Lake Monitoring History

	Cook	*Cowley*	Diamond	*Dubay*	Fish	*French*	Henry	*Jubert*	Mill Pond	*Mud*	Rice	*Sylvqn*	Weaver
2011													
2010		C	T		T	T	C		T	T	C/T		T
2009		C	T		T	T	C		T		C		T
2008			T		T		C				C	C	T
2007		C	T		T		C				C		T
2006		C			T	T	C						T
2005					T	T	C						T
2004			T		T	T							T
2003													
2002					T	C			T				T
2001	T				T	C							T
2000					T			C					T
1999					T				T				T
1998			T		T								T
1997					T							T	T
1996					T								T
1995					T		C						T
1994			C		T								T
1993					T								T
1992	T		T		T								T
1991					T			T	T				T
1990	T				T	T							T
1989			T	T	T			T					T
1988	T				T				T				T
1987					T			T					T
1986	T		T	T	T					T			T

T = monitored by Three Rivers Park District **C** = monitored through CAMP program

Elm Creek Watershed Management Commission
Lake Water Quality Summaries
2010

Fish Lake

Fish Lake has consistently had an average in-lake phosphorus concentration above the MPCA impaired water eutrophication standard of 40 µg/L. The average phosphorus concentration for Fish Lake in 2010 was 47.8 µg/L (Figure 1). The highest phosphorus concentrations coincided with the spring and fall lake turnover cycles in 2010. The process of lake turnover re-suspended nutrients throughout the water column and contributed to high total phosphorus concentrations at the end of April (71.0 µg/L) and beginning of October (98.6 µg/L) (Figure 2). Throughout the remaining portion of the year, the total phosphorus concentrations fluctuated between 34.4 and 73.6 µg/L (Figure 2).

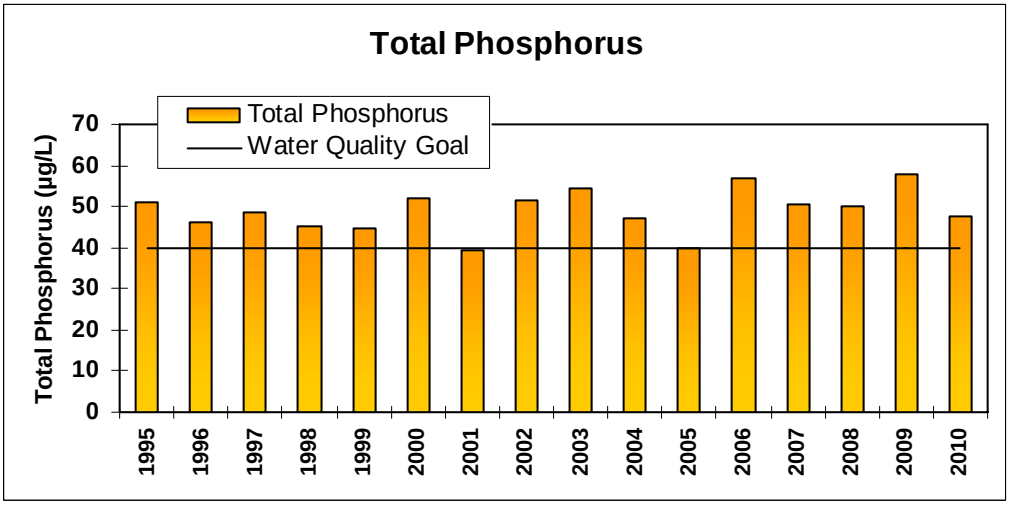

Figure 1. Fish Lake average annual total phosphorus concentrations in 2010.

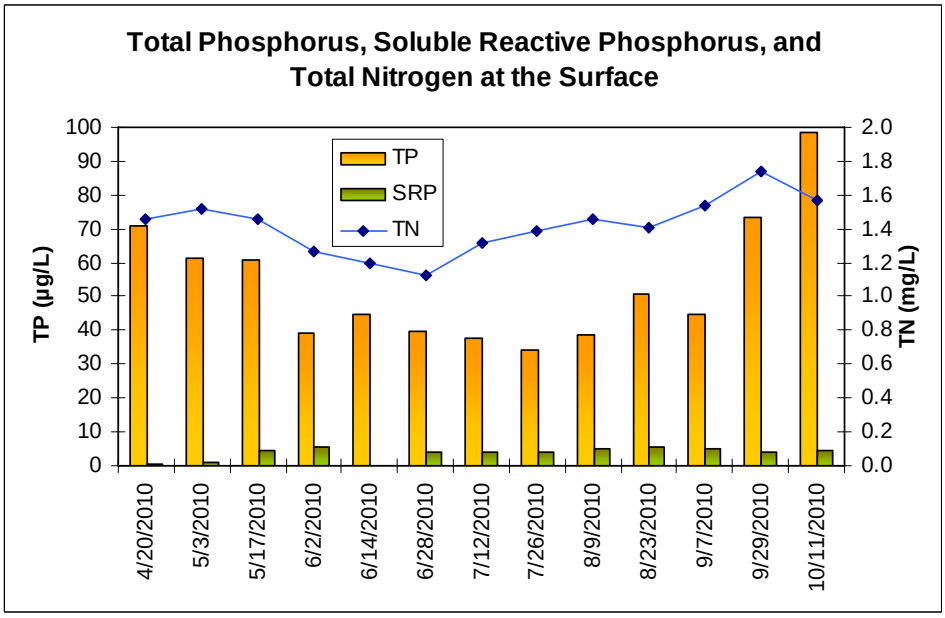

Figure 2. Fish Lake seasonal changes in total phosphorus, soluble reactive phosphorus, and total nitrogen.

The severity of algal blooms in Fish Lake has been extremely variable from year to year. The average chlorophyll-a concentration in 2010 was 14.7 µg/L with values ranging from 4.7 to 21.7 µg/L (Figure 4). The average secchi depth transparency was 1.47 m with values ranging from 0.97 m to 2.92 m (Figure 4). The chlorophyll-a concentrations were slightly higher than the MPCA chlorophyll-a standard for impairment of 14.1 µg/L, but secchi depth transparency did meet the MPCA water clarity standard for impairment of 1.4 m. Since 1995, chlorophyll-a concentrations and secchi depth transparency have been at or near the MPCA standard for impairment with the exception of 2002 through 2007. Algal blooms appeared to be more severe from 2002 through 2007 with average chlorophyll-a concentrations ranging from 25.8 to 38.8 µg/L and secchi depth transparency below 1.4 m (Figure 3). Recently, water clarity conditions have improved in which chlorophyll-a concentrations and secchi depth transparency are at or near the MPCA impairment criteria.

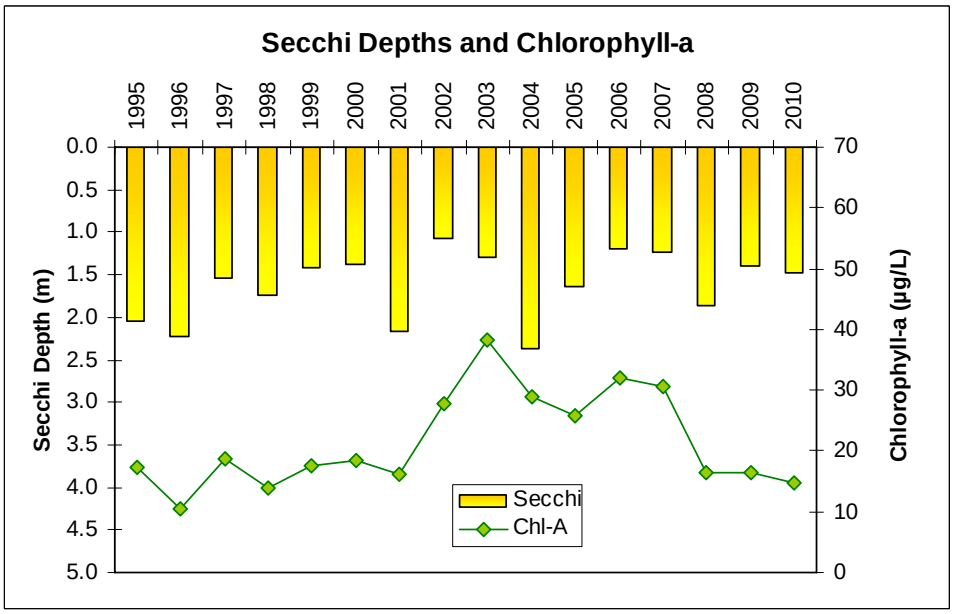

Figure 3. Fish Lake average annual secchi depth and chlorophyll-a concentrations.

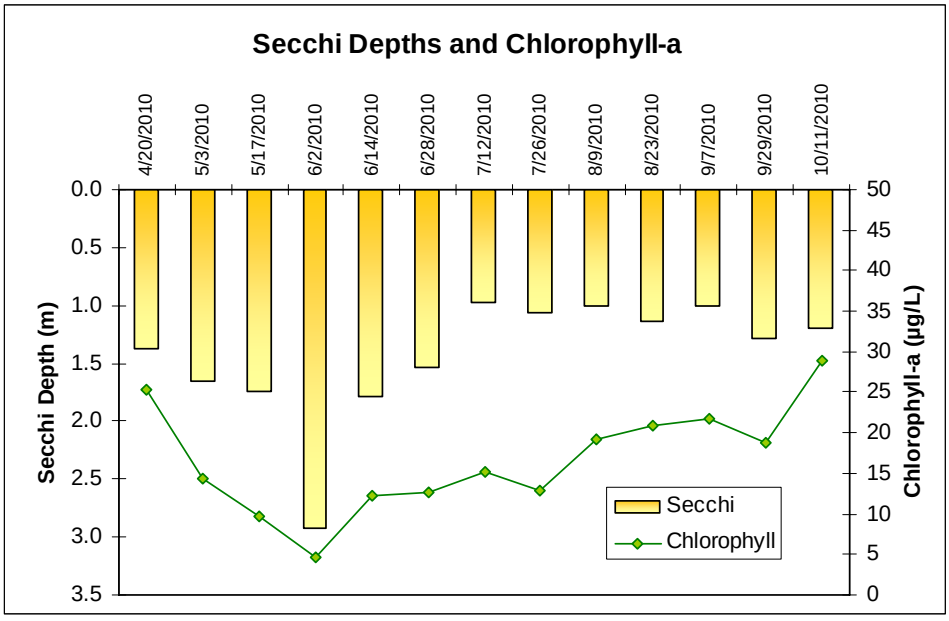

Figure 4. Fish Lake seasonal changes in secchi depth and chlorophyll-a concentrations in 2010.

Weaver Lake

The Weaver Lake water quality conditions have significantly improved. Prior to 2005, the lake frequently had phosphorus concentrations that were above the MPCA impaired water criteria of 40 µg/L (Figure 1). A significant decrease in phosphorus occurred after 2004 in which concentrations have been substantial below the impaired water threshold. The average phosphorus concentrations from 2005 through 2010 have consistently averaged between 20 to 35 µg/L (Figure 1). Currently, the average annual phosphorus concentration was 31.6 µg/L with values ranging from 20.5 to 50.1 µg/L in 2010 (Figure 2). These concentrations are considerably lower in comparison to other lakes within the ecoregion.

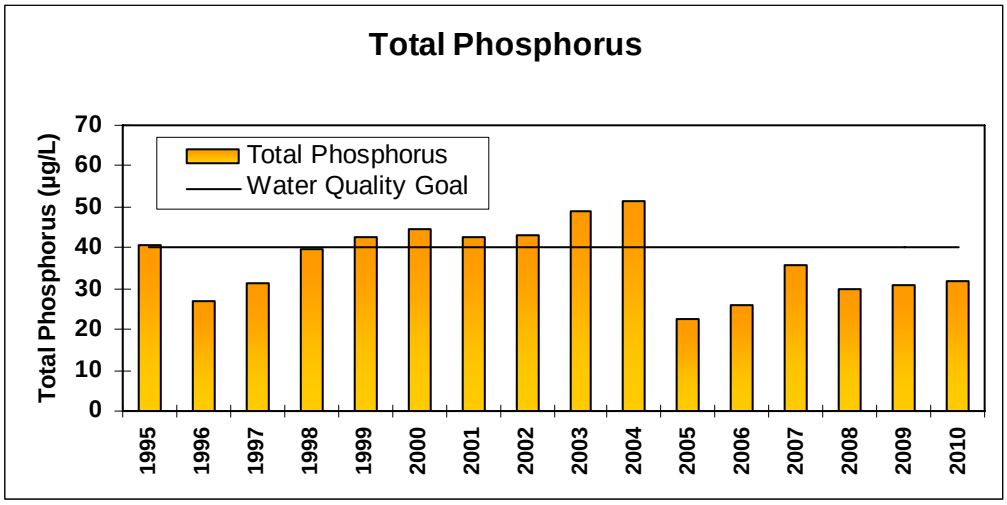

Figure 3. Weaver Lake average total phosphorus concentrations from 1995 to 2010.

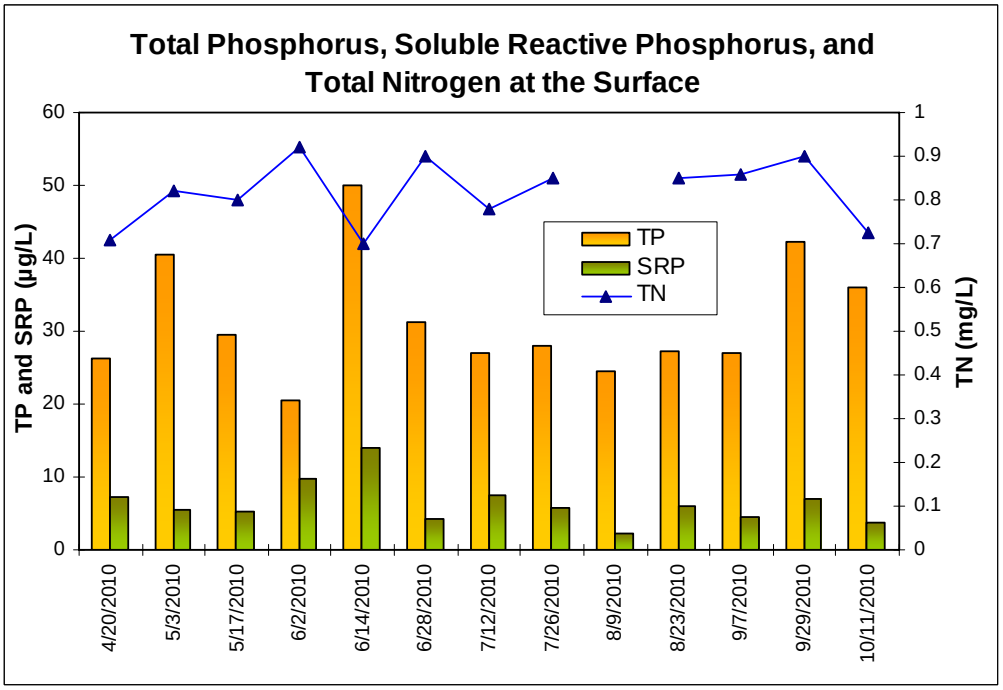

Figure 2. Weaver Lake seasonal changes in total phosphorus, soluble reactive phosphorus, and total nitrogen in 2010.

The low phosphorus concentrations have significantly improved water clarity conditions by reducing the frequency of algal blooms. Weaver Lake has always had moderate algal blooms with relatively good water clarity conditions prior to 2005. However, a significant decrease in algal blooms followed by a noticeable improvement in water clarity became apparent in 2005. The average secchi depth transparency was almost 5.0 m in 2005 and 4.2 m in 2006 (Figure 3). The secchi depth transparency has consistently averaged between 2.43 m and 2.8 m from 2007 through 2009 (Figure 3). Currently, the average secchi depth transparency was 4.1 m in 2010 with values ranging from 1.2 m to 7.2 m (Figure 4). Algal blooms have become almost absent with average chlorophyll-a concentrations consistently below 10 µg/L since 2005 (Figure 4). Weaver Lake has achieved the MPCA water quality standards for secchi depth transparency and chlorophyll-a concentration.

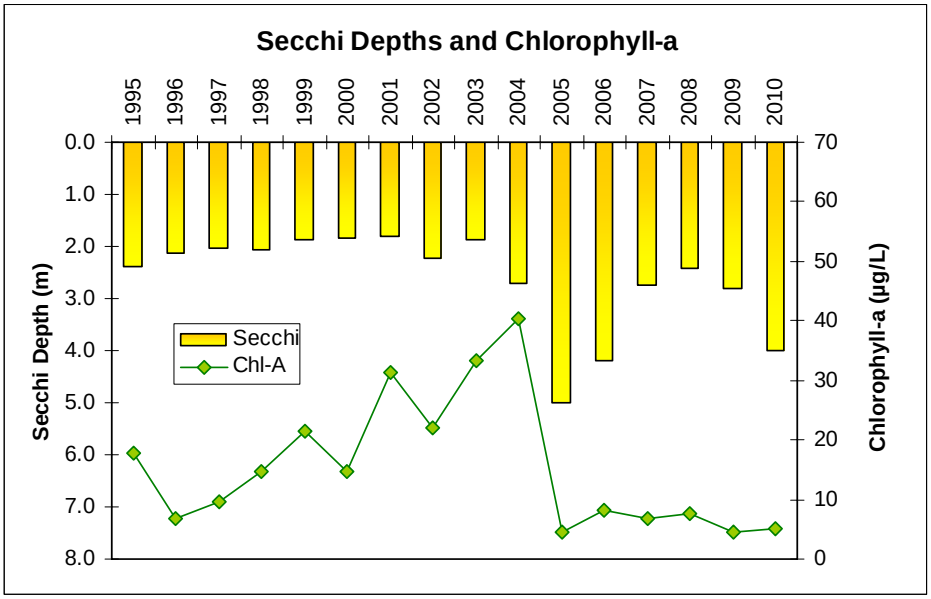

Figure 3. Weaver Lake average annual chlorphyll-a concentrations and secchi depth transparency.

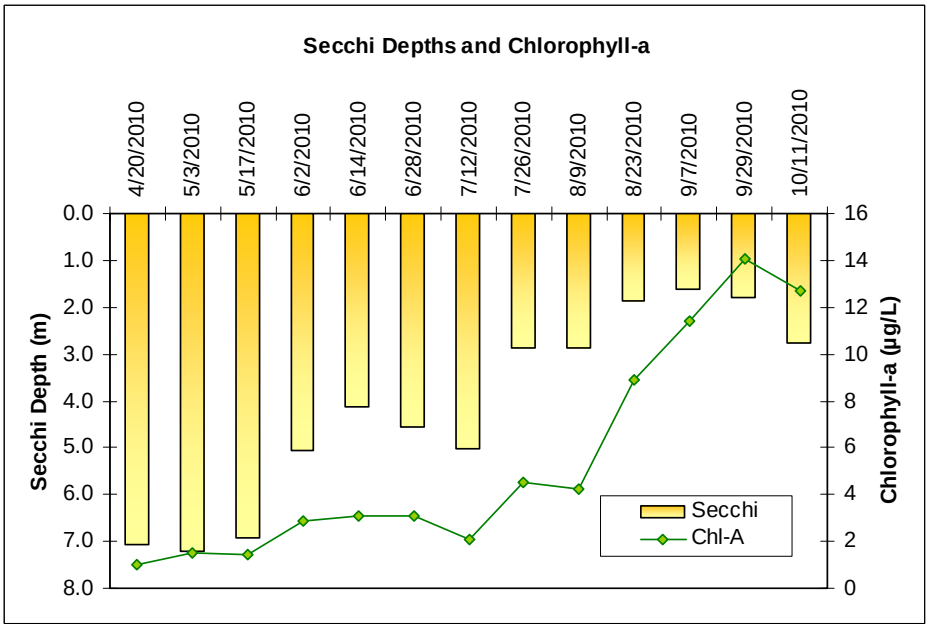

Figure 4. Weaver Lake secchi depth transparency and chlorophyll-a concentrations in 2010.

The improvements in water quality conditions for Weaver Lake correspond with a lake-wide effort to control curlyleaf pondweed. Historically, Weaver Lake has had nuisance growth conditions of curlyleaf pondweed that inhibited recreational use and degraded water quality. Weaver Lake typically developed algal blooms after the senescence of curlyleaf pondweed. In an attempt to control curlyleaf pondweed, herbicide applications occurred throughout the littoral area of the lake with fluridone from 2005 through 2007 and with endothall from 2008 and 2009. The herbicide treatments were successful in controlling curlyleaf pondweed in Weaver Lake. There were also noticeable improvements in water quality that corresponded with the first year of treatment in 2005. Management efforts to control curlyleaf pondweed reduced the amount of internal loading associated with senescence.

Diamond Lake

Diamond Lake continues to have impaired water quality conditions for excessive nutrients. Diamond Lake is a shallow lake that has an eutrophication standard for total phosphorus of 60 µg/L. The lake is extremely eutrophic with phosphorus concentrations consistently above 100 µg/L during the growing season (Figure 1). The average total phosphorus concentrations have declined since 2008, but concentrations are extremely high relative to other shallow lakes within the ecoregion. The average phosphorus concentration in 2010 was 131.0 µg/L, with values ranging between 62.8 µg/L and 329.4 µg/L (Figure 2). The excessive amount of phosphorus in the lake has been conducive for severe algae blooms.

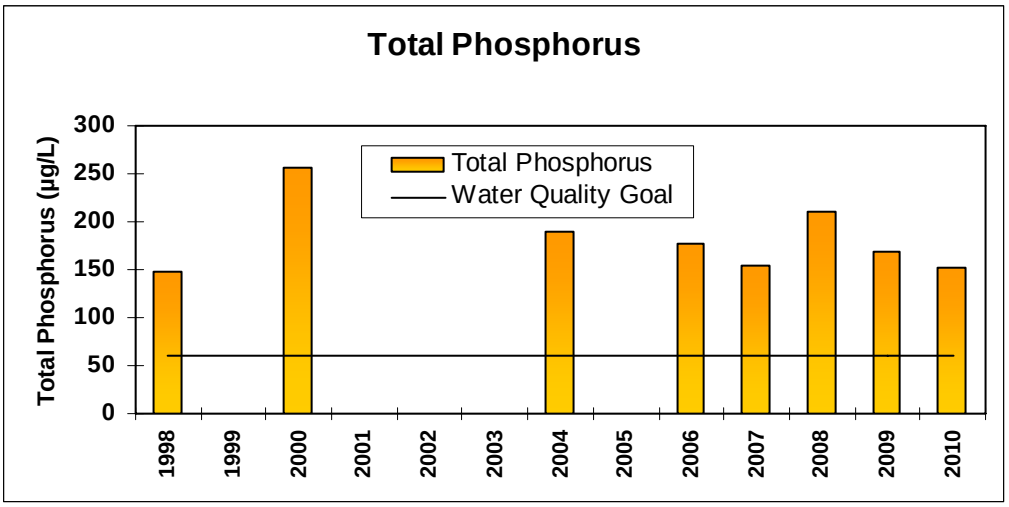

Figure 1. Diamond Lake average annual total phosphorus concentrations between 1998 and 2010.

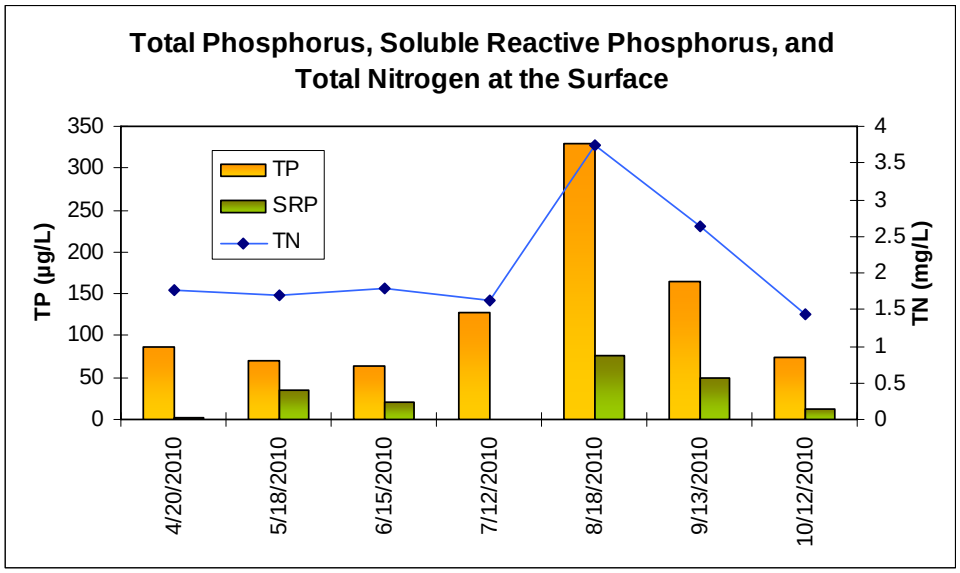

Figure 2. Diamond Lake total phosphorus, soluble reactive phosphorus, and total nitrogen at the surface in 2010.

Diamond Lake typically has severe algal blooms during the summer. The average annual chlorophyll-a concentration in Diamond Lake has consistently exceeded 50 µg/L (Figure 3). These concentrations are considerably higher than the MPCA shallow lake water quality criteria of 20 µg/L. Despite the extremely high chlorophyll-a concentrations, the data suggests that the severity of algal blooms have gradually decreased since 2008. There has been a slight improvement in water clarity as chlorophyll-a concentration has decreased from 2008 through 2010 (Figure 3). This slight improvement in water clarity has been in response to the decrease in phosphorus concentration. Currently, the average chlorophyll-a concentration was 51.3 µg/L with an average secchi depth measurement of 1.3 m (Figure 3). The primary algal specie contributing to degraded water clarity in Diamond Lake has been *Aphanizomenon.* The *Aphanizomenon sp*. have a tendency to clump together at the water surface and are easily displaced by wind action, which may account for variable chlorophyll-a and secchi depth measurements. The chlorophyll-a concentrations ranged from 6.2 to 206.8 µg/L, and secchi depth transparency ranged from 0.35 to 2.1 m (Figure 4). Lakes dominated by large colonial algae, such as *Aphanizomenon sp.*, may have variable water clarity and chlorophyll-a concentration due to an uneven distribution throughout the water column.

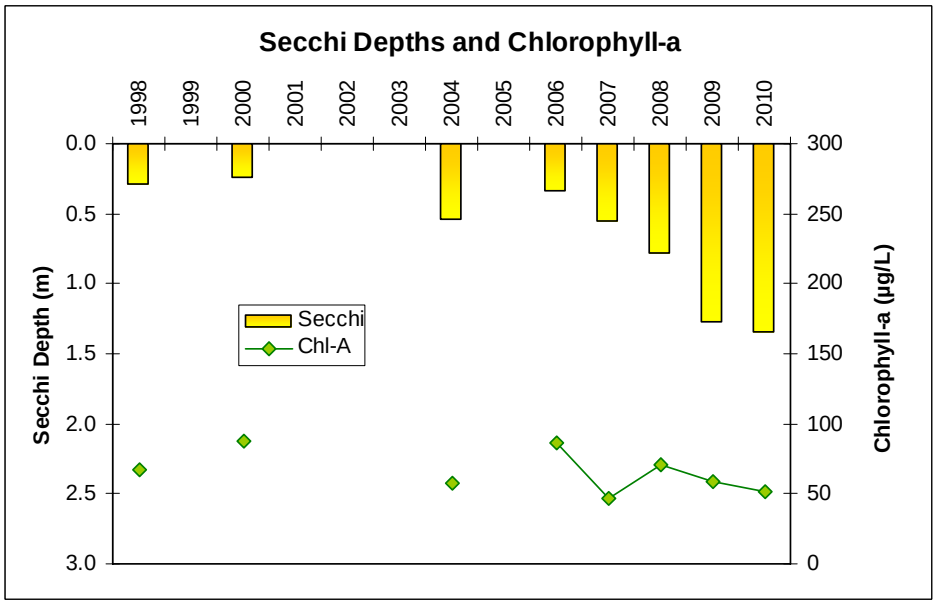

Figure 3. Diamond Lake average chlorophyll-a concentrations and secchi depth.

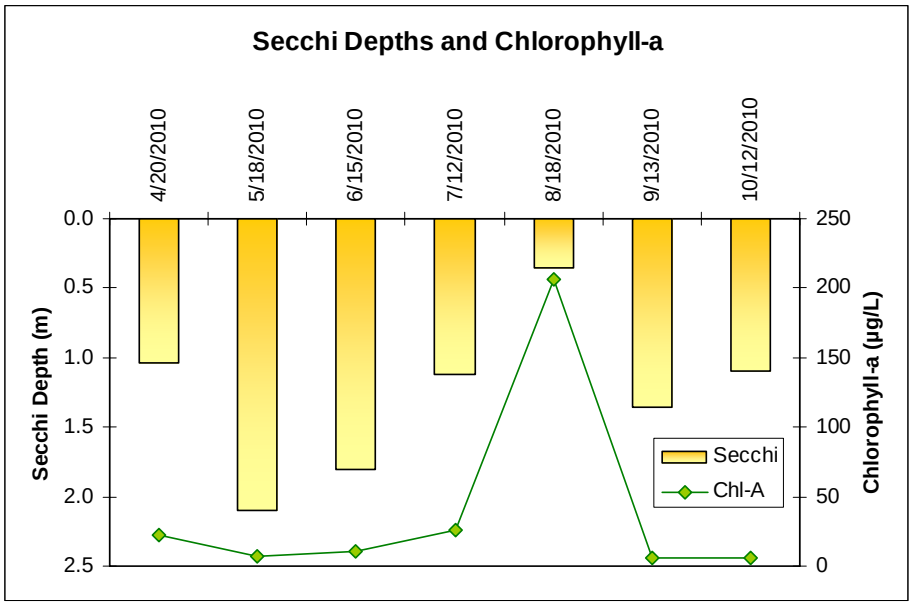

Figure 4. Diamond Lake seasonal changes in secchi depth and chlorophyll-a concentration in 2010.

Overall, water quality has been extremely poor since monitoring began in 1998. The poor water quality conditions are also partially due to large amounts of watershed nutrient loading from surrounding agricultural areas. The lake currently is algal dominated. Severe algae blooms that occur in the summer provide a shading effect that inhibits the development of aquatic macrophytes. Without the presence of aquatic plants, algae often take up the excess nutrients creating poor water clarity. The absence of aquatic plants also may increase turbidity in the water column since rooted aquatic plants stabilize bottom lake sediments. Moreover, the shallow morphology of the lake is extremely conducive for internal loading of nutrients that re-suspend from the sediments. The lake is frequently vulnerable to winter and summer fish kills due to the extreme eutrophic conditions.

French Lake

French Lake is a shallow lake that has impaired water quality conditions. The lake is extremely eutrophic with phosphorus concentrations above the MPCA standard of 60 µg/L (Figure 1). The average phosphorus concentration in 2010 was 181.9 µg/L with values ranging between 48.8 µg/L and 365.8 µg/L. The phosphorus concentrations were relatively low (below the MPCA standard of 60 µg/L) from April through June, but significantly increased from July through October (concentrations ranging from 152.4 to 365.8 µg/L) (Figure 2). These phosphorus concentrations are conducive for the development of algal blooms.

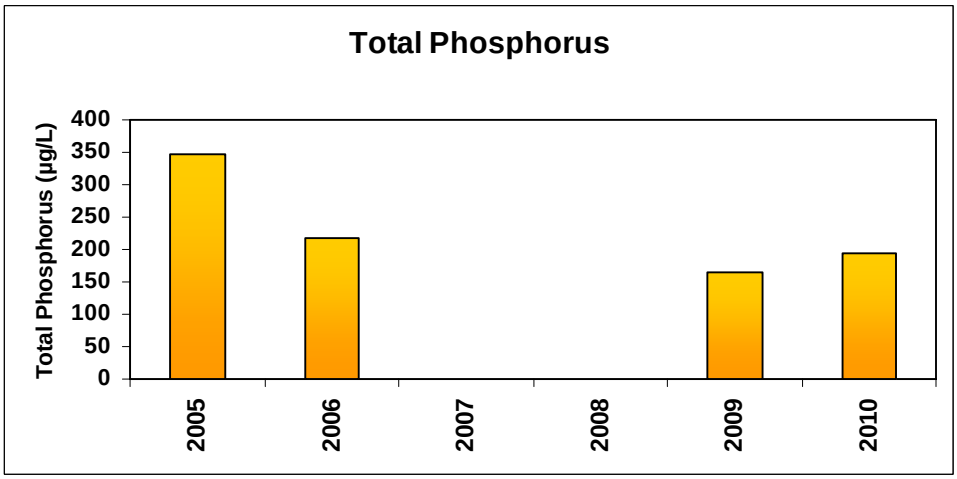

Figure 1. French Lake average annual total phosphorus concentration.

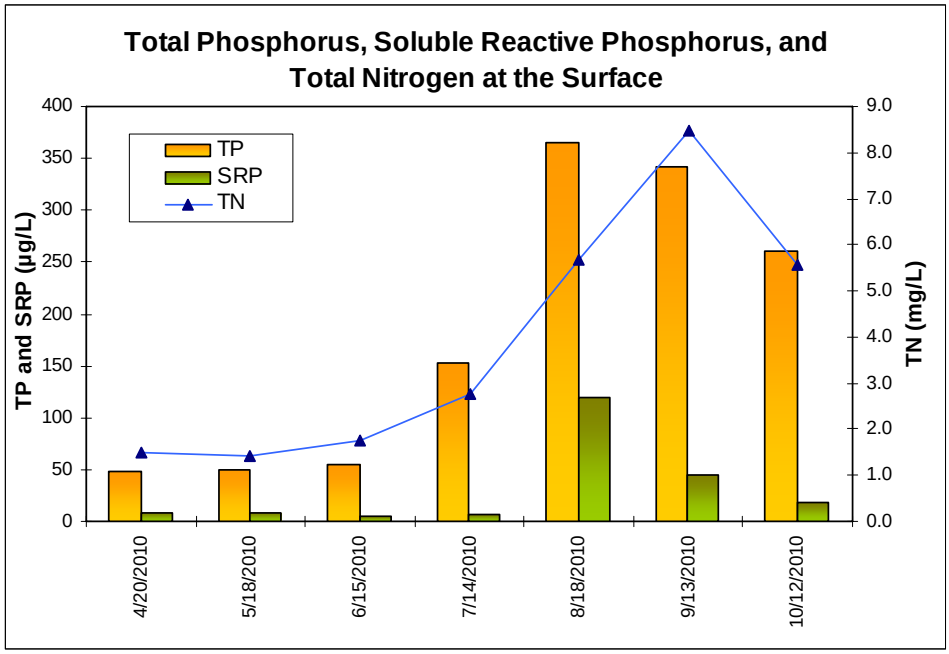

Figure 2. French Lake seasonal changes in total phosphorus, soluble reactive phosphorus, and total nitrogen in 2010.

French Lake has severe algal blooms that reduce water clarity conditions during the summer. In 2010, the average chlorophyll-a concentration was 138.8 µg/L, and the average secchi depth transparency was 0.6 m (Figure 3). The chlorophyll-a concentration and secchi depth did not meet the MPCA water quality standards. Despite the impaired water quality condition, there were periods of better water clarity that occurred from April through June in which chlorophyll-a concentrations were below 10 µg/L (Figure 4). Algal blooms did not begin to develop until July as water temperatures began to increase. Chlorophyll-a concentrations ranged from 47.5 µg/L to 337.7 µg/L from July through October (Figure 4). The development of algal blooms appears to coincide with the observed change in phosphorus concentrations in 2010.

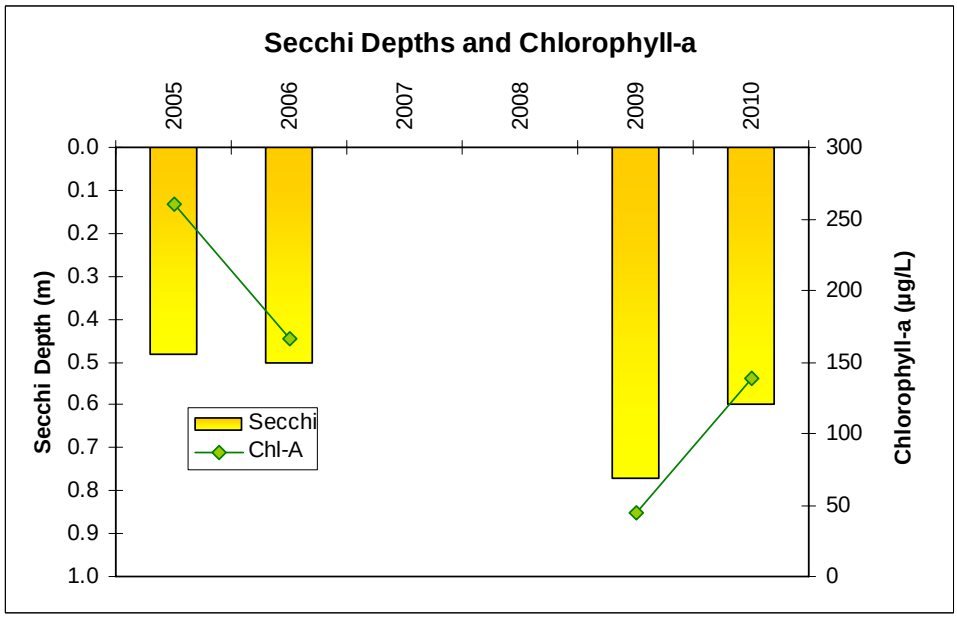

Figure 3. French Lake average chlorophyll-a concentration and secchi depth from 2005 to 2010.

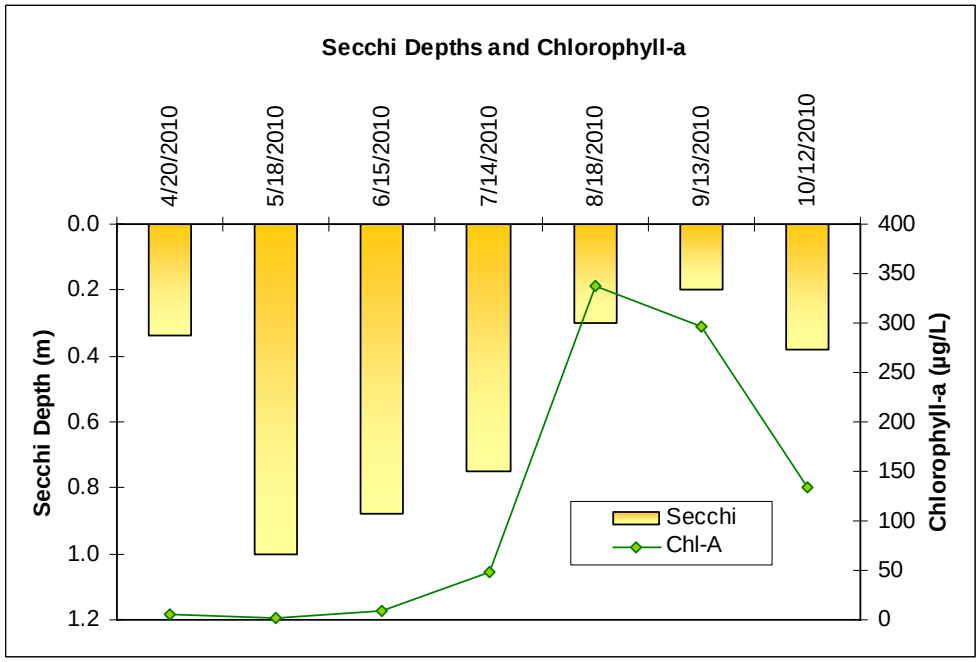

Figure 11. French Lake seasonal changes in chlorophyll-a concentration and secchi depth in 2010.

Mill Pond

Mill Pond is essentially part of the Elm Creek flowage prior to draining to the Mississippi River. Mill Pond is a shallow lake that has hypereutrophic phosphorus concentrations. The average annual phosphorus concentration for Mill Pond was 379.6 µg/L in 2010 with values ranging from 129.8 µg/L to 743.2 µg/L (Figures 1 & 2). These concentrations exceed the MPCA phosphorus standard of 60 µg/L for shallow lakes. These concentrations in Mill Pond are highly indicative of the phosphorus loading exhibited by Elm Creek. Consequently, seasonal changes in phosphorus concentration become dependent upon storm-event run-off volume and loading from Elm Creek.

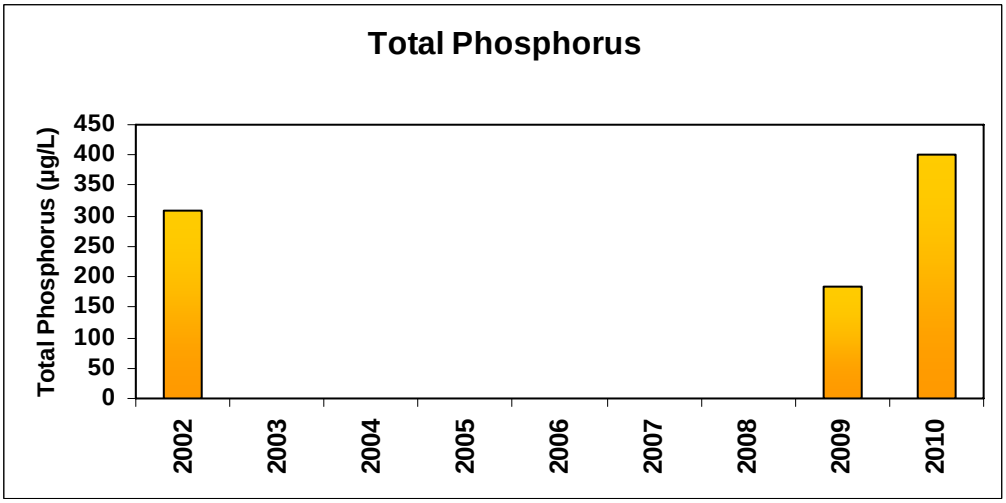

Figure 1. Mill Pond average annual total phosphorus concentrations.

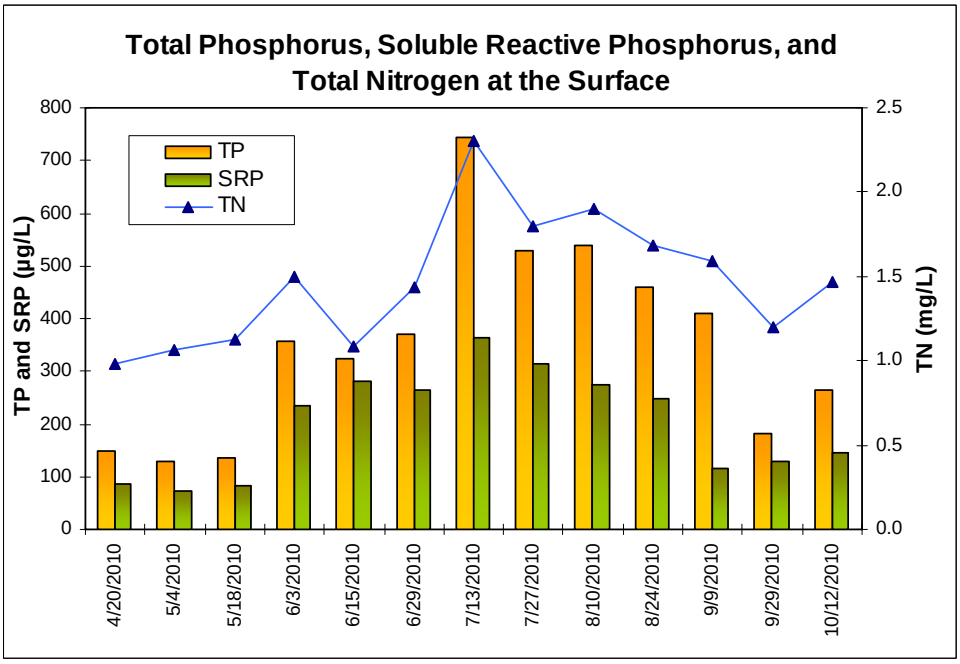

Figure 2. Mill Pond seasonal changes in total phosphorus, soluble reactive phosphorus, and total nitrogen in 2010.

Despite high hypereutrophic phosphorus concentrations, Mill Pond does not appear to have severe algal blooms. The average chlorophyll-a concentration was 6.4 µg/L with values ranging from 1.0 µg/L to 22 µg/L (Figures 3 & 4). Secchi depth transparency was not measured consistently throughout the summer, but secchi depth transparency was frequently on the bottom. The residence time within Mill Pond is relatively short since the shallow lake is essentially part of the Elm Creek flowage. Consequently, Mill Pond has chlorophyll-a concentrations that are more indicative of Elm Creek. The reduced residence time is not conducive for the development of algal blooms despite the high phosphorus concentrations. Algal blooms have the potential to become severe during extended periods with base flow conditions.

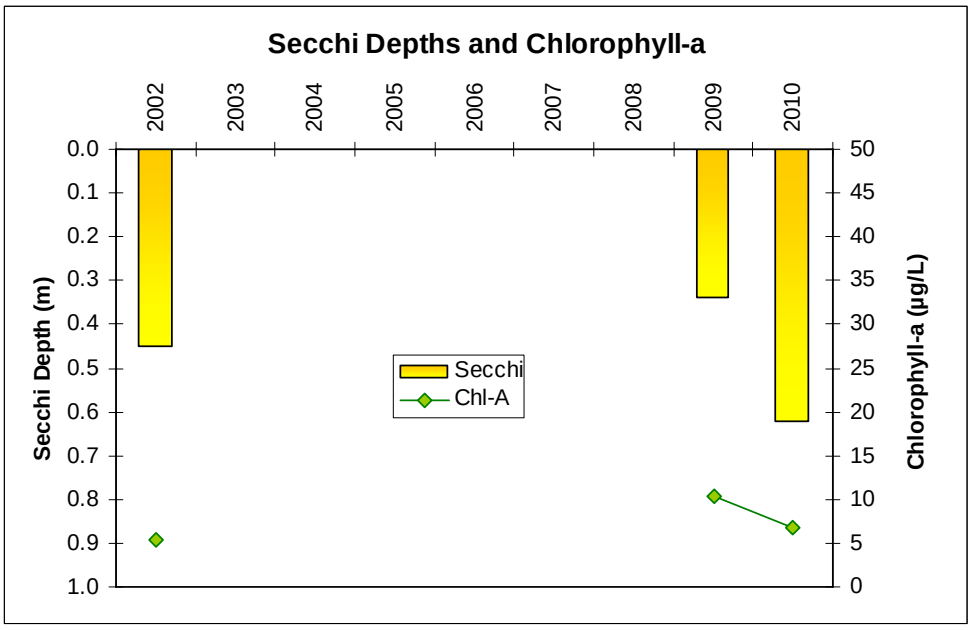

Figure 3. Mill Pond average annual secchi depth transparency and chlorophyll-a concentrations.

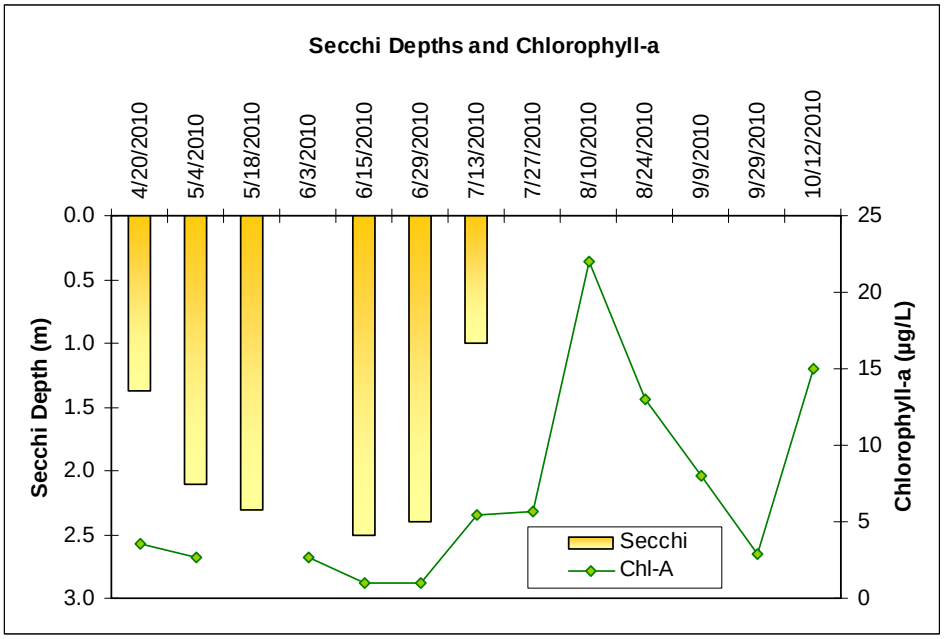

Figure 4. Mill Pond seasonal changes in secchi depth and chlorophyll-a concentration in 2010.