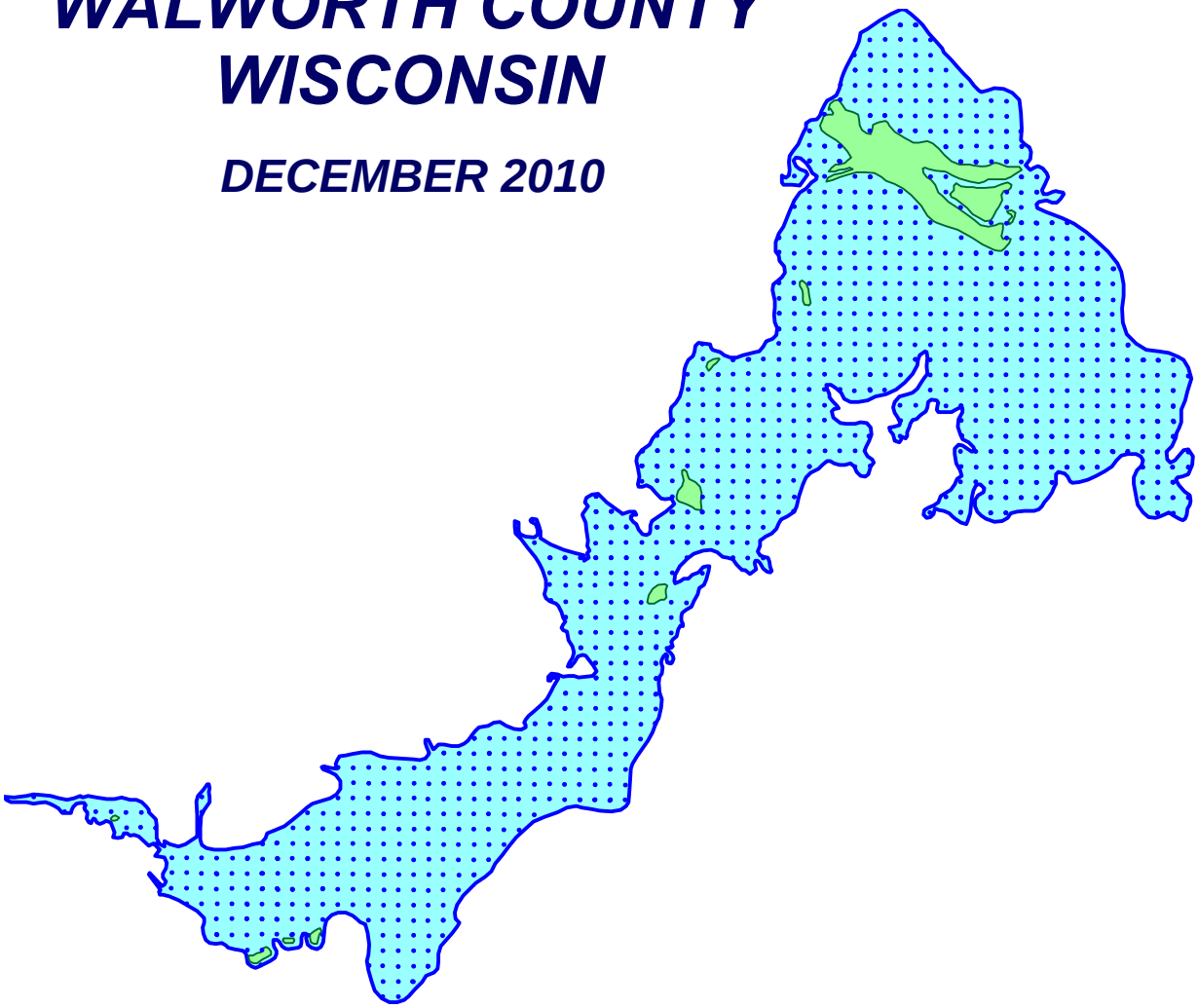
AQUATIC PLANT MANAGEMENT PLAN HARVESTING PATHS LAKE BEULAH WALWORTH COUNTY WISCONSIN

DECEMBER 2010



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AQUATIC PLANT MANAGEMENT PLAN
LAKE BEULAH, WALWORTH COUNTY, WISCONSIN
DECEMBER 2010

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AQUATIC PLANT MANAGEMENT PLAN
LAKE BEULAH, WALWORTH COUNTY, WISCONSIN
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This aquatic plant management plan (APMP) was prepared as partial completion of the tasks for a lake management grant from the Wisconsin Department of Natural Resources (WDNR). Its development was based on the results of an aquatic plant inventory, and the results of historical aquatic plant management activities at Lake Beulah.

1 LAKE CHARACTERISTICS

Lake Beulah is located in northeastern Walworth County, Wisconsin (Figure 1). Lake Beulah is the home to very diverse environments. The lake has a shoreline development factor of 3.8 (not including islands), meaning that the length of its shoreline is nearly 4 times as great as the perimeter of a circle with equal area as Lake Beulah. This results in many bays and points which provide habitats for a wide diversity of species.

The WDNR completed a Sensitive Area Assessment (Assessment) of Lake Beulah in May 1994, pursuant to Chapter NR 107 of the *Wisconsin Administrative Code*. In their study of the lake, eight environmentally sensitive areas were identified, as shown on Figure 2.

All eight areas were defined due to their wide variety of native aquatic plants, with limited occurrence of invasive species. These plants provide spawning habitat for numerous species of fish, as well as nursery areas for young fish. The areas also provide habitat for wildlife, such as ducks and wading birds, as well as muskrats and raccoons.

In addition to the habitats provided by aquatic plants in the sensitive areas, these sensitive areas act as nutrient traps and protect the shoreline from erosion, as well as provide a buffer against invasive species. More detail can be found in the WDNR document, included as Appendix A.

2 AQUATIC PLANT SURVEYS

Plant surveys are conducted to evaluate the occurrence and statistical importance of aquatic plants in the lake. Previous surveys were conducted utilizing transects, or lines extending out from the shore in specific locations, along which samples were collected, with the lakeward extent being determined by the presence of aquatic plants. The most recent survey was conducting by establishing a uniform grid over the entire lake, and samples were collected at each node of the grid.

After the survey is completed, statistical analyses are completed for each of the species found. These include the calculation of frequency, relative frequency, average density and importance. The frequency of a species is simply the number of occurrences of a species divided by the number of sample points were vegetation was found.

The relative frequency is a measure of how one species compares to the others. This is the frequency of the specific species (described above), divided by the total frequency of all species.

Average density relates to the abundance of a species. At each sample point, the density of each species found is rated on a scale of 1 to 3, based on how many of the specific plants are found in the rake. The average density is a calculation in which the sum of all of the density ratings for a species is divided by the number of sample points.

Finally, an importance value is calculated. This is a measure of the species' importance relative to the aquatic community in which it is found, and is calculated as:

Relative frequency x average density x 100

2.1 PREVIOUS SURVEYS

Aquatic plant surveys of Lake Beulah were conducted in 1995 and 1999, with reports presented to the WDNR in 1996 and 2000, respectively. The two earlier surveys appear to have utilized the same transects, so a comparison can be made between 1996 and 1999. These two studies found a rich diversity of native aquatic plants. The following changes to the aquatic plant vegetation were noted (with respect to the statistical importance of the species):

SPECIES	IMPORTANCE	
	1996	1999
INCREASE IN IMPORTANCE:		
Muskgrass	31.4	49.9
Sago Pondweed	1.1	3.2
Eurasian water milfoil	0.65	2.7
White stem pondweed	0	1.6
Floating leaf pondweed	1.07	1.2
Yellow water lily	0	1.1
Variable pondweed	0.82	0.87
DECREASE IN IMPORTANCE:		
Native water milfoil	11.8	6.7
Wild celery	5.2	3.2
Bladderwort	2.3	1.1
Large leaf pondweed	1.5	1.0

2.2 2008 SURVEY

The aquatic plant survey was completed for the Lake Beulah Management District (LBMD) in 2008. In accordance with WDNR requirements, plant samples were collected at pre-determined, grid-based locations. This resulted in 996 sample locations, shown on Figure 3. Numerous samples yielded healthy, native plants; however, many locations also yielded the nonnative, invasive Eurasian water milfoil. Several samples of curly-leaf pondweed were collected as well. These were the only nonnative, invasive species, designated pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, that were identified. Table 1 summarizes the number of locations where each of the species was found; the complete database is presented in Appendix B.

Eurasian water milfoil is one of eight milfoil species found in Wisconsin and the only one known to be exotic or nonnative. Because of its nonnative nature, Eurasian water milfoil has few natural enemies that can inhibit its growth. In those Lakes where Eurasian water milfoil (*Myriophyllum spicatum*) is abundant, certain recreational uses can be limited, the aesthetic quality of the Lake is impaired, and in-lake habitat degraded. The plant primarily interferes with recreational boating activities by encumbering propellers, clogging cooling water intakes, snagging paddles, and slowing sailboats by wrapping around keels and control surfaces. The plant also causes concern among swimmers who can become entangled within the plant stalks. Thus, without control measures, these areas can become problematic to navigation, fishing, and swimming.

Curly-leaf pondweed exhibits a peculiar split-season growth cycle that helps give it a competitive advantage over native plants and makes management of this species difficult. In late summer, the plant produces specialized over-wintering structures, or "turions." In mid-summer, the main body of the plant dies off and drops to the bottom where the turions lie dormant until the cooler fall water temperatures trigger the turions to germinate. Over the winter, the turions produce winter foliage that thrives under the ice. In spring, when water temperatures begin to rise again, the plant has a head start on the growth of native plants and quickly grows to full size, producing flowers and fruit earlier than its native competitors. Because it can grow in more turbid waters than many native plants, protecting or improving water quality is an effective method of control of this species; clearer waters in a Lake can help native plants compete more effectively with curly-leaf pondweed.

Fourteen species of plants represented the majority of plants observed in Lake Beulah. Statistical data are summarized in Table 1. Figure 4 graphs the frequency for the 10 most abundant species in 2008; Figures 5 and 6 plot the importance, with Figure 5 plotted with a logarithmic scale, and 6 with an arithmetic scale. To the extent that data were available, the inventoried plants from 1995 and 1999 are also represented on Figures 5 and 6 and Table 2. As with previous inventories, native muskgrass is the most numerous native species, and the most important. Additionally, their level of importance has increased over the period. The invasive plant, Eurasian water milfoil, is second most statistically important, and its level of importance

has also increased over time, with the native common bladderwort in a close third position. These are followed by northern water milfoil, water celery, white water lily and large leaf pondweed, in order of importance.

As Figure 5 shows, several native species have decreased significantly in importance over the 14-year series of studies. No research has been conducted as to the cause; however, it is likely that Eurasian water milfoil has taken some of their habitat. Because of its nonnative nature, Eurasian water milfoil exhibits "explosive growth" under suitable conditions. The plant exhibits this characteristic growth pattern in lakes with organic-rich sediments, or where the lake bottom has been disturbed. Eurasian water milfoil populations can displace native plant species and interfere with the aesthetic and recreational use of the waterbodies. This plant has been known to cause severe recreational use problems in lakes within the Southeastern Wisconsin Region.

Eurasian water milfoil reproduces by a process of autofragmentation, followed by the rooting of plant fragments. Additionally, some recreational uses of lakes can cause fragmentation, resulting in the expansion of Eurasian water milfoil communities, especially when boat propellers fragment Eurasian water milfoil plants. These fragments, as well as fragments that occur for other reasons, such as wind-induced turbulence or fragmentation of the plant by fishes, are able to generate new root systems, allowing the plant to colonize new sites. The fragments also can cling to boats, trailers, motors, and/or bait buckets, and can stay alive for weeks contributing to the transfer of milfoil to other lakes. For this reason, it is very important to remove all vegetation from boats, trailers, and other equipment after removing them from the water and prior to launching in other waterbodies.

Figure 7 shows the distribution of the Eurasian water milfoil sample collection. The plant was most abundant in the Stringers Bridge area (western tip of the lake), and along the eastern shore. With the exception of the western tip of the lake (Sensitive Area 8), few samples were collected in sensitive areas, and, in most instances, the rake fullness density rating was 1, meaning that small amounts of the plant were found on the rake.

Figure 8 shows the distribution relative to water depth. Over 80 percent of the occurrences of Eurasian water milfoil were at depths of 10 feet or less.

Figure 9 shows the distribution of muskgrass. These native plants are more widespread than Eurasian water milfoil, and are present at deeper locations. Additionally, rake fullness ratings were higher, with many with the 2 and 3 density ratings. Muskgrass is a favorite waterfowl food source and, as an effective bottom sediment stabilizer, benefits water quality. Its prevalence in the plant communities of a lake may be a significant contributing factor to establishing and maintaining good water quality of a lake and, consequently, in establishing water quality conditions that assist native plant species to successfully compete with nonnative species.

As Figure 10 shows, common bladderwort is much less pervasive than muskgrass or Eurasian water milfoil, with its presence mostly confined to the northern portions of the lake. However, like muskgrass, it ventures into deeper areas of the lake than Eurasian water milfoil.

3 MANAGEMENT OF INVASIVE AQUATIC PLANTS

Aside from minor occurrences of curly-leaf pondweed, Eurasian water milfoil was the only invasive aquatic plant identified; however, it was found in abundance. Various options are available for addressing this problem, based on water depth, equipment availability, environmental habitats and water use.

Aquatic plant management measures can be classed into four groups: physical measures, which include lake bottom coverings and water level management; biological measures, which include the use of various organisms, including herbivorous insects and plantings of aquatic plants; manual and mechanical measures, which include harvesting and removal of aquatic plants; and, chemical measures, which include the use of aquatic herbicides. All control measures are stringently regulated and require a State of Wisconsin permit; chemical controls are regulated under Chapter NR 107 of the *Wisconsin Administrative Code*, and all other aquatic plant management practices are regulated under Chapter NR 109 of the *Wisconsin Administrative Code*. Placement of bottom covers, a physical measure, also requires a Wisconsin Department of Natural Resources (WDNR) permit under Chapter 30 of the *Wisconsin Statutes*. Costs range from minimal for manual removal of plants using rakes and hand-pulling, to upwards of $100,000 for the purchase of a mechanical plant harvester, for which the operational costs can approach $2,500 to $25,000 per year, depending on staffing and operation policies.

3.1 PHYSICAL MEASURES

Lake bottom covers and light screens provide limited control of rooted plants by creating a physical barrier which reduces or eliminates the sunlight available to the plants. Sand and gravel are usually widely available and relatively inexpensive to use as cover materials, but plants readily recolonize areas so covered in about a year. Additionally, sand blankets are not permitted under any circumstance, and pea gravel blankets require specific permitting. Synthetic materials, such as polyethylene, polypropylene, fiberglass, and nylon, can provide relief from rooted plants for several years. However, such materials, known as bottom screens or barriers, generally have to be placed and removed annually. Such barriers also are susceptible to disturbance by watercraft propellers or the build-up of gasses from decaying plant biomass trapped under the barriers. In the case of Lake Beulah, the need to encourage native aquatic plant growth while simultaneously controlling the growth of Eurasian water milfoil, suggests that the placement of lake bottom covers as a method to control aquatic plant growth does not appear to be warranted. Thus, such measures are not considered viable for Lake Beulah.

3.2 BIOLOGICAL MEASURES

Biological controls offer an alternative approach to controlling nuisance plants, particularly purple loosestrife (*Lythrum salicaria*), and invasive shoreland wetland plant, and Eurasian water milfoil. Classical biological control techniques have been successfully used to control both nuisance plants with herbivorous insects. Recent evidence shows that *Galerucella pucilla* and *Galerucella calmariensis*, beetle species, and *Hylobius transversovittatus* and *Nanophyes brevis*, weevil species, have potential as biological control agents for purple loosestrife. Extensive field trials conducted by the WDNR in the Southeastern Wisconsin Region since 1999 have indicated that these insects can provide effective management of large infestations of purple loosestrife. In contrast, the few studies of Eurasian water milfoil control utilizing *Eurhychiopsis lecontei*, an aquatic weevil species, have resulted in variable levels of control, with little control being achieved on those lakes having extensive motorized boating traffic. Thus, while the use of insects as a means of shoreland wetland plant management is considered to be viable, the use of *Eurhychiopsis lecontei* as a means of aquatic plant management control, is not considered a viable option for use on Lake Beulah at this time.

The use of grass carp, *Ctenopharyngodon idella*, an alternative biological control used elsewhere in the United States, is not permitted in Wisconsin. This voracious herbivore has been shown to denude lakes and ponds of aquatic vegetation, exposing lake bottom sediments to wind erosion and increasing turbidity in lakes and ponds, and enhancing the likelihood of occurrence of nuisance algal blooms.

A variation on the theme of biological control is the introduction of aquatic plants into a waterbody as a means of encouraging or stimulating the growth of desirable native aquatic plant species in a lake. While few projects of this nature have been undertaken in the Southeastern Wisconsin Region, the Lac La Belle Management District, in partnership with the WDNR and University of Wisconsin-Milwaukee, did attempt to supplement the aquatic plant community of that Lake by selectively planting pondweeds (*Potamogeton* spp.). Several hundred pondweeds were transplanted into Lac La Belle, and, while there is some evidence that a few of these transplants were successful, the net outcome of the project was disappointing. Few of the introduced plants were observed in subsequent years. Given the apparent low success rate, supplemental plantings are not considered to be a viable aquatic plant management option for Lake Beulah at this time.

3.3 MANUAL AND MECHANICAL MEASURES

The physical removal of specific types of vegetation by selective harvesting of plants provides a highly selective means of controlling the growths of nuisance aquatic plant species, including purple loosestrife and Eurasian water milfoil. Pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, manual harvesting of aquatic plants within a 30-foot-wide corridor along the shoreline would be allowed without a WDNR permit, provided the plant material is removed from the Lake. Any other manual harvesting would require a State permit, unless

employed in the control of designated nonnative invasive species, such as Eurasian water milfoil or curly-leaf pondweed.

Aquatic macrophytes also may be harvested mechanically with specialized equipment consisting of a cutting apparatus, which cuts up to about five feet below the water surface, and a conveyor system that picks up the cut plants. Mechanical harvesting can be a practical and efficient means of controlling plant growth as it removes the plant biomass and nutrients from a lake. Mechanical harvesting is particularly effective as a measure to control large-scale growths of aquatic plants. Narrow channels can be harvested to provide navigational access and "cruising lanes" for predator fish to migrate into the macrophyte beds to feed on smaller fish. The harvesting of water lilies and other emergent native plants should be avoided.

"Clear cutting" aquatic plants and denuding the lake bottom of flora, using either manual or mechanical harvesting, should be avoided. However, top cutting of plants, such as Eurasian water milfoil using mechanical harvesters has proven to be beneficial in some lakes as a means of minimizing the competitive advantage of the Eurasian water milfoil plant and encouraging native aquatic plant growths.

In the shoreland area, where purple loosestrife may be expected to occur, bagging and cutting loosestrife plants prior to the application of chemical herbicides to the cut ends of the stems, can be an effective control measure for small infestations of this plant. Loosestrife management programs, however, should be followed by an annual monitoring and control program for up to 10 years following the initial control program to manage the regrowth of the plant from seeds. Manual removal of such plants is recommended for isolated stands of purple loosestrife when and where they occur.

In the nearshore area, specially designed rakes are available to assist in the manual removal of nuisance aquatic plants, such as Eurasian water milfoil. The use of such rakes also provides a safe and convenient method of controlling aquatic plants in deeper nearshore waters around piers and docks. The advantage of the rakes is that they are relatively inexpensive, easy and quick to use, and immediately remove the plant material from the lake, without a waiting period. Removal of the plants from the lake avoids the accumulation of organic matter on the lake bottom, which adds to the nutrient pool that favors further plant growth. State permitting requirements for manual aquatic plant harvesting mandate that the harvested material be removed from the lake. Should the LBMD acquire a number of these specially designed rakes, they could be made available for the riparian owners to use on a trial basis to test their operability before purchasing them.

Hand-pulling of stems, where they occur in isolated stands, provides an alternative means of controlling plants, such as Eurasian water milfoil, in the Lake, and purple loosestrife, on the lakeshore. Because this is a more selective measure, the rakes being nonselective in their harvesting, manual removal of Eurasian water milfoil is considered a viable option in Lake Beulah, where practicable and feasible.

When utilizing a mechanical harvester, a minimum of 12 inches of growth must remain on the lake bed, and no mechanical harvesting should be conducted in areas that have been

chemically treated within the previous 2 weeks. This leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms, and to stabilize the lake bottom sediments. Aquatic plant harvesting also has been shown to facilitate the growth of native aquatic plants in harvested areas by allowing light penetration to the lakebed. Many native aquatic plants are low-growing species that are less likely to interfere with human recreational and aesthetic uses of a lake. A disadvantage of mechanical harvesting is that the harvesting operation may cause fragmentation of plants and, thus, unintentionally facilitate the spread of some plants that utilize fragmentation as a means of propagation, namely Eurasian water milfoil. Harvesting may also disturb bottom sediments in shallower areas where such sediments are only loosely consolidated, thereby increasing turbidity and resulting in deleterious effects, including the smothering of fish breeding habitat and nesting sites. Disrupting the bottom sediments also could increase the risk that an exotic species, such as Eurasian water milfoil, may colonize the disturbed area since this is a species that tends to thrive under disturbed bottom conditions. To this end, most WDNR-issued permits do not allow harvesting in areas having a water depth of less than three feet. Nevertheless, if done correctly and carefully, harvesting has been shown to be of benefit in ultimately reducing the regrowth of nuisance plants when used under conditions suitable for this method of control.

Given the extent of areas needing aquatic plant management, the nature of the bottom sediments and species composition in these areas, mechanical harvesting continues to be considered a viable management option as a control of aquatic plants in areas of Lake Beulah.

3.4 CHEMICAL MEASURES

Chemical treatment with herbicides is a short-term method of controlling heavy growths of nuisance aquatic plants. Chemicals are generally applied to the growing plants in either a liquid or granular form. The advantages of using chemical herbicides to control aquatic macrophytes growth are the relatively low-cost and the ease, speed, and convenience of application. The disadvantages associated with chemical control include unknown long-term effects on fish, fish food sources, and humans; a risk of increased algal blooms due to the eradication of macrophyte competitors; an increase in organic matter in the sediments, possibly leading to increased plant growth, as well as anoxic conditions which can cause fishkills; adverse effects on desirable aquatic organisms; loss of desirable fish habitat and food sources; and, finally, a need to repeat the treatment the following summer due to existing seed banks and/or plant fragments. Widespread chemical treatments can also provide an advantage to less desirable, invasive, introduced plant species to the extent that such treatments may produce conditions in which nonnative species can outcompete the more beneficial, native aquatic plant species. Hence, this is seldom a feasible management option to be used on a large scale. Widespread chemical treatment, therefore, is not considered a viable option for Lake Beulah, although limited chemical control is often a viable technique for the control of the relatively small-scale infestations of aquatic plants, such as Eurasian water milfoil, or shoreland plants, such as purple loosestrife.

To minimize the possible impacts of deoxygenation, loss of desirable plant species, and contribution of organic matter to the sediments, early spring applications should be considered. Such applications also minimize the concentration and amount of chemicals used due to the facts that colder water temperatures enhance the herbicidal effects, while the application of chemical herbicides during periods when most native aquatic plants species are still dormant limit the potential for damage to native aquatic plants. Use of chemical herbicides in aquatic environments is stringently regulated and requires a WDNR permit and WDNR staff oversight during applications. Use of early spring chemical controls, especially in those shoreline areas where mechanical harvesting would not be deemed viable, targeting growths of Eurasian water milfoil or other invasive nuisance aquatic plants and purple loosestrife in and around the Lake, is considered a viable option for Lake Beulah. Late fall applications can also be considered; however, that is considered by the WDNR to be an experimental approach.

When the appropriate chemical is used at the correct time and rate, it can be used as a selective control, with no impact to non-target organisms. Typically, chemical controls are only permitted for invasive species, and not for native species.

4 RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

Efforts should be concentrated on the areas where significant populations of Eurasian water milfoil were found (see Figure 7). A combination of mechanical aquatic plant harvesting and use of aquatic herbicides to target Eurasian water milfoil is recommended. Most harvesters can cut and harvest aquatic vegetation up to 5 feet of depth and the larger ones up to 7 feet of depth. In deeper waters, “top chopping” can be effective. In this process, the harvester is cutting primarily the Eurasian water milfoil, which typically grows taller than the native species. By removing the vegetative canopy of the plant, sunlight can penetrate and native plants, which tend to be lower growing, can germinate and grow. However, the harvesting/top chopping has to be repeated at about 3 to 4 week intervals through the summer to limit re-growth of the Eurasian water milfoil.

Relative to Eurasian water milfoil, the occurrence of Curly leaf pondweed was minor. However, should the LBMD wish to control its advance, early-season harvesting, with the collection of its reproductive structure (turion) can be considered.

In waters shallower than 3 feet depth, individual riparian owners can manage Eurasian water milfoil by raking. Under appropriate conditions, Eurasian water milfoil can be managed chemically. Appropriate conditions would be shallow water (e.g., 5 feet or shallower), an area that is primarily occupied by invasive plants, and outside of environmentally sensitive areas. The appropriate timing is also crucial, in that the degradation of mature plants can cause the depletion of oxygen.

Figure 11 shows much of the information presented in previous figures, along with water depths. Appendix C includes additional detail on harvesting patterns. Based on conditions including depth, environmental sensitivity, and plant inventory, various plant management

options have been identified. As discussed earlier, the WDNR has identified several areas around the lake as being environmentally sensitive. These areas are very important to the environmental health of the lake, and great care should be taken to protect them. As a result, only limited plant management activities are recommended for these areas.

Fortunately, invasive species are not common in the sensitive areas, with the exception of Area 8, which is located east of Stringers Bridge. Because water is shallow in this area, extensive use of a mechanical harvester risks uprooting desired vegetation, thereby causing a reduction in lake bed stability and animal habitat. Consequently, mechanical harvesting is only recommended at depths at which the harvester can cut without damage to native species. Manual harvesting is recommended in these areas as an alternative, and selective chemical treatment is also an option. However, because this is an important area for boating, a 50-foot wide boating channel is recommended to be cut with a harvester.

Sensitive Area 6 is in the narrows between the upper lake and lower lake. Very few invasive plants were inventoried in this area, but it is a significant area for muskgrass. Consequently, aquatic plant control should be minimized in this area, with possible mechanical harvesting only to the extent that may be necessary to maintain a boating channel.

Most of the aquatic plant management activities are needed in the northern portions of the lake, where most of the Eurasian water milfoil occurrences were recorded. Two areas are shown on Figure 11 as being appropriate for chemical treatment; however, other areas may be suitable, as well. Additionally, other portions of the lake have Eurasian water milfoil present, and can be harvested by both manual and mechanical means, as appropriate.

5 SUMMARY

Eurasian water milfoil is a significant presence in Lake Beulah. However, its presence is typically within areas shallow enough to manage by conventional means, and most of it occurs outside of environmentally sensitive areas. Recommended management techniques are based on water depth, environmental setting, equipment availability and water use. Appropriate control measures include, but are not limited to, any permitted aquatic plant management measure, placement of signage, and use of buoys to isolate affected areas of the Lake. Such measures as may be appropriate should be determined in consultation with WDNR staff and conducted in accordance with required permits under Chapters NR 107, NR 109, and NR 198, among others, of the *Wisconsin Administrative Code*.

- *Chemical treatment:* The use of herbicides should be limited, because if not applied properly they have the potential to kill native plants and can harm fish. Additionally, herbicides should be applied within a narrow window of time, as permitted by the WDNR. Figure 11 shows two areas where Eurasian water milfoil is present, and where the conditions would be suitable for herbicide application. Other areas may also be considered, at the review and approval of the WDNR. Aquatic herbicide usage should conform to the WDNR aquatic plant management permit conditions, and be predicated

upon guidance set forth in WDNR publications PUBL-WR-236 90, *Chemical Fact Sheet: 2,4-D*; PUBL-WR-237 90, *Chemical Fact Sheet: Endothall*; PUBL-WR-239 90, *Chemical Fact Sheet: Glyphosate*; PUBL-WR-235 90, *Chemical Fact Sheet: Diquat*; PUBL-WR-240 90, *Chemical Fact Sheet: Fluridone*; and, PUBL-WR-238 90, *Chemical Fact Sheet: Copper Compounds*, all published in May 1990.

- *Mechanical harvesting:* Most of the work of invasive species management can be completed with a mechanical harvester. Depending on the size of the harvester, plant removal can be effective to depths of 5 to 7 feet. Additionally, top chopping can be effective in deeper waters. Harvesting in shallow waters should be completed at least annually; areas where top chopping is conducted should be completed on 3- to 4-week intervals during the growing season. When harvesting, it is important that the plants be collected and removed from the lake, because fragmentation is a means by which Eurasian water milfoil areas expand.
- *Manual harvesting:* Manual harvesting can be completed in shallow waters. Additionally, a major area of Eurasian water milfoil is in Sensitive Area 8, where mechanical means of harvesting should be minimized, and no chemicals used. Special rakes are available for this purpose. As with the mechanical harvesting, plants must be removed from the lake.
- *Boating channels:* Sensitive Areas 6 and 8 are also areas of heavy boat traffic. Area 6 essentially connects the two halves of the lake, and Area 8 is the entrance to the lake from the areas west of Stringers Bridge. In these areas, a 50-foot wide boat path is recommended. However, in Area 6, this path should be within the deepest part of the channel.
- *Miscellaneous harvesting:* The above recommendations address the areas of the lake that are most infested with Eurasian water milfoil. As shown on Figure 5, the invasive species was found in other areas, as well; however, not as widely-spread or in as great a density.
- *Periodic monitoring of aquatic plant communities:* The conduct of in-lake aquatic plant surveys at about three- to five-year intervals, depending upon the observed degree of change in the aquatic plant communities, is recommended. In addition, information on the aquatic plant control program should be recorded and should include descriptions of major areas of nuisance plant growth and areas chemically treated. In addition, periodic monitoring of the aquatic plant community is recommended for the early detection and control of future-designated nonnative species that may occur. Such control could be effected with the assistance of funds provided under the Chapter NR 198, aquatic invasive species control grant program, and should be undertaken as soon as possible once the presence of a nonnative, invasive species is observed and confirmed, reducing the risk of spread from waters where they are present and restoring native aquatic communities. Control of currently designated invasive species, designated pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, using appropriate control measures, is recommended throughout the Lake.
- *Shoreline management:* Use of vegetated buffer strips is recommended in lakeshore areas wherever practical in order to maintain habitat value and the natural ambience of

the lakeshore. Buffer strips also intercept nutrients, silts, organic matter such as leaves and yard debris, and other contaminants that would otherwise be carried into the Lake as the result of storm runoff and contribute to the rooting success of nonnative aquatic plants such as Eurasian water milfoil. Continued maintenance of existing revetments and other protection structures is also recommended. Conversion of bulkheads to rip-rap or natural vegetated shoreline or combinations thereof is recommended to be considered where potentially viable at such time as major repairs are found necessary.

- *Miscellaneous management practices:* The LBMD should continue responsible management practices, such as not harvesting areas that have been chemically treated for two weeks, and leaving at least 1 foot of plant on the lake bed after harvesting.
- *Informational programming:* Aquatic plant management usually centers on the eradication of nuisance aquatic plants for the improvement of recreational lake use. The majority of the public views all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering their environmental impacts. Thus, public information is an important component of an aquatic plant management program. Posters and pamphlets are available from the University of Wisconsin-Extension and WDNR that provide information and illustrations of aquatic plants, their importance in providing habitat and food resources aquatic environments, and the need to control the spread of undesirable and nuisance plant species.

The Lake Beulah Management District should take the lead in implementing this aquatic plant management program. The LBMD should partner with the Lake Beulah Protective and Improvement Association (founded in 1894) in disseminating information on the Lake and its environs, and cooperate with the Town of East Troy and Walworth County in the implementation of this aquatic plant management plan, especially with regard to shoreline management issues.

TABLES

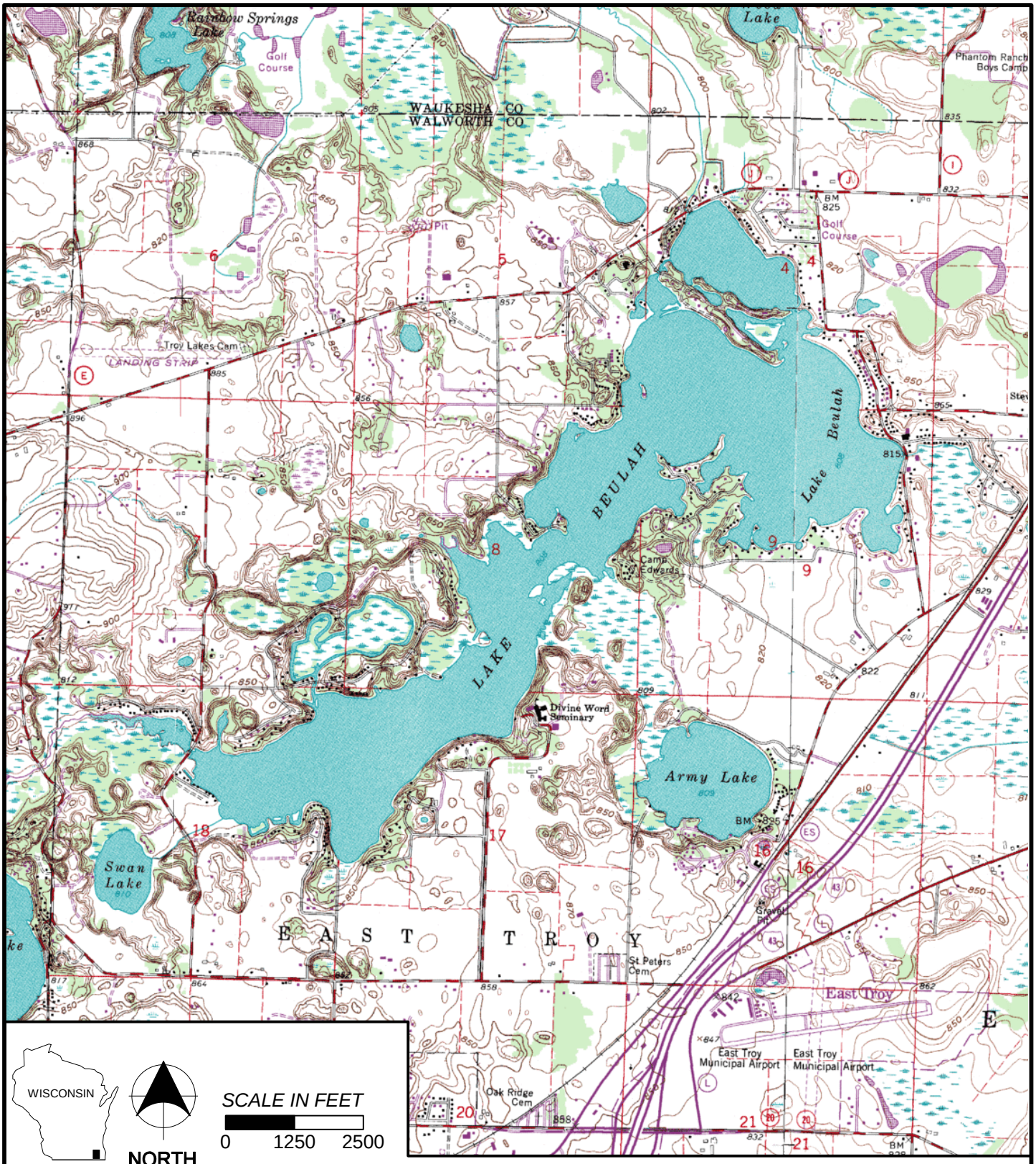
TABLE 1
SPECIES BY NUMBER OF LOCATIONS, FREQUENCY AND DENSITY
2008 AQUATIC PLANT SURVEY
LAKE BEULAH, WISCONSIN

SPECIES	OCCURRENCES	FREQUENCY (%)	AVG. DENSITY
Muskgrasses	470	35.23	1.09
Eurasian water-milfoil	179	13.42	0.27
Common bladderwort	139	10.42	0.16
Large-leaf pondweed	89	6.67	0.11
Northern water milfoil	72	5.40	0.08
Coontail	65	4.87	0.10
White water lilly	61	4.57	0.08
Ditch grass	61	4.57	0.11
Yellow pond lilly	55	4.12	0.07
Wild celery	40	3.00	0.05
Small pondweed	39	2.92	0.06
Spatterdock	15	1.12	0.02
Water bulrush	15	1.12	0.02
Clasping-leaf pondweed	7	0.52	0.01
Floating-leaf pondweed	6	0.45	0.01
Spiny naiad	5	0.37	0.01
Flat-stem pondweed	5	0.37	0.01
Curly-leaf pondweed	3	0.22	0.00
Common waterweed	3	0.22	0.00
Filamentous algae	2	0.15	0.00
Small duckweed	2	0.15	0.00
Bushy pondweed	1	0.07	0.00

TABLE 2
AQUATIC PLANT DISTRIBUTION
1995, 1999 AND 2008

COMMON PLANT NAME	FREQUENCY			RELATIVE FREQUENCY (%)			AVERAGE DENSITY			IMPORTANCE		
	1995	1999	2008	1995	1999	2008	1995	1999	2008	1995	1999	2008
Muskgrasses	0.484	0.588	0.777	*DATA NOT PRESENTED*	20.5	35.2	*DATA NOT PRESENTED*	*DATA NOT PRESENTED*	1.09	31.409	49.882	27.37
Eurasian water-milfoil	0.120	0.203	0.296		7.1	13.4			0.27	0.655	2.728	3.97
Common bladderwort	0.270	0.146	0.230		0.5	10.4			0.16	2.280	1.059	2.39
Large-leaf pondweed	0.182	0.109	0.147		3.8	6.7			0.11	1.534	1.052	0.98
Ditch grass			0.101			4.6			0.08			0.46
Coontail		0.016	0.107		0.5	4.9			0.10		0.017	0.52
Northern water milfoil	0.370	0.245	0.119		8.5	5.4			0.08	11.798	6.664	0.64
White water lilly		0.073	0.101		2.5	4.6			0.11	0.877	0.609	0.46
Yellow pond lilly			0.091			4.1			0.07			0.37
Small pondweed			0.064			2.9			0.05			0.19
Wild celery	0.302	0.0193	0.066		6.7	3.0			0.06	5.176	3.253	0.20
Water bulrush		0.026	0.025		0.9	1.1			0.02		0.099	0.03
Spatterdock			0.025			1.1			0.02			0.03
Clasping-leaf pondweed			0.012			0.5			0.01			0.01
Floating-leaf pondweed	0.161	0.125	0.010		4.4	0.4			0.01	1.073	1.202	0.00
Spiny naiad	0.172	0.083	0.008		2.9	0.4			0.01	1.302	0.378	0.00
Flat-stem pondweed		0.094	0.008		3.3	0.4			0.01		0.510	0.00
Common waterweed			0.005			0.2			0.00			0.00
Small duckweed		0.016	0.003		0.5	0.1			0.00		0.011	0.00
Curly-leaf pondweed		0.000	0.005		0.0	0.2			0.00		0.000	0.00
Bushy pondweed			0.002			0.1			0.00			0.00
Wild rice		0.026	0.000		0.9	0.0			0.00		0.066	0.00
Filamentous algae		0.036	0.003		1.3	0.1			0.00		0.073	0.00

FIGURES



MAP SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, EAST TROY, WISCONSIN, 1994, AND MUKWONAGO, WISCONSIN, 1994.

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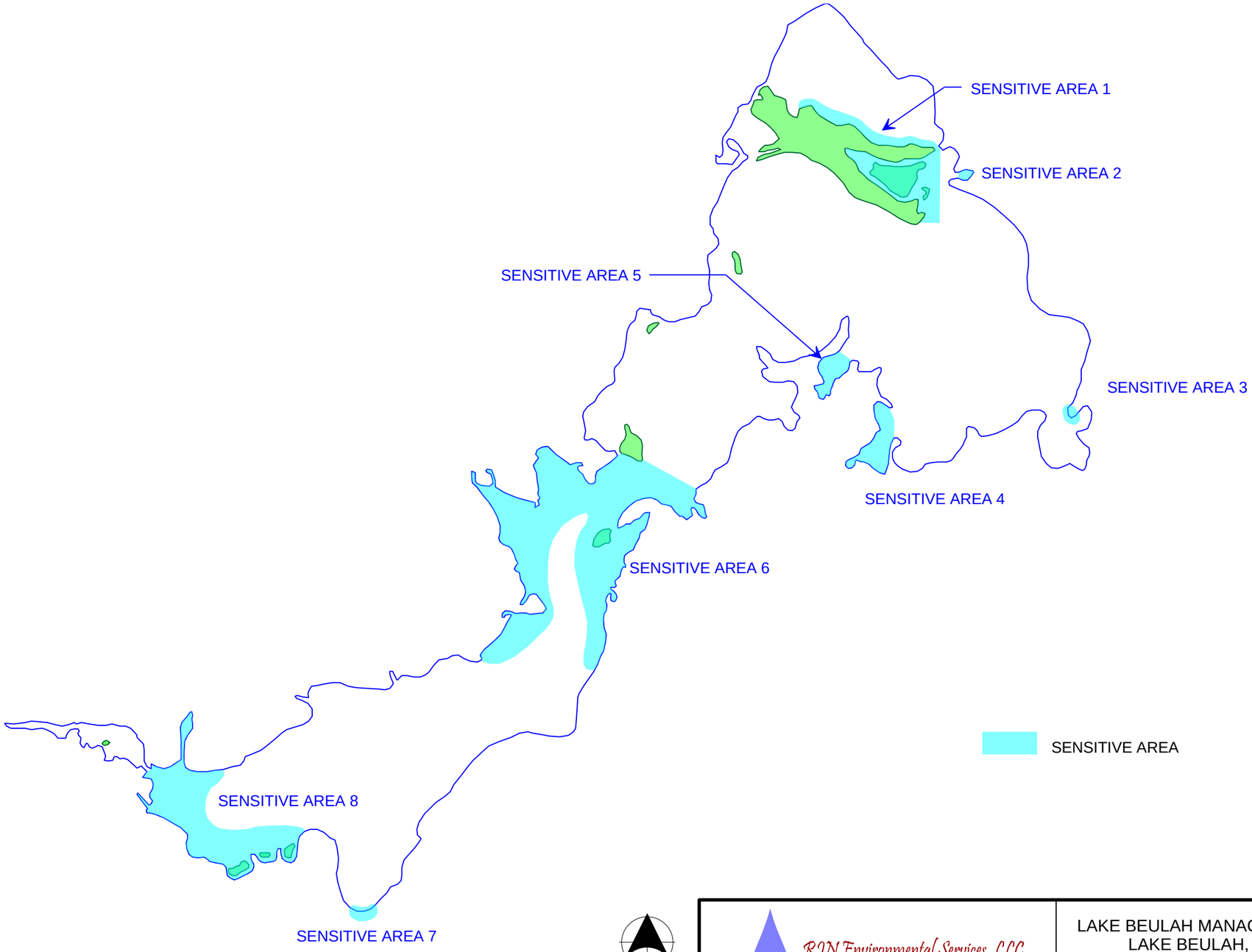
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
SITE LOCATION MAP

FIGURE 1

DRAWN BY	PROJ. No.	DATE	FILE NAME
RN	09-210	10 MAY 10	SITE LOC



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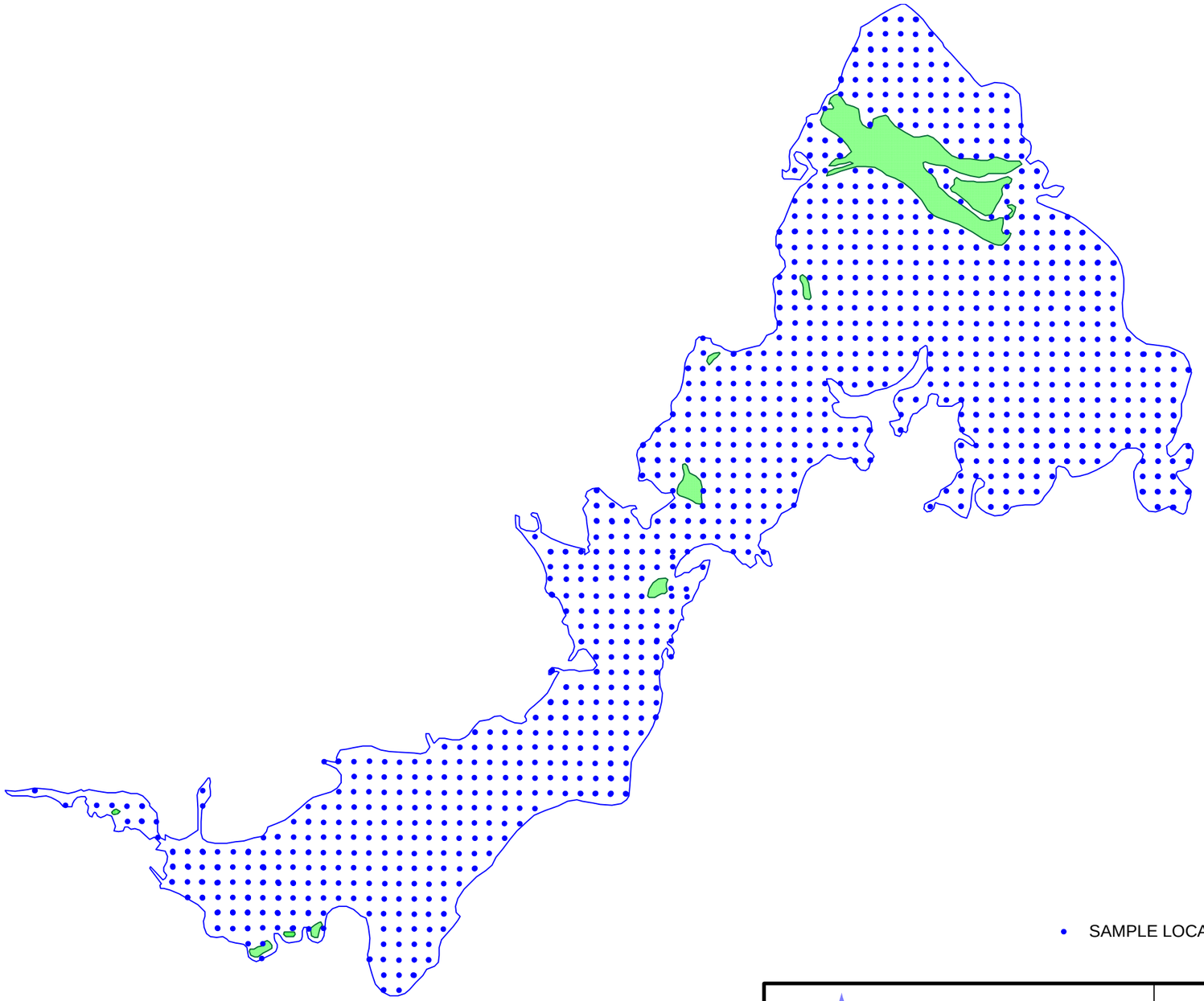
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
ENVIRONMENTALLY SENSITIVE AREAS

FIGURE 2

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	27 APR 10	ALL PLANTS



SAMPLE LOCATION

SCALE IN FEET

0 750 1500 2250 3000

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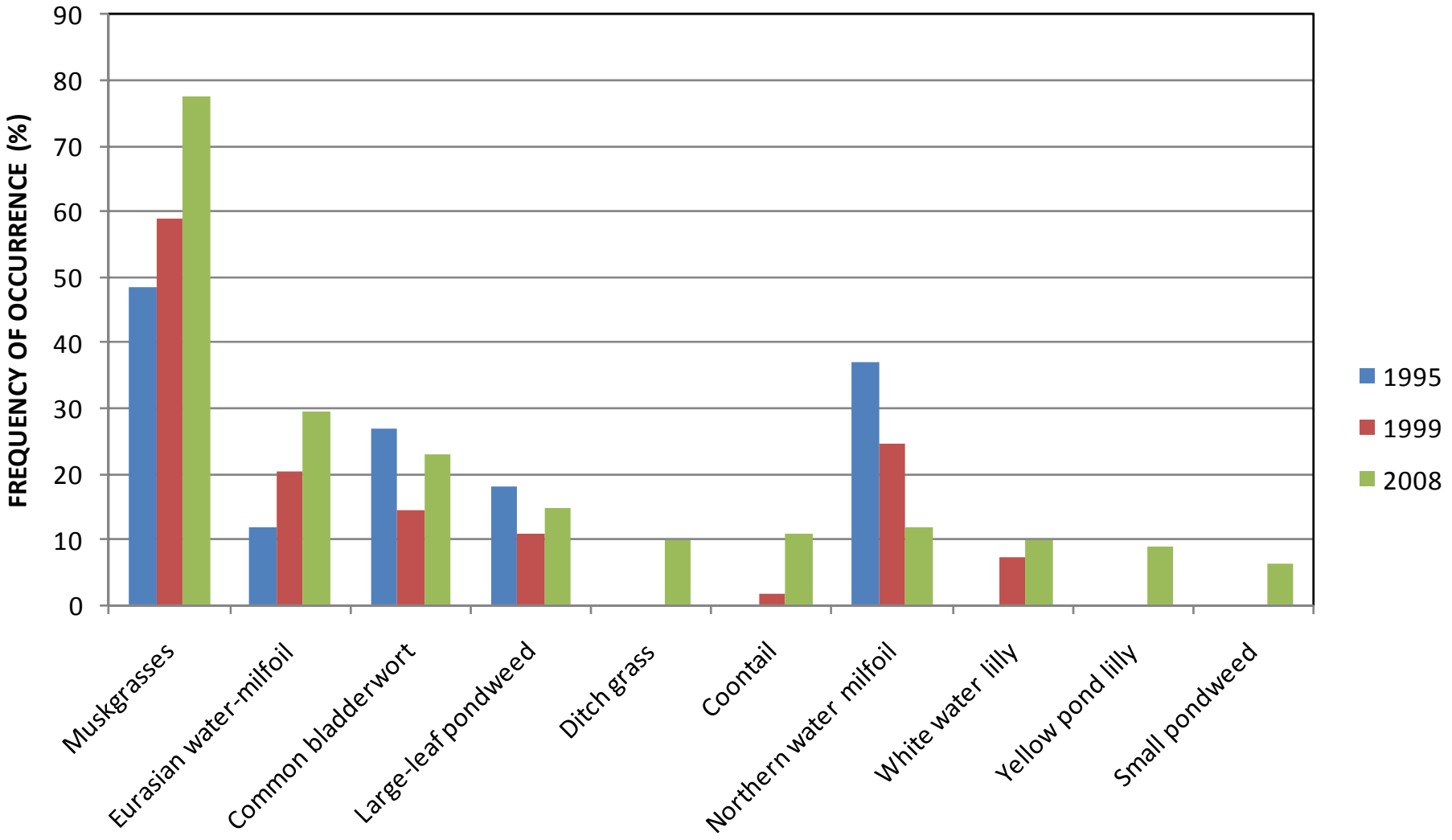
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
AQUATIC PLANT SAMPLE LOCATIONS

FIGURE 3

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	24 MAR 10	SAMP LOC



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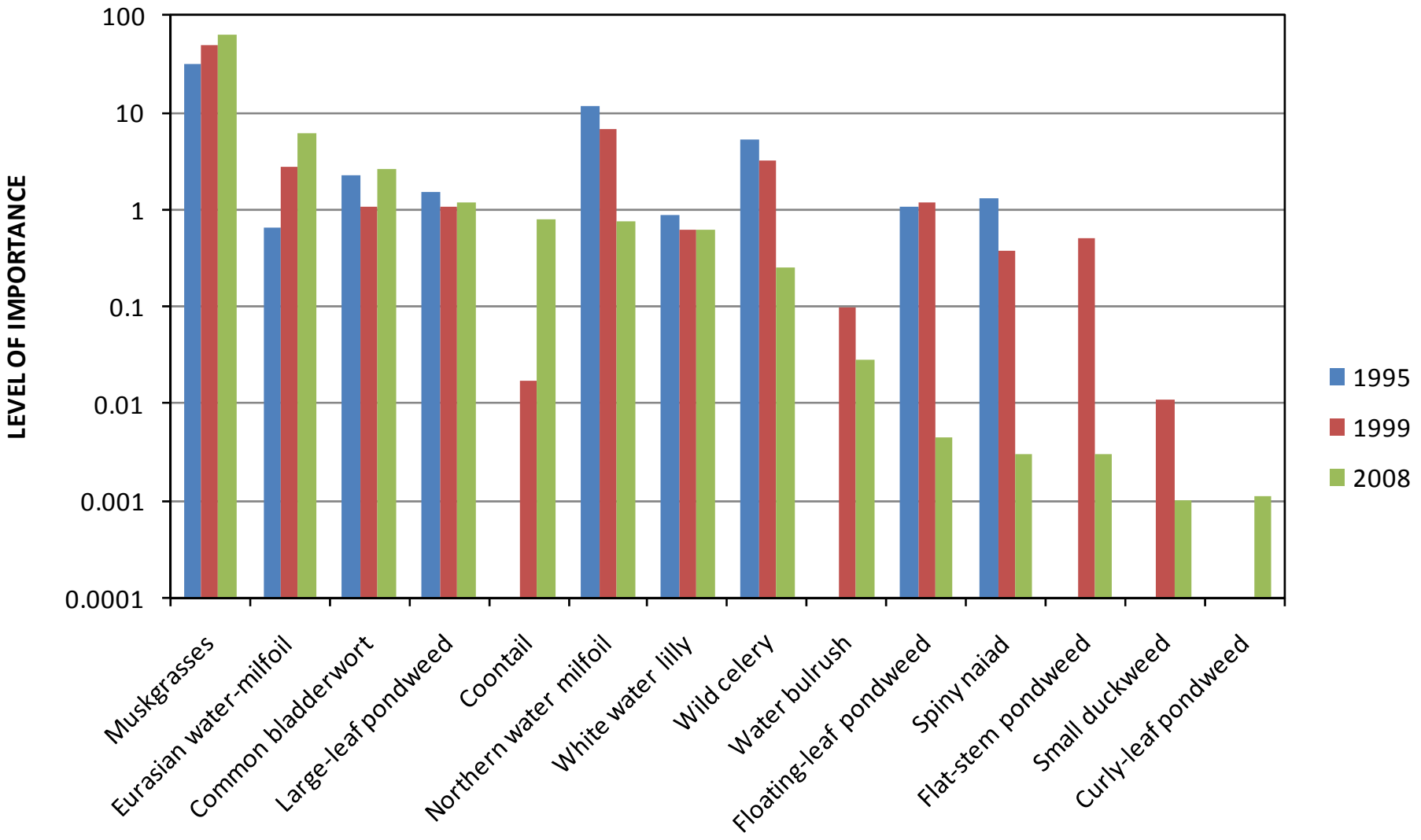
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
FREQUENCY OF OCCURRENCE
10 MOST ABUNDANT SPECIES

FIGURE 4

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	14 JUN 10	FREQUENCY



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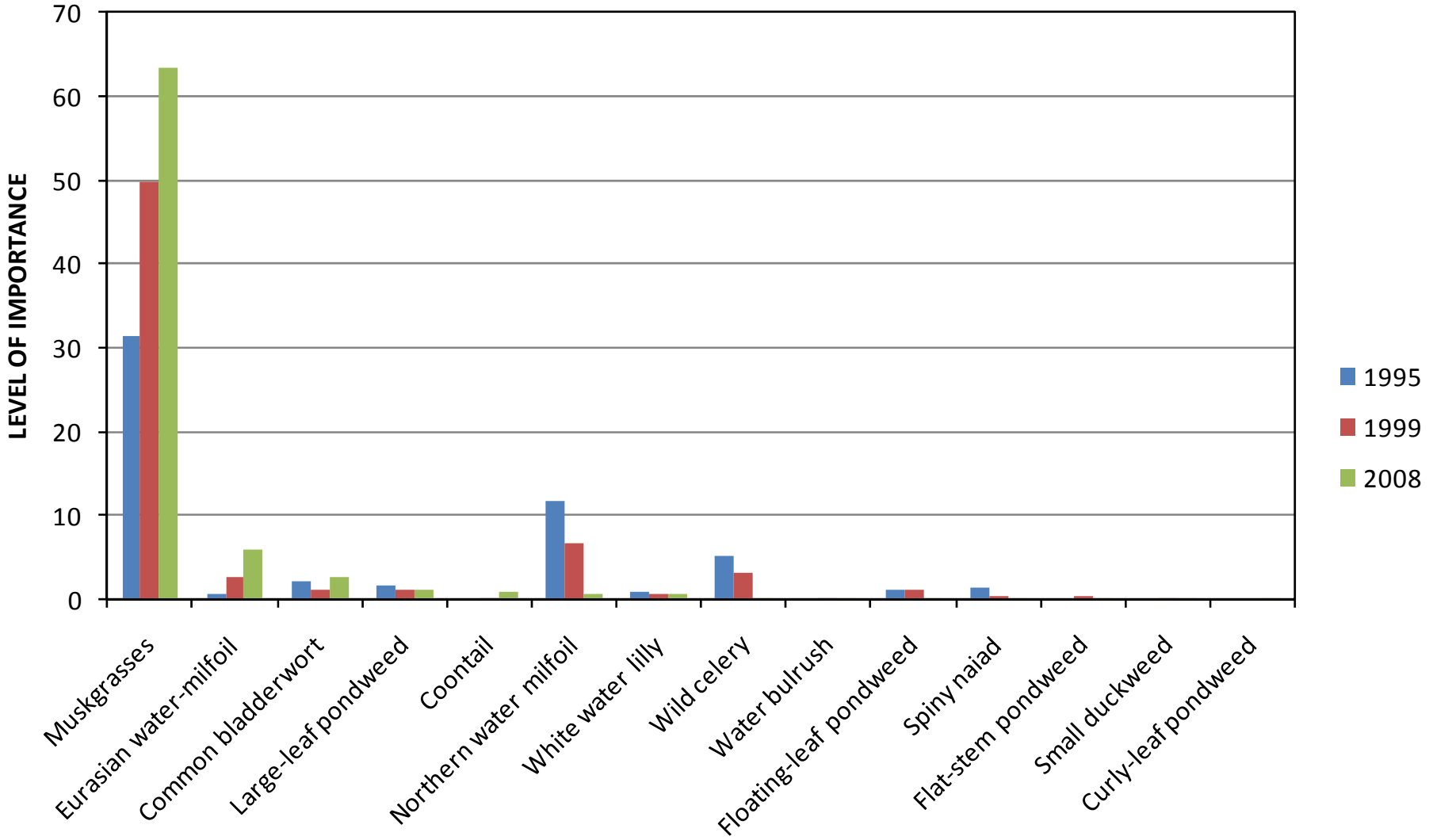
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
IMPORTANCE RANKINGS OF SPECIES
LOGARITHMIC SCALE

FIGURE 5

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	26 APR 10	IMPORTANCE



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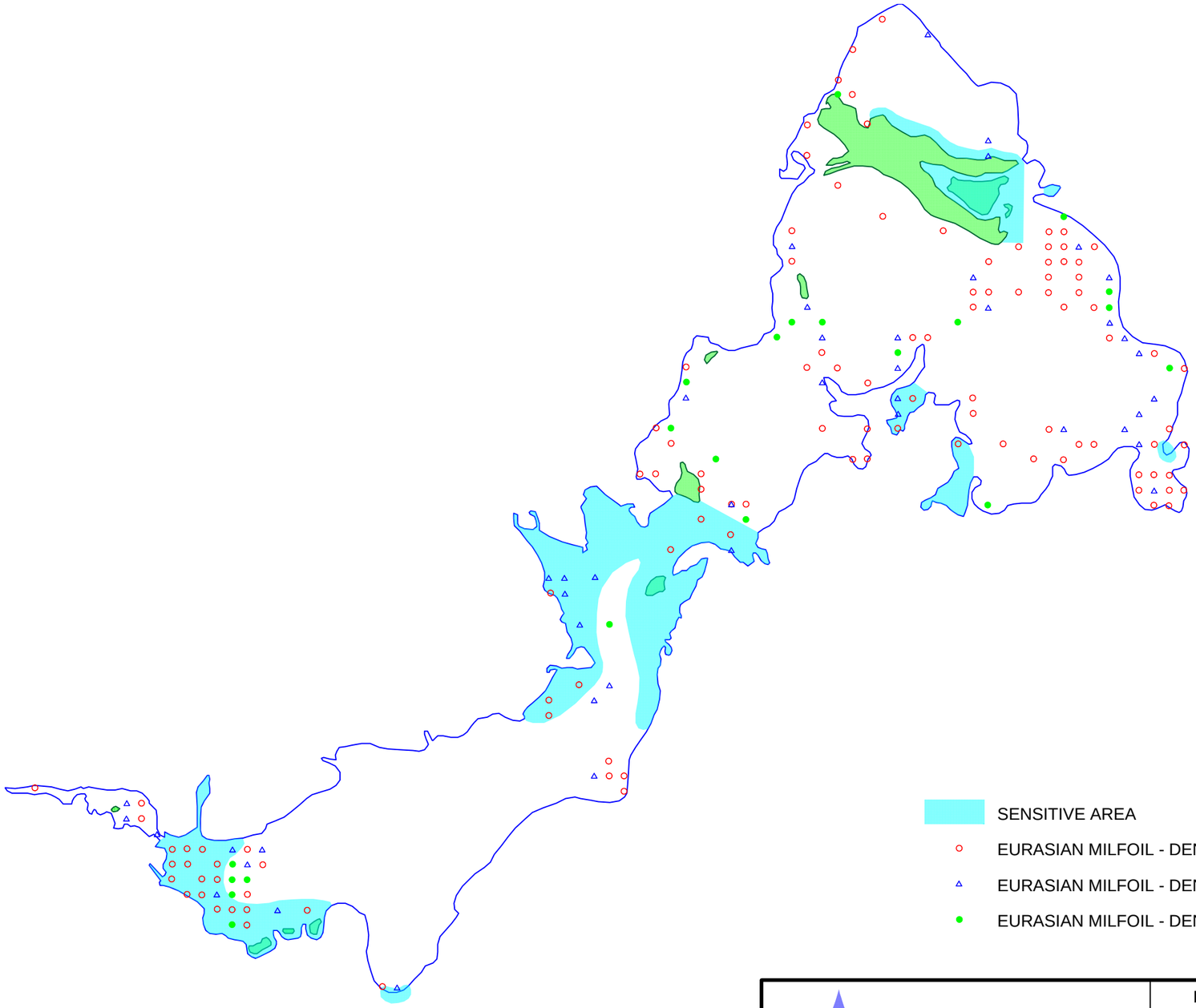
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
IMPORTANCE RANKINGS OF SPECIES
ARITHMETIC SCALE

FIGURE 6

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	26 APR 10	IMPORTANCE-A



SENSITIVE AREA

EURASIAN MILFOIL - DENSITY 1

EURASIAN MILFOIL - DENSITY 2

EURASIAN MILFOIL - DENSITY 3

SCALE IN FEET

0 750 1500 2250 3000

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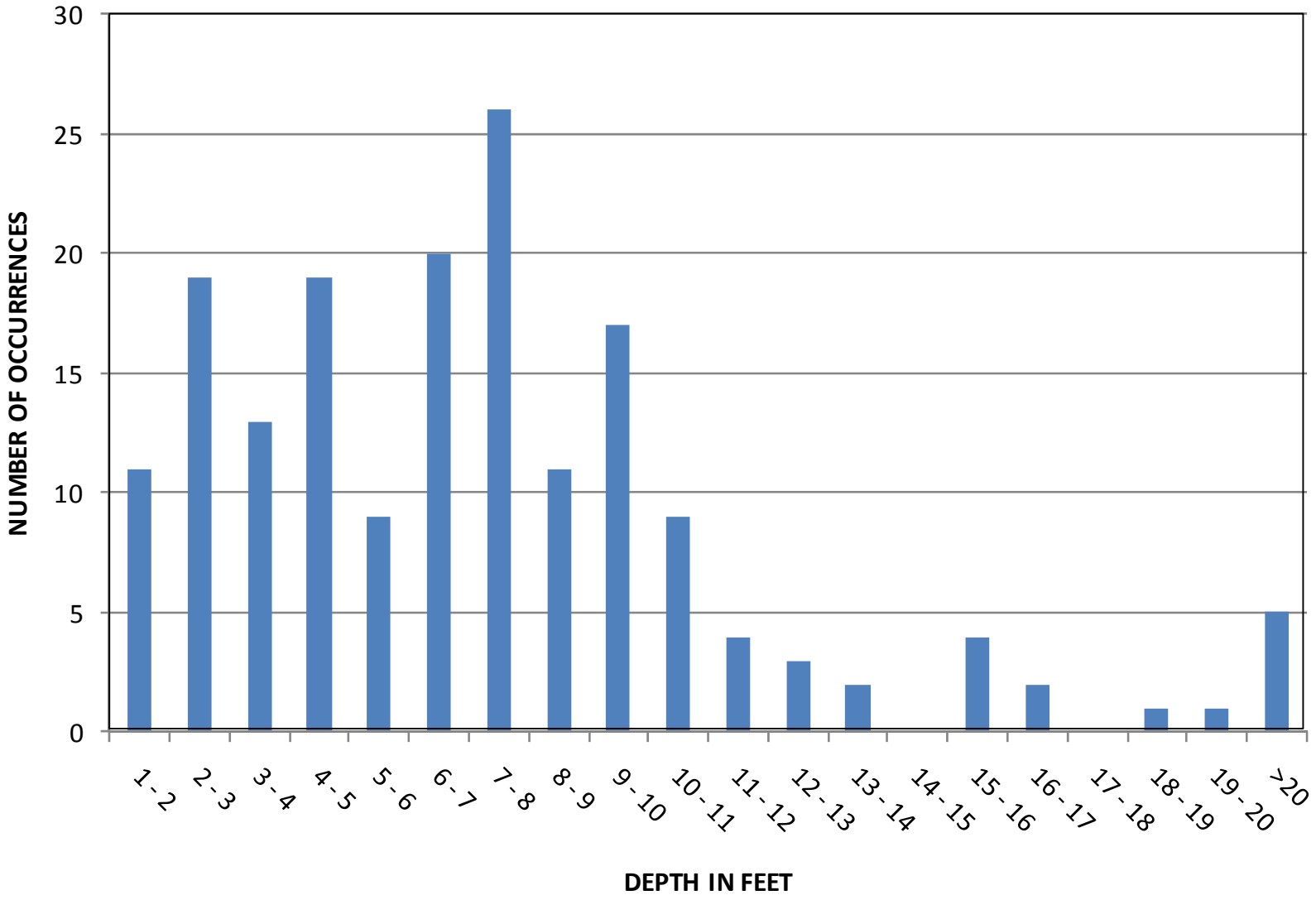
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
EURASIAN WATER MILFOIL
SAMPLE COLLECTION

FIGURE 7

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	22 APR 10	MILFOIL



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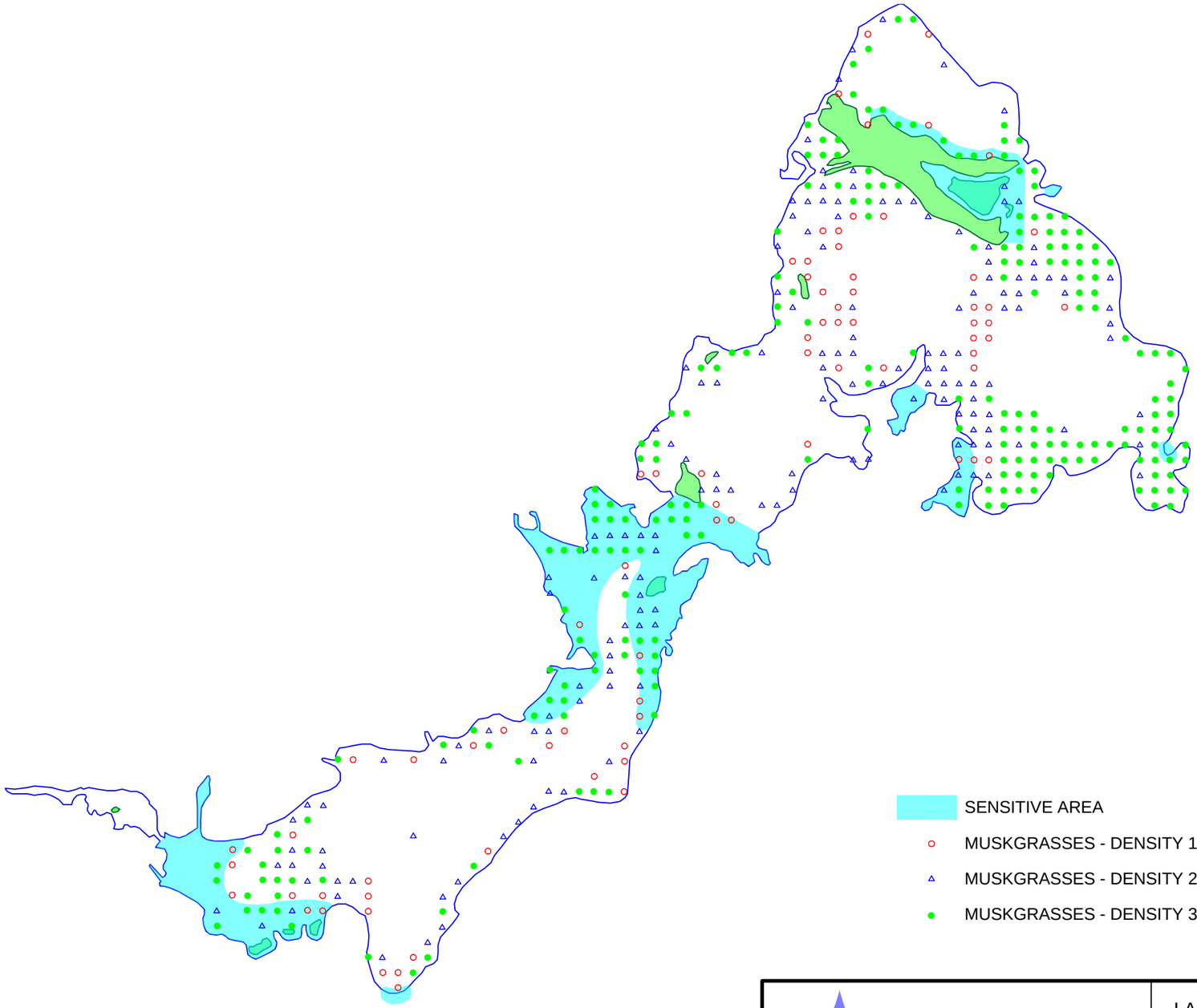
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
DEPTHS OF EURASIAN WATER MILFOIL
SAMPLE COLLECTION

FIGURE 8

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	25 MAR 10	MFOIL DEPTH



SENSITIVE AREA

MUSKGRASSES - DENSITY 1

MUSKGRASSES - DENSITY 2

MUSKGRASSES - DENSITY 3

SCALE IN FEET

0 750 1500 2250 3000

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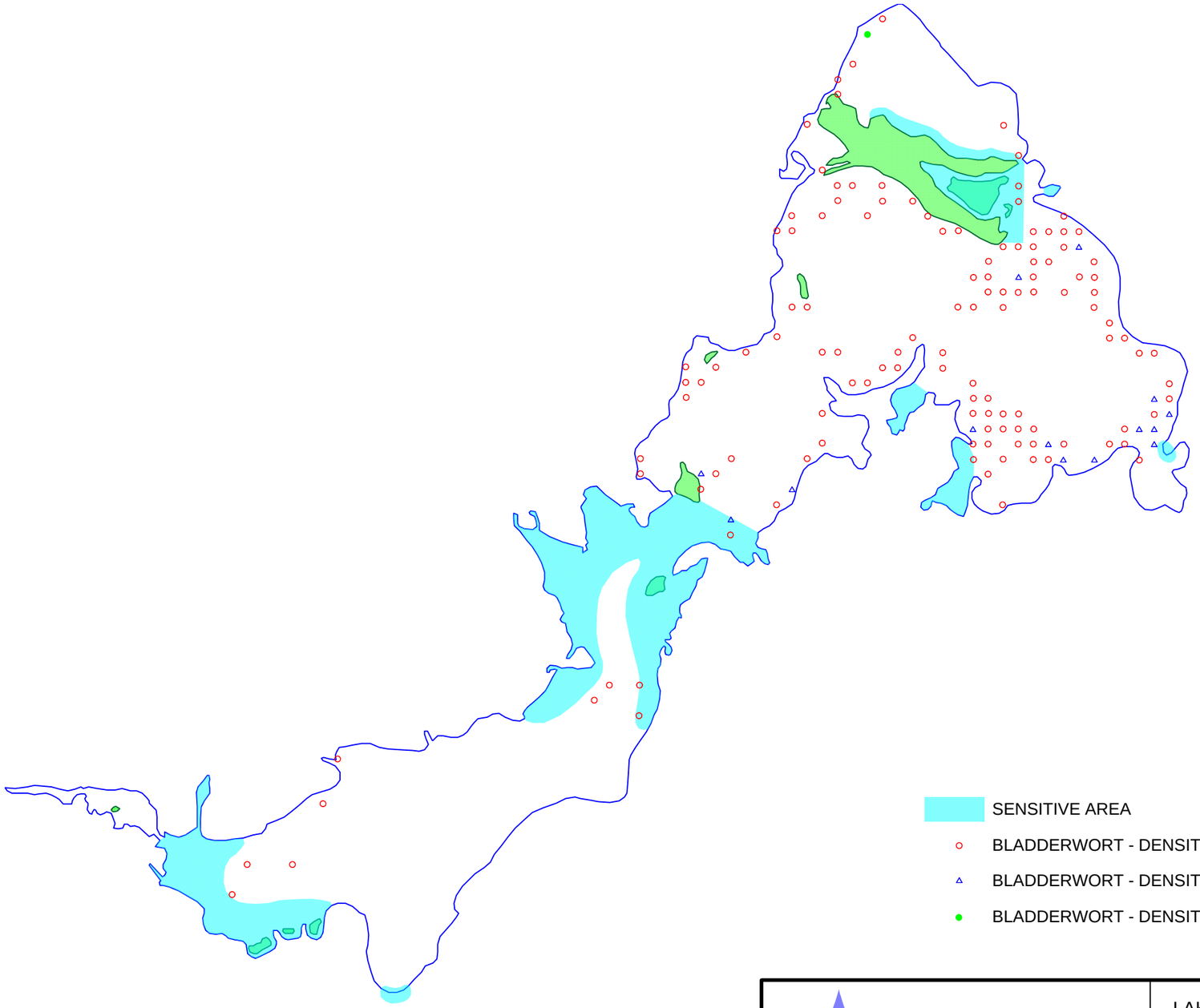
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
MUSKGRASS SAMPLE COLLECTION

FIGURE 9

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	22 APR 10	MUSKGRASS



SENSITIVE AREA

BLADDERWORT - DENSITY 1

BLADDERWORT - DENSITY 2

BLADDERWORT - DENSITY 3

SCALE IN FEET

0 750 1500 2250 3000

NORTH

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LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
BLADDERWORT SAMPLE COLLECTION

FIGURE 10

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	23 APR 10	BLADDERWORT

NORTH

SCALE IN FEET

0 700 1400 2100 2800

10 LAKE DEPTH (FEET)

LITTORAL ZONE

RECREATIONAL AREA

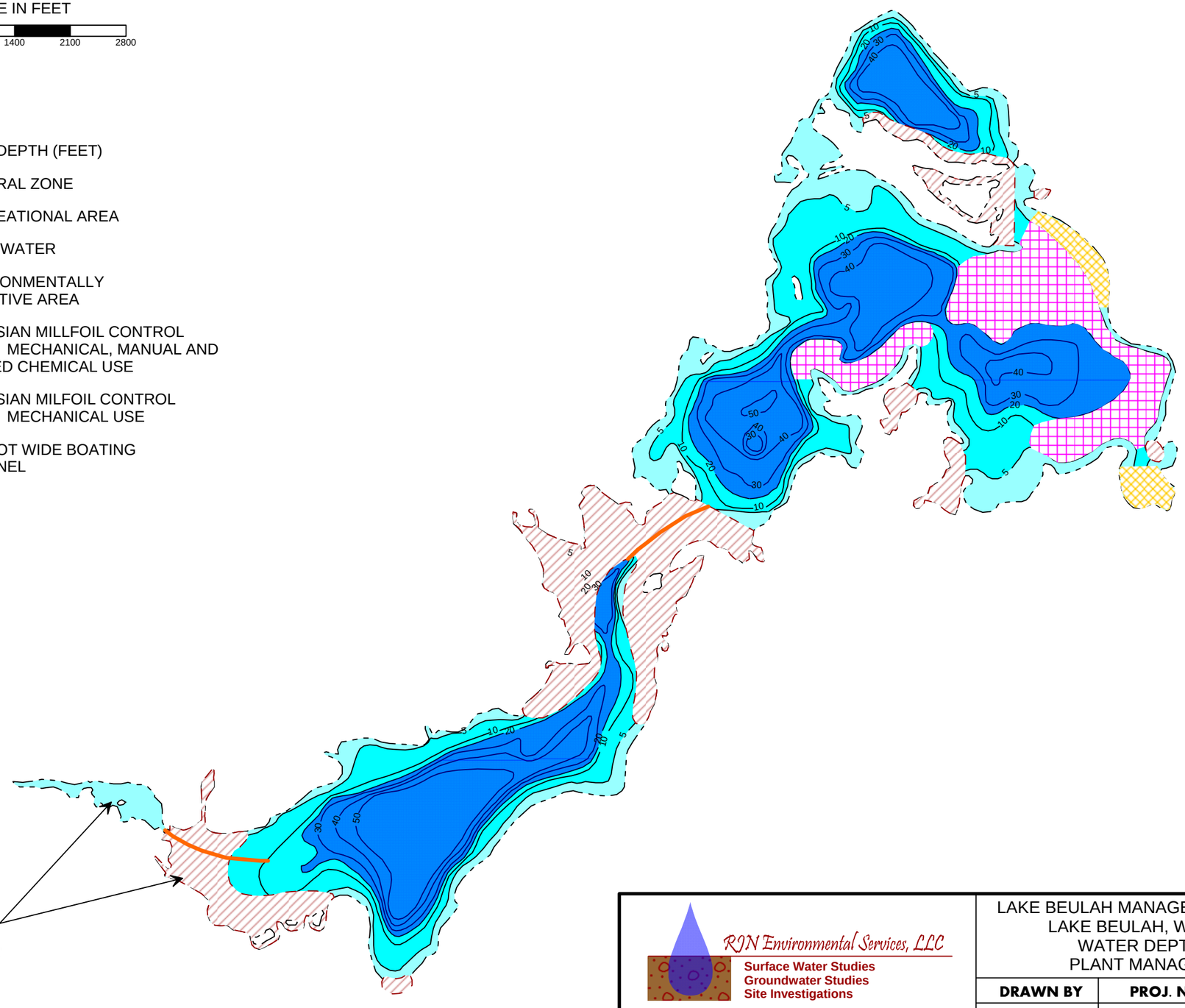
OPEN WATER

ENVIRONMENTALLY SENSITIVE AREA

EURASIAN MILLFOIL CONTROL AREA: MECHANICAL, MANUAL AND LIMITED CHEMICAL USE

EURASIAN MILFOIL CONTROL AREA: MECHANICAL USE

50-FOOT WIDE BOATING CHANNEL



MANUAL AND LIMITED MECHANICAL HARVESTING OF EURASIAN MILFOIL TO RE-ESTABLISH HABITAT FOR NATIVE PLANTS

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LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
WATER DEPTH AND
PLANT MANAGEMENT

FIGURE 11

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	10 MAY 10	D CONTOURS

APPENDIX A

DNR SENSITIVE AREA REPORT

Lake Beulah
Sensitive Area Assessment

Final Report
May 1994

Prepared By
Kathi Dionne
Water Resources Specialist
Dan Helsel
Water Resources Management Specialist
Southeast District
Wisconsin Department of Natural Resources

Acknowledgements

A number of individuals participated in the designation of the sensitive areas on Lake Beulah. Doug Welch (Fish Management) provided information concerning fish use and Mark Anderson (Wildlife Management) provided information concerning wildlife use. Liesa Nesta (Water Regulation and Zoning) evaluated these areas with respect to potential impacts of projects regulated by Chapter 30, such as piers and boardwalks.

Public Meetings

The information included in this report was presented at the Lake Beulah Protective and Improvement Association spring meeting on May 21, 1994. Reports were distributed to riparian property owners abutting the sensitive areas.

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LAKE BEULAH SENSITIVE AREA STUDY

DNR WATER RESOURCES
MAY, 1994

INTRODUCTION

Lake Beulah is a valuable resource of the state of Wisconsin held in trust for the general public. The lake provides recreation, aesthetic enjoyment, opportunities for fishing and wildlife observation, boating and swimming. Lake Beulah has offered enjoyable conditions such as good water quality, abundant fisheries of good sized game fish and areas of aesthetic beauty.

The aquatic plants in this lake are a diverse community which has served the lake well, keeping nutrients and sediments to a minimum and providing valuable food and habitat for many desirable animals such as game fish and waterfowl.

In July of 1993, Department of Natural Resources staff visited Lake Beulah for the purpose of identifying areas which are sensitive and therefor in need of extra protection. Areas are considered sensitive if they fall under the following definition:

> "... areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water." (NR 107, 1989)

These might include:

- Diverse stands of high quality native aquatic plants which help provide a buffer against invasion of Eurasian water milfoil, a very aggressive non native aquatic plant which is increasingly becoming a nuisance in Wisconsin's lakes.
- Areas of vegetation which trap sediments and nutrients flowing into the lake thereby improving water clarity and reducing available nutrients for undesirable plant growth.
- Areas of vegetation which offer spawning nesting or feeding habitat for fish or wildlife.
- Areas of vegetation whose species composition or hydrology make it an ecologically unique community.

Lake Beulah is an 834 acre drainage lake, with a maximum depth of 58 feet and an average depth of 17 feet. The water clarity at Lake Beulah typically ranges between 6 and 11 feet during the summer. There are eight areas in Lake Beulah identified as sensitive. Each of these areas possesses characteristics which are beneficial to the lake as a whole. Their protection will help to preserve the quality of the water in Lake Beulah. A brief description of the eight identified sensitive areas follows:

- Sensitive Area 1 is located along the eastern shore of Jesuit island in the northeastern part of the lake.
- Sensitive area 2 is a small cove located across from Jesuit island.
- Sensitive area 3 is located around a small island along the northeastern shore of the lake.
- Sensitive area 4 is located along the southern shore of the lake in the area also know as Mueller's Cove.
- Sensitive area 5 is in the south shore cove area, located on the southern shore of the eastern end of the lake.
- Sensitive area 6 is located in the narrows between the two basins of the lake.
- Sensitive area 7 is located in the bay near the inlet form Pickerel Lake in the southwestern part of the lake.
- Sensitive area 8 is located just southeast of the East Troy boat launch on the southwestern shore of the lake.

In general, these areas support a diverse community of native aquatic plants with limited areas of Eurasian water milfoil. They offer spawning and nursery areas for several fish species, nesting habitat for animals, act as a sediment and nutrient trap, as well as helping protect the shoreline from erosion.

Sensitive areas are determined by assessment of a team of scientists from the Wisconsin Department of Natural Resources, including fisheries, wildlife, water resources and water regulation and zoning staff. Each team member has expertise in areas relating to water quality and fish or wildlife biology and the ecological value of the area being assessed. The members of the team which investigated this area are:

Doug Welch (Fish Management)
Dan Helsel (Water Resources)
Mark Anderson (Wildlife Management)
Liesa Nesta (Water Regulation and Zoning)

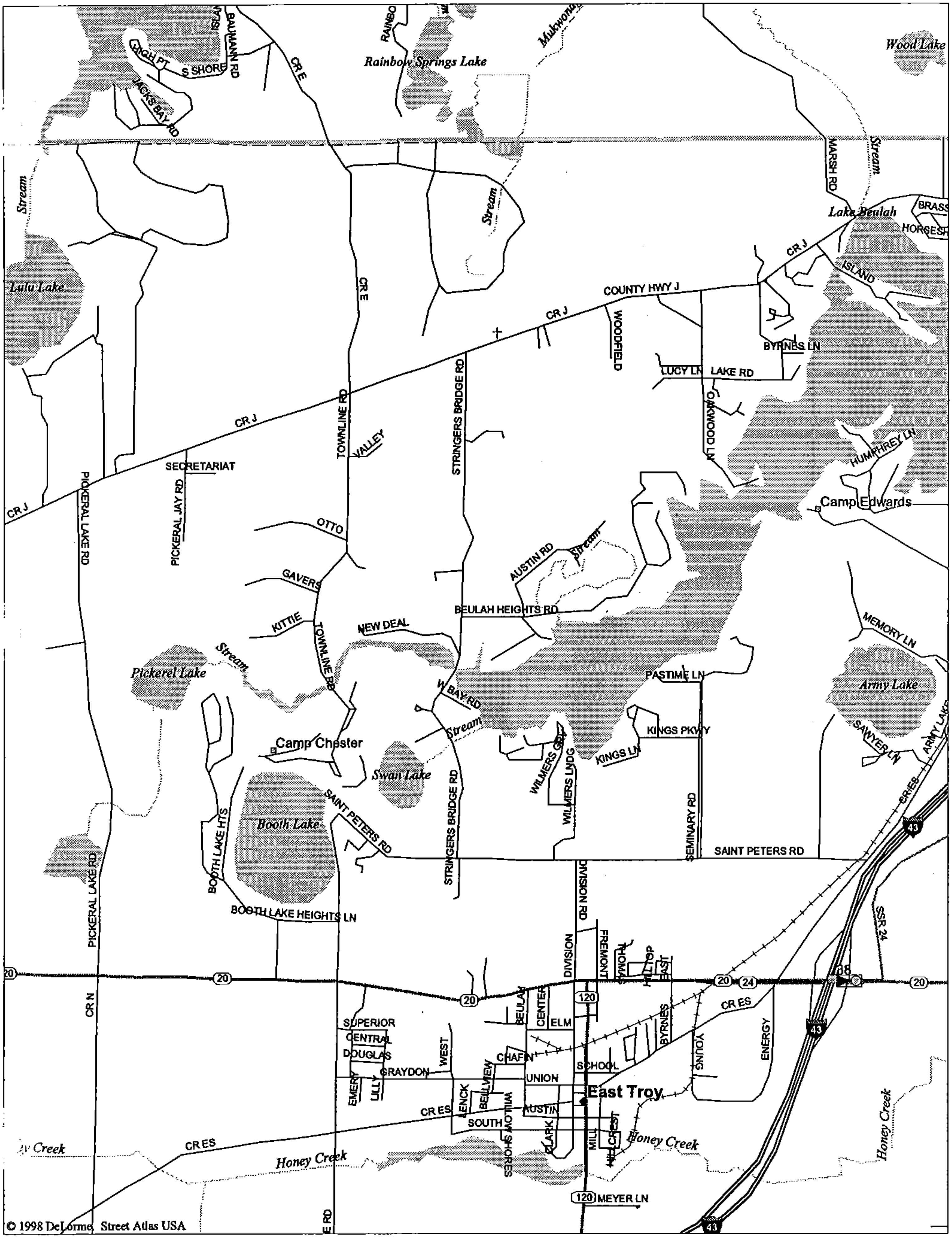
Rainbow Springs Lake
Wood Lake
BAUMANN RD
S SHORE
HIGH PT
JACKS BAY RD
CR E
RAINBO
Mukwona
Stream
Lulu Lake
Lake Beulah
BRASS
HORSESH
MARSH RD
CR J
COUNTY HWY J
ISLAND
WOODFIELD
BYRNES LN
LUCY LN
LAKE RD
OAKWOOD LN
HUMPHREY LN
Camp Edwards
TOWNLINE RD
VALLEY
STRINGERS BRIDGE RD
SECRETARIAT
PICKERAL JAY RD
PICKERAL LAKE RD
OTTO
GAVERS
KITTIE
NEW DEAL
AUSTIN RD
BEULAH HEIGHTS RD
MEMORY LN
Pickerel Lake
Army Lake
PASTIME LN
W BAY RD
KINGS PKWY
KINGS LN
SAWYER LN
ARMY LAKE
Camp Chester
Swan Lake
WILMERS GRV
WILMERS LNDG
SEMINARY RD
Booth Lake
SAINT PETERS RD
BOOTH LAKE HTS
BOOTH LAKE HEIGHTS LN
DIVISION RD
DIVISION
FREMONT
THOMAS
HILLTOP
EAST
SSR 24
CR ES
CR N
20
24
120
43
SUPERIOR
CENTRAL
DOUGLAS
GRAYDON
WEST
BEULAH
CENTER
ELM
CHAFIN
UNION
SCHOOL
BYRNES
YOUNG
ENERGY
EMERY
LILLY
LENCK
BELLVIEW
WILLOW SHORES
AUSTIN
SOUTH
CLARK
MILL
HILLCREST
East Troy
Honey Creek
MEYER LN
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Figure 1. Lake Beulah sensitive areas 1-5

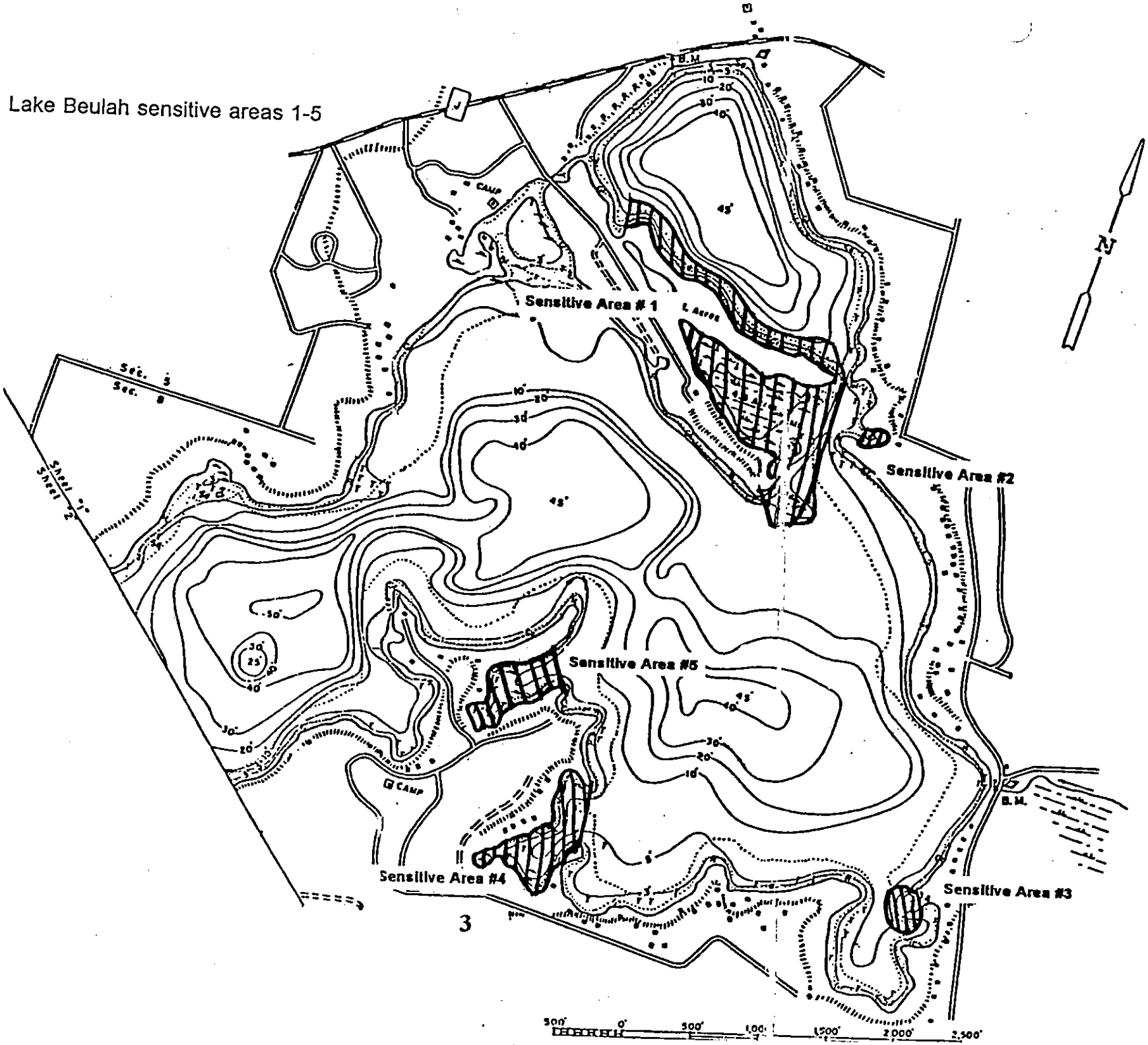


Figure 2. Lake Beulah sensitive areas 6-8

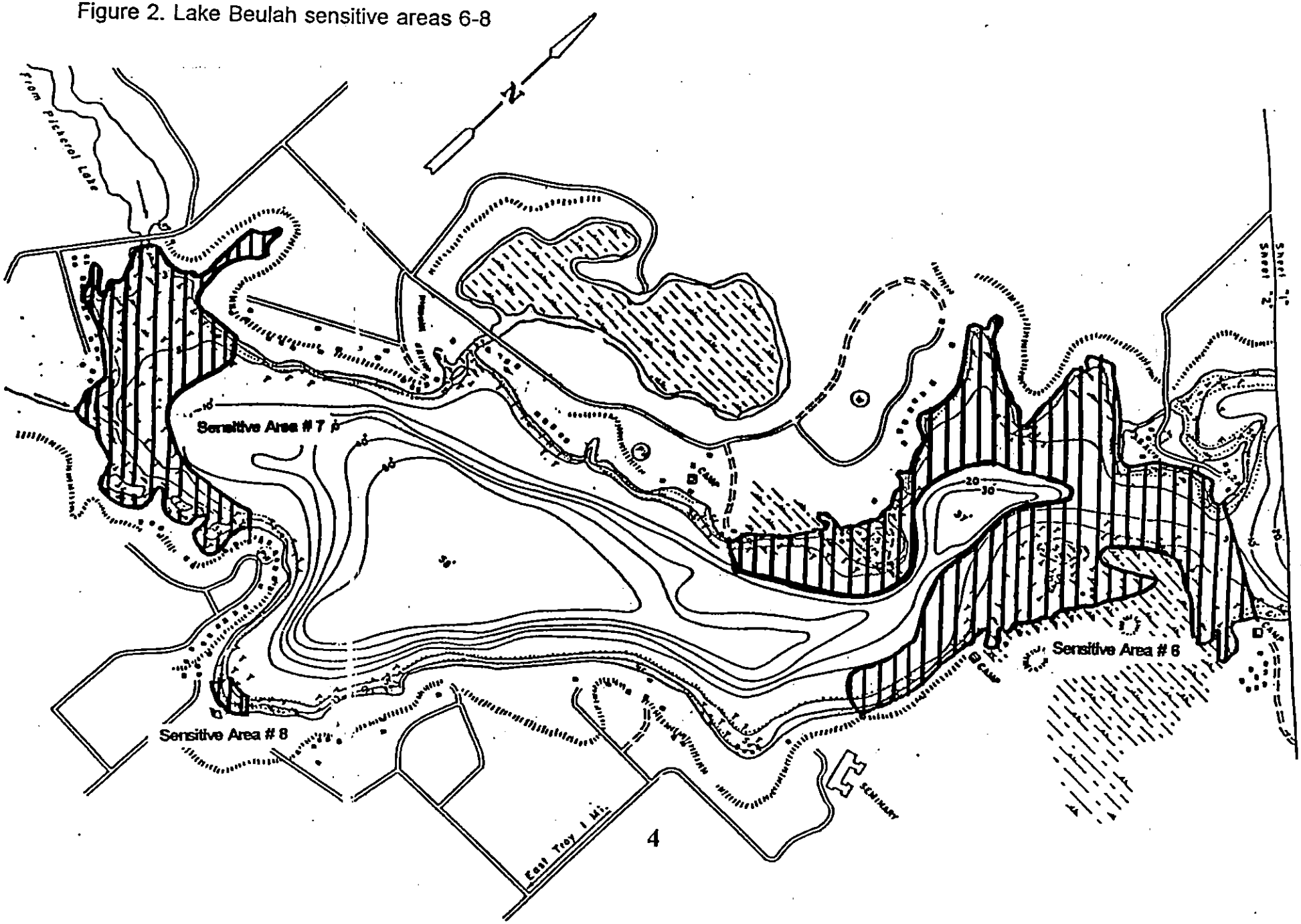
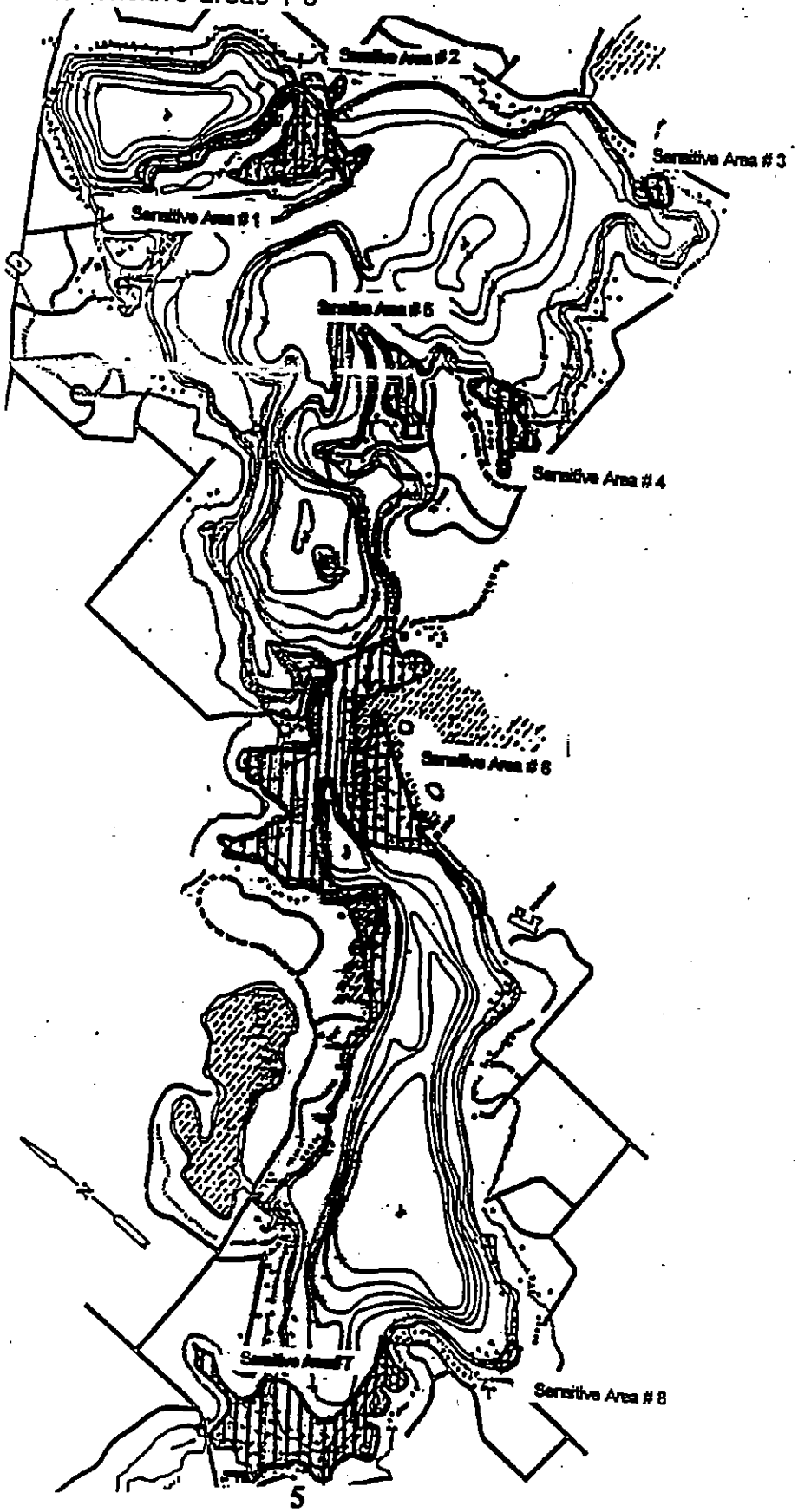


Figure 3. Lake Beulah sensitive areas 1-8



Sensitive area # 1

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #1 is located along the eastern shore of Jesuit Island, in the northeastern part of Lake Beulah. (Figure 1 and 3) It contains approximately 2500 feet of shoreline and extends approximately 150 feet into the lake. The maximum depth in this area is 5 feet. The substrate in the shallow section of sensitive area #1 is 75% muck, 10% sand and silt, and 5% clay. In the areas over 2 feet deep, the substrate is 50% muck, 40% sand and 5% sand and clay.

RESOURCE ASSETS OF SENSITIVE AREA #1

Sensitive area #1 supports a diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*). (Table 1) The emergent and floating leaved community includes swamp loosestrife (*Decodon verticillatus*), white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), sago pondweed (*Potamogeton pectinatus*), clasping leaved pondweed (*P. richardsonii*), floating leaved pondweed (*P. natans*), large leaved pondweed (*P. amplifolius*), chara (*Chara spp.*), bladderwort (*Utricularia sp.*), and eel grass (*Vallisneria americana*).

Fish utilize this community in a variety of ways. The excellent variety of emergent and submerged aquatic plants provides ideal spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and walleye. The vegetated areas also provide high quality nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. All these species will also find excellent feeding habitat in these areas.

Wildlife also depends on the resources provided by sensitive area #1. This area offers high quality habitat for a variety of wetland species. Ducks such as mallards and wood ducks will nest, feed, and rear their young here. Wading birds such as the great blue heron, smaller herons and bitterns feed here, and stop here during migration. Shorebirds such as sandpipers will be found feeding here, and songbirds will find nesting habitat, and will feed and rear their young in the trees and shrubs along the wetlands. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #1 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. It also stabilizes the bottom sediments. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #1 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #1 (Table 3)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian Water Milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community, and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control of any type is not recommended. Hand pulling or manual raking are recommended as an alternative.

Water Regulation and Zoning:

1. Dredging will not be allowed in the area of the wetland complex at the southern part of the designated area. In order to reduce disturbance to the wetland area, other dredging activities will be restricted to navigational purposes only, and will be allowed only if the permit review determines no harm will be done to native plant communities. In addition, native species plantings will be required after any dredging projects in order to reduce the potential for Eurasian water milfoil to become established.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will not be allowed in the wetland area, and is not necessary in the other shoreline areas. Sand will not be allowed.

4. Aquatic plant screens will be considered on a case by case basis, but hand pulling or raking is recommended instead.

5. Special permitted piers/boardwalks will be considered on a case by case basis, and will be allowed only if the permit review determines that no harm will be done to the sensitive area and if the appropriate DNR and local permits are received.

6. Seawall construction or substantial repair generally will not be allowed, but will be considered on a case by case basis in areas with a steep slope and a significant erosion problem.

Riparian Activities:

1. Wetland alterations of any type will not be allowed without the proper DNR and Army Corp. of Engineers permits.

2. Boardwalks will be considered on a case by case basis for the purposes of limited riparian access and public education.

3. Shoreland zoning standards do not allow new homes or other structures such as gazebo's and decks to be built in wetlands. All other construction must comply with all Walworth County requirements, especially the 75 foot setback from the shoreline.

4. Shoreline protection will be limited to riprap and will be allowed only in places where erosion is occurring. It will not be permitted in the wetland areas, and should be minimal in its intrusion into the lake.

Sensitive Area # 2

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #2 is a small cove area located on the northeast side of the channel across from Jesuit Island in the northeastern part of Lake Beulah.(Figure 1 and 3) It contains approximately 200 feet of shoreline and extends approximately 100 feet into the lake. The maximum depth in this area is 3 feet. The substrate in the shallow section of sensitive area #2 is 75% muck, 10% clay and silt, and 5% sand. In the areas over 2 feet deep, the substrate is 30% sand, 20% silt and 10% gravel clay and muck.

RESOURCE ASSETS OF SENSITIVE AREA #2

Sensitive area #2 supports an diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*). (Table 1) The emergent and floating leaved community includes white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), large leaved pondweed (*Potamogeton amplifolius*), narrow leaved pondweed , curly leaved pondweed (*P. crispus*) chara (*Chara spp.*), bladderwort (*Utricularia sp.*), and eel grass (*Vallisneria americana*).

Fish utilize this community in a variety of ways. The excellent variety of emergent and submerged aquatic plants provide high quality spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and walleye. The vegetated areas also provide ideal nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. All these species will also find prime feeding habitat in these areas. In addition, the cove area provides exceptional cover and habitat for minnows such as common shiners and brook silversides, on which the larger fish may feed.

Wildlife also depends on the resources provided by sensitive area #2. This area offers limited wildlife habitat due to its small size and its extensive human development. It does, however, provide some habitat for wading and shore birds such as the great blue heron, smaller herons, sandpipers and bitterns. Ducks and geese will make limited use of this area for feeding and rearing young, and will use the area during migration. Songbirds and kingfishers will find nesting habitat, and will feed and rear their young in the trees and shrubs. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #2 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance

aquatic plants, and improve the clarity of the water.(Table 2)

Sensitive area #2 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake. The minnows which are found here are important to the trophic structure of the fish community.(Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #2 (Table 3)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian Water Milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community, and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control of any type is not recommended. Hand pulling or manual raking is recommended as an alternative.

Water Regulation and Zoning:

1. Dredging will be allowed only if the permit review determines no harm will be done to native plant communities. In addition, native species plantings will be required after any dredging projects in order to reduce the potential for Eurasian water milfoil to become established.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will not be allowed as they are not considered necessary

4. Aquatic plant screens will be considered on a case by case basis, but do not appear to be necessary.

5. Special permitted piers/boardwalks will be allowed if they meet DNR and town permitting requirements.

6. Seawall construction or substantial repair generally will not be allowed, but will be considered on a case by case basis in areas with a steep slope and a significant erosion problem.

Riparian Activities:

1. Shoreline zoning regulations of Walworth county must be followed in all new structures.

2. Shoreline protection will be allowed if a DNR permit is obtained.

Sensitive Area # 3

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #3 is located around a small island along the northeastern shore of Lake Beulah.(Figure 1 and 3) It contains approximately 100 feet of shoreline and extends approximately 50 feet into the lake. The maximum depth in this area is 5 feet.

RESOURCE ASSETS OF SENSITIVE AREA #3

Sensitive area #3 supports a fairly diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*).(Table 1) The emergent and floating leaved community includes white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*).

This small area provides a stand of lily pads, which provide excellent cover for bluegills and minnows.

Wildlife depends on the resources provided by sensitive area #3. This area offers limited wildlife habitat die to its small size and its extensive human development. It does, however, provide some habitat for wading and shorebirds such as the great blue heron, smaller herons, bitterns and sandpipers. Ducks and geese will make limited use of this area for feeding and rearing young, and will use the area during migration. Songbirds and kingfishers will find nesting habitat and rear their young in the trees and shrubs along the shoreline. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #3 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. It also stabilizes the bottom sediments. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #3 is ecologically important to the lake for several reasons. The good native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The floating leaved and submergent plant community and the habitat they provide for minnows are unique to the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #3 (Table 3)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian water milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community and be a part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control of any type is not recommended. Hand pulling or manual raking is recommended to control vegetation in swimming and boating areas.

Water Regulation and Zoning:

1. Dredging activities will be allowed only if the permit review determines no harm will be done to native plant communities. In addition, native species plantings will be required after any dredging projects in order to reduce the potential for Eurasian water milfoil to become established.

2. Filling will not be permitted.

3. Pea gravel/sand blanket are not necessary, but applications will be reviewed on a case by case basis.

Riparian Activities:

1. Shoreland zoning regulations of Walworth county must be followed in all new structures.

2. Shoreline protection will be permitted if a DNR permit is obtained.

Sensitive Area # 4

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #4 is located along the southern shore of Lake Beulah, in an area also known as Mueller's Cove.(Figure 1 and 3) It contains approximately 2500 feet of shoreline and extends across the width of the cove approximately 1000 feet from the shore. The maximum depth in this area is 10 feet.

RESOURCE ASSETS OF SENSITIVE AREA #4

Sensitive area #4 supports a diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*).(Table 1) The emergent and floating leaved community includes soft stem bulrush (*Scirpus validus*), white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), clasping leaved pondweed (*Potamogeton richardsonii*), white stemmed pondweed (*P. praelongus*) and chara (*Chara spp.*).

Fish utilize this community in a variety of ways. The diverse community of emergent and submerged aquatic plants provide excellent spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and walleye. The vegetated areas also provide high quality nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. This area also provides excellent habitat for minnows. All these species will also find ideal feeding habitat in these areas.

Wildlife also depends on the resources provided by sensitive area #4. This area offers habitat for a variety of species. Ducks such as mallards and wood ducks will make limited use of this area for feeding and rearing young. Wading birds such as the great blue heron, smaller herons and bitterns will find good foraging here, and will stop here during migration. Shorebirds such as sandpipers will be found feeding here, and songbirds will find nesting habitat, and will feed and rear their young in the water willows. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #4 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water.(Table 2)

Sensitive area #4 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue

to spread. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #4 (Table 3)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian water milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control is recommended only for control of Eurasian water milfoil. Hand pulling or manual raking is recommended to control vegetation in swimming and boating areas.

Water Regulation and Zoning:

1. Dredging will not be allowed in the area of bulrushes and Water Willow along the shoreline. Dredging in other areas would be considered on a case by case basis. In addition, native species plantings will be required after any dredging projects in order to reduce the potential for Eurasian water milfoil to become established.

2. Filling will be considered on a case by case basis.

3. Pea gravel/sand blanket will be considered on a case by case basis.

4. Aquatic plant screens will be considered on a case by case basis.

5. Special permitted piers/boardwalks will be considered on a case by case basis, and will be allowed only if the permit review determines that no harm will be done to the sensitive area and if the appropriate DNR and local permits are received.

6. Seawall construction or substantial repair generally will not be allowed, but will be considered on a case by case basis in areas with a steep slope and a significant erosion problem.

Riparian Activities:

1. Shoreline zoning regulations of Walworth county must be followed in all new structures.

2. Shoreline protection will reviewed on a case by case basis.

Sensitive Area # 5

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #5 is the south shore cove area, located on the southern shore of the eastern end of Lake Beulah.(Figure 1 and 5) It contains approximately 1500 feet of shoreline and extends across the width of the cove approximately 1000 feet into the lake. The maximum depth in this area is 10 feet. The substrate in sensitive area #5 is mostly muck.

RESOURCE ASSETS OF SENSITIVE AREA #5

Sensitive area #5 supports an diverse reservoir of native aquatic plants, both submergent and emergent; the populated areas of the shoreline have extensive stands of Eurasian water milfoil (*Myriophyllum spicatum*), but in the less disturbed areas it is scattered within the native plant community. (Table 1) The emergent and floating leaved community includes swamp loosestrife (*Decodon verticillatus*), white water lily (*Nymphaea tuberosa*), yellow water lily (*Nuphar variegatum*) and duckweed (*Lemna sp.*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), sago pondweed (*Potamogeton pectinatus*), large leaved pondweed (*P. amplifolius*), chara (*Chara spp.*), and eel grass (*Vallisneria americana*).

Fish utilize this community in a variety of ways. The good variety of emergent and submerged aquatic plants provides spawning habitat for northern pike, largemouth bass, crappie and bluegills. The vegetated areas also provide excellent nursery areas for northern pike, largemouth bass, crappie and bluegill. This area is also prime cover and spawning habitat for minnows. All these species will also find high quality feeding habitat in these areas.

Wildlife also depends on the resources provided by sensitive area #5. Ducks such as mallards and wood ducks will nest, feed, and rear their young here. Wading birds such as the great blue heron, smaller herons, rails and bitterns feed here, and stop here during migration. Songbirds and kingfishers will find nesting habitat, and will feed and rear their young in the trees and shrubs along the shoreline. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #5 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #5 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant

species, as well as a refuge where native species have established and can continue to spread. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake. The minnows which spawn here are important to the trophic structure of the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #5 (Table 4)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian water milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control of any type is not recommended. Hand pulling or manual raking is recommended to control vegetation in swimming and boating areas.

Water Regulation and Zoning:

1. Dredging will not be allowed in the area of the water willow stands in the western part of the designated area. On the side which is heavily developed, some limited dredging will be permitted, however, native species plantings will be required after any dredging projects since Eurasian water milfoil became heavily populated in the area after their last dredging project.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will not be permitted, as it appears unnecessary, and would be ineffective.

4. Aquatic plant screens will be considered on a case by case basis.

Riparian Activities:

3. Shoreland zoning regulations of Walworth County must be followed in all new structures built.

4. Shoreline protection will be limited to riprap and will be allowed only in places where erosion is occurring.

Sensitive Area # 6

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #6 is located in the narrows between the two lake basins of Lake Beulah. (Figure 2 and 3) It contains approximately 4500 feet of shoreline and extends across the width of the channel along the 10 foot contour line. The maximum depth in this area is 10 feet.

RESOURCE ASSETS OF SENSITIVE AREA #6

Sensitive area #6 supports a very diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*). (Table 1) The emergent and floating leaved community includes swamp loosestrife (*Decodon verticillatus*), narrow-leaved cattail (*Typha angustifolia*), bulrushes (*Scirpus sp.*), white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), sago pondweed (*Potamogeton pectinatus*), clasping leaved pondweed (*P. richardsonii*), floating leaved pondweed (*P. natans*), large leaved pondweed (*P. amplifolius*), chara (*Chara spp.*), bladderwort (*Utricularia sp.*), large leaved elodea (*Elodea canadensis*) and eel Grass (*Vallisneria americana*).

Fish utilize this community in a variety of ways. The diverse community of emergent and submerged aquatic plants provide excellent spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and walleye. The vegetated areas also provide high quality nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. All these species will also find ideal feeding habitat in these areas.

Wildlife also depends on the resources provided by sensitive area #6. This area offers high quality habitat for a variety of wetland species. Ducks such as mallards and wood ducks will nest, feed, and rear their young here. Wading birds such as the great blue heron, smaller herons and bitterns feed here, and stop here during migration. Songbirds will find nesting habitat, and will feed and rear their young in the trees and shrubs along the wetlands. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #6 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. It also stabilizes the bottom sediments. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #6 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake.(Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #6 (Table 4)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian water milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: it is recommended that mechanical cutting be used only for navigational channels. Hand pulling and manual raking are the preferred method for controlling aquatic plants in swimming and boating areas.

Water Regulation and Zoning:

1. Dredging will not be permitted.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will be considered on a case by case basis but does not appear to be necessary. Sand will not be permitted.

4. Aquatic plant screens will be considered on a case by case basis.

5. Special permitted piers/boardwalks will be considered on a case by case basis, and will be allowed only if the permit review determines that no harm will be done to the sensitive area and if the appropriate DNR and local permits are received.

6. It is recommended that this area remain a slow/no wake zone for boating in order to reduce disturbance to the plant community and bottom sediments.

Riparian Activities:

1. Wetland alterations of any type will not be allowed without the proper DNR and Army Corp of Engineers permits.

2. Boardwalks will be considered on a case by case basis for the purposes of limited riparian access and public education.

3. Shoreland zoning standards do not allow new homes or other structures such as gazebos and decks to be built in wetlands. All other construction must comply with all Walworth County requirements, especially the 75 foot setback from the shoreline.

4. Additional shoreline stabilization is not required and would be for aesthetic purposes only; therefore rip rap or seawalls will not be permitted.

Sensitive Area # 7

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #7 is located in the bay near the inlet from Pickerel Lake in the southwestern part of Lake Beulah. (Figure 2 and 3) It contains approximately 4000 feet of shoreline and extends across the bay approximately 1500 feet into the lake. The maximum depth in this area is 7 feet.

RESOURCE ASSETS OF SENSITIVE AREA #7

Sensitive area #7 supports an diverse reservoir of native aquatic plants, both submergent and emergent, with no Eurasian water milfoil (*Myriophyllum spicatum*). (Table 1) The emergent and floating leaved community includes swamp loosestrife (*Decodon verticillatus*), bulrushes (*Scirpus sp.*), white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), sago pondweed (*Potamogeton pectinatus*), clasping leaved pondweed (*P. richardsonii*), floating leaved pondweed (*P. natans*), large leaved pondweed (*P. amplifolius*), chara (*Chara spp.*), and eel grass (*Vallisneria americana*).

Fish utilize this community in a variety of ways. The excellent variety of emergent and submerged aquatic plants provide high quality spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and native perch. The vegetated areas also provide ideal nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. All these species will also find good feeding habitat in these areas. Minnows also find cover, feed and spawn here.

Wildlife also depends on the resources provided by sensitive area #7. This area offers high quality habitat for a variety of wetland species. Ducks such as mallards and wood ducks will nest, feed, and rear their young here. Wading birds such as the great blue heron, smaller herons and bitterns feed here, and stop here during migration. Shorebirds such as sandpipers will be found feeding here, and songbirds will find nesting habitat, and will feed and rear their young in the trees and shrubs along the wetlands. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #7 traps sediments and nutrients coming in from Pickerel Lake, as well as protecting the shoreline from erosion. It also stabilizes the bottom sediments. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #7 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The absence of exotic milfoil in this area makes it an especially good buffer against invasion. The emergent, floating leaved and submergent plant community and the spawning grounds they provide for fish are unique to the lake. The Minnows which spawn here are important to the trophic structure of the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #7 (Table 4)

In-lake activities:

Aquatic plant control:

1. Chemical treatment of aquatic plants in this area will not be permitted. There is no Eurasian water milfoil in this area, and it supports a diverse community of native plants. The diversity of this community is essential to its effectiveness as a buffer against milfoil invasion. Chemical treatment would have a detrimental effect on the diversity here.

2. Mechanical: it is recommended that mechanical cutting be used for navigational channels only. Hand pulling or manual raking are the preferred method for control of aquatic plants in swimming and boating areas.

Water Regulation and Zoning:

1. Dredging will not be permitted.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will not be permitted.

4. Aquatic plant screens will not be permitted.

5. Special permitted piers/boardwalks will be considered on a case by case basis, for limited water access only.

6. Seawall construction or substantial repair generally will not be allowed, but will be considered on a case by case basis in areas with a steep slope and a significant erosion problem.

Riparian Activities:

1. Wetland alterations of any type will not be allowed without the proper DNR and Army Corp of Engineers permits.

2. Boardwalks will be considered on a case by case basis for the purposes of limited riparian access and public education.

3. Shoreland zoning standards do not allow new homes or other structures such as gazebo's and decks to be built in wetlands. All other construction must comply with all Walworth County requirements, especially the 75 foot setback from the shoreline.

4. Shoreline protection will be limited to riprap and will be allowed only in places where erosion is occurring. It will not be permitted in the wetland areas, and should be minimal in its intrusion into the lake.

Sensitive Area # 8

SENSITIVE AREA SITE DESCRIPTION

Sensitive area #8 is located just southeast of the East Troy boat launch on the southwestern shore of Lake Beulah. (Figure 2 and 3)

RESOURCE ASSETS OF SENSITIVE AREA #8

Sensitive area #8 supports an diverse reservoir of native aquatic plants, both submergent and emergent, and only limited areas of Eurasian water milfoil (*Myriophyllum spicatum*). (Table 1) The emergent and floating leaved community includes swamp loosestrife (*Decodon verticillatus*), bulrushes (*Scirpus sp.*), white water lily (*Nymphaea tuberosa*) and yellow water lily (*Nuphar variegatum*). The submergent community includes native water milfoil, (*Myriophyllum heterophyllum*), and a variety of pondweed species (*Potamogeton spp.*).

Fish utilize this community in a variety of ways. The diverse community of emergent and submerged aquatic plants provide excellent spawning habitat for northern pike, and very good spawning habitat for largemouth bass and bluegills. The less heavily vegetated areas provide spawning areas for crappie and walleye. The vegetated areas also provide high quality nursery areas for northern pike, largemouth bass, walleye, crappie and bluegill. All these species will also find ideal feeding habitat in these areas.

Wildlife also depends on the resources provided by sensitive area #8. This area offers high quality habitat for a variety of wetland species. Ducks such as mallards and wood ducks will nest, feed, and rear their young here. Wading birds such as the great blue heron, smaller herons and bitterns feed here, and stop here during migration. Shorebirds such as sandpipers will be found feeding here, and songbirds will find nesting habitat, and will feed and rear their young in the trees and shrubs along the wetlands. Muskrats, opossum and raccoons can be found here year round, feeding, nesting and raising their young.

The plant community in sensitive area #8 acts as a sediment and nutrient trap, as well as protecting the shoreline from erosion. It also stabilizes the bottom sediments. These functions benefit the entire lake in that they reduce nutrients available in the water to support the growth of nuisance aquatic plants, and improve the clarity of the water. (Table 2)

Sensitive area #8 is ecologically important to the lake for several reasons. The excellent native species reservoir will act as a buffer against invasion by exotic plant species, as well as a refuge where native species have established and can continue to spread. The emergent, floating leaved and submergent plant community and the

spawning grounds they provide for fish are unique to the lake. (Table 2)

MANAGEMENT RECOMMENDATIONS FOR SENSITIVE AREA #8 (Table 4)

In-lake activities:

Aquatic plant control:

1. Chemical: chemical treatment of aquatic plants will be permitted in this area, but is limited to control of Eurasian Water Milfoil. These chemical applications should be as selective as possible to reduce impacts on the native aquatic plant community and be part of a lake wide Eurasian water milfoil control plan.

2. Mechanical: mechanical control of any type is not recommended.

Water Regulation and Zoning:

1. Dredging will not be permitted.

2. Filling will not be permitted.

3. Pea gravel/sand blanket will not be permitted.

4. Aquatic plant screens will not be permitted.

5. Special permitted piers/boardwalks for water access will be considered on a case by case basis.

Riparian Activities:

1. Wetland alterations of any type will not be allowed without the proper DNR and Army Corp of Engineers permits.

2. Boardwalks will be considered on a case by case basis for the purposes of limited riparian access and public education.

3. Shoreland zoning standards do not allow new homes or other structures such as gazebo's and decks to be built in wetlands. All other construction must comply with all Walworth County requirements, especially the 75 foot setback from the shoreline.

4. Shoreline protection will not be permitted as it is unnecessary in this area.

Common Name	Scientific Name	Sensitive Area Occurrence
Eurasian water milfoil	*Myriophyllum spicatum*	1,2,3,4,5,6,8
Swamp loosestrife	*Decodon verticillatus*	1,5,6,7,8
White water lily	*Nymphaea tuberosa*	1,2,3,4,5,6,7,8
Yellow water lily	*Nuphar variegatum*	1,2,3,4,5,6,7,8
Variable leaved water milfoil (native)	*Myriophyllum heterophyllum*	1,2,4,5,6,7,8
Sago pondweed	*Potamogeton pectinatus*	1,5,6,7
Clasping leaved pondweed	*P. richardsonii*	1,4,6,7
Floating leaved pondweed	*P. natans*	1,6,7
Large leaved pondweed	*P. amplifolius*	1,5,6,7
Narrow leaved pondweed	*P. spp.*	2
White stemmed pondweed	*P. praelongus*	4
Curly leaved pondweed	*P. crispus*	2
Bladderwort	*Utricularia sp.*	1,2,6
Wild celery	*Valisneria americana*	1,2,5,6,7
Musk grass	*Chara sp.*	1,2,4,5,6,7
Duckweed	*Lemna sp.*	5
Narrow leaved cattail	*Typha angustifolia*	6
Large leaved elodea	*Elodea canadensis*	6
Bulrushes	*Scirpus spp.*	4,6,7,8

Table 1. Aquatic plant species found in Lake Beulah sensitive areas and their locations

Resource Value	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Diverse Native Plant Community	X	X	X	X	X	X	X	X
Sediment & Nutrient Trap- protects water quality	X	X	X	X	X	X	X	X
Wildlife & Fishery Value- spawning, nursery, feeding, etc.	X	X	limited by size	X	X	X	X	
Shoreline Erosion Protection	X	X	X	X	X		X	
Stabilization of Bottom Sediments- protects water quality	X		X			X	X	X
Ecological/ hydrological/other	spawning	buffer / refuge	fish cover		very diverse	traps incoming nutrients from Pickerel lake	buffer / refuge	

Table 2. Resource values of sensitive areas in Lake Beulah.

	Activity	Sensitive Area 1	Sensitive Area 2	Sensitive Area 3	Sensitive Area 4
In Lake Activities	Chemical control of aquatic plants	Allowed only as part of a Eurasian water milfoil control plan	Allowed only as part of Eurasian water milfoil control plan	Allowed only as part of Eurasian water milfoil control plan	Allowed only as part of Eurasian water milfoil control plan
	Mechanical harvesting of aquatic plants	Not recommended	Not recommended	Not recommended	Recommended only for Eurasian water milfoil
	Dredging	Navigational purposes only- native plantings required. Southern part only	May be permittable on a case by case basis - native planting required	Permit required - native planting required	Permit required - native planting required - not in shoreline area of bulrushes and willow
	Filling	Not permitted	Not permitted	Not permitted	Permit required
	Pea gravel / sand blanket	Not permitted	Not permitted	Permittable on a case by case basis	Permittable on a case by case basis
	Aquatic plant screens	Permittable	Permit required	NA	Permittable on a case by case basis
	Boardwalks and special permitted piers	Permittable on a case by case basis	Permittable - must meet local and DNR standards	NA	Permittable on a case by case basis
	Other - Seawall construction	Generally not permitted but possible if conditions warrant	Generally not permitted but possible if conditions warrant	NA	Generally not permitted but possible if conditions warrant
Riparian Activities	Wetland alterations	Permit required	NA	NA	NA
	Boardwalks	Permittable for limited riparian and educational uses	NA	NA	NA
	Shoreline protection	Riprap only- not in wetland- only in cases where erosion is occurring	Permit required	Permit required	Permit required
	Shoreline zoning	Must comply with local standards, 75 foot setback	Must comply with local standards	Must comply with local standards	Must comply with local standards

Table 3. Management recommendations and restrictions for Lake Beulah sensitive areas 1-4.

	Activity	Sensitive Area 5	Sensitive Area 6	Sensitive Area 7	Sensitive Area 8
In Lake Activities	Chemical control of aquatic plants	Allowed only as part of Eurasian water milfoil control plan	Allowed only as part of Eurasian water milfoil control plan	Not permitted	Allowed only as part of Eurasian water milfoil control plan
	Mechanical harvesting of aquatic plants	Not recommended	Recommended for navigational channels only	Recommended for navigational channels only	Not recommended
	Dredging	Permittable but limited - native planting required	Not permitted	Not permitted	Not permitted
	Filling	Not permitted	Not permitted	Not permitted	Not permitted
	Pea gravel / sand blanket	Not permitted	Pea gravel possible- sand not permitted	Not permitted	Not permitted
	Aquatic plant screens	Permit required	Permit required	Not permitted	Not permitted
	Boardwalks and special permitted piers	NA	Permittable on a case by case basis	Permittable for limited water access only	Permittable on a case by case basis
	Other - Boating regulations	NA	Recommended to remain slow / no wake	NA	NA
	Other - Seawall construction	NA	NA	Generally not permitted but possible if conditions warrant	NA
Riparian Activities	Wetland alterations	NA	Not permitted	Permit required	Permit required
	Boardwalks	NA	Permittable for education and riparian access	Permittable for education and riparian access	Permittable for education and riparian access
	Shoreline protection	Riprap permittable - only in cases where erosion is occurring	Not permitted	Riprap permittable - only in cases where erosion is occurring	Not permitted
	Shoreline zoning	Must comply with local standards	Must comply with local and shoreline wetland zoning standards	Must comply with local and shoreline wetland zoning standards	Must comply with local and shoreline wetlands zoning standards

Table 4. Management recommendations and restrictions for Lake Beulah sensitive areas 5-8.

References

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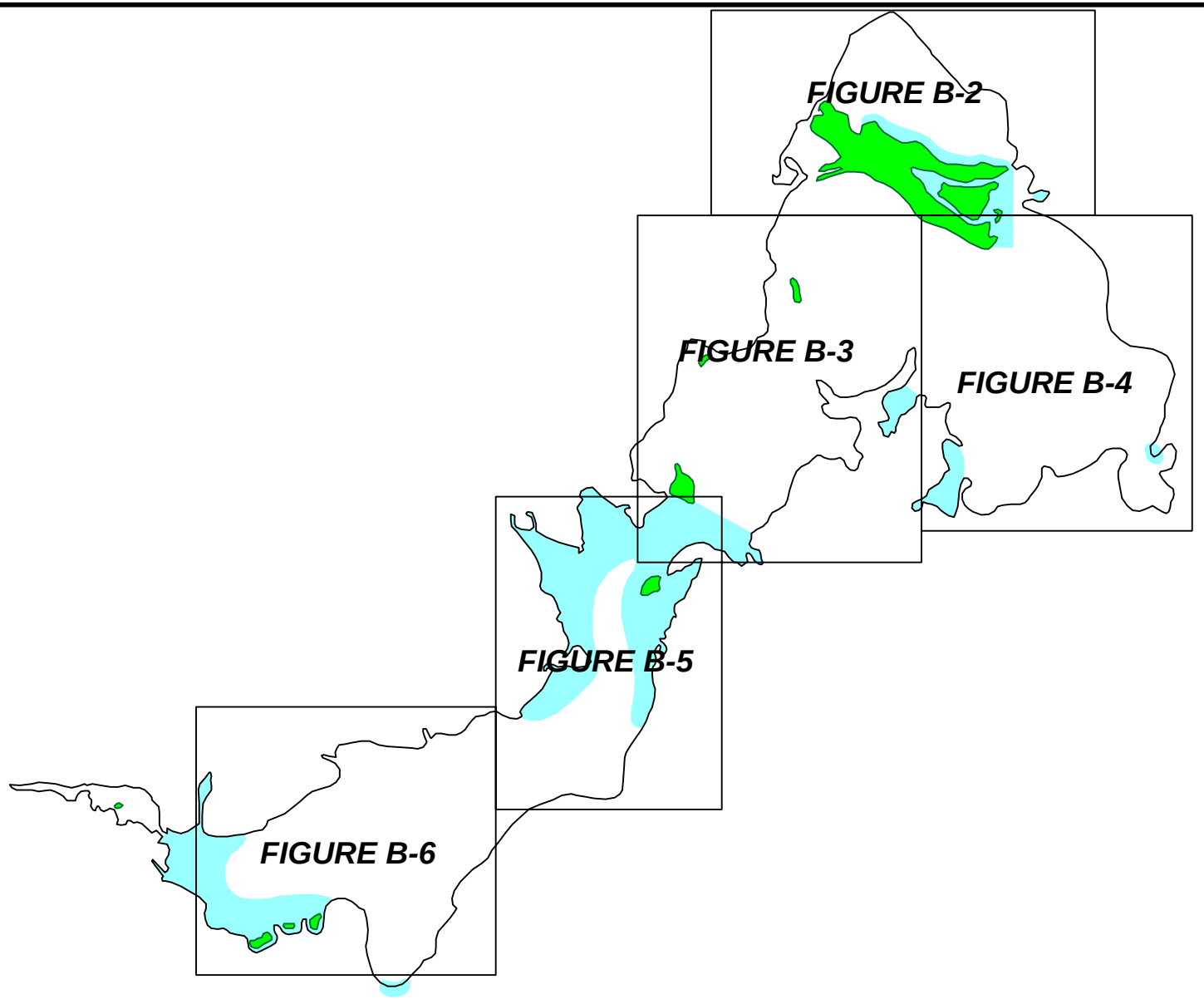
APPENDIX B

AQUATIC PLANT SURVEY DATABASE

(IN SEPARATE FILE ON THIS CD)

APPENDIX C

DETAIL OF AQUATIC PLANT HARVESTING AREAS



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LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
BASEMAP

FIGURE
C-1

DRAWN BY	PROJ. No.	DATE	FILE
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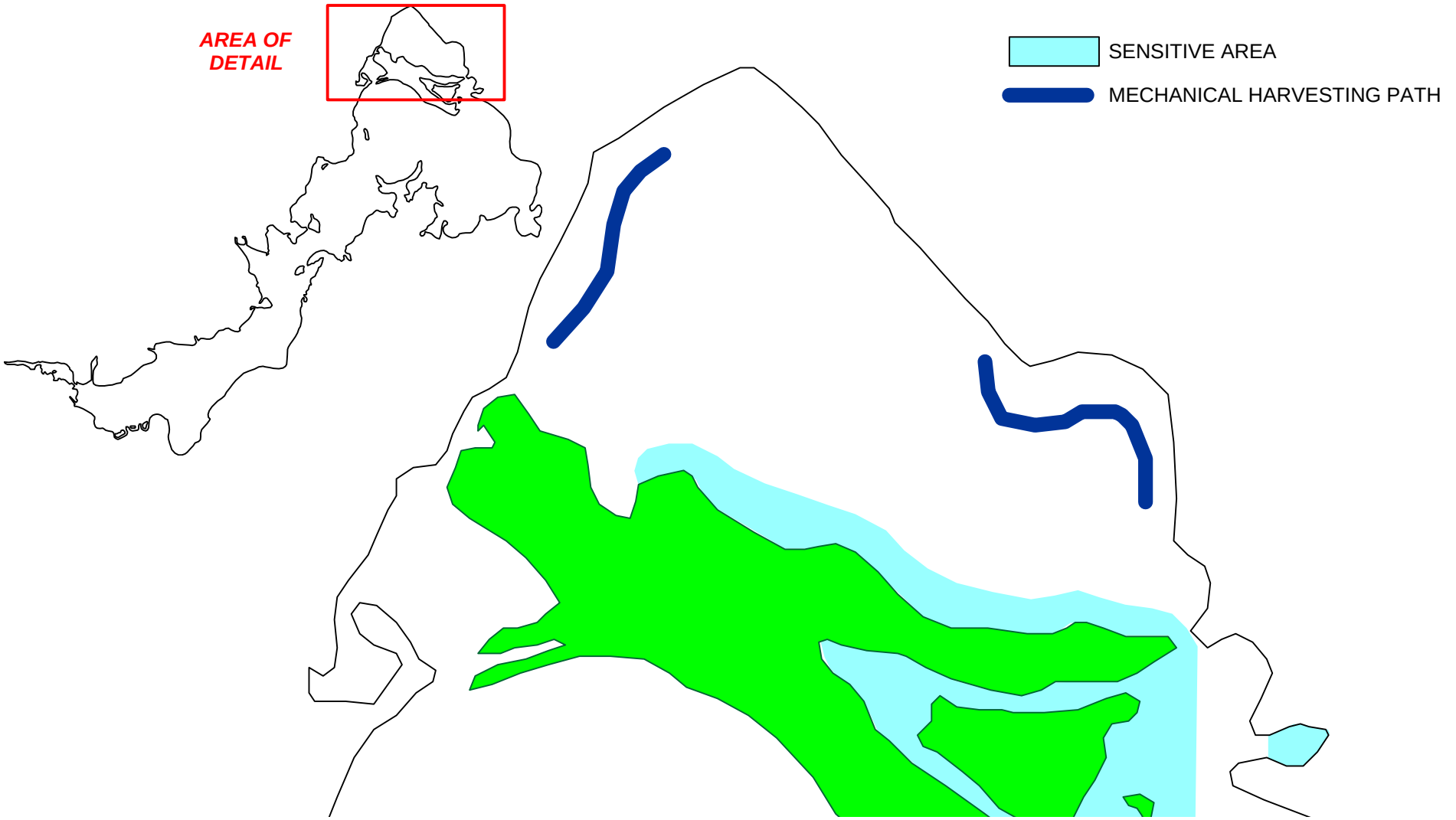

NORTH

SCALE IN FEET

0 250 500

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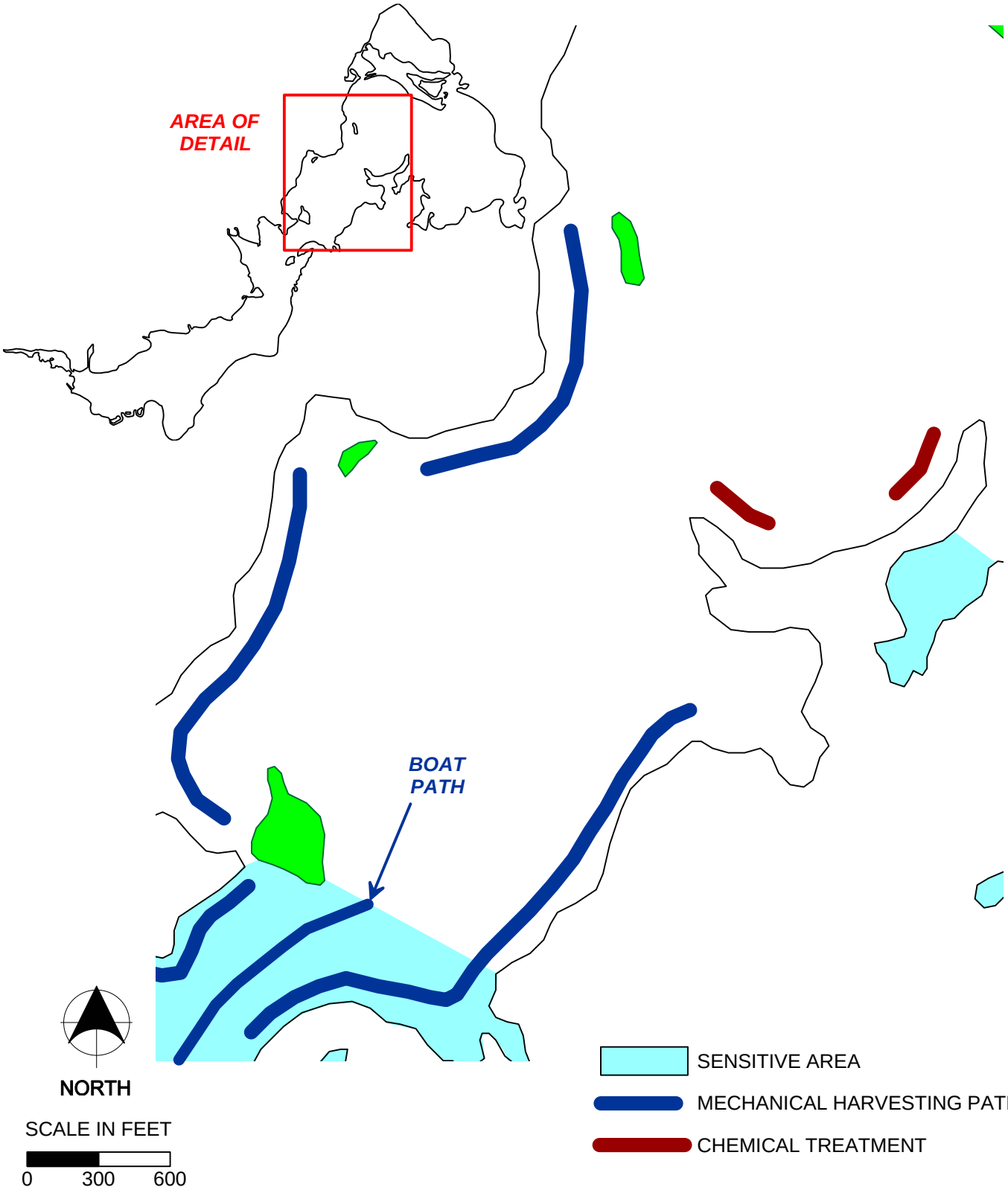
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
NORTHERN AREA

FIGURE
C-2

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	29 JUN 10	B-2



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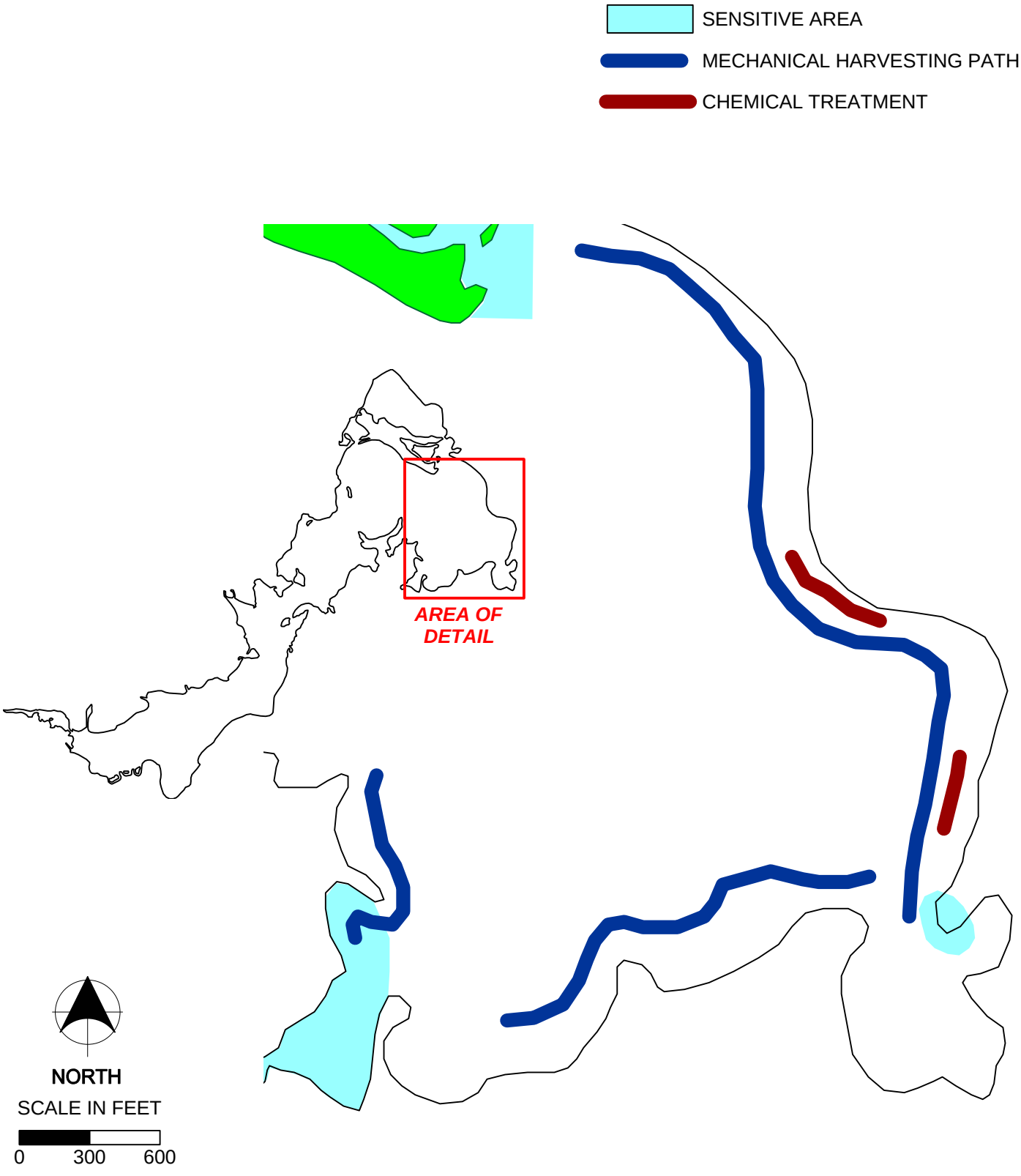
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
NORTH-CENTRAL AREA

FIGURE C-3

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	29 JUN 10	B-3



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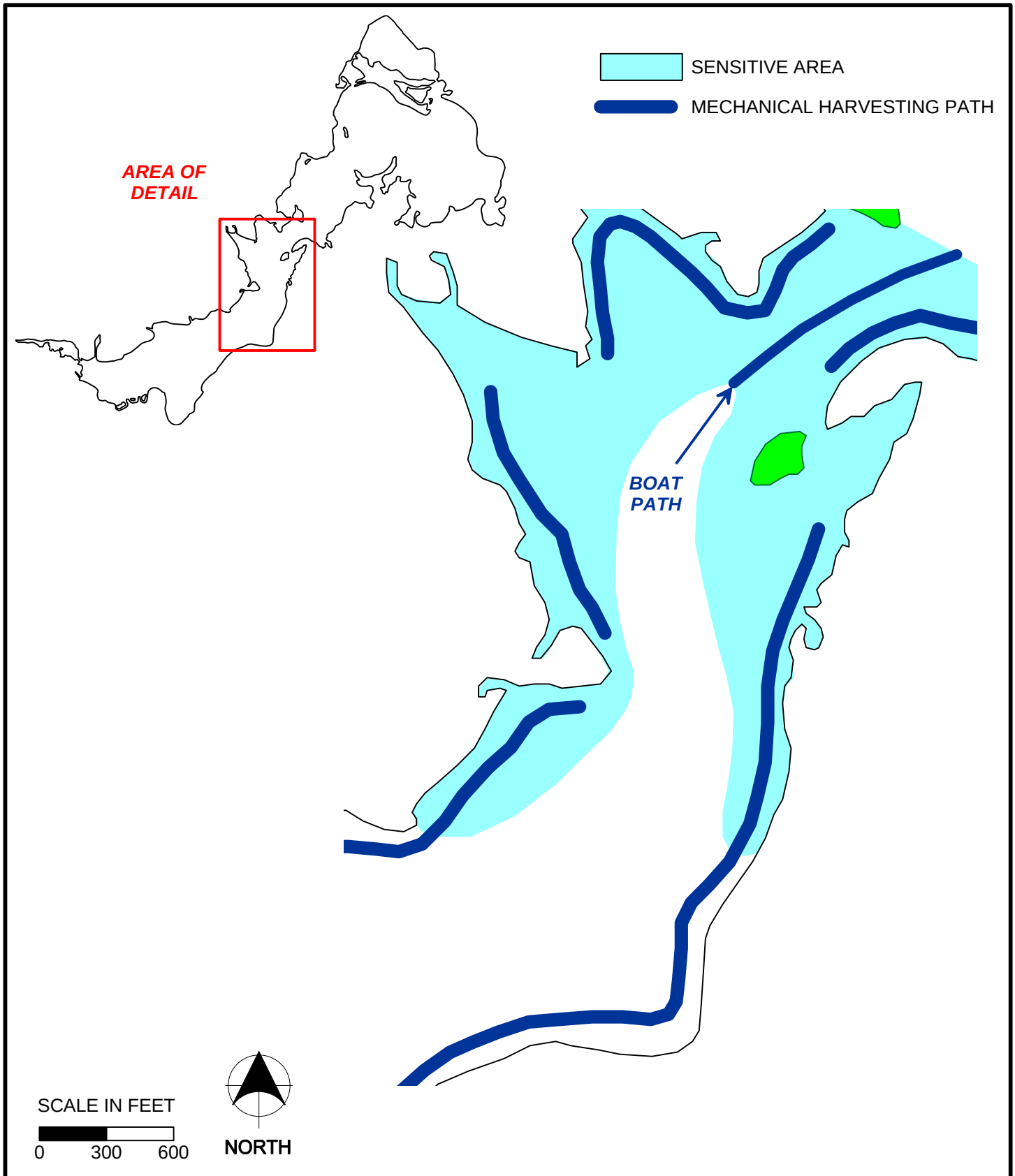
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
EASTERN AREA

FIGURE
C-4

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	29 JUN 10	B-4



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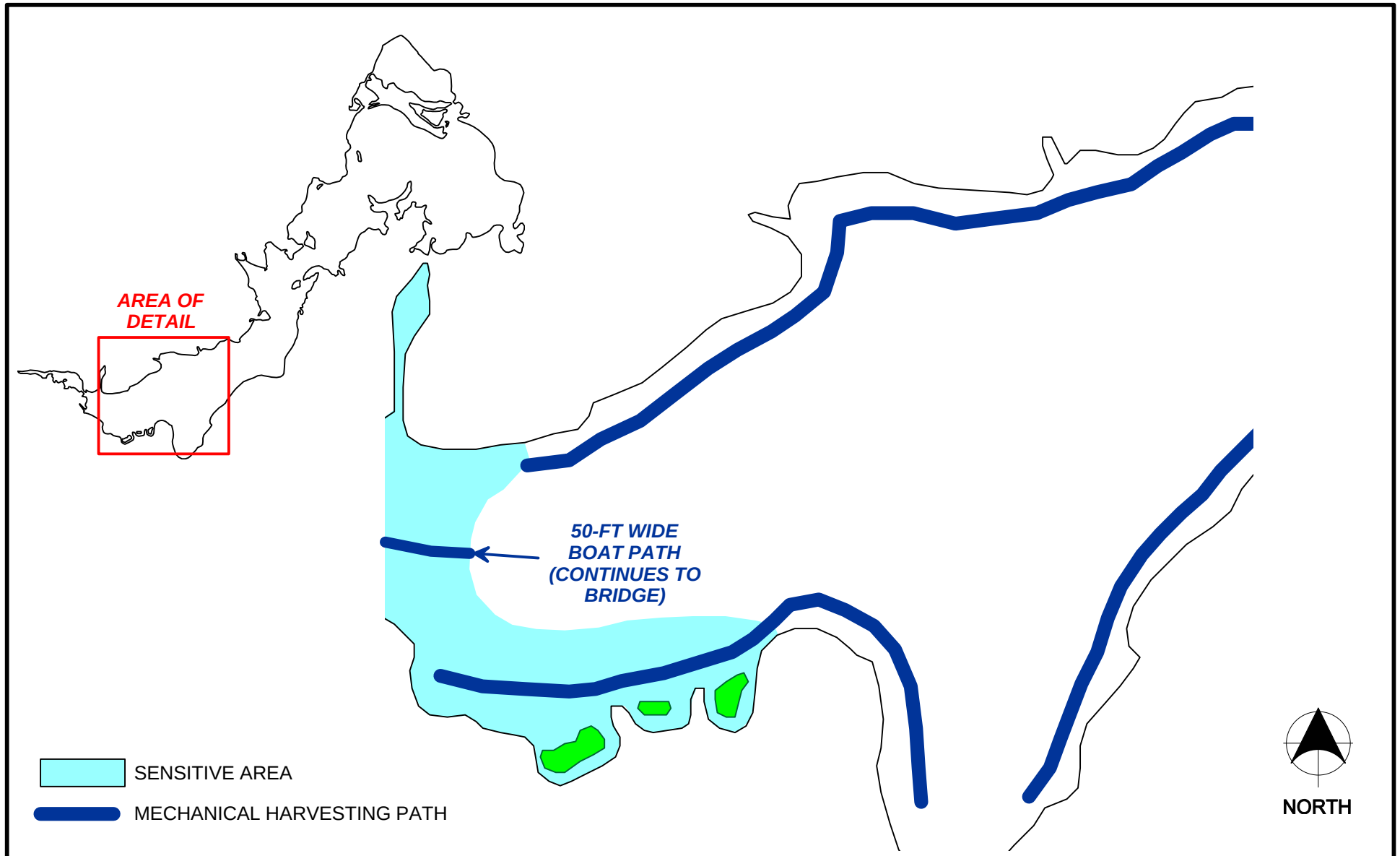
LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
SOUTH-CENTRAL AREA

FIGURE
C-5

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	29 JUN 10	B-5



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LAKE BEULAH MANAGEMENT DISTRICT
LAKE BEULAH, WISCONSIN
HARVESTING AREAS
WESTERN AREA

FIGURE C-6

DRAWN BY	PROJ. No.	DATE	FILE
RN	09-201	29 JUN 10	B-6