Aquatic Plant Management Plan

Rice Lake

Barron County, Wisconsin

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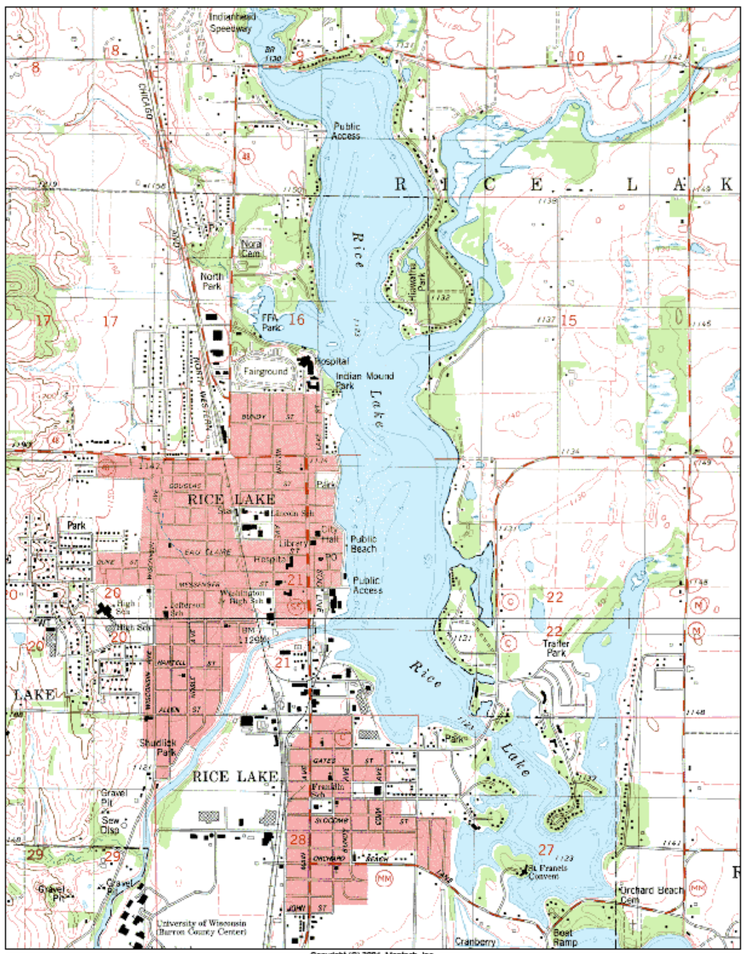

Rice Lake Aquatic Plant Management Plan
Barron County, Wisconsin

Prepared for:
Rice Lake Protection and Rehabilitation District
Rice Lake, Wisconsin

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Executive Summary

The Rice Lake – Lake Protection and Rehabilitation District (Lake District) has been managing aquatic plants in Rice Lake since the early 1980's. The existing Aquatic Plant Management (APM) Plan was established in 1994 and continues today. Variations in how the existing APM plan has been implemented over the last 15 years prompted the Wisconsin Department of Natural Resources (WDNR) to require the Lake District to update their APM Plan and submit the new plan to the state for approval prior to entering the 2010 season or risk losing their management permit. This prompted the Lake District to pursue grant funding in 2008 to complete a new APM Plan, and to re-evaluate what can be done to reduce nutrient loading to the system. This document serves as the new APM Plan for Rice Lake. It also presents broader management recommendations for reducing nutrient loading to the system.

This Aquatic Plant Management Plan addresses the following concerns.

- Continued harvesting and adding chemical treatment of CLP where by at least 80% of the total mass of CLP is removed from the lake on an annual basis.
- Managing for a healthy and diverse native aquatic plant community covering an average 40% of the total lake area, including maintaining native plant diversity and distribution in less disturbed areas like Clearwater Bay and the Bay off C and improving native plant diversity and distribution in areas of greater disturbance like between Hospital Bay and the Red Cedar River Delta.
- Maintaining a healthy and diverse native plant population at approximately 40% of the total surface area of the lake and while reducing the total amount of CLP in the system by 80% should help to maintain or improve the fishery and facilitate improvements in water quality.
- Educating lake users and riparian owners as to how important the presence or absence of aquatic plants in Rice Lake is in maintaining a clean, less algae dominated, healthy lake system.
- Improving lake user, riparian owner, and community understanding and involvement in the activities undertaken by their Lake District to improve the overall health of the lake and public satisfaction with the conditions in the lake.
- Comprehensive lake management planning activities that could help to improve water quality conditions in Rice Lake.

This Aquatic Plant Management Plan includes eleven different goals and the objectives and actions associated with each of these goals. Implementation of the actions associated with these goals will begin with the 2010 aquatic plant management season and be funded in part by the Lake District and state grants, and by volunteer time, donated services, and materials provided by the Lake District and multiple partners concerned about improving conditions in Rice Lake.

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Aquatic Plant Management Plan

Rice Lake

Prepared for Rice Lake Protection and Rehabilitation District

1.0 Introduction

The Rice Lake – Lake Protection and Rehabilitation District (Lake District) has been managing aquatic plants in Rice Lake since the early 1980's. Aquatic plant management (APM) in the lake currently consists of large-scale mechanical harvesting starting in late May and early June for curly-leaf pondweed (CLP), and continuing through the summer season with other native plants. The existing plan was established in 1994 and continues today with little revision (Appendix A). Plant management activities in the 1994 Plan were based on a 1993 Lake Management Plan written by Ayres Associates of Eau Claire, WI (Appendix B). While effective for what it was, variations in how the existing plant management plan has been implemented over the last 15 years prompted Wisconsin Department of Natural Resources (WDNR) officials to set forth an ultimatum for the Lake District in June 2007 to "…update a plan, as the existing plan is inadequate and does not meet current requirements." and that this plan needed to be in place by the 2010 season or they risk losing their harvesting permit (Appendix C). In a meeting held in January 2008 between the Lake District and Pamela Toshner, Northern Region West Lakes Coordinator, the Lake District was given a Lake Management Direction document by Pamela Toshner reiterating what was said in June 2007 and outlining management needs for the lake (Appendix D).

This prompted the Lake District to pursue grant funding in 2008 to complete a new APM plan, and to re-evaluate what can be done to reduce much of the nutrient loading to the system. This document serves as the new APM Plan for Rice Lake and continues practices in the early 1990's plan that are still valid and effective, but also includes new recommendations and a new implementation plan. It will be up to the Lake District to follow through with the approved management recommendations in this Plan.

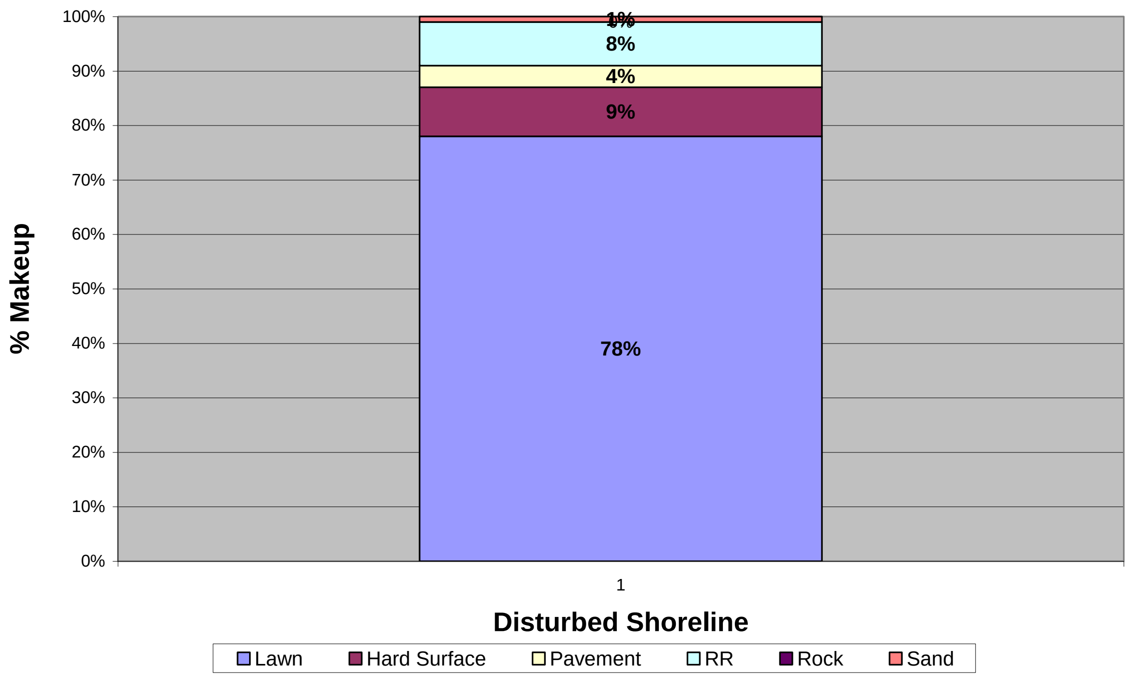
2.0 Lake Characteristics

Rice Lake is located in Barron County in northwestern Wisconsin. The City of Rice Lake is adjacent to the lake and both are substantially impacted by each other. The lake itself is an impoundment on the Red Cedar River approximately 940 acres in size and consists of two relatively shallow and separate basins. According to a 2001 report written by the U.S. Army Engineer District, St Paul, MN (Appendix E), it receives approximately 69% of its input from the Red Cedar River and 31% from Bear Creek. There are several intermittent streams but their input to the lake during normal flow is minimal. The maximum depth of the larger north basin is 15 ft and it receives the inflow from both major tributaries. The smaller south basin has a maximum depth of 19 ft and has several bays including Clear Water Bay, a larger finger-shaped bay which has great diversity of plant life. A narrow channel and bridge separates the two basins effectively giving each its own distinct set of characteristics. A 1996

Lakes Classification Study completed by the Barron County Soil and Water Conservation Department estimated the total volume of the system at 7,950 acre-feet (Thorson, 1996). Both flow toward the outlet in the Upper basin on the west side, over a 12-ft high dam owned by Barron County, and into the Red Cedar River. The Red Cedar River above and below Rice Lake is considered impaired enough to warrant a Wisconsin 303d impaired water designation for low oxygen. The entire Red Cedar River basin is currently under scrutiny, and has a completed, though not approved TMDL Plan (Buzz Sorge, WDNR, 2008 communication). Residence time for the lake ranges from 12 to >30 days under normal flow conditions with an average residence time of 15 days. During periods of storm inflow, residence time is less than 10 days, often less than 5 days (James, 2001).

According to the 1996 Lake Classification Study (Thorson, 1996) Rice Lake has approximately 14.43 miles of shoreline. At that time there were 331 dwellings on Rice Lake, 22.9 dwellings for every mile of shoreline. There were 130 lawns mowed down to the edge of the water, and 135 shoreland protection structures. A shoreline survey completed in 2008 by this consulting agency found approximately 59% or 8.5 miles of the Rice Lake shoreline was in a disturbed or unnatural state. Approximately 78% or 6.6 miles of this disturbed shoreline was mowed lawn down to the edge of the lake (Figure 1).

Figure 1 – Make Up of Disturbed Shoreline Around Rice Lake



Approximately 39.5% or 5.7 miles of the total shoreline had some sort of shoreline protection structure in place. These structures ranged from rock rip rap, to concrete barriers, to wooden retaining systems. The remaining 41% or 5.9 miles of the shoreline was considered to be in a natural state where upland forests were the main type of cover at 61% or 3.5 miles of shoreline, followed by shrub cover at 32% or 1.9 miles of shoreline.

Almost the entire western shoreline of Rice Lake is within the Rice Lake City Limits (Map 1). A significant portion of the lake front is owned by the City and consists of several public parks including FFA, Indian Mounds, Lakeshore Drive, National Lumbering Hall of Fame, Narrows, and Veterans Parks. There are several public access points around the lake, with improved access at the Lumbering Hall of Fame Park and at Veterans Park. Lakeshore Drive is a popular destination for walkers, bicyclers, and people on their lunch break and houses a band shell, public beach, and several public piers. The Narrows Park is a popular destination for people with children as it has adequate room to run and playground equipment.

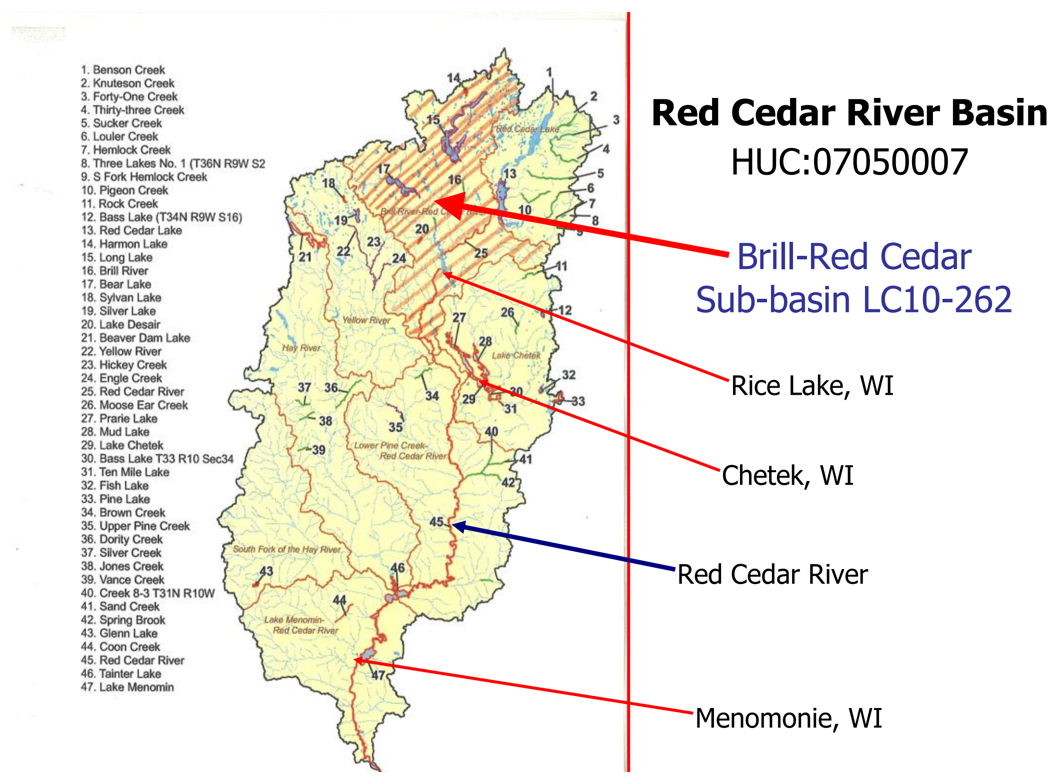
The eastern side of the lake is in the Town of Rice Lake, and has many private properties, Hiawatha Park, and the Red Cedar River inlet. There are several resorts, motels, and apartment complexes around the lake.

Because of the size and nature of the lake, specific areas within the whole lake have been named. Map 2 shows the names given to specific locations on the lake. For instance, the lake is divided into two different basins, Upper Rice Lake and Lower Rice Lake. Hospital Bay is a large bay in the upper basin and Clearwater Bay is a large bay in the lower basin. References throughout this management plan will be made to particular parts of the lake will be based on the names established on Map 2.

3.0 Rice Lake Watershed Characteristics

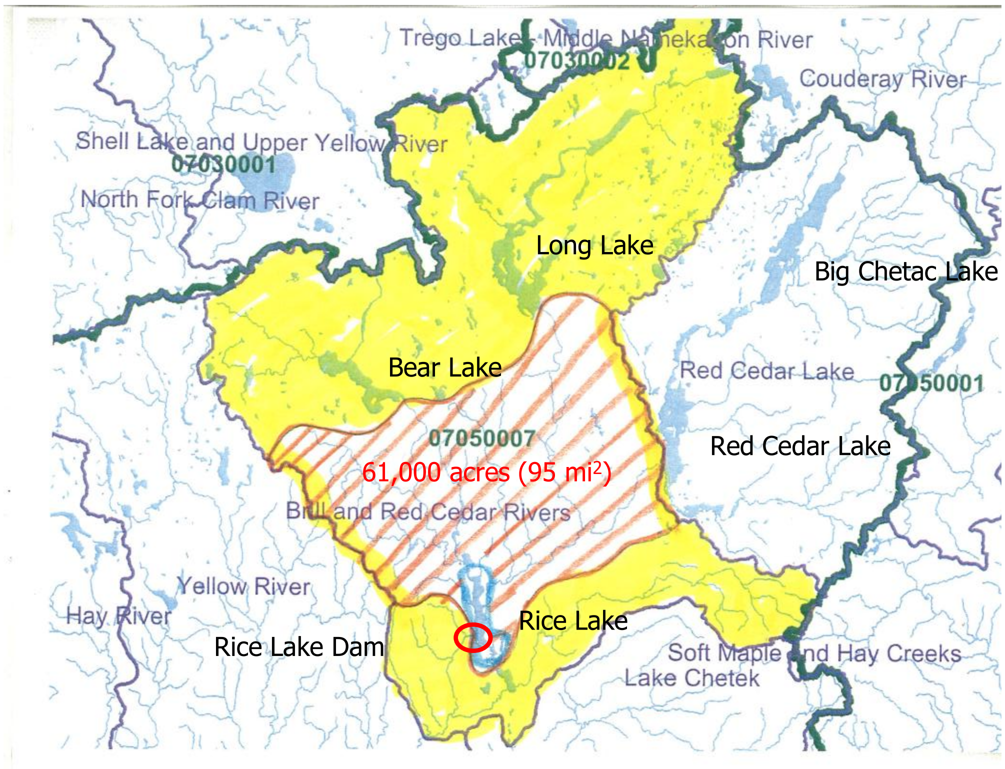
The entire City of Rice Lake, surrounding areas, and the lake itself lie within the Brill and Red Cedar River Sub-basin, part of the larger Red Cedar River Watershed (Figure 2).

Figure 2 – Red Cedar River Basin and the Brill-Red Cedar Sub-basin



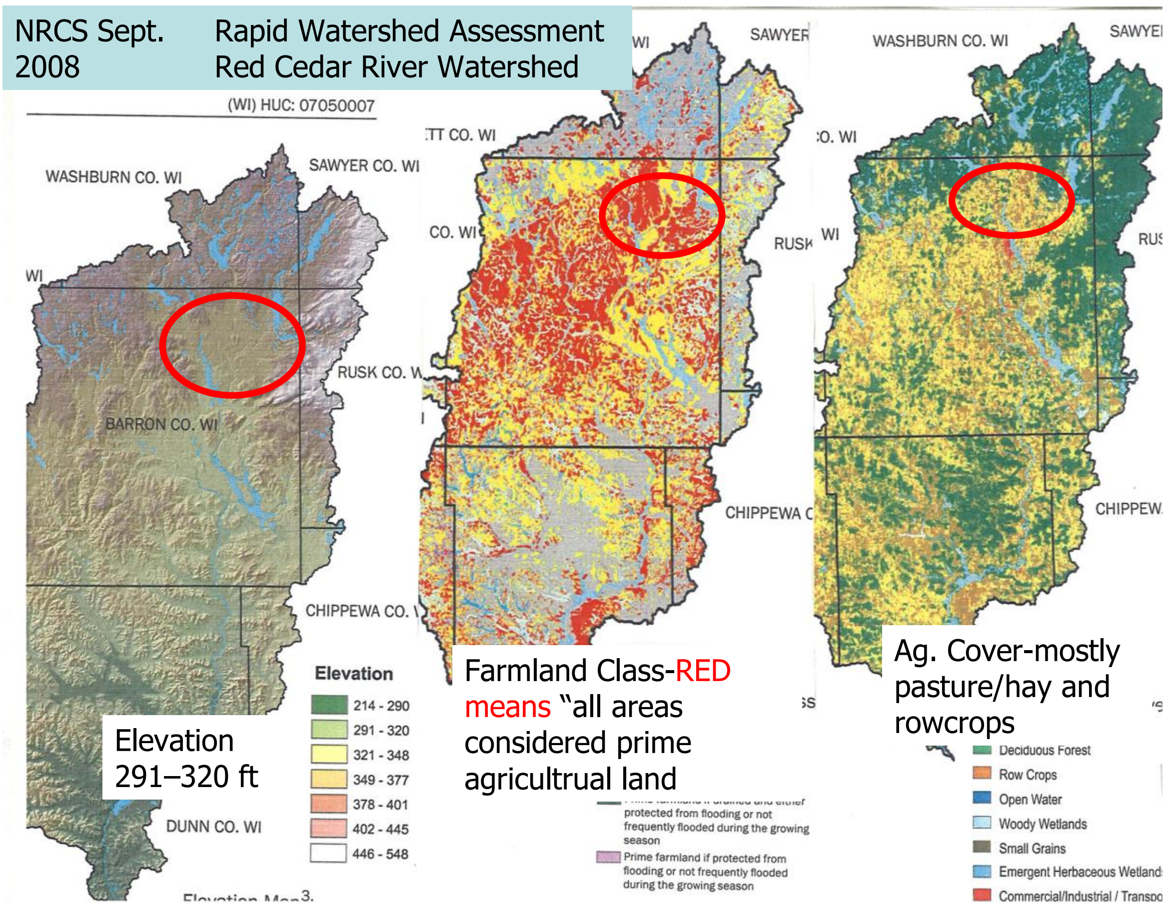
According to the 2008 NRCS Rapid Watershed Assessment Red Cedar River Watershed study (Appendix F), the Brill-Red Cedar Sub-basin is approximately 298 square miles in size, has 265 miles of streams, 6,282 acres of lakes, and almost 16,000 acres of wetlands. The direct drainage area for Rice Lake is approximately 61,000 acres or about 1/3 of the entire sub-basin, including all the land area drained by the Brill River upstream as far as the dam on Long Lake in Washburn County, all the area drained by the Red Cedar River upstream as far as the dam on Red Cedar Lake in Barron County, and all the area drained by Bear and Little Bear Creeks up as far as the dam on Bear Creek in Haugen, WI. In total, it encompasses approximately 95 square miles (Figure 3).

Figure 3 – Direct Drainage Basin for Rice Lake Within the Brill-Red Cedar Sub-basin



The Brill/Red Cedar Rivers Watershed is primarily made up of low, flat, well-drained soils and therefore considered prime farmland, well-suited for most kinds of field crops (NRCS, 2008) (Figure 4). The ecological landscape in this region is considered mostly Central Wisconsin Undulating Till Plain and again is well-suited for agricultural purposes. The soil is mostly sandy loam till and outwash sands.

Figure 4 – Land Elevation, Farmland Class, and Agricultural Cover Within the Direct Drainage Basin of Rice Lake (Red Circles)



The City of Rice Lake forms the entire western shoreline of the lake. The WDNR has evaluated the City of Rice Lake MS4 and determined that it is appropriate to require the City to apply for MS4 permit coverage under Subch. I of NR 216, Wis. Adm. Code (Appendix G). This determination requires the City to address concerns associated with urban runoff to prevent to the maximum extent practicable the discharge of pollutants from municipal separate storm sewer systems.

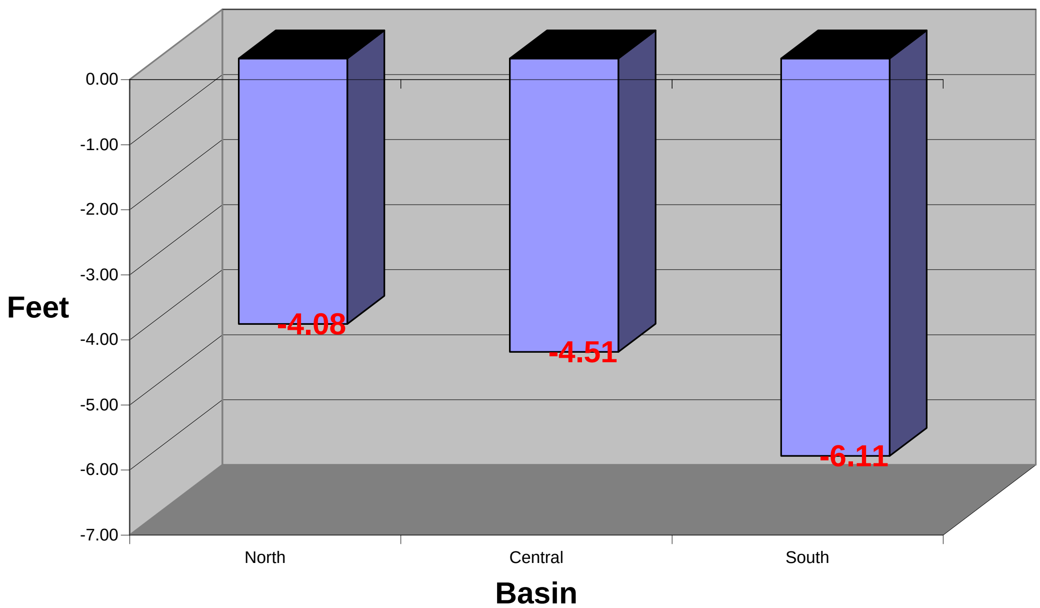
In August 2009, the Rice Lake City Council gave the creation of a new storm water utility higher priority. Rice Lake City Administrator Mark Synder said he expects the WDNR to require the city to upgrade how it handles storm water in the next 2-5 years. A meeting was announced in Sept 2009 to begin public discussion on forming the Storm Water Utility. The mission of the storm water utility will be to improve the quality of Rice Lake water bodies by reducing the impact of storm water from the City of Rice Lake. The utility will finance street sweeping, storm water handling system upgrades, maintenance of the existing storm water system, costs of installing upgraded storm water systems in street projects and public education about the impact of storm water on the environment. The Utility is expected to be started within the next year (Rice Lake Chronotype, 2009).

4.0 Water Quality and Nutrient Loading

Water quality and nutrient loading information for the lake was compiled from several past studies (Olson & Hanson 1993, James 2001). Additional information has been collected by Wisconsin Citizen Lake Monitoring volunteers (Appendix H). Rice Lake is a moderately eutrophic reservoir exhibiting the occurrence of algal blooms and hypolimnetic anoxia in deeper portions of the lake during the summer.

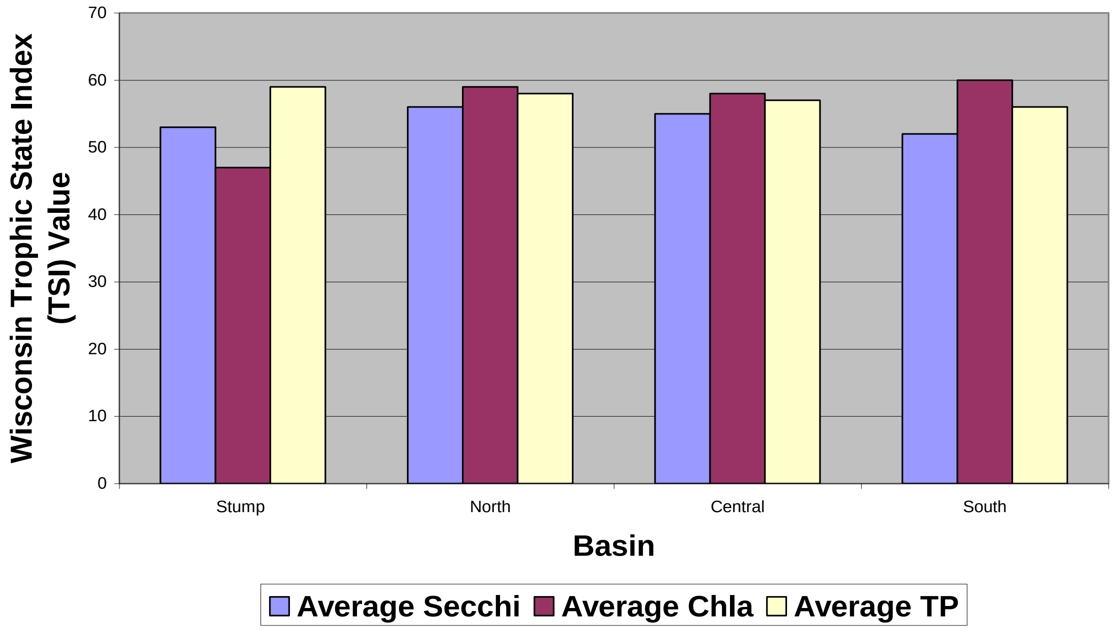
Water clarity data measured with a Secchi Disk has been collected by Citizen Lake Monitoring Volunteers at various times since 1995. While there is not enough consistently gathered data to establish trends, an average of all the readings taken since 1995 gives an idea as to where the water clarity currently sits (Figure 5).

Figure 5 – Average Secchi Disk Readings for Rice Lake from 1995, 2001, and 2007-09 Combined



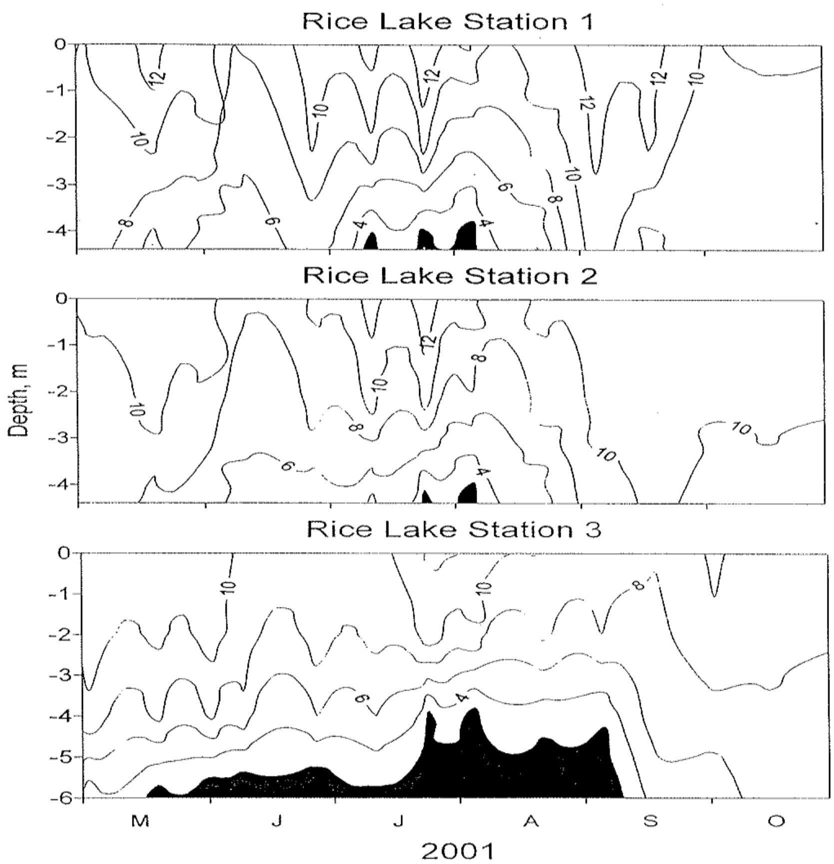
Chlorophyll (a measurement of the total algal mass in a lake) and total phosphorous (considered the limiting nutrient responsible for the majority of algal growth), along with Secchi disk readings of water clarity are considered the primary indicators of water quality in a lake. All three of these parameters can be “fit” onto a Trophic State Index (TSI) Value chart identifying a lake as nutrient poor (oligotrophic), moderately nutrient rich (mesotrophic), or highly nutrient rich (eutrophic or hyper-eutrophic). Average TSI values for all three of these parameters from the 2001 study from four sampling sites are shown in Figure 6. Values below 40 on a 0-100 scale are considered oligotrophic, between 40 and 50 mesotrophic, and above 50 eutrophic.

Figure 6 – Average TSI Values for Secchi, Chlorophyll a, and Total Phosphorous Data Collected as a Part of the 2001 Army Corp of Engineers Water Quality Study



Temperature and dissolved oxygen profiles are also used to help identify processes in a lake that lead to increased phosphorous and algae levels. The South Basin, also known as Station 3, exhibited an extended period of thermal stratification between mid-June and early August. Thermal stratification means that the lake separates into layers with warm water near the surface separated from colder water near the bottom by a barrier known as the thermocline. This layering is the direct result of different water density at different temperatures. Cold water is "heavier" than warm water and will sink to the bottom of a lake in the summer. Really cold water or ice is lighter than warm water so will move to the surface in the winter. In the North and Central Basins (Stations 1&2), thermal stratification was much weaker and more intermittent presumably due to the large amounts of water coming into the Upper lake from the Red Cedar River and Bear Creek. Coincident with periods of thermal stratification in the Lower lake was the occurrence of rapid dissolved oxygen (DO) depletion in the bottom waters and the development of anoxic (no oxygen) conditions. The South Basin had DO values <2 mg/L from mid-May through mid-September. By late-July anoxic conditions had extended up to the 4 meter level (Figure 7).

Figure 7 – Dissolved Oxygen (DO) Depletion at Three Rice Lake Sampling Locations



Station 1/North Basin
Station 2/Central Basin, and
Station 3/South Basin
Blackened areas show periods when no oxygen was recorded

Additional water quality and nutrient loading information is provided in Appendix I.

5.0 Fisheries

One of the complaints voiced repeatedly in the Lake User Survey was that the panfish population in Rice Lake, though abundant, was stunted. A fish survey completed in 2008 by the WDNR confirmed the anecdotal observations of the general public. While the actual report is not included with this management plan, Heath Benike, WDNR Fish Manager for Barron and Polk Counties had the following to say. The overall fishery in Rice Lake is decent including great musky fishing, and low density bass, pike, and walleye. The panfish, especially bluegill, run very small. High densities of bluegills and slow growth are blamed. WDNR fish managers suggest several ways to improve the overall size structure of panfish in Rice Lake. Increasing predation on bluegills and other small panfish is one way to manipulate the system. Muskies generally prefer to prey on suckers and perch if available, and the density of muskies in Rice Lake are too low to act as a biological control tool. Many local fishermen disagree with this assumption due to anecdotal evidence gathered when cleaning fish, in particular large northern pike. Crappies and other panfish are commonly found in their stomachs (Doug Pitts, North Shore Resort, 2009 Communication). There are two species of bass (largemouth and smallmouth) in Rice Lake that do feed on small panfish. Bass growth is generally good, suggesting plenty of forage food. Larger bass size limits could be put in place on the lake. Larger size limits would increase the bass population thereby increasing predation on bluegills. In addition, it is possible that a trophy bass fishery would be created.

In relation to aquatic plants and fishes several predictable responses are noted. Vegetated habitats support higher fish densities than unvegetated areas, aquatic plants lead to reduced risk of predation and structure oriented fish exploit aquatic plant beds. Pelagic (open water) and benthic (bottom feeding) fish species often decline with increased plant cover. When plants occupy the entire water body, fish growth becomes stunted due to depletion of food sources and due to the protection provided to smaller fishes that can maneuver in these dense beds of vegetation from larger predator fish (Dibble et al, 1997).

Many North American fish species are obligatory plant spawners. Bass and bluegill select sites protected from wave action, and although they keep their nests free of vegetation, they prefer to have some vegetation nearby for refuge. Sunfish, yellow perch, and northern pike use abundant plant beds as nurseries for their fry. Most comparative studies conclude that intermediate (10-40% coverage of study sites) promote high species richness and are optimal for growth and survival of fishes (Dibble et al, 1997). Maintaining a healthy and diverse native plant population at approximately 40% of the total surface area of the lake while reducing the total amount of CLP in the system should help to maintain or improve the fishery and facilitate improvements in water quality.

5.1 Wildlife

According to Wisconsin's Natural Heritage working list, two bird species (bald eagle and osprey), two rough fish (weed shiner and greater redhorse sucker), and three natural communities (northern sedge meadow, northern wet forest, and open bog) are found within the local township surrounding Rice Lake. Eagles and osprey are fairly common and often seen working the lake (WI-NHI Portal). Loons are often seen on the lake and occasionally baby loons are spotted with their mothers. A frog and toad survey was completed by Lake District volunteers, and a number of frog species were identified by their calls. At least one pair of eagles nests on Rice Lake. Muskrats are common place, and can be seen just about anywhere around the shore.

Osprey have been doing exceptionally well. There are eight nesting platforms that have been erected in the Rice Lake area. Of these, only two were inactive in 2009. In addition, osprey continue to nest on power poles in the area. Osprey need water with good fish populations and enough water clarity to allow them to fish. Rice Lake and the surrounding area has provided these needs. Just recently several osprey chicks were removed from area nesting platforms for relocation to Iowa. Wisconsin offspring, including several from the Rice Lake area are being used to help re-populate osprey in other states including Iowa and Kansas (Kevin Morgan, WDNR Wildlife Manager, 2009 Communication).

Waterfowl are abundant. Many species of ducks either migrate through in the spring and fall, or stay all year. Feeding ducks is a popular pastime in many of the City Parks, even though signs in these areas specifically request that visitors not feed the ducks. In the spring and early summer broods of ducklings are commonplace. Rice Lake has a substantial muskie population which often target ducklings for feeding.

Along with an abundant duck population, there is an excess of Canada geese. Many lake residents voiced complaints related to the excessive goose population. Geese fowl the shoreline with their waste and eat huge amounts of vegetation both on shore and in the water. Currently the City of Rice Lake conducts limited goose egg oiling, and occasionally extermination. This was done quite extensively in 2008 and the results did not go unnoticed by the general population. There were several comments in the Lake User Survey that suggested fewer geese later in the 2008 season. Given the characteristics of Rice Lake, it is very possible that goose feces are impacting the lake (Appendix J). However, larger sources of nutrient loading including the Red Cedar River and Bear Creek, and the City of Rice Lake storm sewer system are impacting it more.

6.0 2008 Aquatic Plant Surveys

In 2008, both an early season CLP survey and a later summer season whole lake all plants survey was completed by Ecological Integrity Service, LLC (Appendix K). Points generated by the Wisconsin Department of Natural Resources were sampled using approved point-intercept methods (Map 3). A summary of the basic statistics for Rice Lake is provided in Table 1.

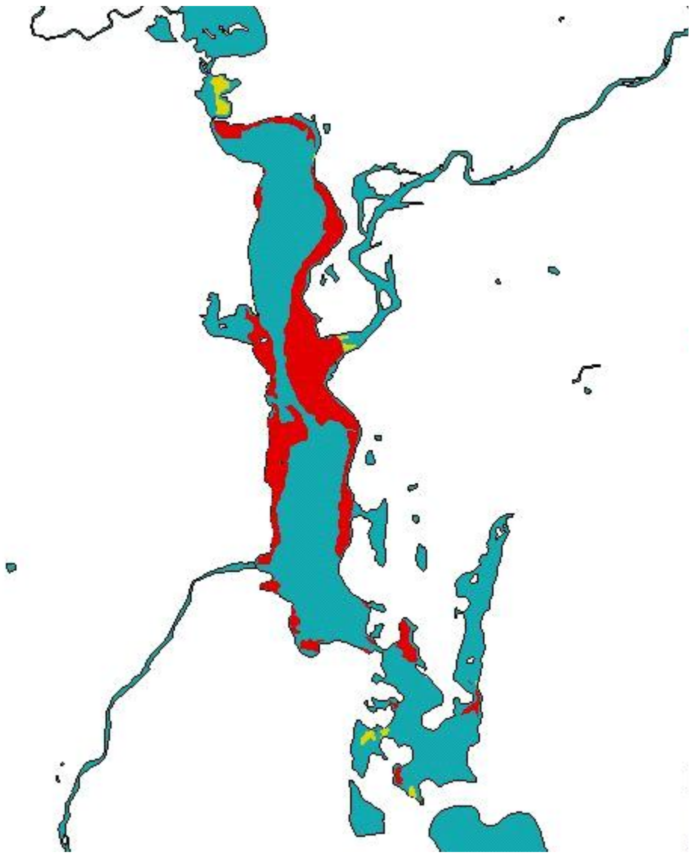
Table 1
Basic Plant Statistics for Rice Lake From the 2008 Early Season Curly-leaf Pondweed and Mid-season Whole-lake All-plant Point Intercept Survey

Total number of points	**843**
Total number of sites with vegetation	**368**
Total number of sites shallower than maximum depth of plants	**658**
Frequency of occurrence at sites shallower than maximum depth of plants	**55.9%**
Frequency of occurrence at all sites (based upon maximum depth of plants)	**43.7%**
Maximum depth of plants (ft)	**16.2**
Average number of all species per site (veg. sites only)	**3.52**
Average number of native species per site (veg. sites only)	**3.42**
Simpson Diversity Index	**0.89**
Species Richness	**41**
Species Richness (including visuals)	**55**

Rice Lake has a healthy diversity of aquatic plants, with a total number of plants species (including visuals) of 55. Of these 55 plant and algal species only two non-native species were found: curly-leaf pondweed and Aquatic Forget-me-nots. Of these, only CLP has and continues to pose a serious threat to the health of the overall lake community. No Eurasian water milfoil (EWM) was identified. Several shoreland invasive species are present including narrow-leaf cattails, and occasional purple loosestrife plant, and a fairly large stand of Japanese knotweed. The Floristic Quality Index value for Rice Lake was calculated at 39.9. More information about the Floristic Quality Index value and how Rice Lake compares to other lakes in northern Wisconsin is found in Appendix L.

The early season (June 12 and 13, 2008) survey found "…expansive, dense coverage of Potamogeton crispus totaling more than 200 acres." Bed mapping completed at this time showed the total coverage of CLP in Rice Lake (Figure 8). The most dense areas of growth was concentrated in the triangle from the "city beach" north to "hospital bay" and then across the lake to the east and the Red Cedar River "delta" area of the lake. Dense coverage of CLP was also identified along the "north shore" and in the "big bay" area north of the Red Cedar River delta. Little CLP was found in the lower basin of the lake.

Figure 8 – June 2008 Curly-leaf Pondweed Coverage in Rice Lake



Red indicates dense coverage with a rakehead fullness measurement of 3 on a 1-3 scale
Yellow indicates a rakehead fullness measurement of 1 or 2 on a 1-3 scale

The late season plant survey (July 25-28, 2008) found a good diversity, but only in a few areas. Large portions of the lake were dominated by coontail (the most abundant native plant species in the lake), flat-stem pondweed, and common waterweed. The majority of areas listed as "sensitive areas" in the original APM Plan drafted in 1994 (Map 4) (Appendix M) are still the areas where the greatest abundance and diversity of native plants exist. "Hospital Bay", Red Cedar River "Delta", "Stein Bay" and the "Bay off C" in the Upper basin of the lake, and "Clearwater Bay", "Vets Landing Bay", Bayview Bay", and "Hanson Bay" in the Lower basin (all listed as sensitive areas in 1993) have an average species diversity of approximately 16.57. Five bays looked at in detail, that are not sensitive area designations (specifically "Lower Rice Lake", "North Shore", "Big Bay", "East Shore", and Lakeshore Drive including "Mounds", "Bundy", "City Park", "City Beach", and "Moose") have an average species diversity of 9.4.

Ten plant species have a "frequency of occurrence" greater than 10%. This means that each plant species was found in more than 10% of the total number of sites with vegetation sampled (368). Coontail and CLP top this list, found in more than 85% of all the sites with vegetation. Common waterweed, flat-stem pondweed, duckweed, wild celery, Robbins pondweed, northern water milfoil, filamentous algae, and small pondweed make up the other ten. Small pondweed was found in just shy of 13% of all the sites with vegetation sampled. In

2008, native plant density measured by rakehead fullness never exceeded 1.5 on a 1-3 scale for any plant in any area covered by the late season survey. CLP density in the early season survey exceeded 3 on a 1-3 scale for the majority of the lake area with CLP.

Coontail and common waterweed have mean conservatism values of 3 on a 1-10 scale. The lower the mean conservatism value for a plant the better it does in degraded water. Plants with mean conservatism values close to 10 can not survive in degraded water. These two species of native plants are the most abundant in the lake. The next two most abundant plants are flat-stem pondweed and water celery. These two plants have mean conservatism values of 6. The top four combined have an average mean conservatism value of 4.5, supporting assertions that the water quality in the lake is categorized as degraded. The greatest plant diversity is in the Clearwater Bay area of the lake which has much better water quality and an average mean conservatism value for 23 species of plants of 6.7.

CLP is a significant problem in Rice Lake. At more than 200 acres of dense growth in the late spring and early summer, it completely dominates the early-season plant growth in large portions of the lake. While it can be argued that this early season plant growth may provide plant structure necessary to support the early season fishery of the lake, it has also been linked to negative effects on the fishery including decreased predator success, stunting of fish year-classes, and impacts on spawning success (Valley et al, 2004). Curly-leaf pondweed can form dense mats on the water's surface which create a canopy that shades other aquatic plants in the under story, inhibiting their growth. These vegetative mats impact recreational use by impeding watercraft and limiting immersion recreation, and are considered aesthetically unpleasant by homeowners and lake users.

Almost the entire area between the Red Cedar River Delta on the east side of the lake and Hospital Bay on the west is encumbered by CLP growth. Harvesting currently removes as much of the CLP as it can, but creates a mess on the lake caused by cut and floating fragments that escape the harvesters. Curly-leaf pondweed dies early in the summer season and begins to senesce. It usually completes its life cycle, including the production of new turions for next years' growth, by mid-June. As it senesces, it releases additional phosphorous into the water column. The reported phosphorous content of CLP varies widely and is likely dependant on a variety of existing conditions in any given lake. The phosphorous content of the CLP from Big Chetac Lake in Sawyer County was calculated to be 0.26% (0.0026) by Craig Roesler, WDNR based on plant samples from 10 different sites. CLP in Big Chetac Lake covers more than 33% of the lakes total surface area, and over 66% of its littoral zone (the area of the lake that supports plant growth). CLP in Rice Lake covers approximately 21.5% of the lakes surface area, and more than 48% of the littoral zone. Total dehydrated vegetative mass of CLP in Big Chetac Lake was estimated at $245 g/m^2$. It is reasonable to assume a similar dehydrated mass in Rice Lake. There are roughly 810,000 square meters of CLP in Rice Lake. This equates to just over 1136 lbs of phosphorous contained in more than 3000 tons of CLP in Rice Lake in any given year.

Not all of this phosphorous gets into the water column to become available for use by algae. Naturally senescing CLP generally settles to the lake bottom where a substantial portion of the decomposition occurs. This would likely result in some of the phosphorous released by CLP being immediately captured in the sediment. Filamentous algae present in the area where CLP is decaying and periphyton on the remaining plant community would likely use up more of the phosphorous released from the CLP. In addition, much of the CLP is removed from the lake by harvesting before it has a chance to senesce or decay. A more conservative estimate of the amount of phosphorous contributed to Rice Lake by CLP may be 375-568 lbs of phosphorous annually. Continued removal of CLP from the lake or chemically treating it early enough in the season to limit the total biomass killed and allowed to sink to the bottom as a result of an herbicide application is important for improving water quality and habitat in the lake. More information on why excessive CLP growth needs to be removed from the lake, and excessive native plant growth doesn't can be found in Appendix N.

Maintaining a healthy and diverse population of native plants and removing the CLP are crucial parts of aquatic plant management in Rice Lake. Removing large amounts of native plants makes more phosphorous available to the algal species which turn the lake water green later in the season. There is anecdotal evidence within Rice Lake to support the claim that a healthy and diverse native plant community helps maintain better water clarity. Clearwater Bay off the lower basin maintains clear water status throughout the summer and fall season. It also has the most abundant and diverse native plant community species on the entire lake. The majority of late season harvesting of native plants occurs in the Upper basin. The Upper basin suffers from green water later in the season.

6.1 Public Input

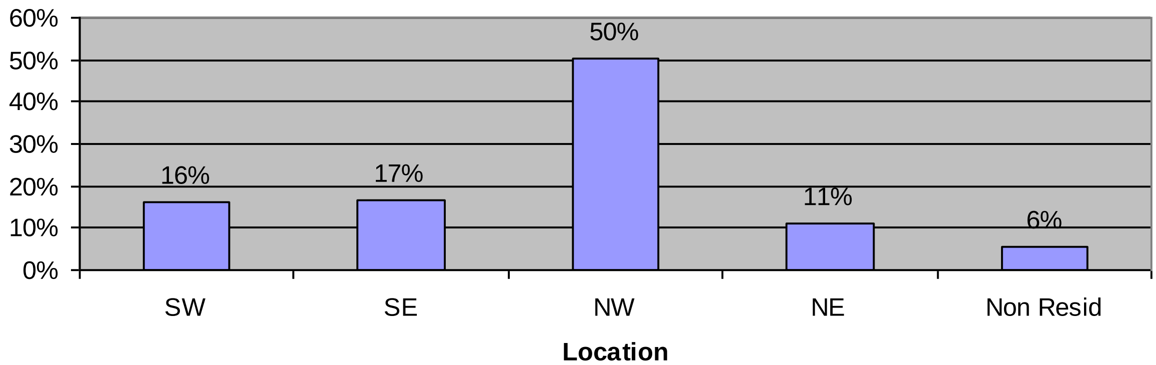
The Rice Lake Protection and Rehabilitation District encompasses all of the City of Rice Lake and a significant portion of the Township of Rice Lake on the east side including residents upstream on the Red Cedar River as far east as County Hwy M and 22nd Avenue (Map 5). Residents in the Stump Lake area north of Rice Lake and residents in the Lake Montanis area south of Rice Lake are not included in the Lake District. A total population greater than 8000 people, is included within the boundaries of the Lake District, and pay taxes to support it. Gathering meaningful public input was not an easy task. In the beginning of the project, a Lake District Fact Sheet was created and distributed to anyone who was interested (Appendix O). Lake District representatives and this agency presented the goals of this project on radio, at community organizations, and through the newspaper and with the establishment of a Lake District Webpage. All Lake District Board Meetings are open to the public. Unfortunately, very few people attend these meetings.

In order to get greater public input, a Lake User Survey was devised and distributed. Several thousand landowner or rental property addresses where identified, and then approximately 1000 addresses were randomly selected to receive a direct mailing of the multiple page survey. The Survey was made available at several locations including the public library, post office, banks, the Rice Lake Town Hall, Chamber of Commerce, and City Hall. Additional surveys were distributed by hand at informational presentations and by Lake District Board members. It was also made available on several local web pages. In all some 1200 surveys were distributed. More than 330 surveys with responses were returned.

Goals of the eight page survey included determination of how the lake is currently being used, lake related issues and concerns, public sentiment regarding the aquatic plants in the lake, public familiarity with non-native invasive species, and support for aquatic plant management. The Survey was divided into six sections, and is included as Appendix P. The following summarizes the results of this public Lake User Survey.

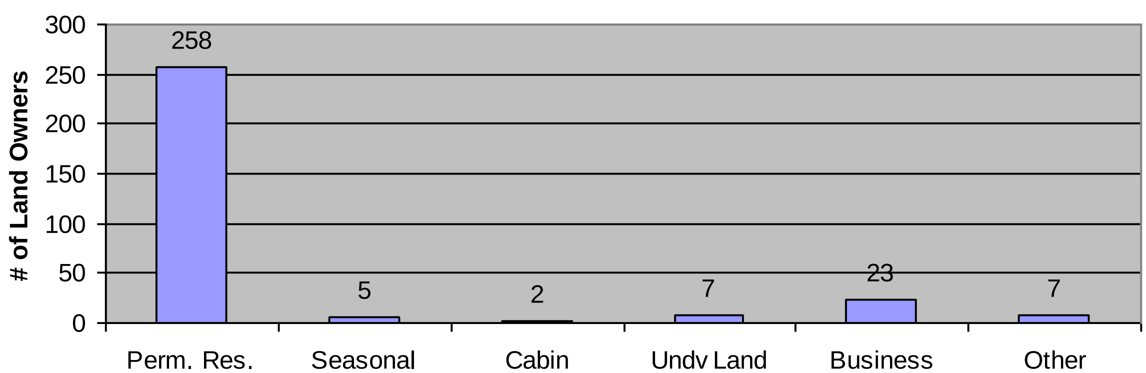
Section One identified what type of responder it was and where they lived. It was important to identify which part of the Lake District the respondent came from. Many different types of respondents could have answered the survey. Lake property owners, residential respondents away from the lake, renters, City businesses, local sportsmen and fishermen, young and old, are all possible respondents with a population the size of what is included in the Lake District. The Lake District was divided into four sub-districts (see Map 5) and a fifth category (outside of the Lake District) was added. Respondents were asked to identify which part of the Lake District they lived in. Figure 9 shows the breakdown of survey responders from each sub-district and from outside the district.

Figure 9 – Total Number of Survey Respondents From Designated Areas of the Lake District



Responders across the District were fairly evenly split except for the NW sub-district which had 50% of the respondents. The NW sub-district probably has the largest people population, though this has not been substantiated, so it makes sense that more respondents would come from this area. A second question was asked with the intent to discover more about the resident status of the responder. Of the 308 that answered this question, 302 owned their property and 8 rented. The breakdown of landowners is included in Figure 10.

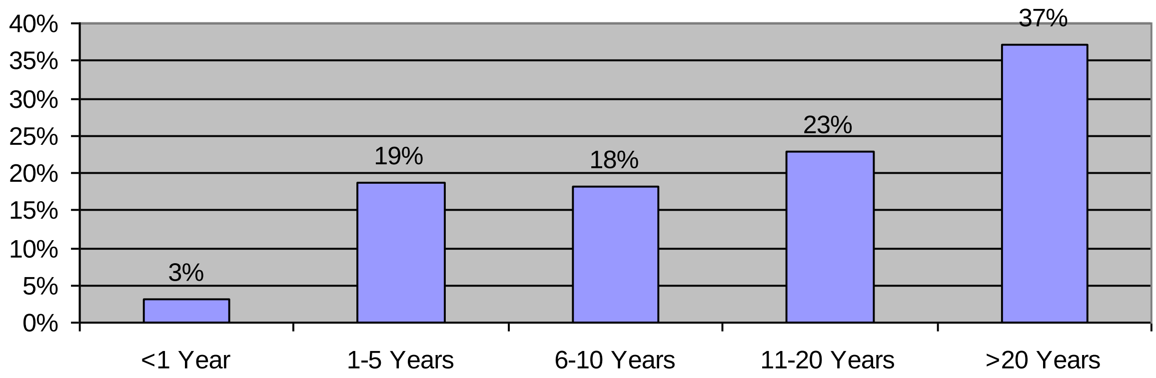
Figure 10 – Land Ownership Among the Survey Respondents



It was also important to know how many responders lived on the lake with direct access, and how many lived away from the lake. Of the responses received, 68% lived off-lake, and 32% lived on-lake. It could be argued that these two population should have been isolated, however, everyone with in the Lake District pays taxes to it, whether they live on the water or not. Making large management recommendations based on one population or the other seemed unjust and inaccurate. Determining the overall feeling of all Lake Users, on-lake or off, helped to determine management recommendations that will be accepted by all. The roughly 70/30 off-lake/on-lake split seems reasonable based on the population logistics of the overall Lake District.

Length of residency was also asked of the survey respondents. A good mix of long and short term residency was garnered (Figure 11).

Figure 11 – Length of Residency For All Survey Respondents

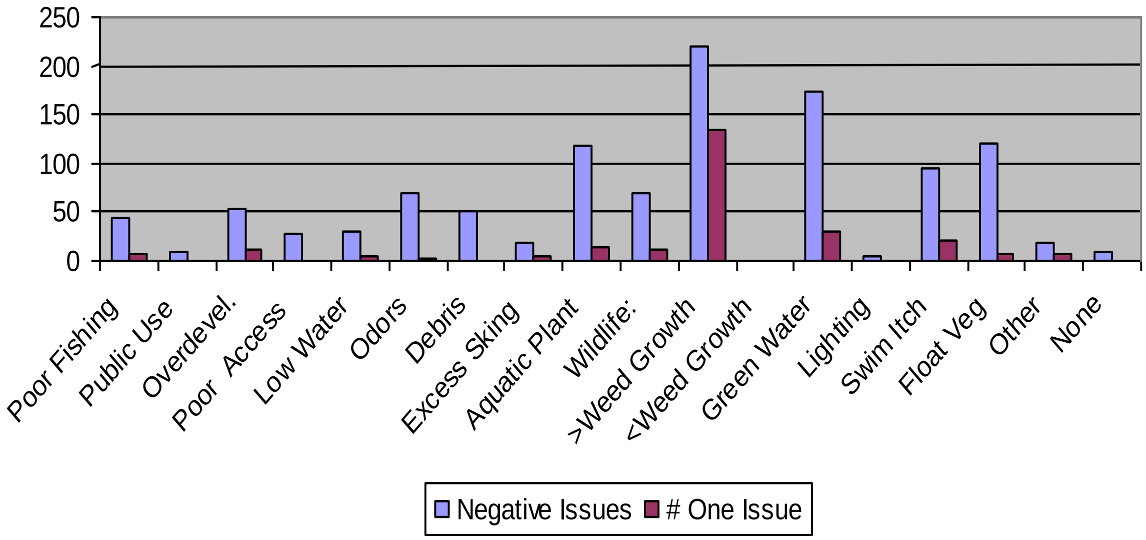


Section Two sought to identify lake use and the issues facing users. Survey responders were asked to identify all lake uses they participated in, and then to rank the top three they did the most. Figure 12 shows the different lake uses and how often each was chosen in the top three ranking. Fishing, walking/biking, rest and relaxation, and wildlife viewing were the top four lake uses.

Figure 12 – Most Frequent Lake Activities With Top Three Considerations

Survey respondents were asked to mark things they consider to be a negative issue for Rice Lake. Then they were asked to pick the one thing of everything they marked to be the issue of most concern to them. Figure 13 shows the results of this line of questioning. Many issues were on the minds of respondents, but weed growth and bad water quality were the top issues of concern. Swimmers Itch, floating vegetation, and the introduction of new non-native invasive aquatic plant species like EWM were also of concern. Comments from this section also included a great deal of concern over the goose and duck population using the lake and fouling the shoreland areas with feces.

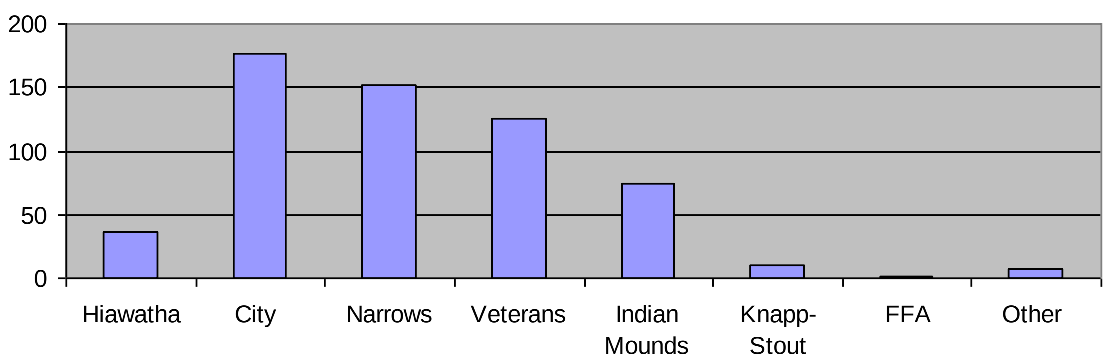
Figure 13 – Lake Issues According To All Survey Respondents



A majority (71%) of respondents had watercraft. Many had multiple watercraft including fishing boats with motors with less than 50 hp engines, pontoons, and canoes and kayaks. Approximately 12% had watercraft with motors larger than 50 hp.

Since City park land is significant portion of the lake front, respondents were asked how frequently they visit which parks. Figure 14 reflects the results of this line of questioning.

Figure 14 – City Park Visitation By Survey Respondents

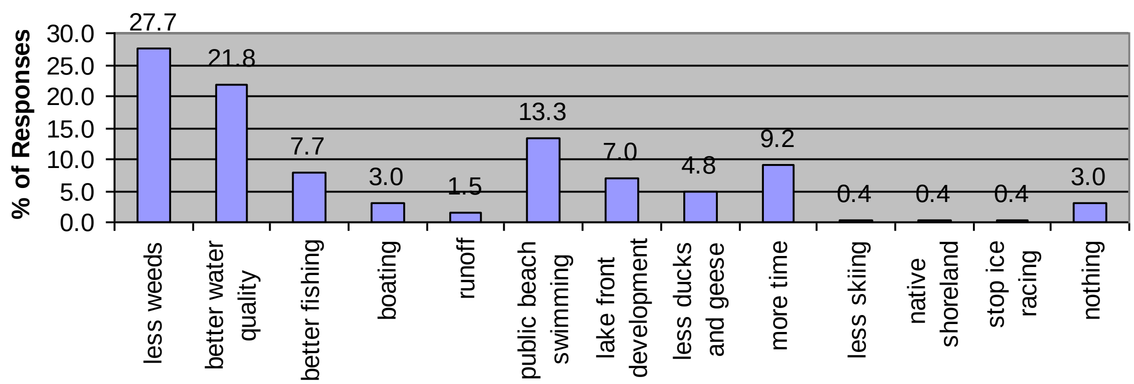


The City Park combined with Indian Mounds Park essentially runs the entire length of Lakeshore Drive from just south of the Hospital to the Moose Lodge and includes a City beach, several docks, an island off the mainland, playground equipment and a band shell. Visits to these two parks accounts for about 43% of the total park visits indicated by the respondents. The Narrows Park and Veterans Park are also frequently visited. Overall, 79% of respondents visit one or more of the City parks at least 2 to 4 times a season.

Respondents were asked if they thought it was important to have a City beach. The responses were essentially split 50/50 yes and no. Comments throughout the survey indicated however, that if the beach had better swimming conditions including higher water quality, less goose feces, and no worries related to Swimmers Itch, it would get more use and be more important overall. More information about Swimmers Itch can be found in Appendix Q.

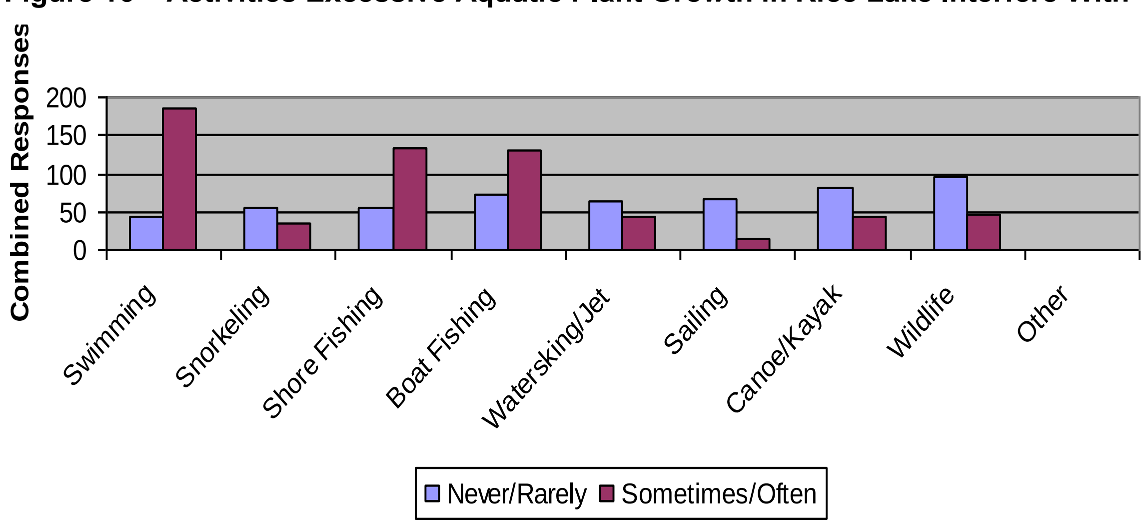
When asked what one thing would increase respondents use of the lake, responses varied, but several things stood out (Figure 15). Controlling weed growth and improving water quality were at the top of the comments. Improving swimming conditions in the lake as a whole and at the City beach also came up a lot. Improving the fishery came in fourth. Approximately 7% of the comments had to do with developing the lake front to include walking and biking trails, lakeside restaurant and bars, and even a shopping center. Improving boat access, controlling waterfowl, and just having more time and money were also mentioned a fair amount.

Figure 15 – Survey Responses For Things That Would Increase Public Use of the Lake



Section Three of the survey sought to learn more about the public's concern over aquatic vegetation in the lake. Most survey responders (62%) felt that the growth of weeds in the lake has increased since they began using the lake. When asked how big an issue aquatic plant growth was, 87% responded moderate or large. Responders were asked how often lake activities that they participated in have been curtailed by aquatic plant growth. Figure 16 reflects these responses. Fishing and swimming were the most affected.

Figure 16 – Activities Excessive Aquatic Plant Growth in Rice Lake Interfere With



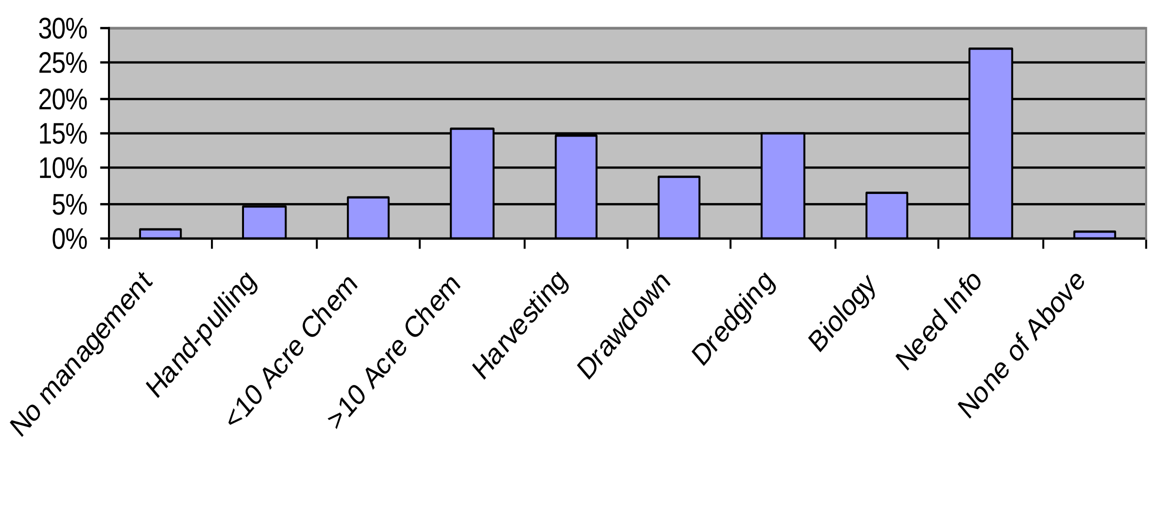
It is not surprising, given this information, that 94% of responders felt that control of aquatic plant growth was necessary in Rice Lake. When asked if the responder knew the difference between native and non-native plants, specifically CLP, 87% pretty sure they couldn't or were unsure. Roughly one-third of responders actually owned property on the lake. Of those, 45% have tried to remove aquatic plants by their property or hired someone to do so. 64% have had vegetation by their property removed by the Lake District harvesters. When asked what time period during the year the aquatic plant growth was at its worst, 52% of responders said July-September. Only 11% said April-June. Some didn't really know (23%).

Algae growth in the water (green water) interfered with lake use sometimes or often for 65% of the respondents. There is a substantial amount of mowed lawn, both private and public, around the lake. When asked if fertilizer was used, 43% said yes. Of the positive responses, about 45% said they used phosphorous-free fertilizers. The rest either did not use phosphorous-free, or did not know what kind of fertilizer they used. Regardless of proximity to the lake, excess phosphorous in fertilizers used on the lawn can end up in the lake via shoreland runoff directly into the lake, and by runoff across lawns into storm sewers which eventually end up in the lake. Lawn clippings, raked leaves, and sediment can also get into the lake via storm sewers, adding additional nutrients to the lake.

Section Four of the User Survey addressed respondent knowledge of aquatic invasive species. While about half of the respondents were aware that CLP was in the lake, 83% were sure they could not identify it, and 84% had little or no knowledge about the weed and the impacts it can have on the lake. A majority of responders were familiar with prevention strategies to prevent new aquatic invasive species from getting into the lake and actively practiced these prevention strategies.

Section Five of the User Survey sought greater detail into what lake users expect and would except in terms of aquatic plant management. More than 80% of responders felt plant management was necessary. When asked what methods should be used, large-scale (> 10 acres) chemical application, harvesting, and dredging each received about 15% support. Not surprising was that 27% of responders wanted more information before making a choice (Figure 17).

Figure 17 – Aquatic Plant Management Methods Most Supported By Survey Respondents Based on a First-Second Choice Rating System



When asked what level of weed control would be accepted, 51% of respondents supported "as needed" or "seasonal" management. 25% wanted the CLP eradicated, 4% wanted all weeds gone. When given the opportunity to share their own ideas for management, responses were wide and varied. Many respondents thought runoff control from upstream both in the Red Cedar River and the Stump Lake watershed was to blame for the poor water quality and that significant changes needed to be made. About as many respondents suggested more controls regarding lakeside runoff prevention through buffer strips and other best management practices both voluntary and required. Drawdown and dredging, large-scale chemical application, and greater use of harvesting were suggested. One responder suggested raising the water level to prevent weed growth. Another suggested that education of lake residents and lake users was the most important thing to do. Still another suggested that the Lake District purchase a pair of moose and let them loose in the lake.

The main function of **Section 6** was to identify people willing to somehow participate in the support of the aquatic plant management in Rice Lake, beyond just paying taxes. Over 80 individuals or families suggested they would be willing to put in a few hours to a few days to help protect and improve the lake.

6.2 Survey Summary

The logistics of getting this lake user survey out to everyone included in the Rice Lake Protection and Rehabilitation District and making it available to any other person who wished to participate was immense. Reproduction and distribution costs affected the size and content of the Lake User Survey. Many more questions could have been asked. One question in particular was missing from the survey. The level of Lake User satisfaction with the current plant management plan (primarily harvesting) should have been asked. Based on the comments in the survey, it seems the satisfaction level overall is low, but for different reasons. Many respondents felt that there is not enough harvesting going on. The machines should be out earlier and longer taking every bit of vegetation they can. Others felt that the current harvesting plan causes larger problems due to a large amount of floating escapee plant fragments. It is clear from this survey that the existing harvesting plan needs to be addressed, and that other alternatives need to be evaluated and likely incorporated in the overall plan..

Education of lake residents and users also stands out as being of major importance. The two most prevalent attitudes from survey responders are that more plants needs to be removed, and that water quality needs to be improved. These two attitudes conflict with each other. Plants are a necessary part of any lake ecosystem and function to provide quality habitat for fish and wildlife, tie up nutrients that may otherwise be used up by algae making the water green, compete with invasive species to keep them at bay, reduce shoreline erosion, and beautify the lake when they are of high quality and not overly excessive. The role aquatic vegetation plays in maintaining a usable lake seems to be lost with many of the respondents. Wanting a "weed free" lake is both naïve and unreasonable (Cooke et al, 2005).Curly-leaf pondweed, the only invasive plant species in the lake at this time causes significant problems and needs to be managed. Native plants under most conditions need to be protected and enhanced and this in the long run will promote better water quality and better fishing.

There were many misconceptions regarding plant and lake management evident in the responses to the lake survey. Assuming the survey responses were representative of the overall public knowledge base and attitudes, much needs to be done to further educate lake users about how the lake "works" and the processes "at work" within the lake. Once the general public understands the role of vegetation, more can be done to improve other areas of lake management including nutrient loading from many of the sources mentioned by responders. Reducing the total amount of phosphorous available for plant and algae growth in the lake is important, and many inexpensive yet effective changes can be made. Large-scale changes can also be pursued, but it all starts with the current management of plants in the lake. Taking out a significant portion of the plant growth (except for CLP) is not the answer, and will generally serve to worsen conditions, not improve them.

7.0 Documentation of Aquatic Plant Problems

At over 200 acres of dense growth in early June 2008, CLP is a significant problem for Rice Lake. CLP interferes with many late spring and early summer activities on the lake, not the least of which is the annual Rice Lake City Aquafest. Current management involves only the use of large-scale harvesting. Floating masses of harvesting escapees are almost more of a problem than the rooted plants themselves. CLP also impacts early season native plant growth by forming dense canopies of vegetation that block sunlight and prevent native plant growth. Once the CLP has senesced and dropped out of the water column, nutrients released by the decaying plants contribute to the total nutrient loading and may impact dissolved oxygen levels. Other lake processes are occurring at the same time as CLP senescence including oxygen depletion in the Lower Basin, increases in pH lake-wide, spring agricultural runoff within the watershed, lawn maintenance in the urban and residential areas, and storm water runoff from City streets leading to increased nutrient enrichment or eutrophication and high levels of algal growth and reduced water clarity.

Soon after CLP drops out of the water column, aquatic plants that do well under eutrophic conditions (coontail, Canadian waterweed, and water celery) begin to emerge and grow to nuisance levels in some places interfering with boat navigation and riparian access in the lake. Managing CLP and in some cases, native plant growth is a necessity in Rice Lake. Managing people’s conception of the plant growth in Rice Lake is equally important to assure acceptance, understanding, and compliance of the management recommendations included in this planning document.

8.0 Past Management History

Rice Lake formed a Lake District in 1977 for the sole purpose of lake protection and rehabilitation. A Lake Management feasibility study completed by the WDNR in 1983 resulted in a weed harvesting program which began in 1985 using pre-owned weed harvesters. An aquatic herbicide application program was also started at that time but was discontinued after two years because of concerns voiced by the general lake public. About this time the Lake District asked, the WDNR for permission to begin lowering the lake level each fall for the purpose of spring clean-up. Permission was granted and the spring clean-up portion of the existing Aquatic Plant Management (APM) Plan began. From 1992 through 1994 the Lake District received grant money to complete an aquatic plant and general lake study project. This study was completed by Ayres Associates of Eau Claire and resulted in a 1993 Lake Management Plan. The current APM Plan was completed in 1994 and included funding to purchase two brand new 10 ft aquatic plant harvesters.

The objectives of the 1994 APM Plan included improving the lake for water-based recreation, recognizing aquatic plants as a resource to be managed and protected, and lessening the consequences of lake aging. The intent of the plan was to remove nuisance level plant growth including CLP, coontail, and common waterweed through harvesting and an annual drawdown for spring shoreline clean-up. Only nuisance level vegetation (primarily CLP) was to be harvested and areas designated “sensitive areas” were to be protected. Post harvesting plant surveys were included to determine the overall effect of the harvesting program on the aquatic vegetation in the lake. Nutrient management in the lake to lessen consequences of lake aging comprised of proper removal and disposal of the harvested plant material.

Both the 1993 Lake Management Plan and the 1994 APM Plan included some education of lake residents, monitoring, and assessment. An annual water quality monitoring program was recommended, but other than a bit of Citizen Lake Monitoring Network volunteer monitoring, this was not carried out. The harvesting plan was to include 3 weeks of shoreline clean-up in late April and early May, followed by intensive CLP harvesting and then seasonal removal of other nuisance plants through September. Two Lake District employees were to be hired to work a combined 45 hours a week in the first three weeks, followed by a combined 55 hours a week for the remainder of the summer and early fall season. Harvesting activities were to be concentrated in just a few areas of the lake and cutting depth was established at “5 ft or to near bottom.” Off-loading sites and disposal sites were designated. Lake District employees were to be trained on-the-job by experienced staff in “all aspects of the harvesting operation.” They were also instructed to keep records related to the total tonnage and plant species harvested. During off-loading Lake District employees were to “look for the presence of game fish, turtles, and other aquatic organisms and remove them back to the lake.” Education and information of the public was to include newspaper and radio reports, monthly and annual meetings, speakers, and handouts. A procedure was put in place to Lake District members to make complaints or appeal actions by the board.

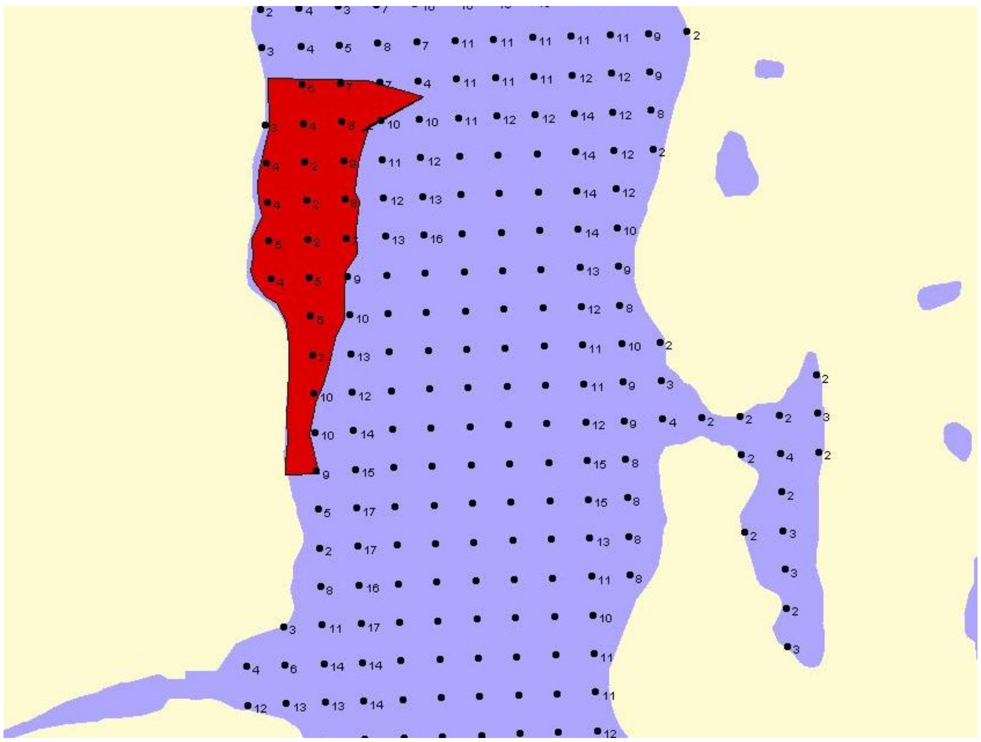
There has been a Lake District Hotline whereby District members can call in complaints or make comments for 15 to 20 years. This hotline is primarily used as a tool for land owners to request individual harvesting operations near their properties. Nowhere in the 1994 Aquatic Plant Management Plan does it indicate that individual landowners could make requests for harvesting services near their shoreline. If this practice is to continue then it needs to be accounted for in the new plan, and harvester operators need to be trained in determining when vegetation is dense enough to warrant harvesting and when it is not. Even if the vegetation is determined to be dense enough for harvesting, only traffic lanes should be opened to allow boaters to get from their docks to the main body of the lake. These types of services may be better provided for with a smaller harvester. Blanket clear cutting of the area to provide large-scale relief should not be implemented.

Reports from 1992 and 1993 vary in terms of the total tonnage of aquatic plants harvested. The 1993 Ayres report indicates that 316 tons were removed in 1992 and 516 tons were removed in 1993. The 1994 APM Plan indicates that 1560 tons were removed in 1992 and 1932 tons were removed in 1993. The next reported tonnage that this consultant has is from 2005 through 2008. During this time frame an average of approximately 1018 tons of vegetation was removed. There are no records related to what plant species were removed but one has to assume that the majority of this tonnage was made up of CLP. From 2005-2007 harvested plants were disposed of at a landfill. In 2008, the harvested plants were delivered to an area farmer to spread on his land at a later date. Records from the in-between years apparently do not exist.

In 1998, the Lake District submitted a Waterways Commission grant for the purchase of a third 10-ft plant harvester. The 1994 APM Plan was re-evaluated by the WDNR, and though it was approved and the grant awarded, and the third harvester purchased, several stipulations or changes were requested by the WDNR. These changes were outlined in a correspondence/ memorandum to Diane Conklin from Frank Koshere dated January 5, 1999 (Appendix R) and included more information about the equipment used for harvesting and a plan to replace said equipment, more information on operator qualifications, training, and safety procedures, more information on how the public is to be kept informed, procedures for complaints, and special circumstances that may warrant additional harvesting. This memorandum also requested that the Lake District provide "a more detailed description of operational records including daily logs for harvesting times, acres, loads, maintenance, etc." It also requests some form of annual summary including a section for problems and proposed improvements for the following years' operation. It appears that very few of these changes were ever executed.

In 2009, the Lake District put in a request for a project description and chemical application permit to complete an early season Endothall treatment for CLP in an 18.7 acre area along Lakeshore Drive from West Knapp Street to Newton Street (Figure 18).

Figure 18 – 2009 Early-Season Chemical Treatment (in Red) of Curly-Leaf Pondweed in That Area of the City Lake Front from West Knapp Street (North End) to Newton Street (South End). Points Indicate the Depth of the Lake in the Treated Area.



This is the area that receives the most attention during the annual Aquafest celebration in mid-June. Preliminary assessments of the possible management alternatives for CLP indicated that the Lake District, the City of Rice Lake, and the lake itself would benefit from this change in management. Normally extensive plant harvesting occurs in this area in an effort to get it ready for the Aquafest celebration. Successful harvesting in the area is affected by the timing of fish spawning and the timing of the CLP growth itself. In many years, despite the best attempts of the Lake District, this area of the lake is a mess with turbid water, floating harvested escapees, etc. The WDNR was convinced that doing a preliminary chemical treatment in 2009 in this area was a reasonable activity and would provide valuable information to use when formatting the new APM Plan to be implemented in 2010.

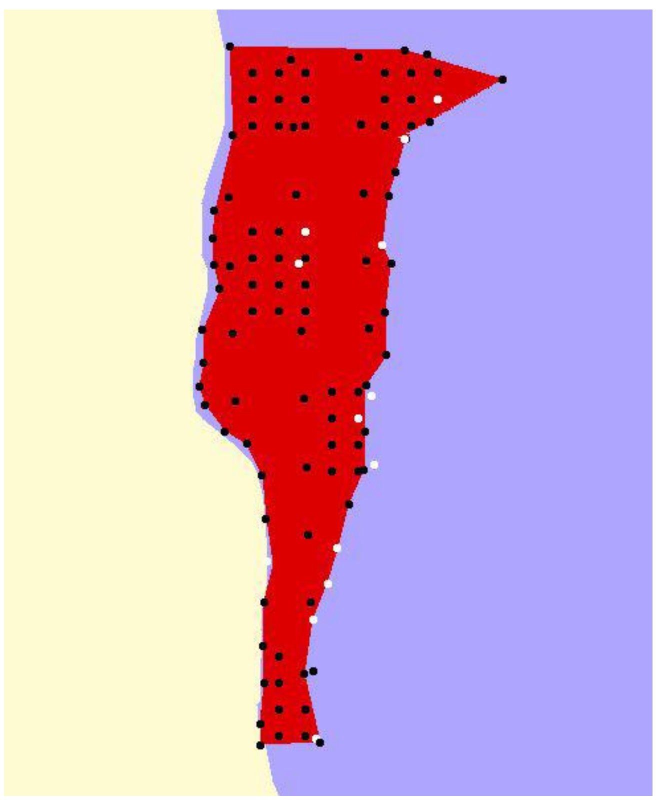
In May 2009 a 20-acre bed of *Potamogeton crispus*-curly leaf pondweed (CLP) was treated with herbicide (Endothall). Prior to treatment, a pre-treatment survey was conducted at 106 predetermined sample points. The density of CLP was recorded at each sample point, along with depth and dominant sediment type. Approximately 4 weeks after treatment took place, a post-treatment survey was conducted. Each of the sample points used in the pre-treatment survey was used. The CLP density was recorded as well as the density of each native plant species found.

The pretreatment showed that CLP was sampled at 88% of the sample points(Figure 2). The mean density considering all of the sample points is 1.33. The mean density when considering only points with CLP was 1.50. The pre-treatment survey did not suggest any changes in the polygon for treatment. Most all of the points had CLP and thus verified location of treatment polygon. Figure 19 shows the results of the presence of CLP throughout the sampling points.

Table 2
Statistical Summary of Pre Treatment and Post Treatment Surveys

Statistic	Pre Treatment	Post Treatment	Change	Significant
Frequency	0.88	0.22	-0.66	Yes (P<0.05) with chi-square
Mean density all pts	1.33	0.25	-1.08	Yes (P<0.05) with t-test
Mean density pre treat CLP pts	1.50	.027	-1.23	Yes (P<0.05) with t-test

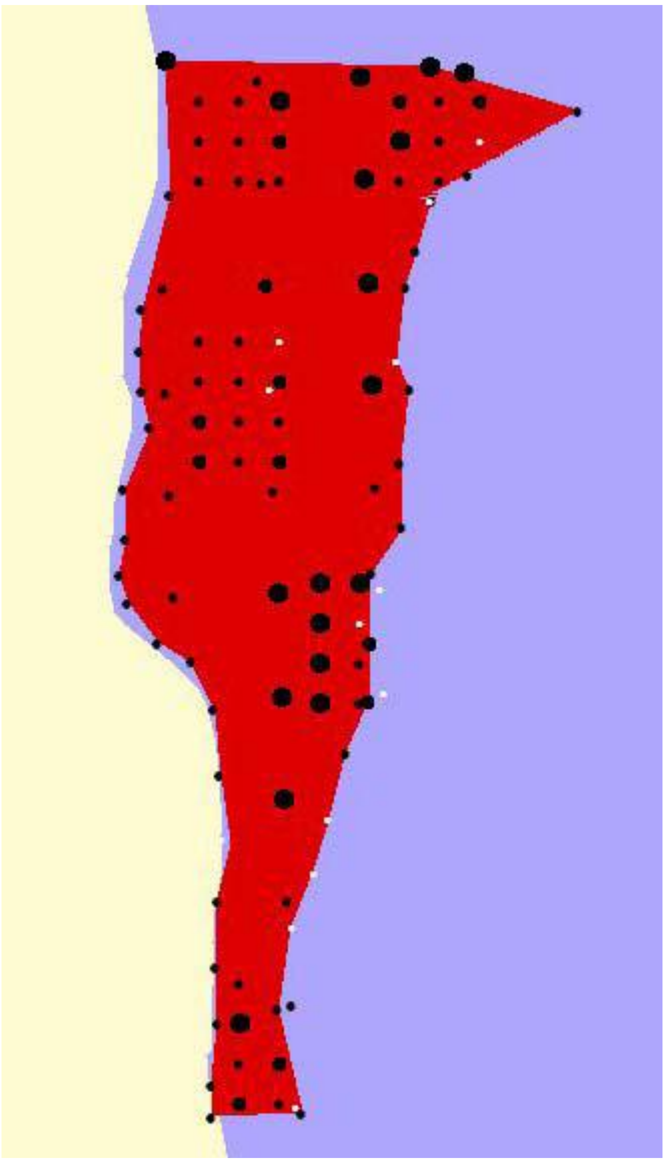
Figure 19 – Pretreatment Sample Points With CLP (Black) and Without (White)

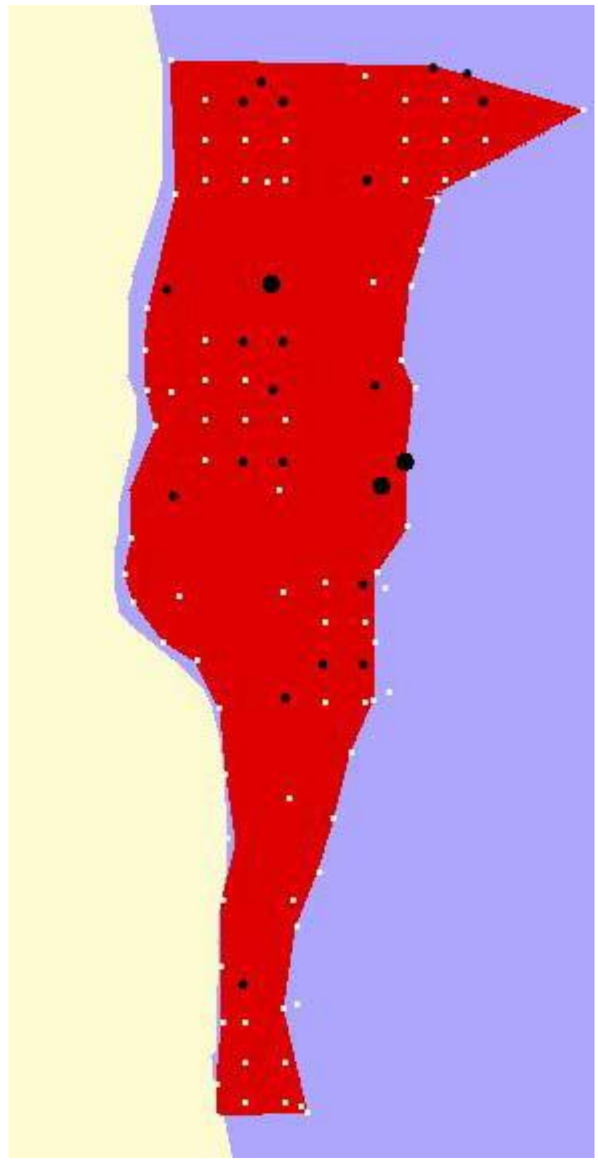


The post-treatment survey showed a significant decrease in CLP coverage and density. The frequency of the CLP went from 88% of the points in the pre treatment survey to 22% of the points (chi square determined this was a significant decrease). The mean density of all points with CLP went from 1.33 to 0.25, which a t-test determined was a significant decrease. In addition the mean density when considering only sample points with CLP in the pretreatment survey went from 1.50 to 0.27. Again the t-test showed this to be a significant reduction.

Figure 20 shows the comparison of the pre treatment density to the post treatment density. The larger the black dots the higher the density with white being a density of "0". This shows graphically a significant change, which is supported by the statistical analysis.

Figure 20 – Pre Treatment Survey and Post Treatment Survey Density Maps





Another aspect of the treatment effect is a comparison of the native plant's response to the herbicide. Unfortunately the only potential comparisons is between the sample points that were part of the point intercept survey from 2008 and those common points that fall within the boundaries of the CLP polygon. This limits the points to be compared in addition to the difference in data collection time. The point intercept survey was conducted in late July to early August while the post treatment survey of 2009 was conducted in June. This could lead to invalid data as some of the natives may not have been robust enough to be sampled in the post treatment survey. Nonetheless, these points were used for a native plant response and are summarized in Table 3.

Table 3
Summary of Native Plants from PI Survey in 2008 and Post Treatment Survey in 2009

Species	# of original PI-24 pts sampled in 2008 w/plant species	# of original PI-24 pts sampled in 2009 w/plant species	Change	P-Value	Significance
Coontail	14	9	decrease	0.148562	No
Elodea	11	13	increase	0.563703	No
Fil. Algae	0	2	increase	0.148562	No
Flat-stem pondweed	4	0	decrease	0.04	Yes
Forked duckweed	1	3	increase	0.29627	No
Leafy pondweed	2	0	decrease	0.15	No
Nittella sp.	1	0	decrease	0.31	No
Northern milfoil	5	3	decrease	0.0438578	No
Small pondweed	7	0	decrease	0.004	Yes
Stiff water crowfoot	0	2	increase	0.148562	No
Wild celery	6	2	decrease	0.121335	No

As can be seen in Table 3, the native plants didn't seem adversely affected across the board. Two species appear to have a significant decrease (as determined by a chi square analysis). However, this could be due to the difference in the sampling times in the summer as mentioned earlier. There were also numerous species that had an apparent increase, but they are not considered significant. As a result, it appears the herbicide had no major affect on the native plants at those sample points.

The complete pre-post treatment plant survey report is included as Appendix S in this report.

As was mentioned before, the area that was chemically treated in 2009 is a high use area of the lake in June because of the Aquafest Celebration. The Chetek Hydroflites Water Ski Team was asked to perform in Rice Lake in the first weekend of Aquafest. When asked what they thought of the conditions on the lake by the lake front, they said the conditions were excellent, the best they had ever seen. Over 700 hundred people gathered on the lake front to view the event, and no one complained about the conditions (Chronotype, 2009).

9.0 Aquatic Plant Management Alternatives

Problematic aquatic plants in a lake can be dealt with in many different ways. When addressing non-native invasive plants like EWM and curly-leaf pondweed management often includes an attempt at complete removal. Eradication is generally not a feasible goal, but large-scale removal is. Both of these plants negatively impact native plant species that provide many benefits to the lake. Early season removal can minimize some of these impacts by opening up the lake canopy to allow for the greater light penetration needed for native plant growth.

While protection of native plants should be a primary focus of plant management, certain native plants can cause lake use and navigation issues of their own. Submersed aquatic plants like coontail, northern watermilfoil, Canadian waterweed, and certain floating leaf plants like watershield and water lilies can cause problems. Emergent plants like pickerel weed, arrowhead, various bulrushes, and wild rice may be considered a nuisance by some riparian owners, but in general are extremely beneficial to a lake and removal should be minimized. In the case of wild rice, it is a highly protected emergent aquatic plant species and basically untouchable. If native plants are to be targeted for management (i.e. removal), clear documentation of the navigational and nuisance level growth issues is necessary.

Regardless of the target plant species, native or non-native, sometimes no management is the best management alternative. Areas considered critical habitat for fish and wildlife may best be left alone. Only if management of non-native plant species in critical habitat areas is expected to benefit that area, should it be considered.

Control methods for nuisance aquatic plants can be grouped into four broad categories: aquatic plant habitat manipulation; biological control; chemical control; and mechanical/physical control. Examples of plant habitat manipulation include dredging, flooding and drawdown. Biological control methods include organisms that use the plants for a food source or parasitic organisms that use the plants as hosts. Biological control may also include the use of species that compete successfully with the nuisance species for resources. Chemical control is typified by the use of herbicides. Mechanical and physical control methods include pulling, cutting, raking and harvesting. In many cases, an integrated approach to aquatic plant management is necessary.

Not all plant management alternatives can be used in a particular lake. What other states accept for aquatic plant management may not be acceptable in Wisconsin. What is acceptable and appropriate in southern Wisconsin lakes may not be acceptable and appropriate in northern Wisconsin lakes. The WDNR has a Northern Region Aquatic Plant Management Strategy (Appendix T) that went into effect in 2007. All aquatic plant management plans developed for northern Wisconsin lakes are evaluated according to the goals of this strategy. The goals of this strategy are as follows:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a” whole-lake approach” for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.

4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

The management alternatives discussed in the following section of this plan are arranged in order of acceptable and appropriate use in Rice Lake. A feasibility statement follows each management alternative.

10.0 Manual Control and Management

Except for wild rice, physical removal of aquatic plants via human power (hand-pulling, raking, or cutting) is allowable in Wisconsin under guidelines provided for in NR 109 (Appendix U). Removal of native plants must be confined to an area not more than 30 ft wide measured along the shoreline including that area which contains boat access to a pier or dock, swimming area, or other recreational use area and not adjacent to an area where plants have been removed by another method. Removal of dislodged aquatic plants that drift on-shore and accumulate is allowed, as is the removal of any amount of EWM, CLP, or purple loosestrife, if it is done in a manner that does not negatively impact other native plant species. Removal of aquatic invasive species by snorkeling or scuba diving is also allowable without a permit. Any plants that are cut or dislodged must be removed from the water so as not to infringe upon the rights of other riparian owners.

Lake User Survey results suggest about 45% of the lake shore owners have tried to remove vegetation by their property. Rice Lake riparian owners should be actively involved in the physical removal of aquatic plants near shore that are considered non-native or reaching nuisance level growth. The physical demands of this type of removal limits the extent to which it can be successfully be done. Shallow, hard-bottom areas near shore are best suited for this type of control and the impacts to the vegetation in the larger lake are minimal. Mulching of the plants removed can provide excellent compost. Pulling, cutting, and/or raking are important physical plant control measures but not always easy to complete and very time consuming on the part of the riparian owner.

Currently, many landowners expect the lake harvesters to come into their individual shorelines and by their docks and beaches to remove vegetation for them. Removal of free-floating plant fragments washed into the near shore area is legal without a permit and can be done at any time. To a certain extent, harvesters can be operated to assist land owners with removal of plant fragments washed into shore, essentially acting as a transport vehicle brought into shore to be hand-loaded with the offending material. However, if the land owners also requests that weeds be cut by their shoreline, this type of removal is no longer physical but mechanical in nature and requires individual landowner or Lake District permitting from the WDNR. If an invasive species is being removed then this activity is warranted. If native vegetation is being removed then it is not warranted unless the plant growth has been documented ahead of time as presenting nuisance or navigation issues. The current harvesters may be too big for this type of assisted shoreland plant removal, and just by going into these shallow areas (less than 3-ft of water) likely do more damage to the lake system as a whole than is necessary or permissible. Using Lake District harvesters for this activity should be limited. A smaller harvester may lessen the impacts overall from this type of activity.

Feasibility: This APM Plan encourages riparian owners to become more involved in the manual removal of nuisance vegetation by their properties. The Lake District will have weed rakes available for members to borrow and under certain restrictions assist riparian landowners with removal of large piles of plant fragments washed onto their shoreline.

10.1 Mechanical Control and Management Approved for Use in Wisconsin

10.2 Harvesting

Mechanical removal of aquatic plants involves the use of motorized accessories to assist in vegetation removal. The most common form of this is the use of large-scale mechanical weed harvesters on the lake. Harvesting assumes that vegetation is cut and removed from the system after cutting. The Lake District currently owns and operates three weed harvesters with 10-ft cutting widths. They are driven by modified paddle wheels and include a cutter that can be raised and lowered, a conveyor system to capture and store the cut plants, and the ability to off-load the cut plants. The depth at which these harvesters cut generally ranges from skimming the surface to as much as five-feet deep. Harvesters can remove thousands of pounds of vegetation in a relatively short time period. They are not, however, species specific. Everything in the path of the harvester will be removed including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone (Booms, 1999). While relatively maneuverable in open water, the sheer size of the machines limits the area they can operate. They are most effective in larger lakes with ample littoral zone depth and where the target species is almost mono-typical.

While large-scale harvesting can remove large amounts of vegetation, re-cutting several times a season is often required to provide adequate annual control (Madsen, 2000). Large-scale plant harvesting in a lake is similar to mowing the lawn. Plants are cut at a designated depth, but the root of the plant is often not disturbed. Cut plants will usually grow back after time, just like the lawn grass. Harvesters can be effective at removing large masses of floating vegetation including CLP near the end of its life cycle and other free-floating plants like coontail and bladderwort. However, the latter two are native plants that should not be removed unless nuisance conditions have been documented. Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (Madsen, 2000).

Part of the effect of harvesting is the alteration of underwater habitat. Some research indicates that after cutting, reduction in available plant cover causes declines in fish growth and zooplankton densities. Other research found that creating deep lake channels by harvesting increased the growth rates of some age classes of bluegill and largemouth bass (Greenfield et al, 2004). In Rice Lake, the current harvesting program removes substantial amounts of CLP, but then also removes a large amount of native plants later in the season. One complaint voiced by lake users in the User Survey is the number of stunted panfish that are caught. Protecting the existing native plants or even enhancing the native population through plant restoration activities could improve the overall panfish fishery as well.

One benefit of large-scale aquatic plant harvesting is the removal of large amounts of plant biomass from a water body. Large beds of CLP, if left in the water body, can be a source of significant phosphorous loading and may affect dissolved oxygen levels, when the plant senesces and decays. Harvesting of large amounts of vegetation alone will not wholly restore a lake to low nutrient enrichment levels, but it may reduce phosphorous loading from at least one source (Madsen, 2000).

When considering large-scale mechanical harvesting as a control measure considerable thought must go into the transfer and disposal of plant material. This plant material is generally more than 90% water and not suitable for feed, and often can not be sold or made into anything useful. It does make good mulch or compost provided all the dead fish material is removed. Off loading sites for the lake must be approved by the WDNR as does the disposal site.

Feasibility: Large-scale mechanical harvesting of CLP and limited harvesting of nuisance level native plant growth to provide navigational relief will be part of the Rice Lake APM Plan.

10.3 Alternative Mechanical Management and Control Either Not Approved for Use in Wisconsin or Not Appropriate for Rice Lake

Cutting w/out plant removal, **grinding** and returning the vegetation to the water body, and **rotovating** are also methods employed to control nuisance plant growth in some lakes. Cutting is just like harvesting except the plants are left in the waterbody. Grinding incorporates cutting and then grinding to minimize the biomass returned to the lake. Smaller particles disperse quicker and decay more rapidly. Rotovating works up bottom sediments dislodging and destroying plant root crowns and bottom growth. All three of these alternatives have major drawbacks when thought of in terms of Wisconsin lakes. Cutting and grinding leave behind a tremendous mess and do nothing to minimize phosphorous input from large mats of decaying plants. Rotovating greatly disrupts the benthic community in a lake, disturbs the sediment/lake water interface increasing turbidity and re-suspension of sediments encouraging nutrient release from those sediments. Without plant removal, cut fragments freely distribute to other areas of the lake through wind, wave, animal, and boat action.

On a smaller scale, **bottom rollers** and **surface sweepers** are available and are usually attached to the end of a dock or pier and sweep through an area adjacent to the dock. Bottom rollers are usually driven by electric motors and run at least once a week. Continued disruption of the bottom area usually causes plants to disappear and light sediments to be swept out. The use of rollers may disturb bottom dwelling organisms and spawning fish. Plant fragmentation of nuisance weeds may also occur. Furthermore, in soft bottom areas, sediment disturbance can be significant. Concern has also been expressed about the use of weed rollers on sediments high in organic matter. The Minnesota Department of Natural Resources regulates management of aquatic vegetation and requires permits for the use of weed rollers to protect littoral habitats (Greenfield et al, 2004).

The Lake Sweeper is an automatic weed control device that may be used in similar areas to the weed roller. Like weed rollers, the Lake Sweeper is attached at one end to a dock or other fixed location and consists of a 24' – 42' metal pole that moves forward and reverse in a 270-degree arc. A pump provides the force to move the floating pole back and forth. Instead of rolling along the sediment, the Lake Sweeper floats along the lake surface, with a series of lightweight rakes dragging behind it. According to the manufacturer, these rakes can kill a variety of submerged aquatic plants within 3 to 5 days by gradually weakening the plants. The Lake Sweeper may be an economically viable management option for small, high use locations. Purchase cost for a Lake

Sweeper is approximately $2,000. Installation is said to be simple and operating costs are reported by the manufacturer to be very low. The potential for the Lake Sweeper to increase the rate of release of viable plant fragments has not been independently evaluated (Greenfield et al, 2004).

Another common, less sophisticated method for removing aquatic plants from a beach or dock area is for riparian owners to hook a bed spring, sickle mower blade, or other contraption to the back of a boat, lawn mower, or ATV and drag it back and forth across the bottom. This type of management is considered mechanical and requires a permit from the WDNR. Another form of mechanical harvesting is using diver operated **suction harvesting** (also referred to as suction dredging) to remove aquatic plants. Diver-operated suction harvesting entails the use of barge-mounted pumps and strainer devices with hoses used by divers to "vacuum up" plants uprooted by hand. This management technique is called harvesting because even though a specialized small-scale dredge is used, sediments are not removed from the system. Sediments are re-suspended during the operation but use of a sediment curtain mitigates these effects. Plants are removed directly from the sediments by divers operating this device. The technique can be very selective with divers choosing what plants to individually remove. Once positioned over a plant, the device sucks up the plant through a hose and it is taken to the surface where mesh bags capture the plant but return the water back to the lake. Removal of individual plant material via this method is efficient and re-growth is limited. It can be an excellent method for removal of small beds of plants or areas of scattered clumps of plants to large for hand harvesting (Madsen, 2000). However, this system is very slow and labor intensive. It is also very expensive.

The cost of the suction harvesting equipment is about $20,000 to $30,000. The operation requires one or more scuba divers, a dredge operator and a person to assist in the disposal of the plants. This could add an additional $500-1000 per person per day to the cost of the operation. Depending on the size of the weed plots to be harvested, a one acre site could take from 2 to 40 days to dredge, or from $1,000 to $25,000 per acre, exclusive of the equipment costs (NYSDEC, 2005).

Feasibility: Limited suction harvesting is being completed in WI, but it is not a widely accepted practice as of yet. It works best for individual plant removal like what is found in new infestations. It will not be considered for aquatic plant control in Rice Lake unless a new species like EWM is introduced. Plant disruption by normal boat traffic is not considered illegal in Wisconsin. One of the best ways for land owners to gain navigation relief near their docks, is to use their watercraft on a regular basis.

10.4 Chemical Control and Management

Chemical management techniques have changed dramatically in the past 20 years. Increased concern about the safety of pesticide use in the 1960's and 1970's changed the review process for all pesticides, particularly for products used in water. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Madsen, 2000). The greatest change for herbicides came with the passage of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) first passed in 1972 and amended in 1988. Due to more stringent and costly standards for testing, fewer compounds are now available for aquatic use. In 1976, 20 active ingredients were available; as of 1995, only six are available with one additional compound (triclopyr) undergoing the registration process. These compounds have undergone the rigorous testing to enable them to be approved by the Environmental Protection Agency (EPA) for use in aquatic settings.

Existing and new chemical compounds must also undergo rigorous testing which often takes more than 10 years to complete, and may cost tens of millions of dollars. The six or seven active ingredients that have been approved not only are ensured safe for aquatic use (when used according to the label) but also have manufacturers committed to the aquatic market. It is important to remember, however, that these products are only considered safe when used according to the label accompanying the product. The EPA approved label provides guidelines for protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. In most states, there exists additional permitting or regulatory restrictions on the use of these herbicides. A typical state restriction requires that these herbicides be only applied by licensed applicators. Annual updates from state regulatory and environmental agencies are necessary to check for changes in label restrictions and application policies or permit requirements, before developing or implementing any plans for applying herbicides (Madsen, 2000).

Herbicides labeled for aquatic use can be classified as either contact or systemic. Contact herbicides act immediately on the tissues contacted, typically causing extensive cellular damage at the point of uptake but not affecting areas untouched by the herbicide. Typically, these herbicides are faster acting, but they do not have a sustained effect, in many cases not killing root crowns, roots, or rhizomes. In contrast, systemic herbicides are translocated throughout the plant. They are slower acting but often result in mortality of the entire plant (Madsen, 2000).

Herbicides are applied in either liquid or granular form. In most cases, the chemicals are applied to the water directly overlying the problem area. Most granular herbicides are activated through photodegradation of the granular structure, releasing the active chemical. These chemicals either elicit direct toxicity reactions or affect the photosynthetic ability of the target plant. The plants die and degrade within the lake. Some herbicide residuals sink to the lake sediment, providing some additional temporary control of vegetation. For some herbicides, however, once the granules sink to the bottom and out of the photic zone (area penetrated by light), photodegradation ceases, and the chemical is no longer effective (NYSDEC, 2005).

When properly applied, certain herbicides can control aquatic vegetation without harming the fish and other wildlife. In some instances, herbicides can be used selectively to control certain plant species without killing others. Aquatic herbicides can be part of an integrated management plan where some areas are treated and others are left with vegetation or treated with another method. They can be particularly effective for controlling aggressive weed species such as EWM. Aquatic herbicides offer temporary solutions. None of the EPA approved products when properly used will eliminate plants from a body of water. Plants will reappear, and re-treatment or application of another control method will usually be necessary.

Correct timing of the chemical application is important, since seeds can germinate and roots can sprout even when the parent plants are killed off. The specific time for the application will depend on the specific target weed, required dosage rate, water temperature, water chemistry characteristics of the lake, weather conditions, water movement and retention time, and recreational use of the lake. Curly-leaf pondweed has a growing season from mid-fall through early summer, while EWM usually grows from early spring through the end of the summer. Herbicide applications must consider the timing of the growing season relative to the algae levels (since photodegradation of herbicides may be slower when algae reduces lake clarity), ice cover, and the effect the chemical application will have on the recreational use of the lake. Most herbicides have restrictions on the use of the water body immediately after treatment, lasting up to 30 days, depending on the dose rate or use of the lake (NYSDEC, 2005).

Chemically-treated lakes may experience some significant side effects. Because herbicides kill plants primarily through toxic response, the toxicity of the herbicide to non-target plants and animals can be of great concern. Non-target plants may not be resistant to the herbicide. If a wide variety of plant species are eradicated by herbicide treatment, the fast-growing ("opportunistic") exotic species that were the original target plants may re-colonize the treatment area and grow to levels greater than before treatment (NYSDEC, 2005).

Short-term impacts of aquatic herbicides have been fairly well studied for most of the inhabitants of lakes and the surrounding environment, and have been deemed to be an "acceptable risk" if applied in the appropriate manner**.** In general, humans and most animals have high tolerance to the toxic effects of herbicides presently approved for use in lakes. This is especially true of the newer generation herbicides that have been formulated to impact metabolic processes specific to chlorophyll-producing plants. However, the long-term impact of herbicides on humans and other plants and animals in the environment continues to be poorly studied (NYSDEC, 2005).

When herbicides are applied in a lake environment, the affected plants drop to the bottom of the lake, die, and decompose. The resulting depletion of dissolved oxygen and release of nutrients could have detrimental effects on the health or survival of fish and other aquatic life as well as stimulating new plant growth (NYSDEC, 2005).

Herbicide costs will vary with the chemical brand and form (liquid or granular), required dose rate, applicator fees, frequency of application, and the amount of pre and post treatment monitoring and assessment that is done. Typical costs for using herbicides are approximately $400-700 per acre of treated area with the majority of these costs associated with the raw materials.

10.5 EPA Approved Aquatic Herbicides Appropriate for Use in the Rice Lake

Endothall is contact herbicide. Its common trade name is Aquathall K or Super K, or Hydrothall. Endothall is a broad spectrum herbicide most commonly used to kill pondweeds like curly-leaf. It is also used to kill EWM, coontail, wild celery, and some species of algae. It is not effective on roots, rhizomes, or tubers. Unlike Diquat, another contact herbicide, it is not affected by particulates or dissolved organic material. It should not be used in tank mixtures with copper, as it can have an antagonistic reaction with chelated copper compounds. Combined early season treatments using 2,4-D and Endothall have been used with some success to control both EWM and CLP when present in the same area (Skogerboe & Getsinger, 2006).

Glyphosate is not effective on submersed plants. It is used for control of emergent or floating leaf plants like purple loosestrife, cattails, phragmites, and lily pads. Glysophate is the herbicide found in the Round-Up (trade name) that is available over the counter for terrestrial weed control. A water-safe version of it called Rodeo is commercially available, but not from the average retail store. The Rodeo form of glysophate must be used when on or near water. It is not legal to use Round-Up on or near water. A surfactant and dye are usually added to it to make it stick to the target vegetation better and to make it more visible after application. Glysophate can be applied in a foliar spray or painted or dabbed onto a cut stem or stems. It is a systemic herbicide drawn into the plant and to the roots, so it will kill all parts of the target plant if applied correctly.

2,4-D is one of the most common systemic herbicides in use today. There are at least 1500 EPA registered products containing 2,4-D. It is a relatively selective herbicide commonly used for treatment of EWM. A few of its most common trade names for use in an aquatic environment are Aqua-kleen, Aquacide or Navigate. It effectively controls broadleaf plants (dicots) like EWM, coontail, and northern watermilfoil with a relatively short contact time, but does not generally harm the pondweeds or water celery. However, it is not effective against elodea or hydrilla. 2, 4-D can impact early season wild rice growth so should not be used in areas where EWM and wild rice cohabitate.

Feasibility: The use of Endothall, glysophate, and 2,4-D will be recommended for use in the Flowage. When applied following accepted and approved guidelines, these herbicides can be a very cost effective, efficient, and successful plant management tool for aquatic plants and shoreline invasive species.

10.6 EPA Approved Aquatic Herbicides Not Appropriate for Use in the Flowage

Complexed copper compounds include a variety of formulations from different companies, under different names and labels, in which copper is chelated in an organic complexing agent that keeps it in solution. Formerly, copper sulfate was used in applications, predominantly for the control of phytoplankton (algae). However, the copper rapidly precipitated, especially in harder water, and was no longer available, leading to the production of complex copper agents. Complexed copper is very effective for algal control, somewhat effective for several vascular plants (particularly hydrilla), and is also used in tank mixes with another herbicide, Diquat, to increase its effectiveness.

Diquat is a contact herbicide that will act on a very short contact time. Its common trade name is Reward. It causes a rapid die-off of the shoot portions of the plant it contacts, but is not effective on roots, rhizomes or tubers, requiring subsequent applications. Diquat will bind to particulate and dissolved organic matter, which restricts its use in some water bodies. It is also effective in a tank mix with copper compounds.

Fluridone is a nonselective systemic aquatic herbicide. Its common trade name is SONAR. It requires very long exposure times (up to 3 months) but may be effective at very low concentrations. Fluridone is widely used for both hydrilla and EWM management. It appears to work best where the entire lake or flowage system can be managed, but not in spot treatments or high water exchange areas.

Triclopyr is a systemic herbicide, similar to 2,4-D used for control of aquatic dicots. It common trade name is Garlon 3A or Renovate. Triclopyr degrades quickly in an aquatic environment making its use most effective in systems with low water-exchange where contact with target plants can be maintained for longer periods of time, though not as long as Fluridone. It does not generally harm pondweeds and coontail. As of 2005, Triclopyr was not a registered herbicide and can only be used under an experimental use permit in the United States. Since then it has been used in many states, but not yet in Wisconsin.

Feasibility: At the current time, none of these aquatic herbicides are being considered for use in the Flowage. Should EWM move in and take over larger areas of the Flowage the use of herbicides will be reevaluated.

Follow-up monitoring should track the fate of any applied chemical, changes in plant communities, water quality conditions, and impaired uses. The effectiveness for any given herbicide treatment varies with the treatment design, and the conditions of the lake and treatment site.

10.7 Aquatic Plant Habitat Disruption

Aquatic plant habitat disruption involves management activities that alter the environment in which aquatic plants are growing which in turn acts upon the plants. Several techniques are commonly used: drawdown or flooding, dredging, benthic barriers, shading or light attenuation, and nutrient inactivation. While not prohibited in Wisconsin, these plant management alternatives will undergo much greater scrutiny by the WDNR, and in most cases will not be permitted.

Drawdown is an effective aquatic plant management technique that alters the plant’s environment. Essentially, the water body has all of the water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdown, to be effective, needs to be at least 1 month long to ensure thorough drying. In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Drawdown requires that there be a mechanism to lower water levels. Although it is inexpensive and has long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and often not in a consistent fashion. Drawdown may provide an opportunity for the spread of highly weedy or adventitious species, particularly annuals (Madsen, 2000). In Wisconsin, the use of a drawdown to control aquatic plants is not usually approved without completing an Environmental Assessment to determine all the possible impacts a drawdown could have.

Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, have inadequate pelagic and hypolimnetic zones, need deepening, or require removal of toxic substances. However, lakes that are very shallow due to sedimentation typically have excess plant growth. This method is effective in that dredging typically forms an area of the lake too deep for plants to grow, thus opening an area for riparian use. By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community. Results of dredging can be very long term. Biomass of *Potamogeton crispus* in Collins Lake, New York remained significantly lower than pre-dredging levels 10 years after dredging. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a multi-purpose lake remediation technique (Madsen, 2000).

A recommendation was made in the 1993 Lake Management Plan assembled by Ayres Associates to dredge the center of the lake between the Red Cedar Delta and Hospital Bay. This recommendation was not implemented and is not included in the new management plan. The water depth in this area is at least 5 ft deep (Map 6) and except for excessive aquatic plant growth does not interfere with boat traffic. Opening several wide navigation channels or one larger channel through plant harvesting would accommodate most boat traffic. Directing boat traffic through these channels would also serve to deepen the channel over time as the sediments would be dislodged by moving boats. Benthic barriers, shading, and raising the water level are not being considered on Rice Lake.

Raising the water level, although not very common, can have a similar effect to dredging as the water depth can be made too great for aquatic plants to grow.

Benthic barriers or other bottom-covering approaches are another physical management technique that has been in use for a substantial period of time. The basic idea is that the plants are covered over with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic and synthetic materials, sediments such as dredge sediment, sand, silt or clay, fly ash, and combinations of the above. The problem with using sediments is that new plants establish on top of the added layer. The problem with synthetic sheeting is that the gasses evolved from decomposition of plants and normal decomposition activities of the sediments underneath the barrier collect under the barrier, lifting it.

Benthic barriers will typically kill plants under them within 1 to 2 months, after which they may be removed. Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively. Sites from which barriers are removed will be rapidly re-colonized. In addition, synthetic barriers may be left in place for multi-year control but will eventually become sediment-covered and will allow colonization by plants. Benthic barriers, effective and fairly low-cost control techniques for limited areas (e.g., <1 acre), may be best suited to high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily effect benthic communities (Madsen, 2000).

A basic environmental manipulation for plant control is **light reduction** or **attenuation**. Shading has been achieved by fertilization to produce algal growth, application of natural or synthetic dyes, shading fabric, or covers, and establishing shade trees. During natural or cultural eutrophication, phytoplankton growth alone can shade macrophytes. Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are of only limited applicability in lakes (Madsen, 2000)

Feasibility: Neither a significant drawdown nor dredging are likely to be seriously considered for Rice Lake. The Rice Lake Dam is already drawn down in the fall to accommodate snow melt and spring runoff in the spring. The State of Wisconsin does not usually support the use of a significant drawdown unless Neither has any particular benefit over the other, and both have issues making them difficult to implement. CLP in Rice Lake grows best in 3-7 ft of water. Lake levels would have to dropped by at least 5-ft to expose enough of the sediments containing CLP turions to be beneficial. Even this drop in water level would not impact all the CLP. A large area within the lake would be drained including areas in Clearwater Bay and other sensitive and critical habitat areas. Negative impacts to the fishery and native plants may also occur.

11.0 Biological Control Measures

Biological control (bio-control) involves using animals, fish, fungi, insects, other plants, or pathogens as a means to control another in the same environment. Non-native competition with native plants is one form of biological control. Another is to use a bio-control agent that could be a species native to a given area, or non-native often from the same geographical area the target species is from to control that target species. The goal of bio-control is to weaken, reduce the spread, or eliminate the unwanted population so that native or more desirable populations can make a comeback. Care must be taken however, to insure that the control species does not become as big a problem as the one that is being controlled. As living things, they do not always behave as researchers or well intentioned individuals or groups intended. Not all bio-controls are introduced for a purpose. Many are introduced accidentally or get here on their own. As effective as they can be, great care and long-term planning for impacts needs to be considered before implementing their use. A special permit is required in Wisconsin before any bio-control measure can be introduced into a new area.

Using native plants to out-compete non-native plants, either by encouraging their growth if they already exist or by introducing or re-introducing them into a system alone or as a part of an integrated approach to management, is a desirable mechanism to control unwanted invasive species. **Native plant restoration** is an ecological approach to managing for a desired plant community. Restoring a native plant community is almost always the end goal of an aquatic plant management program. Lakes currently lacking a native plant community can have these communities reestablished. In communities that have only recently been invaded by non-native species, a propagule seed bank probably exists that will restore the native community after successful management of the non-native plant. However, in communities that have had mono-specific non-native plant dominance for a long period of time (e.g., greater than 10 years), native plants may have to be reintroduced after a successful management program has been instituted. A healthy native plant community might slow invasion or reinvasion by non-native species and will provide the environmental and habitat needs of an aquatic littoral zone. However, even healthy, well-developed native plant communities may eventually be invaded and dominated by non-native species (Madsen, 2000).

Bio-control using other animals, insects, pathogens, or fungi for reduction of nuisance plants in aquatic systems has both positive and negative attributes. A positive aspect of this kind of bio-control is that control agents are often host specific, so effects to non-target species may be reduced. Control agents can also reproduce in response to increases in nuisance species density often without reapplication of the agent. Development and registration (where necessary) of bio-control agents is generally less expensive than chemical agents. Additionally, the ecosystem impacts under bio-control can be more gradual, thereby allowing the system to adjust to loss of a species (Greenfield et al, 2004).

Bio-control can have many potential disadvantages. An important risk is involved when new species are introduced as bio-control agents. To be considered successful, these species are expected to persist indefinitely in the environment where they are used, and may spread to new locations. Therefore, if there are any adverse effects resulting from the bio-control agent, these effects may be difficult or impossible to control. Adverse effects of bio-control agents could include loss of habitat for some fauna, competition with native species, and the production of toxic metabolites that are released to the environment. Other drawbacks include unpredictable success and rates of control that are slower than with chemical methods. Resistance in host species is unlikely to develop but can occur. Finally, agents that work in one area may not be suitable in all ecosystems. Climate, interference from herbicidal application, hydrological conditions, and eutrophication of the system can influence the effectiveness of bio-control agents. The growth of nuisance weeds can be suppressed with the use of bio-control agents, but not fully eliminated (Greenfield et al, 2004).

11.1 Biological Controls Approved for Use in Wisconsin

Many **herbivorous insects** have been and continue to be studied for their impacts on unwanted aquatic plant species. An herbivorous aquatic moth, *Acentria ephemerella*, two native herbivorous weevils, *Euhrychiopsis lecontei* and *Phytobius sp*., and a chironomid species Cricotopus have been associated with the decline of EWM in a waterbody. Several species of insect are being used to control purple loosestrife infestations very effectively. Two *Galerucella spp* are easy to rear, can be extremely effective at reducing large populations of purple loosestrife, and after nearly 20 years of use seem to have no negative affect in the areas they are introduced.

The milfoil weevil (Euhrychiopsis lecontei)

Galerucella species used for purple loosestrife control

To date, this researcher is not aware of any insect controls being studied specifically for the control of curly-leaf pondweed. However, research into establishing bio-controls is on-going. Studying naturalized and native herbivores and pathogens that impact nuisance aquatic and wetland plants increases the number of potential bio-control agents that could be incorporated into invasive plant management programs. The groundwork has been laid for conducting future bio-control research and experimentation. Although not all of the native and naturalized organisms researched can be successful, the information and expertise is now available for potential insects and pathogens to be collected, analyzed, and studied. A continuation of the work that has been started is needed to make available for the future more successful native bio-control agents (Freedman et al, 2007).

Feasibility: Biological control insects have not yet been introduced on Rice Lake. Should large areas of purple loosestrife be found, EWM get introduced in the lake, or an insect for CLP control be found, the use of biological control insects will be reevaluated.

11.2 Biological Controls not Approved for Use in Wisconsin

The **grass carp**, also known as the white amur (*Ctenopharyngodon idella*), feeds on aquatic plants and has been used as a biological tool to control nuisance aquatic plant growth in other states. To reduce the potential for unintended consequences, grass carp must be sterilized for use in waters of the United States. Once grass carp are stocked in a water body, it may take several years for them to control the plant growth and decrease weeds to about 20% of the earlier plant cover. Grass carp are more effective at removing some plant species than others. Highly preferred species include *Egeria densa*, *Hydrilla verticillata*, common elodea (*Elodea canadensis*), and duckweeds (*Lemna* spp. and *Spirodela* spp.). Non-preferred species include coontail (*Ceratophyllum demersum*) and milfoils (*Myriophyllum* spp.). EWM is not a preferred food source and grass carp will consume most other aquatic species before eating it. Also, grass carp may consume submerged species before eating floating species in the same water body (Greenfield et al, 2004).

As with any large-scale ecosystem manipulation, grass carp introduction may cause significant environmental impacts to a water body. Elimination of submerged plants by grass carp foraging could result in increased turbidity, water column nutrients, and phytoplankton production. If all aquatic vegetation is removed, waterfowl, amphibians and aquatic mammals may also be adversely impacted. In light of the fact that grass carp, once introduced, are extremely difficult to remove from a water body, caution should be exercised when considering new waters for grass carp introduction (Greenfield et al. 2004). In addition to grass carp, common carp and tilapia (a fish species) have been added to ecosystems to reduce aquatic vegetation. However, these species are not perceived to be successful and are not generally recommended for use as bio-control agents.

Plant fungi and pathogens are currently still in the research phase. Certain species for control of hydrilla and EWM have shown promise but so far, only laboratory tests in aquariums and small ponds have been conducted. Methods are not available for widespread application. Whether these agents will be successful in flowing waters or large-scale applications remains to be tested (Greenfield et al, 2004).

Organic materials, such as peat, and barley straw, have been used for control of rooted aquatic plants and algae. Theoretically, control is achieved by reduction of nutrient availability to the nuisance species or release of chemicals that impede growth. Organic material amendment results tend to be system specific, creating a need for small-scale pilots prior to widespread application in a specific water body. A number of laboratory studies have demonstrated that natural or human-altered increases in sediment organic matter content can reduce growth of Eurasian watermilfoil. The chemistry of added organic materials can affect their ability to reduce aquatic plant growth; organic material may inhibit plant growth or stimulate plant growth, depending on the nitrogen content of the added organic materials (Greenfield et al, 2004).

Feasibility: Grass carp will not be recommended for control of vegetation in the Rice Lake. Fungi or pathogens could be used at some point in the future as research develops to control purple loosestrife, giant reed grass, or even CLP and EWM. However, at this time these alternatives will not be included. Barley straw will not be recommended.

12.0 Discussion

Results from the analysis of the existing lake information, the 2008 plants surveys, and the Lake User Survey clearly show that continued aquatic plant management is necessary in Rice Lake. Curly-leaf pondweed has been, and continues to be a significant issue in the lake. While the general attitude of the public in and around the City and Township of Rice Lake is to consider most aquatic plant growth (native or invasive) to be a problem, whole sale removal by harvesting or other means is not the best course of action for the lake. Management must incorporate the need to remove aquatic invasive species like CLP and to provide nuisance and navigation relief and the equally important need to protect the growth and establishment of beneficial native plant species. Overall management goals for the lake should enhance and maximize the benefits of a healthy diverse native aquatic plant community by maintaining it at around 40% of the total lake area.. Keeping desirable native plant growth at this level should improve water quality, fisheries and wildlife habitat, lesson nutrient loading issues, and improve lake user and riparian owner satisfaction.

Public education is a significant issue affecting management in Rice Lake. There is a substantial lack of understanding on the part of the general public (as indicted by the User Survey) related to the reasons why, conditions of, impacts of, and results of aquatic plant management in any form in Rice Lake. Two opposing attitudes are clear, (1) get rid of the plants and (2) improve the water quality. The presence or absence of plants directly affects water quality. Rice Lake, already a borderline eutrophic lake, receives substantial nutrient loading from various sources. Currently, aquatic plants use up much of the available nutrients. Even so, there is still a significant amount of nutrients available to and used by green and blue-green algae. It is this algae that causes water quality to degrade later in the summer season. Removing large amounts of aquatic vegetation, particularly that which is considered native and positive in the lake, makes more of the nutrients available for use by algae.

Attendance at Lake District meetings and sponsored functions is low. Total public involvement in Lake District affairs is low. Lake District activities have great impact on the general public in and around the City of Rice Lake and in sections of the Town f Rice Lake, as all are considered part of the Lake District and pay additional taxes to support its activities. The lake and surrounding shoreline is used for many different activities by many different people. Keeping the public involved in its management is essential.

Improving aquatic plant management strategies in Rice Lake will not totally fix the issues affecting the lake. Rice Lake receives substantial input of nutrients (primarily phosphorous) from its watershed and the nearshore area of the lake including riparian owners and the City of Rice Lake. These inputs directly impact water quality and plant growth in the lake. Recommendations will be included in this plan that will help to reduce the total input of unwanted nutrients (Appendix I). These changes, coupled with changes in aquatic plant management, should, over time, improve the conditions in the lake. Lakes shoreland runoff from private and government owned properties, improve the Red Cedar and Bear Creek areas of the watershed, and to modify the City of Rice Lake storm sewer system. Recommendations for duck and Canada geese management will be made Appendix I).

Currently Rice Lake is not known to have Eurasian water milfoil. However, with multiple public access points the risk is high that EWM will be introduced at some point. Recommendations will be made to reduce the risk of EWM or other new aquatic invasive species getting into the lake including an extensive watercraft inspection program at all landings and a well organized in-lake invasive species monitoring program.

13.0 Aquatic Plant Management Plan

The new Aquatic Plant Management Plan for Rice Lake focuses on removing large amounts of CLP while only completing enough native plant removal to provide limited navigation and nuisance relief. Water quality in Rice Lake is dependant on having a healthy and diverse distribution of native plants to help use up excess phosphorous entering the system from the watershed. Watershed improvements are being planned, but for the immediate future protecting and enhancing the positive effects of native plants and reducing the negative effects caused by invasive species is the overall goal of plant management.

The following states the goals and objectives of this Plan and presents actions that will be undertaken by the Lake District and others to accomplish the objectives and meet the goals. This plan covers activities associated with aquatic plant management over a four year period beginning in 2010. A revised aquatic plant/lake management plan will be developed and submitted for WDNR approval in December of 2013 and implemented in 2014 based on the successes and failures of this plan. Map 7 represents the areas within Rice Lake where chemical application and harvest of CLP is to take place in 2010. It shows navigation and nuisance relief channels established for 2010 and the location of the WDNR designated sensitive areas. A similar map of treatment areas will be developed for each year of this APM Plan.

13.1 Goal 1 – Reduce the Total Amount of Curly-leaf Pondweed in Rice Lake by Combining the Use Aquatic Herbicides and Large-Scale Mechanical Harvesting

Objective 1 - Determine the restorative capacity of Rice Lake by removing at least 80% of the total CLP surface area coverage in each year of this plan.

Objective 2 - Restore that area of the Upper Basin along the City owned lakefront and in the Lower Basin to state where CLP has minimal impacts and treatment of any kind may be reduced or eliminated.

Objective 3 - Reduce turion numbers in the sediment in chemical treatment area by 75% and in the harvesting areas by 50% by the end of this 4-yr Project.

Objective 4 - Complete no CLP harvesting in the Lower (South) Basin.

Objective 5 – Provide land owner relief for plant fragments washed into shore.

Action 1 – Early season chemical treatment in the Upper basin in an area along the City of Rice Lake lakefront from Mounds Park to the Moose Club along the western shore using the granular form of Endothall, trade name Aquathol Super K at a concentration of 1.0 mg/L. More information about Endothall and Aquathol Super K can be found in Appendix V.

2010 – 40 plus acres of CLP will be chemically treated early in the season

2011-2014 – to be determined in the previous year and with pre-treatment plant survey data, but similar in location and size of previous treatment

Action 2 – Early season chemical treatment in the Lower basin in Hanson Bay and the entrance to Clearwater Bay using the granular form of Endothall, trade name Aquathol Super K at a concentration of 1.0 mg/L.

2010 – 10 acres of CLP will be chemically treated early in the season

2011-2013 – to be determined in the previous year and with pre-treatment plant survey data, but similar in location and size of previous treatment

Conditions – All chemical will be applied prior to the third week in May (based on weather conditions, water temperature, and CLP growth stage) in each of the next four years (2010-2013).

Applicator – Currently, Midwest Aquacare is the professional applicator chosen by the Lake District to administer the treatment. Midwest Aquacare satisfactorily completed a similar early-season chemical treatment in Rice Lake in 2009. The WDNR will be informed should a new applicator hired, or if licensed Lake District employees are going to take over chemical application.

Monitoring and Assessment – The area to be treated will be mapped in the fall of the previous year based on existing CLP survey work. Plant surveying will be completed in the area prior to the chemical treatment to confirm the presence of CLP, to determine if it is far enough along in its growth to be effectively killed by the herbicide, and to identify any native plants that may be present at this time. Dan Graf, a local high school biology teacher will complete the pre-treatment survey along with his students based on GPS points set up by this consulting agency and its sub-contracted post treatment plant surveyor. Post-treatment plant surveying and turion density and viability sampling will be completed by Ecological Integrity Service, LLC in Amery, WI.

Currently, chemical residual testing program for Endothall is not required by the State of Wisconsin however, one will be set up by at least the second year of the chemical treatment program. Knowing what the herbicide is doing once applied to the water is an important part of the maintaining public support for this management alternative.

Permitting – A WDNR Chemical Application Permit is required before implementing a chemical control program and will be applied for by the Lake District.

Action 3 – Landowner funded requests for CLP chemical treatment outside the Lake District sponsored treatment

2010-2013 – By request only and subject to a pre-treatment inspection by trained Lake District employees, the WDNR, or this consultant

Conditions – Requests will be required to be made prior to March 1st of any given year so that the Lake District can identify and include these properties in their permit application and in the pre-treatment plant survey. Individual land owner treatment contracts are between the land owner and the same chemical applicator used by the Lake District, currently Midwest Aquacare. The Lake District will pay the required WDNR permit fee on behalf of the land owner, but not the applicator fee or the fee for the additional material required to complete the land owner treatment. All treatments will be administered at the same time as the larger Lake District treatment.

Action 4 – Annual large-scale mechanical harvesting of up to 150 acres of dense CLP growth outside the chemical treatment area in the Upper basin.

May – One harvester cutting early growing CLP in Hospital bay and the Red Cedar River Delta.

June – Two harvesters removing as much of the dense growth CLP in the Upper basin as they can. A third harvester will be used to assist with more intensive harvesting and to pick up floating masses of CLP fragments to help minimize wash-up onto shorelines.

July – One harvester cleaning up missed or re-growth in previously harvested areas and escaped fragment pick up. The CLP harvesting program will officially end on July 15th unless a need for continued CLP harvesting has been documented and a letter sent to and approved by the WDNR.

Off-load Sites – Six possible off-loading sites have been identified on the Upper basin. The main off-loading site is in Hospital Bay (Map 8).

Disposal – All plant material removed by the harvesters will be shipped to disposal property approved by the WDNR, Barron County, and the affected local township.

2010 – Disposal site is located at a property previously approved by the WDNR, Barron County, the local township, and the Lake District (Appendix W). Discarded plant material will be used as fertilizer/mulch on agricultural land. The Lake District has already purchased a new truck with dump box and boom loader to handle the expected increase in harvested plant material once this plan is implemented.

2011-2013 – Disposal sites will be evaluated in each year of this plan. The Lake District is considering purchasing its own land for disposal, rather than renting or paying for disposal.

Conditions – Harvesters are required to stay in at least three feet of water and operate their cutters at a maximum depth of 5-ft or two-thirds of the water column, whichever is less. When harvesting close to shore they must operate parallel to shore and remain in at least 3-ft of water. At off-loading sites, Lake District employees will attempt to return game fish, turtles, and other wildlife back to the water.

Monitoring and Assessment – Depth finders are to be installed on all harvesters prior to beginning the 2010 harvesting season. GPS units capable of tracking the movements of the harvesters will be installed on or, at a minimum, carried with the operator whenever harvesting is occurring and must be turned on. At the end of each day, a tracking log will be downloaded from the GPS unit for each harvester used and stored in digital form either on a computer or data disk. Daily log sheets will be kept including the following harvesting information: estimated total daily tonnage, number of loads, surface acres covered, plant ID list, percentage of plant species removed, and plant bed density information.

Permitting – A mechanical harvesting permit is required by the WDNR before a large-scale harvesting program can be implemented and will be applied for by the Lake District.

Action 5 – Harvester assisted removal of plant fragments washed up on the shoreline.

2010-2013 – Landowners may request harvester assistance for removing large piles of plant fragments washed into their shoreline, but not for actual plant cutting and harvesting to, at, or near their docks. Harvesters may be driven perpendicular into shore within the allowed 30-ft riparian viewing corridor around a land owner's dock without operating cutting blades and provided the paddle wheels of the harvester remain in at least three feet of water, and are not operating while piles of fragments are hand-shoveled onto the conveyor belt. Paddle wheels are not to be operated in any manner to "blow out" floating piles of fragments near the shore.

Conditions – Land owner requests for assistance can be made in person, by hotline, or in writing and must be directed to specified Lake District personnel. The land owner's request will be evaluated by Lake District personnel trained to complete this action. No action will occur until the land owner making the request has signed a form clearly stating under what conditions this action can take place. The completed form will be kept on file with the Lake District and is good for one season only. The land owner or another person identified by the land owner on the form must be present to assist the harvester operator with removal, or it will not be completed.

13.2 Goal 2 – Prevent the Spread and Establishment of Aquatic Invasive Species Already Present Along the Shores of and in the Wetlands Adjacent to Rice Lake

Objective 1 – Purple loosestrife monitoring and removal.

Objective 2 – Japanese knotweed monitoring and control.

Action 1 – Lake District employees, volunteers of the Citizen Lake Monitoring Network (CLMN), and National Lumbering Hall of Fame (a non-profit organization managing the new Lumbering Hall of Fame Park and boat landing at Stein Street) representatives will monitor the shoreline of the lake for purple loosestrife in July and August. Purple loosestrife will be pulled where possible, or cut and sprayed if not. In the event a larger patch of purple loosestrife is identified where physical and chemical control is not feasible, biological control will be implemented.

Action 2 – Lake District employees, volunteers of the Citizen Lake Monitoring Network (CLMN), and National Lumbering Hall of Fame representatives will monitor the shoreline of the lake for Japanese knotweed through out the summer season. The National Lumbering Hall of Fame non-profit organization and Barron County have already taken up the cause to try and get this invasive species under control.

Rusty Crayfish and Chinese Mystery Snails – Both of these species are known to be in Rice Lake. Currently no management is planned.

13.3 Goal 3 – Eurasian Watermilfoil Rapid Response Planning

Objective 1 – Provide a plan of action for the Lake District to follow should Eurasian watermilfoil be identified in Rice Lake (Appendix X).

Action 1 - Provide Training for Lake District employees and lake volunteers on how to identify EWM and how to monitor the lake for EWM.

Action 2 – Lake District employee monitoring of the entire Rice Lake shoreline every two months from May to October following Citizen Lake Monitoring Network EWM Monitoring Protocol (Appendix Y).

Action 3 – Lake District employee monitoring of all public access points once a month from May to October.

13.4 Goal 4 – Provide Native Aquatic Plant Management That Protects and Enhances Native Plant Growth and Diversity in Rice Lake

Objective 1 – Limit the harvesting of native aquatic plants to navigation and nuisance relief only in areas designated as high traffic and high public use.

Objective 2 – Increase native plant diversity and distribution in areas of the lake currently with 3 or less identified native plant species in July by at least one native plant species in each of the next 4 years.

Objective 3 – Provide land owner relief for plant fragments washed into shore.

Objective 4 – Improve boating navigation through the shallow, plant dominated area between Hospital Bay and the Red Cedar River Delta.

Action 1 – Annual designation of navigation and nuisance relief channels of varying width in both the Upper and Lower basins in the fall of the year based on the current seasons placement of channels and expected lake use in the coming season.

Conditions – Total surface area opened up by these channels should not exceed 15% of the littoral or plant growing area of the lake. The 15% figure is an arbitrary value based on the expected 2010 total surface area created by channels harvested in order to provide an appropriate amount of navigation and nuisance relief, and is subject to re-evaluation in each year of this APM Plan.

Channel widths are also arbitrary, but based on increments of 10-ft which is the width of the harvesters presently owned by the Lake District. A twenty foot wide channel allows a harvester to cut in one direction and then return in the opposite direction maximizes its efficiency.

In sensitive areas of the lake, navigation channels are not to exceed 20-ft in width. Channel widths in the majority of the lake are currently set at 60-ft. A large channel in the center of the lake between Hospital Bay and the Red Cedar River Delta is currently set at 160-ft to allow two high-speed watercraft to pass each other at a distance of more than 100-ft. An 80-ft wide channel will be created on each side of the 160-ft wide center channel, and will likely be designated as “no-wake” to allow for undisturbed fishing in the channel and to protect small craft and non-motorized boat traffic from larger, faster boat traffic using the center channel.

Action 2 – Mark navigation channels in the area between Hospital Bay and the Red Cedar River Delta with red and green channel marker buoys and no-wake buoys. High speed boat traffic will be directed through the larger center channels marked with the green and red buoys.

Conditions – The Lake District will purchase all buoys. Channel and no wake buoys will be placed in the lake, no later than June 30th, and be removed no later than November 1st.

Permitting – A buoy placement permit is required from the WDNR before buoys can be placed and will be applied for by the Lake District (Appendix Z).

Action 3 – Annual large-scale mechanical harvesting of up to 15% of the littoral zone to open up channels determined in Action 1.

July–September – One harvester on each basin will be used to open and maintain predetermined navigation and nuisance relief channels. The navigation and nuisance relief program will officially end on September 15th unless a need for continued harvesting has been documented and a letter sent to and approved by the WDNR.

Off-load Sites – Six possible off-loading sites have been identified on the Upper basin and two in the Lower basin. The main off-loading site in the Upper basin is Hospital Bay and the main off-loading site in the Lower basin is the trailer park (Map 8).

Disposal – All plant material removed by the harvesters will be shipped to disposal property approved by the WDNR, Barron County, and the affected local township.

2010 – Disposal site is located at a property previously approved by the WDNR, Barron County, the local township, and the Lake District. Discarded plant material will be used as fertilizer/mulch on agricultural land. The Lake District has purchased a new truck with dump box and boom loader to handle the expected increase in harvested plant material once this plan is implemented.

2011-2013 – Disposal sites will be evaluated in each year of this plan. The Lake District is considering purchasing its own land for disposal, rather than renting or paying for disposal.

Conditions – Harvesters are required to stay in at least three feet of water and operate their cutters at a maximum depth of 5-ft or two-thirds of the water column, whichever is less. When harvesting close to shore they must operate parallel to shore and remain in at least 3-ft of water. At off-loading sites, Lake District employees will attempt to return game fish, turtles, and other wildlife back to the water.

Within the pre-determined channels, harvesting is allowed as often as necessary to keep them open. Pick-up of floating mats of vegetation in the open water is allowed, provided no additional rooted plants are harvested. Coontail is a non-rooted, suspended or floating native aquatic plant that is very common in Rice Lake. Floating beds or mats of coontail may not be removed from the open water (other than the pre-determined channels) unless they are floating or suspended in water deeper than 10-ft.

Lake District employees will monitor weed beds throughout the summer season and be trained in bed density determination and basic plant identification. Should the Lake District wish to harvest native plants in an area not included in the pre-determined plan for that year, justification must be sent to the WDNR, and their approval gained before harvesting can begin.

Monitoring and Assessment – Depth finders are to be installed on all harvesters prior to beginning the 2010 harvesting season. GPS units capable of tracking the movements of the harvesters will be installed on or, at a minimum, carried with the operator whenever harvesting is occurring and must be turned on. At the end of each day, a tracking log will be downloaded from the GPS unit for each harvester used and stored in digital form either on a computer or data disk. Daily log sheets will be kept including the following harvesting information: estimated total daily tonnage, number of loads, surface acres covered, plant ID list, percentage of the total of each plant species removed, and plant bed density information.

Permitting – A mechanical harvesting permit is required by the WDNR before a large-scale harvesting program can be implemented and will be applied for by the Lake District.

Action 5 – Harvester assisted removal of plant fragments washed up on the shoreline.

2010-2013 – Landowners may request harvester assistance for removing large piles of plant fragments washed into their shoreline, but not for actual plant cutting and harvesting to, at, or near their docks. Harvesters may be driven perpendicular into shore within the allowed 30-ft riparian viewing corridor around a land owner’s dock without operating cutting blades and provided the paddle wheels of the harvester remain in at least three feet of water, and are not operating while piles of fragments are hand-shoveled onto the conveyor belt. Paddle wheels are not to be operated in any manner to “blow out” floating piles of fragments near the shore.

Conditions – Land owner requests for assistance can be made in person, by hotline, or in writing and must be directed to specified Lake District personnel. The land owner’s request will be evaluated by Lake District personnel trained to complete this action. No action will occur until the land owner making the request has signed a form clearly stating under what conditions this action can take place. The completed form will be kept on file with the Lake District and is good for one season only. The land owner or another person identified by the land owner on the form must be present to assist the harvester operator with removal, or it will not be completed.

13.5 Goal 5 – Improve Record Keeping, Monitoring, and Assessment for All Plant Management Activities

Objective 1 – Regular and comprehensive lake and tributary water quality testing completed by Lake District employees and CLMN volunteers.

Objective 2 – Complete annual pre and post treatment point-intercept plant monitoring following WDNR protocols.

Objective 3 – Lake District employee identification of basic native and non-native plant species found in Rice Lake for the purpose of keeping better records of the type and quantity of aquatic plant species removed by harvesting.

Objective 4 – Lake District employee monitoring of large plant beds and rake-head density ratings to help determine annual plant harvesting areas, or to document nuisance conditions in a request to the WDNR to expand an existing harvesting area.

Objective 5 – Complete annual CLP turion sampling in pre-determined locations within both chemical treated and harvested areas of CLP.

Objective 6 – In-lake aquatic invasive species monitoring EWM and other AIS not currently known to be in Rice Lake

Objective 7 – Lake water sampling by Lake District employees for the purpose of residual testing for Endothall completed by the WI State Lab of Hygiene (SLOH).

Objective 8 – Repeat the 2008 whole lake aquatic plant survey (early season and mid season) in the last year of this APM Plan.

Objective 9 – Improve overall aquatic plant management record keeping and documentation.

Action 1 – Comprehensive and regular lake and tributary water quality monitoring will be completed at three sites in the lake, at three tributary sites, and at the dam (see Map 8). Table 5 shows the parameters that will be sampled for by the combined efforts of Lake District employees (LD), lake volunteers (vol), and field technicians (SEH). Training and equipment will be provided by the CLMN and this consultant. All testing will be completed at the WI SLOH.

Table 4
Water Quality Parameters to be Monitored as a Part of the New APM Plan for Rice Lake and Who Will Be Responsible For Collecting the Data

Parameter	Lake Sites	Tributary Sites	LD/Vol/SEH
Secchi Disk	x		LD/Vol
Dissolved Oxygen	x		LD
Temperature	x		LD
Total Phosphorous	x	x	Vol
Total Nitrogen	x	x	Vol
Ortho Phosphates	x	x	Vol
Nitrite/Nitrate	x	x	Vol
Ammonia	x	x	Vol
pH	x		SEH
Conductivity	x		SEH
Turbidity	x		Vol
Total Suspended Solids		x	LD/Vol
Water Level	x	x	LD/Vol
Flow		x	LD/Vol
Volume		x	SEH

Action 2 – Pre and post chemical treatment plant surveys will be completed according to current WDNR protocols (Appendix AA) A minimum of 200 survey points will be established within the chemical treatment areas and a minimum of 40 points will be established outside the chemical treatment area by this consulting agency or our subs.

Action 3 – All Lake District harvester operators will complete a basic aquatic plant identification training for the purposes of recording the type and quantity of specific aquatic plants removed by the harvesters or causing navigation or nuisance conditions in the lake. The training requirement can be met by attending a Plant ID course offered by the WDNR, UW-Extension Lakes Program, a local educational institution, or qualified consultant or other person.

Action 4 – All Lake District harvester operators will complete training for the purposes of learning accepted WDNR sampling protocol for determining plant bed density. This training requirement can be met by any of the methods mentioned in Action 3. Lake District employees will complete an informal survey of the entire littoral zone in July, August, and September to help determine possible treatment areas for the following year. This training will also help to determine when additional channel harvesting may be needed to provide appropriate navigation and/or nuisance relief.

Action 5 – A minimum of 20 sampling points in the chemical treatment areas and a minimum of 40 points within the harvested areas will be randomly selected to complete turion density sampling. A reduction in the density of turions found in the sediments can be an indicator of CLP management success. Initially, CLP density sampling will be completed by this consultant or one of our subs. It is possible that a Lake District employee could be trained to complete this action.

Action 6 – Lake District employees will complete a monthly (July – October) inspection of the shoreline for new aquatic invasive species (primarily EWM) and complete an inspection of the area in front of all public accesses every two weeks (July – October). Training will be provided by the CLMN AIS Monitoring Program or by this consultant. CLMN presence/absence forms will be completed by Lake District employees and submitted to the WDNR Surface Water Inventory Management System (SWIMS).

Action 7 – Lake District employees will begin collecting water samples for Endothall residual testing by the SLOH in 2011. Establishment of sampling points and sample collection training will be completed by this consultant and our subs.

Action 8 – In the last year of this APM Plan (2013) the aquatic plant survey completed in 2008 will be repeated. Results form the new plant survey will be compared to the 2008 survey to determine if significant changes have occurred in the aquatic plant community of Rice Lake. Management recommendations for the next 5-year APM Plan will be based in part on these results.

Action 9 – Lake District record keeping will be improved by requiring daily log and time sheets to better quantify Lake District employee time associated with the operation and maintenance of the harvesters, and all the actions included in this portion of the APM Plan.

> **Conditions** – Annual award of permit requests for chemical application and harvesting are dependent on the Lake District providing adequate documentation to the WDNR that they are following the APM recommendations approved in this Plan. Monthly reports of harvesting, monitoring, and assessment activities will be sent to the WDNR during the harvesting season between May and October. These reports will be assembled by the Lake District and reviewed by this consulting agency prior to submittal to the WDNR on or before the fifteenth day of the month.
>
> Any inadequacies in these reports will be identified and corrected. All monthly reports will be kept in a digital format and compiled at the end of the season when this consulting agency completes a End-of Year Summary. End-of year summaries are to be kept on file for a minimum of 10 years.

13.6 Goal 6– Provide the General Public With A means to Contact the Lake District to Request Information, Voice Concern Over Aquatic Plant and Other Issues, and Request Appropriate Service

Objective 1 – Maintain the current Lake District Hotline program.

Objective 2 – Provide a place in the newly established Lake District Webpage for the general public to make comments and requests.

Action 1 – Maintain the current Lake District phone in Hotline (715.234.9445) as a means for the general public to request information or provide comment related to aquatic plant and other lake management issues, however the responsibility of responding to Hotline inquiries will be shifted to a Lake District Board Member or other person. Inquiries will be directed to the appropriate Lake District employee, lakes consultant, or board member for action.

Action 2 – The ability for visitors to the Lake District Web page (http://rllakedistrict.org) to leave comments or ask questions will be added to web page operations. A Lake District Board Member or other person will be given the responsibility of responding to messages left.

Conditions – A daily log book will be kept of all Hotline inquiries including when the inquiry was left, who responded to it and when, and whether the issues was resolved, not resolved, or did not require a resolution. All daily log sheets will be compiled and included in the End-of Year Summary, and summarized for the monthly reports. A stipend will be created to help offset the added time this person or persons will be required to give to support this form of public involvement.

13.7 Goal 7– Create an Lake District Employee Handbook Defining Employee Qualifications and Expectations, Training Requirements, and Lake District Contacts

Action 1 – During the first year of this APM Plan, a Lake District Employee Handbook will be created. The hand book will outline the different responsibilities of Lake District employees. Not all employees will be expected to do the same things, and therefore, necessary qualifications will also be different. Current employees and employees hired in 2010 will help define what goes into the handbook.

13.8 Goal 8 – Create a Residential and Riparian Owner Best Management Practices (BMP) Program

Objective 1 – Reduce the total shoreline that is mowed to the edge of the lake to one third of the 2008 total (6.6 mi) replacing it with buffer strips or full shoreland restorations over the next four years.

Objective 2 – Reduce the estimated percent of the total City of Rice Lake phosphorous loading attributed to residential property (currently at 47%) by 10-15% over the next four years.

Objective 3 – Seek to re-establish emergent and floating leaf vegetation along the shoreline targeting those areas with no shoreland protection first and moving into areas where the shoreland protection is failing and then into areas where operating structures are in place.

Objective 4 – Provide recognition for residents within Lake District boundaries that complete activities that will help to improve the lake.

Action 1 – The Lake District will hire a Summer Intern in each of the next four years to administer a Land Parcel Improvement Program. This person will provide educational opportunities for and work with land owners within the boundaries of the Lake District to design and eventually implement best management practices like buffer strips, runoff diversion systems, rain gardens, rain barrels, and full-scale shoreland restorations. A 2011 Lake Protection Grant will provide financial incentives and assistance for implementation of these projects.

Action 2 – The same intern will administer an Emergent Species Restoration Program to identify shoreland around Rice Lake that could benefit from the re-establishment of emergent and floating-leaf vegetation and then approach the land owner for permission in writing to work toward re-establishing these sites.

> **Conditions –** The intern will be employed full time for 14 weeks between Memorial Day and Labor Day and be paid a minimum of $16.00/hr. The Intern will be responsible for meeting with landowners both on the lake and within Lake District boundaries to discuss land parcel improvement and emergent species restoration projects that could benefit the lake. The intern will be expected to provide monthly updates at Lake District Board meetings, GPS all BMP locations, provide copies of all maps, BMP plans, and complete photographic documentation of before, during, and after projects.

Action 3 – Establish a budget for the purchase and construction of “buffer blocker” systems to aide in site restoration (Langlade County Web page). Re-established plants will be both purchased and “moved” from other locations around the lake. Wild rice is just one of the species that will be included in this restoration program. Other plant species include but are not limited to rushes, sedges, smart weed, manna, horsetail, arrowhead, pickerel weed, and various floating leaf species.

Action 4 – Approach land owners with general information about restoring wild rice on their shoreline. If enough Rice Lake land owners interested in restoring wild rice are identified in the 2010, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) may become an active partner in the restoration project. GLIFWC resource specialists would evaluate Rice Lake for appropriate habitat and provide technical assistance, tracking, and cost-sharing for the purchase of seed. The Lake District, along with land owners and other interested parties like the UW Extension program would provide planting services. Guidelines for wild rice re-introduction were provided by Peter David of GLIFWC and can be found in Appendix BB.

> **Permitting** – A permit is not needed for planting native wild rice in a body of water. However permits may be needed for restoring shorelines, transferring aquatic plants from one location to another, installing buffer blocker systems, and incorporating property changes to reduce runoff.

Action 5 – Good lake stewardship activities like sensible shoreland lighting, improving buffer strips, use of phosphorous-free fertilizers both in the City and on the lake shore, proper management and disposal of grass clippings and raked leaves, and septic system maintenance will be promoted through the Lake District Webpage, annual booth at Aquafest and the Barron County Fair, through radio and newspaper ads, radio talk shows, and workshops sponsored by the Lake District. Recognition will be awarded to those land owners incorporating best management practices on their properties.

13.9 Goal 9 – Increase Public Awareness of and Involvement in the Lake District by Improving Public Outreach, Exposure, and Image and Provide Greater Land Owner and Lake User Education

Objective 1 – Set up a Lake District Public Communications Committee.

Objective 2 – Take a more active role in annual celebrations including Aquafest, the Barron County Fair, Homecoming, the Christmas Parade and other city events.

Objective 3 – Increase public participation and attendance at Lake District monthly board meetings by 25% and by 50% at the Annual Meeting based on 2009 numbers.

Objective 4 – Sponsor a half day Lake Fair to promote Lake District activities, public education related to aquatic invasive species, lake protection, best management practices, and good lake stewardship activities.

Objective 5 – Continue a watercraft inspection program at all public accesses to the lake.

Action 1 – A Public Communications Committee will be set up by the Lake District to develop and oversee the activities designed to improve the overall public perception and involvement of the Lake District in the community and surrounding area and will work with the Rice Lake Chamber of Commerce and the Town of Rice Lake to develop an advertising campaign to present all that is positive about the lake. A active member of the community has already agreed to chair this committee and oversee its activities.

Action 2 – The Lake District will sponsor a float in the Aquafest, Homecoming, and Christmas parades, set up a public information booth during the Barron County Fair, and provide a monthly radio spot with the local radio personality. A digital newsletter will be posted on this website and others, and emailed three times a year to anyone who joins the distribution list. A newspaper article will be submitted to the Rice Lake Chronotype five times a year updating Lake District activities and hi-lighting upcoming meetings and special events.

Action 3 – A half day Lake Fair will be held every year in late September or early October at the Lumbering Hall of Fame Park. At least one "keynote" speaker will be on the agenda to present interesting and useful information for improving the lake. Children's activities will be included, and awards given acknowledging partners and members of the Lake District who have contributed significantly to the health and well-being of the lake. Candidates for these awards will be sought throughout the year, and winners determined by the Lake District. Radio, newspaper, and TV media outlets will be invited to cover the event and political representatives invited to attend.

Action 4 – A watercraft inspection program following Clean Boats Clean Waters (CBCW) guidelines has been put in place for Rice Lake and will continue as a part of this Lake Management Plan. At least 400 hours of watercraft inspection will be completed at public access sites around the lake. Much of this time will be completed by lake volunteers trained by certified persons in the program. The local Kiwanis Club, high school biology teacher, and others have already been volunteering time and coordination for this program. The Summer Intern position will expand the services already provided by these people.

> **Conditions** – All CBCW data collected as a part of this APM Plan is required to be submitted to the WDNR SWIMS data base.

13.10 Goal 10 – Implement the Activities Associated With This APM Plan Through a Combination of Lake District and State of Wisconsin Grant Funding

Objective 1 – Begin implementing the activities in this APM Plan in 2010 and continue through 2013.

Objective 2 – Use Lake District tax levy money to fund certain "routine" activities each year.

Objective 3 – Apply for a WI Aquatic Invasive Species Established Infestation Grant to fund additional activities.

Objective 4 – Apply for a WI Lake Planning and Protection Project to fund watershed improvement activities.

Objective 5 – Involve community and other partners in making match requirements for state grants and in supporting the activities included in this plan.

Action 1 – Annual income from a Lake District tax levy currently generates nearly $100,000.00. This money will be used to fund many of the expenses associated with this new APM Plan. The Lake District currently funds all CLP and native plant harvesting that occurs on the lake. It intends to continue funding all harvesting related activities including hauling, disposal, and record keeping. Basic water quality sampling from three lake sites, in-lake monitoring for EWM and other aquatic invasive species, watercraft inspection, public education and involvement, Lake Fair, and public image enhancement will be funded by the Lake District.

Action 2 – An Aquatic Invasive Species Established Infestation Control grant will be applied for in February of 2010 to help fund activities associated with this APM Plan over the next four years. Herbicide application to control CLP for restorative purposes and all associated pre and post treatment plant surveying, turion sampling, and residual testing will be funded by the AIS grant. Depth finders, GPS units, channel marking buoys, and a dissolved oxygen meter will be purchased with grant funding. CLP turion sampling, more comprehensive water quality testing on the lake and within its tributaries, additional pre post treatment plant monitoring, and additional public education and image enhancement will be funded by the AIS grant. The Residential and Riparian Best Management Practices and the Emergent Species Restoration programs will be funded by the AIS grant. Partners in this grant could include but are not limited to SEH, the City of Rice Lake, Town of Rice Lake, Rice Lake High School, Rice Lake Kiwanis and other organizations, the National Lumbering Hall of Fame, Barron County, and the Great Lakes Indian Fish and Wildlife Commission.

> **Conditions** – Should the AIS grant request be denied in February 2010, it will be revised and re-submitted in August of 2010. If denied, 2010 activities related to this APM Plan will be modified. Herbicide treatment in the Upper basin will not occur. The Residential and Riparian Best Management Practices and the Emergent Species Restoration programs will be postponed to a later date. Buoys will only be placed in the main navigation channel. GPS Units and depth finders may not be put on all three harvesters and purchase of a dissolved oxygen meter will be postponed.

Action 3 – A WI Lake Protection and Planning Grant will be applied for in 2011 to help fund activities aimed at reducing nutrient contributions to Rice Lake from the immediate shoreland area, the larger watershed, the City of Rice Lake, and from internal loading. Activities to be included in this funding request are a Farmer Incentive's Program similar to the one proposed in the Turtle Lakes Lake Protection Project, funding incentives for the Residential and Riparian Owner BMP Program projects, a Lower basin alum treatment evaluation, a public beach study to determine how best to re-open it for safe public use, support for City of Rice Lake storm water management projects, and funding the for in-lake plant restoration and natural replacement of failing shoreland protection structure program.

Action 4 – Attempt to involve the Rice Lake Area School District, Barron County Campus, Wisconsin Indianhead Technical College, public institutions and organizations, other lake and river organizations, private businesses and organizations, and local and town governments in management activities associated with this APM Plan. Promote the formation of a Barron County Lakes and Rivers Association.

13.11 Goal 11 – Complete Annual Project Summaries and a Final Project Evaluation

Action 1 – In December of each year this management plan is implemented, an end-of-year summary will be provided detailing the results of activities accomplished. Pre and post plant survey results, turion sampling, residual testing (if done), water quality results, and plant density results will be summarized. Plans for management including herbicide treatment areas, harvesting areas, and late season channels will be addressed preparing the Lake District for submittal of the necessary treatment permits to the WDNR. Progress made in the Residential and Riparian Owner BMP and Emergent Species Restoration programs will be summarized. All public awareness activities will be summarized. Attendance at Lake District functions will be tracked, documented, and compared to the previous year.

Action 2 – An end-of-project report will be provided in the last year of this project. Whole-lake plant survey results will be compared to the 2008 plant survey results. Changes in the plant community will be evaluated. The success of the overall project in accomplishing the goals set for it will be commented on and recommendations for possible changes in the revised or new plan made. Funding for the writing of the new or revised plan will be included in the last year of the Lake Protection Project.

Action 3 – Project Deliverables will include all maps, GIS documents, survey results, treatment records (both herbicide and harvesting) and results, summary reports, photographic records, public participation records, etc. They will be defined in greater detail as a part of the AIS Control and Lake Protection grant applications.

14.0 References

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List of Maps

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1994 Aquatic Plant Management Plan

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1993 Lake Management Plan

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Jan 2008 Email from Frank Koshere to Pamela Toshner

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