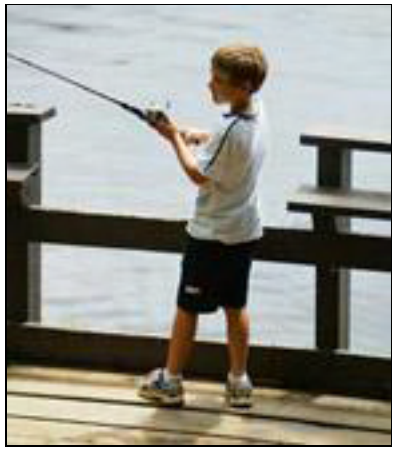
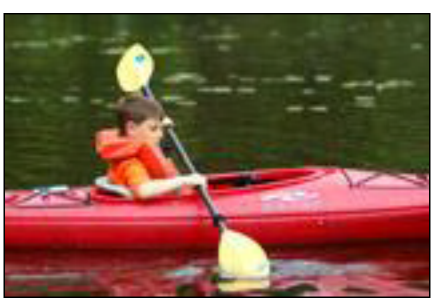
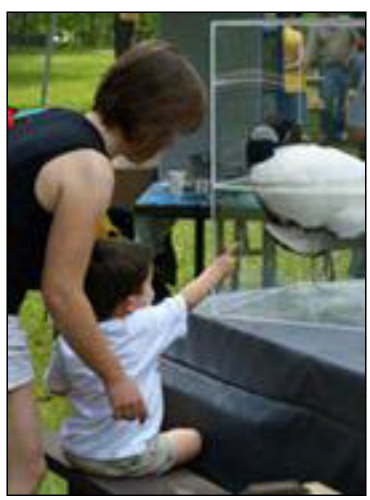




# Lake Wissota Aquatic Plant Management Plan


*Sarah Braun*
*Beaver Creek Reserve Citizen Science Center*

*30 April 2010*


*The purpose of the Lake Wissota Aquatic Plant Management Plan is to protect the characteristic recreational and scenic integrity that makes Lake Wissota a relaxing destination for lake users and to protect and improve habitat quality for fish, wildlife and aquatic life, through the protection of the aquatic plant community, which is directly linked to water quality.*

*11 June 2009*

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# *Lake Wissota Advisory Committee*

The Lake Wissota Advisory Committee met four times between October 2008 and April 2009 to develop and discuss the aquatic plant management plan. The following individuals generously contributed their time to serve on the Lake Wissota Advisory Committee (in alphabetical order):

| | |
|---|---|
| Tony Belohlavek | Chippewa Rod and Gun Club |
| Sarah Braun | Beaver Creek Reserve Citizen Science Director |
| Andrew Dane | University of Wisconsin Extension (UWEX) Community Development Specialist for Chippewa and Barron Counties |
| Don Dukerschein | Chippewa Valley Outdoor Recreation Alliance |
| Scott Erickson | Lake Wissota State Park Manager |
| Mary Jo Fleming | Lake Wissota Improvement and Protection Association (LWIPA) Member |
| Patrick Goggin | UWEX Lake Specialist |
| Ann Gordon | LWIPA President |
| Dr. Sean Hartnett | University of Wisconsin Eau Claire Geography Professor |
| Roger Kees | LWIPA Member and Past President |
| Bill Kroll | Friends of Lake Wissota State Park |
| Joseph Kurz | Wisconsin Department of Natural Resources (WDNR) Fisheries Biologist |
| Susann Lane | Town of Lafayette Supervisor |
| Gary Lazarz | Town of Anson Chairman |
| Dan Masterpole | Chippewa County Land Conservationist |
| Matt Miller | Xcel Energy |
| Jordan Petchenik | WDNR Sociologist |
| Scott Provost | WDNR Water Resources Management Specialist |
| Tony Roder | Chippewa County Zoning Specialist |
| Michael Sedlacek | Town of Eagle Point Chairman |
| Ken Schreiber | WDNR Watershed Expert |
| Buzz Sorge | WDNR Lake Specialist |
| Dan Zerr | UWEX Basin Educator |

*Cover Photos courtesy of Maureen K. Stelz at the 2008 Lake Wissota Lake Fair. Photo on p. 2 is from the Lake Wissota Improvement and Protection Association website.*

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This project was conducted under Wisconsin Department of Natural Resources Aquatic Invasive Species Control Grant # AEPP-109-08. Lake Wissota's Waterbody Indentification Code (WBIC) is 2152800.

# I. Lake Wissota, for All Generations

## Why Have an Aquatic Plant Management Plan?

Lake Wissota is a remarkable resource and one of western Wisconsin's leading recreational lakes. A great recreational lake is characterized by good water quality and good water quality is attained only through a healthy aquatic ecosystem. Respondents to the Lake Wissota Planning Survey overwhelmingly indicated that Lake Wissota was valuable to them for the natural beauty and the recreational value it offers them. Fishing, swimming, boating, and spending time with family were responses repeated over and over when asked, "What does Lake Wissota mean to you?" The purpose of the Lake Wissota Aquatic Plant Management Plan is to protect the recreational and scenic values that make Lake Wissota a relaxing destination for lake users and to protect and improve habitat quality for fish, wildlife and aquatic life, through the protection of the aquatic plant community, which is ***directly linked to water quality.*** Families and citizens, particularly our children and future generations, deserve to have a lake with clean water to use and enjoy.

*Respondents to the Lake Wissota Planning Survey overwhelmingly indicated that Lake Wissota was valuable to them for the beauty and the recreational value it offers them.*

## Goals

The goals of the Lake Wissota Aquatic Plant Management plan are to:

(1) **Protect and enhance the native aquatic plant community** so that it provides sustainable and sufficient habitat for fish, wildlife, and aquatic life, especially those species mentioned in the Designation of Critical Habitat Areas, Lake Wissota, Chippewa County report (Konkel, 2007).

(2) **Control the aquatic invasive species currently in the lake**, Eurasian water milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*), at levels below that which would displace or otherwise harm the native aquatic plant community, wildlife, and recreation.

(3) **Prevent new aquatic invasive species from entering the lake and prevent the spread of Lake Wissota invasive species to other lakes** by continuing to educate boaters through the Clean Boats, Clean Waters program and other education outreach.

(4) **Monitor the health and changes to the aquatic plant community on Lake Wissota over time** by conducting a full plant survey of the lake once every five years to assess the health of the aquatic plant community.

(5) **Reduce phosphorous loading to the lake** to reduce nuisance algal blooms and improve water quality.

## Implementation

To accomplish the goals of the Lake Wissota aquatic plant management plan, it is necessary to maintain an adaptable, multi-faceted aquatic plant management strategy, as no single management strategy can achieve these goals.

A multi-faceted strategy for Lake Wissota will include all or some of the management strategies listed in Table 1.

**Table 1. Aquatic plant management goals and strategies for Lake Wissota for 2008-2012.**

| *Goal 1: Protect and enhance the native aquatic plant community* | | | |
|---|---|---|---|
| Management Strategies | Who will help implement them? | Timeline for Completion? | Who will pay for it? |
| Educate lake users about the function of the aquatic plant community in Lake Wissota, the strategies in this plan to manage that plant community, and the actions they can take to help implement those strategies (ie. informational workshops, trainings, newsletters, etc.) | LWIPA, Beaver Creek Reserve, WDNR | Continuing with annual review | LWIPA and Beaver Creek Reserve |
| Encourage shoreline restoration practices | LWIPA, Chippewa County, Towns of Anson, Eagle Point, and Lafayette, Beaver Creek Reserve, Chippewa Rod and Gun Club, Muskies Inc., local media, WDNR | Begin in 2009, continuing with annual review | LWIPA and Beaver Creek Reserve via grants |
| Evaluate and revise shoreline zoning ordinances to ensure shoreland buffers are protected and restored | Chippewa County, LWIPA, Towns of Anson, Eagle Point and Lafayette, WDNR | 2011 | Chippewa County WDNR |
| Implement strategies for the protection of critical habitat areas | LWIPA, Towns of Anson, Eagle Point and Lafayette, WDNR | 2012 | LWIPA, Towns of Anson, Eagle Point and Lafayette, WDNR |

| *Goal 2: Control aquatic invasive species currently in Lake Wissota* | | | |
|---|---|---|---|
| Management Strategies | Who will help implement them? | Timeline for Completion? | Who will pay for it? |
| Post signs, where possible, of Eurasian water milfoil beds | LWIPA, Towns of Anson, Eagle Point and Lafayette, WDNR | 2010 | LWIPA via grants |
| Continue treatment with appropriate herbicides such as 2,4-D by certified applicators | LWIPA, Beaver Creek Reserve | Begin in 2009, continuing with annual review | LWIPA via grants |
| Hand pulling/raking, possibly with divers, small populations | | | |
| Strategic water level manipulation of the lake; Levels and duration to be defined by goals. Requires FERC approval | WDNR, LWIPA, Xcel | Only in the event of major infestation IF recommended by WDNR | To be determined |

**Table 1 cont'd on pg. 11.**

**Table 1 cont'd. Aquatic plant management goals and strategies for Lake Wissota for 2008-2012.**

| Goal 3: Prevent new aquatic species from entering the lake | | | |
|---|---|---|---|
| **Management Strategies** | **Who will help implement them?** | **Timeline for Completion?** | **Who will pay for it?** |
| Continue Clean Boats, Clean Waters program | LWIPA, UW-Extension Lakes, Beaver Creek Reserve, lake users and riparian land owners, WDNR, Lake Wissota State Park | Ongoing with annual review | LWIPA, Beaver Creek Reserve, UW-Extension Lakes, WDNR |
| Develop a Citizen Lake Monitoring team | | Begin in 2009, ongoing with annual review | |
| Provide educational materials and presentations about Clean Boats, Clean Waters and aquatic invasive species to the local community and visitors | | Ongoing with annual review | |
| Continue the citizen early detection reporting system (Neighborhood Watch) and volunteer monitoring | | | |

| Goal 4: Monitor the health and changes to the aquatic plant community on Lake Wissota over time | | | |
|---|---|---|---|
| **Management Strategies** | **Who will help implement them?** | **Timeline for Completion?** | **Who will pay for it?** |
| Conduct a plant survey of the lake every 5 years or less | LWIPA, Beaver Creek Reserve, WDNR | Begin in 2009, once every 5 years | LWIPA and Beaver Creek Reserve via WDNR and Xcel |
| Explore need for additional scientific study of sediment type and nutrient levels | | 2010 | N/A |
| Conduct volunteer monitoring | | Ongoing with annual review | LWIPA, Beaver Creek Reserve, WDNR |

| Goal 5: Reduce phosphorous loading to the lake | | | |
|---|---|---|---|
| **Management Strategies** | **Who will help implement them?** | **Timeline for Completion?** | **Who will pay for it?** |
| Develop phosphorous loading reduction implementation strategies to achieve the recommendations of the Little Lake Wissota and Yellow River TMDL's | WDNR, Chippewa County, LWIPA, Towns of Anson, Eagle Point, and Lafayette | Ongoing with annual review | WDNR, NRCS, EPA |
| Assist in developing the Little Lake Wissota and Yellow River TMDL Implementation Plans | | Begin in 2010, ongoing with annual review | WDNR and LWIPA via grants |

## Potential Management Strategies for Lake Wissota

Descriptions of potential management strategies for Lake Wissota are listed in this section to provide a brief introduction to the various strategies. Always with invasive species, prevention is the best first management strategy, followed by early detection and rapid response (for new invasions), followed by control.

Shoreline restoration. Shoreline restoration is being used on many Wisconsin lakes as a tool to reduce erosion, improve water quality, and increase wildlife habitat (Figure 1). In the case of near-shore restoration, adding woody debris, such as dead trees, to areas near the shoreline often improves fish habitat. A study of 55 lakes in West Central Wisconsin (24 impoundments and 31 natural lakes) conducted between 2001 and 2006 found that natural shorelines had better quality aquatic plant communities than disturbed shorelines. The study also documented that **the mean occurrence of exotic aquatic invasive species was significantly greater** (statistically: p>0.001) **for disturbed shorelines than natural shorelines** (Konkel and Evans 2006). The second phase of the study showed that as the amount of disturbed shoreline on a lake increased, so did the occurrence of non-native species, filamentous algae, and macrophytic algae. These data demonstrate the importance of preserving and/or restoring the natural shoreline of the lake in order to preserve the aquatic plant community and discourage the spread of aquatic invasive species.

**Figure 1. A well-vegetated shoreline on Lake Wissota.**

A brochure describing shoreline restoration techniques and plant communities appropriate to Lake Wissota was developed by Beaver Creek Reserve Citizen Science Center (CSC) in conjunction with the Lake Wissota Improvement and Protection Association (LWIPA) and is available on the LWIPA and CSC websites or in hard copy from the LWIPA or the CSC.

Shoreland zoning. Shoreland zoning information is available on the Chippewa County website under "Your Government/Code of Ordinances" (Chapter 54) or at http://www.co.chippewa.wi.us/departments/zoning/shoreland.htm. Properties which are 1,000 feet from a lake and/or 300 feet from a river or stream are regulated by this ordinance. The ordinance should be reviewed by land owners before beginning any new projects on their property. Development of any new ordinances requires that all townships along the lake enact the same ordinance. Townships along Lake Wissota include: the Town of Anson, the Town of Eagle Point, the Town of Lafayette, and Chippewa Falls.

No-wake zones. The establishment of no-wake zones is one method of protecting shoreline and shallow water habitat, particularly critical habitat areas and shoreland restoration sites. No-wake zones prevent excessive erosion along shorelines and can protect aquatic plants in sensitive areas, near-shore areas, along sand bars, and during sensitive stages of growth. They could also be used to help prevent the spread of invasive species in known areas of infestation. Development of any new ordinance requires that all townships abutting the lake enact the same ordinance.

Herbicide treatments. Herbicide treatments are one method used to control Eurasian water milfoil in Lake Wissota and have been used in some areas of the lake since 2006. Which herbicide to use and when to apply it should be determined by a WDNR aquatic plant management specialist as the factors influencing treatment change frequently. Effects of herbicide treatment on the native aquatic plant and animal community are influenced by a multitude of factors.

The following herbicide information, marked by **, is taken from a draft of the McDill Pond Aquatic Plant Management Plan (2009) with some modifications for Lake Wissota: A chart indicating the pros and cons of the various herbicides available for use is included in Appendix A.

**The appropriate chemical will be one that targets the nuisance plant growth specifically and does not unintentionally impact many native plants. Removal of native plants would open up bare ground for exotic species to invade.

Herbicides must be applied at the correct time and correct dosage to be effective. Once Eurasian water milfoil reaches the surface, it slows its growth and is less susceptible to some chemical treatments. A licensed professional is usually required to apply herbicides. Early spring, while the plant is first actively growing, is the best time to treat the exotic species EWM and CLP [curly-leaf pondweed]. The plants are readily absorbing and transporting nutrients throughout their systems as they are recovering from winter and are very susceptible to herbicide treatments. Moreover, many native plants are not yet actively growing, which provides an excellent opportunity to treat the exotics without the risk of damage to native plants. Protection of native plants is vital to control EWM and CLP re-growth…However, impoundments often have their highest flows at this time of year. Higher flow results in a shorter retention time, allowing less time for the chemical to contact the plant. The pellet form of 2,4-D requires a 14-day contact time. Later in the season when the flow generally decreases, the plants are less susceptible to chemicals. The [Lake Wissota Lake Association] should work with the chemical applicator and WDNR to decide the most effective time to apply chemical treatments.

*Contact Herbicides.* Contact herbicides affect only the plant tissue in contact with the chemical. These are typically fast-acting and are often used on annual plants (e.g. CLP). Plants that regenerate from roots, tubers, or rhizomes (perennials) can be harder to manage with contact herbicides because the foliage is often killed but not the roots. Herbicides that contain Endothall (Aquathol, Hydrothol), Glyphosate (Rodeo, RoundUp), or Diquat (Reward) are typical contact herbicides.

*Systemic Herbicides.* These are herbicides that are absorbed by the plant through leaves or roots and travel throughout the plant, interfering with growth or nutrient uptake. Systemic herbicides can be much more effective on perennials (e.g. EWM) than contact herbicides because the herbicide can kill the roots, preventing re-growth. Commonly used aquatic systemic herbicides are 2,4-D (Navigate, Weedar 64) and Triclopyr (Renovate). Systemic herbicides should only be used for EWM control on Lake Wissota in early-season treatments when water temperatures are near 60˚ F. Surviving colonies of EWM should be treated early in the season with a selective herbicide.

*Algaecides.* Algaecides are used to control nuisance algae. They work on-contact and kill a wide range of algae species. Some blue-green algae (cyanobacteria) are somewhat resilient and may not be affected, whereas most green algae are easily controlled. Algae treatments can be effective but often the relief is short-lived. Areas where algae are treated can often be re-colonized because of wind-blown mats translocating from other untreated areas. Other concerns are long-term use of copper-containing algaecides because copper toxicity may build up in the sediments that may affect important components of the lake ecosystem. Algaecides should be avoided in [Lake Wissota].

Some systemic and contact herbicides can be applied together for synergistic reasons. Using these two together ultimately uses less herbicide and has shown to deliver excellent results. As more research becomes available, the Lake [Association] should investigate the most efficient and safe manner of synergistic herbicide use.**


**Figure 2. The Stop Aquatic Hitchhikers message is often symbolized by an image of a stop sign with a boat launching into the water.**

Hand pulling/raking. Hand pulling and raking are two manual methods of controlling small Eurasian water milfoil beds in the lake. This method has been utilized in Lake Wissota at the State Park beach as well as along the Rod and Gun Club shoreline with some success. Hand pulling and raking are also useful methods for controlling "newly-established" milfoil plants.

Water level manipulation. Water level manipulation is a method of controlling aquatic plants, such as Eurasian water milfoil, but is not appropriate for every lake or for an individual lake under all conditions. The WDNR aquatic plant management specialist and fisheries biologist should be consulted to determine if and when water level manipulation is an appropriate management strategy for controlling Eurasian water milfoil on Lake Wissota. Effects of water level manipulation on the native aquatic plant and animal community are influenced by a multitude of factors. The late-winter drawdowns that were historically conducted on Lake Wissota were deemed inappropriate for the lake ecosystem because of how and when they were conducted, however a different drawdown strategy might be an appropriate option for the lake in the future. Again, the WDNR should be consulted to determine recommended time of year and length for a drawdown that would ensure the health of the aquatic ecosystem.

Clean Boats, Clean Waters. Clean Boats, Clean Waters is an educational program in which volunteers and sometimes paid staff, work at boat landings and educate boaters about aquatic invasive species (Figure 2). Volunteers and staff also inspect watercraft before they enter and after they leave the lake to ensure that no aquatic invasive species hitch a ride to the next lake. The Clean Boats, Clean Waters program is especially important to Lake Wissota because of the large amount of traffic the lake receives. The movement of so many boaters from nearby lakes and many other states to Lake Wissota and vice versa provides numerous opportunities for aquatic invasive species to enter or leave the lake and be spread to a previously uncontaminated lake nearby. The term for a high-traffic lake that contains one or multiple invasive species, like Lake Wissota, is a “super-spreader” lake. The Lake Wissota Improvement and Protection Association and the Beaver Creek Reserve Citizen Science Center have and should continue to pursue grants to hire paid watercraft inspectors to work with and assist volunteer watercraft inspectors on the lake.

Water Quality Improvement. Non-point nutrient runoff from agricultural lands increases phosphorous loading to the lake, which stimulates algae blooms. The WDNR and local partners are working to develop implementation plans to identify the most feasible means to reduce nutrient influx and phosphorous loading to the lake.

Volunteer monitoring for Eurasian water milfoil (EWM). Volunteers interested in Lake Wissota are trained to identify Eurasian water milfoil and taught how to tell it apart from Northern water milfoil. They agree to monitor areas of the lake, for example the area around their dock or a nearby channel, for Eurasian water milfoil and report it if and when it is discovered. This type of monitoring has been conducted on Lake Wissota since Eurasian water milfoil was first discovered and should continue.

**Figure 3. Spiny softshell turtle in Lake Wissota, 2009.** *Photo courtesy of Jessica Soine.*

Citizen Lake Monitoring. The Citizen Lake Monitoring program trains volunteers to measure secchi depths and collect water samples for phosphorous and chlorophyll-*a* testing. It can be used to track changes in the water quality of a lake over time and should continue to be conducted on Lake Wissota.

Additional educational outreach. Educational outreach to all users of the lake is ongoing through a variety of groups such as the Lake Wissota Improvement and Protection Association and Beaver Creek Reserve. As new issues arise related to the lake, new educational efforts should continue to be conducted. These efforts may take the form of presentations from knowledgeable individuals, local lake fairs, sponsorship of new Lake Leaders, visits to local schools, and other educational outreach.

Mechanical Harvesting. Mechanical harvesting is a method of plant control that typically involves a large weed harvester or a rotovator. Harvesters cut and remove aquatic plants, but they are not selective to any particular species and often leave fragments of vegetation behind. Mechanical harvesting is not considered a viable option for Eurasian water milfoil on Lake Wissota because the fragments left behind by the harvester will probably contribute more to spreading the milfoil to uninfested locations than to controlling it.

Rotovators are essentially large tillers for the lake bottom and are used to till up the sediment in the lake. The use of a rotovator in Lake Wissota to control Eurasian water milfoil is impractical because it would create many fragments of milfoil that could float around the lake and infest new areas.

Biological Control. Biological control mechanisms using the milfoil weevil, *Eurychiopsis lecontei*, native to some WI lakes, is being investigated by researchers.

These weevils feed on all milfoil, both native and non-native species and damage milfoil by feeding on the top portion of the stem. It is thought that the weevils do not fly or swim well and they need natural vegetation near the water's edge to overwinter (Maccoux 2007). No milfoil weevils are known to be present on Lake Wissota. Biological control with the milfoil weevils is not considered a viable option for Lake Wissota at this time.

Bottom Barriers. Bottom barriers are often sold as mats of plastic or fabric, of varying colors, that can be laid over a bed of aquatic plants to stifle their growth. These barriers are non-selective and will kill off plants, however sediment collects on top of the barriers which allows new plants to establish growth. In addition, when barriers are removed, aquatic invasive species often re-establish in the site more readily than the natives that might have been mixed in with the invasive species previously. Bottom barriers are not considered a viable option to control Eurasian water milfoil in Lake Wissota at this time.

Dredging. Dredging of a lake is often done to remove excess sediment from the lake or restructure parts of the lake that may have altered in a negative way over time. Dredging is very expensive and takes a lot of time. It is not an effective method for removing aquatic invasive species and is not recommended for Lake Wissota at this time.

# *II. Lake Wissota, Yesterday and Today*

## Lake Description

Lake Wissota was created between 1915 and 1917 when a dam was built on the Chippewa River, which created the 4-mile long and 2-mile wide main impoundment (Borman 1991). Lake Wissota is 6,024 acres and has a maximum depth of 64 feet (Konkel 2007, Hartnett and Molnar 2005). There are two smaller embayments, Little Lake Wissota and Moon Bay. The Wissota dam impounds water up to the Jim Falls dam, 13 miles upstream. The Yellow River, Stillson Creek, Frederick Creek and Paint Creek empty into the lake and drain an area of roughly 941 square miles (Brakke 1996). Lake Wissota has a total drainage area of approximately 5,548 square miles (Tinker 1996). Lake Wissota is located north east of Chippewa Falls in T28-29N R7-8W, in the civil towns of Anson, Eagle Point and Lafayette, and the city of Chippewa Falls. The Waterbody Identification Code (WBIC) for Lake Wissota is 2152800. A 2005 map of Lake Wissota, Little Lake Wissota, and Moon Bay is included in Appendix B. A new map of the lake will be available in 2010.

*Fishing, swimming, boating, and spending time with family were responses repeated over and over when asked, "What does Lake Wissota mean to you?"*

## Sociological Survey

A sociological survey entitled Lake Wissota Planning Survey (Braun, 2009) was conducted in 2008 and **was critical to the development of this Lake Wissota Aquatic Plant Management Plan**. The thoughts and ideas provided by survey respondents helped determine what management strategies might best fulfill the needs of the lake as well as the lake users. The survey was sent to 2,170 people living within a quarter-mile of Lake Wissota. Lake Association members and Beaver Creek Reserve staff also handed out an additional 20 surveys at public boat landings on the lake in July 2008. The total number of surveys distributed was 2,190. Of the surveys distributed, 452 (21%) were returned. "It is important to note that with a usable return rate of 21%, we cannot say the results represent with statistical accuracy the target population of Lake Wissota property owners and users. The results represent the opinions and experiences of those who responded to the survey. Results, however, do provide us with a level of insight previously unknown, and will be used with discretion to help inform the Lake Wissota planning process," (Petchenik 2009, pers. comm.). Over half of the surveys returned were from people who had waterfront property on Lake Wissota (307 respondents, 67.9%), while 32.1% (145 respondents) were from people without waterfront property.

*Nearly three-quarters of [survey] respondents practice Clean Boats, Clean Waters steps by removing aquatic plants and other debris from their boat and trailer when they leave a lake.*

The purpose of the survey was to determine (1) citizen perceptions and opinions about the water quality of the lake, (2) opinions about and knowledge of the aquatic plant community, (3) the knowledge of and action in regards to aquatic invasive species (including the effectiveness of the Clean Boats, Clean Waters program on Lake Wissota), (4) the knowledge of the relationship between shoreline restoration and water quality, (5) opinions about recreation on the lake, and (6) overall thoughts about the value of the lake to survey participants. The survey also included one question about their opinion of the fishery in Lake Wissota. The final summary of the Lake Wissota Planning Survey Report is included here. The complete final report from the survey can be found on the Lake Wissota Improvement and Protection Association website (www.lwipa.net).

Sociological Survey Summary. Respondents to the Lake Wissota Planning Survey overwhelmingly indicated that Lake Wissota was valuable to them for the natural beauty and the recreational value it offers them. Fishing, swimming, boating, and spending time with family were responses repeated over and over when asked, "What does Lake Wissota mean to you?" Enjoyment and relaxing were other common responses. Responses to questions about recreation on the lake indicated that scenic viewing, motorized boating, fishing, and swimming are the types of activities most often enjoyed by lake users. Respondents are concerned about recreational safety on Lake Wissota. The availability of the recreational activities indicated by respondents is strongly linked to water quality, which respondents considered Fair or Good. However, when asked if they had any additional concerns about Lake Wissota, 44 of the respondents that answered this question indicated they were concerned about algae and 26 respondents expressed concern about runoff, fertilizer and phosphorous. Erosion, too many boats on the lake, and water quality were also common concerns.

Most users surveyed indicated an understanding of the link between large amounts of phosphorous and poor water quality (as it relates to algae blooms). More than half of all respondents seemed to understand that shoreline restoration can prevent large amounts of nutrients from flowing into the lake, although 18.1% of respondents were "unsure".

It is less clear whether respondents understand the link between water quality and the aquatic plant community. The vast majority of respondents agreed that native aquatic plants are important to maintaining a healthy lake ecosystem. However, when asked whether removal of aquatic plants improves water clarity, 25.3% of respondents strongly agreed or agreed and 23.2% of respondents were “unsure”. Just under half of respondents also indicated they thought there were too many aquatic plants in Lake Wissota.

Most respondents indicated an understanding of what aquatic invasive species are and believe that they have a negative impact on the economies of the communities surrounding the lake. Respondents also believe that aquatic invasive species have a negative impact on the aesthetics of the lake. Most respondents are concerned about Eurasian water milfoil and believe that invasive species should be controlled wherever possible. A majority of respondents indicated that they would like further information about how to control and identify invasive species.

**Figure 4. Eurasian water milfoil from Lake Wissota.** ***Photo courtesy of Jessica Soine 2009.***

The Clean Boats, Clean Waters program was believed by respondents to be an effective way to keep aquatic invasive species from spreading to uninfested lakes and nearly three-quarters of respondents indicated that they have received information about CBCW at Lake Wissota boat landings. Nearly three-quarters of respondents also practice Clean Boats, Clean Waters steps by removing aquatic plants and other debris from their boat and trailer when they leave a lake.

## Management History

Historical Control Actions. Prior to 2000, Northern States Power Company (now Xcel Energy) conducted late winter drawdowns of between 4 and 15 feet in Lake Wissota for hydropower generation (Appendix C). It was found that the duration and magnitude of these drawdowns were negatively impacting the plant and animal communities within the lake (Konkel 1998, Delong and Mundahl 1994, Kurz, pers. comm. 2009).

Northern States Power Company’s hydropower license with the Federal Energy Regulatory Commission (FERC Project #2567) expired in 2000. Efforts to renew this license began in 1997, and as part of the negotiations, the Lower Chippewa River Settlement team was formed. This team was comprised of members from: Northern States Power Company (now Xcel Energy), City of Eau Claire, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, National Park Service, River Alliance of Wisconsin, Wisconsin Conservation Congress, Chippewa Rod and Gun Club, Lake Holcombe Improvement and Protection Association, Lake Wissota Improvement and Protection Association, and Lower Chippewa Restoration Coalition, Inc. To provide information for the relicensing process, Northern States Power Company and the Wisconsin Department of Natural Resources conducted a series of studies to evaluate the impacts of drawdowns on water quality, aquatic plants, fish and aquatic invertebrates.

The results of these studies revealed that the late-winter drawdowns had some negative impacts, which included: fish stranding and loss of spawning and nursery habitat, mortality of benthic invertebrates and loss of habitat, and alterations of the aquatic plant community such that some drawdown sensitive species, such as lily pads, were unable to support healthy populations. These discoveries led to the reduction of the late-winter drawdown of Lake Wissota in 2001. Drawdowns are now restricted to a maximum of 3 feet for one week before spring run-off and in the event of emergencies such as flooding (Xcel Energy 2001). The reduction of the late-winter drawdown was the first major management action taken to alter the aquatic plant community in Lake Wissota. In the future, drawdowns may be a viable management tool on Lake Wissota if the timing and length of the drawdowns were altered to protect the aquatic community of the lake. Department of Natural Resource records indicate that in the 1970s, lakeshore property owners in Moon Bay obtained permits from the Department to chemically treat "nuisance" aquatic plants along their shorelines. A high abundance of Elodea appeared to have been the major complaint by these landowners (Kurz, pers. comm. 2009).

Current Control Actions. Eurasian water milfoil was discovered in Lake Wissota in 2005 (Figure 4). In cooperation with the WDNR, the Citizen Science Center, and local townships, the Lake Wissota Improvement and Protection Association (LWIPA) received four Aquatic Invasive Species (AIS) Rapid Response grants and conducted hand pulling and chemical treatments with 2,4-D of known infestations of EWM in 2006-2009. Treatments occurred in all known areas infested with EWM each year. Nine acres of milfoil were treated in 2006, one area near the Lake Wissota State Park (LWSP) boat landing and one area in Moon Bay. Treatment success was mixed as some areas continued to see milfoil growth. After the treatment, a late-developing bed of milfoil was discovered in the Chippewa Rod and Gun Club bay. In 2007, 14 acres of milfoil were treated with 2,4-D in Moon Bay and near the LWSP boat landing. In 2008, seven acres of milfoil were treated, including smaller areas in Moon Bay, near the LWSP boat landing, and at the LWSP beach. New milfoil beds were discovered along Hwy X and at the mouth of Paint Creek in Little Lake Wissota in 2008 after the herbicide treatment had occurred. As of 2009, approximately 44 acres of milfoil were known to be present in the lake. Areas of milfoil were mapped in Moon Bay, Little Lake Wissota, Stillson Creek, and near the Rod and Gun Club bay (Figures 5-7) by Beaver Creek Reserve Citizen Science Center researchers. Most of the milfoil beds contain sparse to intermediate stands of milfoil, with the exception of some of the smaller (<0.2 acre) beds in the east end of Moon Bay.

Each year from 2005 to 2009, LWIPA also implemented CBCW programs at the three largest boat landings on the lake (Rod and Gun Club, Town of Lafayette, and Lake Wissota State Park), conducted periodic monitoring of susceptible areas, and hand-pulled pioneer infestations that were not chemically treated. In addition, LWIPA created numerous informational opportunities for lake association members, lake residents, and recreational users in 2007 and 2008, including open meetings, presentations at local community events, and a lake fair for the public.

No known control actions are being conducted for curly-leaf pondweed at this time.

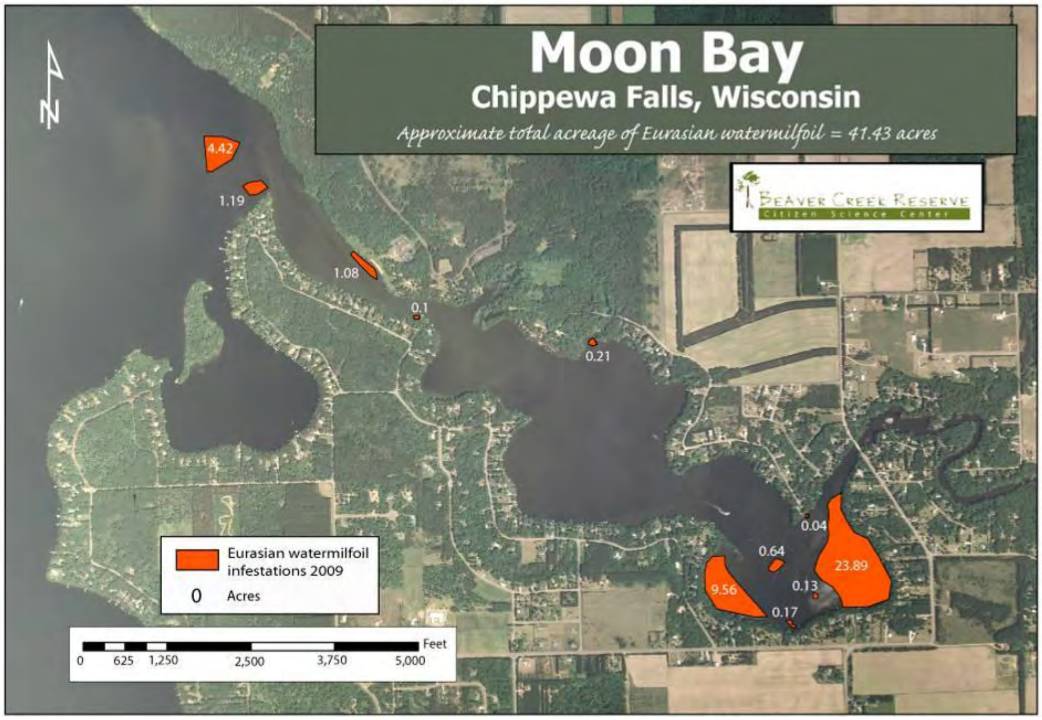



**Figure 5. Known infestations of Eurasian water milfoil in Moon Bay totaling 41.43 acres, 2009.**


**Figure 6. Known infestations of Eurasian water milfoil near the Rod and Gun Club totaling 0.1 acres, 2009.**


**Figure 7. Known infestations of Eurasian water milfoil in Little Lake Wissota and Stillson Creek totaling 2.58 acres, 2009.**

## Plant Community

A healthy aquatic plant community in Lake Wissota is essential because aquatic plants (1) **improve water quality,** (2) provide wildlife habitat, (3) provide necessary habitat for fish, (4) can limit nuisance aquatic plant growth, (5) stabilize sediments, and (6) provide oxygen to aquatic organisms.

History. Whole lake plant surveys were conducted in 1989, 2005, and 2009 using the same sampling techniques for each study to allow for comparison between studies. A list of the plant species found during those studies is found in Appendix D. The species found at each transect were documented in map format as well and are included in the plant study reports from 2005 and 2009. An example of a map from the 2009 study is included in Appendix E. The first aquatic plant survey was conducted from 1989-1990 in preparation for the Wissota dam re-licensing project in 2000. The survey was designed to determine baseline data about the aquatic plant community that could be replicated in the future to determine any changes in the plant community. The species present, their distribution, and their frequency and abundance were recorded. In 1998, the Wisconsin Department of Natural Resources conducted a study of the impact of late-winter drawdowns on the aquatic plant community. In 2005, the aquatic plant survey from 1989 was repeated and the data from the 1989 and 2005 studies were compared. In 2009, the aquatic plant study was repeated again and the data compared to 2005 and 1989.

Thirty-one plant species were documented during the 1989 plant study. The 1989 study showed that aquatic plants were primarily found in areas with silty or mucky sediment and that the composition of the plant community slightly favored plants that were drawdown tolerant. The species list indicates that there was only one aquatic invasive plant species in Lake Wissota at that time, curly-leaf pondweed (*Potamogeton crispus*).

*A healthy aquatic plant community in Lake Wissota is essential because aquatic plants (1) provide necessary spawning habitat for fish, (2) provide shelter for animals such as ducks and otters, (3) improve water quality, (4) can limit aquatic plant growth, (5) stabilize sediments, (6) provide oxygen to aquatic organisms, and much more.*

A study in 1998 (Konkel 1998) provided anecdotal evidence about how the Lake Wissota plant community differed from other impoundment lakes in the West Central region of the state that do not experience late-winter drawdowns. It was suggested that the reduction of the late-winter drawdowns might lead to an expansion of littoral zone vegetation into deeper water of the lake, which might enlarge the plant community and might potentially lead to increased plant diversity.

In 2005, the 1989 aquatic plant survey was repeated. Thirty-three plant species were present in 2005. The results of the two studies were compared and showed that following the reduction of the late-winter drawdowns, although not necessarily as a direct result of the reduction, there was an increase in silt and muck sediment areas, a slight shift in the aquatic plant community that allowed some species that are sensitive to water level fluctuations (ie. drawdowns), such as white water-lily (*Nymphaea odorata*, Figure 7) and yellow pond lily (*Nuphar variegata*), to survive, although in low frequencies. The presence of <u>two</u> aquatic invasive plant species, curly-leaf pondweed and Eurasian water milfoil (*Myriophyllum spicatum*) were also documented.

In 2009, the aquatic plant survey was repeated again and results compared to 2005 and 1989. Thirty two plant species were present in 2009, compared to 33 in 2005 and 31 in 2009.

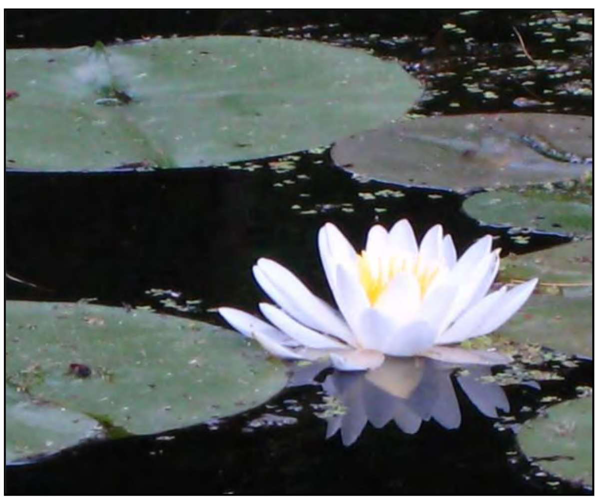


**Figure 8. Water lily on Lake Wissota.** *Photo courtesy of Jessica Soine.*

<u>Dominance.</u> The 2009 study included a comparison of the dominance of species between 1989, 2005, and 2009 (Figure 7). Dominant species are those that are found most frequently and have the highest densities. In all years, the dominant species in Lake Wissota was *Elodea canadensis*, also know as common waterweed or elodea. The second most dominant species in 1989 was *Ceratophyllum demersum* (coontail), followed by *Najas flexilis* (Slender naiad). In 2005, the second most dominant species changed to *Vallisneria americana* (water celery), followed by *C. demersum* and this remained the same in 2009.

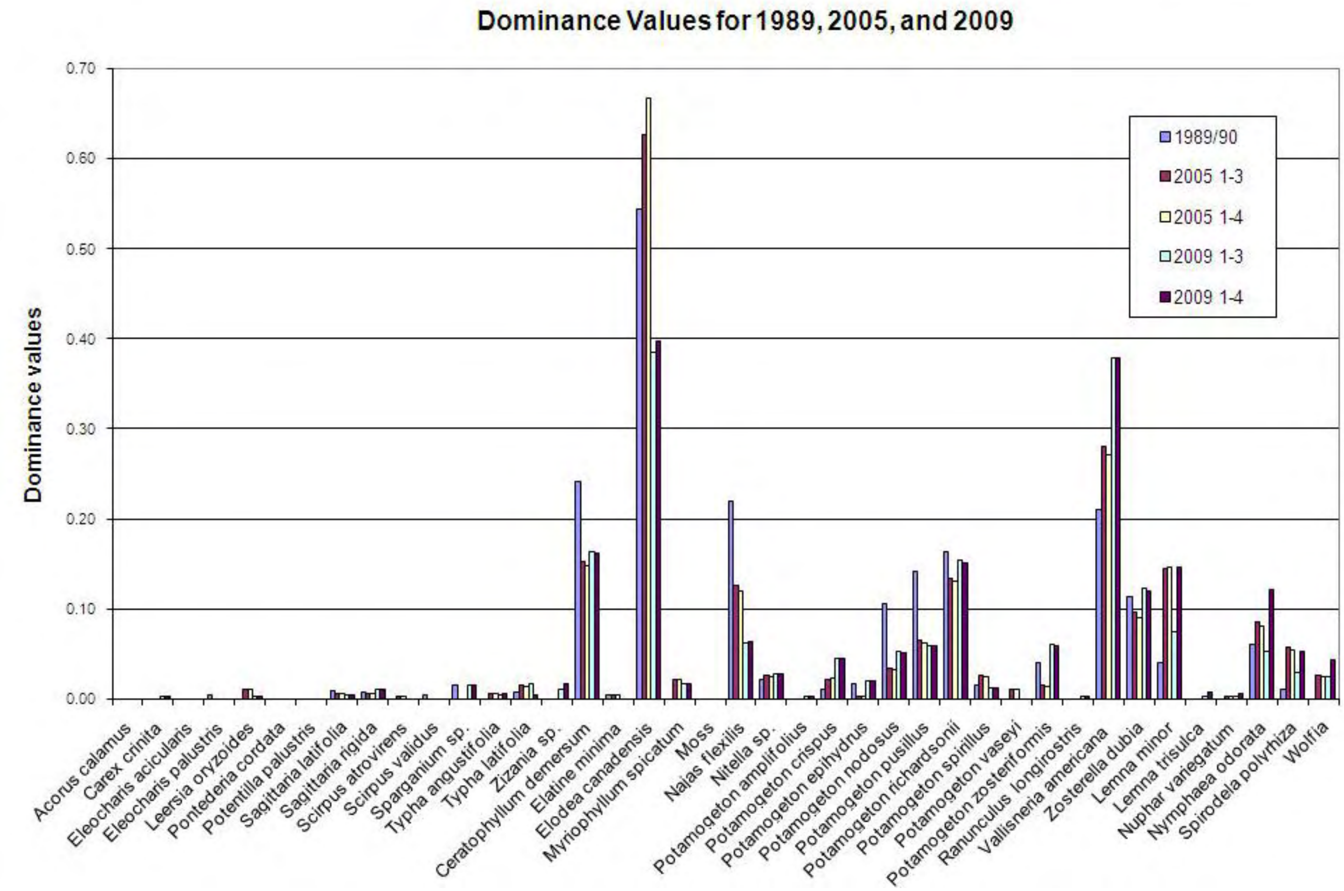



**Figure 9. Plant species percent (%) dominance for 1989, 2005, and 2009 (Data from Swanson 2009)**

<u>Frequency.</u> The frequencies of the most prevalent aquatic plant species in Lake Wissota for 1989, 2005, and 2009 are included in Table 2. The most frequent species in all years was *Elodea canadensis* (common waterweed) although in 2009, *Vallisneria americana* was a close second (24.96% *E. canadensis*; 24.63%, *V. americana*). Both *E. canadensis* and *V. americana* are considered resilient to water level disturbances (Swanson 2009). The least frequent species in 1989 was *Zosterella dubia* (water stargrass), and in 2005 was *Potamogeton pusillus* (small pondweed). In 2009, four species tied for least frequent: *Leersia oryzoides* (rice cut-grass), *Pontederia cordata* (pickerelweed), *Potamogeton amplifolius* (large-leaf pondweed), and *Ranunculus longirostris* (stiff water crowfoot). *P. cordata*, *P. amplifolius*, and *R. longirostris* are species that thrive in areas with more stable water levels. It will be important to monitor these species to see if their frequencies increase as time since drawdown reduction increases. *Nuphar variegata* and *Nymphaea odorata* frequencies both increased in the 2009 study.

<u>Depths of Aquatic Plants.</u> The results of the 2009 plant study indicated that aquatic plants were found most frequently at the 1.5-5ft zone (consistent with the 2005 study), followed by the 0-1.5ft zone (Swanson 2009). In 2005 and 1989, the 5-10ft zone was the second most frequently dominated zone (Heuschele 2005). The fact that the 0-1.5ft zone has an increasing frequency of aquatic plants indicates that this area is recovering as a result of the reduction of the

late-winter drawdowns. These areas may become valuable spawning areas for fish and provide habitat for aquatic invertebrates, which is good news for Lake Wissota anglers. In all years, plants were found least frequently in the 10-20ft zone. It is important to note that in 1989, no plants were found growing in the 10-20ft zone.

**Table 2. Percent frequencies of prevalent aquatic plant species in Lake Wissota.**

| Species | 1989/90 | 2005 | 2009 |
|---|---|---|---|
| *Elodea canadensis* | 28% | 30% | 25% |
| *Ceratophyllum demersum* | 14% | 7% | 11% |
| *Najas flexilis* | 13% | 6% | 5% |
| *Vallisneria americana* | 12% | 11% | 25% |
| *Potamogeton richardsonii* | 10% | 7% | 12% |
| *Potamogeton pusillus* | 10% | 3% | 5% |
| *Zosterella dubia* | 8% | 5% | 9% |
| *Nymphaea odorata* | 4% | 4% | 10% |
| *Lemna minor* | 3% | 6% | 10% |

**Figure 10. Beaver Creek Reserve researchers conducting Eurasian watermilfoil survey prior to herbicide treatment, 2009.** *Photo courtesy of Sarah Braun.*

Lake Bottom Sediment Types. Just as soil type is important for terrestrial plants, lake bottom sediment types are important for aquatic plants. Silty or mucky sediment is the most favorable for aquatic plant growth (Boreman 1991).

The lake bottom sediment types in Lake Wissota were recorded during all of the plant studies. "There is some subjectivity to the assessment of substrates, however, as guidelines as to particle size per category were not established, for example, there was not a clear cut off point between rock and gravel" (Swanson, 2009).

In 1989, the sediment type was predominantly sand or sand/gravel (62%) and only 7.8% of the sampled points had silt or muck sediment. However, the silt or muck points had the highest frequency of plant occurrence (86.5% of silt/muck sample points had plants) and the highest plant densities (Boreman 1991). In 2005 and 2009, muck and silt points still had the highest frequency of plant occurrence, with 100% of points containing vegetation. 56% and 53% of sample points contained sand or sand/gravel sediment in 2005 and 2009, respectively, while 13% contained muck or silt sediment in both years (Swanson 2009). Figure 11 provides an example of the distribution of the sediment types for the northern shoreline of the main lake as they were mapped during the 2009 aquatic plant study (Swanson 2005). Additional substrate maps can be found in the aquatic plant study reports (Heuschele 2005, Swanson 2009).

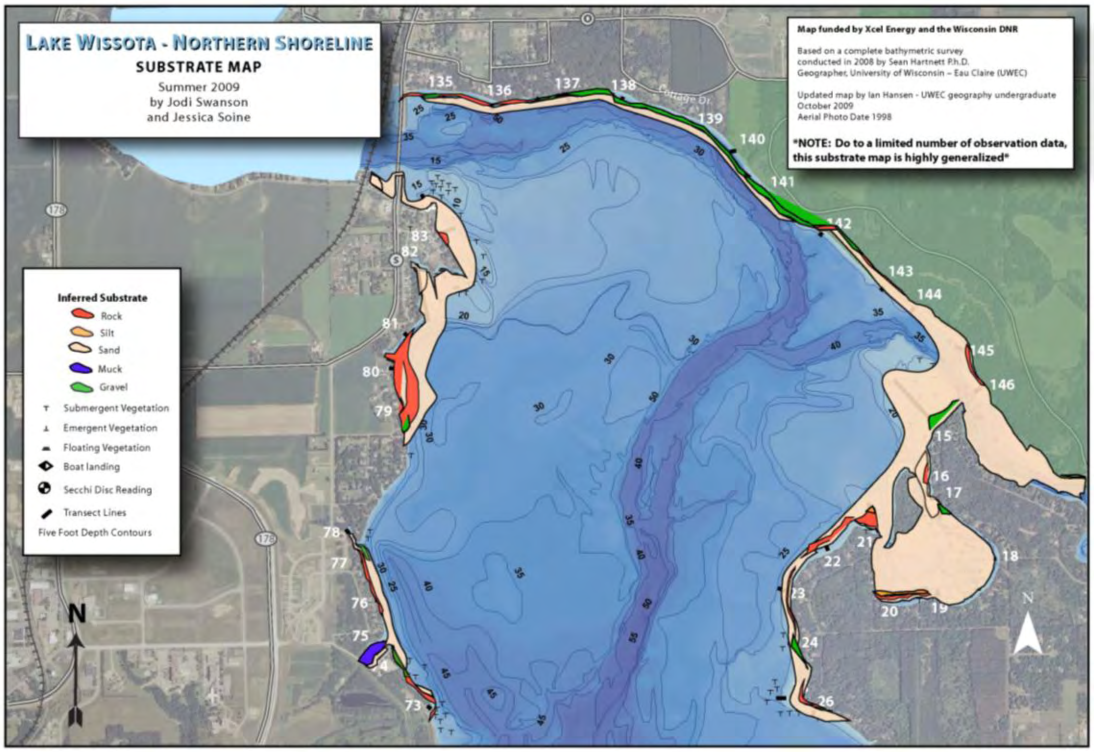



**Figure 11. Substrate map for Lake Wissota northern shoreline from summer 2009. (Swanson and Soine 2009).**

Near Shore Vegetation. Near shore vegetation is the area along the shore and in the water (not the shoreline) that contains submerged and emergent vegetation. This area often provides important breeding and nesting habitat for fish and other wildlife, acts as a sediment trap, and buffers the shoreline from wave action, thereby reducing erosion of the shore (Dudiak 2000). Over the course of 20 years from the first study in 1989, to the most recent study in 2009, the percentage of the vegetated points in the zone from 0-1.5ft from shore increased from 29% (1989) to 37% (2005) to 57% (2009). The 1.5-5ft zone also saw an increase in the percentage of vegetated points, from 52% (1989) to 55% (2005) to 62% (2009). This indicates a slight increase in the overall frequency of plants in the near shore depth zones (Swanson, 2009).

Floristic Quality Index. The Floristic Quality Index utilizes the number of aquatic plant species and the identity of aquatic plant species in a lake to determine lake quality. The FQI was developed in Wisconsin for Wisconsin lakes. The range for FQI is 3.0-44.6, the median is 22.2, and the higher the number, the better the lake quality (Aron et al. 2006). In 1989 and 2005, the FQI value for Lake Wissota was calculated at 28.24 and 28.00, respectively.

In 2009, the FQI value increased to 29.3. The values for all years are higher than the state and regional averages (Swanson 2009).

Aquatic Invasive Plants. Two aquatic invasive plants are found in Lake Wissota, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian water milfoil (EWM, *Myriophyllum spicatum*). Both species have increased in frequency over the 20-year course of the three plant studies. *P. crispus* increased from 0.63% in 1989 to 3.45% in 2009. *M. spicatum* increased from 0% in 1989 to 0.98% in 2005 to 1.48% in 2009. These frequencies are low compared to other species in the lake (ie. *Elodea canadensis* had a 25% frequency in 2009). However, in areas like Moon Bay where there are several beds of EWM, the EWM may begin to crowd out native plants, if it hasn't begun to do so already. It is also disconcerting that the frequency of EWM is increasing at all, given that it has been treated each year since it was first documented in the lake. It would seem that the frequency of this plant should have decreased with the 2009 survey rather than increased, since it had been treated by herbicides for several seasons prior to the survey. It also is cause for concern that new areas of infestation appear each year. The increase in frequency of *P. crispus* should be monitored carefully to determine if it is displacing native plants.

Total Acreage Vegetated. Visual estimations of plant bed sizes totaled 495.5 (7.9%) acres over the entire water system, 162.9 (45.7%) acres in Moon Bay, 47.8 (11.9%) acres in Little Lake and 152.5 (13.2%) acres in the Chippewa River north of the main basin (Table 6). Shoreline vegetation occurred on 39.3 miles (70.1%) of the entire shoreline (Swanson 2009; Figure 12).

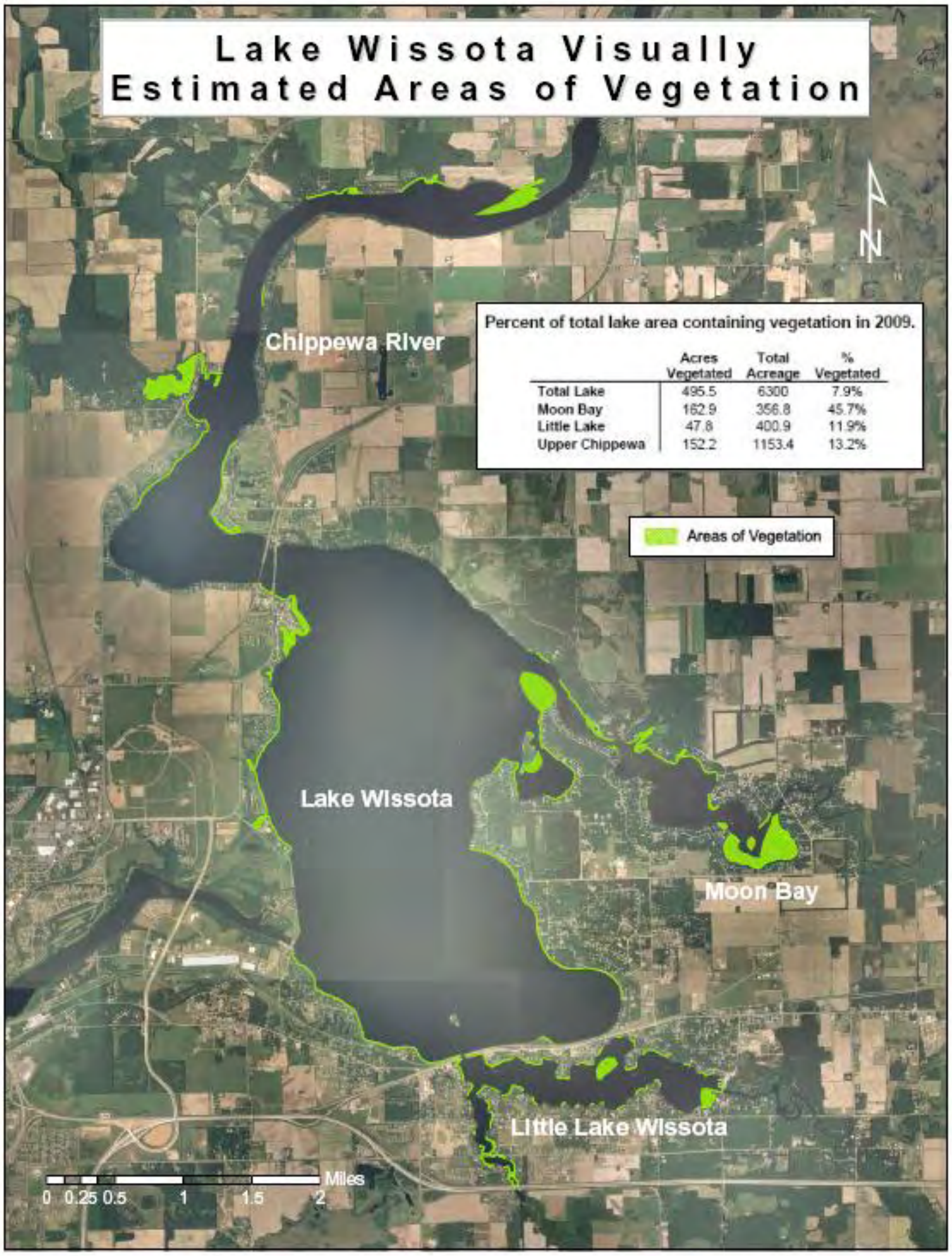
## Fisheries

The Wisconsin Department of Natural Resources has recorded 47 species of fish from 11 families in Lake Wissota between 1976 and 2008, (Appendix F). A state endangered species, the slender madtom (*Noturus exilis*) was reported in the lake, but there is dispute about its identification, and it may have been a misidentified stonecat. The greater redhorse (*Moxostoma valenciennesi*) is a state, threatened species that was found in the lake in 1994. The lake sturgeon (*Acipenser fulvescens*), common in the lake, is considered a species of special concern in Wisconsin. Species of special concern are species about which some problem of abundance or distribution is suspected but not proven. The main purpose of this category is to focus attention on these species before they become threatened or endangered. Common carp (*Cyprinus carpio*) was the only species in Lake Wissota not native to Wisconsin.

*The Wisconsin Department of Natural Resources fisheries has recorded 47 species of fish from 11 families in Lake Wissota between 1976 and 2008.*

Twelve species were captured only one time in Lake Wissota: bigmouth buffalo (1975), greater redhorse (1994), warmouth (2006), blacknose shiner (*Notropis heterolepis*, 2005), bluntnose minnow (*Pimephales notatus*, 1994), hornyhead chub (*Nocomis biguttatus*, 1994), largescale stoneroller (*Campostoma oligolepis*, 1994), longnose dace (*Rhinichthys cataractae*, 1994), river shiner (*Notropis blennius*, 1976), blackside darter (*Percina maculata*, 2005), Iowa darter (*Etheostoma exile*, 1994), and central mudminnow (*Umbra lima*, 1994).

No efforts were made to document all fish species present in Lake Wissota prior to or after the elimination of the drawdowns on the lake. However, fish surveys conducted after the major late-winter drawdowns were eliminated have shown improvements in fish populations that are dependent on aquatic vegetation for part of their life history, most notably, largemouth bass, northern pike, bluegill and yellow perch (Joseph Kurz, pers. comm. 2009).




Map created by Jodi Swanson 2010

**Figure 12. Map of visually estimated areas of vegetation on Lake Wissota from 2009.**

Six fish species are considered abundant in Lake Wissota: walleye (*Sander vitreus*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), silver redhorse (*Moxostoma anisurum*), and emerald shiner (*Notropis atherinoides*). An additional nine species are considered common: channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), muskellunge (*Esox masquinongy*), northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieu*), golden redhorse (*Moxostoma erythrurum*), shorthead redhorse (*Moxostoma macrolepidotum*), golden shiner (*Notomigonus crysoleucas*), and troutperch (*Percopsis omiscomaycus*).

Three species are considered rare on Lake Wissota: bigmouth buffalo (*Ictiobus cyprinellus*), warmouth (*Lupomis gulosus*), and creek chub (*Semotilus atromaculatus*).

**Figure 13. Green Heron on Lake Wissota, 2009.**
*Photo courtesy of Jessica Soine.*

## Wildlife Habitat

The wildlife habitat available on Lake Wissota was assessed during a critical habitat area study conducted on 25 September 2006. Critical Habitat Areas are identified areas that provide food, shelter, or spawning/nesting habitat for wildlife (Figure 14) and invertebrates or areas that provide important navigational or scenic beauty locations for the public. **Critical Habitat Areas may also be identified because of their importance in maintaining water quality**. Critical habitat areas are NOT docks, rafts, or boathouses, etc. Twelve Critical Habitat Areas have been designated on Lake Wissota (Figure 14) (Konkel, 2007).

Critical Habitat Areas on Lake Wissota provide more than 180 acres of critical wildlife habitat along more than 6.4 miles of shoreline (11% of the 56 total miles of shoreline around the lake) (Konkel 2007). Some of the fisheries and wildlife that benefit from these areas include: walleye, northern pike, musky, largemouth and smallmouth bass, crappie, bluegill, yellow perch, lake sturgeon, catfish, suckers, waterfowl, eagles, kingfishers, geese, coots, double crested cormorants, great blue herons, other shorebirds, songbirds and upland birds, muskrat, beaver, otter, deer, mink, turtles frogs, toads, snakes and salamanders.

Critical Habitat Areas also provide an important buffer for the shoreline, which reduces erosion and absorbs nutrient runoff. Wave action is absorbed by submergent and emergent vegetation that reduce the force of the waves as they reach the shore. Vegetation also traps nutrients that run off the shoreline and into the lake during rain events. A copy of the Critical Habitat study can be obtained from the LWIPA website (www.lwipa.net) or from the WDNR website (http://dnr.wi.gov/lakes/critical habitat/ )

The wildlife in Lake Wissota ultimately depend on organisms a little further down the food chain, the macroinvertebrates (insects, crustaceans, etc.), which are an important food source for many organisms. The macroinvertebrate community in Lake Wissota was inventoried during 1993-94 (Delong and Mundahl 1995) and demonstrated that the late-winter drawdowns of the lake had negative consequences for the macroinvertebrates that inhabited the littoral zone (near-shore area) of the lake. (Properly timed water-level fluctuations may not have the same negative consequences that the late-winter drawdowns had on the invertebrate community). As a base level in the food chain, the macroinvertebrate community affects the entire lake system. Maintaining a stable condition in the lake littoral zone, the most diverse area of a lake system, is therefore crucial to maintaining an ecologically sound body of water (Wetzel 2001). The macroinvertebrate community is scheduled to be re-inventoried during 2009-10 and this study will help determine how the macroinvertebrate community may have changed since the reduction of the late-winter drawdowns.


**Figure 14. Critical Habitat Areas (highlighted in yellow and labeled with LW_#) for Lake Wissota (from Konkel, 2007).**

## 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.

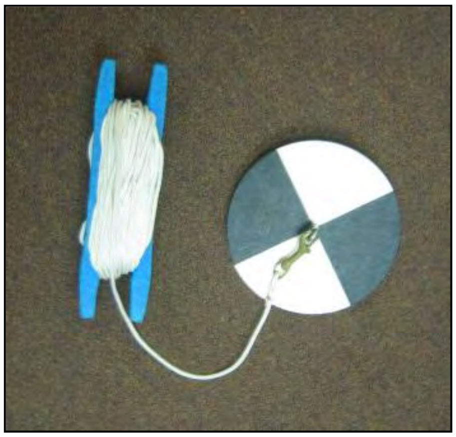


**Figure 15. A secchi disk, a tool used to measure water clarity.**
*Photo courtesy of Anna Mares 2009.*

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.

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.

Chlorophyll-*a.* 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.

Public Access. (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 use and availability for public use. These access points were mapped and photographed. The map and text from the report are available on the Town of Lafayette website (www.lafayettetownship.org). In addition, a listing and map created by the DNR fisheries biologist in 2006 closely parallels the Lafayette study (Joe Kurz, pers comm., 2009).

*Lake Wissota is an important regional recreational lake for the state of Wisconsin and the Chippewa Valley. 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).*

Of these 34 identified access points in the Town of Lafayette, 13 are apparently being used regularly by the public and one has been recently abandoned by the Chippewa County Circuit Court. Most of the remaining sites are either not used by the public (due to lack of knowledge of the site or because the site is too difficult to identify) or only used by adjacent landowners.

An examination of plats recorded at the Chippewa County Register of Deeds since 2006 did not reveal any further plats that border Lake Wissota, thus no other access points have been recorded in subdivision plats. There are a few discrepancies between the two listings generated in these two studies that should be examined. There are an additional 15 subdivisions on the lake that do not have platted access points.

**Table 5. List of Public access points on Lake Wissota as mapped in Figure 17.**

| Map Key | Name | Estimated Parking |
|---|---|---|
| 1 | Town of Anson – Jim Falls | 15 |
| 2 | Chippewa County | 7 |
| 3 | Lake Wissota State Park | 30 |
| 4 | Town of Anson – Moon Bay | 3 |
| 5 | Chippewa Rod and Gun Club (Fee) | 60 |
| 6 | Town of Lafayette (Fee) | 40 |
| 7 | Wissota View (Fee) | 20 |
| 8 | Town of Lafayette – Paint Creek | 10 |

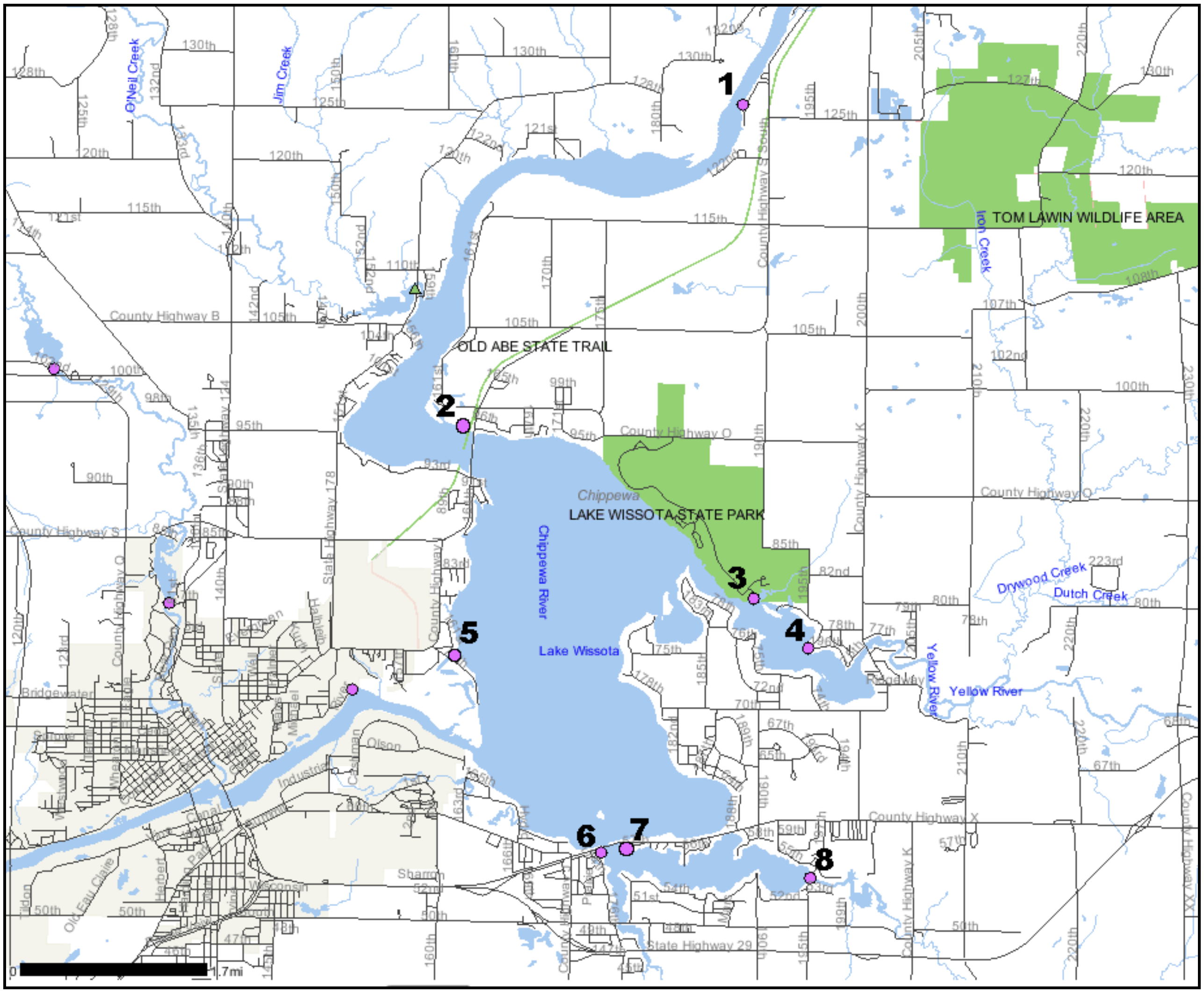



**Figure 18. Public boat landings on Lake Wissota.**

<u>Key Use Areas.</u> Key use areas of Lake Wissota include the main body of the lake (sometimes referred to as "the big lake"), Little Lake Wissota, Moon Bay, the Chippewa River, Pine Harbor, Lake Wissota State Park and the State Park beach, Ray's Beach, and the Chippewa Rod and Gun Club (Figure 19).


**Figure 19. Key use areas of Lake Wissota.**

Surface Use Ordinances. While all of Wisconsin's lake ordinances should be understood and followed by boaters, two in particular should receive special attention on Lake Wissota. The first deals with slow no-wake and the second with personal watercraft (PWC).

Wisconsin Act 31 designates a slow no-wake zone for all motorboats within 100 feet of the lake's shoreline beginning February 24, 2010. This is a state designation and applies to all Wisconsin lakes.

Sect. 30.66(3)(b) states that personal watercraft (PWC) cannot operate within 100' of another craft or 200' of the shoreline of a lake and cannot operate within 100' of a boat towing a skier, the ski rope, or the skier (WDNR 2007).

Slow no-wake problem areas for Lake Wissota include the Hwy X bridge between the Lake Wissota main body and Little Lake Wissota as well as the Lake Wissota State Park area between the Lake Wissota Main Body and Moon Bay (Cody Adams, pers. comm., 2009). Boaters should take extra care to follow slow no-wake rules in these areas.

## Watershed Description

The Lake Wissota watershed, as defined here, encompasses 5,548 square miles of land. **The land use activities occurring within those 5,548 square miles will directly affect water quality in Lake Wissota.** For the purposes of this aquatic plant management plan, only a small portion of the entire basin is being considered. The watershed focus region reaches north to encompass Cornell Flowage, east to the eastern edge of the Chequamegon Waters Flowage, west almost to Bloomer, and south to just over the Eau Claire County border (Figure 20). This watershed includes the sub-watersheds of 19 creeks whose waters eventually combine and drain into Lake Wissota.

Watersheds. The watersheds of Lake Wissota, as determined by the WDNR, are McCann Creek /Fisher River and Lower Yellow River as depicted in Figure 20.

Subwatersheds. The subwatersheds included in Figure 21 are similar to those depicted by the WDNR, but are based on the United States Geological Survey Hydrologic Unit Codes (HUCs). These subwatersheds are slightly different than the WDNR watersheds and are broken down into smaller sections. The subwatersheds include: McCann Creek, Marsh-Miller Lake-O'Neill Creek, Bob Creek, French Creek-Chippewa River, Buck Creek-Fisher River, Pike Creek, Witt Flowage-Fisher River, Elder Creek, Yellow River, Play Creek, Otter Creek, Lotz Creek-Yellow River, Big Drywood Creek, Little Drywood Creek, Old Abe Lake-Chippewa River, Jim Creek-O'Neill Creek, Lake Wissota, South Fork of Paint Creek-Paint Creek, and Sherman Creek-Paint Creek.

Land Cover. Land cover within the Lake Wissota watershed will directly influence water quality in the lake, as water flowing off of the land in the watershed will pick up nutrients, sediment, and potential pollutants as it flows to the lake. Within the watershed are 15 different land cover types including: water, developed open space, developed low intensity, developed medium intensity, developed high intensity, barren land, deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland/herbaceous, pasture/hay, cropland, woody wetlands, and herbaceous wetlands. The most prominent cover type in the watershed is deciduous forest (38.75%) followed closely by cropland (38.47%) (Figure 22). The distribution of the two dominant cover types is such that the deciduous forest land is more dominant in the northern part of the watershed, while the cropland is more dominant in the southern part of the watershed, especially near Lake Wissota. Developed land (high, medium, and low) makes up 0.73% of the watershed land cover, while wetlands (woody and herbaceous) make up 9.57%.

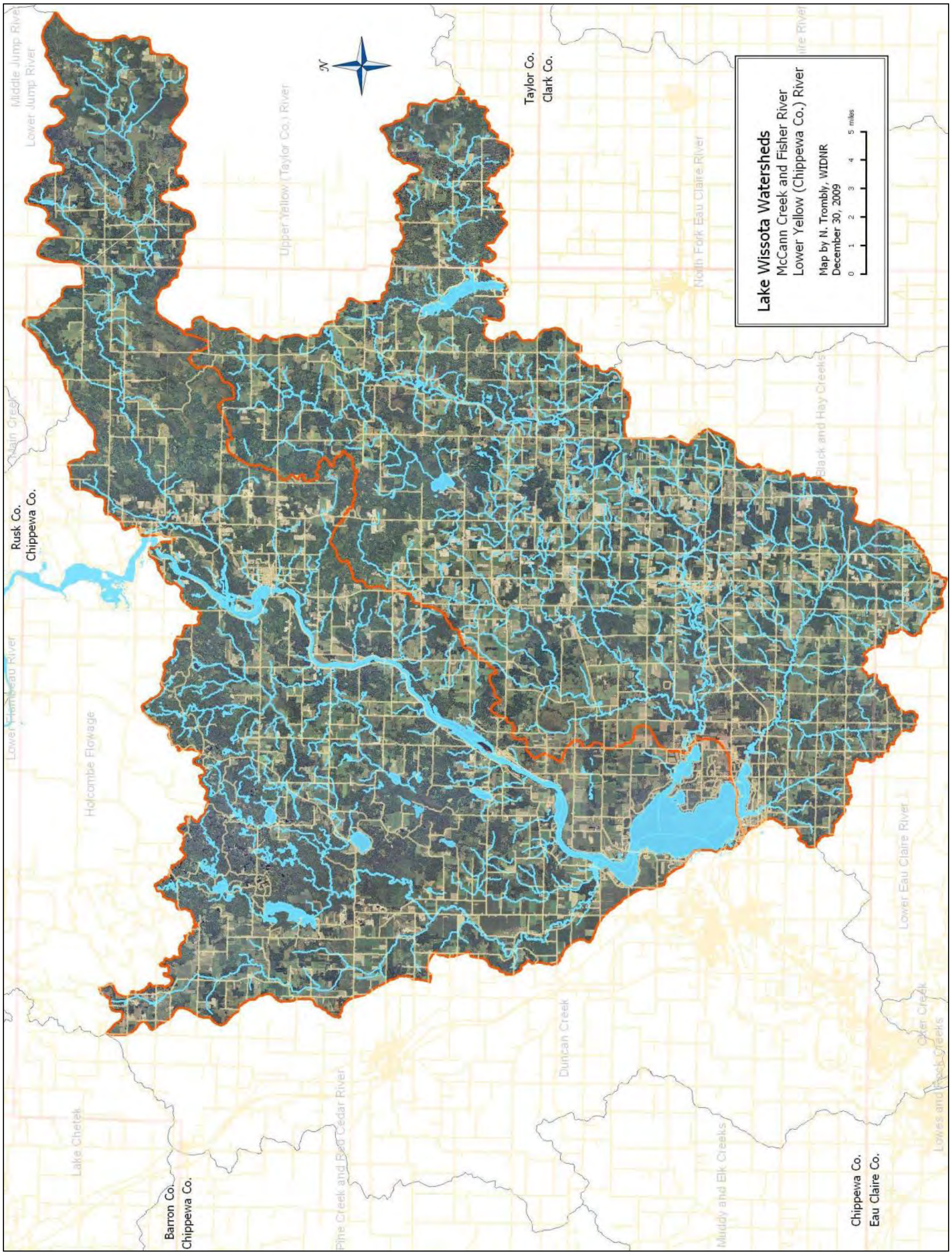



**Figure 20. Watershed boundaries for Lake Wissota, including McCann Creek/Fisher River and Lower Yellow River, as delineated by the Wisconsin Department of Natural Resources in 2009.**

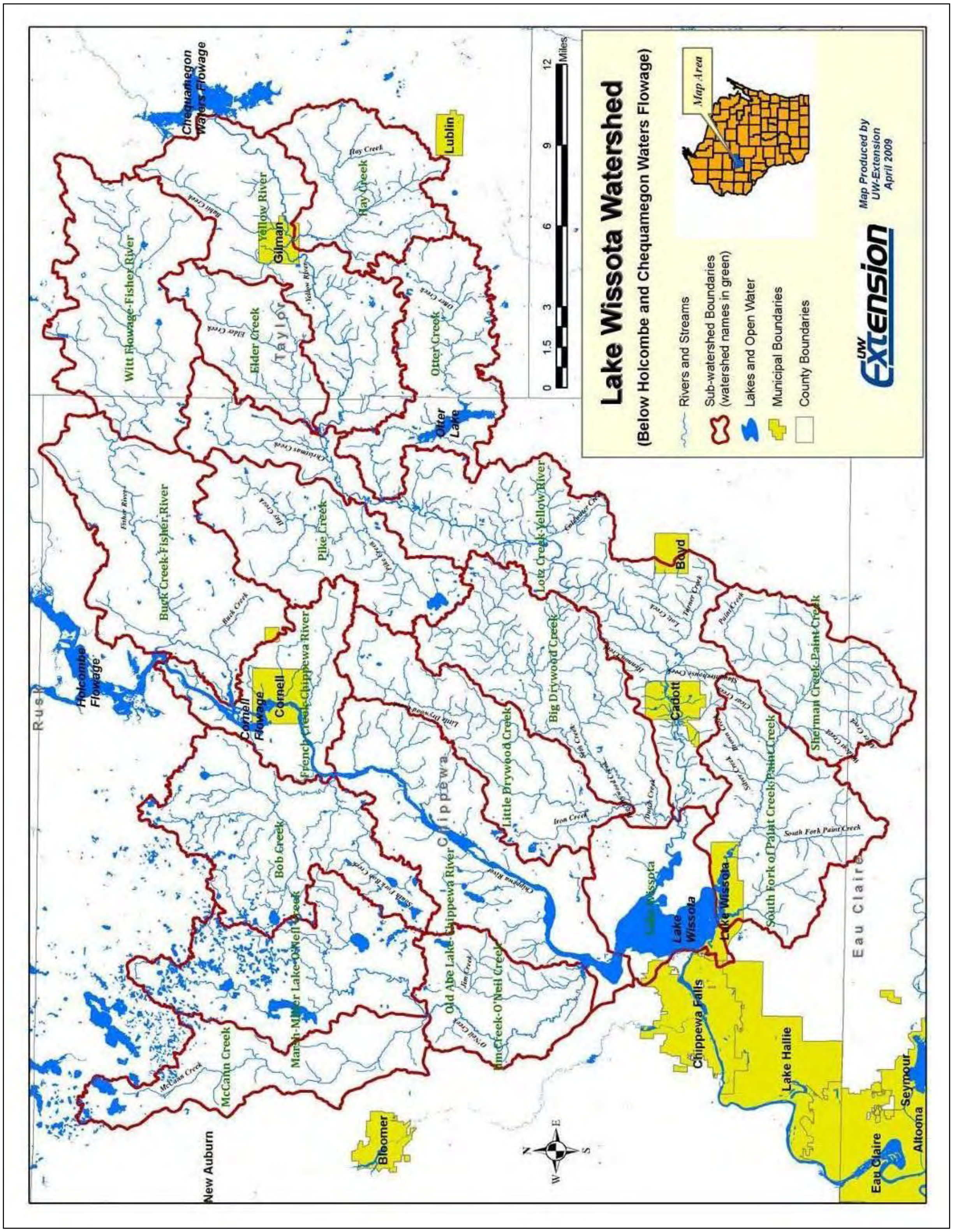



**Figure 21. Subwatersheds of Lake Wissota (below Holcombe and Chequamegon Waters Flowage). Map courtesy of UW-Extension Basin Educator Dan Zerr.**

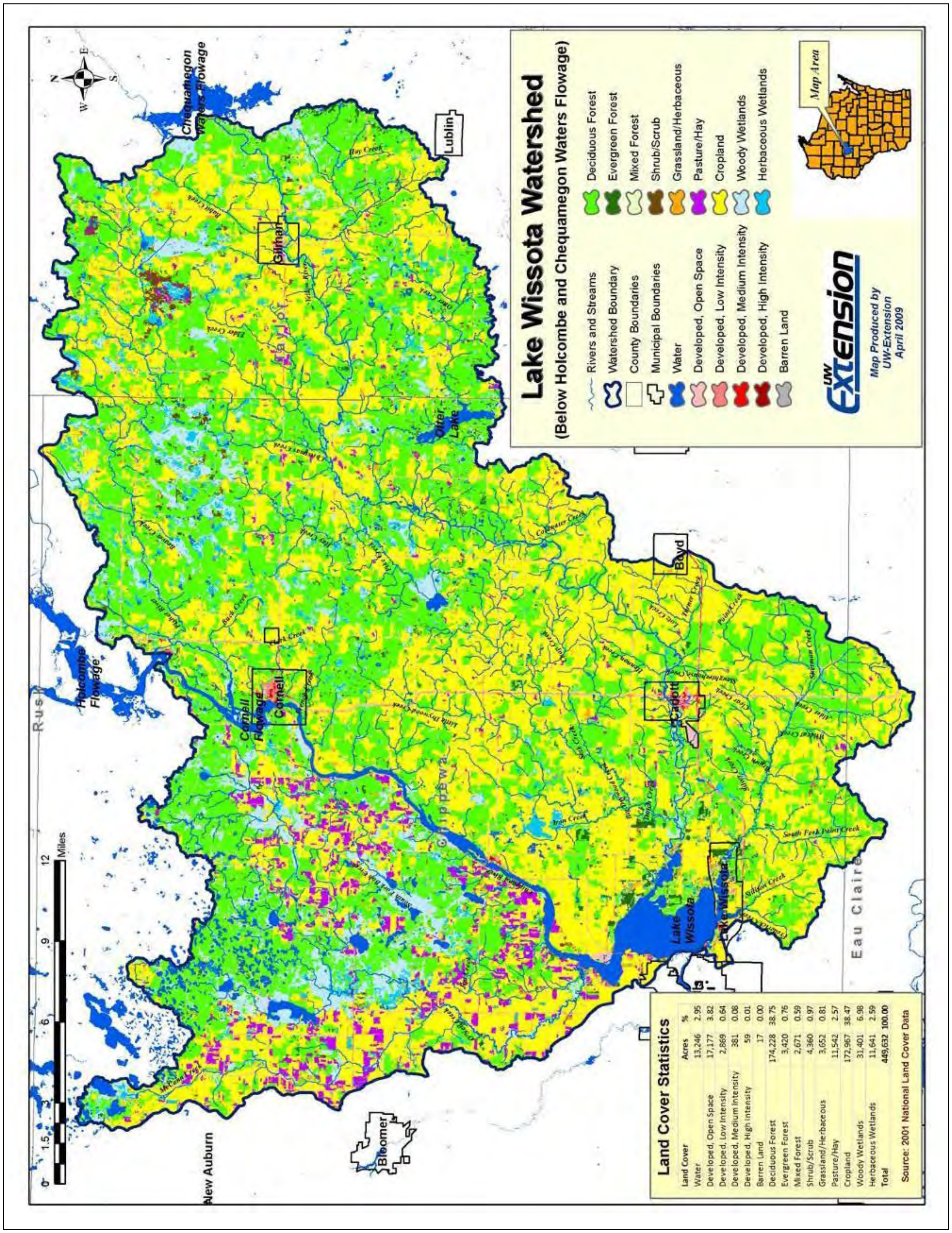



**Figure 22. Land cover types of the Lake Wissota watershed (below Holcombe and Chequamegon Waters Flowages). Map courtesy of UW-Extension Basin Educator Dan Zerr.**

**Land Cover Statistics**

| Land Cover | Acres | % |
|---|---|---|
| Water | 13,246 | 2.95 |
| Developed, Open Space | 17,177 | 3.82 |
| Developed, Low Intensity | 2,869 | 0.64 |
| Developed, Medium Intensity | 381 | 0.08 |
| Developed, High Intensity | 59 | 0.01 |
| Barren Land | 17 | 0.00 |
| Deciduous Forest | 174,228 | 38.75 |
| Evergreen Forest | 3,420 | 0.76 |
| Mixed Forest | 2,671 | 0.59 |
| Shrub/Scrub | 4,360 | 0.97 |
| Grassland/Herbaceous | 3,652 | 0.81 |
| Pasture/Hay | 11,542 | 2.57 |
| Cropland | 172,967 | 38.47 |
| Woody Wetlands | 31,401 | 6.98 |
| Herbaceous Wetlands | 11,641 | 2.59 |
| **Total** | **449,632** | **100.00** |

Source: 2001 National Land Cover Data

**Figure 23. Land cover statistics table enlarged from Figure 22.**

# V. Recommendations of the Advisory Committee

The Lake Wissota Advisory committee recommends that the aquatic plant management plan be treated as a working document. As new research is conducted, it should be evaluated and incorporated into the management plan as appropriate to the lake. The lake community and its constituents should implement the goals set forth in the management plan over the next five years and revisit the management plan in detail at the end of those five years to define the goals and strategies that are best suited for the lake at that time. A new advisory committee should be formed to review and update the aquatic plant management plan with any new information that is available.

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# *Appendix A*

## Chemical treatments and their pros and cons

| Chemical Treatment | Pros | Cons |
|---|---|---|
| 2,4-D | Highly effective on EWM | May cause oxygen depletion |
| | Can be used in synergy with Endothall for early-season treatments | Monocots are not affected, including curly-leaf pondweed |
| | Comes in granular or liquid form | Toxic to aquatic fauna if applied at improperly high dosage |
| | Does not affect monocots | |
| | Can be selective depending on concentration and seasonal timing | |
| Endothall (Aquathol) | Effective on EWM and CLP | Kills many native pondweeds |
| | Can be selective depending on concentration and seasonal timing | Not as effective in dense vegetation |
| | Can be combined with 2,4-D or copper treatments | Toxic to aquatic fauna if applied at improperly high dosage |
| Diquat (Reward) | Effective on EWM | Broad-spectrum, may impact native pondweeds, Elodea and coontail |
| | Fast-acting | Toxic to many native plants at the concentration needed to kill EWM |
| | Limited toxicity to fish and other fauna | Toxic to aquatic invertebrates |
| | | Ineffective in cold or turbid water |
| | | Contact herbicide, does not work as a systemic at label-prescribed rate |
| Fluridone (Sonar, Avast) | Effective on EWM | EWM has shown elsewhere in the US to develop resistance |
| | Has minor effect on dissolved oxygen levels | Requires long contact time, which [Moon Bay and Little Lake Wissota] do not have |
| | Applied at low concentration | Affects many native plants found in [Lake Wissota] at concentration needed to control EWM |
| | Low toxicity to aquatic fauna | |

## Chemical treatments and their pros and cons cont'd

| Chemical Treatment | Pros | Cons |
|---|---|---|
| Glyphosate (Rodeo) | Effective on floating and emergent plants (ie. purple loosestrife) | Ineffective in turbid water |
| | Non-toxic to most aquatic animals at recommended dosages | No controlling effect on submerged plants |
| | | Contains phosphorous |
| | | Inexpensive terrestrial form (RoundUp) is inappropriate for shorelines due to lethality to herps |
| Triclopyr (Renovate) | Effective on emergent and floating plants | Negative impact to some native plants |
| | Results in 3-5 weeks | Breaks down quickly in UV (sun)light |
| | Low toxicity to aquatic animals | |
| | No recreational use restrictions following treatment | |
| Copper Compounds (Cutrine Plus) | Reduces algae growth (increases water clarity) | Copper accumulates and persists in sediment |
| | No recreational restrictions following treatment | Short-term results (2 weeks) |
| | | Toxicity to invertebrates and fish may be caused after extended use |

# *Appendix B*

**Map of Lake Wissota, Little Lake Wissota, and Moon Bay from 2005**

# *Appendix C*

**(Xcel Energy Records)**
**Summary of Lake Wissota Drawdowns From 1966 To 2008 * +**

| | |
|---|---|
| 2008 | Lowered approximately 3 ft. from March 31 to April 5 |
| 2007 | No drawdown |
| 2006 | No drawdown |
| 2005 | No drawdown |
| 2004 | No drawdown |
| 2003 | No drawdown |
| 2002 | No drawdown |
| 2001 | Lowered 3 ft. beginning March 15 and refilled on April 5 |
| 2000 | No drawdown |
| 1999 | Lowered 9.2 ft. beginning March 16 and refilled on April 1 (for entrainment study) |
| 1998 | Lake drawdown did not occur due to the lack of snow in upstream watershed. |
| 1997 | Lowered 12 ft. beginning 2/17/97 and refilled on 3/31/97 (high flood threat). |
| 1996 | Lowered 10 ft. between 2/12/96 and 4/17/96 (high flood threat). |
| 1995 | Lowered 5 ft. between 3/1/95 and 3/18/95; (early runoff) |
| 1994 | Lowered 10 ft. between 2/14/94 and 4/9/94 (macroinvertebrates/drawdown assessment study) |
| 1993 | Lowered 12 ft. between 2/16/93 and 4/5/93 for inspection of spillway gates. |
| 1992 | Lowered 5 ft. between 2/19/92 and 3/8/92. Lowered 5 ft. again on 3/17/93 to 4/9/92. |
| 1991 | Lowered 5 ft. between 3/6/91 and 3/23/91. |
| 1990 | Lowered 8 ft. between 12/14/89 and 1/10/90 for dam repairs; began refilling on 1/22/90. |
| 1989 | Lowered 8 ft. between 1/30/89 and 2/17/89 for dam repairs. |
| 1988 | Lowered 5 ft. beginning first week of March (6"/day) |
| 1987 | Lowered 5 ft. beginning 2/23/87 (6"/day) |
| 1986 | Lowered 15 ft. throughout the period 1/1/86 to 3/17/86 (construction drawdown). |
| 1985 | Began 15 ft. construction drawdown on 12/15/85 at rate of 6"/day. Began 15 ft. spring drawdown on 3/1/85. |
| 1984 | Began 14.5 ft. spring drawdown on 2/13/84 and completed about 3/25/84. |
| 1983 | Drawdown information is not available. |
| 1982 | Drawdown information is not available. |
| 1981 | Drawdown information is not available. |
| 1980 | 15 ft. drawdown * |
| 1979 | 15 ft. drawdown; 2/26/79 - 4/1/79 ** |
| 1978 | Began 15 ft. spring drawdown on 2/10/78; drawdown was terminated on 4/6/78 (55 days). |
| 1977 | Began 4 ft. spring drawdown on 3/1/77; drawdown was completed on 3/30/77 (4 days). |
| 1976 | Began 15 ft. spring drawdown on 1/21/76; drawdown was completed on 3/30/76 (68 days). |
| 1975 | 15 ft. drawdown; 2/10/75 - 3/27/75. ** |

1974 15 ft. drawdown; 2/11/74 - 3/27/74. **
1973 14 ft. drawdown; 2/12/73 - 3/27/73. **

1972 15 ft. drawdown; 2/14/72 - 3/27/72. **
1971 15 ft. drawdown; 2/11/71 - 3/27/71. **
1970 15 ft. drawdown; 2/9/70 - 3/27/70. **
1969 15 ft. drawdown (actual)
1968 7.4 ft. drawdown (actual)

1967 Began 15 ft. drawdown on 2/1/67 for concrete work on piers of spillway. Drawdown continued until 3/27/67. **
1966 7.8 ft. drawdown (actual).

* The dates indicate the time that the pond was reduced from below the normal low water level (897.0) until the pond was refilled to the normal low water level at the conclusion of the drawdown.

** The dates and the extent of drawdown performed on Lake Wissota was dependent upon snow conditions in the Chippewa and Flambeau River Basins and the timing of spring runoff.

+ This appendix was taken directly from Heuschele, J. 2006. A comparison of the distribution and density of aquatic plants in Lake Wissota, Chippewa County, Wisconsin, between 1989 and 2005. Beaver Creek Reserve Citizen Science Center.

# *Appendix D*

## Plants Present in Lake Wissota by Year

**<u>1989/90</u>**

**Emergents (12)**
*Acorus calamus*
*Carex crinita*
*Eleocharis palustris*
*Leersia oryzoides*
*Potentilla palustris*
*Sagittaria latifolia*
*Sagittaria rigida*
*Scirpus atrovirens*
*Scirpus validus*
*Sparganium sp.*
*Typha angustifolia*
*Typha latifolia*

**Floating-leaf (5)**
*Lemna minor*
*Lemna trisulca*
*Nuphar variegatum*
*Nymphaea odorata*
*Spirodela polyrhiza*

**Submergents (14)**
*Ceratophyllum demersum*
*Elatine minima*
*Elodea canadensis*
*Najas flexilis*
*Nitella sp.*
*Potamogeton crispus*
*Potamogeton epihydrus*
*Potamogeton nodosus*
*Potamogeton pusillus*
*Potamogeton richardsonii*
*Potamogeton spirillus*
*Potamogeton zosteriformis*
*Vallisneria americana*
*Zosterella dubia*

**<u>2005</u>**

**Emergents (12)**
*Carex crinita*
*Eleocharis palustris*
*Eleocharis acicularis*
*Leersia oryzoides*
*Pontederia cordata*
*Sagittaria latifolia*
*Sagittaria rigida*
*Scirpus atrovirens*
*Scirpus validus*
*Sparganium sp.*
*Typha angustifolia*
*Typha latifolia*

**Floating-leaf (5)**
*Lemna minor*
*Nuphar variegatum*
*Nymphaea odorata*
*Spirodela polyrhiza*
*Wolfia columbiana*

**Submergents (16)**
*Ceratophyllum demersum*
*Elatine minima*
*Elodea canadensis*
*Myriophyllum spicatum*
*Najas flexilis*
*Nitella sp.*
*Potamogeton crispus*
*Potamogeton epihydrus*
*Potamogeton nodosus*
*Potamogeton pusillus*
*Potamogeton richardsonii*
*Potamogeton spirillus*
*Potamogeton vaseyi*
*Potamogeton zosteriformis*
*Vallisneria americana*
*Zosterella dubia*

**<u>2009</u>**

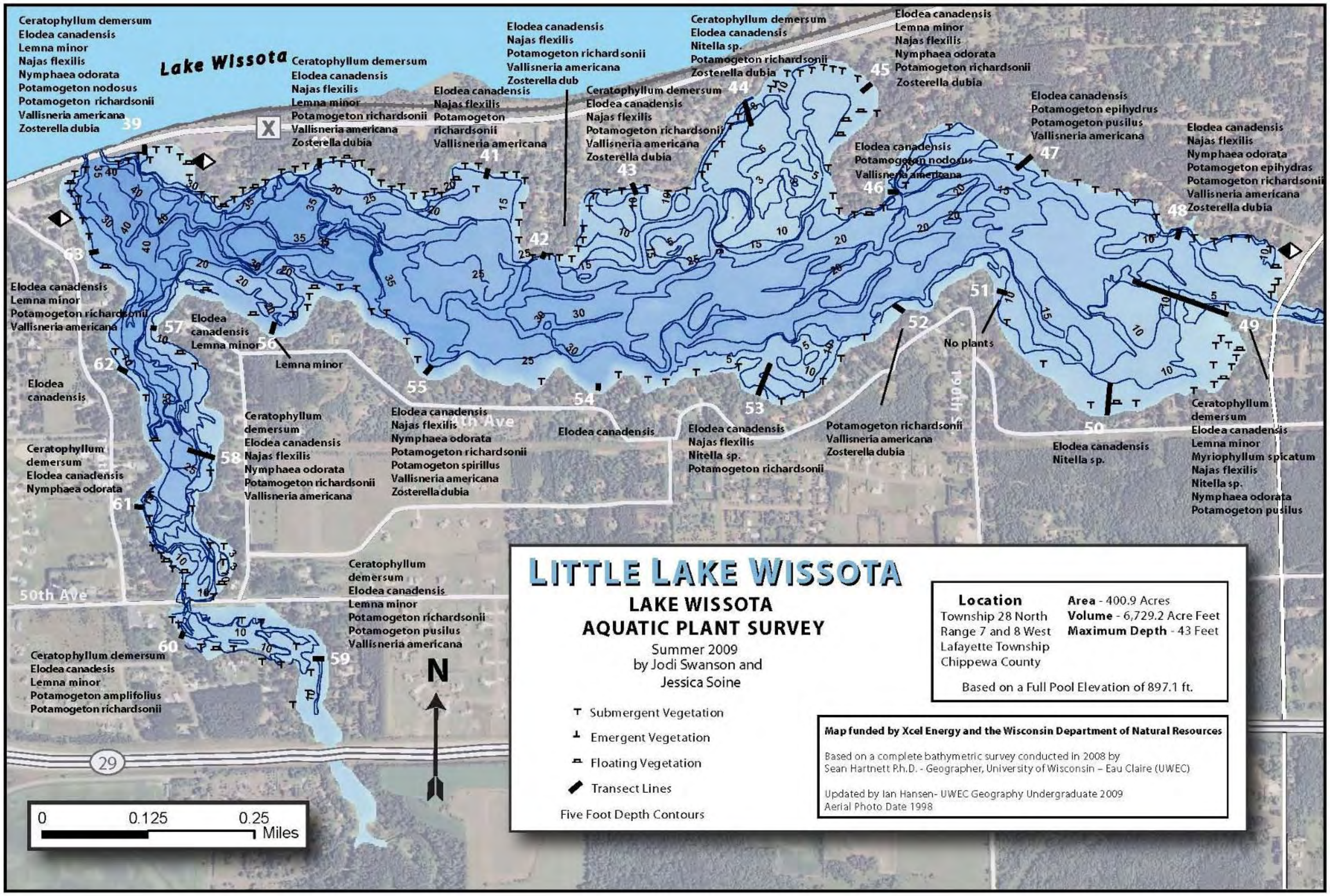
**Emergents (10)**
*Carex crinita*
*Leersia oryzoides*
*Pontederia cordata*
*Sagittaria latifolia*
*Sagittaria rigida*
*Scirpus validus*
*Sparganium sp.*
*Typha angustifolia*
*Typha latifolia*
*Zinzinia sp.*

**Floating-Leaf (6)**
*Lemna minor*
*Lemna trisulca*
*Nuphar variegatum*
*Nymphaea odorata*
*Spirodela polyrhiza*
*Wolfia columbiana*

**Submergents (16)**
*Ceratophyllum demersum*
*Elodea canadensis*
*Myriophyllum spicatum*
*Najas flexilis*
*Nitella sp.*
*Potamogeton amplifolius*
*Potamogeton crispus*
*Potamogeton epihydrus*
*Potamogeton nodosus*
*Potamogeton pusillus*
*Potamogeton richardsonii*
*Potamogeton spirillus*
*Potamogeton zosteriformis*
*Ranunculus longirostris*
*Vallisneria americana*
*Zosterella dubia*

# *Appendix E*

**Map of the aquatic plant survey conducted on Little Lake Wissota in 2009.**



# *Appendix F*

## Fish Species Collected in Lake Wissota, 1976-2008, by Family

| Acipenseridae-Sturgeon Family | |
|---|---|
| *lake sturgeon [P] | *Acipenser fulvescens* |

| Atherinidae-Silverside Family | |
|---|---|
| brook silverside [P] | *Labidesthes sicculus* |

| Catostomidae-Sucker Family | |
|---|---|
| bigmouth buffalo [R - 1976] | *Ictiobus cyprinellus* |
| golden redhorse [C] | *Moxostoma erythrurum* |
| **greater redhorse [U - 1994] | *Moxostoma valenciennesi* |
| northern hogsucker [P] | *Hypentelium nigricans* |
| quillback [R] | *Carpiodes cyprinus* |
| shorthead redhorse [C] | *Moxostoma macrolepidotum* |
| silver redhorse [A] | *Moxostoma anisurum* |
| white sucker [P] | *Catostomus commersonii* |

| Centrarchidae-Sunfish and Bass Family | |
|---|---|
| largemouth bass [P] | *Micropterus salmoides* |
| smallmouth bass [C] | *Micropterus dolomieu* |
| black crappie [A] | *Pomoxis nigromaculatus* |
| bluegill [A] | *Lepomis macrochirus* |
| green sunfish [P] | *Lepomis cyanellus* |
| pumpkinseed [P] | *Lepomis gibbosus* |
| rock bass [P] | *Ambloplites rupestris* |
| warmouth [R - 2006] | *Lepomis gulosus* |

| Esocidae-Pike Family | |
|---|---|
| muskellunge [C] | *Esox masquinongy* |
| northern pike [C] | *Esox lucius* |

| Gadidae-Freshwater Cod Family | |
|---|---|
| burbot [U] | *Lota lota* |

| Ictaluridae-Catfish Family | |
|---|---|
| channel catfish [C] | *Ictalurus punctatus* |
| flathead catfish [C] | *Pylodictis olivaris* |
| black bullhead [P] | *Ameiurus melas* |
| yellow bullhead [P] | *Ameiurus natalis* |
| ***slender madtom [U - 2005] | *Noturus exilis* |

| Percidae-Perch Family | |
|---|---|
| blackside darter [U - 2005] | *Percina maculata* |
| fantail darter [U] | *Etheostoma flabellare* |
| Iowa darter [U - 1994] | *Etheostoma exile* |
| johnny darter [U] | *Etheostoma nigrum* |
| logperch [U] | *Percina caprodes* |
| walleye [A] | *Sander vitreus* |
| yellow perch [A] | *Perca flavescens* |

| Percopsidae-Troutperch Family | |
|---|---|
| troutperch [C] | *Percopsis omiscomaycus* |

***Continued on next page*…**

## Fish Species Collected in Lake Wissota, 1976-2008, by Family cont'd

| **Cyprinidae-Minnow family** | |
|---|---|
| blacknose shiner [U - 2005] | *Notropis heterolepis* |
| bluntnose minnow [U - 1994] | *Pimephales notatus* |
| common carp [P] | *Cyprinus carpio* |
| common shiner [P] | *Luxilus cornutus* |
| creek chub [R] | *Semotilus atromaculatus* |
| emerald shiner [A] | *Notropis atherinoides* |
| golden shiner [C] | *Notemigonus crysoleucas* |
| hornyhead chub [U - 1994] | *Nocomis biguttatus* |
| largescale stoneroller [U - 1994] | *Campostoma oligolepis* |
| longnose dace [U - 1994] | *Rhinichthys cataractae* |
| river shiner [U - 1976] | *Notropis blennius* |
| spotfin shiner [U] | *Cyprinella spiloptera* |

| **Umbridae-Mudminnow Family** | |
|---|---|
| central mudminnow [U - 1994] | *Umbra limi* |

A = abundant
C = common
P = present
R = rare
U = unknown status

| |
|---|
| *Lake sturgeon is listed as a species of concern in Wisconsin. |
| **Greater redhorse is listed as a threatened species in Wisconsin. |
| ***Slender madtom is listed as an endangered species in Wisconsin. Question the identification of this individual, since the northern part of its range is in southern Wisconsin. Suspect it was a stonecat. |