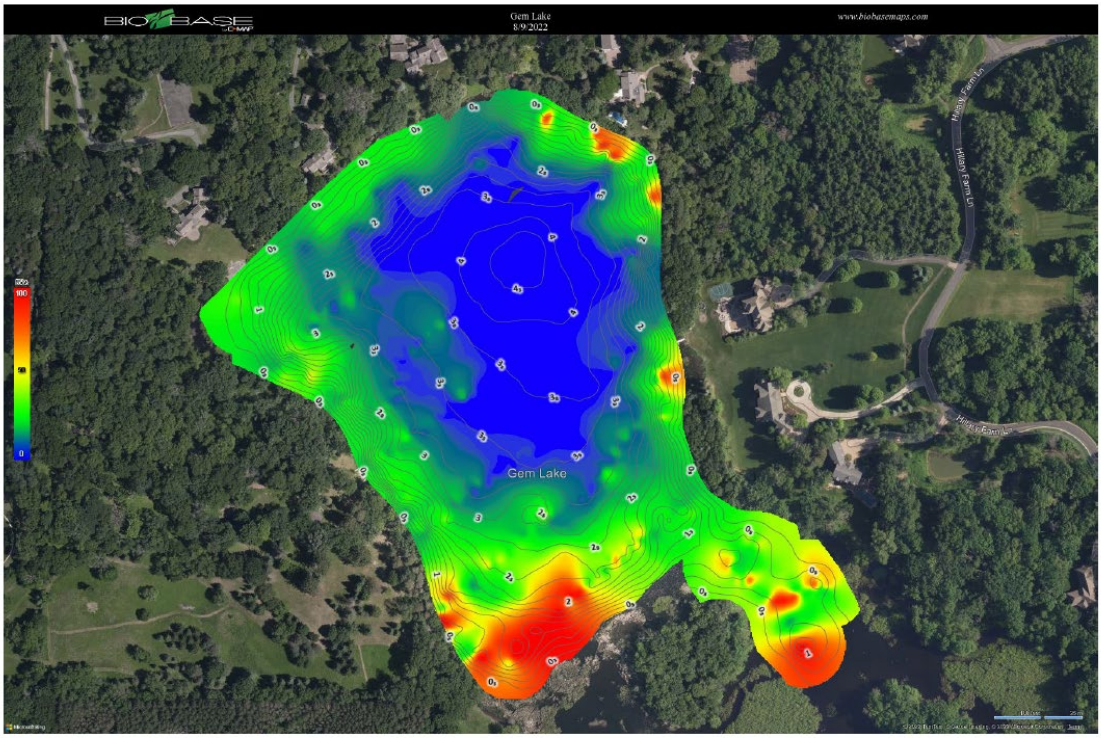


Figure 7. North Gem Lake vegetation biovolume with 1m contours taken on August 9, 2022. Percent values range from zero to one hundred; Blue = 0%, Yellow = 50% and Red = 100%.

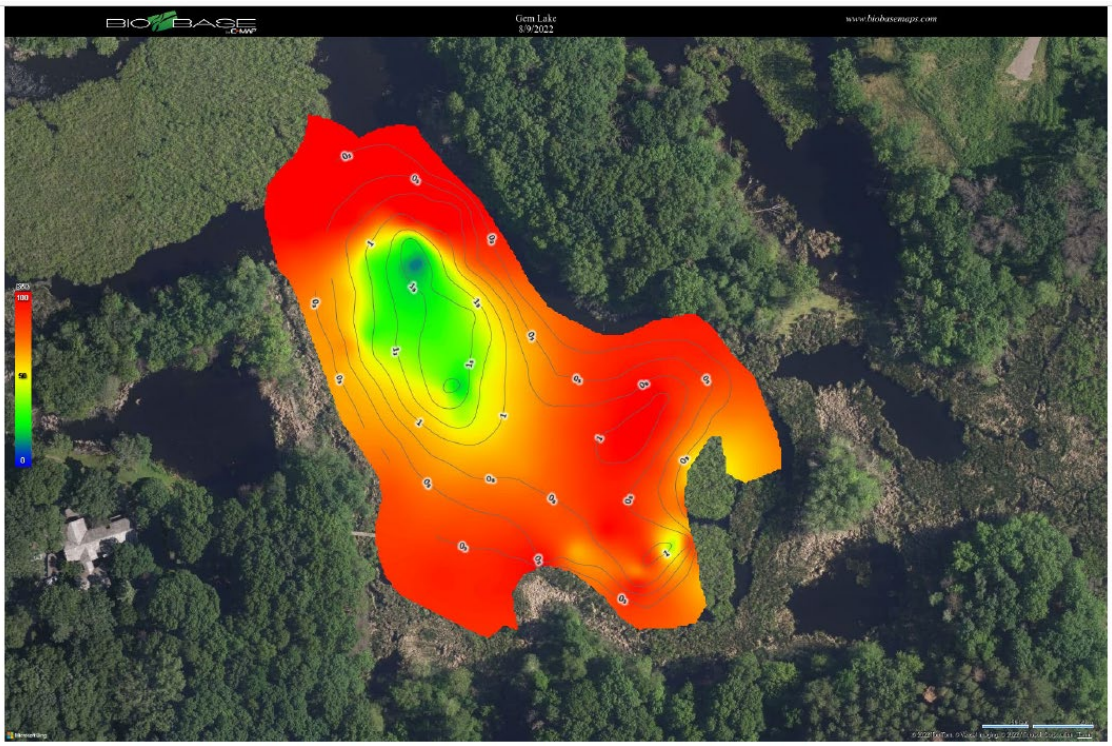


Figure 8. South Gem Lake vegetation biovolume with 1m contours taken on August 9, 2022. Percent values range from zero to one hundred; Blue = 0%, Yellow = 50% and Red = 100%.

3.3 FISH SURVEY (2011)

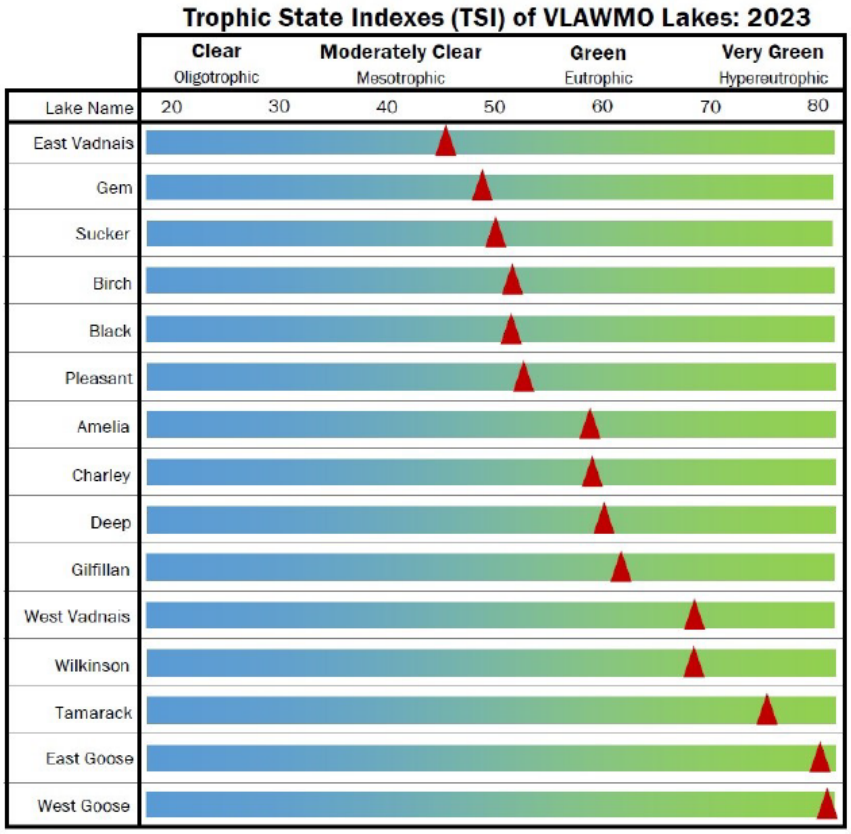
Blue Water Science was hired to conduct a fish survey in September 2011. The report is linked on the VLAWMO website. The survey found that the lake had a healthy supply of black crappies and concluded that Gem Lake is likely susceptible to winter fish kills. If the lake were to experience a fish kill, crappies would likely be eliminated, and minnows would become dominant. Since Gem Lake is landlocked, there is no opportunity for fish to migrate naturally. In the report, stocking was not recommended unless a winter aeration system was installed, since the fish likely be lost with winter kills. Installation of an aeration system was not recommended. Gem Lake is considered more conducive to other wildlife, rather than a recreational fishery.

Figure 19: Photo of crappies from Gem Lake, September 2011

3.4 WATER QUALITY SUMMARY

Gem Lake is shallow and falls closest to the moderately clear/mesotrophic classification on the Trophic State Index (TSI) (shown below using the Carlson scale, MPCA). Gem Lake had a score of 53 (2021), 52 (2022), and 49 (2023).

Figure 20: TSI scores for VLAWMO lakes



VLAWMO has collected water quality (WQ) data on Gem Lake since 1997. VLAWMO staff collects WQ data and water samples biweekly, May-September, for water clarity (secchi disk), nutrients (TP, Chl-a, SRP, nitrogen), and chemistry (temperature, conductivity, dissolved oxygen, and potential hydrogen [pH]). Total Phosphorus (TP) and Chlorophyll A (Chl-a) analyses are conducted by a contracted lab.

- TP is the primary cause of excessive plant and algae growth in lake systems. Phosphorus originates from a variety of sources, many of which are human related. Major sources include human and animal waste, soil erosion, detergents, septic systems, and stormwater runoff. Internal loading can also be present in a lake. Internal loading can result from P becoming resuspended into the water column from the sediment. High amounts of P in sediments may occur as a result of historical land uses including, but not limited to, waste disposal into the lake.

- Chl-a is a green pigment in algae. Measuring Chl-a concentration gives an indication of algae abundance.

- The MN Pollution Control Agency (MPCA) has impairment standards for the levels of TP and Chl-a. For shallow lakes in Minnesota, the impaired water quality standard levels are: <60µg/L for TP, <20µg/L for Chl-a, and <230 mg/L for Chloride.

- Red numbers indicate values that exceed MN State Standards.

Table 2: Gem Lake monitoring data 1997-2023

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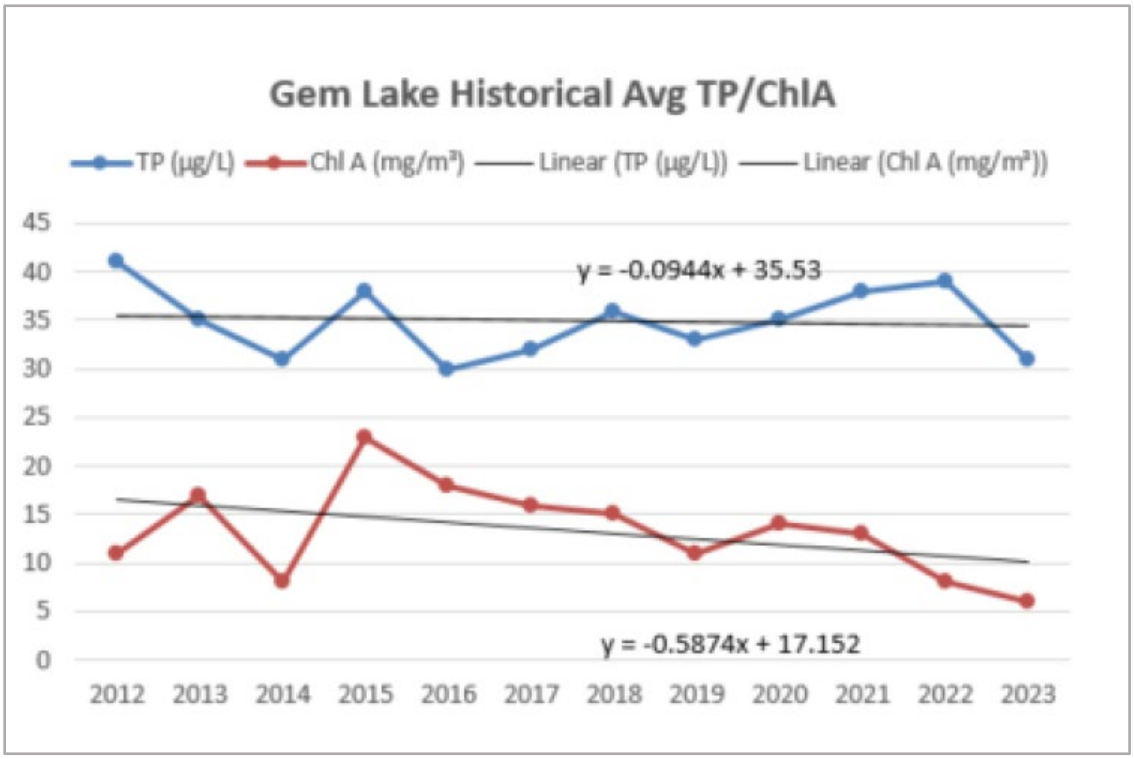
Gem Lake Historical Avg TP/Chl A/ SDT			
Year	**TP (µg/L)**	**Chl A (µg/L)**	**Secchi (m)**
1997	54	23	1.2
1998	33	24	-
1999	26	16	1.2
2000	36	17	1.1
2001	56	12	1.8
2002	39	25	1.3
2003	52	20	1.4
2004	49	-	1.5
2005	43	26	-
2006	63	25	-
2007	48	33	1.1
2008	64	17	1.5
2009	89	28	1.3
2010	53	24	1.4
2011	32	6.4	2.1
2012	41	11	2.0
2013	35	17	2.0
2014	31	8	2.9
2015	38	23	2.2
2016	30	18	1.6
2017	32	16	1.5
2018	36	15	1.8
2019	33	11	1.8
2020	35	14	2.4
2021	38	13	2.4
2022	39	8	2.4
2023	31	6	2.6

Figure 21: Water quality trends in Gem Lake

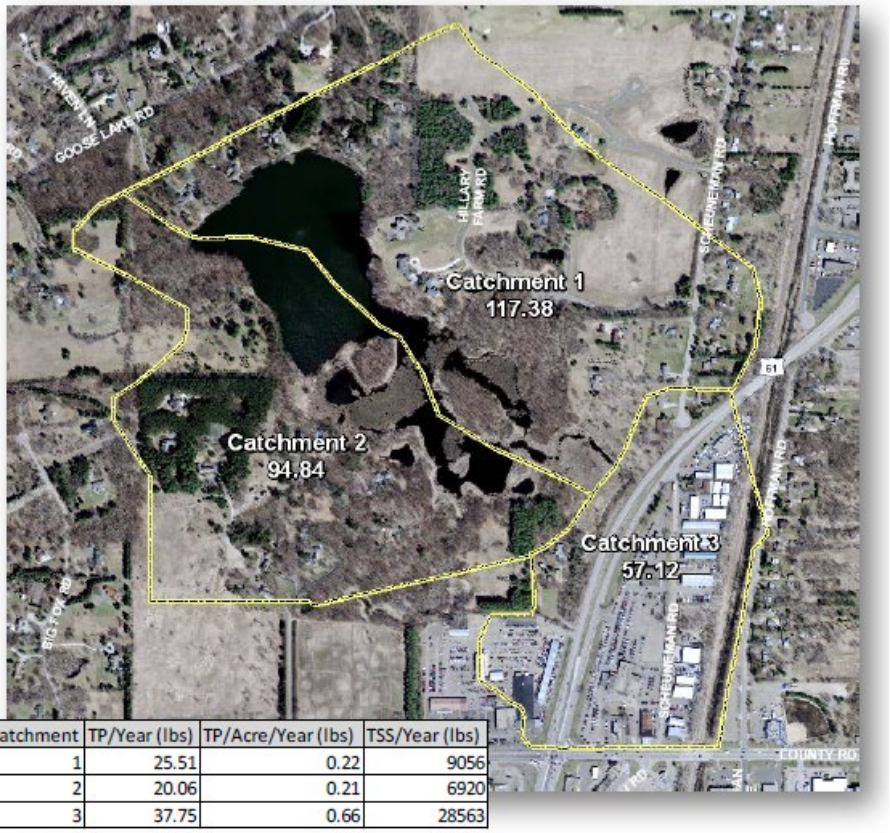


4.1 RETROFIT REPORT

Retrofit Report (2012)

In 2012, the Ramsey Conservation District (RCD), now RCSWCD, completed a Retrofit Report for Gem Lake. This was part of a larger effort to assess the full watershed and subwatershed scales and identify optimal locations for BMPs.

Figure 22: Gem Lake Subwatershed: 3 subcatchments focused upon for recommended retrofits



Catchment	TP/Year (lbs)	TP/Acre/Year (lbs)	TSS/Year (lbs)
1	25.51	0.22	9056
2	20.06	0.21	6920
3	37.75	0.66	28563

Figure 23: Bioswales were the primary BMP type that was recommended. The locations within the 3 focal subcatchments are shown below

Figure 4. Outline of Catchment 3-3 and area of future BMP locations

Figure 7. Outline of Catchment 3-5 and area of future BMP locations

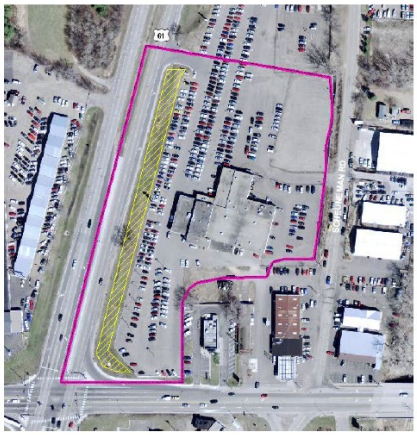
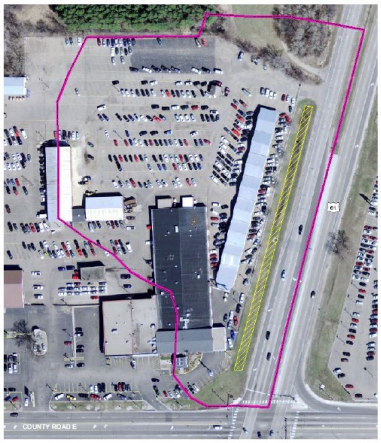


Figure 10. Outline of Catchment 3-5 and area of future BMP locations



4.2 COMPLETED BMPS AND PROJECT PARTNERSHIPS IN THE SUBWATERSHED

Best Management Practices (BMPs) are implemented to improve and protect water quality. Common small-scale examples of BMPs include raingardens, infiltration basins, shoreline restorations, rain barrels, and native restorations and plantings. Larger BMPs include stormwater retention basins, iron-enhanced sand filters, weirs and stormwater conveyance retrofits, and in-lake treatments such an alum treatment, rough fish management, or aquatic vegetation management.

Completed BMPs for Gem Lake included major efforts incorporated with road reconstruction in 2010 and 2011 that led to delisting Gem Lake in 2018:

2010: Scheuneman Road upgrades

Scheuneman Road (north and west of Hwy 61) sanitary sewer lining; East of Gem Lake

- Lined sanitary sewer lines, potentially ceasing shallow groundwater nutrient loading from leaking lines into Gem Lake

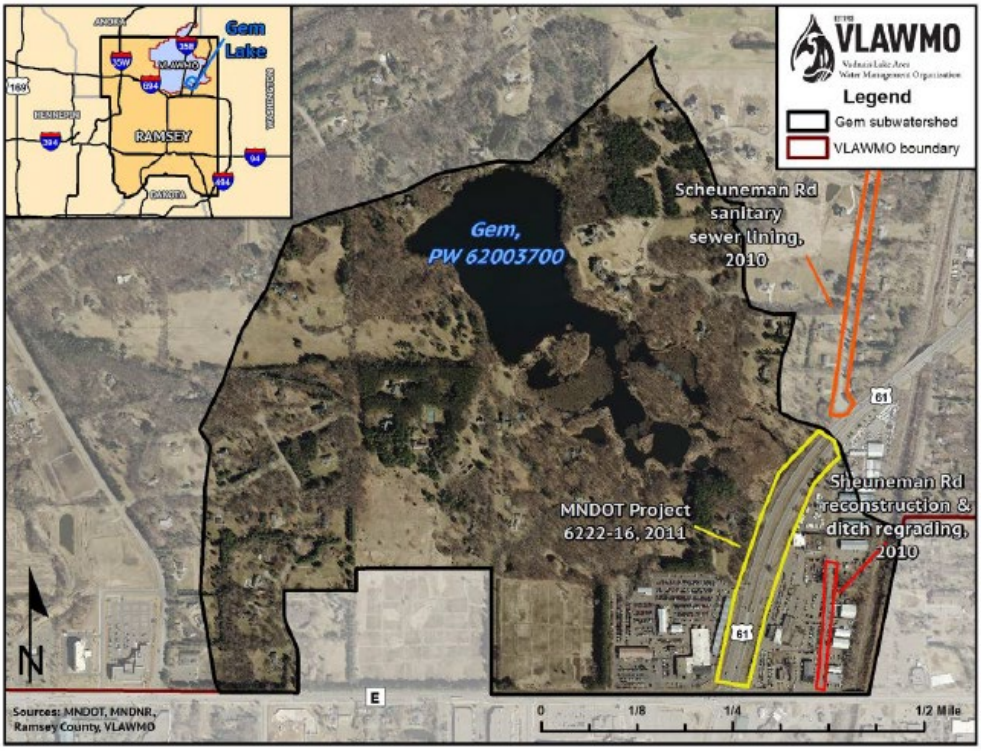
Scheuneman Road (south and east of Hwy 61) reconstruction

- Re-grading of the west ditch, including re-seeding and the addition of rip-rap at the end of the ditch
- Stormwater from ditch flows underground and over to the east ditch of the NB lane of Highway 61

2011: Highway 61 reconstruction (MnDOT Project 622-161)

- Improved grading and removed sediment
- Replaced and improved storm sewer infrastructure
- Ditch block installed in ditches to slow stormwater and increase infiltration prior to Gem Lake
- Established vegetation (MNDoT seed mix 250) where erosion was once and issue, slowing discharge rates and increasing infiltration in the NB ditches and swales before they flow west to the SB ditch wetland and then into Gem Lake

Figure 24: Highway 61 reconstruction project area



Residential Grant Projects

As one of VLAWMO's core program areas, VLAWMO's grant programs work to implement in-ground BMPs within VLAWMO's boundaries, for the improvement and preservation of water quality. For more information, visit www.vlawmo.org/grants/. Within the Gem Lake subwatershed, 1 VLAWMO grant project was implemented in 2021.

Figure 25: Gem Lake subwatershed implemented projects and BMPs.