

Appendix B

Water Quality Monitoring

2008 Lake Water Quality Study

Sweeney Lake and Twin Lake

*Prepared by
Bassett Creek Watershed Management Commission*

February 2009



Executive Summary

Since 1970, water quality has been monitored in ten major lakes under the management of the Bassett Creek Watershed Management Commission (BCWMC). 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 BCWMC's efforts to maintain and improve water quality. The BCWMC 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 BCWMC'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 2008 in Sweeney and Twin Lakes in Golden Valley. The lakes were monitored for both chemical and biological 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 2008 water quality monitoring are as follows:

Sweeney Lake

- Water quality status of Sweeney Lake was mesotrophic (moderate nutrients and good water quality) although the summer average phosphorus concentration was mildly eutrophic (nutrient rich and poor water quality) during the 2008 growing season.
- Vegetation (submerged and floating leaf) was found throughout the lake's littoral (shallow) zone to depths of 10 feet during June and 13 feet during August.
- Two undesirable non-native species, curlyleaf pondweed (*Potamogeton crispus*) and purple loosestrife (*Lythrum salicaria*), were observed during 2008. Both were also observed in 2005. No changes in coverage or density since 2005 are apparent.
- Sweeney Lake water quality has improved when compared to 2007 and 2005 because chlorophyll *a* and total phosphorus have decreased while Secchi depth has increased, and water quality is the best since monitoring began in 1972.

- Despite improvements, Sweeney Lake did not meet the BCWMC Level I water quality goal for total phosphorus (average summer concentration not to exceed 30 µg/L), although the 2008 average summer concentration (32 µg/L) was very close to the goal (within 2 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) goals were met in 2008.
- In 2008, Sweeney Lake water quality met the state water quality standards.
- Phosphorus buildup in the lake's bottom waters during 2008 resulted from internal loading. Because the aeration system was not in operation during 2008, lake mixing did not occur and the phosphorus pool was trapped in the lake's bottom waters during the summer.
- A comparison of 2005 and 2008 water quality data indicate the lake's aeration system causes mixing of the phosphorus from the lake's bottom waters into the surface waters.
- Because phosphorus from internal loading mixes during the fall and spring mixing events, this phosphorus contributes to the lake's annual phosphorus load which affects the lake's water quality during the subsequent growing season. The TMDL study that is underway should evaluate options to minimize internal loading and its impact upon the lake's spring and summer water quality.

To further evaluate the changes in lake water quality observed during 2008, it is recommended that the lake be monitored without the operation of the aeration system during 2009. Samples would be collected prior to ice-out and throughout the growing season.

Twin Lake

- The summer average of the total phosphorus concentrations indicates that Twin Lake is in the eutrophic category, while the summer average chlorophyll *a* concentration and Secchi disc transparency are within the upper limits of the mesotrophic classification. With the exception of the June measurement, 2008 Secchi disc data points are in the eutrophic category.

- In 2008, Twin Lake did not meet the BCWMC Level I water quality goal for total phosphorus (average summer concentration not to exceed 30 µg/L) or Secchi disc transparency (average summer depth of at least 2.2 meters). The lake's average summer total phosphorus concentration was 44 µg/L and Secchi disc transparency was 2.0 meters. The lake's average summer chlorophyll *a* concentration of 6.7 µg/L met the BCWMC Level I water quality goal (average summer concentration not to exceed 10 µg/L).
- In 2008, Twin Lake did not meet the state water quality standards. The lake's average summer total phosphorus concentration (44 µg/L) exceeded the state standard (maximum of 40 µg/L). However, the lake's average summer chlorophyll *a* (6.7 µg/L) and Secchi disc transparency (2.0 meters) both met the state standard (chlorophyll *a* maximum of 14 µg/L and Secchi disc minimum of 1.4 meters).
- Historical data indicate an improvement in water quality between 1982 and 1992 after which it remained relatively constant from 1992 to 2005. However all three nutrient-related parameters indicate that water quality has decreased greatly between 2005 and 2008 and the water quality of the lake during 2008 was at or near the poorest water quality observed since monitoring began.
- 2008 noted substantially higher numbers of phytoplankton (algae - microscopic plants) during the late summer as compared with 2000 and 2005. The higher numbers indicate the lake's water quality has decreased greatly between 2000 and 2008.
- A substantial decline in large-bodied zooplankters (microscopic crustaceans) occurred from early June to early July of 2008. Large-bodied zooplankters can improve a lake's water quality by eating substantial quantities of algae. A substantial decline in large-bodied zooplankters greatly reduces the quantity of algae that are consumed and results in decreased water quality. The reduced control by zooplankton during this period corresponded with a tripling of the number of phytoplankton in the lake despite declining phosphorus concentrations.
- A comparison of 2000, 2005, and 2008 zooplankton (microscopic crustaceans) indicates substantially higher numbers of zooplankton were observed during June of 2008 than were observed in June of 2000 and 2005. Because zooplankton consume

algae, the lake's capacity to control algae through zooplankton consumption was higher during June of 2008 than during June of 2000 and 2005. Declines in zooplankton during June and July of 2008 resulted in similar numbers of zooplankton during August of 2008 as were observed during August of 2000 and 2005. The capacity of the lake's zooplankton to control algae was essentially the same during August of 2000, 2005, and 2008.

- A larger number of plant species was observed in 2008 than during 1996 through 2005. A total of 15 to 19 individual species were observed in 1996 through 2005 compared with 21 to 22 species in 2008.
- Curlyleaf pondweed, an undesirable non-native species, was observed in light density along the northeastern shore during June of 2000, was not observed during 2005, and was observed in light density at a single location along the southeastern shore during August of 2008. The August growth would be a new growth from turions (seeds) since the plant's growth cycle begins in late summer, continues through the winter, and concludes in late June each year.
- Purple loosestrife, an undesirable non-native species, was first observed growing along the south shoreline during 2000 and has been observed at this same location during 2005 and 2008. Although no increase in coverage has been observed, the presence of purple loosestrife is of concern because this plant typically displaces native vegetation and becomes the sole emergent species. It is recommended that the BCWMC work with the Minnesota Department of Natural Resources (MDNR) to manage purple loosestrife along Twin Lake's south shoreline.

To determine the cause of the high phosphorus concentration in Twin Lake, additional monitoring is recommended to determine changes in the lake's phosphorus concentrations before and after ice-out. Specifically, it is recommended that samples be collected prior to ice-out and that samples be collected throughout the growing season. In addition, lake level monitoring of both Sweeney Lake and Twin Lake is recommended immediately after ice-out to rule out the possibility that Sweeney flows into Twin during periods of high water levels such as following spring snowmelt.

2008 Lake Water Quality Study Sweeney Lake and Twin Lake

Table of Contents

Executive Summary	i
Sweeney Lake	i
Twin Lake	ii
1.0 Introduction.....	1
2.0 Methods	6
2.1 Water Quality Sampling	6
2.2 Ecosystem Data	7
3.0 Sweeney Lake.....	9
3.1 Site Description	9
3.2 Goal.....	9
3.3 State Standard	9
3.4 Watershed and Lake Management Plan.....	10
3.5 Water Quality Data	11
3.5.1 Temperature.....	11
3.5.2 Dissolved Oxygen.....	12
3.5.3 Total Phosphorus, Chlorophyll <i>a</i> , and Secchi Depth.....	12
3.6 Historical Trends	16
3.7 Biota.....	17
3.7.1 Phytoplankton.....	17
3.7.2 Zooplankton.....	19
3.7.3 Macrophytes	21
3.8 Conclusions.....	25
3.9 Recommendations.....	26
4.0 Twin Lake.....	27
4.1 Site Description	27
4.2 Goal.....	27
4.3 State Standard	27
4.4 Watershed and Lake Management Plan.....	27
4.5 Water Quality Data	28
3.5.1 Temperature.....	28
3.5.2 Dissolved Oxygen.....	28
3.5.3 Total Phosphorus, Chlorophyll <i>a</i> , and Secchi Depth.....	29
4.6 Historical Trends	33
4.7 Biota.....	34
4.7.1 Phytoplankton.....	34

4.7.2 Zooplankton.....	36
4.7.3 Macrophytes	38
4.8 Conclusions.....	42
4.9 Recommendations.....	43
5.0 References.....	44

List of Tables

Table 1	Lakes Monitored in the Basset Creek Watershed BCWMC Area.....	1
Table 2	Trophic State Classifications for Total Phosphorus, Chlorophyll <i>a</i> , and Secchi Disc Transparency.....	4
Table 3	Sample Collection Dates.....	6
Table 4	Lake Water Quality Parameters	7

List of Figures

Figure 1	Location of Lakes Included In 2008 Water Quality Study.....	3
Figure 2	2008 Sweeney Lake Total Phosphorus Concentration	13
Figure 3	2008 Sweeney Lake Surface and Bottom Total Phosphorus Concentration.....	14
Figure 4	2008 Sweeney Lake Chlorophyll <i>a</i> Concentration.....	15
Figure 5	2008 Sweeney Lake Secchi Depth	16
Figure 6	Historical Water Quality in Sweeney Lake.	17
Figure 7	2008 Sweeney Lake (North Basin) Phytoplankton Data Summary by Division	18
Figure 8	2008 Sweeney Lake (South Basin) Phytoplankton Data Summary by Division	19
Figure 9	2008 Sweeney Lake (North Basin) Zooplankton Data Summary by Division	20
Figure 10	2008 Sweeney Lake (South Basin) Zooplankton Data Summary by Division	20
Figure 11	Comparison of 2005 and 2008 Zooplankton in Sweeney Lake (South Basin)	21
Figure 12	Sweeney Lake Macrophyte Survey June 5, 2008.....	23
Figure 13	Sweeney Lake Macrophyte Survey August 12, 2008.....	24
Figure 14	2008 Twin Lake Total Phosphorus Concentration.....	29
Figure 15	Comparison of 2000, 2005, and 2008 Twin Lake Surface Total Phosphorus Concentrations	30
Figure 16	Twin Lake 2008 Surface and Bottom Total Phosphorus Concentration	31
Figure 17	2008 Twin Lake Chlorophyll <i>a</i> Concentration	32
Figure 18	2008 Twin Lake Secchi Depth.....	32
Figure 19	Historical Water Quality Data in Twin Lake.....	34
Figure 20	2008 Twin Lake Phytoplankton Data Summary by Division	35
Figure 21	Comparison of 2000, 2005, and 2008 Twin Lake Phytoplankton.....	36
Figure 22	2008 Twin Lake Zooplankton Data Summary by Division	37
Figure 23	Comparison of 2000, 2005, and 2008 Twin Lake Zooplankton.....	38
Figure 24	Twin Lake Macrophyte Survey June 5, 2008	40
Figure 25	Twin Lake Macrophyte Survey August 12, 2008	41

List of Appendices

Appendix A	2008 Sweeney Lake Data
Appendix B	2007 Sweeney Lake Data

- Appendix C 2005 Sweeney Lake Data
- Appendix D 2008 Twin Lake Data
- Appendix E 2005 Twin Lake Data
- Appendix F 1972-2008 Twin Cities Monthly and Yearly Precipitation Data
- Appendix G Sweeney and Twin 2007-2008 Lake Level Data