2005 Lake Water Quality Study

Northwood Lake, Sweeney Lake, and Twin Lake

Prepared by
Bassett Creek Watershed Management Commission

February 2006

Bassett Creek Watershed Management Commission
www.bassettcreekwmo.org

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BARR

4700 West 77th Street

Minneapolis, MN 55435-4803

Phone: (952) 832-2600

Executive Summary

Since 1970, water quality has been monitored in ten major lakes under the management of the Bassett Creek Watershed Management Commission (Commission). The main objective of this program is to detect changes or trends in lake water quality over time that will help determine the effects from changing land use patterns within the watershed as well as the Commission's efforts to maintain and improve water quality. The Bassett Creek Watershed Management Commission adopted its current watershed management plan in 2004. The second generation plan complies with the provisions of the Minnesota Rules Chapter 8410, the Metropolitan Surface Water Management Act, the Water Resources Management Policy Plan, and other regional plans. The Commission's Plan sets the vision and guidelines for managing surface water within the boundaries of the BCWMC.

This report summarizes the results of water quality monitoring during 2005 in Northwood Lake in New Hope and Sweeney and Twin Lakes in Golden Valley. The lakes were monitored for both chemical (Appendix A) and biological (Appendices B and C) water quality parameters, the latter including phytoplankton, zooplankton and macrophytes (aquatic plants). Monitoring results are summarized by lake and include a description of the results along with graphical representations of the data.

The conclusions from 2005 water quality monitoring are as follows:

Northwood Lake

- Water quality status of Northwood Lake was eutrophic (nutrient rich) to hypereutrophic (very nutrient rich) during the 2005 growing season. The lake was slightly degraded when compared to the 2000 monitoring period, but was within the range of variability seen since 2000. The lake was treated with barley straw during 2000 through 2003. Treatment was discontinued after the 2003 growing season.

- Secchi disc transparency reached the bottom of the lake at both sampling stations (1.25 m) during most of the season.

- Summer averages of chlorophyll *a* (47.1 µg/L) and total phosphorus (177.5 µg/L) were elevated when compared to 2000 (chlorophyll *a* of 17.4 µg/L and total phosphorus of 120 μg/L) but were well below historical highs detected in 1977 (chlorophyll *a* of 170 μg/L) and 1982 (total phosphorus of 437 μg/L).

- Based on average summer Secchi disc transparency, the recreational suitability index for Northwood Lake is 4, indicating recreational use impairment by algae in the lake.

- Similar to the 2000 macrophyte survey, macrophytes (aquatic plants) were detected throughout the lake in 2005. Macrophytes became established in the lake in 2000 when water clarity increased due to barley straw treatment. Although barley straw treatment was discontinued after the 2003 growing season, macrophytes continue to be present in the lake.

- Northwood Lake is classified as a Level II water body—appropriate for all recreational uses except full body contact activities. The level II goals are: (1) average summer total phosphorus concentration not to exceed 45 μg/L, (2) average summer chlorophyll *a* concentration not to exceed 20 μg/L, and (3) average Secchi disc transparency of at least 1.4 meters. In 2005, the average summer total phosphorus concentration was 177.5 μg/L , the average chlorophyll *a,* concentration was 47.1 μg/L, and the average Secchi disc transparency was 1.1 meters. Northwood Lake did not meet goals 1 and 2, but would have likely met goal 3, if the water depth at the sampling stations had been deep enough.

- Historical records indicate water quality declined during 2000 through 2005, but generally remains improved when compared to years previous to 2000.

Sweeney Lake

- According to the averages of the three nutrient related parameters (total phosphorus, chlorophyll *a*, and Secchi depth), the water quality status of Sweeney Lake was eutrophic (nutrient rich) during the 2005 growing season

- Both chlorophyll *a* and Secchi depth improved when compared to the 2000 sampling season whereas total phosphorus was slightly elevated

- Macrophytes (aquatic plants) were abundant on both sampling dates and curlyleaf pondweed (an exotic, invasive species) was present in heavy densities during the June survey whereas purple loosestrife, another exotic, invasive species, was detected in the August survey

- Based on average summer Secchi disc transparency, the recreational suitability index for Sweeney Lake is 3, indicating slight recreational use impairment by algae in the lake.

- Despite improvements, Sweeney Lake did not meet Level I water quality goals for total phosphorus (average summer concentration not to exceed 30 µg/L), chlorophyll *a* (average summer concentration not to exceed 10 µg/L), or Secchi disc transparency (average summer depth of at least 2.2 meters) in 2005. The lake's average summer total phosphorus concentration was 52.6 µg/L, average summer chlorophyll *a* concentration was 19.4 µg/L, and average summer Secchi depth was 1.8 meters.

- Historical records indicate the lake's 2005 water quality was substantially better than the lake's 1982 water quality and was also better than the lake's 2000 water quality.

Twin Lake

- Water quality status for Twin Lake was in the mesotrophic range (i.e. moderate level of nutrients) during the summer of 2005. The lake has the best water quality of the lakes discussed in this report.

- Despite the lake's good water quality throughout the summer period, the lake noted a brief period of poor water quality during the spring of 2005. The lake's trophic status during April of 2005 ranged from eutrophic (nutrient rich) to hypereutrophic (very nutrient rich). Internal loading likely contributes to unusually poor water quality in spring due to mixing of water containing high levels of phosphorus during spring turnover. A spring algal bloom used up the lake's excess phosphorus and the lake's water quality was good by summer. Because the lake's goals are based upon average summer conditions, the lake's poor spring water quality did not prevent goal attainment. The lake's good water quality throughout the summer period met the lake's goals.

- Historical records back to 1972 indicate water quality has remained relatively constant since water quality improvement occurred between the 1982 and 1992 sampling seasons.

- Based on average summer Secchi disc transparency, the recreational suitability index for Twin Lake is 1, indicating no recreational use impairment by algae in the lake.

- A healthy macrophyte (aquatic plants) community was observed on both the June and August sampling dates. Curlyleaf pondweed, an undesirable, exotic, invasive species detected in 2000, was not found in 2005.

- Twin Lake water quality during summer 2005 met Level I water quality goals for total phosphorus (average summer concentration not to exceed 30 µg/L), chlorophyll *a* (average summer concentration not to exceed 10 µg/L), and Secchi disc transparency (average summer depth of at least 2.2 meters) in 2005. The lake's average summer total phosphorus concentration was 20.8 µg/L, average summer chlorophyll *a* concentration was 3.6 µg/L, and average summer Secchi depth was 3.7 meters.

2005 Lake Water Quality Study
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1.0 Introduction

The policy of the Bassett Creek Watershed Management Commission (Commission) is to preserve and improve (where possible) water quality of surface water runoff, and of lakes and streams within the Bassett Creek watershed. To accomplish this, a program was established in 1970 to monitor lake water quality in ten major lakes under the supervision of the Commission. The objective of the program is to detect changes in water quality over time, thereby determining in-lake effects from both changing land use patterns and efforts by the Commission to maintain water quality in the lakes. Non-point source pollution is the predominant external factor causing lake water quality degradation within the Bassett Creek watershed area.

The Commission established an annual lake water monitoring program in 1991 that generally followed Metropolitan Council recommendations (Osgood 1989a) for a "Level I, Survey and Surveillance" data collection effort. The lake sampling program monitors ten lakes on a four-year, rotating basis and includes three to four lakes per year. Major lakes are listed below with prior monitoring years in parenthesis:

- Crane (1977, 1982, 1993, 1997, 2001)
- Medicine (1977, 1982, 1933, 1984, 1988, 1994[1], 1999[1])
- Parker's (1977, 1982, 1992, 1996, 2000)
- Sweeney (1977, 1982, 1985, 1992, 1996, 2000, 2005)
- Westwood (1977, 1982, 1993, 1997)
- Lost (1977, 1982, 1993, 1997)
- Northwood (1972, 1977, 1982, 1992, 1996, 2000, 2005)
- Sunset Hill, Cavanaugh (1977, 1982, 1994, 1998)
- Twin (1977, 1982, 1992, 1996, 2000, 2005)
- Wirth (1977, 1982)

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[1] Joint monitoring with Three Rivers Park District (Formerly Hennepin Parks)

Wirth Lake is currently monitored by the Minneapolis Park and Recreation Board and is thus not included in the lake monitoring program performed by the Commission. The Three Rivers Parks District currently monitors Medicine Lake and is periodically assisted by the Commission.

The lake sampling program also monitors other selected water bodies (years sampled in parenthesis) on a more limited basis including:

- Courtland, East Ring, and West Ring Ponds (1993)
- Grimes Pond (1996)
- North Rice and South Rice Ponds (1994, 1998)

This report presents the results of water quality monitoring of Northwood, Sweeney and Twin Lakes in 2005 (Figure 1). Each lake was monitored for chemical (Appendix A) and biological (Appendices B and C) water quality parameters, the latter including phytoplankton, zooplankton and macrophytes (aquatic plants). Results are summarized by lake and include a description of results for each lake along with a graphical representation of collected data.

Water quality is generally defined by three main, nutrient related indicators: total phosphorus (TP), chlorophyll *a*, and Secchi disc transparency (Secchi depth). Chlorophyll *a* is the primary photosynthetic pigment found in phytoplankton (algae) in lakes and is indicative of the amount of algae present in the water column. Phosphorus is the limiting nutrient in most freshwater lakes and therefore controls the growth of algae. Increased algal growth lowers the water clarity, or Secchi depth, in a lake. Thus, both total phosphorus and chlorophyll *a* are related to the water clarity (Secchi disc transparency) in a lake. Water quality conditions were categorized using a trophic state scale that is based on total phosphorus concentration, chlorophyll concentration, and Secchi depth (Table 1).

P:23\27\051\Graphics_Figures\Lakes included in 2005 WQ Study.CDR RLG

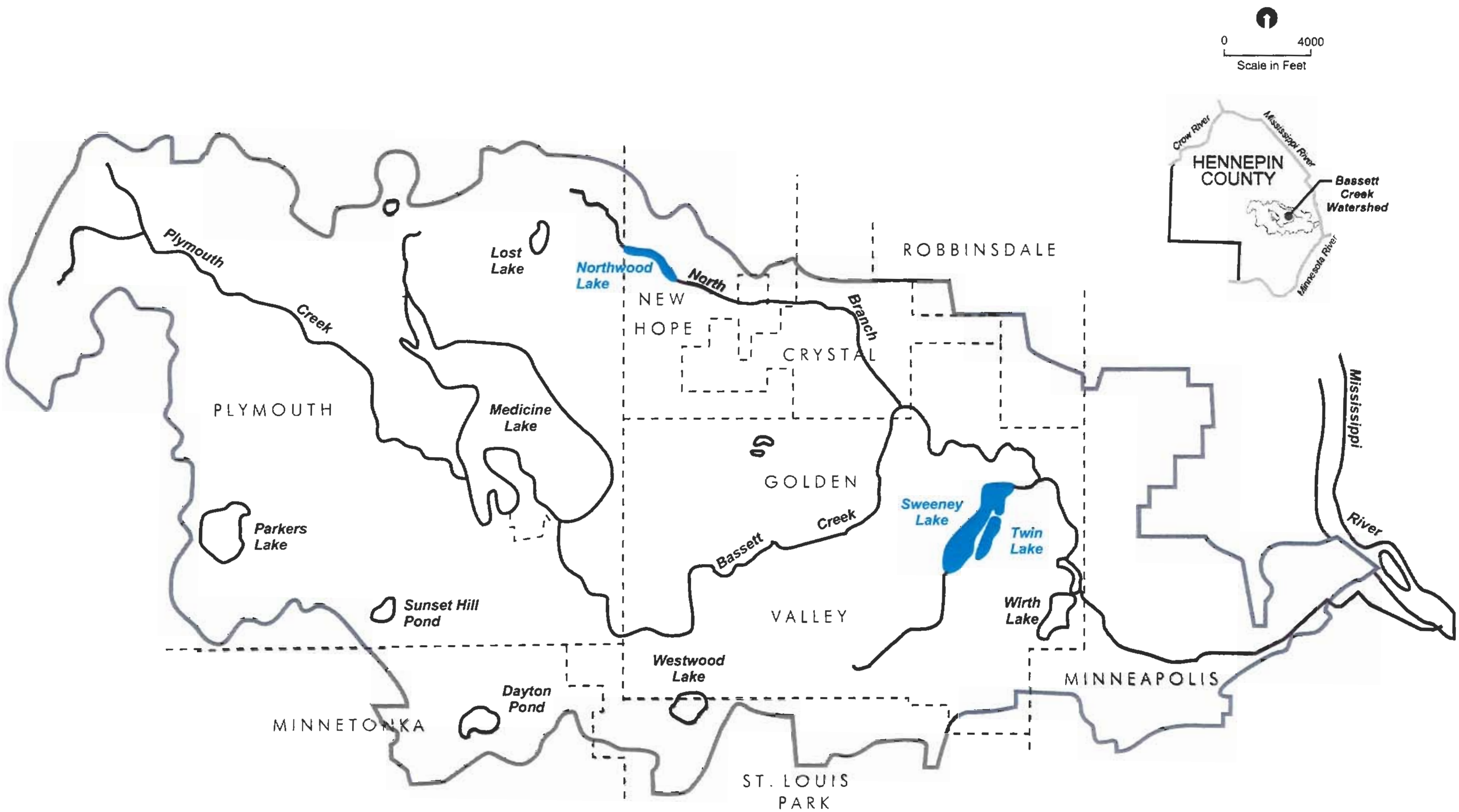


Figure 1

LOCATION OF LAKES INCLUDED IN
2005 WATER QUALITY STUDY
Identified in Blue)

Table 1
Trophic State Classifications for Total Phosphorus, Chlorophyll a, and Secchi Disc Transparency.

Lake Classification	Total Phosphorus	Chlorophyll *a*	Secchi Disc Transparency
Oligotrophic (nutrient poor)	Less than 10 µg/L	Less than 2 µg/L	Greater than 15 ft (4.6 m)
Mesotrophic (moderate nutrient levels)	10 µg/L– 24 µg/L	2 µg/L – 7.5 µg/L	15 ft. –6.6 ft. (4.6 m –2.0 m)
Eutrophic (nutrient rich)	24 µg/L – 57 µg/L	7.5 µg/L – 26 µg/L	6.6 ft. –2.8 ft. (2.0 m –0.85 m)
Hypereutrophic (extremely nutrient rich)	Greater than 57 µg/L	Greater than 26 µg/L	Less than 2.8 ft. (0.85 m)

The Recreational Suitability Index (RSI) was also calculated for each lake. The RSI is an index of recreational status in a lake and is less detailed than the trophic status scale but potentially more meaningful to lake users. The RSI is divided into 5 different categories of use impairment and parallels an index of physical condition (Table 2). Secchi disc transparency data were used to calculate the RSI, which was originally based upon empirical relationships developed by Osgood (1989b) using data from lakes in the Twin Cities Metro area.

In addition to chemically based water quality parameters, biological data were compiled and evaluated in this study as well. Phytoplankton, zooplankton and macrophyte data can help determine the health of aquatic systems and can also indicate changes in nutrient status over time. Biological communities in lakes interact with each other and influence both short- and long-term variations in observed water quality.

Table 2
Recreational Suitability Index Compared to a Physical Conditions Index.

Scale	Recreational Suitability Index	Physical Condition Index
1	Beautiful, could not be better	Crystal clear
2	Very minor aesthetic problems	Not quite crystal clear; some algae visible
3	Swimming and aesthetic enjoyment slightly impaired	Definite color caused by algae
4	Desire to swim and level of enjoyment substantially reduced	High algal levels with limited clarity and/or mild odor apparent
5	Swimming and aesthetic enjoyment nearly impossible because of algae	Severely high algal levels; includes massive floating scums, strong foul odor, or fish-kill

Source: Osgood, 1989b

Phytoplankton (algae) – form the base of the food web in lakes and directly influence fish production and recreational use. Chlorophyll *a*, the main pigment found in algae, is a general indicator of algal biomass in lake water. The identification of species and their abundance provides additional information about the health of a lake and can indicate changes in lake status as algal populations change over time. Different algal species provide varying levels of "food quality" and thus can affect the growth of zooplankton in a lake. Larger algal species that are difficult to consume or those of low food quality are less desirable for zooplankton and can limit overall productivity in a lake.

Zooplankton (microscopic crustaceans) – are the main consumers of phytoplankton and are food themselves for many fish species. A healthy zooplankton community increases the viability of a fishery and the general health of a lake. Zooplankton are generally comprised of three groups: Cladocera, Copepoda, and Rotifera. If present in abundance, large Cladocera can substantially decrease the amount of algae and improve water transparency within a lake.

Macrophytes (vascular aquatic plants) – grow in the shallow (littoral) area of a lake. Macrophytes are a natural part of lake communities and provide many benefits to fish, wildlife and people. Macrophytes are primary producers in the aquatic food web, providing food for other life forms in and around the lake.

2.0 Methods

2.1 Water Quality Sampling

Samples were collected from representative lake sampling stations (i.e., located at the deepest location(s) in each lake basin) on at least 6 occasions. Twin Lake samples were collected from one basin and Sweeney Lake and Northwood Lake samples were collected from two basins. The lakes were generally monitored from April through September as follows:

- One sample was collected within two weeks of ice out
- One sample was collected in mid-June
- One sample was collected in mid-July
- One sample was collected in the first week of August
- One sample was collected in the third week of August
- One sample was collected during the first week of September

Table 3 lists the water quality parameters and specifies at what depths the samples or measurements were collected. Dissolved oxygen, temperature, specific conductance, pH, and Secchi disc transparency (Secchi depth) were measured in the field, water samples were analyzed in the laboratory for total phosphorus, soluble reactive phosphorus, total nitrogen, and chlorophyll *a*. Sampling and analysis of water quality parameters were completed by Three Rivers Park District. Phytoplankton and zooplankton samples were collected by Three Rivers Park District (see ecosystem data) and were delivered to Barr Engineering for analysis.

2.2 Ecosystem Data

Ecosystem data were collected from April to September 2005. Phytoplankton and zooplankton samples were collected by Three Rivers Park District and analyzed by Barr Engineering.

- **Phytoplankton—**A composite 0-2 meter sample was collected during each water quality sampling event from Sweeney and Twin and a 0-1 meter sample was collected from Northwood Lake during the period from April thorough September. All samples were analyzed.

- **Zooplankton**—A zooplankton sample was collected (i.e., bottom to surface tow) during each water quality sample event during the period April through September. All samples were analyzed.
- **Macrophytes**—Macrophyte surveys were completed during June and August.

Table 3
Lake Water Quality Parameters

Parameters	Depth (Meters)	Sampled or Measured During Each Sample Event
Dissolved Oxygen	Surface to bottom profile at one meter intervals	X
Temperature	Surface to bottom profile at one meter intervals	X
Specific Conductance	Surface to bottom profile at one meter intervals	X
Secchi Disc	—	X
Total Phosphorus	0-2 Meter Composite Sample for Sweeney and Twin, 0-1 Meter Composite Sample for Northwood	X
Total Phosphorus	For Sweeney and Twin, one sample above the thermocline, one below the thermocline, and one near bottom sample from 0.5 meters above the bottom. For Northwood Lake, one near bottom sample from 0.5 meters above the bottom	X
Soluble Reactive Phosphorus	0-2 Meter Composite Sample for Sweeney and Twin, 0-1 Meter Composite for Northwood	X
Total Nitrogen (or Nitrogen Species Needed to Determine Total Nitrogen)	0-2 Meter Composite Sample for Sweeney and Twin, 0-1 Meter Composite for Northwood	X
pH	0-2 Meter Composite Sample for Sweeney and Twin, 0-1 Meter Composite for Northwood	X
pH	For Sweeney and Twin, one sample above the thermocline, one below the thermocline, and one near bottom sample from 0.5 meters above the bottom. For Northwood Lake, one near bottom sample from 0.5 meters above the bottom	X
Chlorophyll *a*	0-2 Meter Composite Sample for Sweeney and Twin, 0-1 Meter Composite for Northwood	X

3.0 Northwood Lake

3.1 Site Description

Northwood Lake is located along the North Branch of Bassett Creek, south of Rockford Road and immediately west of Highway 169 in the city of New Hope (Figure 1). It has a water surface area of 15 acres (6.1 hectares), a maximum depth of 5 feet (1.5 meters), and a mean depth of 2.7 feet (0.8 meters). Because of the shallow nature of the lake, the entire area is considered to be littoral (shallow). The Northwood Lake watershed area is approximately 1,341 acres (543 hectares), excluding the Northwood Lake water surface area. The watershed lies within the Cities of Plymouth and New Hope, the latter being fully developed. The lake formerly consisted of the North Branch of Bassett Creek and surrounding wetland area. During the early 1960s the basin was dredged and the water leveled raised creating Northwood Lake.

Northwood Lake has been designated by the DNR as a Type V wetland (DNR designation #627P). Type V wetlands typically have a water depth of less than 10 feet, may contain submergent vegetation species and may be fringed by emergent vegetation. The Northwood Lake shoreline is developed with single family homes, except for a short stretch that abuts highway 169 and a section within Northwood Park on the northeastern shore. Most of the residential lawns extend to the water's edge and approximately 15 to 30 percent of lakeshore property owners have installed riprap. The Northwood Lake outlet consists of a two-stage weir and a 48-inch reinforced concrete pipe that discharges from the southeast side of the lake under Boone Avenue.

Most of the lakeshore residents use Northwood Lake for aesthetics and wildlife viewing, however, the lake is also used for fishing and boating. Geese and duck populations have summered on Northwood Lake in the past and appear to graze heavily on Northwood Park lawns.

The Northwood Lake Watershed and Lake Management Plan was completed in June 1996 by the Commission (Barr 1996). The watershed of the lake was divided into four drainage districts to help evaluate nutrient loading to the lake and for recommendations of appropriate best management practices. Recommendations included (1) construction or improvement of wet detention basins within each drainage district to increase the removal of phosphorus from stormwater, (2) a study of the lake's fishery to estimate phosphorus loading by benthivorous fish, (3) a study of waterfowl which reside in Northwood Lake to calculate the dissolved phosphorus load entering the lake from waterfowl, and (4) monitoring to estimate the internal phosphorus load released from the lake's sediments. The Plan indicated water quality goal attainment may not be possible for Northwood Lake.

In 2000, the City of New Hope implemented a new management technique for clearing lake waters to improve the water clarity of Northwood Lake. Barley straw was carefully placed at pre-determined locations throughout the lake. The theory for the barley straw's ability to improve water clarity is as follows. As barley straw decays, it apparently adds a substance to the lake's water, which inhibits algal growth, despite the presence of high concentrations of phosphorus. The use of barley straw during 2000 greatly improved the lake's water transparency and the lake was transparent to its bottom. Sunlight reaching the lake's bottom enabled macrophytes to grow and two species of plants were observed in 2000. It was noted that visual inspection during the 2000 growing season indicated a substantial decline in algal mats when compared to previous years. A similar treatment in Valley Lake, Lakeville had beneficial results in terms of lake water quality. Barley straw treatment of Northwood Lake continued annually during 2000 through 2003 and was discontinued after the 2003 growing season.

Lake water quality monitoring has continued as part of the Citizen Assisted Monitoring Program (CAMP).

3.2 Water Quality

Northwood Lake was sampled seven times during 2005 in two locations (North and South sampling stations) corresponding to the deepest points in the lake. Water quality data (Appendix A) for Northwood Lake include:

- Vertical profiles of temperature, dissolved oxygen concentration, specific conductivity, and pH
- 0-1 m composite samples analyzed for chlorophyll *a*, total phosphorus, soluble reactive phosphorus, and total nitrogen
- Total phosphorus at mid depth on one occasion and at near bottom on all occasions

- Secchi disc transparency

Temperature and dissolved oxygen concentration indicate the lake water is generally mixed throughout the growing season (polymictic) with intermittent periods of stagnation and stratification despite bubble aerators operating during the summer (Appendix A). This is similar to data collected during the 1996 study when periods of stratification (and dissolved oxygen depletion) were detected. In the 2000 study, stratification was not evident during any of the sample periods. During longer periods of stratification, iron, a key phosphorus sorption element in soil, becomes reduced causing it to release phosphorus into the water column. When stratification and dissolved oxygen depletion were evident during the 2005 sampling season, total phosphorus was not higher in the near bottom sample (i.e., collected near the sediment surface) indicating the stratification was recently developed.

Total phosphorus, chlorophyll *a* and Secchi depth data are graphically summarized in Figure 2.

Summer average total phosphorus at the north and south sampling stations averaged 168 µg/L and 187 µg/L, respectively, and was in the hypereutrophic (very nutrient rich) range for lake trophic status. The lake-wide summer average total phosphorus was 178 µg/L. Higher total phosphorus concentrations were observed during June and lower concentrations occurred during April and during July through September. Above average precipitation during June likely resulted in increased volumes of stormwater runoff to the lake. The increased stormwater in June likely conveyed higher nutrient loads to the lake than occurred during April and during the July through September period. Despite fluctuations, the lake's total phosphorus concentrations were high throughout the growing season and suggested the lake has the potential for dense algal blooms.

Summer average chlorophyll *a* averaged 58 µg/L and 37 µg/L in the north and south sampling stations, respectively. The lake-wide summer average chlorophyll *a* was 47 µg/L, and was in the hypereutrophic (very poor water quality) range for lake trophic status. Higher chlorophyll *a* concentrations occurred during June and lower concentrations occurred during April and during July through September. Despite fluctuations in chlorophyll *a*, concentrations throughout the growing season were high and suggested problematic algal blooms were present in the lake.

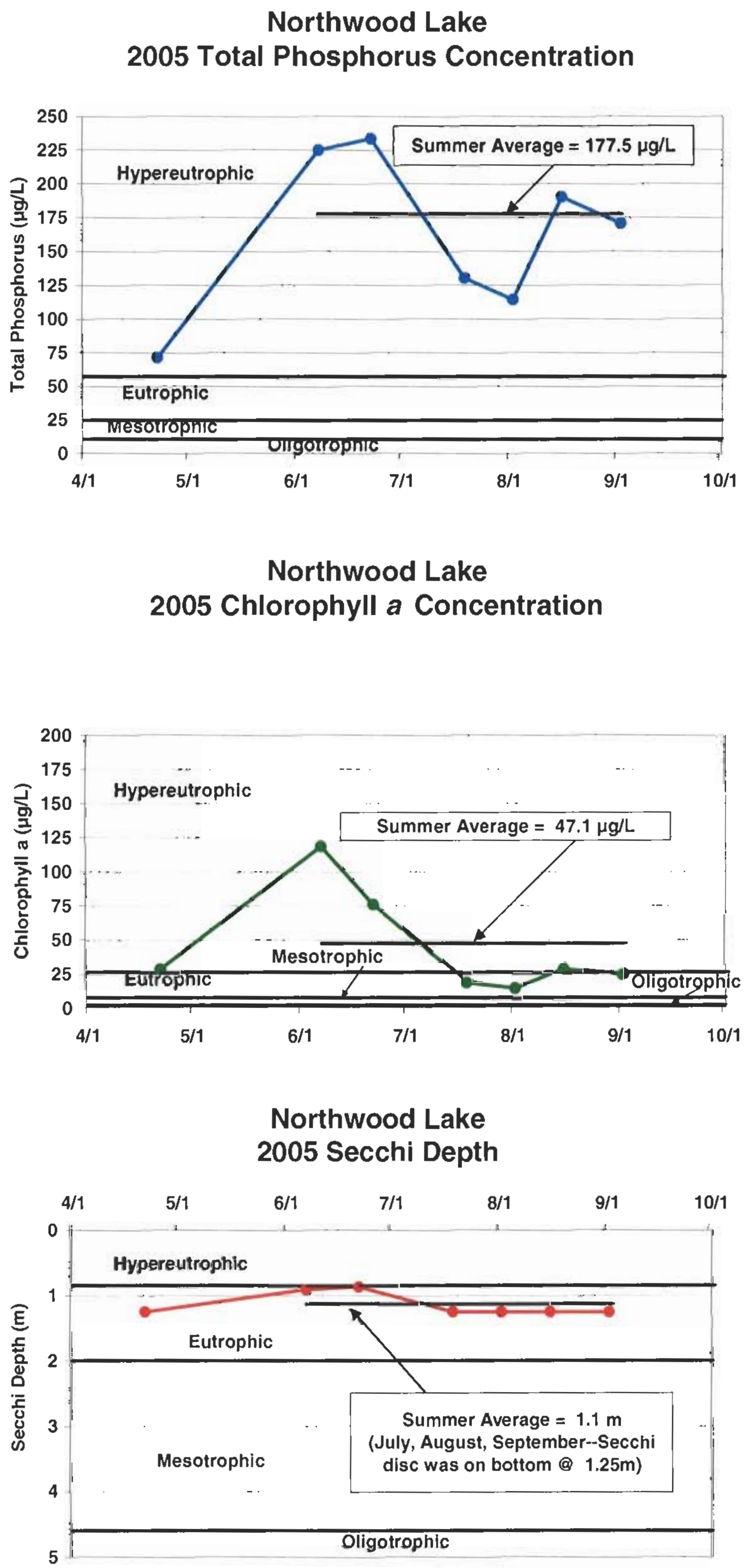


Figure 2 Nutrient Related Water Quality Parameters in Northwood Lake 2005.

Summer average Secchi depth was 1.1 meters in both the north and south sampling stations. This is likely an underestimate of true water clarity because only two of the seven measurements were taken at less than the maximum depth of the lake. These two measurements occurred during June when highest total phosphorus and chlorophyll a concentrations were observed.

3.3 Historical Trends

Historical water quality data is available for the growing seasons of 1972, 1977, 1982, 1992, 1996 and 2000 (Figure 3). The growing season mean (average, June through September) was used for year to year consistency to illustrate historical trends. Water quality in Northwood Lake declined somewhat when compared to the 2000 sampling season, but remained better than water quality during the 1996 sampling season.

Because an extra sample was collected in June 2005 (2 samples) when compared to the 2000 collection (1 sample), the following method was used to compute the 2005 summer average to compare with the 2000 summer average. The two samples from June 2005 were averaged to give one data point for June. The June data point was then used to compute the 2005 summer average so comparisons between years would not be affected by differences in sample frequency. A comparison of the 2005 and 2000 summer averages follows.

The 2005 summer lake-wide average total phosphorus was 151 µg/L. This value is 25% higher than the average total phosphorus in 2000 (121 µg/L), but was unchanged from the CAMP sampling average total phosphorus for 2004 (151 µg/L) (Anhorn 2005). The 2005 lake-wide chlorophyll *a* average of 30.5 µg/L was nearly double that measured in 2000 (17 µg/L) and was also higher than the average of 19 µg/L detected by CAMP monitoring in 2004. Average summer Secchi depth was near the maximum lake depth for both bays and averaged 1.2 m in both the north and south portions of the lake. This is lower than the 2000 average of 1.3 meters, but is likely an underestimate of true water clarity because only one out of the 6 measurements taken was less than the maximum depth of the lake.

There was a general decline in observed water quality when comparing 2000 and 2005. Compared to years previous to 2000, however, lake water quality generally remains improved. According to data collected by the CAMP program (Anhorn 2005), 2005 water quality generally remains within the range observed since inception of barely straw treatment (indicated by a dashed line in Figure 3) in 2000. Although barley straw treatment was discontinued at the end of the 2003 growing season, the lake's water quality continues to be improved when compared to years previous to 2000.

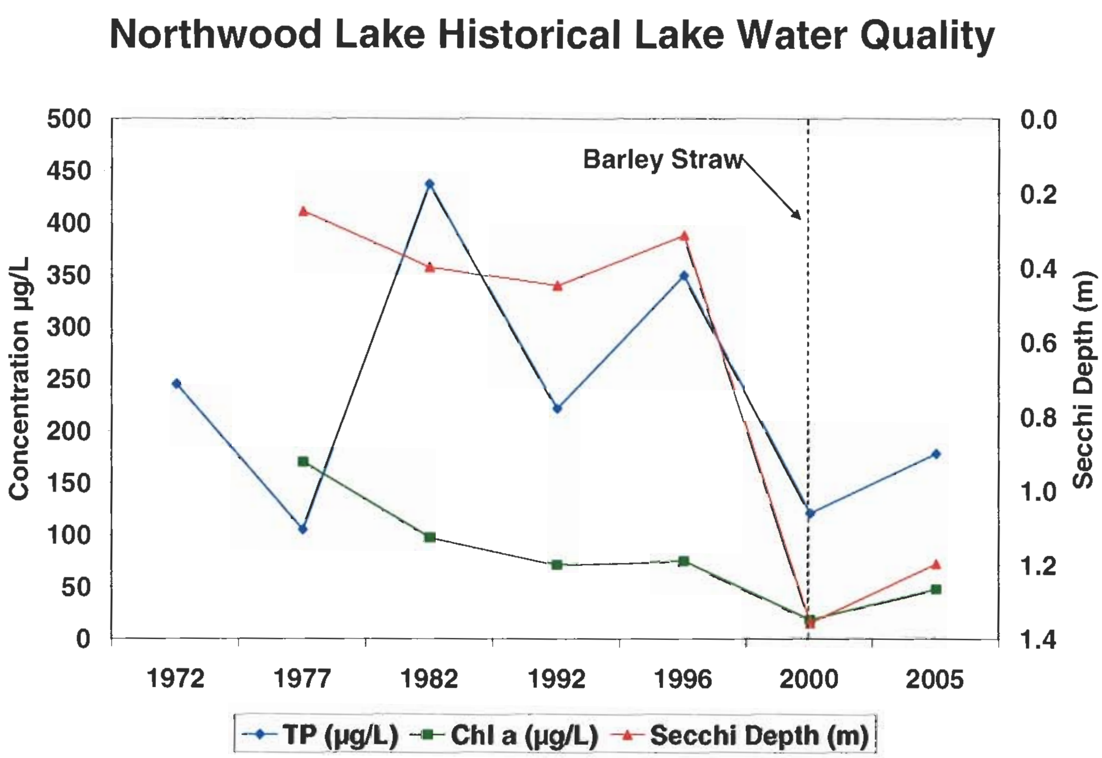


Figure 3 Historical Water Quality Data in Northwood Lake

3.4 Recreational Suitability

Based on average summer Secchi disc transparency readings in Northwood Lake, the recreational suitability index (RSI) was 4, indicating recreational use impairment by algae in the lake. As noted previously however, all but one of the Secchi disc measurements were at the bottom of the lake during the summer indicating an average Secchi depth greater than the maximum depth of the lake. Therefore, the RSI based on Secchi depth is not a suitable indicator of water quality in this case (i.e. it will underestimate lake water quality).

3.5 Biota

Three components of lake biota are presented herein: phytoplankton, zooplankton, and macrophytes. Fisheries status is managed by the Department of Natural Resources and is not covered in this report.

3.5.1 Phytoplankton

Phytoplankton, also called algae, are single celled aquatic plants naturally present in 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 eaten by fish. A phytoplankton population in balance with the lake's zooplankton 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, reduce the lake's water clarity.

The 2005 phytoplankton data confirmed the presence of algal blooms throughout the lake. Highest numbers of phytoplankton occurred during the April through June period and lower numbers were observed during July through September (See Figures 4 and 5).

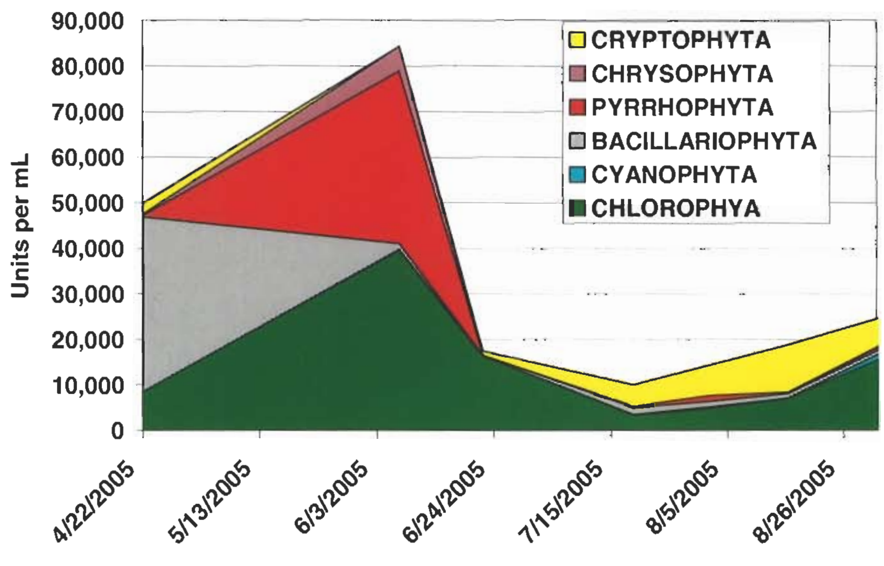


Figure 4 2005 Northwood Lake (North Basin) Phytoplankton Data Summary by Division

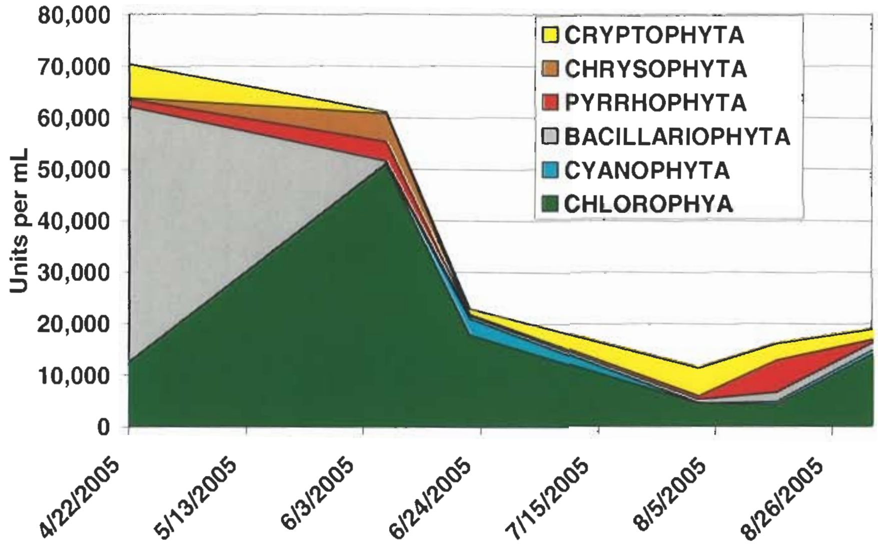


Figure 5 2005 Northwood Lake (South Basin) Phytoplankton Data Summary by Division

3.5.2 Zooplankton

Zooplankton are microscopic animals that feed on particulate matter, including algae, and are, in turn, eaten by fish. Healthy zooplankton communities are characterized by balanced densities (number per meter squared) of the three major groups of zooplankton: Cladocera, Copepods, and Rotifers. Fish predation, however, may alter community structure and reduce the numbers of larger bodied zooplankters (i.e., larger bodied Cladocera).

All three groups of zooplankton were well represented in Northwood Lake during 2005 (See Figures 6 and 7). However, small bodied zooplankters dominated the community throughout the growing season. The low numbers of large-bodied zooplanters in the lake result from fish predation. The lake is shallow and there is no "refuge" for the zooplankters to hide from fish predation. Hence, fish predation removes the larger animals leaving smaller animals to dominate the community. Larger numbers of zooplankton were observed at the south sampling location than the north sampling station during the spring and late summer periods.

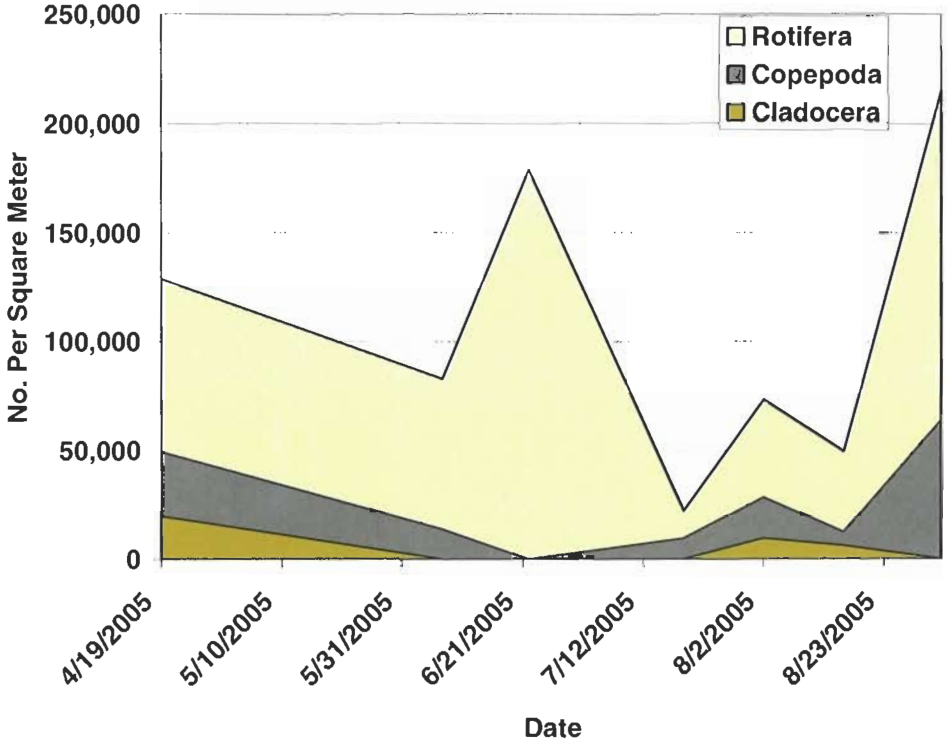


Figure 6 2005 Northwood Lake (North Basin) Zooplankton Data Summary by Division

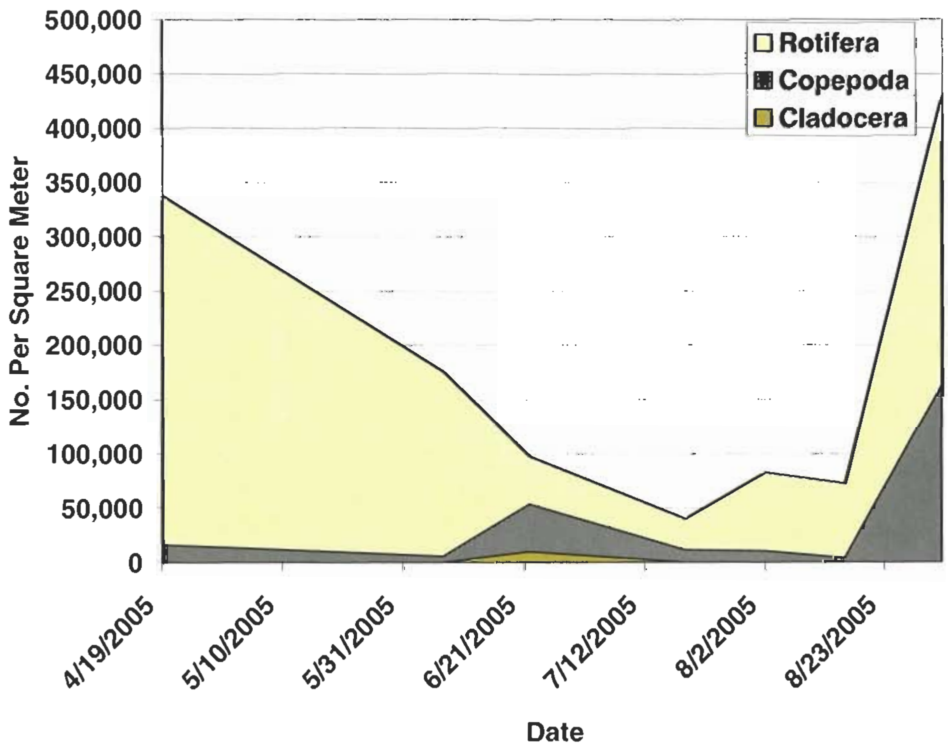


Figure 7 2005 Northwood Lake (South Basin) Zooplankton Data Summary by Division

3.5.3 Macrophytes

Prior to 2000, no macrophytes (aquatic vegetation, also called aquatic weeds) were observed in Northwood Lake during lake surveys completed by the Commission. Plants in the lake consisted of microscopic one-celled plants called algae that grew so densely that the lake appeared green in color and was very cloudy. The dense algal blooms reduced water transparency in the lake to about 0.5 meters (about 20 inches) in June and to 0.2 to 0.3 meters during July and August (about 8 to 12 inches). The green color of the algal cells shaded the lake bottom and prevented plants from growing. Surveys of the lake prior to 2000 indicated the lake was cloudy, green in color, and no macrophytes were growing in the lake.

The use of barley straw during 2000 appeared to greatly improve the lake's water transparency and the lake was transparent to its bottom. Sunlight reaching the lake's bottom enabled macrophytes to grow. In 2000, two species of macrophytes were observed in the lake. A narrow leaf pondweed, *Potamogeton sp.*, was found throughout the lake in light growth. Coontail, *Ceratophyllum demersum*, was found primarily in the northern portion of the lake. Barley straw was used during the 2000 through 2003 growing seasons.

On August 6, 2003, an evaluation of the lake by the City of New Hope indicated the same two plant species observed during 2000 were again observed in 2003. However, coontail was observed throughout the lake during 2003. The changes in coontail coverage in the lake during the 4-year barley straw treatment program indicated improved light conditions resulted in increased coontail coverage. The use of barley straw was discontinued after the 2003 growing season.

In 2005, the number of plant species in the lake doubled and four plant species were observed in the lake. The same 2 species observed in 2000 and 2003 (narrowleaf pondweed and coontail) were observed throughout the lake in 2005. In addition, Elodea, *Elodea canadensis*, and curlyleaf pondweed, *Potamogeton crispus*, were observed throughout the lake in 2005. During the survey conducted on June 21st 2005, submerged plants were found throughout the lake and emergent aquatic vegetation were found along the lake's shore (Figure 8). Along with native species in the lake, the non-native, invasive species *Potamogeton crispus* (curlyleaf pondweed) was detected as well. Curlyleaf pondweed can increase phosphorus concentrations during summer months because it begins to die back at mid-season.

During the August 18th survey, submerged plants were found throughout the lake and emergent plants were found along the lake's shore (Figure 9). As expected, curlyleaf pondweed was much less dense throughout the lake in August as compared to June. Curlyleaf pondweed dies in late June or early July and a new growth begins in August.

Algal mats were present in both the June and August surveys. Algal mats were also present during 2000 and 2003. Improved light conditions have affected both macrophytes and algal mats in the same way. Both plants require light penetration to the lake's bottom. Filamentous algae begin growth on the lake's bottom. Oxygen produced by the plants causes the mats to rise to the water surface. An illustration to understand how oxygen buoys filamentous algal mats to the surface is the air in a life jacket that keeps a person floating at the water's surface. Individual algal filaments are a series of cells joined end to end. As the algal cells grow on the lake's bottom, the filaments stick together forming large mats. The texture of the mats may be slimy, cottony, or coarse. Eventually the mats float to the lake's surface and remain floating until death and decay occur. Algal mats become caught on aquatic vegetation, preventing the algal filaments from being washed out of the lake via its outlet. This encourages algal mats to remain in the lake and increase in coverage during the growing season.

- Macrophytes Found Throughout Entire water Body. Less Dense within Dashed Line.
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy
- Algal Mats Present.
- *Ceratophyllum demersum* is More Dense Near the Center of Entire Pond.

	Common Name	Scientific Name
Submerged Aquatic Plants:	Curlyleaf pondweed Narrowleaf pondweed Coontail Elodea	*Potamogeton crispus* *Potamogeton sp. (narrowleaf)* *Ceratophyllum demersum* *Elodea canadensis*
Floating Leaf:		
Emergent:	Bulrush Cattail Giant bur-weed Narrowleaf sedge	*Scirpus sp.* *Typha sp.* *Sparganium eurycarpum* *Carex sp.*
No Aquatic Vegetation Found:		

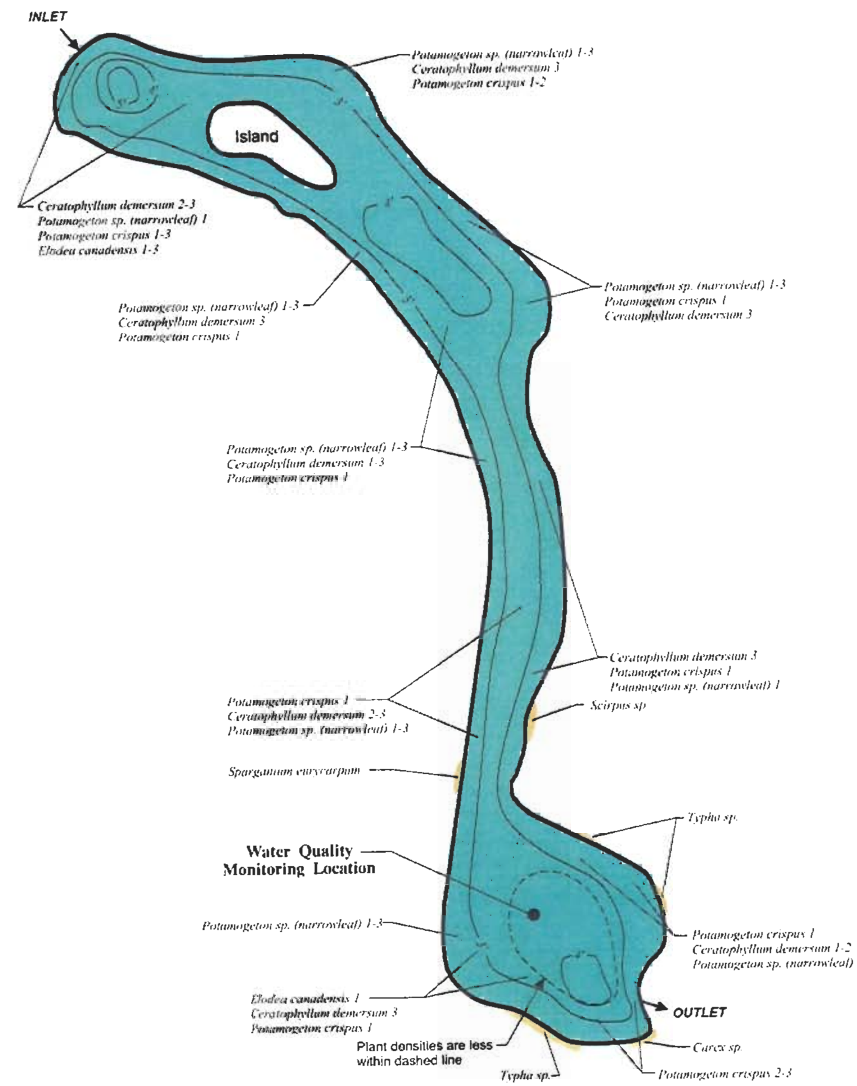


Figure 8

NORTHWOOD POND
MACROPHYTE SURVEY
JUNE 21, 2005

- Macrophytes Found Throughout Entire water Body, Less Dense within Dashed Line.
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy
- Algal Mats Present.
- *Ceratophyllum demersum* is More Dense Near the Center of Entire Pond.

	Common Name	Scientific Name
Submerged Aquatic Plants:	Curlyleaf pondweed	*Potamogeton crispus*
	Narrowleaf pondweed	*Potamogeton sp. (narrowleaf)*
	Coontail	*Ceratophyllum demersum*
	Elodea	*Elodea canadensis*
Floating Leaf:		
Emergent:	Bulrush	*Scirpus sp.*
	Cattail	*Typha sp.*
	Giant bur-weed	*Sparganium eurycarpum*
	Narrowleaf sedge	*Carex sp.*
No Aquatic Vegetation Found:		
Algal Mat:		

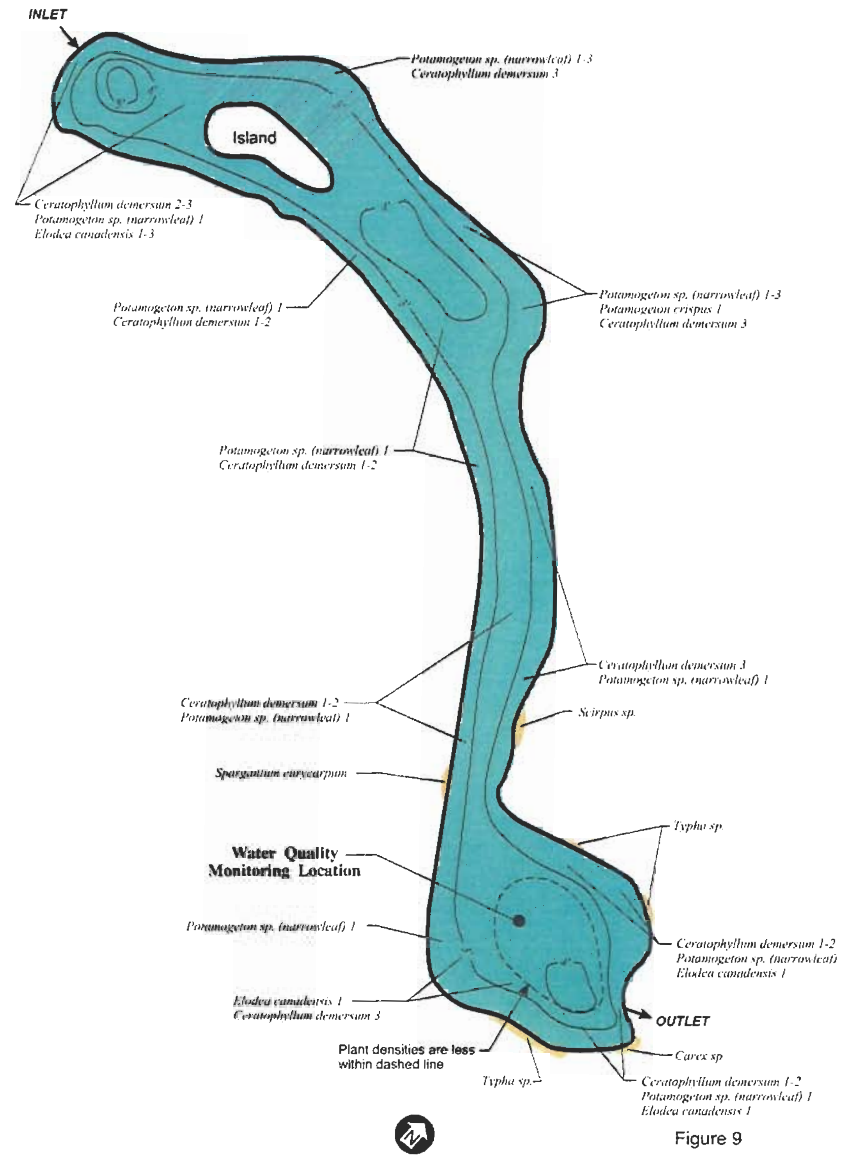


Figure 9

NORTHWOOD POND
MACROPHYTE SURVEY
AUGUST 18, 2005

P:\23\27\... Northwood Pond ... August 2005 CDR RLG 12-02-05

3.6 Conclusion

- Water quality status of Northwood Lake was eutrophic (nutrient rich) to hypereutrophic (very nutrient rich) during the 2005 growing season. The lake was slightly degraded when compared to the 2000 monitoring period, but was within the range of variability seen since 2000. The lake was treated with barley straw during 2000 through 2003. Treatment was discontinued after the 2003 growing season.

- Secchi disc transparency reached the bottom of the lake at both sampling stations (1.25 m) during most of the season.

- Summer averages of chlorophyll *a* (47.1 µg/L) and total phosphorus (177.5 µg/L) were elevated when compared to 2000 (chlorophyll *a* of 17.4 µg/L and total phosphorus of 120 µg/L) but were well below historical highs detected in 1977 (chlorophyll *a* of 170 µg/L) and 1982 (total phosphorus of 437 µg/L).

- Based on average summer Secchi disc transparency, the recreational suitability index for Northwood Lake is 4, indicating recreational use impairment by algae in the lake.

- Similar to the 2000 macrophyte survey, macrophytes (aquatic plants) were detected throughout the lake in 2005. Macrophytes became established in the lake in 2000 when water clarity increased due to barley straw treatment. Although barley straw treatment was discontinued after the 2003 growing season, macrophytes continue to be present in the lake.

- Northwood Lake is classified as a Level II water body—appropriate for all recreational uses except full body contact activities. The level II goals are: (1) average summer total phosphorus concentration not to exceed 45 µg/L, (2) average summer chlorophyll *a* concentration not to exceed 20 µg/L, and (3) average Secchi disc transparency of at least 1.4 meters. In 2005, the average summer total phosphorus concentration was 177.5 µg/L , the average chlorophyll *a,* concentration was 47.1 µg/L, and the average Secchi disc transparency was 1.1 meters. Northwood Lake did not meet goals 1 and 2, but would have likely met goal 3, if the water depth at the sampling stations had been deep enough.

- Historical records indicate water quality declined during 2000 through 2005, but generally remains improved when compared to years previous to 2000.

4.0 Sweeney Lake

4.1 Site Description

Sweeney Lake, located in the City of Golden Valley (Hennepin County), has a water surface area of approximately 67 acres (27.1 hectares), a maximum depth of 26 feet (8.0 meters) and a mean depth of 11.8 feet (3.6 meters). It is surrounded by a 2,400 acre watershed and approximately half of the lake is considered littoral (shallow) area. The Sweeney Lake branch of Bassett Creek flows into the lake on the southern end and it exits at the northern end over a concrete dam. Sweeney Lake is connected to Twin Lake by a meandering channel that runs through a cattail marsh reaching from the northeastern shore of Sweeney Lake to the northern shore of Twin Lake. Privately-owned, single family homes line the entire western and southern shorelines of Sweeney Lake. Hidden Lakes residential development and park land borders the eastern shore and the northern shore is bordered by the Golden Valley Health Center. The lake is primarily used by area residents for canoeing, boating, fishing, and aesthetic viewing purposes.

The Sweeney Lake Watershed and Lake Management Plan was completed in January 1994 by the Commission and recommended a two-phase program. Phase I included recommendations to implement watershed-wide BMPs including the construction of a wet detention pond at the outlet of the storm sewer system draining from the west into the DNR protected wetland south of Sweeney Lake which was completed in 1997. Phase II recommendations would be contingent on the evaluation of the lake's internal loading.

4.2 Water Quality

Sweeney Lake was sampled six times in the northern basin and five times in the southern basin during the 2005 growing season. Samples from both stations were averaged for each sampling date to allow comparisons to data collected in previous years. During the 2000 sampling period, samples were collected only from the southern basin, although samples were collected from both basins during 1996. Water quality data (Appendix A) for Sweeney Lake include:

- Vertical profiles of temperature, dissolved oxygen concentration, specific conductivity, and pH

- 0-2 m composite samples analyzed for chlorophyll *a*, total phosphorus, soluble reactive phosphorus, and total nitrogen

- Total phosphorus at mid depth and near bottom

- Secchi disc transparency

Vertical profiles of temperature and dissolved oxygen concentration collected during 2005 show that the lake was generally mixed with periods of low dissolved oxygen near the sediment surface (Appendix A). A portion of the deeper water (6-8 meters) in Sweeney Lake had dissolved oxygen concentrations below 5 mg/L, mainly in August. Dissolved oxygen concentrations decreased during this time to 0.2 and 0.0 mg/L in the deepest sample taken in the northern (7 m) and southern (7.5 m) basins, respectively. Panfish and gamefish species within the lake require dissolved oxygen concentrations of 5 mg/L or greater. Hence, they are unable to live in the lake's deeper waters when dissolved oxygen concentrations are less than 5 mg/L. Slightly elevated total phosphorus concentrations near the sediment surface were also detected during this period indicating internal loading of phosphorus due to oxygen depletion. The cause of the oxygen depletion in the lake is due to microbial degradation of organic material from settled algal material and stormwater inputs.

Total phosphorus, chlorophyll *a*, and Secchi depth are graphically summarized in Figure 10. Lake wide total phosphorus concentration averages ranged from 45 µg/L (August) to 68 µg/L (June) and averaged 52.6 µg/L during the summer months (June through September). The average was slightly higher than both the 2000 and 1996 summer averages (49 µg/L and 41 µg/L, respectively). Total phosphorus concentrations near the bottom of the lake were generally similar to the surface concentrations, but were slightly elevated in August when dissolved oxygen concentrations were low.

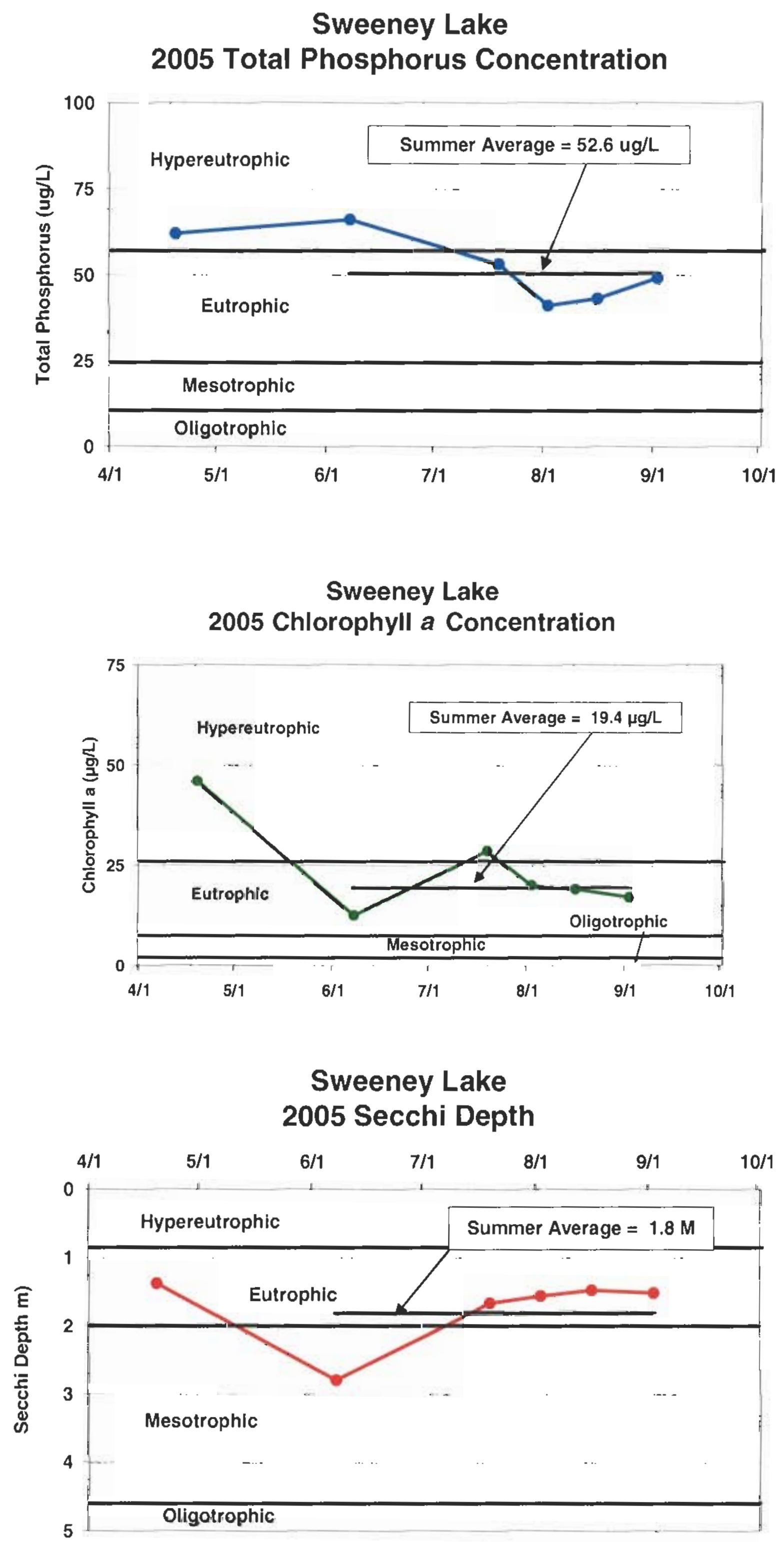


Figure 10 Nutrient Related Water Quality Parameters in Sweeney Lake 2005.

Average summer chlorophyll *a* concentrations ranged from 12.5 μg/L (June) to 46 μg/L (April) across the lake and the average summer concentration was 19.4 μg/L. This was lower than the average summer concentration in 2000 (32 μg/L), but higher than that measured in 1996 (14 μg/L).

Secchi disc transparency ranged from 1.4 m (April) to 2.8 m (June) and averaged 1.8 m across the lake during the summer months. This was better than both Secchi disc transparency averages from the 2000 (1.0 m) and 1996 (1.7 m) sampling periods.

Overall the water quality in Sweeney Lake improved when compared to 2000 because both chlorophyll *a* and Secchi depth improved even though TP was slightly elevated. Secchi disc transparency was near the highest depth on record of 2.0 m (1972). According to the averages of the three nutrient related water quality parameters sampled, the lake was in the eutrophic (nutrient rich, poor water quality) range in 2005.

4.3 Historical Trends

Historical water quality data for Sweeney Lake are available for 1972, 1977, 1982, 1985, 1992, 1996, and 2000 (Figure 11). For historical trends, the growing season mean (average, June through September) is used. Additionally, CAMP data are available from 1999 through 2004 and include total phosphorus, chlorophyll *a*, Secchi depth, and total nitrogen (Anhorn 2005). As shown in Figure 11, the highest average growing season total phosphorus concentration occurred in 1982 (152 μg/L). Chlorophyll *a* also peaked in 1982 (37.7 μg/L). The lake's 2005 water quality was substantially better than the lake's 1982 water quality. Current data also indicate better water quality than that determined during the 2000 sampling period. A comparison of 2005 and 2000 data indicate total phosphorus was slightly elevated in 2005, but chlorophyll *a* and Secchi depth improved. In 2005, the lake's second highest Secchi depth (1.8 m) was measured. The lake's highest value of 2.0 meters was observed in 1972.

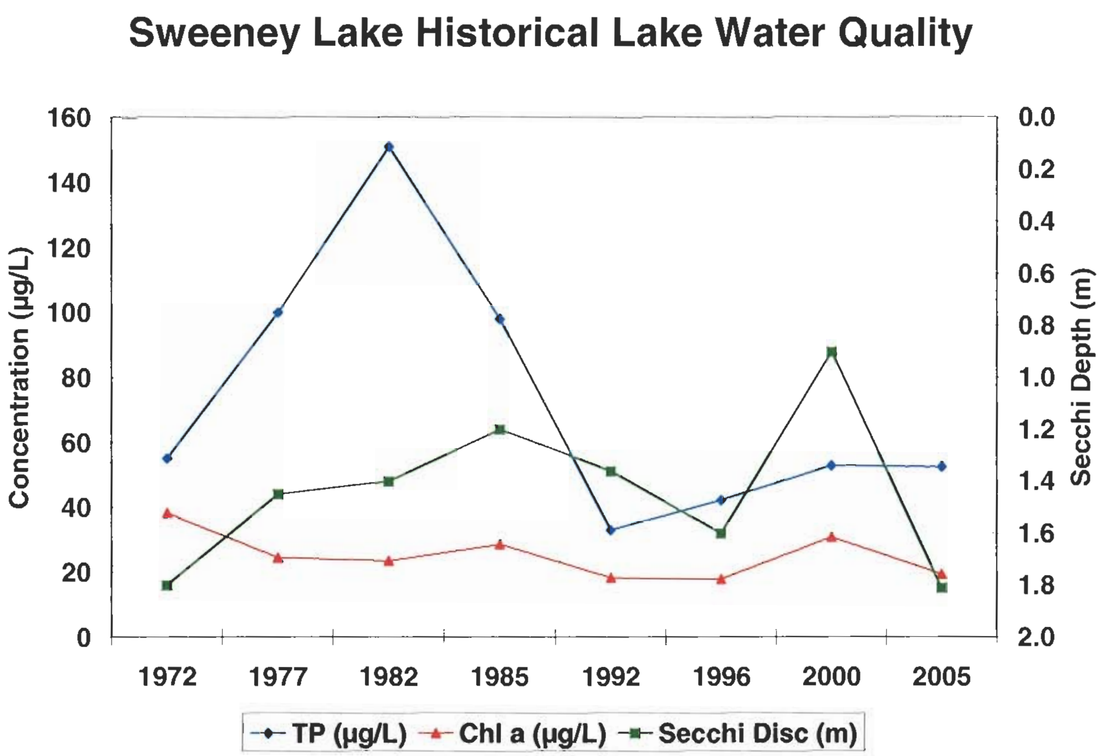


Figure 11 Historical Water Quality in Sweeney Lake.

4.4 Recreational Suitability Index

Based on the average summer Secchi transparency, Sweeney Lake has an RSI value of 3, indicating slight recreational use impairment by algae in the lake. At this RSI level the presence of algae should be obvious.

4.5 Biota

Three components of lake biota are presented herein: phytoplankton, zooplankton, and macrophytes. Fisheries status is managed by the Department of Natural Resources and is not covered in this report.

4.5.1 Phytoplankton

The 2005 phytoplankton data confirmed the presence of algal blooms throughout the lake. Higher numbers of phytoplankton occurred during the late summer than occurred during the spring and early summer. The north basin generally observed higher numbers of phytoplankton than the south basin (See Figues 12 and 13). Although lake's diverse algal community was comprised of the five major algal groups (i.e., chlorophyta or green algae, cyanophyta or blue-green algae, bacillariophyta or diatoms, pyrrophyta or dinoflagellates, and cryptophyta or cryptomonads), green algae generally dominated the phytoplankton community. The green algal cells dominating the community were a valuable food source for the lake's zooplankton community. They were small in size and edible by the lake's larger bodied zooplankters.

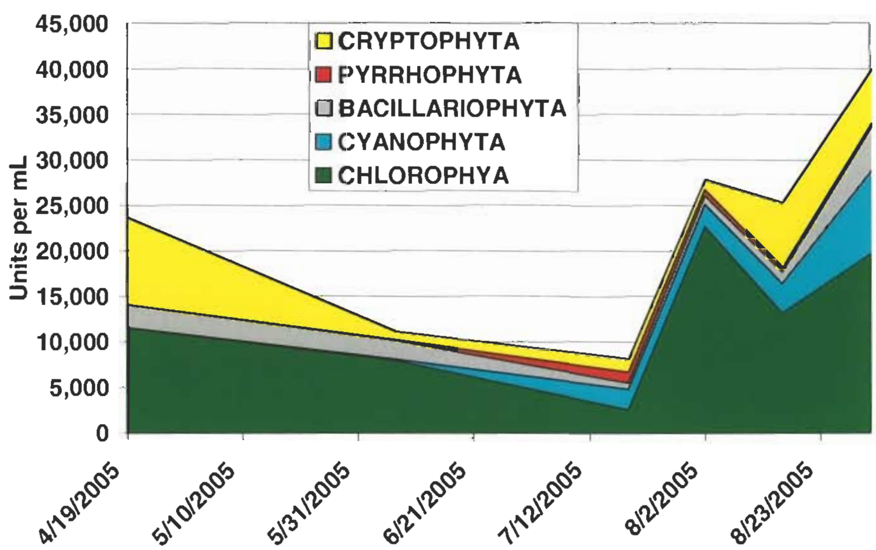


Figure 12 2005 Sweeney Lake (North Basin) Phytoplankton Data Summary by Division

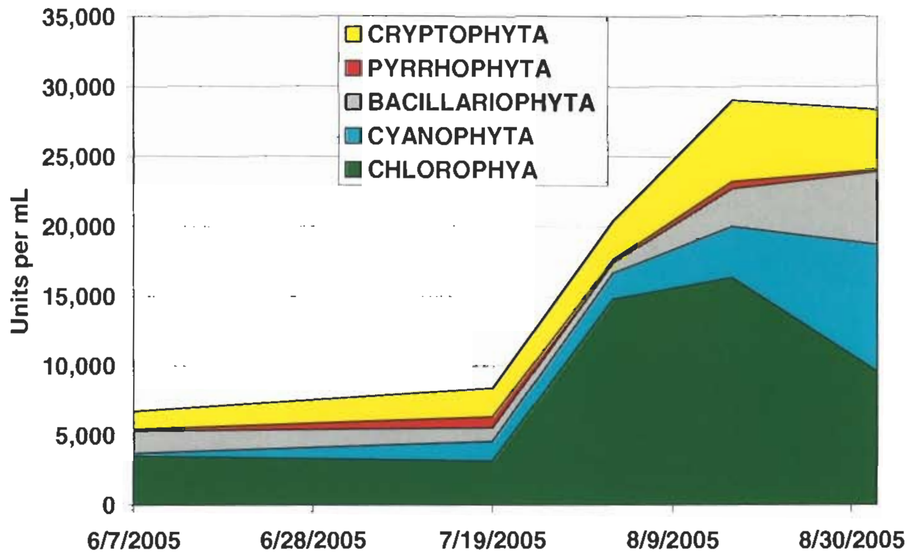


Figure 13 2005 Sweeney Lake (South Basin) Phytoplankton Data Summary by Division

4.5.2 Zooplankton

All three groups of zooplankton were well represented in Sweeney Lake during 2005 (See Figures 14 and 15). Large-bodied cladocerans were observed throughout the growing season at both the north and south sampling locations. Grazing by large-bodied cladocerans reduces the numbers of algae in the water and improves water transparency. The data indicate the lake has a healthy zooplankton community which supports the lake's fishery and exerts some control over the lake's algal community.

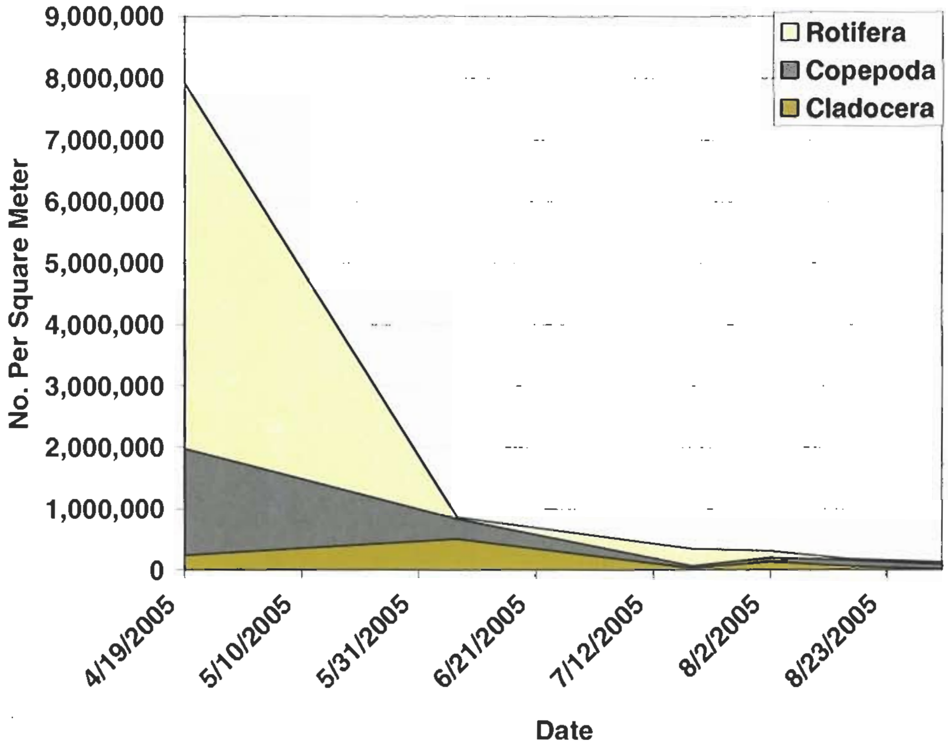


Figure 14 2005 Sweeney Lake (North Basin) Zooplankton Data Summary by Division

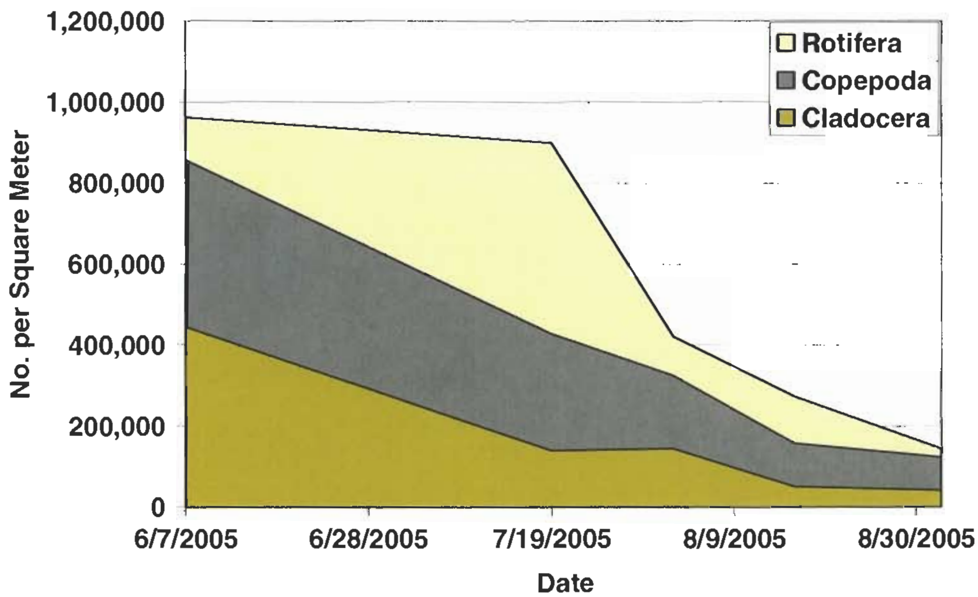


Figure 15 2005 Sweeney Lake (South Basin) Zooplankton Data Summary by Division

4.5.3 Macrophytes

Macrophytes were sampled two times in Sweeney Lake during 2005, on June 21st and August 18th. During the June 2005 survey, macrophytes were observed at depths less than 9 to10 feet (Figure 16). Submerged, floating leaf and emergent macrophytes species were present along with one non-native, invasive species, curlyleaf pondweed. As noted previously, curlyleaf pondweed can have detrimental effects on water quality because the aquatic plant dies off (senesces) in mid-June, creating a phosphorus source for algae in the lake. Where found, the density of curlyleaf pondweed was generally high in Sweeney Lake during the June survey.

In August, a macrophyte community similar to that found in June, was again detected at depths less than 9 to10 feet (Figure 17). Curlyleaf pondweed density was lower due to natural die-off. An additional non-native, invasive species, *Lythrum salicaria* (purple loosestrife) was found along the lake's shoreline in August.

Data from macrophyte surveys completed during June and August of 1996, 2000, and 2005 were compared. In all the surveys, a healthy, diverse plant community was found throughout the lake wherever the water depth was less than 6 to 10 feet. In 1996, plants grew to the 8 foot depth in early summer and to the 6 foot depth in late summer. In both 2000 and 2005, plants grew to the 10 foot depth. A total of 12 to 18 individual species were observed during each plant survey. The large number of species noted in Sweeney Lake is indicative of a stable and healthy aquatic plant community. The density of individual species ranged from light to heavy.

Despite the favorable attributes of the lake's plant community, the growth of two undesirable exotic (non-native) species, curlyleaf pondweed (*Potamogeton crispus*) and purple loosestrife (*Lythrum salicaria*), is of concern.

Curlyleaf pondweed was observed during the 1996, 2000, and 2005 June plant surveys. Densities were similar during the 3 surveys, ranging from light to heavy. Curlyleaf pondweed begins growing in late August, grows throughout the winter at a slow rate, grows rapidly in the spring, and dies in early summer. Curlyleaf pondweed senescences and adds phosphorus to Sweeney Lake, which may increase algal growth during the summer.

Purple loosestrife was first observed growing at the northeast end of the lake during August of 2005. This plant typically eventually replaces native vegetation and rapidly becomes the sole emergent species. Purple loosestrife can be effectively managed through the use of leaf-

- No Macrophytes Found in Water > 9.0' to 10.0'
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy

	Common Name	Scientific Name
Submerged Aquatic Plants:	Curlyleaf pondweed	*Potamogeton crispus*
	Floating leaf pondweed	*Potamogeton natans*
	Narrowleaf pondweed	*Potamogeton sp. (narrowleaf)*
	Small pondweed	*Potamogeton pusillus*
	Variable pondweed	*Potamogeton gramineus*
	Flatstem pondweed	*Potamogeton zosteriformis*
	Sago pondweed	*Potamogeton pectinatus*
	Coontail	*Ceratophyllum demersum*
	Elodea	*Elodea canadensis*
	Muskgrass	*Chara sp.*
	Bushy pondweed and naiad	*Najas flexilis*
	Bushy pondweed and naiad	*Najas sp.*
	Water star grass	*Zosterella dubia*
Floating Leaf:	Spadderdock	*Nuphar variegata*
	Small yellow waterlily	*Nuphar microphyllum*
	White waterlily	*Nymphaea tuberosa*
Emergent:	Cattail	*Typha sp.*
No Aquatic Vegetation Found:		

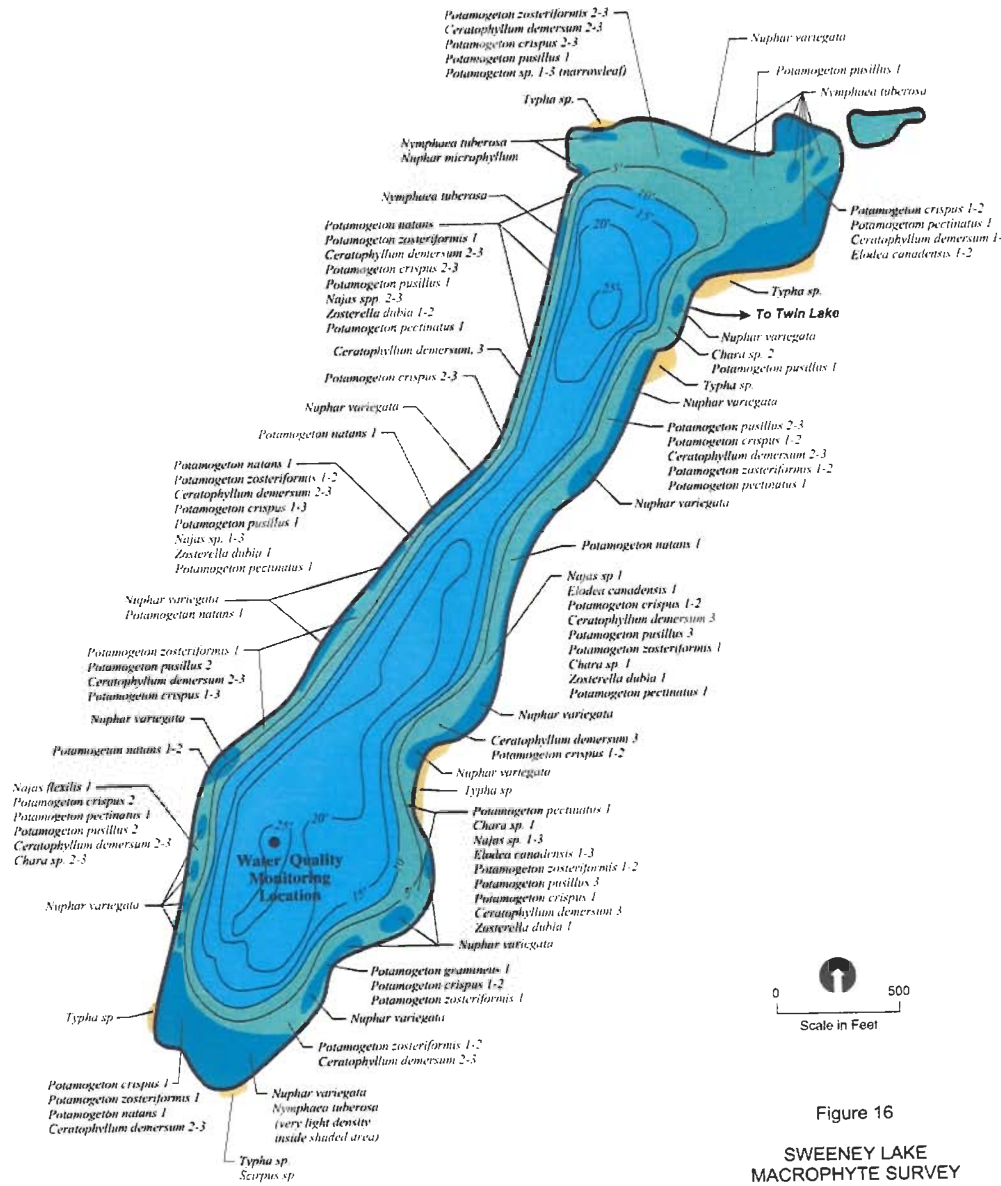


Figure 16

SWEENEY LAKE
MACROPHYTE SURVEY
JUNE 21, 2005

P:\23\27\051\LakeMacrophyteMaps\Sweeney\2005 Maps\June 2005 CDR RLG 07-12-05

- No Macrophytes Found in Water > 9.0' to 10.0'
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy
  Algal Mats Observed Growing on Rooted Vegetation

	Common Name	Scientific Name
Submerged Aquatic Plants:	Illinois pondweed	*Potamogeton illinoensis*
	Floating leaf pondweed	*Potamogeton natans*
	Narrowleaf pondweed	*Potamogeton sp. (narrowleaf)*
	Small pondweed	*Potamogeton pusillus*
	Variable pondweed	*Potamogeton gramineus*
	Flatstem pondweed	*Potamogeton zosteriformis*
	Sago pondweed	*Potamogeton pectinatus*
	Coontail	*Ceratophyllum demersum*
	Elodea	*Elodea canadensis*
	Muskgrass	*Chara sp.*
	Bushy pondweed and naiad	*Najas flexilis*
	Bushy pondweed and naiad	*Najas sp.*
	Water star grass	*Zosterella dubia*
Floating Leaf:	Spadderdock	*Nuphar variegata*
	Small yellow waterlily	*Nuphar microphyllum*
	White waterlily	*Nymphaea tuberosa*
Emergent:	Cattail	*Typha sp.*
	Purple loosestrife	*Lythrum salicaria*
No Aquatic Vegetation Found:		

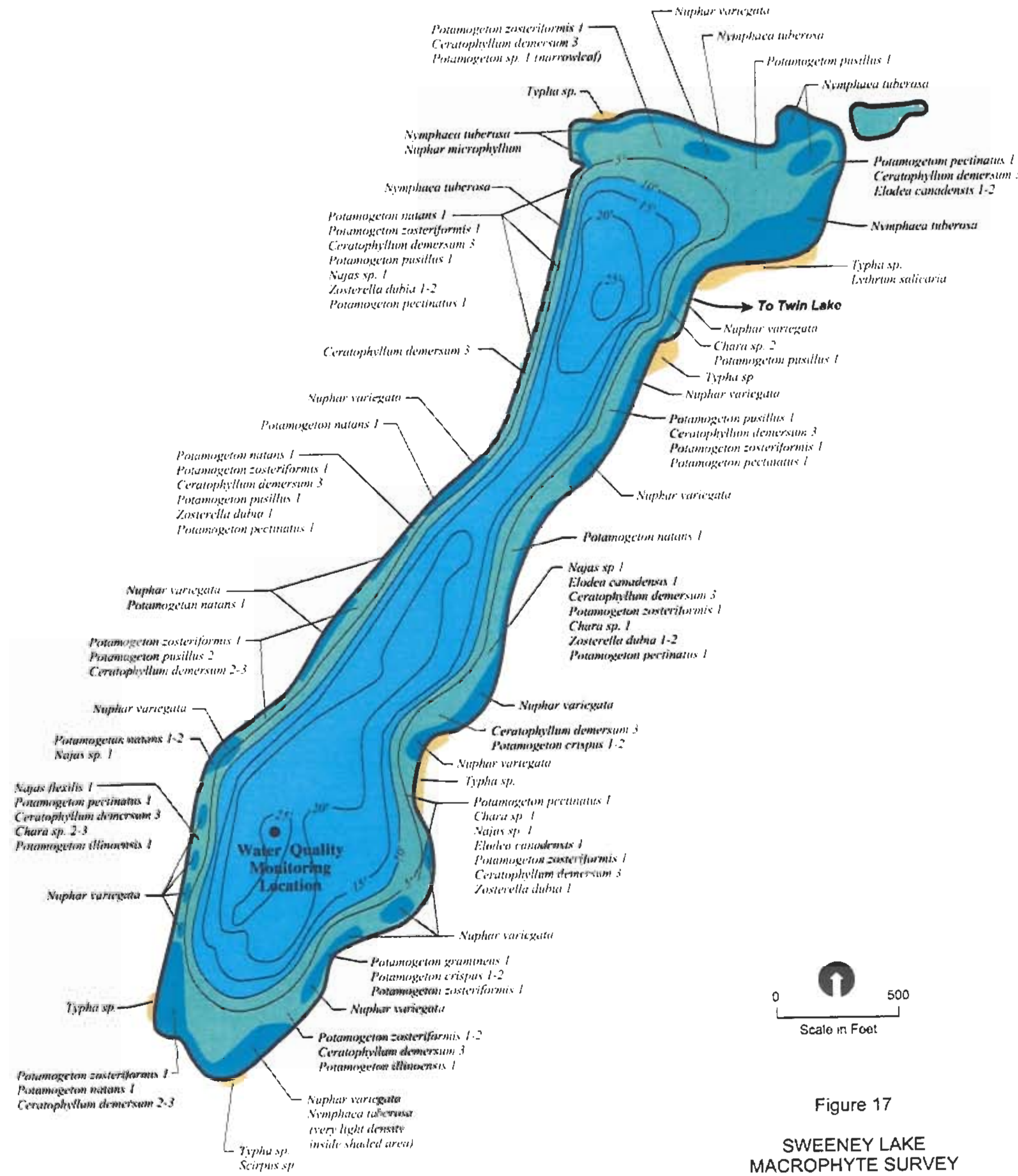


Figure 17

SWEENEY LAKE
MACROPHYTE SURVEY
AUGUST 18, 2005

eating beetles, which reduce plant growth and seed production by feeding on the leaves and new shoots. Beetles can be obtained from the Minnesota Department of Natural Resources.

4.6 Conclusions

- According to the averages of the three nutrient related parameters (total phosphorus, chlorophyll *a*, and Secchi depth), the water quality status of Sweeney Lake was eutrophic (nutrient rich) during the 2005 growing season.

- Both chlorophyll *a* concentrations and Secchi depth improved when compared to the 2000 sampling season, whereas total phosphorus was slightly elevated in 2005.

- Macrophytes were abundant on both sampling dates and curlyleaf pondweed (an exotic, invasive species) was present in heavy densities during the June survey, whereas purple loosestrife, another exotic, invasive species, was detected in the August survey.

- Based on average summer Secchi disc transparency, the recreational suitability index for Sweeney Lake is 3, indicating slight recreational use impairment by algae in the lake.

- Despite improvements, Sweeney Lake did not meet Level I water quality goals for total phosphorus (average summer concentration not to exceed 30 µg/L), chlorophyll *a* (average summer concentration not to exceed 10 µg/L), or Secchi disc transparency (average summer depth of at least 2.2 meters) in 2005. The lake's average summer total phosphorus concentration was 52.6 µg/L, average summer chlorophyll *a* concentration was 19.4 µg/L, and average summer Secchi depth was 1.8 meters.

- Historical records indicate the lake's 2005 water quality was substantially better than the lake's 1982 water quality and was also better than the lake's 2000 water quality.

5.0 Twin Lake

5.1 Description

Twin Lake (Golden Valley, Hennepin County) has a water surface area of approximately 21 acres (8.5 hectares), a maximum depth of 54.5 feet (16.6 meters), and a mean depth of 25.7 feet (7.8 meters). The lake has a small watershed and during periods of high water it connects to Sweeney Lake via a meandering channel that runs through a wetland. The northern half of the lake is surrounded by the wooded Hidden Lakes residential development. The southern half of the lake is surrounded by Minneapolis Park and Recreation Board property and consists of wooded brush areas including a marsh at the southern end of the lake. The lake is used for all recreational activities, including swimming.

The Twin Lake Watershed and Lake Management Plan was completed in June 2000 by the Commission. Because Twin Lake had previously met Level I water quality goals and watershed modeling indicated only modest improvements could be made with structural BMPs, emphasis for management was placed on using general watershed BMPs.

5.2 Water Quality Data

Twin Lake was sampled at the deepest point six times during the 2005 growing season. Water quality data collected for Twin Lake are summarized in Appendix A, and include:

- Vertical profiles of temperature, dissolved oxygen concentration, specific conductivity, and pH
- 0-2 m composite samples analyzed for chlorophyll *a*, total phosphorus, soluble reactive phosphorus, and total nitrogen
- Total phosphorus at mid depth and near bottom
- Secchi disc transparency

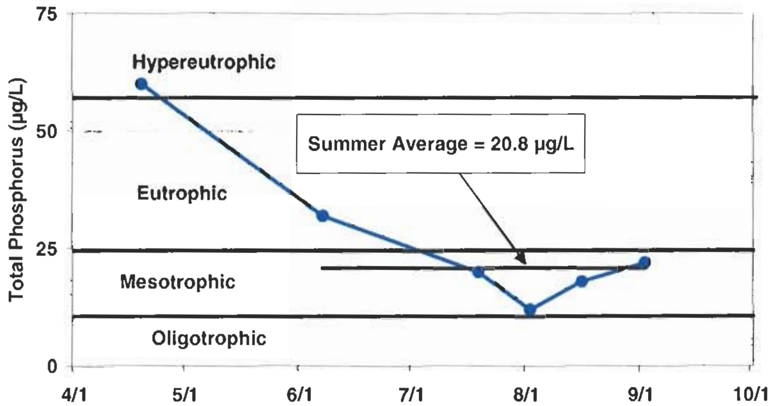
Vertical profile measurements of temperature and dissolved oxygen indicate the lake was strongly stratified as early as April and throughout the remainder of the 2005 growing season. The zone of dissolved oxygen depletion extended as high as the 2 meter water column depth in April and then was generally between 4 meters and the bottom of the lake throughout the summer. Because panfish and gamefish species within the lake require dissolved oxygen concentrations of 5 mg/L or greater, they were unable to live in the lake's deeper waters throughout the 2005 growing season. Only the upper 3 to 5 meters of the lake contained suitable oxygen levels for panfish and gamefish.

Total phosphorus, chlorophyll *a*, and Secchi depth are summarized in Figure 18. Average total phosphorus concentration (0-2 m composite sample) was the lowest (i.e. best) of the lakes sampled in this study. Total phosphorus concentration ranged from 60 μg/L (April) to 12 μg/L (August) and averaged 20.8 μg/L during the summer months (June through September). This was similar to total phosphorus during the 1996 sample period (20 μg/L), but elevated when compared to 2000 (14 μg/L). Elevated total phosphorus in the spring could be due to, at least in part, high concentrations of phosphorus in the hypolimnion (bottom water) during stratification. Dimictic lakes stratify two times a year and, even though there is no data, it is likely that Twin Lake experiences low dissolved oxygen concentrations during winter stratification as well. Anoxic conditions (low oxygen) cause iron in lake sediment to become reduced, causing the release of phosphorus normally bound to sediment matter. This can lead to a build-up of phosphorus in the hypolimnion that, when mixed at spring turnover, would lead to higher surface total phosphorus concentrations. Total phosphorus concentration in the hypolimnion ranged from 732 μg/L to 881 μg/L during the sample period. Soluble reactive phosphorus, analyzed in the April sample, was 85% of total phosphorus and indicates most of the phosphorus in the hypolimnion is in a form that is easily available for uptake. The lake's elevated spring phosphorus concentration was brief because a spring algal bloom used up the lake's excess phosphorus. Following the spring algal bloom, the lake's water quality was good and remained good throughout the summer.

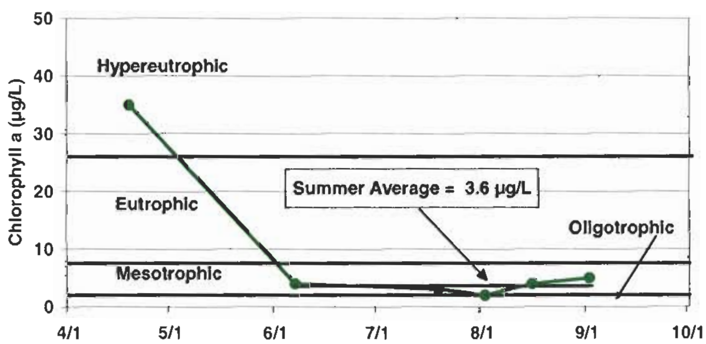
Chlorophyll a was also the lowest (best) of the three lakes detailed in this report, ranging from 2 μg/L (August) to 35 μg/L (April) and averaging 3.6 μg/L during the summer months. This was nearly identical to the summer averages for both 1996 and 2000 (4 μg/L for both years) in Twin Lake.

Secchi disc transparency ranged from 1.3 m (April) to 4.3 m (June), averaging 3.7 m throughout the summer months. This is comparable to the average summer month Secchi depth readings measured in 1996 (4.1 m) and 2000 (3.6 m).

Twin Lake
2005 Total Phosphorus Concentration



Twin Lake
2005 Chlorophyll a Concentration



Twin Lake
2005 Secchi Depth

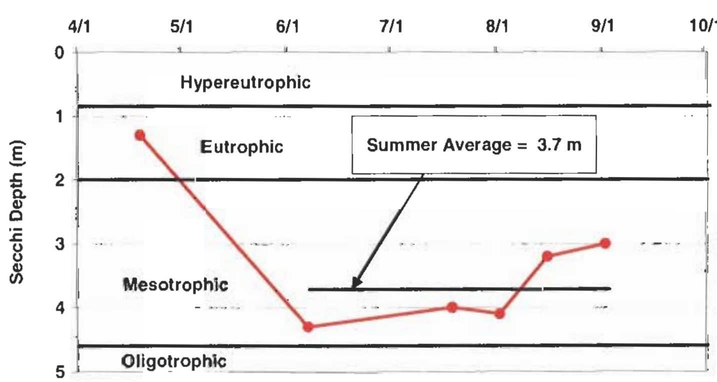


Figure 18 Nutrient Related Water Quality Parameters in Twin Lake 2005

All three nutrient related water quality parameters collected during 2005 indicate that Twin Lake water quality is in the mesotrophic (good water quality) range and that water quality, in general, has remained constant given natural variability found in lake systems.

5.3 Historical Trends

Historical water quality data are available for 1972, 1977, 1982, 1992, 1996, and 2000 (Figure 19). For historical trends, the mean of samples collected during the summer months (average, June through September) is used. Historical data indicate an improvement in water quality between 1982 and 1992 that has remained relatively constant since 1992. Seasonal patterns in 2005 were similar to those recorded in both 2000 and 1996 surveys. Poorer water quality occurred in early spring and improved conditions occurred throughout the summer. As stated above, it is likely this is due, at least in part, to mixing of bottom waters containing high levels of phosphorus during spring turnover.

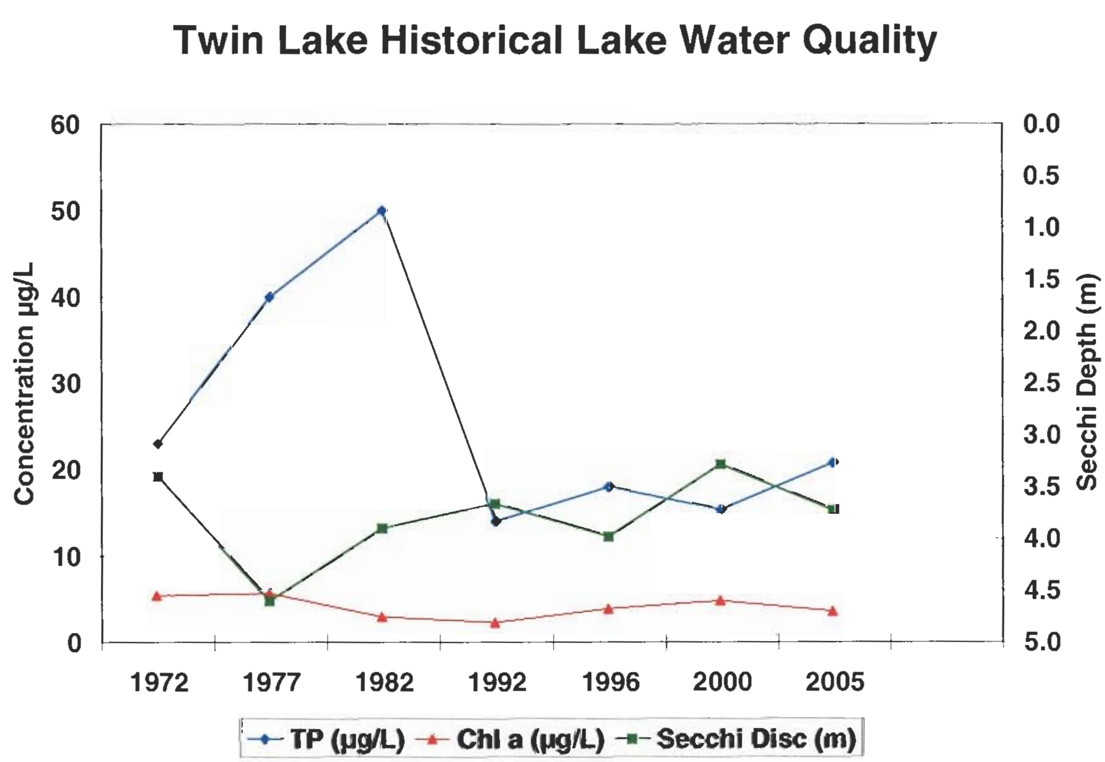


Figure 19 Historical Water Quality Data in Twin Lake

5.4 Recreational Suitability

Based on the average summer Secchi transparency, Twin Lake has an RSI index value of 1, indicating there is no recreational use impairment caused by algae. When compared with other lakes in the Basset Creek and Twin Cities Metro areas, Twin Lake has high transparency.

5.5 Biota

Three components of lake biota are presented herein: phytoplankton, zooplankton, and macrophytes. Fisheries status is managed by the Department of Natural Resources and is not covered in this report.

5.5.1 Phytoplankton

The lake's phytoplankton community indicated an algal bloom occurred in April and relatively low numbers of algae were observed during the remaining portion of the growing season. The data indicate the lake observed good water quality throughout the summer period. Seasonal changes were observed in the lake's phytoplankton community. Green algae were dominant during April, green algae, diatoms, and bluegreen algae were dominant in June, green algae and blue-green algae were dominant in July and early August, and blue green algae were dominant during late August and September.

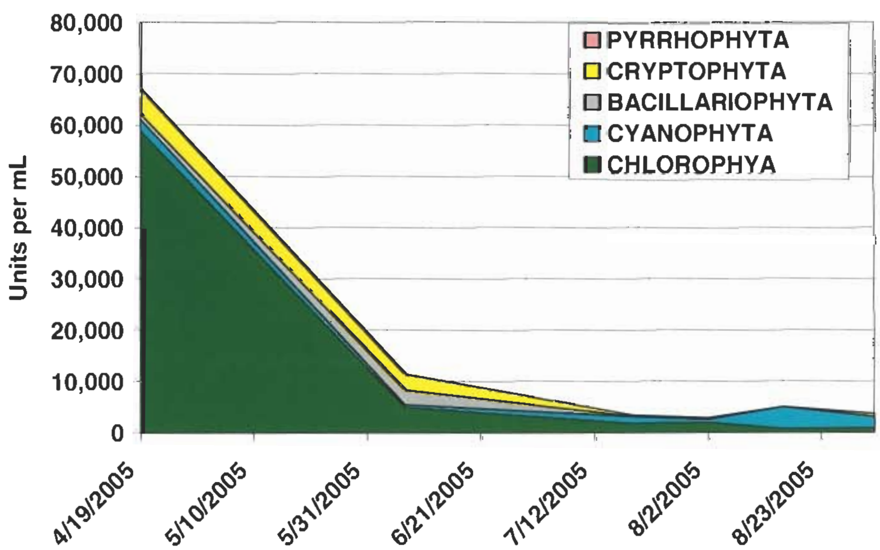


Figure 20 2005 Twin Lake Phytoplankton Data Summary by Division

5.5.2 Zooplankton

All three groups of zooplankton were well represented in Twin Lake during 2005. Changes in numbers of zooplankton paralleled changes in numbers of phytoplankton. High numbers of phytoplankton and zooplankton were observed following spring turnover and lower numbers were found throughout the summer. Large-bodied cladocerans were observed throughout the growing season. Grazing by large-bodied cladocerans reduces the numbers of algae in the water and improves water transparency. The data indicate the lake has a healthy zooplankton community which supports the lake's fishery and exerts some control over the lake's algal community.

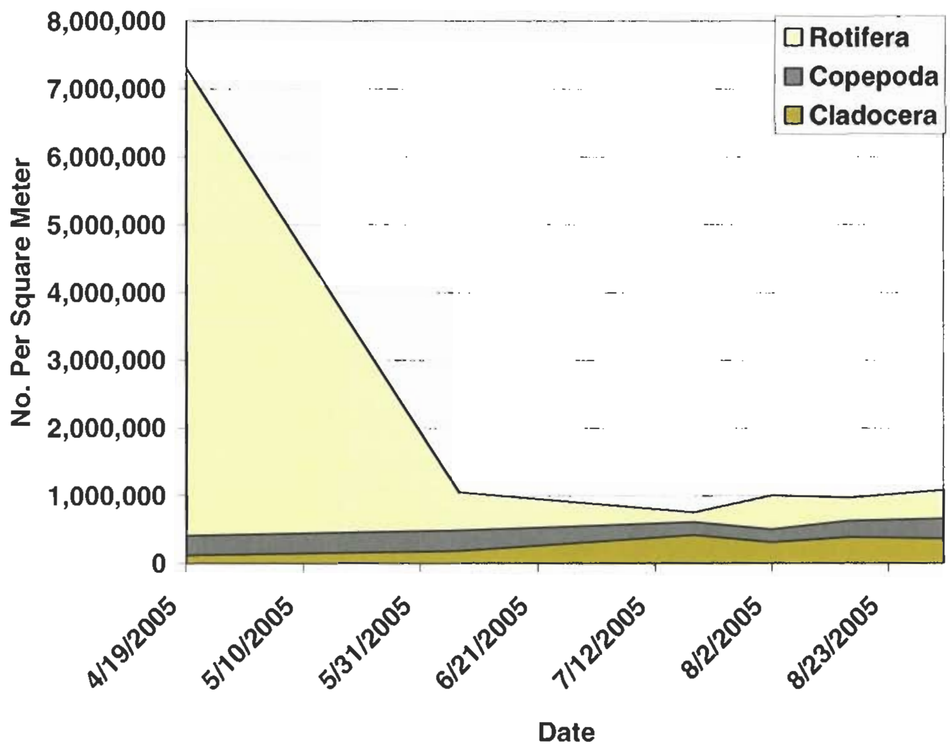


Figure 21 2005 Twin Lake Zooplankton Data Summary by Division

5.5.3 Macrophytes

Twin Lake had a diverse macrophyte community in 2005 with 19 species of submerged, floating leaf, and emergent aquatic species detected during the June survey (Figure 22). One non-native, invasive species, purple loosestrife, was found as well. During August 2005, the same number of species was found and purple loosestrife was still present (Figure 23).

- No Macrophytes Found in Water > 8' - 11' Rooted, 13' - 16' Ceratophyllum demersum
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy, 3+ Extremely Dense
- Algal Mats Present Throughout Lake

	Common Name	Scientific Name
Submerged Aquatic Plants:	Floating leaf pondweed	*Potamogeton natans*
	Illinois pondweed	*Potamogeton illinoensis*
	Bladder wort	*Utricularia sp.*
	Narrowleaf pondweed	*Potamogeton sp. (narrowleaf)*
	Grassy pondweed	*Potamogeton gramineus*
	Flatstem pondweed	*Potamogeton zosteriformis*
	Large leaf pondweed	*Potamogeton amplifolius*
	Sago pondweed	*Potamogeton pectinatus*
	Northern milfoil	*Myriophyllum sibiricum*
	Coontail	*Ceratophyllum demersum*
	Elodea	*Elodea canadensis*
	Muskgrass	*Chara sp.*
	Bushy pondweed and naiad	*Najas sp.*
	Water star grass	*Zosterella dubia*
Floating Leaf:	Spadderdock	*Nuphar variegata*
	White waterlily	*Nymphaea tuberosa*
Emergent:	Bulrush	*Scirpus sp.*
	Cattail	*Typha sp.*
	Purple loosestrife	*Lythrum salicaria*
No Aquatic Vegetation Found:		

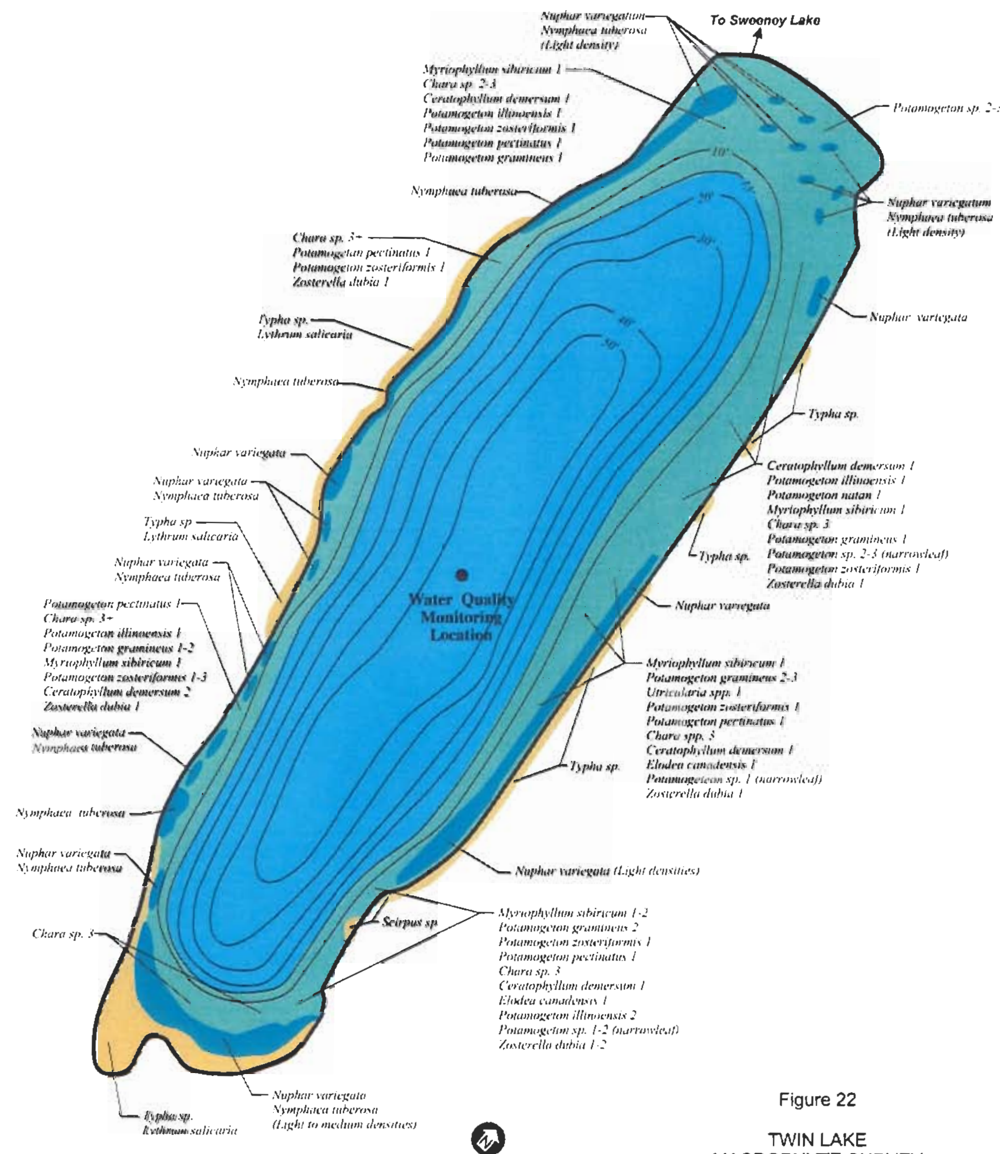


Figure 22

TWIN LAKE
MACROPHYTE SURVEY
JUNE 21, 2005

- No Macrophytes Found in Water > 8' - 11' Rooted, 13' - 16' Ceratophyllum demersum
- Macrophyte Densities Estimated as Follows: 1 = light; 2 = moderate; 3 = heavy, 3+ Extremely Dense
- Algal Mats Present Throughout Lake

	Common Name	Scientific Name
Submerged Aquatic Plants:	Floating leaf pondweed	*Potamogeton natans*
	Illinois pondweed	*Potamogeton illinoensis*
	Bladder wort	*Utricularia sp.*
	Narrowleaf pondweed	*Potamogeton sp. (narrowleaf)*
	Grassy pondweed	*Potamogeton gramineus*
	Flatstem pondweed	*Potamogeton zosteriformis*
	Large leaf pondweed	*Potamogeton amplifolius*
	Sago pondweed	*Potamogeton pectinatus*
	Northern milfoil	*Myriophyllum sibiricum*
	Coontail	*Ceratophyllum demersum*
	Elodea	*Elodea canadensis*
	Muskgrass	*Chara sp.*
	Bushy pondweed and naiad	*Najas sp.*
	Water star grass	*Zosterella dubia*
Floating Leaf:	Spadderdock	*Nuphar variegata*
	White waterlily	*Nymphaea tuberosa*
Emergent:	Bulrush	*Scirpus sp.*
	Cattail	*Typha sp.*
	Purple loosestrife	*Lythrum salicaria*
No Aquatic Vegetation Found:		

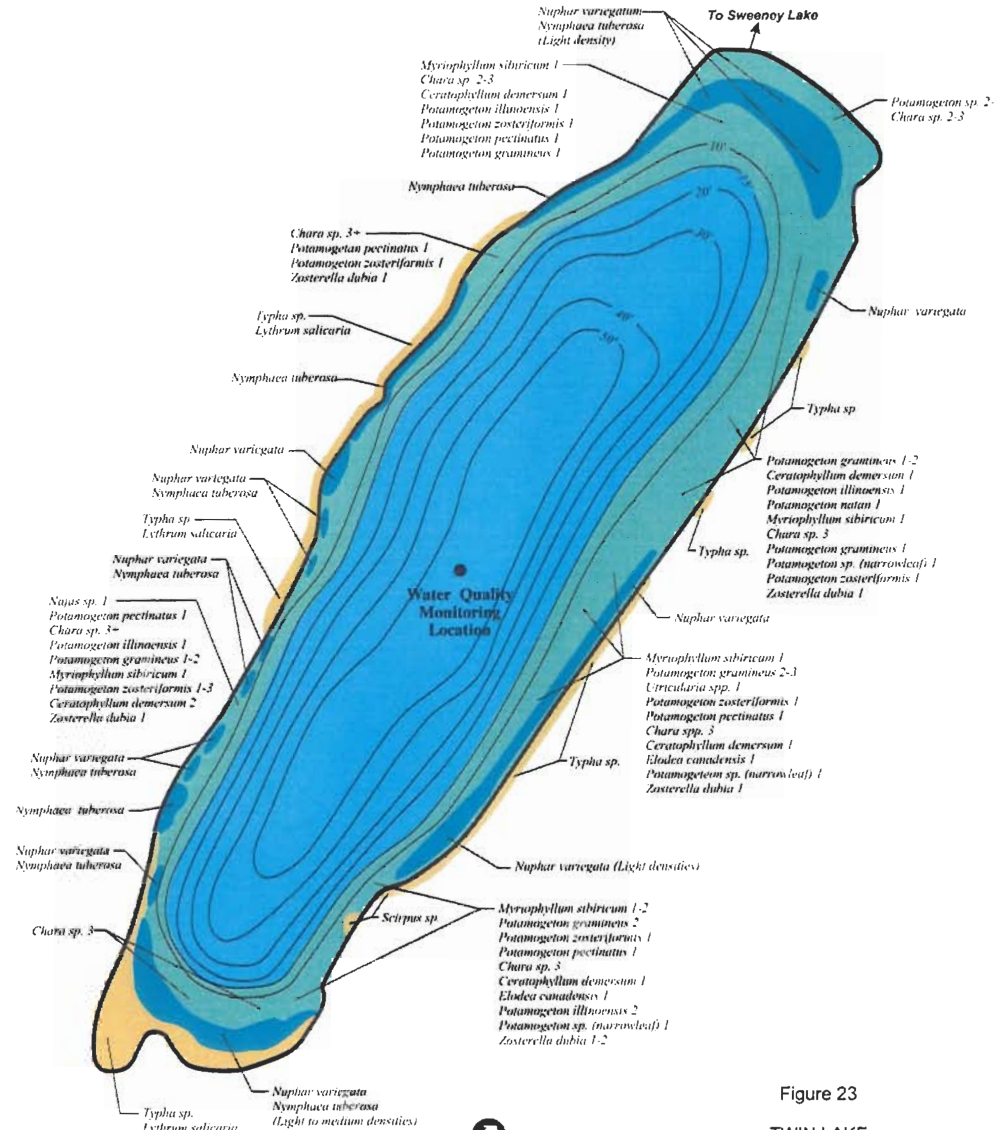


Figure 23

TWIN LAKE
MACROPHYTE SURVEY
AUGUST 18, 2005

During both surveys, most macrophytes were found at water depth less than 8 to13 feet, but *Ceratophyllum demersum* (coontail) was detected in waters up to 13 to16 feet in depth. The non-native, invasive species curlyleaf pondweed, detected in the 2000 macrophyte survey, was not found in either survey during 2005. The native species *Myriophyllum sibiricum* (northern watermilfoil), often confused with *Myriophyllum spicatum* (Eurasian watermilfoil), was found. The presence of northern watermilfoil indicates good water quality because the plant is sensitive to low light conditions found in eutrophic lakes.

5.6 Conclusions

- Water quality status for Twin Lake was in the mesotrophic range (i.e. moderate level of nutrients, good water quality). The lake has the best water quality of the lakes discussed in this report.

- Despite the lake's good water quality throughout the summer period, the lake noted a brief period of poor water quality during the spring of 2005. The lake's trophic status during April of 2005 ranged from eutrophic (nutrient rich) to hypereutrophic (very nutrient rich). Internal loading likely contributes to unusually poor water quality in spring due to mixing of water containing high levels of phosphorus during spring turnover. A spring algal bloom used up the lake's excess phosphorus and the lake's water quality was good by summer. Because the lake's goals are based upon average summer conditions, the lake's poor spring water quality did not prevent goal attainment. The lake's good water quality throughout the summer period met the lake's goals.

- Historical records back to 1972 indicate water quality has remained relatively constant since water quality improvement occurred between the 1982 and 1992 sampling seasons.

- Based on average summer Secchi disc transparency, the recreational suitability index for Twin Lake is 1, indicating no recreational use impairment by algae in the lake.

- A healthy macrophyte community was observed on both the June and August sampling dates. Curlyleaf pondweed, an undesirable species, was detected in 2000, but was not found in 2005.

- Twin Lake water quality during summer 2005 met Level I water quality goals for total phosphorus (average summer concentration not to exceed 30 μg/L), chlorophyll *a* (average summer concentration not to exceed 10 μg/L), and Secchi disc transparency (average summer depth of at least 2.2 meters) in 2005. The lake's average summer total phosphorus concentration was 20.8 μg/L, average summer chlorophyll *a* concentration was 3.6 μg/L, and average summer Secchi depth was 3.7 meters.

6.0 References

Anhorn, R.J. 2005. A 2004 Study of the Water Quality of 145 Metropolitan Area Lakes. Metropolitan Council Publication No. 32-04-015.

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Barr Engineering Company. 2000. Northwood Lake Watershed and Lake Management Plan. Prepared for the Basset Creek Water Management Commission.

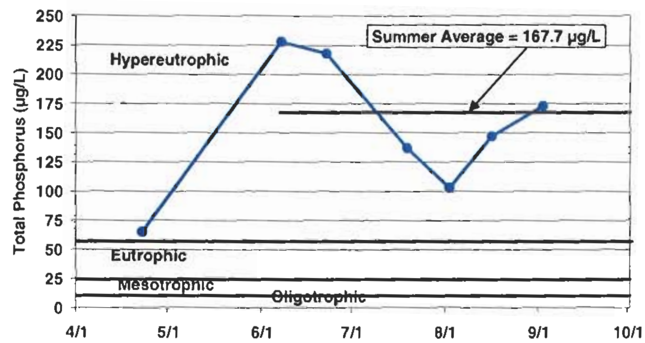
Osgood, R., A. 1989a. An evaluation of Lake and Stream Monitoring Programs in the Twin Cities Metropolitan Area. Metropolitan Council Publication No. 590-89-128.

Osgood, R., A. 1989b. 1989 Study of the Water Quality of 20 Metropolitan Area Lakes. Metropolitan Council Publication No. 590-89-130.

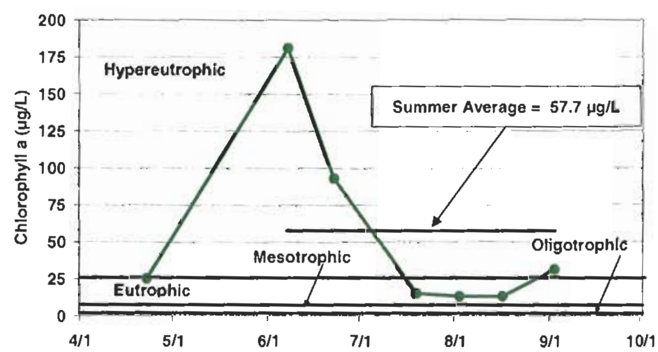
Appendix A

Lake Data

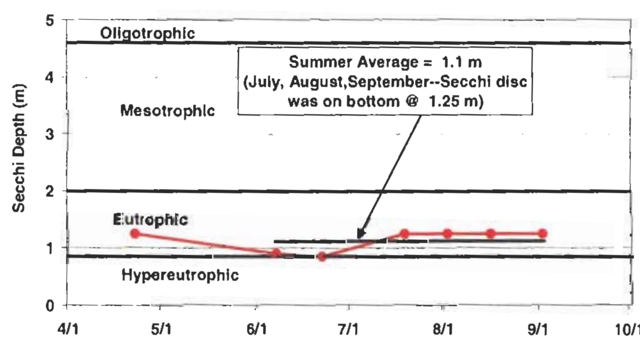
Northwood Lake (North Basin)
2005 Total Phosphorus Concentration



Northwood Lake (North Basin)
2005 Chlorophyll *a* Concentration



Northwood Lake (North Basin)
2005 Secchi Depth

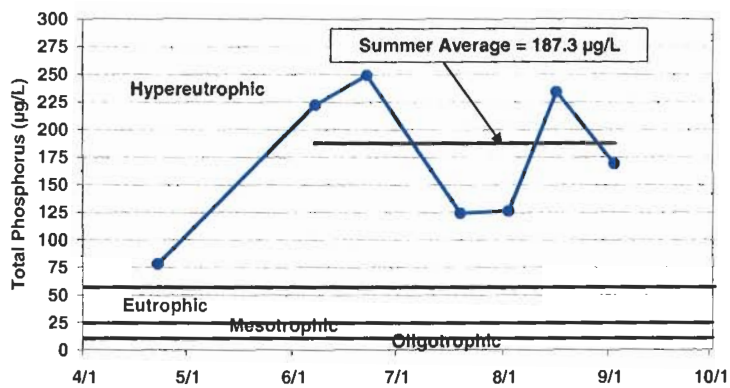


Northwood Lake (North Basin)

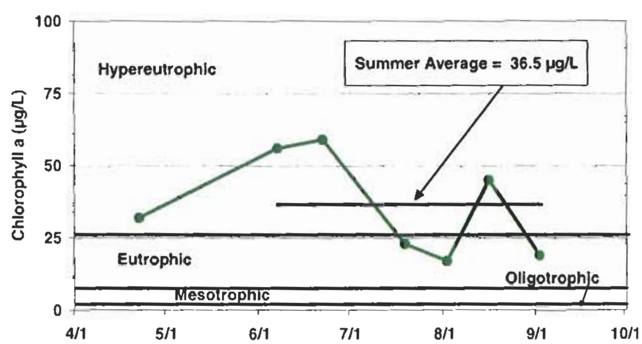
Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
4/22/05	1.5	0-1	>1.25*	25.0	--	--	--	0.065	0.057	0.68	--
		0.0			5.4	13.3	685	--			6.7
		1.0			4.6	12.2	671	0.062			6.7
6/7/05	1.5	0-1	0.9	181.0	--	--	--	0.228	--	2.01	--
		0.0			10.4	25.1	716	--			7.1
		1.0			9.6	22.7	727	--			6.9
6/22/05	2.0	0-1.5	0.85	93	--	--	--	0.218	0.025	1.21	--
		0.0			11.3	24.9	216	--			7.8
		1.0			2.4	22.7	435	--			7.6
		1.5			0.9	22.2	465	0.212			7.3
7/19/05	1.7	0-1.2	>1.25*	15.0	--	--	--	0.137	0.047	1.0	--
		0.0			10.4	26.4	442	--			8.4
		1.0			10.1	26.1	439	0.136			8.6
		1.2			13.0	26.1	439	0.132	0.046		8.8
8/2/05	1.7	0-1.2	>1.25*	13.0	--	--	--	0.103	0.032	0.94	--
		0.0			12.0	28.3	469	--			8.9
		1.0			12.5	27.9	466	0.115			8.9
		1.2			10.2	27.5	495	--			8.9
8/16/05	1.7	0-1.2	>1.25*	13.0	--	--	--	0.147	0.050	0.82	--
		0.0			10.6	24.2	486	--			8.0
		1.0			7.7	23.4	495	0.143			7.9
		1.2			1.5	23.3	527	--			7.8
9/2/2005	1.7	0-1.2	>1.25*	31.0	--	--	--	0.173	0.054	0.95	--
		0.0			5.9	21.1	349	--			7.3
		1.0			5.7	20.8	349	0.168			7.3
		1.2			1.8	21.4	684	--			6.7

*Secchi disc transparency was to the bottom of the lake

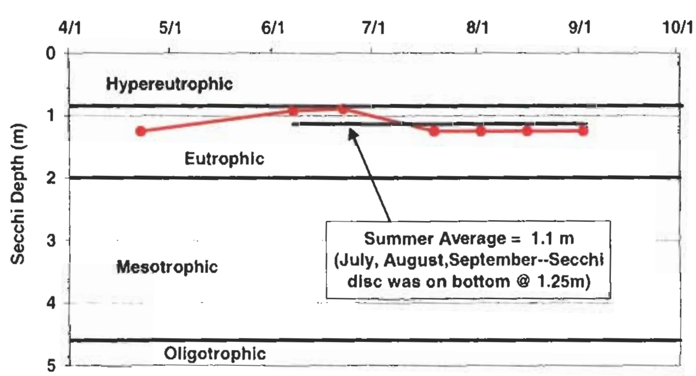
Northwood Lake (South Basin)
2005 Total Phosphorus Concentration



Northwood Lake (South Basin)
2005 Chlorophyll *a* Concentration



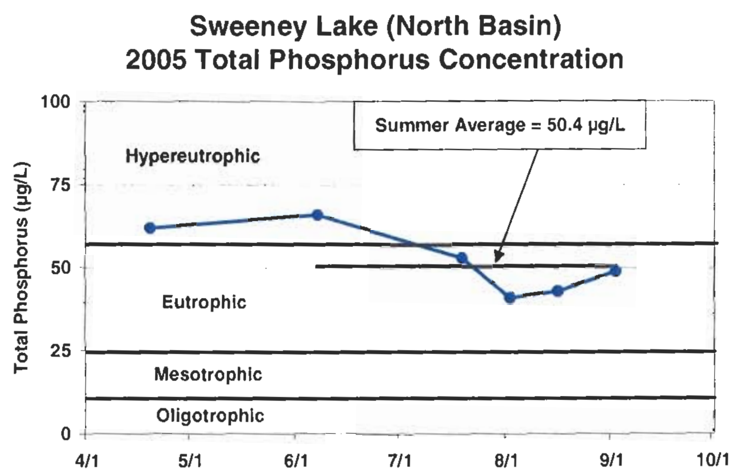
Northwood Lake (South Basin)
2005 Secchi Depth

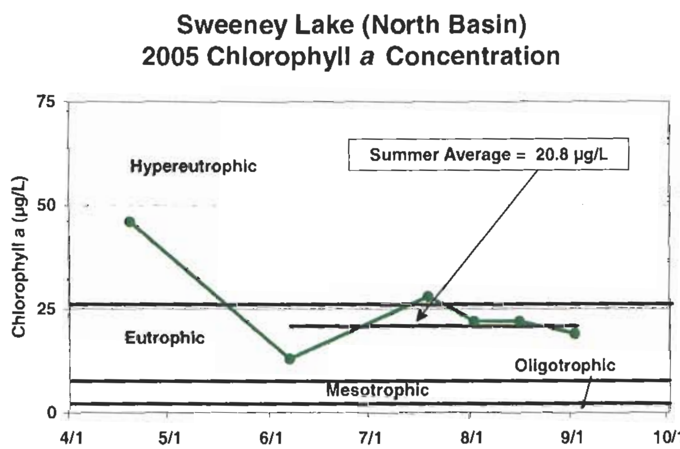


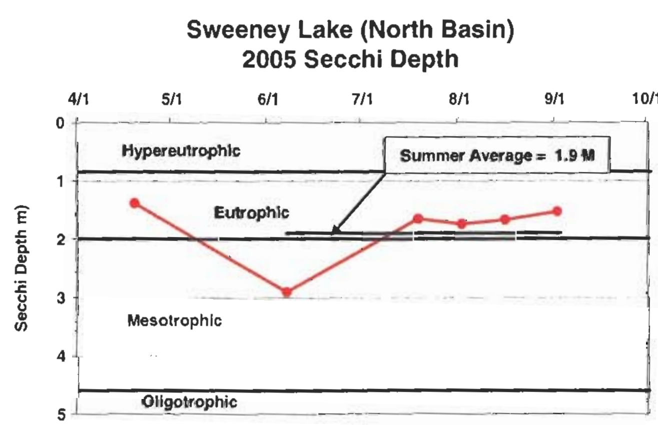
Northwood Lake (South Basin)

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
4/22/05	1.5	0-1	>1.25	32.0	--	--	--	0.078	0.007	0.86	--
		0.0			5.0	14.0	699	--			7.0
		1.0			4.5	13.9	703	0.067			6.9
6/7/05	1.5	0-1	0.92	56.0	--	--	--	0.222	0.025	1.54	--
		0.0			10.4	25.0	705	--			7.5
		1.0			6.6	22.5	767	--			6.9
6/22/05	2.0	0-1.5	0.89	59.0	--	--	--	0.249	0.048	1.2	--
		0.0			10.2	25.4	451	--			8.1
		1.0			1.1	24.0	449	--			7.9
		1.5			0.4	23.0	514	0.222			7.6
7/19/05	1.7	0-1.2	>1.25	23.0	--	--	--	0.124	0.033	1.12	--
		0.0			8.7	26.2	428	--			8.2
		1.0			6.5	26.1	430	0.118			7.9
		1.2			5.6	26.1	430	0.124	0.026		7.9
8/2/05	1.7	0-1.2	>1.25	17.0	--	--	--	0.126	0.036	1.09	--
		0.0			11.4	28.6	447	--			9.2
		1.0			11.5	28.3	446	0.119			9.1
		1.2			2.3	27.5	514	--			7.7
8/16/05	1.7	0-1.2	>1.25	45.0	--	--	--	0.234	0.063	1.26	--
		0.0			9.4	24.0	460	--			8.6
		1.0			6.1	23.4	467	0.218			8.5
		1.2			1.2	23.4	490	--			7.9
9/2/2005	1.7	0-1.2	>1.25	19.0	--	--	--	0.169	0.046	0.60	--
		0.0			4.8	21.3	352	--			7.4
		1.0			5.3	20.9	352	0.187			7.5
		1.2			2.6	20.9	356	--			7.4

*Secchi disc transparency was to the bottom of the lake

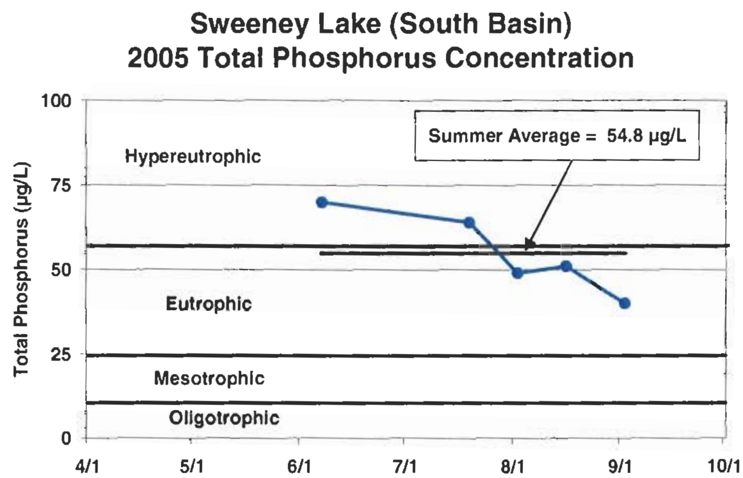

Sweeney Lake (North Basin)
2005 Total Phosphorus Concentration
Summer Average = 50.4 µg/L
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Total Phosphorus (µg/L)
100
75
50
25
0
4/1
5/1
6/1
7/1
8/1
9/1
10/1

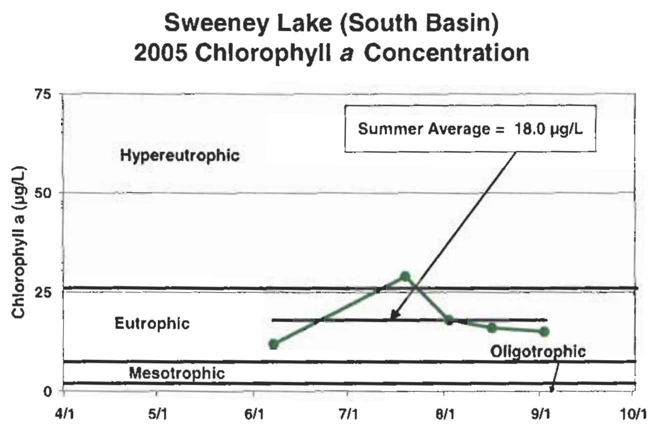

Sweeney Lake (North Basin)
2005 Chlorophyll a Concentration
Summer Average = 20.8 µg/L
Hypereutrophic
Eutrophic
Oligotrophic
Mesotrophic
Chlorophyll a (µg/L)
75
50
25
0
4/1
5/1
6/1
7/1
8/1
9/1
10/1

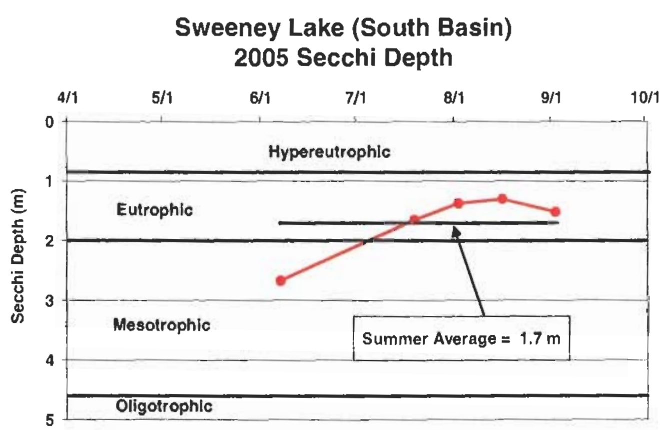

Sweeney Lake (North Basin)
2005 Secchi Depth
Summer Average = 1.9 M
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Secchi Depth m)
4/1
5/1
6/1
7/1
8/1
9/1
10/1
0
1
2
3
4
5

Sweeney Lake (North Basin)

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
4/19/05	7.5	0-2	1.4	46.0	--	--	--	0.062	0.003	1.25	--
		0.0			8.3	14.4	1177	--			6.6
		1.0			8.3	14.2	1177	--			6.6
		2.0			8.2	13.8	1178	--			6.5
		3.0			8.1	13.2	1177	0.073	0.003		6.5
		4.0			7.9	12.9	1181	--			6.5
		5.0			7.6	12.2	1198	--			6.4
		6.0			6.8	11.3	1221	--			6.4
		7.0			6.3	10.8	1227	0.051	0.16		6.3
6/7/05	7.5	0-2	2.9	13.0	--	--	--	0.066	0.004	0.93	--
		0.0			9.5	22.7	1041	--			7.3
		1.0			9.4	22.6	1042	--			7.3
		2.0			9.4	21.8	1042	--			7.3
		3.0			8.6	20.7	1044	--			7.2
		4.0			8.2	19.8	1046	0.048			7.1
		5.0			7.6	19.3	1047	--			7.1
		6.0			6.4	18.7	1050	--			7.1
		7.0			2.9	17.2	1050	0.047			6.6
7/19/05	7.5	0-2	1.7	28.0	--	--	--	0.053	0.003	0.67	--
		0.0			8.9	28.2	894	--			8.0
		1.0			8.1	27.9	894	--			8.0
		2.0			8.5	27.7	893	--			8.1
		3.0			7.3	27.4	893	--			8.0
		4.0			6.1	27.2	893	0.054	0.005		8.0
		5.0			5.8	27.2	893	--			8.0
		6.0			5.8	27.0	893	--			8.0
		7.0			2.6	26.7	899	0.051	0.010		7.7
8/2/05	7.5	0-2	1.7	22.0	--	--	--	0.041	0.004	0.67	--
		0.0			11.5	29.8	929	--			8.3
		1.0			11.8	29.2	929	--			8.3
		2.0			9.8	27.2	930	--			8.1
		3.0			7.4	26.8	929	--			7.9
		4.0			4.9	26.3	928	--			7.6
		5.0			2.3	25.9	930	0.039			7.4
		6.0			0.6	25.6	931	--			7.3
		7.0			0.2	25.2	939	0.063			7.1
8/16/05	8.0	0-2	1.67	22.0	--	--	--	0.043	0.003	0.58	--
		0.0			9.0	26.3	934	--			7.8
		1.0			8.5	25.7	934	--			7.8
		2.0			8.1	25.5	933	--			7.8
		3.0			7.1	24.9	930	--			7.7
		4.0			6.3	24.9	931	0.040			7.7
		5.0			5.8	24.8	931	--			7.7
		6.0			4.2	24.7	935	--			7.7
		7.0			3.6	24.7	935	0.065			7.6
		7.5			1.5	24.5	952	--			7.3
9/2/05	8.0	0-2	1.53	19.0	--	--	--	0.049	<0.003	0.59	--
		0.0			9.2	23.7	930	--			7.3
		1.0			8.3	23.2	925	--			7.3
		2.0			7.9	23.0	880	--			7.3
		3.0			7.7	23.0	880	--			7.4
		4.0			7.5	22.9	880	--			7.4
		5.0			7.4	22.8	880	0.037			7.4
		6.0			7.3	22.8	882	--			7.4
		7.0			6.7	22.7	882	--			7.4
		7.5			5.6	22.6	926	--			7.2


Sweeney Lake (South Basin)
2005 Total Phosphorus Concentration
Summer Average = 54.8 µg/L
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Total Phosphorus (µg/L)
100
75
50
25
0
4/1
5/1
6/1
7/1
8/1
9/1
10/1

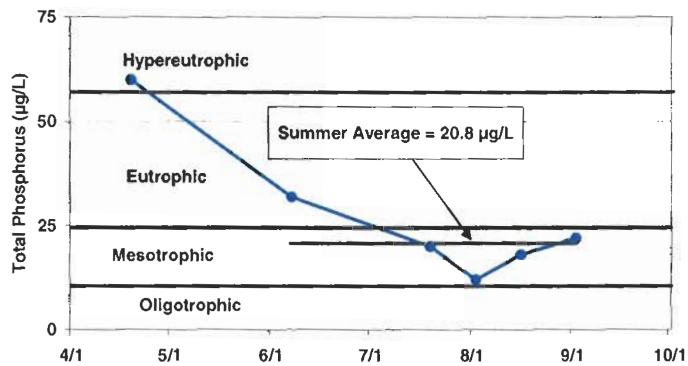

Sweeney Lake (South Basin)
2005 Chlorophyll a Concentration
Summer Average = 18.0 µg/L
Hypereutrophic
Eutrophic
Oligotrophic
Mesotrophic
Chlorophyll a (µg/L)
75
50
25
0
4/1
5/1
6/1
7/1
8/1
9/1
10/1


Sweeney Lake (South Basin)
2005 Secchi Depth
4/1
5/1
6/1
7/1
8/1
9/1
10/1
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Summer Average = 1.7 m
Secchi Depth (m)
0
1
2
3
4
5

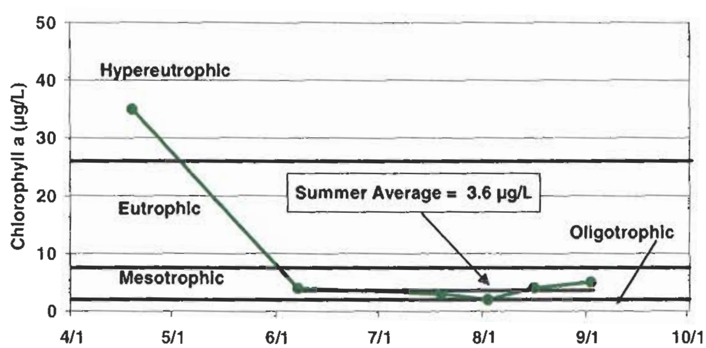
Sweeney Lake (South Basin)

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
6/7/05	7.5	0-2	2.7	12.0	--	--	--	0.070	0.004	0.98	--
		0.0			8.8	21.4	1046	--			7.0
		1.0			8.7	21.1	1046	--			7.0
		2.0			8.4	20.7	1046	--			6.9
		3.0			8.3	20.4	1046	--			6.9
		4.0			8.1	19.7	1047	0.054			6.9
		5.0			7.7	19.5	1047	--			6.9
		6.0			6.6	18.7	1052	--			6.8
		7.0			5.0	17.9	1054	0.044			6.8
7/19/05	8.5	0-2	1.7	29.0	--	--	--	0.064	0.008	0.93	--
		0.0			9.4	27.9	898	--			8.1
		1.0			8.4	27.7	899	--			8.0
		2.0			7.4	27.3	902	--			8.0
		3.0			6.6	27.2	902	--			7.9
		4.0			6.3	27.1	902	0.051	0.010		7.9
		5.0			6.2	27.0	902	--			7.9
		6.0			5.5	26.9	899	--			7.9
		7.0			2.5	26.2	924				7.8
		8.0			0.5	23.4	967	0.580	0.015		7.2
8/2/05	8.0	0-2	1.4	18.0	--	--	--	0.049	0.011	0.73	--
		0.0			8.9	28.2	935	--			7.9
		1.0			8.0	27.8	935	--			7.9
		2.0			7.5	27.1	933	--			7.8
		3.0			7.1	26.8	934	--			7.8
		4.0			5.9	26.4	928	--			7.7
		5.0			2.8	26.0	931	0.035			7.5
		6.0			1.1	25.7	932	--			7.4
		7.0			0.0	25.3	945	0.054			7.2
		7.5			0.0	25.2	946	--			7.1
8/16/05	8.0	0-2	1.3	16.0	--	--	--	0.051	<0.002	0.57	--
		0.0			8.6	25.6	940	--			7.8
		1.0			8.1	25.2	944	--			7.8
		2.0			7.6	25.0	939	--			7.8
		3.0			7.2	24.9	940	--			7.7
		4.0			7.2	24.9	940	0.040			7.7
		5.0			7.6	24.8	944	--			7.7
		6.0			6.9	24.8	944	--			7.7
		7.0			5.9	24.5	973	0.061			7.7
		7.5			1.7	24.3	992	--			7.3
9/2/05	8.0	0-2	1.52	15.0	--	--	--	0.040	<0.003	0.66	--
		0.0			8.0	23.4	884	--			7.5
		1.0			7.9	23.0	884	--			7.5
		2.0			7.8	22.9	884	--			7.5
		3.0			7.6	22.8	884	--			7.5
		4.0			7.4	22.8	884	--			7.5
		5.0			7.3	22.7	884	0.035			7.5
		6.0			7.0	22.6	887	--			7.6
		7.0			6.1	22.4	893	0.046			7.5
		7.5			2.4	22.2	1161	--			7.1

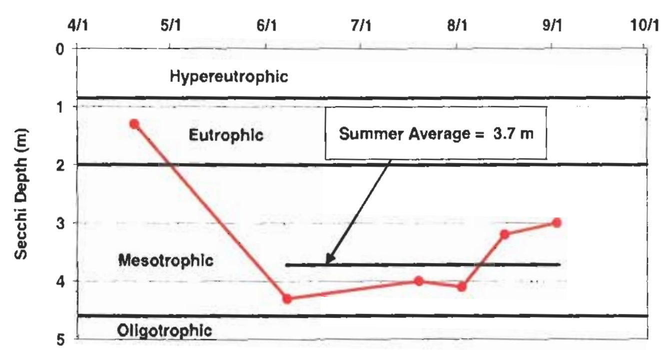
Twin Lake
2005 Total Phosphorus Concentration



Twin Lake
2005 Chlorophyll a Concentration



Twin Lake
2005 Secchi Depth



Twin Lake

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
4/19/05	16.0	0-2	1.3	35.0	--	--	--	0.060	0.005	1.3	--
		0.0			10.8	16.8	555	--			
		1.0			10.0	16.4	560	--			6.7
		2.0			8.5	13.1	590	--			6.6
		3.0			2.1	5.4	691	--			6.5
		4.0			0.8	4.0	704	0.100	0.005		6.5
		5.0			0.3	4.0	704	--			6.6
		6.0			0.0	3.5	714	--			6.5
		7.0			0.0	3.4	721	--			6.5
		8.0			0.0	3.3	723	--			6.5
		9.0			0.0	3.3	734	--			6.5
		10.0			0.0	3.3	734	--			6.5
		11.0			0.0	3.5	745	--			6.5
		12.0			0.0	3.7	753	--			6.5
		13.0			0.0	4.0	766	--			6.5
		14.0			0.0	4.1	773	--			6.5
		15.0			0.0	4.1	783	--			6.4
		16.0			0.0	4.3	789	0.732	0.623		6.4
6/7/05	16.0	0-2	4.3	4.0	--	--	--	0.032	0.003	0.75	--
		0.0			9.3	24.4	832	--			7.5
		1.0			9.2	24.2	808	--			7.5
		2.0			10.6	20.4	814	--			7.3
		3.0			8.4	14.3	829	--			6.7
		4.0			2.4	9.3	853	--			6.2
		5.0			0.7	5.6	859	0.056			6.1
		6.0			0.6	4.4	861	--			6.0
		7.0			0.3	3.8	864	--			6.0
		8.0			0.3	3.8	782	--			6.0
		9.0			0.2	3.7	791	--			5.9
		10.0			0.2	3.6	796	--			5.9
		11.0			0.2	3.7	805	--			5.9
		12.0			0.2	3.8	810	--			5.9
		13.0			0.2	3.9	824	--			5.8
		14.0			0.2	4.1	834	--			5.8
		15.0			0.1	4.1	837	--			5.8
		16.0			0.2	4.2	785	0.732			5.7

Twin Lake

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
7/19/05	16.0	0-2	4.0	3.0	--	--	--	0.020	<0.002	0.72	--
		0.0			8.2	27.7	611	--			8.3
		1.0			8.2	27.6	610	--			8.3
		2.0			8.3	27.1	607	--			8.3
		3.0			9.6	25.5	630	--			8.2
		4.0			12.3	17.0	672	--			7.8
		5.0			2.6	9.7	703	0.026	<0.002		7.0
		6.0			1.0	6.6	705	--			6.8
		7.0			0.8	4.4	722	--			6.7
		8.0			0.6	4.4	722	--			6.6
		9.0			0.6	4.3	722	--			6.6
		10.0			0.5	3.9	735	--			6.6
		11.0			0.5	3.8	745	--			6.5
		12.0			0.4	3.8	754	--			6.5
		13.0			0.4	3.9	771	--			6.4
		14.0			0.4	4.0	786	--			6.4
		15.0			0.3	4.2	796	--			6.4
		16.0			0.3	4.3	777	0.844	0.700		6.3
8/2/05	15.0	0-2	4.1	2.0	--	--	--	0.012	0.003	0.67	--
		0.0			8.3	28.8	682	--			7.9
		1.0			8.9	28.4	677	--			8.0
		2.0			9.1	27.0	676	--			8.0
		3.0			9.1	25.7	683	--			7.9
		4.0			9.7	21.4	729	--			7.6
		5.0			2.5	11.7	777	0.019			6.8
		6.0			0.0	7.7	779	--			6.6
		7.0			0.0	5.5	796	--			6.6
		8.0			0.0	4.7	796	--			6.5
		9.0			0.0	4.4	796	--			6.5
		10.0			0.0	4.2	800	--			6.4
		11.0			0.0	4.0	821	--			6.4
		12.0			0.0	4.0	830	--			6.4
		13.0			0.0	4.0	843	--			6.3
		14.0			0.0	4.1	857	--			6.3
		15.0			0.0	4.2	855	0.534			6.3

Twin Lake

Date	Max Depth (m)	Sample Depth (m)	Secchi Depth (m)	Chl. a (ug/L)	D. O. (mg/L)	Temp (°C)	Sp. Cond. (µmho/cm @ 25°C)	Total P (mg/L)	Ortho P (mg/L)	Total Nitrogen (mg/L)	pH (S.U.)
8/16/05	16.0	0-2	3.2	4.0	--	--	--	0.018	0.002	0.60	--
		0.0			10.1	25.3	672	--			8.0
		1.0			10.1	24.8	671	--			8.0
		2.0			9.2	24.4	672	--			8.0
		3.0			9.1	24.2	674	--			8.0
		4.0			9.6	21.4	716	--			7.9
		5.0			5.0	13.7	759	--			7.4
		6.0			0.9	9.3	768	0.023			7.3
		7.0			0.6	5.8	787	--			7.1
		8.0			0.4	4.6	791	--			7.1
		9.0			0.4	4.3	791	--			7.0
		10.0			0.3	4.2	791	--			7.0
		11.0			0.3	4.0	810	--			6.9
		12.0			0.3	3.9	822	--			6.8
		13.0			0.3	4.0	838	--			6.8
		14.0			0.3	4.1	856	--			6.8
		15.0			0.3	4.2	869	--			6.7
		16.0			0.5	4.2	842	0.881			6.6
9/2/05	16.5	0-2	3.0	<5.0	--	--	--	0.022	<0.003	0.56	--
		0.0			9.2	22.8	677	--			7.4
		1.0			9.1	22.6	676	--			7.5
		2.0			9.1	22.5	676	--			7.5
		3.0			7.9	22.2	684	--			7.6
		4.0			6.3	21.2	703	--			7.6
		5.0			2.3	15.7	754	--			7.2
		6.0			0.6	10.3	772	0.036			6.8
		7.0			0.5	7.0	778	--			6.7
		8.0			0.3	4.9	792	--			6.5
		9.0			0.3	4.3	796	--			6.5
		10.0			0.3	4.2	800	--			6.4
		11.0			0.3	4.0	816	--			6.3
		12.0			0.2	4.0	830	--			6.3
		13.0			0.2	4.0	842	--			6.3
		14.0			0.2	4.1	864	--			6.2
		15.0			0.2	4.2	875	--			6.2
		16.0			0.3	4.3	808	0.732			6.1
		16.5			0.3	4.3	801	--			6.1

Appendix B

Phytoplankton Data

NORTHWOOD LAKE--NORTH BASIN

0-1 METERS

STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

DIVISION	TAXON	4/22/2005 units/mL	6/7/2005 units/mL	6/22/2005 units/mL	7/19/2005 units/mL	8/2/2005 units/mL	8/16/2005 units/mL	9/2/2005 units/mL
CHLOROPHYTA (GREEN ALGAE)		95	150	0	0	0	0	0
	Ankistrodesmus falcatus	857	5,839	493	123	56	617	1,563
	Chlamydomonas globosa	6,853	31,141	62	3,022	3,831	5,366	13,390
	Golenkinia sp.	0	449	0	0	0	0	0
	Eudorina elegans	0	0	2,344	0	0	0	0
	Kirchneriella obesa	0	0	0	0	0	0	68
	Lagerheimia sp.	0	150	62	0	0	0	0
	Pandorina morum	0	0	13,199	0	56	123	476
	Pyramimonas tetrarhynchus	0	0	0	62	56	0	68
	Schroederia Judayi	95	0	0	0	0	0	0
	Scenedesmus quadricauda	0	150	0	0	0	0	0
	Scenedesmus sp.	0	299	0	0	0	0	0
	Selenastrum sp..	476	1,347	0	123	777	740	340
	Sphaerocystis Schroeteri (Colony)	0	0	0	0	0	62	68
	Tetraedron minimum	0	0	0	0	56	0	0
	Treubaria setigerum	0	0	62	0	0	0	0
	CHLOROPHYTA TOTAL	**8,376**	**39,525**	**16,221**	**3,330**	**4,830**	**6,908**	**15,973**
CHRYSOPHYTA (YELLOW-BROWN ALGAE)	*Dinobryon sociale*	286	5,390	0	0	0	0	204
	CHRYSOPHYTA TOTAL	**286**	**5,390**	**0**	**0**	**0**	**0**	**204**
CYANOPHYTA (BLUE-GREEN ALGAE)	*Anabaena affinis*	0	0	62	0	0	0	0
	Aphanizomenon flos-aquae	0	0	0	123	222	0	68
	Microcystis incerta	0	0	0	0	56	62	476
	Oscillatoria limnetica	0	150	0	0	0	0	612
	CYANOPHYTA TOTAL	**0**	**150**	**62**	**123**	**278**	**62**	**1,155**
BACILLARIOPHYTA (DIATOMS)	*Amphora ovalis*	0	0	0	62	0	0	0
	Cocconeis placentula	0	150	0	123	111	0	0
	Cymbella sp.	0	0	0	62	0	62	0
	Fragilaria capucina	0	0	0	62	0	0	68
	Gomphonema sp.	0	150	62	62	0	0	0
	Melosira granulata	0	0	0	0	56	0	0
	Navicula sp.	0	150	0	123	0	0	68
	Nitzschia sp.	0	0	0	0	0	0	68
	Stephanodiscus Hantzschii	37,787	449	0	802	777	493	476
	Stephanodiscus sp.	0	299	0	0	0	0	0
	Synedra acus	0	0	0	0	56	0	68
	Synedra ulna	761	150	62	308	278	493	204
	BACILLARIOPHYTA TOTAL	**38,549**	**1,347**	**123**	**1,604**	**1,277**	**1,048**	**952**
CRYPTOPHYTA (CRYPTOMONADS)	*Cryptomonas erosa*	2,380	0	925	4,811	6,826	10,485	6,049
	CRYPTOPHYTA TOTAL	**2,380**	**0**	**925**	**4,811**	**6,828**	**10,485**	**6,049**
EUGLENOPHYTA (EUGLENOIDS)	*Euglena sp.*	95	150	62	0	111	0	68
	Phacus sp.	190	37,729	0	0	167	0	272
	EUGLENOPHYTA TOTAL	**286**	**37,878**	**62**	**0**	**278**	**0**	**340**
PYRRHOPHYTA (DINOFLAGELLATES)	*Ceratium hirundinella*	0	0	0	0	0	0	136
	Peridinium cinctum	0	0	0	247	944	308	136
	PYRRHOPHYTA TOTAL	**0**	**0**	**0**	**247**	**944**	**308**	**272**
	TOTALS	**49,878**	**84,291**	**17,393**	**10,115**	**14,434**	**18,811**	**24,945**

NORTHWOOD LAKE--SOUTH BASIN

0-1 METERS
STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

DIVISION	TAXON	4/22/2005 units/mL	6/7/2005 units/mL	6/22/2005 units/mL	7/19/2006 units/mL	8/2/2005 units/mL	8/16/2005 units/mL	9/2/2005 units/mL
CHLOROPHYTA (GREEN ALGAE)	*Actinastrum Hantzschii*	0	0	0	0	0	62	0
	Ankistrodesmus falcatus	1,080	2,925	123	185	123	308	2,529
	Chlamydomonas globosa	11,190	45,229	7,154	6,661	2,960	3,330	10,917
	Coelastrum microporum	0	0	1,110	0	62	0	0
	Cosmarium sp.	0	0	0	0	62	62	0
	Eudorina elegans	0	0	0	0	123	0	0
	Kirchneriella obesa	0	338	62	0	0	0	0
	Pandorina morum	154	0	8,388	123	123	123	0
	Pediastrum Boryanum	0	0	0	0	0	62	0
	Pyramimonas tetrarhynchus	0	0	0	0	0	0	62
	Quadrigula sp.	0	0	0	0	0	0	0
	Schroederia Judayi	0	0	0	0	0	62	0
	Scenedesmus dimorphus	0	0	0	0	0	62	0
	Scenedesmus quadricauda	0	0	0	0	0	62	0
	Scenedesmus sp.	0	0	123	0	0	0	62
	Selenastrum sp..	0	2,475	925	2,529	987	62	247
	Sphaerocystis Schroeteri (Colony)	0	0	0	0	0	0	62
	Tetraedron sp.	0	0	0	0	0	0	62
	CHLOROPHYTA TOTAL	**12,425**	**50,967**	**17,886**	**9,498**	**4,441**	**4,194**	**13,939**
CHRYSOPHYTA (YELLOW-BROWN ALGAE)	*Dinobryon sociale*	232	5,400	0	0	0	0	62
	CHRYSOPHYTA TOTAL	**232**	**5,400**	**0**	**0**	**0**	**0**	**62**
CYANOPHYTA (BLUE-GREEN ALGAE)	*Anabaena affinis*	0	0	0	0	0	247	0
	Anabaena flos-aquae	0	0	0	0	0	62	62
	Aphanizomenon flos-aquae	0	0	493	62	62	0	247
	Merismopedia tenuissima	0	0	370	0	0	0	0
	Merismopedia sp.	0	0	62	0	0	0	62
	Microcystis aeruginosa	77	113	62	123	0	123	62
	Microcystis incerta	0	0	247	0	0	185	0
	Oscillatoria limnetica	77	113	493	62	0	0	0
	Oscillatoria redekii	0	0	1,419	0	0	0	247
	Phormidium mucicola	0	0	0	0	0	0	123
	CYANOPHYTA TOTAL	**154**	**225**	**3,145**	**247**	**62**	**617**	**802**
BACILLARIOPHYTA (DIATOMS)	*Amphora ovalis*	0	0	0	62	0	0	0
	Cocconeis placentula	77	113	0	185	123	62	62
	Cymbella sp.	0	0	0	62	0	0	62
	Gomphonema sp.	0	0	62	0	0	62	0
	Navicula sp.	0	0	123	123	185	247	62
	Stephanodiscus Hantzschii	48,543	225	247	4,749	185	555	1,048
	Stephanodiscus sp.	309	113	62	0	62	0	0
	Synedra acus	463	0	0	62	0	62	123
	Synedra actinastroides	0	0	0	0	62	0	0
	Synedra ulna	154	0	62	370	123	863	123
	BACILLARIOPHYTA TOTAL	**49,548**	**450**	**555**	**5,612**	**740**	**1,850**	**1,480**
CRYPTOPHYTA (CRYPTOMONADS)	*Cryptomonas erosa*	6,560	338	1,048	3,392	5,674	3,392	2,220
	CRYPTOPHYTA TOTAL	**6,560**	**338**	**1,048**	**3,392**	**5,674**	**3,392**	**2,220**
EUGLENOPHYTA (EUGLENOIDS)	*Euglena sp.*	77	450	62	0	0	62	0
	Phacus sp.	1,312	3,263	123	123	0	185	62
	Trachelomonas sp.	77	0	0	0	0	62	0
	EUGLENOPHYTA TOTAL	**1,466**	**3,713**	**185**	**123**	**0**	**308**	**62**
PYRRHOPHYTA (DINOFLAGELLATES)	*Ceratium hirundinella*	0	0	0	0	185	0	308
	Peridinium cinctum	0	113	123	247	493	5,921	247
	PYRRHOPHYTA TOTAL	**0**	**113**	**123**	**247**	**678**	**5,921**	**555**
	TOTALS	**70,384**	**61,205**	**22,943**	**19,119**	**11,595**	**16,282**	**19,119**

SWEENEY LAKE--NORTH BASIN

0-2 METERS
STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

DIVISION	TAXON	4/19/2005 units/mL	6/7/2005 units/mL	7/19/2005 units/mL	8/2/2005 units/mL	8/16/2005 units/mL	9/2/2005 units/mL
CHLOROPHYTA (GREEN ALGAE)	*Ankistrodesmus falcatus*	56	0	0	472	247	247
	Chlamydomonas globosa	11,436	5,181	1,604	8,691	5,386	9,498
	Coelastrum microporum	0	0	62	28	62	62
	Crucigenia quadrata	0	0	0	0	0	247
	Elakotothrix gelatinosa	0	0	0	28	0	0
	Golenkinia sp.	0	0	0	31	0	0
	Kirchneriella lunaris	0	0	0	3,886	0	0
	Kirchneriella obesa	0	0	0	111	62	0
	Oocystis parva	0	0	0	148	0	0
	Pandorina morum	0	0	0	305	0	0
	Pediastrum duplex var. clathratum	0	0	62	28	0	0
	Pediastrum simplex var. duodenarium	0	0	0	62	0	62
	Quadrigula sp.	0	0	0	0	0	62
	Schroederia Judayi	0	2,714	62	59	0	0
	Scenedesmus dimorphus	0	0	0	31	0	0
	Scenedesmus quadricauda	0	0	123	86	123	247
	Scenedesmus sp.	0	0	123	3,118	308	2,097
	Selenastrum sp..	0	0	555	5,520	6,846	7,401
	Sphaerocystis Schroeteri (Colony)	0	62	0	62	0	62
	Tetraedron muticum	0	0	0	31	0	0
	Tetraedron sp.	0	0	0	0	123	0
	CHLOROPHYTA TOTAL	**11,492**	**7,956**	**2,590**	**22,695**	**13,137**	**19,983**
CHRYSOPHYTA (YELLOW-BROWN ALGAE)	**CHRYSOPHYTA TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**
CYANOPHYTA (BLUE-GREEN ALGAE)	*Aphanizomenon flos-aquae*	0	123	0	120	123	308
	Cylindrospermopsis raciborski (straight morph)	0	0	0	0	1,542	4,379
	Lyngbya limnetica	0	0	0	56	0	0
	Merismopedia tenuissima	0	0	123	111	493	185
	Merismopedia sp.	0	0	0	0	62	432
	Microcystis aeruginosa	0	0	432	299	123	185
	Microcystis Incerta	0	0	185	534	863	3,084
	Oscillatoria limnetica	0	0	62	1,008	0	617
	Oscillatoria Agardhii	0	0	1,419	89	62	123
	Phormidium mucicola	56	0	0	167	0	0
	CYANOPHYTA TOTAL	**56**	**123**	**2,220**	**2,384**	**3,269**	**9,313**
BACILLARIOPHYTA (DIATOMS)	*Asterionella formosa*	2,165	678	308	151	247	493
	Fragilaria capucina	0	0	0	0	0	123
	Fragilaria crotonensis	0	0	247	0	123	185
	Melosira granulata	0	0	0	0	0	62
	Navicula sp.	111	0	62	89	0	123
	Stephanodiscus Hantzschii	56	0	0	274	802	3,145
	Stephanodiscus sp.	0	1,295	0	222	0	123
	Surirella sp.	56	0	0	0	0	0
	Synedra acus	0	0	0	62	0	62
	Synedra ulna	111	62	123	207	123	802
	BACILLARIOPHYTA TOTAL	**2,498**	**2,035**	**740**	**1,005**	**1,295**	**5,119**
CRYPTOPHYTA (CRYPTOMONADS)	*Cryptomonas erosa*	9,604	925	1,357	1,055	7,154	5,859
	CRYPTOPHYTA TOTAL	**9,604**	**925**	**1,357**	**1,055**	**7,154**	**5,859**
EUGLENOPHYTA (EUGLENOIDS)	*Euglena sp.*	0	0	0	123	0	62
	Phacus sp.	0	0	0	207	62	185
	EUGLENOPHYTA TOTAL	**0**	**0**	**0**	**330**	**62**	**247**
PYRRHOPHYTA (DINOFLAGELLATES)	*Ceratium hirundinella*	0	62	1,110	0	0	0
	Peridinium cinctum	0	0	62	327	308	0
	PYRRHOPHYTA TOTAL	**0**	**62**	**1,172**	**327**	**308**	**0**
	TOTALS	**23,650**	**11,102**	**8,080**	**27,796**	**25,225**	**40,521**

SWEENEY LAKE--SOUTH BASIN

0-2 METERS
STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

DIVISION	TAXON	6/7/2005 units/mL	7/19/2005 units/mL	8/2/005 units/mL	8/16/2005 units/mL	9/2/2005 units/mL
CHLOROPHYTA (GREEN ALGAE)	*Actinastrum Hantzschii*	0	0	0	0	62
	Ankistrodesmus falcatus	62	167	0	222	247
	Ankistrodesmus Brauni	0	0	62	0	0
	Chlamydomonas globosa	2,097	2,387	7,031	4,719	3,392
	Coelastrum microporum	0	0	0	56	0
	Crucigenia quadrata	0	0	0	56	432
	Kirchneriella obesa	0	56	185	111	0
	Pediastrum simplex v. duodenarium	0	56	0	0	185
	Pediastrum duplex v. clathratum	0	56	0	0	0
	Quadrigula sp.	0	0	0	56	0
	Rhizoclonium hieroglyphyicum	0	0	0	56	0
	Schroederia Judayi	1,357	0	0	0	0
	Scenedesmus dimorphus	0	0	0	0	62
	Scenedesmus quadricauda	0	111	0	444	432
	Scenedesmus sp.	0	167	2,035	555	370
	Selenastrum minutum	0	167	5,427	0	4,379
	Selenastrum sp..	0	0	0	10,048	0
	Sphaerocystis Schroeteri (Colony)	0	0	62	0	62
	CHLOROPHYTA TOTAL	**3,516**	**3,164**	**14,802**	**16,322**	**9,621**
CHRYSOPHYTA (YELLOW-BROWN ALGAE)	**CHRYSOPHYTA TOTAL**	**0**	**0**	**0**	**0**	**0**
CYANOPHYTA (BLUE-GREEN ALGAE)	*Anabaena affinis*	0	56	0	0	0
	Anabaena flos-aquae	0	0	0	111	62
	Aphanizomenon flos-aquae	123	0	62	111	2,097
	Cylindrospermopsis raciborski (straight morph)	0	0	0	222	123
	Merismopedia tenuissima	0	111	62	278	493
	Merismopedia sp.	0	0	0	56	185
	Microcystis aeruginosa	62	0	247	56	185
	Microcystis incerta	0	222	123	1,665	1,665
	Oscillatoria limnetica	0	0	1,172	722	740
	Oscillatoria Agardhii	0	833	0	278	1,295
	Oscillatoria redekii	0	0	0	0	2,220
	Phormidium mucicola	0	167	185	167	0
	CYANOPHYTA TOTAL	**185**	**1,388**	**1,850**	**3,664**	**9,066**
BACILLARIOPHYTA (DIATOMS)	*Amphora ovalis*	0	0	0	56	0
	Asterionella formosa	493	222	62	500	678
	Cocconeis placentula	0	56	0	111	62
	Cyclotella glomerata	0	0	0	0	62
	Cymbella sp.	0	0	62	0	0
	Diatoma vulgare	0	0	0	111	0
	Fragilaria capucina	123	56	62	0	62
	Fragilaria crotonensis	0	278	62	167	185
	Gomphonema sp.	0	0	123	0	0
	Melosira granulata	0	111	0	56	308
	Navicula sp.	0	56	0	56	247
	Nitzschia sp.	0	56	62	0	0
	Stephanodiscus Hantzschii	123	56	0	1,055	2,714
	Stephanodiscus sp.	802	0	62	0	247
	Synedra acus	0	56	0	0	62
	Synedra ulna	62	56	247	611	617
	BACILLARIOPHYTA TOTAL	**1,604**	**999**	**740**	**2,720**	**5,242**
CRYPTOPHYTA (CRYPTOMONADS)	*Cryptomonas erosa*	1,295	2,054	2,775	5,774	4,256
	CRYPTOPHYTA TOTAL	**1,295**	**2,054**	**2,775**	**5,774**	**4,256**
EUGLENOPHYTA (EUGLENOIDS)	*Euglena sp.*	0	0	0	56	0
	Phacus sp.	0	0	0	56	0
	EUGLENOPHYTA TOTAL	**0**	**0**	**0**	**111**	**0**
PYRRHOPHYTA (DINOFLAGELLATES)	*Ceratium hirundinella*	123	777	0	0	62
	Peridinium cinctum	0	0	185	389	62
	PYRRHOPHYTA TOTAL	**123**	**777**	**185**	**389**	**123**
	TOTALS	**6,723**	**8,383**	**20,353**	**28,979**	**28,309**

TWIN LAKE
0-2 METERS
STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

DIVISION	TAXON	4/19/2005 units/mL	6/7/2005 units/mL	7/19/2005 units/mL	8/2/2005 units/mL	8/16/2005 units/mL	9/2/2005 units/mL
CHLOROPHYTA (GREEN ALGAE)	*Ankistrodesmus falcatus*	120	62	0	0	0	0
	Ankistrodesmus Brauni	0	62	56	527	0	83
	Chlamydomonas globosa	58,607	4,749	1,582	1,221	444	611
	Coelastrum microporum	0	0	56	0	0	0
	Crucigenia sp.	0	0	0	0	0	56
	Lagerheimia sp.	0	0	0	28	0	0
	Oocystis parva	0	62	83	167	278	0
	Pandorina morum	0	0	0	0	0	28
	Schroederia Judayi	0	62	0	0	0	28
	Scenedesmus sp.	0	0	0	28	0	0
	Selenastrum minutum	0	0	0	0	0	28
	Sphaerocystis Schroeteri (Colony)	120	0	0	0	0	0
	Tetraedron minimum	0	0	0	0	28	0
	Tetraedron muticum	0	0	0	0	0	28
	CHLOROPHYTA TOTAL	**58,847**	**4,996**	**1,777**	**1,971**	**749**	**860**
CHRYSOPHYTA (YELLOW-BROWN ALGAE)	**CHRYSOPHYTA TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**
CYANOPHYTA (BLUE-GREEN ALGAE)	*Anabaena affinis*	0	0	28	0	56	0
	Anabaena flos-aquae	0	0	56	139	111	0
	Aphanizomenon flos-aquae	2,166	308	0	0	139	361
	Coelosphaerium Naegelianum	0	0	28	222	0	0
	Merismopedia tenuissima	0	62	0	0	0	0
	Merismopedia sp.	0	0	28	28	0	0
	Microcystis aeruginosa	0	62	0	83	0	194
	Microcystis incerta	120	62	1,194	111	3,942	1,638
	CYANOPHYTA TOTAL	**2,287**	**493**	**1,332**	**583**	**4,247**	**2,193**
BACILLARIOPHYTA (DIATOMS)	*Asterionella formosa*	120	1,110	0	0	0	0
	Cocconeis placentula	0	0	0	28	0	0
	Navicula sp.	120	0	0	0	0	0
	Nitzschia sp.	0	0	0	0	0	28
	Stephanodiscus Hantzschii	0	0	83	28	28	0
	Stephanodiscus sp.	120	1,419	0	0	0	28
	Synedra ulna	722	247	0	0	0	0
	BACILLARIOPHYTA TOTAL	**1,083**	**2,775**	**83**	**56**	**28**	**56**
CRYPTOPHYTA (CRYPTOMONADS)	*Cryptomonas erosa*	4,814	3,084	222	222	0	527
	CRYPTOPHYTA TOTAL	**4,814**	**3,084**	**222**	**222**	**0**	**527**
EUGLENOPHYTA (EUGLENOIDS)	**EUGLENOPHYTA TOTAL**	**0**	**0**	**0**	**0**	**0**	**0**
PYRRHOPHYTA (DINOFLAGELLATES)	*Ceratium hirundinella*	0	0	28	28	0	0
	Peridinium cinctum	0	62	0	0	0	0
	PYRRHOPHYTA TOTAL	**0**	**62**	**28**	**28**	**0**	**0**
	TOTALS	**67,031**	**11,410**	**3,442**	**2,859**	**5,024**	**3,636**

Appendix C

Zooplankton Data

NORTHWOOD LAKE
NORTH BASIN
ZOOPLANKTON ANALYSIS

DIVISION	TAXON / *Vertical Tow (m)*	*04/19/05* #/m2	*06/07/05* #/m2	*06/22/05* #/m2	7/19/2005 #/m2	8/2/2005 #/m2	8/16/2005 #/m2	9/2/2005
CLADOCERA	*Bosmina longirostris*	9,903	0	0	0	0	0	0
	Chydorus sphaericus	0	0	0	0	9,549	0	0
	Diaphanosoma leuchtenbergianum	9,903	0	0	0	0	6,189	0
	CLADOCERA TOTAL	**19,806**	**0**	**0**	**0**	**9,549**	**6,189**	**0**
COPEPODA	*Cyclops sp.*	9,903	13,793	0	9,549	12,732	0	7,958
	Nauplii	19,806	0	0	0	6,366	6,189	55,704
	COPEPODA TOTAL	**29,709**	**13,793**	**0**	**9,549**	**19,099**	**6,189**	**63,662**
ROTIFERA	*Brachionus havanaensis*	0	0	8,930	0	0		
	Filinia longiseta	19,806	20,690	0	3,183	0	0	0
	Lecane sp.	0	0	0	3,183	3,183	6,189	7,958
	Keratella cochlearis	19,806	34,483	53,582	0	22,282	30,947	119,366
	Keratella quadrata	0	0	17,861	6,366	0	0	0
	Kellicottia bostoniensis.	19,806	6,897	98,234	0	3,183	0	7,958
	Polyarthra vulgaris	0	6,897	0	0	9,549	0	15,915
	Trichocerca multicrinis	0	0	0	0	6,366	0	0
	Immature Unidentified Rotifer	19,806	0	0	0	0	0	0
	ROTIFERA TOTAL	**79,224**	**68,967**	**178,607**	**12,732**	**44,563**	**37,136**	**151,197**
	TOTALS	**128,738**	**82,760**	**178,607**	**22,282**	**73,211**	**49,515**	**214,859**

NORTHWOOD LAKE

SOUTH BASIN

ZOOPLANKTON ANALYSIS

DIVISION	TAXON — *Vertical Tow (m)*	*04/19/05* #/m2	*06/07/05* #/m2	*06/22/05* #/m2	7/19/2005 #/m2	8/2/2005 #/m2	8/16/2005 #/m2	9/2/2005
CLADOCERA	*Diaphanosoma leuchtenbergianum*	0	0	9,726	0	0	0	0
	CLADOCERA TOTAL	**0**	**0**	**9,726**	**0**	**0**	**0**	**0**
COPEPODA	*Cyclops sp.*	8,046	5,482	38,904	5,703	0	0	22,282
	Diaptomus sp.	0	0	0	0	2,564	3,802	14,854
	Nauplii	8,046	0	4,863	5,703	7,692	0	126,263
	COPEPODA TOTAL	**16,092**	**5,482**	**43,768**	**11,406**	**10,257**	**3,802**	**163,399**
ROTIFERA	*Asplanchna priodonta*	8,046	0	0	0	0	0	0
	Brachionus havanaensis	16,092	0	0	0	0		
	Filinia longiseta	0	32,892	0	0	0	0	0
	Lecane sp.	8,046	0	0	1,901	0	0	0
	Keratella cochlearis	32,185	115,122	43,768	13,307	61,540	41,822	222,816
	Keratella quadrata	104,600	0	0	0	0	3,802	0
	Kellicottia bostoniensis.	136,785	10,964	0	3,802	0	3,802	0
	Polyarthra vulgaris	0	10,964	0	7,604	0	0	37,136
	Trichocerca cylindrica	0	0	0	0	2,564	0	0
	Trichocerca multicrinis	8,046	0	0	0	5,128	7,604	7,427
	Immature Unidentified Rotifer	8,046	0	0	1,901	2,564	11,406	0
	ROTIFERA TOTAL	**321,846**	**169,942**	**43,768**	**28,515**	**71,796**	**68,436**	**267,380**
	TOTALS	**337,938**	**175,424**	**97,261**	**39,921**	**82,053**	**72,238**	**430,778**

SWEENEY LAKE
NORTH BASIN
ZOOPLANKTON ANALYSIS

DIVISION	TAXON	Vertical Tow (m) 04/19/05 #/m2	06/07/05 #/m2	07/19/05 #/m2	8/2/2005 #/m2	8/16/2005 #/m2	9/2/2005 #/m2
CLADOCERA	*Bosmina longirostris*	215,119	70,028	0	0	18,038	0
	Ceriodaphnia sp.	0	0	6,897	0	0	0
	Daphnia galeata mendotae	21,512	389,045	6,897	0	0	0
	Daphnia pulex	0	23,343	0	0	0	0
	Daphnia retrocurva	0	0	6,897	0	0	0
	Diaphanosoma leuchtenbergianum	0	15,562	6,897	132,982	42,088	13,705
	CLADOCERA TOTAL	**236,631**	**497,977**	**27,587**	**132,982**	**60,125**	**13,705**
COPEPODA	*Cyclops sp.*	1,355,248	62,247	20,690	24,934	36,075	38,374
	Diaptomus sp.	21,512	256,769	13,793	33,246	24,050	24,669
	Nauplii	344,190	15,562	0	8,311	30,063	13,705
	Copepodid	21,512	0	0	0	6,013	0
	COPEPODA TOTAL	**1,742,462**	**334,578**	**34,483**	**66,491**	**96,200**	**76,748**
	Asplanchna priodonta	0	0	89,657	16,623	0	0
	Brachionus havanaensis	0	7,781	0	0	6,013	
	Filinia longiseta	0	7,781	62,070	66,491	0	0
	Keratella cochlearis	64,536	0	55,174	0	0	24,669
	Keratella quadrata	677,624	0	0	8,311	6,013	0
	Keratella serrulata	118,315	0	0	0	0	0
	Kellicottia bostoniensis.	5,076,802	0	6,897	0	0	0
	Polyarthra vulgaris	0	0	34,483	8,311	0	5,482
	Trichocerca multicrinis	0	0	34,483	8,311	12,025	2,741
	Immature Unidentified Rotifer	0	7,781	0	0	0	2,741
	ROTIFERA TOTAL	**5,937,277**	**23,343**	**282,765**	**108,048**	**24,050**	**35,633**
	TOTALS	**7,916,369**	**855,898**	**344,835**	**307,522**	**180,375**	**126,086**

SWEENEY LAKE

SOUTH BASIN
ZOOPLANKTON ANALYSIS

DIVISION	TAXON	Vertical Tow (m) 06/07/05 #/m2	07/19/05 #/m2	8/2/2005 #/m2	8/16/2005 #/m2	9/2/2005 #/m2
CLADOCERA	*Bosmina longirostris*	117,774	0	24,050	14,324	0
	Chydorus sphaericus	0	0	0	0	10,257
	Daphnia galeata mendotae	281,350	10,699	18,038	0	20,513
	Daphnia pulex	45,801	10,699	0	0	0
	Daphnia retrocurva	0	21,397	18,038	0	0
	Diaphanosoma leuchtenbergianum	0	96,289	84,175	35,810	10,257
	CLADOCERA TOTAL	**444,925**	**139,083**	**144,300**	**50,134**	**41,027**
COPEPODA	*Cyclops sp.*	78,516	42,795	30,063	50,134	30,770
	Diaptomus sp.	235,549	160,481	144,300	28,648	51,283
	Nauplii	98,145	85,590	6,013	28,648	0
	COPEPODA TOTAL	**412,210**	**288,866**	**180,375**	**107,429**	**82,053**
	Asplanchna priodonta	0	74,891	12,025	0	0
	Filinia longiseta	0	32,096	18,038	7,162	0
	Lecane sp.	6,543	0	0	0	0
	Keratella cochlearis	0	32,096	6,013	21,486	10,257
	Keratella quadrata	13,086	32,096	0	28,648	10,257
	Keratella serrulata	6,543	0	0	0	0
	Kellicottia bostoniensis.	78,516	203,276	18,038	35,810	0
	Polyarthra vulgaris	0	85,590	12,025	0	0
	Trichocerca multicrinis	0	10,699	18,038	14,324	0
	Immature Unidentified Rotifer	0	0	12,025	7,162	0
	ROTIFERA TOTAL	**104,688**	**470,744**	**96,200**	**114,591**	**20,513**

TWIN LAKE

ZOOPLANKTON ANALYSIS

DIVISION	TAXON	Vertical Tow (m) 04/19/05 #/m2	06/07/05 #/m2	07/19/05 #/m2	8/2/2005 #/m2	8/16/2005 #/m2	9/2/2005 #/m2
CLADOCERA	*Bosmina longirostris*	12,758	28,736	0	0	0	0
	Chydorus sphaericus	12,758	0	0	0	0	0
	Daphnia galeata mendotae	63,788	74,714	152,081	127,324	212,206	130,860
	Daphnia pulex	25,515	51,725	98,853	70,028	99,472	98,145
	Daphnia retrocurva	0	0	0	0	26,526	58,887
	Diaphanosoma leuchtenbergianum	0	0	121,665	108,225	6,631	71,973
	Immature Cladocera	0	28,736	45,624	6,366	39,789	6,543
	CLADOCERA TOTAL	**114,819**	**183,912**	**418,223**	**311,943**	**384,624**	**366,409**
COPEPODA	*Cyclops sp.*	153,092	258,626	167,289	89,127	179,049	202,834
	Diaptomus sp.	0	34,483	7,604	0	46,420	71,973
	Nauplii	140,334	11,494	15,208	101,859	19,894	19,629
	COPEPODA TOTAL	**293,425**	**304,604**	**190,101**	**190,985**	**245,363**	**294,436**
	Asplanchna priodonta	12,758	74,714	0	0	0	6,543
	Brachionus havanaensis	12,758	0	0	0	0	
	Filinia longiseta	25,515	5,747	15,208	280,112	72,946	248,635
	Keratella cochlearis	63,788	17,242	15,208	12,732	6,631	0
	Keratella quadrata	676,154	178,165	30,416	120,957	79,577	13,086
	Keratella serrulata	12,758	0	0	0	53,052	0
	Kellicottia bostoniensis.	6,085,389	241,384	83,645	31,831	0	39,258
	Polyarthra vulgaris	12,758	22,989	0	19,099	13,263	6,543
	Immature Unidentified Rotifer	0	17,242	0	31,831	112,734	104,688
	ROTIFERA TOTAL	**6,901,877**	**557,483**	**144,477**	**496,562**	**338,203**	**418,753**
	TOTALS	**7,310,121**	**1,045,999**	**752,801**	**999,491**	**968,190**	**1,079,599**