



**Shadow Lake WBIC #258600 and Mirror Lake WBIC #258700,  
Waupaca County  
Point Intercept Aquatic Plant Survey  
July 3 & 4, 2024**

**Friends of Mirror & Shadow Lakes,**

Golden Sands Resource Conservation & Development Council, Inc (RC&D) completed a Point Intercept Aquatic Plant Survey (PI Survey) on Shadow Lake on July 3, 2024 and Mirror Lake on July 4, 2024. The survey was completed by Golden Sands RC&D staff Chris Hamerla, Andrew Senderhauf and Mara Lince to keep the lake data current. Previous surveys were completed on June 11 and 12, 2018 as follow up to the Eurasian watermilfoil (EWM) and curly-leaf pondweed (CLP) management that had been completed, to see the effectiveness of the management. This new data will also be submitted to the Wisconsin Department of Natural Resources and will allow staff to understand any changes in plant communities over time. Onterra LLC also completed surveys on July 29 - 30 2020 and a previous survey was also completed by UWSP in 2011.

**Benefits of Aquatic Plants**

Aquatic plants are an important part of the state's wet ecosystems. They produce oxygen and help protect water quality. They help clarify water in wetlands, lakes and rivers by using nutrients like phosphorus and nitrogen that might otherwise be used to produce algal blooms. Aquatic plants help reduce wave action and current flow which reduces shoreland erosion and helps stabilize sediments in the waterbody. Perhaps most apparent, plants provide food, shelter and habitat for fish, invertebrates and all sorts of wildlife. Finally, diverse, healthy plant communities can help prevent invasive species from establishing. Invasive species are more likely to become established in disturbed areas.

**Aquatic Invasive Species**

Aquatic invasive species (AIS) are plants or animals that are not native to a particular area and dominate an area where they are introduced. They can be very successful because they fill a niche that isn't occupied, are able to tolerate a wider range of living conditions, they don't have any natural predators or diseases or perhaps they begin growing earlier. EWM, curly leaf pondweed and purple loosestrife are common examples of AIS. AIS can threaten an area both ecologically and economically. They can disrupt food chains and degrade habitat which negatively impacts fish, invertebrates and wildlife. Nuisance levels of AIS can reduce or even

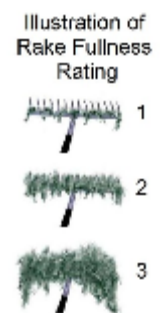
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prevent recreational opportunities like fishing, boating, wildlife watching, etc... These reduced recreational opportunities have negative impacts to the local and statewide economy. AIS such as zebra mussels can negatively impact water quality, food chains, aquatic habitat, recreation and industry. Unfortunately the effects of AIS are difficult to foresee since the degree of impact can vary greatly from one place to another. One system may be completely taken over by AIS while AIS in another nearby system may become a part of the community and have little to no negative effects.

## Point Intercept Aquatic Plant Surveys

Point intercept (PI) surveys are completed by traveling to predetermined GPS points across the lake. Each PI lake map is based on the area and depth specific to that lake. The maps with GPS coordinates are obtained through the WDNR. Mirror Lake contains 244 sample points and Shadow Lake contains 185 points. Using a GPS, staff completed the survey by boat. At each point a two-sided rake was used to sample roughly a one foot area of the lake bottom. Sediment type (sand, rock or muck), water depth in half foot increments and the aquatic plant community was recorded. Once the rake is brought to the surface the amount of plant material on the rake is assessed and recorded. The overall fullness of plants on the rake is rated a one, two or three (see illustration to the left). Then the individual species are ranked using one, two or three. All data is recorded on the PI worksheet. Plants seen within six feet of the sample point are recorded as a "visual". Other plants seen on the lake are recorded as a "boat survey". Points which can not be reached are labeled as Non Nav Plants, Dock, Land, etc... and no data is collected. (Figure 1 shows a map with the survey points on Mirror Lake. Figure 2 shows a map of survey points on Shadow Lake) To learn more about PI sampling methods and how data is collected please visit:



<https://dnr.wi.gov/lakes/plants/research/project.aspx?project=96832337>

*Frequency of occurrence* is the percentage of time a species is found on the rake out of the total number of points sampled. Not all sample points are capable of supporting plant growth. *Littoral frequency of occurrence* is how often a species is found out of the total number of points that support plant growth. (Shown in Table 1 Mirror Lake and Table 3 for Shadow Lake) The deepest depth where plant growth is found is called *maximum depth of plant growth*. *Species richness* is the total number of different species found on the rake while sampling points. *Floristic Quality Index (FQI)* is the ranking of the plants in the lake that compares to an undisturbed lake. The higher the FQI the closer the plant community is to that of an undisturbed system. Approximately 250 lakes across Wisconsin are used to calculate the statewide and ecoregion averages for comparison. Only species which were found on the rake during the PI survey are used to calculate FQI and species richness. This helps to standardize surveyor efforts across the entire state and is why visual observations are not included. Table 2 summarizes Mirror Lake's littoral frequency of occurrence, maximum depth of plant growth, species richness and FQI. Table 4 summarizes Shadow Lake. It should be noted that a lake falling below the statewide average for that ecoregion isn't necessarily "disturbed". Many influences play a role in determining the species and abundance of plants in a lake. Water chemistry, acidity, hardness, clarity and bottom sediment are examples of natural influences. Increased nutrient runoff, use of chemicals, development and water control structures are examples of human influences.

It should also be noted that plant species may differ from year to year on the following Tables 1 and 3. GPS coordinates are accurate only within twenty feet and plant communities can shift. Tables 1 and 3 represent species which were detected on the rake with a numerical value. Species observed within six feet of a point but not collected on the rake are listed as visuals. CURRENT YEAR 2024 species are in the fourth column with previous years following.

**Table 1: Species Present in Mirror Lake**

% Littoral frequency of occurrence: This is calculated by taking the total number of times a species is recorded divided by the total number of points in the lake where plant growth is possible. \*\* Did not have the raw data for 2020 or 2011 so these columns only represent if the plants were recorded (X). \* Means a non-native species, potentially invasive.

Common Name	Scientific Name	Plant type: floating leaf, free floating, submergent, emergent	% Littoral Frequency of Occurrence 2024	** Plants recorded in 2020 by Onterra LLC	% Littoral Frequency of Occurrence 2018	** Plants recorded in 2011 by UWSP
*Eurasian water milfoil	* <i>Myriophyllum spicatum</i>	submersed	18.31	X	1.96	
*Curly-leaf Pondweed	* <i>Potamogeton crispus</i>	submersed	18.31	X	1.96	
Coontail	<i>Ceratophyllum demersum</i>	submersed	35.21	X	20.59	X
Muskgrasses	<i>Chara sp.</i>	submersed	39.44	X	48.04	X
Common Waterweed	<i>Elodea canadensis</i>	submersed	7.04		2.94	
Water stargrass	<i>Heteranthera dubia</i>	submersed	8.45	X	–	
Forked Duckweed	<i>Lemna trisulca</i>	submersed	1.41	X	0.98	
Various-leaved watermilfoil	<i>Myriophyllum heterophyllum</i>	submersed	not observed		0.98	
Northern watermilfoil	<i>Myriophyllum sibiricum</i>	submersed	visual	X	15.69	X
Spatterdock	<i>Nuphar variegata</i>	floating leaf	visual	X	0.98	X
White water lily	<i>Nymphaea odorata</i>	floating leaf	12.68	X	0.98	X
Small duckweed	<i>Lemna minor</i>	floating leaf		X		
Watermeal	<i>Wolffia sp</i>	floating leaf		X		
Variable pondweed	<i>Potamogeton gramineus</i>	submersed	visual	X	0.98	
Illinois pondweed	<i>Potamogeton illinoensis</i>	submersed	1.41	X	0.98	X

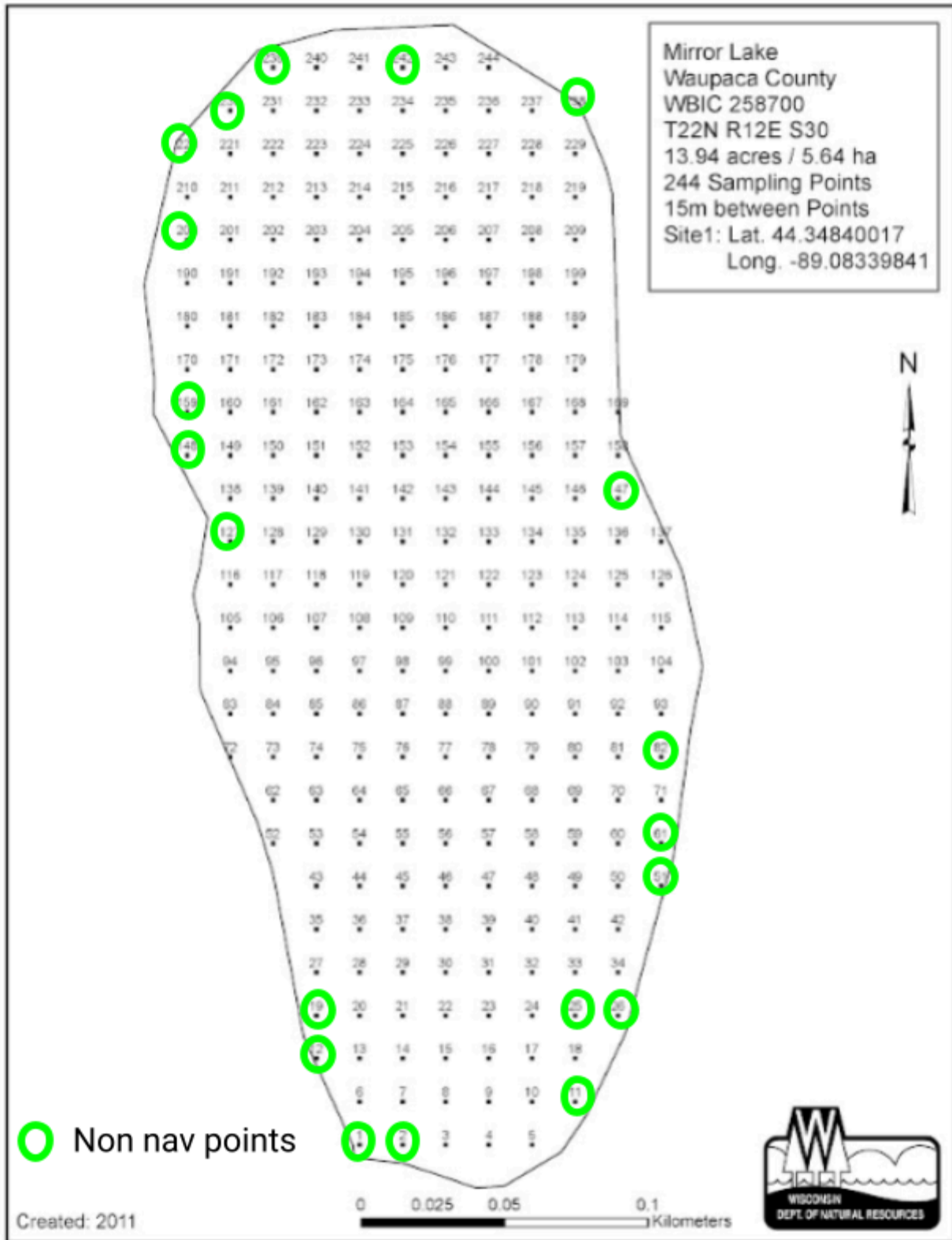
Fries' pondweed	<i>Potamogeton friesii</i>	submersed	50.7	X	33.33	
Floating leaf pondweed	<i>Potamogeton Natans</i>	floating leaf		X		
Small pondweed	<i>Potamogeton pusillus</i>	submersed	2.82		–	
Stiff pondweed	<i>Potamogeton strictifolius</i>	submersed		X		
Flat-stem pondweed	<i>Potamogeton zosteriformis</i>	submersed	11.27	X	–	
Whiter water crowfoot	<i>Ranunculus aquatilis</i>	submersed	8.45	X	–	
Yellow water crowfoot	<i>Ranunculus flabellaris</i>	submersed				X
Sago pondweed	<i>Stuckenia pectinata</i>	submersed	32.39	X	14.71	X
Arrowhead species	<i>Sagittaria sp</i>	emergent	visual		–	X
Wild Celery	<i>Vallisneria americana</i>	submersed	19.72	X	5.88	X
Filamentous algae		free floating	not observed		3.92	
Cattail species	<i>Typha sp</i>	emergent	visual	X	–	

Table 2: **Mirror Lake Survey Summary** Did not have the raw data for 2020 or 2011 so these years are not shown. (filamentous algae and visuals are not included in species richness)

	<b>Mirror Lake 2024</b>	<b>Mirror Lake 2018</b>	<b>Statewide Average</b>	<b>North Central Hardwoods Forests Ecoregion Average</b>
Littoral Frequency of Occurrence (%)	<b>80.28</b>	<b>65.69</b>	<b>74.3</b>	<b>76.0</b>
Maximum Depth of Plant Growth	<b>23</b>	<b>27</b>	<b>15.3</b>	<b>15.9</b>
Species Richness	<b>16</b>	<b>17</b>	<b>16.8</b>	<b>16.2</b>
Floristic Quality Index (FQI)	<b>22.45</b>	<b>20.52</b>	<b>24.1</b>	<b>23.3</b>

Figure 1: **Mirror Lake PI map**

\* PI points on Mirror Lake are 15 meters or approximately 49 feet apart.



**Table 3: Species Present in Shadow Lake**

% Littoral frequency of occurrence: This is calculated by taking the total number of times a species is recorded divided by the total number of points in the lake where plant growth is possible. \*\* Did not have the raw data for 2020 or 2011 so these columns only represent if the plants were recorded. \* Means a non-native species, potentially invasive.

Common Name	Scientific Name	Plant type: floating leaf, free floating, submergent , emergent	% Littoral Frequency of Occurrence 2024	** Plants recorded in 2020 by Onterra LLC	% Littoral Frequency of Occurrence 2018	** Plants recorded in 2011 by UWSP
*Eurasian water milfoil	* <i>Myriophyllum spicatum</i>	submersed	17.81	X	—	
*Curly-leaf pondweed	* <i>Potamogeton crispus</i>	submersed	4.11	X	3.90	
Coontail	<i>Ceratophyllum demersum</i>	submersed	52.05	X	25.97	X
Muskgrasses	<i>Chara sp.</i>	submersed	43.84	X	46.75	X
Common waterweed	<i>Elodea canadensis</i>	submersed	9.59	X	—	X
Water stargrass	<i>Heteranthera dubia</i>	submersed	1.37	X	—	X
Small duckweed	<i>Lemna minor</i>	free floating	not observed		1.30	
Turion duckweed	<i>Lemna turionfera</i>	free floating	2.74	X	—	
Forked duckweed	<i>Lemna trisulca</i>	free floating	4.11	X	1.30	X
Northern watermilfoil	<i>Myriophyllum sibiricum</i>	submersed	not observed	X	18.18	X
Slender naiad	<i>Najas flexilis</i>	submersed	5.48	X	2.60	X
Spatterdock	<i>Nuphar variegata</i>	floating leaf	1.37	X	1.30	X
White water lily	<i>Nymphaea odorata</i>	floating leaf	10.96	X	3.90	X
Variable pondweed	<i>Potamogeton gramineus</i>	submersed	6.85	X	3.90	
Illinois pondweed	<i>Potamogeton illinoensis</i>	submersed	visual	X	1.30	
Long-leaf pondweed	<i>Potamogeton nodosus</i>	submersed	1.37		1.30	
Fries' pondweed	<i>Potamogeton friesii</i>	submersed	45.21	X	62.34	

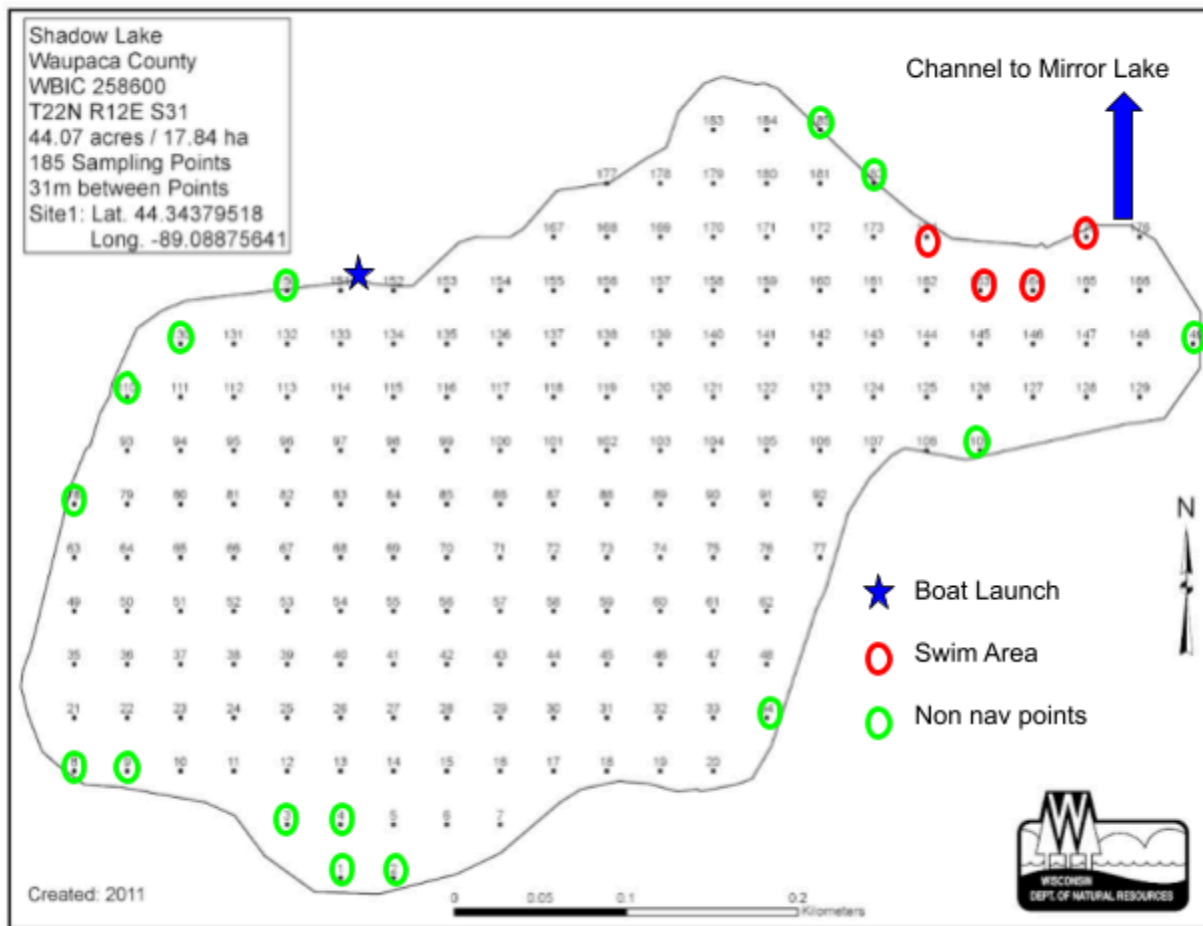
Floating leaf pondweed	<i>Potamogeton natans</i>	floating leaf	visual	X	—	
Small pondweed	<i>Potamogeton pusillus</i>	submersed	1.37		—	
Clasping leaf pondweed	<i>Potamogeton richardsonii</i>	submersed		X		
Flat-stem pondweed	<i>Potamogeton zosteriformis</i>	submersed	24.66	X	—	X
White water crowfoot	<i>Ranunculus aquatilis</i>	submersed	4.11	X	—	
Large duckweed	<i>Spirodela polyrhiza</i>	submersed	4.11	X	2.60	
Sago pondweed	<i>Stuckenia pectinata</i>	submersed	39.73	X	23.38	X
Common bladderwort	<i>Utricularia macrorhiza</i>	free floating	5.48	X	2.60	X
Small bladderwort	<i>Utricularia minor</i>	submersed		X		
Wild celery	<i>Vallisneria americana</i>	submersed	26.03	X	1.30	X
Common watermeal	<i>Wolffia columbiana</i>	free floating	1.37	X	1.30	
Slender riccia	<i>Riccia fluitans</i>	free floating		X		
Softstem bulrush	<i>Schoenoplectus tabernaemontani</i>	emergent	visual	X	—	
Broadleaf cattail	<i>Typha latifolia</i>	emergent	visual		—	
Water smartweed	<i>Persicaria amphibia</i>	emergent	visual	X	—	
Stonewort sp	<i>Nitella sp</i>	submersed		X		
Filamentous algae			not observed		5.19	
Aquatic moss	<i>Aquatic moss sp</i>	submersed	1.37		—	

Table 4: **Shadow Lake Survey Summary** Did not have the raw data for 2020 or 2011 so these years are not shown. (filamentous algae and visuals are not included in species richness)

	Shadow Lake 2024	Shadow Lake 2018	Statewide Average	North Central Hardwoods Forests Ecoregion Average
Littoral Frequency of Occurrence (%)	<b>84.93</b>	<b>89.61</b>	<b>74.3</b>	<b>76.0</b>
Maximum Depth of Plant Growth	<b>22</b>	<b>18</b>	<b>15.3</b>	<b>15.9</b>
Species Richness	<b>22</b>	<b>20</b>	<b>16.8</b>	<b>16.2</b>
Floristic Quality Index (FQI)	<b>24.25</b>	<b>23.77</b>	<b>24.1</b>	<b>23.3</b>

Figure 2: **Shadow Lake PI map**

\* PI points on Mirror Lake are 31 meters or approximately 102 feet apart.



If there are questions regarding the PI survey or results please contact Golden Sands RC&D, Chris Hamerla, [chris.hamerla@goldensandsrcd.org](mailto:chris.hamerla@goldensandsrcd.org) (715) 343-6215