Chetek Lakes Water Quality Management Plan/TMDL

Prepared for
Chetek Lakes Protection Association

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Contents

Chetek Lakes Management Plans/TMDLs

Chetek Lakes—Prairie Lake, Mud Lake, Pokegama Lake, Lake Chetek, and Ten Mile Lake--are interconnected lakes in Chetek, Barron County, Wisconsin. The lakes are used for recreational purposes, including water-skiing, fishing, and boating, so clean water is considered highly important. Currently, increasing levels of pollution have placed the lakes on the Environmental Protection Agency's "Impaired" list.

The water quality of Chetek Lakes has degraded considerably since they were last studied in 1996. Because the cause of this deterioration is unknown, Barr recommends that a new study be undertaken to determine the cause of the deterioration. The cause could be the watershed, which includes cropland, or internal sources, such as phosphorous being released into the water column from sediment and phosphorus being released into the water column from decaying plants. However, the cause of the deterioration is at present unknown.

First steps to improvement

We recommend that the watershed cropland best management practices (BMPs), as set out in the Red Cedar Basin total maximum daily load (or TMDL), be implemented immediately. The Red Cedar Basin TMDL goal is a reduction in the phosphorus load by 45 percent from the 1990 levels. This can be implemented while lake-specific TMDLs are completed by the Chetek Lakes Protection Association. We recommend beginning to implement these at Prairie Lake, where 44 percent, or 4,905 pounds, of the 1996 total phosphorus load was from cropland in lake's direct watershed.

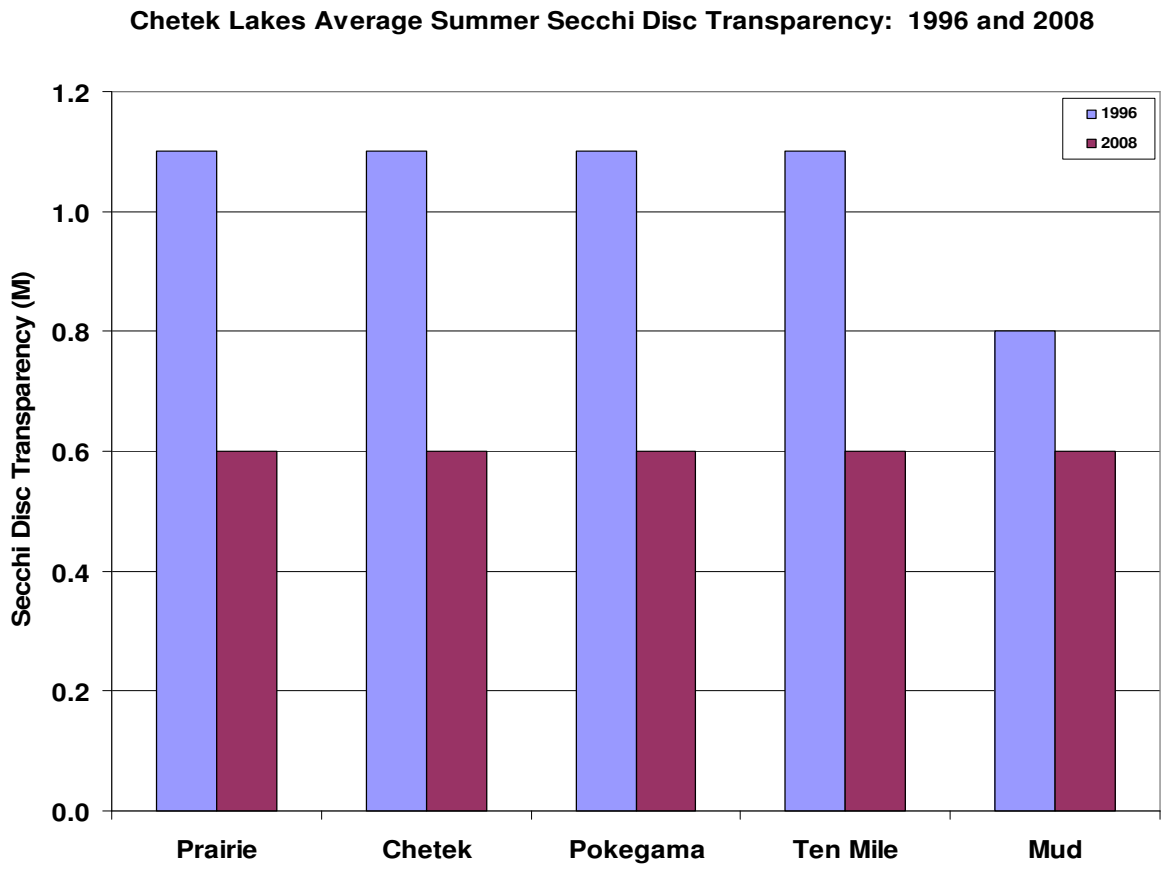
We recommend that Barron County apply for lake protection and total runoff management grants to fund watershed cropland BMPs. The Wisconsin DNR offers complementary grants. An outstanding funding-related question is whether the Red Cedar TMDL would be sufficient for obtaining grants to begin watershed work, or if a lake-specific, DNR-approved management plan will be required.

Additionally, we recommend that the Wisconsin Department of Natural Resources and the Chetek Lakes Protection Association establish water quality goals for Chetek Lakes. For example, a goal could be 60 or 90 micrograms of phosphorus per liter. Another goal could be improving water transparency. Currently the water quality is at 0.6 feet, and a possible goal is one or two feet of clarity. These goals would be preliminary, and could be changed as new information is acquired. After these goals are determined by the Chetek Lakes Protection Association and the Wisconsin DNR, we recommend hosting a public meeting to receive comments and finalize the goals.

In 1996, the annual phosphorous loads to Pokegama and Chetek Lakes were mainly from lakes further upstream, such as Prairie Lake. It may seem that mitigation methods for the other Chetek lakes would therefore improve these lakes now. However, because the lakes are on the EPA's list of impaired bodies of water, a TMDL is necessary. The DNR could require TMDLs of these lakes, and returning to perform survey work later could be more costly than performing the studies on all five lakes in the Chetek Lakes at the same time.

Why can't we use the data from the extensive—and expensive—1996 studies? In the 12 years that have passed since that study was completed, the water quality of the lakes has

deteriorated considerably. If the water quality had been consistent over the years, the data from that study would have been a good starting point. As the table included below indicates, the changes are dramatic enough that more recent information is necessary to determine a remediation plan as well as receive grant monies for remediation efforts. A new study will supply the current causes and levels of pollutants in the lakes.



After the goals are set, we recommend completing a water quality study of the Chetek Lakes. This study will uncover the current reasons for the lakes' high phosphorus levels. A complete water quality study of the lakes will include tributary montoring, in-lake monitoring, sediment monitoring, and aquatic plant monitoring.

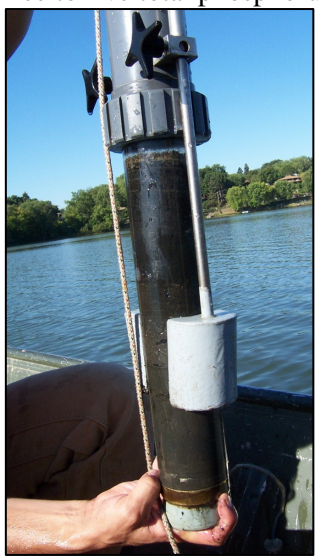
Tributary monitoring

We recommend monitoring Pokegama Creek, the outflow of Mud Lake to Prairie Lake, Moose Ear Creek, and Ten Mile Creek. At a minimum, between April and September, when the year's major rain events occur, we would take continuous flow samples. These would measure the depth of the stream every 15 minutes from the time that a measuring device is placed in the water to the time it is removed. We would take approximately 8 storm samples and weekly baseflow samples (estimate 25 samples) to

uncover both storm and baseflow water quality. Additional samples could be taken during October and November if funds permit.

In-lake monitoring

Lake monitoring will determine the lake's current water quality and will also reveal whether the phosphorus is coming from within the lake. We recommend twice-per-month samplings from May to September, taken from the same single location as in the 1996 survey. We recommend three to five total phosphorus samples are taken per lake per event, at zero-to-two meters and then at one-meter intervals to the bottom of the lake. We will measure the soluble reactive phosphorus (or SRP), the amount of chlorophyll (Chl), and the acidity of the lake water (pH); measure the temperature and dissolved oxygen levels; and measure Secchi disc transparency to evaluate clarity of the water. We also recommend an analysis of best management practices to improve the lakes' water quality and the development of management plans.



Core samples, such as the one pictured above, were taken at various depths of Red Rock Lake (below), another lake tested by Barr.

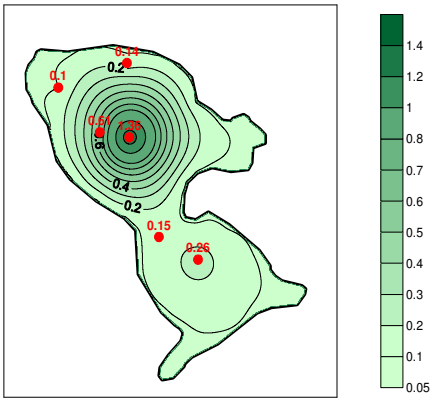
Sediment monitoring

Sediment monitoring will establish the contribution of sediment to the water quality problems. Phosphorus sinks into sediment, where it can be released back into the water column, where it will be readily available for uptake by algae. The ability of phosphorus to become mobile can be reduced by binding it to iron, calcium, and aluminum. Once bound, it cannot be released back into the water column.

In order to determine the concentration of phosphorus in the sediment, specialists at Barr have developed a sampling method and a sampling plan for the Chetek Lakes. We have determined a total of 46 locations that should be sampled:

- Mud Lake – seven locations
- Prairie Lake – 18 locations
- Pokegama Lake – seven locations
- Chetek Lake – eight locations
- Ten Mile Lake – six locations

The sediment cores collected from these locations (see picture at right) will be sampled by slicing them into sections, yielding 320 samples. Each sample will be analyzed for several types of phosphorus, including mobile phosphorus and organic phosphorus, a type of phosphorus added to lake sediments by decaying plants.



Aquatic Plant Monitoring

We recommend that the Chetek Lakes Protection Association explore the feasibility of monitoring aquatic plants by Wisconsin DNR research staff. We recommend that they work with WDNR staff, including Tim Asplund and Jennifer Hauxwell, to determine if WDNR research staff would be willing to monitor the aquatic plants in Chetek Lakes. Already in 2008, the Wisconsin DNR has mapped curlyleaf pond-

weed. These maps could be used to determine curlyleaf pondweed coverage in the lakes if additional aquatic plant monitoring is not feasible. Curlyleaf pondweed, an invasive species, provides heavy loads of phosphorus that give rise to inedible blue-green algae, seriously impairing lakes.

Methods for Reducing Phosphorus

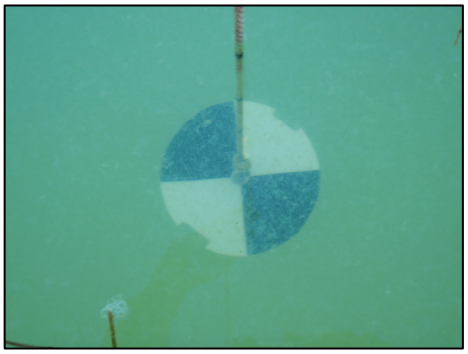
Our monitoring data will be used to model how much phosphorus comes from tributaries and how much is loaded internally from phosphorus in sediment and from decaying aquatic plants. This will allow us to determine the right BMPS and prepare a TMDL for the Chetek Lakes.

If most of the phosphorus is coming from tributaries, one option to improve lake water quality is preventing the phosphorus from reaching the lake in the first place. One method to achieve this is constructing an inflow alum treatment facility at the confluence of Pokegama Creek and Mud Lake and a second facility at the confluence of Ten Mile Creek and Ten Mile Lake. Inflow alum treatment facilities take water from the creek and pump it to a pond, where alum is added. When alum enters water it forms large flakes that attract phosphorus. The heavy flakes then settle to the bottom of the pond, removing the dissolved and total phosphorus from the water before it enters the lake. (Periodically, this pond is cleaned out). The treated water then flows into either Mud Lake or Ten Mile Lake.

Alternatively, phosphorus that already exists in lakes can be treated with alum. A slurry of alum is sprayed into the lake, where the phosphorus in the lake bonds to the alum and sinks to the sediment at the bottom of the lake. In the sediment, the alum bonds to mobile phosphorus. This permanent bond between the mobile phosphorus and the alum traps the phosphorus in the sediment so that it is unable to enter the water. Effective for ten years, alum treatments have been shown to reduce total phosphorus by 50 percent and improve clarity to six meters in Lake Calhoun, a well known lake in Minneapolis, Minnesota. Barr engineers have been pioneers in understanding the right amount of alum for a lake, so that the lake remains clear for a decade.

Alum is stored in the pictured tank (above). The phosphorus remains in this pond (below).

This lake is being treated with alum (above). Alum floc (below) settles to the bottom of the lake, where it binds the phosphorus found in sediment, preventing it from going back into the lake.



Funding

Funding for studying and managing the Chetek Lakes can be in part funded by grants. We recommend that Barron County apply

for a TRM grant by April 15, 2009, and for a lake protection grant by May 1, 2009. This would allow the implementation of watershed BMPs to move forward in 2009, rather than waiting another year. The grant monies would be awarded July 1, 2009.

Additionally, we recommend that the Chetek Lakes Protection Association apply for a lake protection grant by May 1, 2009, for a diagnostic/feasibility study. This grant money would be awarded July 1, 2009. Study of the Chetek Lakes and tributaries could move forward in 2010.

Schedule for Action

We recommend that the Chetek Lakes Protection Association and WDNR determine lake goals July 2009 through March 2010. The tributary and lakes monitoring program would take place from April through September 2010, and the modeling take place in October and November 2010. Management plans and TMDLs would be drafted in December 2010 and January 2011, allowing a review, discussion, and editing of the materials in February 2011. A public meeting to obtain comments on the management plans would take place in March 2011. Based on this meeting, the management plans/TMDLs would be finalized in April 2011. An application for lake protection grants for implementation would be made by May 1, 2011, and the plans would be implemented beginning in July 2011.