Water Quality

Establishing good water quality in Lake Wissota is critical to maintaining the elements of beauty, recreation, and a healthy aquatic community that lake users value. Water quality in WI lakes can be measured in several ways, including: (1) taking secchi disk readings to assess water clarity and (2) measuring nutrient enrichment by taking water samples for total phosphorous and chlorophyll-*a* concentrations.

Several water quality studies have been conducted on Lake Wissota and are summarized below in reverse chronological order. Summaries are also included that explain water clarity, phosphorous, and chlorophyll-*a* data that have been collected on the lake.

The TMDL goals for Little Lake Wissota are 4.92 ft (~1.5 m) for secchi depth, 48 ppb for phosphorous, and 20 ppb for chlorophyll-a.

Total Maximum Daily Load. The water quality in Little Lake Wissota and Moon Bay is threatened by excessive levels of phosphorous and sedimentation. These water bodies have been placed on the state Impaired Waters list due to excessive algae growth. The Wisconsin DNR and local lake partners are developing plans to improve the water quality of both bays, which will ultimately lead to improved water quality for other parts of the lake. These plans are known as Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet the water quality standard or designated use.

The WDNR, along with local lake partners, has developed a water quality plan for Little Lake Wissota and is in the process of developing a plan for Moon Bay. These plans use water and land use information to set water quality goals and predict changes in the overall water quality of the lake under a variety of different land management scenarios. Data for the Little Lake Wissota TMDL was collected in 2001-2002 and summarized in a draft report (WDNR 2009). The goals for the Little Lake Wissota set in the TMDL are to significantly reduce the amount of phosphorous and sediment loading to the lake and reduce the corresponding frequency and severity of summer algal blooms. The TMDL goals for Little Lake Wissota are 4.92 ft minimum (~1.5 m) for secchi depth, 48 ppb maximum for phosphorous, and 20 ppb maximum for chlorophyll-*a*. These goals are expressed as summer average lake concentrations.

Water samples collected from Little Lake Wissota in 2001 and 2002 found average phosphorous concentrations of 68 and 62 ppb, respectively which are well above the target of 48 ppb (WDNR 2009). The next step for the Little Lake Wissota TMDL is to develop an implementation plan that will identify the most feasible means to reduce phosphorous loading to the lake. Agencies and partners need to concentrate efforts towards this endeavor.

Lake Wissota Diagnostic and Feasibility Analysis. The Lake Wissota Diagnostic and Feasibility Analysis conducted in 1996 indicated that low water quality in the Main Basin of Lake Wissota and the two embayments, Little Lake Wissota and Moon Bay, was primarily a result of high levels of phosphorous and nitrogen in the lake which resulted in frequent and intense blue-green algae blooms. The two primary sources of phosphorous and nitrogen to the lake were from the surrounding watershed and included the effluent from the Cadott Waste Water Treatment Plant (CWWTP) and agricultural runoff.

Data indicated that blue-green algae levels and secchi disk readings in the lake were similar to that of eutrophic (nutrient rich) and sometimes hyper-eutrophic lakes. The report resulted in recommendations for the reduction of phosphorous loading from the CWWTP and the implementation of agricultural best management practices in the watershed using practices that are best suited to the conditions of the watershed. Some suggested best management practices included runoff controls to change peak flow and volume (examples: no or minimum tillage, winter cover crop, contour plowing and strip cropping, terraces, grassed outlets and vegetated borders, detention ponds) and nutrient loss controls (examples: timing and frequency of fertilizer application, amount and type of fertilizer used, control of fertilizer transformation to soluble forms, crop rotation with legumes, and storage of manure during winter). It was also suggested that restoration efforts for the lake be focused on the watershed as a whole, rather than just the lake, and that water quality objectives be developed through agency and community partnerships.

Lower Chippewa River Water Quality Assessment. The Lower Chippewa River Water Quality Assessment was conducted in 1989 for the following impoundments: Holcombe Flowage, Cornell Flowage, Old Abe Flowage, Lake Wissota, Chippewa Falls Flowage and Dells Pond. The purpose of the study was to gather baseline water quality data for the impoundments so that water quality across the impoundments could be compared. The results of the study indicated that the water quality of all of the impoundments was poor to very poor. Moon Bay had some of the worst water quality of all of the areas studied, while the southern half of the main basin of Lake Wissota had some of the best water quality of the areas studied. The recommendation of the study team was that efforts be made to improve the water quality of the impoundments, especially the small bays, which seemed to have worse water quality.

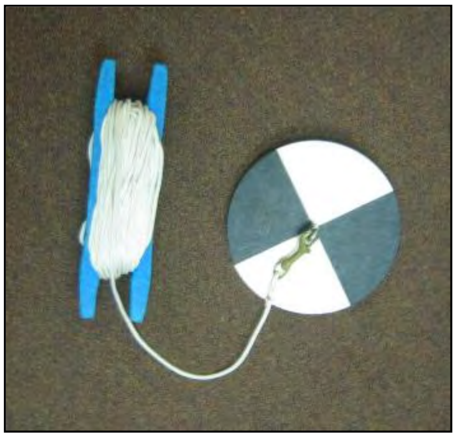

Figure 15. A secchi disk, a tool used to measure water clarity.
Photo courtesy of Anna Mares 2009.

Water Clarity. Water clarity is measured using a Secchi disk and can be influenced by natural water color, algae, and suspended sediments (Figure 15). "Water clarity is a critical factor for plants. Aquatic plants can survive with a minimum of 1-2% of original surface illumination. Plants vary in their tolerance to low light levels, so changes in water clarity could cause shifts in an aquatic plant community. Water clarity is reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color the water. Secchi disk readings measure both turbidity and color. Lake Wissota has a characteristic reddish-brown color created by humic and tannic acids released by decomposing plants in the watershed. Water samples taken at five sites on Lake Wissota during May and November 1989 had 50-70 standard color units. Forty to 100 units are a moderate level of color in lakes (Borman, 1991)…Secchi disk readings fluctuated during the summer depending on whether there was an algae bloom occurring," (Heuschele 2005). Based on Secchi disk readings from 1989, 2005, and 2007, Lake Wissota is considered a eutrophic lake (Table 3; Vennie, 2007). A eutrophic lake is a lake characterized by high nutrient inputs and high productivity, and often experiences algal blooms and abundant weed growth (Betz and Howard 2005).

Table 3. Secchi disk readings for Lake Wissota in feet from 1989 (number of data points unknown), 2001 (10 data points each for Little Lake Wissota and Moon Bay), 2002 (10 data points for Little Lake Wissota and 9 data points for Moon Bay), and 2005 (averages; individual dates samples were taken were not available) (Data from Heuschele, 2005 and Ken Schreiber, pers. comm., 2009).

	1989	2001	2002	2005
Little Lake Wissota	3.51 ft.	4.04 ft.	4.30 ft.	4.53 ft.
Moon Bay	2.99 ft.	3.41 ft.	3.51 ft.	3.09 ft.
Main Basin North	3.19 ft.	-	-	3.97 ft.
Main Basin South	3.51 ft.	-	-	4.89 ft.

The target Secchi depth for Little Lake Wissota, is 4.92 ft (~1.5 m) or deeper (TMDL 2009). Notice in Table 3 that the Secchi depth for Little Lake Wissota in 1989 was 3.51 ft and in 2005 was 4.53 ft. Both readings were shallower than the target depth. Three Secchi disk readings from each of three sampling locations in the main basin of Lake Wissota were collected by the Beaver Creek Reserve Citizen Science Center during the summer of 2007 (Table 4). The Secchi depths in the main basin of the lake fluctuated from month to month and area to area.

Table 4. Secchi disk readings obtained by the Beaver Creek Reserve Citizen Science Center in 2007.

	GPS (UTMs)	July 6, 2007	July 26, 2007	August 15, 2007
Main Body Site #1	15T 0631723 4981342	6.0 ft.	3.0 ft.	4.25 ft.
Main Body Site #2	15T 0632754 4978840	4.5 ft.	4.0 ft.	4.5 ft
Main Body Site #3	15T 0633105 4976462	4.5 ft.	5.25 ft.	4.5 ft.

A map showing the locations where the 2007 secchi disk readings were taken is shown in Figure 16. One sample was taken in the northern part of the lake, one near the center of the lake, and one near the south end of the lake.

Figure 16. Secchi disk sampling sites on Lake Wissota for 2007.

<u>Phosphorous Loads</u>. Phosphorous is the primary nutrient affecting the growth of aquatic plants and algae in most of Wisconsin's lakes. "Phosphorous at levels above 30 parts per billion (ppb (µg/l = ppb)) can lead to nuisance aquatic plant growth…" (UWSP 2005). Little Lake Wissota phosphorous levels are more than twice that amount (average of 68 and 62 ppb in 2001 and 2002 respectively) (WDNR 2009).

"The summer flow weighted mean total P concentration in Paint Creek was 86 ppb and 88 ppb in 2001 and 2002, respectively. The flow weighted mean total P concentration in the Yellow River at CTH XX was 93 ppb in both 2001 and 2002 (United States Army Corp of Engineers 2004)." The proposed draft state standard for phosphorous in streams is 74 ppb (Ken Schreiber, pers. comm. 2009). Paint Creek and the Yellow River both exceed the proposed standard. The next step for the Little Lake Wissota TMDL is to develop an implementation plan that will identify the most feasible means to reduce phosphorous loading to the lake.

Agencies and partners need to concentrate efforts towards this endeavor.

<u>Chlorophyll-*a*.</u> Chlorophyll-*a* is the green pigment in plants and algae. Measuring chlorophyll-*a* in a water sample is a means of measuring the amount of algae in that water sample. High levels of phosphorous can lead to high levels of algae growth, which in turn can lead to high levels of chlorophyll-*a*. Very clear lakes have chlorophyll-*a* levels of <5 μg/l, while lakes with levels above 30 μg/l are considered very poor (Betz and Howard, 2005).

Chlorophyll-*a* was measured in Moon Bay, Little Lake Wissota, and the main basin of the lake in 1993. Samples indicated chlorophyll-*a* levels generally <25 μg/l but peak concentrations were up to 100 μg/l during August. Samples were also collected in 2001 and 2003 and "exhibited a peak in early July, 2001, and declined in concentration between late July and September, 2001. Chlorophyll concentrations were very low for an extended period between May and July, 2002. A peak in chlorophyll of 39 mg/m^3 was observed in August, 2002" (United States Army Corp of Engineers 2004). "Simulated decreases in external P[hosphorous] loading from Paint Creek resulted in predicted decreases in the average summer concentration of total P[hosphorous] and chlorophyll of the surface waters and increases in Secchi transparency (United States Army Corp of Engineers 2004).

Figure 17. People enjoying Lake Wissota by canoe. *Photo courtesy of Robert Wierman.*

Water Use

Lake Wissota is an important regional recreational lake for the state of Wisconsin and the Chippewa Valley (Figure 15). It is a destination lake and in 1991 was ranked the 2nd most visited water in the Wisconsin DNR's Western District behind the Mississippi River (WDNR 1991). **The recreational value of Lake Wissota is directly linked to the water quality of the lake,** therefore it is essential that the water quality be improved. Guidelines provided by the previously described TMDL can help guide water quality improvements. In 1996, Lake Wissota received well over 50,000 visitors to the lake whom are estimated to have contributed nearly $6 million dollars to the local economy as a result of their use of the lake (Olson and Johnson 1998). Those visitors may be lost to other water bodies if the water quality of Lake Wissota is not improved.

<u>Public Access.</u> (Map and text for the Public Access section of this report were written and created by Roger Kees 2008). There are eight public boat landings on Lake Wissota as identified in Figure 18. There are an estimated 185 parking spaces available at these landings. The Chippewa County landing has additional parking at the Old Abe Bike Trail parking lot a short distance from the landing. There is also a parking area and potential carry in site for canoes, and kayaks and smaller boats at the Hwy 178 bridge over O'Neill Creek.

In the summer of 2007, the Town of Lafayette and the Wisconsin DNR identified 34 platted access points with widely varied