# SPOONER LAKE

# AQUATIC PLANT MANAGEMENT PLAN

MAY 2019

SPONSORED BY:

SPOONER LAKE PROTECTION AND REHABILITATION DISTRICT

PREPARED BY:

HARMONY ENVIRONMENTAL

ECOLOGICAL INTEGRITY SERVICE

## *INSERT DNR PLAN APPROVAL LETTER*

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## INTRODUCTION

This aquatic plant management plan presents data about the plant community, watershed, and water quality of Spooner Lake. Goals and strategies to coordinate sound management of aquatic plants in the lake are presented based on this data. Aquatic plant management includes preservation of native species, managing nuisance aquatic plants, reducing growth and spread of the invasive curly leaf pondweed, and preventing the establishment of additional aquatic invasive species. This plan updates the 2012 Spooner Lake Aquatic Plant Management Plan to guide the Spooner Lake Protection and Rehabilitation District (SLD) and Wisconsin Department of Natural Resources in plant management through 2024.

A very important theme of this and any other Aquatic Plant Management Plan is to understand the importance of aquatic plants in a lake. Aquatic plants provide many benefits to the lake ecosystem. They are the base of the food chain and provide the primary habitat for aquatic organisms. Aquatic plants also:

- Provide habitat for invertebrates, fish, and other wildlife,
- Provide important forage areas for fish,
- Provide plants and plant cover for fish reproduction,
- Aerate waters with oxygen release during photosynthesis,
- Reduce wave energy, thereby reducing erosion,
- Stabilize shoreline areas and lake sediments, and
- Absorb nutrients that may otherwise be available for algae to bloom.

## SPOONER LAKE PROTECTION AND REHABILITATION DISTRICT

This plan is sponsored and the lake is managed by the Spooner Public Inland Lake Protection and Rehabilitation District, commonly known as the Spooner Lake District (SLD). The Town of Spooner Board created the SLD by resolution in 1987.

The electors of the SLD adopted by-laws to define and regulate the activities of the Spooner Lake District, its officers, and committees. These by-laws are interpreted in a manner consistent with the laws of the State of Wisconsin and Chapter 33 of the Wisconsin Statues under which the SLD was created and operates.

The SLD Board is responsible for:

1. Initiating and coordinating research and surveys to gather data on the lake, related shorelands, and the drainage basin.
2. Planning lake protection and rehabilitation projects.
3. Contacting and attempting to secure the cooperation of government agencies in the area for the purpose of enacting ordinances deemed necessary by the Board to further the objectives of the District.
4. Adopting and carrying out lake protection and rehabilitation plans and obtaining any necessary permits.
5. Maintaining a good relationship with the Department of Natural Resources.

The SLD works closely with the Town of Spooner, Wisconsin Department of Natural Resources (WDNR), and Washburn County Land and Water Conservation Department (LWCD) in conserving Spooner Lake. The 2006 Spooner Lake Watershed Management Plan prepared by Cedar Corporation and an Aquatic Plant Management Plan prepared by Harmony Environmental and Ecological Integrity Service in 2006, 2012, and 2019 are important resources in conserving Spooner Lake for the enjoyment and recreational use of residents and visitors.

The SLD Board meets at least quarterly at the Spooner Town Hall, N6124 Blooming Vale Road, Spooner. Also, the SLD annual meeting and budget hearing is held between May 22, and September 8. A written notice of the annual meeting and budget hearing is mailed at least 14 days in advance of the meeting to all property owners and to the Department of Natural Resources. A notice of the annual meeting and budget hearing is also published twice in a paper of general circulation in the area.

The SLD mailing address is P. O. Box 73, Spooner, WI 54801; the e-mail address is Photo7589@gmail.com; and the website address is www.spoonerlakewi.com. The SLD website contains information about its bylaws, board members, committees, meetings, and activities.

## PUBLIC INPUT

The 2019 committee members to update the Spooner Lake Aquatic Plant Management Plan are listed below. This committee met three times to review goals and strategies from the 2012 plan, native aquatic plant and curly leaf pondweed monitoring data, and to update concerns regarding plant management. They also provided information, reviewed and selected alternative management options, reviewed draft documents, and attended the public meeting for the draft plan.

Aquatic Plant Management Plan committee members:

Michael A. Plisky, SLD Chairman, Aquatic Plant Committee

Mort Dahl, SLD Secretary, Aquatic Plant Committee, Clean Boats Clean Waters Program Lead

Nancy Hanson, SLD Treasurer, Aquatic Plant Committee

Ed Fisher, SLD Board Member, Aquatic Plant Committee, AIS Identification Lead

Mark Schultz, SLD Board Member, Aquatic Plant Committee, Algae and Aquatic Plant Management Lead

Frank Gray, Citizen Representative, 2012 SLD APM Plan Committee Member

John Meacham, Citizen Representative, 2012 SLD APM Plan Committee Member

Plant management advisors:

Lisa Burns, Washburn County Conservation Coordinator

Pamela Toshner, Wisconsin Department of Natural Resources, Lakes Coordinator

Mark Sundeen, Wisconsin Department of Natural Resources, Aquatic Plant Management

## PUBLIC REVIEW

This plan was available for public review and comment at the Spooner Public Library and on the Spooner Lake District (SLD) website spoonerlakewi.com. This availability was announced in the Spooner Advocate newspaper and a notice was mailed to all SLD property owners. The SLD held a public meeting to present the plan prior to submitting for approval on May 25, 2019. The SLD Board also approved the plan for submittal to the WDNR. The WDNR approved the plan XXXX, 2019.

## SCHEDULE FOR PLAN COMPLETION

| | |
|---|---|
| Advisory Committee Meetings | March 9, 2019 |
| | March 15, 2019 |
| | April 6, 2019 |
| Draft Plan for Committee Review | mid-April |
| Comments back from Committee | April 30, 2019 |
| Plan for Public Review (post on website, at library) | May 10, 2019 |
| Lake District Public Meeting | May 25, 2019 |
| Comments from Public Due | June 3, 2019 |
| Plan submitted to DNR | June 10, 2019 |
| 60 Day Review | |

## LAKE INFORMATION

Spooner Lake is a 1,132 acre lake located in Washburn County, Wisconsin in the town of Spooner (T39N R12W S22, 23, 26, 27, 34 and 35); WBIC: 2685200. The lake is a drainage lake with one main inlet, Crystal Brook and an outlet, the Yellow River. The lake outlet is controlled by a dam. Spooner Lake was impounded with a wooden dam in 1876 and replaced by a concrete dam in 1912. The City of Spooner purchased the dam in 1912. The City of Spooner made improvements to the dam in 1996 and Washburn County made improvements in 2015. The watershed area is approximately 7,811 acres. The maximum lake depth is 17 feet, and the mean depth is 7 feet.

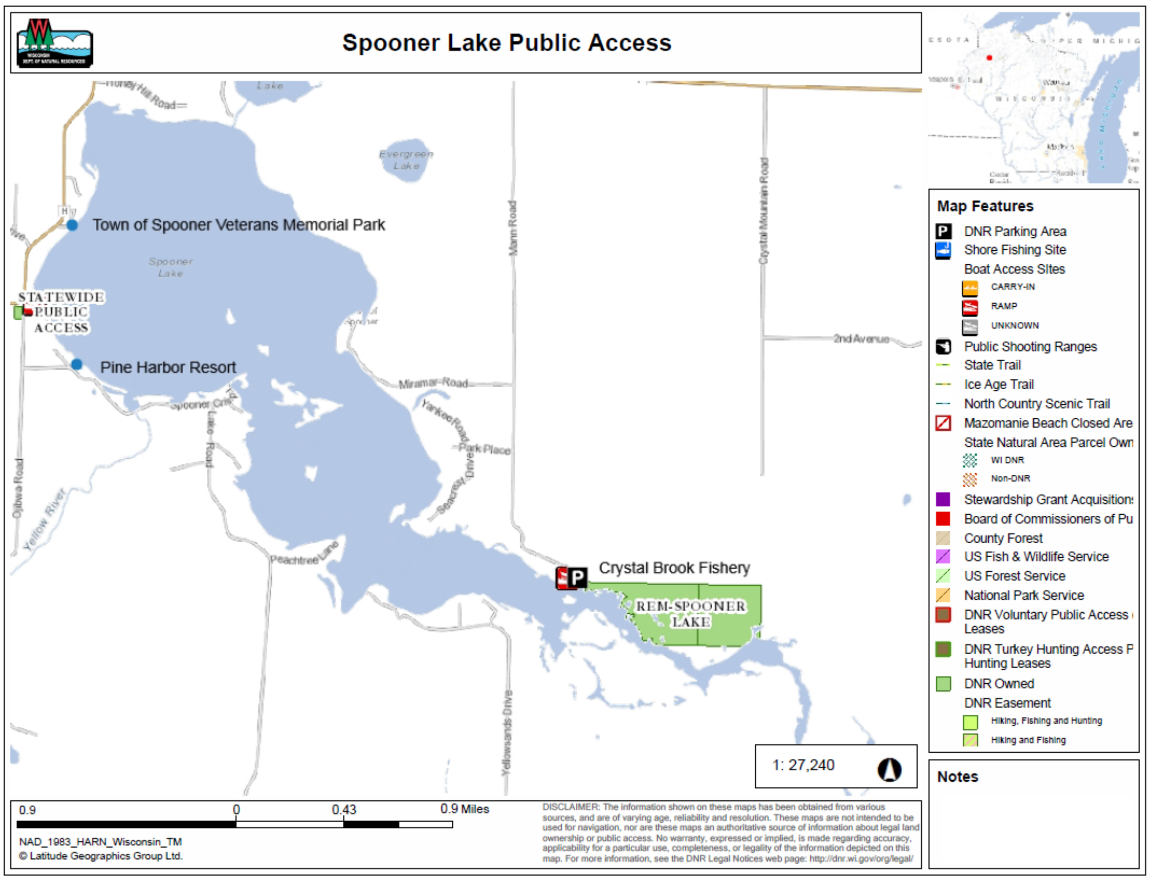


**Figure 1. Spooner Lake Map**

## LAKE ACCESS

There are two public landings on Spooner Lake. The West Landing, owned by the Town of Spooner, is on County Highway H. The Wisconsin Department of Natural Resources owns the nearby parking area. A second WDNR-owned landing is on the south end of the lake on Mann Road. The Town of Spooner adopted Ordinance No. 08-13-2018, the Spooner Lake boat launching fee ordinance, effective January 1,

2019. Boat launch fees are collected to help the SLD protect the water quality and environment of Spooner Lake.

## FISHERIES[1]

Largemouth bass, bluegill, black crappie, and northern pike are the primary sport fish present in Spooner Lake. Other fish species include yellow perch; pumpkinseed; black, brown, and yellow bullhead; rock bass; and white sucker. Some brown trout overwinter in Spooner Lake from Crystal Brook. No walleye were sampled in a 2008 survey, and they are assumed to be either at extremely low levels or absent.

**Table 1. Fish Spawning Information[2]**

| Species | Spawning Temp in °F | Spawning Substrate | Comments |
|---|---|---|---|
| Black Crappie | Upper 50's to lower 60's | Nests built in 1-6 feet of water | Build nests |
| Bluegill/Largemouth Bass and Pumpkinseed | Mid 60's to lower 70's | Nests built in less than 3 feet of water | Build nests |
| Northern Pike | Upper 30's to mid 40's: soon after ice-out | Emergent vegetation in 6-10 inches of water | Eggs broadcast onto vegetation |
| Yellow Perch | Mid 40's to lower 50's | Submergent vegetation or large woody debris | Eggs broadcast |
| Bullheads[3] | 70-77 | Muddy bottom for blacks, sandy/rocky for browns, and heavy vegetation for yellows | Make nests in bottom and broadcast eggs into nests protected by vegetation and/or woody debris |

[1] Information from Jamison Wendell, Fisheries Biologist, Wisconsin DNR. Email communication 10/25/2012. Reviewed by Craig Roberts, WDNR Fisheries Biologist 01/01/2019.

[2] Information on spawning from Heath Benike, Fisheries Biologist, Wisconsin DNR.

[3] Information on bullheads from Mecozzi, Maureen. *Bullheads*. Wisconsin DNR Bureau of Fisheries Management. PUBL-FM-706 89. May 1989.

## CRITICAL HABITAT AREAS

The Department of Natural Resources designates Critical Habitat Areas that include both Sensitive Areas and Public Rights Features. The Critical Habitat Area designation provides a holistic approach to ecosystem assessment and protection of those areas within a lake that are most important for preserving the character and qualities of the lake. These sites are sensitive and fragile areas that support wildlife and fish habitat, provide the mechanisms that protect the water quality in the lake, harbor quality plant communities, and preserve the places of serenity and aesthetic beauty for the enjoyment of lake residents and visitors.

Critical Habitat Areas include Sensitive Areas that offer critical or unique fish and wildlife habitat, including seasonal or life stage requirements, or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). The Wisconsin Department of Natural Resources is given the authority for the identification and protection of Sensitive Areas of the lake in this code. Public Rights Features are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty. Protecting these Critical Habitat areas requires the protection of shoreline and in-lake habitat.

Designation of Critical Habitat aims to serve four primary purposes:

1. Resource protection through science based regulatory review.
2. Community-based resource protection through community education, planning, and zoning.
3. A guide to land-trusts and others that acquire land and conservation easements.
4. A mechanism to track long-term changes in these habitats.

## SENSITIVE AREA SURVEY[4]

The Wisconsin Department of Natural Resources conducted an integrated sensitive area survey in August 2000. Nine areas were designated as “sensitive” containing very important habitat for fish and wildlife and important plant species. The WDNR has since officially approved these as Critical Habitat Areas. Figure 2 shows the designated areas.

[4] *Spooner Lake Sensitive Area Survey and Management Guidelines*. Wisconsin Department of Natural Resources. 2000.

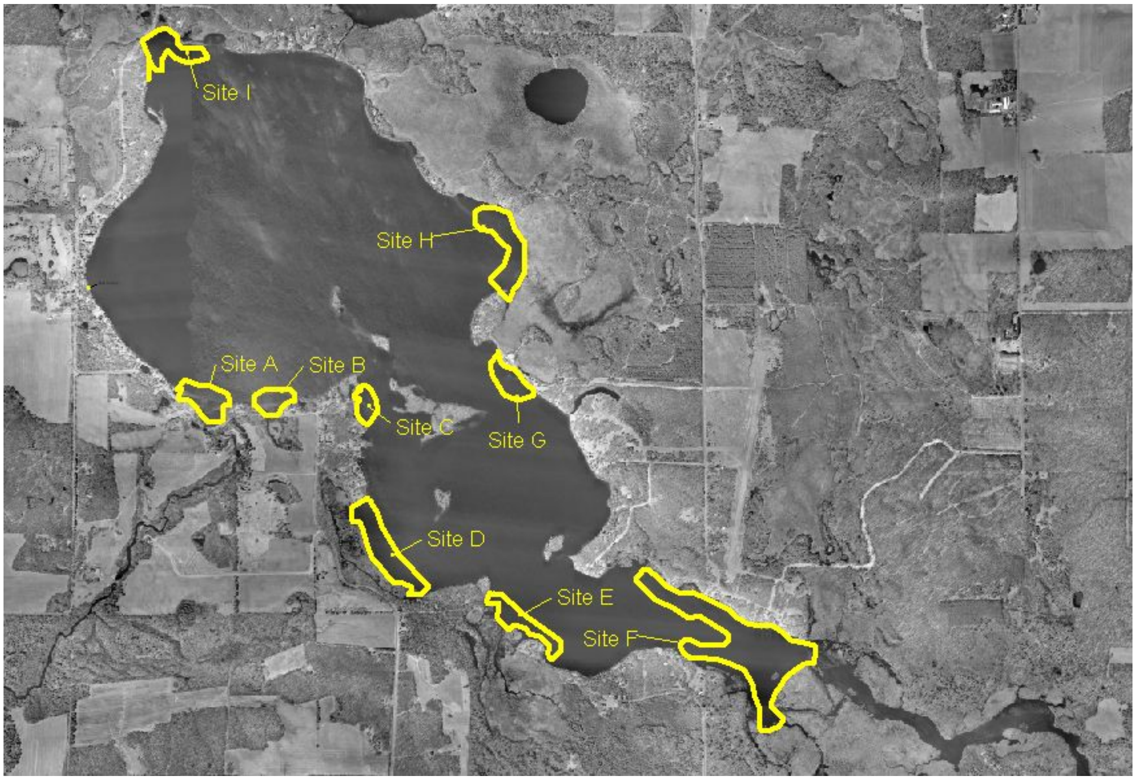


**Figure 2. Sensitive Area Designations**

The following management guidelines are encouraged for these aquatic plant sensitive areas:

1. Limit aquatic vegetation removal to navigational channels no greater than 25 feet wide, where necessary. These channels should be kept as short in length as possible and it is recommended that there is not complete elimination of aquatic vegetation with the navigational channel. Remove only what is necessary to prevent fouling of propellers to provide access to open water areas. Chemical treatments should be discouraged and if a navigational channel must be cleared, pulling by hand is preferable over mechanical harvesters, where practical.

2. Prohibit littoral zone alterations covered by Wisconsin Statutes Chapter 30, unless such alterations clearly benefit the lake's ecosystem. Rock riprap permits should not be approved for areas that already have a healthy native plant community stabilizing the shoreline.

3. Leave large woody debris in the littoral zone to provide habitat for fish, wildlife, and other aquatic organisms.

4. Leave an adequate shoreline buffer of un-mowed natural vegetative cover and keep access corridors as narrow as possible (less than 30 ft. or 30% of any developed lot, whichever is less).

5. Prevent erosion, especially at construction sites.

6. Strictly enforce zoning ordinances and support development of new zoning regulations where needed.

7. Eliminate nutrient inputs to the lake caused by lawn fertilizers, failing septic systems, and other sources.

8. Manage for invasive/exotic species.

The sensitive areas provide food and habitat for many fish and other aquatic species as well as some terrestrial species. Protection of these areas is strongly encouraged. Chemical treatments and/or mechanical harvesting are strongly discouraged. Historical chemical treatments and mechanical harvesting should be limited to navigational channels only and other chemical treatments/mechanical harvesting should be scrutinized.

Specific site descriptions from the report are included below:

Value of Site A
*This area provides important habitat for centrarchid (bass and panfish) and sucker species for spawning, feeding, protection and as nursery for young. Esocid (northern pike) will use this area for spawning, feeding, protection and as a nursery for young. This area also provides important habitat for forage species.*

*Wildlife is also reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, amphibians and reptiles benefit from this valuable habitat.*

Value of Site B
*This area provides habitat for largemouth bass and northern pike. These species will use the area for spawning, feeding, protection and as nursery for young. This area also provides important habitat for forage species. Wildlife values same as Site A.*

Value of Site C
*This area provides important habitat for centrarchid (panfish) and esocid (northern pike). These species will use this area for spawning, feeding, protection and as nursery for young. This area also provides important habitat for forage species. Wildlife values same as Site A.*

Value of Site D
*This sensitive area rates as outstanding for natural scenic beauty.*

*This area provides important habitat for centrachid (panfish and bass) and esocid (northern pike). Northern pike will use this area for spawning. Small mouth bass and panfish will use this area for feeding and protective cover. This area also provides important habitat for forage species.Wildlife values same as other sites.*

Value of Site E
*This sensitive area rates as outstanding for natural scenic beauty.*

*This area provides important habitat for centrarchid and esocid. Northern pike and panfish will use this area for spawning, feeding, protection, and as nursery for young. Largemouth bass will use this area for feeding, protection and as a nursery for young. Wildlife values same as other sites.*

Value of Site F

*This sensitive area has good natural scenic beauty with no development. Fish and wildlife value is very similar to other sites.*

Value of Sites G, H and I

*These areas were stated to have average natural scenic beauty. The fish and wildlife values are very similar to other sites.*

## RARE AND ENDANGERED SPECIES HABITAT

The Department of Natural Resources Natural Heritage Inventory documents threatened, endangered, and special concern species in the towns where the lake and watershed are located. This information is available at https://dnr.wi.gov/topic/NHI/data.asp?tool=township. The Washburn County map documents that aquatic occurrences include sections where the lake is located. No state or federally listed threatened, endangered, rare, or special concern plant species were found in the lake plant surveys.

## WATER QUALITY

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. At the high end of the eutrophic scale blue-green algae dominate and algae scums are present, sometimes throughout the summer. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic. Monitoring results place Spooner Lake in the eutrophic to upper mesotrophic range TSI range depending upon the year.

Citizen lake monitoring volunteers have collected data at the deep hole of Spooner Lake sporadically through the years. Results are available from the WDNR website.[5] For better comparison between lakes, only July and August results are summarized and reported in the figures that follow. Figure 3 illustrates the annual summer Secchi depth averages for the lake. Figure 4 graphs the Trophic State Index for Spooner Lake, based upon Secchi depth, and for some years, chlorophyll, dissolved oxygen, and total phosphorus results. Note that some years' results are based on only one sample rather than a series of samples which can be misleading. This is true for 1978, 1984, 1998, and 2005 – some of the years where the best secchi and trophic state results are recorded.

[5] http://dnr.wi.gov/lakes/CLMN.

It is important to note that aquatic plants play a critical role in maintaining water quality in Spooner Lake. This is a system with a large watershed, high volume of accumulated sediments, and high nutrient levels. Without aquatic plants present, nutrient-rich sediments would be re-suspended and water clarity would be expected to decrease dramatically. For shallow-water lakes and flowages, an aquatic plant dominated system is highly preferable to a flowage without aquatic plants. In fact, restoration efforts for shallow lakes frequently focus on re-establishing aquatic plants in order to improve water clarity.

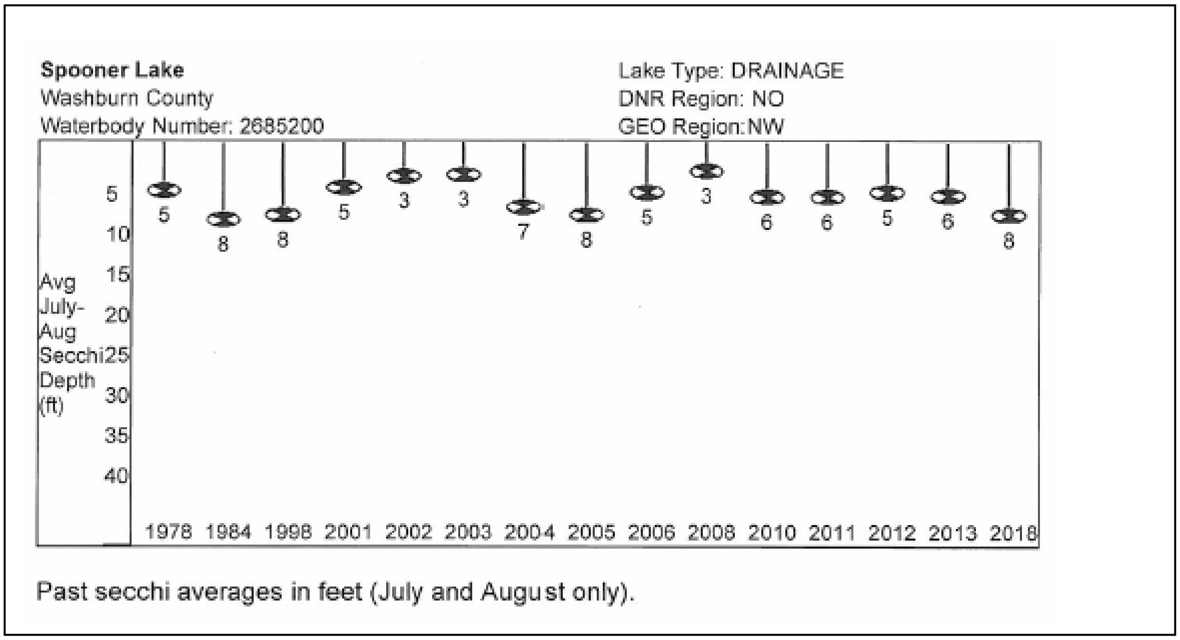


**Figure 3. Secchi Depth Summer Averages for Spooner Lake**

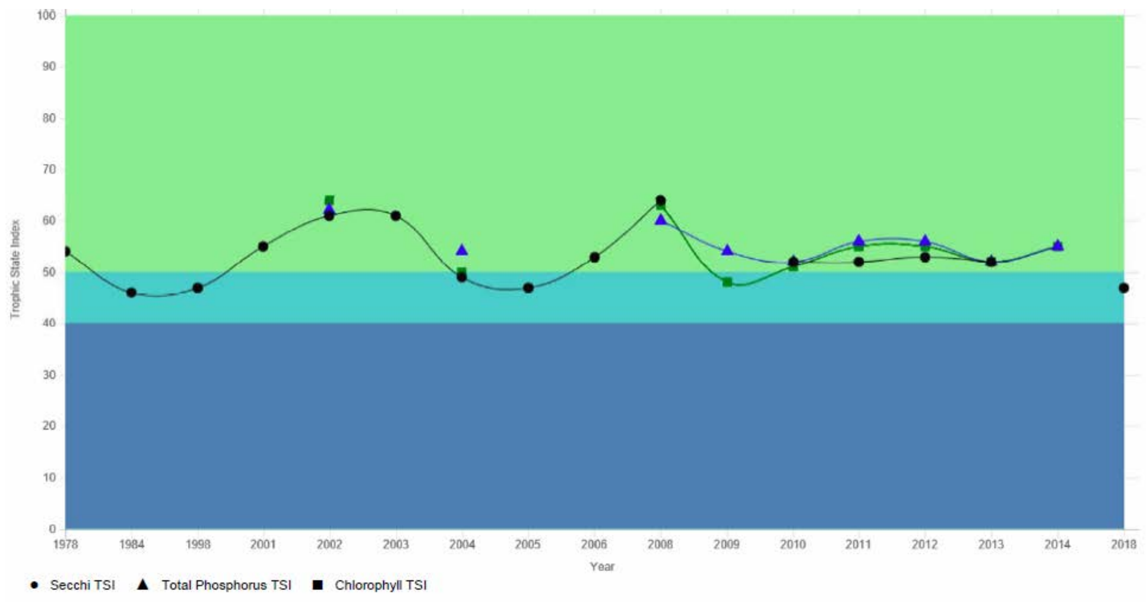


**Figure 4. Trophic State Index Graph for Spooner Lake**

Limited depth profiles of temperature from 2004 and 2008 show the lake did not stratify during the summer months. Without stratification of water temperature, water can readily mix storms and wind events. In addition, the dissolved oxygen profiles conducted in 2004 indicate that the lake becomes anoxic in the deep hole during a very short period of time in July. This could allow for a small phosphorus release from the sediments. No indication of anoxic conditions was found in 2008.[6]

[6] Citizen Lake Monitoring Data. http://dnr.wi.gov/lakes/CLMN. 12/08/2019.

## WATERSHED DESCRIPTION

The Spooner Lake watershed is part of the Shell Lake and Upper Yellow River watershed in the St. Croix River Basin. The Spooner Lake watershed totals 7,811 acres. The watershed is large, mainly due to the Crystal Creek inlet, which has a vast watershed area. The lake's watershed extends into the towns of Beaver Brook, Madge, and Crystal. Crystal Creek is a cold-water stream that flows continuously throughout the entire year.

There is a fair amount of residential development on Spooner Lake. The buildings are indicated on the topographical map as small, black squares (Figures 5 and 6). The percentage of shoreline developed is unknown at this time. Most of the development is on the west shore and on the north and south shore toward the inlet. Much of the east shore is comprised of a large area of wetlands and is undeveloped.

There are two main public access points on the lake. The West Landing on County Highway H is owned by the Town of Spooner. WDNR owns the parking area for the West Landing. There is little use of the WDNR landing on the east side. Additional use of the lake occurs at the Pine Harbor Resort on Spooner Lake Road on the southwest shore of the lake. The Spooner Golf Club brings additional visitors to the lake. According to a survey in 2002, most resort visitors travel at least 300 miles to visit the lake.

The lake is located within 115 miles of the Twin Cities of St. Paul and Minneapolis, MN and in close proximity to the city of Spooner. Spooner, population of 2,603, is the most populated municipality in Washburn County.[7] There are 164 homes on the lake, and approximately 70% of these are seasonal. Lake district representatives report that many of the approximately 50 permanent residences have residents who are senior citizens some of whom may have difficulty with extensive volunteer work. In any case, they report it is difficult finding volunteers for lake activities.[8]

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[7] Wisconsin Demographic Services Center. Final Population Estimates 2018. https://doa.wi.gov/DIR/Final_Ests_MCD_2018.pdf.

[8] Personal communication. Mabi and Michael Plisky. 02/01/2019.

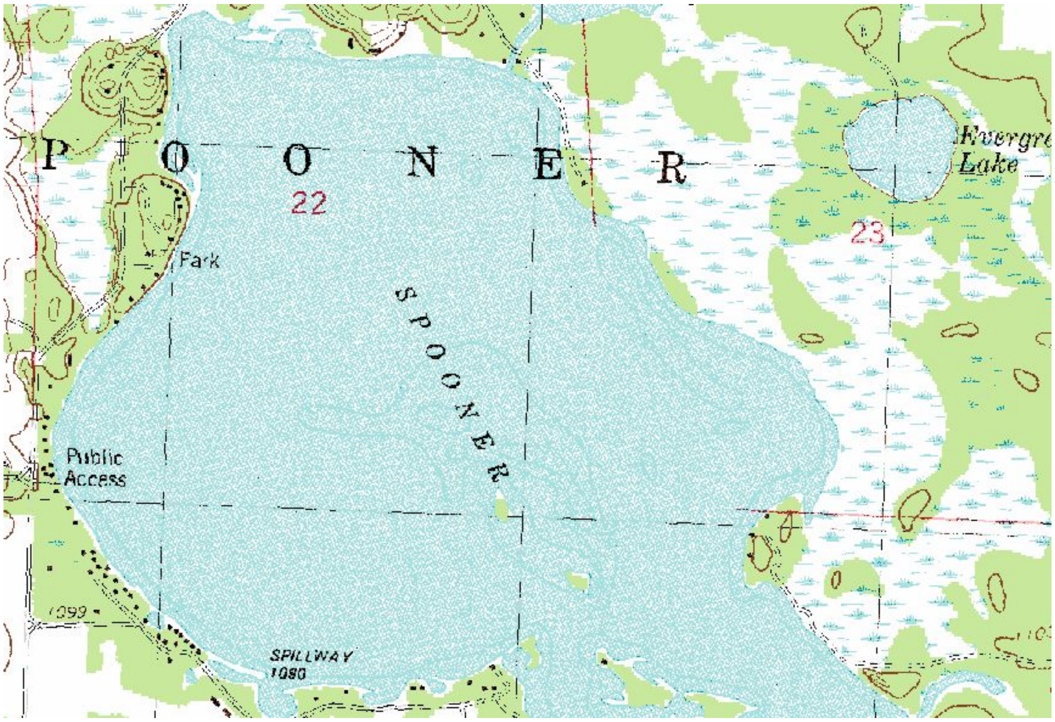


**Figure 5. Topographical Map of Spooner Lake – Northern Portion**

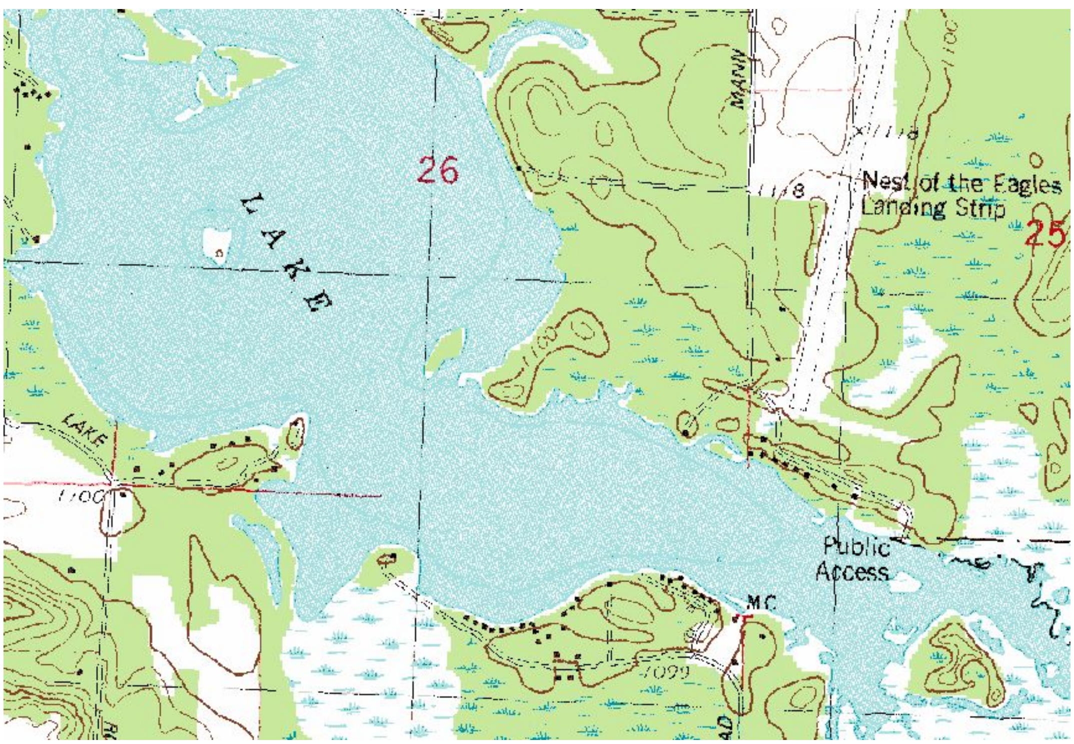


**Figure 6. Topographical Map of Spooner Lake - Southern Portion**

## WATERSHED LAND COVER

The dominant land cover category in the Spooner Lake watershed is forest which makes up approximately 54% of the land cover area. Grassland is the next most dominant at 15% followed by wetland at 14%. Agriculture makes up about 6% of the land cover. Figure 7 illustrates land cover in the watershed and Table 3 summarizes acres of each land cover type. The land covers likely to have potentially significant impact on Spooner Lake water quality are agriculture, single family residential, and commercial because of resulting high nutrient and sediment loads.

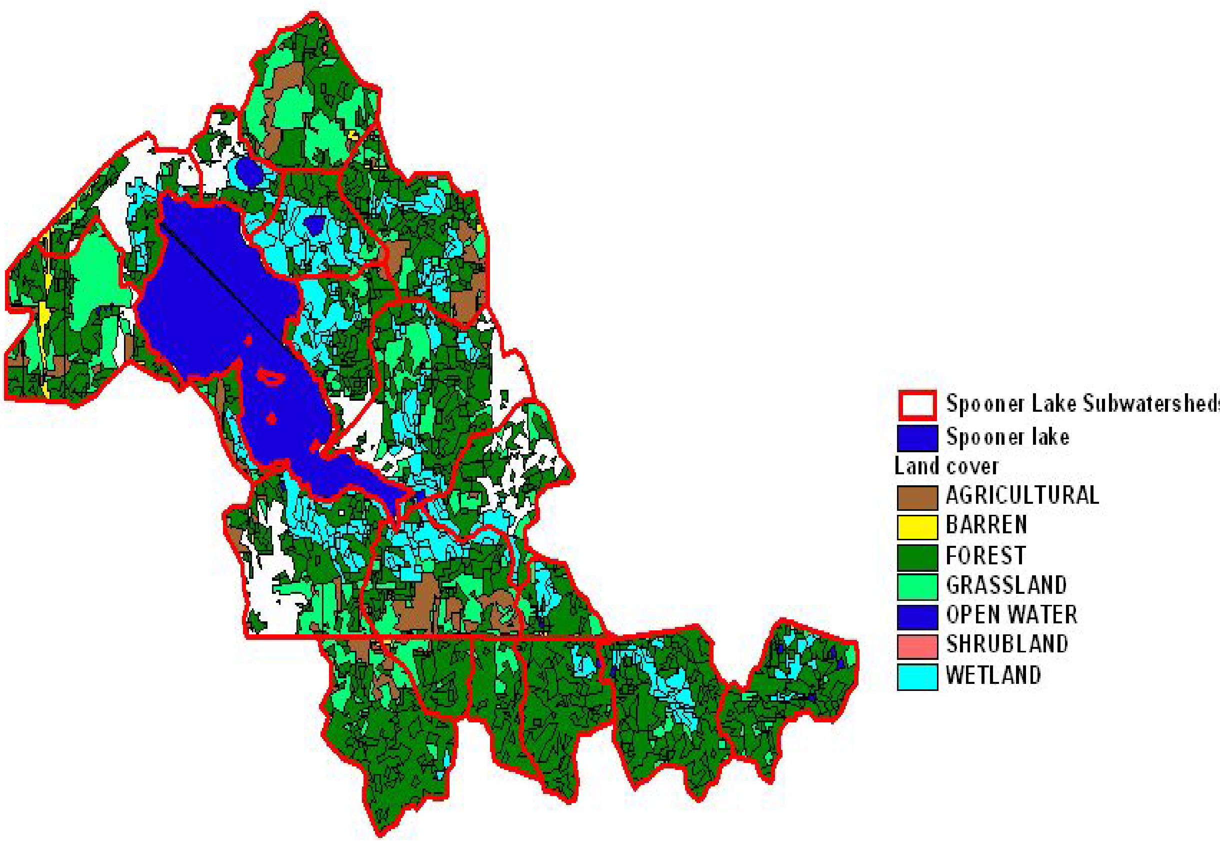


**Figure 7. Watershed Map of Spooner Lake**[9]

[9] Map provided by Cedar Corporation, Menomonie, Wisconsin. 2006.

**Table 2. Spooner Lake Watershed Land Cover (2006)**[10]

| Current | Acres |
|---|---|
| AGRICULTURAL | 748.66 |
| COMMERCIAL | 2.52 |
| FOREST | 4,457.28 |
| GRASSLAND | 1,059.45 |
| OPEN WATER | 59.07 |
| RECREATION | 136.36 |
| RURAL RESIDENTIAL | 41.04 |
| SINGLE FAMILY | 168.70 |
| WETLAND | 1,138.07 |
| **Grand Total** | 7,811.15 |

The Lake Watershed Management Plan for the Spooner Lake District[11] includes the following:

- a general overview of watersheds and lake water quality,
- a description of the physical environment,
- a delineation of lake watersheds and land uses,
- a report of water quality monitoring results,
- a discussion of water quality problems and sources of pollutant loading,
- results of a community survey,
- an overview of regulations and plans, and
- water quality recommendations.

[10] Data provided by Cedar Corporation, Menomonie, Wisconsin. 2006.

[11] Cedar Corporation.

## PLANT COMMUNITY

Ecological Integrity Service conducted whole lake aquatic macrophyte surveys in 2006, 2012, and 2018. The 2018 survey found a moderately diverse plant community with thirty-six species of aquatic plants sampled on the rake (34 native species and two non-native species). The two non-native species sampled were curly leaf pondweed and narrow leaf cattail. Both are designated by NR 40 as restricted invasive species in Wisconsin. When viewed species (seen within six feet of sample point) were included, the number of species increased to thirty-eight.

Table 3 summarizes various data from the Spooner Lake point intercept survey. Survey results show that Spooner Lake has widespread, dense coverage of aquatic plants. The mean rake fullness was 1.9 (scale of 0-3). Within the defined littoral zone, 91.55% of the sample points had plants present. The maximum depth of plants was 15.3 feet. The mean depth of plants was 15.3 feet. This depth indicates moderate water clarity, which allows light penetration for growth at moderate depths.

The Simpson's Diversity Index was 0.91 which is relatively high, indicating that most species were different in most samples. High diversity areas occurred in various locations around the lake. Habitat conducive for plant growth occurs nearly everywhere in Spooner Lake.

The species frequency shows that the three most common plants have high relative frequency, showing that these three plants are dominant. There is no one plant completely dominating the plant community. Table 3 contains the frequency data for each species sampled.

**Table 3. Spooner Lake Point Intercept Data Summary**

| | |
|---|---|
| Total number of sites visited | 711 |
| Total number of sites with vegetation | 650 |
| Total number of sites shallower than the maximum depth of plants | 710 |
| Frequency of occurrence at sites shallower than the maximum depth of plants | 91.55 |
| Simpson Diversity Index | 0.91 |
| Maximum depth of plants | 15.30 ft. |
| Mean depth of plants | 5.30 ft. |
| Average number of all species per site (shallower than max depth) | 2.49 |
| Average number of all species per site (vegetated sites only) | 2.72 |
| Mean rake fullness (scale 0-3) | 1.9 |
| Species richness | 36 |
| Species richness (including visuals) | 38 |

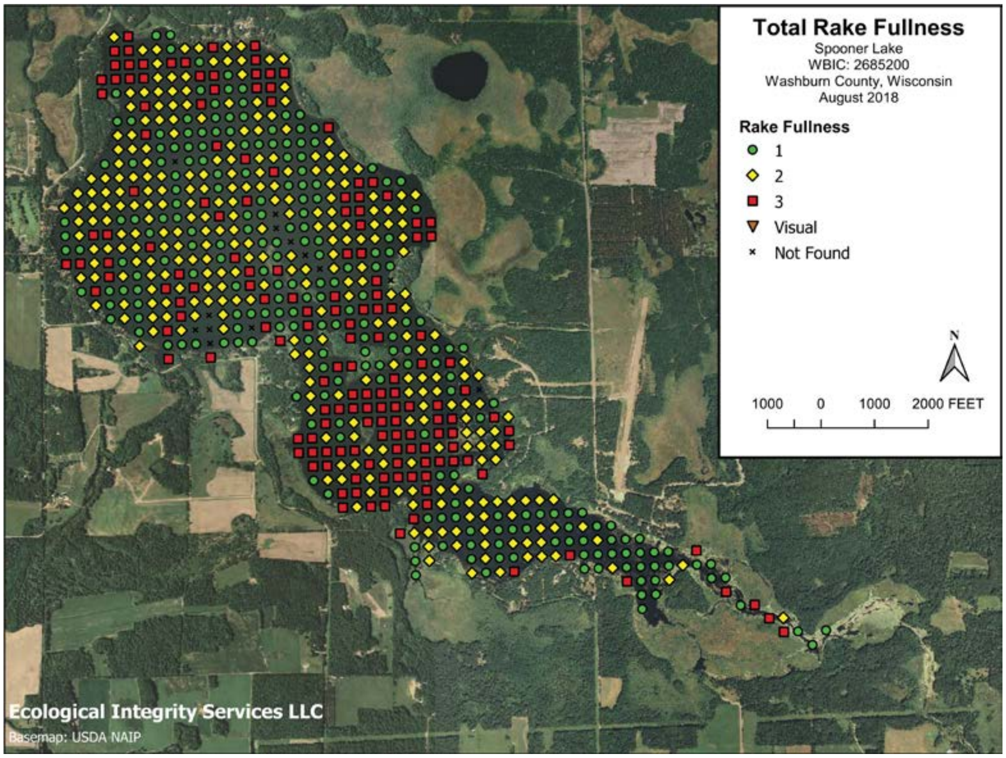


Figure 8. Rake Fullness at Each Sample Point on Spooner Lake August 2018

Table 4. Spooner Lake Aquatic Plant Species Data August 2018

| Species<br>FOO=Frequency of Occurrence | FOO Vegetated | FOO Littoral | Relative Frequency | Number Sampled | Mean Rake Fullness |
|---|---|---|---|---|---|
| *Elodea canadensis*, Common waterweed | 48.92 | 44.79 | 17.97 | 318 | 1.17 |
| *Potamogeton zosteriformis*, Flat-stem pondweed | 34.00 | 31.13 | 12.49 | 221 | 1.23 |
| *Myriophyllum sibiricum*, Northern water-milfoil | 33.54 | 30.70 | 12.32 | 218 | 1.20 |
| *Ceratophyllum demersum*, Coontail | 25.85 | 23.66 | 9.49 | 168 | 1.25 |
| *Heteranthera dubia*, Water star-grass | 20.62 | 18.87 | 7.57 | 134 | 1.56 |
| *Potamogeton robbinsii*, Fern pondweed | 19.38 | 17.75 | 7.12 | 126 | 1.16 |
| *Potamogeton praelongus*, White-stem pondweed | 14.31 | 13.10 | 5.25 | 93 | 1.02 |
| *Stuckenia pectinata*, Sago pondweed | 13.23 | 12.11 | 4.86 | 86 | 1.08 |
| *Potamogeton friesii*, Fries' pondweed | 13.08 | 11.97 | 4.80 | 85 | 1.05 |
| *Vallisneria americana*, Wild celery | 9.85 | 9.01 | 3.62 | 64 | 1.08 |
| *Najas flexilis*, Slender naiad | 9.54 | 8.73 | 3.50 | 62 | 1.05 |
| *Chara sp.,* Muskgrasses | 7.38 | 6.76 | 2.71 | 48 | 1.38 |
| *Potamogeton richardsonii*, Clasping-leaf pondweed | 6.77 | 6.20 | 2.49 | 44 | 1.11 |
| *Potamogeton amplifolius*, Large-leaf pondweed | 2.62 | 2.39 | 0.96 | 17 | 1.06 |
| *Potamogeton pusillus*, Small pondweed | 2.62 | 2.39 | 0.96 | 17 | 1.06 |
| *Nymphaea odorata*, White water lily | 1.69 | 1.55 | 0.62 | 11 | 1.00 |
| *Nitella sp*., Nitella | 1.08 | 0.99 | 0.40 | 7 | 1.43 |
| *Sagittaria rigida*, Sessile-fruited arrowhead | 1.08 | 0.99 | 0.40 | 7 | 1.14 |
| *Lemna minor*, Small duckweed | 0.92 | 0.85 | 0.34 | 6 | 1.00 |
| *Nuphar variegata*, Spatterdock | 0.92 | 0.85 | 0.34 | 6 | 1.00 |
| *Pontederia cordata*, Pickerelweed | 0.77 | 0.70 | 0.28 | 5 | 1.20 |
| *Potamogeton crispus*,Curly leaf pondweed | 0.46 | 0.42 | 0.17 | 3 | 1.00 |
| *Spirodela polyrhiza*, Large duckweed | 0.46 | 0.42 | 0.17 | 3 | 1.00 |
| *Wolffia columbiana*, Common watermeal | 0.46 | 0.42 | 0.17 | 3 | 1.00 |
| *Eleocharis acicularis*, Needle spikerush | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Eleocharis palustris*, Creeping spikerush | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Ranunculus aquatilis*, White water crowfoot | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Schoenoplectus acutus*, Hardstem bulrush | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Typha angustifolia*, Narrow leaved cattail | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Typha latifolia*, Broadleaf cattail | 0.31 | 0.28 | 0.11 | 2 | 1.00 |
| *Bidens beckii* , Water marigold | 0.15 | 0.14 | 0.06 | 1 | 1.00 |
| *Carex comosa*, Bottle brush sedge | 0.15 | 0.14 | 0.06 | 1 | 1.00 |
| *Decodon verticillatus*, Swamp loosestrife | 0.15 | 0.14 | 0.06 | 1 | 3.00 |
| *Isoetes echinospora*, Spiny spored-quillwort | 0.15 | 0.14 | 0.06 | 1 | 1.00 |
| *Potamogeton natans*, Floating-leaf pondweed | 0.15 | 0.14 | 0.06 | 1 | 1.00 |
| *Sagittaria sp*., Arrowhead rosette | 0.15 | 0.14 | 0.06 | 1 | 1.00 |
| Freshwater sponge | 0.31 | 0.28 | n/a | 2 | 1.00 |
| Filamentous algae | 19.38 | 17.75 | n/a | 126 | 1.21 |

**Table 5. Viewed Species: Plant Intercept Survey and Boat Survey**

| |
|---|
| **Observed in Point Intercept Survey** |
| *Sparganium eurycarpum*, Common bur-reed |
| *Sagittaria latifolia*, Common arrowhead |
| **Observed in Boat Survey** |
| *Bidens sp.* |
| *Calla palustris*, Wild calla |
| *Cicuta bulbifera*, Bulb bearing water hemlock |
| *Iris pseudacorus*, Yellow iris |
| *Phalaris arundinacea*, Reed canary grass |
| *Schoenoplectus tabernaemontani*, Soft-stem bulrush |

## FLORISTIC QUALITY INDEX

The floristic quality index (FQI) is a calculation based upon species richness and mean conservatism values assigned to various plants. The FQI can indicate the adverse effects of human activity around the lake that lead to habitat degradation. The FQI for Spooner Lake was higher than the eco-region median for lakes within the region. The mean conservatism was lower than the eco-region median. This indicates that the plants in Spooner Lake are less sensitive on average, but the FQI is higher due to the higher species richness. The plant community appears minimally affected by human activity.

**Table 6. Floristic Quality Index Spooner Lake August 2018**

| FQI Values | Spooner Lake 2018 | Eco-region Median |
|---|---|---|
| **N (Number)** | 33 | 13 |
| **Mean C (Conservatism Value)** | 5.8 | 6.7 |
| **FQI** | 33.2 | 24.3 |

## FILAMENTOUS ALGAE

Filamentous algae are a class of algae that grow into long, entangled stands. These algae can blanket the bottom and aquatic plants. During certain periods, the mats of algae can build up gas and float to the surface, creating nuisance mats of algae. Spooner Lake has a history of rather extensive filamentous algae in various regions within the lake. Figure 9 shows the map of filamentous algae from the 2018 survey.

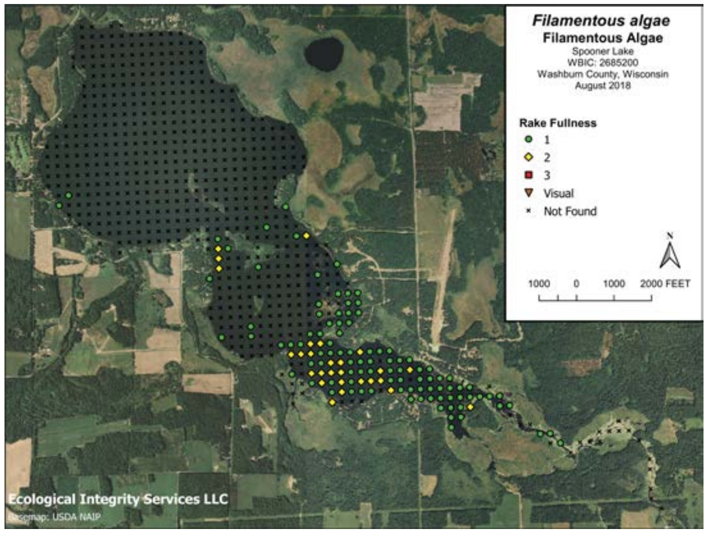


**Figure 9. Distribution Map for Filamentous Algae in Spooner Lake (2018)**

The map shows that most filamentous algae were located in the southeastern portion of Spooner Lake. During the survey, some bays in this area were inundated with floating mats of filamentous algae. Repeated chemical treatment in 2018 using chelated copper may have created these dying mats of algae, or the algae may have naturally senesced and was floating. Regardless, filamentous algae was severely hampering navigation in these areas and degrading aesthetics of lake.

## NEAR SHORE VEGETATION

In areas of development, the near shore vegetation is mostly lawn. In areas without development, the shoreline vegetation is mostly shrubs, leading to a tree layer. There are some large areas of wetlands that border the lake that appear to have a rather diverse collection of wetland plants growing. These include *Typha sp., Sagittaria sp., Schoenoplectus sp.,* and *Phragmites sp.*

## COMPARISON OF 2018, 2012, AND 2006 AQUATIC PLANT SURVEYS

Management practices and other human activities can change the aquatic plant community over time. A chi-square analysis is conducted to compare the frequency of occurrences of plants sampled (not viewed or observed) between previous year's surveys. The baseline survey was in 2006. A subsequent survey was conducted in 2012, and the survey was repeated in 2018. Plant survey methods were consistent.

As Table 7 shows, the plant community diversity has increased over time. 2018 had the highest species richness and Simpson's diversity index of all the survey years. The plant coverage decreased slightly, but there is still vast coverage of plants in nearly the entire lake. The depth of plants varied somewhat between sampling dates.

**Table 7. Aquatic Plant Survey Results Comparison (2006, 2012, 2018)**

| | 2006 | 2012 | 2018 |
|---|---|---|---|
| **% of Littoral Zone with Plants** | 99.56 | 96.72 | 91.55 |
| **Species Richness** | 20 | 32 | 36 |
| **Dominant Species** | 1. *Potamogeton zosteriformis*<br>2. *Myriophyllum sibiricum-*<br>3. *Ceratophyllum demersum* | 1. *Ceratophyllum demersum*<br>2. *Potamogeton zosteriformis*<br>3. *Potamogeton robbinsii* | 1. *Elodea canadensis*<br>2. *Potamogeton zosteriformis*<br>3. *Myriophyllum sibiricum* |
| **Simpson's Diversity Index** | 0.86 | 0.84 | 0.91 |
| **Maximum Depth of Plants** | 16.5 | 13.7 | 15.3 |

Table 8 summarizes statistically significant increases and decreases of aquatic plants from 2006 to 2018 (based upon chi-square analysis). These data indicate that the plant community in Spooner is remaining healthy. The changes do not indicate adverse effects of human activities in Spooner Lake.

There is no conclusive evidence that herbicide treatment of the invasive curly leaf pondweed was the source of reductions in native plant species. Some reductions may be due simply to sampling variation. However, some of the species reductions occurred for species with high frequencies and widespread distribution such as coontail (*Ceratophyllum demersum*) and flat-stem pondweed (*Potamogeton zosteriformis*). These reductions are not likely due to sampling variation.

**Table 8. Aquatic Plant Species with Statistically Significant Changes (2006-2018)**

| 2012-2018 Significant Decrease | 2012-2018 Significant Increase | 2006-2012 Significant Decrease | 2006-2018 Significant Increase |
|---|---|---|---|
| **1 species** | **10 species** | **6 species** | **12 species** |
| *Ceratophyllum demersum* Coontail | *Elodea Canadensis* Common waterweed | *Potamogeton zosteriformis,* Flat-stem pondweed | *Elodea canadensis,* Common waterweed |
| | *Myriophyllum sibiricum* Northern water-milfoil | *Myriophyllum sibiricum,* Northern water-milfoil | Heteranthera dubia, Water star-grass |
| | *Heteranthera dubia* Water star-grass | *Ceratophyllum demersum,* Coontail | *Potamogeton praelongus,* White-stem pondweed |
| | *Potamogeton praelongus,* White-stem pondweed | *Potamogeton robbinsii,* Fern pondweed | *Stuckenia pectinata,* Sago pondweed |
| | *Stuckenia pectinata* Sago pondweed | *Potamogeton friesii,* Fries' pondweed | *Najas flexilis,* Slender naiad |
| | *Potamogeton friesii* Fries' pondweed | *Potamogeton* crispus, Curly leaf pondweed **(AIS)** | *Chara sp.,* Muskgrasses |
| | *Vallisneria americana* Wild celery | | *Potamogeton richardsonii,* Clasping-leaf pondweed |
| | *Chara sp.,* Muskgrasses | | *Nymphaea odorata,* White water lily |
| | *Potamogeton pusillus* Small pondweed | | *Nitella sp.,* Nitella |
| | *Nitella sp.,* Nitella | | *Sagittaria rigida,* Sessile-fruited arrowhead |
| | | | *Nuphar variegata,* Spatterdock |
| | | | *Pontederia cordata,* Pickerelweed |

## FLORISTIC QUALITY INDEX

As described previously, the floristic quality index is an indicator of human impact on the plant community. Table 9 compares the FQI data from each survey. These data indicate that the plant community is not adversely affected by human activities.

**Table 9. Floristic Quality Index Data**

| | 2006 | 2012 | 2018 |
|---|---|---|---|
| **N (Number)** | 19 | 32 | 33 |
| **Mean Conservatism** | 5.7 | 5.4 | 5.8 |
| **FQI** | 25.0 | 30.8 | 33.2 |

## NON-NATIVE INVASIVE SPECIES OR AQUATIC INVASIVE SPECIES (AIS)

Two non-native species were sampled in Spooner Lake in 2018: *Potamogeton crispus* (curly leaf pondweed) and *Typha angustifolia* (narrow leaf cattail). Both are restricted invasive species according to NR40. Two additional non-native species were observed in the 2018 boat survey: *Phalaris arundinacea* (reed canary grass) and *Iris pseudacorus* (yellow iris). Yellow iris is a restricted invasive species according to NR40 as are some cultivated varieties of reed canary grass. Restricted invasive species are already established in the state and cause or have the potential to cause economic or environmental harm or harm to human health, and for which statewide or regional eradication or containment may not be feasible. Non-native plants observed in the 2012 survey in areas other than the sample point locations included aquatic forget-me-not, reed canary grass, and giant reed.

Curly leaf pondweed was sampled in the past and has been managed for several years in Spooner Lake. Figures 10-11 show the sample locations of curly leaf pondweed in June and August and Figure 12 shows locations of narrow leaf cattail samples in August.

Narrow leaf cattail occurs in various cattail beds around the lake. This plant is typically found in similar habitat as the native broadleaf cattail and each serve similar roles. However, narrow leaf cattail is not native. Narrow leaf cattail tends to occur in deeper water than broadleaf cattail.

Reed canary grass is a very common invasive species. There are scattered areas of reed canary grass occurring mostly in disturbed areas. There was no evidence of reed canary grass dominating wetland areas around the lake.

Yellow iris is a bright yellow flowering plant, often planted as an ornamental. This plant has begun to spread beyond flower gardens on many lakes. It can expand in wetland areas and therefore should be removed from the few locations it was observed. The yellow iris was observed on the west shoreline in the southeastern portion of Spooner Lake. These locations are recorded and should be checked and removed in June 2019.

Washburn County aquatic invasive species staff confirmed the presence of Japanese knotweed near the Town of Spooner West Landing in November 2012.[12] There were still stands of knotweed present near the boat landing and in and around the Town of Spooner Veterans Memorial Park in 2018.[13] There are likely other locations where this plant is growing around the lake. Japanese knotweed is a restricted invasive species. Lake residents also report the presence of purple loosestrife around the lake.

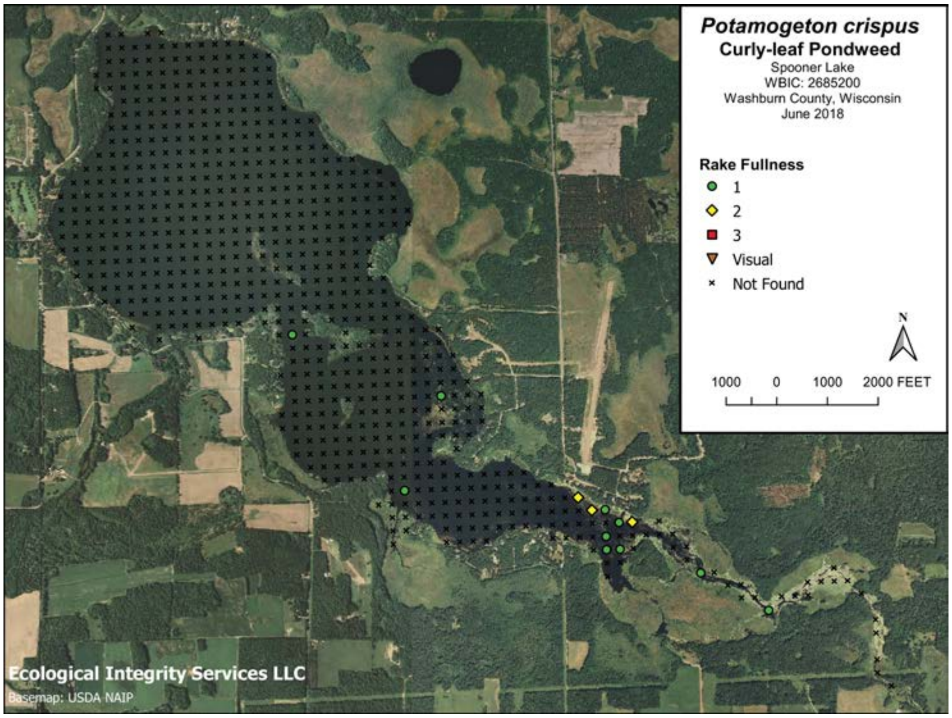


**Figure 10. Curly Leaf Pondweed (CLP- *Potamogeton crispus*) Distribution June 2018**

## ZEBRA MUSSELS

While not an aquatic plant, zebra mussels are an invasive species that will be addressed in this plan. Zebra mussels were discovered in nearby Big and Middle McKenzie Lakes in Burnett and Washburn County in 2016. Information about zebra mussels is found in Appendix C. Prevention and monitoring methods for zebra mussels are discussed in subsequent pages.

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[12] Personal communication. Lisa Burns. Washburn County Land and Water Conservation Department. 11/28/2012.

[13] Update from Lisa Burns, Washburn County. 01/02/2019.

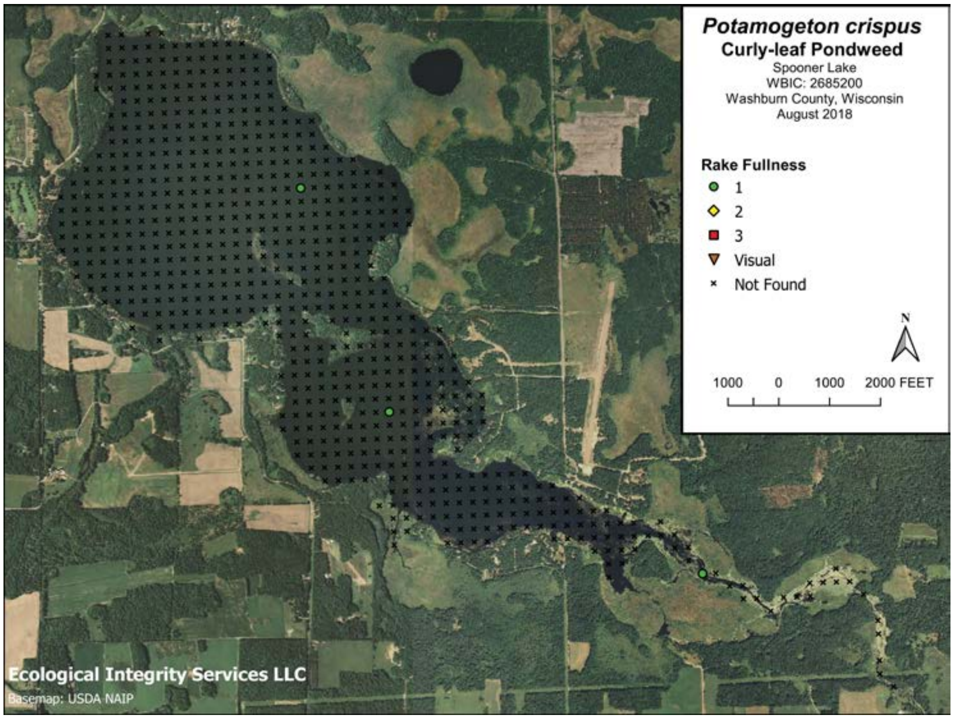


**Figure 11. Curly Leaf Pondweed (CLP- *Potamogeton crispus*) Distribution August 2018**

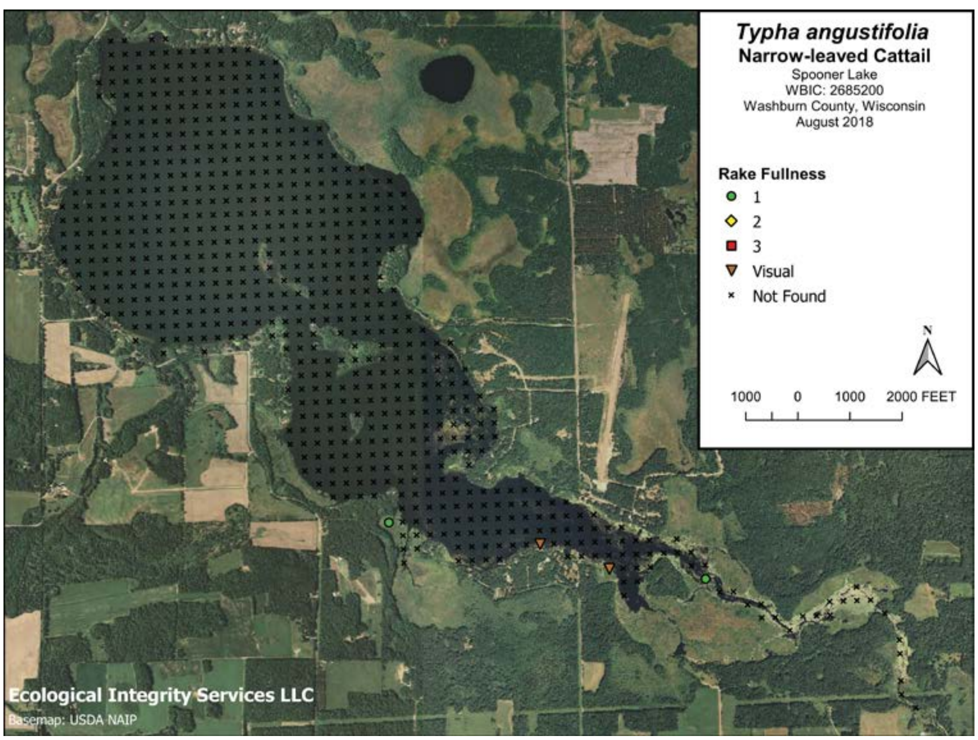


**Figure 12. Narrow Leaf Cattail (*Typha angustifolia*) Distribution August 2018**

## CURLY LEAF PONDWEED

Curly leaf pondweed is specifically designated as an aquatic invasive species (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a "non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)."

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

> It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.[14]

The state of Minnesota DNR website explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish and some waterfowl species feed on the seeds and winter buds.[15]

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[14] *Wisconsin's Comprehensive Management Plan to Prevent Introductions and Control Existing Populations of Aquatic Invasive Species.* Wisconsin Department of Natural Resource. September 2003.

[15] Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

## CURLY LEAF PONDWEED (POTAMOGETON CRISPUS)[16]


### IDENTIFICATION

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters 1 to 3 meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as 2 meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa and Australia and is now spread throughout most of the United States and southern Canada.

### CHARACTERISTICS

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

### REPRODUCTION AND DISPERSAL

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer, and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, they germinate in the fall, over-wintering as a small plant. The next summer they mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

### ECOLOGICAL IMPACTS

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

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[16] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

## CURLY LEAF PONDWEED CONTROL

Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed back over time.  It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants will aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Information about additional invasive species is found in Appendix C.

## AQUATIC PLANT MANAGEMENT

This section presents aquatic plant management goals for Spooner Lake and the potential management methods available to reach these goals. A recent history of aquatic plant management on Spooner Lake is also reported. The goals were developed by the plant committee and reflect the concerns identified from public involvement, the Spooner Lake District (SLD) board of directors, and suggestions from the Wisconsin Department of Natural Resources.

### AQUATIC PLANT MANAGEMENT GOALS

1. PROTECT AND RESTORE HEALTHY NATIVE AQUATIC PLANT COMMUNITIES.

   *Native aquatic plants provide important functions in Spooner Lake including fish and wildlife habitat, maintaining water quality, and stabilizing lake sediments.*

2. PREVENT THE SPREAD OF CURLY LEAF PONDWEED AND RESTORE HEALTHY NATIVE PLANT COMMUNITIES IN ITS PLACE.

   *Curly leaf pondweed control can decrease the growth of this plant, but it is well-established and is likely to persist in Spooner Lake. This plant tends to grow in the lake in areas 4 – 6 feet and deeper.*

3. IMPROVE NATIVGATION PROBLEMS CAUSED BY NUISANCE LEVELS OF AQUATIC PLANTS.

   *Current navigation problems from aquatic plants occur primarily in East Bay and in the access corridors surrounding lake residents' docks.*

4. REDUCE NUISANCE LEVELS OF FILAMENTOUS ALGAE.

   *Nuisance levels of filamentous algae occur primarily in East Bay. East Bay also is likely the source of filamentous algae that drifts to other areas of the lake.*

5. PREVENT INTRODUCTION AND SPREAD OF NEW AQUATIC INVASIVE SPECIES.

   *Current priority threats based on proximity and likelihood of spread are zebra mussels and Eurasian water milfoil.*

## DISCUSSION OF MANAGEMENT METHODS

This section reviews the potential management methods available to reach plan goals and existing management activities for Spooner Lake. Techniques to control the growth and distribution of aquatic plants are discussed in Appendix D. Permitting requirements and management methods for curly leaf pondweed are discussed below. The application, location, timing, and combination of techniques must be considered carefully because of potential impacts to native plants and aquatic habitats.

### PERMITTING REQUIREMENTS

The Wisconsin Department of Natural Resources regulates the removal of aquatic plants when chemicals are used and when plants are removed mechanically, or when plants are removed manually from an area greater than 30 feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107-Aquatic Plant Management. A permit is required for any aquatic chemical application in Wisconsin.

The requirements for manual and mechanical plant removal are described in NR 109-Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline limited to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal means the control of aquatic plants by hand or hand-held devices without the use or aid of external or auxiliary power.

### CURLY LEAF PONDWEED

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: Diquat, Endothall, and Fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

## EARLY SEASON HERBICIDE TREATMENT:[17]

Studies have demonstrated that curly leaf pondweed (CLP) can be controlled with Aquathol K (a formulation of Endothall) in 50 - 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion formation. Several lakes in northwestern Wisconsin use early season treatment with Endothall to control CLP.

Because the dosage is at lower rates than dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Calm winds are also desirable to maintain herbicide contact in the treatment area. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[18]

## CLP TURION MONITORING

Turions are the reproductive structures from which new CLP plants will germinate in late fall and early spring. CLP turions can live in lake sediments for many years. A primary objective of the CLP herbicide treatment program was to kill CLP plants before they can form turions, thereby depleting the turion bank in the sediments and preventing future CLP growth.

Turion monitoring measures the density of turions in the sediment. Turion sediment monitoring is conducted late in the summer after CLP plants die back. A sediment sampler is used to collect bottom sediment at several randomly selected sample points within the treatment beds. The sample is then filtered with a filter bucket, and the turions are counted. Because the sample collection area is known, the number of turions per square meter of lake bed can be estimated.

Repeated years of turion density measurements provide a means to predict the following year's CLP growth and to evaluate the long term effectiveness of the herbicide treatment program. The data will aid in decisions regarding continuation or suspension of herbicide treatment. Turion monitoring is recommended for Spooner Lake CLP management.

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[17] Research in Minnesota Control of Curly Leaf Pondweed. Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

[18] Personal communication, Frank Koshere. Wisconsin DNR. March 2005.

## HISTORICAL PLANT MANAGEMENT PRACTICES[19]

### DRAWDOWN

In the fall of 1984, Spooner Lake went through a drawdown in an attempt to reduce what was recognized as extensive aquatic plant growth that had been occurring for the past 20 years. The lake was refilled in spring 1985. Informal reports from various interested parties were that the drawdown was a success. However, there is virtually no plant data available pre and post drawdown. Therefore, there is no data to validate this claim[20]. The Wisconsin DNR did state that the plant community was largely made up of species susceptible to drawdown techniques and that the plants were growing less the following year. The fisheries did seem to respond positively to the drawdown. It was reported that the largemouth bass fishing was outstanding following drawdown. The WDNR conducted a fish survey in 1989 (five years after drawdown). The report contained the following significant points:

1. More large northern pike in 1989 than in 1984.
2. Twice as many largemouth bass were sampled in 1989 vs. 1984.
3. Walleye appear to be almost gone.
4. Pan fish growth is less than the average in lakes of northwest Wisconsin.

In 1995 another drawdown was performed for repairing the dam. Information is limited, but it appears it was only a one-foot level reduction. There was no information found regarding the plant or fisheries response.

The SLD investigated drawdown as a plant management alternative in preparation for this plan, and received feedback from the WDNR and project consultants as a result. This feedback is included in Appendix E.

### MECHANICAL HARVESTING

In past years, some mechanical harvesting has occurred. One summer, the mechanical harvest was reported as a success, with noticeable reduction in aquatic plants. On another occasion, the harvest was reported as a failure with many plant fragments floating around in the lake. The actual data of these harvesting efforts were not available.

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[19] From Wisconsin DNR files on Spooner Lake. Viewed 01/11/2007 and via email 10/30/2012.

[20] Larry Dammon, Wisconsin DNR Fish Biologist, stated he was unable to locate this information.

## CHEMICAL TREATMENTS[21]

As Table 10 indicates, many chemical treatments were carried out prior to the 2007 aquatic plant management plan. However, treatments were limited in size, and only the navigational channel was treated by the SLD. The navigational channel was marked with buoys every year since beginning this management.

**Table 10. Chemical Treatment History**

| Date | Treatment | Acres Treated |
|---|---|---|
| 7/12 | Navigational channel for Spooner Lake P&R District: Tribune (Diquat) | 5.11 |
| 07 | Navigational channel for Spooner Lake P&R District: Tribune | 5.11 |
| 6/06-8/06 | Private riparian owners: Aquathol K, Cutrine Plus, Reward | 0.69 |
| 6/05 | Private riparian owners: chemicals not noted | 0.52 |
| 6/04 | Private riparian owners: Aquathol K, Cutrine Plus, Reward | 0.69 |
| 6/03 | Private riparian owners: Aquathol K, Cultrine Plus, Reward | 0.34 |
| 7/02 | Private riparian owners: Aquathol K, Copper Sulfate, Reward | 1.26 |
| 7/02 | Navigational channel for Spooner Lake P&R District: Copper Sulfate, Reward | 5.85 |
| 6/01 | Navigational channel for Spooner Lake P&R District: Aqualthol K, Copper Sulfate | 5.85 |
| 7/01 | Private riparian owners: Hydrothol Gran, Copper Sulfate, Reward, 2-4 D LVG Ester | 3.76 |
| 8/01 | Navigational channel for Spooner Lake P&R District: Reward | 5.85 |
| 7/00 | Navigational channel for Spooner Lake P&R District: Aquathol K, Reward, Copper Sulfate | 6.9 |
| 6/00 | Navigational channel for Spooner Lake P&R District: Aquathol K, Copper Sulfate, Reward | 6.9 |
| 6/00 | Private riparian owners: Aquathol K, Hydrothol, Copper Sulfate, Reward | 2.15 |
| 6/00 | Private riparian owners: Aquathol K, Hydrothol, Copper Sulfate, Reward | 1.47 |
| 6/99 | Private riparian owners: chemicals not noted | 0.64 |
| 6/98 | Private riparian: owners: Aquathol K, Hydrothol, 2-4 D, Cutrine T, Copper Sulfate, Aquakleen[22] | 0.64 |
| 7/97 | Private riparian owners: chemicals not noted | 0.64 |

[21] From files provided by Wisconsin DNR, Spooner Office, January 2007.

[22] This chemical was recorded in the treatment files from 06/08/1998 in a difficult to read hand written note.

## FILAMENTOUS ALGAE CONTROL

The SLD used chelated copper to treat floating mats of filamentous algae of 1000 square feet or more since 2015. The mats usually form in Kohler's Bay (near the inlet) and float around and out into the main lake or catch on surfacing plant beds. Treatment is intended to alleviate nuisance conditions,[23] although there appears to be no measure of efficacy. Treatments have generally been 4 or 5 times each year totaling 21 acres. There were three applications in 2018: June 25 (6.5 acres), July 3 (5.5 acres) and July 17 (2 acres).[24]

## CURLY LEAF PONDWEED CONTROL

The map in Figure 13 illustrates the coverage of CLP in Spooner Lake in 2006. CLP growth was concentrated near the inlet in the East Bay. CLP was less dense in the main basin of the lake. The strategy for CLP control in the 2007 plan was to treat beds that were a nuisance or an area of concern. Nuisance areas were defined as areas of dense growth (rake density of 3, aerial coverage > 80%) with plant growth reaching the surface to impede navigation. Areas of concern were defined as small beds approaching nuisance levels. An early season treatment of Endothall was used to target CLP and avoid impacts to native plants. The overall objective was to prevent spread into the main basin of the lake. To accomplish this, the objective for the treatment beds was to have a 90% reduction in CLP coverage by area and a mean rake density rating during a post treatment survey of <1. The stands originally proposed for treatment were small, isolated, dense areas of curly leaf pondweed. These beds were chosen for treatment since they were dominated by CLP and were in the main lake where CLP coverage was limited.

With reductions in CLP growth through 2012, the overall objective for CLP treatment changed in the 2012 APM plan. The SLD went from a strategy of containment to the East Bay to one of reduction and removal of CLP throughout the lake.

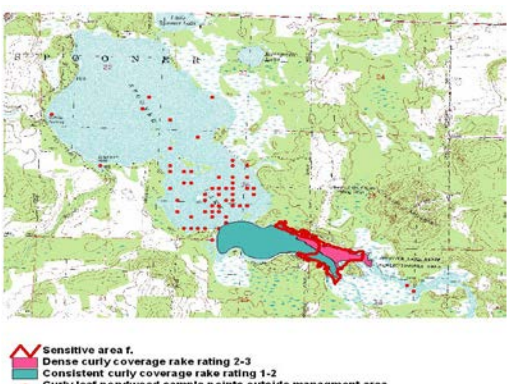


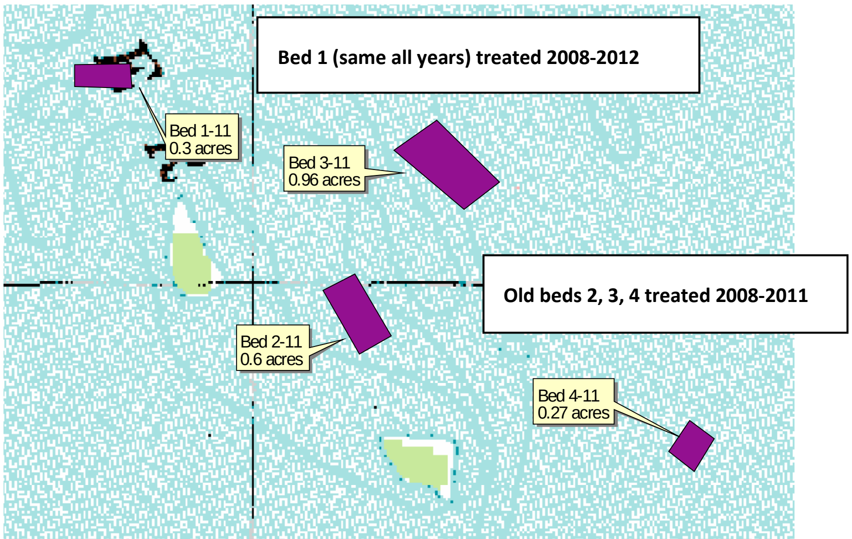

**Figure 13. Curly Leaf Pondweed (*Potamogeton crispus*) Locations 2006**

[23] Personal communication via email. Mark Sundeen, WDNR Aquatic Plant Management Specialist, 12/27/2018.

[24] Lake Restoration, Inc. Form 3200-111 Aquatic Plant Management Herbicide Treatment Record.

## SPOONER LAKE CLP TREATMENT SUMMARY (2008-2018)[25]

Tracking the efficacy of Spooner Lake's CLP herbicide treatment program is challenging because CLP growth and therefore treatment has moved around in the lake. In years 2008-2011 the SLD treated CLP beds 1-4, 6, and 7 in the main lake as shown in Figure 14 below. After 2011, beds 2, 3, 4 and 7 were eliminated because no CLP was present. Bed 6 decreased in size.



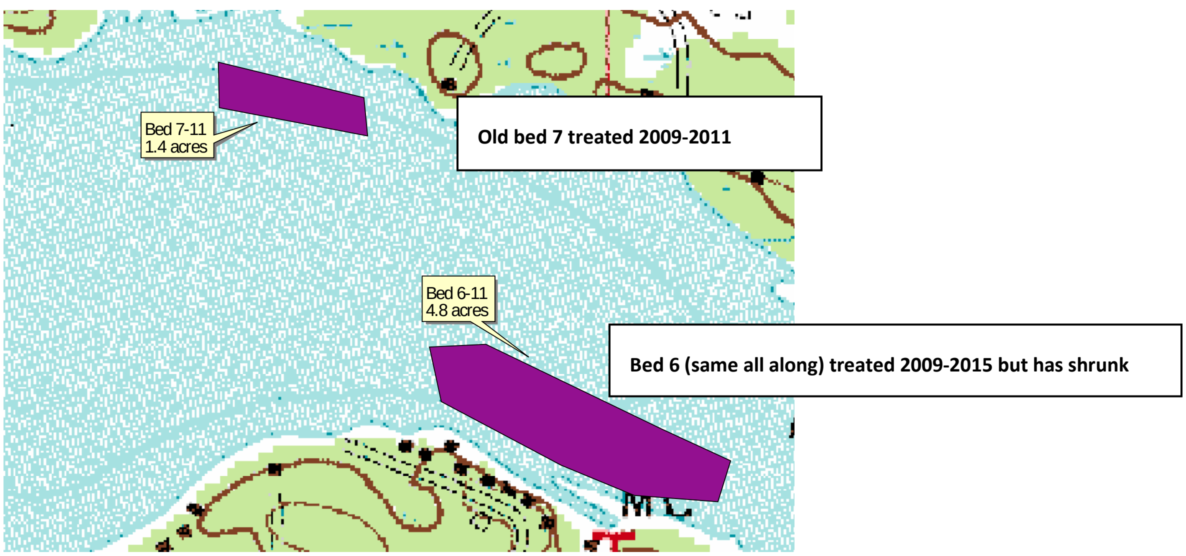




**Figure 14. Spooner Lake CLP Treatment Beds 2011**

[25] The information is based on CLP Pre and Post Herbicide Treatment Monitoring Reports. Steve Schieffer. Ecological Integrity Service.

From 2012 until 2015 additional areas of CLP growth were treated following natural declines from previous years. Figure 15 illustrates CLP beds treated from 2012-2015.

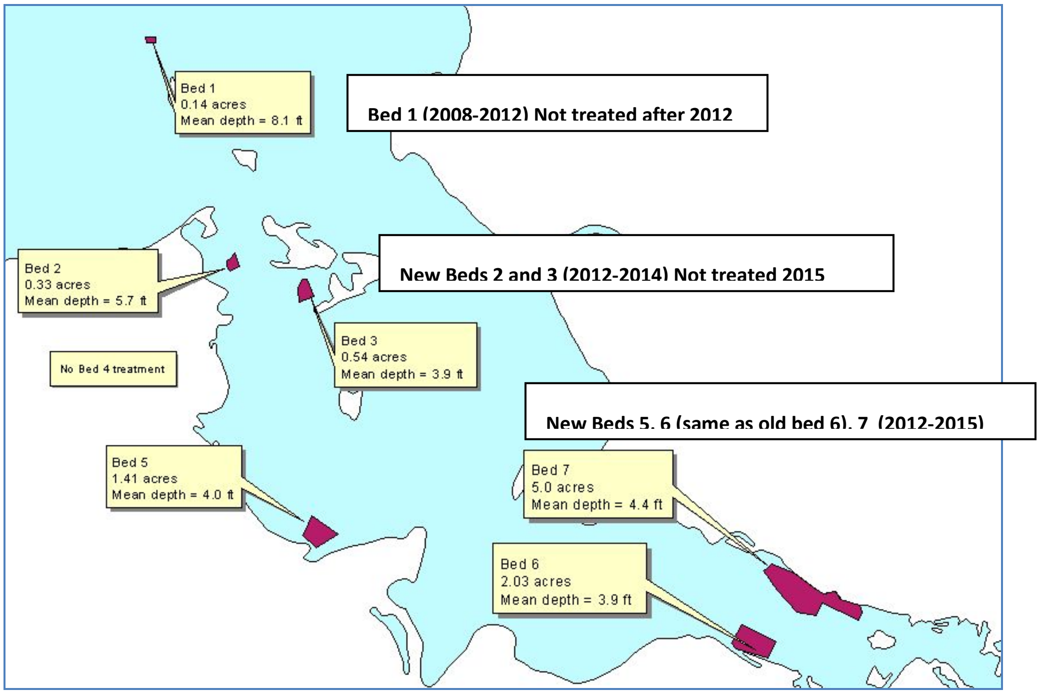



**Figure 15. Spooner Lake CLP Beds (2012 – 2015)**

In summary, bed 1 was treated 2008-2012. Old beds 2, 3, 4 (in main lake as referred to in the 2007 Spooner Lake APM plan) and 6, 7 (in lower part of lake) were treated from 2008-2011. New beds 2, 3, 5 and 7 and an adjusted bed 6 (in lower part of lake) were treated in 2012-2015. In 2016 and 2017 treatment beds changed again as shown in Figure 16 and Figure 17 .

## NATIVE PLANT RESPONSE

Pre and post monitoring of native plant species has shown occasional statistically significant reductions in native plant species in herbicide treatment areas. However, these have been often accompanied by statistically significant increases in other native plant species. For example, from 2017 to 2018 there was a statistically significant decline in northern water-milfoil (*Myriophyllum sibiricum*) along with changes in other native species. From 2016 to 2017 one native plant species, slender naiad (*Najas flexilis*), had a significant reduction. One native species waterweed (*Elodea Canadensis*) had a significant increase. These changes may be due to seasonal variation rather than the herbicide treatments.

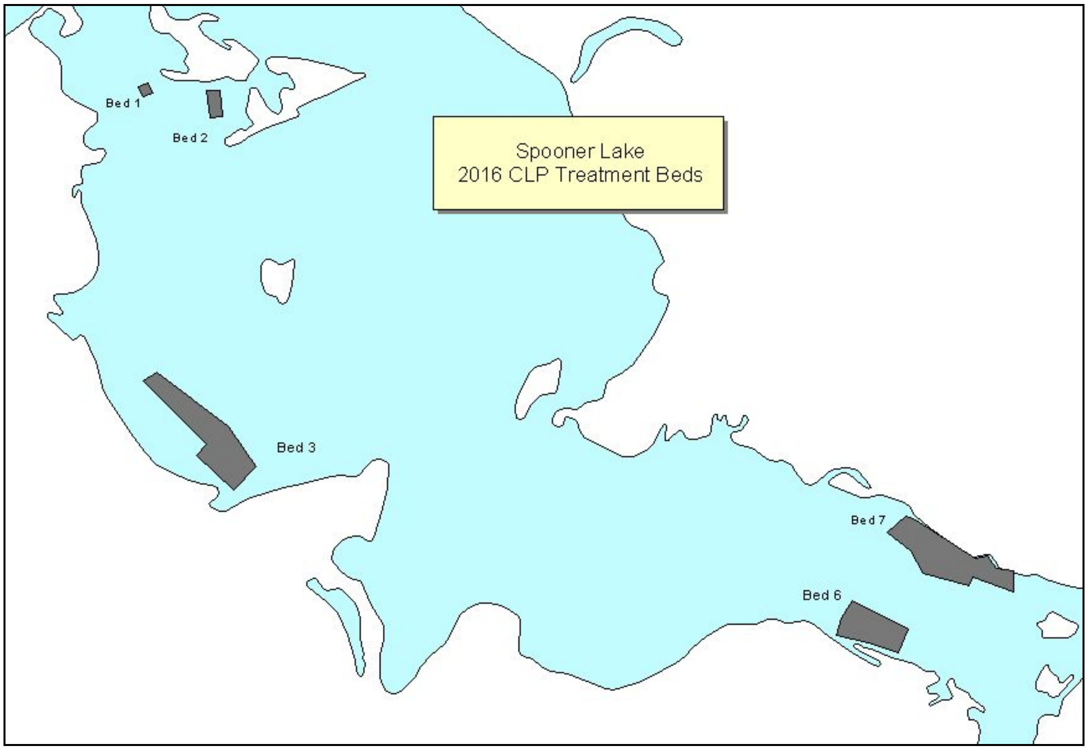



Figure 16. Spooner Lake CLP Treatment Beds (2016)

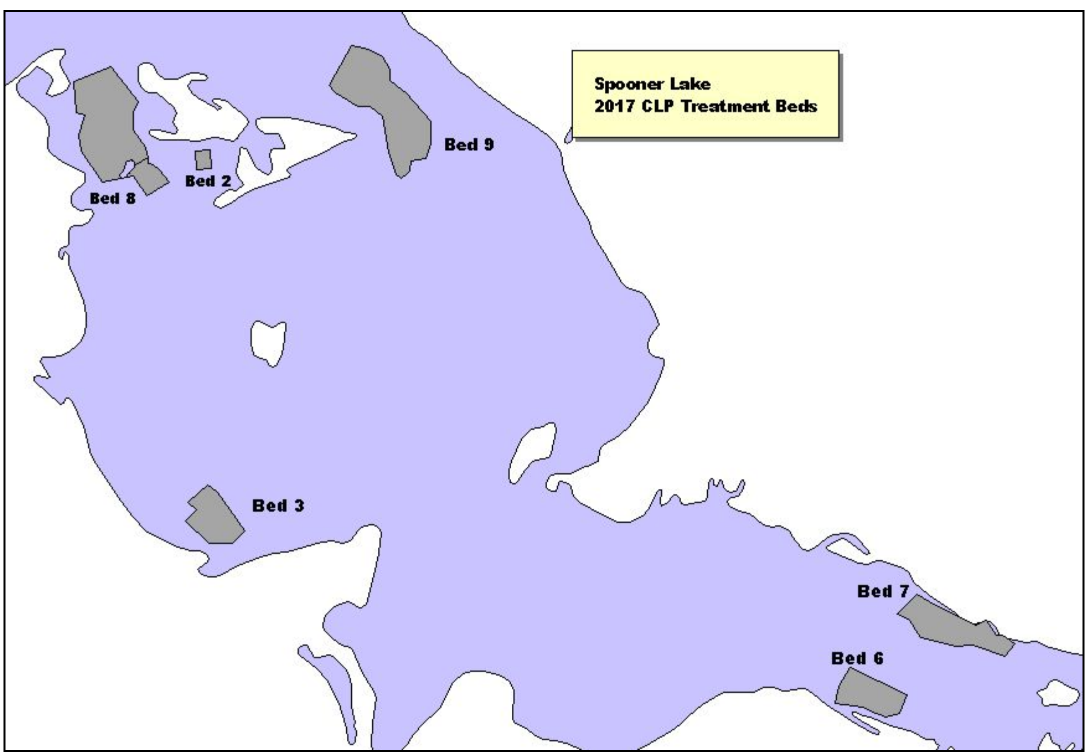



Figure 17. Spooner Lake CLP Treatment Beds (2017)

## SPOONER LAKE CLP TREATMENT 2018

The SLD treated six CLP beds with herbicide in 2018. Figure 18 shows the treatment bed locations, and Table 11 summarizes information about the herbicide treatment. No additional beds of CLP were located following the 2018 herbicide treatment. Beds 6-9 were treated in previous years.  Bed 10 (added to 7) and bed 11/12 were new treatment beds in 2018.

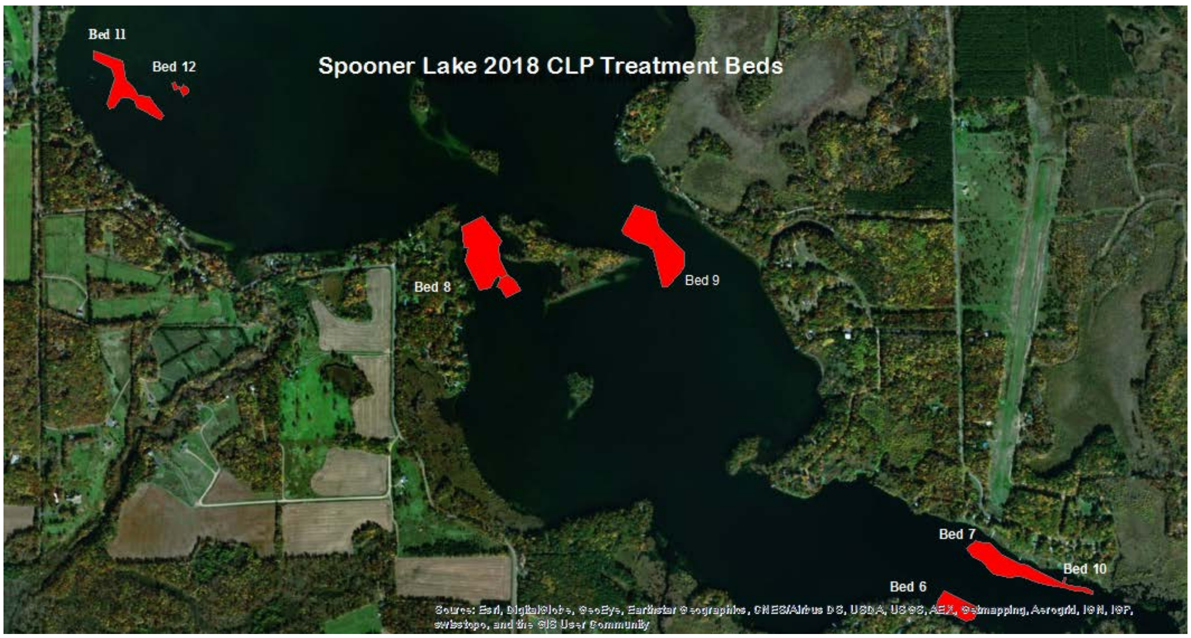



Figure 18.  Spooner Lake CLP Treatment Beds (2018)

Table 11. 2018 Spooner Lake CLP Treatment Information

| Bed | Area(acres) | Mean Depth | Acre-feet | Endothall Target conc. | Wind (mph) | Water temp.[26] |
|---|---|---|---|---|---|---|
| **6** | 2.2 | 4.3 | 9.46 | 1.5 ppm | 5-7 | 65°F |
| **7/10** | 4.6 | 4.3 | 19.78 | 1.5 ppm* | 5-10 | 69°F |
| **8** | 6.9 | 5.2 | 35.88 | 1.5 ppm | 5-7 | 65°F |
| **9** | 6.35 | 6.2 | 39.37 | 1.5 ppm | 5-7 | 65°F |
| **11** | 3.7 | 5.9 | 21.83 | 1.5 ppm | 0-5 | 67°F |
| **12** | 0.32 | 6.5 | 2.08 | 1.5 ppm | 0-5 | 67°F |
| **Total** | 24.07 | | 128.4 | | | |

*ppm: parts per million

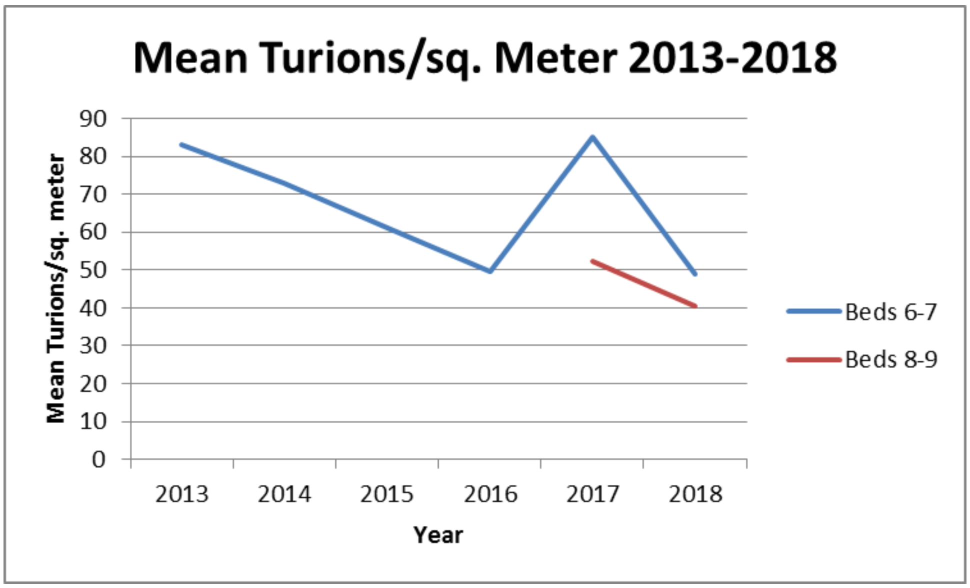



Figure 19. Mean Turion Density (all beds) from 2013 to 2018.

[26] Permit conditions generally require that treatment occur when water temperature is <60F. However, ice-out was very late in 2018, and water temperature subsequently warmed rapidly. It is assumed that the WDNR allowed the herbicide applicator to treat at temperatures that exceeded permit conditions.

**Table 12. Annual CLP Treatment Results**

| Year | Acres Treated | Beds Treated | Sig. Freq. Reduction post (previous yr)/post | Sig. Freq. Reduction pre (previous yr)/pre | Sig Density Reduction from Previous Year? (post/post) |
|---|---|---|---|---|---|
| 2008 | 3.36 | (4) 1, 2, 3, 4 | No | NA | NA |
| 2009 | 8.66 | (6) 1, 2, 3, 4, 6, 7 | **Yes** | NA | **Yes** |
| 2010 | 10.3 | (6) 1, 2, 3, 4, 6, 7 | No | NA | No |
| 2011 | 8.3 | (6) 1, 2, 3, 4, 6, 7 | **Yes** | NA | **Yes** |
| 2012 | 9.45 | (6) 1, 2*,3*,5,6,7* | **Yes** | No | **Yes** |
| 2013 | 9.49 | (5) 2*, 3*, 5, 6, 7* | **Yes** | No | No (increase) |
| 2014 | 9.49 | (5) 2*, 3*, 5, 6, 7* | No | **Yes** | No (slight increase) |
| 2015 | 8.82 | (3) 5, 6, 7* | No | No (increase) | No |
| 2016 | 11.33 | (5) 1*, 2, 3, 6, 7 | No | No | **Yes** |
| 2017 | 21.34 | (8) 2, 3, 4, 5, 6, 7, 8, 9 | No (increase) | No (increase) | No (increase) |
| 2018 | 24.07 | (5) 6, 7/10, 9, 11, 12 | **Yes** | **Yes** | **Yes** |
| | | * indicates new beds from previous beds with same number | | | |

It is difficult to track long term success of the Spooner Lake CLP treatment program, because location of CLP growth (and therefore CLP beds) has varied from year to year. Table 12 summarizes each treatment, and compares frequency and density of CLP growth from previous years. **Success of treatment (reduction in CLP frequency and density from previous years) has been inconsistent. In general, there are few years that show a significant decrease in CLP growth early in the year - presumably as a result of the previous year's treatment.** Mean turion density (a measure of the potential for future growth) has decreased in treated beds from 2013-2018.

## CLP TREATMENT RECOMMENDATIONS

CLP growth in Spooner Lake has varied a great deal annually. As a result, monitoring future CLP growth prior to treatment is recommended – perhaps even waiting a year or two before pursuing treatment of a newly identified bed. Conditions such as late ice out can dramatically impact annual CLP growth.

Since turions are still present in each bed treated in 2018, it is anticipated that CLP will return, but at lower density. Ongoing herbicide treatment in current CLP beds is expected to further reduce frequency and density based on treatment history. However, treatment history also indicates that CLP growth is likely to reoccur in various areas of the lake in the future.

## AQUATIC INVASIVE SPECIES PREVENTION

There are several methods available to the SLD to prevent invasive species introduction and establishment: education to lake users, Clean Boats Clean Waters inspection program, boat decontamination, landing surveillance cameras, and lake monitoring. A rapid response strategy for any new invasive species is also recommended.

### EDUCATION TO LAKE USERS

Education efforts focus on identification and prevention of new invasive species. Public education about aquatic plant management on Spooner Lake is provided via meetings, semi-annual newsletters, signage at the public landings and private boat launch areas, and the website. The most highly attended SLC meetings are held each year Memorial Day and Labor Day weekends. The website will include information about the Clean Boats, Clean Waters monitoring, what owners can do to prevent introduction of invasive species, invasive species identification, and aquatic plant management plan implementation, among other topics. The website address is http://spoonerlakewi.com/

### CLEAN BOATS, CLEAN WATERS PROGRAM

Since 2008, the SLD has managed a Clean Boats, Clean Waters (CBCW) Program with the guidance and assistance of the WDNR and the Washburn County Land and Water Conservation Department. Clean Boats, Clean Waters inspectors provide boaters with information on the threat posed by Eurasian and hybrid water milfoil and other invasive species. They offer tips on how to keep boats, trailers, and equipment free of aquatic hitchhikers. They also collect information on boater behavior, concerns, and knowledge of existing local and state laws related to anti-AIS measures. WDNR Clean Boats, Clean Waters grants can currently provide 75% funding as long as a minimum of 200 hours are covered at a landing or pair of landings. Hours and boats inspected at the West Landing off of County Road H are shown in Figure 20 and Figure 21.

In 2018, the SLD contracted a CBCW Coordinator and Inspectors. Under the supervision of the CBCW Program Lead, the Coordinator assisted and scheduled the inspectors to perform the watercraft inspections at the West Landing from the fishing day opening weekend through the Labor Day weekend. The same will occur in 2019. The Washburn County Land and Water Conservation Department provides annual and as needed CBCW training sessions at the Spooner WDNR office and supplies materials.

Signs alerting boaters to take appropriate aquatic invasive species precautions and to identify curly leaf pondweed and Eurasian water milfoil are present at both the West Landing and the WDNR landing on the southeast side of the lake.

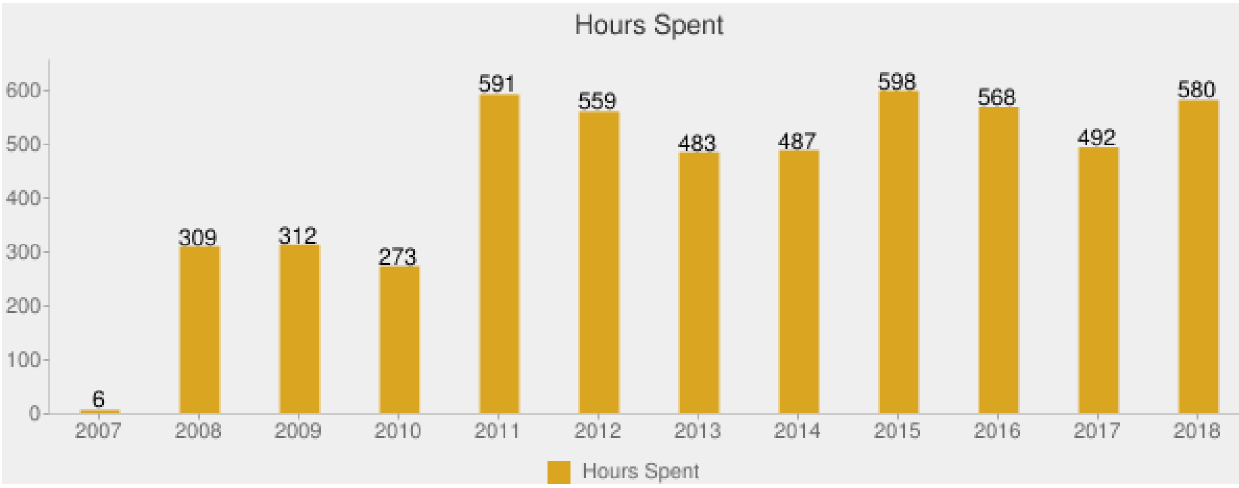



Figure 20. Clean Boats, Clean Waters Hours Spent Spooner Lake West Landing (2007-2018)

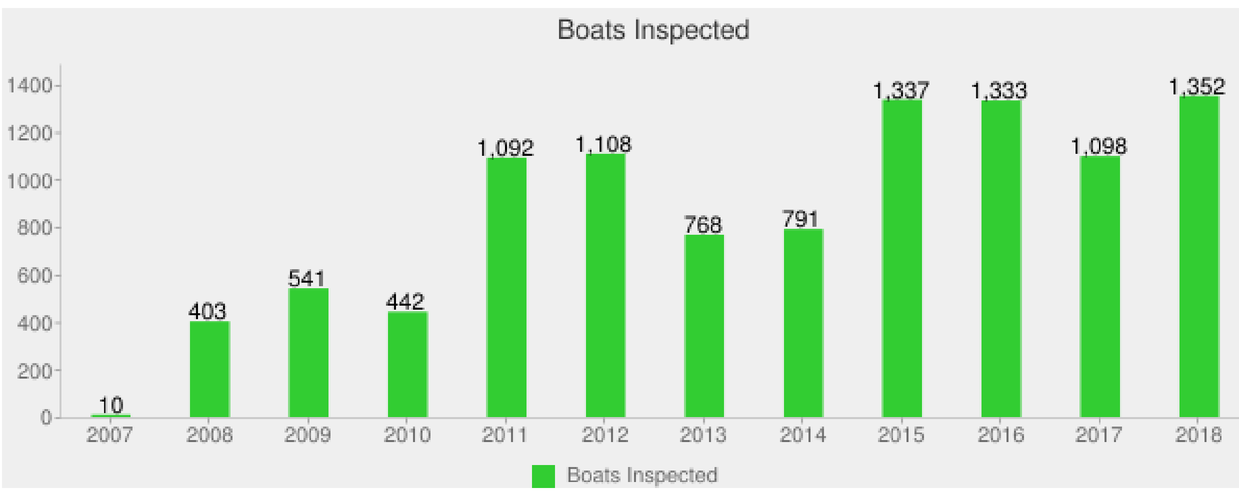



Figure 21. Clean Boats, Clean Waters Boats Inspected Spooner Lake West Landing (2006-2018)

## BOAT WASHING/DECONTAMINATION

Boat and equipment decontamination can use hot water or steam (>140 degrees F), pressure washing, and/or chemicals such as chlorine to prevent transfer of invasive species. Burnett and Washburn Counties have ordinances in place which require decontamination if offered at a public or private water access.

The Wisconsin Department of Natural Resources (WDNR) trialed a portable boat washing station at the West Landing on the WDNR-owned parking lot in the summer of 2012. This was part of the WDNR Water Guard program. The SLD had considered a boat washing station in this same location in past years.

The SLD installed a decontamination station which uses a mild bleach solution along with appropriate signage and tools at the Town of Spooner West Landing on County Highway H in August 2018. Spooner Lake District volunteers maintain the decontamination station, replacing the bleach solution regularly. With the station in place, decontamination is required by users of the launch according to Washburn County Ordinance (Chapter 46. Article 4. Sec. 46-48).


**Figure 22. Boat Cleaning and Decontamination Station on Spooner Lake**

## LAKE MONITORING

The objective of lake monitoring is to look for new invasive species. Monitoring for invasive aquatic plant species is generally focused around boat landings and other areas of high public use. Trained volunteers or consultants may complete the monitoring. Divers may be used. The Washburn County Land and Water Conservation Department offers training sessions as needed.

## ZEBRA MUSSEL MONITORING

Because zebra mussels attach to hard surfaces, cinder blocks or plate samplers placed in shallow water and checked regularly provide a good monitoring method. The SLD installed three sets of zebra mussel plate samplers on docks in 2018 in cooperation with Washburn County (Figure 24). Net tows aim to collect zebra mussel veligers (the larval stage). Early July is the best time to collect veliger tows. Spooner Lake District volunteers and the county staff are also working together to collect veliger tows each year.

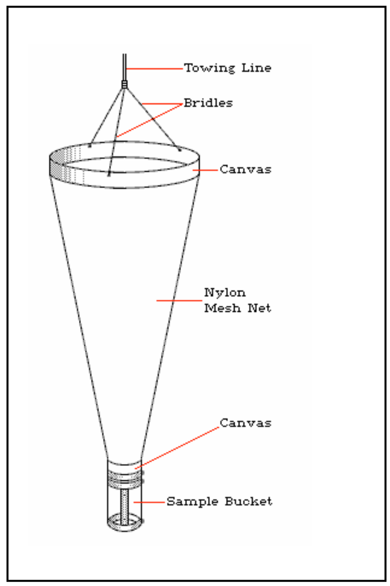



**Figure 23. Monitoring Equipment: Cinder Blocks, Sampling Plates, and Nets for Veliger Tows**

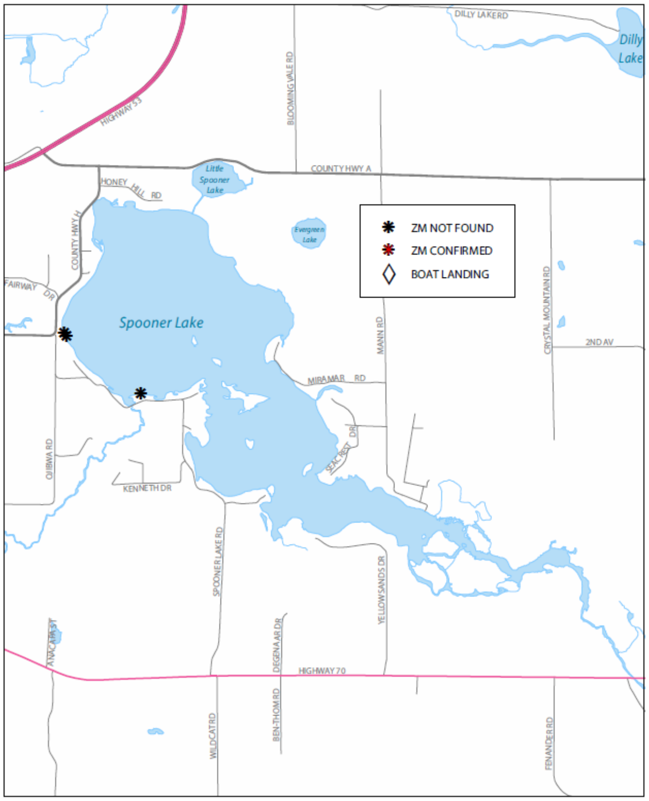



**Figure 24. Spooner Lake Zebra Mussel Plate Sampler Locations (2018)**

## RAPID RESPONSE FOR NEW INVASIVE SPECIES

The activity is intended to control any new invasive species that are found in the lakes. Rapid response protocols include the following:

- monitoring for invasive species,
- education of lake residents and visitors,
- contacts to confirm invasive species identification,
- procedures for notification for new invasive species found,
- plans for removal and control, and
- funding contingencies and grants.

A rapid response plan is included as Appendix A.

Invasive species information is included in Appendix C and is available on the WDNR website, https://dnr.wi.gov/topic/Invasives/.

## LANDING SURVEILLANCE CAMERAS

Some lake organizations use video cameras at public landings to record landing activity. Videos are reviewed, and if a watercraft is launched with vegetation attached, action is taken. Violations of the county ordinance and state rule which prohibit transporting and launching boats and trailers with vegetation attached (NR 40) can be enforced by local law enforcement officers. The camera also serves as a reminder for boaters to check their equipment. WDNR AIS Education, Prevention and Planning grants can be used to support camera installation (up to $4,000 in grant funds for each). Maintenance and video/photo review are not grant-eligible expenses.

## MAINTAINING BOATING AND SWIMMING ACCESS CORRIDORS

No recent records were found of property owners maintaining an opening in front of their waterfront by using herbicides on Spooner Lake. Using herbicides to maintain a waterfront access corridor is not recommended in this plan. The WDNR recommends (and may require) that residents who wish to maintain an opening for boating and swimming use rakes or other hand methods.

The Department of Natural Resources Northern Region Aquatic Plant Management Strategy (May 2007) requires documentation of severely impaired navigation or nuisance conditions before native plants may be managed with herbicides. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface. This document is included as Appendix F.

## IMPLEMENTATION PLAN

### RESPONSIBLE PARTIES FOR PLAN IMPLEMENTATION AND MONITORING

**Spooner Lake Protection and Rehabilitation District (SLD) Board** – elected representatives responsible for oversight of the lake management district. Some actions such as hiring a contractor or consultant require a vote of the SLD Board.

**Aquatic Plant (AP) Committee** - assist with aquatic plant management activities including monitoring as needed.

**Aquatic Plant Management (APM) Lead** – makes day-to-day aquatic plant management decisions and directs contractors in harvesting or herbicide treatments and related monitoring. The APM Lead may have interns, volunteers, and consultants to assist in these activities.

**Clean Boats, Clean Waters (CBCW) Lead** – leads and coordinates volunteer and staffed aquatic invasive species education activities including Clean Boats, Clean Waters program monitoring and education at the boat landings.

**AIS Identification (ID) Lead** – is the lead monitor for zebra mussels, Eurasian water milfoil (EWM), and other aquatic invasive species (AIS) and the initial contact for suspected AIS identification on the lake.

**Harvesting Contractor** - the contractor hired by the SLD Board to complete harvesting as permitted by the Wisconsin Department of Natural Resources.

**Herbicide Contractor** – the herbicide applicator hired by the SLD Board to complete herbicide treatment as permitted by the Wisconsin Department of Natural Resources.

**APM Monitor**– a consultant hired to complete monitoring under the direction of the APM Lead and the SLD Board.

**DNR** – Lakes staff will review aquatic plant management plans, grants, and permit applications, enforce permit conditions, and confirm aquatic invasive species identification.

**Washburn County LWCD** – Staff from the Washburn County Land and Water Conservation Department will assist with education and AIS identification.

## GOALS FOR AQUATIC PLANT MANAGEMENT

1. PROTECT AND RESTORE HEALTHY NATIVE AQUATIC PLANT COMMUNITIES.

   *Native aquatic plants provide important functions in Spooner Lake including fish and wildlife habitat, maintaining water quality, and stabilizing lake sediments.*

2. PREVENT THE SPREAD OF CURLY LEAF PONDWEED AND RESTORE HEALTHY NATIVE PLANT COMMUNITIES IN ITS PLACE.

   *Curly leaf pondweed control can decrease the growth of this plant, but it is well-established and is likely to persist in Spooner Lake. This plant tends to grow in the lake in areas 4 – 6 feet and deeper.*

3. IMPROVE NATIVGATION PROBLEMS CAUSED BY NUISANCE LEVELS OF AQUATIC PLANTS.

   *Current navigation problems from aquatic plants occur primarily in East Bay and in the access corridors surrounding lake residents' docks.*

4. REDUCE NUISANCE LEVELS OF FILAMENTOUS ALGAE.

   *Nuisance levels of filamentous algae occur primarily in East Bay. East Bay also is likely the source of filamentous algae that drifts to other areas of the lake.*

5. PREVENT INTRODUCTION AND SPREAD OF NEW AQUATIC INVASIVE SPECIES.

   *Current priority threats based on proximity and likelihood of spread are zebra mussels and Eurasian water milfoil.*

## PLAN GUIDING PRINCIPLES

This plan is a living document to be used and regularly updated by the SLD Board.

The plan and its implementation identify initial methods to address plan goals. Changes in results and updated available information could lead to adaptations in management efforts.

There are state statutes, regulations, and guidelines for aquatic plant management and aquatic invasive species (AIS) prevention that may limit options available for management.

## ALTERNATIVES ANALYSIS GOALS 2, 3, AND 4

The Aquatic Plant Management Plan Committee selected the implementation strategy for goals 2, 3, and 4 using the alternatives analysis presented in Table 13 through Table 17. The tables list advantages, disadvantages, approximate costs, and recommended monitoring for each potential management method under each goal. The initial course of action to begin plan implementation in 2019 is presented in the implementation plan. However, it was acknowledged that management strategies may be changed based on results in initial years of plan implementation. An adaptive management approach will be used to allow the SLD to respond to lessons learned along the way and new management methods that become available. Evaluation criteria are included in the tables to evaluate the results of a method chosen for initial implementation or to lead to choosing an alternative method in the future. If the method was not chosen for initial or back-up implementation, evaluation criteria are not included.

## AQUATIC PLANT MANAGEMENT PLAN OUTREACH

Educational activities will be critical to reach all of the plan goals. One of the first tasks is to raise awareness about the plan itself. Educational methods for the Spooner Lake District (SLD) will include meetings, newsletters, printed information, and the website to reach residents. Educational messages are included for the plan goals.

Education Message

- Spooner Lake residents will be aware of this aquatic plant management plan and related planned actions.

## GOAL 1. PROTECT AND RESTORE HEALTHY NATIVE AQUATIC PLANT COMMUNITIES.

*Native aquatic plants provide important functions in Spooner Lake including fish and wildlife habitat, maintaining water quality, and stabilizing lake sediments.*

The aquatic plant community in Spooner Lake is very diverse and extensive. Over 90% of the lake area is covered with aquatic plants. Based on phosphorus levels and water clarity readings, aquatic plants are likely helping to keep the water clarity in Spooner Lake much higher than expected.

### ACTIONS

1. Consider native aquatic plant benefits when implementing aquatic plant and filamentous algae control measures.

2. Provide outreach to residents to aid in understanding the importance of native aquatic plant communities.

Educational Messages:

- Aquatic plants in Spooner Lake provide key habitat for diverse fish populations. They also prevent shoreline erosion in some critical areas.
- Although some residents have expressed interest in significantly reducing the plant density in Spooner Lake, it is important to understand that these plants play an important role in the lake ecosystem.

If the reduction of aquatic plants should occur, it must be done in a systematic, careful manner.

- Reducing the plant community too much could lead to adverse effects in Spooner Lake. These could include algae blooms, reduced fish reproduction, and increased sedimentation.
- Discourage boating disturbance within 100 feet of the shoreline.

  Although this is a no-wake zone according to state regulation, many boaters still travel close to the shoreline. This activity is strongly discouraged for the following reasons:

  - Boats may uproot native plants and break aquatic plants into fragments.
  - Bare substrate is more likely to be colonized by non-native species.
  - Plant fragments contribute phosphorus to the water as they decay.

Waterfront residences can also negatively affect native plant communities by causing disturbance of existing plant beds and altering sediment characteristics.

- Regular waterfront use like boating, swimming, and clearing removes native aquatic plants.
- Healthy native plant populations prevent colonization by invasive plants.
- Erosion and runoff from waterfront property may alter sediment characteristics encouraging spread of invasive plants.

## GOAL 2. PREVENT THE SPREAD OF CURLY LEAF PONDWEED AND RESTORE HEALTHY NATIVE PLANT COMMUNITIES IN ITS PLACE.

*Curly leaf pondweed control can decrease the growth of this plant, but it is well-established and is likely to persist in Spooner Lake. This plant tends to grow in the lake in areas 4 – 6 feet and deeper.*

### OBJECTIVES FOR CLP MANAGEMENT

A. Maintain navigation for fishing, boating, and access to lake residences.

B. Reduce CLP frequency and density.

C. Restore healthy native plant communities.

**Table 13. Alternatives Analysis Goal 2: Prevent the Spread of Curly Leaf Pondweed and Restore Healthy Native Plant Communities in its Place**

| Method | Advantages | Disadvantages | Approximate Costs | Recommended Monitoring | Evaluation Criteria |
|---|---|---|---|---|---|
| **No Action** – Do not chemically treat or harvest. | Allows evaluation of CLP growth with no control. | CLP growth varies greatly from year to year, so one year evaluation will not demonstrate much.<br><br>Risk of increased CLP growth. | No treatment cost.<br><br>Monitoring CLP growth: $1600.<br><br>Turion monitoring: $600. | CLP frequency and density (point intercept and bed mapping) in June only.<br><br>Turions. | Is no action a viable long-term alternative? Does nuisance CLP growth occur/ Is navigation maintained?<br><br>What is CLP frequency and density compared with previous years?<br><br>How does native plant growth compare with previous years? |

| Table 13. Alternatives Analysis Goal 2: Prevent the Spread of Curly Leaf Pondweed and Restore Healthy Native Plant Communities in its Place | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **Chemical Treatment** – Identify thresholds for treatment and pursue if thresholds are exceeded. | Early season treatment targets invasive CLP and limits harm to native plants.<br><br>Provides ability to address conditions evident in early spring. | Does not demonstrate what occurs without treatment.<br><br>Necessary to establish treatment thresholds in planning process (can be modified with experience). | Treatment: $1,000/acre.<br><br>CLP bed mapping: $600, pre and post treatment monitoring: $1,200.<br><br>Turion monitoring: $600.<br><br>Permit fee: varies (up to $1,270). | CLP bed mapping.<br><br>Pre and post treatment (within treated beds).<br><br>Turions. | When would chemical treatment method be selected? Harvesting is deemed not effective or is too costly.<br>No action resulted in nuisance growth of CLP.<br>If chemical method is selected, when should treatment occur?<br>Duration of bed existence: at least 2 out of 3 years.<br>Frequency: at least 30% CLP in bed.<br>Rake density: at least 1.5.<br>Impacts navigation: blocks access to residences or other critical areas of lake. |
| **Contracted Harvesting**<br><br>(cont. on next page) | Provides ability to trial method without large capital investment and logistics. | Contracted harvesting may not be available for spring 2019. | Proposals are available; cost to be reviewed at member meeting 5/25/19.<br><br>Monitoring to target CLP beds and evaluate before and after harvesting: $1600.<br><br>Turion monitoring: $600. | Harvesting logs: date, location, generally describe plants harvested, amount/loads harvested, area harvested, and cost.<br><br>Volunteer assessment: qualitative report of effectiveness of | When would contract harvesting option be selected?<br><br>Experienced, cost effective harvesting contractor is available to provide services.<br><br>Harvesting is effective and meets needs, e.g., navigation is possible through areas of CLP growth. |

**Table 13. Alternatives Analysis Goal 2: Prevent the Spread of Curly Leaf Pondweed and Restore Healthy Native Plant Communities in its Place**

| Method | Advantages | Disadvantages | Approximate Costs | Recommended Monitoring | Evaluation Criteria |
|---|---|---|---|---|---|
| **Contracted Harvesting** (cont.) | | Contracted harvesting brings risk of AIS if equipment is not properly decontaminated. | Maximum permit fee: $300 (vs. up to $1,270 for chemical treatment).<br><br>Harvesting likely not funded under existing AIS Control grant. | harvesting at improving navigation.<br><br>CLP frequency and density (point intercept and bed mapping) in June only.<br><br>Turions (every 1-3 years). | |
| **Lake District/Locally Owned and Operated Harvester** | Ability to address CLP beds over the long term.<br><br>Harvesting programs have demonstrated decreases in CLP frequency and density.<br><br>Equipment could be used to address other goals. | High cost to acquire equipment.<br><br>Logistics and cost of operating: maintenance, hiring and payroll, training, liability insurance, storage, etc. | Capital cost: $180,000 - $220,000 (Harvester, Conveyor, Trailer, Truck, and Storage).<br><br>O&M: $10,000 to $20,000.<br><br>Monitoring to target CLP beds and evaluate before and after harvesting: $1600.<br><br>Turion monitoring: $600. | Harvesting logs: date, location, generally describe plants harvested, amount/loads harvested, and area harvested.<br><br>Annual cost.<br><br>CLP frequency and density (point intercept and bed mapping) in June only.<br><br>Turions (every 1-3 years). | When would SLD harvester purchase and operation be pursued?<br><br>Harvesting is effective and meets needs, e.g., navigation is possible through areas of CLP growth.<br><br>Ability to harvest larger area is desired.<br><br>Ownership is more cost effective over a chosen time interval.<br><br>Harvesting has successfully accomplished multiple objectives.<br><br>Logistics of operating and maintaining harvester are viable. |

## SELECTED ACTIONS GOAL 2

1. Take no action for curly leaf pondweed management in 2019.
2. Monitor CLP and native plant growth in 2019.
    a. Conduct spring CLP point intercept survey.
    b. Map beds of CLP including measurements of CLP frequency and rake density.
    c. Complete fall turion survey.
    d. Review and record navigation conditions through areas of CLP growth.
3. Evaluate results of no action with CLP monitoring results.
    a. Does nuisance CLP growth occur/ Is navigation maintained?
    b. What is CLP frequency and density compared with previous years?
    c. How does native plant growth compare with previous years?
4. Develop CLP action plan for 2020 and beyond selecting method based upon management alternatives evaluation criteria in Table 13.

## GOAL 3. IMPROVE NAVIGATION PROBLEMS CAUSED BY NUISANCE LEVELS OF AQUATIC PLANTS.

*Current navigation problems from aquatic plants occur primarily in East Bay and in the access corridors surrounding lake residents' docks.*

### OBJECTIVES FOR NAVIGATION

A. MAINTAIN ACCESS TO INDIVIDUAL ACCESS CORRIDORS TO LAKE RESIDENCES.

B. MAINTAIN ACCESS THROUGH THE EAST BAY AND OTHER AREAS OF DENSE AQUATIC PLANT GROWTH FOR NAVIGATION.

**Table 14. Alternatives Analysis Goal 3, Objective A: Maintain Access to Individual Access Corridors to Lake Residences**

| Method | Advantages | Disadvantages | Approximate Costs | Recommended Monitoring | Evaluation Criteria |
|---|---|---|---|---|---|
| **No Action** - Residents remove plants with hand methods. | No chemicals or physical methods will impact near shore habitat.<br><br>Lake district role is education and information only. | Physically difficult for some residents. Expensive for residents to hire contractors. | No cost to lake district. | Track number and content of resident complaints. | Is current strategy for maintaining access to properties viable? |

| Table 14. Alternatives Analysis Goal 3, Objective A: Maintain Access to Individual Access Corridors to Lake Residences | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **Chemical Treatment -** Residents contract with applicators. | Ability to target chemical treatment based upon nuisance conditions and plants present at each site. | Very few sites permitted. Thresholds for nuisance conditions difficult to establish and high threshold to allow treatment based on WDNR guidance.<br><br>Need to establish a process to allow chemical treatment for access corridors in the plan. | Paid by homeowners. | | Not recommended. |
| **Drawdown - 3 feet**<br><br>(cont. on next page) | Within 3-foot limit established by WDNR and physical limits of dam.<br><br>Potentially addresses substantial portion of area around docks. | Uncertain results on first 3 feet of aquatic plant growth – effectiveness and species favored.<br><br>Necessary to repeat even if drawdown is successful. | | Detailed aquatic plant and fisheries surveys before and after drawdown.<br><br>Aquatic plant surveys will include volunteer written and photographic documentation of periods of time when nuisance conditions occur around docks. | When would 3-feet drawdown option be selected?<br><br>Drawdown is effective at maintaining access to individual's properties.<br><br>Dam safety is maintained. |

| Table 14. Alternatives Analysis Goal 3, Objective A: Maintain Access to Individual Access Corridors to Lake Residences | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **Drawdown - 3 feet** (cont.) | No chemicals used.<br><br>Relatively inexpensive process.<br><br>Spooner Lake has extensive plant coverage, so overall plant community impacts would be limited. | Frequent repeated drawdowns may have unforeseen/ undesired consequences. | | Representative properties will be assessed both prior to and following a drawdown. Documentation will include specific activities that are limited during these nuisance conditions. | Fisheries, wildlife (especially amphibians, reptiles, and mammals), and native plants in are not negatively affected in the long term. |

## SELECTED ACTIONS GOAL 3, OBJECTIVE A

OBJECTIVE A. Maintain access to individual access corridors to lake residences.

1. Residents are responsible to maintain individual access corridors to their residences by manual means.
2. The SLD will provide information to lake residents regarding rules for individual access corridor maintenance.
3. Evaluate selection of no action alternative by tracking number and content of resident complaints. (See analysis of alternatives in Table 14.)

Additional Information

Aquatic plants can create nuisances for residents attempting to swim and boat from the shoreline. It is important that riparian owners are aware of the importance of native aquatic plants and know that complete removal can be a high risk. Critical habitat can be lost and the chance of colonization by invasive, non-native species can be increased. Chemical treatment for residential access is discouraged. In fact, it is illegal to apply aquatic herbicide without a permit. Instead residents should hand pull or rake to allow access to docks.

**Nuisance** means vegetation grows thickly and forms mats on the water surface. Activities such as boating and swimming are limited under nuisance conditions.

Residents should be aware that the only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width along the shore and is not within a designated sensitive area. In sensitive areas the opening is limited to 25 feet. The non-native invasive plants (Eurasian water milfoil, curly leaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit.

Educational Messages

- Residents may not remove native plants along their shorelines using chemical means on Spooner Lake. Hand removal is limited to a width of 30 feet or less along an owner’s shoreline. Hand raking is recommended if native plant removal is needed for navigation.
- Aquatic plant raking services may be available for hire.

| Table 15. Alternatives Analysis Goal 3, Objective B: Maintain Access through East Bay and other Areas of Dense Aquatic Growth for Navigation | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **No Action** | No cost.<br>No chemicals used. | Navigation and nuisance conditions not addressed. | $0 | | |
| **Chemical Treatment** | No need to obtain or contract for equipment.<br><br>Chemical treatment can readily be contracted. | Greater limits on areas where native aquatic plants can be managed per WDNR.[27]<br><br>Likely limited to navigation channel approaching East Bay and off-shoots of this channel. | $3,100 - $5,200 | Weekly volunteer assessment: qualitative report of effectiveness before and after treatment. | When would chemical treatment be selected?<br>Harvesting is not a cost-effective management alternative.<br>Does chemical treatment effectively open navigation in a given area?<br>How long is navigation channel clear before repeat treatment is needed? |
| **Contracted Harvesting**<br><br>(cont. on next page) | Provides ability to trial method without large capital investment and logistics. | Contracted harvesting brings risk of AIS if equipment is not properly decontaminated. | Proposals are available; cost to be reviewed at member meeting 5/25/19.<br><br>Monitoring to identify areas to be harvested (?). | Harvesting logs: date, location, generally described plants harvested, amount/loads harvested, area harvested, and cost. | When would contract harvesting option be selected?<br><br>Is experienced, cost effective harvesting contractor available to provide services? |

[27] The WDNR Northern Region Aquatic Plant Management Strategy 2007 is found in Appendix F.

| Table 15. Alternatives Analysis Goal 3, Objective B: Maintain Access through East Bay and other Areas of Dense Aquatic Growth for Navigation | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **Contracted Harvesting** (cont.) | | | Maximum permit fee:$300. | Weekly volunteer assessment: qualitative report of effectiveness of harvesting. | Does harvesting effectively open navigation in a given area?<br><br>How long is navigation channel clear before repeat harvesting is needed? |
| **Lake District/Locally Owned and Operated Harvester** | Ability to alleviate nuisance conditions beyond the navigation channel.<br><br>Equipment could be used to address other goals. | High cost to acquire equipment.<br><br>Logistics and cost of operating: maintenance, hiring and payroll, training, liability insurance, storage, etc. | Capital cost: $180,000 - $220,000 (Harvester, Conveyor, Trailer, Truck, and Storage).<br><br>O&M: $10,000 to $20,000.<br><br>Monitoring to evaluate harvesting effectiveness (?).<br><br>Maximum permit fee:$300. | Harvesting logs: date, location, generally described plants harvested, amount/loads harvested, and area harvested.<br><br>Annual cost.<br><br>Weekly volunteer assessment: qualitative report of effectiveness of harvesting. | <u>When would SLD harvester purchase and operation be pursued?</u><br><br>Harvesting is effective at maintaining navigation.<br><br>Ability to harvest larger area is desired.<br><br>Ownership is more cost effective over a chosen time interval.<br><br>Harvesting has successfully accomplished multiple objectives.<br><br>Logistics of operating and maintaining harvester are viable. |

## SELECTED ACTIONS GOAL 3, OBJECTIVE B

OBJECTIVE B. Maintain access through the East Bay and other areas of dense aquatic plant growth for navigation.

1. Conduct a trial of contracted harvesting services in 2019.
    a. Select contractor and seek member approval at May 25, 2019 meeting.
    b. Obtain WDNR harvesting permit.
    c. Develop harvesting contract.
        - Include SLD inspection for AIS decontamination requirements.
        - Include harvesting data logs: date, location of harvesting, generally described plants harvested, amount/loads harvested, area harvested, and cost.
    d. Identify areas to be harvested and harvest these areas.
2. Monitor harvesting.
    1. Review contractor logs and cost.
    2. Review and record navigation conditions weekly through identified areas of dense aquatic plant growth targeted for harvesting.
3. Evaluate effectiveness of contract harvesting.
    a. Is experienced, cost effective harvesting contractor available to provide services?
    b. Does harvesting effectively open navigation in a given area?
    c. How long is navigation channel clear before repeat harvesting is needed?
4. Develop navigation action plan for 2020 and beyond selecting method based upon management alternatives evaluation criteria in Table 15.

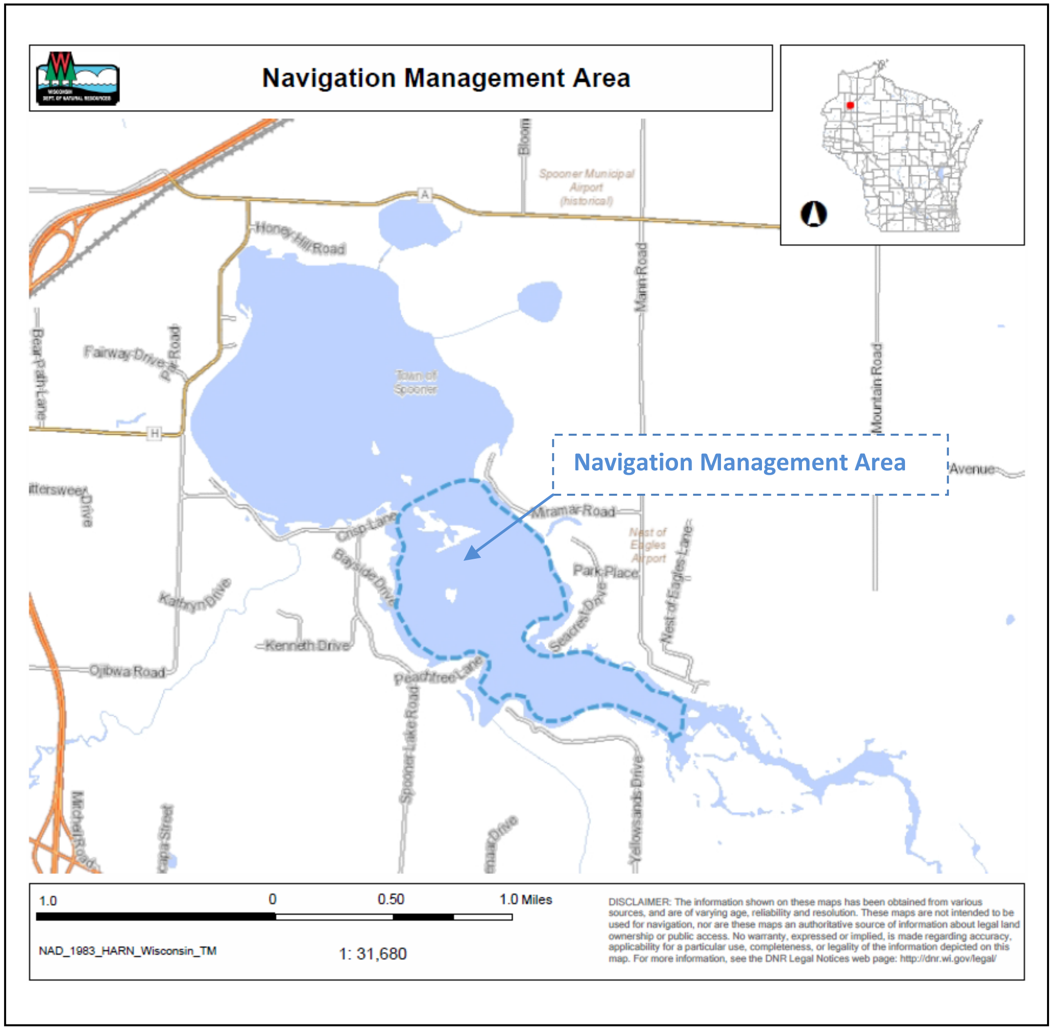



**Figure 25. Map of Spooner Lake Management Area**

## GOAL 4. REDUCE NUISANCE LEVELS OF FILAMENTOUS ALGAE.

*Nuisance levels of filamentous algae occur primarily in East Bay. East Bay also is likely the source of filamentous algae that drifts to other areas of the lake.*

Filamentous algae growth creates nuisance conditions in late summer when it floats on the surface. The Spooner Lake District has used copper sulfate and chelated copper treatments in an attempt to alleviate nuisance conditions. There are concerns regarding effectiveness and impacts of this method.

### OBJECTIVE

A. Alleviate late summer nuisance conditions caused by filamentous algae growth.

**Table 16. Alternatives Analysis Goal 4: Reduce Nuisance Levels of Filamentous Algae**

| Method | Advantages | Disadvantages | Approximate Costs | Recommended Monitoring | Evaluation Criteria |
|---|---|---|---|---|---|
| **No Action -** Remove dead/dying filamentous algae on lake surface near docks with hand rakes and other hand removal methods. | No cost.<br>No chemicals used. | Navigation and nuisance conditions not addressed. | $0 | | |

| Table 16. Alternatives Analysis Goal 4: Reduce Nuisance Levels of Filamentous Algae | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| | | | | | |
| **Chemical Treatment** with copper products. | A familiar method that has been used for years. | Environmental concerns regarding repeated applications of copper products.<br>Lack of demonstrated effectiveness.<br>Chemical treatments may be increasing nuisance odors and distribution when algae are killed.<br>Chemical treatment is a temporary fix. Algae will regrow with available nutrients. | $7,346.25 (for 21 acres treated in 2018). | In-lake nutrient levels following treatment.<br>Volunteer assessment: suspended and filamentous algae growth following treatment at weekly intervals.<br>Copper in lake sediment. | Not recommended. |
| **Contract Harvesting**<br><br>(cont. on next page) | Ability to trial effectiveness.<br>Best potential to remove filamentous algae appears to be when | Uncertain results. Skimmers have mixed or poor reviews. | Monitoring to identify areas to be harvested (?).<br><br>Maximum permit fee: $300. | Harvesting logs: date, location, generally described plants harvested, amount/loads harvested, area harvested, and cost.<br><br>Volunteer assessment: | When would contract harvesting option be selected?<br>Is experienced, cost effective harvesting contractor available to provide services? |

| Table 16. Alternatives Analysis Goal 4: Reduce Nuisance Levels of Filamentous Algae | | | | | |
|---|---|---|---|---|---|
| **Method** | **Advantages** | **Disadvantages** | **Approximate Costs** | **Recommended Monitoring** | **Evaluation Criteria** |
| **Contract Harvesting** (cont.) | harvesting aquatic plants. | | | filamentous algae growth immediately following harvesting and at weekly intervals thereafter during past peak growth periods. | Does harvesting effectively reduce filamentous algae nuisance conditions? |
| **Lake District/Locally Owned and Operated Harvester** | Ability to alleviate nuisance conditions.<br>Equipment could be used to address other goals. | High cost to acquire equipment.<br>Logistics and cost of operating: maintenance, hiring and payroll, training, liability insurance, storage, etc. | Capital cost: $180,000 - $220,000 (Harvester, Conveyor, Trailer, Truck, and Storage).<br>O&M: $10,000 to $20,000.<br>Monitoring to identify areas to be harvested (?).<br>Maximum permit fee: $300 | Harvesting logs: date, location, generally described plants harvested, amount/loads harvested, and area harvested.<br>Annual cost.<br>Volunteer assessment: growth of filamentous algae immediately following harvesting and at weekly intervals thereafter during past peak growth periods. | When would SLD harvester purchase and operation be pursued?<br>Harvesting is effective at maintaining navigation.<br>Ability to harvest larger area is desired.<br>Ownership is more cost effective over a chosen time interval.<br>Harvesting has successfully accomplished multiple objectives.<br>Logistics of operating and maintaining harvester are viable. |

## SELECTED ACTIONS GOAL 4

1. Conduct a trial of contracted harvesting services in 2019.
    a. Select contractor and seek member approval at May 25, 2019 meeting.
    b. Obtain WDNR harvesting permit.
    c. Develop harvesting contract.
        - Include SLD inspection for AIS decontamination requirements.
        - Include harvesting data logs: date, location of harvesting, generally described plants harvested, amount/loads harvested, area harvested, and cost.
    d. Identify areas to be harvested for filamentous algae and harvest these areas.
2. Monitor harvesting.
    a. Review contractor logs and cost.
    b. Assess growth of filamentous algae immediately following harvesting and at weekly intervals thereafter during past peak growth periods
3. Evaluate effectiveness of contract harvesting.
    a. Is experienced, cost effective harvesting contractor available to provide services?
    b. Does harvesting effectively reduce filamentous algae nuisance conditions?
4. Develop filamentous algae action plan for 2020 and beyond selecting method based upon management alternatives evaluation criteria in Table 16.

**Table 17. Summary of Aquatic Plant Management Alternatives**

| | **Goal 2.** **CLP Management** | **Goal 3A.** **Navigation: Individual Access Corridors** | **Goal 3B.** **Navigation: Main Lake** | **Goal 4.** **Filamentous Algae** |
|---|---|---|---|---|
| **No Action** | **SELECTED METHOD** | **SELECTED METHOD** | | |
| **Chemical Treatment** | OPTION – annual cost | Rarely permitted | OPTION – annual cost | Not recommended |
| **Drawdown 3 feet**[28,29] | Not effective | Uncertain result | Not effective | Not effective |
| **Contract Harvesting** | OPTION – annual cost | Not allowed | **SELECTED METHOD** | **SELECTED METHOD** |
| **Lake District Harvester**[30] | OPTION – high initial cost, moderate annual cost | Not allowed | OPTION – high initial cost, moderate annual cost | Depends upon results of trial |

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[28] A DNR Letter dated 02/19/2019 entitled Response to Spooner Lake District Drawdown Request is found in Appendix E.

[29] On 09/01/2018 the membership directed the SLD Board to investigate drawdown advantages and disadvantages. A report presentation will be made to the SLD membership on 05/25/2019.

[30] On 09/01/2018 the membership directed the SLD Board to prepare a request for a bid to obtain a proposal from at least two contractors to perform Spooner Lake harvesting services for the SLD and private property owners. A report presentation will be made to the SLD membership on 09/25/2019.

## GOAL 5. PREVENT INTRODUCTION AND SPREAD OF NEW AQUATIC INVASIVE SPECIES.

*Current priority threats based on proximity and likelihood of spread are zebra mussels and Eurasian water milfoil.*

### OBJECTIVES

A. Lake residents and visitors understand the significance of avoiding invasive species introduction to Spooner Lake.

B. Lake residents can identify curly leaf pondweed, Eurasian water milfoil, zebra mussels, and other common invasive species threats.

C. Identify invasive species introductions early.

D. Rapidly respond to new invasive species introduction.

### ACTIONS

1. Continue a Clean Boats/Clean Waters program for Spooner Lake.  This includes public access education and inspection. Assistance for training will be provided by Washburn County Land and Water Conservation Department.

2. Monitor for the presence of Eurasian water milfoil, zebra mussels, and other aquatic invasive species at the boat landings and other areas of likely AIS introduction. Consider professional AIS monitoring in the future to supplement volunteer monitoring.

   The AIS volunteer monitoring kit will include an aquascope, rake, plant ID plates, phone numbers, and bags. Volunteers from the Aquatic Plant Committee will be trained to identify Eurasian water milfoil (EWM), zebra mussels, purple loosestrife, Japanese knotweed, and other common invasive species. The areas around the two public boat landings will be the focal points for monitoring, as these are the most likely introduction sites. The area near the inflow will be a third focal point as this could be another introduction site. Areas where northern water milfoil has been sampled should also be monitored as Eurasian water milfoil tends to grow in similar habitats. Lake residents will be encouraged to learn to identify Eurasian water milfoil, curly leaf pondweed, zebra mussels, and purple loosestrife and establish a contact for verification of identification. This training will be provided by Washburn County Conservation Coordinator and WDNR staff.

3. Follow the Rapid Response Plan in Appendix A.

   - Train and support lake resident volunteers to identify Eurasian water milfoil, zebra mussels, and other invasive plants.
   - Maintain a non-lapsing contingency fund of at least $10,000 for removal of invasive species.
   - Designate board and resident responsibilities for the Rapid Response Plan.

4. Maintain a boat decontamination station that provides hand tools and a mild bleach solution for washing boats and equipment.
5. Conduct a whole lake macrophyte survey every 5 years. This survey will follow the WDNR guidelines and use the point intercept method of data collection.
6. Consider a hot water, high pressure decontamination system if warranted.

Educational Messages

- Why invasive species introduction is a concern for Spooner Lake.
- Methods to prevent Eurasian water milfoil, zebra mussel, and other invasive species introduction.
- How to identify curly leaf pondweed, Eurasian water milfoil, zebra mussels, and other invasive aquatic species. Contact the AIS Identification (ID) Lead or SLD Board Member if you have questions about invasive species identification.

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## APPENDIX A. RAPID RESPONSE FOR EARLY DETECTION OF AQUATIC INVASIVE SPECIES

1. The Spooner Lake District (SLD) Board will maintain a contingency fund of at least $10,000 for rapid response to aquatic invasive species (AIS).

2. The Aquatic Plant Committee will monitor at the public landings, the East Bay inlet, and other likely areas of AIS introduction. A map of likely areas of introduction will be prepared and made available to monitors. If a suspected plant is found, contact the Aquatic Invasive Species (AIS) ID Lead or SLD Board Member.

3. Direct lake residents and visitors to contact the AIS ID Lead or SLD Board member if they see a plant or animal in the lake they suspect might be an aquatic invasive species (AIS). Signs at the public boat landings, website pages, handouts at annual meeting, and newsletter articles will provide AIS photos and descriptions, contact information, and instructions.

4. If an AIS is suspected, the AIS ID Lead will confirm identification with Washburn County LWCD or the WDNR. If a plant:

    a. Take a digital photo of the plant in the setting where it was found (if possible). Then collect 5 to 10 intact specimens. Try to get the root system and all leaves as well as seed heads and flowers when present. Place in a zip lock bag with no water. Place on ice and transport to refrigerator. Two entire intact rooted adult specimens of the suspect plants will be collected and bagged and delivered to the WDNR, (810 West Maple Street, Spooner, WI 54801).

    b. Inform SLD Board.

    If an animal other than a fish:

    a. Take a digital photo of the animal in the setting where it was found (if possible). Then collect up to five specimens. Place in a jar with water; put on ice and transport to refrigerator. Transfer specimen to a jar filled with rubbing alcohol (except for Jellyfish – leave in water).

    b. Inform SLD Board.

5. This AIS ID Lead will mark the location of suspected AIS. Use GPS points, if available, or mark the location with a small float.

6. If identification is positive, the AIS ID Lead will:

    a. Inform the person who reported the AIS and the SLD Board, who will then inform Washburn County LWCD and WDNR, and the lake management consultant.

If a plant:

b. Fill out plant incident form http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf.

c. Contact WDNR staff, then deliver collected plants to the WDNR (810 W. Maple St., Spooner, WI 54801) as soon as possible (or to the location they specify).

If an animal:

d. Be sure the suspected invasive species has not been previously found on the waterbody.

e. If a zebra mussel, report to WDNR and Washburn County LWCD.

f. Fill out form 3200-126 – Aquatic Invasive Animal Incident Report.

g. Mark the location of AIS with a more permanent marker.

7. The SLD Board will post a notice at the public landing (WDNR has these signs available) and include a notice in the next newsletter. Notices will inform residents and visitors of the approximate location of AIS and provide appropriate means to avoid its spread.

8. The SLD Board will hire a consultant to determine the extent of the AIS introduction. A diver may be used if water clarity is high enough. If small amounts of AIS are found during this assessment, the consultant will be directed to identify locations with GPS points and remove by hand methods (unless not recommended for a particular species). All plant fragments will be removed from the lake when hand pulling.

9. The SLD Board will select a control plan in cooperation with the WDNR. The goal of the rapid response control plan will be eradication of the AIS.

    a. Control methods may include hand pulling, use of divers to manually or mechanically remove the AIS from the lake bottom, application of chemicals, and/or other effective and approved control methods.

10. The SLD Board will implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.

11. Spooner Lake District funds may be used to pay for any reasonable expense incurred during the implementation of the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.

12. The SLD Board will work with the WDNR to confirm, as soon as possible, a start date for an Early Detection and Rapid Response AIS Control Grant. Thereafter, the SLD Board shall formally apply for the grant.

13. The APM Lead and SLD Board will frequently inspect the area of the AIS to determine the effectiveness of the treatment and whether additional treatment is necessary.

14. The SLD Board will review and update the procedures and responsibilities of this rapid response plan on an annual basis.

## EXHIBIT A[31]

SPOONER LAKE PROTECTION AND REHABILITATION DISTRICT

| | |
|---|---|
| AIS ID Lead | Ed Fischer: 715.635.7704<br>efischer812@icloud.com |
| APM Lead | Mark Schultz: 715.520.0296<br>hillsiderealty@centurytel.net |
| SLD Board/Aquatic Plant Committee: | Photo7589@gmail.com |

WASHBURN COUNTY LAND AND WATER CONSERVATION DEPARTMENT (LWCD)

| | |
|---|---|
| Conservation Coordinator | Lisa Burns: 715-468-4654<br>Lburns@co.washburn.wi.us |

WISCONSIN DEPARTMENT OF NATURAL RESOURCES (WDNR)

| | |
|---|---|
| Grants | Pamela Toshner: 715-635-4073<br>Pamela.toshner@wisconsin.gov |
| Permits | Mark Sundeen: 715-635-4074<br>Mark.sundeen@wisconsin.gov |
| AIS Identification and Notice | Spooner Lakes Team: 715-635-4073 |

APM MONITORS

| | |
|---|---|
| Ecological Integrity Services | Steve Schieffer: 715-554-1168<br>ecointegservice@gmail.com |

DIVERS

| | |
|---|---|
| Ecological Integrity Services | Steve Schieffer: 715-554-1168 |
| Endangered Resource Services | Matt Berg: 715-483-2847<br>saintcroixdfly@gmail.com |

[31] The SLD Board will review and update this list each year.

## APPENDIX B. HERBICIDE TREATMENT ANALYSIS-*POTAMOGETON CRISPUS* 2018

# Herbicide Treatment Analysis- *Potamogeton crispus*

## Spooner Lake
## Washburn County WI
## 2018

Prepared by: Ecological Integrity Service, LLC
Amery, WI

## Abstract

On June 1st, 5th and 6th in 2018 an herbicide treatment with endothall on six *Potamogeton crispus*-Curly leaf pondweed (CLP) beds occurred totaling 24.07 acres. A pretreatment survey and post treatment survey revealed a statistically significant reduction in the CLP after treatment (comparing the 2018 pretreatment CLP frequency to the 2018 post treatment CLP frequency) from 47.7% to 2.3% frequency of occurrence. The 2018 post treatment CLP frequency of occurrence was lower than the 2017 post treatment CLP frequency, from 12% in 2017 to 2.3% in 2018, which is a significant reduction. The pretreatment survey from 2017 compared to the pretreatment survey from 2018 showed a decrease from 70.4% in 2017 to 47.7% in 2018. There was one native plant species with a significant reduction. The 2018 turion analysis resulted in a decrease in turion density from 2017 to 2018. A whole lake meander survey was conducted for CLP and no beds of CLP were observed.

## Introduction

This report analyzes the effectiveness of an herbicide treatment for *Potamogeton crispus*-curly leaf pondweed (CLP). This treatment occurred on June 1, 5 and 6 in 2018. This analysis will review and compare treatment surveys of all beds treated in 2017, to the treatment surveys in 2018. It will also analyze the effectiveness comparing a pretreatment survey (conducted just before treatment) to the post treatment survey (conducted approximately four weeks after treatment) in 2018.

There were six beds of CLP treated with herbicide in 2018. They will be referred to as Beds 6, 7/10, 9, 11, 12. The results of beds 11 and 12 were combined. Figure 1 shows the bed locations and Table 1 summarizes bed statistics.

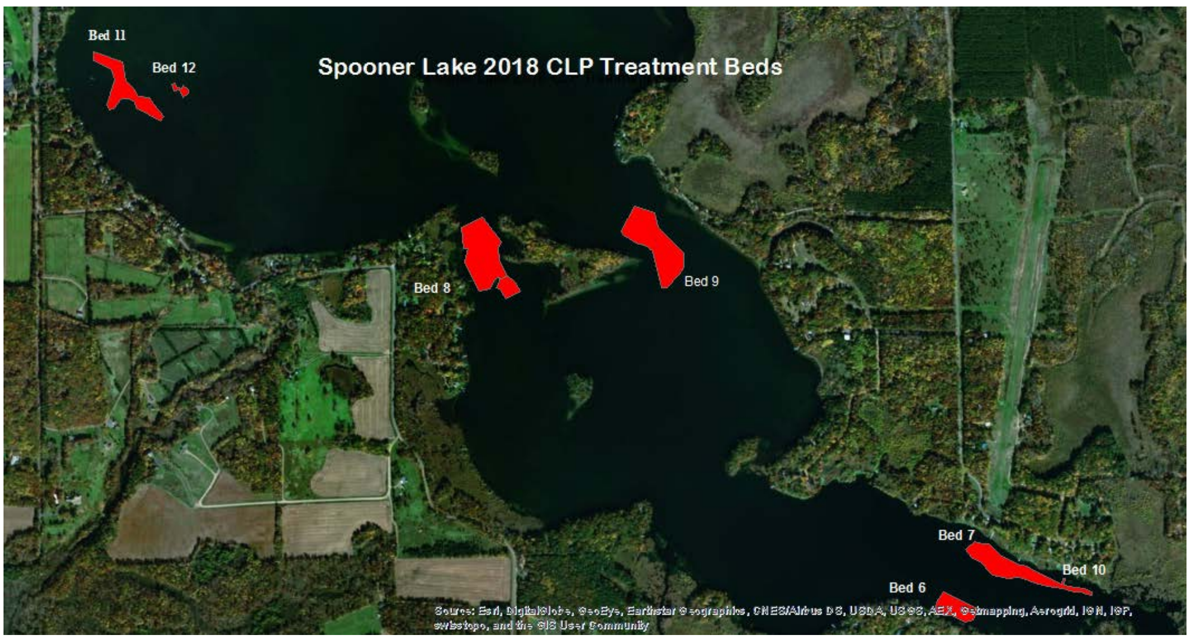


**Figure 1: Map of 2018 CLP treatment beds-Spooner Lake.**

Beds 6-9 have been treated in previous years. Beds 10 (added to 7) 11/12 are new treatment beds for 2018, which were mapped in 2017.

| Bed | Area(acres) | Mean Depth | Acre-feet | Endothall Target conc. | Wind (mph) | Water temp. |
|---|---|---|---|---|---|---|
| **6** | 2.2 | 4.3 | 9.46 | 1.5 ppm | 5-7 | 65°F |
| **7/10** | 4.6 | 4.3 | 19.78 | 1.5 ppm | 5-10 | 69°F |
| **8** | 6.9 | 5.2 | 35.88 | 1.5 ppm | 5-7 | 65°F |
| **9** | 6.35 | 6.2 | 39.37 | 1.5 ppm | 5-7 | 65°F |
| **11** | 3.7 | 5.9 | 21.83 | 1.5 ppm | 0-5 | 67°F |
| **12** | 0.32 | 6.5 | 2.08 | 1.5 ppm | 0-5 | 67°F |
| **Total** | 24.07 | | 128.4 | | | |

**Table 1: Summary of treatment bed and treatment statistics, 2018.**
***Note: Treatment is supposed to occur in water temperatures <60, but 2018 had a very late ice out with water temperatures warming rapidly. It is assumed applicator worked with WI DNR.***

**Methods**
To conduct and analyze the treatment, two surveys are conducted following the Wisconsin DNR treatment protocol outlined in 2009 by the Wisconsin DNR. The first survey is referred to a pretreatment survey. This involves going to predetermined GPS coordinates within the proposed treatment area. A high definition underwater camera as well as a rake is used to determine the presence of CLP at that sample point. Density is not measured as the plants are typically very small and density is very subjective. The presence of CLP is simply determined. There are many points checked outside of the bed delineation to assure the boundary is correct.

The second survey is referred to as the post treatment survey. This survey involves going to the same GPS coordinates as the pre-treatment survey and doing a rake sample at the point. If any CLP is on the rake, the density of the CLP is recorded (see Figure 2 for reference). All other species are also recorded from the rake sample in order to verify no damage to the native plants.

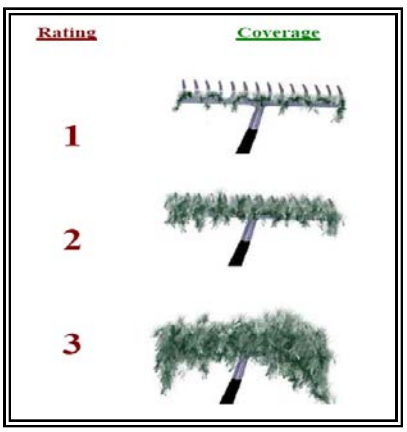


**Figure 2: Density rating system and example CLP rake sample.**

When the surveys are complete, the frequency of occurrence is determined as well as the mean density for each bed as well as all beds combined. The frequency of occurrence for each native plant species sampled is also calculated. A chi-square analysis is then used to determine if the change in frequency is statistically significant ($p<0.05$). The goal is to find the chi-square analysis show that the frequency of CLP is significantly reduced and the native plants are not significantly reduced.

The comparison for reduction is two-fold. First, the result from the previous year's post treatment survey is compared to the present year post treatment survey. This reflects a long-term effectiveness. As more treatments are done in annual succession, these frequency values can become very similar since the CLP growth is reduced so much. This can make it appear the treatment is not progressing successfully since the frequency appears to not be reduced. Each year, new turions can germinate in the fall/winter creating new growth. The result is a low frequency in the post treatment survey, but in the next spring the CLP has grown immensely, and results in a high frequency.

In order to reflect that new growth and the effect the treatment has on it, a second comparison is done. This compares the frequency of CLP in the spring, pre-treatment survey to the post treatment results in that same year. This shows what the CLP growth really was just before treating and the result after treatment.

In the end, we want to see a statistically significant reduction when comparing the pre-treatment frequency to the post treatment frequency. We would also like to see a consistent frequency reduction from year to year, depending on how low it is. If the frequency in any post treatment survey is very low (less than 10% as an example), then lowering it even more may not be realistic, but is the goal. Turions can remain viable for several years, which can affect reduction amounts achieved.

In order to further reflect potential future growth and the cumulative success of treatments, a turion analysis is conducted. This analysis involves going to sample points near the middle of the CLP bed (assuming this will reflect the highest density). At each sample point a sediment sampler is lowered to the lake sediment and a sediment sample is obtained. Two samples are obtained from each side of the boat at each location. The samples are then separated with a screened bucket to isolate the turions. The turions are then counted and the density of turions is calculated in turions/square meter. Consistently successful treatments should show a trend of reduced turion density each year. This way we know the treatments are killing plants prior to turion production, resulting in overall reduction in CLP in those beds.

*a.*

*b.*

**Figure 3: Pictures showing turion density methods. a. shows sediment sample; b. shows separation; c. shows separated turions.**

*c.*

## Results

The pretreatment survey was completed on April 23, 2016. Two beds of CLP were added to the treatment this year (Beds 11 and 12) based upon mapped CLP in June 2017. This survey (coupled with the CLP observed in June 2017) resulted in the elimination of Beds 2 and 3. Beds 6 and 7 were left the same size. The pretreatment survey resulted in a frequency of 47.7%. This shows the turions germination returned CLP growth in all of the treatment beds from 2017. Figure 4 shows the pretreatment survey maps of each bed. Table 2 shows the frequency data breakdown.


**Figure 4: Pretreatment maps showing presence of CLP in each bed 2018.**


**Figure 5: Post treatment density maps from post treatment survey-Spooner Lake 2018.**

| Bed | 2017 pre FOO | 2017 post FOO | 2018 Pre Freq. | 2018 Post Freq. | 2018 Pre to 2018 Post change | 2017 Post to 2018 Post (just beds 6-9) | 2017 Pre to 2018 Pre (just beds 6-9) | 2018 Mean Density |
|---|---|---|---|---|---|---|---|---|
| **6** | 75.0% | 50.0% | 38.1% | 0.0% | -100.0% | decrease | decrease | 0 |
| **7** | 43.8% | 9.4% | 62.7% | 1.96% | -96.9% | decrease | increase | 0.02 |
| **8** | 89.3% | 0.0% | 48.1% | 0.0% | -100.0% | n/c | decrease | 0 |
| **9** | 100.0% | 8.7% | 54.2% | 0.0% | -100.0% | decrease | decrease | 0 |
| **10** | n/a | n/a | 100.0% | 42.8%(small sample) | -40.0% | n/a | n/a | 0.4 |
| **11/12** | n/a | n/a | 27.2% | 0.0% | -100.0% | n/a | n/a | 0 |
| **All Beds** | 70.4% | 12.0% | 47.7% | 2.3% | -80.9%*** | Decrease | Decrease* | 0.02 |

Significance: *p<0.05, **p<0.001, ***p<0.0001

**Table 2: Summary of treatment results with frequency from 2017-18 surveys.**

The 2017 post treatment survey was conducted on June 21, 2018. It shows that the treatment applied in 2018 appears effective at reducing the CLP that was growing in the spring, 2018. The pretreatment frequency was reduced in each bed and showed a statistically significant frequency reduction in all beds together when comparing the pretreatment frequency to the post treatment frequency (based upon a chi-square analysis). The comparison between the 2017 post treatment frequency and the 2018 post treatment frequency resulted in a reduction in frequency of occurrence that was shown in the chi-square analysis to be significant. The pretreatment frequency comparison also shows a decrease from 2017 to 2018 (see table 3). Since the CLP turions germinate in the fall and continue growing into the spring, the CLP often returns within beds that had successful reduction the prior year. The comparison of pretreatment frequency can show long-term reductions as the turion bed density gets reduced from successful treatments. The decrease can indicate reduced long-term reduction. See Figure 6 for a graphical comparison.

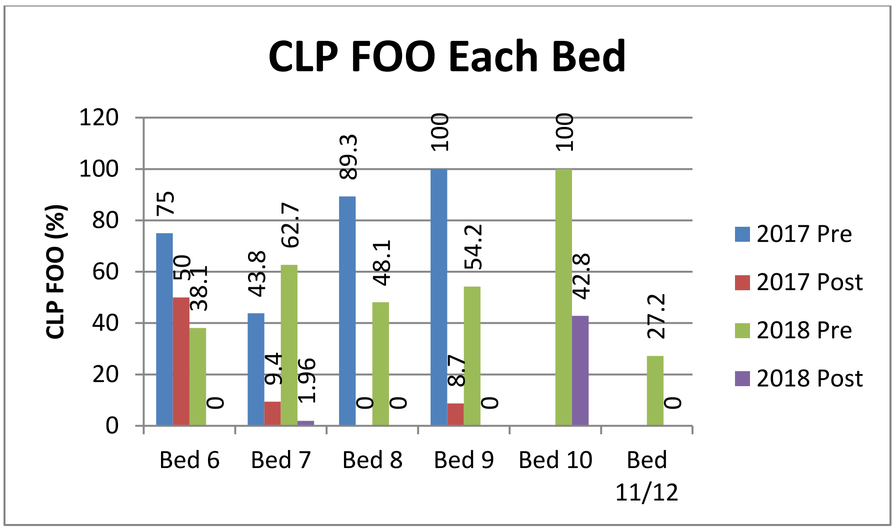


**Figure 6: Graph showing frequencies of occurrence (FOO) from pretreatment and post treatment surveys (2017-18)**

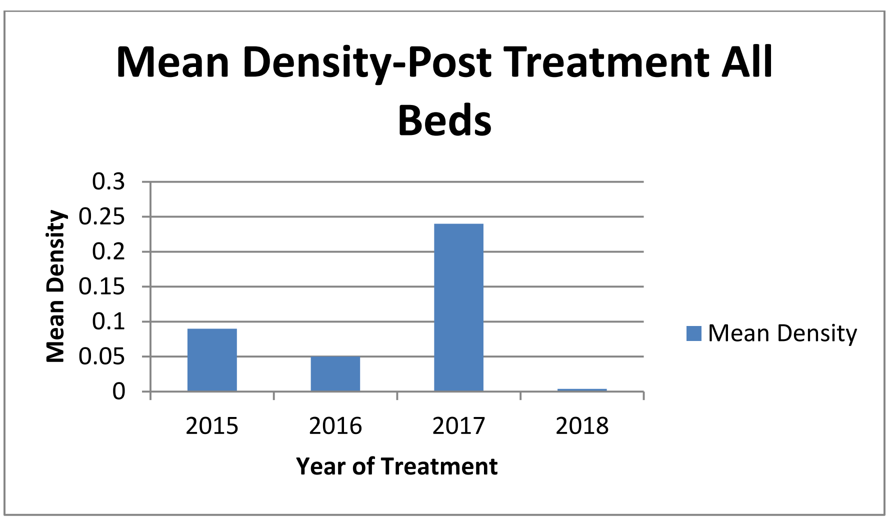


**Figure 7: Mean density of all beds from 2015 thru 2018.**

## Native plant community

The frequency of native plants is also compared between the post treatment results to the previous year's post treatment results. This is to verify that the CLP was targeted with little or no adverse effects on the native plant community. Table 4 shows that there were decreases in six native species with one (*Myriophyllum sibiricum*-northern watermilfoil) that was statistically significant based upon a chi-square analysis (the sample points that were comparable for 2017 and 2018 treatment areas were used for chi-square). The cause of this reduction could be herbicide use, but it could also be due to season variation or sampling variation. There was an increase in several native species along with some small decreases, so it appears the herbicide did not have much effect on the native species.

| Species | 2017 Freq. | 2018 Freq. | Change 2017 to 2018 (Significance) |
|---|---|---|---|
| Waterweed *Elodea canadensis* | 33.6% | 37.9% | Increase |
| Coontail *Ceratophyllum demersum* | 44.0% | 31.5% | Decrease |
| Northern water-milfoil *Myriophyllum sibiricum* | 48.8% | 29.8% | Decrease (**) |
| Sago pondweed *Stuckenia pectinatus* | 10.4% | 4.8% | Decrease |
| Water stargrass *Heteranthera dubia* | 9.6% | 12.1% | Increase |
| Slender naiad *Najas flexilis* | 0.0% | 1.6% | Increase |
| White lily *Nymphaea odorata* | 0.8% | 0.8% | n/c |
| Wild celery *Vallisneria americana* | 0.8% | 0.0% | Decrease |
| Flatstem pondweed *Potamogeton zosteriformis* | 2.4% | 6.5% | Increase |
| Muskgrass *Chara sp.* | 1.6% | 1.6% | n/c |
| Clasping pondweed *Potamogeton richardsonii* | 0.8% | 5.6% | Increase |
| Forked duckweed *Lemna trisulca* | 0.8% | 0.0% | Decrease |
| Spatterdock *Nuphar variegata* | 0.8% | 0.0% | Decrease |
| Arrowhead rosette *Sagittaria sp.* | 0.8% | 0.0% | Decrease |
| Whitestem pondweed *Potamogeton praelongus* | 0.8% | 5.6% | Increase |
| Whitewater crowfoot *Ranunculus aquatilis* | 0.0% | 0.8% | Increase |

Significance *$p<0.05$, **$p<0.02$, ***$p<0.01$

**Table 4: Summary of native plant frequencies 2017 and 2018.**

## Turion analysis

The turion density was analyzed on Oct. 6, 2018. The combined averages for beds 6,7 and 8,9 were separated due to different treatment years. Bed 11/12 was treated for the first time in 2018 so was not included in the overall averages. Table 5 shows the historical means of turion density.

| Bed | 2013 Mean turion density ( $T/m^2$) | 2014 Mean turion density ($T/m^2$) | 2015 Mean turion density ($T/m^2$) | 2016 Mean turion density ($T/m^2$) | 2017 Mean turion density ($T/m^2$) | 2018 Mean turion density (T/m2) |
|---|---|---|---|---|---|---|
| **6** | 84.2 | 59.5 | 48.4 | 16.3 | 54.25 | 43.0 |
| **7/10** | 82.0 | 86.7 | 73.7 | 82.7 | 115.7 | 49.1 |
| **8** | n/a | n/a | n/a | n/a | 27.4 | 23.9 |
| **9** | n/a | n/a | n/a | n/a | 77.2 | 57.3 |
| **11/12** | n/a | n/a | n/a | n/a | n/a | 92.0 |
| **6-7** | 83.1 | 73.1 | 61.0 | 49.5 | 85.0 | 49.0 |
| **8-9** | n/a | n/a | n/a | n/a | 52.3 | 40.6 |

**Table 5: Turion density by bed, 2013 through 2018 (not all beds treated all of these years).**

Figure 8 is a map that shows the turion density at each treatment bed. The turion data in 2018 had a decrease in density in all old beds except beds as compared to 2017. Bed 7 had an increase in turion density from 2016 to 2017, but decreased by a large amount in 2018. 2018 was the second year of treatment for beds 8 and 9, with both showing a turion reduction. Bed 11/12 was treated for the first time in 2018 but the turion density is already quite low. For comparison, some lakes have shown turion densities of 1200 turions/$m^2$, so the density in Spooner Lake is not high by comparison. It does indicate that CLP should return in all beds in 2019, but density should not be very high with the turion density levels present.


**Figure 8: Map of turion density each bed, 2018.**

Figure 9 shows the mean turion density for each treatment bed in 2018. As shown, Bed 11/12 had the highest density with 2018 being the first year of treatment.

Figure 10 shows, the overall turion density increased in 2018 from previous years. This decrease follows an increase in 2017, due to Bed 7 in 2017. It is desired to continue this decrease if future treatments should occur.

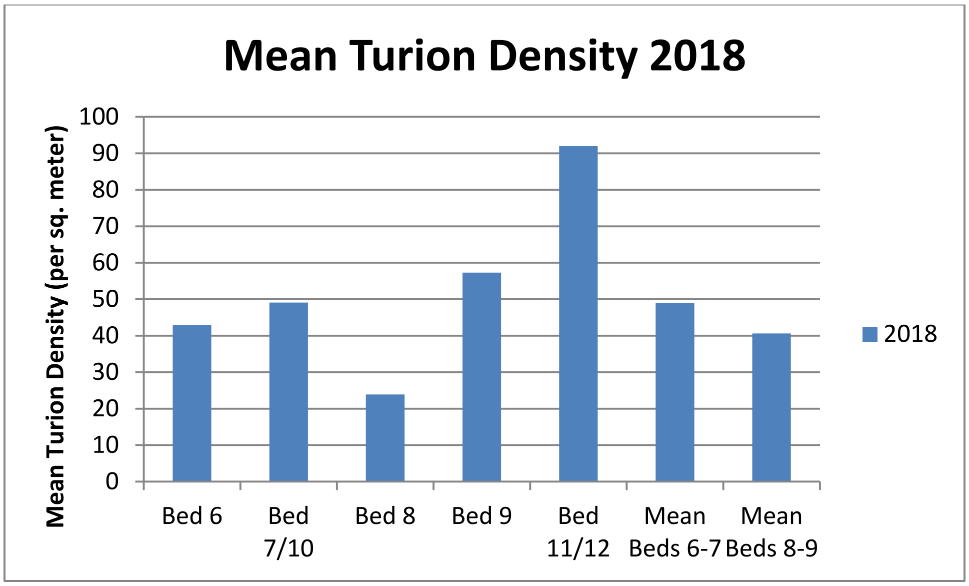


**Figure 9: Graph showing turion density for each bed 2018.**

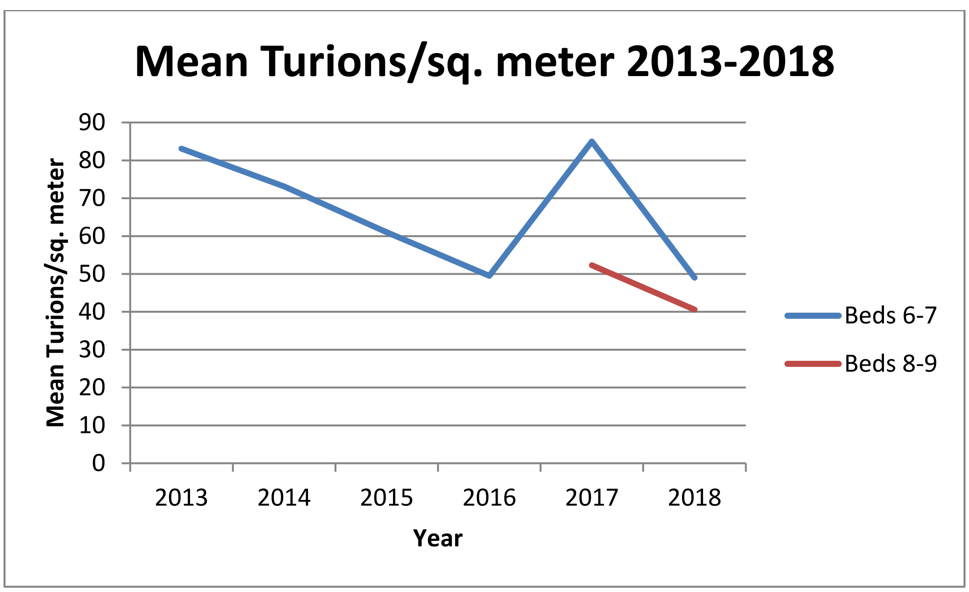


**Figure 10: Mean turion density changes from 2013-18 for the old beds only (doesn't include beds 8 and 9 as they were treated for the first time in 2017).**

### CLP Mapping

Each year the CLP is remapped to determine the aerial coverage of dense CLP beds. Typically, beds that have a mean density greater than 2 and have CLP at or near the water surface are delineated and mapped on Spooner Lake. The CLP had been declining annually, but increased slightly in 2017. This is due to successful treatments and some apparent natural variation that has been a decline overall, but can vary from year to year.

There were no CLP beds to map in 2018. Only a few CLP plants were located outside of the treatment areas. This follows a trend in Spooner Lake, with the CLP growth being highly variable. In past years, a rather large bed may disappear the following year in spite of no treatment.

## Discussion

The herbicide treatment in 2018 was successful at reducing CLP. There was very little CLP growth after treatment in all beds, with only 4 of 172 sample points with CLP (and were individual plants sampled) Overall, the reduction from what was growing before treatment to after treatment was statistically significant ($p<0.0001$). Comparing only beds treated in 2017, there was a decrease in frequency from pretreatment 2017 to pretreatment 2018. The post treatment comparisons between 2017 and 2018 showed a significant decrease in frequency. The new bed could not be compared as a whole, but their frequency and density were reduced significantly after treatment as compared to the pretreatment frequency.

The turion analysis showed a decrease in turion density from 2017 to 2018. It is desired to see annual decreases in turion density as this shows long-term reduction.

The mapping of CLP in the whole lake had no CLP beds being observed to map. CLP growth in Spooner Lake has varied a great deal annually, so it may be wise to wait to see what any new beds do in terms of growth in the future before treating. Furthermore, ice out on Spooner Lake occurred unusually late in spring of 2018 and may have affected CLP growth.

If continued CLP reduction is desired, these treatment areas will need to have herbicide application occur again in 2018. Since turions are still present in each bed, it can be anticipated that CLP will return, but should not be very dense.

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Borman, Susan, Robert Korth and Jo Tempte. *Through the Looking Glass.* University of Wisconsin-Extension. Stevens Point, Wisconsin. 1997. 248 p.

Crow, Garrett E. and C. Barre Hellquist. *Aquatic and Wetland Plants of Northeastern North America.* The University of Wisconsin Press. Madison, Wisconsin. Volumes 1 and 2. 2000. 880p.

Ecological Integrity Service. *Herbicide Treatment Analysis-Potamogeton crispus Spooner Lake, Washburn County WI.* 2014.

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## APPENDIX C. INVASIVE SPECIES INFORMATION[32]

### EURASIAN WATER MILFOIL (*MYRIOPHYLLUM SPICATUM*)[33]

The ecological risks associated with an infestation of Eurasian water milfoil appear to surpass those associated with curly leaf pondweed. This plant is not present in Spooner Lake. However, there is a risk that Eurasian water milfoil may become established in Spooner Lake.

Public boat landings are located at the west side of the lake and the southeast corner of the lake. Many fishermen travel from the Twin Cities, Minnesota metropolitan area, and access the lake at this boat landing. With Eurasian water milfoil present in many urban Twin Cities lakes, such as White Bear Lake and Lake Minnetonka, the danger of transporting plant fragments on boats and motors is very real. The lake is also situated near a major highway, providing easy access to the Twin Cities. According to the Minnesota Sea Grant Office:

> *Eurasian water milfoil can form dense mats of vegetation and crowd out native aquatic plants, clog boat propellers and make water recreation difficult. Eurasian water milfoil has spread to over 150 lakes [in Minnesota], primarily in the Twin Cities area.*

Department of Natural Resource scientists have also found Eurasian water milfoil in the nearby counties of Burnett (Ham Lake and Round Lake) Washburn (Nancy Lake, Totagatic River and the Minong Flowage), Barron (Beaver Dam, Sand, Kidney, Shallow, Duck, and Echo Lakes), Sawyer (Callahan, Clear, Connors, Little Round, Mud, Osprey, Round Lakes and Lake Chippewa, Raddison flowage) and Polk (Long Trade) in Wisconsin.

The following Eurasian water milfoil information is taken from a Wisconsin DNR fact sheet. Both northern milfoil and coontail, mentioned below as frequently mistaken for Eurasian water milfoil are present in Spooner Lake.

#### IDENTIFICATION

Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down,

[32] Information taken from http://dnr.wi.gov/topic/Invasives.

[33] Wisconsin DNR Invasive Species Factsheets from www.dnr.state.wi.us.

often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but it does not have individual leaflets.

## CHARACTERISTICS

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is usually restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lakebeds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

## REPRODUCTION AND DISPERSAL

Unlike many other plants, Eurasian water milfoil does not normally rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring.

## ECOLOGICAL IMPACTS

Eurasian water milfoil's ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead." Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes.

## CONTROL METHODS

Preventing a Eurasian water milfoil invasion requires various efforts. The first component is public awareness of the necessity to remove weed fragments at boat landings. Inspection programs should provide physical inspections as well as a direct educational message. Native plant beds must be protected from disturbance caused by boaters and indiscriminate plant control that disturbs these beds. A watershed management program would keep nutrients from reaching the lake and reduce the likelihood that Eurasian milfoil colonies will establish and spread.

Monitoring is also important, so that introduced plants can be controlled immediately. The SLD and lakeshore owners should check for new colonies and control them before they spread. The plants can be hand pulled or raked. It is imperative that all fragments be removed from the water and the shore.

If Eurasian water milfoil is introduced, additional control methods should be considered including mechanical control, chemical control, and biological control. As always, prevention is the best approach to invasive species management.

Because Eurasian water milfoil is found in nearby lakes, it is prudent to provide a contingency plan to be best prepared to control milfoil, should it be found in the lake. A rapid response plan including a systematic monitoring program and a fund to provide timely treatments is found in Appendix A.

## JAPANESE KNOTWEED (*POLYGONUM CUSPIDATUM*)

### DESCRIPTION

Japanese knotweed is an herbaceous perennial that forms large colonies of erect, arching stems resembling bamboo. Stems are round, smooth, hollow and reddish-brown. Plants reach up to 10 feet.

### IDENTIFICATION

Leaves: Simple, alternate, 3-4” wide and 4-6” long. Leaves are egg shaped to nearly triangular and more heart-shaped on young shoots. They have long petioles that are broad at the base and narrow to a fine point. The upper surface is dark green while the lower surface is pale green.

Flowers: Creamy white or greenish; tiny 0.125” wide; borne in plume-like clusters in upper leaf axils near the end of stems. Bloom August through September.

Fruits and seeds: Seeds are small, triangular, shiny, black produced by female plants; rare since colonies seldom have both male and female plants. The seed is enclosed in a winged calyx that contributes to its buoyancy. The seeds have no dormancy requirement and germinate readily.

Roots: Roots are present along the rhizome and extend deeply into the soil creating a dense impenetrable mat.

### CONTROL

Mechanical: Hand-pull young plants; dig or till when soil is soft. Plants should be pulled up by the root crown, trying to remove as much of the rhizomes as possible because any rhizomes remaining in the soil will produce new plants at each node. It is possible to eradicate small patches of knotweed with repeated and persistent cutting of the plants.

Chemical: Plants are more susceptible to herbicides if they are cut when 4-5’ tall and the regrowth treated around 3’ tall. Foliar application of glyphosate with a surfactant, triclopyr formulated for use with water, dicamba, or imazapyr may be effective on large populations. Tests involving large-bore needle injection of glyphosate into the lower nodes of each stem have been successful.

## PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)

### DESCRIPTION

Purple loosestrife is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes (underground stems) that form a dense mat.

### CHARACTERISTICS

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

### REPRODUCTION AND DISPERSAL

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

## ECOLOGICAL IMPACTS

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

## MECHANICAL CONTROL

Purple loosestrife (PL) can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective, but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps nor root tips, while large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full twelve months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

## CHEMICAL CONTROL

This is usually the best way to eliminate PL quickly, especially with mature plants. The chemicals used have a short soil life. Timing is important. Treat in late July or August, but before flowering to prevent seed set. Always back away from sprayed areas as you go, to prevent getting herbicide on your clothes. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem, but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

**Glyphosate herbicides:** Currently, glyphosate is the most commonly used chemical for killing loosestrife. Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife and there is no cost. Contact your regional Aquatic Plant Management Coordinator for permit information.

## BIOLOGICAL CONTROL

Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles (*Galerucella calmariensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratus*) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

## ZEBRA MUSSELS (*DREISSENA POLYMORPHA*)


The zebra mussel is a tiny (1/8-inch to 2-inch) bottom-dwelling clam native to Europe and Asia. Zebra mussels were introduced into the Great Lakes in 1985 or 1986, and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals.

Zebra mussels were first found in Wisconsin waters of Lake Michigan in 1990. They are now found in a number of inland Wisconsin waters. Zebra mussels are the only freshwater mollusks that can firmly attach themselves to solid objects. They are generally found in shallow (6-30 feet deep), algae-rich water.

Zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals, and debris for food. This process can lead to increased water clarity and a depleted food supply for fish and other aquatic organisms. The higher light penetration fosters growth of rooted aquatic plants which, although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers, and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since zebra mussels avoid consuming this type of algae but not others.

Once zebra mussels are established in a water body, very little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Be sure to follow the Clean Boats, Clean Waters procedure in preventing the spread of aquatic hitchhikers. In addition to these measures, boaters can take specific precautions in protecting their motors from zebra mussels.

### CONTROL

No selective method has been developed that succeeds in controlling zebra mussels in the wild without also harming other aquatic organisms. To a certain extent, ducks and fish will eat small zebra mussels, but not to the point of effectively controlling their populations. As of yet, no practical and effective controls are known, again emphasizing the need for research and prevention.

# APPENDIX D. AQUATIC PLANT MANAGEMENT METHODS

Techniques to control the growth and distribution of aquatic plants are discussed in following text. The application, location, timing, and combination of techniques must be considered carefully.

## MANUAL REMOVAL[35]

Manual removal involving hand pulling, cutting, or raking plants will effectively remove plants from small areas. It is likely that plant removal will need to be repeated during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants that possess rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil (EWM) establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking can be used to clear nuisance growth in riparian area corridors up to 30 feet wide. Recent costs for hand-pulling EWM using divers on Minocqua and Kawaguesaga Lakes in Oneida County were about $28,000 to remove an estimated <4,000 lbs.

## MECHANICAL CONTROL

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver assisted suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. Department of Natural Resources permits under Chapter NR 109 are required for mechanical plant removal.

**Aquatic plant harvesters** are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from 1 to 6 feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. A harvester can also be used to gather dislodged, free-floating plant fragments such as from coontail or wild celery. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and resulting harvesting capabilities of these machines, vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases, the plants are transported to shore by the harvester itself for disposal, while in other cases, a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm to be used as compost (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

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[35] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Sediment suspension and shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species such as Eurasian water milfoil to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures do not make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the cost and time efficiency of the operation.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since contracted machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines. Harvesting is an alternative for removing curly leaf pondweed and maintaining navigation channels for Spooner Lake.

**Skimming for Filamentous Algae Removal.** Harvesting equipment outfitted with narrow grates is sometimes used to skim free-floating filamentous algae and duckweed. Operators report poor success with such equipment[36], and

[36] Personal communication, Dale Richardson, Apple River Protection and Rehabilitation District. 02/20/2019.

best results were obtained when algae and duckweed was attached to aquatic plants or when filamentous algae was present in large masses that could be collected with conventional equipment.[37]

**Diver dredging operations** use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant including the subsurface portions should be removed.

Plant fragments can be formed from this type of operation. Fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated to be effective. When applied toward a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates can play an important part in the effectiveness of a diver dredging operation. Soft substrates allow easy harvesting. Divers can remove the plant and root crowns with little problem. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

**Diver Assisted Suction Harvesting (DASH)**

With Diver Assisted Suction Harvesting (DASH) divers hand pull aquatic invasive plants from the lake-bed. A suction line transports removed plants to the surface. This method is probably most appropriate for relatively small and less dense areas of invasive plant growth. Poor water clarity will make it more difficult to use DASH.[38]

The Tomahawk Lake Association (TLA) developed and has used a DASH system for several years, although they call their system a hydraulic conveyor system (HCS). HCS is an automated system that removes, filters, and bags harvested EWM after it has been hand harvested from the lake bed by divers. The TLA HCS includes a floating chassis, a "jet pump" water system, a three tiered separation system, and a Hookah diver air supply system.[39] Use of the TLA HCS began in the summer of 2007. A second generation HCS began operation in 2011. Capital costs for the system are just over $25,000, and annual operating costs are about $31,000. The TLA harvested about 20,000 lbs. each year through 2014.

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[37] Personal communication. Dale Richardson, Apple River Protection and Rehabilitation District and Rod Preble, Balsam Lake Protection and Rehabilitation District. 02/20/2019.

[38] Wisconsin Lakes Convention Presentation. 2016.

[39] Wisconsin Lakes Convention presentation, TLA Hydraulic Conveyor System. Ned Greedy, 2014.


Figure 26. DASH Contract Harvesting

Because of the mechanical elements of the system, a WDNR aquatic plant management harvesting permit is required. Contracted DASH systems are available. Decontamination of the system is especially important with a contracted DASH system that moves between lakes. A recent estimate for 2017 from a contractor was $2,500/day with harvesting amounts varied with total EWM acreage and density. With high density, the contractor reported removing 3,000 pounds in a single day.[40]

**Rotovation** involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling sediments that are contaminated could possibly release toxins to the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

[40] TSB Lakefront Restoration Email Communication. January 2017.

## BIOLOGICAL CONTROL[41]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, as well as plant-specific control. On the other hand, there are several disadvantages to consider, including very long control times of years instead of weeks, lack of available agents for particular target species, and relatively narrow environmental conditions for success.

While this theory has worked in practice for control of some nonnative aquatic plants, results have been varied (Madsen, 2000). Beetles are commonly used to control purple loosestrife populations in Wisconsin with good success. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations. Grass carp introduction is not allowed in Wisconsin.

**Eurasian Water milfoil Biocontrol**

A potential management method for EWM is the use of the native weevil *Euhrychiopsis lecontei*. This weevil has a larvae stage that feeds on both native milfoils and Eurasian water milfoil. The larvae tunnel into the stem causing the plant to presumably lose the ability to transport nutrients and gases. *E. lecontei* adults swim and climb from plant to plant, feeding on leaflets and stem material. After mating, the female lays an average of 1.9 eggs a day, usually 1 egg per water milfoil apical meristem (growing tip). One female may lay hundreds of eggs in her lifetime. The eggs hatch, and the larvae first feed on the apical meristem and then mine down into the stem of the plant, consuming internal stem tissue. Weevils pupate inside the stem in the pupal chamber, a swelled cavity in the stem. Adults emerge from the pupal chamber to mate and lay eggs. In the autumn, adults travel to the shore where they over-winter on land. In the laboratory, *E. lecontei* take 20 to 30 days to complete 1 life cycle, depending on water temperatures. For complete development, weevils require about 310 degree-days with temperatures above 10 degrees C. Two to four generations per year are generally observed in the field.[42]

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[41] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005 except as otherwise noted.

[42] *Euhrychiopsis lecontei* fact sheet. Cornell University Research Ponds Facility.

< http://www.eeb.cornell.edu/ponds/weevil.htm>.

Since this weevil naturally occurs in many Wisconsin lakes, its use involves the augmentation of the natural population of weevils present in the lake. This augmentation can significantly increase the population of larvae per stem of milfoil. The premise is that this increase will lead to more destruction of the plants.

**Purple Loosestrife Biocontrol**[43]

Biocontrol may be the most viable long term control method for purple loosestrife control. The WDNR and University of Wisconsin-Extension (UWEX), along with hundreds of citizen cooperators, have been introducing natural insect enemies of purple loosestrife, from its home in Europe to infested wetlands in the state since 1994. Careful research has shown that these insects are dependent on purple loosestrife and are not a threat to other plants. Insect releases monitored in Wisconsin and elsewhere have shown that these insects can effectively decrease purple loosestrife size and seed output, thus letting native plants reduce its numbers naturally through enhanced competition.

A suite of four different insect species has been released as biological control organisms for purple loosestrife in North America and Wisconsin. Two leaf beetle species called "Cella" beetles that feed primarily on shoots and leaves were the first control insects to be released in Wisconsin, and are the insects available from WDNR for citizens to propagate and release into their local wetlands. A root-mining weevil species and a type of flower-eating weevil have also been released and are slowly spreading naturally. The Purple Loosestrife Biocontrol Program offers cooperative support, including free equipment and starter beetles from WDNR and UWEX, to all state citizens who wish to use these insects to reduce their local purple loosestrife.

The length of time required for effective biological control of purple loosestrife in any particular wetland ranges from one to several years depending on factors such as site size and loosestrife densities. The process offers effective and environmentally sound control of the plant, not elimination, in most cases. It is also typically best done in some combination with occasional use of more traditional control methods such as digging and herbicide use. Biocontrol with beetles may be appropriate at some point in time should purple loosestrife become well-established around Spooner Lake.

## RE-VEGETATION WITH NATIVE PLANTS

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant removal is probably not necessary on Spooner Lake because a healthy, diverse native plant population is present.

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[43] http://dnr.wi.gov/topic/Invasives/loosestrife.html.

## PHYSICAL CONTROL[43]

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required.

**Dredging** removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a lake remediation technique.

Dredging is not suggested for Spooner Lake as part of the aquatic plant management plan at this time.

**Drawdown,** or significantly decreasing lake water levels, can be used to control nuisance plant populations. With drawdown, the water body has water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980).

Although drawdown is inexpensive and has long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and often not in a consistent fashion (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals.

There have been two drawdowns performed in Spooner Lake.  One was for the sole purpose of reducing aquatic plants. The results were viewed as relatively positive on a short-term basis.  There is no scientific data to verify the result. If drawdown were used as a management tool, it would have to occur often. This would make plant management difficult since it would eventually select species that are resistant to

[43] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

drawdown, making it less effective through time. Drawdown could potentially have a dramatic effect on the lake ecosystem beyond the plant community.

In the future, if drawdown is necessary for dam maintenance, it may also be considered for aiding in plant management. The desired amount of water level reduction for plant management can be evaluated prior to a drawdown operation.

**Benthic Barriers,** or other bottom-covering approaches, are another physical management technique. The basic idea is that the plants are covered over with a layer of a growth-inhibiting substance. Many materials have been used including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt, or clay; fly ash; and combinations of the above (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from decomposition of plants and sediment decomposition collect under and lift the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill plants under them within 1 to 2 months, after which they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, benthic barriers are too expensive to use over widespread areas, and they heavily affect benthic communities by removing fish and invertebrate habitat. A Department of Natural Resources permit would be required for a benthic barrier and is not recommended for Spooner Lake.

**Shading or light attenuation** reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general, these techniques are of only limited applicability. Physical control is not currently proposed for management of aquatic plants in Spooner Lake.

## HERBICIDE AND ALGAECIDE TREATMENTS

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. Wisconsin

Department of Natural Resources permits under Chapter NR 107 are required for herbicide application. **Aquatic herbicides must be applied only by licensed applicators.**

General descriptions of herbicide classes are included below.[44]

## CONTACT HERBICIDES

Contact herbicides act quickly and are generally lethal to all plant cells that they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly re-sprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat,** and **copper** are contact aquatic herbicides.

## SYSTEMIC HERBICIDES

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides, and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides because they must move within the plant. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

## BROAD SPECTRUM HERBICIDES

Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but they can also be used selectively under certain circumstances.

[44] This discussion is taken directly from: Managing Lakes and Reservoirs. North American Lake Management Society.

## SELECTIVE HERBICIDES

Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

## ENVIRONMENTAL CONSIDERATIONS

Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community that can, in turn, affect other organisms. Or, weed control operations can affect water chemistry that, in turn, affects organisms.

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[45] Chemicals commonly used in Wisconsin lakes are listed and described in Table 18 below.

**Table 18. Herbicides Used to Manage Aquatic Plants in Wisconsin**

| Brand Name(s) | Chemical | Target Plants |
|---|---|---|
| Captain, Nautique, Cutrine Plus, Mizzen | Copper compounds | Free floating and filamentous algae, also coontail, curly leaf pondweed, water celery, pondweeds |
| Aquathol K, Hydrothal | Endothall | Curly leaf pondweed also other submergent plants: coontail, milfoil, pondweed, water celery |
| Reward | Diquat | Pondweeds, coontail, Eurasian water milfoil |
| Aquakleen, Navigate | 2,4-D | Eurasian and other milfoils |

[45] These descriptions are taken from Hoyer/Canfield: Aquatic Plant Management. North American Lake Management Society. 1997.

## COPPER[46]

Copper is an essential trace element that tends to accumulate in sediments and can be toxic to aquatic life at elevated concentrations (United States Environmental Protection Agency, June 2008).

A study completed by MacDonald et al. (2000) developed consensus based numerical sediment quality guidelines for metals in freshwater ecosystems. This study provides guidelines for metals in freshwater ecosystems that reflect threshold effect concentrations (TECs, below which harmful effects are unlikely to be observed) and probable effect concentrations (PECs, above which harmful effects are likely to be observed). The consensus based TEC for copper is 31.6 mg/kg and the consensus based PEC for copper is 149 mg/kg.

## 2,4-D

2,4-D photodegrades on leaf surfaces after applied to leaves and is broken down by microbial degradation in water and sediments. Complete decomposition usually takes about 3 weeks in water and can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

Recent WDNR studies contradict the above information. Under certain conditions, residual concentrations of 2,4-D above 100 ug/L may be present well past label irrigation restriction guidelines of 21 days. Degradation takes longer in some lakes:

- Oligotrophic (low-nutrient) lakes
- Low alkalinity lakes
- Lakes with no history of herbicide usage
- When water temperatures are cool. (WDNR, 2011)

Granular formulations of 2,4-D and other herbicides dissipate at about the same rate as liquid formulations of herbicides (WDNR, 2011).

Some recent studies indicate a need to consider the long-term effects of 2,4-D use. One is the effect on the endocrine system and reproduction of fat head minnows (DeQuattro, 2015). There is also some evidence that hybrid EWM can acquire resistance to 2,4-D (LaRue et al, 2013).

## DIQUAT

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by

[46] Copper background information is from the Long Lake Management Plan prepared by the Polk County Land and Water Resources Department. March 2013.

microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

### ENDOTHALL

Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

### FLURIDONE

Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs. Microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter when the sun's rays are less direct and days are shorter result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

With the aquatic herbicide fluridone (Sonar®), hybrid tolerance appears to be limited to fewer hybrid lineages. While hybrid resistance to fluridone has been observed in a small percentage of lakes, hybridity does not necessarily infer fluridone tolerance. (Groves, 2015)

### GLYPHOSATE

Glyphosate is not applied directly to water for weed control. However, when it does enter the water, it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

### ALGAECIDE TREATMENTS FOR FILAMENTOUS ALGAE

Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

## HERBICIDE USE TO MANAGE AQUATIC INVASIVE SPECIES

### CURLY LEAF PONDWEED

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Early season herbicide treatment:[47]

Studies have demonstrated that curly leaf pondweed (CLP) can be controlled with Aquathol K (a formulation of endothall) in 50 - 60 degree F water, and treatments of CLP this early in its life cycle can prevent turion formation. Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are yet dormant, this early season treatment selectively targets curly leaf pondweed.

Because the dosage is at lower rates than dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[48]

## EURASIAN WATER MILFOIL

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: complexed copper, 2,4-D, diquat, endothall, fluridone, and triclopyr. Early season treatment of Eurasian water milfoil is also recommended by the Department of Natural Resources to limit the impact on native aquatic plant populations. 2,4-D is frequently used to target EWM (a dicot) over many other native plants (monocots).

However, large-scale treatments can result in significant damage to both monocots and dicots.

- Dicots susceptible to both 2,4-D and fluridone include native water milfoils (particularly northern), bladderworts, water lilies, and coontail.
- Monocot species such as elodea, several narrow leaf pondweeds, and naiads are also impacted by fluridone and some 2,4-D use.
- Fewer natives are affected at lower dosages. (WDNR, 2011)

Wisconsin DNR research indicates that larger scale treatments seem to have more consistent reduction from herbicide use than smaller treatments. These results are based upon data collection in many Wisconsin lakes where herbicides were used for EWM control. (Nault, 2015)

Herbicides can dissipate off of a small treatment site very rapidly. 2,4-D dissipated rapidly after treatment after it was applied to 98 small (0.1-10 acre) treatment areas across 22 study lakes with application rates of 2-4 parts per million (ppm). The following results were found:

- Initial 2,4-D concentrations detected in the water column were well below application targets.
- Herbicide moved quickly away from treatment sites within a few hours after treatment.

[47] Research in Minnesota on Control of Curly Leaf Pondweed. Minnesota Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

[48] Personal communication, Frank Koshere. March 2005.

- The rapid dissipation of herbicide indicates that the concentrations in target areas may be lower than what is needed for effective EWM control. (Nault, 2012)

## NATIVE PLANT AQUATIC PLANT MANAGEMENT

The WDNR Northern Region released an Aquatic Plant Management Strategy in the summer of 2007 to protect the important functions aquatic plants provide in lakes. As part of this strategy, the WDNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.[49] Permits for waterfront corridors were issued in 2008 only for formerly permitted sites where impairment of navigation and/or nuisance conditions were demonstrated. Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners is carefully reviewed. The WDNR has not allowed removal after January 1, 2009, unless the “impairment of navigation” and/or “nuisance” conditions are clearly documented.

The WDNR recommends (and may require) that residents who wish to maintain an opening for boating and swimming use rakes or other hand methods.

[49] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

## APPENDIX E. DRAWDOWN GUIDANCE FROM WDNR AND PROJECT CONSULTANT

**State of Wisconsin**
**DEPARTMENT OF NATURAL RESOURCES**
**101 S. Webster Street**
**Box 7921**
**Madison WI 53707-7921**

**Tony Evers, Governor**
**Preston D. Cole, Secretary**
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

February 19, 2019

Michael Plisky - Chairman
Spooner Lake District

Subject: DNR response to Spooner Lake District drawdown request

Dear Mr. Plisky,

Below are the DNR criteria we would want Spooner Lake District to investigate/consider with a winter drawdown of Spooner Lake. This response is broken down by different environmental areas that we will have concerns with followed by a bulleted list of specific criteria for a drawdown:

**FISHERIES**

After looking through our old files and consulting with Stan Johannes and Larry Damman (the previous two fisheries biologists in Spooner), it appears that a drawdown would likely not result in a large fish kill based on previous survey information. Both former biologists felt that it was effective tool for aquatic plant management and did not negatively affect the fish populations long term in 1984/1985. Stan and Larry both felt it did result in positive impacts for the fishery. They also stated that it is something that cannot be done frequently. I could not find any data related to other Spooner Lake drawdowns. No restocking occurred in prior drawdowns. With this knowledge, Fisheries would like to accurately survey the fish population before and after a potential drawdown. We (DNR Fisheries) could commit to surveying the lake post-drawdown to check for potential impacts. If possible, we might do a pre-drawdown survey also, dependent on our workload. These surveys will likely take place during the fall and be electrofishing.

Some thoughts to consider:

- This management idea is proposed for control of aquatic vegetation and is not an activity DNR fisheries would recommend as a fisheries management tool for Spooner Lake due to its inclination to have winterkills.
- There is still a chance of a severe winterkill if the conditions are right. Obviously, these scenarios rely on weather. There is no way to predict that.
- To minimize a chance of winterkill, a winter drawdown should stay in place until ice out the following spring. Fisheries would also like to see Spooner Lake refilled by May at the latest.
- Refill during a dry spring could be an issue and potentially harm fish spawning in the lake due to fluctuation of water levels.
- Angler access at Mann Rd will likely be impacted by a drawdown. Ice fishing and open water fishing may be impacted.

**WILDLIFE/ ENDANGERED RESOURCES**

These are concerns shared by our DNR wildlife and endangered resources staff. Minimally mobile invertebrates such as mollusks are susceptible to drawdowns initiated while they are in shallow water. However, many invertebrates (particularly snails) move offshore for the winter, limiting impacts of a winter drawdown. For turtles and frogs, a drawdown that reaches its lowest level by October 1 will minimize mortality of these species during a winter drawdown. Some turtles, like snappers, can move during winter, while others, like painted and Blanding's turtles, cannot, making them susceptible to late season drawdowns. Overwintering green frogs and mink frogs (if present) are also likely to be negatively impacted by a drawdown if the lowest level is not reached until after October 1. However, frog species can have frequent years of high reproduction and will be able to repopulate much more rapidly than turtles.

Beaver, muskrats, otter, and mink that den in the banks may be forced to move. Any negative impacts will be minimal because beaver and muskrat populations are healthy. There are potential human/wildlife negative impacts as the beaver and muskrat are forced to move elsewhere and potentially cause problems for neighboring landowners. Beaver lodges are protected, because furbearers and other wildlife use it for shelter and for nesting. Otter and mink handle change better and may benefit from more successful fishing if fish are artificially concentrated. Local trappers may be negatively affected if the animals move from trapping locations that were previously scouted or set with traps. Waterfowl hunting access may be limited and negatively impacted during the drawdown year. Vegetation growth in associated wetlands may negatively impact waterfowl use of those areas. A slower than expected refill could impact nesting/habitat of waterfowl and loons within Spooner Lake.

- If a winter drawdown occurs the recommendation is that the lowest water level be reached by no later than Oct 1 to minimize or eliminate impacts to overwintering herptiles and other wildlife.

**LAKE VEGETATION/ WATER QUALITY**

Aquatic plants form the foundation of healthy and flourishing lake ecosystems - both within lakes and rivers and on the shores around them. They not only protect water quality, but they also produce life-giving oxygen. Aquatic plants are a lake's own filtering system, helping to clarify the water by absorbing nutrients like phosphorus and nitrogen that could stimulate algal blooms. Plant beds stabilize soft lake and river bottoms and reduce shoreline erosion by reducing the effect of waves and current. Healthy native aquatic plant communities help prevent the establishment of invasive non-native plants like Eurasian water-milfoil. In most instances, control of native aquatic plants is discouraged or should be limited to high use recreational areas that are next to piers and docks or within navigational channels.

Flowage drawdowns are a tool for managing aquatic plants. By drawing down water levels and exposing aquatic plants to freezing temperatures over the winter aquatic plants and their seeds may be negatively impacted. Heavy snowfall before extended freezing temperatures can insulate the exposed areas preventing adequate conditions to insure successful outcomes. If successful, plant population levels in this exposed area will recolonize within a few years.

In most cases the targeted aquatic plants to be managed by this technique are aquatic invasive species (AIS). Spooner Lake has one AIS, curly-leaf pondweed, which the district has been managing using herbicides since 2008. CLP is growing at depths in Spooner Lake deeper than the expected drawdown depth and will likely be unaffected by a drawdown.

The 1969 WDNR Spooner Lake Survey Map shows both 3 and 5- foot contours. According to the WDNR Spooner Lake Survey Map, 11% of Spooner Lake is less than 3 feet deep (122.3 acres) and there is approximately 11.2 miles of shoreline. Obviously, distances of exposed lake bed will vary but calculations indicate that a drawdown of Spooner Lake to the 3-foot contour would result in a lake wide average exposed lakebed of 90 feet extending from shore.

The following information is necessary prior to DNR supporting a drawdown for aquatic plant management purposes:

- Clear management goals and objectives for the drawdown and a monitoring plan to determine if the goals and objectives were met. If the overarching goal is to reduce native aquatic plant nuisance conditions, "nuisance" should be defined in a measurable way and the corresponding objective should include a quantitative reduction and timeline. We suggest incorporating these management goals, objectives, and definitions into your aquatic plant management plan update regardless if a drawdown is pursued in the near future.
- A public participation effort, possibly including a stakeholder survey and information meeting.
- If expected drawdown is other than 3 feet, a map showing the exposed lake bed and calculations showing the expected exposed area should be included.

**DAM SAFETY**

As far as DNR Dam Safety is concerned, because there is no ordered minimum water level for Spooner Lake and only a normal and maximum water level, a **formal permit and formal hearing are not required** from DNR.

Dam safety does require that 25% of the low flow (considered the 7Q10) is maintained because it is a navigable stream (Ch. 31.34). According to the approved 2015 dam reconstruction plans created by Ayres, this was considered to be 5 cfs. The USGS regression equations used in the Department's Surface Water Data Viewer (SWDV) also reflect this number. The Department will require a discharge of 5 cfs to be maintained at all times if the drawdown is to occur. Based on the current configuration of the dam with a current normal water level of 1089.5 ft (NAVD88) and the sluice gate invert of 1085.5, the minimum water level to be maintained is 1086.35. This corresponds to a maximum allowable drawdown of 3.2 ft from the normal water level which will maintain the 5 cfs 7Q10. To prevent sedimentation downstream, we also advise a drawdown rate no greater than 6 in/day. Dam Safety would like to be involved and updated during the drawdown and refill process, if the proposed drawdown occurs.

**WATER REGULATION**

DNR would suggest that if this drawdown is going to happen, that Spooner Lake District petition Washburn County to hold an informal informational hearing once we get all the needed information from the dam owner/Lake District. It also would be good for the County to publish a news release, and post this on social media sites of interest as well.

- If the drawdown occurs, since there are upstream historic wild rice beds (on Spooner Lake), and existing beds downstream (between Hwy 70 and the dam in the City of Spooner, near the hatchery), formal tribal consultation will be required.

When making a final recommendation, the Department will evaluate the costs versus benefits of a drawdown, taking into account a number of the below criteria. Below is a summary of criteria that should be carried out by the Spooner Lake District prior to considering or during a potential drawdown. This list will form the basis for the Department to make a final recommendation on the proposed drawdown of Spooner Lake.

- Work with Washburn County to setup an informational public meeting, advertise in local newspapers/social media.
- As far as Dam Safety is concerned, because there is no ordered minimum water level for Spooner Lake and only a normal and maximum water level, a **formal permit and formal hearing are not required** from DNR. As a result, there are no permit fees associated with DNR.
- Consider doing a stakeholder survey for all lake residents to formalize support of a drawdown.
- A <u>maximum allowable drawdown of 3.2 ft (1086.35 ft NAVD88)</u> is allowed which will maintain the 5 cfs 7Q10. To prevent sedimentation downstream, we also advise a drawdown rate no greater than 6 in/day. Dam Safety would like to be involved and updated during the drawdown and refill process, if the proposed drawdown occurs.
- For fisheries, a refill should not occur until ice-out. Ideally, it would be refilled by May to avoid disrupting fish spawning activity.
- For wildlife/endangered resources, if a winter drawdown occurs the recommendation is that the lowest water level be reached by no later than Oct 1 to minimize or eliminate impacts to overwintering herptiles and other wildlife.
- Update your Aquatic Plant Management plan with clear management goals and objectives for the drawdown and a monitoring plan to determine if the goals and objectives were met. If the overarching goal is to reduce native aquatic plant nuisance conditions, "nuisance" should be defined in a measurable way and the corresponding objective should include a quantitative reduction and timeline. We suggest incorporating these management goals, objectives, and definitions into your aquatic plant management plan update regardless if a drawdown is pursued in the near future.
- If expected drawdown is other than 3 feet, a map showing the exposed lake bed and calculations showing the expected exposed area should be included.
- If the drawdown occurs, since there are upstream historic wild rice beds (on Spooner Lake), and existing beds downstream (between Hwy 70 and the dam in the City of Spooner, near the hatchery), formal tribal consultation will be required.

Please contact me or anyone else listed below if you have questions regarding these criteria. This letter was drafted in consultation with the below DNR staff members in Spooner.

Sincerely,

Craig M Roberts

Craig Roberts
Fisheries Biologist

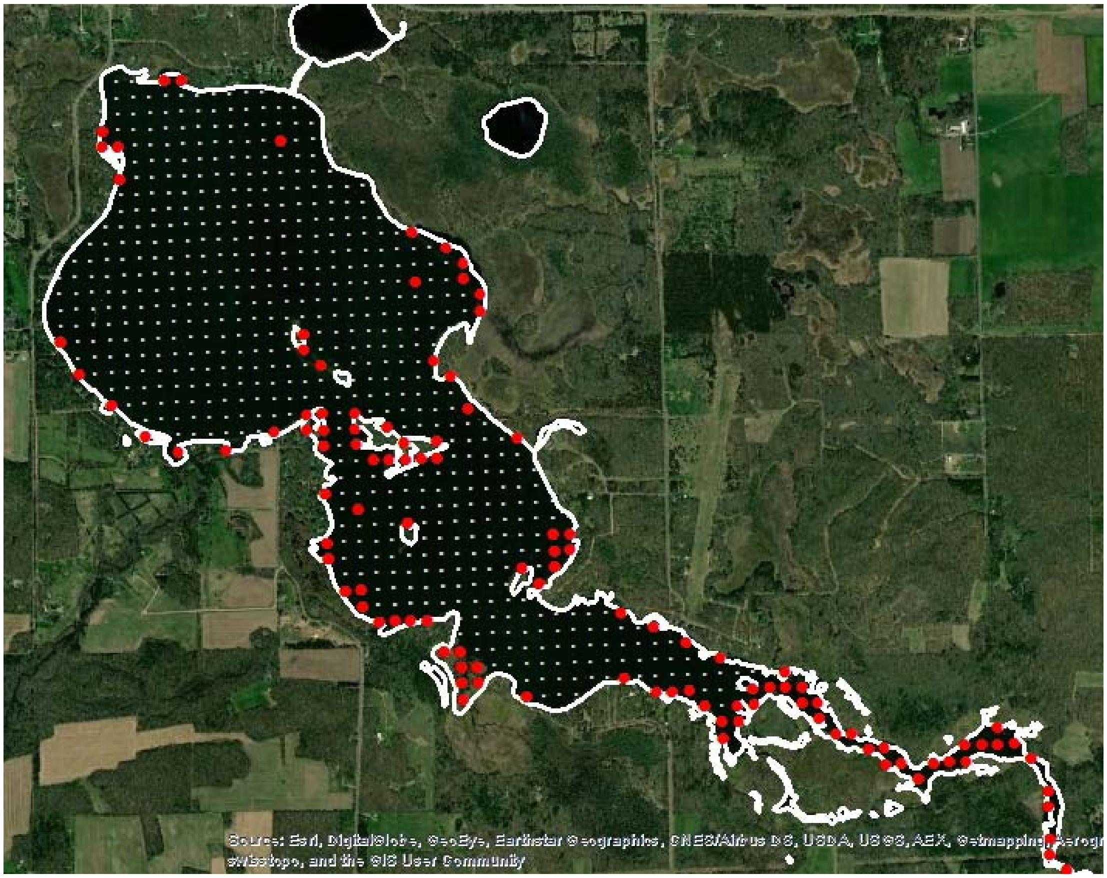
Ecc: Nancy Christel, Wildlife Biologist
Jacob Druffner, Water Management Engineer
Dan Harrington, Water Management Specialist
Ryan Magana, Conservation Biologist
Mark Sundeen, Water Resources Management Specialist
Pamela Toshner, Water Resources Management Specialist- Advanced

### *Ecological Integrity Service Perspectives on Spooner Lake Drawdown*

Assuming Spooner Lake has some nuisance level plant growth in some areas of the lake that can adversely affect navigation and recreational lake use, drawdown may be a viable option as a management tool. However, there are many things to consider and most (if not all) have been outlined by the Wisconsin DNR. The following bullet points are things we consider in this decision:

- This management tool has been used, so there hopefully is some information as to its effectiveness.
- The aquatic plant coverage in Spooner Lake is nearly 100%, so this should not adversely affect the plant community overall.
- A winter drawdown would likely kill aquatic plants if there is sufficient freeze. If there is thick snow cover early in winter, it could reduce the effectiveness by reducing degree of freezing.
- Thick nuisance areas within the drawdown depth would likely decrease in density, assuming sufficient freeze.
- The reduction in plant density will be temporary. The number of growing seasons needed to return to previous density would be unknown (evaluate past drawdown). Plants with rhizomes could recover more rapidly than plants that grow only from seed. Therefore, it would likely vary from species to species, thus some areas of the lake at different rates.
- This management would not likely be effective for AIS control of *Potamogeton crispus*, since it is present in depths that exceed the drawdown depth.
- If reduction of filamentous algae occurs, the recovery time would be unknown (evaluate past drawdown and is there data from another lake?).
- There are no known highly sensitive plants or threatened or endangered plants that would be adversely affected.
- A concern would be the effect on fisheries. It may be significant or not. The DNR fisheries would need to address this.
- A concern would be the effect on amphibians, reptiles and possibly mammals. They could likely relocate, but there could be some negative effects. Rare, threatened or endangered fauna should be evaluated to eliminate any concern for these organisms should they be present.
- A three foot drawdown would have a limited area of lake bed affected. This could reduce negative side effects, but could also limit desired results.
- This management tool shouldn't cost much if anything and does not involve chemical use and does not increase the chance for AIS.

Map from PI survey showing the locations of sample points 3 feet or less in depth. The three foot depth can be delineated in the future. All points in red are 3 ft or less and had water present in August 2018. ~Historical bathymetry reports as 11% of lake area in <3ft.



## APPENDIX F: NORTHERN REGION WDNR AQUATIC PLANT MANAGEMENT STRATEGY

# AQUATIC PLANT MANAGEMENT STRATEGY

## Northern Region WDNR
## Summer, 2007

# AQUATIC PLANT MANAGEMENT STRATEGY
# Northern Region WDNR

## ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote “whole lake” management plans
- Limit the number of permits to control native aquatic plants.

## BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the “up-north” appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these “invaders” benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

**GOALS OF STRATEGY**:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

**BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE**

**State Statute 23.24 (2)(c)** states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). "

**State Statute 23.24(3)(b)** states:
"The department may require that an application for an aquatic plant management permit contain a plan for the department's approval as to how the aquatic plants will be introduced, removed, or controlled."

**Wisconsin Administrative Code NR 109.04(3)(a)** states:
"The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities."

# AQUATIC PLANT MANAGEMENT STRATEGY
# Northern Region WDNR

## APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents “impairment of navigation” and/or “nuisance conditions”. Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of “impairment of navigation” and/or “nuisance conditions”. No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR’s Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or “mixed stands” of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if “impairment of navigation” and/or “nuisance conditions” is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or “mixed stands” of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

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* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

# AQUATIC PLANT MANAGEMENT STRATEGY
# Northern Region WDNR

## DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

**Documentation of *impairment of navigation*** by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

**Documentation of the *nuisance*** must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

# AQUATIC PLANT MANAGEMENT STRATEGY
# Northern Region WDNR

## DEFINITIONS

| | |
|---|---|
| Manual removal: | Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver. |
| Native aquatic plants: | Aquatic plants that are indigenous to the waters of this state. |
| Invasive aquatic plants: | Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. |
| Sensitive area: | Defined under s. NR 107.05(3)(i) (sensitive areas are 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). |
| Rapid Response protocol: | This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established. |

## APPENDIX G. FUNDING SOURCES

### GRANT PROGRAM: AQUATIC INVASIVE SPECIES

Wisconsin Department of Natural Resources

Program Goals/Objectives: prevent and control aquatic invasive species

Eligible Applicants: qualified lake and river management organizations and qualified school districts

Eligible Project Elements: education, prevention, and planning; early detection and response; controlling established infestations

Funding Limits and Rate: 75% of project costs up to $150,000 for education, prevention, planning; 75% of project costs up to $200,000 for controlling established infestations; and 75% of project costs up to $20,000 for early detection and rapid response

Application Deadline: December 10th of each year

Contact: Pamela Toshner 715.635.4073

### GRANT PROGRAM: LAKE PLANNING

Wisconsin Department of Natural Resources

Program Goals/Objectives: collect information in order to manage lakes

Eligible Applicants: qualified lake and local government organizations; qualified school districts

Eligible Project Elements: monitoring and education; organization development; studies or assessments

Funding Limits and Rate: small scale-67% state share with a cap of $3000; large scale-up to 67% state share with a cap of $25,000

Application Deadline: December 10th of each year

Contact: Pamela Toshner 715.635.4073

## APPENDIX H. DEFINITIONS

**Critical Habitat Area -** Critical Habitat areas include both Sensitive Areas and Public Rights Features. These sites are sensitive and fragile areas that support wildlife and fish habitat, provide the mechanisms that protect the water quality in the lake, harbor quality plant communities, and preserve the places of serenity and aesthetic beauty for the enjoyment of lake residents and visitors. (Administrative code 107.05(3)(1)(1)).

**Eutrophic -** refers to a nutrient-rich lake. Large amounts of algae and weeds characterize a eutrophic lake.

**Invasive species** – means nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (Section 23.22 (1) (c), Stats). Prohibited and restricted invasive species are designated in Chapter NR 40.

**Native species** – means a species indigenous to Wisconsin, and includes an individual specimen. For fish, "native species" means those fish species identified as native fish species in *Wisconsin Fishes 2000: Status and Distribution,* by Lyons, J., P. A. Cochran, and D. Fago, published by University of Wisconsin Sea Grant Institute, and includes an individual specimen, regardless of the specimen's origin (Chapter NR 40).

**Non-native species** – means a species not indigenous to Wisconsin, and includes an individual specimen (Chapter NR 40).

**Littoral zone –** means the region of a body of water extending from shoreline outward to the greatest depth occupied by rooted aquatic plants.

**Mesotrophic -** refers to a moderately fertile nutrient level of a lake between the oligotrophic and eutrophic levels.

**Navigation channel** – is a long, narrow zone where aquatic plants are controlled to allow navigation. A navigation channel could also be defined to avoid navigation hazards.

**Oligotrophic -** refers to an unproductive and nutrient-poor lake. Such lakes typically have very clear water.

**Prohibited invasive species or prohibited species** - means an invasive species that the department, at the time of listing under s. NR 40.04 (2), has determined is likely to survive and spread if introduced into the state, potentially causing economic or environmental harm or harm to human health, but which is not found in the state or in that region of the state where the species is listed as prohibited in s. NR 40.04 (2), with the exception of isolated individuals, small populations or small pioneer stands of terrestrial species, or in the case of aquatic species, that are isolated to a specific watershed in the state or the Great Lakes, and for which statewide or regional eradication or containment may be feasible.

**Restricted invasive species or restricted species** - means an invasive species that the department, at the time of listing under s. NR 40.05 (2), has determined is already established in the state or in that region of the state where the species is listed as restricted in s. NR 40.05 (2) and that causes or has the potential to cause economic or environmental harm or harm to human health, and for which statewide or regional eradication or containment may not be feasible.

**Sensitive Area** - is an area of a lake that offers critical or unique fish and wildlife habitat, including seasonal or life stage requirements, or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)).

**Trophic state** – means the level of growth or productivity of a lake as measured by phosphorus content, algae.