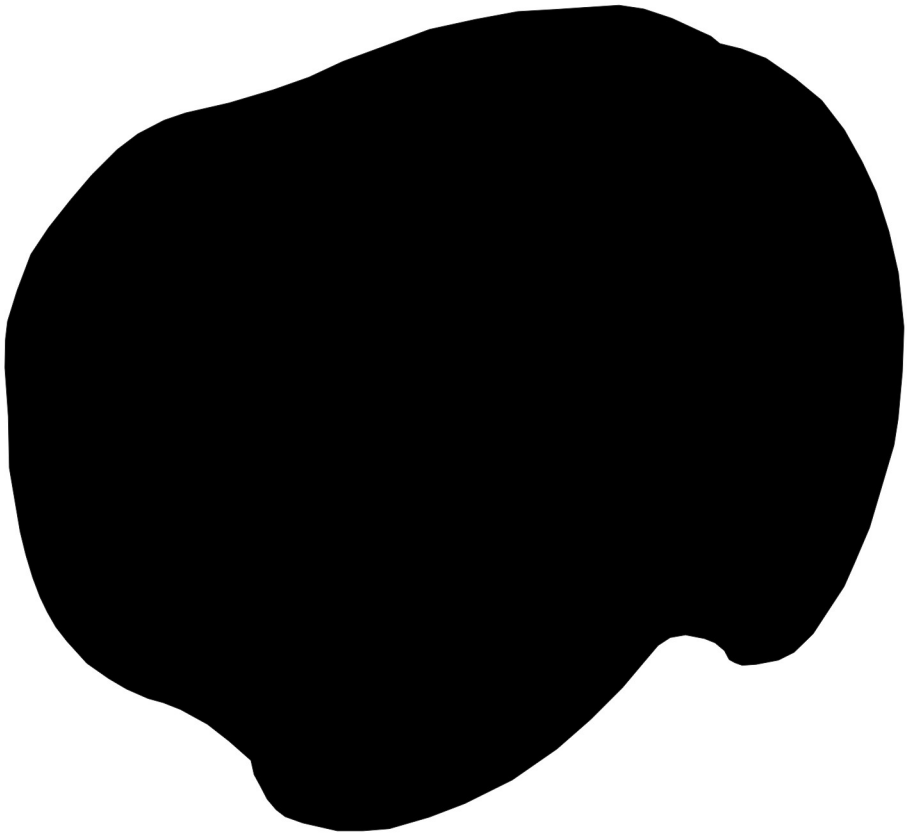
GRACE LAKE
HUBBARD COUNTY
MINNESOTA



AQUATIC PLANT SURVEY
2025

Grace Lake Aquatic Plant Survey

Prepared for Grace Lake Watershed Improvement Association

2025

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Field Surveys by

Ethan Hosey and Alex Barker

Cite as

Limnopro Aquatic Science, Inc. 2025. Grace Lake Plant Survey. Prepared for Grace Lake Watershed Improvement Association. 8 pp with appendices.

GRACE LAKE AQUATIC PLANT SURVEY

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EXECUTIVE SUMMARY

Between August 20-25, 2025, Limnopro Aquatic Science, Inc., completed a full point-intercept survey of Grace Lake, identifying plants at one point per acre across the 340-acre littoral zone down to a depth of 20 feet. Dense native growth from 23 different plants was observed at 91% of sites. On average, each rake pull brought up four species, with a high of eight. Naiad (also known as "bushy pondweed") emerged as the dominant species comprising 25% of collected biomass and occupying 66% of all sites surveyed. Five species—naiad, Canada waterweed, sago, flatstem pondweed and northern watermilfoil—accounted for 66% of total biomass. Near surface growth of plants to within 2 feet of the surface covered 126 acres primarily in water less than 5 feet deep along most shorelines and may occasionally be experience as nuisance. Despite all of the most common AIS, including starry stonewort, Eurasian watermilfoil, zebra mussels, and curlyleaf pondweed, occurring within 30 miles of Grace Lake, none of these were detected during the survey. After the survey was complete, the MN DNR reported that curlyleaf pondweed was found at a single location on Grace Lake in July 2025 by fisheries staff, via fragments in gillnets within the southeast bay. This would be the first known occurrence of this invasive plant species in the lake and warrants attention in the spring of 2026. Grace Lake has above average water clarity which supports robust plant habitat. Compared to the last known full lake survey in 2007 by the MN DNR, the plant community has remained remarkably stable over 18 years, with consistent site occupancy (91–96% in 0–15 ft depths), taxa richness (~20–23 natives), and dominant species rankings, underscoring the lake's resilient native vegetation. Within the Mississippi River Headwaters Watershed, Grace Lake remains a top priority for monitoring and early detection by reporting any suspicious plants immediately, particularly given how close many AIS are to the lake.

INTRODUCTION

This report details results of an aquatic plant survey that was conducted on Grace Lake during August 2025 at the request of the Grace Lake Watershed Improvement Association. We used a standard point-intercept method to sample at one point per acre of the lake's shallows, giving a robust picture of where different species grow, how dense they are, and whether any invasive species have arrived. These surveys help spot problems early, gauge the lake's overall health, and help guide decisions that keep Grace Lake clear, fish-friendly, and enjoyable for everyone who uses it.

Plants shape everything in lakes from water clarity to fish habitat to swimming and boating conditions. They hold bottom sediments in place, calm waves along shorelines, and lock up nutrients that would otherwise fuel algae blooms. This "conservation value" is strongest when plant cover stays moderate, species stay diverse, and growth forms stay mixed—broad leaves, narrow leaves, low carpets, and taller canopies all working together. Too much of one kind, or thick surface mats, creates challenges for recreation and can hurt the lake's ecological balance.

Three main plant survey methods exist, each with its own purpose. Point-intercept surveys, like the one we ran, map species and density across the whole lake typically at one point per littoral acre or half acre, the littoral zone being where plants can

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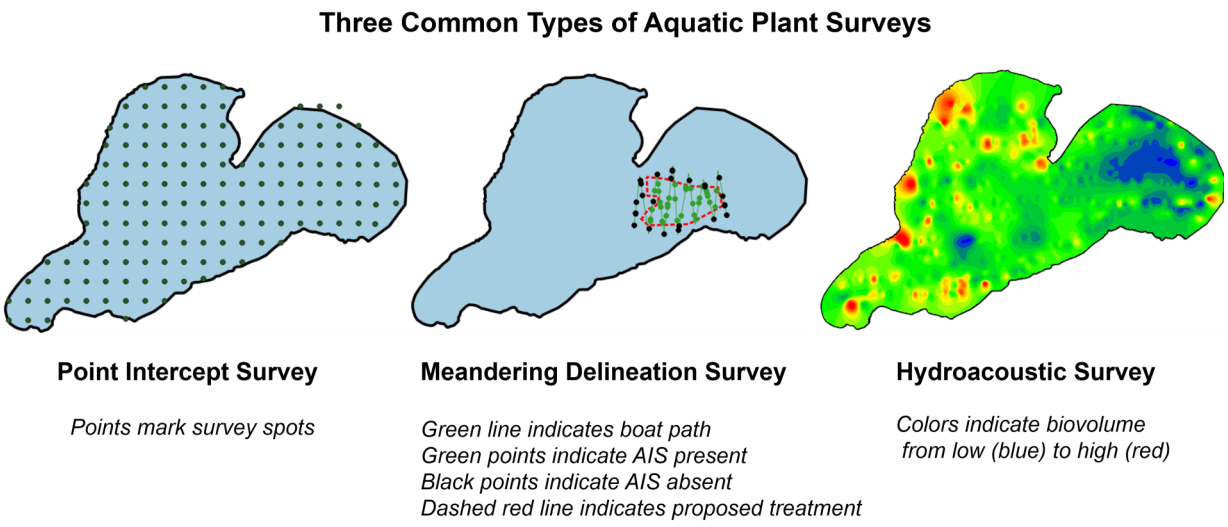


Fig. 1. Example of three types of aquatic plant surveys commonly done in Minnesota for a fictious lake.

root and get enough sun to grow, typically to about 15 feet in Minnesota lakes. Meandering delineation surveys, invented by the MN DNR, focus on outlining known invasive plots for treatment planning. Hydroacoustic surveys use sonar to map plant height and water-column occupied by plants—and depth to the plant canopy (Fig. 1).

Grace Lake (DOW 29-0071-00) is located about 12 miles southeast of the city of Bemidji in northwestern Minnesota. It lies on the border of Beltrami and Hubbard counties. It is one of 144 lakes (with a surface area greater than 100 acres) within the Mississippi River Headwaters Watershed. Major lakes within this watershed include Itasca, Bemidji, Cass, Winnibigoshish, Ball Club and Pokegama, representing a mix of upstream (Itasca, Bemidji, Cass) and downstream (Winnibigoshish, Ball Club, Pokegama) positions relative to Grace Lake. Lakes in this watershed typically support healthy native aquatic plant populations.

Within a 30-mile buffer of Grace Lake, curlyleaf pondweed (*Potamogeton crispus*) has been documented in at least 11 locations across Clearwater, Hubbard, Itasca, and Cass counties (first records 1976–2025), Eurasian watermilfoil (*Myriophyllum spicatum*) in 9 sites (2002–2023), starry stonewort (*Nitellopsis obtusa*) in 20 sites (2016–2025), primarily in Beltrami and Cass counties, and zebra mussels (*Dreissena polymorpha*) in 71 loca-

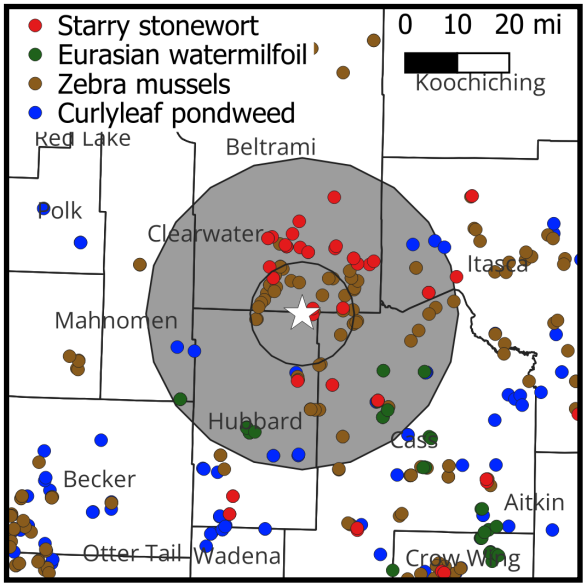


Fig. 2. Listed aquatic invasive species (AIS) within a radius of Grace Lake (white central star). Gray area is 30 mile radius and the inside ring is 10 miles. Data current as of 11/10/2025 and obtained from MnGEO.

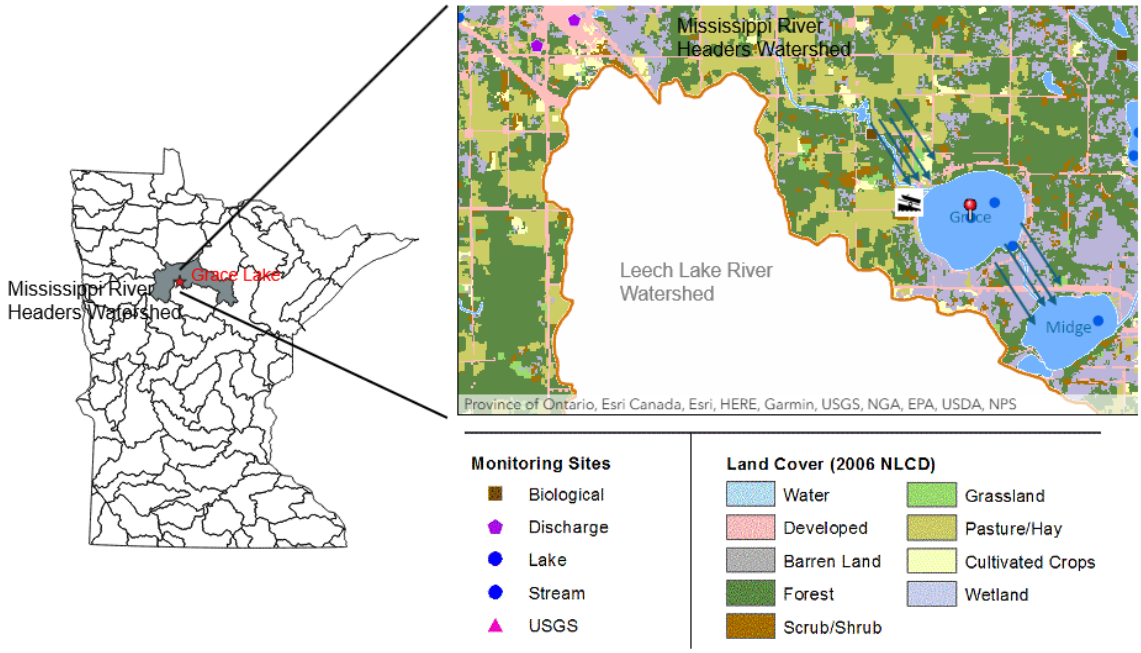


Fig. 3. Grace Lake position in Mississippi River Headwaters Watershed and land use. Data obtained from the MPCA.

tions (2012–2025) across Beltrami, Cass, Hubbard, and Itasca counties. Zebra mussels, which increase clarity and may expand plant growth by reducing algae, pose a growing risk via boat traffic and water connections. Grace Lake is in a a Minnesota invasive hot zone (Fig. 2).

Grace Lake has a surface area of 860 acres, with 340 acres classified as littoral. Maximum depth is 42 feet; mean depth is 17 feet. The immediate watershed that includes Grace Lake is 5,966 acres for a watershed to lake ratio of 7:1. Flows to and from Grace Lake are intermittent. There are two inlets on the northwest corner of the lake that run during spring runoff and periods of heavy rains. The outlet on the southeast corner of the lake is generally dry but when outflow does occur, it runs southeast to Midge Lake, then north to Wolf Lake before entering into the Mississippi River.

Land cover within the Grace Lake watershed is primarily agricultural and upland deciduous forest. About 104 acres of wetland occur in the watershed, including a wetland area on the northwest side of the lake. The shoreline of Grace Lake is mostly forested but heavily developed with residential homes. There is a public boat launch on the west shore (Fig. 3).

Water clarity ranks high for the region, clearest in spring and declining through summer (Fig. 4). The last reported on MN DNR fisheries survey in 2020 found no common carp, so conditions suit plants. Common carp are an invasive fish species known to have detrimental impacts to a lake's plant community and water quality.

The last known full plant survey, conducted by the MN DNR on July 24 and 25, 2007 (Perleberg 2007), recorded 20 native taxa growing down to 26 feet, with 96% of shallow sites (0–15 feet) containing vegetation. The most common submerged plants included bushy pondweed (*Najas flexilis*), coontail (*Ceratophyllum demersum*), flatstem pondweed (*Potamogeton zosteri-*

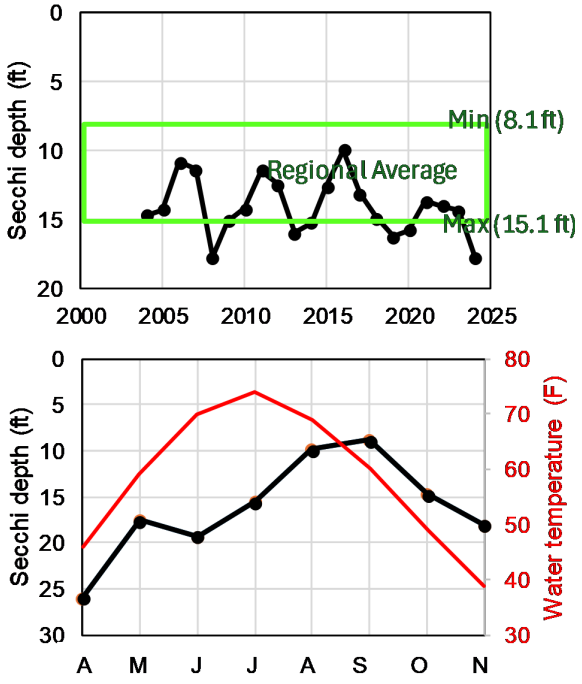


Fig. 4. Water clarity as measured by Secchi depth on Grace Lake. Higher values indicate clearer water. Top panel shows annual averages with the green box indicating expected condition of similar lakes in the same part of the state. Bottom pattern shows the average water clarity through a typical year on the lake from April through November. For comparison average surface temperature over a typical year for the lake is overlaid in red.

formis), Canada waterweed (*Elodea canadensis*), muskgrass (*Chara* sp.), and northern watermilfoil (*Myriophyllum sibiricum*). Approximately eight acres of bulrush (*Scirpus* spp.) were mapped along the edges.

A limited MN DNR Minnesota Biological Survey on June 14, 2006, focused on the west shore and documented 15 submerged, emergent, and shoreline species, including both bushy pondweed and Guadalupe Island naiad (*Najas guadalupensis* ssp. *guadalupensis*).

METHODS

The point intercept survey took place between August 20-25, 2025, with three days on the water. We loaded a grid of points—one per littoral acre—into an onboard GPS sonar unit. At each point, we tossed a double-sided rake on a rope off the port side and dragged it with four steady pulls over about a 10-foot area. Every plant that came up was identified to species, or lowest practicable level, and rated on a density scale from 0 (none) to 3 (dense; Fig. 5).

While moving between points, a Lowrance HDS Gen 3 sonar unit recorded continuous data as .sl2 files. We processed these through BioBase's EcoSound service to map biovolume percent and depth to the plant canopy. We flagged anything growing within 2 feet of the surface as a recreational nuisance—most boats struggle to keep a clean propeller through dense growth that tall. Learn more about BioBase outputs at www.biobasemaps.com.

Back in the lab, QGIS 3.28 handled mapping and statistics using multilevel b-spline interpolation. For the plant community, we calculated (1) frequency of occurrence for each species, (2) frequency by growth type, (3) native and non-native species counts

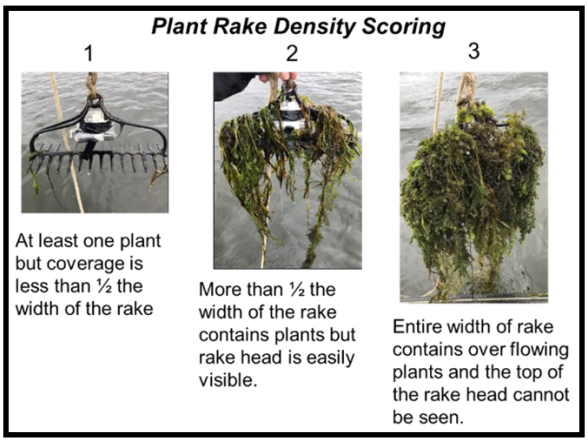


Fig. 5. Aquatic point intercept survey rake density method for density scoring.

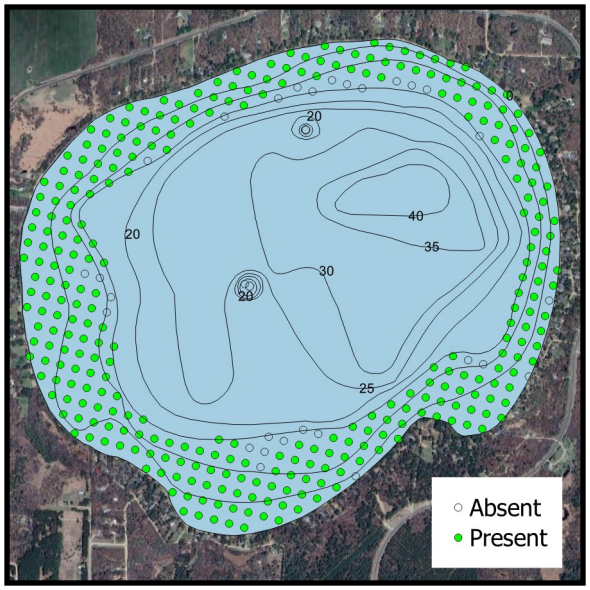


Fig. 6. Presence and absence of plants in Grace Lake in late August 2025. All sampling locations are shown.

per point, and (4) maximum depth of submersed plants.

RESULTS

Current aquatic plant community

Plants appeared at 91% of all sampled sites (Fig. 6). Growth extended to 20 feet deep, but coverage dropped sharply between 14 and 15 feet. We recommend 15 feet as the practical "weedline" for most of the lake,

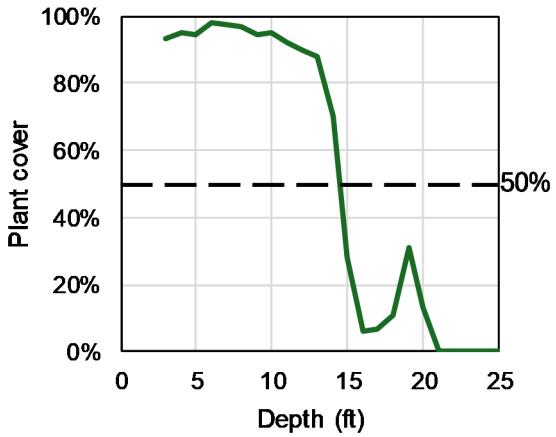


Fig. 7. Percentage of sites at a given depth where at least one plant was found during either sampling period.

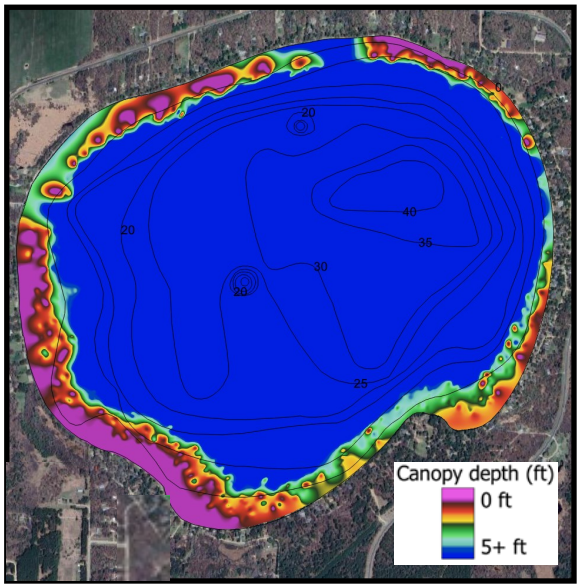


Fig. 9. Sonar-based measurements of "canopy depth" or the distance between the top of the plants and the surface of the water. .

where about half the sites still supported plants (Fig. 8).

Large areas exhibited nuisance-level growth. Plants within 2 feet of the surface covered 126 acres (Fig. 9), mostly in water less than 5 feet deep along 80% of shorelines. The primary contributors were northern watermilfoil, sago pondweed, flatstem pondweed, and clasping-leaf pondweed.

We identified 23 native aquatic plant kinds, including submerged, emergent, and macroalgae types (full list, Appendix Table A-1).

Rakes averaged four kinds per pull, with a maximum of eight. The invasive banded mystery snail was present, but no invasive plants were found. Five species dominated, accounting for 66% of biomass (Fig. 10). Naiad (commonly called bushy pondweed) led at 25% and was the most widespread (Fig. 11). The others were Canada waterweed, sago pondweed, flatstem pondweed, and northern watermilfoil.

Thirteen of the 23 species were relatively

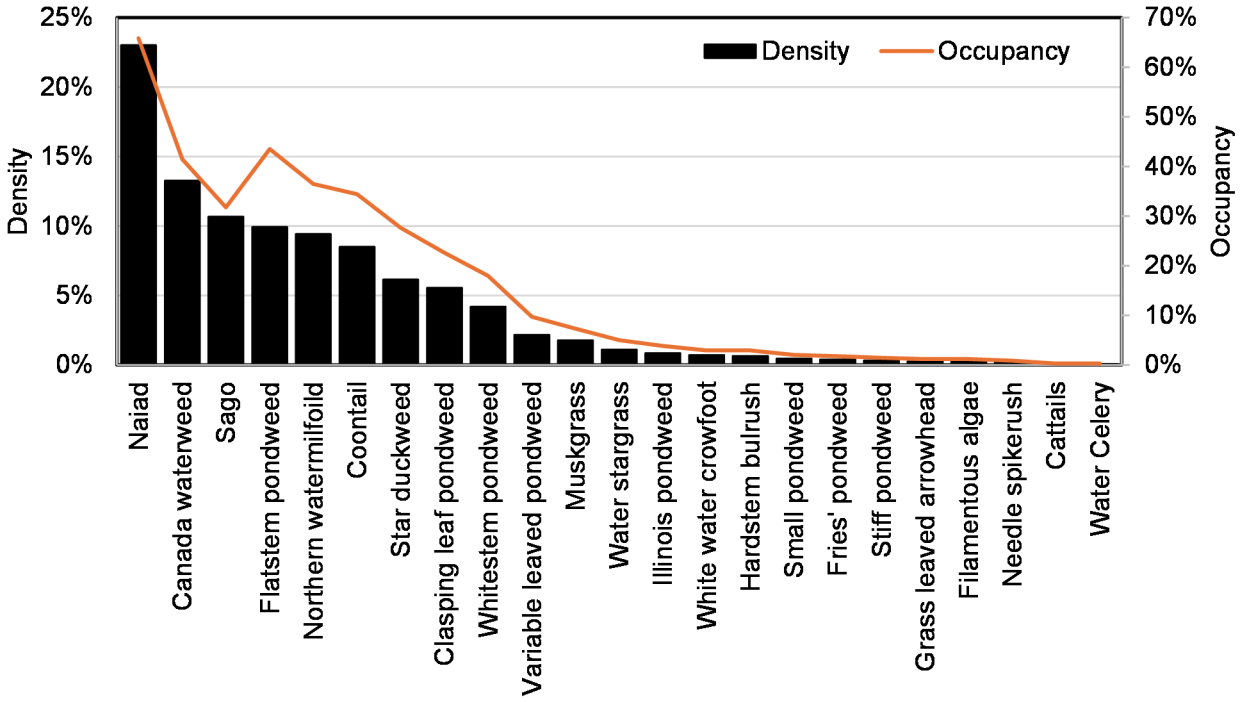


Fig. 10. Types and species of vegetation collected on Grace Lake. Density (black bars) is the total amount of plant material collected during the two surveys belonging to the listed type while frequency (orange line) indicates the proportion of sites surveyed out of 340 where at least one individuals of a given species was identified and counted.

rare, occurring at fewer than 10% of points—a typical pattern where a few species dominate and many play specialized roles. Full spatial density plots and a photo atlas of all species are in the appendix.

Comparison to 2007 DNR Survey

Shallow coverage (0–15 feet) remained similar: 96% in 2007 versus 91% in 2025. Native taxa increased slightly from 20 to 23. Naiad stayed dominant, up 12%; Canada waterweed rose 32%, sago pondweed 24%, and northern watermilfoil 16%, while coontail dropped 12% (Table 1). Plants reached 26 feet in 2007 and 20 feet in 2025, declining rapidly past 15 feet. Bulrush coverage held steady at ~8 acres.

DISCUSSION

Grace Lake's plant environment appears healthy, much like 18 years ago, with small boosts in the main kinds. Naiad has long been the key player, now in two-thirds of spots and one-quarter of plant weight. Rises in Canada waterweed, sago pondweed, and northern watermilfoil are indicative of

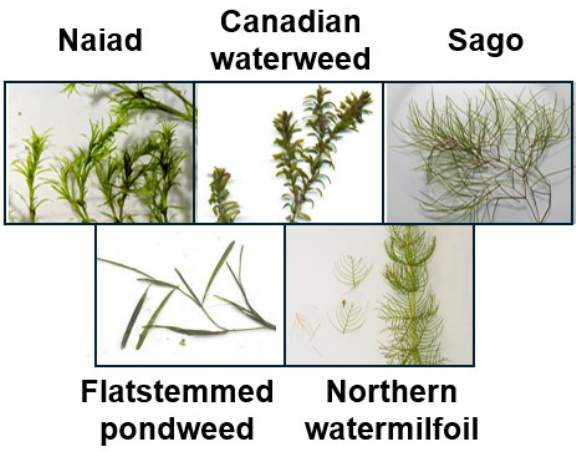


Fig. 11. Most commonly sampled vegetation on Grace Lake. These five combined for 66% of all plants collected. .

Table 1. Frequency of occurrence for dominant submerged species over 18 years from MNDNR 2007 survey to current Limnopro survey 2025.

Species	2007 Frequency	2025 Frequency	Change
Naiad (*Najas* spp.)	54%	66%	↑ +12%
Canada waterweed (*Elodea canadensis*)	34%	66%	↑ +32%
Sago pondweed (*Stuckenia pectinata*)	19%	43%	↑ +24%
Northern watermilfoil (*Myriophyllum sibiricum*)	20%	36%	↑ +16%
Coontail (*Ceratophyllum demersum*)	40%	28%	↓ -12%

good sustained water clarity stretching the growth season for cover. Coontail's small drop likely shows normal give-and-take in a balanced lake. Overall, 91% coverage and ~20 kinds keep the lake clear, protect shores, and support fish.

The 2007 DNR survey (Perleberg 2007) identified the dominant naiad as bushy pondweed (*Najas flexilis*), while the 2006 Minnesota Biological Survey noted both bushy pondweed and Guadalupe Island naiad (*Najas guadalupensis* ssp. *guadalupensis*) on the west shore. These two naiad species look very similar and are hard to tell apart without the aid of a microscope. Given how widespread naiad was across the lake in 2025, and in line with the 2007 full-lake report, we recorded it as the generic *Naiad* sp. It is probable that most of it is bushy pondweed, though some of this "Southern naiad" may be present as noted in 2006.

In assembling this report and searching for other supporting documents for the lake, we ran across a report on the national EDDMaps database for invasive species that indicated curlyleaf pondweed had been reported in Grace Lake during the 2025 MN DNR standard fisheries survey approximately one month before our survey. The EDDMaps listing was verified by photograph by the MN DNR Ecological Water and Resources Invasive Species group. The plant was found at a single location on the southeast at a depth of approximately 10 foot where gillnets as part of MN DNR fisheries survey of the lake (Fig. 12). This is the first aquatic invasive species plant confirmed in Grace Lake.

Whether curlyleaf pondweed has been present long term or if this is a new finding is unclear as our survey in August would have been far too late to adequately sample and find curlyleaf pondweed. Curlyleaf pondweed has a unique life cycle compared to almost all other aquatic plants in Minnesota, which in part contributes to its suggest as an invader in early summers.

Curlyleaf starts under ice, long before most natives, shading them as they wake up (Fig. 13). It rules until early July, then dies, dumping nutrients that spark algae and cutting oxygen as it rots—sometimes stressing fish.

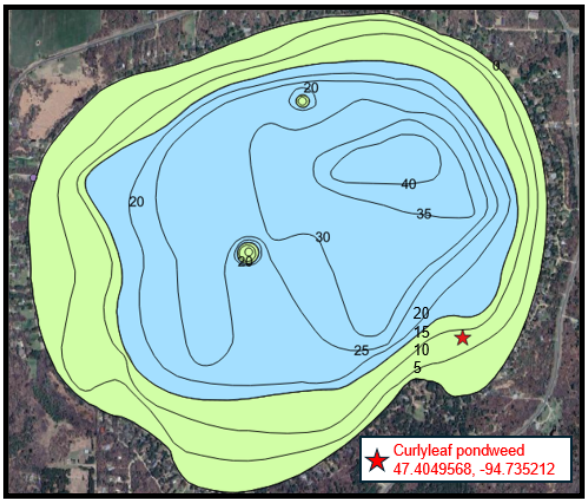


Fig. 12. Location of CLP discovered by the MNDNR fisheries on Grace Lake.

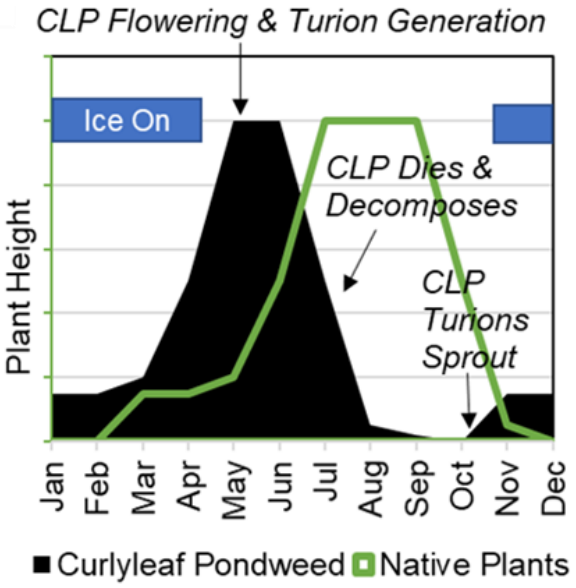


Fig. 13. Curlyleaf pondweed idealized life cycle (black solid area) interposed with "native" plants (hollow green area).

Most natives and other invasives like Eurasian watermilfoil or starry stonewort start after water hits 60°F around June 1, peaking July to early September. For lakes with curlyleaf, we usually do spring (for curlyleaf) and late summer (for natives and other invasives) checks; we did not know this lake had it. This August work focused on summer plants and screened for Eurasian watermilfoil and starry stonewort.

Fig. 14. Curlyleaf pondweed form. Left Shows the characteristic lasagna noodle appearance with round tips while right shows a close up of the toothed leaf margin.

While some curlyleaf can persist through the year, it generally does so in deeper areas and only in sparse populations so that it can be easy to miss later in the year.

This curlyleaf pondweed finding warrants some attention. If this is a brand new infestation, to be assessed by spring 2026 meandering or point intercept survey, it may be worth aggressively trying to remove what is there, assuming that it's contained. Options for control may include hand pulling or herbicide treatments. These steps, plus quick reports of odd plants to MN DNR EDDMapS, will keep the lake clear, full of life, and enjoyable. Asking membership to keep their eyes open for curlyleaf pondweed is a useful first step. Mature plants show wavy, serrated "lasagna-noodle" leaves with rounded tips (Fig. 14), though young growth can mimic natives.

Given this new finding of curlyleaf pondweed as well as the proximity to all of the most common AIS threats for lakes, we strongly recommend a formal AIS early detection and response plan be put together and annual inspections be made for potential new infestation to whatever extent a budget allows. Early detection and remediation is far less expensive than management should an infestation occur.

Grace Lake's recreational importance warrants protections to maintain its robust vegetation. The lake presently shows a healthy and typical Northwoods plant community, helped by its water flow and land cover.

Acknowledgments

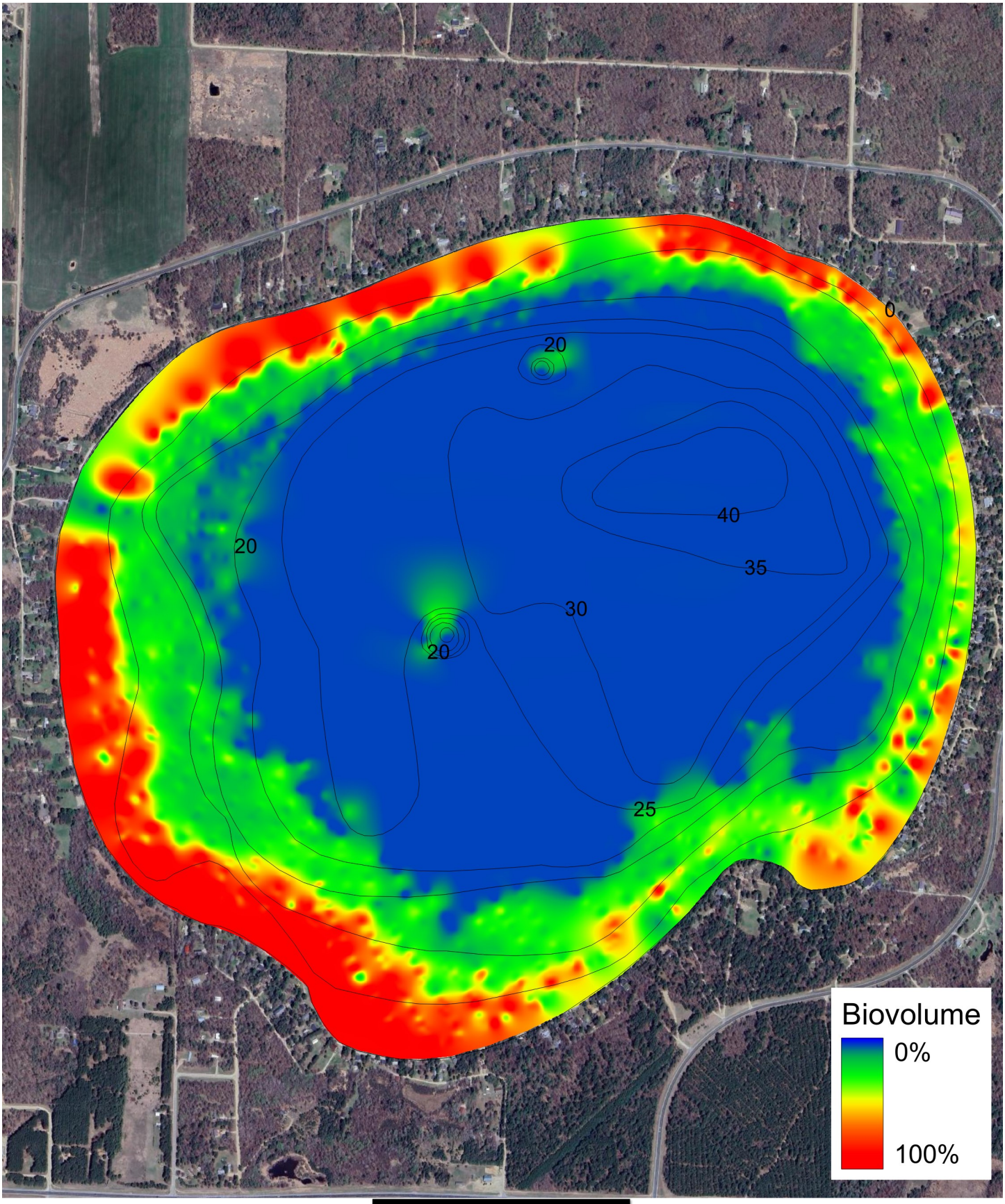
Thanks to Grace Lake Watershed Improvement Association and the MN DNR for historical data.

Appendix

Density and Frequency of Occurrence for All Species

		7/2007	8/2025	
Common Name	Scientific Name	Occupancy	Occupancy	Density
Naiad	*Najas flexilis*	54%	66%	23%
Canada waterweed	*Elodea canadensis*	39%	41%	13%
Sago	*Stuckenia pectinata*	7%	32%	11%
Flatstem pondweed	*Potamogeton zosterformis*	41%	44%	10%
Northern watermilfoil	*Myriophyllum sibiricum*	20%	36%	9%
Coontail	*Ceratophyllum demersum*	44%	34%	9%
Star duckweed	*Lemna triscula*	0%	28%	6%
Clasping leaf pondweed	*Potamogeton richardsonii*	5%	23%	6%
Whitestem pondweed	*Potamogeton praelongus*	7%	18%	4%
Variable leaved pondweed	*Potamogeton gramineus*	1%	10%	2%
Muskgrass	*Chara* sp.	21%	7%	2%
Water stargrass	*Heteranthera dubia*	1%	5%	1%
Illinois pondweed	*Potamogeton illinoensis*	7%	4%	1%
White water crowfoot	*Ranunculus aquatilis*	1%	3%	1%
Hardstem bulrush	*Schoenoplectus acutus*	1%	3%	1%
Small pondweed	*Potamogeton pusillus*	0%	2%	0.5%
Fries' pondweed	*Potamogeton friesii*	12%	2%	0.4%
Stiff pondweed	*Potamogeton strictifolius*	0%	1%	0.3%
Grass leaved arrowhead	*Sagittaria graminea*	1%	1%	0.3%
Filamentous algae	Various	0%	1%	0.3%
Needle spikerush	*Eleocharis acicularis*	1%	1%	0.2%
Cattails	*Typha* sp.	1%	0.3%	0.1%
Water Celery	*Vallisneria americana*	0%	0.3%	0.1%

Grace Lake point intercept surveys by MN DNR (2007) and Limnopro (2025)



750 1,500 ft

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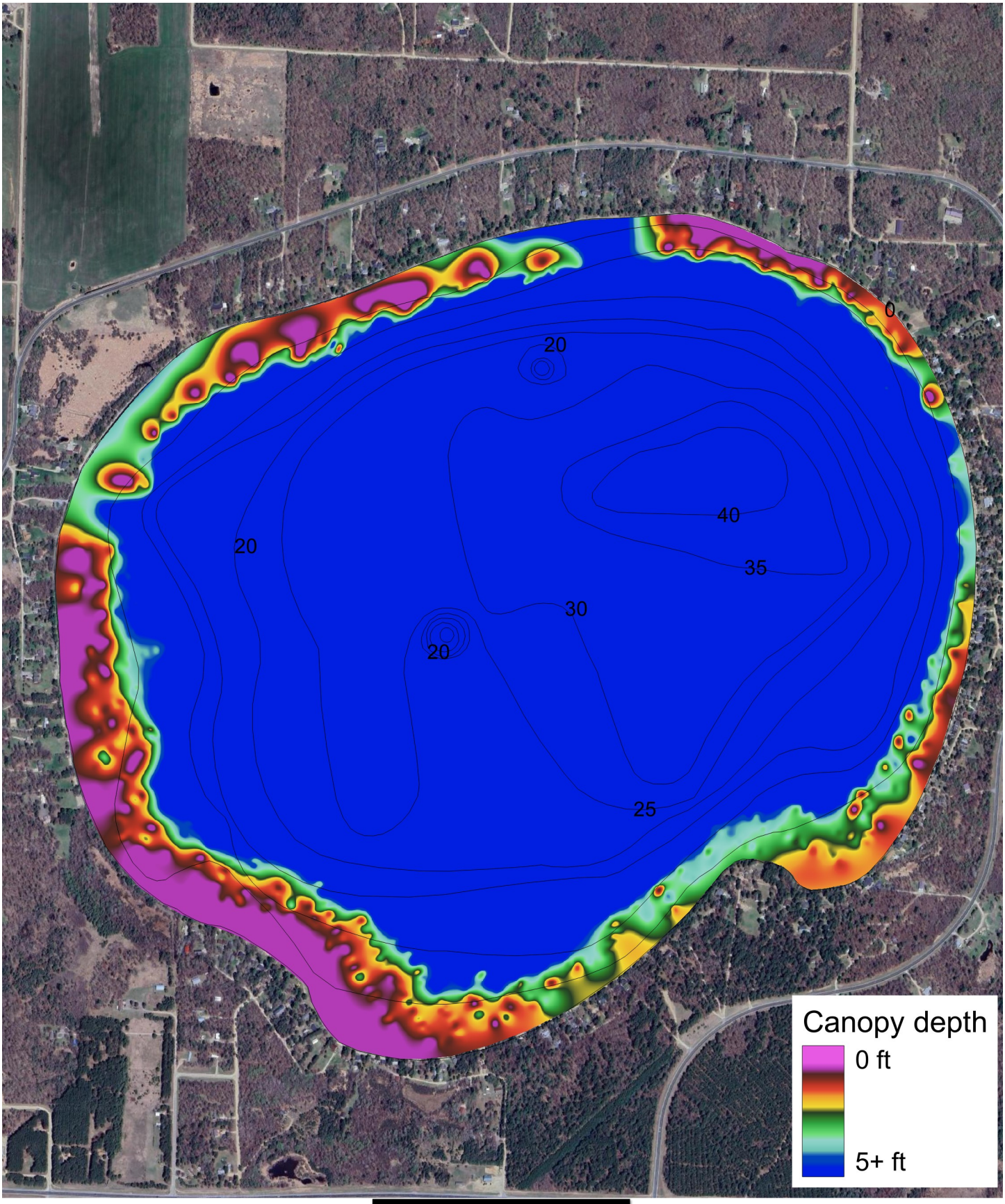
Grace Lake
08/20/2025
Biovolume Percent



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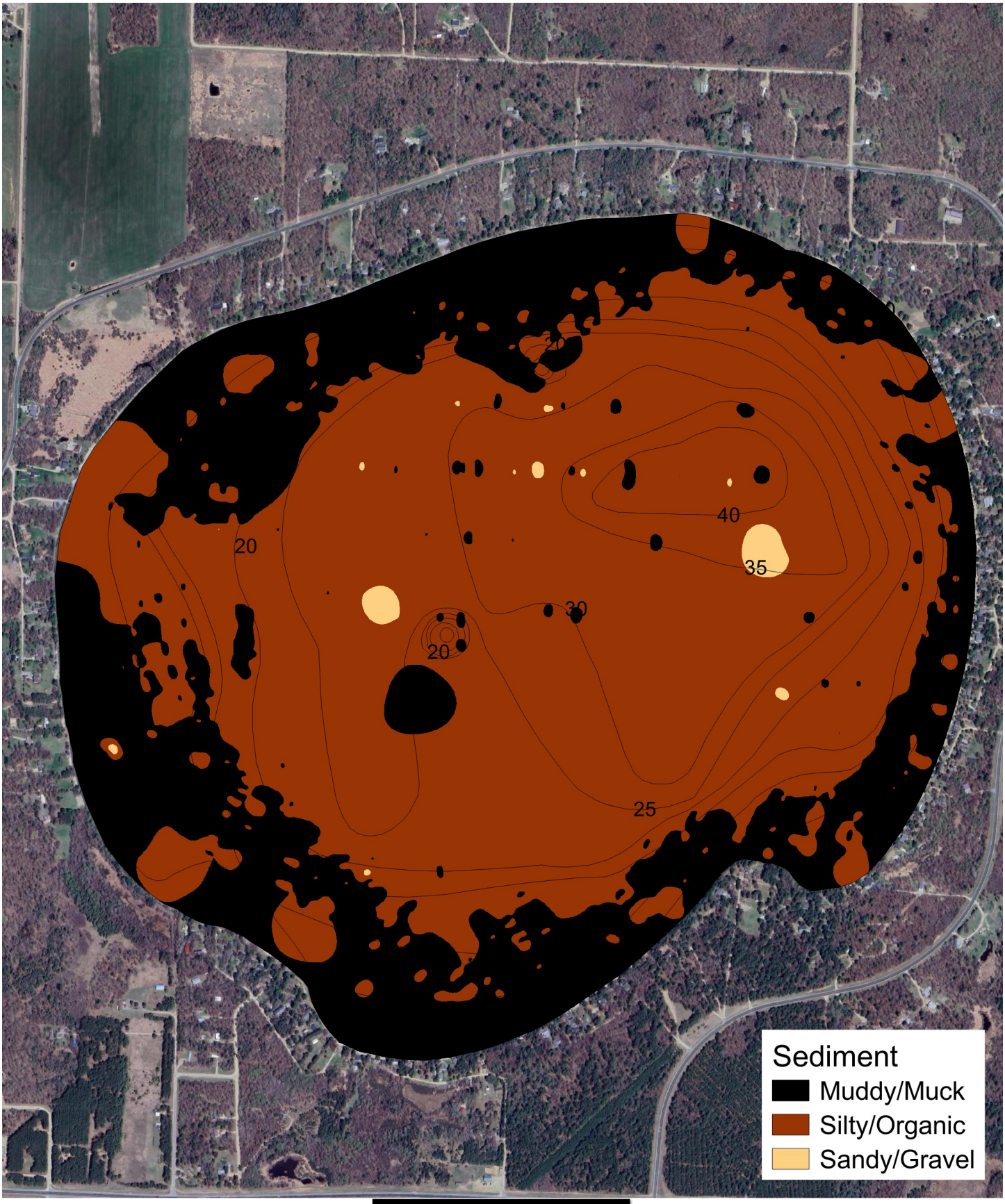
Grace Lake
08/20/2025
Canopy Depth (ft)



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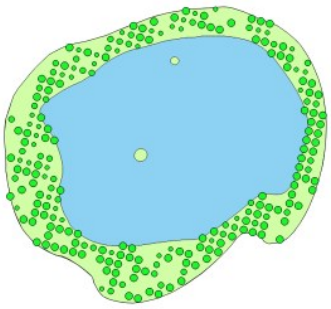
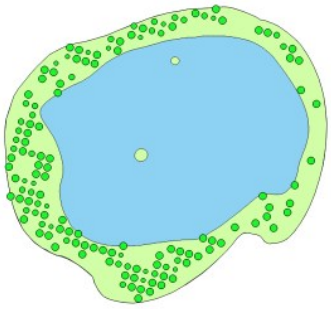
Grace Lake
08/20/2025
Sediment

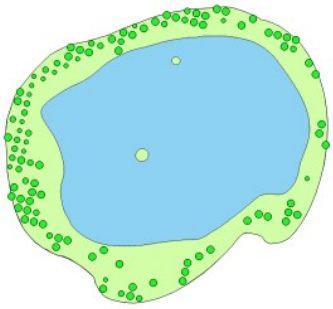
Naiad



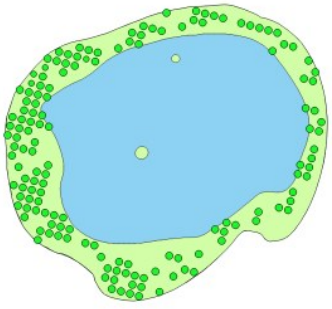
Canada Waterweed



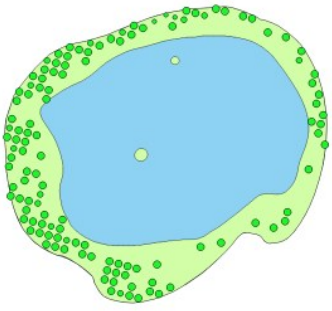
Sago Pondweed



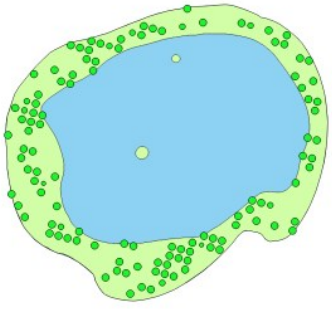
Flatstem Pondweed



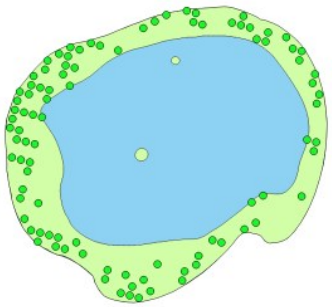
Northern Watermilfoil



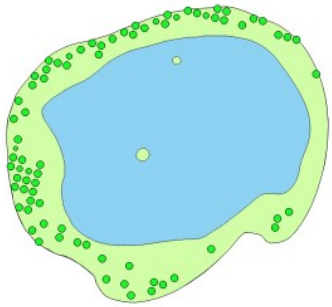
Coontail



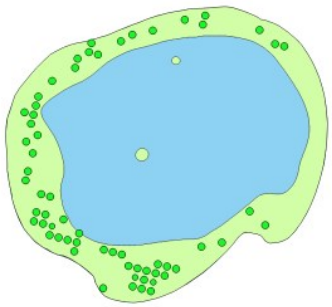
Star Duckweed



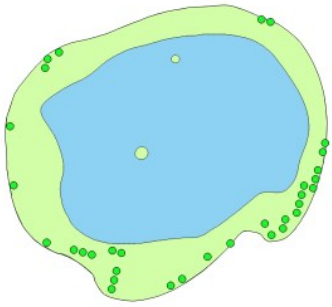
Claspingleaf Pondweed



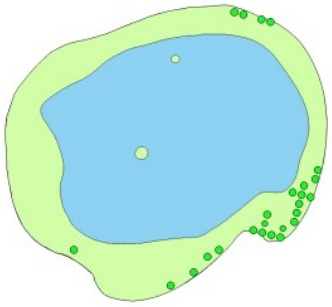
Whitestem Pondweed



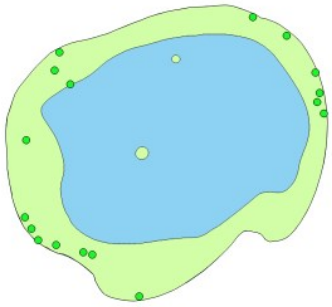
Variable-leaf Pondweed



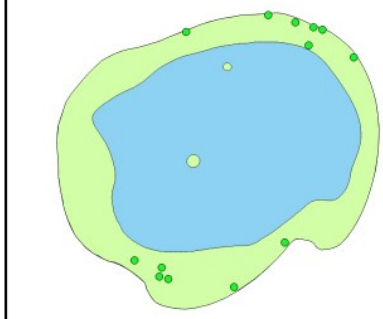
Chara



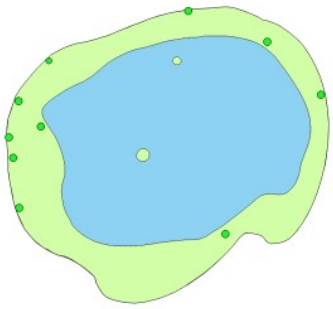
Water Stargrass



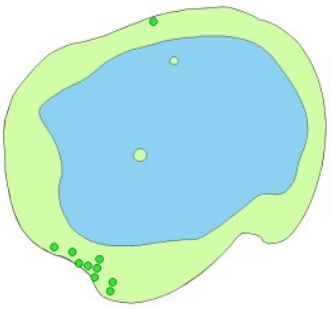
Illinois Pondweed



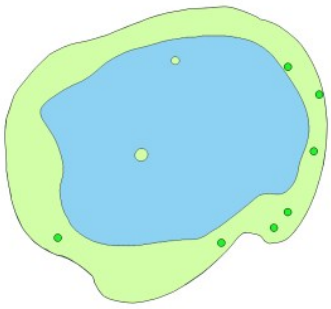
White Water-crowfoot



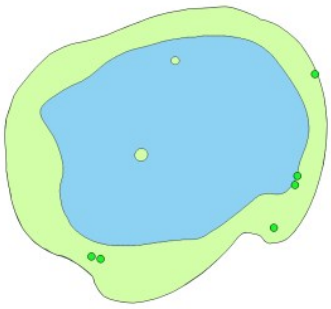
Bulrush

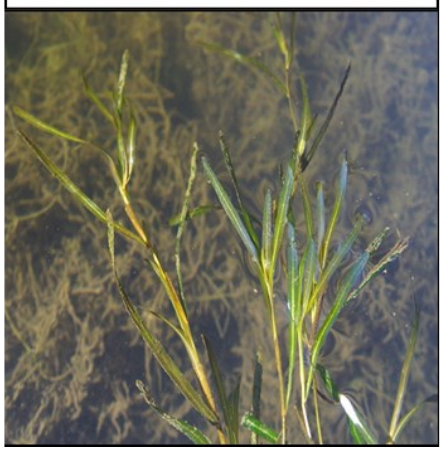


Small Pondweed

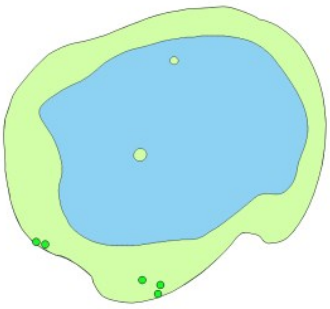


Fries' Pondweed

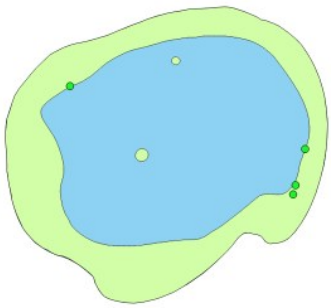


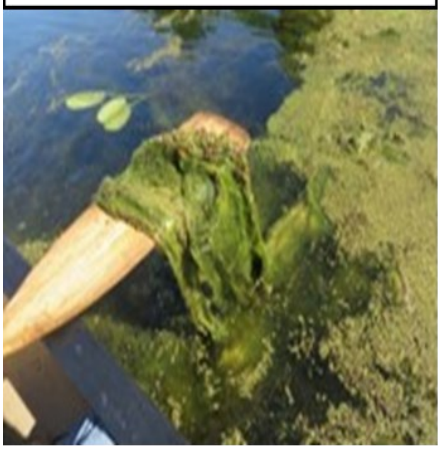


Stiff Pondweed

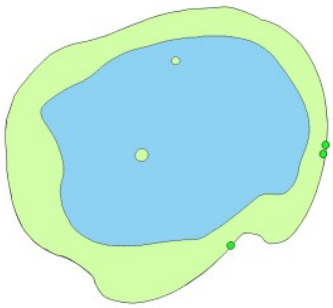


Filamentous Algae

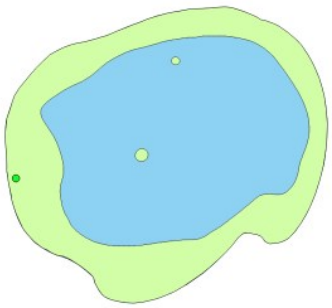




Needle Spikerush



Cattail



Eelgrass