MINOCQUA LAKE
SENSITIVE AREA SURVEY REPORT
AND MANAGEMENT GUIDELINES

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CONTENTS

Minocqua Lake, Oneida County, Wisconsin
Integrated Sensitive Area Survey Report

Date of Survey: July 14 and 15, 2003 Number of Sensitive Areas: 15

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Introduction:

This survey was conducted on July 14 and 15, 2003 using the Wisconsin Department of Natural Resources protocol guidelines for conducting and implementing sensitive area surveys. Surveys of this type are an integrated team approach to resource management, utilizing the expertise of many DNR resource managers. As a team, resource experts collaborate to identify locations around a lake that are critical to the future health and balance of the lake's ecosystem. Sensitive area surveys provide lake organizations, owners of shoreline property, county zoning officials, DNR personnel and other interested individuals with specific management recommendations that can be used to help protect and improve the overall health of lakes.

Fifteen sites identified on Minocqua Lake contain critical habitat and were designated as sensitive areas (refer to Appendix A for site location). Natural resource managers identified these areas and recommend the need for additional protection in the future.

Overview of Sensitive Area Designations:

Sensitive areas are often located in areas that consist of aquatic/wetland vegetation, terrestrial vegetation, gravel/rubble lake substrate or areas that contain downed woody cover (fallen trees or logs). These areas may provide water quality benefits to the lake, reduce shoreline erosion, and provide habitat that is necessary for seasonal and/or life stage requirements of fish, invertebrates and wildlife. A 'designated sensitive area' alerts interested individuals (i.e. DNR personnel, county zoning personnel, lake associations, etc.) that the area contains critical habitat vital to sustaining a healthy lake ecosystem or may feature an endangered plant or animal. Consequently, permit reviews and decisions regarding water-based actions within a sensitive area should be highly scrutinized by management personnel. Thus information presented in a sensitive area report may discourage certain permits from being approved within these sites. Although only 15 specific areas have been designated as sensitive areas, this entire body of water is unique and should be considered sensitive to development and loss of habitat.

General Lake Information:

Minocqua Lake in Oneida County, Township 39 North, Range 6 East, Sections 11, 12, 13, 14, 15, 18, 22 is 1360 acres with a maximum depth of 60 feet. This is a soft water drainage lake with light brown water of moderate transparency. Drainage lakes have both an inlet and outlet. Minocqua Lake has two inlets and one outlet. The Minocqua and Tomahawk Thoroughfares are the inlets and Kawaguesaga Lake is the outlet.

Water Quality

DNR Water Resource Specialists conducted water quality sampling on Minocqua Lake during the summer of 2003. Average phosphorus (measure of the amount of nutrients), chlorophyll A (measure of the amount of algae) and secchi disk (measure of water clarity) results for three different sampling periods are as follows: Average phosphorus (18 µg/L), average chlorophyll A (4.2 µg/L) and average secchi disk readings (11.3 feet). These water quality results indicate that Minocqua Lake is a mesotrophic lake. A mesotrophic lake has moderate water clarity and a moderate amount of nutrients in the lake compared to eutrophic (high nutrients, low water clarity) and oligotrophic (low nutrients, high water clarity) lakes. Mesotrophic lakes have occasional algae blooms and generally support a good fishery.

Volunteer self-help water quality monitors have been collecting secchi disk readings on Minocqua Lake since 1989 and collecting water samples which have been analyzed for phosphorus and chlorophyll A since 1992. Data collected by the volunteers supports the data that was collected by DNR Water Resource Specialists. Refer to Appendix C for a summary report of the data that has been collected by self-help volunteers.

Fisheries

Minocqua Lake contains the following game and non-game fish species: walleye, northern pike, muskellunge, smallmouth bass, largemouth bass, grass pickerel, black crappie, bluegill, pumpkinseed, and rock bass. Walleye population estimates in lakes with good natural reproduction average around 4 adult walleyes per acre. Results from a 1998 Minocqua Lake fish survey indicated a population estimate of 4.61 adult walleyes per acre. Of these adult walleyes, 47% were larger than 15 inches and 31% were larger than 20 inches. Minocqua Lake has good natural reproduction and is a periodic source of walleye and muskellunge eggs for the Art Oehmke Hatchery in Woodruff. Current stocking consists of 'plant-back' of fry or fingerlings to replace some of the eggs taken to the hatchery, however natural reproduction sustains the fishery. During the years the lake was stocked more heavily, there was little relationship between walleye stocking and subsequent year classes.

Wildlife

Shoreland areas on lakes provide habitat for many species of wildlife. Areas where the shoreline and adjacent uplands are undeveloped or remain mostly natural provide the best quality and diversity of wildlife habitat. On the uplands, diverse vegetative layers provide important structure for wildlife. Some species occupy the canopy, some the sub-canopy, others the sapling layer, and so forth down through shrubs, tall herbs, short herbs and ground cover (surface) plants. Snags (standing dead and dying trees) provide a very important, often-overlooked, aspect of wildlife habitat. They provide forage sites for insect-eating birds and nest sites for woodpeckers and songbirds. Cavities in trees provide den sites for many species of birds and

mammals. Downed and rotting logs provide homes to many species of wildlife including reptiles, amphibians, small mammals and invertebrates. To improve wildlife habitat, snags should be retained. It is common for landowners to remove many of the vegetative layers, especially at the lakeshore, thereby eliminating much of the wildlife habitat. The best of the developed habitat is where landowners have maintained a narrow corridor to the lake, have retained shrubs for structure on the uplands, and have maintained a buffer along the shoreline. In these nearshore areas, submerged, floating and emergent vegetation and fallen trees provide critical habitat for many types of invertebrates, fish and wildlife.

Giant Canada geese have become more numerous on Minocqua Lake and large amounts of fecal material are a concern in certain areas, particularly at Torpy Park. Geese are attracted to grassy lawns and avoid areas with brush, trees or vegetation that obstructs their view and hides predators. There are several methods to deter geese from using an area. The booklet "Managing Problems Caused by Urban Canada Geese" is available through U.S.D.A Wildlife Services by calling 1-800-228-1368.

Aquatic Plants

The sensitive area designation (SAD) study on Minocqua Lake did not involve conducting a complete survey of all aquatic vegetation present in the lake. This survey was an overview of the aquatic plant community and only general observations were obtained on species abundance.

"A healthy aquatic plant community plays a vital role within the lake ecosystem. A balanced, healthy plant community provides important fishery and wildlife resources. Plants, including algae, start the food chain that supports many levels of wildlife, and at the same time produce oxygen needed by animals. Plants are used as food and cover by a variety of wildlife and as food, cover and spawning sites by fish. Aquatic plants serve as a place to live and graze for invertebrate populations. The larger and more diverse invertebrate populations that result will support larger and more diverse fish populations. Mixed stands of macrophytes support 3-8 times as many invertebrates and fish as monocultural stands (Engel, 1990)."

Fifty species of aquatic plants were found during the sensitive area survey on Minocqua Lake. Of these fifty species, forty-five are native to Wisconsin. Forty-five species of aquatic plants represents very good diversity. Refer to Appendix B for a complete list of aquatic plants that were found during this survey.

An aquatic plant survey was carried out as part of the long-term trend study on Minocqua Lake in 1989, 1993 and 1996. Information from these surveys indicate that coontail (*Ceratophyllum demersum*), bushy pondweed (*Najas flexilis*), water celery (*Vallisneria americana*) and flatstem pondweed (*Potamogeton zosteriformes*) were the most abundant species. The sensitive area survey from 2003 shows coontail and water celery to be abundant in many of the study areas. The sample population in the sensitive area survey (as well as the long-term trend study) was dominated by submergent aquatic plant species, with the genus *Potamogeton* (pondweeds) showing the highest diversity. There are relatively few areas of native floating-leaf and emergent plant species on Minocqua Lake and these areas should be protected. Stands of floating-leaf and emergent plants offer greater habitat diversity.

It is likely that recreational use affects the plant community in Minocqua Lake. Plant species that do not do well in disturbed areas will be limited to areas of lesser boat traffic. As more people use the lake for recreation, there is increased stress placed on the aquatic plant community. Boats and personal watercraft fragment and uproot plants that can float onto beaches and decay. Aquatic plants that do not do well in turbid water situations and cannot adjust to disturbances may decline. Plant species that are more tolerant of disturbance and turbidity may not be preferred wildlife plants and often are species that are not tolerated by lake residents.

One should also consider the effects of piers and boathouses on the aquatic plant community. These structures shade the water blocking out sunlight. These structures and their associated uses likely affect the plants found in Minocqua Lake.

Public Access
Minocqua Lake contains three public boat landings. One landing is by the Thirsty Whale (off of Park Street), another is off of Chicago Avenue and the third is near Stacks Bay off Highway 47.

Special Concern and Threatened Species

Special concern species are those species about which some problem of abundance or distribution is suspected but not yet proven. The main purpose of this category is to focus attention on certain species before they become threatened or endangered. Threatened species are species that may in the future become endangered and a problem of abundance or distribution has been proven. There are special concern and threatened species present in Minocqua Lake, however there were no threatened or special concern species found during this survey.

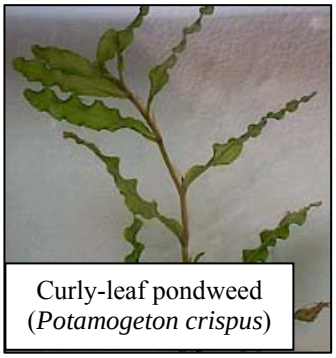
Exotic Species

Exotic species are non-native species that can threaten the diversity and abundance of native species, alter ecosystems and affect our economy and recreational activities. Exotic species found in Minocqua Lake include purple loosestrife, curly-leaf pondweed, Eurasian water-milfoil, flowering rush, zebra mussels and rusty crayfish.

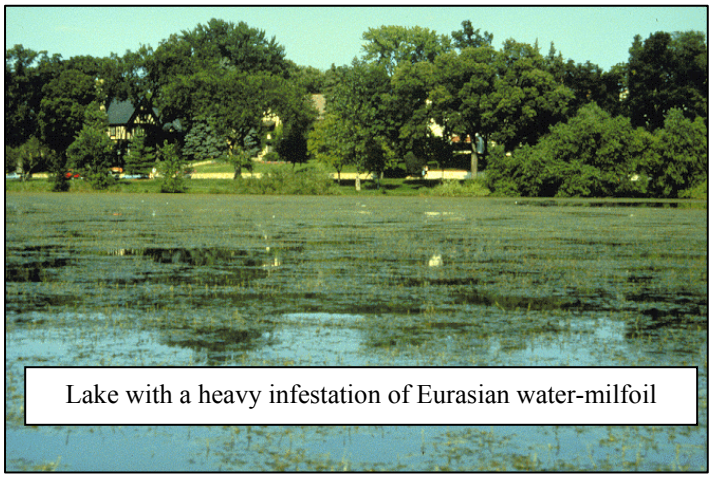
During this survey, **purple loosestrife** was found at three of the areas that were designated sensitive. Purple loosestrife was first found on Minocqua Lake in 1989. Purple loosestrife has become a major problem in the lake by primarily colonizing the large wetland complexes around the Tomahawk and Minocqua Thoroughfares. The threat of purple loosestrife is always a concern and should be dealt with immediately. Purple loosestrife is an aggressive invader and can quickly outcompete native vegetation. Methods for control are to remove the entire plant before it produces seeds or to cut the flower head and spray with an approved herbicide. Biological control is also occurring using *Galerucella sp*. beetles. These leaf-feeding beetles are approved for release by the Department of Agriculture as a biological control agent and have been released by the DNR and volunteer cooperators. You should contact the DNR


Purple loosestrife (*Lythrum salicaria*)

before any of these methods are implemented.


Curly-leaf pondweed (*Potamogeton crispus*)

Curly-leaf pondweed was found at two of the areas that were designated sensitive. Curly-leaf pondweed was first discovered on Minocqua Lake in 1989 during a long-term trend study. Curly-leaf pondweed can outcompete native vegetation by forming dense mats of vegetation and may create a nuisance for recreational boaters, swimmers and other users. In addition, mid-summer dieback of the plant may cause the dying curly-leaf to accumulate on shore and/or increase phosphorus concentrations that could lead to nuisance algae blooms. Since curly-leaf dieback generally takes place by mid-July, management activities should occur in the spring or early summer. In northern Wisconsin, curly-leaf plants usually complete their life cycle by late June or early July. Turions, which are a vegetative form of reproduction, form on the plant before dieback occurs. After dieback, turions fall to the bottom of the lake. Turions begin to sprout in late summer, responding to shorter day length and cooler water temperatures. The new growth continues under the ice of winter. Once the ice has melted and the water warms, curly-leaf pondweed begins to grow rapidly. This allows the stems to reach the water's surface before any other plant. By late spring a dense canopy of curly-leaf may have formed preventing sunlight from reaching other plants. Please contact the DNR before implementing any control measures on curly-leaf pondweed.


Lake with a heavy infestation of Eurasian water-milfoil

Eurasian water-milfoil was first found in Minocqua Lake in 2000 near the Chicago Avenue boat landing. Eurasian water-milfoil was not found at any of the sites that were designated as sensitive areas. Eurasian water-milfoil can have many negative impacts on a body of water. For example, because of its potential for explosive growth and its incredible ability for fragments to regenerate, Eurasian water-milfoil can successfully outcompete most native aquatic plants, especially in disturbed areas. In a number of Wisconsin lakes, Eurasian water-milfoil has formed huge monoculture stands with vast mats of surface foliage that shade out native aquatic plants and diminish the aesthetic beauty. Recreational activities like swimming, boating and sport fishing are also diminished on lakes infested with Eurasian water-milfoil. A variety of techniques have emerged for controlling Eurasian water-milfoil populations on Wisconsin's lakes. These techniques include mechanical cutting and harvesting in open areas and limited use of herbicide treatments (contact a local DNR Aquatic Plant Manager to obtain required permits). A native weevil, *Euhrychiopsis lecontei*, that feeds on native milfoil as well as Eurasian water-milfoil is present in many northern Wisconsin lakes. Native weevils can be released for Eurasian water-milfoil control, however a free permit is required. Of the seven species of native water-milfoil in Wisconsin, two were found in Minocqua Lake. These native species have evolved in Wisconsin

lakes and are a normal, healthy part of a lake community. Eurasian water-milfoil is often confused with northern water-milfoil, so proper identification is required before any control methods occur.


Flowering rush (*Butomus umbellatus*)

Flowering rush, another exotic aquatic plant species, was found at seven sites designated as sensitive areas on Minocqua Lake. One extensive bed of flowering rush was found (site 15) and other scattered populations were discovered throughout the lake. Since it is not known when this plant became established in the lake, DNR aquatic plant specialists do not know how quickly the plant is spreading. Flowering rush was likely brought to North America from Europe as a garden plant and was first found in North America (Canada) in 1897. It is still sold today in Wisconsin as an ornamental. It was first discovered in Minocqua Lake when the long-term trend study was conducted in 1989. Flowering rush grows as either an emergent or submergent plant that can form dense stands that interfere with recreation and can crowd out native plants. As an emergent, it has a triangular-shaped stem that can be confused with native plants like bur-reed. It can grow in water up to 10 feet deep. In deeper water, it produces limp leaves. Umbrella-shaped clusters of about 30 showy pink flowers are produced. Research has shown that the plant only produces flowers in very shallow water or on dry sites. Aquatic plant specialists did not find any flowers on the flowering rush plants found during the sensitive area survey. Flowering rush spreads locally from rhizomes, as it does not produce well from seed. If the roots of the plant are disturbed, small reproductive structures on the root can break off and reproduce. It is a "pioneer" species that can easily invade areas not occupied by other aquatic or wetland plants.

Eradicating flowering rush is difficult. If the plants do not have their distinctive flowers, they may be confused with native plants. Thus beds of flowering rush should be verified before attempting to eliminate them. Cutting off the plant below the water line can be effective, however this will not kill the plant, only reduce the abundance. Multiple cuttings throughout the growing season may be needed. All cut plants must be removed from the water to an upland location. Plants with root material should not be composted close to the water or a wetland. Raking or hand pulling is not recommended since this will disturb the root system causing the plant to spread. The plant is difficult to kill using herbicides. A permit is required from the DNR for chemical control.

Zebra mussels (*Dreissena polymorpha*), another aquatic exotic species, can also have many negative impacts on a body of water. To date, no zebra mussels have been found in Minocqua Lake. Zebra mussel monitoring has occurred on Minocqua Lake since 1995. They form large colonies that grow on almost any solid underwater material. These colonies can grow to contain as many as 100,000 mussels per square meter. Zebra mussels were found in July of 2001 in Metonga Lake in Forest County, the only known lake in northern Wisconsin with zebra mussels. This picture is a zebra mussel plate pulled from Metonga Lake in September of 2003. As you

can see, the plate is completely covered by tiny zebra mussels. Zebra mussels can clog the intake pipes in water treatment plants, power generating plants and industrial facilities, reducing waterflow and causing occasional shutdowns. They attach to piers, navigational buoys, docks, etc. interfering with navigation and increasing corrosion. Zebra mussels can grow on boat hulls and inside engine systems, possibly damaging engines. They can outcompete native mussels for food and also filter large amounts of phytoplankton from the water, reducing food availability for other filter-feeding organisms and many fish. There are no known control methods for zebra mussels in lake or river systems. Present control methods only work on industrial water intake systems (pipes).

Zebra mussel plate from Metonga Lake, Forest County

Rusty crayfish are present in Minocqua Lake. Rusty crayfish are native to Ohio, Kentucky and Tennessee and were probably introduced into Wisconsin by non-resident anglers who brought them north to use as fishing bait. Invading rusty crayfish frequently displace native crayfish, reduce the amount and kinds of aquatic plants and invertebrates, and reduce some fish populations. Environmentally sound ways to eradicate or control introduced populations of rusty crayfish have not been developed.

Rusty Crayfish (*Orconectes rusticus*)

Volunteers should monitor rusty crayfish populations. Rusty crayfish monitoring protocol can be obtained by contacting Laura Herman at (715) 365-8984. Rusty crayfish prefer gravel and rock substrate, therefore monitoring and trapping activities should be concentrated on areas of the lake with this substrate.

Many aquatic exotics such as Eurasian water-milfoil, curly-leaf pondweed and zebra mussels are brought in by human activity (boating, fishing, etc.). Exotics have a better chance of establishing in areas where the bed of the lake has been disturbed and/or where native plants are sparse. Protection of native plant beds will help slow the spread of exotics if exotics enter this system. Lake users can also do several things to help control the spread of exotic species:

- Remove any plants or animals that are present on your boat, trailer or equipment before leaving a lake.
- Drain livewells, bilge water and transom wells before leaving the access area.
- Empty bait buckets on land.
- Dry the boat and equipment in a sunny location for at least five days before transferring to a new lake. If drying isn't possible, wash boat, tackle and trailers with hot water.

- Flush water through the motor's cooling system and other boat parts that normally get wet.
- Learn what exotic organisms look like. Report questionable species and contact your local DNR service center for identification assistance.
- Have trained volunteer "exotic watch" monitors on lake to watch for Eurasian water-milfoil, curly-leaf pondweed, zebra mussels, flowering rush and rusty crayfish.
- Volunteer watercraft inspectors can educate boaters and protect Minocqua Lake from exotics.

Shoreland Management

Wisconsin's Shoreland Management Program, a partnership between state and local government, works to protect clean water, habitat for fish and wildlife and natural scenic beauty. The program establishes minimum standards for lot sizes, structural setbacks, shoreland buffers, vegetation removal and other activities within the shoreland zone. The shoreland zone includes land within 1000 feet of lakes and within 300 feet of rivers and floodplains. With research demonstrating that current standards may be inadequate to protect water resources and the fish and animals that depend on them, many communities chose to go beyond the minimum standards to ensure our natural resources are adequately protected. This report will provide management guidelines for activities within the lake and in the immediate shoreland area. Before any recommendations in this report are completed please check with the DNR and units of local governments for required approvals.

A vital step in protecting our water resources is to maintain an adequate vegetative buffer. At a minimum, the shoreland buffer should extend from the water onto the land 35 to 50 feet. Studies have shown that buffers less than 35 feet are not effective at preventing water pollution. Deeper buffers of 50 feet or more can help provide important wildlife habitat for songbirds, turtles, frogs, and other animals, as well as help to filter out pollutants from runoff. In general, no mowing should occur in the buffer area, except perhaps in a viewing access corridor. This buffer should match the typical ecosystem in northern Wisconsin and include herbaceous, shrub and tree layers.

In addition, the reader should also investigate other innovative ways to reduce the impacts of runoff flowing into the lake while improving critical shoreline habitat. This may include using phosphorus-free fertilizer, installing rain gardens, setting the lawnmower at a higher mower height, decreasing the area of impervious surfaces or restoring aquatic plant communities.

Whole Lake Management Recommendations

1. Promote the use of bioengineering, biologs and native vegetation rather than riprap for shoreland protection and erosion control.
2. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the ordinary high water mark (point on the bank or shore where water is present often enough to leave a distinct wear mark), herein referred to as OHWM, and within the 35-foot shoreland buffer and shoreland zone.
3. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.
4. Minimize the chance of additional invasions of exotic plants by protecting native aquatic plants.
5. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
6. Protect snag trees, large woody cover and live den trees in the upland and shallow water habitat zone.

Resource Value of Sensitive Area Site 1 – Islands

1(a) **School House Island** (refer to Appendix A) is located in the northern part of the west basin near School House Bay. Primary reasons for site selection include aquatic vegetation, wildlife habitat and natural scenic beauty. This site offers a physical buffer zone where existing vegetation provides protection against shoreline erosion. The island also reduces the fetch (the distance along open water or land over which the wind blows) across the lake minimizing wave action and erosion potential. Substrate around the island is primarily sand and muck. The shoreland area around the island is approximately 90% wooded and 10% developed. Large woody cover is common with 3-6 pieces per 100 feet of shoreline. The natural scenic beauty rating, herein referred to as NSB, is outstanding compared to other areas of the lake. There is one well-hidden house with 2 piers on this island.

1(b) **Clumb's Island** (refer to Appendix A) is located in the east basin, south of Huber Bay. Primary reasons for site selection include aquatic vegetation, wildlife habitat and natural scenic beauty. This site offers a physical buffer zone where existing vegetation provides protection against shoreline erosion and a biological buffer zone where the existence of native plants reduces the likelihood of exotic invasions. The island also reduces the fetch across the lake minimizing wave action and erosion potential. Substrate is primarily sand and muck with gravel present. The shoreland area around the island is approximately 90% wooded and 10% developed. Large woody cover is common with 3-6 pieces per 100 feet of shoreline. With only one well-hidden house on the island the NSB rating is outstanding compared to other areas on the lake.

1(c) **Kline Island** (refer to Appendix A) is a small island directly north of Jossart Island in the east basin. The primary reason for site selection was wildlife habitat. This site offers a physical buffer zone where existing vegetation provides protection against shoreline erosion and a biological buffer zone where the existence of native plants reduces the likelihood of exotic invasions. The island also reduces the fetch across the lake minimizing wave action and erosion

potential. The island is nearly 100% wooded with a small cabin that is concealed behind trees. The NSB rating is outstanding compared to other areas of the lake.

1(d) **Jossart Island** (refer to Appendix A) is located in the east basin directly south of Kline Island. Primary reasons for site selection include fisheries habitat, wildlife habitat and natural scenic beauty. This site offers a biological buffer zone where the establishment of existing vegetation reduces the likelihood of an exotic invasion. The island also reduces the fetch across the lake minimizing wave action and erosion potential. Substrate is primarily sand with a gravel/rubble bar present on the east side of the island. The shoreland area around the island is approximately 90% wooded and 10% developed. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. With one boat house present the NSB rating is good compared to other areas of the lake.

1(e) **Fisher's Island,** (refer to Appendix A) the largest island on Minocqua Lake, is located in the central part of the east basin. Primary reasons for site selection include fisheries habitat, wildlife habitat, aquatic vegetation and natural scenic beauty. This site offers a biological buffer zone where the establishment of existing vegetation on the southeast portion of the island reduces the likelihood of exotic invasion. Aquatic vegetation also stabilizes sediments, which reduces nutrient recycling and the likelihood of algae blooms. The island also reduces the fetch across the lake minimizing wave action and erosion potential. Substrate is primarily gravel and rubble on the northern portion of the island and sand and muck on the southeast portion. Large woody cover is common with 3-6 pieces per 100 feet of shoreline. The NSB rating is outstanding compared to other areas of the lake.

1(f) **Crescent Island** (refer to Appendix A) is a small island east of Fisher's Island. Primary reasons for site selection include aquatic vegetation, wildlife habitat and natural scenic beauty. This site offers a biological buffer zone where existing vegetation on the southeast portion of the island reduces the likelihood of exotic invasion. Aquatic vegetation also stabilizes sediments, which reduces nutrient recycling and the likelihood of algae blooms. The island also reduces the fetch across the lake minimizing wave action and erosion potential. Substrate is primarily sand and gravel. Shoreland area around the island is 100% wooded. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. With no human disturbances the NSB rating is outstanding compared to other areas of the lake.

Summary

Overall, the islands in Minocqua Lake provide valuable fish habitat for a variety of different species. Game species such as walleye and smallmouth bass will rely on the gravel/rubble substrate for spawning. A variety of other game and non-game species will also rely on aquatic vegetation and large woody cover for their habitat needs.

A variety of wildlife species such as furbearers, birds, amphibians and reptiles use aquatic vegetation, snag trees and fallen logs for their functional needs. Depending on the type of habitat present around each island, wildlife may rely on the area for cover, nesting and/or feeding.

Flowering rush, an exotic aquatic plant was found at Clumb's, Kline, Jossart and Fisher's Islands. Curly-leaf pondweed, another exotic aquatic plant species, was also found at Clumb's Island. The following is a list of aquatic plant species that were found at each island:

School House Island

PRESENT	COMMON	ABUNDANT	DOMINANT
Free Floating Lemna trisulca (forked duckweed) Nymphaea odorata (white waterlily)	**Free Floating** Nuphar variegata (spatterdock)	**Algae** Filamentous	
Submergents Ranunculus trichophyllus (crowfoot) Elodea canadensis (waterweed) Vallisneria americana (wild celery) Zosterella dubia (water stargrass)	**Potamogetons** P. amplifolius (large-leaf) P. richardsonii (clasping-leaf) P. pusillus (small pondweed)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)	
Turf Formers/Rosettes Eriocaulon aquaticum (pipewort)			
Potamogetons P. gramineus (variable) P. robbinsii (fern) P. praelongus (white-stem) P. zosteriformis (flat-stem)			

Clumb's Island

PRESENT	COMMON	ABUNDANT	DOMINANT
Exotics P. crispus (curly-leaf)	**Exotics** Butomus umbellatus (flowering rush)		
Potamogeton P. gramineus (variable)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)		

Kline Island

PRESENT	COMMON	ABUNDANT	DOMINANT
Potamogetons P. richardsonii (clasping-leaf) P. amplifolius (large-leaf)	**Potamogeton** P. gramineus (variable)		
Floating Leaf Nuphar variegata (spatterdock)			
Exotics Butomus umbellatus (flowering rush)			

Jossart Island

PRESENT	COMMON	ABUNDANT	DOMINANT
Exotics Butomus umbellatus (flowering rush)	**Floating Leaf** Nuphar variegata (spatterdock)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)	
Floating Leaf Nymphaea odorata (white waterlily)	**Turf Formers/Rosettes** Juncus pelocarpus (rush)		
Algae Chara sp. (muskgrass)			
Submergents Najas flexilis (bushy pondweed)			
Potamogetons P. gramineus (variable) P. robbinsii (fern) P. richardsonii (clasping-leaf) P. zosteriformis (flat-stem) P. berchtoldii (small pondweed)			

Fisher's Island

PRESENT	COMMON	ABUNDANT	DOMINANT
	Potamogetons P. amplifolius (large-leaf)	**Submergents** Ranunculus tricophyllus (white water crowfoot) Myriophyllum sibiricum (northern water-milfoil)	
		Turf Formers/Rosettes Sagittaria graminea (arrowhead)	
		Exotics Butomus umbellatus (flowering rush)	

Crescent Island

PRESENT	COMMON	ABUNDANT	DOMINANT
Turf Formers/Rosettes Sagittaria graminea (arrowhead)	**Potamogetons** P. gramineus (variable)		

Management Recommendations for all Islands:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM and within the 35-foot shoreland buffer.
2. No chemical, physical or mechanical removal of native aquatic plants.
3. Need to prevent the spread of flowering rush, curly-leaf pondweed and other exotics.
   - Learn to identify flowering rush. Reduce or eliminate flowering rush beds by cutting just below the surface of the water several times per season and/or monitor size of beds for change.

- Learn to identify curly-leaf pondweed. Determine size of curly-leaf pondweed beds in mid to late June. If bed is small, hand pulling is an option. For control of larger areas of curly-leaf please contact your local DNR Aquatic Plant Manager for options.
- Conduct rusty crayfish monitoring.

4. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within these areas.
5. Protect snag trees, large woody cover and live den trees in the upland and shallow water habitat zone.
6. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.
7. Reduce boat traffic (slow-no-wake) around the islands to minimize shoreline erosion.

Resource Value of Sensitive Area Site 2


Healthy aquatic plant community

Site 2 (refer to Appendix A) is School House Bay which is located on the northern part of the lake in the west basin. Primary reasons for site selection include fisheries habitat, wildlife habitat and aquatic vegetation. Aquatic plants provide a nutrient buffer zone where existing vegetation at or within the lake takes up nutrients, thus reducing nuisance algae blooms. Aquatic plant beds also provide a biological buffer zone where the existence of native plants within the lake reduces the likelihood of exotic invasions. With a healthy submergent aquatic plant community present, plants stabilize sediments, which in turn reduce nutrient recycling and the likelihood of nuisance algae blooms. Bottom substrate in the bay is primarily muck. The shoreland area is approximately 50% developed and 50% shallow marsh wetland habitat. A small portion of the site also contains bog habitat. Large woody cover was not present at this site. The southern portion of the bay has a good NSB rating, while the northern portion has a very poor NSB rating compared to other areas of the lake because it contains many human disturbances.

Fisheries habitat was chosen as one of the primary reasons for site selection. Aquatic plants provide valuable habitat for a variety of game and non-game fish species. Northern pike, muskellunge, largemouth bass, bluegill, pumpkinseed, yellow perch and bullhead may all use this site for spawning, rearing, feeding and protective cover.

Wildlife habitat was also chosen as a primary reason for site selection. Emergent and submergent aquatic vegetation, snag trees and perch trees provide valuable habitat for many different species of furbearers, birds, amphibians and reptiles. A variety of furbearers, birds, amphibians and reptiles, including beaver, otter, muskrat, mink, ducks, loons, geese, songbirds, eagles, osprey, frogs, toads, turtles and snakes are likely to use this area for cover, nesting and feeding.

Aquatic vegetation was a primary reason this site was selected as a sensitive area. The aquatic plant community was quite diverse at this site and was one of the few areas where floating and emergent vegetation were common. Three exotic plant species, purple loosestrife, curly-leaf pondweed and forget-me-nots, were common at this site. Exotic species like curly-leaf pondweed were found near piers where native aquatic vegetation has been removed. Exotics are more likely to invade areas where native aquatic plants have been removed. The following is a list of aquatic and wet edge plant species that were present:

PRESENT	COMMON	ABUNDANT	DOMINANT
Herbs Iris versicolor (blue flag iris)	**Emergents** Scirpus validus (softstem bulrush)	**Emergents** Decodon verticillatus (swamp loosestrife)	**Potamogetons** P. robbinsii (fern)
Floating Leaf Lemna trisulca (forked duckweed) Spirodela polyrhiza (large duckweed)	**Submergents** Elodea canadensis (waterweed) Ceratophyllum demersum (coontail)	**Floating Leaf** Nuphar variegata (spatterdock) Nymphaea odorata (white water lily)	
	Potamogetons P. richardsonii (clasping-leaf) P. pusillus (small pondweed)	**Algae** Filamentous	
	Exotics Lythrum salicaria (purple loosestrife) P. crispus (curly-leaf) Myosotis scorpioides (forget-me-nots)	**Submergents** Ranunculus tricophyllus (crowfoot) Vallisneria americana (wild celery) Myriophyllum sibiricum (northern water-milfoil)	

Management Recommendations:

1. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
2. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
3. No chemical, physical or mechanical removal of native aquatic plants.
4. Need to prevent the spread of curly-leaf pondweed, purple loosestrife and other exotics in this area by protecting native plants.
   - Learn to identify curly-leaf pondweed. Determine size of curly-leaf pondweed beds in mid to late June. If bed is small, hand pulling is an option. For control of larger areas of curly-leaf please contact your local DNR Aquatic Plant Manager for options.
   - Learn to identify purple loosestrife. Blossoms should be cut from the plant to prevent spreading. Contact your local DNR Aquatic Plant Manager before using chemical control or removing plants as biocontrol (beetle release) may be occurring nearby.
5. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
6. Protect snag trees and live den trees in the upland and shallow water habitat zone.
7. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Resource Value of Sensitive Area Site 3 & 3a

Site 3 (refer to Appendix A) is a bay on the western shore in the west basin of the lake and Site 3a is a gravel/rubble point directly adjacent to the bay. Primary reasons for site selection include fisheries habitat, wildlife habitat, aquatic vegetation and natural scenic beauty. Aquatic plant beds within this site take up nutrients such as phosphorus, reducing nuisance algae blooms. Aquatic plants also stabilize sediments, which reduces nutrient recycling and the likelihood of nuisance algae blooms. Substrate is primarily muck in the bay (Site 3) and primarily gravel and rubble on the point (Site 3a). The shoreland area is approximately 65% marsh, 25% developed and 10% wooded. Large woody cover is common with 3-6 pieces per 100 feet of shoreline. The NSB rating is outstanding (other than houses on very edge of site) compared to other areas of the lake.

Fisheries habitat was one of the primary reasons Site 3 (bay) was selected as a sensitive area. Large woody cover, emergent, submergent, floating leaf and over-hanging vegetation provide valuable habitat for a variety of fish species in this bay. Northern pike, muskellunge, largemouth bass, bluegill, pumpkinseed, yellow perch, black crappie and bullhead are all likely to use this area for spawning, rearing, feeding and protection. Walleye may also use this area for rearing, feeding and protective cover. Fisheries habitat was the primary reason Site 3a (gravel/rubble point) was chosen as a sensitive area. Walleye, smallmouth bass and white sucker may all use the clean (free of silt) gravel and rubble for spawning habitat.

Wildlife habitat was a primary reason Site 3 was chosen as a sensitive area. This bay contains valuable habitat including aquatic vegetation, brush, snags, perch trees and fallen logs upon which a variety of wildlife species rely. A variety of wildlife including deer, beaver, otter, muskrat, mink, ducks, loons, geese, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely use this site for cover, nesting and feeding.

Aquatic vegetation was a primary reason Site 3 was chosen as a sensitive area. The aquatic plant community was quite diverse at this site. Purple loosestrife, an exotic plant species, was found at this site (densities were not thick). The following is a list of aquatic plant species that were found in the bay:

PRESENT	COMMON	ABUNDANT	DOMINANT
Emergents Pontederia cordata (pickerelweed)	**Shrubs** Salix sp. (willow)	**Sedges** Carex sp. (sedge)	
Floating Leaf Brasenia schreberi (watershield)	**Emergents** Typha latifolia (cattail) Scirpus validus (softstem bulrush) Decodon verticillatus (swamp loosestrife)	**Algae** Filamentous (algae)	
Submergents Zosterella dubia (water stargrass)	**Floating Leaf** Nuphar variegata (spatterdock) Nymphaea odorata (white water lily)	**Submergents** Ceratophyllum demersum (coontail) Myriophyllum sibiricum (northern water-milfoil)	
Turf Formers/Rosettes Sagittaria graminea (arrowhead)	**Submergents** Vallisneria americana (wild celery)	**Potamogetons** P. amplifolius (large-leaf) P. zosteriformis (flat-stem)	
Potamogetons P. spirillus (spiral-fruited) P. pusillus (small pondweed)	**Potamogetons** P. robbinsii (fern) P. praelongus (white-stem)		
Exotics Lythrum salicaria (purple loosestrife)			

Management Recommendations:

1. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
2. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
3. No chemical, physical or mechanical removal of native aquatic plants.
4. Need to prevent the spread of purple loosestrife and other exotics in this area by protecting native plants.
   - Learn to identify purple loosestrife. Blossoms should be cut from the plant to prevent spreading. Contact your local DNR Aquatic Plant Manager before using chemical control or removing plants as biocontrol (beetle release) may be occurring nearby.
   - Conduct rusty crayfish monitoring.
5. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
6. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
7. Addition of plants within shrub layer would benefit wildlife.
8. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.
9. Creation of a slow-no-wake zone within this area would help protect critical habitat.

Resource Value of Sensitive Area Site 4


No homes – Better wildlife habitat

Site 4 (refer to Appendix A) is the old railroad grade (now Bearskin Trail) north of the entrance into Kawaguesaga Lake. Primary reasons for site selection include fisheries habitat, wildlife habitat and natural scenic beauty. Site length is approximately 1,770 feet. Bottom substrate primarily consists of sand with some embedded gravel and rubble. The shoreland area is 75% wooded and 25% developed (bike trail). Large woody cover is common with 3-6 pieces per 100 feet of shoreline. With no homes present and a long vegetated shoreline the NSB rating is outstanding compared to other areas of the lake.

Fisheries habitat was chosen as one of the primary reasons for site selection. A variety of game and non-game fish species may rely on the submergent vegetation and gravel substrate for spawning, rearing, feeding and protective cover. There were numerous bass spawning beds along both sides of this site. Walleye, smallmouth bass, largemouth bass, bluegill, pumpkinseed and yellow perch are likely to use this site for spawning, rearing, feeding and protection. Muskellunge and northern pike may also feed and rely on vegetation and large woody cover for protection. With the presence of rubble in this area, rusty crayfish, an exotic species in Wisconsin, may also be found at this site.

Wildlife habitat was also chosen as one of the primary reasons for site selection. Fallen logs, snag trees, perch trees, shrubs and brush provide valuable wildlife habitat at this site. Furbearers, birds, reptiles and amphibians, including beaver, otter, muskrat, mink, ducks, songbirds, loons, eagles, osprey, frogs, toads, turtles and snakes are likely to use this area for cover, nesting and feeding.

The aquatic plant community was not very diverse at this site, thus aquatic vegetation was not a primary reason for site selection. Curly-leaf pondweed, an exotic plant species, was common at this site. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Floating Leaf Nuphar variegata (water lily)	**Submergents** Vallisneria americana (wild celery) Najas flexilis (bushy pondweed)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)	
Submergents Ranunculus trichophyllus (crowfoot)	**Potamogetons** P. richardsonii (clasping-leaf) P. zosteriformis (flat-stem) P. spirillus (spiral-fruited)		
	Exotics P. crispus (curly-leaf)		

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. No chemical, physical or mechanical removal of native aquatic plants.
3. Need to prevent the spread of curly-leaf pondweed and other exotics in this area by protecting native plants.
   - Learn to identify curly-leaf pondweed. Determine size of curly-leaf pondweed beds in mid to late June. If bed is small, hand pulling is an option. For control of larger areas of curly-leaf please contact your local DNR Aquatic Plant Manager for options.
   - Conduct rusty crayfish monitoring.
4. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
5. Protect snag trees, large woody cover and live den trees in the upland and shallow water habitat zone.
6. Addition of half-logs would create valuable habitat for smallmouth bass. Please contact a local DNR fish biologist before doing this.

Resource Value of Sensitive Area Site 5

Site 5 (refer to Appendix A) is a bay located in the southern most part of the west basin. The primary reason for site selection was wildlife habitat. Site length is approximately 1,870 feet. Bottom substrate is primarily muck with minimal gravel on a point. The shoreland area is approximately 75% wooded and 25% developed. Large woody cover is common with 3-6 pieces per 100 feet of shoreline. Due to some human disturbances along this shoreline, the NSB rating is average compared to other areas of the lake.


Critical fish & wildlife habitat

Fisheries habitat was not selected as a primary reason for site selection, however submergent, floating leaf and overhanging vegetation along with large woody cover provide valuable habitat for a variety of game and non-game fish species. Walleye, largemouth bass, bluegill, pumpkinseed, yellow perch and black crappie likely utilize this area for spawning, rearing, feeding and protective cover. Muskellunge and northern pike may also rely on this area for feeding and protection. Rock substrate also makes the area habitable for rusty crayfish, an exotic species.

Wildlife habitat was the primary reason this site was selected as a sensitive area. Floating leaf vegetation, shrubs, brush, snag trees and fallen logs provide valuable habitat for a variety of furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, ducks, songbirds, eagles, osprey, herons, frogs, toads, turtles and snakes likely utilize this area for cover, nesting and feeding. Deer may also rely on this area for feeding and shelter. Loons and geese may be seen at times feeding in this area as well.

Although aquatic plants were not a primary reason this site was selected as a sensitive area, the aquatic plant community is somewhat diverse at this site. The following is a list of aquatic plant species that were found:

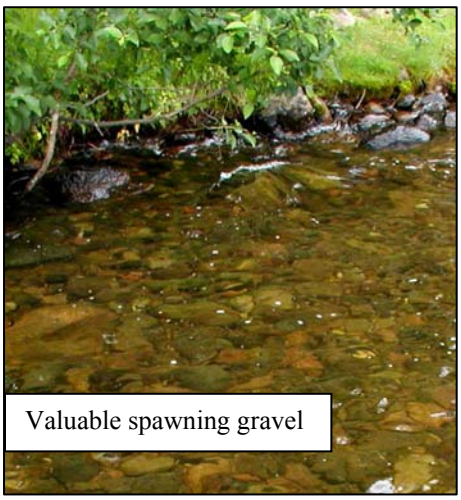
PRESENT	COMMON	ABUNDANT	DOMINANT
Floating Leaf Nuphar variegata (spatterdock) Nymphaea odorata (white water lily)	**Emergents** Typha (cattail)		
Submergents Ranunculus trichophyllus (crowfoot) Vallisneria americana (wild celery)	**Algae** Filamentous (algae)		
Potamogetons P. gramineus (variable) P. pusillus (small pondweed)	**Submergents** Elodea canadensis (waterweed) Myriophyllum sibiricum (northern water-milfoil)		
	Potamogetons P. robbinsii (fern) P. amplifolius (large-leaf) P. richardsonii (clasping-leaf)		

Management Recommendations:

1. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
2. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
3. No chemical, physical or mechanical removal of native aquatic plants.
4. Need to prevent the invasion of exotic plant species in this area by protecting native plants.
5. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
6. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
7. Addition of tree drops would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
8. Addition of plants within the shrub layer on developed sites would benefit wildlife.
9. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.
10. Conduct rusty crayfish trapping and monitoring.

Resource Value of Sensitive Area Site 6

Site 6 (refer to Appendix A) is located in the southern portion of the west basin directly north of site 5. Primary reasons for site selection include fisheries and wildlife habitat. Site length is approximately 1,265 feet. Substrate primarily consists of gravel and rubble with sand present in places. The shoreland area is approximately 50% wooded and 50% developed. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. Due to some development within this site the NSB rating is average compared to other areas of the lake.


Valuable spawning gravel

Fisheries habitat was chosen as one of the primary reasons for site selection. This area consists of a steep drop off with spawning gravel/rubble that extends out into much deeper water compared to other areas of the lake. This site is an excellent area for walleye, smallmouth bass and crappie spawning and feeding. Walleye may also rely on this site for a rearing area. Bottom substrate is also suitable for white sucker spawning. Rock substrate also makes this area habitable for rusty crayfish, an exotic species.

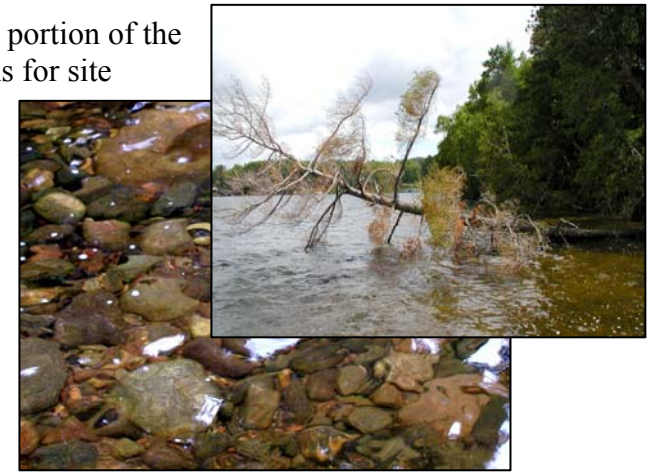
Wildlife habitat was also chosen as one of the primary reasons for site selection. Shrubs, brush, fallen logs, snag trees and perch trees provide valuable habitat for a variety of furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on this area for cover, nesting and feeding. Ducks may feed in this area as well.

With a gravel/rubble substrate and a steep drop off, aquatic plants were not present at this site.

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
3. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
4. Addition of tree drops would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
5. Minimize erosion on this steep slope by reducing boat speeds near shore and around piers and also keep foot traffic to a minimum around areas likely to erode.
6. Conduct rusty crayfish trapping and monitoring.

Resource Value of Sensitive Area Site 7



Site 7 (refer to Appendix A) is located in the southern portion of the east basin just south of Jossart Island. Primary reasons for site selection include fisheries habitat and wildlife habitat. Site length is approximately 2,550 feet. Substrate is primarily comprised of sand, gravel and rubble. The shoreland area is approximately 50% wooded and 50% developed. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. Due to development along this site the NSB rating is poor compared to other areas of the lake.

Fisheries habitat was chosen as one of the primary reasons for site selection. Gravel and rubble provide valuable spawning grounds for walleye, smallmouth bass and white sucker. These species may also rely on the area for rearing, feeding and protective cover in and around the large woody cover and aquatic plants. There is a small spikerush bed at this site that black crappie may use for spawning, rearing, feeding and protective cover. Rock substrate also makes the area habitable for rusty crayfish, an exotic species.

Wildlife habitat was also chosen as one of the primary reasons for site selection. Emergent vegetation, shrubs, brush, snag trees, perch trees and large woody cover provide valuable habitat for deer, furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on this area for cover, nesting and feeding. Deer and other upland species will also use the upland areas for feeding and cover. Ducks and loons will rely on this site for feeding as well.

The aquatic plant community was not very diverse within this site. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Algae Chara sp. (muskgrass)	**Sedges** Eleocharis palustris (spike-rush) 10' X 15' bed		
Submergents Najas flexilis (bushy pondweed)	**Herbs** Iris versicolor (blue flag iris)		
Turf Formers/Rosettes Sagittaria graminea (arrowhead)	**Shrubs** Myrica sp. (sweet gale)		
Potamogetons P. gramineus (variable)	**Emergents** Scirpus validus (soft-stem bulrush)		

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.

2. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
3. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
4. Addition of plants within the shrub layer on developed sites would benefit wildlife.
5. No chemical, physical or mechanical removal of native aquatic plants.
6. Need to prevent the invasion of exotic plant species in this area by protecting native plants.
7. Monitor bulrush beds for presence of flowering rush. If flowering rush encroaches, control by hand cutting.
8. Conduct rusty crayfish trapping and monitoring.

Resource Value of Sensitive Area Site 8

Site 8 (refer to Appendix A) is located in the southern portion of the east basin just south of Fisher's Island. Primary reasons for site selection include fisheries habitat and wildlife habitat. Site length is approximately 2,360 feet. Substrate is primarily sand, gravel and rubble. With heavy development, the NSB rating is poor compared to other areas of the lake.

Fisheries habitat was chosen as one of the primary reasons for site selection. Gravel substrate provides excellent spawning opportunity for walleye, smallmouth bass and white sucker. Walleye and smallmouth bass may also use this area for rearing and feeding. Rock substrate also makes the area habitable for rusty crayfish, an exotic species.

Wildlife habitat was also chosen as one of the primary reasons for site selection. Shrubs, brush, snag trees, perch trees and large woody cover provide valuable habitat for a variety of wildlife species. Deer, beaver, otter, muskrat, mink, ducks, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on this site for cover, nesting and feeding.

There were very few aquatic plants within this site. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Algae Chara sp. (muskgrass)			
Potamogetons P. gramineus (variable)			

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
3. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
4. Addition of plants within the shrub layer on developed sites would benefit wildlife.

5. No chemical, physical or mechanical removal of native aquatic plants.
6. Need to prevent the invasion of exotic plant species in this area by protecting native plants.
7. Conduct rusty crayfish trapping and monitoring.
8. Addition of tree drops and half-logs would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
9. Do not authorize reconstruction of existing sea walls and remove existing sea walls where appropriate.

Resource Value of Sensitive Area Site 9

Site 9 (refer to Appendix A) is a bay located in the southern portion of the east basin just south of Crescent Island. Primary reasons for site selection include fisheries habitat, wildlife habitat and aquatic vegetation. Aquatic plants provide a nutrient buffer zone where existing vegetation at or within the lake takes up nutrients, thus reducing nuisance algae blooms. Aquatic plant beds also provide a biological buffer zone where the existence of native plants within the lake reduces the likelihood of exotic invasions. With a healthy aquatic plant community, vegetation provides protection against shoreline erosion. Bottom substrate is primarily muck with some gravel present on the point adjacent to the bay. The shoreland area is approximately 25% wooded and 75% developed. Shallow marsh wetland provides excellent fish and wildlife habitat within this site. This site has a well-defined herbaceous, shrub and tree layer providing excellent wildlife habitat. Large woody cover was not present at this site. With heavy development at this site, the NSB rating was very poor compared to other areas of the lake.

Fisheries habitat was chosen as one of the primary reasons for site selection. Gravel, submergent vegetation, emergent vegetation and floating leaf vegetation all provide valuable habitat for a variety of game and non-game fish species. This is one of the few areas on the lake that has a large bed of floating leaf plants. Walleye, northern pike, muskellunge, bluegill, pumpkinseed, black crappie and bullheads likely rely on the habitat in this area for spawning, rearing, feeding and protection. Largemouth bass will likely use this bay for rearing, feeding and protection as well. Rusty crayfish, an exotic species, may also be found within this sensitive area.

Wildlife habitat was also chosen as one of the primary reasons for site selection. Aquatic vegetation, shrubs, brush, snag trees and perch trees all provide critical habitat for a variety of wildlife species. Beaver, otter, muskrat, mink, ducks, songbirds, eagles, osprey, frogs, toads, turtles and snakes are likely to use the habitat at this site for cover, nesting and feeding.

The aquatic plant community was quite diverse at this site and therefore was chosen as one of the primary reasons for site selection. Flowering rush, an exotic plant species, was found at this site. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Sedges Scirpus validus (softstem bulrush)	**Emergents** Decodon verticillatus (swamp loosestrife) Eleocharis palustris (creeping spikerush)	**Emergents** Pontederia cordata (pickerelweed)	
Free-Floating Lemna trisulca (forked duckweed)	**Submergents** Vallisneria americana (wild celery) Myriophyllum sibiricum (northern water-milfoil)	**Floating Leaf** Nuphar variegata (spatterdock) Nymphaea odorata (white water lily)	
Submergents Ranunculus trichophyllus (crowfoot)	**Potamogetons** P. gramineus (variable)	**Submergents** Elodea canadensis (waterweed)	
	Exotics Butomus umbellatus (flowering rush)	**Potamogetons** P. amplifolius (large-leaf)	

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
3. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
4. Addition of plants within the shrub layer on developed sites would benefit wildlife.
5. No chemical, physical or mechanical removal of native aquatic plants.
6. Need to prevent the spread of flowering rush and other exotic plant species in this area by protecting native plants.
   - Learn to identify flowering rush. Reduce or eliminate flowering rush beds by cutting just below the surface of the water several times per season and/or monitor size of beds for change.
7. Conduct rusty crayfish trapping and monitoring.
8. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.

Resource Value of Sensitive Area Site 10

Site 10 (refer to Appendix A) is located in the southeastern portion of the east basin, directly east of Site 9. Fisheries habitat was the primary reason this site was selected as a sensitive area. Site length is approximately 790 feet long. Substrate primarily consists of gravel and rubble. Shoreland area is approximately 20% wooded and 80% developed. Large woody cover was not

present at this site. With heavy development at this site, the NSB rating was very poor compared to other areas of the lake.

Fisheries habitat was the primary reason this site was selected as a sensitive area. The entire site has a gravel/rubble shoreline, which is important spawning habitat for walleye, smallmouth bass and white sucker. Walleye and smallmouth bass may also use this area for rearing and feeding. Rock substrate also makes the area habitable for rusty crayfish, an exotic species. Rusty crayfish depend on rocks for cover.

With heavy development and no aquatic plants, this site does not provide diverse, high quality habitat for wildlife.

No aquatic plants were found at this site.

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
3. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
4. Addition of tree drops and half-logs would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
5. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.
6. Conduct rusty crayfish trapping and monitoring.

Resource Value of Sensitive Area Site 11

Site 11 (refer to Appendix A) is Stacks Bay which is located in the most eastern portion of the east basin. This is also the location of the outlet to Mid Lake. Primary reasons for site selection include fisheries habitat, wildlife habitat, aquatic vegetation and natural scenic beauty. Aquatic plants provide a nutrient buffer zone where existing vegetation at or within the lake takes up nutrients, thus reducing nuisance algae blooms. Aquatic plant beds also provide a biological buffer zone where the existence of native plants within the lake reduces the likelihood of exotic invasions. With a healthy aquatic plant community, vegetation provides protection against shoreline erosion. Substrate is primarily muck. Shoreland area is

approximately 40% shallow marsh and bog habitat, 30% wooded and 30% developed. This site has a well-defined herbaceous, shrub and tree layer providing valuable wildlife habitat. Large woody cover was not present at this site. The NSB rating was average around the edge of the bay and outstanding in the middle, compared to other areas of the lake.

Fisheries habitat was chosen as one of the primary reasons for site selection. Stacks Bay has the most valuable muskellunge and northern pike spawning habitat in the entire lake. Muskellunge seek shallow, mucky bays covered with dead vegetation for spawning. Northern pike rely on shallow bays with emergent vegetation for spawning. These two species may also rely on this area for rearing, feeding and protection. Stacks Bay contains habitat valuable for other game and non-game fish species as well. This site contains valuable habitat for walleye feeding and protection. The shoreline near the boat launch contains some smallmouth bass spawning habitat. Largemouth bass, bluegill, pumpkinseed, yellow perch, black crappie and bullheads may rely on this area for spawning, rearing, feeding and protection as well. Overall, this is a site that many different species of fish rely on for their functional needs.

Wildlife habitat was also chosen as a primary reason for site selection. Stacks Bay contains valuable habitat such as aquatic vegetation, shrubs, brush, snag trees and perch trees for many different species of furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, ducks, loons, geese, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on this site for cover, nesting and feeding.

The aquatic plant community in Stacks Bay and the thoroughfare was very diverse and is the site of one of the largest areas of watershield on the lake. *Sparganium eurycarpum* (bur-reed) was also found at this site. This plant looks similar to sterile flowering rush plants. Care should be taken not to eliminate bur-reed if a flowering rush elimination program is undertaken. Purple loosestrife, an exotic plant species, was found at this site. The following is a list of aquatic plants that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Emergents Sagittaria latifolia (arrowhead) Sparganium eurycarpum (bur-reed)	**Sedges** Scirpus validus (bulrush)	**Emergents** Pontederia cordata (pickerelweed) Decodon verticillatus (swamp loosestrife)	
Floating Leaf Brasenia schreberi (watershield)	**Emergents** Typha latifolia (cattail)	**Free floating** Lemna trisulca (forked duckweed)	
Submergents Elodea canadensis (waterweed) Utricularia vulgaris (common bladderwort) Vallisneria americana (wild celery)	**Floating Leaf** Nuphar variegata (spatterdock) Nymphaea odorata (white water lily) **Free-Floating** Lemnar minor (small duckweed)	**Emergents** Ceratophyllum demersum (coontail)	
Potamogetons P. natans (floating leaf)	**Submergents** Ranunculus trichophyllus (crowfoot) Myriophyllum sibiricum (northern water-milfoil)	**Potamogetons** P. amplifolius (large-leaf)	

	Potamogetons P. robbinsii (fern) P. richardsonii (clasping-leaf)		
	Exotics Lythrum salicaria (purple loosestrife)		

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
3. Addition of plants within the shrub layer on developed sites would benefit wildlife.
4. No chemical, physical or mechanical removal of native aquatic plants.
5. Need to prevent the spread of purple loosestrife and other exotic plant species in this area by protecting native plants.
   - Learn to identify purple loosestrife. Blossoms should be cut from the plant to prevent spreading. Contact your local DNR Aquatic Plant Manager before using chemical control or removing plants as biocontrol (beetle release) may be occurring nearby.
6. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
7. Dredging in this area would diminish fish and wildlife habitat values.
8. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Resource Value of Sensitive Area Site 12 & 12a

Sites 12 and 12a (refer to Appendix A) are located on the northeastern shore of the east basin. Site 12 consists of a bay and the primary reasons for site selection were wildlife habitat and aquatic vegetation. Site 12a is a rock bar off the point that is adjacent to site 12. Fisheries were the primary reason this site was selected as a sensitive area. The presence of aquatic plants in the bay provides a biological buffer zone by reducing the likelihood of exotic species invasion. Substrate is primarily gravel and rubble off the point and sand and muck in the bay. The shoreland area is approximately 40% wooded and 60% developed. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. The NSB rating is average compared to other areas of the lake.

Fisheries habitat was not the primary reason Site 12 was selected as a sensitive area, however minimal gravel, emergent vegetation and submergent vegetation still provide valuable habitat for

a variety of game and non-game fish species. Walleye, smallmouth bass, bluegill, pumpkinseed, yellow perch and black crappie are likely to use this site for spawning, rearing, feeding and protection. Fisheries habitat was the primary reason Site 12a was selected as a sensitive area. This site has a rock bar that extends out from the point, west of the Stacks Bay boat landing. This gravel/rubble bar provides excellent spawning opportunities for walleye, smallmouth bass and white suckers. This site is also suitable for rusty crayfish. Rusty crayfish rely on rocks for cover.

Wildlife habitat was one of the primary reasons Site 12 was selected as a sensitive area. Aquatic vegetation, shrubs, brush, snag trees, perch trees, large woody cover and rocks provide valuable habitat for a variety of upland wildlife, furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on this area for cover, nesting and feeding. Ducks and loons will also use this area for feeding. Deer will take cover and feed here as well.

The aquatic plant community was somewhat diverse and was one of the primary reasons Site 12 was chosen as a sensitive area. Flowering rush, an exotic plant species, was found at this site. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Submergents Ranunculus trichophyllus (crowfoot)	**Exotics** Butomus umbellatus (flowering rush)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)	
Potamogetons P. gramineus (variable) P. pusillus (small pondweed)	**Submergents** Ceratophyllum demersum (coontail)	**Potamogetons** P. amplifolius (large-leaf)	
	Potamogetons P. robbinsii (fern) P. richardsonii (clasping-leaf) P. zosteriformis (flat-stem)		

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
3. Addition of plants within the shrub layer on developed sites would benefit wildlife.
4. No chemical, physical or mechanical removal of native aquatic plants.
5. Need to prevent the spread of flowering rush and other exotic plant species in this area by protecting native plants.
    - Learn to identify flowering rush. Reduce or eliminate flowering rush beds by cutting just below the surface of the water several times per season and/or monitor size of beds for change.
6. Conduct rusty crayfish trapping and monitoring.
7. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.

8. Addition of tree drops would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
9. Dredging in this area would diminish fish and wildlife habitat values.
10. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Resource Value of Sensitive Area Site 13

Site 13 (refer to Appendix A) is located on the north central shoreline of the east basin. Wildlife habitat was the primary reason this site was selected as a sensitive area. Site length is approximately 2,000 feet. Substrate is primarily sand. Shoreland area is approximately 60% wooded and 40% developed. Large woody cover is present with 1-2 pieces per 100 feet of shoreline. The NSB rating is poor compared to other areas of the lake. Homes are fairly well buffered from the lake, however piers are very abundant within this site, thus the poor NSB rating (the above photo depicts an area where piers were not as common compared to other locations within this site).

Fisheries habitat was not chosen as a primary reason for site selection. Bottom substrate is sand with no aquatic plants and very little large woody cover. This site does not provide diverse, high quality habitat for fish.

Wildlife habitat was chosen as the primary reason for site selection. The shoreland area contains shrubs, brush, snag trees and perch trees that provide valuable habitat for a variety of wildlife species. Beaver, otter, muskrat, mink, frogs, toads, turtles and snakes likely rely on this site for cover, nesting and feeding. Deer, songbirds, eagles and osprey will also use the shoreland area for cover and feeding. Ducks and loons may feed at this site as well.

No aquatic plants were found at this site.

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. Addition of plants within the shrub layer on developed sites would benefit wildlife.
3. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
4. Addition of tree drops would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
5. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Resource Value of Sensitive Area Site 14

Site 14 (refer to Appendix A) is Huber Bay, which is located in the very northern part of the east basin. Primary reasons for site selection include wildlife habitat and aquatic vegetation. This site offers a nutrient buffer zone where existing vegetation takes up nutrients, thus reducing the likelihood of nuisance algae blooms. Site length is approximately 2,250 feet. Bottom substrate is primarily sand, silt and muck. Shoreland area is approximately 15% wooded and 85% developed. Large woody cover was not present at this site. With heavy development, the NSB rating is very poor compared to other areas of the lake.

Valuable wildlife habitat

Fisheries habitat was not a primary reason this site was selected as a sensitive area, however emergent, submergent and floating leaf vegetation (much of the vegetation around piers has been removed) does provide valuable habitat for a variety of game and non-game fish species. Northern pike, muskellunge, largemouth bass, bluegill, pumpkinseed and yellow perch likely rely on vegetation that is present in this bay for spawning, rearing, feeding and protection. Habitat is not suitable for walleye or black crappie spawning, however these two species may rely on this area for rearing, feeding and protection.

Wildlife habitat was chosen as one of the primary reasons for site selection. Valuable wildlife habitat such as emergent vegetation, floating leaf vegetation, shrubs, brush, snags and perch trees provide an area that is useful for a variety of upland wildlife, furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, ducks, songbirds, eagles, osprey, frogs, toads, turtles and snakes likely rely on the habitat in Huber Bay for cover, nesting and feeding. The shoreland area has habitat suitable for deer feeding and shelter. Loons and geese may feed in this bay also.

The aquatic plant community in Huber Bay is very diverse and is one of the few areas with floating and emergent vegetation. For these reasons, this site was selected as a sensitive area. *Sparganium eurycarpum* (bur-reed) was found at this site. This plant looks similar to sterile flowering rush plants. Care should be taken not to eliminate bur-reed if a flowering rush elimination program is undertaken, as these two species closely resemble each other. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Herbs Iris versicolor (blue flag iris)	**Sedges** Carex sp. (sedge)	**Algae** Chara sp. (muskgrass)	
Emergents Pontederia cordata (pickerelweed) Typha latifolia (cattail)	**Emergents** Sparganium eurycarpum (bur-reed) Scirpus validus (softstem bulrush)	**Submergents** Ranunculus tricophyllus (crowfoot) Myriophyllum sibiricum (northern water-milfoil)	

Free-Floating Lemna trisulca (duckweed)	**Floating Leaf** Nuphar variegata (spatterdock) Nymphaea (white water lily)	**Potamogetons** P. praelongus (white-stem) P. richardsonii (clasping-leaf) P. zosteriformis (flat-stem)	
Submergents Elodea canadensis (waterweed) Vallisneria americana (wild celery) Zosterella dubia (water stargrass)	**Algae** (Filamentous)		
Turf Formers/Rosettes Eriocaulon sp. (pipewort) Juncus pelocarpus (brown-fruited rush) Lobelia dortmanna (water lobelia) Sagittaria cuneata (arum-leaved arrowhead) Sagittaria graminea (grass-leaved arrowhead)	**Submergents** Ceratophyllum demersum (coontail) Najas flexilis (bushy pondweed)		
Potamogetons P. robbinsii (fern) P. spirillus (spiral-fruited pondweed)	**Turf Formers/Rosettes** Eleocharis acicularis (needle spikerush) Myriophyllum tenellum (dwarf water-milfoil) Elatine minima (waterwort) Juncus pelocarpus (brown-fruited rush)		
	Potamogetons P. gramineus (variable) P. amplifolius (large-leaf)		

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. No chemical, physical or mechanical removal of native aquatic plants.
3. Need to prevent the invasion of exotic plant species in this area by protecting native plants.
4. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
5. Addition of plants within shrub layer on developed sites would benefit wildlife.
6. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
7. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
8. Bank protection is recommended with the use of biologs, not riprap.
9. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Resource Value of Sensitive Area Site 15

Site 15 (refer to Appendix A) is located on the northwest part of the east basin. Primary reasons for site selection include fisheries habitat and wildlife habitat. Aquatic plants provide a nutrient buffer zone where existing vegetation at or within the lake takes up nutrients, thus reducing nuisance algae blooms. Aquatic plant beds also provide a biological buffer zone where the existence of native plants within the lake reduces the likelihood of exotic invasions. With a healthy aquatic plant community, vegetation provides protection against shoreline erosion as well. Site length is approximately 1,180 feet. Substrate is primarily sand. Shoreland area is approximately 80% wooded and 20% developed. Large woody cover is present with less than 1-2 pieces per 100 feet of shoreline. The NSB rating is average compared to other areas of the lake.

Native floating leaf and emergent plant populations offer some diversity at this site. A bed of flowering rush (approximately 220 yards by 20 yards) should be monitored or reduced in size. The existing flowering rush bed may offer some habitat for game and non-game fish species but due to its large size (largest flowering rush bed on lake), it is of concern to aquatic plant managers.

Wildlife habitat was another primary reason for site selection. Emergent vegetation, shrubs, brush, snag trees and perch trees provide valuable habitat for a variety of upland wildlife, furbearers, birds, amphibians and reptiles. Beaver, otter, muskrat, mink, ducks, songbirds, eagles, osprey, frogs, toads, turtles and snakes may use this site for cover, nesting and feeding. Deer will rely on the undeveloped areas for shelter and feeding. Loons and geese may feed in this area as well.

The aquatic plant community was somewhat diverse at this site. Flowering rush, an exotic plant species, was found. The following is a list of aquatic plant species that were found:

PRESENT	COMMON	ABUNDANT	DOMINANT
Emergents Scirpus validus (soft-stem bulrush)	**Submergents** Myriophyllum sibiricum (northern water-milfoil)	**Exotics** Butomus umbellatus (flowering rush)	
Floating Leaf Nuphar variegata (spatterdock) Nymphaea odorata (white water lily)	**Potamogetons** P. zosteriformis (flat-stem)		
Potamogetons P. praelongus (white-stem)			

Management Recommendations:

1. Minimize shoreline disturbances (grading, cutting, mowing, placement of structures, etc.) below the OHWM, 35-foot shoreland buffer and within the shoreland zone.
2. No chemical, physical or mechanical removal of native aquatic plants.
3. Need to prevent the spread of flowering rush and other exotic plant species in this area by protecting native plants.
   - Learn to identify flowering rush. Reduce or eliminate flowering rush beds by cutting just below the surface of the water several times per season and/or monitor size of beds for change.
4. Restore shoreland buffers on developed properties where near-shore upland vegetation has been removed.
5. Addition of plants within the shrub layer on developed sites would benefit wildlife.
6. Protect snag trees, live den trees and large woody cover in the upland and shallow water habitat zone.
7. Addition of tree drops would create more valuable habitat for fish and wildlife. Please contact a local DNR fish biologist before doing this.
8. Activities that would impact lake sediments, such as addition of pea gravel or sand blankets, should not be permitted within this area.
9. Bank protection is recommended with the use of biologs, not riprap.
10. If using fertilizers on lawns, limit the amount applied and use phosphorus-free fertilizers.

Conclusion:

In conclusion, fifteen sensitive areas were designated on Minocqua Lake. This report identifies important areas of habitat and management recommendations for each site. Lakes are one of the state's most valuable resources and without proper protection the water quality of our lakes will quickly deteriorate and thus decrease the quality of fish and wildlife habitat and recreational opportunities. Shoreline development has increased over 200% in the last 35 years on northern Wisconsin lakes (Northern Initiatives Lakes and Shorelands-1999). As development increases, there is an increase in pressure on water resources. All lake ecosystems are sensitive to change and man's impact. It is critical that we protect and restore these valuable resources.

All the data that was used to complete this report can be obtained at the Rhinelander DNR Service Center.

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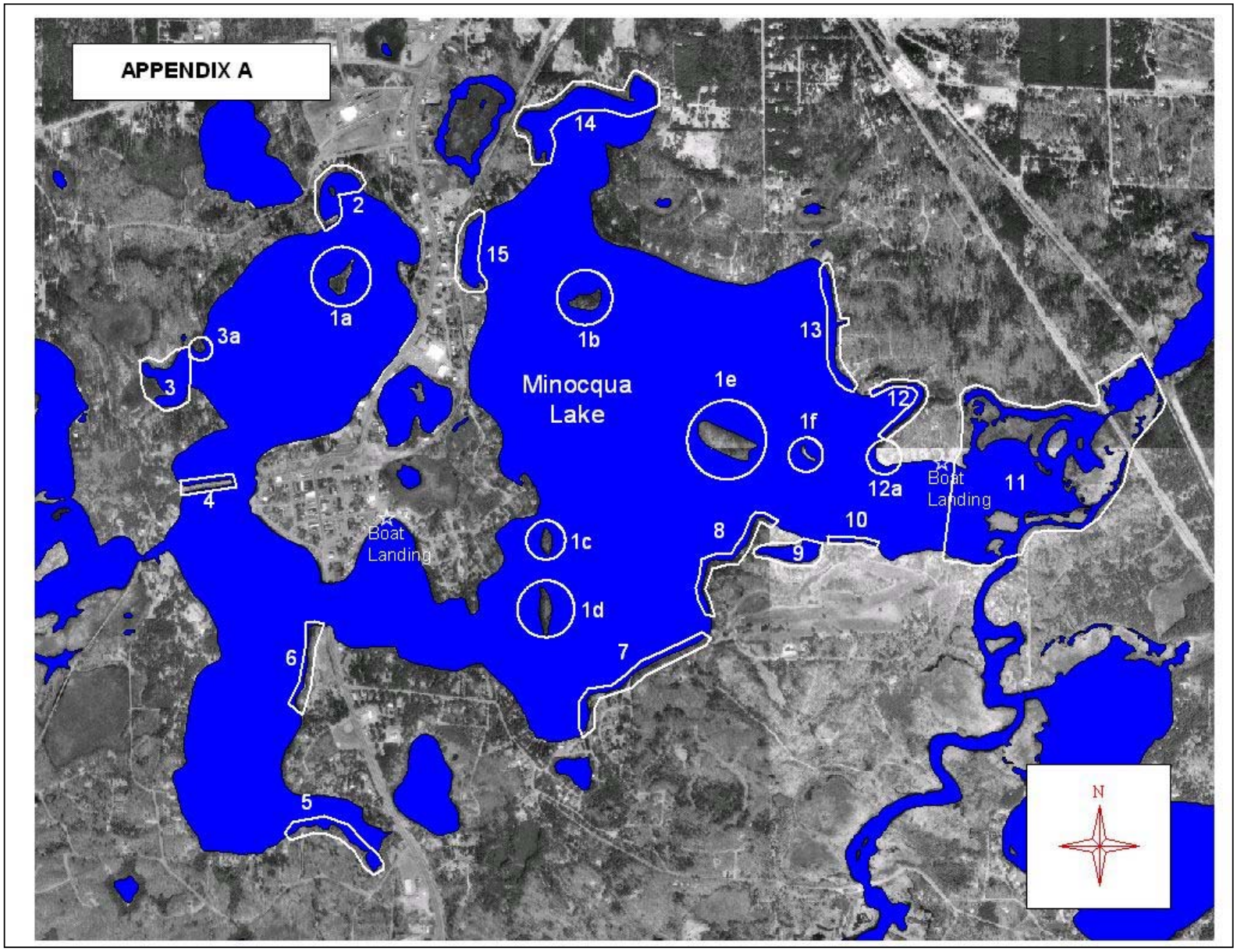
APPENDIX A
Minocqua Lake
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12a
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Boat Landing
Boat Landing
N

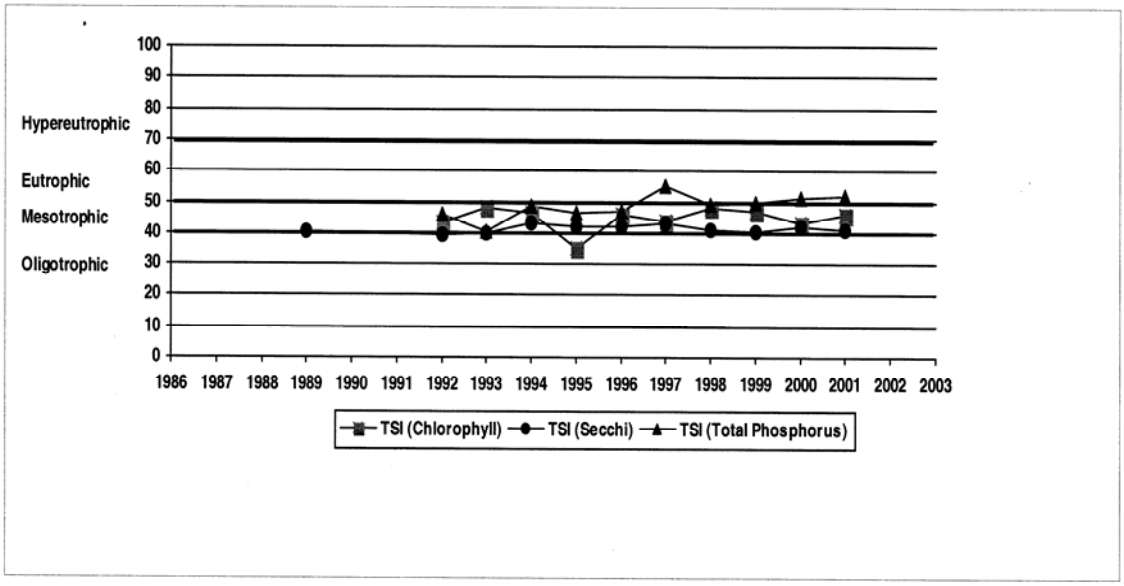
APPENDIX B – Aquatic plants found during 2003 Minocqua Lake sensitive area survey

Plant Name	Native or Non-Native	Life Form
Bidens beckeii - water marigold	native	submergent
Brasenia schreberi - watershield	native	floating leaf
Butomus umbellaus – flowering rush	non-native	emergent
Carex spp. - sedge	native	emergent
Ceratophyllum demersum - coontail	native	submergent
Chara spp. - musk grass	native	submergent
Decodon verticillatus - swamp loosestrife	native	emergent
Elatine minima - waterwort	native	submergent
Eleocharis acicularis-needle spike rush	native	submergent
Eleocharis palustris - creeping spikerush	native	emergent
Elodea canadensis - common waterweed	native	submergent
Eriocaulon aquaticum - pipewort	native	submergent
Filamentous algae		
Iris versicolor - northern blue flag	native	emergent
Isoetes spp. - quillwort	native	submergent
Juncus pelocarpus - brown-fruited rush	native	submergent
Larix laricina - tamarack	native	emergent
Lemna trisulca - forked duckweed	native	submergent
Lobelia dortmanna - water lobelia	native	submergent
Lythrum salicaria - purple loosestrife	non-native	emergent
Myosostis scorpiodes - forget-me-not	non-native	terrestrial
Myrica gale - sweet gale	native	emergent
Myriophyllum sibiricum - northern water-milfoil	native	submergent
Myriophyllum tenellum - dwarf water-milfoil	native	submergent
Najas flexilis - bushy pondweed	native	submergent
Nuphar variegata - spatterdock	native	floating
Nymphaea odorata - white water lily	native	floating
Pontederia cordata - pickerelweed	native	emergent
Potamogeton amplifolius - large leaf pondweed	native	submergent
Potamogeton berchtoldii - small pondweed	native	submergent
Potamogeton crispus - curly-leaf pondweed	non-native	submergent
Potamogeton gramineus - variable pondweed	native	submergent
Potamogeton natans - floating-leaf pondweed	native	submergent
Potamogeton praelongus - white stem pondweed	native	submergent
Potamogeton pusillus - small pondweed	native	submergent
Potamogeton richardsonii - clasping-leaf pondweed	native	submergent
Potamogeton robinsii - Robbins pondweed	native	submergent
Potamogeton spirillus - spiral-fruited pondweed	native	submergent
Potamogeton zosteriformes - flat-stem pondweed	native	submergent
Ranunculus trichophyllus – white water crowfoot	native	submergent
Sagittaria cuneata - arum-leaved arrowhead	native	emergent
Sagittaria graminea - grass-leaved arrowhead	native	emergent
Sagittaria latifolia - common arrowhead	native	emergent
Salix spp. - willow	native	emergent
Scirpus validus - softstem bulrush	native	emergent
Spirodela polyrhiza - large duckweed	native	floating
Typha latifolia - broad-leaved cattail	native	emergent
Utricularia vulgaris - common bladderwort	native	submergent
Vallisneria americana - water celery	native	submergent
Water moss	native	
Zosterella dubia - water stargrass	native	submergent

APPENDIX C – Minocqua Lake Self-Help Water Quality Report (data collected by Minocqua Lake self-help volunteers)

TROPHIC STATE INDEX GRAPH FOR MINOCQUA LAKE, CENTER BASIN, ONEIDA COUNTY

SUMMER AVERAGES (JULY AND AUGUST) FROM 1989 to 2001



Understanding Trophic State Index (

The Trophic State Index is a scale that gives us an indication of how nutrient-enriched a lake is. The index can be calculated via. mathematical equations from Secchi depth, chlorophyll (the green pigment in algae) or phosphorus. The Trophic State Index ranges from 0-100 with lower values indicating nutrient-poor (oligotrophic) waters and higher values indicating more nutrient-rich (eutrophic) waters.

It is important to note that lakes naturally vary -- some lakes have always been nutrient-rich and full of plants and algae; others are naturally nutrient-poor. Lakes can change slightly over the year and from year to year because of weather and other natural cycles. What we don't want to see is a lake that is becoming noticably more eutrophic over several years -- if we can see a lake "age", it's most likely because of cultural (human-caused) eutrophication. Immediate action is needed to protect these lakes.

Trophic State Index Scale:

Which TSI value should you use to determine the overall TSI? If you have TSI (Chl), use that number. Otherwise use TSI(Secchi).

1-40	**Oligotrop**	Clear water; nutrient poor, few plants and algae. Oxygen rich at all depths, except if close to mesotrophic border, then may have low or no oxygen; coldwater fish likely in deeper lakes.
41-50	**Mesotrophic**	Moderately clear water, increased nutrients and more plants. Increasing chance of low dissolved oxygen in deep water during summer.
51 - 70	**Eutrophic**	Decreased water clarity; high nutrient levels, frequent algae blooms, lots of plants. Probably no oxygen in bottom waters during summer. Warm water fisheries only. Blue-green algae likely in summer in upper range of scale.
71-100	**Hypereutroph**	Heavy algal blooms throughout the summer; if >80, fish kills likely in summer and rough fish dominate.

If your TSI(Chl) = TSI(TP) = TSI(Secchi) then algae dominate light attenuation; If TSI(Chl) > TSI(Secchi), Large particulates such as Aphanaizomenon dominate. If TSI(TP) = TSI(SD) > TSI(CHL) then Non-algal particulates or color dominate. If TSI(SD) = TSI(CHL) > TSI(TP) then Phosphorus limits algal biomass. If TSI(TP)>TSI(Chl)=TSI(Secchi) then algae dominate light attenuation but some factor (nitrogen limitation, zooplankton grazing or ...)...