Silver Lake

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Contents

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1.1 Silver Lake Watershed Goals

The approved Riley-Purgatory-Bluff Creek Watershed District Water Management Plan, 1996, (Water Management Plan) inventoried and assessed the thirteen lakes in the district. The plan articulated five specific goals for these lakes, and the 2003 Silver Lake Use Attainability Analysis refined the watershed for to Silver Lake. These goals address recreation, aquatic communities, water quality, water quantity, and wildlife.

1.1.1 Watershed Goals

1.1.1.1 Water Quantity

The water quantity goal for Silver Lake is to provide sufficient water storage during a regional flood (100-yr, 24-hr storm event). This goal is attainable with no action (UAA, 2003).

1.1.1.2 Water Quality

Silver Lake is unclassified by the MPCA, MDNR, and the City of Chanhassen. Hence, the lake's target water quality goals were based upon the RPBCWD policy of nondegredation of current lake water quality conditions.

The RPBCWD The intended water quality goal is protection of the lake's current water quality. The 1996 plan listed the TSI_{SD} as 70, or a Secchi disk measurement of 0.5 meters (Table IA2). The 2003 UAA states that this goal was based on modeled predictions of the lake's current water quality, and not on actual data. Primary data collected during 1996 and 2000 indicate the lake's average summer Secchi disk measurement was poorer than modeled estimates, but closer to 80. The 2003 UAA recommended a goal change to TSI_{SD} 83 (i.e. Secchi disc measurement of 0.2 meters).

1.1.1.3 Recreation

Water based recreation uses of Silver Lake include canoeing and aesthetic viewing. The lake is not used for swimming due to the snapping turtles living within the lake that create unsafe conditions for swimmers (UAA, 2003). The recreation goals for this lake are currently being met with no additional action.

District lake management policy is nondegredation of the lakes' current water quality and achievement of national and state goals and policies. However, in 2001, changes in state lake management criteria were made that were based on the assumption that all waters of the state must achieve a full support of swimmable use. The criteria are both unreasonable and unattainable for Silver Lake. The state criteria change mandates a District policy change. The recommended change in District policy is to achieve national and state criteria deemed reasonable by the District and work to affect change in unreasonable criteria.

1.1.1.4 Aquatic Communities

The aquatic communities goal for Silver Lake is preservation of the lake's wetland habitat. The habitat is used by seasonal waterfowl, such as ducks and geese, and other aquatic life. The goal has been attained. However, nuisance non-native plants threaten future non-attainment of the goal. Management of non-native plants will insure continued goal attainment (UAA, 2003).

1.1.1.5 Wildlife

The wildlife goal for Silver Lake is to protect existing beneficial wildlife uses. The wildlife goal can be achieved with no action. (UAA, 2003)

1.2 Existing Watershed Conditions

Silver Lake is located in the City of Shorewood in the northwestern part of the Riley-Purgatory-Bluff Creek watershed. The outlets to Silver and Lotus Lakes are the beginning of Purgatory Creek. The two streams later merge to become a single stream.

1.2.1 Watershed Description

1.2.1.1 Land Use

Land use is an important watershed characteristic that has a direct impact on a lake and its water quality. Increasingly intensive land use will increase both sediment and phosphorus loads, as well as alter the routine hydrology of a lake and its tributaries. Urbanization can also lead to thermal impacts which in turn can play a role in fisheries habitat. Sound watershed planning needs to consider both existing and future land use.

Land use data was obtained from the Metropolitan Council Generalized Land Use Maps. The maps are based on 2005 existing land use and a projected land use for 2020. Both existing and projected are summarized in Table SI-1. No land use changes are anticipated as this watershed is fully built out. The small differences in the single family residential and parkland numbers are accounted for in the 2020 accounting of total road right-of-ways. The 2005 existing land use data set includes only major highways, grouping smaller right-of-ways in with residential developments, commercial areas, or other land uses.

TABLE SI-1

Silver Lake Existing and Projected Land Use

Land Use	2005 Existing Area (ac)	2020 Projected Area (ac)
Single family or low density residential	**254.73**	**245.19**
Parks, undeveloped land and other open areas	**10.94**	**3.57**
Major Highway/Road Right-of-Way (2020)	**0**	**17.41**
Water	**94.78**	**95.76**

TABLE SI-1

Silver Lake Existing and Projected Land Use

Land Use	2005 Existing Area (ac)	2020 Projected Area (ac)
Single family or low density residential	**254.73**	**245.19**
Total	**361**	**361**

1.2.1.2 Major Hydrologic Characteristics

Silver Lake has a 361-acre tributary watershed, a surface area of 84.4 acres (during a year of average precipitation) at a lake elevation of 898 feet, a maximum depth of approximately 13 feet, and a mean depth of 3.0 feet. The UAA determined that the lakes' volumes, outflow volumes, and hydrologic residence times vary with climatic conditions (Table SI-2).

TABLE SI-2
Silver Lake Estimated Volumes, Outflow Volumes and Hydrologic Residence Times

Climatic Condition (Water Year, Inches of Precipitation)	Estimated Lake Volume (m^3 / ac-ft)	Estimated Annual Lake Ouflow* (m^3/ac-ft)	Estimated Hydraulic Residence Time (years)
Wet Year (1983, 41 Inches)	248,042 / 201	259,250 / 210	1
Average Year (1995, 27 Inches)	248,042 / 201	76,328 / 62	3
Model Calibration Year (1997, 34 Inches	248,042 / 201	39,365 / 32	6
Dry Year (1988, 19 Inches)	248,042 / 201	8,556 / 7	17.3

Source: Silver Lake Use Attainability Analysis (Barr Engineering, May 2003)

1.2.2 Silver Lake Water Quality

The water quality of a lake provides an indication of how a lake functions. A standardized lake rating system is often used to classify the ecological conditions of a lake. The rating system uses phosphorus, chlorophyll *a*, and Secchi disc transparency values to classify a lake into four categories: Oligotrophic (clear, low productivity lakes with excellent water quality), Mesotrophic (intermediate productivity lakes with good water quality), Eutrophic (high productivity lakes with poor water quality) and Hypereutrophic (extremely productive lakes with poor water quality).

1.2.2.1 Data Collection

Data for the previous watershed management plan was collected from 1972 to 1994. Additional data was collected in 1996 and 2000 to support the Silver Lake UAA. An additional sampling year was accomplished in 2005.

1.2.2.2 Baseline/Current Water Quality

In general, Silver Lake water quality has not changed significantly throughout the more recent monitoring (1996 – 2006).

Total phosphorus concentrations were typically in the eutrophic (nutrient rich) category in the spring and increased to a peak in the hypereutrophic (extremely nutrient rich) category in the mid to late summer (Figure SI-1). Chlorophyll *a* concentrations from the monitoring period show a similar trend. Secchi disc depths start within the eutrophic category and, extend into the hypereutrophic category for most of the summer (Figure SI-2 and Figure SI-3).

FIGURE SI-1
Silver Lake Total Phosphorus

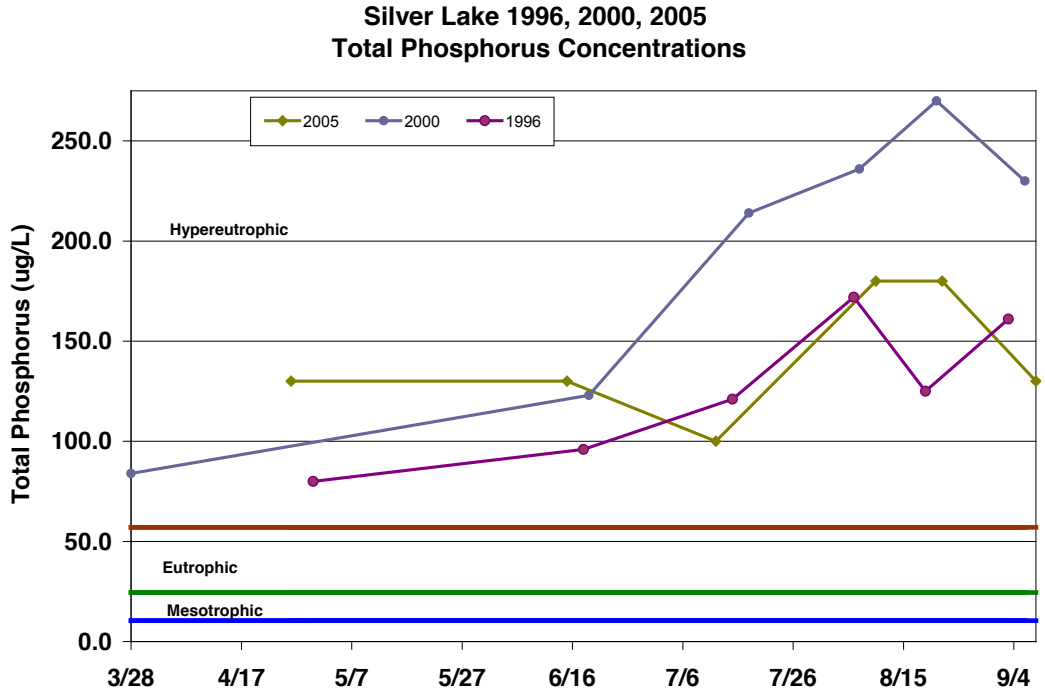


FIGURE SI-2
Silver LakeChlorophyll *a*

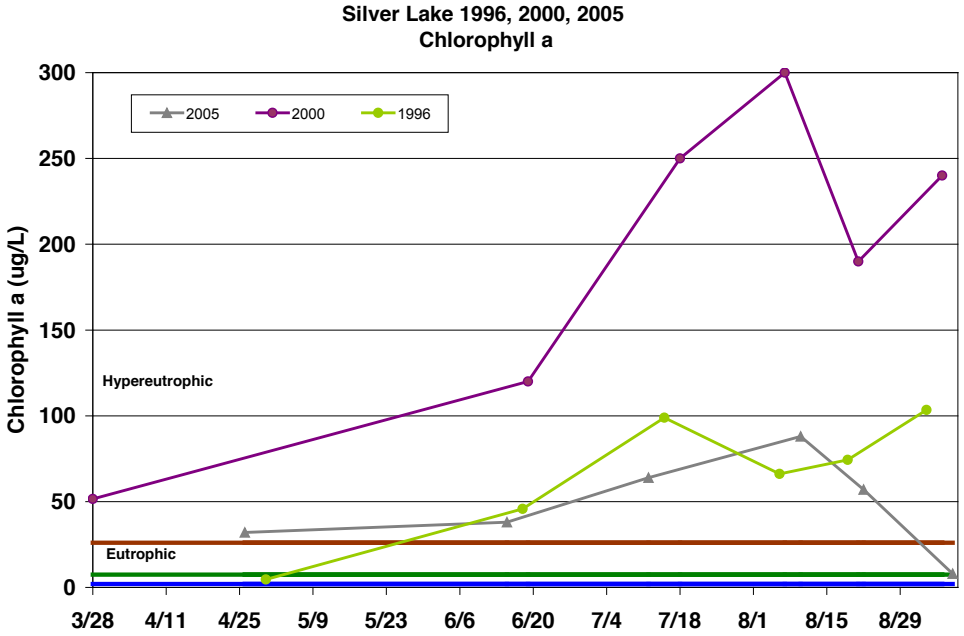
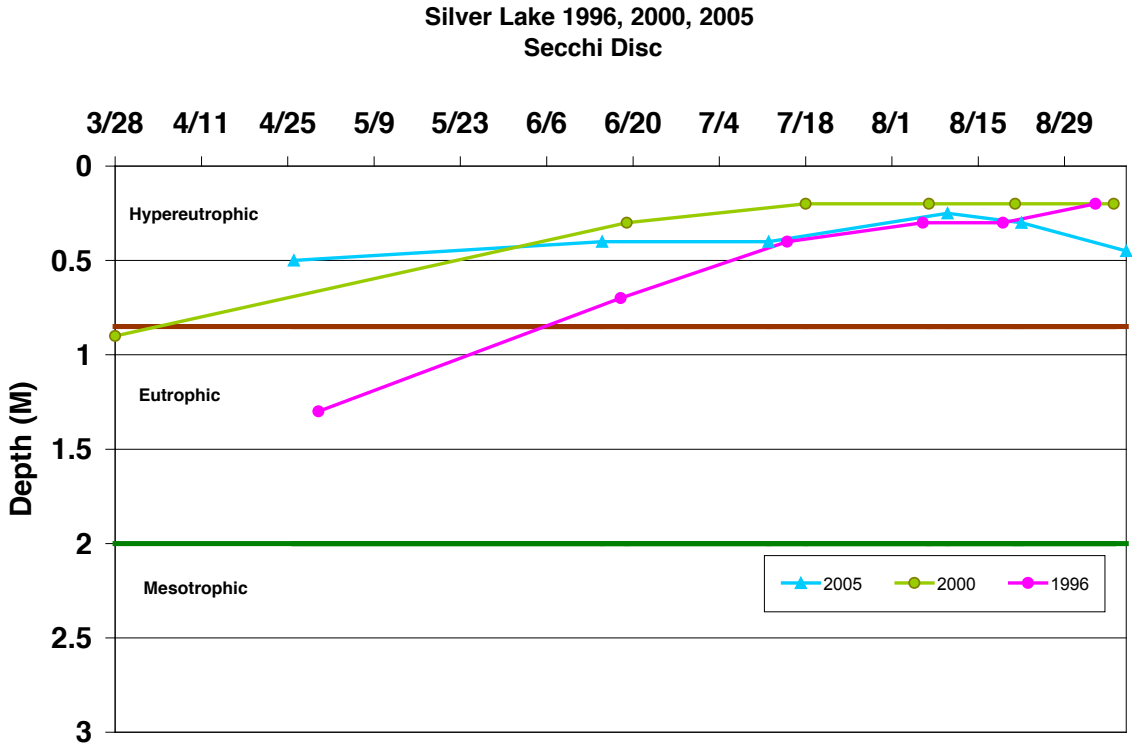


FIGURE SI-3
Silver LakeSecchi Disc



1.2.3 Ecosystem Data

No current lake classification is available in the data set. The lake has been stocked with fish until 1943 (UAA, 2003). Silver Lake provides habitat for seasonal waterfowl and other wildlife.

1.2.3.1 Aquatic Ecosystems

The encroachment of non-native species is the main threat to the aquatic ecosystem of Silver Lake (UAA 2003).

1.2.3.2 Phytoplankton

The phytoplankton species in Silver Lake form the base of the lake's food web and directly impacts the lake's fish production. Phytoplankton, also called algae, are small aquatic plants naturally present in all lakes. They derive energy from sunlight (through photosynthesis) and from dissolved nutrients found in lake water. They provide food for several types of animals, including zooplankton, which are in turn eaten by fish. A phytoplankton population in balance with the lake's zooplankton population is ideal for fish production. An inadequate phytoplankton population reduces the lake's zooplankton population and adversely impacts the lake's fishery. Excess phytoplankton, however, reduces water clarity which in turn in interferes with the recreational usage of a lake.

Lake survey results for 1996, 2000 and 2005 were analyzed to determine the composition and abundance of phytoplankton in Silver Lake. Blue-green algae was especially dominant in 2000 and 2005. In 1996 and 2000, the blue-green algae peaked in early August, but peaked in late August in 2005.. The 1996, 2000, and 2005 results are summarized in Figures SI-4, SI-5 and SI-6.

Green algae are edible to zooplankton and serve as a valuable food source. Blue-green algae are considered a nuisance type of algae because they:

- Are generally inedible to fish, waterfowl, and most zooplankters,
- Float at the lake surface in expansive algal blooms,
- May be toxic to animals when occurring in large blooms, and
- Can disrupt lake recreation because they are most likely to be present during the summer months.

Blue-green and green algal growth is stimulated by excess phosphorus loads. The growing conditions during July and August are particularly favorable to blue-greens, and they have a competitive advantage over the other algal species during this time. However, the phytoplankton populations profiled in 1996 and 2005 do show the green algae surviving in significant numbers throughout the period when blue-green algae normally outcompetes the green algae, decimating the green algae population.

FIGURE SI-4
Silver Lake Phytoplankton Data Summary (1996)

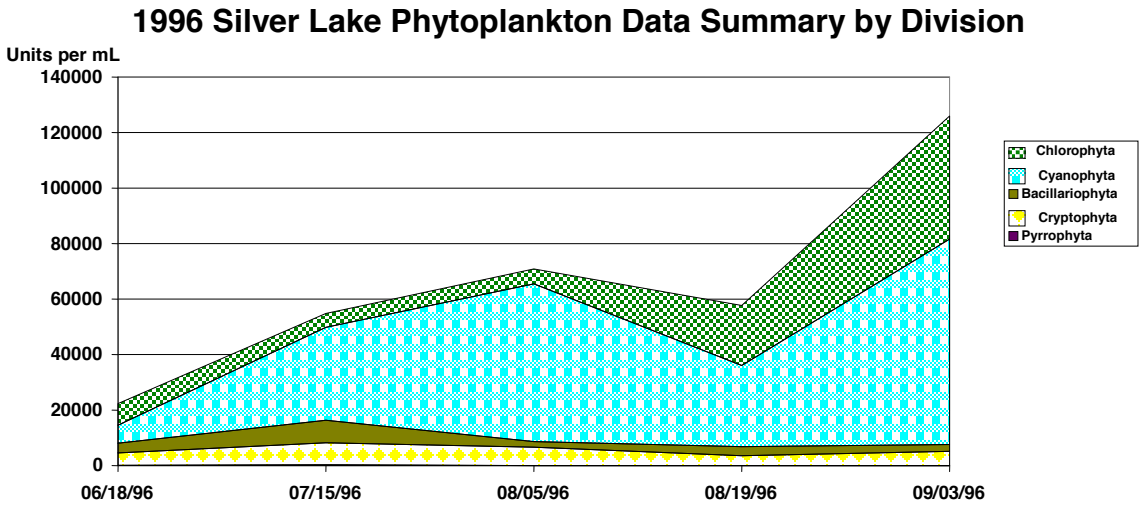


FIGURE SI-5
Silver Lake Phytoplankton Data Summary (2000)

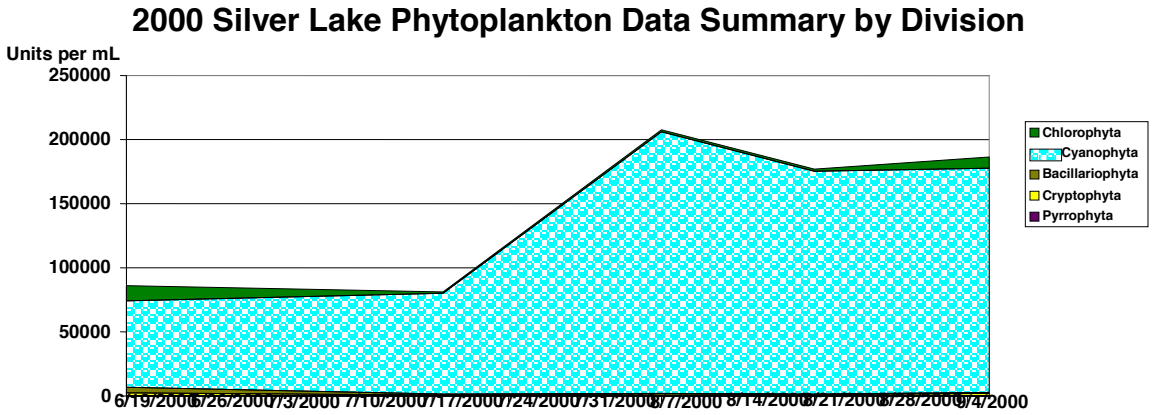
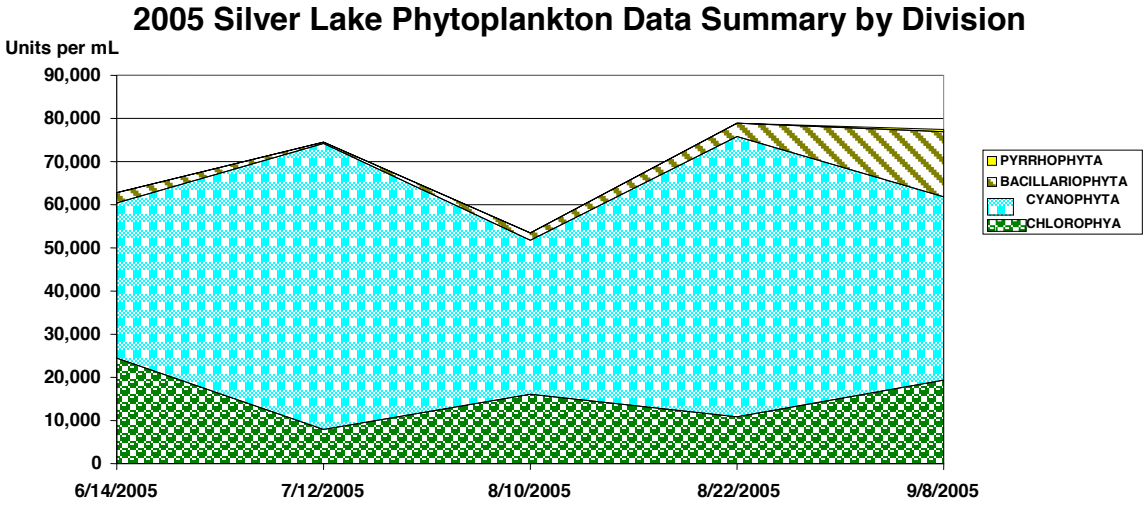


FIGURE SI-6
Silver Lake Phytoplankton Data Summary (2005)



1.2.3.3 Zooplankton

Zooplankton are an important component of the aquatic ecosystem of Silver Lake. They are the second step in the Silver Lake food webs and are particularly vital to the lake's fishery and for the biological control of algae. They are microscopic animals that feed on particulate matter, including algae, and are, in turn, eaten by fish. Protection or enhancement of the lake's zooplankton community through judicious management practices affords protection to the lake's fishery. Healthy zooplankton communities are characterized by balanced densities (number per meter squared) of the three major groups of zooplankton: Cladocera, Copepoda, and Rotifera. Fish predation, however, may alter community structure and reduce the numbers of larger-bodied zooplankters (i.e., larger bodied Cladocera).

The rotifera and copepoda in Silver Lake graze primarily on extremely small particles of plant matter and do not significantly affect the lake's water quality. However, the Cladocera graze primarily on algae and can improve water quality if present in abundance. The 2000 survey (Figure SI-8) showed the greatest abundance of Cladocera.

FIGURE SI-7
Silver Lake Phytoplankton Data Summary (1996)

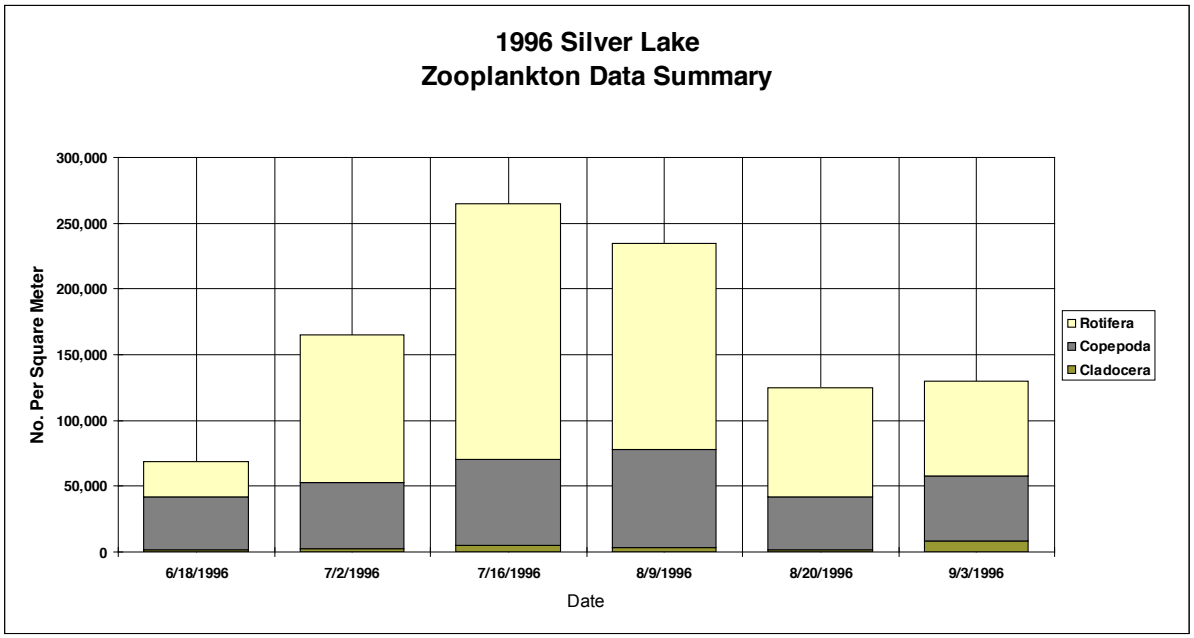


FIGURE SI-8
Silver Lake Phytoplankton Data Summary (2000)

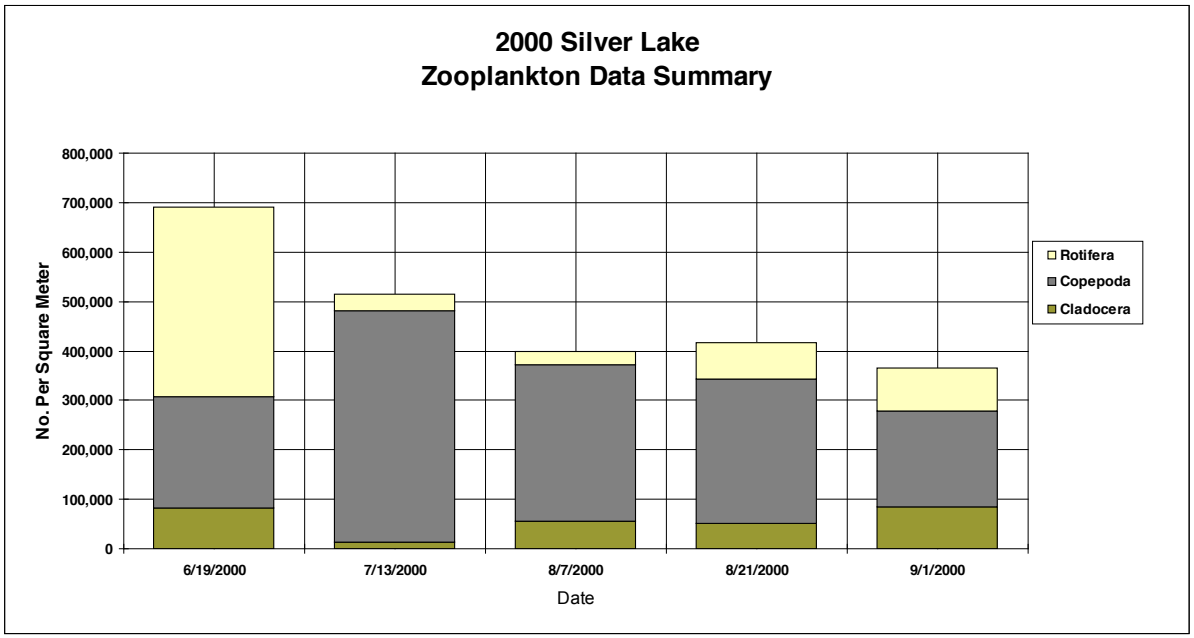
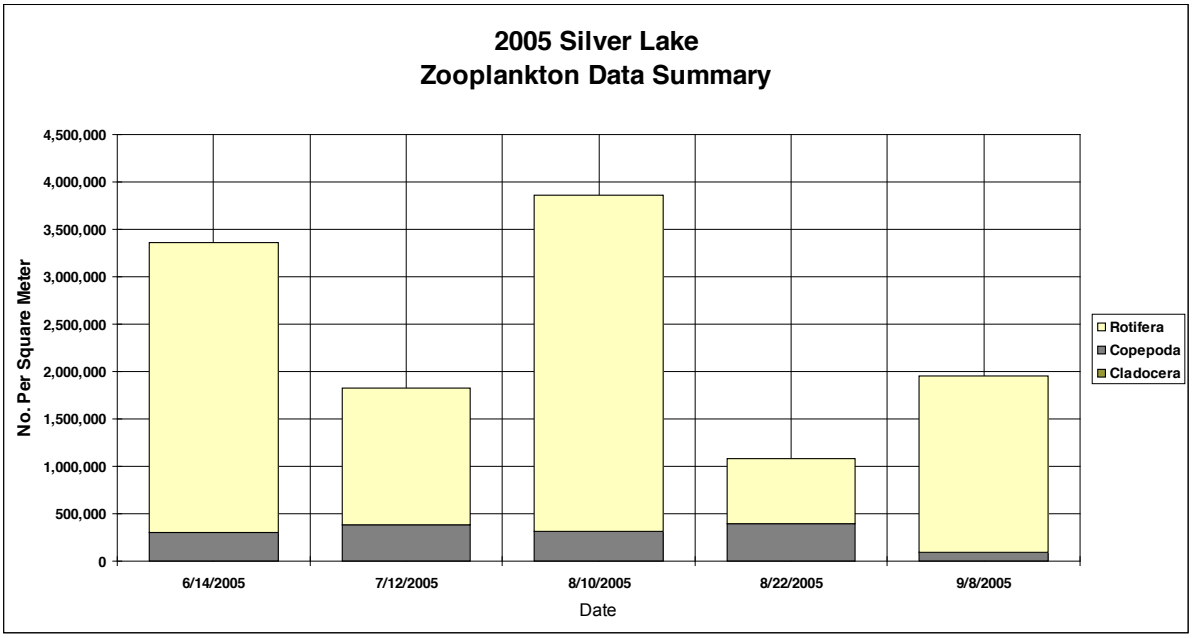


FIGURE SI-9
Silver Lake Phytoplankton Data Summary (2005)



1.2.3.4 Macrophytes

Aquatic plants are a natural part of most lake communities and provide many benefits to fish, wildlife, and people. Typical functions of a lake's macrophyte community include the following:

- Provide habitat for fish, insects, and small invertebrates
- Provide food for waterfowl, fish, and wildlife
- Produce oxygen
- Provide spawning areas for fish in early spring/provide cover for early life stage of fish
- Help stabilize marshy borders and protect shorelines from wave erosion
- Provide nesting sites for waterfowl and marsh birds

Macrophyte surveys of the aquatic plant community in Silver Lake were completed by the District in June and August of 1996, 2000, and 2005 and are summarized in Table 4. A density rating of 1 denotes a density rating of light, 2 of medium, and 3 of dense. Dashes in the floating leaf plants and emergent plants categories denote the presence of the plant during the macrophyte surveys, but no density rating was recorded.

TABLE 4
Silver Lake Aquatic Plants (1996, 2000, and 2005)

Common Name	Scientific Name	1996 Density	2000 Density	2005 Density
Submerged Aquatics				
Curlyleaf pondweed	***P. crispus***	**1-2**	**1-2**	**1-2**
Flatstem pondweed	***P. zosteriformis***	**1-3**	**1-3**	**1-3**
Sago pondweed	***P. pectinatus***	**1-2**	**1**	**1-2**

TABLE 4
Silver Lake Aquatic Plants (1996, 2000, and 2005)

Common Name	Scientific Name	1996 Density	2000 Density	2005 Density
Narrowleaf pondweed	***P. spp.***	**1-3**	**--**	**1-3**
Bladdwort	***Utricularia spp.***	**--**	**1**	**1**
Coontail	***Ceratophyllum demersum***	**1-2**	**1-2**	**1-3**
Elodea	***Elodea Canadensis***	**1**	**1-2**	**1-3**
Wild rice	***Zizania aquatica***	**--**	**1**	**1-2**
Floating Leaf Plants				
White waterlily	***Nymphaea turberosa***	**--**	**--**	**--**
Greater duckweed	***Spirodela polyrhiza***	**--**	**--**	**--**
Lesser duckweed	***Lemna minor***	**--**	**--**	**--**
Emergent Plants				
Bulrush	***Scirpus spp.***	**--**	**--**	
Cattail	***Typha spp***	**--**	**--**	**--**
Purple loosestrife	***Lythrum salicaria***	**--**	**--**	**--**

According to the 2003 UAA, macrophytes were identified to a relative depth of 4-6 feet for these surveys. In some areas, the submerged plants were dominated by a dense growth of coontail (*Ceratophyllum demersum*, a native species) in June and August. Curly-leaf pondweed (*Potamogeton crispus*) was also identified in some areas among the submerged plants in June but appears to die off later in the summer as it is not present in the August surveys. Curly-leaf pondweed is an undesirable non-native species. It frequently replaces native species in lakes and exhibits a dense growth that may interfere with the recreational use of a lake. A dense growth also creates a refuge for small fish, making it difficult for larger fish, such as bass, to find and capture the small fish they need for food. Purple loosestrife (*Lythrum salicaria*), an undesirable exotic species, was identified among the emergent plants in some areas. This plant should be controlled because it can replace cattails (*Typha sp.*) and subsequently destroy that wildlife habitat.

1.2.4 Water-Based Recreation

Silver Lake is used by riparian residents for canoeing and aesthetic viewing. Riparian residents report that snapping turtles living in the lake prevent swimming as the presence of the turtles would be unsafe for swimmers. The lake has no public access.

1.2.5 Fish and Wildlife Habitat

MN DNR discontinued stocking of the lake in 1943. The DNR currently believes the lake does not hold permanent gamefish and is unsuitable for game fish. Silver Lake is classified by the U.S. Fish and Wildlife Service as a Type 25 wetland, indicating it is comprised of

shallow open water. Silver Lake provides habitat for seasonal waterfowl, such as ducks and geese. MN DNR recommends management of the lake to maintain or improve its wetland function. Hence, the recommended management focus of Silver Lake is the preservation of its current habitat and aquatic life community.

1.2.6 Natural and Urban Drainage Systems

1.2.6.1 Natural Conveyance Systems

The natural inflow to Silver Lake is comprised of stormwater runoff from its direct watershed and groundwater discharge. There are no streams or rivers that convey flow to Silver Lake.

1.2.6.2 Stormwater Conveyance Systems

The stormwater conveyances to Silver Lake were investigated in the 2003 UAA, and the findings are presented below.

1.2.6.3 Public Ditch Systems

There are no public ditch systems that affect Silver Lake.

1.2.7 Water Appropriations

There are no known water appropriations from Silver Lake.