2023-27 AQUATIC PLANT MANAGEMENT PLAN

Big and Little Trade Lakes

Round Trade Lakes Improvement Association, Inc.

December 2022

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Appendix D – Aquatic Plant Management Discussion
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Executive Summary

Big and Little Trade Lakes are popular recreation lakes and are home to many species of birds, game fish, and a diverse aquatic plant community. Unfortunately, invasive Curly-leaf pondweed (*Potamogeton crispus*, CLP*)*) and Eurasian watermilfoil (*Myriophyllum spicatum*, EWM)) have become established in these lakes, threatening their biodiversity, recreational opportunities, and overall health as a functioning ecosystem. As such, management of these and other AIS are necessary to protect this valuable resource and maintain its status as a high-quality waterbody. An integrated management approach that relies on a combination of control methods is recommended to for Big and Little Trade Lakes.

The Round Trade Lakes Improvement Association, Inc. (RTLIA) takes an active role in managing the lakes, and the purpose of this Aquatic Plant Management Plan (APM Plan) is to outline a strategy meant to control invasive species, protect native plant communities, and prevent the introduction of additional aquatic invasive species. Aquatic plant management in Big and Little Trade Lakes will be completed with the following goals in mind. Each goal has one or more objectives and a list of management actions to help meet those objectives. Therefore, the primary goal of this plan is to protect Big and Little Trade Lakes' ecosystem and native plant community through management efforts to control AIS including CLP, EWM, and purple loosestrife.

1. **Educate the Populace.** Provide education, outreach opportunities, and materials to the lake community

2. **Prevent the Introduction and Spread of AIS.** Increase the awareness and knowledge base of those who use the lakes.

3. **Manage Aquatic Invasive Species.** A combination of management alternatives will be used to help minimize the negative impacts of AIS in Big and Little Trade Lakes

4. **Protect Native Aquatic Plant Species.** Implement AIS management actions in a way that negative impacts to non-target plant species are minimized.

5. **Maintain or Improve Water Quality.** Collect water quality information to establish long-term trends that will be used for current and future lake and aquatic plant management planning.

6. **Implement Adaptive Management.** Provide annual and end of project assessment and evaluation reports that will be used for current and future lake and aquatic plant management planning.

Review and Comment into the Development of this APM Plan

A completed draft of the 2023-27 Aquatic Plant Management Plan for Big and Little Trade Lakes was first presented to the constituency of the RTLIA at the September 17, 2022 Annual Meeting held at T-Dawgs in Grantsburg, WI. The meeting was well attended, with representatives and constituents from Big and Little Trade Lake, Round Lake, and even Long Trade Lake. Long Trade Lake had pulled out of the RTLIA at the beginning of 2022.

During the Annual Meeting, Dave Blumer, owner/operator of LEAPS prepared a PowerPoint presentation introducing the new 2023-27 APM Plan and then gave the RTLIA Board and constituency an opportunity to comment. After the September meeting, a shortened version of the APM Plan that included the "management discussion section" along with a timeline for implementation was posted on the RTLIA webpage. Since that time, no additional comments have been shared with the consultant. The entire 2023-27 APM Plan and associated Appendices have been posted on the LEAPS webpage at https://leapsllc.com/index.php/round-trade-lake-improvement-association/.

Aquatic Plant Management (APM) Strategy

We recommend the continuation of a combination of chemical and manual control methods to curb the spread of EWM in Big and Little Trade to prevent it from further dominating the lakes. The overall goal of this plan is to protect this outstanding resource from degradation by maximizing prevention of new invasions and through the containment and control of existing aquatic invasive species while maintaining the health and recreational use of the lakes.

This plan supports sustainable practices to protect, maintain and improve the native aquatic plant community, the fishery, and the recreational and aesthetic values of the lake. This plan is intended to be a living document that will be evaluated annually to determine if it is meeting stated goals and community expectations, and can it be revised if necessary. The RTLIA sponsored the development of this APM Plan, funded through a Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species Education, Prevention, and Planning Grant and in-kind donations by RTLIA volunteers.

APM Plans developed for northern Wisconsin lakes are evaluated according to Northern Region Aquatic Plant Management Strategy goals developed by the WDNR (Appendix A). APM Plans and the associated management permits (chemical or harvesting) are reviewed by the WDNR. Additional review may be completed by the Voigt Intertribal Task Force (VITF) in cooperation with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). WDNR aquatic plant management planning guidelines, the goals in the Northern Region Aquatic Plant Management Strategy, and the goals of the RTLIA in conjunction with the current state of the lake formed the framework for the development of this APM Plan. This plan is designed to be implemented over the course of 5 years with goals and objectives to be met throughout that time frame.

Lake Information

Background

Big and Little Trade Lakes are lowland lakes situated on the Trade River and are managed, in addition to Round Lake, by the RTLIA (Figure 1). Little Trade Lake is 126 acres with a maximum depth of 19 feet and a mean depth of 11 feet and flows to Big Trade through a small channel (Figure 1). Big Trade Lake is approximately 327 acres with a maximum depth of 39 feet and an average depth of 15 feet. Both lakes have primarily mucky substrate with some areas of sand. Water quality data collected by Citizen Lake Monitoring Network volunteers has determined that both lakes are eutrophic with high levels of algae and nutrients with low water clarity. It has been documented for many years that the lakes suffer from high nutrient loading that can likely be attributed to some natural sources but mainly from surrounding agriculture. Aquatic vegetation is abundant, supporting a fishery of musky, northern pike, walleye, largemouth bass, and panfish.

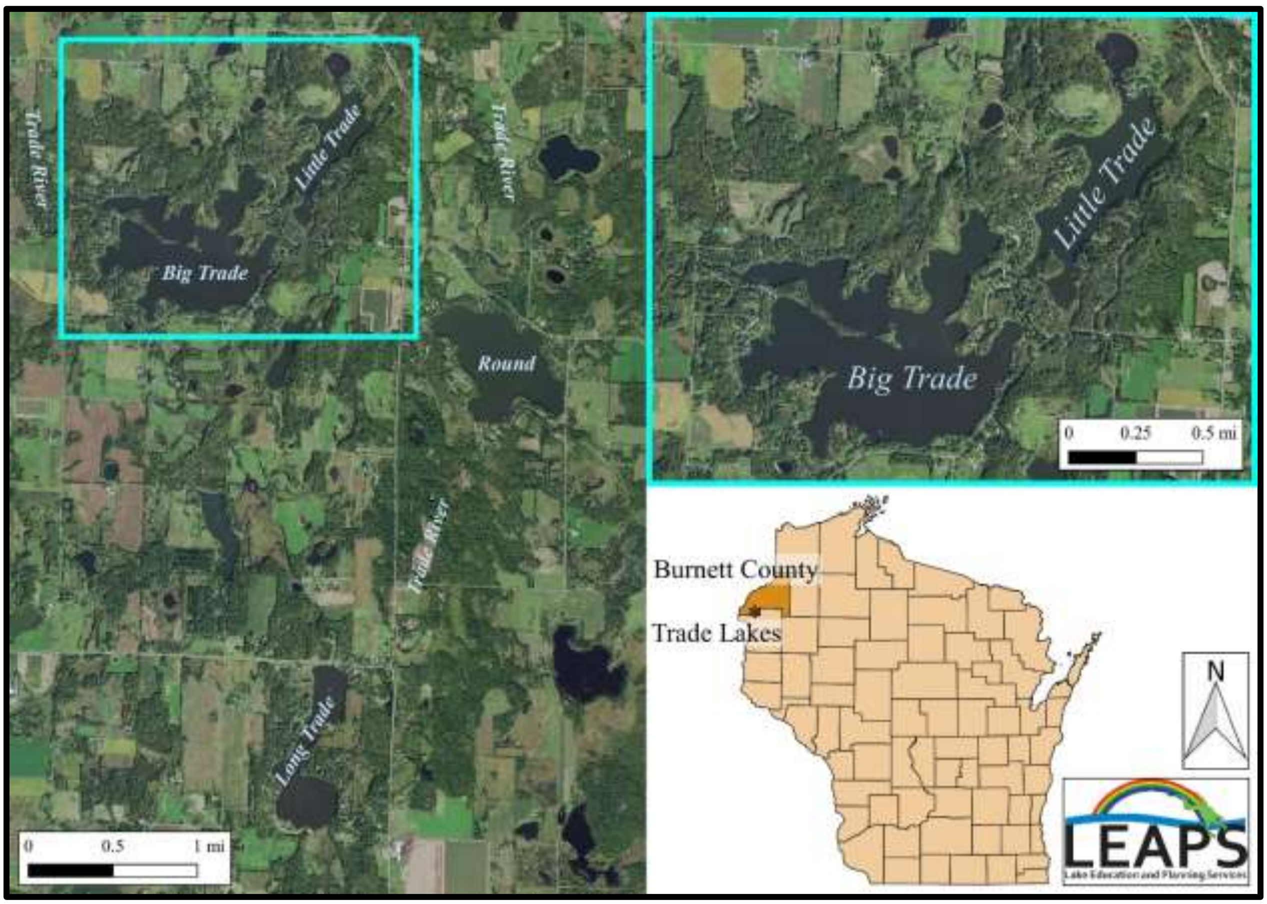

Figure 1: Location of Big and Little Trade Lakes, Burnett County, Wisconsin

Watershed Land Cover

A watershed is an area of land from which water drains to a common surface water feature such as a stream, lake, or wetland. Big and Little Trade lakes are part of the Trade River watershed (96,743 acres; Figure 2). The watershed is mostly forested (44.4%) with some large wetland complexes (23.1%) and some land used for agriculture (24.3%; Figure 3). This area is rich in natural resources – including 2,902 acres of lakes, 167 miles of streams, and 42,956 acres of forests – with relatively little development (Figure 3). Upstream of the Trade Lakes contains more agriculture (34.7%), less wetlands (13.1%), more development (7.2%) than the entirety of the watershed, which likely results in the significant nutrient loading in the lakes (Figure 3).

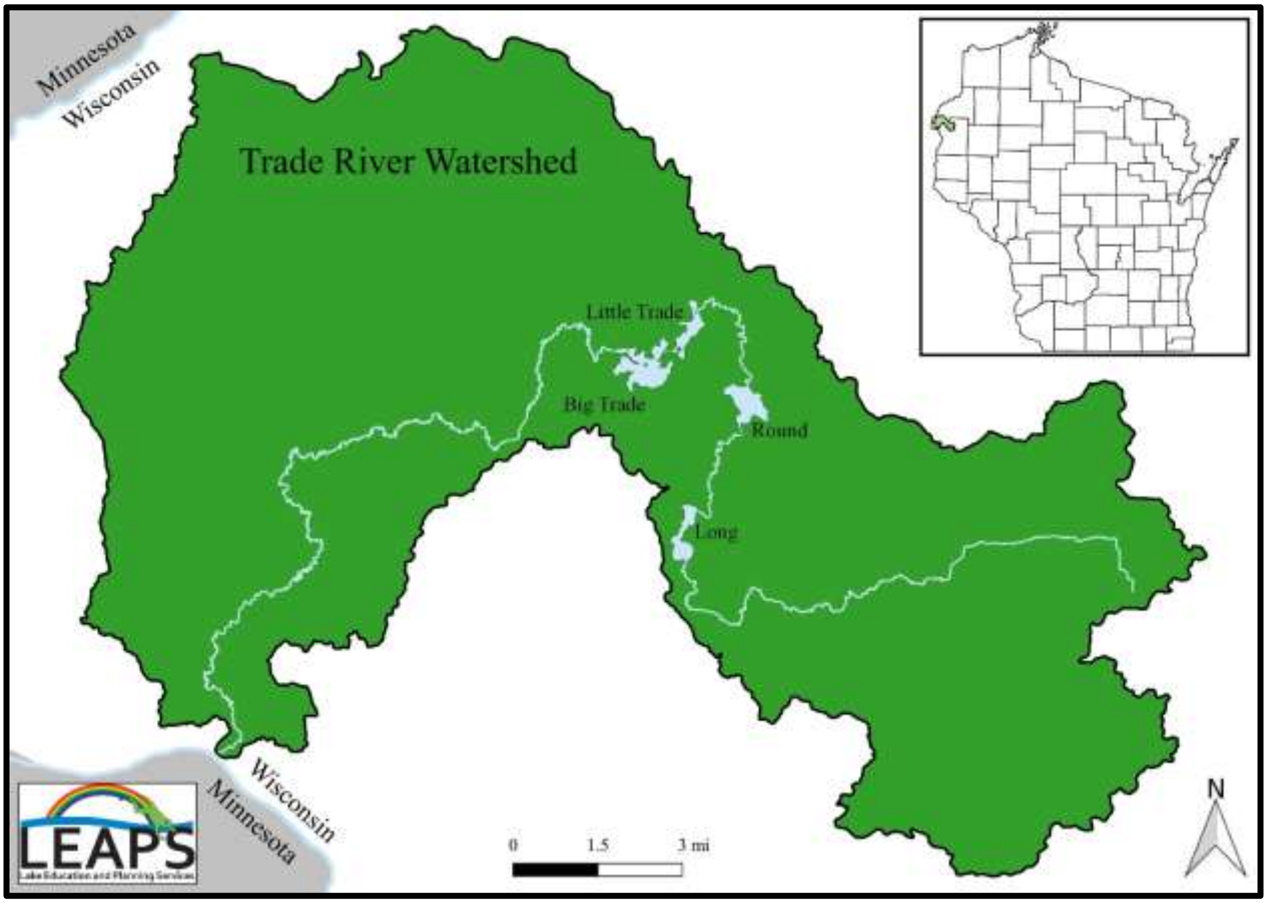

Figure 2: Trade River Watershed Location

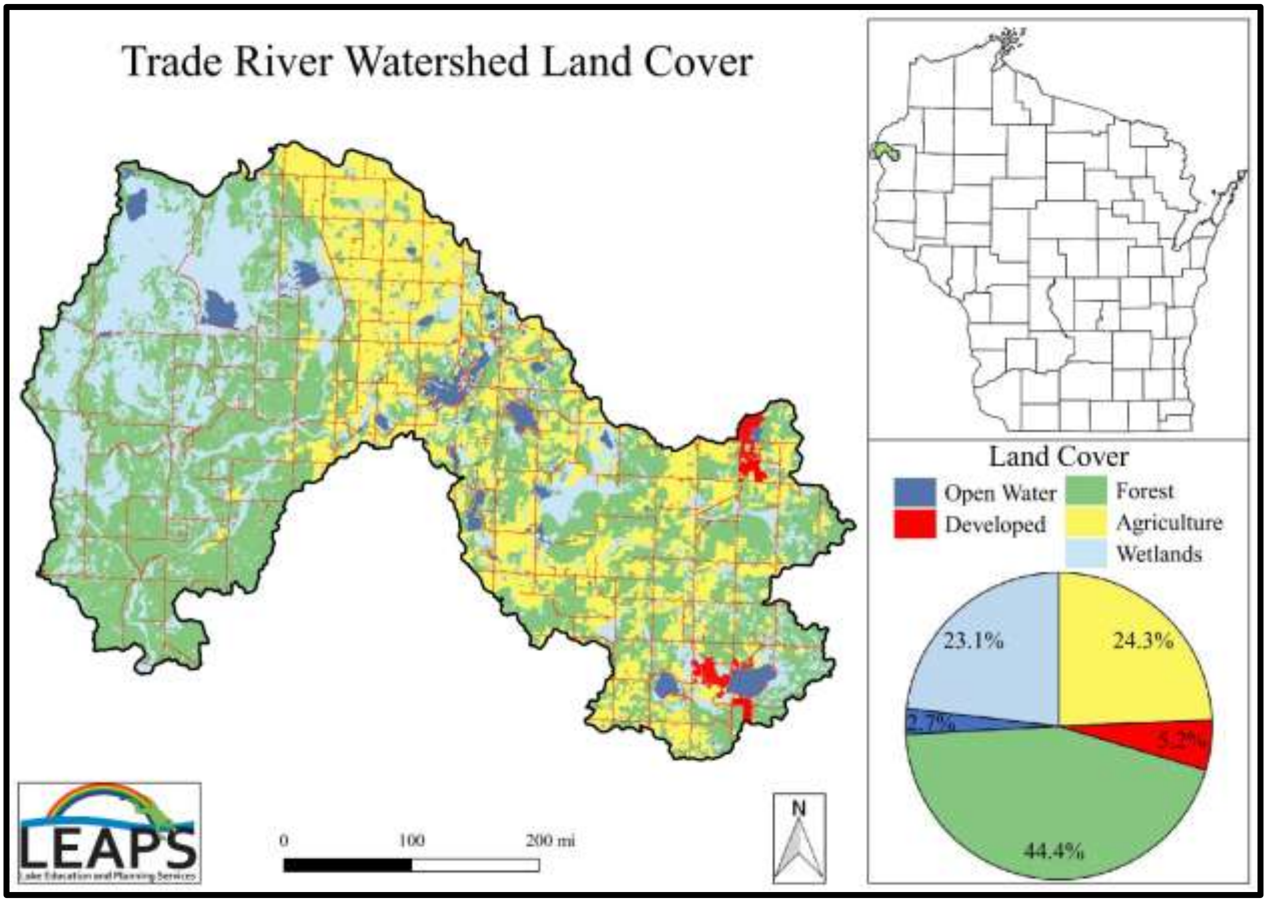

Figure 3: Land use within the Trade River watershed (NLCD, 2016)

Trophic State and Water Quality

Trophic state and water quality are often used synonymously; however, they are not the same. Trophic state describes the biological condition of a lake using a scale that is based on water clarity, total phosphorus (TP), and chlorophyll-*a* (Carlson, 1977). Water quality is typically based on a perception of the lake, which may be subjective for different lake users. People who use the lake for primarily swimming usually classify lakes with clear water as having better water quality while the same lake might be classified as having poor water quality by a fisherman because the low productivity limits fish growth.

By combining data for water clarity, phosphorus, and chlorophyll-*a* in Big and Little Trade Lakes, the trophic state as determined by Carlson's Trophic Status Index (1977) is able to be determined (Figure 4; Figure 5). Eutrophic lakes typically have large amounts of aquatic plant growth, higher nutrient concentrations, low water clarity due to algae blooms, and oxygen-depleted bottom waters. On the other end of the spectrum, oligotrophic lakes are nutrient-poor, have clear and cold water, and oxygen throughout the water column continually. Mesotrophic lakes fall in the middle and have intermediate nutrient levels, occasional algal blooms, and may experience bottom water oxygen depletion in the summer.

The specific measurements of water quality and trophic status in Big Trade Lake have remained relatively constant over time as measured by volunteers. Secchi depth average 5.3 feet, which is consistent with eutrophic readings (Figure 4; Figure 5). Chlorophyll-*a* in those same years, ranged from 8.26 to 31.9 μg/L and averaged17.2 µg/L, which also classifies Big Trade as a eutrophic lake (Figure 4; Figure 5). TP ranged from 20.0 to171.0 µg/L, averaging 46.6 µg/L. Overall, Big Trade Lake is a eutrophic lake with relatively frequent algal blooms and low water quality (Figure 6; Figure 8). More information can be found at: https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2638700&page=facts.

In Little Trade Lake, water quality has also remained relatively constant over time. Secchi readings average 4.1 feet, indicating that Little Trade is also eutrophic. Chlorophyll-*a* has ranged from 10.6 to 75.4 µg/L, averaging 34.6 µg/L, which also classifies Little Trade as a eutrophic lake (Figure 4; Figure 5). TP ranged from 32.9 to 145.0 µg/L, averaging 68.8 µg/L (Figure 4; Figure 5). These higher nutrient levels place Little Trade Lake as slightly more eutrophic than Big Trade Lake. More information can be found at: https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2639300&page=facts.

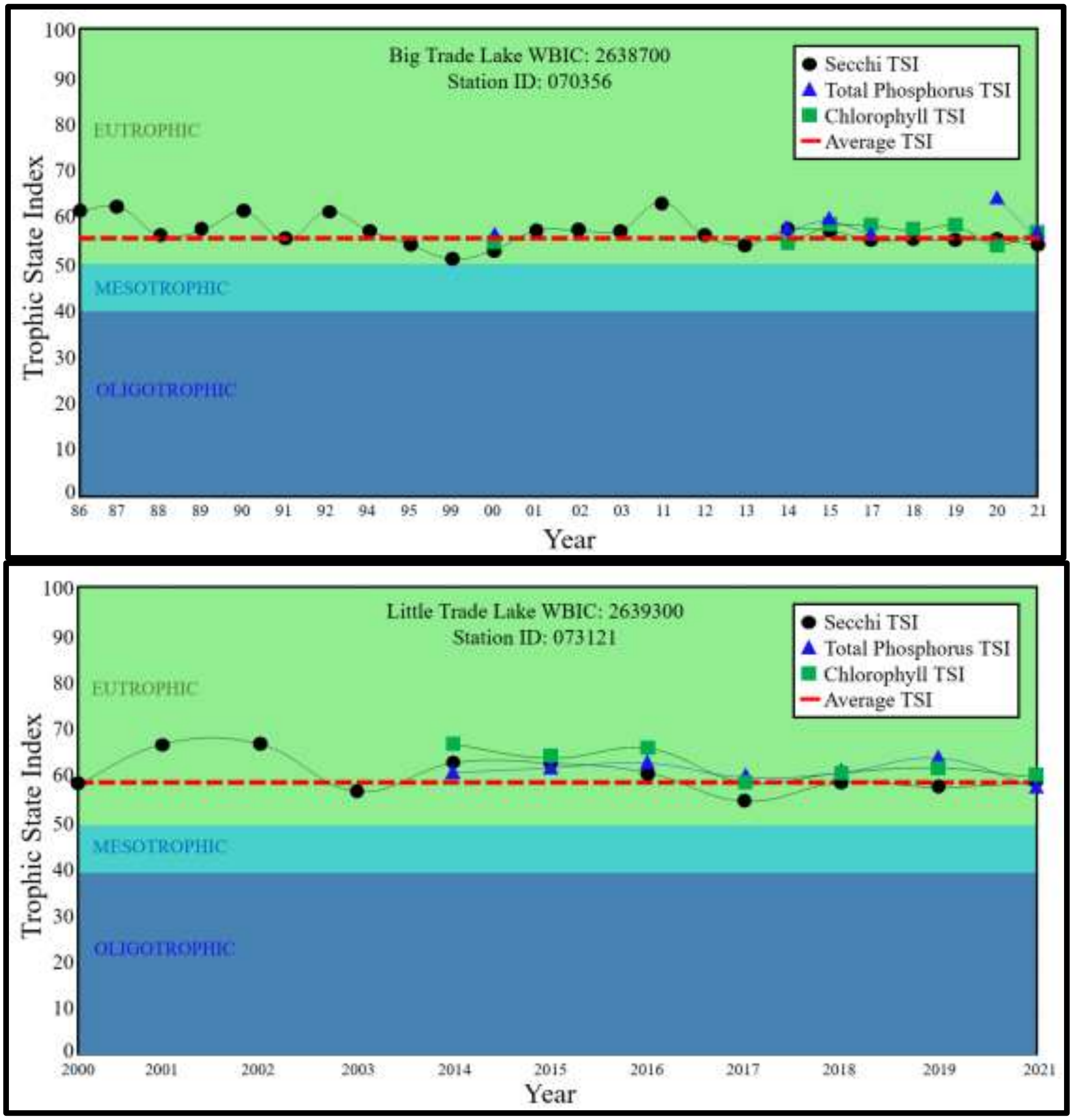

Figure 4: Big and Little Trade Lakes trophic status index data (WDNR)

TSI	Chlorophyll-a (ug/L)	Secchi Depth (ft)	Total Phosphorus (ug/L)	Classification	Attributes	Fisheries and Recreation
<30	<0.95	>26	<6	ULTRAOLIGOTROPHIC	clear water, many algal species, oxygen throughout the year in bottom water, cold water	oxygen-sensitive, cold water fish species in deep lakes
30-40	0.95 - 2.6	13 - 26	6 - 12	OLIGOTROPHIC	clear water, many algal species, oxygen throughout the year in bottom water except possibly in shallow lakes, cold water	oxygen-sensitive, cold water fish species in deep lakes only
40-50	2.6 - 7.3	6.5 - 13	12 - 24	MESOTROPHIC	water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer	walleye may dominate
50-60	7.3 - 20	3 - 6.5	24 - 48	EUTROPHIC	decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident	warm-water fisheries (pike, perch, bass, etc.)
60-70	20 - 56	1.5 - 3	48 - 96	EUTROPHIC	blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible	thick aquatic vegetation and algal scums may discourage swimming and boating
70-80	56 - 155	0.75 - 1.5	96 - 192	HYPEREUTROPHIC	heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight)	summer fish kills possible, rough fish dominant
>80	>155	<0.75	192 - 384	HYPEREUTROPHIC	Algal scums, few plants	

Figure 5: Big and Little Trade Lakes trophic state summary (red circles = Big Trade; blue squares = Little Trade)

Circled values indicate the values and corresponding TSI scores for Big and Little Trade Lakes from data collected by citizen volunteers. This figure is adapted from Carlson and Simpson 1996, information from the WDNR and publicly available CLMN water quality data.

Impaired Water Status

Oxygen

Dissolved oxygen is essential for the survival of most aquatic animals, just like atmospheric oxygen is essential for most terrestrial animals. Surface waters (also called the epilimnion) exchange oxygen with the atmosphere and are usually oxygen-rich. In deeper lakes, or smaller lakes that are generally sheltered from prevailing winds, the water in the lake stratifies (or separates) into distinct zones during the summer months, impacting water quality and affecting biota. These zones are the epilimnion (usually oxygen-rich surface waters), the thermocline (the layer separating the surface and bottom waters), and the hypolimnion (oxygen-depleted bottom waters; Figure 6).

Citizen Lake Monitoring dissolved oxygen and temperature profile data has shown that Big Trade Lake thermally stratifies in the summer months between 9 and 12 feet in depth. The shallow depth of Little Trade may not allow the lake to thermally stratify. There is limited oxygen profile data for either lake, but it is likely that Big and Little Trade experience hypolimnetic hypoxia (oxygen depletion) in their bottom waters during summer months. However, any stratification that does occur is reversed during fall turnover as the warmer surface waters cool and mix with the colder bottom waters. Additionally, heavy boat traffic and large storm/wind events can re-mix the lakes at any point, especially in shallow Little Trade Lake.

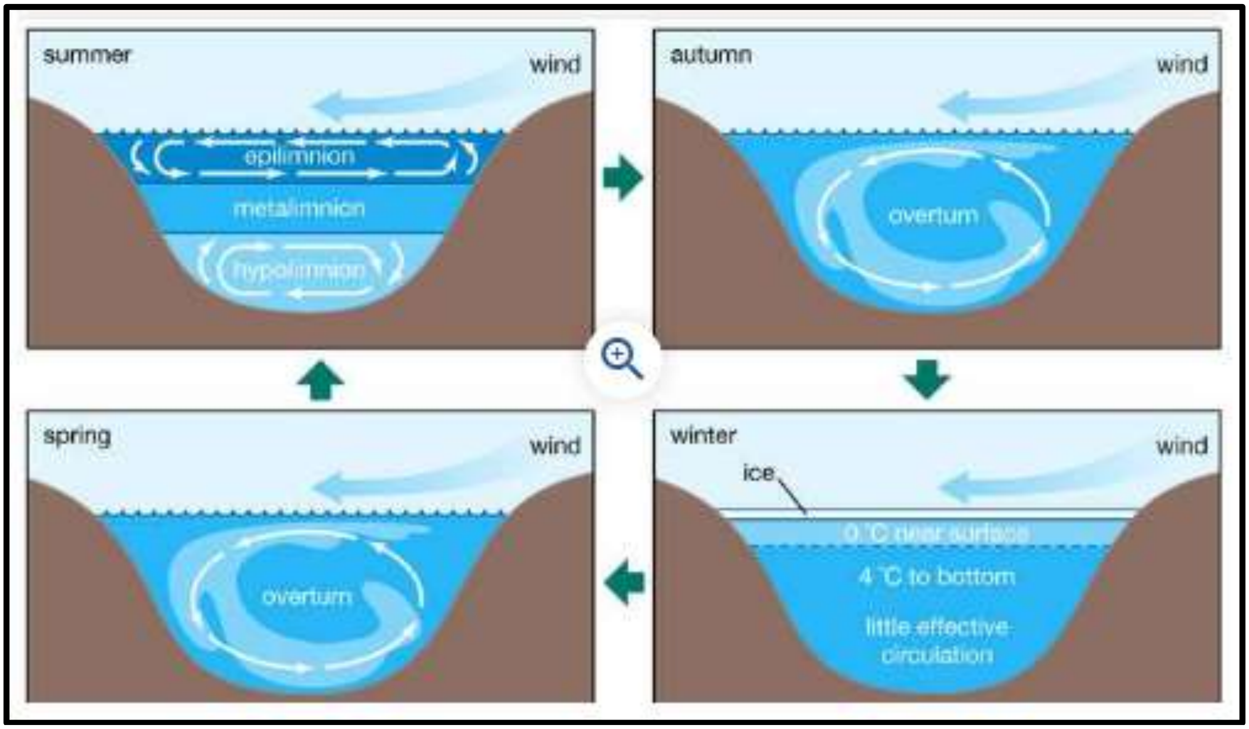

Figure 6. Seasonal thermal stratification in lakes (Encyclopedia Britannica)

Fisheries

Big and Little Trade support a warm water fishery primarily consisting of muskellunge, largemouth bass, and panfish. Also present in lower numbers are walleye and northern pike. Surveys conducted by the WDNR in 2001, 2002, 2008, and 2021 have monitored fish populations and tracked population characteristics in densities and length of fish. In the most recent 2021 nighttime electrofishing and fyke netting surveys, DNR personnel observed 112 largemouth bass (averaging 11.6 inches in length, maximum of 18.5 inches), 12 muskellunge (averaging 39.7 inches, max of 45.3 inches), 6 northern pike (averaging 24.6 inches, max of 32.9 inches), 10 walleye (averaging 16.0 inches, max 21.0 inches), 213 bluegill (averaging 6.0 inches, max of 8.1 inches), 10 pumpkinseed (averaging 6.0 inches, max of 7.3 inches), and 11 black crappie (averaging 8.2 inches, max 9.9 inches; Craig Roberts, personal communications). Of note, 22% of largemouth bass observed in the survey were greater than 14 inches, and 39% of bluegills were greater than 7 inches (Craig Roberts, personal communications). A fisheries management report, to be completed in 2022, summarizing these findings and further management recommendations is currently being drafted by Craig Roberts, Burnett County Fisheries Biologist.

Fish stocking efforts are relatively low on Big and Little Trade Lakes. Muskellunge are the only species currently being stocked by the WDNR, and they have been stocked on a regular basis approximately every two years since 1991 in low numbers (generally between 85-217 individuals). The muskellunge are Upper Chippewa River strain and are stocked as large fingerlings (10-12 inches in length). An additional 1,000,000 walleye fry were stocked in the lakes in 1991, but none have been stocked in subsequent years.

For information on daily bag limits:
https://cida.usgs.gov/wdnr_regs/apex/f?p=wdnr_fishing_regulations:lake_regulations:0::NO:20:P20_WBIC:2434700#R770266518172521259

For more information on Wisconsin fish stocking:
https://cida.usgs.gov/wdnr_biology/Public_Stocking/StateMapHotspotsAllYears.htm

For more information on stocking in Big Trade:
https://dnr.wi.gov/fisheriesmanagement/Public/Summary/Index

Wildlife

Both Big and Little Trade Lakes are home to many species of plants and animals. Many species of waterfowl use these lakes for nesting and throughout their migration. Great blue herons, green herons, sandhill cranes, and many other bird species have been observed around the lakes. Muskrats, beavers, and otters are also common visitors. Painted turtles, snapping turtles, Blanding's turtles and several snake species can also be found in the lakes. It is common to hear spring peepers in the spring and green frogs, American toads, and other frog species throughout the summer. Whitetail deer are common in the area and have been observed browsing near the lakes. The lakes also fall within the Karner Blue Butterfly High Potential Range. Karner blue butterflies (Figure 8) are a federally endangered species of butterfly (for more information: https://dnr.wisconsin.gov/topic/endangeredresources/karner).

Figure 7: Karner Blue Butterfly (WDNR)

For more information on plants and animals that have been documented in the area, or to document a species, visit: https://www.inaturalist.org.

Public Use

Big and Little Trade Lakes are popular destinations for fishing and water recreation including swimming, waterskiing, tubing, and general boating use. The shoreline around Big Trade Lake is mostly developed so recreational use of the lake by property owners on the lake is also extensive. Little Trade Lake is only accessible by boat by going through a short channel between the two lakes. In that channel is a low bridge that under times of high water, prevent all but the smallest watercraft from going underneath it. Under normal water levels, most boats can travel under it including pontoon boats if their canopies are down.

A large portion of Little Trade Lake is undeveloped, though over the last decade or so, more buildable lots have been identified and the number of homes and/or cabins has on the lake have increased.

Both lakes receive a lot of ice fishing pressure, but Big Trade Lake receives much more. In the winter, it is not uncommon to see a community of ice fishing shacks placed over the deepest area of the lake not far off the east side landing.

Big Trade Lake has two public access boat landings, a state-owned landing on the west side of the lake near where the Trade River exits the lake; and a township owned landing on the east side of the lake. There is one large resort/campground on the long point that juts out past the DNR landing on the west side of the lake.

Little Trade Lake does not have its own access point – boat landing.

Public Input

In 2021 a Public Use/Sociologic Survey was sent in paper form to all property owners on all four lakes that at the time were included in the RTLIA – Long Trade, Round, Little Trade, and Big Trade. The purpose of the survey was to gather background information on how the constituency of the RTLIA likes to enjoy the lakes so that the RTLIA can work to improve those aspects of the lake. The survey asked a series of questions to gather background information on constituency knowledge and concerns related to water quality, aquatic invasive species, fishing, boating, shoreline improvement opportunities.

A total of 341 surveys were sent out around in early August 2021. Over a period of 4-6 weeks, 115 completed surveys were returned for a 33.7% return rate. Of the surveys completed and returned, 36 were from users/property owners on Big Trade Lake and 16 were from Little Trade Lake. Responses to the survey were tabulated by LEAPS. A copy of the survey and summary report of the results is included in Appendix B.

The average age of respondents on Big Trade Lake was 63; on Little Trade it was 56. Across all lakes included in the RTLIA, 24% of all respondents were permanent residents, the rest were at the lake less than full-time. Average years of ownership of property on Big Trade was more than twice the average ownership of property on Little Trade Lake suggesting either that Little Trade Lake properties have seen more turnover, or more likely that in the last 10-15 years there have been more properties previously undeveloped that now have homes or cabins on them.

Water Quality, Lake Use, and Shoreland Health

When asked about water quality a majority of respondents from Big Trade Lake (53%) felt it was worse now than when they first purchased property or came to the lake. Only 28% felt it was better now than in the past. On Little Trade Lake, a majority of respondents (54%) felt the water quality was unchanged or they didn't know for sure. Only 33% felt it was worse, with 13% responding that it was better. Again, this may be directly related to length of property ownership.

A majority of respondents on both lakes (72% - Big Trade, 87% Little Trade) considered water quality to be either fair or good, but in both cases "fair" was the most frequent answer. There were no "excellent" answers from either lake. The biggest concerns about water quality included algae/green water, too much aquatic vegetation, and water clarity. Algae, vegetation, and water clarity are all related, so addressing these top concerns should be a priority of the RTLIA.

The top five main lake uses across all four lakes were, in order, fishing, swimming, canoe/kayaking, nature appreciation, and power boating. Power boating includes activities like water skiing, tubing, and wake-boarding. The top five most important aspects of time at the lake were time with friends and family, clean water, scenery, fishing, and wildlife. People do value the natural state of the lakes, as well as the social aspect of having lake property. These should be a focus of the RTLIA.

Fishing was generally considered fair or good in both lakes. Boating concerns included large wakes, too many plants, and reckless driving. People would generally like to see less large wakes, less reckless driving, and less plants in the lake. To accomplish this, slow no wake zones could be reestablished, restrictions on wake boats could be discussed, and AIS should be managed in high traffic areas.

When asked about the quality or condition of the shoreline around the lakes, a majority of respondents considered it good or fair. The survey did not ask respondents to describe what they considered to be a good or fair shoreline. Education events on what a quality shoreline looks like and how to achieve that should be a focus of the RTLIA, and people responded that they would be interested in this type of event.

Aquatic Plants and Aquatic Invasive Species

In Big and Little Trade Lakes, CLP, EWM, and purple loosestrife are the most prevalent aquatic invasive species. When survey respondents were asked how confident they were that they could identify these and other species in the lakes, 38% were confident or very confident and 56% were not confident that they could. When asked if aquatic invasive species were better or worse since they came to the lake, 50% of the Big Trade Lake respondents felt they were worse, while the rest felt they were better (25%) or unchanged (25%). On Little Trade, 27% felt they were worse, with 18% thinking them better, but 55% were unsure or thought them unchanged.

These survey results suggest that people need more education to be effective partners in the control of AIS. This is one of the areas of most interest as an educational event, expressed by survey respondents.

The survey did not specifically ask about what management actions to control aquatic plants and aquatic invasive species would be most supported by the constituency, but past management actions have included physical removal by property owners and the application of aquatic herbicides. These actions have been supported in the past with little to no opposition.

Education and Information

Survey respondents were asked to rank what lake improvement initiatives they would like to see the RTLIA focus on. They were given a list of activities/initiatives and asked to check those that were important or that they would support. The following is a list of those activities and the number of times they were "checked" by the 104 respondents that answered this question.

62 - Activities to control AIS

60 - Agricultural incentives to change farming practices that negatively affect the lake

55 - Riparian (near the water) improvement actions (no-mow areas, native plantings, rain gardens)

50 - Stabilization/protection of the shoreline to prevent erosion

46 - Catch and release fishing

44 - The creation of slow-no-wake zones in shallow areas

42 - Financial and other incentives to encourage shoreline improvement projects

35 - Fish stocking

34 - Engage in a septic re-inspection program

31 - Improving boat landings

31 - Boat inspections at landings

30 - Discussing a restriction on wake boat usage

27 - Improve communication between property owners and Round Trade Lakes Improvement Association

27 - Implementing quiet hours that limit personal watercraft/water sport activity

23 - Projects that increase woody habitat/trees in the water

19 - Public access on Little Trade Lake

The topics of most interest to survey respondents for education events are water quality, aquatic invasive species, shoreland improvement, fish, general lake rules, and the formation of a Lake District.

Round Trade Lakes Improvement Association

Almost all of the survey respondents (96%) were aware that the lakes had a lake association (the RTLIA), but only 50% of the respondents had ever attended a meeting. The number of property owners paying annual dues to be a part of the RTLIA runs about 30% each year. To improve these numbers, the RTLIA should focus on how to get people to attend meetings – advance notice and talking about issues people care about (water quality, wake boats, district, AIS, stocking walleye, etc.) should help.

When asked about the formation of a Lake District that would include taxing authority of all property owners around the lakes, respondents from Big Trade Lake were 29% supportive, 20% opposed, with 51% needing more information or taking a neutral stance. Respondents from Little Trade Lake were 21% supportive, 21% opposed, with 57% needing more information or taking a neutral stance.

Other concerns expressed by survey respondents included addressing rental properties on the lakes, and using the RTLIA as a local political lobby group, specifically as it relates to the development of Concentrated Animal Feeding Operations or CAFO's.

Recent changes in the RTLIA have forced a complete change in the officers of the RTLIA. Long Trade Lake has now pulled out of the RTLIA and formed its own lake organization. Round Lake, Little Trade Lake, and Big Trade Lake are still part of the RTLIA.

Shoreland Habitat Improvement and Runoff Reduction

As a part of the project to update the Aquatic Plant Management Plans for Big and Little Trade Lakes a shoreland habitat assessment was completed on both lakes. The purpose of the assessment was to identify properties that have the greatest potential to implement habitat improvement and runoff reduction projects that may help improve the lake. While not directly related to aquatic plant management, reducing nutrient and sediment loading into the lakes and increasing the amount of natural or undisturbed shoreline does help reduce the amount of unwanted vegetation in the lakes – including AIS. During the assessment, each parcel around the lakes was evaluated on several parameters to determine the potential of the property for implementing shoreland habitat improvement and runoff reduction projects. Following the assessment, a list of projects based on the WDNR Healthy Lake and River Initiative were identified for each property. Figure 8 reflects the potential for habitat improvement and runoff reduction projects for each property. Yellow and light green properties have the greatest potential for the implementation of projects.

More information on each individual parcel assessment is available in the Shoreland Habitat Assessment Report developed for and housed with the RTLIA.

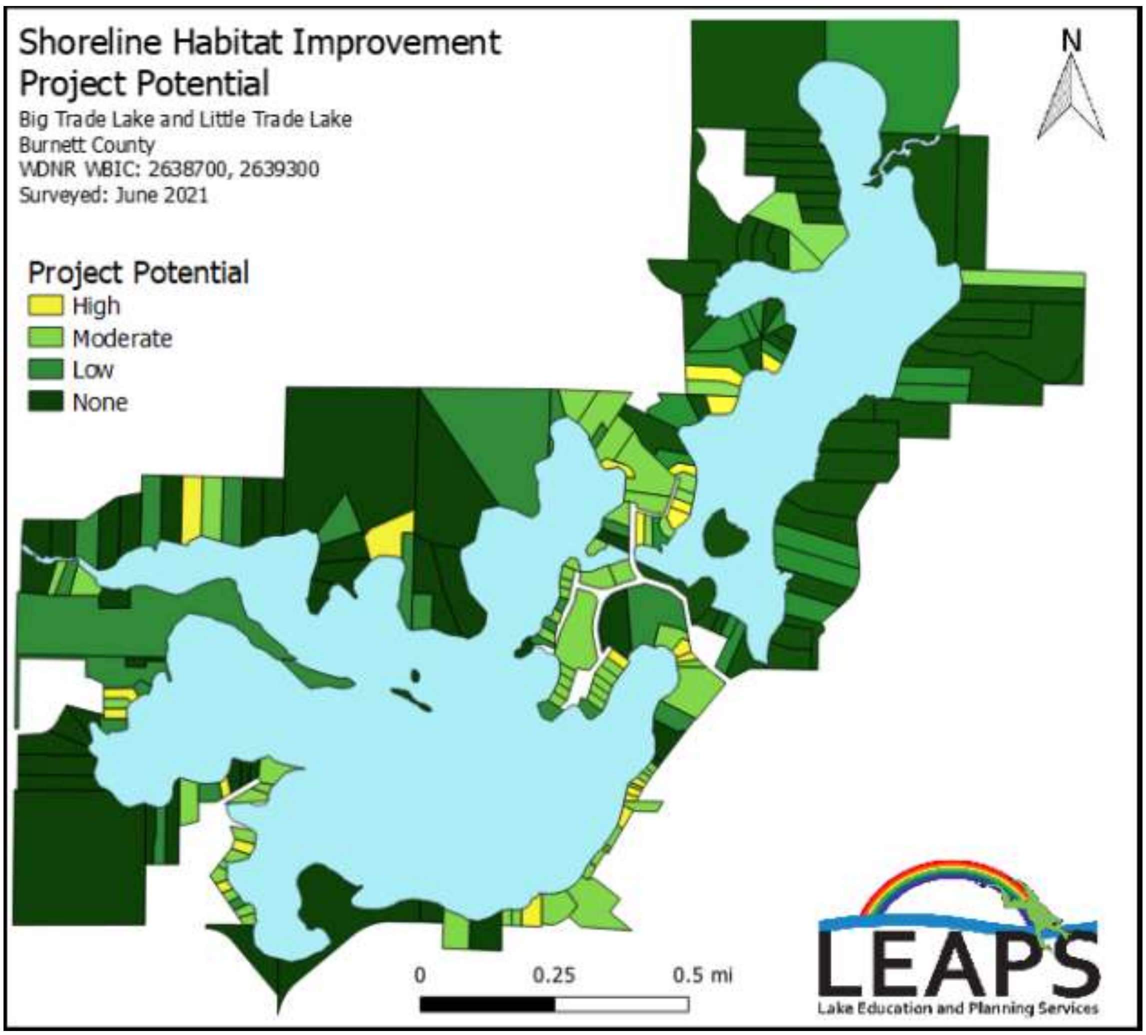

Figure 8: Habitat improvement and runoff reduction project potential for Big and Little Trade Lake properties

Lake Management Best Practices (Healthy Lakes and Rivers Initiative)

The Healthy Lakes Initiative is a program that has been set up by the WDNR to provide support through information and grant funding to small scale projects that will help improve both shoreline habitat and lake health. Lake health is improved by reducing runoff into the lakes from the developed areas around the lakes. The grants available for these projects are intended for fairly small, inexpensive projects, so there is $1000 limit in grant funding per project. This program is focused on helping individual property owners improve their shoreline. There are five projects that are eligible for Healthy Lakes Grants. The projects that qualify for these grants are installing fish sticks, rain gardens, native plantings, diversions, and rock infiltrations.

Fish Sticks Installation

Fish Sticks involve taking trees from the inland area of the lake, and installing them in the lake to mimic shore trees that will eventually fall into the lake (Figure 9). The trees used must be taken from a minimum of 35 feet inland and are then secured to the shore with cables for approximately 3 years. This provides habitat for fish, birds, and many other animals. In addition to providing habitat, fish sticks help protect the shoreline from bank erosion. Fish sticks project costs range anywhere from $100 to $1000, averaging about $500. These are very low maintenance because it is only necessary to occasionally check the cables to ensure they are secure. This practice would work well for almost any of the undeveloped properties on Big and Little Trade Lakes. Several fishsticks projects have already been installed on Big Trade Lake.

Figure 9: Fishsticks installation (left) and after ice out (right)

Rain Gardens

Rain gardens are shallow depressions that contain loose soil and native plants (Figure 10). These are intended to capture the runoff, allowing the water to be filtered, naturally through the ground instead of flowing directly into the lake. Rain gardens are designed to allow the rainwater to soak into the ground with 1-2 days, to prevent any of the issues created by standing water. The project cost for rain garden range anywhere from $500 to $9,500, but this is very dependent on the size of the rain garden. The maintenance is fairly low, only requiring watering for about two weeks, until the plants have established, and weeding is occasionally needed during the first year. This project is best suited to parcels on a smaller incline to catch rainwater runoff that would otherwise run into the lakes.

Figure 10: Rain garden installation (left) and upon completion (right)

Native Plantings

Native plantings (Figure 11) are intended to establish a buffer zone between the developed portion of a parcel and the lake. The buffer helps filter and slow rainwater runoff so much of it filters into the ground. This buffer zone is created by changing a strip of turf grass, at least ten feet wide, along the shoreline to a natural area composed of native shoreline plants. Similar to rain gardens, these are fairly low maintenance requiring water only until the plants have become established. The only ongoing maintenance is the removal of any invasive species that find their way into the planting. On average, native plantings cost around $1000. This project will work for almost any developed parcel that does not have a sand beach as the primary frontage.

Figure 11: Completed native planting (photo from HealthyLakesWI.com)

Diversions

Diversions (Figure 12) are placed across a sloping path or driveway to divert runoff water to an area where it can be absorbed into the ground instead of flowing directly into the lake. In addition to helping improve lake health, these can also reduce the effects of erosion on the paths that the diversions are installed on. Diversions are created by entrenching a log or creating a small earthen berm approximately 30 degrees from the angle of the slope. The cost of these range anywhere from $25 to $3,750, but the average diversion costs $200. These are very low maintenance, and only require some debris removal that could get stuck in the diversion and occasionally ensuring everything is still secure and in place. This practice does not work well for the purposes of this particular survey, but it is mentioned here as a nod to projects that could be completed further inland than this survey was meant to assess.

Figure 12: Completed diversion (photo from HealthyLakesWI.com)

Rock Infiltration Trenches

Rock infiltrations (Figure 13) are meant for relatively low traffic areas as a way to catch rainwater runoff and divert it into the ground. These consist of a pit which is no more than five feet deep. This pit is lined with filter fabric and filled with small rock. More filter fabric is placed on top and larger rock is then placed over that to hold everything in place. These range in price from $500 to $9,500, on average costing $3800. This requires some maintenance to function properly. It is necessary to remove any debris such as leaves or pine needles that may collect. It is also necessary to occasionally clean out the rock as it collects sediment. This works well around building that can be seen in the riparian zone. The rock infiltrations allow for rainwater coming off of the roof to be collected and filtered without damaging the building it surrounds.

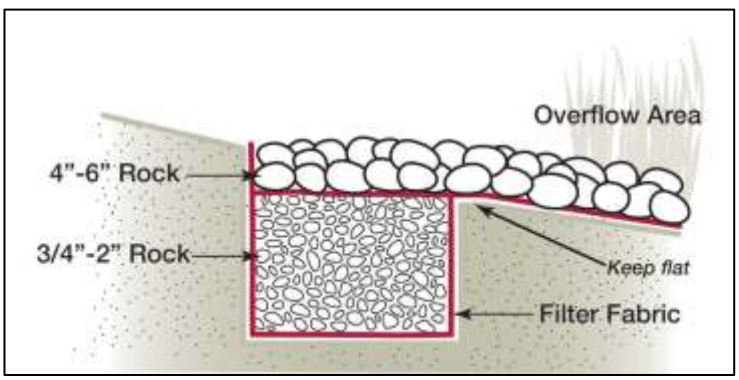

Figure 13: Rock Infiltration Set-up

Aquatic Plant Community – Big Trade Lake

A prerequisite to updating the APM Plans for Big and Little Trade Lakes was to compare how the lake's vegetation had changed since whole-lake point-intercept survey data has been collected. On Big Trade Lake, a whole-lake PI survey was completed for the first time in 2009. It was repeated again in 2017, then again in 2021. The first survey was completed by the Polk County Land and Water Conservation Department in August 2009. It was repeated in 2017 by Endangered Resource Sciences (ERS) on July 13. During the 2009 survey no EWM was documented in the lake. In 2016, 4 points were identified with EWM during the summer survey, with an additional 4 points having a visual record. Though widespread throughout the lake in 2017, its density was still quite low. This is no longer the case. In 2021 EWM was found on the rake at 17 points, a significant increase.

Warm-water Full Point-intercept Macrophyte Survey

Depth was recorded at 652 points on the lake to help formulate the most accurate bathymetric map possible (Figure 14). The lake has five separate basins that bottomed out at over 24ft+ with the deepest areas occurring south of Cedar Point and east of the lake's two central sunken islands. Numerous side bays tended to be shallower with depths in the 6-12ft range. Around and between the islands/sunken islands, sharp drop offs, shallow flats, and rocky saddles produced a rich underwater topography.

Of the points where the bottom substrate could be determined, the lake's bottom was categorized as 78.1% organic and sandy muck, 6.8% pure sand, and 15.1% rock (Figure 14). The smaller areas of sand and rock were scattered along the shoreline, on exposed points, around the island, over humps, saddles and sunken islands, and at the river inlet and outlet.

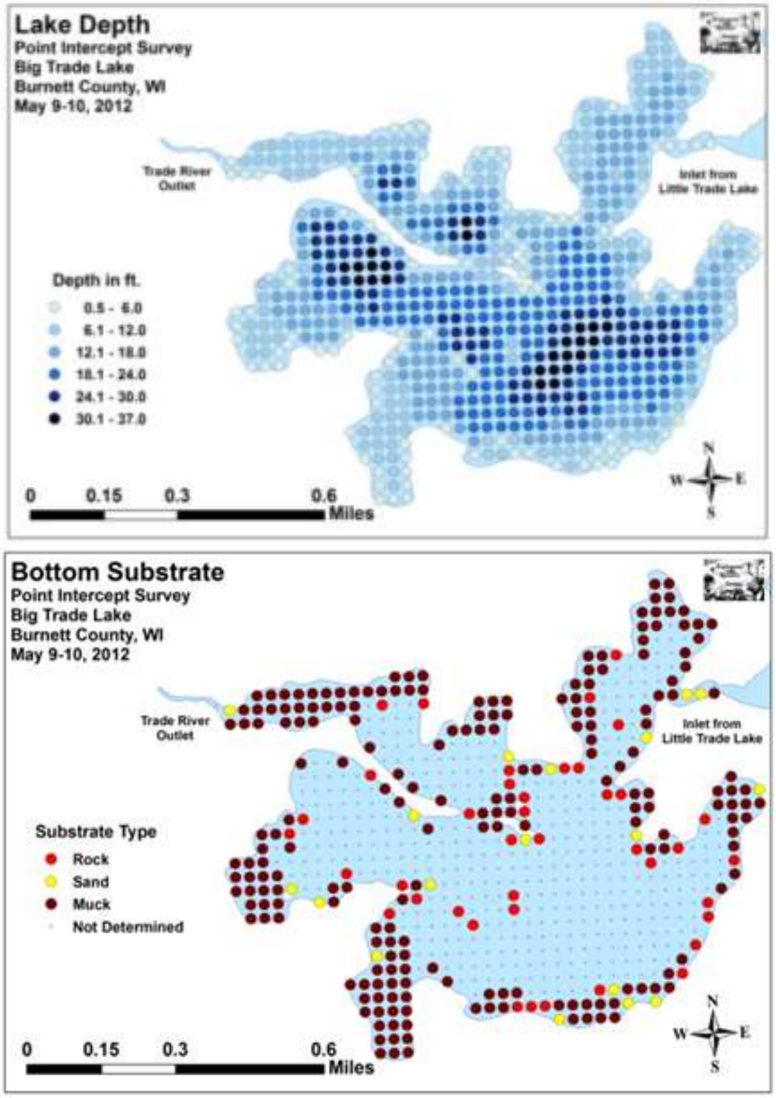

Figure 14: Lake Depth and Bottom Substrate

In 2021, plants were found growing to 12.0ft, up from 10.0ft in 2017, and 11.0ft in 2009. Despite the fact that in the 2021 survey 172 points had vegetation on the rake, the amount of vegetation in the littoral or designated plant growing area of the lake was down to about 60.6%. In 2017, 156 points had vegetation (86.7% of the littoral zone). Both of these values are better than what they were in 2009 when only 142 points had vegetation (50.0% of the then littoral zone). Plant growth in both 2017 and 2021 was skewed to deeper water as the mean depths in those years (5.0ft and 4.5ft) were greater than the median depths of 4.5ft and 4.0ft. In 2009 these values were 4.2ft and 4.0ft. There could be several parameters affecting these values including elevated water levels due to rainfall and better water clarity in the lake. Table 1 reflects all of the whole-lake, aquatic plant, point-intercept (PI) survey data from the three completed surveys.

Table 1: Aquatic Macrophyte PI Survey Summary Statistics Little Trade Lake, Burnett County 2009, 2017, and 2021

SUMMARY STATS: Big Trade Lake, Burnett Cty.	2009	2017	2021
Total number of sites visited	632	652	652
Total number of sites with vegetation	142	156	172
Total number of sites shallower than maximum depth of plants	285	180	284
Frequency of occurrence at sites shallower than maximum depth of plants	49.82	86.67	60.56
Simpson Diversity Index	0.86	0.88	0.90
Maximum depth of plants (ft)**	11.00	10.00	12.00
Number of sites sampled using rake on Rope (R)	10	0	0
Number of sites sampled using rake on Pole (P)	201	265	265
Average number of all species per site (shallower than max depth)	1.39	2.96	2.38
Average number of all species per site (veg. sites only)	2.79	3.41	3.94
Average number of native species per site (shallower than max depth)	1.33	2.89	2.24
Average number of native species per site (veg. sites only)	2.69	3.38	3.74
Species Richness	20	32	33
Species Richness (including visuals)	21	39	39
Species Richness (including visuals and boat survey)	21	41	43
Mean depth of plants (ft)	4.42	5.00	4.50
Median depth of plants (ft)	4.00	4.50	4.00
Mean rake fullness (veg. sites only) est. based on max species rake value	2.13	2.23	2.62

Simpson's Diversity Index

A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's Diversity Index, the index value represents the probability that two individual plants (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the same species.

The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be more resistant to invasion by exotic species.

Plant diversity has been increasing in Big Trade Lake and is moderately high with a Simpson Index value of 0.90 in 2021, 0.88 in 2017, and only 0.86 in 2009. Species Richness was better in 2021 with 33 species found on the rake. This was about the same as what was found in 2017 (32) and much higher than what was found in 2009 (20). The most likely reason for this change is the experience of the entity completing the survey. In 2009 it was Polk County. In 2017 and 2021 it was Endangered Resource Services, LLC. When adding species that were seen in the lake, but not on any point, the total species for 2021 jumped to 43, the highest number recorded in the three surveys. The average number of native aquatic plant species per point continued to increase in 2021 to 3.74 from 3.38 in 2017 and 2.69 in 2009.

Total rake fullness continued to increase as well to 2.62 in 2021, from 2.23 in 2017 and 2.13 in 2009.

Changes in the Big Trade Lake Plant Community

The Big Trade Lake ecosystem is home to a somewhat limited plant community that is typical of high-nutrient lakes with fair to poor water quality. From 2009 to 2017 the number of plant species identified certainly increased but that may have been more due to a different aquatic plant surveyor than from an actual increase in plants. What is clear is from 2009 to 2017, the number of points where plant species that generally do well in degraded water quality conditions were found increased. That trend continued in the 2021 survey. Tables 2 & Figure 15 reflect those species that saw significant increases or decreases from 2009 to 2021. The species in the green are species that do well under degraded water quality conditions and saw significant increases. The four species that saw significant decreases are in yellow.

Table 2: Aquatic plant species in Big Trade Lake that showed significant increases (green) or decreases (yellow) from 2009 to 2021

Species	2009	2017	2021
White waterlily	20	55	62
Small duckweed	12	49	68
Large duckweed	11	49	68
Common watermeal	11	48	69
Small pondweed	3	5	21
Eurasian watermilfoil	0	4	17
Forked duckweed	0	1	10
Common waterweed	34	36	16
Northern watermilfoil	33	34	22
Sago pondweed	8	8	2
Chara sp.	9	1	3

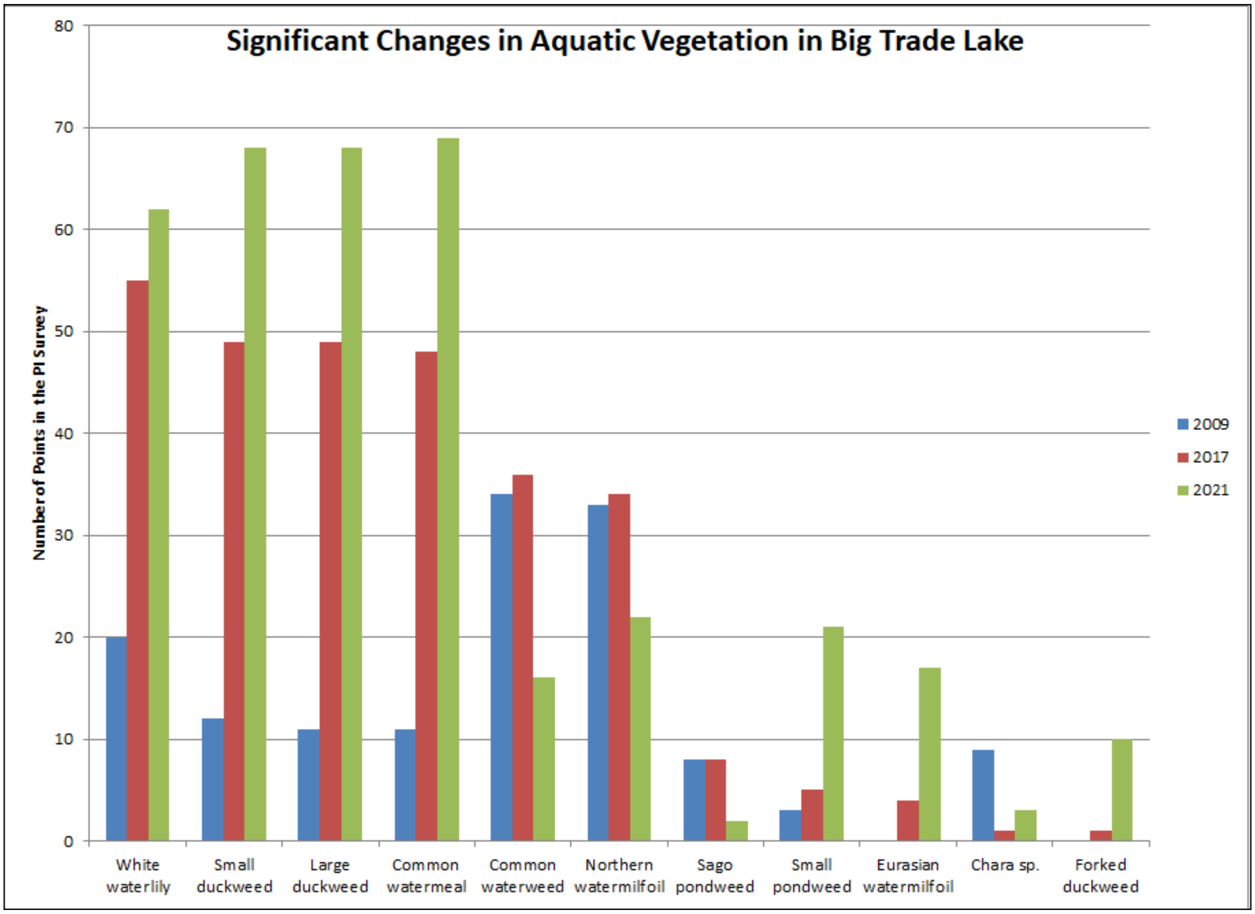

Figure 15: Aquatic plants in Big Trade Lake with significant changes from 2009 to 2017, to 2021

Comparison of Native Macrophyte Species in 2009, 2017, and 2021:

During the July 2009 survey, PCLWD biologists found that Coontail, Flat-stem pondweed, Common waterweed, Northern watermilfoil, Water celery, White waterlily, Curly-leaf pondweed, and White water crowfoot were the most common species. They were present at 90.1%, 41.6%, 23.9%, 23.2%, 14.8%, 14.4%, 12.0%, and 12.0% of survey points with vegetation respectively and accounted for 79.1% of the total relative frequency, percent of all vegetation in the lake. Small duckweed also had a relative frequency over 3.0 with two other species (Common watermeal and Large duckweed) being close.

In 2017, Coontail, White water lily, Small duckweed, and Large duckweed, Common watermeal, Common waterweed, and Northern watermilfoil were the most common species. They were found at 92.31%, 35.3%, 31.4%, 31.4%, 30.8%, 23.1%, and 21.8% of sites with vegetation respectively and accounted for 78.0% of the total relative frequency, percent of all vegetation in the lake. Flat-stem pondweed and White-water crowfoot also had relative frequencies over 3.0.

In 2021, Coontail, Common watermeal, Small duckweed, Large duckweed, White waterlily, and Flat-stem pondweed were the most common species. They were found at 90.7%, 40.1%, 39.5%, 39.5%, 36.1%, and 28.5% of the sites with vegetation respectively and accounted for 69.7% of the total relative frequency, percent of all vegetation in the lake. Two other species Northern watermilfoil and Small pondweed had a relative frequency over 3.0.

From this data, it appears again like those species that do well under degraded water quality conditions are increasing and those that do not, like Wild celery and White water crowfoot are disappearing.

Floristic Quality Index (FQI)

This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. Only the species that were recorded on the rake during the survey are included in calculating the index. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species.

Statistically speaking, the higher the index value, the healthier the lake's aquatic plant community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Big Trade Lake is in the North Central Hardwood Forests Ecoregion. Table 3 reflects the number of species from each survey used to calculate the FQI (N), the Mean C, and the actual FQI value from each of the whole-lake PI surveys that were completed.

Table 3: FQI values from Big Trade Lake 2009, 2017, and 2021

Floristic Quality Index	2009	2017	2021
N (number of species)	19	29	29
Mean C	5.4	5.5	5.6
FQI	23.6	29.5	29.9

In 2009, PCLWD biologists identified a total of 19 native index species in the rake during the point-intercept survey. They produced a Mean C of 5.4 and a FQI of 23.6. In 2017, a total of 29 native index plants in the rake were identified during the point-intercept survey. They produced a Mean C of 5.5 and a Floristic Quality Index of 29.5. Both the FQI and Mean C were better, but this was again likely due to a different aquatic plant surveyor. In 2021, the same surveyor as in 2017 again identified 29 native index plants (Table 4) that produced a Mean C and FQI slightly higher than in 2017. Nichols (1999) reported an average mean C for the North Central Hardwood Forests Region of 5.6 putting Big Trade Lake about average for this part of the state. The FQI was above the median FQI of 20.9 for the North Central Hardwood Forests (Nichols 1999). Unlike Little Trade Lake, seven aquatic plant species from Big Trade Lake identified on the rake had C values ≥ 7, including several with a C of 8 or 9 (Table 4). This suggests that, at least at the moment, Big Trade Lake is less impacted by human development than is Little Trade Lake (see next section).

Table 4: Floristic Quality Index of Aquatic Macrophytes Big Trade Lake, Burnett County July 12, 2021

Common Name	C
River bulrush	6
Coontail	3
Muskgrasses	7
Bald spikerush	3
Common waterweed	3
Water star-grass	6
Small duckweed	4
Forked duckweed	6
Northern water-milfoil	6
Slender naiad	6
Spatterdock	6
White water lily	6
Common reed	1
Fries' pondweed	8
Variable pondweed	7
Long-leaf pondweed	7
Small pondweed	7
Clasping-leaf pondweed	5
Flat-stem pondweed	6
White water crowfoot	8
Grass-leaved arrowhead	9
Common arrowhead	3
Sessile-fruited arrowhead	8
Hardstem bulrush	6
Common bur-reed	5
Large duckweed	5
Sago pondweed	3
Wild celery	6
Common watermeal	5

Comparison of Filamentous Algae in 2009, 2017, and 2021

Filamentous algae, normally associated with excessive nutrients in the water column, were located at 85 points in 2021. This was a significant increase from the 63 points with filamentous algae in 2017 and the 59 points in 2009. Filamentous algae are another plant species that general increases with increased nutrients and degraded water quality.

Aquatic Plant Community – Little Trade Lake

In 2009, a warm-water, whole-lake, point-intercept survey of aquatic plants was completed on Little Trade Lake by the Polk County Land and Water Conservation Department. This survey was repeated in 2016 by Endangered Resource Sciences (ERS) on July 12, and again by ERS in July 2021. During the 2009 survey EWM was documented at three points with another eleven points having a visual record of the plant. In 2016, no points were identified with EWM during the summer survey. In 2021, EWM was identified at only one point. On average from all three surveys, the littoral or plant growing zone of the lake covers about 75 acres or 60% of the total surface area of the lake.

Warm-water Full Point-intercept Aquatic Plant Survey

Depth readings taken at Little Trade Lake's 336 survey points revealed the central basin was a generally uniform elongated bowl with steep sides that rapidly dropped off into >9ft of water. The north bay at the river inlet was also a bowl with the deepest areas bottoming out at 10ft in the northwest corner. In the west-central finger bay, the southeast bay, and the river outlet in the lake's southwest corner, the drop-off from shore was more gradual and these areas were never deeper than 9ft (Figure 16).

Of the points where the bottom substrate could be determined, the lake's bottom was categorized as 76.5% organic and sandy muck, 17.5% pure sand, and 6.0% rock. Most sandy and rocky areas occurred immediately along the shoreline, on exposed points, and around the island. These areas quickly transitioned to nutrient-poor sandy and organic muck at most depths over 4ft (Figure 16).

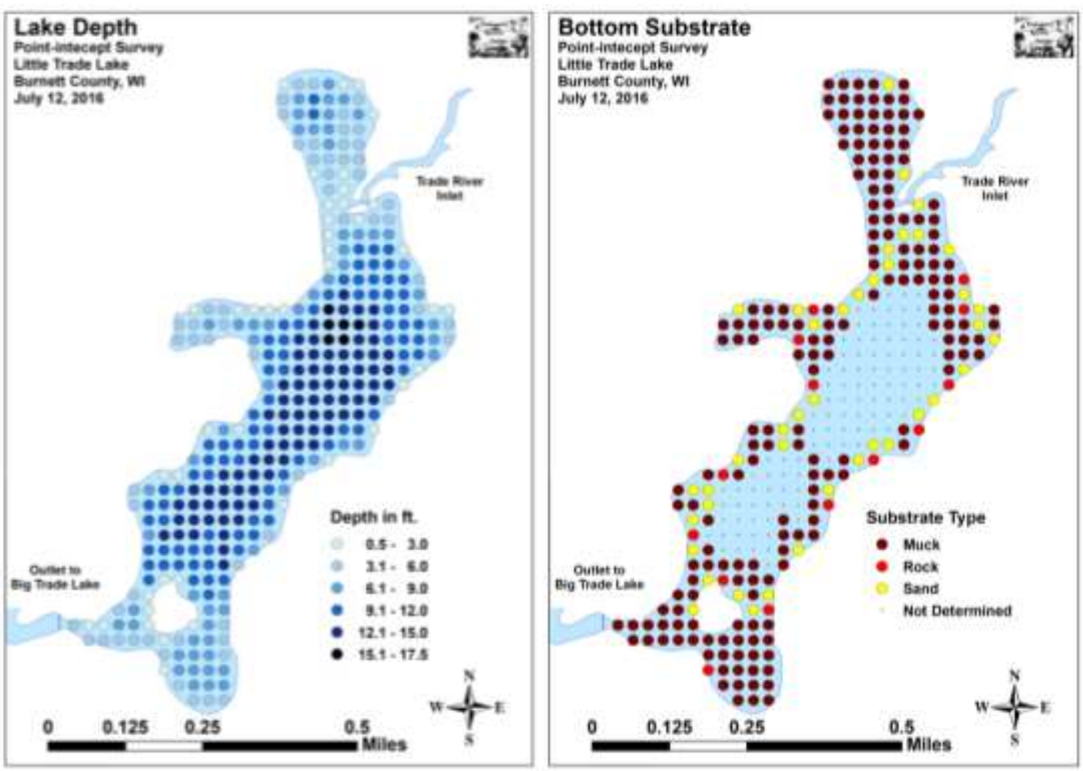

Figure 16: Lake Depth and Bottom Substrate

In 2021, plants were found growing to 11.5ft, up from 10.5ft in 2016, and 8.0ft in 2009. Despite the fact that in the 2021 survey 152 points had vegetation on the rake, the amount of vegetation in the littoral or designated plant growing area of the lake was down to about 57.0%. In 2016, 114 points had vegetation (61.0% of the littoral zone), and in 2009, 115 points had vegetation (72.8% of the littoral zone). Plant growth in both 2016 and 2021 was skewed to deeper water as the mean depth 4.3ft was greater than the median depth of 4.0ft. In 2009 these values were 3.5ft and 3.0ft. There could be several parameters affecting these values including elevated water levels due to rainfall and better water clarity in the lake.

All aquatic plant survey statistics from the three surveys are included in Table 5.

Table 5: Aquatic Macrophyte P/I Survey Summary Statistics Little Trade Lake, Burnett County 2009, 2016, and 2021

SUMMARY STATS:	2009	2016	2021
Total number of sites visited	329	336	336
Total number of sites with vegetation	115	114	152
Total number of sites shallower than maximum depth of plants	158	187	268
Frequency of occurrence at sites shallower than maximum depth of plants	72.78	60.96	56.72
Simpson Diversity Index	0.83	0.83	0.83
Maximum depth of plants (ft)**	8.00	10.50	11.50
Number of sites sampled using rake on Rope (R)	0	0	0
Number of sites sampled using rake on Pole (P)	174	235	0
Average number of all species per site (shallower than max depth)	1.73	1.82	1.80
Average number of all species per site (veg. sites only)	2.37	2.98	3.17
Average number of native species per site (shallower than max depth)	1.48	1.79	1.62
Average number of native species per site (veg. sites only)	2.11	2.96	2.91
Species Richness	12	19	22
Species Richness (including visuals)	12	21	26
Species Richness (including visuals and boat survey)	12	26	30
Mean depth of plants (ft)	3.46	4.30	4.26
Median depth of plants (ft)	3.00	4.00	4.00
Mean rake fullness (veg. sites only)	ND	2.04	2.53

Simpson's Diversity Index

Plant diversity is moderately high and unchanging in Little Trade Lake with a Simpson Index value of 0.83 in each of the three surveys (2009, 2016, & 2021). Species Richness was better in 2021 with 22 species found on the rake. This was higher than what was found in 2016 (19) and much higher than what was found in 2009 (12). When adding species that were seen in the lake, but not on any point, the total species for 2021 jumped to 30, again higher than both previous surveys. The average number of native aquatic plant species also remained high at 2.91, just slightly off the 2016 value of 2.96.

Total rake fullness jumped significantly in 2021 to 2.53 on a 1-3 rake fullness scale, up from a rake fullness value in both 2009 and 2016 of just barely over 2.0.

Changes in the Little Trade Lake Plant Community

The Little Trade Lake ecosystem is home to a somewhat limited plant community that is typical of high-nutrient lakes with fair to poor water quality. From 2009 to 2016 the number of plant species identified certainly increased but that may have been more due to a different aquatic plant surveyor than from an actual increase in plants. What is clear, is from 2009 to 2016, the number of points where plant species that generally do well in degraded water quality conditions increased. That trend continued in the 2021 survey. Table 6 & Figure 17 reflect those species that saw significant increases or decreases from 2009 to 2021. The species in the green are species that do well under degraded water quality conditions and saw significant increases. The three species that saw significant decreases are in yellow.

Table 6: Aquatic plant species that showed significant increases (green) or decreases (yellow) from 2009 to 2021

Species	2009	2016	2021
Coontail	92	105	144
Filamentous algae	89	55	105
Curly-leaf pondweed	36	2	44
Small duckweed	23	44	68
White waterlily	21	45	47
Large duckweed	21	43	68
Watermeal	21	43	68
Spatterdock	0	6	7
Common waterweed	30	31	13
Flat-stem pondweed	13	0	2
Northern watermilfoil	11	0	1

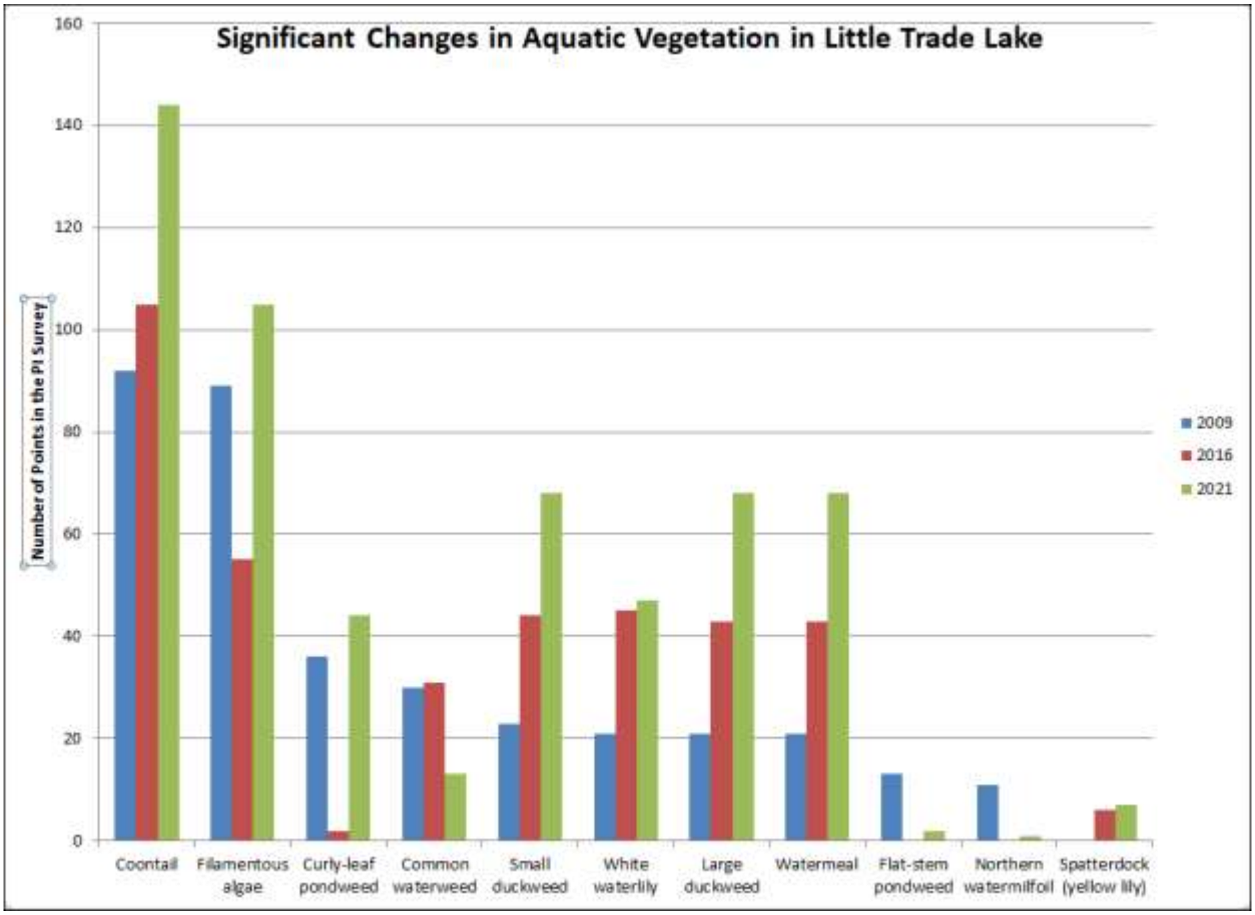

Figure 17: Aquatic plants with significant changes from 2009 to 2016, to 2021

Comparison of Native Aquatic Plant Species in 2009, 2016, and 2021

During the July 2009 survey, PCLWD biologists found that Coontail, Curly-leaf pondweed, Common waterweed, and Small duckweed were the most common species. They were present at 80.00%, 31.30%, 26.09%, and 20.00% of survey points with vegetation respectively and accounted for 66.30% of the total relative frequency. White water lily (7.69), Large duckweed (7.69), Common watermeal (7.69), Flat-stem pondweed (4.76), and Northern water-milfoil (4.03) also had relative frequencies over 3.0.

In 2016, Coontail, White water lily, Small duckweed, and Large duckweed were the most common species. They were found at 92.11%, 39.47%, 38.60%, and 37.72% of sites with vegetation and accounted for 69.71% of the total relative frequency. Common watermeal (12.65) and Common waterweed (9.12) also had relative frequencies over 3.0.

In 2021, Coontail, Small duckweed, Large duckweed, Common watermeal, and White waterlily were the most common species. They were found at 94.7%, 44.7%, 44.7%, 30.9%, and 29.0% of the sites with vegetation and accounted for 91.1% of the total relative frequency. No other species had a relative frequency over 3.0, though Common waterweed was close at 2.7%.

Floristic Quality Index (FQI)

Little Trade Lake is in the North Central Hardwood Forests Ecoregion as established by Nichols (1999). Table 7 reflects the number of species from each survey used to calculate the FQI (N), the Mean C, and the actual FQI value from each of the whole-lake PI surveys that were completed.

Table 7: FQI values from Little Trade Lake 2009, 2016, and 2021

Floristic Quality Index	2009	2016	2021
N (number of species)	10	15	17
Mean C	4.9	4.7	4.7
FQI	15.5	18.1	19.4

In 2009, PCLWD biologists identified a total of 10 native index species in the rake during the point-intercept survey. They produced a Mean C of 4.9 and a FQI of 15.5. In 2016, a total of 15 native index plants in the rake were identified during the point-intercept survey. They produced a Mean C of 4.7 and a Floristic Quality Index of 18.1. While the FQI was better, the Mean C declined. In 2021, the 17 native index plants (Table 8) produced a Mean C exactly the same as in 2016, but again the FQI was a bit higher at 19.4 (Table 6). Nichols (1999) reported an average mean C for the North Central Hardwood Forests Region of 5.6 putting Little Trade Lake well below average for this part of the state. The FQI was also below the median FQI of 20.9 for the North Central Hardwood Forests (Nichols 1999). Long-leaf pondweed (C = 7) was the only species with a conservatism value higher than 6, suggesting that nearly all of the plants in the lake are those that are either unaffected by human development or those that have taken over, or taken advantage because of human development.

Table 8: Floristic Quality Index of Aquatic Macrophytes Little Trade Lake, Burnett County July 12, 2021

Species	Common Name	C
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Myriophyllum sibiricum	Northern water-milfoil	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Phragmites australis	Common reed	1
Potamogeton nodosus	Long-leaf pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton zosteriformis	Flat-stem pondweed	6
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium eurycarpum	Common bur-reed	5
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Wolffia columbiana	Common watermeal	5

Comparison of Filamentous Algae in 2009, 2016, and 2021

Filamentous algae, normally associated with excessive nutrients in the water column, were located at 105 points in 2021. While this was a highly-significant increase from the 55 points with filamentous algae in 2016, it was not at all significantly different from the 89 points they were found at in 2009. However, the mean rake fullness showed a significant increase in density from 1.57 in 2009 to 1.76 in 2016, to 2.0 in 2021.

Wild Rice

According to the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Big Trade and Little Trade Lakes are not wild rice waters. Additionally, wild rice was not found during any the aquatic plant surveys of the lakes or during the Sensitive Areas survey.

Aquatic Invasive Species

Several aquatic invasive species are already established in Big and Little Trade Lakes. These include the invasive plant species curly-leaf pondweed (CLP), Eurasian watermilfoil (EWM), purple loosestrife, yellow iris, narrow-leaf cattail, and reed canary grass. Of these, CLP, EWM, and purple loosestrife are the most problematic. Chinese mystery snails are an aquatic invasive animal species that is present. Management of CLP, EWM, and purple loosestrife is on-going in the lakes. The rest are species that should be monitored for expansion in the lakes. There are also several plant and animal species that have not been identified in the lakes that should be monitored for on a regular basis. These include zebra mussels, rusty crayfish, giant reed grass, and Japanese knotweed.

Non-native, Aquatic Invasive Plant Species

Eurasian watermilfoil and curly-leaf pondweed are the most problematic non-native, aquatic invasive species in the lakes. Both are submerged vegetation species (rooted to the bottom of the lake and growing under the surface of the water) that have the potential to outcompete more desirable native aquatic plants. Purple loosestrife and yellow iris reed canary grass are shoreland or wetland plants not generally problematic within the lake, but can be very problematic on the shores and in the wetlands adjacent to the lake. More information is given for each non-native species in the following sections.

Eurasian Watermilfoil (Myriophyllum spicatum)

EWM (Figure 18) 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, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits,

EWM is difficult to distinguish from Northern water milfoil. EWM 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 does not have individual leaflets.

EWM grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is 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 lake beds, 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.

Unlike many other plants, EWM does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces 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. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, and 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, EWM is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM 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 EWM 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 EWM may lead to deteriorating water quality and algae blooms in infested lakes.

Figure 18: EWM complete root and stem and floating fragment with adventitious roots

Curly-leaf Pondweed (Potamogeton crispus)

Curly-leaf pondweed (CLP) is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia. It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. By early July, the plant completes its life cycle, dies, and drops to the lake bottom (Figure 19). CLP is commonly found in alkaline and high nutrient waters, preferring soft substrate and shallow water depths. It tolerates low light and low water temperatures.

CLP spreads through burr-like winter buds (turions), which are moved among waterways (Figure 20). These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making curly-leaf pondweed one of the first nuisance aquatic plants to emerge in the spring. It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out-compete native plants in the spring. In mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. CLP forms surface mats that interfere with aquatic recreation (Figure 20).

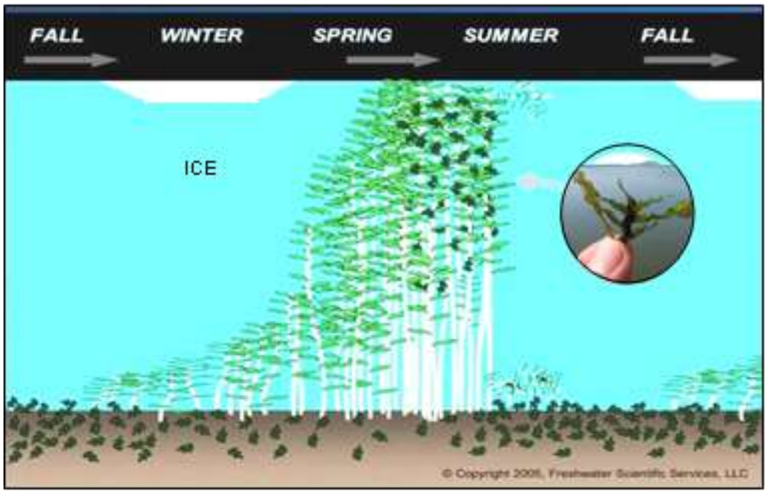

Figure 19: Diagram showing annual CLP life-cycle in northern lakes (Freshwater Scientific Services, 2008).

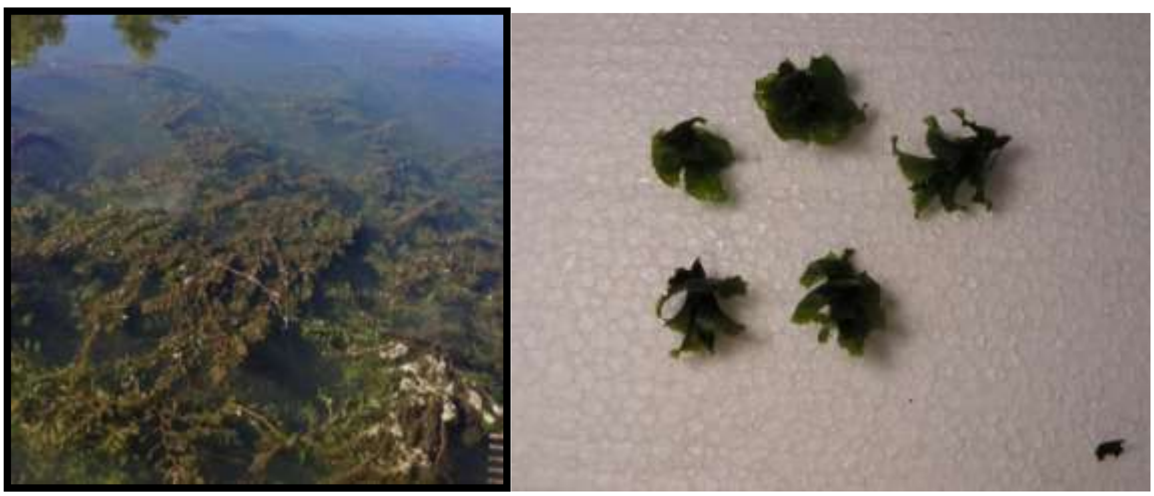

Figure 20: CLP plants and turions (not from Horseshoe Lake)

Purple Loosestrife (Lythrum salicaria)

Purple loosestrife (Figure 21) 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 that vary from purple to magenta possess 5-6 petals aggregated into numerous long spikes, and bloom from August to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat. 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.

This plant's optimal habitat includes marshes, stream margins, alluvial 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.

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. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months. 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 perturbation is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. Plants may be quite large and several years old before they begin flowering. 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. Invasion usually begins with a few pioneering plants that build up a large seed bank in the soil for several years. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland or shoreland area. The plant's ability to adjust to a wide range of environmental conditions gives it a competitive advantage; coupled with its reproductive strategy, purple loosestrife tends to create monotypic stands that reduce biotic diversity.

Figure 21: Purple loosestrife

Yellow Flag Iris (Iris pseudacorus)

Yellow flag iris (Figure 22) is a showy perennial plant that can grow in a range of conditions from drier upland sites, to wetlands, to floating aquatic mats. A native plant of Eurasia, it can be an invasive garden escapee in Wisconsin’s natural environments. Yellow flag iris can produce many seeds that can float from the parent plant, or plants can spread vegetatively via rhizome fragments. Once established it forms dense clumps or floating mats that can alter wildlife habitat and species diversity. All parts of this plant are poisonous, which results in lowered wildlife food sources in areas where it dominates. This species has the ability to escape water gardens and ponds and grow in undisturbed and natural environments. It can grow in wetlands, forests, bogs, swamps, marshes, lakes, streams and ponds. Dense areas of this plant may alter hydrology by trapping sediment and/or blocking flow.

Yellow iris has broad, sword-shaped leaves that grow upright, tall and stiff. They are green with a slight blue-grey tint and are very difficult to distinguish from other ornamental or native iris species. Flowers are produced on a stem that can grow 3-4 feet tall among leaves that are usually as tall or taller.

The flowers are showy and variable in color from almost white to a vibrant dark yellow. Flowers are between 3-4 inches wide and bloom from April to June. Three upright petals are less showy than the larger three downward pointing sepals, which may have brown to purple colored streaks.

Seeds are produced in fruits that are 6-angled capsules, 2-4 inches long. Each fruit may have over 100 seeds that start pale before turning dark brown. Each seed has a hard outer casing with a small air space underneath, which allows the seeds to float.

The roots are thick, fleshy pink-colored rhizomes spread extensively in good conditions, forming thick mats that can float on the surface of the water.

When not flowering, yellow flag iris could be easily confused with the native blue flag iris (*Iris versicolor*) as well as other ornamental irises that are not invasive. Blue flag iris is usually smaller and does not tend to form as dense clumps or floating mats. When not flowering or showing fruiting bodies, yellow flag iris may be confused with other wetland plants such as cattails (*Typha* spp.) or sweet flag (*Acorus* spp.) species.

Small populations may be successfully removed using physical methods. Care should be taken if hand-pulling plants as some people show skin sensitivity to plant sap and tissues. All parts of the plant should be dug out – particularly rhizomes and disposed of in a landfill or by burning. Cutting the seed heads may help decrease the plant spreading.

Aquatic formulas of herbicides may be used to control yellow flag iris, however, permits may be needed. Foliar spray, cut stem/leaf application and hand swiping of herbicide have all shown effectiveness.

Figure 22: Yellow flag iris

Narrow-leaf Cattail, Reed Canary Grass, Giant Reed Grass, and Japanese Knotweed

The following species either are already in the lakes (narrow-leaf cattail & reed canary grass) or could be introduced (giant reed grass & Japanese knotweed), but active management is not planned (Figure 23).

Narrow-leaf Cattail (*Typha angustifolia*)

Narrow-leaf cattails have leaves that are erect, linear, and flat. The leaf blades are 0.15-0.5" wide, and up to three feet long. About 15 leaves emerge per shoot that are dark green in color and rounded on the back of the blade. The top of the leaf sheath has thin, ear-shaped lobes at the junction with the blade that usually disintegrates in the summer.

Numerous tiny flowers are densely packed into a cylindrical spike at end of the stem that is divided into the upper section of yellow, male flowers and the lower brown, sausage-shaped section of female flowers. The gap between male and female sections is about 0.5-4" in narrow-leaved cattail. They flower in late spring. These plants also reproduce vegetatively by means of starchy underground rhizomes that form large colonies.

For more information about narrow-leaf cattail including how to control it, go to: https://dnr.wisconsin.gov/topic/Invasives/fact/NarrowLeavedCattail.html.

Reed Canary Grass (*Phalaris arundinacea*)

Reed canary grass (Figure 17) is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades. Blades are flat and have a rough texture on both surfaces. Single flowers occur in dense clusters from May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas such as bergs and spoil piles.

For more information about reed canary grass including how to control it, go to: https://dnr.wisconsin.gov/topic/Invasives/fact/ReedCanaryGrass.html.

Common Reed Grass (*Phragmites australis*)

Often just called phragmites, common reed grass is a perennial wetland grass that grows three to 20 feet tall with dull, very slightly ridged, stiff and hollow stems. It creates dense clones where canes remain visible in winter. Leaf sheaths tightly clasp the stem, are difficult to remove, and stay on throughout the winter. Its flowers are bushy, light brown to purple plumes that are composed of spikelets that bloom July-September. The plumes are 7.5-15 inches long and resemble feather dusters. It roots are stout, oval rhizomes that can reach up to six feet deep into the ground and 10 feet horizontally.

For more information about common reed grass including how to control it, go to: https://dnr.wisconsin.gov/topic/Invasives/fact/Phragmites.html.

Japanese Knotweed (*Fallopia japonica or Polygonum cuspidatum*)

Japanese knotweed is an herbaceous perennial that forms large colonies of erect, arching stems (resembling bamboo). Stems are round, smooth and hollow with reddish-brown blotches. Plants reach up to 10' and the dead stalks remain standing through the winter.

New infestations of Japanese knotweed often occur when soil contaminated with rhizomes is transported or when rhizomes are washed downstream during flooding. It poses a significant threat to riparian areas where it prevents streamside tree regeneration and increases soil erosion. Root fragments as small as a couple of inches can resprout, producing new infestations. The plant can disrupt nutrient cycling in forested riparian areas, and contain allelopathic compounds (chemicals toxic to surrounding vegetation).

For more information about reed canary grass including how to control it, go to: https://dnr.wisconsin.gov/topic/Invasives/fact/JapaneseKnotweed.html.

Figure 23: Narrow-leaf cattail (upper left), Reed canary grass (upper right), Phragmites (lower left), and Japanese knotweed (lower right)

Non-native Aquatic Invasive Animal Species

At present, Chinese mystery snails are the only non-native animal species beside common carp in the lakes. Several non-vegetative, aquatic, invasive animal species could be introduced to the lakes, but have not been identified at the present time. It is important for lake property owners and users to be knowledgeable of these species in order to identify them if and when they show up.

Chinese and Banded Mystery Snails

The Chinese mystery snails and the banded mystery snails (Figure 24) are non-native snails that have been found in a number of Wisconsin lakes. There is not a lot yet known about these species, however, it appears that they have a negative effect on native snail populations. The female mystery snail gives birth to live crawling young. This may be an important factor in their spread as it only takes one impregnated snail to start a new population. Mystery snails thrive in silt and mud areas although they can be found in lesser numbers in areas with sand or rock substrates. They are found in lakes, ponds, irrigation ditches, and slower portions of streams and rivers. They are tolerant of pollution and often thrive in stagnant water areas. Mystery snails can be found in water depths of 0.5 to 5 meters (1.5 to 15 feet). They tend to reach their maximum population densities around 1-2 meters (3-6 feet) of water depth. Mystery snails do not eat plants. Instead, they feed on detritus and in lesser amounts algae and phytoplankton. Thus removal of plants in your shoreline area will not reduce the abundance of mystery snails.

Lakes with high densities of mystery snails often see large die-offs of the snails. These die-offs are related to the lake's warming coupled with low oxygen (related to algal blooms). Mystery snails cannot tolerate low oxygen levels. High temperatures by themselves seem insufficient to kill the snails as the snails could move into deeper water.

Many lake residents are worried about mystery snails being carriers of the swimmer's itch parasite. In theory they are potential carriers, however, because they are an introduced species and did not evolve as part of the lake ecosystem, they are less likely to harbor the swimmer's itch parasites.

Figure 24: Chinese (left) and Banded (right) Mystery Snails

Zebra Mussels

Zebra mussels have not been identified in either lake. The closest populations of zebra mussels are in Big and Middle McKenzie lakes on the Burnett/Washburn County line just a few miles west of Spooner, WI. Additional populations are established in Deer Lake off Hwy 8 in Polk County and in Lake Superior.

Zebra mussels (Figure 25) are an invasive species that have inhabited Wisconsin waters and are displacing native species, disrupting ecosystems, and affecting citizens' livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources. 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 the 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.

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. Recently, the WDNR has supported the installation of Decontamination Stations at public boat landings. The main purpose for these stations is to prevent the spread of zebra mussels by encouraging boaters to spray their watercraft down with a light bleach and water combination. Draining all water from the boat and livewells is also important.

Figure 25: Zebra Mussels

Rusty Crayfish

Rusty crayfish (Figure 26) live in lakes, ponds and streams, preferring areas with rocks, logs and other debris in water bodies with clay, silt, sand or rocky bottoms. They typically inhabit permanent pools and fast moving streams of fresh, nutrient-rich water. Adults reach a maximum length of 4 inches. Males are larger than females upon maturity and both sexes have larger, heartier, claws than most native crayfish. Dark "rusty" spots are usually apparent on either side of the carapace, but are not always present in all populations. Claws are generally smooth, with grayish-green to reddish-brown coloration. Adults are opportunistic feeders, feeding upon aquatic plants, benthic invertebrates, detritus, juvenile fish and fish eggs.

Rusty crayfish reduce the amount and types of aquatic plants, invertebrate populations, and some fish populations--especially bluegill, smallmouth and largemouth bass, lake trout and walleye. They deprive native fish of their prey and cover and out-compete native crayfish. Rusty crayfish will also attack the feet of swimmers. On the positive side, rusty crayfish can be a food source for larger game fish and are commercially harvested for human consumption.

It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except the Mississippi River). It is also illegal to release crayfish into a water of the state without a permit.

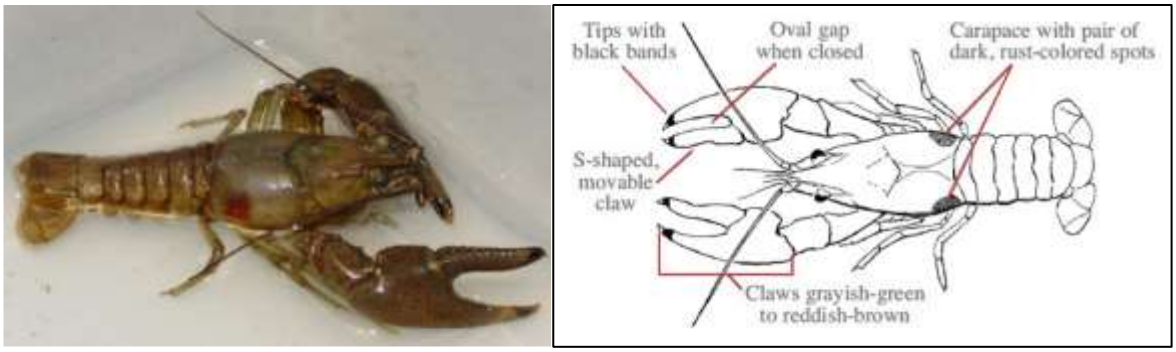

Figure 26: Rusty Crayfish and identifying characteristics

AIS Prevention Strategy

Burnett County has an "Illegal transport of aquatic plants and invasive animals" ordinance (Chapter 18, Article V). The purpose of this ordinance is to prevent the spread of aquatic invasive species in Burnett County and surrounding water bodies. The ordinance makes it illegal to operate a vehicle or transport vehicles, watercraft, and equipment from a navigable water onto a public highway if aquatic plants, terrestrial plants, or aquatic animals are attached. Exceptions are made for aquatic plant harvesting, study, or commercial use. An amendment in 2018 added a provision that requires decontamination both upon entering and leaving a water body if decontamination is available at an access point. Citations are as follows: first offense $25 plus costs, second offense $25 to $100 plus costs, and for third and subsequent offences, $100 to $250 plus costs. Citations are issued by law enforcement officers of Burnett County. The Conservation Division provides assistance with enforcement efforts.

Burnett County also has a county-wide AIS Coordinator who works with area lake groups to complete monitoring, education and training, and management planning and implementation support.

As mentioned, Big and Little Trade Lakes have several AIS already present in them. The RTLIA with support from other entities will continue to implement a watercraft inspection and AIS Signage program at the public access points on Big Trade Lake. Little Trade Lake does not currently have its own public access point. Information will be shared with lake residents and users in an effort to expand the watercraft inspection message. In addition to the watercraft inspection program, an in-lake and shoreland AIS monitoring program will be implemented. Both of these programs will follow UW-Extension Lakes and WDNR protocol through the Clean Boats, Clean Waters program and the Citizen Lake Monitoring Network Aquatic Invasive Species Monitoring program.

Additionally, having an educated and informed lake constituency is the best way to keep non-native aquatic invasive species at bay in area lakes. To foster this, lake community events including AIS identification and management workshops; distribution of education and information materials to lake property owners and lake users; newsletters, webpage postings, and general mailing will be completed annually.

CLP and EWM Management History

Eurasian watermilfoil (EWM) was identified in Little Trade Lake in 2009 and has been managed using application of herbicides starting in 2012. Curly-leaf pondweed (CLP), another aquatic invasive species has been in the lake for a longer period of time, and has also been managed with aquatic herbicides.

EWM was identified two years later in Big Trade Lake in 2011 and has been managed using physical removal and application of herbicides starting in 2012. CLP has been in the lake for a longer period of time, and initially (through 2016) it was targeted for management using aquatic herbicides at the same time that EWM was managed. Since 2016, CLP has not been targeted for management. Instead, management focused on trying to prevent the spread of EWM in Big Trade Lake. Three whole lake summer surveys of vegetation in Big Trade Lake have been completed. The first summer point-intercept (PI) survey was completed by Polk County in 2009. Endangered Resource Services (ERS) completed a summer PI survey in 2017 and again in 2021. During the 2009 survey there was no EWM identified in Big Trade Lake. In 2017 it was identified at 4 points with an additional four visuals, representing about 4.0 acres of EWM. In 2021 it was identified at 17 points with an additional 12 visuals, representing about 14.5 acres of EWM.

Big Trade Lake

When EWM was first found in Big Trade Lake in late 2011, physical removal was incorporated through 2013. In 2014, aquatic herbicides were used for the first time with the expectation that property owners around the lake would also do physical removal anytime they found a new or pioneering EWM plant growing near their docks or shorelines. From 2014-2016, both CLP and EWM was targeted for management using the endothall-based herbicides Aquathol K (liquid) and Aquathol Super K (granular) (Table 9). Since 2016, only EWM has been targeted for management in Big Trade Lake using 2,4D based herbicides including DMA 4 and Shredder Amine 4 (liquid) and Navigate (granular). Of all these years, the 2018 treatment when granular 2,4D was used on smaller beds and liquid 2,4D was used on larger beds, was the most effective, significantly reducing EWM from 2017 to 2018. No chemical treatment was completed in either 2021 or 2022 despite a rather urgent need to do so, due to a lack of grant funds and some turnover in the RTLIA. It is expected that a large-scale or whole-lake/whole-basin chemical treatment will be completed in either in 2023 or 2024.

Despite management using aquatic herbicides over the last 8 years, EWM has continued to spread in Big Trade Lake. Much of this is due to the fact that almost no physical removal of new, pioneering EWM plants around the lake was completed by property owners despite annual training and pleas for physical removal to take place. Figures 27-29 reflect the changes in EWM since 2012 based on annual fall EWM bed mapping. To be called a bed, an area must have EWM at or near the surface, have a definable boundary, and have at least 50% of the vegetation present be EWM (Berg ??). These figures do not include the sometimes 100's of additional points outside of the beds that were documented at the same time that fall bed mapping was done. Figures 30-32 reflect three years where beds and points are included on the same map. Figure 33 shows all of the fall bed mapping results (without individual points) on the same map.

Table 9: 2011-2022 Management of EWM using aquatic herbicides in Big Trade Lake

EWM Management on Big Trade Lake, 2011-2022												
Task	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Spring EWM Treatment (acres)				1.51	1.42	2.07	2.7	13.36	3.67	10.52	0	0
Spring CLP Treatment (acres)				1.51	1.42	2.07						

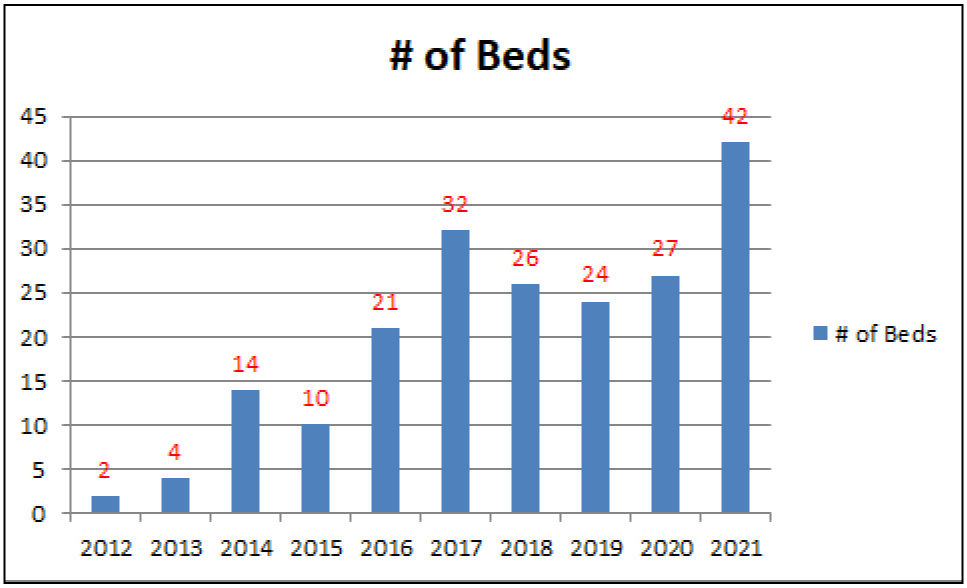

Figure 27: 2012-2021 Number of EWM beds in Big Trade Lake based on fall EWM bed mapping

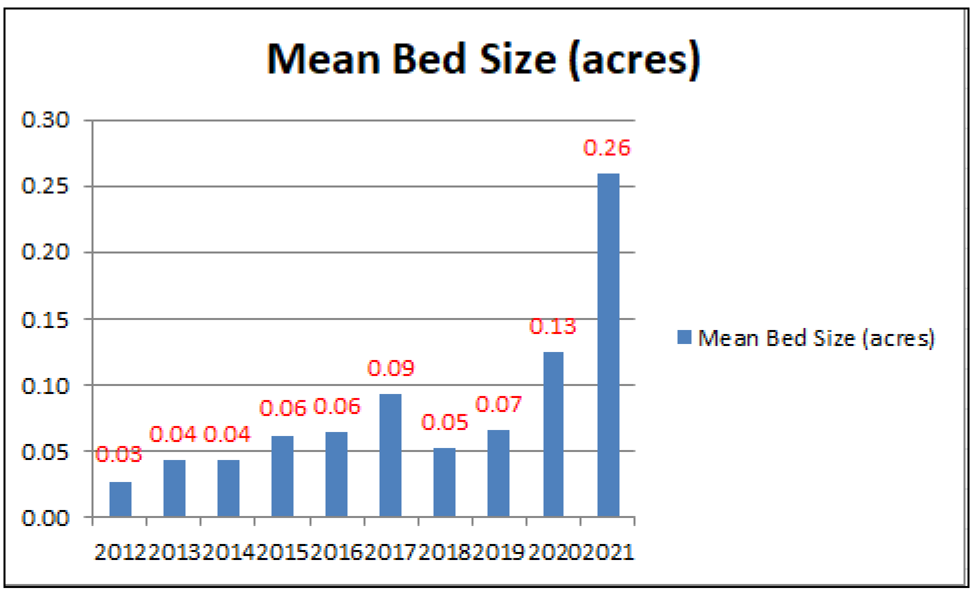

Figure 28: 2012-2021 Mean EWM bed size (acres) in Big Trade Lake based on fall EWM bed mapping

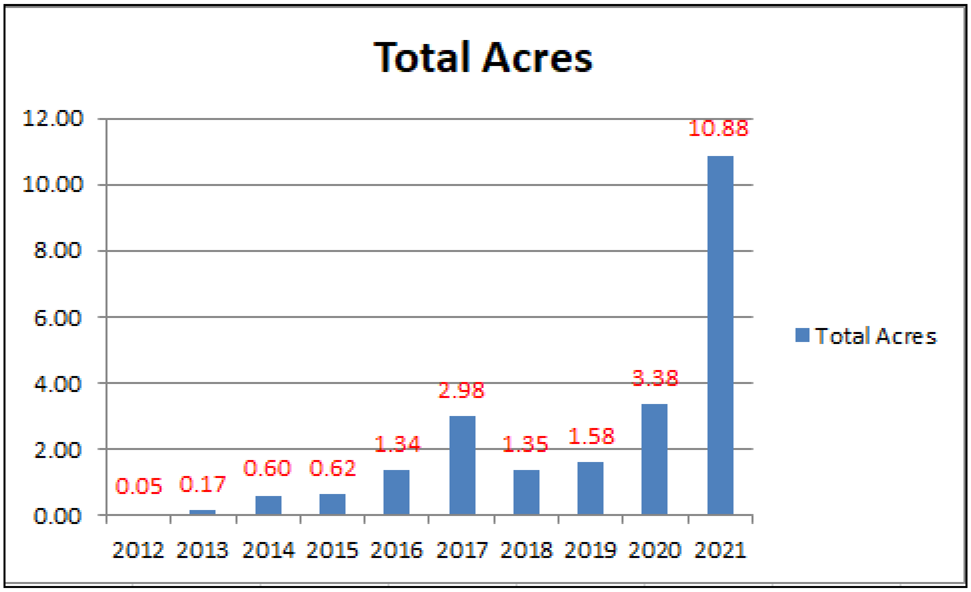

Figure 29: 2012-2021 Total annual acres of EWM in Big Trade Lake based on fall EWM bed mapping

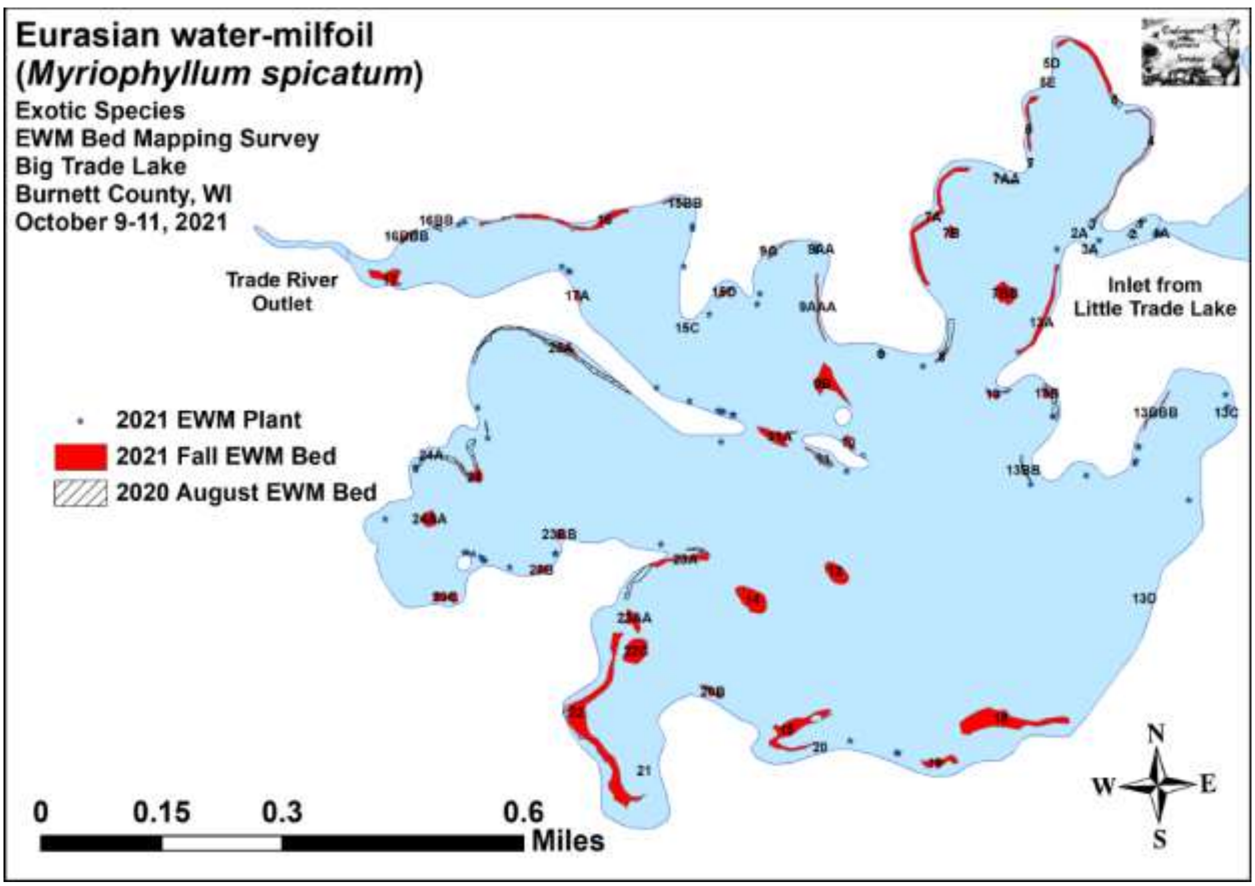

Figure 30: 2021 Fall EWM bed mapping with beds (42) and points (55)

Figure 31: 2019 Fall EWM bed mapping with beds (24) and points (136)

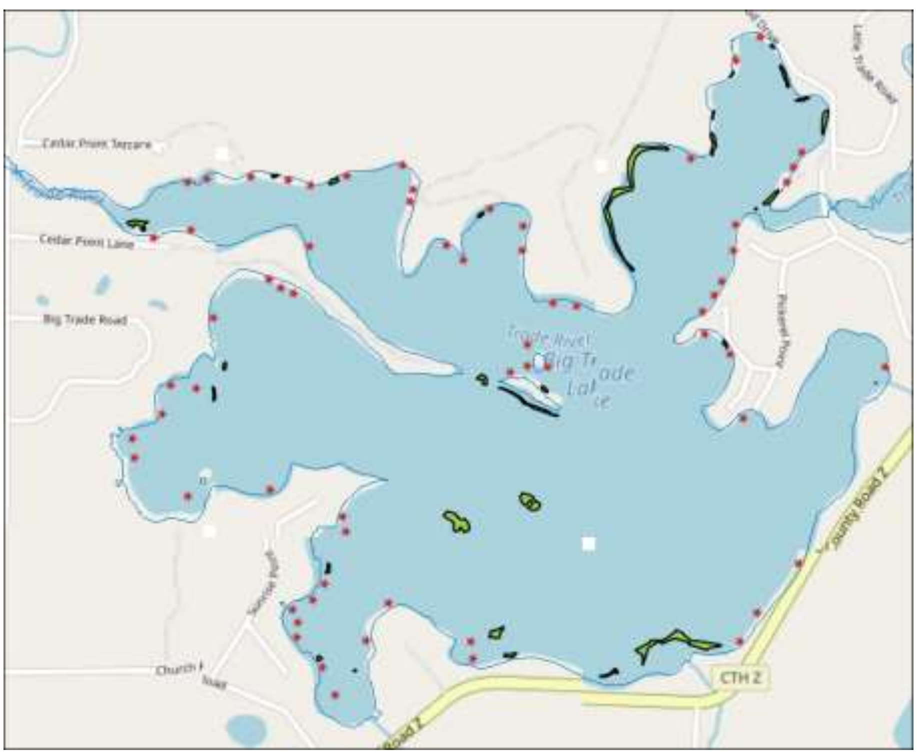

Figure 32: 2017 Fall EWM bed mapping with beds (32) and points (120)

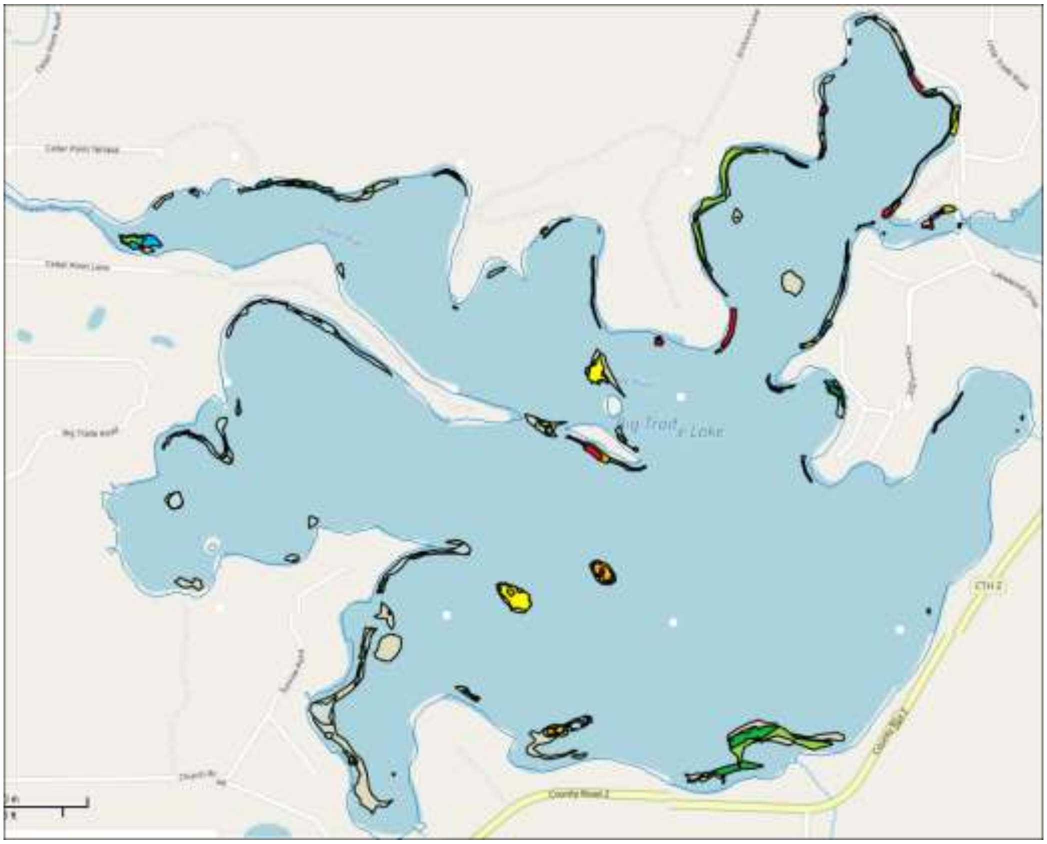

Figure 33. 2012 (tan), 2014 (red), 2015 (orange), 2016 (yellow), 2017 (lt. green), 2018 (blue), 2019 (green), 2020 (lt. blue), and 2021(gray) EWM bed mapping results on Big Trade Lake

Whole-lake, cold-water, early season, point-intercept surveys to document CLP in Big Trade Lake were completed in 2012 and again in 2021. In 2012, the points with CLP equated to about 50 acres of CLP in the lake. From 2014 to 2016 CLP in Big Trade Lake was chemically treated, and while the treatments successfully knocked back the CLP where treated, in 2021, the second whole-lake survey documented about 59 acres of CLP in the lake.

Little Trade Lake

CLP and EWM have been managed in Little Trade Lake using aquatic herbicides since 2012 (Table 10). In each year herbicides have been used, both CLP and EWM have been targeted – sometimes with different herbicides, sometimes with the same herbicide. Two endothall-based herbicides (Aquathol K and Aquathol Super K), two diquat-based herbicides (Reward and Tribune), and two 2,4D-based herbicides (DMA 4 and Shredder Amine 4) have been used at varying concentrations to control both CLP and EWM.

For the most part, these treatments have been effective at providing at least one season and in some years, multiple seasons of relief from dense growth CLP and EWM. Over time, these treatments have reduced the overall abundance of both CLP and EWM in Little Trade Lake.

Spring PI surveys in 2012, 2016, and 2021 identified CLP at 139, 120, and 88 points respectively. This number of points represents about 52, 45, and 33 acres of CLP respectively in Little Trade Lake during the three surveys. The average rakehead density based on a 1-3 scale for all the points with CLP was 2.42, 2.18, and 1.86 respectively. This decline in points with CLP, total acres, and average rakehead density from 2012 to 2021 is despite 2021 being an outstanding year for CLP growth across northern Wisconsin.

EWM bed mapping since 2012 has identified between 0.16 (2020) and 4.65 (2012) acres of EWM in the lake (Table 11). Prior to 2016, fall EWM bed mapping averaged nearly 4.0 acres annually. From 2016 to 2021, fall EWM bed mapping averaged approximately 1.0 acres annually.

Table 10: CLP and EWM management in Little Trade Lake from 2007 to 2022

AIS Management on Little Trade Lake, 2007-2014								
Task	2007	2008	2009	2010	2011	2012	2013	2014
Spring EWM Treatment (acres)						4.13	5.14	
Spring CLP Treatment (acres)						4.13	5.14	

AIS Management on Little Trade Lake, 2015-2022								
Task	2015	2016	2017	2018	2019	2020	2021	2022
Spring EWM Treatment (acres)	6.52	10.05		4.11	1.84	7.27		
Spring CLP Treatment (acres)	6.52	10.05		7.42	5.84	7.01		

Table 11: Historic EWM bed mapping in Little Trade Lake

Bed Number	2021 Area in Acres	2020 Area in Acres	2019 Area in Acres	2018 Area in Acres	2017 Area in Acres	2016 Area in Acres	2015 Area in Acres	2014 Area in Acres	2013 Area in Acres	2012 Area in Acres
1	0.37	0.10	0	0.93	0	0.06	0	3.84	4.61	2.16
1A	0	0	0	0.18	0.04	0	0	0	0	0
2	0	0	0	0	0	0.02	0	Merged	Merged	Merged
3	0.01	0	0.22	0	0	0	0.65	0.23	0.03	0
4	0	0	0.04	0.06	0.07	0	0.58	0	0	0
4B	0	0	0	0	0.07	0	0.26	0	0	0
5 and 5A	0.02	0	0	0	0.01	0	0.52	0	0	0
5B	0.10	<0.01	<0.01	0.02	0.07	0	0.33	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0.03	0	0.22	0.06	0.04	0.02	0.31	0	0	0
8A and 8B	0	0	0.19	0	0.10	0	0.42	0	0	0
9 and 9A	0.12	0.04	0.07	0	0.01	0	0	0	0	0
10	0.15	0	0.11	0.05	0.05	0	0.51	0	0	0
10A	0.17	0.02	0.15	0	0.10	0.11	0	0	0	0
10B	0	0	0	0	0	0	0.05	0	0	0
11	0	0	0.05	0	0	0.01	0	0	0	0
12	0	0	0	0	0	0	0.26	0	0	0
12B	0	0	0	0	0	0	0	0	0	0.02
12C	0	0	0	0	0	0	0	0	<0.01	0.08
13	0.11	0	0.53	0.10	0.27	0.05	0.08	0.14	<0.01	0
13B	0	0	Merged	0	0.16	0.02	0.26	0	0	0
14	0.03	0	0.01	0	0.10	0.05	0	0.10	<0.01	0.31
Total Acres	**1.11**	**0.16**	**1.59**	**1.40**	**1.09**	**0.34**	**4.23**	**4.32**	**4.65**	**2.57**

Integrated Pest Management

Integrated Pest Management (IPM) is an ecosystem-based management strategy that focuses on long-term prevention and/or control of a species of concern. IPM considers all the available control practices such as: prevention, biological control, biomanipulation, nutrient management, habitat manipulation, substantial modification of cultural practices, pesticide application, water level manipulation, mechanical removal and population monitoring (Figure 34). In addition to monitoring and considering information about the target species' life cycle and environmental factors, groups can decide whether the species' impacts can be tolerated or whether those impacts warrant control. Then, an IPM-based plan informed by current, comprehensive information on pest life cycles and the interactions among pests and the environment can be formed.

After monitoring and considering information about the target species' life cycle and environmental factors, groups can decide whether the species' impacts can be tolerated or whether those impacts warrant control. If control is needed, data collected on the species and the waterbody will help groups select the most effective management methods and the best time to use them.

The most effective, long-term approach to managing a species of concern is to use a combination of methods. Approaches for managing pests are often grouped in the following categories:

- **Assessment** – is the use of learning tools and protocols to determine a waterbodies' biological, chemical, physical and social properties and potential impacts. Examples include: point-intercept (PI) surveys, water chemistry tests and boater usage surveys. This is the most important management strategy on every single waterbody.
- **Biological Control** – is the use of natural predators, parasites, pathogens and competitors to control target species and their impacts. An example would be beetles for purple loosestrife control.
- **Cultural controls** – are practices that reduce target species establishment, reproduction, dispersal, and survival. For example, a Clean Boats, Clean Waters program at boat launches can reduce the likelihood of the spread of species of concern.
- **Mechanical and physical controls** – can kill a target species directly, block them out, or make the environment unsuitable for it. Mechanical harvesting, hand pulling, and diver assisted suction harvesting are all examples.
- **Chemical control** – is the use of pesticides. In IPM, pesticides are used only when needed and in combination with other approaches for more effective, long-term control. Groups should use the most selective pesticide that will do the job and be the safest for other organisms and for air, soil, and water quality.

(Additional information on each method is outlined in the following section).

IPM is a process that combines informed methods and practices to provide long-term, economic pest control. A quality IPM program should adapt when new information pertaining to the target species is provided or monitoring shows changes in control effectiveness, habitat composition and/or water quality.

While each situation is different, eight major components should be established in an IPM program:

1. Identify and understand the species of concern
2. Prevent the spread and introduction of the species of concern

3. Continually monitor and assess the species' impacts on the waterbody
4. Prevent species of concern impacts
5. Set guidelines for when management action is needed
6. Use a combination of biological, cultural, physical/mechanical and chemical management tools
7. Assess the effects of target species' management
8. Change the management strategy when the outcomes of a control strategy create long-term impacts that outweigh the value of target species control.

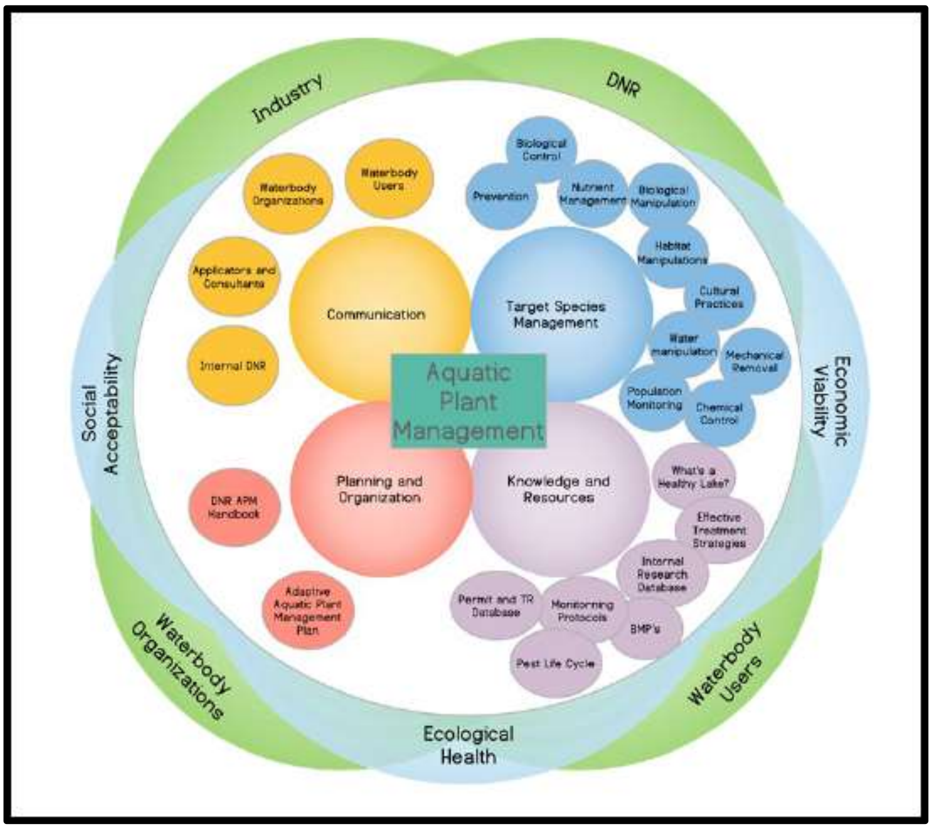

Figure 34: Wisconsin Department of Natural Resources: Wisconsin Waterbodies – Integrated Pest Management March 2020

Aquatic Plant Management Alternatives

Protecting native plants and limiting CLP and EWM through IPM is a primary focus of plant management in both Big and Little Trade Lakes due to their diverse plant communities and the benefits they offer. Generally, control methods for nuisance aquatic plants can be grouped into four broad categories:

- Chemical control: use of herbicides
- Mechanical/physical control: pulling, cutting, raking and harvesting
- Biological control: the use of species that compete successfully with the nuisance species for resources
- Aquatic plant habitat manipulation: dredging, flooding, and drawdowns

In most cases, an IPM approach to aquatic plant management is the best way to protect and enhance the native plant community while maintaining functional use of the lake.

Physical/Manual Removal: Recommended

Physical removal of both CLP and EWM using a rake or through hand-pulling will be completed by educated landowners who monitor their own shorelines or by a trained AIS Management Team sponsored by the RTLIA. There is no limit to how much CLP and EWM can be physically removed from the lakes and it does not require a permit under most circumstances. Landowners should continually monitor near their docks and swimming areas in the open water season and remove rooted CLP and EWM plants as well as floating fragments that wash into their shoreline. Native vegetation can only be cleared without a permit in an area up to 30-ft wide and adjacent to a property owner's dock, but the area can reach out into the lake as far as necessary to get to the nuisance vegetation. Physical removal using a rake or through hand-pulling has essentially no cost and can be practiced by many lake residents. It can however, be labor intensive, particularly when tackling large areas of CLP and EWM.

Diver Removal

Pulling CLP and/or EWM while snorkeling or scuba diving in deeper water is also allowable without a permit and can be effective at slowing the spread of a new aquatic invasive species infestation within a waterbody when done properly. Diver removal will most likely be used once the over-whelming amount of CLP and EWM has been reduced to such a point where diver removal can be effective. Efforts would be focused on removing small areas in between years when chemical treatments are used, or to remove areas missed or too small to be managed using herbicides.

Diver Assisted Suction Harvest

Diver Assisted Suction Harvesting (DASH) is a hand removal method that requires a diver to handfeed the offending vegetation into an underwater suction tube once removed from the lake bottom. DASH is considered mechanical harvesting as it requires the assistance of a mechanical system to implement (Figure 35). DASH increases the ability of a diver to remove the offending vegetation from a larger area, faster, but also requires a Mechanical Harvesting permit from the WDNR. The cost to implement DASH is also more expensive than employing a diver alone. A DASH boat consists of a pontoon boat equipped with the necessary water pump, catch basin, suction hose, and other apparatus (Figure 35). Estimates to build a custom DASH boat, range from $15,000.00 to $20,000.00. Contracted DASH services usually run in the $2,000.00 to $3,000.00 per day range.

Like diver removal, DASH would be focused on removing small areas of CLP and EWM in between years when herbicides are used.

Figure 35. DASH – Feeding EWM into the underwater Suction Hose (Marinette Co.); and a sample DASH Pontoon Boat (Beaver Dam Lake Management District)

Mechanical Harvesting: Recommended

Mechanical harvesting involves the use of devices not solely powered by human as a means to aid removal. This includes gas and electric motors, ATV's, boats, tractors, etc. Using these instruments to pull, cut, grind, or rotovate aquatic plants is illegal in Wisconsin without a permit. DASH is also considered mechanical removal. To implement mechanical removal of aquatic plants a Mechanical/Manual Aquatic Plant Control Application is required annually. The application is reviewed by the WDNR and other entities and a permit awarded if required criteria are met. Using repeated mechanical disturbance such as bottom rollers or sweepers can be effective at control in small areas, but in Wisconsin these devices are illegal and generally not permitted.

Harvesters can remove thousands of pounds of vegetation in a relatively short time period. They are not, however, species specific. Everything in the path of the harvester will be removed, including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone (Booms, 1999). Plants are cut at a designated depth, but the root of the plants is often not disturbed. Cut plants will usually grow back after time, and re-cutting several times a season is often required to provide adequate annual control (Madsen, 2000).

Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (Madsen, 2000). Even the best aquatic plant harvesters leave some cutting debris in the water to wash up on the shoreline or create loose mats of floating vegetation on the surface of the lake. This "missed" cut vegetation can potentially increase the amount of EWM in a lake by creating more fragments that can go on to establish new sites elsewhere. Floating mats of "missed" cut vegetation can pile up on shorelines creating another level of nuisance that property owners may have to deal with.

A major benefit, however, of aquatic plant harvesting is the removal of large amounts of plant biomass from a water body. This large-scale removal can help reduce organic material build up in the bottom of the lake over time and even help to improve water clarity and reduce phosphorus loading. Also, once a permit for mechanical harvesting has been approved, harvesting can occur in the approved areas as often as necessary to manage the vegetation.

Large-Scale Mechanical Harvesting

Large-scale mechanical harvesting is commonly used for control of CLP, and in the absence of other management alternatives or conditions that prevent the use of other management alternatives, can also be an effective way to reduce EWM biomass in a water body, particularly if the EWM is in the same area as the CLP being harvested. With harvesting of EWM, there is substantial risk of increasing fragmentation, so the risk of doing so should be weighed appropriately.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The size and the 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). 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.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Harvesters can remove thousands of pounds of vegetation in a relatively short time period. 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 build-up of organic material that normally occurs as a result of the decaying of this plant matter is reduced. Additionally, repeated harvesting may result in thinner, more scattered growth.

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 don’t 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 efficiency of the operation, in terms of time and cost.

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 CLP, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments or other plant parts with them, and facilitate the spread of aquatic invasive species from one body of water to another.

Mechanical harvesting in Big Trade Lake is recommended and could help manage both CLP and EWM. Figure 36 shows the results of a May 2012 CLP bed mapping survey and the results of the most recent fall EWM bed mapping survey completed in October 2021. The density and distribution of CLP changes on an annual basis, as does EWM, but the two maps reflect what could be considered the “worst case scenario” for both species in Big Trade Lake. Harvesting to remove CLP would likely also remove a fair amount of EWM.

Mechanical harvesting on Little Trade Lake is made more difficult by the fact that there is no public access to the lake. To get to Little Trade Lake, a boat must travel through a channel and under a bridge that is way too low for a harvester to pass. Unless an access point is created, a mechanical harvester purchased for Big Trade Lake would not be able to be used in Little Trade Lake.

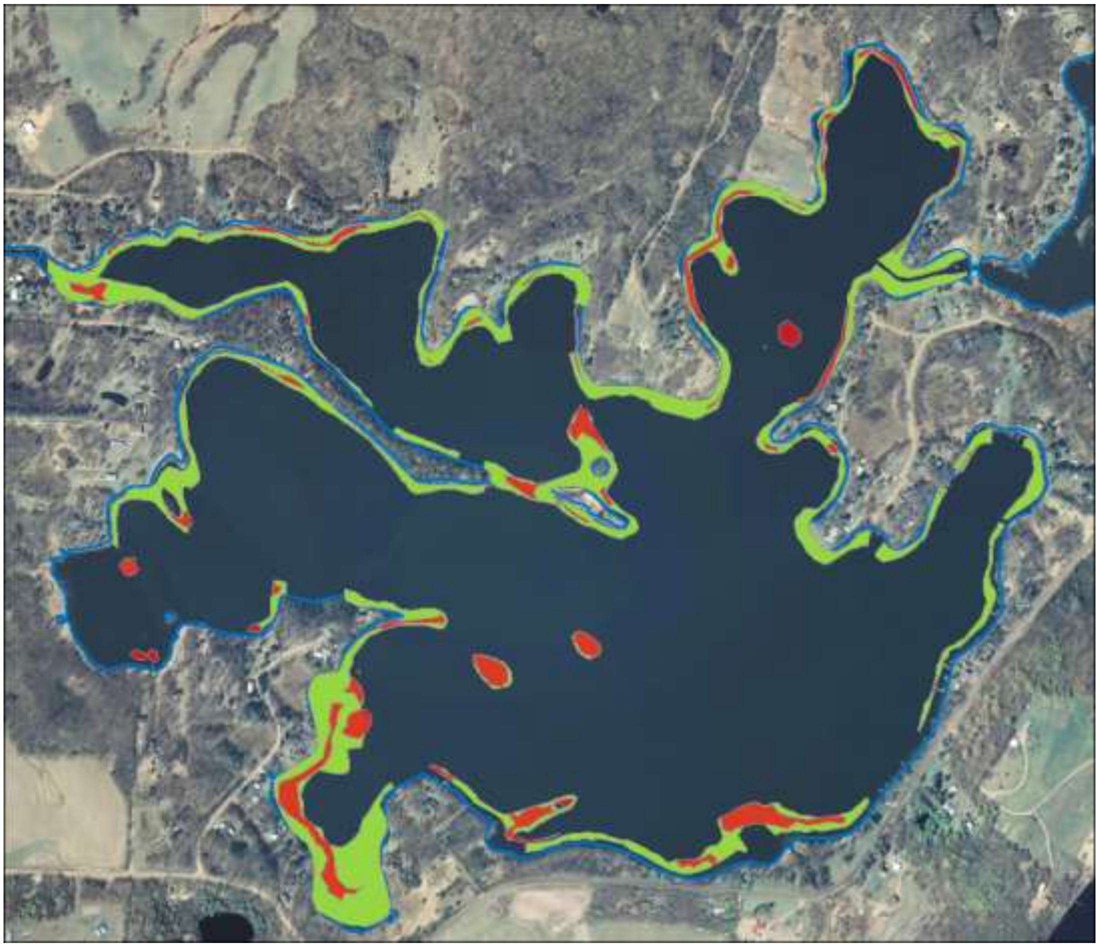

Figure 36: May 2012 CLP bed mapping results (green) and October 2021 EWM bed mapping results (red) in Big Trade Lake

Harvesting Totals and Estimated Costs (Owning versus Contracting Services)

Costs per acre to harvest vary with numbers of acres harvested, accessibility of disposal sites to the harvested areas, density and species of the harvested plants, and whether a private contractor or public entity does the work. However, using a report from Dane County, WI prepared by Koegel et al. (1974), and extrapolating their costs to current costs, an estimate of cost per acre of harvesting can be made when owning the equipment. Their calculations include paid operator cost, gas and lubrication, repair and maintenance and a mechanic to do the work, supervision of operators, storage and transportation, and the annual investment cost over 15 years. They estimated the cost of a mechanical harvester to be about $55,000.00. That value was upped to $255,000.00 in 2021. Their calculations estimated the cost in 1974 to be about $68.50/acre. When updating their numbers to 2021, the estimated cost is about $418.50/acre. If the RTLIA harvests 35 acres during the season, the cost is about $14,650.00. This number does not include the cost of any additional equipment like trailers or elevators or the cost of insurance.

For comparison purposes, the Rice Lake Protection and Rehabilitation District harvests up to 160 acres of CLP and another 60 acres of navigation lanes later in the season. They run three harvesters with 10-ft cutting heads. Their 2022 estimated annual budget to support its harvesting program is $130,000.00 and does include investment costs (as they just purchased a new harvester two years ago), the cost of other equipment, operating expenses, maintenance, insurance, and supporting consultant fees. At 220 acres, the cost is about $590.91/acre. At 35 acres, this would be a cost of $20,681.85 annually on Big Trade Lake.

Local private harvesting contractors generally charge around $2,000 to $3,000 per day for harvesting services. There is one locally available contractor in NW Wisconsin, and there are several companies from southern WI and from MN. It is estimated that a large harvester (10-ft cutting head) can harvest about 0.78 acres per hour or 7.8 acres in a 10 hour day. It would take 4.5 days for a contractor to harvest 35 acres for a total of $9,000.00. If the harvesting was needed twice in the same year, the cost would be about $18,000.00 annually. If a smaller harvester is used, like one with only a 5-ft cutting head, then would likely take twice as long to harvest 35 acres, so the cost could be as high as $18,000.00 for one time, and $36,000.00 for two.

Benefits and Drawbacks

There are benefits and drawbacks for both contracted harvesting and purchasing a harvester outright. With contracted harvesting, the cost per acre can vary depending on vegetation density, distance between the area being harvesting and the off-loading site, and the distance to the designated disposal site. Another issue presented by contracting is that the timing of the harvesting is entirely dependent upon the contractor's schedule which can result in the vegetation being harvested after the optimal time. However there are many benefits to contracted harvesting, the biggest one being the reduced upfront costs associated with contracting. There is also no maintenance and storage costs, and there are reduced or no costs if less or no harvesting is completed in any given year.

Purchasing, on the surface, is the more expensive option due not only to the initial cost of purchase, but also insurance, storage, maintenance, and an operator's salary (unless volunteer operated). However, depending on the actual cost of the contractor and the efficiency in which the contractor can handle the harvesting project, purchasing may be less expensive overall. Purchasing a harvester eliminates the potential for new AIS to be introduced to the lake from the harvester, the cost per acre tends to go down the longer a harvester is operational, and these costs will not increase dramatically if the amount of vegetation being harvested increases. This also allows harvesting to be done during the best times as well as providing a way to maintain navigation channels throughout the summer. The biggest drawbacks to purchasing a harvester are the increased up-front cost and the annual costs associated with maintaining the harvester. Even during years with less harvesting, the maintenance, storage, and other miscellaneous costs will remain around the same as those costs would be during years that require large amounts of harvesting.

Operating a Mechanical Harvester on Big Trade Lake

The majority of Big Trade Lake is accessible to the harvester, however as mentioned before, the harvester would not be able to operate on Little Trade Lake unless a boat landing was established. Harvesting operations are generally required to stay in at least 3-ft of water, which may limit access in some areas of the lake.

Chemical Herbicide Treatments: Recommended

In lieu of or in addition to physical removal and mechanical harvesting, aquatic herbicides will be used to manage existing and new CLP and EWM areas with moderate to severe growth density and deemed too large for effective physical or DASH removal. Determining which herbicide to use (as approved by the state of Wisconsin) and at what concentration will be determined on a yearly basis during the treatment planning phase.

Characteristics like the size, depth, location, and density of aquatic vegetation directly impact how effective the use of aquatic herbicides can be. Spring application of herbicides is preferred to reduce negative effects on native plants and fish habitat. Larger areas respond better to chemical treatments than do small areas. Deep water and shallow water on the edge of deeper drop-offs require differing amounts of herbicides to be effective than do shallow flats. Most important for the use of an aquatic herbicide is how long it is expected that the herbicide will be in contact with the target plant species. Shorter contact times require higher concentration of herbicide, some form of artificial containment system to hold the herbicide in place longer, and/or perhaps a different type of herbicide altogether. Where longer contact times are possible, herbicide concentrations can be less, an artificial containment area may not be needed, and there are more herbicide choices.

Application of herbicide requires a Chemical Application permit from the WDNR. It is illegal in WI to put any chemical into the waters of the state without a permit, no exception. Herbicides must be applied by a licensed applicator. It is possible for a member of a lake organization to complete the requirements to become a licensed applicator, but in most cases, the lake organization will contract with a company specializing in herbicide application.

Micro and Small-scale Herbicide Application

The determining factor in designating chemical treatments as micro or small-scale is the size of the area being treated. Small-scale herbicide application involves treating areas less than 10 acres in size. The dividing line between small-scale and micro treatments is not clearly defined, but is generally considered to be less than an acre. Small-scale chemical application is usually completed in the early season (April through May). Recent research related to micro and small-scale herbicide application generally shows that these types of treatment are less effective than larger scale treatments due to rapid dilution and dispersion of the herbicide applied. Some suggested ways to increase the effectiveness is to increase the concentration of herbicide used, use an herbicide like diquat or ProcellaCOR that does not require as long a contact time to be effective, or in some manner contain the herbicide in the treated area by artificial means such as installing a limno-barrier or curtain.

Large-scale Herbicide Application

Large-scale herbicide application involves treating areas more than 10 acres in size. Like small-scale applications, this is usually completed in the early-season (April through May) for control of non-native invasive species like CLP and EWM to minimize impacts on native species. It is generally accepted that lower concentration of herbicide can be used in large-scale applications as the likelihood of the herbicide staying in contact with the target plant for a longer time is greater. If the volume of water treated is more than 10% of the volume of the lake, or the treatment area is ≥160 acres, or 50% of the lakes littoral zone, effects can be expected at a whole-lake scale. Large-scale herbicide application can be extended in some lakes to include whole basin or even whole lake treatments. The bigger the treatment area, the more contained the treatment area, and the depth of the water in the treatment area, are factors that impact how whole basin or whole lake treatments are implemented.

Whole-Lake or Whole-Basin Herbicide Application

Whole-lake or whole-basin treatments are those where the herbicide may be applied to specific sites, but the goal of the strategy is for the herbicide to reach a target concentration when it equally distributes throughout the entire volume of the lake (or lake basin). The application rate of whole-lake treatments is dictated by the volume of water in with which the herbicide will reach equilibrium. Because exposure time is expected to be so much longer, sometimes several weeks, effective herbicide concentrations for whole-lake treatments are significantly less than required for spot treatments. Whole-lake treatments are typically conducted when the target plant is spread throughout the majority of the lake or basin.

The longer the expected herbicide/target species exposure or contact time, the lower the overall concentration of herbicide can be applied and expected results still achieved. If the contact time between the applied herbicide and the target plant in a whole body of water or protected basin can be increased to, or is already expected to be several days to a week or more, the concentration of an herbicide like 2,4-D can be in the range of 0.25-0.5 ppm instead of the 2-4 ppm that is typically used in small-scale, spot, or micro treatments.

Planning to treat the whole lake can be further designed to minimize the herbicide needed to affect the desired outcome. The method used to implement whole-lake treatments changes with the type of lake. Herbicide applied to a shallow, mixed lake is expected to mix throughout the entire volume of the lake. In deep water lakes that stratify, herbicide can be applied at such a time when it is expected that it will only mix with the surface water above the thermocline in an area known as the epilimnion.

With whole-basin treatments, a limno-barrier/curtain could be installed to partition off sections of the lake to reduce the size of a treated area.

Installation of a Limno-Barrier/Curtain

Herbicide applications can be made more effective by installing a limno-barrier or curtain around a treatment area to help hold the applied herbicide in place, longer. By doing so, the herbicide/target species contact time is increased. The curtain is generally a continuous sheet of plastic that extends from the surface to the bottom of the lake (Figure 37). The surface edge of the curtain is generally supported by floatation devices. The bottom of the curtain is held in place by some form of weighting. The curtain or barrier, sometimes thousands of feet of it, is installed around the proposed treatment area with the purpose of holding the herbicide in place longer by preventing dilution and drift away from the treated area (Figure 38).

Figure 37: Limno-curtain material on a roll before installation (photo from Marinette Co. LWCD)

Figure 38: Limno-curtain installed on Thunder Lake (photo from Marinette Co. LWCD)

In the Thunder Lake, Marinette County limno-curtain trial completed in 2020, a curtain was installed around two small areas (0.9 and 2.9 acres) of dense growth EWM prior to chemical treatment. Liquid 2,4-D was applied at 4.0ppm inside the barrier. The barriers stayed in place until 48 hours after treatment. Herbicide concentration testing (see following section) was completed within the treated areas to determine how long the herbicide stayed in place and at what concentration. Figure 39 reflects what happened to the herbicide that was applied within the barrier in Thunder Lake. Herbicide concentrations stayed relatively high for a longer period of time (48 hrs). Once the curtain was removed, the herbicide dissipated rapidly. Similar studies have been completed on other lakes with similar results.

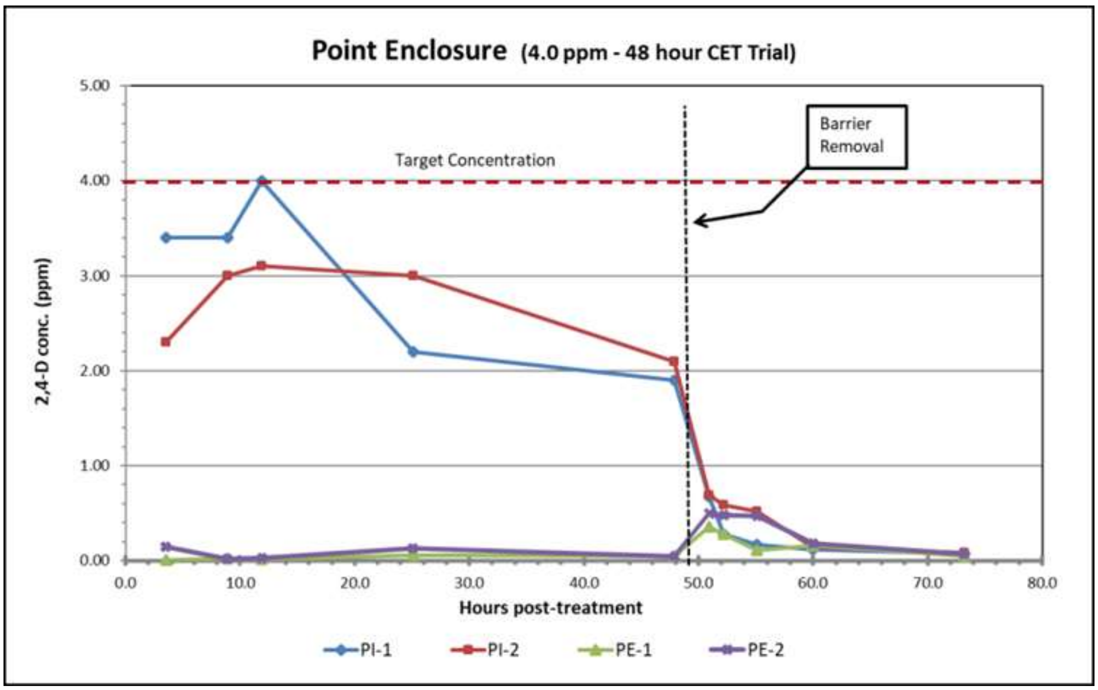

Figure 39: Herbicide concentration results from 2020 Thunder Lake limno-curtain trial (Marinette Co LWCD)

Installing a Limno-barrier in Big Trade Lake

EWM is widespread in Big Trade Lake, as such; a whole-lake application of herbicides is a reasonable management action. With its many lobes or bays, however, a limno-barrier could be installed to separate portions of the lake and reduce the size of a given treatment area. With one or more of the curtains installed in Figure 40, the size of a whole-basin treatment area could be reduced to between 20 and 150 acres instead of 329 acres. The limno-barrier may also minimize the impacts of water flow through the system. The drawback of course, in order to use a curtain, it has to be built and then deployed. Once deployed, it may have to be moved several times to cover different treatment areas. In order to improve the efficiency of a whole-basin treatment in the lake, the curtain would need to be in place for 2 to 5 days.

The main basin of Big Trade Lake is 39-ft deep and stratifies, meaning the warm surface water is separated from the deeper cool water by a thermocline. Because of this, an epilimnion (above the thermocline) treatment could be planned to reduce the amount of herbicide needed. The bottom of the curtain would likely have to reach at least 15-ft down in the water to accommodate for stratification.

All large-scale or whole-lake/whole-basin herbicide applications require a WDNR approved APM Plan, pre- and post-treatment aquatic plant surveying, and likely chemical concentration/residual monitoring.

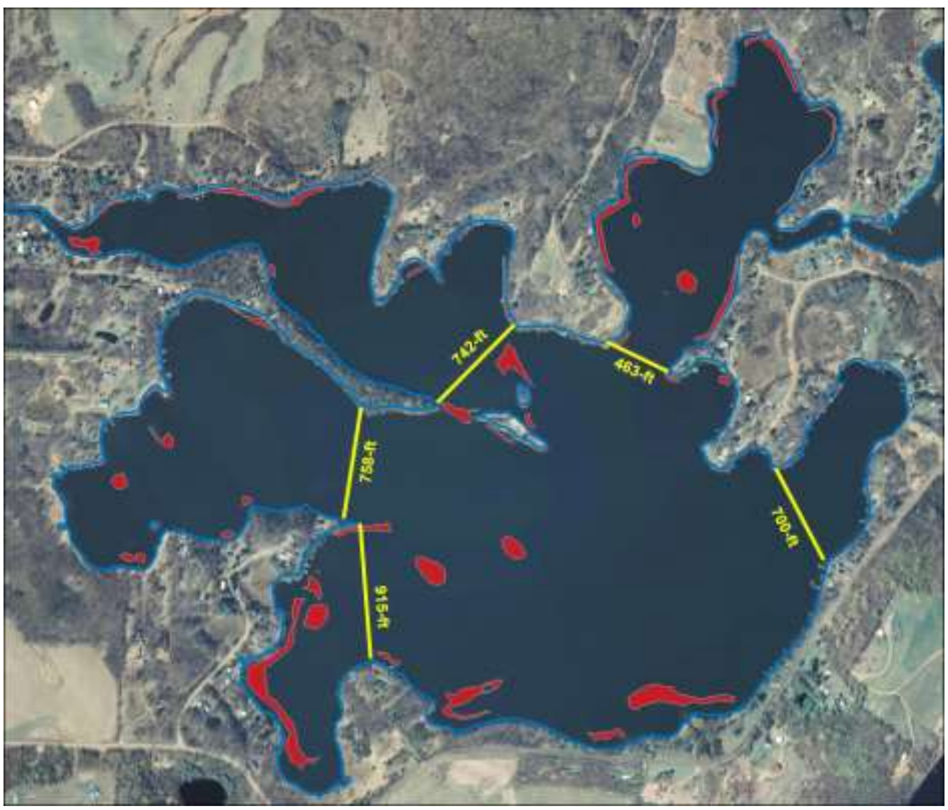

Figure 40: 2021 EWM bed mapping and possible locations for limno-barrier installation in Big Trade Lake

Recommended Aquatic Herbicides for EWM

There are several chemical herbicide options currently available in the State of Wisconsin (as approved by the Environmental Protection Agency). There are two classes of aquatic chemical herbicides currently in use:

1) Systemic herbicides move through the entire plant. It is absorbed through the leaves or stem and moves through the entire plant and usually results in the death of the entire plant within two or more weeks. Systemic herbicides also tend to be more plant species specific, meaning a systemic herbicide used to kill EWM would likely not kill CLP or other native pondweeds. It would kill similar plants like northern watermilfoil.

2) Contact herbicides kill the plant at the point of contact. The entire plant may not be damaged, and the roots may still be viable for regrowth. Contact herbicides are mostly used when a more immediate removal of the target plant is required. They are generally not target plant specific, meaning that when applied they will likely impact all plant species in the treated areas.

The following herbicides are recommended for control of EWM in Big and Little Trade lakes.

ProcellaCOR®

ProcellaCOR® is a relatively new systemic, selective herbicide that can be used to target EWM with limited impact to most native species. It is also very fast acting (4 hours), making it an effective control measure on smaller beds, especially ones in high boat traffic areas and/or deeper water. In addition, applications rates are measured in ounces, not gallons as is common with almost all other liquid herbicides. And while it is more expensive to use than 2,4-D equivalents, it has been shown to provide two or more years of control without re-application.

Triclopyr

Triclopyr is a selective, systemic herbicide used to control plants like EWM. Liquid triclopyr (Renovate®) or granular triclopyr combined with granular 2,4D (Renovate Max G®) may be an option for larger treatment areas, however neither triclopyr nor 2,4D based herbicides are recommended for small-scale (<3ac) EWM treatments because required contact times to kill the target plant are often in the 16-24 hour range and difficult to attain due to dilution. It can be more effective if a limno-barrier is used. Triclopyr products are generally more expensive than 2,4D products.

2,4D (liquid)

2,4D is a commonly used systemic herbicide that targets plants like EWM. Shredder Amine 4®, also referred to as 2,4D Amine 4® is a liquid formulation of 2,4D. It has been successfully used on Big Trade Lake to control EWM, and is a viable option again in the future if EWM beds that are included in a management plan reach or exceed several acres in size. Like triclopyr, 2,4D requires a contact time of 16-24 hours to be effective. And like triclopyr, it can be more effective if a limno-curtain is used.

ProcellaCOR, triclopyr, and 2,4D target dicot species or plants like EWM, Northern and other native milfoils, several related species, and lily pads. Monocot species like CLP, Flat-stem and other native pondweed are generally not affected by these herbicides.

It may be beneficial to alternate the use of different herbicides in an effort to reduce the ability of target plants to build up a resistance to an herbicide that is applied too often.

Recommended Aquatic Herbicides for CLP

The following herbicides have also been used effectively for control of CLP in Big and Little Trade lakes.

Endothall (liquid)

Endothall is a non-selective contact herbicide. As such, it is not species specific and will negatively impact any aquatic plant it comes in contact with. This herbicide is most often used to control CLP very early in the season when other native aquatic plants have not begun to actively grow. Like the herbicides used for EWM, how effective the treatment is depends on many characteristics including but not limited to depth, water movement, and size of the treatment area. Because it is a contact herbicide, at high enough concentrations it can also be used to manage EWM, but not generally by itself. It may be combined with an herbicide like 2,4D to treat CLP and EWM simultaneously.

Diquat (liquid)

Diquat is another non-selective herbicide that is commonly used to control emergent and submersed aquatic vegetation including CLP and EWM. It is faster-acting than endothall, triclopyr, or 2,4D but can have reduced effectiveness in water containing suspended sediment. Also, as a contact herbicide, it will negatively impact any aquatic plant species it comes in contact with – it is not species specific.

Each of the aquatic herbicides mentioned in the previous sections come with various restrictions for use. There may or may not be restrictions for swimming, fish, fish consumption, wildlife, irrigation, and/or drinking water. However, every one of the herbicide mentioned has been approved for control of vegetation in an aquatic setting by the Environmental Protection Agency and the WDNR. Working with an accredited applicator and/or a consultant specializing in aquatic plant management will help ensure those that could be affected by a chemical treatment will be informed.

Pre and Post Treatment Aquatic Plant Surveying

When introducing new chemical treatments to lakes where the treatment size is greater than ten acres or greater than 10% of the lake littoral area and more than 150-ft from shore, the WDNR requires pre and post chemical application aquatic plant surveying.

The WDNR protocol assumes that an APM Plan has identified specific goals for non-native invasive species and native plants species. Such goals could include reducing coverage by a certain percent, reducing treatments to below large-scale application designations, and/or reducing density from one level to a lower level. A native plant goal might be to see no significant negative change in native plant diversity, distribution, or density. Results from pre and post treatment surveying are used to determine the impacts of a chemical treatment, improve consistency in analysis and reporting, and in making the next season's management recommendations.

The number of pre and post treatment sampling points required is based on the size of the treatment area. Ten to twenty acres generally requires at least 100 sample points. Thirty to forty acres requires at least 120 to 160 sampling points. Areas larger than 40 acres may require as many as 200 to 400 sampling points. Regardless of the number of points, each designated point is sampled by rake, recording depth, substrate type, and the identity and density of each plant pulled out, native or invasive.

In the year prior to an actual treatment, the area to be treated must have a mid-season/summer/warm water point intercept survey completed that identifies the target plant and other plant species that are present. A pre-treatment readiness aquatic plant survey is done in the year the herbicide is to be applied, prior to application to confirm the presence and level of growth of the target species. A post-treatment survey should be scheduled when native plants are well established, generally mid-July through mid-August and can be done in the year following application. If treating CLP a post treatment survey needs to be completed before seasonal growth ends (i.e. mid-June). For the post-treatment survey, repeat the PI for all species in the treatment polygons, as was done the previous summer. For whole-lake scale treatments, a full lake-wide PI survey should be conducted.

Chemical Concentration Testing

Chemical concentration testing is often done in conjunction with treatment to track the fate of the chemical herbicide used. Testing is completed to determine if target concentrations are met, to see if the chemical moved outside its expected zone, and to determine if the chemical breaks down in the system as expected. It may also be required to determine if the herbicide stays clear of areas that should be protected from herbicide impacts (like in beds of wild rice). Monitoring sites are located both within and outside of the treatment area, particularly in areas that may be sensitive to the herbicide used, where chemical drift may have adverse impacts, where movement of water or some other characteristic may impact the effect of the chemical, and where there may be impacts to drinking and irrigation water. Water samples are collected prior to treatment and for a period of hours and/or days following chemical application.

Biological Control: Recommended

Biological control uses one or more living organisms to control, or suppress, another living organism. There are approved biological controls for Eurasian watermilfoil and purple loosestrife. At the present time, there are no biological controls for curly-leaf pondweed.

Eurasian Watermilfoil

Milfoil weevils (*Euhychiopsis lecontei)* are one method used to manage EWM. Weevils are an alternative to chemical treatments and potentially damaging mechanical harvesting. However, they are expensive to rear, easily predated on by sunfish, and only suppress – not eliminate – EWM. The milfoil weevil is native to North America and is likely present at some level in the lake. Survey work could be completed to determine their presence or absence, however attempting to artificially increase their population as a biological control method is not recommended.

Purple Loosestrife

Galerucella beetles (*Galerucella pusilla and G. calmariensis*) are currently approved for the control of purple loosestrife in Wisconsin (Figure 41). The entire lifecycle of Galerucella beetles is dependent on purple loosestrife. In the spring, adults emerge from the leaf litter below old loosestrife plants. The adults then begin to feed on the plant for several days until they begin to reproduce. Females lay their eggs on loosestrife leaves and stems. When the larvae emerge from these eggs they begin feeding on the leaves and developing shoots. When water levels are high these larvae will burrow into the loosestrife stems to pupate into adult beetles. These new adults emerge and begin feeding on the loosestrife again (Sebolt, 1998). Galerucella beetles do not forage on any plants other than purple loosestrife. Because of this the populations, once established, are self-regulating. When the purple loosestrife population drops off, the beetle population also declines. When the loosestrife returns, the beetle numbers will usually increase. These beetles do not eradicate purple loosestrife entirely, but do help to reduce its dominance which will allow other native plants to recover.

The RTLIA has been rearing and releasing beetles for several years, with release sites along the Trade River where it enters Round Lake, and on Big Trade Lake off Church Rd on the south side of the lake. It is recommended that beetle rearing continue and the areas where beetles have already been released should be monitored for beetle activity.

Figure 41: Galerucella Beetle

Habitat Manipulation: Not Recommended

Habitat manipulation can take the form of flooding, dredging and drawdowns. None of these options are recommended or viable in Big or Little Trade lakes. Flooding and drawdowns are not possible because there are no water level control structures on or near the lake that could be used to manipulate the water levels. Dredging is not recommended for management of aquatic plants because the high-water quality and valuable habitat of the lake would be jeopardized by removing large quantities of substrate and bottom materials.

No Management: Not Recommended

Regardless of the target plant species, native or non-native, sometimes no management is the best management option. Plant management activities can be disruptive to areas identified as critical habitat for fish and wildlife and should not be done unless it can occur without ecological impacts. This management alternative is not recommended for either lake due to the potential for greater expansion of both CLP and EWM in the lakes and the negative implications it would likely have on both public and property owner use and access on the lake. CLP management is recommended, but is second to the management of EWM. If the two species can be managed together that would be best. Additionally, limiting the spread of CLP and EWM within the lake through management protects the ecological integrity of the lake long-term.

Aquatic Plant Management Discussion

Need for Management

Both Big and Little Trade Lakes support a valuable aquatic plant community and a quality fishery valued by the lake community and the general public. Both lakes are heavily impacted by curly-leaf pondweed and Eurasian watermilfoil. In addition, Big Trade Lake, in particular, supports abundant growth of purple loosestrife on its shoreline. Of these three aquatic invasive species, EWM is the most problematic. Five years ago in Big Trade Lake (2017), EWM was identified on the rake at 4 points for a relative frequency of 0.75%. In 2021 it was found on the rake at 17 points for a relative frequency of 2.51%, >3x what it was in 2017. If the points that EWM was found near, but not on the rake, were included then 8 points had EWM in 2017 and 29 points had it in 2021. At 327 acres, each point represents about a half-acre of surface water. This means that in 2017 there was up to 4 acres of EWM in the entire lake. In 2021, there was up to 14.5 acres. Bed mapping confirms this with 2.99 acres in 2017 and 10.88 acres in 2021. Neither of these numbers includes the 100's of additional pioneering plants that were found during both the 2017 and 2021 surveys. It is conceivable, that if left unmanaged, EWM could easily take over as much surface area as does the CLP now, 35 acres or more.

EWM in Little Trade Lake is not nearly as bad. Six years ago in Little Trade Lake (2016), EWM, though known to be present in the lake, was not identified at any rake point; therefore it had no relative frequency. In 2021, it was found on the rake at 2 points for a relative frequency of 0.28%. If the points that EWM was found near, but not on the rake, were included then 4 points had EWM in 2021. In 2016, there were no visuals near any point. At 126 acres, each point represents about a third of an acre of surface water. This means that in 2016 there was not enough EWM to consider how many acres it covered. In 2021, the 4 points represent up to 1.5 acres of EWM in the entire lake. The number of individual pioneering EWM plants was also very limited. Bed mapping confirms this with only 0.34 acres mapped in 2016 and 1.11 acres mapped in 2021. Unlike the management actions implemented on Big Trade Lake that didn't work, the management actions implemented in Little Trade Lake did.

Mapping has not been completed in 2022 yet, on either lake, but it is expected that the total amount in both lakes will increase further, given that no management has been done in either lake since 2020. Clearly, management actions to control EWM in Big Trade Lake need to be continued and expanded, but utilizing different strategies. What has been done on Little Trade Lake to control EWM appears to have been effective at keeping the levels down, and should be continued.

Curly-leaf pondweed in both lakes is even more dominant than the EWM. In early spring, both lakes present shorelines almost entirely overrun with CLP. The only thing that makes the amount of CLP less of a management priority is the fact that it drops out of the water column, usually by the 4th of July. That said, where management of EWM and CLP can be done together, in both lakes, it should be. However, if resources – primarily financial – are limited, focus should remain on EWM.

Management of purple loosestrife includes shoreline surveys and physical removal where possible. Individual or new pioneering plants should at very least, have the flowering heads removed to prevent them from going to seed. On Big Trade Lake, beetles should continue to be reared and released until an established population can be verified. In order to verify that population, survey work should be completed in May, and again in July, to see what level of predation and beetle population is present.

For each of these invasive species, nuisance conditions and navigation impairment occur in both lakes throughout the open water season. The main goal of this management plan is to control all three in a sound, ecological manner to minimize the negative effect on native plants, water quality, shoreland habitat, and visitor and property owner use of the lakes for recreational purposes.

Using Physical Removal and/or DASH to Manage CLP and EWM

Physical methods, including hand-pulling, rake removal, snorkel, divers, and/or diver-assisted suction harvest (DASH) can be implemented at any time for any amount of CLP or EWM. Hand-pulling, rake removal, snorkel, and diver removal does not require a permit to implement. Implementation of DASH requires a mechanical harvesting permit from the WDNR. These management actions are recommended for control of EWM in both lakes as a means to help maintain a low level of EWM, particularly after a large-scale herbicide application that is likely to be completed.

These management actions can be completed for CLP as well, but they likely will not have any significant impact on reducing the amount of CLP in the lakes. Given the complete domination of the littoral zone exhibited by CLP in both lakes, it will be some time before these actions can be relied upon to help keep CLP levels in the lake low.

Implementing hand-pulling, rake removal, snorkel, diver, and/or DASH removal will depend on the resources, financial and human, available to the RTLIA in any given year. These management alternatives can be used in any combination to remove CLP and EWM from the lake regardless of the size of the bed.

Using Mechanical Harvesting to Manage CLP and EWM

In a more perfect world where financial and human resources were readily available, the best management alternative for both CLP and EWM in Big and Little Trade Lakes would be mechanical harvesting. CLP already dominates more than 50% of the littoral zone of both lakes (Figure 42), and at least on Big Trade Lake, EWM appears headed in the same direction (Figure 36). If the RTLIA had the resources to purchase and operate their own aquatic plant harvester, it could be used to manage both species and be held to fewer restrictions than what are in place for the use of aquatic herbicides.

Once a mechanical harvesting permit has been approved for a given year, harvesting could be completed as often as necessary in the designated areas to keep invasive species at bay. Harvesting would reduce the amount of CLP over time if done during the appropriate window. And while harvesting is generally not recommended for EWM control because of the increased fragmentation, in the case of Big and Little Trade Lakes, EWM has already spread throughout the littoral zone so it may not matter. Furthermore, if necessary at some time in the future, the same harvesting could be used to maintain access and navigation corridors through nuisance growth native vegetation.

Using mechanical harvesting to control CLP and EWM in both lakes has one major issue, at the present time, there is no public access/boat landing on Little Trade Lake that would allow the launch of the harvester, and access between the two lakes for the harvester is blocked by a low bridge over the channel between them. The easiest solution to this issue would be developing an access point on Little Trade Lake.

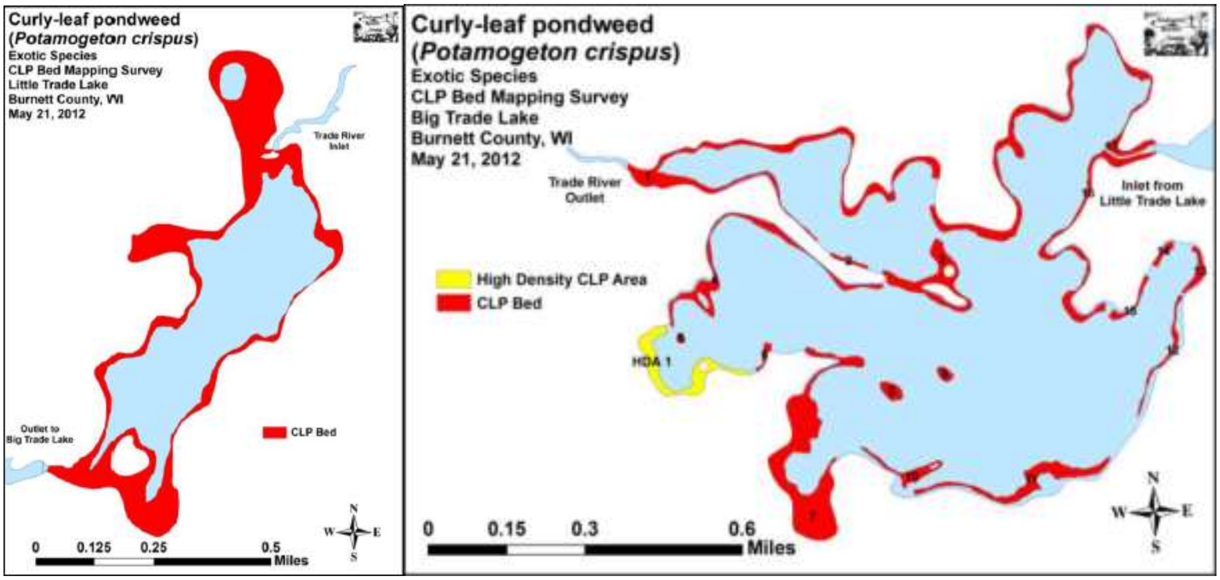

Figure 42: 2012 CLP bed mapping results in Little and Big Trade Lakes

Using Aquatic Herbicides to Manage CLP and EWM

Until such a time when the RTLIA obtains a mechanical harvester and access is created to Little Trade Lake, aquatic herbicides can be used effectively to manage both CLP and EWM.

EWM

Prior to 2021, the amount of EWM mapped in Big Trade Lake never exceeded 3.5 acres or 2.5% of a littoral zone estimated at about 142 acres or 43.4% of the lake's surface area over the last three PI surveys. When EWM was present at that level, few property owners and lake users noticed it or thought it to be a major issue. At more than 10 acres now, a large-scale herbicide application is likely the best management action to bring it back down to that level. Once brought back to that level, keeping the amount at or below that level is reasonable. To do this, any amount of EWM can and should be managed, albeit in different ways.

The amount of EWM mapped in Little Trade Lake over the last 10 years has averaged 2.15 acres or 2.8% of a littoral zone estimated at about 78 acres or 62% of the lakes surface area in the last three PI surveys. Keeping the amount of EWM mapped in Little Trade Lake annually at or below 2.5% (1.95 acres) of the littoral zone is reasonable. As with Big Trade Lake, to do this, any amount of EWM can and should be managed, albeit in different ways.

By itself, the use of herbicides cannot keep EWM from spreading in the lakes. Other management actions must be done in complement to the use of herbicides. No management of EWM has been completed in Big Trade Lake since 2020, not even any physical or diver/DASH removal. This will have to change during the implementation of this current plan. Between herbicide applications, property owner removal, diver, and DASH removal will have to increase or the gains from the herbicide treatment will be lost quickly – leading to another large-scale management action.

With the current results from whole-lake aquatic plant surveys, there is no undeniable proof that the spread of EWM has negatively impacted the native aquatic plant community in either lake. Neither is there any undeniable proof that the use of herbicides, as was done prior to 2021, has had a significant negative impact on native aquatic vegetation in either lake.

Once a large-scale herbicide application on Big Trade Lake has reduced the amount of EWM in the system, the use of herbicides will again be limited in nature and used only when the level of EWM in a given area exceeds what is manageable by other means. Through careful management planning that includes abundant aquatic plant surveys, appropriate timing, and calculated herbicide application rates, the previous small-scale use of aquatic herbicides can be continued without negatively impacting native aquatic vegetation, while at the same time reducing the negative impacts of EWM on lake use.

Herbicides that are 2,4-D or triclopyr-based, and ProcellaCOR are best suited to effectively control EWM in both lakes. ProcellaCOR is the best alternative, and recommended for the first large-scale management application on Big Trade, and all future smaller scale herbicide applications. Future large-scale (>10 acres) applications could consider the use of other herbicides, particularly if the financial resources available for completing EWM management are restrictive. Using different herbicides at different times may actually improve efficiency as there is some research that suggests EWM can build up a resistance to 2,4-D based herbicides at the concentrations traditionally used for submerged aquatic plant control (Poovey, 2007) (Glomski, 2010).

In general, EWM management in Big and Little Trade Lakes will be based on the following criteria.

1) EWM bedmapping will be completed every year.
2) Any amount of EWM in the lake can be managed at any time if chemical management is not used. Non-chemical management actions include hand pulling, rake removal, and snorkel/scuba diver removal, and/or DASH removal.
    a. DASH removal requires a mechanical harvesting permit from the WDNR.
3) Chemical management of EWM may be implemented if prior year bed mapping identifies a total of 3.5 or more acres of EWM on Big Trade Lake or 1.95 or more acres on Little Trade Lake. An individual bed or combination of beds will only be chemically treated if it is at least 1.0 acres in size, unless the use of new herbicides like ProcellaCOR are approved for smaller treatment areas by the WDNR.
    a. The use of aquatic herbicides requires a chemical application permit from the WDNR.
    b. Herbicides will be applied early in the season, generally prior to June 15, unless weather and lake conditions are prohibitive.
    c. Applied herbicide concentrations should be based on current research and existing lake characteristics.
4) Herbicides applied to EWM beds that reach or exceed 10.0 acres in total will be considered large-scale chemical treatments. With a large-scale chemical treatment, the following activities will be added in support of that treatment.
    a. Pre and post-treatment, point-intercept surveys will be completed.
    b. Herbicide concentration testing will be completed unless deemed unnecessary by the WDNR.
5) The same area will not be chemically treated with the same herbicide, two years in a row.

CLP

CLP is well established in both Big and Little Trade Lakes covering 50% or more of the littoral zone in any given year based on 2009, 2016/17, and 2021 cold-water PI survey results. The majority of this growth is considered moderate to dense in nature interfering with native aquatic plant growth in the spring, causing navigation and nuisance conditions in parts of the lake in the late spring and early summer, and then contributing to nutrient loading and organic material build up in the sediment mid-summer. Unless a mechanical harvester is purchased by the RTLIA, it is recommended that only aquatic herbicides by used to manage CLP. Physical removal whether by hand or using a diver or DASH is not recommended. There is simply too much CLP for these management actions to have any quantifiable benefit to the lakes.

To date, CLP management using aquatic herbicides has only been done in tandem with management of EWM using aquatic herbicides that occurred at the same time. This approach has worked well on Little Trade Lake, with the three early season, whole-lake, point-intercept surveys showing a consistent decline in CLP. Since 2012, CLP has been treated in seven different years including two separate 3-yr periods (2013-2016 and 2018-2020) resulting in a 37% reduction in the amount of CLP in the lake. In some years on Little Trade Lake, more CLP than EWM was managed using aquatic herbicides.

On its face, this approach did not work well in Big Trade Lake as there was more CLP in 2021 then there was in 2012. However, unlike in Little Trade Lake, CLP was only treated in tandem with EWM in Big Trade in three years (2014-2016) since 2012. The difference was two separate 3-yr AIS control grant periods. In the first period (2013-2016), both CLP and EWM were targeted in both lakes. At that time, EWM was still a new infestation in Big Trade Lake. In the second period (2018-2020), CLP and EWM were targeted in Little Trade Lake, but only EWM was targeted in Big Trade Lake. It could be that if the CLP management using aquatic herbicides had continued on Big Trade Lake like it did on Little Trade Lake, that a decline in CLP would have been the result.

With that thought in mind, it is recommended that CLP continue to be managed using aquatic herbicides in the same areas that are treated for EWM at the same time in both lakes with a goal of reducing the amount of CLP by 35% (12 acres in Little Trade Lake and 21 acres in Big Trade Lake) over the five year period covered by this Plan. Any CLP that is targeted for management using aquatic herbicides should be treated for a minimum of three successive years for the best outcomes, regardless of the status of the EWM in those areas.

Endothall and diquat based herbicides have been successfully used in both lakes in the past to control CLP. It is recommended that endothall-based herbicides be used for future management at 1-3 parts per million (ppm). Diquat-based herbicides could also be used at maximum label rate, particularly after the first year when ProcellaCOR may have been applied to control EWM. Diquat-based herbicides provide a cheaper alternative to endothall. As non-selective, contact herbicides, both endothall and diquat should be applied as early as possible to minimize negative impacts on native vegetation. However, if the resources are not available to do both, management of EWM is a priority.

If both CLP and EWM are treated at the same time, a combination of aquatic herbicides could be used. Endothall can be combined with 2,4-D products and with ProcellaCOR to complete treatment of both species. Another aquatic herbicide, penoxsulam, sold under the trade name Galleon SC® can be added to ProcellaCOR to increase the impact on CLP as well. Penoxsulam is considered a systemic herbicide, rather than a contact herbicide.

In general, CLP management in both Big and Little Trade Lakes will be based on the following criteria.

1) June bed mapping must be completed in the year prior to a planned chemical treatment.
2) Any amount of CLP in the lake can be managed at any time if chemical management is not used.
    a. Non-chemical management actions include hand pulling, rake removal, and snorkel/scuba diver removal, and/or DASH removal
        i. DASH is considered mechanical removal, is more expensive than diver removal, and requires a WDNR permit.
3) Chemical management of CLP may be completed if prior year mapping has been completed and the CLP is within a planned EWM chemical treatment area and ≥1.0 acres in size.
    a. A WDNR permit is required.
    b. Treatment should be completed no later than late May (weather and water temperature related).
    c. Endothall-based or penoxsulam herbicides should be used in combination with ProcellaCOR when CLP and EWM are treated simultaneously.
        i. Applied herbicide concentrations should be based on current research and existing lake characteristics.
    d. At least three consecutive years of CLP management in the same area is recommended.
        i. Once started, chemical treatments can be completed in the same areas even if EWM is not being managed.
        ii. If only CLP is being managed, endothall or diquat based herbicides should be used.

The long-term success of EWM and CLP management actions will be measured by whole-lake, point-intercept surveys repeated near the end of the five year period covered by this management plan; by pre and post-chemical treatment point-intercept aquatic plant surveys completed during treatment, and by spring and fall bed-mapping where appropriate.

Purple Loosestrife and Other AIS

A fair amount of purple loosestrife is present along the shores of and in wetlands adjacent to Big Trade Lake in particular. Monitoring for purple loosestrife and other aquatic invasive plant species including yellow iris, giant reed grass, and Japanese knotweed will continue on both Big and Little Trade Lakes. Purple loosestrife will continue to be managed with the release of Galerucella beetles. Management of yellow iris will be pursued if the resources are available to do so. Monitoring for zebra mussels will be made more active and immediate given the lakes' proximity to lakes in both Burnett and Polk County that have established populations.

Aquatic Plant Management Goals, Objectives, and Actions

This Aquatic Plant Management Plan establishes the following goals for aquatic plant management in Big and Little Trade Lakes:

1. **Educate the Populace.** Provide education, outreach opportunities, and materials to the lake community

2. **Prevent the Introduction and Spread of AIS.** Increase the awareness and knowledge base of those who use the lakes.

3. **Manage Aquatic Invasive Species.** A combination of management alternatives will be used to help minimize the negative impacts of AIS in Big and Little Trade Lakes

4. **Protect Native Aquatic Plant Species.** Implement AIS management actions in a way that negative impacts to non-target plant species are minimized.

5. **Maintain or Improve Water Quality.** Collect water quality information to establish long-term trends that will be used for current and future lake and aquatic plant management planning.

6. **Implement Adaptive Management.** Provide annual and end of project assessment and evaluation reports that will be used for current and future lake and aquatic plant management planning.

Each goal includes several management objectives and actions to help meet those objectives.

Goal 1. Educate the Populace

Providing education, outreach opportunities, and materials to the lake community will improve general knowledge and likely increase participation in lake protection and restoration activities. It is further recommended that the RTLIA continue to cultivate an awareness of the problems associated with AIS and enough community knowledge about certain species to aid in detection, planning, and implementation of management alternatives within their lake community. It is also recommended that the RTLIA continue to strive to foster greater understanding and appreciation of the entire aquatic ecosystem including the important role plants, animals, and people play in that system.

Objective 1 – Increase the level of understanding lake property owners, lake users, and others have about the things that impact the lake they live and/or recreate on.

Action: Obtain AIS educational materials (brochures, videos, pamphlets, newsletters, URLs, etc.) that can be distributed with relative ease through multiple outlets (meetings, webpage, social media, mailings, etc.) and that provide a brief summary of AIS species.

Action: Obtain educational materials (brochures, videos, pamphlets, newsletters, URLs, etc.) that can be distributed with relative ease through multiple outlets (meetings, webpage, social media, mailings, etc.) that explain the connection between shore land practices, water quality, and lake health.

Action: Provide approximate number of materials and their topic matter distributed through multiple outlets in an annual report.

Action: Provide at least one in-person educational opportunity (picnic at the lake, public workshop, guest speakers, etc.) annually on aquatic invasive species and other factors that affect the lakes.

Action: Document attendance at each event including volunteer time, mileage, and boat use in an annual report.

Goal 2. Prevent Introduction and Spread of AIS

Aquatic invasive species (AIS) can be transported via a number of vectors, but most invasions are associated with human activity. Increasing the awareness and knowledge base of those who use the lakes will help to prevent new AIS from entering the lake, existing AIS from leaving the lake, and aid in early identification of new invasions. Early detection and rapid response efforts increase the likelihood that a new aquatic invasive species will be addressed successfully while the population is still localized and levels are not beyond that which can be contained.

Objective 1 – Provide AIS prevention information and other lake data to the public at the boat landings.

Action: Continue to maintain and update signage, including Decontamination Stations, at the boat launches as necessary.

Action: Implement a watercraft inspection program, possibly supported by WDNR Clean Boats Clean Waters grant program, at both landings.

Action: Work with and encourage resort owners on the lakes to provide AIS educational materials and other publications (Ex. disturbances caused by wakes) that provide tips for education and prevention.

Action: Document hours worked and number of people reached at boat landings and include the approximate number of educational materials distributed to resort owners in an annual report.

Objective 2 - Implement a proactive and consistent AIS monitoring program.

Action: Train volunteers on how to identify AIS and where to look in the lake to find them.

Action: Patrol the shoreline and shallow areas of the lake looking for AIS at least three times during the open water season.

Action: Record monitoring events as a part of the UW-Extension Lakes/WDNR Citizen Lake Monitoring Network (CLMN) AIS Monitoring Program.

Action: Document hours worked and number of people involved in AIS monitoring in an annual report.

Goal 3. Manage Aquatic Invasive Species

Aquatic invasive species at best, continue to be a nuisance in Big and Little Trade Lakes reducing lake accessibility, negatively impacting the aesthetic of the lakes, and dominating current management discussion. At worst, they do all of the afore mentioned things and potentially have a negative impact on the native aquatic plant species, aquatic life, and water quality in the lakes as they continue to spread and dominate parts of the littoral zone. A combination of management alternatives will be used to help minimize the negative impacts of AIS in Big and Little Trade Lakes including the possibility of mechanical harvesting, small-scale physical removal, diver removal and/or DASH, and targeted use of aquatic herbicides.

Eurasian Watermilfoil

Since the discovery of just a couple single plants in the channel coming from Little Trade Lake, EWM in Big Trade Lake has spread to where it now is found in the entirety of the littoral zone, with upwards of 11 acres of dense, bed-forming mats when last mapped in the fall of 2021. From 2019 to 2021, without any management, EWM went from 24 beds with an average bed size of 0.07 acres covering <2.0 acres, to 42 beds with an average bed size of 0.26 acres covering almost 11 acres (Figures 27-29). Bringing EWM back down to a more manageable level and keeping it there is the goal.

EWM has been in Little Trade Lake since at least 2009. Management actions and lake conditions have kept it at just over 2 acres for the last ten years, including in 2021 when only 1.1 acre of EWM was mapped. Keeping EWM at a low level in the lake is the goal.

Objective 1 - Reduce the amount of EWM in Big Trade Lake to 3.5 acres or less.

Action: Complete a large-scale herbicide application in 2023
Note: Manage CLP and EWM at the same time using ProcellaCOR and Galleon.
Action: Complete pre and post-treatment PI aquatic plant survey work
Action: Complete herbicide concentration testing
Action: Complete late season bed mapping of EWM
Action: Document management actions in an annual report.

Objective 1a - Keep the amount of EWM in Big Trade Lake at or below 3.5 acres annually.

Action: Property Owner Physical Removal
Action: Diver and/or DASH Removal
Action: Small-scale herbicide applications
Action: Complete late season bed mapping of EWM
Action: Document management actions in an annual report.

Objective 2 – Keep the amount of EWM in Little Trade Lake at or below 1.95 acres annually.

Action: Property Owner Physical Removal
Action: Diver and/or DASH Removal
Action: Small-scale herbicide applications
Action: Complete late season bed mapping of EWM
Action: Document management actions in an annual report.

Curly-leaf Pondweed

CLP continues to be a nuisance in Little and Big Trade Lakes, dominating early season plant growth likely to the detriment of early season native aquatic plant growth. Large amounts of CLP interfere with lake use and accessibility, and could be contributing to the degradation of water quality later in the season. The goal of CLP management is to see a decline in CLP distribution and density in the treated areas from the first year included in this APM Plan to the last year included.

Objective 3 – Reduce the amount of CLP in Big Trade Lake by 35% or 21 acres based on 2021 survey results.

Action: Complete large-scale herbicide applications for at least three years
Action: Complete pre and post-treatment PI aquatic plant survey work
Action: Complete herbicide concentration testing
Action: Document management actions in an annual report.

Objective 4 – Reduced the amount of CLP in Little Trade Lake by 35% or 12 acres based on 2021 survey results

Action: Small-scale herbicide applications for at least three years.
Action: Document management actions in an annual report.

Purple Loosestrife

Purple loosestrife has been found in many locations around Big Trade Lake but is most abundant in the shoreland wetlands off that part of Big Trade Lake adjacent to Church Road. Several times over the last 5 years, volunteers have physically removed isolated purtple loosestrife plant in other parts of the lake, but did not work in the area adjacent to Church Road. For the last two years (2021 and 2022) beetles have been released in that area. Only isolated plants have been found in Little Trade Lake with most of these physically removed.

Objective 5 – Prevent purple loosestrife from gaining a larger foothold than it already has in Big and Little Trade Lakes.

Action: Train volunteers on how to identify purple loosestrife and then monitor the shoreline of both lakes between late July and late August annually looking for isolated plants.

Action: Document the locations of purple loosestrife identified with a GPS or on a handwritten map

Action: Physically remove isolated plants if possible, or at least remove the flowering head of the plant.

Action: Complete the required beetle rearing paperwork (permit and release site) each year and continue to raise and release Gallerucella beetles on the lake.

Action: Document monitoring and management actions in an annual report.

Other Aquatic Invasive Species

There are several other AIS that have been documented in and on the shores of Big and Little Trade Lake. These include plants - Yellow Iris, Giant Reed Grass, Narrow-leaf Cattail, and Reed Canary Grass; and animals – Chinese Mystery Snails. Of these invasive species, only Yellow Iris presents opportunities for management.

Objective 6 – Prevent yellow iris from gaining a larger foothold than it already has in Big and Little Trade Lakes.

Action: Train volunteers on how to identify yellow iris and then monitor the shoreline of both lakes between late May and early July annually looking for isolated plants.

Action: Document the locations of yellow iris identified with a GPS or on a handwritten map.
Action: Physically remove isolated plants if possible.
Action: Document monitoring and management actions in an annual report.

Goal 4. Protect Native Aquatic Plant Species

When an AIS like CLP or EWM increases in distribution and density in a lake, it may start to have a negative impact on the native aquatic plant community. At the present time, this is likely true with CLP in both lakes, but probably not with EWM. When an AIS is managed with aquatic herbicides, it may have some negative impact on the native aquatic plant community as well. Physical removal, diver removal, or removal by DASH can minimize negative impacts simply due to these being a “species specific” management action. Aquatic plant harvesting and the use of herbicides are not wholly species specific but can be implemented in a way where negative impacts to non-target plant species are minimized, and removing the AIS may improve conditions for new or increased native aquatic plant growth.

Objective 1 – Avoid negative impacts to native aquatic plant when implementing management using aquatic herbicides.

Action: Use "species select" systemic aquatic herbicides to the extent possible (florpyrauxifen-benzyl (ProcellaCOR), 2,4D, or triclopyr based herbicides for EWM). Contact herbicides like endothall and diquat are only species specific when used at appropriate times (Ex. early spring for CLP).

Action: Follow all label and accepted management guidelines when planning how much area/volume should be managed and the concentration of herbicide to be used.

Action: Apply aquatic herbicides in the early spring or spring (CLP and EWM), or in the early summer (prior to June 15) or fall (EWM only) when growth of native species is less active.

Action: Complete pre and post-treatment aquatic plant surveying on large-scale treatment to help document the impacts on target and non-target species.

Action: Repeat whole-lake, point-intercept, aquatic plant surveys in 2026, compare with survey statistics from previous years.

Goal 5. Maintain or Improve Water Quality

Long-term data can be used to identify the factors leading to changes to water quality. Aquatic plant management activities, changes in the watershed land use, and the response of the lakes to environmental changes all have a direct impact on water quality. The CLMN Water Quality Monitoring Program supports volunteer water quality monitors across the state following a clearly defined schedule. There are two levels to the CLMN program: 1) Collecting Secchi disk readings of water clarity and often temperature profiles; and 2) Expanded monitoring that includes Secchi disk readings, temperature profiles, collection of water samples for total phosphorus and chlorophyll-a, and often dissolved oxygen profiles.

Available data suggests that the RTLIA has been monitoring water quality as a part of the Citizen Lake Monitoring Network (CLMN) at the Deep Hole in Big Trade Lake since 1986 with data gaps from 1996-1998, 2004-2011, and 2016. CLMN water quality monitoring in Little Trade Lake began in 2000, with a large data gap from 2004 to 2013. The background information and trends provided by these and future data are invaluable for current and future lake and aquatic plant management planning.

Objective 1 – Track long-term changes in water quality in both lakes.

Action: Maintain at least one trained volunteer to continue water quality monitoring as a part of the CLMN expanded monitoring program on both lakes.

Action: Evaluate the intensity/success of water quality monitoring efforts and the ability of given volunteers to collect all the suggested data each year.

Action: Enter all data collected into the WDNR SWIMS database.

Action: Share the results of water quality monitoring with the lake community at the annual meeting or other event, and in annual reports.

Goal 6. Implement Adaptive Management

This APM Plan is a working document guiding management actions on Big and Little Trade Lakes for the next five years. This plan will follow an adaptive management approach by adjusting actions based on the results of management and data obtained about that management. This plan is therefore a living document, progressively evolving and improving to meet environmental, social, and economic goals, to increase scientific knowledge, and to foster good relations among stakeholders.

Annual and end of project assessment reports are necessary to monitor progress and justify changes to the management strategy, with or without state grant funding. Project reporting will meet the requirements of all stakeholders, gain proper approval, allow for timely reimbursement of expenses, and provide the appropriate data for continued management success. Success will be measured by the efficiency and ease in which these actions are completed.

The RTLIA and their retainers will compile, analyze, and summarize management operations, public education efforts, and other pertinent data into an annual report each year. The information will be presented to members of the RTLIA, Burnett County, and the WDNR and made available in hardcopy and digital format on the internet. These reports will serve as a vehicle to propose future management recommendations and will therefore be completed prior to implementing following year management actions (approximately March 31st annually). At the end of this five-year project, all management efforts (including successes and failures) and related activities will be summarized in a report to be used for revising the APM Plan.

Timeline of Activities

The activities in this APM Plan are designed to be implemented over a 5-year period beginning in 2023. The plan is intended to be flexible to accommodate future changes in the needs of the lake and its watershed, as well as those of the RTLIA. Some activities in the timeline (Appendix C) are eligible for grant support to complete.

Potential Funding

There are several WDNR grant programs that may be able to assist the RTLIA in implementing its new APM Plan for Big and Little Trade Lakes. AIS grants are specific to actions that involve education, prevention, planning, and in some cases, implementation of AIS management actions. Lake Management Planning grants can be used to support a broad range of management planning and education actions. Lake Protection grants can be used to help implement approved management actions that would help to improve water quality.

More information about WDNR grant programs can be found at:
https://dnr.wisconsin.gov/aid/SurfaceWater.html

Outside Resources to help with Future Planning

Many of the actions recommended in this plan cannot be completed solely by the VLA. They will continue to need the help of an outside consultant or other outside resource. Multiple outside resources and expertise exist to help guide implementation. The following is a list of outside resources that the VLA will need to partner with to implement the actions in this plan.

Burnett County

Soil and Water Conservation

In most cases, the Soil and Water Conservation Department for a given county has a mission is to administer land and water conservation projects to meet local priorities, conditions, and the needs of county land users. County management plans and often state-funded, cost-share programs are administered for the purpose of implementing conservation practices. Conservation Departments are responsible for administering programs such as: Aquatic Invasive Species Program; Environmental Reserve Fund; short-term, grant-funded programs; providing technical assistance for all types of conservation practices; implementing information and education programs; updating various soil and water resource inventories; and nurturing partnerships with other county, state, and federal agencies.

https://www.burnettcounty.com/1106/Conservation-Division

Cooperative Extension

County-based Extension educators are University of Wisconsin (UW) faculty and staff who are experts in agriculture and agribusiness, community and economic development, natural resources, family living, and youth development. Extension county-based faculty and staff live and work with the people they serve in communities across the State. Extension specialists work on UW System campuses where they access current research and knowledge. Collaboration between county and campus faculty is the hallmark of Cooperative Extension in Wisconsin.

https://www.burnettcounty.com/391/University-of-Wisconsin-Extension

University and Collegiate

Lake Superior Research Institute – UW-Superior

The Lake Superior Research Institute (LSRI) at UW-Superior was created in 1967 and formally recognized by the UW Board of Regents in 1969. LSRI's mission is to conduct environmental research and provide services that directly benefit the people, industries, and natural resources of the Upper Midwest, the Great Lakes Region, and beyond; provide non-traditional learning and applied research opportunities for undergraduate students; and foster environmental education and outreach in the Twin Ports and surrounding communities.

Areas of expertise include: analytical chemistry; aquatic invasive species monitoring and outreach; benthic and zooplankton taxonomy; habitat restoration; microbiology; sediment and aquatic toxicology; quality assurance and data management; watershed management and planning; and wetland assessment and monitoring. Current research includes: aquatic and sediment toxicity testing, aquatic invasive species ecology, ballast water management system testing, beach monitoring and microbial source testing, biological monitoring and inventory of aquatic and terrestrial communities, endangered species management planning, habitat restoration, and mercury analysis in biota.

https://www.uwsuper.edu/lsri/index.cfm

Mary Griggs Burke Center for Freshwater Innovation

The Mary Griggs Burke Center for Freshwater Innovation (Burke Center) at Northland College in Ashland, WI focuses on scientific research, communication, and thought leadership on water issues in the Great Lakes region and beyond. The Burke Center specializes in "translating" science to the general public, government agencies, NGOs, agriculture, and the private sector, helping to edify water policy in a wide variety of geographies and subject areas. Two such areas are Integrated Ecosystem Management and Environmental Monitoring and Assessment.

Effective management of freshwater ecosystems is dependent on an understanding of how human activities and value sets intersect with the environmental processes that sustain water resource integrity. Their work focuses on integrating approaches from the natural and social sciences to conduct and develop integrated assessments and management plans for freshwater ecosystems.

Public decision-making surrounding water resources is dependent on a range of data that describe the condition of freshwater ecosystems and the current—and potential future—stressors that may impact their integrity. Their work focuses on the use of environmental monitoring and analytical technologies to develop long-term data sets to support public decision-making for freshwater resources. The Burke Center is involved in multiple projects that collect and analyze a variety of data including bacteria, e-coli, zooplankton, aquatic plants, wild rice, water quality, etc.

https://www.northland.edu/centers/mgbc/

Center for Land Use Education

The Center for Land Use Education (CLUE) is a joint venture of the College of Natural Resources at the UW-Stevens Point and the UW-Madison Division of Extension. It is a focal point for land-use planning and management education. Through applied research, teaching and outreach, CLUE specialists and faculty support students, local government officials, communities and K-12 audiences on a variety of land and water topics including planning and zoning, land divisions, fragmentation, sustainability, bio- and renewable energy, food systems, shorelands and wetlands. By providing up-to-date and comprehensive training on planning and zoning tailored to address specific local needs, CLUE specialists are able to assist towns, villages, cities and counties in making sound land use decisions.

https://erc.cals.wisc.edu/programs/center-for-land-use-education/

Center for Watershed Science and Education

The Center for Watershed Science and Education (CWSE) at UW-Stevens Point supports watershed understanding and stewardship across and beyond the state of Wisconsin. The center includes specialists with expertise in groundwater, lakes, streams, water chemistry and analysis, and data science. The center helps individuals, organizations and private and public water resources professionals understand water quality and quantity in private wells, groundwater, lakes and rivers. Through their programming, center staff provides guidance on sampling and data collection, education on water quantity and quality, and interpretation and evaluation of monitoring results. The center also performs applied research and creates data visualization tools to improve watershed understanding.

Current research explores the movement of nitrate-nitrogen in soil and groundwater, the quantity and chemistry of groundwater, changes in lake water quality and the occurrence of pharmaceuticals and new pesticides in the water.

https://erc.cals.wisc.edu/programs/center-for-watershed-science-and-education/

Center for Limnological Research and Rehabilitation

The Center for Limnological Research and Rehabilitation (CLRR) at UW-STOUT focuses on eutrophication issues and management solutions for freshwater systems. They provide limnological research services to the surrounding community, including: diagnosing eutrophication-related problems in lakes and reservoirs; conducting comprehensive hydrologic and limnological monitoring programs; identifying and quantifying important phosphorus sources that drive cyanobacterial blooms; and developing and implementing management plans to sustainably rehabilitate degraded aquatic systems.

Their laboratory facilities provide an array of analytical capabilities for the examination of nutrients (primarily phosphorus species) and algae in water and sediment. They have a variety of field monitoring equipment for quantifying tributary flow and phosphorus loads discharging into lakes, boats and sampling equipment for monitoring lake chemistry and biology, and coring capabilities for the examination of aquatic sediment. In particular, they have unique expertise for determining important mobile phosphorus fractions in aquatic sediments and nutrient exchanges between sediments and the overlying water.

https://www.uwstout.edu/directory/center-limnological-research-and-rehabilitation

Natural Resources Education Program

NRE Water Programming

Natural Resource Educators (NRE) are providing leadership on nutrient reduction and water quality projects across the state. Key efforts include outreach to increase local capacity to reduce nonpoint source pollution in the Lower Fox, Wisconsin, St. Croix, Red Cedar and Rock River watersheds and the Lower Fox River Demo Farm Network initiative. Projects are carried out in collaboration with federal, state and local partners as well as producer-led watershed initiatives. The Demo Farm initiative works with farmers and their advisers to conduct on-farm demonstrations that measure and share the effectiveness of conservation practices to reduce erosion and sediment runoff, control phosphorus runoff and address other nonpoint sources of pollution.

NRE Forestry Programming

ERC-based Natural Resources Educators and key partners are leading classes (Learn About Your Land and Your Land, Your Legacy) and other efforts to engage landowners in the sustainable management of Wisconsin's privately-owned forests. NREs create content for landowners on a variety of topics in publication, video, and website formats.

https://erc.cals.wisc.edu/programs/regional-natural-resources-education-program/

Aquatic Invasive Species Outreach

Wisconsin's aquatic invasive species (AIS) program focuses on preventing the introduction of new invasive species to Wisconsin, containing the spread of invasives that are already in the state, and managing established populations when possible. In close cooperation with the Wisconsin Department of Natural Resources and Extension Lakes program, UW– Madison Division of Extension education efforts focus on working with resource professionals and citizens statewide to teach boaters, anglers and other water users the steps they should take to prevent transporting aquatic invasives to new waters. Efforts also address other potential mechanisms of introduction, including aquarium pet release and water gardening.

https://erc.cals.wisc.edu/programs/aquatic-invasive-species-outreach/

UW-Extension Lakes Program

Based at UW-Stevens Point, the Extension Lakes Program seeks to preserve Wisconsin's legacy of lakes through education, communication and collaboration. The program works with over 800 local lake associations and lake districts in Wisconsin, assisting them through education and capacity building. Lakes also partners with the Wisconsin DNR to coordinate a number of programs and projects to assist those concerned with the future of our lakes, including the Citizen Lake Monitoring Network, the Clean Boats, Clean Waters program and the Lake Leaders Institute. The *Lake Tides* newsletter reaches thousands of readers throughout the region.

https://erc.cals.wisc.edu/programs/extension-lakes-program/

Works Cited

Booms, T. (1999). Vertebrates removed by mechanical weed harvesting in Lake Keesus, Wisconsin. *Journal of Aquatic Plant Management*, 34-36.

Carlson, R. (1977). A trophic state index for lakes. *Limnology and Oceanography*, 361-369.

Glomski, L. M. (2010). Response of Eurasian and hybrid watermilfoil to low use rates and extended exposures of 2, 4-D and triclopyr. *Journal of Aquatic Plant Management 48 (12)*.

Koegel, R., Livermore, D., & and Bruhn, H. (1974). *Costs and Productivity in Harvesting of Aquatic Plants.* Madison: University of Wisconsin.

LaRue, E. Z. (2012). *Hard to Kill: Hybrid Watermilfoil are less sensitive to a commonly used herbicide.*

Madsen, J. (2000). *Advantages and disadvantages of aquatic plant management techniques.* Vicksburg, MS: US Army Corps of Engineers Aquatic Plant Control Research Program.

Nichols, S. (1999). Floristic Quality Assessment of Wisconsin Lake Plant Communities wiht Example Applications. *Journal of Lake and Reservoir Management*, 133-141.

Poovey, A. S. (2007). Susceptibility of Eurasian watermilfoil (Myriophyllum spicatum) and a milfoil hybrid (M. spicatum x M. sibiricum) to triclopyr and 2, 4-D amine. *Journal of Aquatic Plant Management 45*, 111-115.

Sebolt, D. (1998, January). *Galerucella calmariensis and G. pusilla:Biological Control Agents of Purple Loosestrife*. Retrieved January 3, 2017, from Midwest Biological Control News Online: http://www.entomology.wisc.edu/mbcn/kyf501.html

APPENDIX A

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPENDIX B

2021 Public Use/Sociological Survey and Results

APPENDIX C

Five Year Timeline of Management Actions

APPENDIX D

Aquatic Plant Management Discussion Document