Hey and Associates, Inc.

AQUATIC PLANT MANAGEMENT PLAN

for

Camp and Center Lakes

Prepared for:

Camp and Center Lakes Rehabilitation District
Kenosha County, Wisconsin

May 31, 2006

PN: 03223

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TABLE OF CONTENTS

Tables:

Figures:

Exhibits:

Appendix:

INTRODUCTION

The purpose of this aquatic plant management plan is to report the inventory findings of the aquatic plant communities present, their relative densities and species composition within Camp and Center Lakes. Review of the past and present aquatic plant community information will be used to formulate an aquatic plant management plan to provide a variety of lake uses, while protecting significant aquatic resources. This plan outlines a strategy to implement an aquatic harvesting program that will provide for recreational lakes uses through nuisance species control by mechanical removal. Significant aquatic resources areas that help promote water quality, and provide resources such as habitat and fish spawning should be protected from unnecessary negative impacts.

This plan will update and revise the preceding plan by Hey and Associates, Inc. dated October 1995 and is prepared at the request of the Camp and Center Lakes Rehabilitation District to assist lake managers and regulatory agencies in directing future aquatic plant management activities.

Goals and Objectives

Overall Management Strategy for Camp and Center Lakes

The development of this plan is to attempt to balance the recreational needs of lake users with the need to promote a diverse and balanced aquatic plant community with the assistance of the Camp and Center Lake Rehabilitation District.

Goals:

1. Maintain a variety water-orientated recreational opportunities and aesthetic opportunities for lake users in an environmentally sound way.
2. Provide nuisance aquatic plant control to increase lake use and access, while protecting diverse aquatic natural resources.
3. Utilize mechanical harvesting techniques for aquatic plant management and various near shore manual and chemical aquatic plant control options, to limit disturbance to the lake ecosystem.
4. Educate district landowners about the benefits of aquatic vegetation and various near shore aquatic plant control options.
5. Provide better recreational opportunities through aquatic plant management, especially nuisance plant species control.
6. Protect and restore valuable wildlife and fish habitats.

Objectives:

1. Cut access lanes in water depths greater than three feet to channels containing residential properties. Permitted aquatic herbicide treatments may be used is water depths less than three feet for access lanes.
2. Cut access lanes to all public and private boat access points in water depths greater than three feet. Permitted aquatic herbicide treatments may be used is water depths less than three feet for access lanes.
3. Control nuisance aquatic plants including coontail, and Eurasian water milfoil, to promote the growth of desirable native plants.

4. Restrict aquatic plant harvesting in native aquatic plant communities such as water lily bed and stands of bulrush.
5. Specific harvesting areas will be recommended by the District appointed "Weed Scout" by severity of aquatic plant growth, prevailing weather conditions and water depth. The CCLRD Board has the authority to override the Weed Scout harvesting recommendations that do not follow the recommendations in the Aquatic Plant Management Plan for Camp and Center Lakes. The "Weed Scout will document and file all recommendations, and submit copies to the District Board with the annual report.
6. The "Weed Scout" will determine when fish spawning has completed and near shore aquatic plant harvesting can begin. (See Appendix C)
7. Create fishing access lanes in dense aquatic plant beds for use by fisherman and predatory fish species.
8. Minimize the spread of Eurasian water milfoil by propeller cutting and lake bottom scouring in shallow water by utilizing deeper open water areas for more intensive recreational watercraft use. Proposed signs or lake maps at public boat access sites will provide first time lake users information on no wake zones and lake water depths.
9. Provide multiple types of recreational uses including boating, fishing, swimming, water-skiing, snowmobiling, ice fishing and ice-skating through public access and aquatic plant management

WATERBODY CHARACTERISTICS

Camp and Center Lakes are glacial kettle lakes located in southwestern Kenosha County. The lakes were formed 10,000 to 15,000 years ago when the last glaciers covered Wisconsin. Center Lake is located to the northeast of and flows into Camp Lake. A narrow bermed isthmus that hosts railroad tracks, County Trunk Highway SA, and some residential properties separates the two lakes. A low-head dam located on the southern end of Center Lake acts as an outlet structure controlling flow into Camp Lake across the narrow isthmus. Camp Lake flows over a low-head dam on the west side of the lake to an outlet creek. This creek flows south to the Peat Lake wetland complex and continues south into Channel Lake in Lake County, Illinois and eventually to the Fox River in Illinois.

Combined, the two lakes are nearly 600 acres in size. The total watershed for both lakes is 5,410 acres or 8.4 square miles in size. The lakes are located in the township of Salem in Kenosha County, Wisconsin. Camp Lake has an irregular pear shape, with a major axis from north to south (Exhibit 1). Center Lake has an irregular dogleg shape with major axis from east to west along the east portion of the lake, and north to south along the west portion of the lake (Exhibit 1). The lakes are relatively shallow. The physical characteristics for both lakes are summarized in Table 1.

Camp Lake

Camp Lake is the larger of the two hydrologically connected drainage lakes. Camp Lake covers an area of about 461 acres. The deepest portion of Camp Lake is in the north section, which reaches a maximum depth of about 19 feet. The majority of the southern portion of Camp Lake is relatively flat and shallow, reaching a maximum depth of just over five feet. Camp Lake has a direct drainage area of about 3,010 acres, slightly larger than Center Lake. Approximately one-third of the shoreline of Camp Lake is comprised of emergent cattail marsh. The remaining two-thirds of the shoreline consist of mostly residential homes.

Center Lake

Center Lake is divided into two basins that cover an area of about 120 acres. The east basin is the deeper of the two with a maximum depth of 28 feet, and the south basin has a maximum depth of 22 feet. The two basins are separated by a narrow, which is approximately 15 feet in depth. Center Lake has a direct drainage area of about 2,400 acres. Approximately one-quarter of the shoreline of Center Lake is comprised of emergent cattail marsh. The remaining three-quarters of the shoreline of Center Lake consist of mostly residential homes.

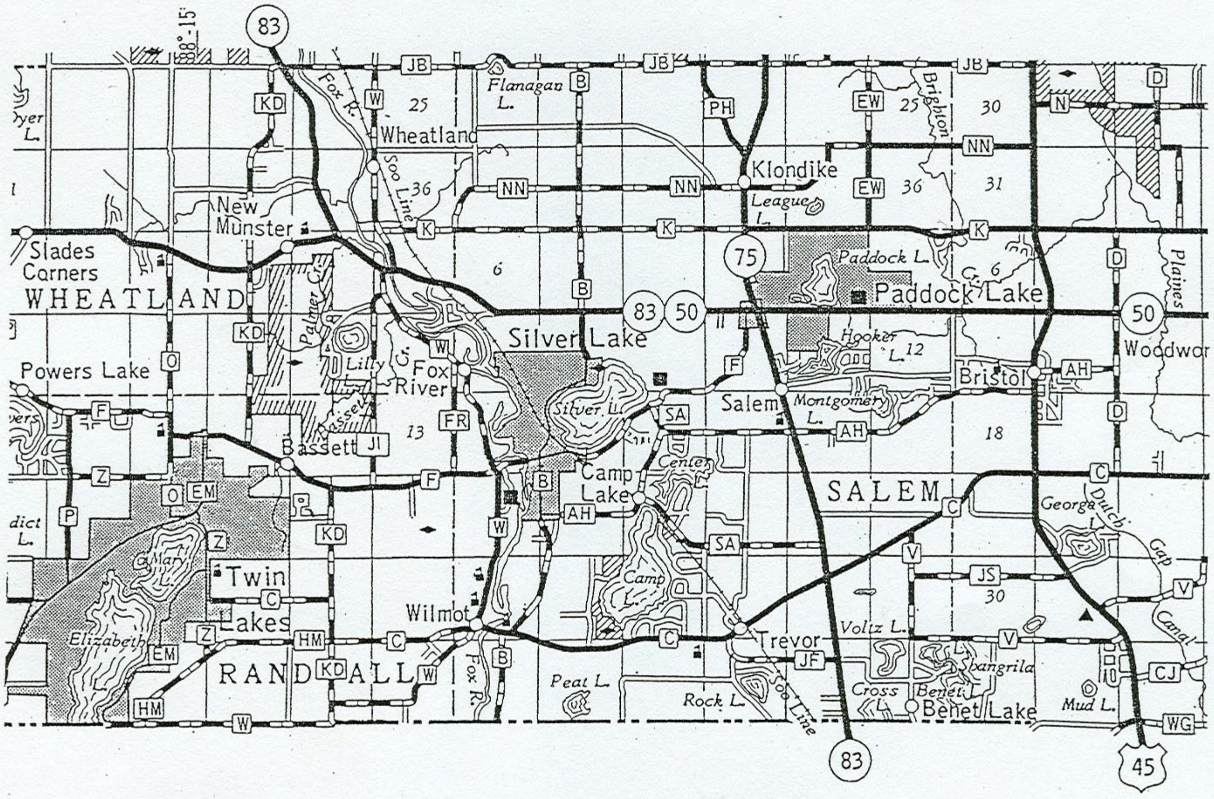
Table 1
Physical Characteristics of Camp and Center Lakes

Parameter	Camp Lake	Center Lake
Area of lake	461acres	120 acres
Watershed area	5,410 acres	2,400 acres
Lake volume	2,327 acre-feet	1,136 acre-feet
Lake elevation	740 feet above MSL	741 feet above MSL
Maximum depth	19 feet	28 feet
Mean depth	5 feet	8.8 feet

Source: Wisconsin Department of Natural Resources (1969) and Hey & Associates, Inc.

EXHIBIT 1

STUDY AREAS
CAMP AND CENTER LAKE
KENOSHA COUNTY, WISCONSIN



SCALE
Not to Scale

EXISTING DATA

A limited amount of information has been published for Camp and Center Lakes. Past publications include Juday, 1914, Wisconsin Department of Natural Resources 1969, and Belonger 1969. The latter being the most comprehensive aquatic plant survey conducted within lakes of the Fox (Illinois) River watershed. A 1990 lake and watershed report was completed by Applied Ecological Services with an initial aquatic plant management plan completed by Hey and Associates, Inc. in 1995. In 2000 R.A. Smith and Associates and Hey and Associates, Inc. summarized water quality data on the lakes collected between 1993 and 1998.

To understand the importance of surface runoff on the quality of the lakes, the Wisconsin Department of Natural Resources (WDNR) in 1995 conducted an inventory of the two lakes' watersheds. The study was funded through the state's Priority Watershed Program. Important watershed characteristics that influence pollutant levels in surface runoff and groundwater flow include land use, soil types, steepness of slopes, and vegetative cover.

Land Use

Land use in a lake's watershed plays an important role in the amount and types of pollutants that enter a water body. The land use tributary to each lake is presented in Table 2. The water resources located within the boundary of the Camp and Center Lakes Watershed include two lakes, five intermittent tributaries and numerous wetland complexes (WDNR, 1996). Agriculture is the largest land use in the two lake's watersheds and likely has the greatest impact on the water quality of the lakes.

Both lakes have developed shorelines in those areas where large wetland complexes have not limited residential development surrounding the lakes. The Center Lake shoreline is approximately 50 percent developed and Camp Lake is estimated to be 44 percent developed (Exhibit 2; R. A. Smith and Associates, 1994) Most of the shoreline residential development was in place by 1960, with minor infilling and upgrading on existing residential sites.

Table 2
Land Use Tributary to Camp and Center Lakes

Land Use	Center Lake (acres)	Camp Lake (acres)	Total Watershed (acres)	Percent of Total Watershed
Agriculture	1,212	1,083	2,295	42 %
Forest	436	464	900	17 %
Urban	151	219	370	7 %
Residential	255	310	565	10 %
Wetland	203	457	660	13 %
Surface Water	143	477	620	12 %
Total	2,400	3,010	5,410	100 %

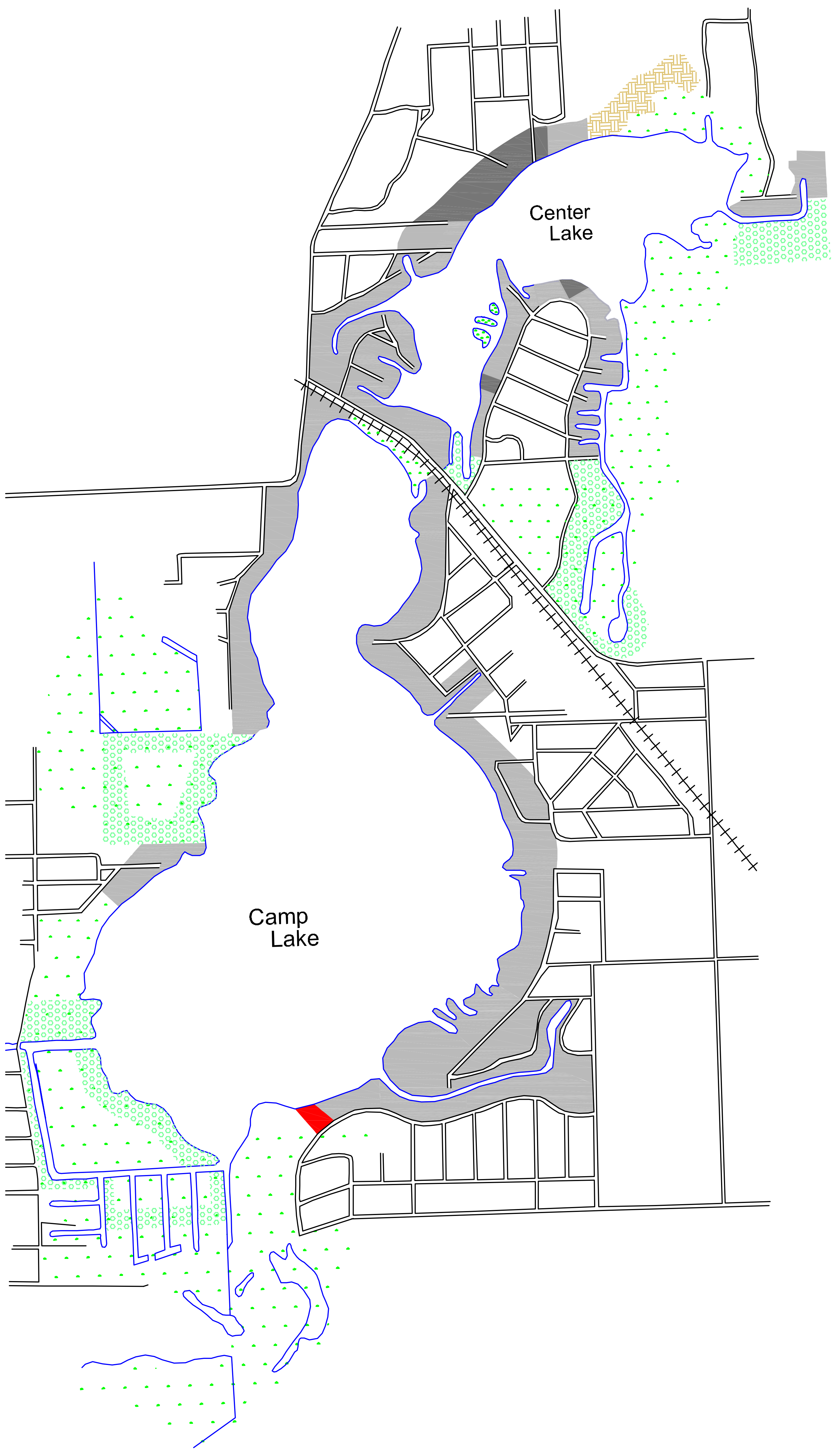
Source: Wisconsin Department of Natural Resources (1995)

Water Quality

The Lake Management District contracted with R. A. Smith & Associates, Inc. to conduct a multi-year water quality study of the lakes. Samples were collected from the deepest part of the two lakes at the surface and bottom from 1993 through 1998.

Water clarity or transparency is a measure of the overall water quality of the lake. Clarity is measured with a Secchi disk, which is a black and white eight-inch disk that is lowered into the water until a depth is reached at which the disk is no longer visible. The depth is known as the Secchi disk reading.

The Secchi disk readings are illustrated in Figures 1 and 2. The length of the bars on the two graphs illustrates the depth that the Secchi disk was visible. In Camp Lake during the period from 4/27/93 to 8/26/98, the Secchi readings varied from 0.4 to 8.5 feet, with an average of 2.4 feet. In Center Lake over the same time period, the readings varied from 0.4 to 7.5 feet, with an average of 2.2 feet. The Secchi reading averages for both lakes fall into the “poor” water clarity zone in comparison to other Wisconsin lakes. Secchi depths on July 1, 2004 were 3 feet for both Camp and Center Lakes. Secchi depths taken on October 27, 2004 were 3.5 feet in Camp Lake and 4.7 feet in Center Lake.



SOURCE: SEWRPC

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SCALE: 1" = 1200'

LEGEND

- RESIDENTIAL
- WETLAND
- WOODLAND
- AGRICULTURAL
- RECREATIONAL
- COMMERCIAL

No.	Revision/Issue	Date
1	Shoreland Boundary Update	01/06/05

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Camp and Center Lake Rehabilitation District

Camp and Center Lake Shoreline Land Use Map: 2000

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DRAWN BY	MTF	01/07/05	
CHECKED BY			
APPROVED BY			

Figure 1 Water Clarity Readings Camp Lake

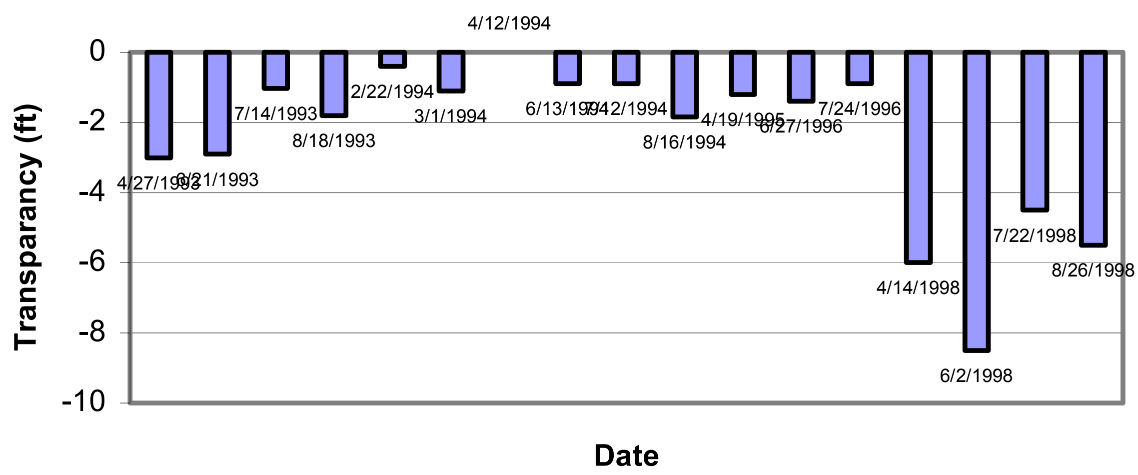
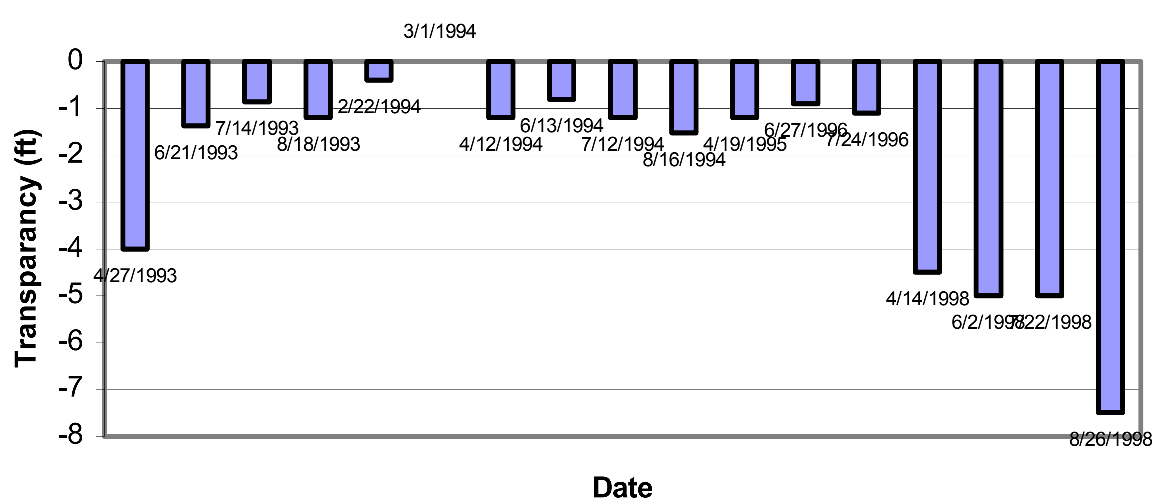


Figure 2 Water Clarity Readings Center Lake



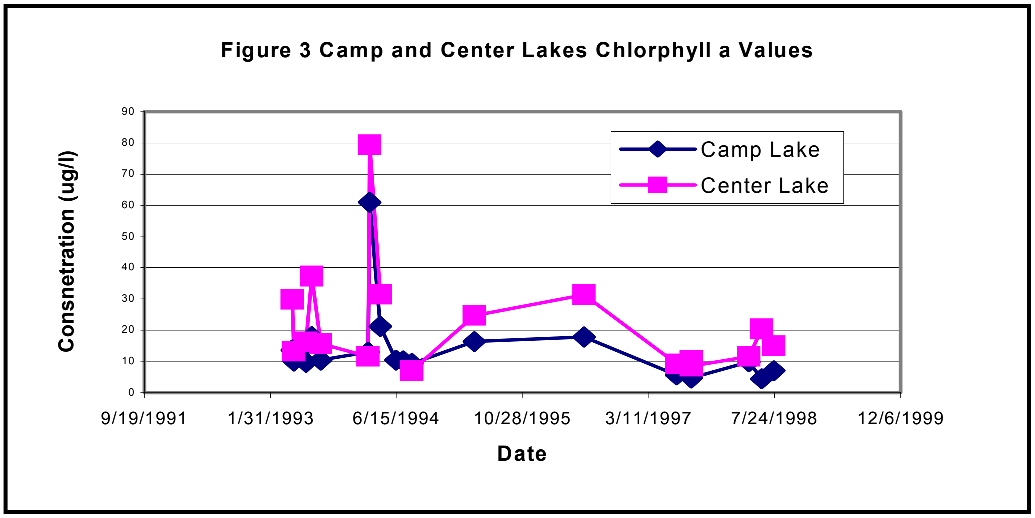
Chlorophyll-a is a major photosynthetic pigment in algae. The amount of Chlorophyll-a present is an indicator of the biomass of live algae in the water. Chlorophyll-a concentrations are usually lowest in the winter and reach their peak in the summer, when algae populations reach their maximum. Chlorophyll-a concentrations in Camp and Center Lakes are summarized in Table 3 and illustrated in Figure 3. The Chlorophyll-a concentrations during the spring and summer months in Camp Lake ranged from 4.46 to 61.0 ug/l, with an average of 13.68 ug/l. In Center Lake, Chlorophyll-a concentrations ranged from 7.06 to 79.4 ug/l, with an average of 21.96 ug/l. The concentrations indicate moderate to high levels of algae growth, which in part explains the lower water clarity values discussed previously.

Table 3

Chlorophyll-a Concentrations in Camp and Center Lakes

Date	Camp Lake (ug/l)	Center Lake (ug/l)
4/27/93	13.70	29.90
5/4/93	10.15	13.30
6/21/93	9.76	16.20
7/14/93	18.00	37.40
8/18/93	10.40	15.70
2/22/94	13.00	11.60
3/1/94	61.00	79.40
4/12/94	21.30	31.50
6/13/94	10.40	na
7/12/94	10.10	na
8/16/94	9.34	7.06
4/19/95	16.40	24.70
6/27/96	17.80	31.40
6/30/97	5.63	9.27
8/28/97	6.90	10.30
8/28/97	4.73	8.55
4/14/98	9.84	11.60
6/2/98	4.46	20.5
7/22/98	7.00	15.00
Average	13.68	21.96

Source: R. A. Smith & Associates, Inc. and WDNR



Source: R. A. Smith & Associates, Inc. and WDNR

Recent studies in Wisconsin lakes have shown that while phosphorus is usually the limiting nutrient for algae, nitrogen is typically the limiting nutrient for rooted aquatic plants. Therefore, both nitrogen and phosphorus should be of concern when developing a lake protection plan.

Table 4 summarizes the total phosphorus concentrations monitored in Camp and Center Lakes for the study period. The data for the surface and bottom of the two lakes is illustrated in Figures 4 and 5 respectively.

Total phosphorus concentrations at the surface of in Camp Lake during the study ranged from 13 to 310 ug/l, with a geometric mean of 30 ug/l. Surface total phosphorus concentrations in Center Lake during the study ranged from 11 to 649 ug/l, with a geometric mean of 41ug/l.

The phosphorus concentrations at the bottom of the lake typically increase as the summer progresses and reach a maximum in July and August. When organisms die, they sink to the bottom of the lake and decompose. Phosphorus from these organisms is stored in the bottom sediments. Phosphorus is not highly soluble in water and readily forms insoluble precipitates with calcium, iron, and aluminum. However, when the bottom of Center and Camp Lakes become depleted of oxygen during thermal stratification, phosphorus changes chemical form and is released from the sediments, resulting in the increased concentrations observed. During the period of stratification, these nutrients are trapped at the bottom of the lake and are not available for algae or aquatic plant growth. However, at spring and fall turnover, the phosphorus is mixed throughout the lake and is recycled for new algae or aquatic plant growth the following year. Both Camp and Center Lakes show increases in bottom phosphorus concentrations in the summer months (Figure 5).

Table 4
Camp and Center Lakes Total Phosphorus Concentrations 1993-1998

Date	Camp Lake		Center Lake	
	Surface (ug/l)	Bottom (ug/l)	Surface (ug/l)	Bottom (ug/l)
4/27/93	38	44	54	57
6/21/93	22	25	29	87
7/14/93	23	37	41	300
8/18/93	20	na	26	290
2/22/94	310	na	520	140
3/01/94	260	na	470	na
4/12/94	40	40	50	60
6/13/94	29	52	27	340
7/12/94	24	24	23	394
8/16/94	21	na	17	na
2/28/95	13	11	24	75
4/19/95	34	31	43	40
2/22/96	37	31	34	175
6/27/96	23	31	31	29
7/24/96	33	51	296	na
6/30/97	21	65	23	186
7/30/97	21	99	20	174
8/28/97	20	30	24	649
4/14/98	22	28	30	30
6/02/98	17	35	25	125
7/22/98	24	109	24	79
8/26/98	18	51	21	112
Average	49	44	84	176
Geometric Mean	30	39	41	123

Source: R. A. Smith & Associates, Inc. and WDNR

Bottom total phosphorus concentrations in Camp Lake during the study ranged from 11 to 109 ug/l, with a geometric mean of 39 ug/l. The mean phosphorus concentration at the bottom of Camp Lake was not much greater than the surface mean of 30 ug/l, indicating limited build up of phosphorus in the bottom waters. Total phosphorus concentrations in Center Lake bottom waters ranged from 29 to 649 ug/l, with a geometric mean of 123ug/l. Center Lake exhibited a large buildup of phosphorus in the bottom waters, likely due to a combination of the lakes greater depth and longer period of thermal stratification, and more nutrient enriched bottom sediments.

Concentrations of total phosphorus at the surface layer of the lakes are relatively high, resulting in high algae production during the summer months. The Southeastern Wisconsin Regional Planning Commission has recommended that total phosphorus concentrations not exceed 0.020 mg/l at spring turnover to maintain healthy lake conditions. This concentration was exceeded on both lakes throughout the sampling period.

Figure 4 Surface Total Phosphorus Concentrations Camp and Center Lakes

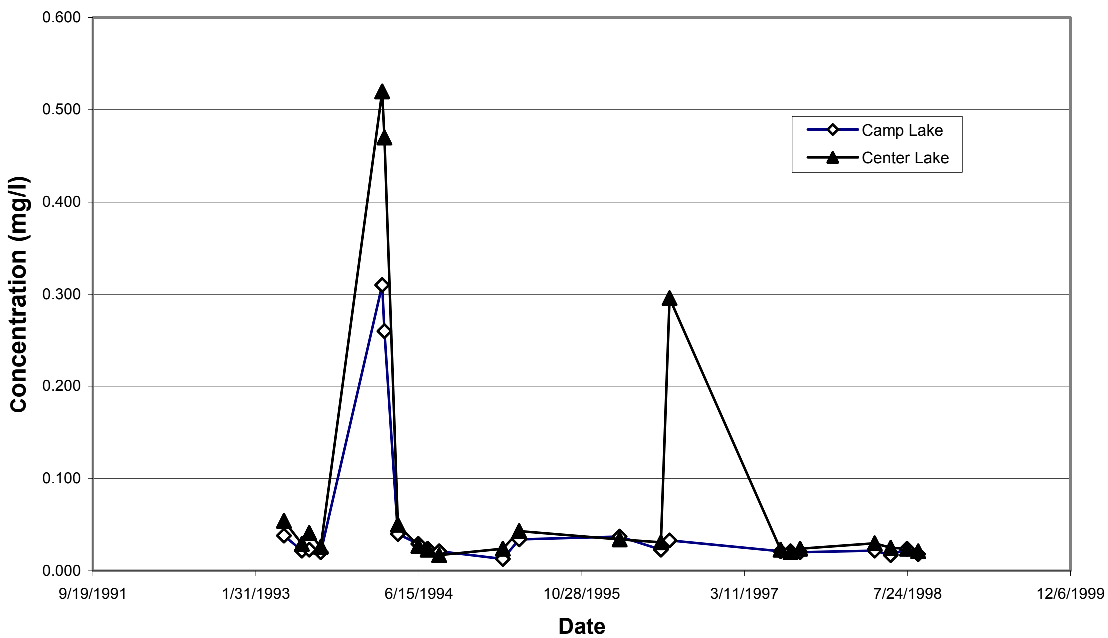
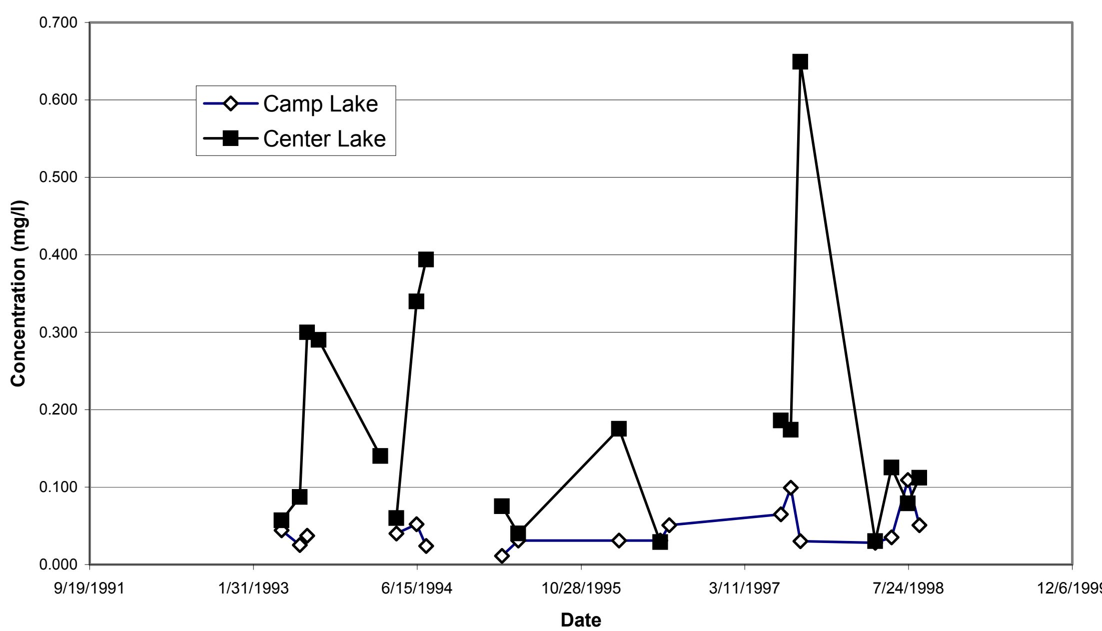


Figure 5 Bottom Total Phosphorus Concentrations Camp and Center Lakes



Trophic State Index

The trophic state index (TSI) assigns a trophic condition rating based on Secchi disk, total phosphorus, and Chlorophyll-a and can be used to summarize the quality of a lake. The trophic state index was developed by Carlson in 1977 to compare the three water quality values on a scale from 0 to 100. Values from 0 to 35 describe lakes defined as **oligotrophic—**lakes that are generally clear, deep, and free of rooted aquatic plants and algae blooms. Values above 50 define **eutrophic** lakes—lakes that are high in nutrients and tend to support large biomass of rooted aquatic plants and algae. **Mesotrophic** lakes with values from 35 to 50, lie between oligotrophic and eutrophic lakes.

The average TSI values based on Secchi disc, Chlorophyll-a, and total phosphorus measurements are summarized in Table 5. Based on these averages, both lakes are classified as eutrophic using Carlson's system. Figures 6 and 7 illustrate the variability of the three indexes during the study period for the two study lakes.

Table 5
Average TSI Values for Camp and Center Lakes

Parameter	Camp Lake	Center Lake
Secchi disc	68	70
Chlorophyll-a	63	68
Total phosphorus	53	57
Average of all 3 parameters	61	65

Source: Hey and Associates, Inc.

The average TSI values for secchi disc (water clarity) are higher than the average values for Chlorophyll a or total phosphorus, indicating that poor water clarity may be due to more than algal growth and may also be a factor of suspended sediment in the water column.

Figure 6 Carlson Trophic State Indexes for Camp Lake

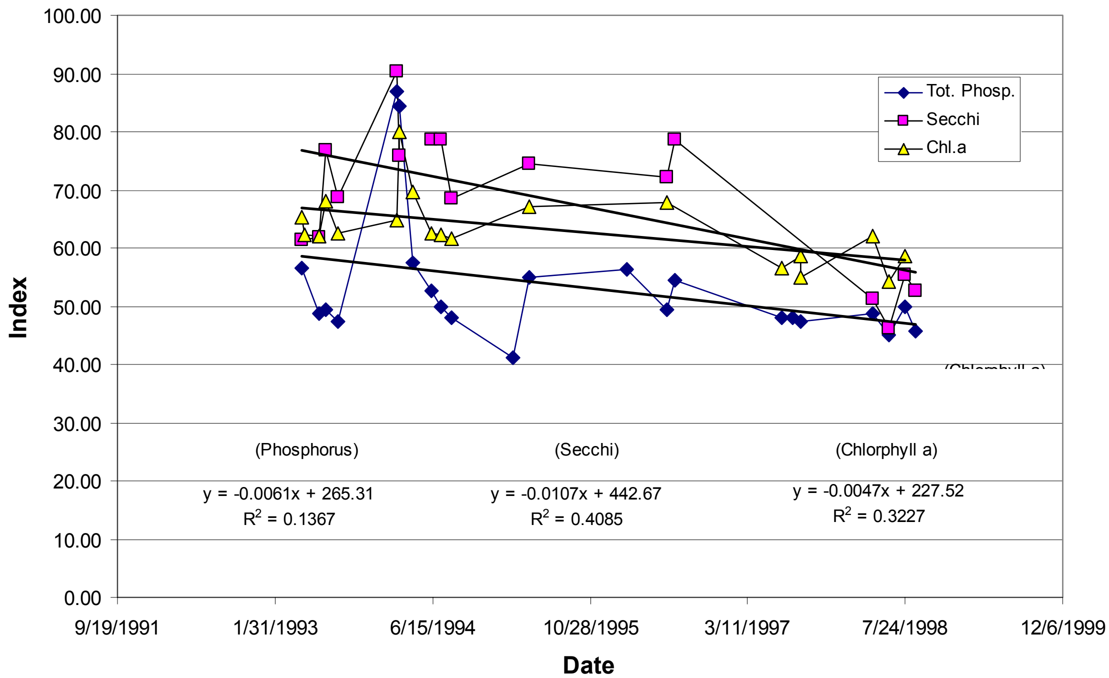
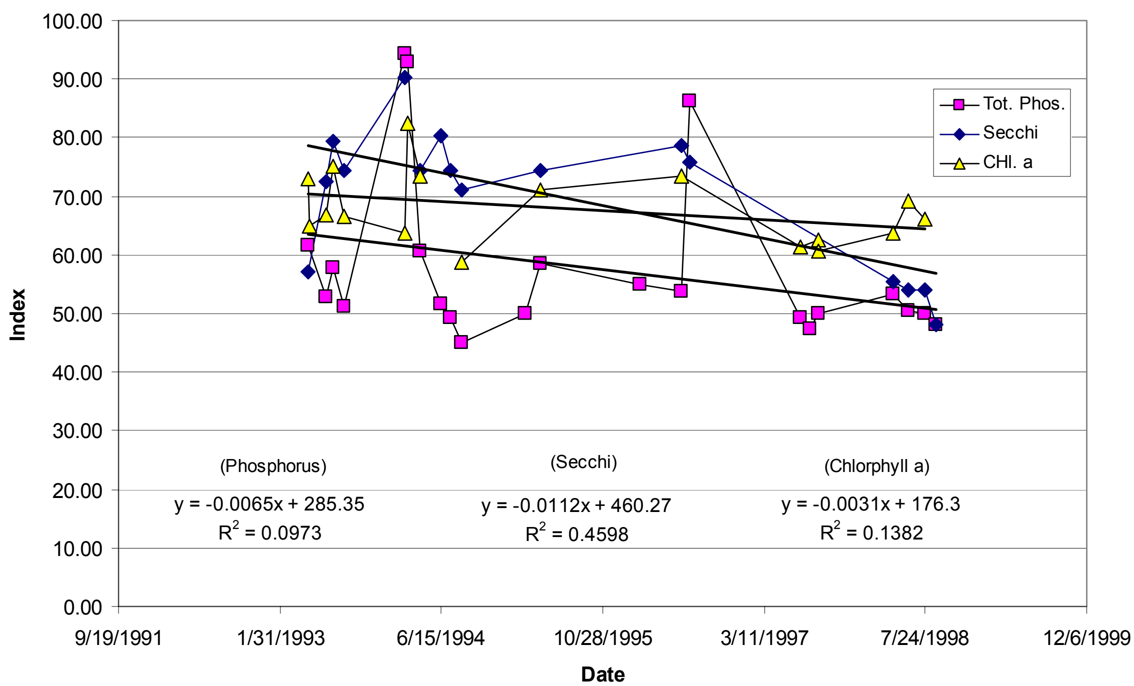
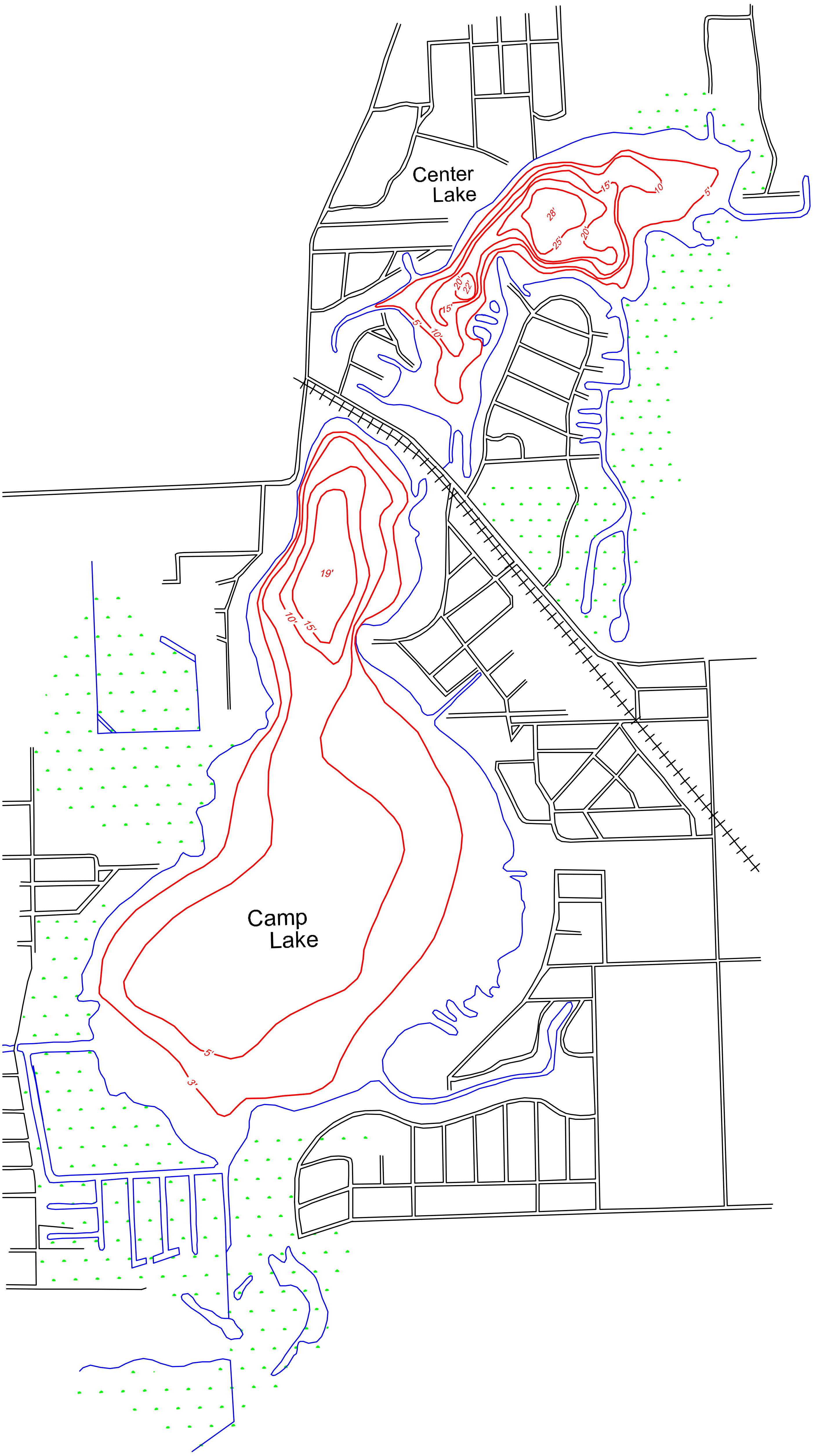


Figure 7 Carlson Trophic State Index Center Lake



The TSI graphs appear to show a visual trend of lower numbers from 1993 through 1998. To see if this trend is statistically significant a linear regression analysis was run on the data (Figures 6 and 7). Table 5 summarizes the results of the analysis. For the trend to be significant, the R^2 values for each linear regression line should be above 0.7. The closer the R^2 value is to 1.0 the better the fit of the data to a linear trend. The values for all of the TSI parameters for both Camp and Center Lakes show poor R^2 values, indicating that the visual trend is not statistically significant. An analysis of just the mid-summer values showed similar results to the entire data set. Generally, five years of data is too short to observe long-term trends in water quality data. Seasonal and annual variations in water quality caused by typical weather variability make trend analysis of short-term data difficult. Typically ten or more years of data is required to identify any long-term trends. The bathymetric map for both lakes is provided as Exhibit 3.



BASEMAP SOURCE: SEWRPC

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SCALE: 1" = 1200'

LEGEND

No.	Revision/Issue	Date
1	Shoreland Boundary Update	01/06/05

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Camp and Center Lake Rehabilitation District

Camp and Center Lake Bathymetric Map

PROJECT NO:	03223	DATE	EXHIBIT NO:
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DRAWN BY	MTF	01/07/05	
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APPROVED BY			

Vegetation

The management of aquatic macrophyte populations can be troublesome because of the life histories of the species involved and the complex interactions with the lake ecosystem as a whole (Engle, 1985). Often the beneficial values provided or supported by aquatic vegetation, (e.g., shoreline stabilization, fish and wildlife habitat, etc.) are overshadowed by impaired lake uses by dense bed of aquatic plants (Nichols, 1991; Carpenter and Lodge, 1986; Engel, 1985; Engel, 1990).

Camp Lake

Historically the aquatic vegetation as described by Belonger (1969) documents the dominant vegetation as wigeon grass, *Ruppia maritime*, forming dense beds from 1 to 13 feet in depth in most areas of the lake except at the east shore. Other common species included pondweeds (*Potamogeton crispus, P. praelongus, P. natans, P. pectinatus, and Potamogeton* spp.), coontail, (*Ceratophyllum demersum*) and muskgrass, (*Chara vulgaris*). The east shore was dominated by milfoil, (*Myriophyllum* spp.), with a variety of associates, including pondweeds, coontail, (muskgrass), eel grass (*Vallisneria Americana*), blatterwort, (*Utricularia vulgaris*) and buttercup, *Ranunculus* sp.). Beds of the floating leaved yellow water lily, (*Nuphar* spp.) were common, with scattered beds of white water lily, (*Nymphaea* sp). Emergent beds of narrow-leaved cattail, (*Typha angustifolia*) occurred on all the shorelines and beds of soft-stemmed bulrush, (*Scirpus validus*) were found farther from shore.

Center Lake

Belonger (1969) found muskgrass and spiny naiad, (*Najas marina*) to be the most common plants within Center Lake, especially from the shoreline to 4.5 feet. Coontail was also common in some areas. Various other species such as pondweeds, milfoil, eel grass, common waterweed (*Elodea Canadensis*), previously (*Anacharis*) and bladderwort were found throughout the vegetated areas. Stands of white and yellow water lilies occurred along many shorelines with some duckweed, (*Lemna minor*). Emergents along the shoreline included cattail, waterwillow, (*Decodon* verticillatus), soft-stem bulrush and arrowhead, (*Sagittaria*). A maximum rooting depth was found to be 11 feet, although many areas having depths between 5 and 11 feet were devoid of vegetation.

Wildlife and Fishery Resources

Camp Lake

Camp Lake has extensive wetland and aquatic plant beds, both sustaining important wildlife and fishery resources. The floating mats of cattails along the entire southern part of the lake provide nesting habitat for marsh-nesting birds such as American coot, Gallinule, and Pied-billed grebe. Canada geese, Blue-winged teal, and Mallards are commonly seen throughout the lake during the breeding season. Sandhill cranes nest within the Valmar Marsh, which flows into Camp Lake Canal. During migration, large flocks of waterfowl congregate on the lake. The shallow, well-vegetated flats in the lake provide excellent feeding and migratory stopping grounds for puddle and particularly diving ducks.

The quality of the Camp Lake fishery is moderate, and the lake is susceptible to periodic winterkill due to shallow depths. Panfish, northern pike and largemouth bass are the most common gamefish in the lake. Rough fish are a problem. Currently stocking walleye continues on both lakes.

Recent fishery surveys done in 2003 by the WDNR indicate that species diversity and overall numbers are similar to past surveys. A July 2004 fish survey by John Lyons, WDNR using shoreline seines was similar to those done in 1975 and 1978 but found slightly less overall species diversity. However, David Marshall, WDNR states that sustaining healthy aquatic plant beds in the lake are absolutely essential for sustaining a healthy fishery including rare fish species. The extensive bulrush beds, emergent plants, floating-leaf beds and diverse submersed plant communities are the reason rare fish species still flourish in Camp Lake. See email dated August 25, 2400 in Appendix C.

Center Lake

The wetland areas along the northeastern and eastern perimeter of the lake provide wildlife habitat. Muskrat, mink, and other common wetland associated wildlife are likely inhabitants. Red-winged blackbirds, Common yellowthroats and Marsh wrens would be expected throughout the marshes. Migratory waterfowl also use this lake for stopover.

Center Lake's fishery is healthy and self-sustaining. The major game fish include crappie, bluegill, largemouth bass, northern pike and walleye.

Weevil Stocking and Results

In July 1999 an initial survey for weevil was conducted on both lakes. An indigenous population of weevils was present at stocking sites on both lakes. Seven thousand weevils were stocked in two areas on Camp Lake and three thousand weevils were stocked in one area of Center Lake in dense areas of Eurasian water milfoil (EnviroScience 1999). An August 1999 survey showed mild damage to Eurasian water milfoil beds in Camp Lake and very little damage to Eurasian water milfoil beds in Center Lake.

Survey results in August 2000 concluded that weevil population in Camp and Center Lakes had not become fully established due to premature harvesting (EnviroScience 1999). In 2001, the Lake District restocked weevils in both lakes. Weevils were attached to Eurasian Milfoil beds on both Camp and Center Lakes in 2001 and no visual effect was noticed in either area in 2001 or 2002. However, in 2003 the areas treated on both lakes had Eurasian Milfoil with noticeable weevil stem damage. In 2004 Eurasian Milfoil was virtually non existent on Camp

Lake. However, the cause of this is unknown. It is also important to note that other lakes in southeastern Wisconsin experienced the same lack of Eurasian Milfoil that year. In 2005, Eurasian Milfoil was once again abundant in both Camp and Center Lakes and no areas on either lake showed any evidence of weevils or stem damage (personal communication, Dennis Faber, CCLRD).

RECREATIONAL USES

A calculation of usable acreage that includes a “resource carrying capacity” by lake includes surface water area from the deepest part of a lake to a five-foot depth minus the area of quality aquatic plants (Korth and Dudiak, 2002). Hey and Associates calculated the area of native aquatic plants and excluded the area near the center of the lakes that are almost exclusively Eurasian water milfoil and nuisance levels of coontail. For example, using this calculation Camp Lake would have a usable water area of about 120 acres. Center Lake would have a useable water area of about 71 acres.

Camp and Center Lakes provide multiple use types of recreational uses including boating, fishing, swimming, water skiing, ice fishing, ice-skating and snowmobiling.

Camp Lake has two public boating access sites. The Wisconsin Department of Natural Resources owns one boat launch located on the south side of the lake and provides 15 vehicle-trailer parking spaces. The Town of Salem owns a boat launch on the west side of the lake providing public access. Check with Town for parking regulations or restrictions.

Center Lake has one public access point. The Town of Salem owns the boating launch located on the northwest side of the lake. The local town parking restrictions regulate roadside parking.

RESULTS OF THE 2004 AQUATIC PLANT SURVEY

The 2004 aquatic plant survey was conducted using the guidelines adopted by the WDNR. The macrophyte survey procedures are based on the grid sampling method of Jessen and Lound (1962) and recently modified by Deppe and Lathrop (1992). The method utilizes a grid system determined by the size and morphology of the lake, adequate to achieve transects to survey all major aquatic plant communities and specific areas of interest. No attempts were made to catalog riparian wetland areas. Transects were established on both lakes beginning in the shallow water and continuing to deep water devoid of vegetation.

Data were collected at regular intervals with a garden rake on a graduated pole. Aquatic plants were sampled at 2 feet, 5 feet, 8 feet and 11 feet depth. Due to unusually high water level during the survey, the actual normal water level survey depths would be 1.5 feet, 4.5 feet, 7.5 feet and 10.5 feet. Additional points were sampled on shallow, long transects to incorporate the mapping of aquatic plant communities.

A comparison of the results from the 1995 survey to the 2004 survey may show a possible trend of an increased frequency of Eurasian water milfoil and a decrease in frequency of Eel grass as shown in Table 7. It may be possible that changes such as this could be a result of past management activities.

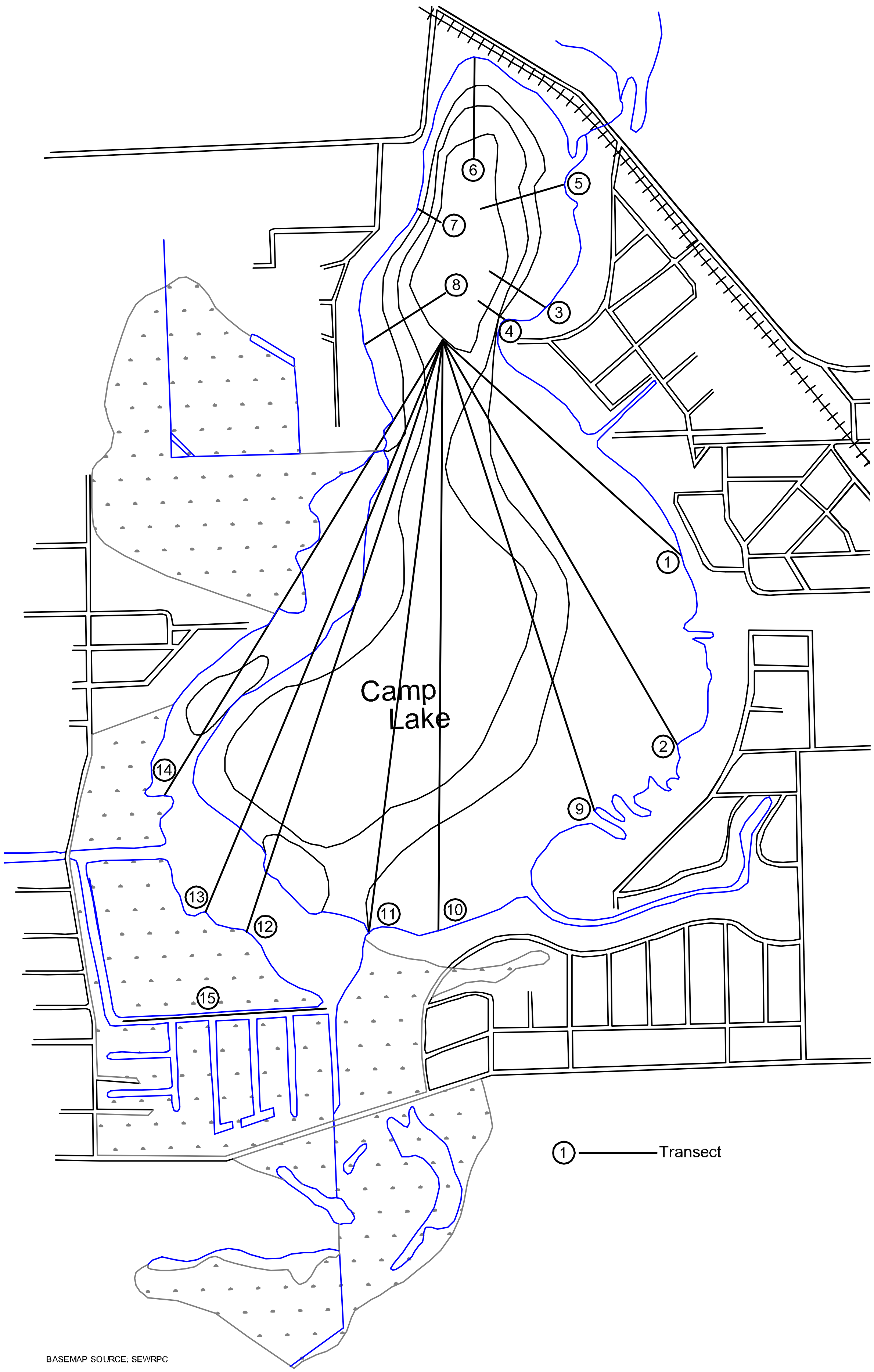
Additional information during the fieldwork included substrate composition and wildlife observations. Secchi depth was documented during the sampling period.

Camp Lake

A total of 14 transects were surveyed on June 17, 24, and July 1, 2004 to categorize the vegetation communities and distribution within Camp Lake (Exhibit 4). Exhibit 5 is an aquatic vegetation map representing the dominant species within major depth categories. Secchi depth was 3 feet during the sampling period. Maximum rooting depth was about 13 feet. The littoral zone occupies 95 percent of the lake area, with 21 acres devoid of submerged or emergent vegetation. A total of 15 species were encountered during the transect surveys (Table 6).

The four most common aquatic plant species within Camp Lake are Eurasian water milfoil, coontail, Wigeon grass, and muskgrass that were found at the sampling points approximately 77 percent; 44 percent; 53 percent and 26 percent of the time, respectively.

Wigeon grass is especially common in the central portion of the southern lobe of the lake were it was found at all sampling depths but was more dense between 5-foot and 8-foot depths. Though wigeon grass may not be considered a native plant in Wisconsin, it is commonly found in the northern prairie pothole region and the eastern Great Lakes (Fassett, 1960; Nichols and Vinnie, 1991). Wigeon grass has been reported in only five lakes in Wisconsin (Nichols and Martin, 1990). The exact cause of the extensive population of wigeon grass in Camp Lake given the apparent scarce statewide distribution is unknown at this time.



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LEGEND

No.	Revision/Issue	Date
1	Revised Transect Lines	01/03/05

Hey and Associates, Inc.
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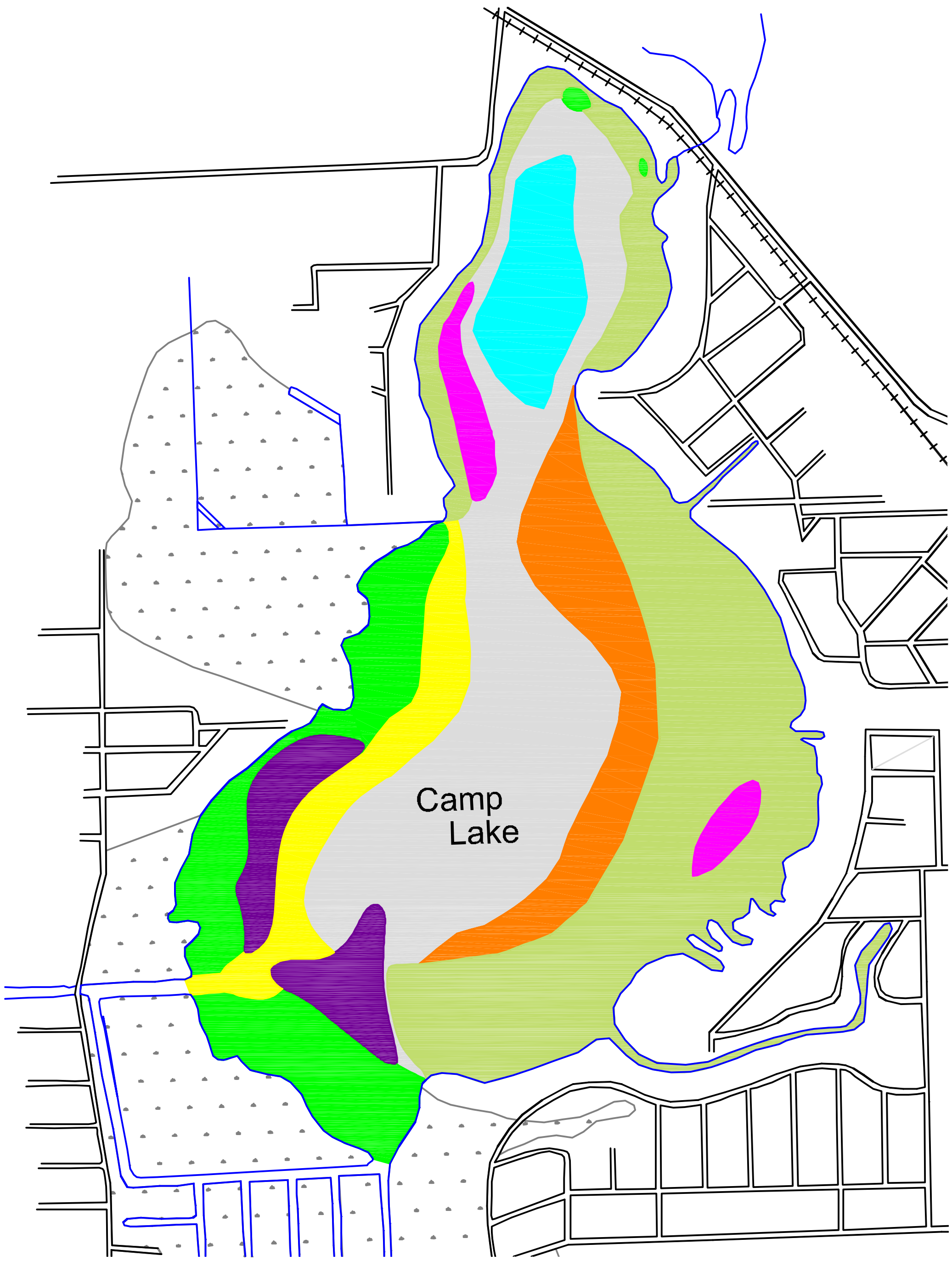
Camp and Center Lake Rehabilitation District

Camp Lake Aquatic Plant Monitoring Transects

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	4
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			



BASEMAP SOURCE: SEWRPC

- *Wigeon Grass, Eurasian Water Milfoil, Native Milfoil and Coontail (With Water Stargrass, Eel Grass, Brushy Pondweed, Flat–stem Pondweed and White Water Lily)*
- *White Water Lily and Yellow Water Lily (Significant Aquatic Resources)*
- *Eurasian Water Milfoil, Coontail, Wigeon Grass and Sago Pondweed*
- *Eurasian Water Milfoil, Coontail and Wigeon Grass*
- *Wigeon Grass, Native Milfoil, Floating Leaf Pondweed, Small Leaf Pondweed Pondweeds, Muskgrass and Bladderwort*
- *Hard–stem Bulrush and Muskgrass (Significant Aquatic Resources)*
- *Dense Area of Eurasian Water Milfoil*
- *Open Water*

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LEGEND

Revision/Issue	Date

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Camp and Center Lake Rehabilitation District

Center Lake Aquatic Plant Communities

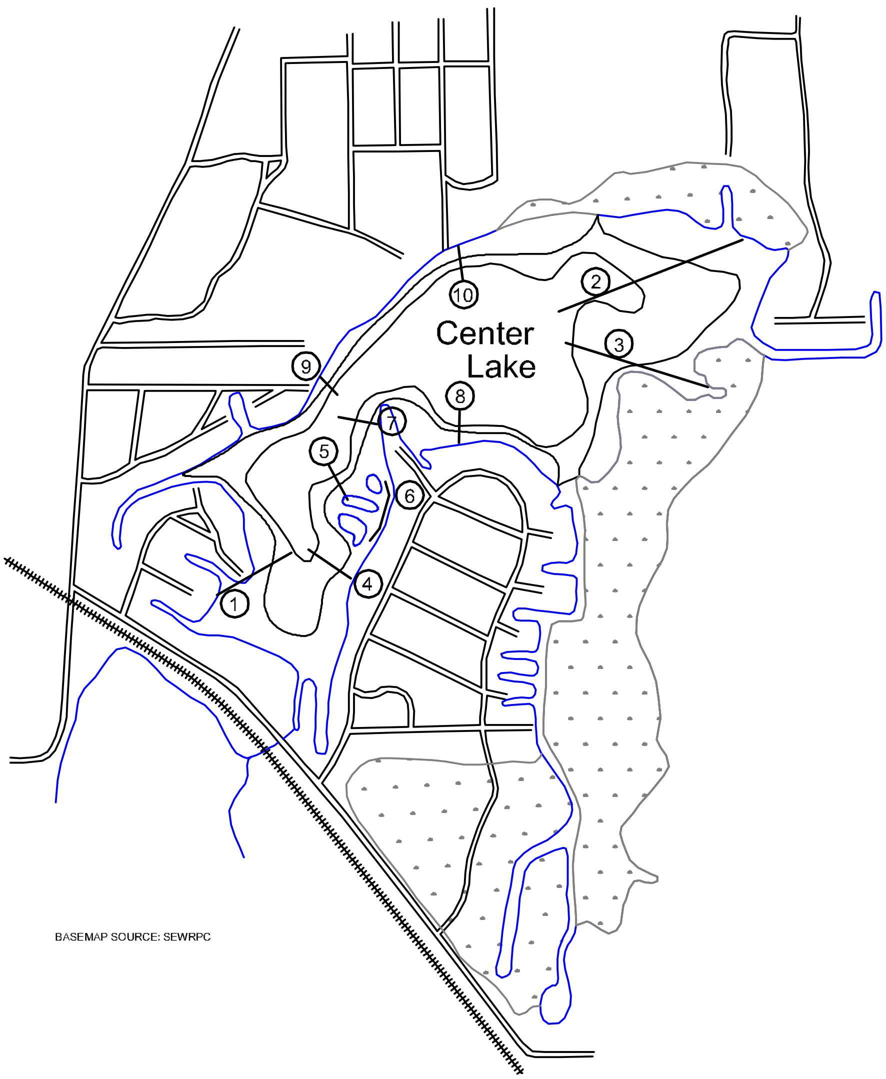
PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	5
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			

Center Lake

A total of 11 transects were surveyed on June 17, and July 1, 2004 to categorize the vegetation communities and distribution within Camp Lake (Exhibit 6). Exhibit 7 is an aquatic vegetation map representing the dominant species within major depth categories. Secchi depth was 3 feet during the sampling period. Maximum rooting depth was about 12 feet. The littoral zone occupies 73 percent of the lake area, with 35 acres devoid of submerged or emergent vegetation. A total of 10 species were encountered during the transect surveys (Table 6).

The four most common aquatic plant species within Center Lake are Eurasian water milfoil, coontail, eel grass, and bushy pondweed that were found at the sampling points approximately 95 percent; 78 percent; 26 percent and 22 percent of the time, respectively.

Diversity and lower density of aquatic plants in Center Lake as compared to Camp Lake are likely due primarily to water quality and water clarity impacts. Since clear and or shallow water tends to grow more macrophytic vegetation than turbid water, lower Secchi disk readings and poor clarity of the water would suggest lower plant densities. The shallower rooting depth and limited Secchi depths follow similar trends found by Canfield et al (1985). Narrower littoral zones and limited light availability restricted the plant densities mostly to the near shore areas. Also, Center Lake does have sandier substrates in the non-channel areas than does Camp Lake, which naturally limits most plant densities.



1 ——— Transect

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LEGEND

No.	Revision/Issue	Date
1	Revised Transect Lines	12/30/04

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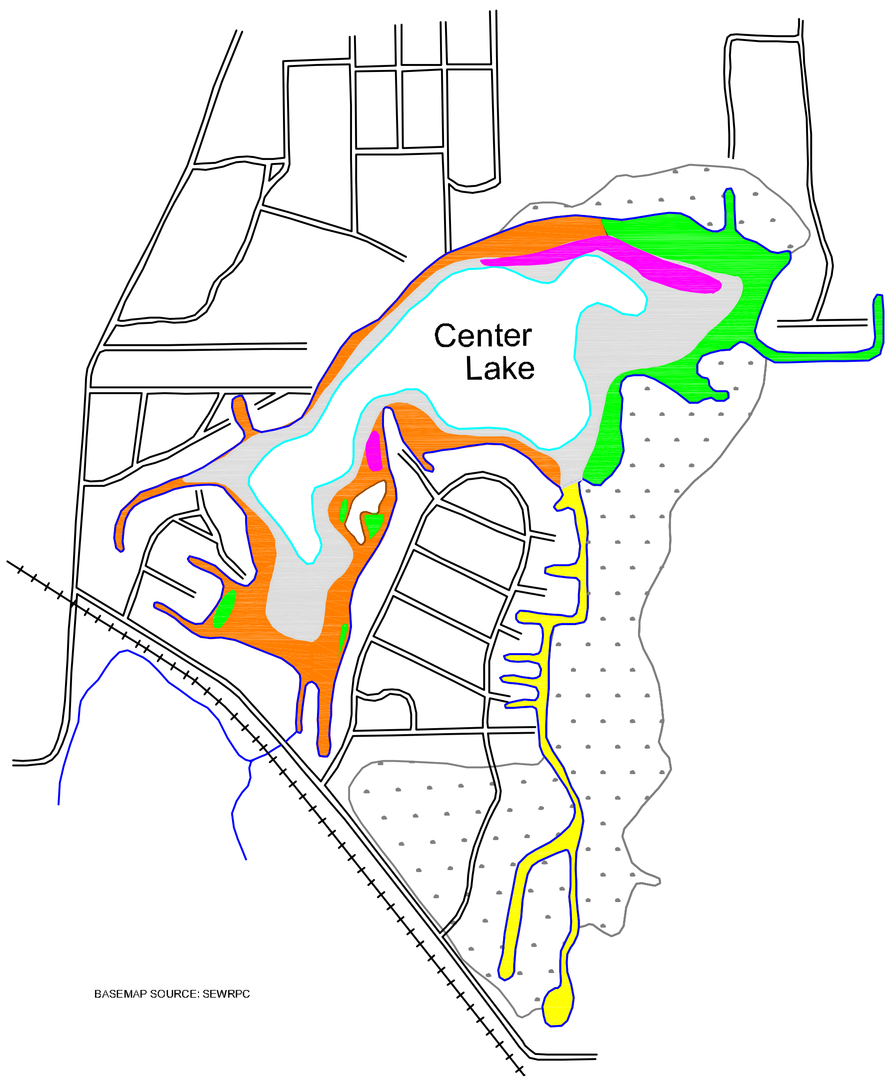
Camp and Center Lake Rehabilitation District

Center Lake Aquatic Plant Monitoring Transects

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	6
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			



- *White Water Lily, Yellow Water Lily, Coontail, Eurasian Water Milfoil, Sago Pondweed and Duckweed*
- *Coontail, Eurasian Water Milfoil and Duckweed*
- *Eurasian Water Milfoil, Coontail, Bushy Pondweed, Eelgrass, Muskgrass, Saggo Pondweed and Wigeon Grass*
- *Eurasian Water Milfoil and Coontail*
- *Dense Area of Eurasian Water Milfoil*
- *Cattails and Waterwillow*
- *Open Water*

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LEGEND

No.	Revision/Issue	Date

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Camp and Center Lake Rehabilitation District

Center Lake Aquatic Plant Communities

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	7
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			

Table 6
Camp and Center Lakes Aquatic Plant Surveys: June and July 2004

Aquatic Plant Species	Found at Sites		Percent Frequency of Occurrence		Density Found at Sites[b]		Density at All Sites[b]		Percent Relative Frequency of Occurrence[c]	
	Camp Lake	Center Lake	Camp Lake	Center Lake	Camp Lake	Center Lake	Camp Lake	Center Lake	Camp Lake	Center Lake
Coontail *(Ceratophyllum demersum)*	22	32	44.9	78.0	2.9	2.8	1.3	2.2	12.4	26.2
Muskgrass *(Chara vulgaris)*	13	8	26.5	19.5	2.2	2.3	0.6	0.4	7.3	6.6
Common waterweed *(Elodea canadensis)*	1	- -	2.0	- -	1.0	- -	0.02	- -	0.6	- -
Eurasian water milfoil *(Myriophyllum spicatum)* [d]	38	39	77.6	95.1	2.9	3.5	2.2	3.3	21.3	32.0
Native water milfoil *(Myriophyllum* sp.*)*	12	- -	24.5	- -	2.3	- -	0.6	- -	6.7	- -
Bushy pondweed *(Najas flexilis)*	11	9	22.4	22.0	1.8	2.2	0.4	0.5	6.2	7.4
Curly-leaf pondweed *(Potamogeton crispus)* [d]	2	2	4.1	4.9	1.5	1.0	0.1	<0.1	1.1	1.6
Variable pondweed *(Potamogeton gramineus)*	1	3	2.0	7.3	2.0	1.3	<0.1	0.1	0.6	2.5
Illinois pondweed *(Potamogeton illinoensis)* [e]	- -	1	- -	2.4	- -	1.0	- -	<0.1	- -	0.8
Floating-leaf pondweed *(Potamogeton natans)* [e]	3	- -	6.1	- -	1.0	- -	0.1	- -	1.7	- -
Sago pondweed *(Potamogeton pectinatus)* [e]	12	7	24.5	17.1	1.4	1.4	0.3	0.2	6.7	5.7
Small pondweed *(Potamogeton (pusillus?))*	1	- -	2.0	- -	3.0	- -	0.1	- -	0.6	- -
Flat-stem pondweed *(Potamogeton zosteriformis)*	3	- -	6.1	- -	1.0	- -	0.1	- -	1.7	- -
Wigeon grass *(Ruppia maritima)*	26	6	53.1	14.6	2.2	1.8	1.1	0.3	14.6	4.9
Eel grass *(Vallisneria americana)* [e]	6	11	12.2	26.8	1.2	1.8	0.1	0.5	3.4	9.0
Water star grass *(Zosterella dubia)*	4	- -	8.2	- -	1.3	- -	0.1	- -	2.2	- -
Filamentous algae *(Cladophora* sp. ?*)*	23	4	46.9	9.8	2.3	1.8	1.1	0.2	12.9	3.3

NOTE: A total of 49 points were sampled in Camp Lake on June17, 24, and July 1, 2004. A total of 41 points were sampled in Center Lake on June 17 and July 1, 2004. The maximum water depth for aquatic plant growth during the survey was 13 feet in Camp Lake and 12 feet in Center Lake.

[a]A maximum frequency equals 100.

[b]Density range is from 0.0 to 5.0. Absent (density rating equals zero), Scarce (density rating equals 1to 2), Common (density rating equals 2 to 3), Abundant (density rating of 3 to 4) and Dense (density rating of 4 to 5). A maximum density equals 5.0.

[c]Total relative frequency of occurrence equals 100 percent.

[d]Invasive or nonnative plant species as listed in Section NR 109.07 of the Wisconsin Administrative Code.

[e]Considered a high value species of aquatic plants as listed in Section NR 107.08 (4) of the Wisconsin Administrative Code.

***Source**: Hey and Associates, Inc.*

Table 7
Species Summary Table (From Transect Survey)
On Camp and Center Lakes: 1995 Vs 2004

	Percent Frequency of Occurrence[a]		Percent Frequency of Occurrence[a]	
Plant Species	**Camp Lake 1995**	**Camp Lake 2004**	**Center Lake 1995**	**Center Lake 2004**
Ceratophyllum demersum	81.65	44.9	71.43	78.0
Chara vulgaris	10.09	26.5	28.57	19.5
Elodea canadensis	5.50	2.0	- -	- -
Zosterella dubia	9.17	8.2	8.16	- -
Lemna minor	3.67	- -[b]	2.04	- -[b]
Myriophyllum exalbescens	51.38	- -	4.08	- -
Myriophyllum spicatum	61.47	77.6	83.67	95.1
Myriophyllum verticillatum	2.75	- -	- -	- -
Myriophyllum spp.	- -	24.5	- -	- -
Najas flexilis	0.92	22.4	- -	22.0
Najas guadelepensis	17.43	- -	8.16	- -
Najas marina	0.00	- -	44.90	- -
Nuphar advena	2.75	- -[b]	6.12	- -[b]
Nuphar variegatum	0.92	- -[b]	2.04	- -[b]
Nymphaea odorata	5.50	- -[b]	8.16	- -[b]
Nymphaea tuberosa	17.43	- -[b]	8.16	- -[b]
Polygonum amphibium	0.92	- -	- -	- -
Pontedaria cordata	0.92	- -[b]	- -	- -[b]
Potamogeton amplifolius[c]	4.59	- -	- -	- -
Potamogeton crispus	0.92	4.1	10.20	4.9
Potamogeton gramineus	5.50	2.0	4.08	7.3
Potamogeton illinoensis[c]	- -	- -	- -	2.4
Potamogeton natans	4.59	6.1	- -	- -
Potamogeton nodosus	2.75	- -	- -	- -
Potamogeton pectinatus[c]	15.60	24.5	42.86	17.1
Potamogeton richardsonii[c]	10.09	- -	- -	- -
Potamogeton zosteriformis	3.67	6.1	- -	- -
Potamogeton (pusillus?)	- -	2.0	- -	- -
Potamogeton spp.	6.42	- -	8.16	- -
Ruppia maritima	91.74	53.1	6.12	14.6
Scirpus acutus[c]	2.75	- -[b]	- -	- -[b]
Scirpus pungens	0.92	- -[b]	- -	- -[b]
Sparganium eurycarpum	0.92	- -[b]	- -	- -[b]
Typha angustifolia	0.92	- -[b]	4.08	- -[b]
Utricularia vulgaris	12.84	- -	4.08	- -
Vallisneria americana[c]	18.35	12.2	40.82	26.8
Zannichellia palustris[c]	1.83	- -	- -	- -

[a] Maximum number equals 100.
[b] Floating-leaved and emergent vegetation was not statistically measured using the Jesson and Lound sampling method.
[c] High value plant species under Wisconsin Administrative Code NR 107.

The diversity could be affected by the water clarity and predominance of nuisance species such as coontail, curly-leaved pondweed and Eurasian water milfoil. Center Lake is upstream of Camp Lake and acts as a large filtering pond, promoting sediment deposition and some nutrient uptake prior to discharge to Camp Lake.

Initially, Hey and Associates, Inc. conducted an aquatic plant survey in 1995 and Table 7 compares the percent frequency of occurrence between the two lake during the sample years of 1995 and 2004. Observations by the Lake District and local lake uses have noticed a lack of dense Eurasian water milfoil during the 2004 growing season. Since Eurasian water milfoil is cyclic in nature and most of our lakes do experience similar low Eurasian water milfoil biomass years. It is suggested that because of late ice out on the lakes, unusually high levels of spring rainfall that brought in additional nutrients from the surrounding watershed and increased suspended materials in the water column may have increased nutrients and lowered water clarity giving algae the advantage over Eurasian water milfoil in the competition for light and nutrients. Though the Eurasian water milfoil may not have been as dense in 2004 the overall distribution of Eurasian water milfoil within the lakes may be more widespread than during the 1995 survey, as shown in Table 7.

ALTERNATIVES FOR AQUATIC PLANT CONTROL

Various methods of aquatic plant control are available to lake managers, including dredging, mechanical harvesting, herbicide usage, and shading, among others (Dunst, et al, 1974; Nichols, 1991; Engels, 1990; Winkelman and Lathrop, 1993). Some of the techniques are impractical on a large scale, since the actual biomass and surface area for treatment are often too extensive for the techniques to be effective. Other techniques have drastic impacts on other lake functions. Appendix A provides an overall summary of aquatic plant management options.

Manual Harvesting

Hand cutting tools and weed “rollers” are manufactured for use by residence owners to clear areas along piers. This equipment allows for “manicuring” small areas for recreational use, although it cannot remove much plant material on a large scale or in deeper water. Similarly, several types of specialty rakes and drags are made to clear small areas of aquatic plants. McComas (1993) provides a useful summary of available equipment and manufacturers. These items are relatively inexpensive but are labor intensive and impractical if the aquatic plants are dense or large in area. Manual harvesting is limited to clearing an area no more than 30 feet in width that includes dock and existent swimming beaches on a riparian property. Clearing more than 30 feet wide will need a permit. However, Eurasian water milfoil and Curly-leaf pondweed may be removed from the whole riparian property without obtaining a permit.

Mechanical Harvesting

Mechanical harvesting is a popular and effective means of selectively controlling large or small areas of aquatic plants. Aquatic plants are cut generally about 5 feet below the surface of the water and removed from the lake to be trucked to a disposal site. Aquatic plants are cut at a depth which will minimize lake-user conflicts with nuisance levels of plant within harvested areas, while still providing some habitat structure for fish and invertebrates. Harvesting can be used to create openings in dense aquatic vegetation allowing predatory fish to more effectively seek out panfish that may otherwise become stunted.

Harvesting equipment can disturb bottom sediments and plant fragments can spread or be blown by the wind to shoreline area. A harvesting program should focus on controlling dense area of nuisance aquatic plants while managing for a health aquatic plant community.

Substrate Barriers

Another technique available to limit aquatic plant growth is to install mats or barrier fabric on the lake bottom, thereby shading out the vegetation. These barriers are best installed in the spring after fish spawning but before dense plant growth. The fabric is attached to the lake bottom during the growing season and removed during the winter. This technique works best in limited areas of shallow water where installation is the easiest. The WDNR should be consulted prior to installation, as these activities may require a permit.

Dredging

The potential for dredging specific areas in both lakes has been considered by the District, which commissioned a dredging feasibility study (R.A. Smith and Associates, Inc., 1994). Cost constraints (estimated cost of over $1 million) and permitting requirements make dredging an unattractive option at this point in time. Dredging would alleviate some of the access problems in shallow channels and near shore areas along private shorelines. However, dredging can lead to a decrease in plant species diversity and cause a shift toward disturbance tolerant species such as Eurasian water milfoil (Nichols, 1984). Also, the major aquatic plant problem areas on Camp Lake would not be addressed.

Aquatic Herbicides

Aquatic herbicide usage can provide excellent plant control when properly applied. For instance a public swimming beach might use a non-selective herbicide to control aquatic plants in a relatively small area. While spot herbicide treatments targeting only invasive species such as Eurasian water milfoil or Curly-leaf pondweed might occur in selected area on a lake. Aquatic herbicides are available in various chemical forms and applications, with the proper chemical chosen depending on target species and growth forms. Diquat, 2,4-D, Endothall, copper compounds and alum are described in Appendix A. The average cost of commercial aquatic herbicide runs approximately $200-350 an acre. Permits are needed from the WDNR, including approved quantities, chemicals and application area.

Biological Controls

Biological controls offer an alternative approach to controlling nuisance aquatic plants.

The weevil *Euhrychiopsis lecontei* is suspected to cause declines in Eurasian water milfoil in many lakes around the United States (Jester, Bozek, Helsel and Sheldon, 2000). Still the effectiveness of stocking weevil into lakes has yet to be clearly documented. Weevils cause damage to the plant stem of water milfoil. Weevils overwinter in leaf litter along shoreline and returns to milfoil bed to lay eggs in the spring on the host milfoil plants.

Research using a fungus *Mycoleptodiscus terredtris* to control Eurasian water milfoil is receiving some recent attention.

Grass carp, *Ctenopharyngodon idella* is an exotic fish that feeds on aquatic vegetation and can be effective in lowering densities of some pondweeds. The State of Wisconsin does not allow Grass carp to be used.

Boating Ordinances

No wake zones can protect shallow areas, reduce shoreline erosion, lake bottom scouring and may be used to protect ecologically significant areas. Currently the Town of Salem enforces a 200-foot no wake area from the shoreline lakeward.

Public Information and Education

Providing information to lake property owners and lake users on the benefits of a healthy aquatic plant community including the management issues in controlling nuisance aquatic plants. Annual meetings, newsletters and informational materials provided by the Department of Natural Resources and the University of Wisconsin-Extension can assist lake users in understanding the many areas of aquatic plant management and ways to protect lakes from other invasive species. Encourage and support one or two volunteers from each lake in lake participating in the DNR-Self Help Lake Monitoring Program to assist in monitoring overall health of the lakes.

AQUATIC PLANT HARVESTING EQUIPMENT PAST AND PRESENT

The District decided at its 1991 annual meeting to adopt a policy of no District sponsored herbicide usage on either Camp or Center Lake. The most popular choice by District constituents was to institute a mechanical harvesting program to be conducted by a private contractor. At the same time, it was decided to begin budgeting set-aside monies in anticipation of the District purchasing its own harvesting equipment at some time in the future.

The Lake District currently owns and operates two Aquarius Systems HM-420 aquatic plant harvesters, one transporter, two shore conveyors and one dump truck. The purpose of the each harvester is to accomplish harvesting in recreational boating use area and boating accessing channels and fishing lanes. However, there are certain times when aquatic plant growth on either of the lakes requires both harvesters to be working on one lake at the same time.

In 2001 the district was asked by the WDNR to submit harvesting records at the end of the season in accordance with NR 109. In 2002 the total dump truck load harvest was Camp Lake 635.95 loads, Center Lake 94.5 loads, for a total of 730.45 from both Lakes. In 2003 the total dump truck harvest was Camp Lake 670.5 loads, Center Lake 127.5 for a total of 796. In 2004 the total dump truck harvest was Camp Lake 104.2 loads, Center Lake 215 loads for a total of 319.2 loads.

The Lake District may want to consider the purchase of an addition 4-foot width cut harvester to accomplish the need of both lakes that include harvesting in areas near or between piers and in shallow channels.

An additional harvester or transporter could be used for a shoreline pickup program. This equipment could be used to collect aquatic plant material manually harvested or floating plant material washed along shoreline that is collected by residents and piled at the ends of piers or piled along shorelines for removal by the District. This program may leave controlling some or all aquatic plant control along piers and shorelines to the residents and it may be problematic for those resident unable to accomplish these task such as the elderly or some seasonal or weekend residents.

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

Goals and Objectives for Camp and Center Lakes

Goals:

1. Provide nuisance aquatic plant control to increase lake use and access, while protecting diverse aquatic natural resources.
2. Utilize mechanical harvesting techniques for aquatic plant management. While pursuing the use of -aquatic herbicides, biological controls, boating ordinances and public education as other aquatic plant control options.
3. Educate district landowners about benefits of aquatic vegetation and various near shore aquatic plant control options.
4. Provide better recreational opportunities through aquatic plant management, especially nuisance plant species.
5. Protect and restore valuable wildlife and fish habitats.
6. Evaluate the efficacy and environmental impacts of the plant management activities.

Objectives:

1. Provide access lanes to all public and private boat access points Mechanical harvesting will be used in lanes with water depths greater than three feet. Permitted aquatic herbicide treatments may be used in water depths less than three feet for access lanes.
2. Cut access lanes in water depths greater than three feet to enhance navigation to open water from residential properties. Permitted aquatic herbicide treatments may be used in water depths less than three feet for access lanes.
3. Continue to control the nuisance aquatic plants including coontail, Eurasian water milfoil and widgeon grass to promote the growth of desirable native plants.
4. Restrict aquatic plant harvesting in high quality aquatic plant communities (Significant aquatic resources).
5. Specific harvesting areas will be recommended by the District appointed "Weed Scout" by severity of growth, prevailing weather conditions and water depths. The CCLRD Board has the authority to override the Weed Scout harvesting recommendations that does not follow the recommendations in the Aquatic Plant Management Plan for Camp and Center Lakes. The "Weed Scout will document and file all recommendations, and submit copies to the District Board with the annual report.
6. The "Weed Scout" will help determine when fish spawning has completed and near shore aquatic plant harvesting can begin. (See Appendix C)
7. Create fishing access lanes in dense plant beds for use by fisherman and predator fishes.
8. Minimize the spread of Eurasian water milfoil from propeller cutting and lake bottom scouring in shallow water by utilizing deeper open water areas for more intensive

recreational watercraft use. Proposed signs or lake maps at public boat access sites will provide first time lake users information on no wake zones and lake water depths.

9. Conduct a professional aquatic plant survey every five years to review and refine harvesting activities and formulate recommended actions to update the current aquatic plant management plan.
10. Use of aquatic herbicides is a small-scale, designed beta-test area to control the spread of invasive exotic species. Monitor and collect data on the effectiveness of this aquatic plant control measure. Apply aquatic herbicide in 3 foot or less depths of water to create access and/or navigation channels. CCLRD has identified certain general, access and/or navigational areas for the use of aquatic herbicides on an annual basis. Aquatic herbicides will be applied as early as possible each calendar year (i.e. May and/or June) in order to treat the spread of invasive species early in the growing season before plant mass and densities become prohibitive. CCLRD will use its best efforts to collect data on the effectiveness of the aquatic plant control measure each year under this plan and present the findings to the public at the Lake District's Annual Meeting.
11. The District can provide educational handouts such as those provided by UW-Extension and WDNR relating to aquatic plant protection and control options and to provide updated information on potential invasive as available.
12. Provide multiple types of recreation uses including boating, fishing, swimming, water-skiing, snowmobiling, ice fishing, and ice-skating through public access and aquatic plant management.

NOTES:

1. No harvesting in less than 3-foot of depth.
2. Conduct open lake harvesting after applying aquatic herbicides to control nuisance plants in channels and pier areas and after fish spawning.
3. "Weed Scout" should survey all non-channel areas prior to harvesting.
4. Proposed harvesting zones are approximate. Actual harvesting lane widths and intensities should be determined annually.

Aquatic Plant Management Recommendations

Specific areas on both lakes will continue to need harvesting repeatedly each year, concentrating on removing nuisance levels of aquatic plants to provide navigation and areas to allow recreational boating and fishing activities. The key goal of the harvesting program must be adequate control of aquatic plants (especially nuisance species) in common use areas of the lakes, while protecting ecologically important aquatic resources (Table 8).

Table 8
Aquatic Plant Management Recommendations for Different Areas of Lakes

	No Restriction Area	Watch Area	Sensitive Area
Criteria	Areas of lake with limited plant diversity; high densities of nuisance species	Areas which contain increasing densities of desirable species, decreasing densities of nuisance species	High diversity of desirable native species; significant wildlife and fish habitat
Aquatic Plant Management	▪ Maximize plant harvesting to meet recreational demands ▪ No harvesting in less than three-foot depth except for access channels. ▪ Prior to harvesting, monitor for relative densities of nuisance and desirable species	▪ Maximize harvesting if only nuisance species present ▪ Management should emphasize harvesting of nuisance species by varying cutting depths when desirable species are encountered through rake sampling ▪ Potential for lake plant restoration through long-term control of nuisance species	▪ Strictly prohibited except for channel clearing only ▪ Harvesting restricted to boat access only ▪ Some strategic harvesting possible for approved fish management projects
Aquatic Plant Harvesting	Maximized under most conditions	Few restrictions, unless desirable species dominate	Prohibited, except for channel clearing
Aquatic Herbicide Treatment	Primary use in access channels with water depths less than three feet	For spot treatments of areas dominated by nuisance non-native aquatic plant species	Not recommended except in special instances for spot treatments of areas dominated by nuisance non-native aquatic plant species
Activity Restrictions	None	None	Limited boat traffic; No Wake zones

Prior to the implementation of the annual harvesting program, it would be highly desirable to dispatch a "weed scout" to determine area-specific management strategies for that harvesting period. The "weed scout" could be any reasonably trained person familiar with overall aquatic plant management strategies and basic plant identification (e.g., harvesting contractor personnel, District consultant, lake volunteer, etc.) By executing spot monitoring of the aquatic plant communities within specific areas, priority harvesting zones, cutting depths and intensities can be formulated. Also, information on general plant community trends and water quality (e.g., Secchi depth) can be collected. It would be most appropriate to monitor those areas where plant densities change yearly and where harvesting is not always mandatory. Detailed sampling in areas near access pointes or navigation channel where harvesting will likely take place perennially regardless of the species composition or relative densities rather concentrate sampling efforts in off-shore plant beds where cutting for fishing or water skiing is desirable. The "weed scout" should make an inspection in all non-channel areas at least once per month during the growing seasons to assess the overall species composition and densities to be able to make recommendations for harvesting priorities.

At this point in time, nuisance species shall be defined as those species (native or exotic), which produce excessive biomass as to hinder realistic lake uses. For Camp Lake, these species are coontail, Eurasian water milfoil, and Widgeon grass. For Center Lake, these species are coontail and Eurasian water milfoil.

Limiting disruption of native aquatic plant beds meets long-term management goals by maintaining plant materials for recolonization of areas of the lakes, which now may be dominated by nuisance species. The cyclic nature of Eurasian water milfoil, improvements in the watershed protection and general effectiveness of the harvesting program may promote improved conditions for the increased densities of desirable native species whose growth forms and biomass production tendencies may be more compatible with lake uses (Engel, 1987; Nichols et al, 1988). For example, most pondweeds, wild celery, and water stargrass are desirable native species that generally do not become nuisance species. These species most often grow in lower densities than the nuisance plants and provide excellent wildlife and fish resources. Through limited or reduced harvesting of these and similar species, their populations may flourish and compete with the nuisance species that are being continually harvested. The protection of the desirable species will provide natural "seedbanks" or "plantbanks" for re-establishment into other areas of the lakes. Appendix B provides a flow chart to assist with the development of harvesting strategies based on the aquatic plant density and composition of that cutting period.

Additional options for near shore aquatic plant management can include having lake residents maintain areas of their shoreline as appropriate and the District would manage a shoreline pickup program that would pick up aquatic plants removed by shoreline residents and floating aquatic plants that have washed ashore and pick up by lakeshore residents and piled on the shoreline or at ends of piers as suggested by the District. Shoreline residents are encouraged to help control Eurasian water milfoil and Curly-leaf pondweed by removing them from the near shore area.

Aquatic plant fences can be used in connection with harvesting to prevent cut fragments from drifting and blowing around the lake. The fences are rooted plants that have grown to the surface of the water. At the end of the day plant fragments are collected within these fences. Opening should be left in the plant fences to permit boat travel (UW-Extension, Lakes Management Program, 1988).

Aquatic herbicide treatments may be used to control areas of heavy aquatic plant growth, especially in water depths of less than 3 feet, to allow for navigation in access channels and spot treatments of nuisance non-native aquatic plants. Aquatic herbicides can be applied as a liquid or granular form. Depending upon aquatic plant species targeted, chemical herbicides can be fairly selective for specific aquatic plant control. Treatment areas can require additional herbicide treatments later in the season and/or yearly treatments to acquire desired results. The District will also assist private riparian owners in the permitting and application of aquatic herbicides to reduce the possibility of multiple application times, various application rates and format. The District will only be using granular to help minimize drift), and non-permitted applications. Use of aquatic herbicides should be assessed on an annual basis in coordination with a certified and licensed professional applicator, the District and the WDNR.

Those wanting other options or unable to accomplish manual aquatic plant removal could be considered for aquatic herbicide spot treatments on an individual basis or as might be provided by the District. A permit must be obtained by the Department of Natural Resources before using aquatic herbicides on either of the lakes.

Shoreland Buffers

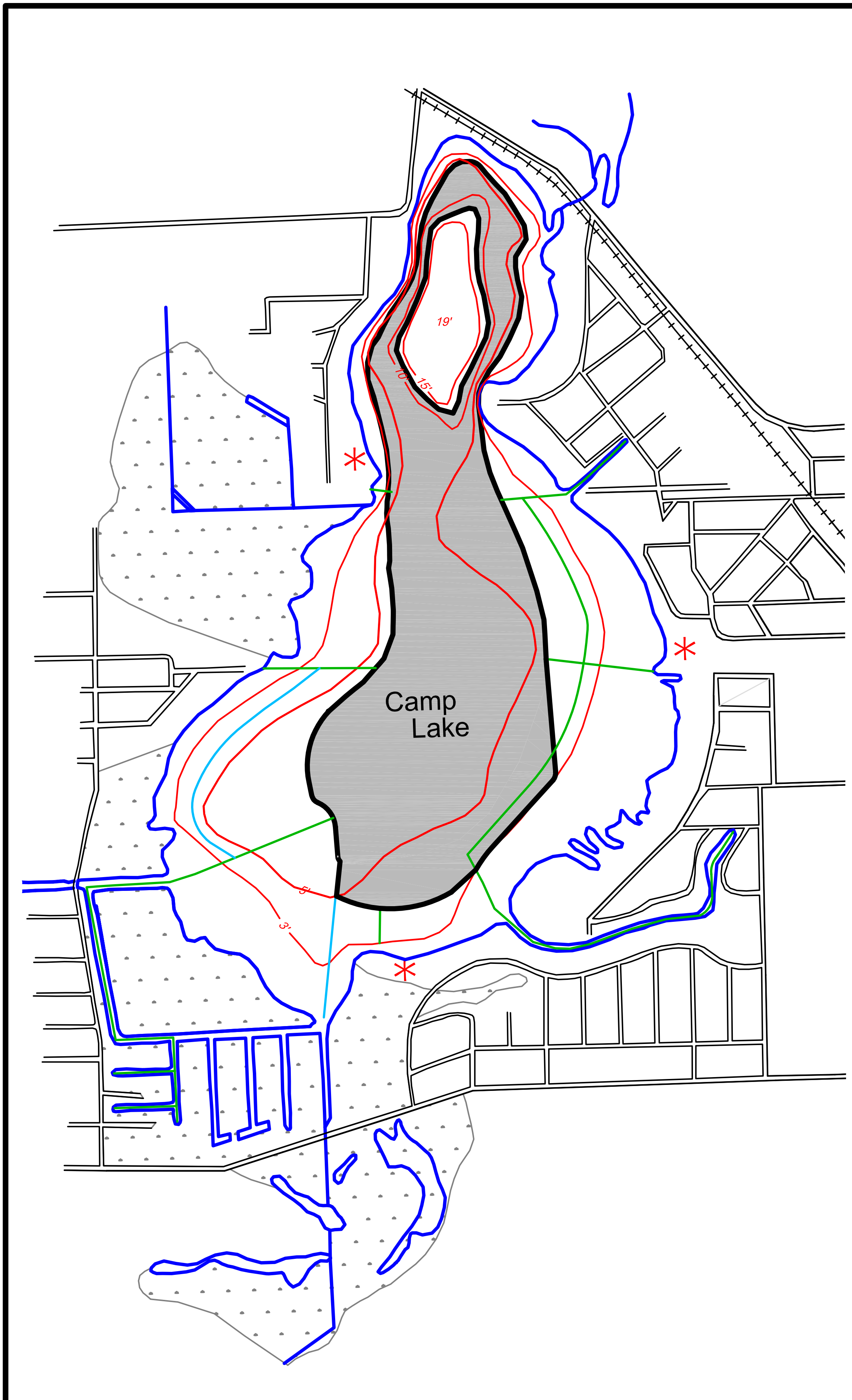
Creating a shoreland buffer can be as basic as leaving a strip of unmowed grass along the shoreline. Additional seeding or planting of native species will support a variety of native birds and wildlife. (UW-Extension, 1994). Dense ground cover buffers helps to slow yard runoff, while proper use of pesticides and fertilizers will prevent excess pollutants and nutrients from reaching the lake. High profile plantings help deter Canada geese from visiting buffered lawns.

Camp Lake

The primary goals of the aquatic plant management program are to increase recreational boating and fishing opportunities by clearing a wide navigation area in the central lake, and channel cutting in the access channels and fishing and fish channels. By far the largest management hurdle is the extensive and dense aquatic plant beds, which occupy much of the southern two thirds of this lake. Water depths generally are less than six feet and often average only three feet. The aquatic plant beds, both submerged and floating leaved growth forms, occupy most of the lake. The northern end of the lake is deeper and water depth tends to control plant growth in that area. However, the shallow shoreline areas also contain dense macrophyte beds. Exhibit 8 shows the approximate current harvesting area and access lanes on Camp Lake.

Exhibit 9 shows the proposed harvesting map and harvesting priorities for Camp Lake. Exhibit 10 shows the planned harvesting areas and access lanes on Camp Lake. Access to and from all boat landings and private piers should be prioritized. A wide navigation area within the lake proper will be necessary to allow multiple recreational uses. The main navigation areas should be harvested at least five cutter widths wide, wider if time permits and plant densities are low.

Cutting needs to be limited in the southeastern and southwestern ends of the lake, roughly corresponding with the water lily and hardstem bulrush beds. Some of these areas contain high numbers of desirable native species and are not suitable or safe for intense recreational uses because of their shallow depth. To increase fishing opportunities, spot harvesting of nonnative nuisance species to create "Fishing Channels" three cutter widths wide in strategic areas for fishing boat access is acceptable as well as, "Fish" channels two cutter widths wide so predatory fish can gain access to the prey fish that live in the dense vegetation, as long as the harvesting does not promote the expansion of undesirable species. Motorboat intrusions into these areas should be kept to a minimum to prevent fragmentation of species such a coontail and Eurasian water milfoil, which may then invade the beds of native species. Also, boat traffic and harvesting should be limited in near shore areas along developed shorelines, which are found to contain low densities of the aforementioned nuisance species. Access for unloading harvested plants onto shore conveyors is located in "Yaws Subdivision" and is located one half miles from dumping site and is the most economical for fuel consumption and allows the fastest turn around or cycle time.



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LEGEND

ACCESS POINTS

LAKE DEPTHS

FISH OR FISHING ACCESS LANES

APPROXIMATE ACCESS CHANNELS

APPROXIMATE HARVESTING AREAS

No.	Revision/Issue	Date
1	Access Channel Revision	06/27/05

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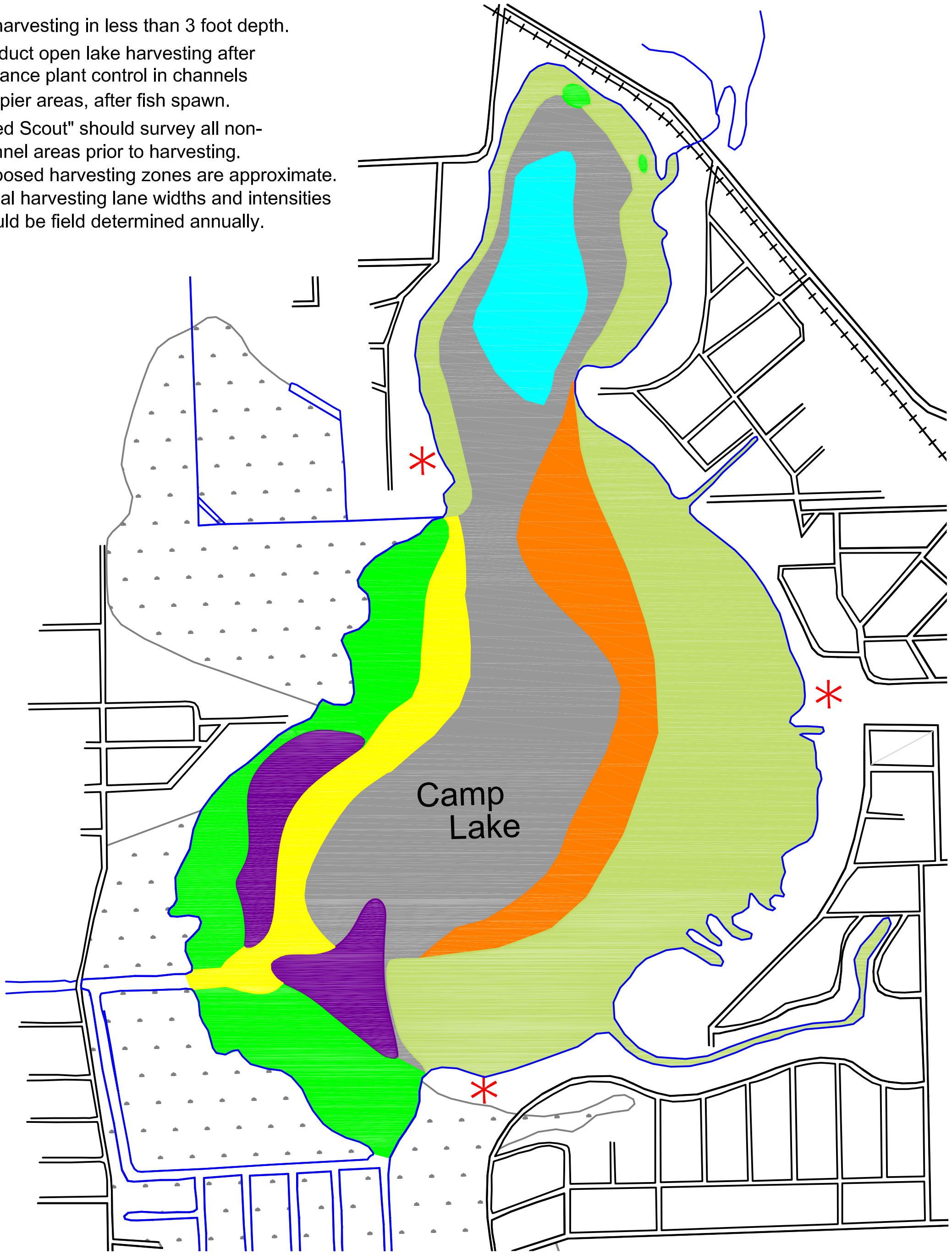
Camp and Center Lake Rehabilitation District

Camp Lake Current Harvesting Areas and Access Lanes

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	04/19/05	8
DRAWN BY	MTF	04/19/05	
CHECKED BY			
APPROVED BY			

Notes:

1. No harvesting in less than 3 foot depth.
2. Conduct open lake harvesting after nuisance plant control in channels and pier areas, after fish spawn.
3. "Weed Scout" should survey all non-channel areas prior to harvesting.
4. Proposed harvesting zones are approximate. Actual harvesting lane widths and intensities should be field determined annually.



BASEMAP SOURCE: SEWRPC

- Harvesting prioritized for access channels and access points - 3rd PRIORITY
- Limit harvesting for channel clearing only (Ecologically Significant Area)
- No restriction on harvesting after fish spawn - 2nd PRIORITY
- No restriction on harvesting after fish spawn - 1st PRIORITY
- Limit harvesting for channel clearing only (Ecologically Significant Area) - 4th PRIORITY
- Avoid harvesting (Ecologically Significant Area)
- Open Water
- * Access Points

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LEGEND

Revision/Issue	Date

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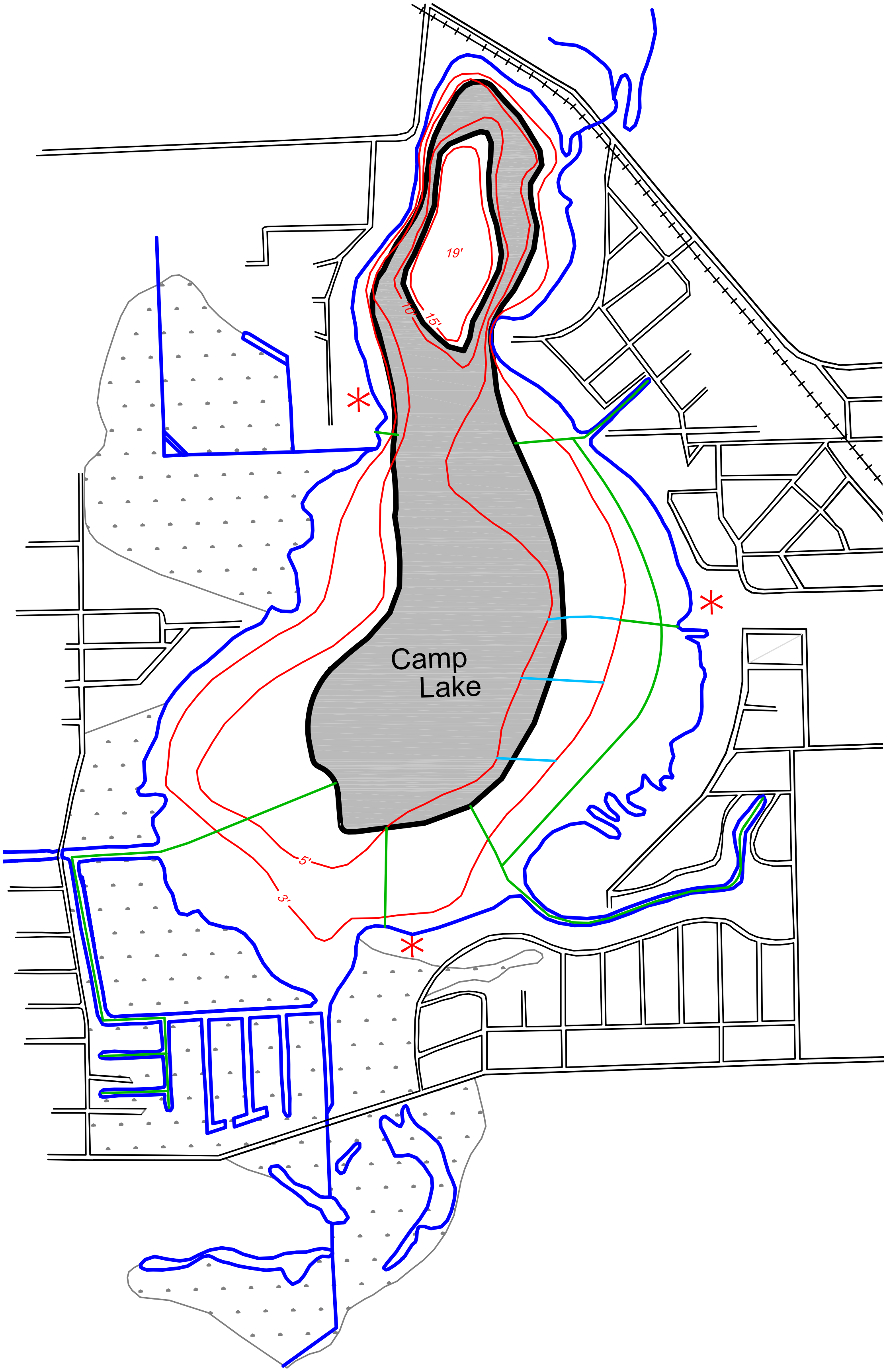
Camp and Center Lake Rehabilitation District

Camp Lake - Proposed Aquatic Plant Harvesting Map

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	9
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			



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LEGEND

ACCESS POINTS

LAKE DEPTHS

FISH OR FISHING ACCESS LANES

APPROXIMATE ACCESS CHANNELS

APPROXIMATE HARVESTING AREAS

Revision/Issue | Date

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Camp and Center Lake Rehabilitation District

Camp Lake Planned Harvesting Areas and Access Lanes

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	04/19/05	10
DRAWN BY	MTF	04/19/05	
CHECKED BY			
APPROVED BY			

It is generally recommended that harvesting activities avoid fish spawning periods (personal communication, Doug Welch, WDNR). The WDNR will not approve any harvesting that promotes large scale cutting during the time of fish spawning. However, realizing that weed growth already can be excessive by late May, limited harvesting can begin along the access areas and avoid the more natural shorelines and plant beds. This corresponds well with the general harvesting approach of promoting access. Cutting into larger plant beds away from shore should begin after fish spawning to allow for spawning fish to complete their breeding and disperse from the nesting grounds.

To increase fishery opportunities, lanes could be cut perpendicular to the main navigation areas to open up access for fishing. Research conducted in Wisconsin has shown that areas at the edge of aquatic plant beds generally have the highest usage by bluegill and other prey species (Storlie, it al, 1995). This is likely due to the increased macroinvertebrates production along the ecotonal edge between plant beds and open water. By harvesting lanes in the previously dense plant beds, greater edge habitat could be created. This would provide greater food success for smaller fish and better access for larger fish to prey upon them. Also, fisherman access would be greater, allowing for more of the lake to be successfully fished.

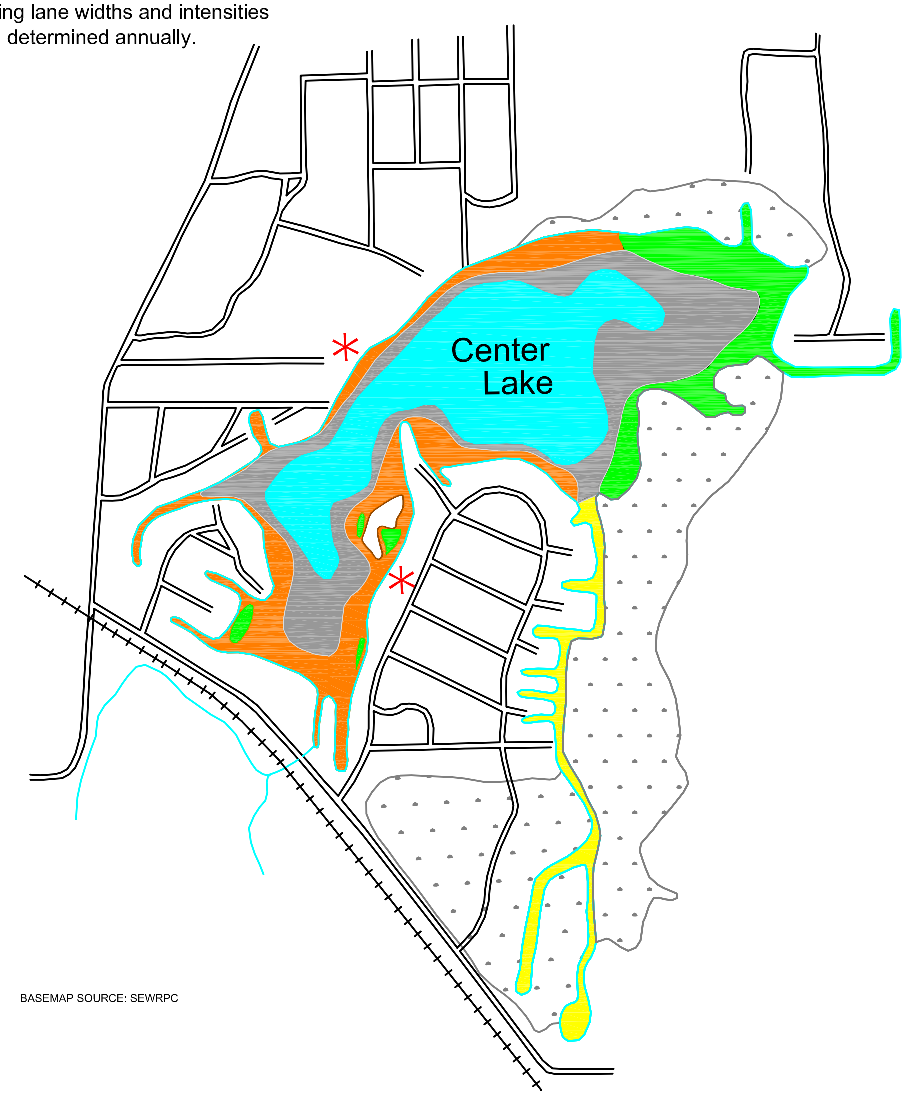
Center Lake

Aquatic plant harvesting is most imperative in the channels adjoining residential properties. Once out of the channels, harvesting locations depend on the specific locations of plant beds. Water depth, water clarity and to a lesser degree substrate are the main factors limiting aquatic plant growth with this lake. The channels are shallow and contain highly organic sediments, providing ideal growth conditions for macrophytes. Harvesting in the channels should optimize plant removal, since a high percentage of the species are undesirable. Limit channel harvesting in less that 3-foot depths with high percentages of native aquatic plants exist.

Exhibit 11 shows the proposed harvesting map and harvesting priorities for Center Lake. Cutting depths should be raised in areas of high concentrations of eel grass. Harvesting in the lily beds along the northeastern shore should be conducted for fishing and access channels only. Similar fishery enhancement lanes as described for Camp Lake could be implemented in specific areas. No harvesting should be conducted in these areas until nuisance plant control has been achieved. The lily beds require only 2-3 weeks for grow back, limiting the effectiveness of harvesting. Motorboat access also should be restricted to access channels, and fishing and fishing channels. Exhibit 12 shows current/planned harvesting areas and access channels.

Notes:

1. No harvesting in less than 3 foot depth.
2. Conduct open lake harvesting after nuisance plant control in channels and pier areas, after fish spawn.
3. "Weed Scout" should survey all non-channel areas prior to harvesting.
4. Proposed harvesting zones are approximate. Actual harvesting lane widths and intensities should be field determined annually.



- Limited harvesting for channel clearing and fishing access - 4th PRIORITY
- No restrictions on harvesting - 3rd PRIORITY
- No restrictions on harvesting after fish spawn - 2nd PRIORITY
- No restrictions on harvesting after fish spawn - 1st PRIORITY
- Avoid harvesting
- Open Water
- * Access Points

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LEGEND

Revision/Issue	Date

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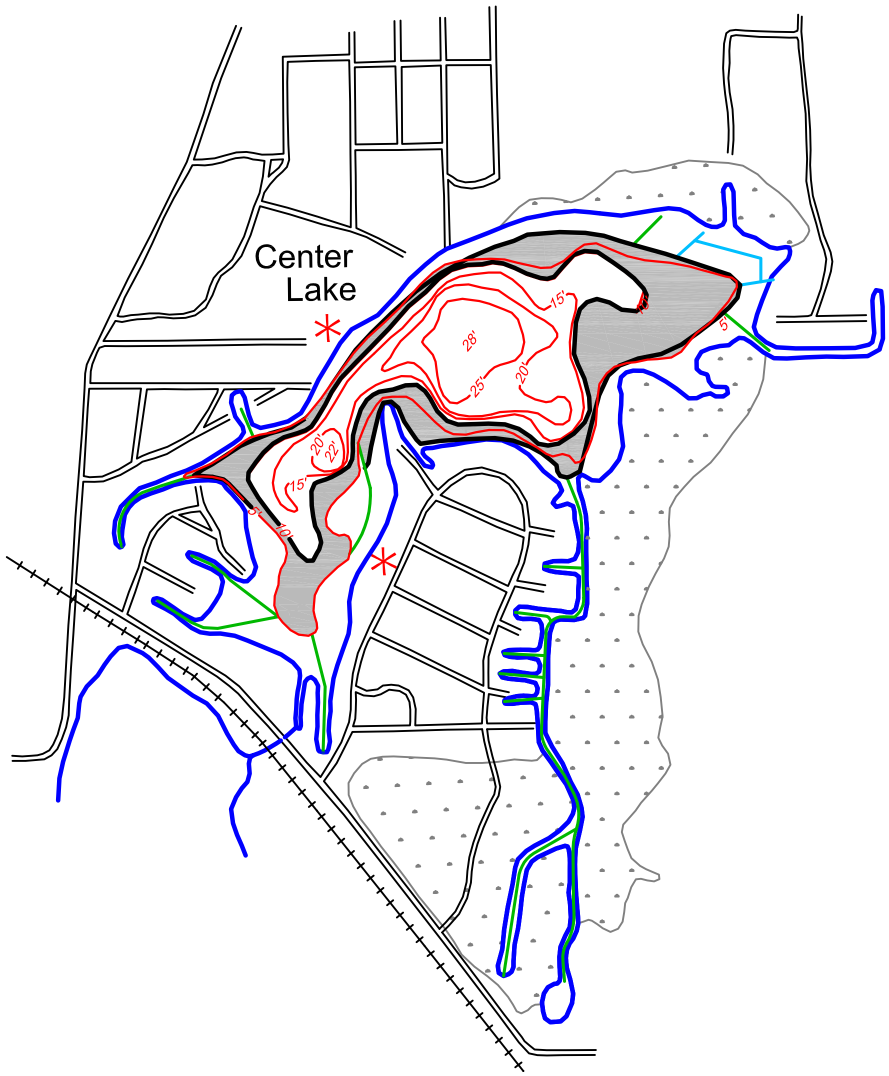
Camp and Center Lake Rehabilitation District

Center Lake - Proposed Aquatic Plant Harvesting Map

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	10/18/04	11
DRAWN BY	MTF	10/18/04	
CHECKED BY			
APPROVED BY			



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ACCESS POINTS

LAKE DEPTHS

FISH OR FISHING ACCESS LANES

APPROXIMATE ACCESS CHANNELS

APPROXIMATE HARVESTING AREAS

No.	Revision/Issue	Date

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Camp and Center Lake Rehabilitation District

Center Lake Planned Harvesting Areas and Access Lanes

PROJECT NO:	03223	DATE	EXHIBIT NO:
DESIGNED BY	REL	04/20/05	12
DRAWN BY	MTF	04/20/05	
CHECKED BY			
APPROVED BY			

SUMMARY

Camp and Center Lakes continue to provide a diverse aquatic plant community. However the lakes continue to experience nuisance levels of Eurasian water milfoil and coontail, including wigeon grass on Camp Lake. The aquatic plant harvesting program for Camp and Center Lakes has demonstrated an ongoing effort to manage the aquatic resources while providing for multiple use recreation on both lakes, with an increasing demand for recreational opportunities by lake users from growing residential neighboring communities.

The District is currently active in writing a purple loosestrife (*Lythrum salicaria*) control plan for Camp and Center Lakes watershed.

A special contingency plan and funding would allow for an aggressive reaction plan in the event that a new exotic invader arrives to the lakes. The DNR will likely specify a strategy to deal with any new exotic invader.

Prior to the next aquatic plant management plan update planned in about four years, it is suggested that the District send a Lake Users Survey to members of the District. The survey results can assist the District in evaluating past accomplishments and future lake management goals that can be addressed in future plans.

REFERENCES

Applied Ecological Services. 1990. Lake and watershed assessment and management recommendations report, Camp and Center Lakes, Kenosha County, Wisconsin. Unpublished Report. Submitted to the Camp and Center Lake Rehabilitation District.

Belonger, 1969. Aquatic Plant Survey of major lakes in the Fox-Illinois Watershed. Wisconsin Department of Natural Resources. Madison, WI. 60 pp.

Canfield, Jr., D.E., K.A. Langeland, S.B. Linda and W.T. Haller. 1985. Relations between water transparency and maximum depth of macrophyte colonization in lakes. *Aquatic Plant Management* 23:25-28.

Carpenter, S.R. and D. Lodge. 1986. Effects of submerged macrophytes on ecosystem processes. *Aquatic Botany*. 26:341-370.

Deppe, E. and R.C. Lathrop. 1992. A comparison of two rake sampling techniques for sampling aquatic macrophytes. Wisconsin Department of Natural Resources. *Res. Manage. Find.* No. 32. 4 pp.

Dresen, Michael and Korth, Robert. Life on the Edge….Owning Waterfront Property. University of Wisconsin Extension, Lakes Management Program. 1994.

Dunst, R.C. et al. 1974. Survey of lake rehabilitation techniques and experiences. Technical Bulletin No. 75 Wisconsin Department of Natural Resources, Madison, Wisconsin. 179 pp.

Engel, S. 1985. Aquatic community interactions of submerged macrophytes. Tech. Bull. No. 156. Department of Natural Resources, Madison, WI. 81 pp.

Engel, S. 1987. Concepts in Lake Management: Restructuring littoral zones. Research/Management Findings No. 2. Wisconsin Department of Natural Resources, Madison, Wisconsin. 3 pp.

Engel, S. 1990. Ecosystem response to growth and control of submerged macrophytes: a literature review. Technical Bulletin No. 170. Wisconsin Department of Natural Resources, Madison, WI. 22 pp.

EnviroScience, Inc. 1999. Initial Progress Report for the Implementation of the Middfoil Process of Eurasian Watermilfoil Control to the Camp and Center Lakes, WI. 8pp.

Fassett, N.C. 1969. A manual of aquatic plants. University of Wisconsin Press, Madison. 405 pp.

Jessen, R. and R. Lound. 1962. An evaluation of a survey technique for submerged aquatic plants. Minnesota Department of Conservation. Game Investigational Report No. 6. 12 pp.

Jester, Laura L., Michael A. Bozek, Daniel R Helsel, and Sallie P. Sheldon. 2000. Euhrychiopsis lecontei Distribution, Abundance, and Experimental Augmentations for Eurasion Watermilfoil Control in Wisconsin Lakes. *J. Aquat. Plant Manage.* 38: 88-97.

Juday, C. 1914. The inland lakes of Wisconsin: The hydrography and morphometry of the lakes. Bulletin No. XXVII; Scientific Series No. 9. Wisconsin Geological and Natural History Survey, Madison, WI. 137 pp.

Korth, R. and Dudiak, T. 2002. How's the Water? Planning for Recreational Use on Wisconsin Lakes & Rivers. University of Wisconsin-Stevens Point. Wisconsin Department of Natural Resources Publication FH-397-2002.

Helsel, D. 1995. Camp and Center Lakes Priority Watershed Project Water Resource Appraisal. Revised Edition; April, 1995. Wisconsin Department of Natural Resources.

Hey and Associates, Inc. 2000. Camp and Center Lakes Water Quality Summary Report. Draft, Unpublished Report. Submitted to the Camp and Center Lakes Management District.

Hosper, H.S. and E. Jagtman. Biomanipulation additional to nutrient control for restoration of shallow lakes in the Netherlands. *Hydrobiologia*. 200-201: 523-533.

Lind, O.T. 1979. Handbook of common methods in limnology. Second Edition. C.V. Mosby Company. St. Louis, MO. 199 pp.

Martin, L. 1965. The physical geography of Wisconsin. Univ. of Wisconsin Press, Madison, WI. 608 pp.

McComas S. Lakesmarts: The First Lake Maintenance Handbook. Terrene Institute. Washington, D.C. 215 pp.

Nichols, S.A. 1991. The interaction between biology and the management of aquatic macrophytes. *Aquatic Botany*. 41: 225-252.

Nichols, S.A. 1984. Macrophyte community changes in a dredged Wisconsin lake. *Water Resources Bulletin*. 20(4):573-576.

Nichols, S.A., S. Engel and T. McNabb. 1988. Developing a plan to manage lake vegetation. *Aquatics* 10(3):10, 14-19.

Nichols, S.A. and R. Martin. 1990. Wisconsin Lake Plant Database. Information Circular 69. University of Wisconsin-Extension, Geological and Natural History Survey. 29 pp.

Nichols, S.A. and J.G. Vennie. 1991. Summary Sheets: Attributes of Wisconsin Lake Plants. Open-file Report 91-4. University of Wisconsin-Extension, Geological and Natural History Survey. 117 pp.

Nichols, S.A. 1999. Distribution and habitat descriptions of Wisconsin lake plants. Bulletin 96. University of Wisconsin-Extension, Geological and Natural History Survey. 266 pp.

Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the upper Midwest states. U.S. Environmental Protection Agency. EPA/600/3-88/037.

R.A. Smith and Associates, Inc. 1994. Camp and Center Lake Dredging Feasibility Study. Unpublished Report. Submitted to the Camp and Center Lake Rehabilitation District.

SEWRPC. 1993. Assessments and Ranking of Watersheds for Nonpoint Source Management Purposes in Southeastern Wisconsin: 1993. SEWRPC Staff Memorandum. April 23, 1993.

Sturlie, C.H., T.D. Pellet, D.J. Sloey, and J.M.L. Unmoth. 1995. Wisconsin Department of Natural Resources Research. Highlights. July, 1995. Monona, WI.

Swink, F. and G. Wilhelm. 1994. Plants of the Chicago region. 4th Edition. The Morton Arboretum. Lisle, IL. 921 pp.

University of Wisconsin Extension, Lakes Management Program. 1988. Machine Harvesting of Aquatic Plants. PUBL-WR-201 88.

Voss, E.G. 1967. A vegetative key to the genera of submersed and floating aquatic vascular plants of Michigan. The Michigan Botanist 67: 35-50.

Voss, E.G. 1972. Michigan Flora Part I. gymnosperms and monocots. Cranbrook Institute of Science pub. 55 Bloomfield Hills, MI. 488 pp.

Winkelman, J. and R.C. Lathrop. 1993. Aquatic Plants in Lake Waubesa: Their status and implications for management. Wisconsin Department of Natural Resources, Bureau of Research. 62 pp.

Winterringer, G.S. and A. Lopinot. 1966. Aquatic plants of Illinois. Illinois State Museum Science Series. Vol. VI 142 pp.

Wisconsin Department of Natural Resources. 1969a. Camp Lake, Kenosha County, Wisconsin. Lake Use Report No. FX-12. Wisconsin Department of Natural Resources. 27 pp.

Wisconsin Department of Natural Resources. 1969b. Center Lake, Kenosha County, Wisconsin. Lake Use Report No. FX-27. Wisconsin Department of Natural Resources. 26 pp.

Wisconsin Department of Natural Resources. 1974. Survey of lake rehabilitation techniques and experiences. Tech. Bull. No. 75. Department of Natural Resources, Madison, WI. 179 pp.

Wisconsin Department of Natural Resources. 1982. Surface water resources of Kenosha County. Department of Natural Resources, Madison, WI. 85 pp.

Wisconsin Department of Natural Resources. 1983. Limnological characteristics of Wisconsin lakes. Tech. Bull. No. 138. Department of Natural Resources, Madison, WI. 116 pp.

Wisconsin Department of Natural Resources. 1996. Nonpoint Source Control Plan for the Camp-Center Lakes Priority Watershed Project.

APPENDIX A

SUMMARY OF AQUATIC PLANT MANAGEMENT OPTIONS

SUMMARY OF MECHANICAL, PHYSICAL, BIOLOGICAL, HABITAT MANIPULATION, AND CHEMICAL MEANS OF CONTROLLING AQUATIC PLANTS

*Table C-1. Mechanical and physical control technologies for aquatic plants**

Method	Procedure	Cost	Advantages	Disadvantages
HARVESTING**	Plant stems and leaves are cut up to 8 ft below the water surface, collected, and removed from lake. Up to 10-ft-wide swath can be cut at once. Machine can work in shallow water (to 18 inches).	Cost of new machine is $40,000 and up[a]. Cost does not include dump trucks, offloading conveyor, and other equipment for efficiency. 1992 personnel, maintenance and operational costs were $209,171 (see Table 11, section III).	Can be used on a large scale. Immediately creates open water areas. Removes nutrients from the lakes. Permits removal of weedy species (through selective cutting by adjusting cutting depth), minimizes impact to native species, and can leave lower part of plant intact as habitat.	Creates plant fragments, increasing potential for vegetative spread of weedy plants. Requires plant disposal (Sec. 30.125, Wis. Stats.) Requires constant machine maintenance. Involves short-term results. Removes small aquatic organisms (e.g., invertebrates and fish).
DEEP CUTTING	A steel blade attached to a hydraulic arm works like a hedge trimmer to cut aquatic plants in water up to 25 ft deep. A barge or conventional harvester follows behind to collect cut plants.	Cost of a new machine is $75,000.	Immediately creates open water areas. Control is long-term. Can cut up to three times deeper than regular harvesters.	Creates plant fragments. Requires plant collection by either a barge or harvester. Requires plant disposal (Sec. 30.125 Wis. Stats.) Requires maintenance.
DIVER-OPERATED SUCTION HARVESTING	One or two SCUBA divers operate a 4 inch suction hose that selectively remove plants from the lake bottom. Plants are collected in a wire basket which is later unloaded.	Operational cost is from $800-10,000/acre, depending on divers, type of sediment, travel time to sites within the lake, etc. Cost of new machine starts at $22,000 and more.	Effectively removes roots. Is not limited by depth as are other mechanical methods. Selectively removes plants. Can work in confined and rocky areas. Controls plant long-term.	Is slow and labor intensive. Is expensive. Involves small-scale use only. Creates short-term turbidity. Involves potential hazards to SCUBA divers. Requires constant machine maintenance. Requires plant disposal (Sec. 30.125, Wis. Stats.) Requires a permit (Sec. 30.20, Wis. Stats.)

Method	Procedure	Cost	Advantages	Disadvantages
HANDPULLING	Plants and roots are removed by hand, using SCUBA diving, snorkeling, or wading. Plants and fragments are collected in mesh bags carried by handpullers and are later disposed of on shore.	Cost is variable, depending on whether or not volunteers are used. Diver costs range from $25-60/hr.	Can selectively remove weedy plants. Can be done with volunteers to keep costs down. Can be done in hard-to-access areas. Is effective on newly established populations that are scattered in density.	Is too expensive to use on a large-scale. Creates short-term turbidity, which makes it difficult to see remaining plants. Creates fragments. Is slow and labor intensive.
HAND-HELD HARVESTER	Stainless steel blades on a pole work like a hedge trimmer to cut weed stems at their bases. Machine cuts a 4 ft wide swath, which can be expanded to 12 ft wide. Machine operates off of a boat battery.	Operational cost is negligible. Cost of a hand-held harvester alone is $350.	Immediately creates open area. Can be done in hard-to-access areas.	Is only a short-term solution. Creates fragments. Requires plant disposal (Sec. 30.125, Wis. Stats.) Involves small-scale use only. Is not selective for weedy species in deep water.
HYDRO-RAKING	Mechanical rake removes plants (including some roots) and deposits them on shore. Machine can work in up to 14 ft of water.	Operational cost is $1,500-2,000/acre. Raking is done most frequently by hired consultants rather than local groups purchasing a machine.	Immediately creates open water areas. Controls plants long-term. Removes nutrients from the lake.	Creates fragments. Disturbs organisms on the lake bottom and degrades habitat. Creates short-term turbidity. Requires plant disposal (Sec. 30.125, Wis. Stats.) Is followed by rapid re-growth of plants. Involves small-scale use only. Requires a permit (Sec. 30.20, Wis. Stats.)

Method	Procedure	Cost	Advantages	Disadvantages
ROTOTILLING	Sediment is "tilled" to a depth of 4-6 inches to dislodge plant roots and stems. Tiller head is 10 ft wide. Machine can work in depths up to 17 ft. Plants are collected by a harvester; if done in late fall, plants wash ashore and dry out over winter.	Operational cost is $700-1,200/acre. Cost of new machine is $100,000+.	Immediately decreases stem density. Offers large-scale control. Controls plants long-term.	Creates short-term turbidity. Disturbs organisms on the lake bottom and degrades habitat. Requires constant machine maintenance. Requires plant disposal (Sec. 30.125, Wis. Stats.) Requires a permit (Sec. 30.20, Wis. Stats.)
HYDRAULIC DREDGING	Steel cutter blade dislodges sediment and plants which are removed by a suction pump. Spoils are pumped to a barge or directly to land.	Operational costs start at $2,500/acre or more. Cost of new machine is $100,000+. Work usually hired out to a consultant.	Effectively removes roots.	Is expensive. Requires removal of spoils. Creates turbidity. Disturbs organisms on the lake bottom and degrades habitat. Short-term, small-scale results. Requires a permit (Sec. 30.20, Wis. Stats.)
MANUAL RAKING	A small rake with long tines and attached rope is used to drag weeds off of lake bottom. Rake can be used from a pier or boat or while wading.	Cost of rake alone is $90.	Immediately creates open water areas. Has no depth limit. Can be done in hard-to-access areas.	Creates fragments. Requires plant disposal (Sec. 30.125, Wis. Stats.) Creates short-term turbidity. Disturbs organisms on the lake bottom. Is not selective for weedy species in deep water. Involves small-scale use only.

Method	Procedure	Cost	Advantages	Disadvantages
WEED ROLLER	Three rollers with fins mount on dock and roll in a broad arc over the lake bed, dislodging weeds and silt. Machine is power operated, and each roller is up to 30 ft long (i.e., the 3 10-ft rollers are linked).	Operational cost depends on how much it is used and electricity costs; it runs on 24 volts DC. Cost of roller alone is $1,800.	Is easy to operate. Removes weeds at their roots. Immediately creates open water areas.	Is a new product and its effectiveness is unknown. Creates plant fragments. Requires plant removal (Sec. 30.125, Wis. Stats.) Involves small-scale use only. Is not selective for weedy species. Disturbs organisms on the lake bottom and degrades habitat. Requires a permit (Sec. 30.12, Wis. Stats.)

* Data sources: Vt. Dep. Environ. Conserv. (1991); Cooke et al. (1986); Andrews (1986); Wis. Dept. Nat. Resour. (1990); Aquarius Systems, D&D Products Inc., North Prairie, WI; Aquatic Biologists, Inc., Fond du Lac, WI; Waterside Products Corp., Lake Carmel, NY; Lake Restoration, Inc., Hamel, MN; and Crary Co., West Fargo, ND.
** Currently used in Yahara lakes.
[a] D&D harvester manufacturer quote; however, Dane County Department of Public Works usually constructs their own machinery, reducing costs by about one half.

*Table C-2. Biological technologies for aquatic plant control**

Method	Procedure	Cost	Advantages	Disadvantages
GRASS CARP	Plant-eating fish native to the Orient are stocked. Stocking in lakes occurs at varying rates depending on plant species present, water temperature, amount of vegetation present, etc.	Cost is based on number of fish per vegetated area. An 8- to 11-inch fish costs $3.50. Cost does not include transport of fish, stocking, or containment barriers. Cost also excludes indirect impacts to the resource (e.g., habitat destruction, increasing turbidity).	May provide cost-effective, long-term control. Does not interfere with water supplies or water use. Is maintenance free (unless barriers need to be cleaned of plant debris). Does not involve risk of fish population explosion since sterile hybrids (triploid carp) are available.	Is difficult to properly gauge, since accurate stocking rate for large, cold water lakes are hard to determine. Eliminates desirable plant species more palatable than Eurasian water milfoil, the primary weed. Has potential for negative impacts to water quality, native plants and fish and wildlife habitat destruction. May spread to surrounding water bodies. Is prohibited in Wisconsin (Sec. 29.47(6), Wis. Stats.)
CRAYFISH *(Orconectes* spp.)	Plants are eaten by crayfish.	Cost is not available at this time.	Reduce macrophyte biomass. Involves a species that is native to Wisconsin and that already exists in the Madison lakes.	Is not selective for weedy species. Is not successful in productive, soft bottom lakes with many fish predators. Is prohibited in Wisconsin (Wis. Admin. Code NR 19.27)
PATHOGENS	Plant tissue is intentionally infected with a pathogen, such as bacteria or fungi, to induce plant mortality.	Product is still in experimental stage and costs are not available at this time.	If feasible, may provide more cost-effective, long-term control. Appears to be host specific. Involves a wide variety of organisms. Exerts a limiting effect on plants without eradication. Poses few dangers to humans or animals.	Involves unknowns (e.g., shelf-life and delivery system of fungus not yet determined). Is not commercially available at this time. Involves some organisms that may not be highly pathogenic on their own (e.g., may penetrate plant only through wounds) and thus are potentially more effective in conjunction with harvesting. Encourages development of host resistance. Plant specificity is important. May involve legal issues, but these are unclear at this time.

Method	Procedure	Cost	Advantages	Disadvantages
BIOMANIPULATION	Food web dynamics are modified by manipulating lake biota and effect a change in water quality and improve the fishery. Fish community is restructured to favor fish-eating vs. plankton-eating fish.	Cost is not available at this time. Cost of fish stocking depends on numbers and species stocked.	Improves the quality of the fishery. Increases water clarity and interrupts internal nutrient cycling. Attacks plant control at its source. Has potential for long-term, cost-effective control.	Is experimental and ability to control macrophytes is uncertain. Is not immediately effective. Creates improved water clarity which may improve conditions for macrophyte growth.
ALLELOPATHY	Aquatic plants that release chemical compounds into the water or sediment and inhibit other plants from growing are introduced.	Cost is unavailable at this time.	May provide long-term, cost-effective, maintenance-free control. Includes one species (small spikerushes or *Eleocharis* spp.) that appears to inhibit Eurasian water milfoil growth.	For spikerushes, involves initial transplanting that is slow and labor intensive. Spikerushes are native to Wisconsin, and if they could effectively limit growth they would probably already do it. May not work if wave action along shore makes it difficult for plants to establish themselves. Cannot be used in deep water. Involves limited commercial availability of plants. May involve legal implications, but these are unclear at this time.
HERBIVOROUS INSECTS	Native or exotic aquatic insects (moths, weevils, etc.) that feed on plant stems and leaves and cause damage or death when introduced.	Cost is not available at this time.	If feasible, may provide cost-effective, long-term control. Is maintenance-free once insects are introduced. Includes one species (a weevil native to North America) that appears to feed mainly on milfoil.	Involves insects that are not commercially available at this time. Is sometimes slow (i.e., results may not be quickly seen). May involve potential problems associated with introducing new species. May not be host-specific. May involve legal implications, but these are unclear at this time.

* Data sources: Vt. Dep. Environ. Conserv. (1991); Nichols (1991); Cooke et al. (1986); Andrews (1986).

*Table C-3. Habitat manipulation technologies for aquatic plant control**

Method	Procedure	Cost	Advantages	Disadvantages
SEDIMENT BLANKETS	Bottom sediments are covered with fly ash, sand, gravel, or clay to physically isolate nutrient rich sediments from plant roots.	No cost estimate found.	Inactivates "fertilizer" in sediments.	For fly ash, raises pH, depletes dissolved oxygen, reduces sulfate to sulfide, releases heavy metals and clogs and crushes bottom organisms, bioaccumulates, and poisons fish and macroinvertebrates. May not sufficiently alter sediment. Adds nutrients, thereby offsetting its effectiveness. Is not feasible for large areas. Requires a permit (Sec. 30.12, Wis. Stats.)
BOTTOM BARRIERS	Sheets of material (nylon, silicone, rubber, fiberglass, polypropylene) are anchored to the lake bottom; they kill plants by compression and by blocking out sunlight. One barrier--fiberglass products known as Aquascreens—has been extensively used in Wisconsin.	Cost varies by product but is generally from \$0.15-0.35/ft^2, not including installation (which may be done individually). Aquascreen is sold in 7 ft x 100 ft rolls for \$250/roll.	Does not require weeds to be removed. May provide long-term control if properly installed and maintained. Screens may last 10-15 years if maintained. Provides immediate control throughout the entire water column. May be used in areas not accessible by other methods. Involves uncomplicated installation, either in water or from boat.	Is not feasible on a large scale because of cost and labor intensiveness. Requires seasonal maintenance (installation and removal). If not firmly anchored, may float up allowing plants to grow beneath it. Can be snagged by fish hooks. Requires a permit (Sec. 30.12, Wis. Stats.)

Method	Procedure	Cost	Advantages	Disadvantages
DRAWDOWN**	Lake water level is lowered so plants are exposed to drying and freezing temperatures. Current conditions reflect winter drawdown of about 1.5 ft in Lakes Monona and Waubesa.	Operational cost is frequently low or non-existent. If drawdown is increased above the current levels, costs of undesirable impacts (e.g., lowers level of shallow wells, habitat destruction, and poor refill) to resource may need to be considered.	May provide opportunity to work around shoreline while water level is low.	Drawdown over current levels has potential for significant negative impacts to aquatic plants, invertebrates, and fish and wildlife. May affect water intakes and shallow wells. Kills some plants and enhances growth of others. Cannot exceed authorized minimum and maximum levels. Is affected by weather for success of refill. If poor refill occurs, may impact water levels along Yahara chain of lakes.
COLORANTS (DYES)	Blue dye is used to darken water in order to prevent sunlight from reaching plants.	Cost is $62.00/acre for average water depth of 4 ft.	Reduces plant growth.	Can be used only in small, contained, shallow ponds that have little or no outflow and are not used for human consumption. Impairs aesthetics.
NUTRIENT REDUCTION**	Nutrients (phosphorus and nitrogen) which stimulate weed growth, are removed and internal nutrient cycling is disrupted by removing weeds and filamentous algae. Chemical treatments (e.g., alum) can make nutrients unavailable to macrophytes (see Table C-4). Eliminate external sources by modifying watershed practices.	Cost is integrated into expense of operating lake management program (e.g., harvesting program, shoreline cleanup) and watershed pollution abatement programs.	Attends to problem at its source. Prevents further deterioration of lake conditions. Involves long-term, large-scale results. Native plants may be able to compete better in low nutrient, clear water conditions.	Is slow (i.e., results may not be quickly seen). Will probably increase water clarity, creating potential for macrophyte growth. Most nutrient reduction/inactivation targets phosphorus, while nitrogen may be more important. Ability to control macrophytes is unknown.
BIOMANIPULATION	See Table C-2.			

* Data sources: Vt. Dep. Environ. Conserv. (1991); Cooke et al. (1986); Engel (1982, 1984); Nichols (1991); S. Borman, WDNR Western District (pers. comm.); and Aquatic Biologists, Inc., Fond du Lac, WI.
** Currently used in Yahara lakes.

*Table C-4. Chemical control technologies for aquatic plant control. All chemical applications require a WDNR permit.**

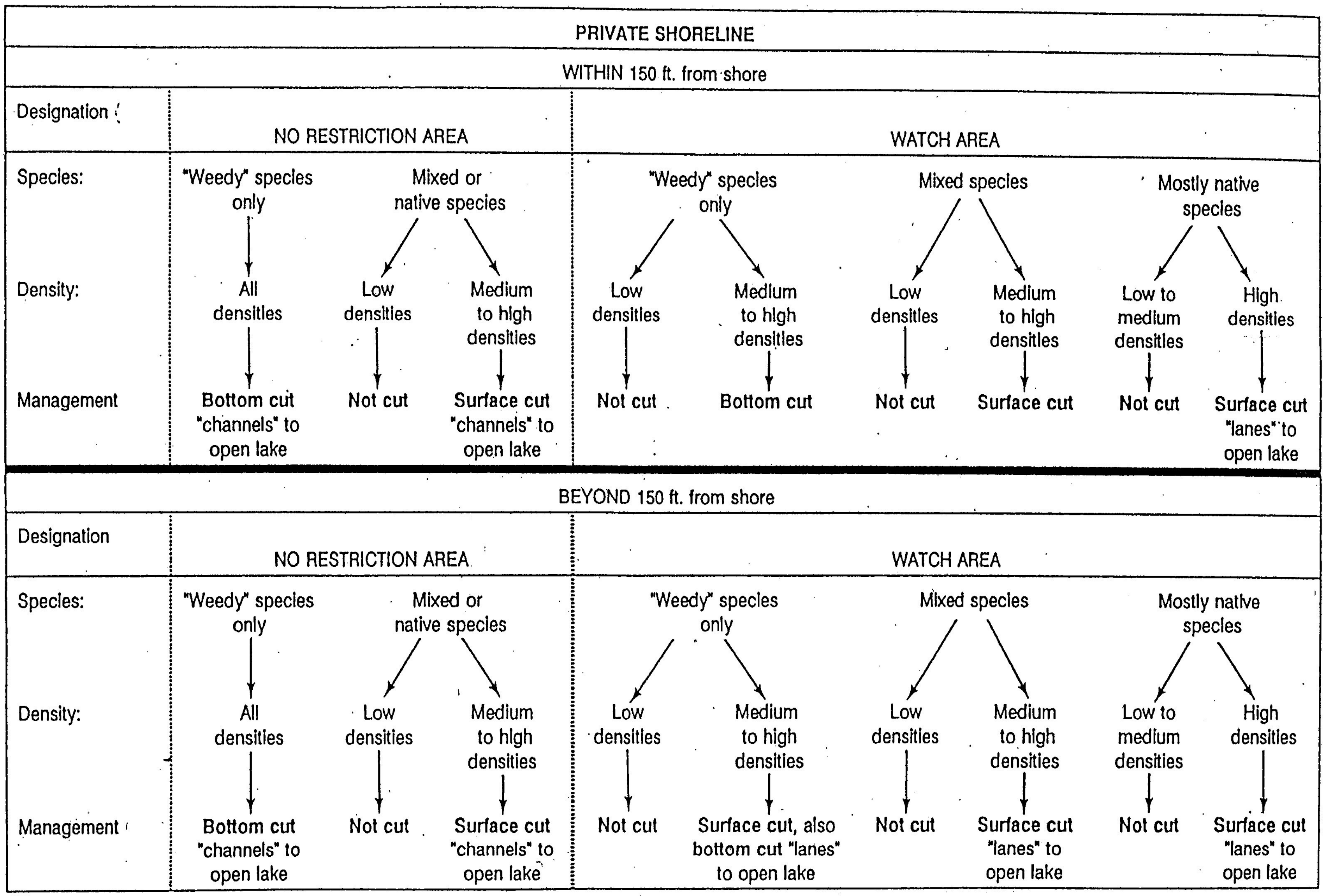
Method	Procedure	Cost	Advantages	Disadvantages
DIQUAT**	A non-selective contact herbicide that is absorbed by plant foliage and directly damages cell tissues. May be used only to control Eurasian water milfoil, duckweed (*Lemna* spp.), and elodea.	Cost was $0.69/ft^2 frontage + $18.00 administrative fee + $6.00 WDNR permit fee per property in 1992, as organized through Clean Lakes Association (see section III). Clean Lakes charges one price for all treatments.	Reduces plant growth. Is easy to apply. Has no direct toxic effects on spawning fish.	Involves water use restrictions during and after treatment. Is not selective for "weedy" species and kills native species (e.g., pondweeds, water celery, naiads). May affect, through drift, areas that were not treated. May perpetuate monotypic stands of weedy species by slowing recovery of native plants. May be associated with health risk, but testing of health effects is not complete.
2, 4-D	A systemic herbicide that moves through the plant and interferes with normal cell growth and division. Is a "selective" herbicide, targeting Eurasian water milfoil and not affecting most submersed native species. Can be applied at surface or subsurface in early spring as soon as plants start to grow, or later in the season.	Cost is not applicable since chemical is not allowed in the Yahara lakes.	Reduces plant growth. Is easy to apply. Targets Eurasian water milfoil, leaving most native submerged species unharmed.	Involves water use restrictions during and after treatment. May be associated with health risk, but testing of health effects is not complete. May affect, through drift, areas not treated.
ENDOTHALL	A non-selective contact herbicide that prevents certain plants from making necessary proteins.	Cost is not applicable, since this chemical is not allowed in the Yahara lakes.	Reduces plant growth. Is easy to apply.	Kills native and weedy species alike. Not especially effective on Eurasian water milfoil. Involves water use restrictions during and after treatment. Involves some products that may be toxic to fish. May affect, through drift, areas not treated. May be associated with health risk, but testing of health effects is not complete.

Method	Procedure	Cost	Advantages	Disadvantages
COPPER COMPOUNDS**	A systemic herbicide that prevents photosynthesis. Is used primarily to control planktonic and filamentous algae.	1992 cost was the same as for Diquat because is purchased and applied through Clean Lakes Association (see section III).	Reduces plant growth. Is easy to apply. Involves no water use restrictions.	Accumulates and persists in sediments. Involves short-term results; algae degradation releases nutrients, enabling regrowth. In alkaline waters, precipitates rapidly. May be associated with health risk, but testing of health effects is not complete.
ALUM	A chemical treatment that tightly binds phosphorus to sediments (retarding its release to water column during anoxic conditions) which makes the phosphorus unavailable to rooted plants.	Cost is expensive when chemical, application equipment, and labor considered.	Makes phosphorus in sediments unavailable to macrophytes. Has long-term effects.	Introduces a potentially toxic substance to the lake. Increases water transparency, which may extend the outer limit of macrophyte growth. Ability to control plant growth is questionable.

* Data sources: Andrews (1986); Vt. Dep. Environ. Conserv. (1991); WDNR herbicide information sheets (1990); Cooke et al. (1986); Nichols (1991); S. Borman, WDNR Western District (pers. comm.); S. Nichols, UW-Extension (pers. comm.); Diquat manual – Valent.
** Currently used in Yahara lakes.

APPENDIX B

FLOW CHART OF AQUATIC PLANT HARVESTING STRATEGIES



Harvesting recommendations for private shorelines

PUBLIC SHORELINE

WITHIN 150 ft from shore

Designation	NO RESTRICTION AREA			WATCH AREA					NATURAL AREA
Species:	"Weedy" species only	Mixed or native species		"Weedy" species only		Mixed species		Mostly native species	All species
Density:	All densities	Low densities	Medium to high densities	Low to medium densities	High densities	Low to medium densities	High densities	All densities	All densities
Management	Bottom cut "channels" to open lake	Not cut	Surface cut "channels" to open lake	Not cut	Surface cut, also bottom cut in "lanes"	Not cut	Surface cut	Not cut	Not cut

BEYOND 150 ft from shore

Designation	NO RESTRICTION AREA			WATCH AREA					NATURAL AREA
Species:	"Weedy" species only	Mixed or native species		"Weedy" species only		Mixed species		Mostly native species	All species
Density:	All densities	Low densities	Medium to high densities	Low densities	Medium to high densities	Low to medium densities	High densities	All densities	All densities
Management	Bottom cut "channels" to open lake	Not cut	Surface cut "channels" to open lake	Not cut	Surface cut, also bottom cut in "lanes"	Not cut	Surface cut "lanes" to open lake	Not cut	Not cut

Harvesting recommendations for public shorelines.

APPENDIX C

CORRESPONDENCE FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN DEPT. OF NATURAL RESOURCES

Jim Doyle, Governor
Scott Hassett, Secretary
Gloria L. McCutcheon, Regional Director

Sturtevant Service Center
9531 Rayne Rd Suite 4
Sturtevant, Wisconsin 53177
Telephone 262-884-2300
FAX 262-884-2310

September 24, 2003

Dennis Faber
P.O. Box 237
Camp Lake, WI 53109

Subject: Aquatic Plant Harvesting Plan

Dear Dennis:

Thank you for your letter dated September 3, 2003 requesting my perspective on aquatic plant harvesting on Camp and Center Lakes. Many aquatic plant harvesting programs are conducted on lakes in Racine, Kenosha, and Walworth Counties. As I observe these operations I have seen many young fish of several species trapped within the harvested plants. The mortality rate for these trapped fish is probably high. Since most of the trapped fish are desirable game species, impacts to the sport fish community may be significant.

Use of plant harvesters during fish spawning periods may also negatively impact the sport fish community. Nest building fish will use any suitable substrate and nesting sites will likely be unevenly distributed along the shoreline. Operation of the harvester in shallow water areas used by spawning fish disturbs spawning activity of nest building largemouth bass, bluegill, pumpkinseed, and crappie. This occurs when the harvester drives nest guarding adult fish off the nest, destroys the nest, or disturbs sediments which cover and kill developing fish eggs. To avoid negative impacts to the fish community I suggest that plant harvesting activities during spawning periods be restricted to cutting access lanes to piers and boat launches.

Peak spawning periods for nest building fish are usually in May and June. Since water temperatures determine specific spawning periods, spawning activity may be accelerated or delayed. Warmer than usual temperatures will trigger earlier spawning and cooler than usual temperatures may delay spawning until late June or early July. Setting a specific date to begin plant harvesting is inflexible and ignores variations in water temperatures from year to year.

I suggest that the timing of plant harvest activities be based on the presence of active nests. The timing of spawning activity will probably not be very different in most years. But when an odd year comes along, the flexibility incorporated in the plan will allow for harvesting that will have the least impact on the fish community.

Sincerely,

Doug

Douglas E. Welch
Senior Fisheries Biologist
(262)884-2364

From: Lyons, John D. [John.Lyons@dnr.state.wi.us]
Sent: Tuesday, February 08, 2005 3:09 PM
To: rlang@heyassoc.com
Cc: Lyons, John D.
Subject: Camp Lake fish data

Rachel,

Here are the Camp Lake data we talked about on the phone. We seined 7 locations along the shoreline of the lake on July 8, 2004. We collected 19 species of fish and 1419 individuals, and I've listed those of particular relevance to aquatic plant management:

State threatened:
Pugnose shiner - 32 total individuals, 2 locations

State special concern:
Pugnose minnow - 4 individuals, 1 location
Banded killifish - 6 individuals, 1 location
Least darter - 2 individuals, 2 locations

Intolerant (=sensitive) species often associated with aquatic plants
Blackchin shiner - 61 individuals, 5 locations
Blacknose shiner - 58 individuals, 4 locations
Iowa darter - 20 individuals, 4 locations

Let me know if you have any questions of need more info.

John

John Lyons, Ph.D.
Principal Ichthyologist, Wisconsin Department of Natural Resources
Curator of Fishes, University of Wisconsin Zoological Museum
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phone: (608) 221-6328
fax: (608) 221-6353
e-mail: john.lyons@dnr.state.wi.us

From: dennis faber [dfaber2@wi.rr.com]
Sent: Tuesday, August 31, 2004 7:30 AM
To: Rachel
Subject: Fw: Camp Lake Fish Survey Results

----- Original Message -----
From: Marshall, David W.
To: dfaber2@wi.rr.com
Cc: Bunk, Heidi J ; Lyons, John D.
Sent: Wednesday, August 25, 2004 5:20 PM
Subject: Camp Lake Fish Survey Results

Hello Dennis, it was great meeting you today and hearing about your plans for protecting aquatic plant communities in Camp Lake. Sustaining healthy aquatic plant beds in the lake are absolutely essential for sustaining a healthy fisheries and the rare species highlighted in **bold** below. Below I tried to address your questions and provided the Camp Lake rare fish species and WDNR study press release that you requested.

As you are aware, John Lyons with WDNR Fisheries Research is leading an effort to re-sample nearshore fish populations (using small mesh seines) in lakes that were sampled during the 1970's as part of the Fish Distribution Study. So far this summer we have sampled 12 lakes and Camp Lake supported the highest number of rare species. While these species were common during the 1970's, our recent sampling indicates significant declines in most of the lakes. The most likely cause for these declines are loss of aquatic plant beds and nearshore habitat destruction. The extensive bullrush beds, emergent plants, floating-leaf beds and diverse submersed plant communities are the reason these species still flourish in Camp Lake. While not everyone is concerned about small minnows and darters, species they probably did not know existed, the small fish are indicators of overall ecological health of a lake. In some lakes, their loss foreshadows other problems including reduced gamefish growth rates.

Any protection efforts such as no-wake zones, no motor boat areas and Sensitive Areas Designations can go a long way toward protecting the important native aquatic plant communities in the lake. Where Eurasian watermilfoil dominates, cutting channels to create edge effect can benefit fish growth rates while potential beneficial insects such as weavils can thrive and hopefully control the exotic plant. About 10 years ago I was part of a research team looking at the response panfish and largemouth bass populations after cutting channels in dense Eurasian watermilfoil beds. The results of the study demonstrated improved growth rates. If the Lake Management District desires clearer water, then that would be another reason for not clear-cutting Eurasian watermilfoil. Research has demonstrated that rooted aquatic plants compete for nutrients with planktonic algae. Protecting shallow zones from motorboat scour would also assist rooted plant growth and clearer water. In lakes with abundant rooted plant populations, clear water is typical even if nutrient levels are higher than optimum. While fragmentation of Eurasian watermilfoil can improve gamefish growth rates, fragmentation of native plant populations is not recommended and can reduce their vital habitat values. So harvesting should focus solely on Eurasian watermilfoil.

Sincerely,

Dave Marshall, Water Resources Management Biologist

Camp Lake rare fish species found on July 8, 2004

Pugnose shiner State Threatened

Blackchin shiner Intolerant and becoming rare

Blacknose shiner Intolerant and becoming rare

Pugnose minnow State Special Concern

Banded killifish State Special Concern

Least darter State Special Concern