A Summary of Findings from LakeScan™
Guided Surveys and Analysis of:

Cedar Lake North

Alcona and Iosco County

2025 DATA AND ANALYSIS SUMMARY REPORT WITH MANAGEMENT RECOMMENDATIONS

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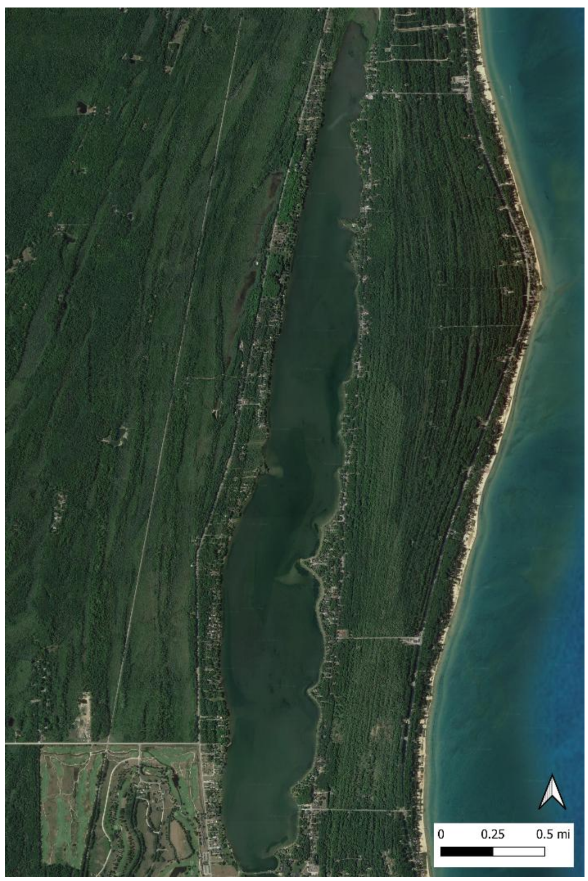

Executive Summary

Kieser & Associates, LLC (K&A) conducted vegetation monitoring on Cedar Lake North (Alcona and Iosco Counties, MI) during the summer of 2025 using LakeScan™ assessment methods. The purpose of these efforts was to assess aquatic vegetation during the summer recreational season in the context of nuisance conditions and management needs/outcomes. LakeScan™ methods combine detailed field data collection with mapping capabilities and whole-lake analyses based on established scientific metrics to score various lake conditions. This approach allows lake managers to readily and consistently identify successful lake management activities, highlight potential issues requiring intervention, and gather critical planning information necessary to improve the ecological and recreational conditions of the lake.

To summarize the overall findings on the lake in 2025, LakeScan™ metrics were averaged across the early and late-season vegetation surveys, revealing that Cedar Lake North met the optimal management goals for all metrics in 2025 (Table ES-1). These findings demonstrate a continued favorable diversity in both species and structures types throughout the lake. The floristic quality index in 2025 was the highest recorded since 2022, indicating a favorable ratio in coverage of native plant species compared to invasive species. The algal bloom risk rating for Cedar Lake is "low" reflecting the small proportion of agricultural and urban land use draining to the lake.

Table ES-1 – Summary of lake analysis metrics.

LakeScan™ Metric	2025 Average	Management Goal
Species Richness	21.5	n/a
Shannon Biodiversity Index	9.7	> 9.4
Shannon Morphology Index	8.5	> 6.4
Floristic Quality Index	27.3	> 20
Recreational Nuisance Presence	1%	< 10%
Algal Bloom Risk	Low	Low

The Cedar Lake North early-season LakeScan™ survey was conducted on July 1 and 2, 2025. The most common native species observed during the survey were *Chara* (*Chara sp.*), broadleaf pondweed (*Potamogeton amplifolius)*, rush (*Juncus pelocarpus Meyer),* and Richardson's pondweed *(Potamogeton richardsonii). Chara* was noted causing recreational nuisance concerns in Aquatic Resource Observation Sites (AROS) 358 and 357 where it was growing to the surface with green filamentous algae. In AROS 338, 429, 420, 419, 434, 432, and 461, tall pondweeds were growing to the surface causing minor recreational nuisance conditions.

The submerged aquatic invasive species, hybrid Eurasian watermilfoil (*Myriophyllum spicatum x sibiricum*), was found in the trenches along the western portion of the lake (#500 AROS) and in single stand-alone clusters in AROS 370 and 379-381. The emergent wetland invasive species purple loosestrife (*Lythrum salicaria L.*) was found in scattered patches in AROS 307, 332, 352-354, 392, and 399, not causing management concerns at the time of the late-season survey.

The late-season LakeScan™ survey was conducted on August 26 and 27, 2025. The most common native species observed during the survey were *Chara*, variable pondweed (*Potamogeton gramineus)*, naiad, rush, and wild celery (*Vallisneria americana*). *Chara* was still observed growing densely and nearly to the surface in AROS 358 and 357, but the area lacked the green filamentous algae observed in July.

During the late-season survey, Eurasian watermilfoil was found widely distributed in the trench locations at AROS 566, 577 and 579-580. Outside of the trenches, Eurasian watermilfoil was found in AROS 367 and 357 as single stalks. Purple loosestrife was found in scattered patches across the shoreline and was the densest in the natural shoreline areas at AROS 391 and 340. Observations of *Phragmites (Phragmites australis)* were made in AROS 377 and 361. A suspected stalk of *Phragmites* was observed at AROS 343 but it could not be reasonably identified from the boat.

Over the last five years, coverage of variable-leaf watermilfoil (*Myriophyllum heterophyllum),* a native species known to cause nuisance concerns on the lake, has exhibited a declining trend. Coverage of Eurasian watermilfoil, purple loosestrife, and *Phragmites* have, however, exhibited increasing trends (Figure ES-1). Coverage of variable-leaf watermilfoil has decreased by 3% since 2021, remaining consistently under 1% coverage across the last three years. Invasive Eurasian watermilfoil coverage has likewise remained consistently under 1% over the past five years, but the coverage increased by 0.6% in the last year, and was at its highest observed average coverage since 2019. It is important to note that the early-season survey occurred before the first herbicide treatment, which could have influenced the calculated increase in average coverage observed in 2025. If Eurasian watermilfoil coverage continues to increase in future surveys, alternative management options may need to be explored. Although the trendlines indicate coverage increases, purple loosestrife and *Phragmites* have remained at relatively low coverages with purple loosestrife declining 0.5% from 2024 (despite no targeted treatments), and *Phragmites* having almost negligible coverage of 0.05% across the last two years. *Phragmites* spot treatments started in late 2024 and were expanded in 2025.

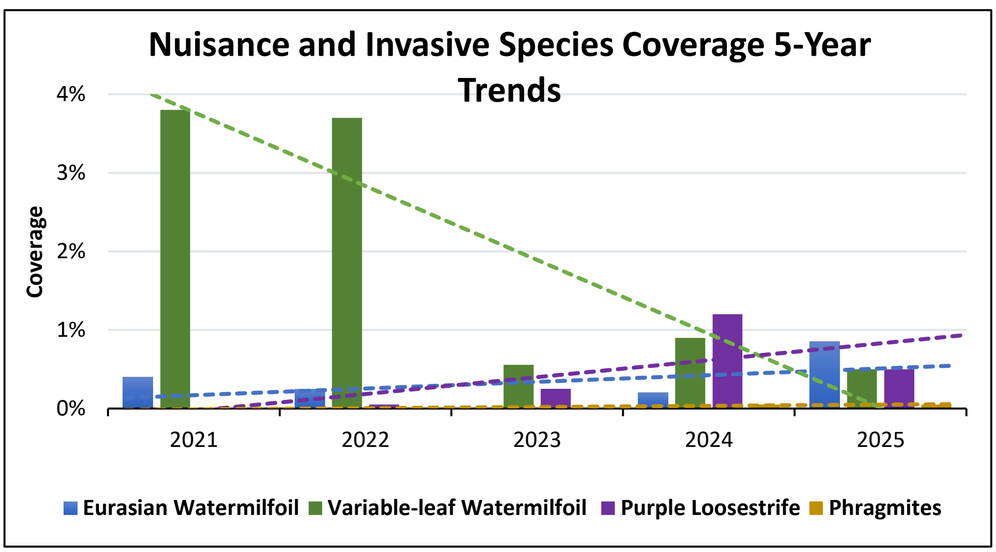

Figure ES-1 – Nuisance and invasive species average yearly coverage 5-year trends.

Based on 2025 findings, K&A recommends the following management considerations for 2026:

- **Continued management of Eurasian watermilfoil.**
  - Eurasian watermilfoil coverage has remained under 1% across the last 3 years, indicating that although there have been some minor coverage increases, current management interventions appear to be effective at suppressing growth and reducing the cumulative coverage of nuisance presence. Despite less than 1% coverage in 2025, Eurasian watermilfoil displayed a slight increase in coverage over the past year, indicating the possibility of species rebound. A late-season rebound of Eurasian watermilfoil was also observed in the trenches following treatment. Based on these observations, it is recommended that the Cedar Lake Improvement Board explores management options similar to the ones implemented in 2024 where Eurasian watermilfoil was less evident in the trenches following treatment.
- **Continued ProcellaCOR applications to treat Eurasian watermilfoil in the northern trenches of Cedar Lake North**.
  - In previous years, ProcellaCOR applications in Cedar Lake North appeared to have been an effective strategy for the management of nuisance hybrid Eurasian watermilfoil. However, applications in 2025 did not include ProcellaCOR and post-treatment rebound of the species was observed in the trenches, indicating that the herbicide combination used in 2025 may be less effective than what has been used previously on the lake.
- **Continued monitoring of nutrient loading by the outlet of Jones Ditch.**
  - Dense algae and *Chara* growth was observed around Jones Ditch in both the early and late-season surveys in 2025 indicating nutrient loading concerns. The early-season survey in particular included observations of dense filamentous green algae mixed with the *Chara*. Based on July observations, K&A began investigating the site with water quality monitoring. It is recommended that these water quality investigations continue in 2026 to best understand nutrient loading concerns in the area and implement possible solutions. Such monitoring efforts are reported separately from this LakeScan™ report.[1]
- **Continued monitoring of coverage and nuisance conditions of emergent invasive species.**
  - It will be crucial to monitor and document *Phragmites* coverage in Cedar Lake North following the treatment on September 18, 2024. Close monitoring will reveal the effectiveness of the treatment and inform if follow-up treatments are warranted. An additional on-the-ground survey of the treated areas might be pursued by the lake board to achieve reliable and accurate monitoring data on *Phragmites* populations across the broader landscape opposed to only along the shoreline.
  - Though 2025 late-season observations suggest a lower coverage than 2024, there appears to be an increasing 5-year trend of shoreline distribution of purple loosestrife. Depending on 2026 vegetation observations, it may be recommended that the lake board consider the use of biocontrols over a few seasonal applications to manage the spread of the species.

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[1] Cedar Lake Nearshore Sampling Summary and Final Nearshore Monitoring Final Technical Memorandum accessed online: https://cedarlakewmp.net/monitoring-reports

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1.0. Introduction

Inland lakes are complex systems, and managing them for both ecological health and recreational enjoyment involves balancing goals that are sometimes at odds with each other. Successful lake management requires an understanding of the current ecological and recreational conditions of a lake, as well as how those conditions change over time. The LakeScan™ program combines a detailed data collection methodology with mapping capabilities and whole-lake analysis metrics backed by scientific literature. This analysis allows lake managers to identify successful lake management activities and highlight potential issues requiring intervention. Appropriately targeted aquatic plant suppression can minimize weedy and nuisance species while allowing beneficial species to flourish at ecologically balanced levels supporting healthy lake conditions. This kind of adaptive management system provides a scientifically sound and consistent methodology to better manage lake ecological and recreational conditions.

The LakeScan™ analysis involves collecting data over two vegetation surveys during the critical summer recreational season. These surveys are based on a system where the lake is first divided into vegetation growth areas based on bathymetry then further subdivided into Aquatic Resource Observation Sites (AROS; Figure 1). AROS numbers on Cedar Lake are represented with 300s at the shoreline, 400s off the shoreline, and 500s in excavated trenches or holes.

For each survey, field personnel record the density, distribution, and position in the water column of each aquatic plant species in each AROS, as well as noting any nuisance conditions. Dissolved oxygen profiles, temperature profiles, and Secchi depth are additionally recorded. Other water quality sampling can be included under an additional scope as requested.

Aquatic plant communities change over the course of a year, so the surveys are split into early and late-season observations. Early-season surveys are scheduled with the goal of taking place within 14 days of early-summer treatments to best observe treatment-targeted and non-targeted vegetation. Late-season surveys are scheduled to occur roughly two months after the early-season survey. However, this scheduling is subject to timing of treatments, weather, and times of increased boat activity.

Figure 1 - Map of Aquatic Resource Observation Sites (AROS).

2.0. Lake and Watershed Characteristics

Knowing the characteristics of a lake and its associated watershed can inform key management considerations, including runoff concerns, nutrient loading, and algal bloom risk. K&A compiles lake and watershed characteristics for each LakeScan™ lake to display the hydrological and physiological factors that are at play when managing a lake ecosystem. Lake and watershed characteristics of Cedar Lake are listed below. Further information regarding the watershed of Cedar Lake can be found within the watershed management plan, updated in 2025.[2]

Location

County: Alcona and Iosco

Townships: Greenbush and Oscoda

Township/Range/Section(s): T25N and T24N, R9E Sections: 15, 22, 27, 34, and 3

GPS Coordinates: 44.528853, -83.331903

Morphometry

Approximate Lake Area: 910 acres (for North Cedar Lake)

Shoreline Length: 47,339 feet

Maximum Depth: 10 feet

Average Depth: 5 feet

Administrative Management

Management Authority: Cedar Lake Improvement Board

Years in LakeScan™ Program: 2003 to present (22 years)

2.1. Algal Bloom Risk Level

K&A calculates an algal bloom risk level for each LakeScan™ lake based on the characteristics of its watershed. Phosphorus is the limiting nutrient that drives algal blooms and agricultural and urban land uses typically contribute more phosphorus to receiving waters than grasslands or forested land uses. Therefore, lakes with watersheds that have high proportions of agricultural and urban land uses are more likely to be at risk of algal blooms.

Not all algal blooms contain blue-green algae (cyanobacteria) and their associated toxins, which can make an algal bloom harmful for human use (referred to as a Harmful Algal Bloom or HAB). Some green algae for instance are considered benthic, or bottom dwelling, but becomes apparent in the spring as

[2] Cedar Lake Watershed Management Plan 2025 Update. Accessed online: https://cedarlakewmp.net/

they rise off the bottom due to increased water temperatures. These rising benthic algae mats can be an aesthetic nuisance but typically do not cause human health concerns like HABs.

Based on watershed land-use and reporting in the watershed management plan,[2] the algal bloom risk for Cedar Lake North is: **Low.** This risk is a reflection of the summary of watershed land-use composition for Cedar Lake North, which has minor inputs from urban and agricultural sources.

3.0. Dissolved Oxygen and Temperature Profiles

During each survey, Secchi depth, dissolved oxygen and temperature data are collected. Secchi disk transparency is the depth at which a Secchi disk (a flat white or black and white platter, approximately 20 centimeters in diameter) suspended into a lake disappears from the investigator's sight. In general, the greater depth at which the Secchi disk can be viewed, the lower the productivity of the water body. Secchi depth readings of greater than 15 feet can be indicative of low productivity or oligotrophic conditions.[3] Some variation in Secchi disk reporting may be a result of cloud cover, time of day, recent rain events, and recreational lake usage. Dissolved oxygen levels and temperature were measured by K&A using a YSI ProSolo dissolved oxygen meter, calibrated prior to use.

A sufficient supply of dissolved oxygen (DO) in lake water is necessary for most forms of desirable aquatic life. Colder waters contain more dissolved oxygen than warmer waters. In highly productive lakes, oxygen depletion can occur in deeper, unmixed bottom waters during warmer summer months. This decrease in oxygen is due in part to dead algae and other organic matter, such as leaves, grass and plant debris settling to the bottom of the lake and getting consumed, along with oxygen, by organisms in the sediment. DO depletion is most often observed in lake bottom waters during periods of temperature stratification in warmer summer months and, to a lesser degree, under winter ice cover conditions. Shallow lakes, like Cedar Lake, may not experience stratification and would not be expected to have as notable of oxygen depletion in the lake bottom waters compared to deeper bodies of water.

Secchi disk clarity on Cedar Lake North decreased from 7.3 ft to 6.5 ft between the early and late-season surveys. This decrease in water clarity could likely be attributed to a slight increase in lake productivity later in the growing season, wave and sunlight conditions, and/or an increase in turbidity caused by sediment disturbance from swimming, boating, and other recreational activities increasing throughout the summer. The DO and temperature profiles remained consistent across the two surveys with no notable stratification (Figures 2 and 3). This is to be expected due to the shallow depths of the lake. The only notable difference between the two profiles was the 5 °C lower temperatures observed in the late-season.

[3] US Geological Survey. 2012. "Water Quality Characteristics of Michigan's Inland Lakes, 2001-10." Scientific Investigations Report 2011–5233. Available online at: https://pubs.usgs.gov/sir/2011/5233/.

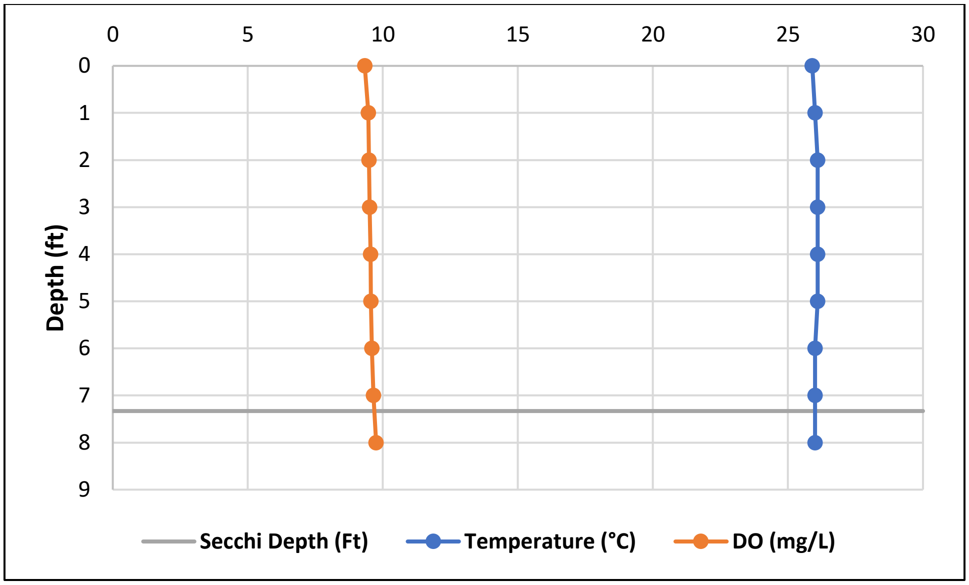


Figure 2 – Early-season survey (7/2/25) dissolved oxygen and temperature profiles with Secchi depth.

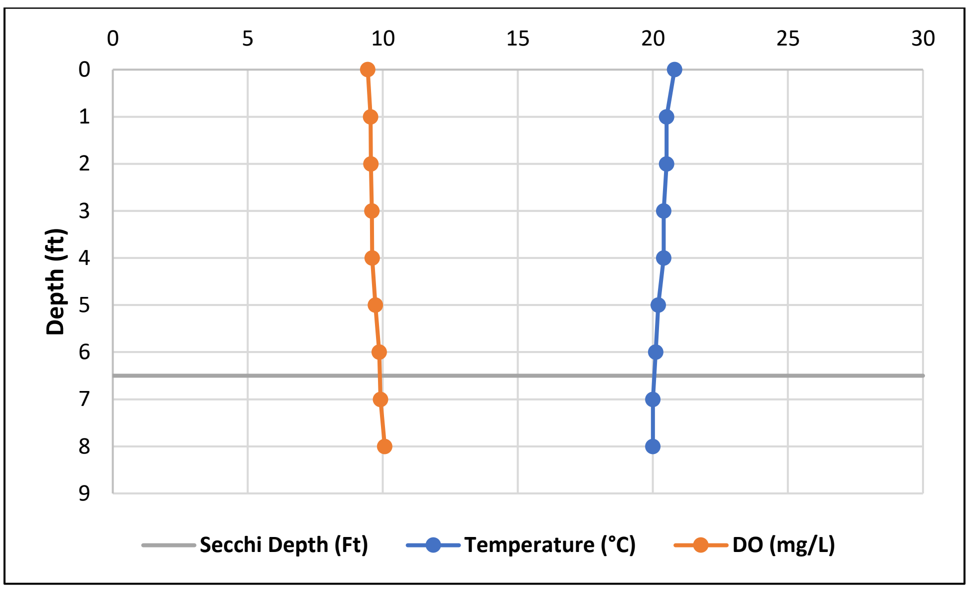


Figure 3 – Late-season survey (8/27/25) dissolved oxygen and temperature profiles with Secchi depth.

4.0 Aquatic Vegetation

4.1 Early-season Survey

The Cedar Lake North early-season LakeScan™ survey was conducted on July 1 and 2, 2025. The weather throughout the survey was mostly sunny with temperatures around 78°F and gentle northwestern winds at 4 mph. Visibility in the water column was good with a Secchi Disk reading of 7.3 feet.

The most common native species observed during the survey were *Chara*, broadleaf pondweed, rush, and Richardson's pondweed. *Chara* was the most commonly observed species and was found at moderate to high densities throughout a majority of observation areas and was noted causing recreational nuisance concerns in AROS 358 and 357 where the species was growing to the surface with green filamentous algae. Water quality samples in these AROS locations were collected during the survey to provide insights into possible nutrient loading concerns. *Chara* was also observed bubbling to the surface in AROS 567, likely caused by rising gas or another water column disturbance.

Broadleaf pondweed and Richardson's pondweed were observed at moderate densities around the lake, often flowering, but typically not dense enough to cause any nuisance concerns. In some shoreline and nearshore AROS, flowering pondweeds may have caused some minor recreational nuisance conditions, but were expected to likely drop from the water column after flowering. Vegetation growth was the densest in the excavated trenches (#500 AROS) which were typically dominated by *Chara*, American elodea (*Elodea sp.),* naiad (*Najas sp.),* sago pondweed (*Stuckenia pectinatus*), and Richardson's pondweed (Figure 4). Variable-leaf watermilfoil, which has caused nuisance concerns on the lake in the past, was noted sporadically across the northern portion of the lake in low densities (Figure 5).

The only submerged aquatic invasive species observed in Cedar Lake North during the 2025 early-season survey was hybrid Eurasian watermilfoil. Hybrid Eurasian watermilfoil was found in single stand-alone clusters in AROS 370 and 379-381. In AROS 379-381 the milfoil appeared to be advancing shoreward out of the AROS 579-580 trench. Eurasian watermilfoil was additionally found in the trenches along the western portion of the lake (AROS 566, 567, 574, 575, 577, 579, 580, 582, 583; Figure 6). It is important to note that these observations occurred before the first herbicide application of the year, so treatment impacts on the species were not yet observed.

The emergent wetland invasive species purple loosestrife was found in scattered patches in AROS 307, 332, 352-354, 392, and 399, not causing management concerns at the time of the survey (Figure 7). No observations of *Phragmites (Phragmites australis)* could be reasonably identified from the boat survey.

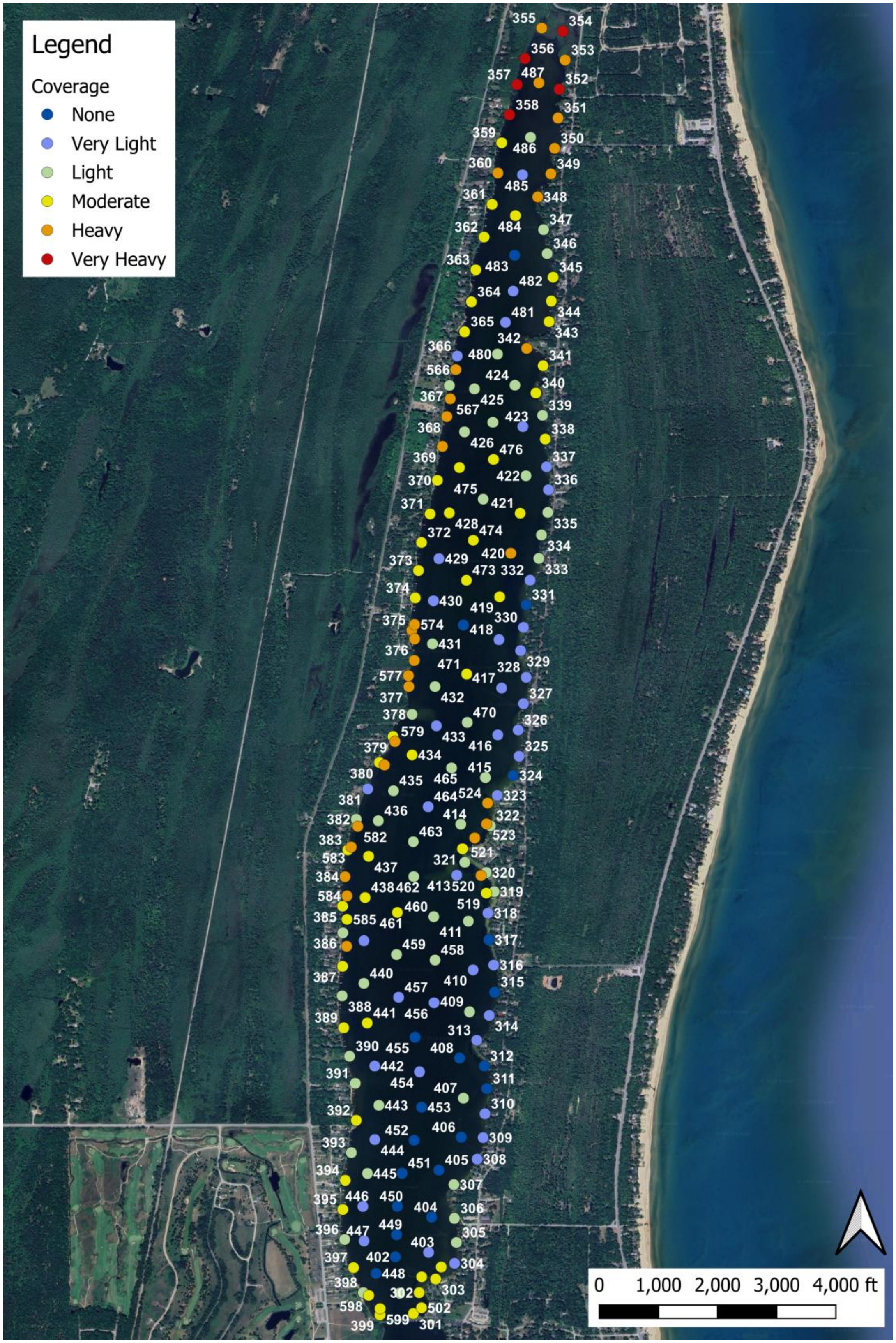


Figure 4 – Early-season survey (7/2/25) vegetation 3D Density (a function of observed vegetation coverage, and height of all vegetation species).

Figure 5 – Early-season (7/2/25) Variable-leaf watermilfoil coverage (a combination of the LakeScan™ density and distribution observations).

Figure 6 – Early-season (7/2/25) hybrid Eurasian watermilfoil coverage.

Figure 7 – Early-season (7/2/25) purple loosestrife coverage.

4.2. Late-Season Survey

The Cedar Lake North late-season LakeScan™ survey was conducted on August 26 and 27, 2025. The weather throughout the survey was mostly sunny with temperatures around 70 °F and gentle southwestern winds around 5-10 mph. Visibility in the water column was good with a Secchi Disk reading of 6.5 feet.

The most common native species observed during the survey were *Chara*, variable pondweed, naiad, rush, and wild celery. *Chara* was the most commonly observed species and was found at moderate to high densities throughout a majority of observation areas. Unlike in the early season survey, *Chara* was not noted causing recreational nuisance concerns at any location in the lake. At AROS 358 and 357 the species was again growing densely and nearly to the surface, but lacked the green filamentous algae observed in July. Water quality samples in these areas were again collected as a part of a broader water quality investigations. Summaries of water quality investigations performed in the area can be found on the Cedar Lake Watershed Management Plan website.[4]

Variable pondweed, wild celery, and Richardson's pondweed were commonly found flowering throughout the lake which were noted as possible sources of minor recreational nuisance concerns; however, the species were again expected to likely to drop from the water column after flowering. Vegetation growth was again the densest in the excavated trenches (#500 AROS) which were typically dominated by *Chara*, naiad (*Najas sp.),* and Richardson's pondweed (Figure 8). Variable-leaf watermilfoil was found scattered in the northern portion of the lake in a similar distribution as the early-season survey (Figure 9).

The only submerged aquatic invasive species observed in Cedar Lake North during the 2025 late-season survey was hybrid Eurasian watermilfoil. Hybrid Eurasian watermilfoil was found widely distributed in AROS 566 and 577 (the northernmost trench "Trench 1") and AROS 579 and 580 ("Trench 3"). These trench locations were included in the July 8, 2025 treatments. Outside of the trenches, Eurasian watermilfoil was found in AROS 367 and 357 as single stalks (Figure 10).

The emergent wetland invasive species purple loosestrife was found in scattered patches across the shoreline and was the densest in the natural shoreline areas at AROS 391 and 340 (Figure 11). Observations of *Phragmites* were made in AROS 377 and 361 (Figure 12). A suspected stalk of *Phragmites* was observed at AROS 343 but could not be reasonably identified from the boat.

[4] Cedar Lake Nearshore Sampling Summary and Final Nearshore Monitoring Final Technical Memorandum accessed online: https://cedarlakewmp.net/monitoring-reports

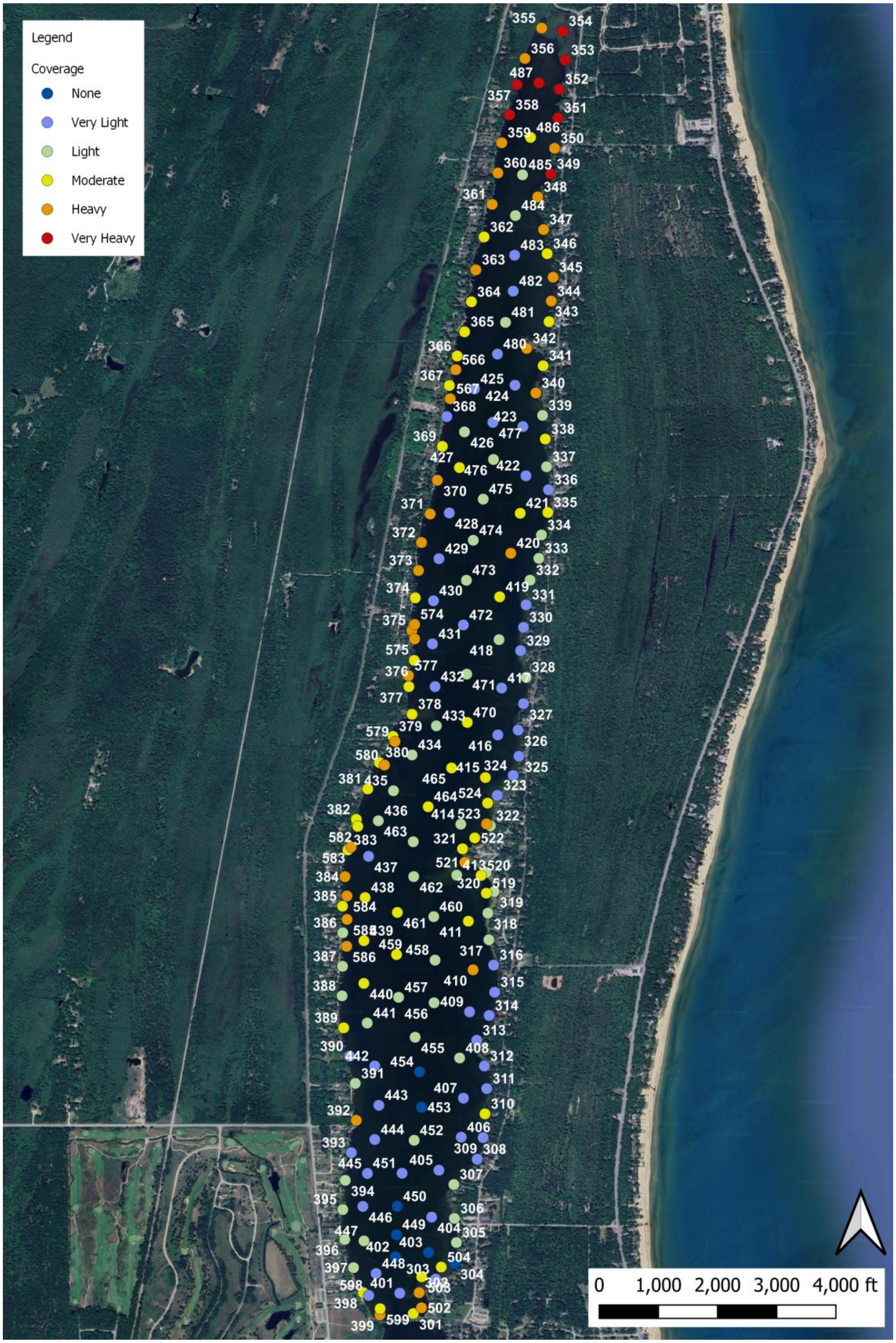


Figure 8 – Late-season survey (8/26-27/25) vegetation 3D Density (a function of observed vegetation coverage, and height of all vegetation species).

Figure 9 – Late-season (8/26-27/25) variable-leaf watermilfoil coverage (a combination of the LakeScan™ density and distribution observations).

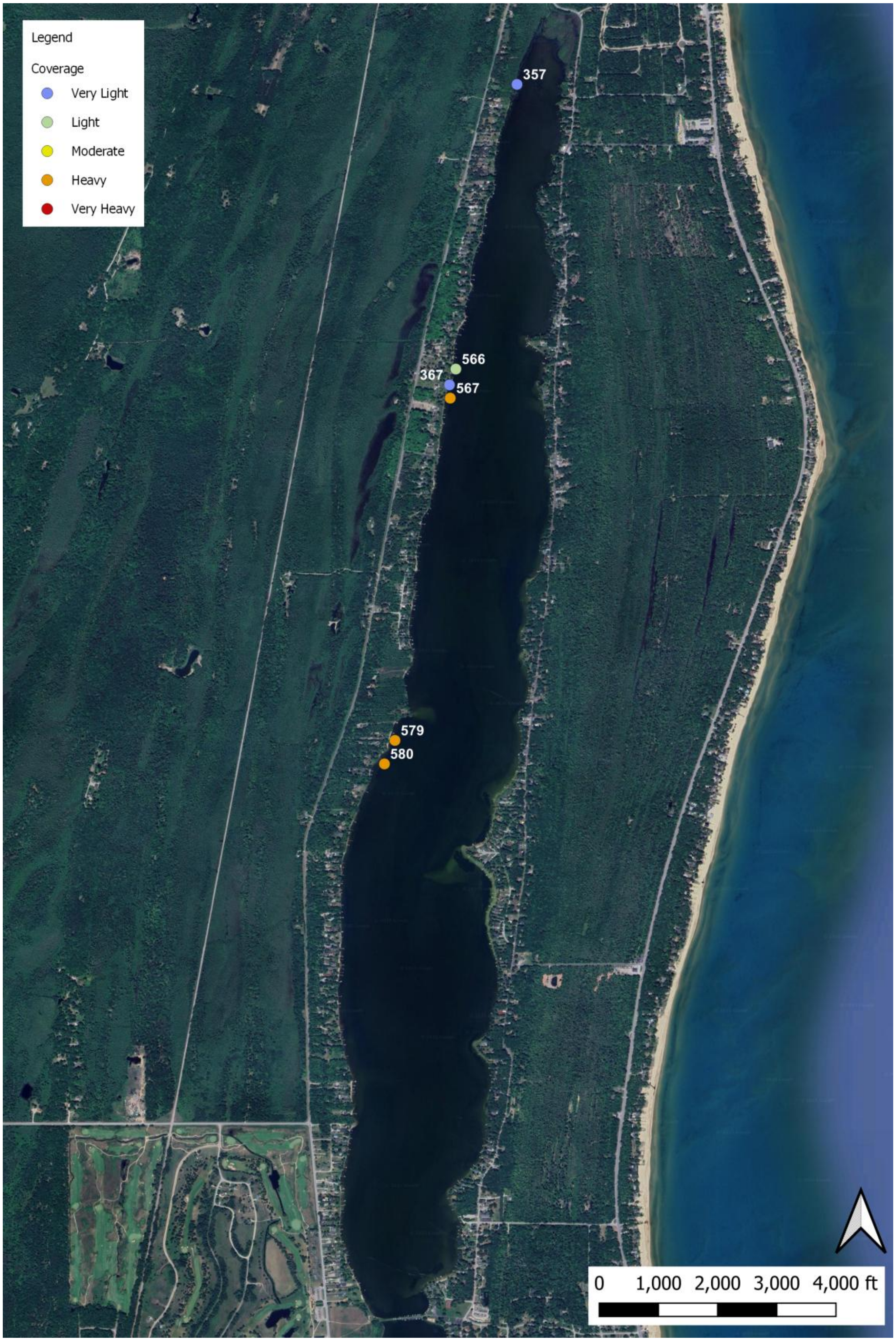


Figure 10 – Late-season (8/26-27/25) hybrid Eurasian watermilfoil coverage.

Figure 11 – Late-season (8/26-27/25) purple loosestrife coverage.

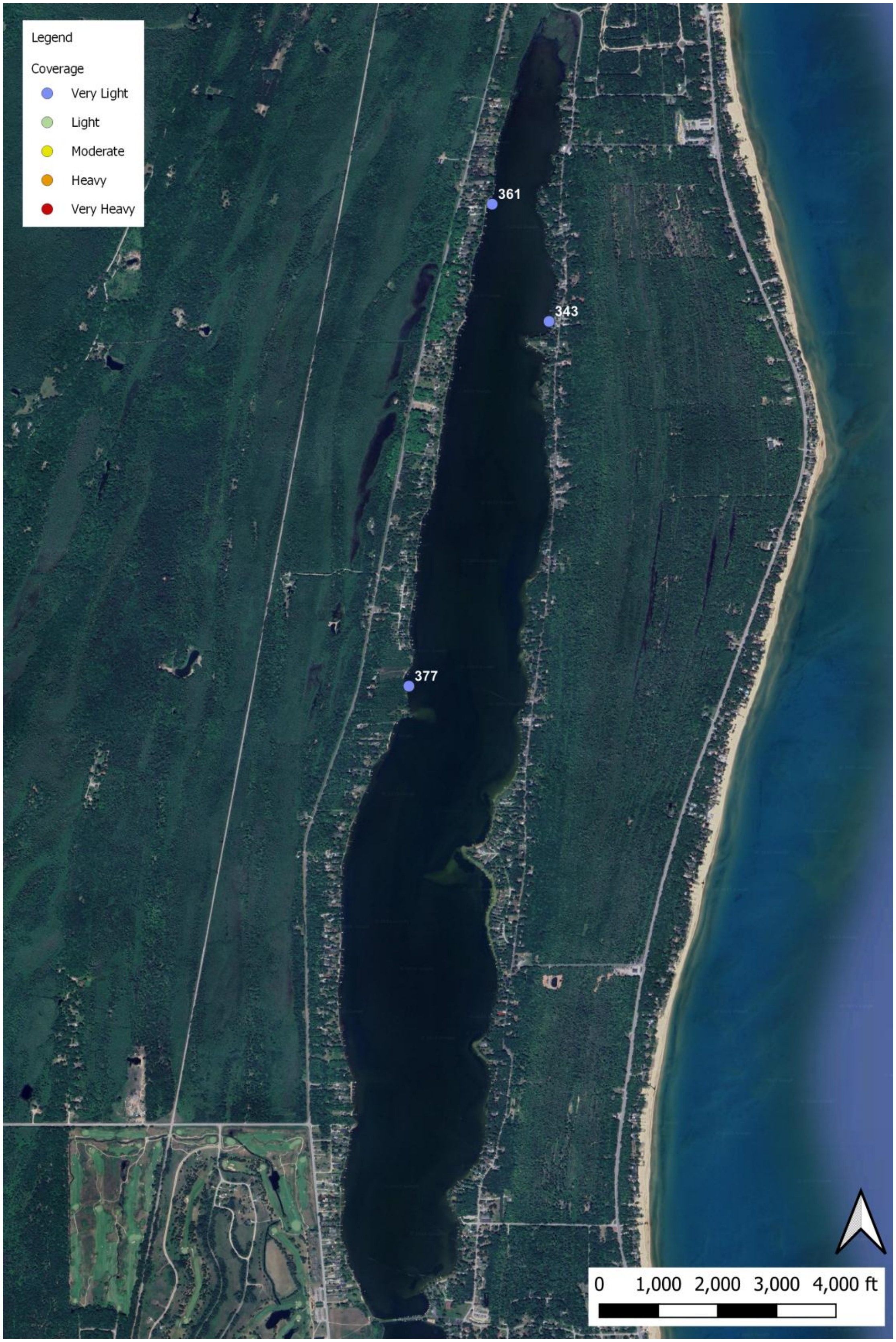


Figure 12 – Late-season (8/26-27/25) Phragmites *coverage.*

4.3. Summary Observations for Early and Late-Season Surveys

All aquatic plant species observed during the 2025 vegetation surveys were paired with their associated C-value and recorded for frequency, coverage, and dominance (Table 1). The Coefficient of Conservation, or C-Value, is a qualitative value ranging from 0 to 10 that is assigned to each species representing the estimated probability that it is likely to occur in a landscape. A C-value of 0 is given to plants that may be found almost anywhere, while a C-value of 10 is applied to plants that are almost always restricted to high-quality natural areas.[5] 'Frequency' represents the percentage of survey sites (AROS) where a given species was found. 'Coverage' represents the spatial cover observed for each species, represented as a percentage of available area. 'Dominance' represents the degree to which a species is more numerous than its competitors.

Table 1 - Aquatic Plant Species Observed in 2025.

Common Name	C-Value	Frequency (%)		Coverage (%)		Dominance (%)	
		Early 2025	Late 2025	Early 2025	Late 2025	Early 2025	Late 2025
Eurasian Watermilfoil Hybrid	0	6.4	3	0.8	0.9	1.4	1.3
Purple Loosestrife	0	3.5	11.9	0.2	0.8	0.4	1.2
Phragmites	0	0	1.5	0	0.1	0	0.1
Variable-leaf Watermilfoil	6	3.5	4.5	0.3	0.6	0.6	0.9
Common Bladderwort	6	12.4	21.3	1	1.5	1.7	2.1
Elodea	3	14.9	0.5	3.2	0.1	5.6	0.1
Naiad	6	17.8	46	2.7	10.3	4.7	14.9
Chara	7	77.7	95	17.3	20.3	29.9	29.4
Flat Stem Pondweed	5	1.5	1.5	0.2	0.1	0.3	0.2
Swamp Loosestrife	7	1.5	0	0.1	0	0.2	0
Richardsons Pondweed	5	30.7	25.2	7.1	7.6	12.2	11
Variable Pondweed	5	51.0	66.8	6.2	9.8	10.8	14.3
Illinois Pondweed	5	0	0.5	0	0	0	0
White Stem Pondweed	8	0.5	0	0.1	0	0.1	0
Broadleaf Pondweed	6	53.5	0	6.7	0	11.5	0
Sago Pondweed	3	9.9	5	1.6	1.2	2.8	1.8
Thin Leaf Pondweed	4	2	0	0.2	0	0.4	0
Wild Celery	7	4	27.2	0.6	4.9	1	7.1
Rush	8	32.7	31.2	2.5	2.4	4.3	3.5
Waterlily	6	19.8	23.8	3.2	5.4	5.5	7.8
Pygmy Waterlily	6	1	0	0.1	0	0.1	0
Spatterdock	7	14.4	6.4	2.5	1.4	4.3	2.1
Pickerelweed	8	5.9	5	0.6	0.6	1.1	0.8
Iris	5	2	0.5	0.2	0	0.3	0
Cattail	1	5.9	8.9	0.6	1	1	1.4

[5] Michigan Department of Natural Resources Wildlife Division. (n.d.). Floristic Quality Assessment with Wetland Categories and Examples of Computer Applications for the State of Michigan.

4.4. LakeScan™ Metrics

Six important metrics for defining lake conditions are included in the LakeScan™ analyses, where early and late-season scores are averaged for a yearly score and compared against a management goal for each metric (Table 2). Management goals are based on median Michigan lake values (Shannon biodiversity index and Shannon morphology index), scientific literature (floristic quality index), and professional judgement (recreational nuisance presence and algal bloom risk). Green shading in Table 2 represents scores meeting management goals, while yellow shading represents scores needing improvement. Descriptions of each of the six metrics are detailed below:

- **Species Richness** – the number of aquatic plant species present in the lake. More species are generally indicative of a healthier ecosystem, but not all species are desirable.
- **Shannon Biodiversity Index** – a measure of aquatic plant species diversity and distribution evenness, indicative of the stability and diversity of the plant community. Also known as the Shannon Expected Number of Species.[6]
- **Shannon Morphology Index** – a measure of aquatic plant morphology type diversity and distribution evenness, indicative of fish and macroinvertebrate habitat quality. This is calculated using morphology types instead of species.
- **Floristic Quality Index**[7] – a measure of the distribution of desirable aquatic plants. This index is used by Midwestern states for aquatic habitats, with higher scores indicative of increased biodiversity and a positive ratio of desirable versus undesirable aquatic plant species.
- **Recreational Nuisance Presence** – the percentage of survey sites that identified aquatic plants inhibiting recreational activities.
- **Algal Bloom Risk** – a calculated algal bloom risk level based on the characteristics of the lake watershed. Lakes with watersheds that have high proportions of land in agricultural and urban land uses are more likely to be at risk of algal blooms because these land uses contribute more phosphorus to receiving waters than grasslands or forests.

Table 2 – 2025 LakeScan™ Metric Results.

LakeScan™ Metric	Score Range	2025 Early Season	2025 Late Season	2025 Average	Management Goal
Species Richness	5 - 30	23	20	21.5	n/a
Shannon Biodiversity Index	1 -15	10.4	8.9	9.7	> 9.4
Shannon Morphology Index	1 - 10	9.0	7.9	8.5	> 6.4
Floristic Quality Index	1 - 40	27.9	26.6	27.3	> 20
Recreational Nuisance Presence	0 - 100%	1%	1%	1%	< 10%
Algal Bloom Risk	Low - High	n/a	n/a	Low	Low

*n/a = not applicable

[6] Hill, M. O. (1973). Diversity and evenness: a unifying notation and its consequences. *Ecology*, 54(2), 427-432.
[7] Nichols, S. A. (1999). Floristic quality assessment of Wisconsin lake plant communities with example applications. *Lake and Reservoir Management*, 15(2), 133-141.

All metrics for Cedar Lake North met the optimal management goals across both surveys in 2025, except the Shannon biodiversity index in the late-season survey which just slightly missed the optimal management goal of 9.4. All metrics besides the recreational nuisance presence declined slightly between the early and late-season surveys indicating a drop-off in species diversity later in the growing season. These declines are to be expected due to the seasonality of Michigan inland lake species. The average LakeScan™ scores in 2025 improved in species richness, the floristic quality index, and in recreational nuisance presence from conditions surveyed in 2024, demonstrating improving lake trends over time. Overall, conditions in Cedar Lake North appear stable and favorable for fish and macroinvertebrates on a year-to-year scale.

2025 marked the highest FQI score on Cedar Lake North since 2022, indicating improving trends in the ratio between native and invasive species in the lake (Figure 13). Cedar Lake North has met the FQI management score of 20 for the past the last five years, displaying a high level of floristic quality that is being maintained from year-to-year by the current management regimen.

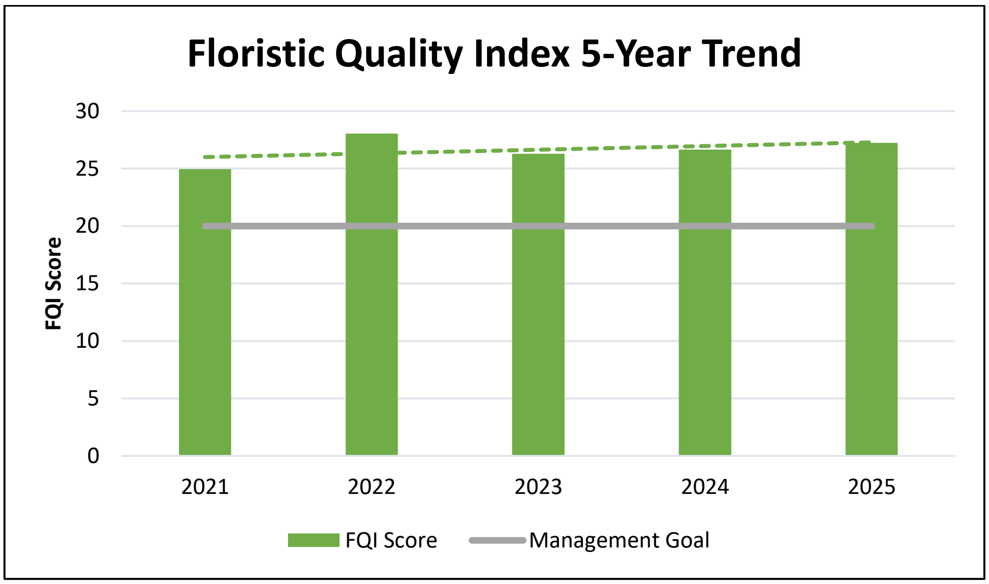


Figure 13 – Floristic Quality Index 5-Year Trend.

Over the last five years, coverage of variable-leaf watermilfoil has exhibited a notable declining trend. Coverage of Eurasian watermilfoil, purple loosestrife, and *Phragmites* have, however, exhibited increasing trends (Figure 14). Coverage of variable-leaf watermilfoil decreased by 3% since 2021, remaining consistently under 1% coverage across the last three years. Invasive Eurasian watermilfoil coverage has remained consistently under 1% over the past five years, but the species increased in coverage by 0.6% in the last year, and was at its highest observed average coverage since 2019. It is important to note that the early-season survey occurred before the first treatment, which could have influenced the increase in coverage observed in 2025. If Eurasian watermilfoil coverage continues to increase in future surveys, alternative management options may need to be explored. Although the trendlines indicate coverage increases, purple loosestrife and *Phragmites* have remained at relatively low coverages with purple loosestrife declining 0.5% from 2024 and *Phragmites* having almost negligible coverage of 0.05% across the last two years.

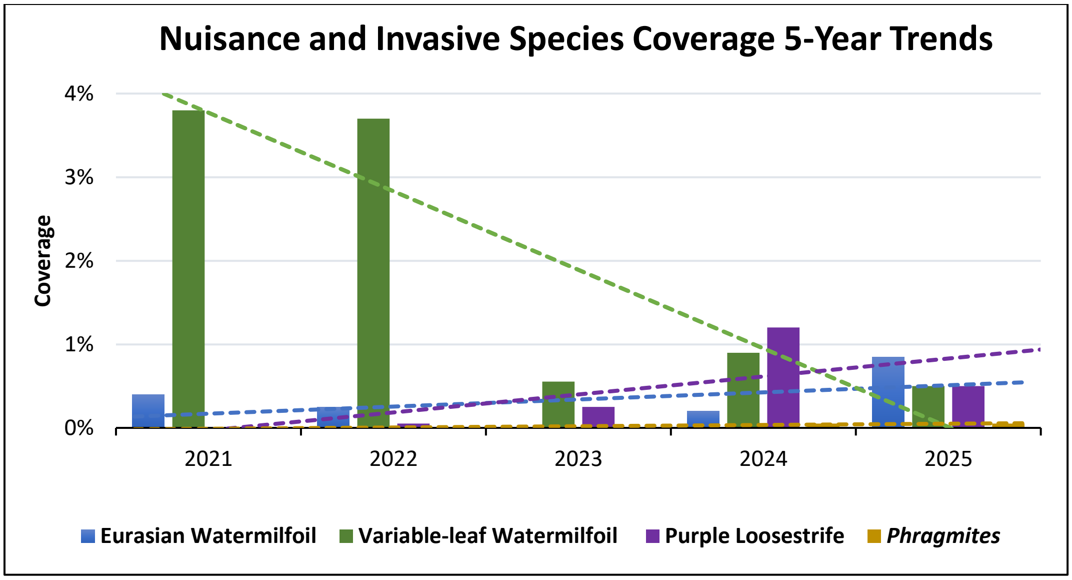


Figure 14 – Nuisance and invasive species average yearly coverage 5-year trends.

5.0. Lake Management

There are several species that typically become a nuisance in Michigan's inland lakes during the summer growing season. These species are usually targeted for selective control to prevent them from becoming an aesthetic or recreational nuisance and to protect desirable plants that are part of healthy lake ecosystems. More information on common nuisance species in Michigan and their associated management options can be found in Appendix A.

The first treatment on Cedar Lake North occurred on July 8, 2025 targeting 15 acres of Eurasian watermilfoil along five trenches on the western edge of the lake. The treatment was performed by SOLitude Lake Management using Tribune, Aquathol K, Stingray and Cutrine-Plus. A follow-up treatment was performed on September 18, 2025 targeting 3.75 acres of Eurasian watermilfoil re-treatment in two trenches. The treatment used the same chemical herbicide combination as the first treatment. Treatment data and maps provided by SOLitude Lake Management in 2025 are available in Appendix B.

In addition to the submerged aquatic species, a treatment on *Phragmites* was also performed on September 18, 2025. The treatment targeted three shoreline areas where *Phragmites* was found during the late-season survey (AROS 361, 343, and 377). An off-lake area of *Phragmites* was additionally targeted near Kings Corner Road, but the area is not included in routine K&A lake monitoring. No information of the *Phragmites* treatment was made publicly available or directly supplied to the Lake Board. Aquatic Nuisance Control (ANC) permits submitted to the state only require the submission of *Phragmites* treatment data if the species was treated in standing water. A conversation with the applicator from SOLitude who performed the application, indicated that the treatment used a combination of Aquaneat, Habitat, and Cygnet Plus. In absence of publicly available documentation, maps supplied by K&A and the Lake Board for *Phragmites* treatment are included in Appendix B.

Each species of interest on Cedar Lake North increased in coverage from the early-season to the late season survey (Figure 15). The increase in Eurasian watermilfoil across the two surveys may indicate that management activities conducted on Cedar Lake in 2025, may not have had a high level of treatment efficacy. This was also made evident by the persistence of Eurasian watermilfoil in the trenches that had been treated on July 8, 2025. No management actions were taken on the Variable-leaf watermilfoil, purple loosestrife, or phragmites prior to the surveys, so increases in species coverage could be attributed to higher plant productivity later in the growing season or the species becoming more conspicuous during the late-season survey as they flower.

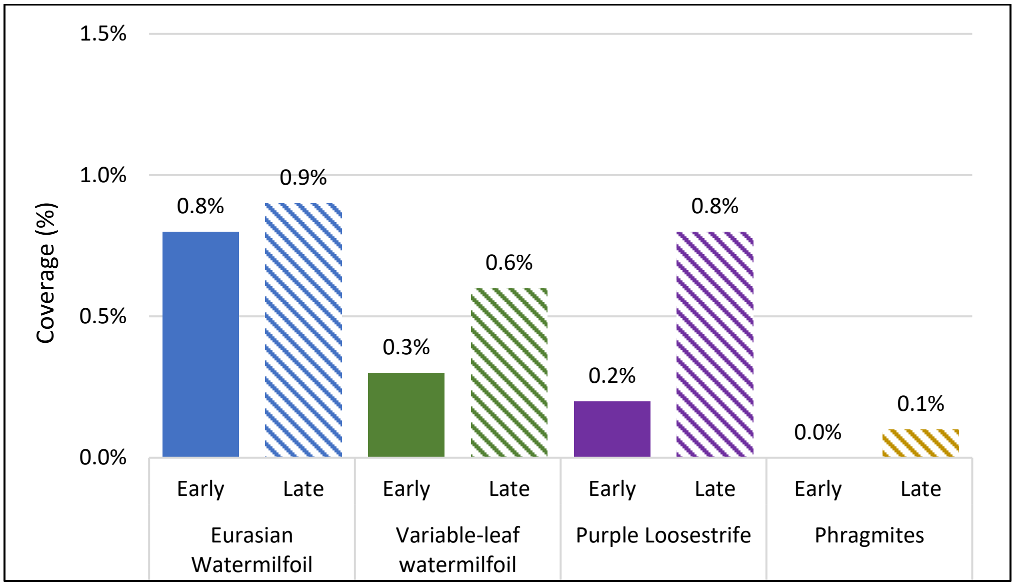


Figure 15 – Changes in 2025 coverage across both surveys for targeted species.

5.1. Management Recommendations

Eurasian watermilfoil coverage has remained under 1% in across the last 3 years, indicating that although there have been some minor coverage increases, current management interventions appear to be effective at suppressing growth and reducing the cumulative coverage of nuisance presence on a broader temporal scale. Despite less than 1% coverage in 2025, Eurasian watermilfoil displayed a slight increase in coverage over the past year, indicating the possibility of species rebound. A late-season rebound of Eurasian watermilfoil was also observed in the trenches following treatment. Based on these observations, it is recommended that the Cedar Lake Improvement Board explores management options similar to the ones implemented in 2024 where Eurasian watermilfoil was less evident in the trenches following treatment.

In previous years, ProcellaCOR applications in Cedar Lake North appeared to have been an effective strategy for the management of nuisance hybrid Eurasian watermilfoil. However, applications in 2025 did not include ProcellaCOR and post-treatment rebound of the species was observed in the trenches, indicating that the herbicide combination used in 2025 may be less effective than what has been used previously on the lake.

Dense *Chara* growth was observed around Jones Ditch in both the early and late-season surveys in 2025 indicating nutrient loading concerns, with early-season survey observations including heavy filamentous green algae growth. Upon these observations, K&A began investigating the site for water quality conditions. It is recommended that these water quality investigations continue in 2026 to best understand nutrient loading concerns in the area and implement possible solutions. These would be separate from the LakeScan™ survey scope.

It will be crucial to monitor and document *Phragmites* coverage in Cedar Lake North following the treatment on September 18, 2024. Close monitoring will reveal the effectiveness of the treatment and inform if follow-up treatments are warranted. An additional on-the-ground survey of the treated areas might be pursued by the lake board to achieve reliable and accurate monitoring data on *Phragmites* populations across the landscape opposed to only along the shoreline. Given an increasing shoreline distribution of purple loosestrife (though lower in 2025 than 2024), it is recommended that the lake board consider the use of biocontrols over a few seasonal applications to manage the spread of the species following 2026 survey observations.

6.0. Appendices

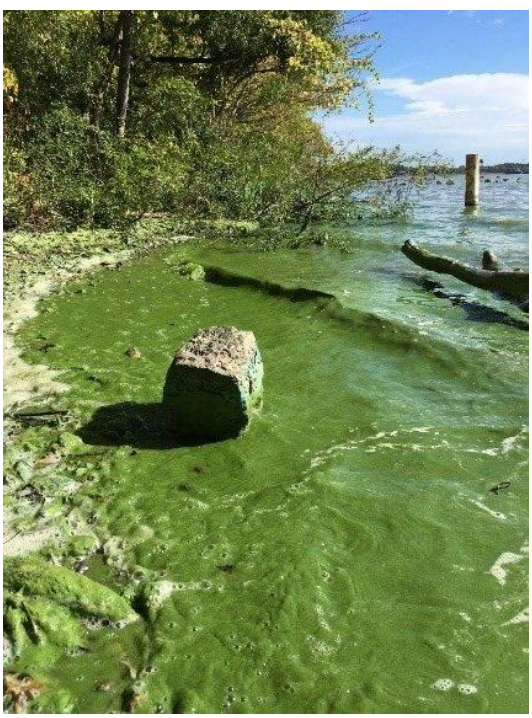
6.1. Appendix A: Information About Nuisance and Aquatic Invasive Species

Blue-green Algae

Background: Blue-green algae blooms can appear as though green latex paint has been spilled on the water, or resemble an oil slick in enclosed bays or along leeward shores (Figures A1 and A2). These blooms are usually temporal events and may disappear as rapidly as they appear. Blue-green algae blooms are becoming more common for a variety of reasons; including nutrient loading, septic system leaching, and warmer water temperatures.

Blue-green algae are a form of bacteria known as cyanobacteria, studies have revealed that substances made and released into the water by some of these nuisance algae can be toxic or carcinogenic. They are known to have negative impacts on aquatic ecosystems and can potentially poison and sicken pets, livestock, and wildlife. People can be exposed to the phytotoxins by ingestion or dermal absorption (through the skin). They can also be exposed via inhalation of aerosols created by overhead irrigation, strong winds, and boating activity.

It is recommended that persons not swim in waters where blue-green algae blooms are conspicuously present. Specifically, people should avoid contact with water where blooms appear as though green latex paint has been spilled on the water, or where the water in enclosed bays appears to be covered by an “oil slick”. Pets should be prevented from drinking tainted water. Since blue-green algal toxins can enter the human body through the lungs as aerosols, it is suggested that water containing obvious blue-green algae blooms not be used for irrigation.



Figures A1 & A2 - Example of blue-green algal blooms taken by K&A field crews in 2020 (left) and 2019 (right).

Blue-green algae typically bloom and become a nuisance when resources are limiting or when biotic conditions reach certain extremes. Some of the reasons that blue green algae can bloom and become noxious are listed below:

TP and TN: The total phosphorus (TP) concentration in a water resource is usually positively correlated with the production of suspended algae. Very small amounts of phosphorus may result in large algae blooms. If the ratio of total nitrogen (TN) to total phosphorus is low (<20), suspended algae production may become nitrogen limited and noxious blue-green algae may dominate a system because they are able to "fix" their own nitrogen from atmospheric sources. Other common and desirable algae are not able to do this.

Biotic Factors: Zebra mussels and zooplankton (microscopic, free-floating animals) are filter feeding organisms that strain algae and other substances out of the lake water for food. Studies have shown that filter-feeding organisms often reject blue-green algae and feed selectively on more desirable algae. Over time, and given enough filter feeding organisms, a lake will experience a net loss in "good" algae and a gain in "bad" blue-green algae as the "good" algae are consumed and the "bad" algae are rejected back into the water column.

Management*:* Treatment methods for blue-green algae are generally preventative rather than reactionary. One of the most common forms of algae treatment is limiting nutrients, namely phosphorus, from entering the lake ecosystem through several sources. Phosphorus mainly enters lake systems through surface water inputs such as rivers, creeks, or overland runoff. In some inland lakes that experience late-summer stratification, sediment-bound phosphorus at the lake bottom becomes mobilized due to low-oxygen conditions which, under high sustained wind conditions, can mix surface and bottom waters. This is particularly problematic in the late summer. Phosphorus-reducing practices include: implementing Best Management Practices (BMPs) in upstream agricultural and urban areas, limiting nutrient (fertilizer) applications on lawns, planting vegetative buffer strips between nutrient-producing areas and surface water, reducing septic system leaching (if riparian homes are not sewered), binding lake-bottom phosphorus using alum or other adsorbent materials (e.g., Phoslock®), and treating/infiltrating stormwater prior discharge into upstream surface waters of the lake.

Research has shown that water circulation devices such as bubblers or aeration systems may limit the viability of blue-green algae over native algae species as well.[8] Blue-green algae are more buoyant than native algae species and often float to the water's surface during quiescent conditions to increase the amount of sunlight needed for photosynthesis. Circulation systems disturb the water column and eliminate this evolutionary advantage portrayed by blue-green algae. The intended result is a shift from a blue-green algae dominated community to a mix of green algae species. When nuisance conditions occur, contact algaecides or hydrogen peroxide may be used as a reactionary treatment to destroy algae cells present in the water column. However, chemicals should be applied with caution due to concerns of bioaccumulation and toxicity to other forms of aquatic life. Moreover, chemical applications will often need to 'chase' blooms that can be pushed to different areas of the lake with prevailing winds.

[8] Pastorok, R., T. Ginn, AND M. Lorenzen. Evaluation of Aeration/Circulation as a Lake Restoration Technique. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/3-81/014 (NTIS PB81191884), 1981.

Hybrid Eurasian Watermilfoil

Background: Anecdotal evidence suggests that hybrid milfoil has been found in Michigan inland lakes since the late 1980's. Experience has proven that it is usually not possible to determine whether the milfoil observed is either Eurasian or hybrid genotype based on phenology alone (Figures A3 and A4). However, because they play such similar roles in lake ecology, they are simply "lumped together" and referred to collectively as hybrid Eurasian watermilfoil.

Management: Lake disturbance, such as weed control, unusual weather, and heavy lake use can destabilize the lake ecosystem and encourage the sudden nuisance bloom of weeds, like Eurasian watermilfoil. Eurasian watermilfoil is a threat to the stable biological diversity of the lake ecosystem. Species selective, systemic herbicide combinations have been used to suppress the nuisance production of Eurasian watermilfoil and support the production of more desirable flora. However, the species is becoming more resistant to herbicidal treatments. Herbicide resistant Eurasian watermilfoil and hybrid watermilfoil have been observed in many lakes throughout the Midwest.[9,10] Continued chemical applications can select for herbicide resistant plants, resulting in hybrid watermilfoil.[11] Some research suggests this resistance can be counteracted with the use of microbiological system treatments. Eurasian watermilfoil community genetics are dynamic and careful monitoring is needed to adapt to the expected changes in the dominance of distinct Eurasian watermilfoil genotypes. Some of these genotypes may be more herbicide resistant than others and treatment strategies must be adjusted to remain effective in different parts of the lake.


Figures A3 & A4 - Examples of Hybrid Eurasian Watermilfoil taken by K&A field staff in 2019.

[9] Berger, S. T., Netherland, M. D., & MacDonald, G. E. (2015). Laboratory documentation of multiple-herbicide tolerance to fluridone, norflurazon, and topramazone in a hybrid watermilfoil (*Myriophyllum spicatum× M. sibiricum)* population. Weed Science, 63(1), 235-241.

[10,9] Netherland, M. D., & Willey, L. (2017). Mesocosm evaluation of three herbicides on Eurasian watermilfoil (*Myriophyllum spicatum*) and hybrid watermilfoil (*Myriophyllum spicatum x Myriophyllum sibiricum*): Developing a predictive assay. J. Aquat. Plant Manage, 55, 39-41.

Starry Stonewort

Background: Starry stonewort, a macroalgae native to northern Eurasia, invaded North American inland lakes after becoming established in the St. Lawrence Seaway/Great Lakes system. Starry stonewort has likely been present in Michigan's inland lakes since the late 1990's. Since then, this invasive species has spread throughout Michigan (Figure A5). Able to spread by both fragmentation and asexual reproduction, starry stonewort has thrived in Michigan's high-quality oligotrophic and mesotrophic lakes, particularly those with marl sediments. Once established, this opportunistic species will bloom and impose a deleterious impact on many ecosystem functions. Bloom events are often unpredictable and can happen at any time of the year. In some years, starry stonewort can become a nuisance while it can be inconspicuous in others. The species can comingle with other similar species and be very difficult to find when it is not blooming.

Figure A5 - Example of Starry Stonewort underwater growth, taken by K&A field crew in 2020.

Management: Starry stonewort is difficult to control due to its asexual reproductive structures (bulbil) which embed in lake sediments.[12] While many strategies have been employed to manage starry stonewort, no single strategy has emerged as a panacea for controlling infestations. Diver-assisted suction harvesting (DASH) or diver-assisted hand-pulling of small starry stonewort infestations could reduce populations over time, but these methods are expensive and labor-intensive which require long-term commitments.[13,14] These strategies may not be viable for large-scale infestations, however, due to their labor-intensive nature and their potential for increasing distribution of the target plant species through fragmentation during removal.

[12,11] Glisson, W. J., Wagner, C. K., McComas, S. R., Farnum, K., Verhoeven, M. R., Muthukrishnan, R., & Larkin, D. J. (2018). Response of the invasive alga starry stonewort (*Nitellopsis obtusa*) to control efforts in a Minnesota lake. Lake and Reservoir Management, 34(3), 283-295.

[14] Larkin, D.J., Monfils, A.K., Boissezon, A., Sleithd, R.S., Skawinski, P.M., Welling, C.H., Cahill, B.C., and Karold, K.G. 2018. Biology, ecology, and management of starry stonewort (*Nitellopsis obtusa*; Characeae): A Red-listed Eurasian green alga invasive in North America. https://doi.org/10.1016/j.aquabot.2018.04.003

Starry stonewort chemical treatments using copper-, diquat- and endothall-based algaecides have produced mixed results and long-term management has yet to be achieved using chemical biocides alone.[15] While starry stonewort is susceptible to most selective algaecides, the dense mats of vegetation are very difficult to penetrate and provide reasonable biocide exposure. Consequently, multiple algaecide applications may be required to “whittle down” dense starry stonewort growth if the mats reach sufficient height.

Curly Leaf-Pondweed

Background: Curly-leaf pondweed is one of the world’s most widespread aquatic plant species. Although it is found worldwide, curly-leaf pondweed is native to only Eurasia. The earliest verifiable records of the plant in the United States are from Pennsylvania in the 1840s, and has been found in Michigan since 1910. Curly-leaf pondweed is currently found in inland lakes of 34 counties in Michigan, distributed both in the upper and lower peninsulas.[16] Scientific literature suggests that curly-leaf pondweed is an aggressively growing species that often expands to nuisance levels when native plants are damaged.

Curly-leaf pondweed can create problems such as recreational nuisances, ecological nuisances (by outcompeting native species and reducing light availability to other plants), and degraded fish spawning habitat. Curly-leaf pondweed is easily detectable in early-spring because it is one of the few plants readily growing and often the first submersed plant to reach the surface. This gives it a competitive advantage and can grow 4 to 5 feet tall before other plants begin germinating from the bottom sediments. As water temperatures rise in late-June and early-July, curly-leaf pondweed stems begin to die, break down, and can be completely gone by mid-July.[17]

Figure A6 - Example curly leaf pondweed image from the 2021 LakeScan™ field crew.

[15] Pokrzywinski, K. L., Getsinger, K. D., Steckart, B., & Midwood, J. D. (2020). Aligning research and management priorities for *Nitellopsis obtusa* (starry stonewort).
[16] EGLE. (2018). “State of Michigan’s Status and Strategy for Curly-leafed Pondweed (*Potamogeton crispus L*.).” Accessed online: <https://www.michigan.gov/documents/invasives/egle-ais-potamogeton-crispus_708948_7.pdf>.
[17] Hart, Steven, M. Klepinger, H. Wandell, D. Garling, L. Wolfson. (2000). “Integrated Pest Management for Nuisance Exotics in Michigan Inland Lakes.” Accessed online: <https://www.michigan.gov/documents/invasives/egle-great-lakes-aquatics-IPM-manual_708904_7.pdf>.

Management: Like other invasive species, curly-leaf pondweed is difficult to control once established and is considered widespread in Michigan. Therefore, prevention of new populations in uninfected waters is the most economical management approach. Several herbicides have been shown to be effective at long-term control of curly-leaf pondweed, but eradication is difficult after establishment. Bottom barriers have shown effectiveness at combating curly-leaf pondweed in small areas, and mechanical harvesting of curly-leaf pondweed can be effective if timed and managed correctly.[18]

The most viable ways to control curly-leaf pondweed is through chemical and physical means after developing an integrated pest management plan. Early infestations may best be controlled by manual assisted suction harvesting (DASH), or benthic barrier use during spring before turions are produced. Aquatic herbicides including endothall, diquat, and imazamox are the most effective for general applications. Aquatic herbicides including flumioxazin and imazamox are effective for specific types of application and in specific environments. Chemical treatments are a part of a long-term integrated management plan as the turions are viable for at least 5 years and only diquat, fluridone, and some hormone treatments have shown a reduction of turion development in the laboratory.[19]

[18,17] EGLE. (2018). "State of Michigan's Status and Strategy for Curly-leafed Pondweed (*Potamogeton crispus L*.)." Accessed online: <https://www.michigan.gov/documents/invasives/egle-ais-potamogeton-crispus_708948_7.pdf>.

6.2. Appendix B: Herbicide Applicator Data and Maps

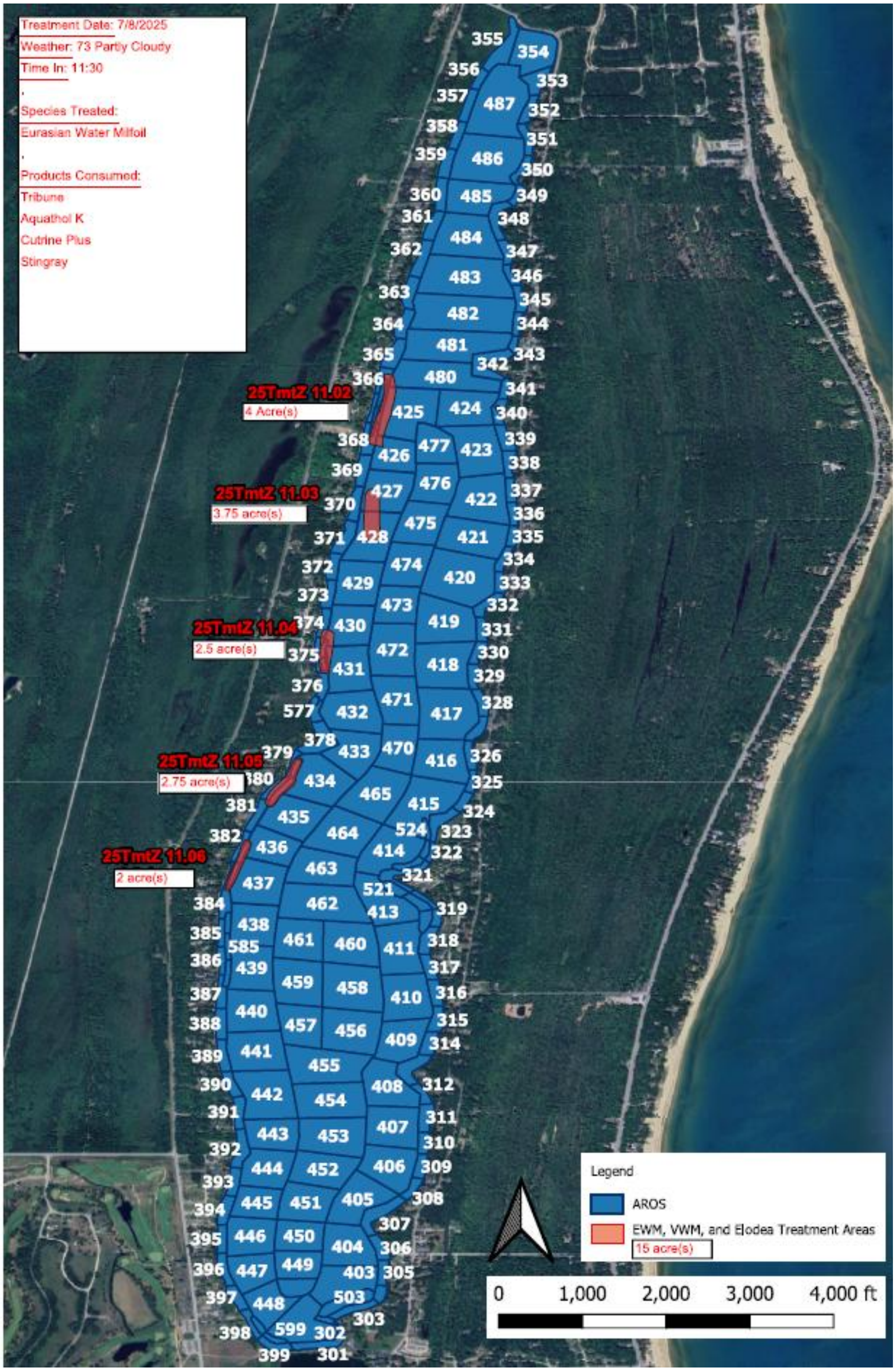


Figure B1. Herbicide applicator map and data provided by SOLitude Lake Management from the Cedar Lake North treatment on July 8, 2025.

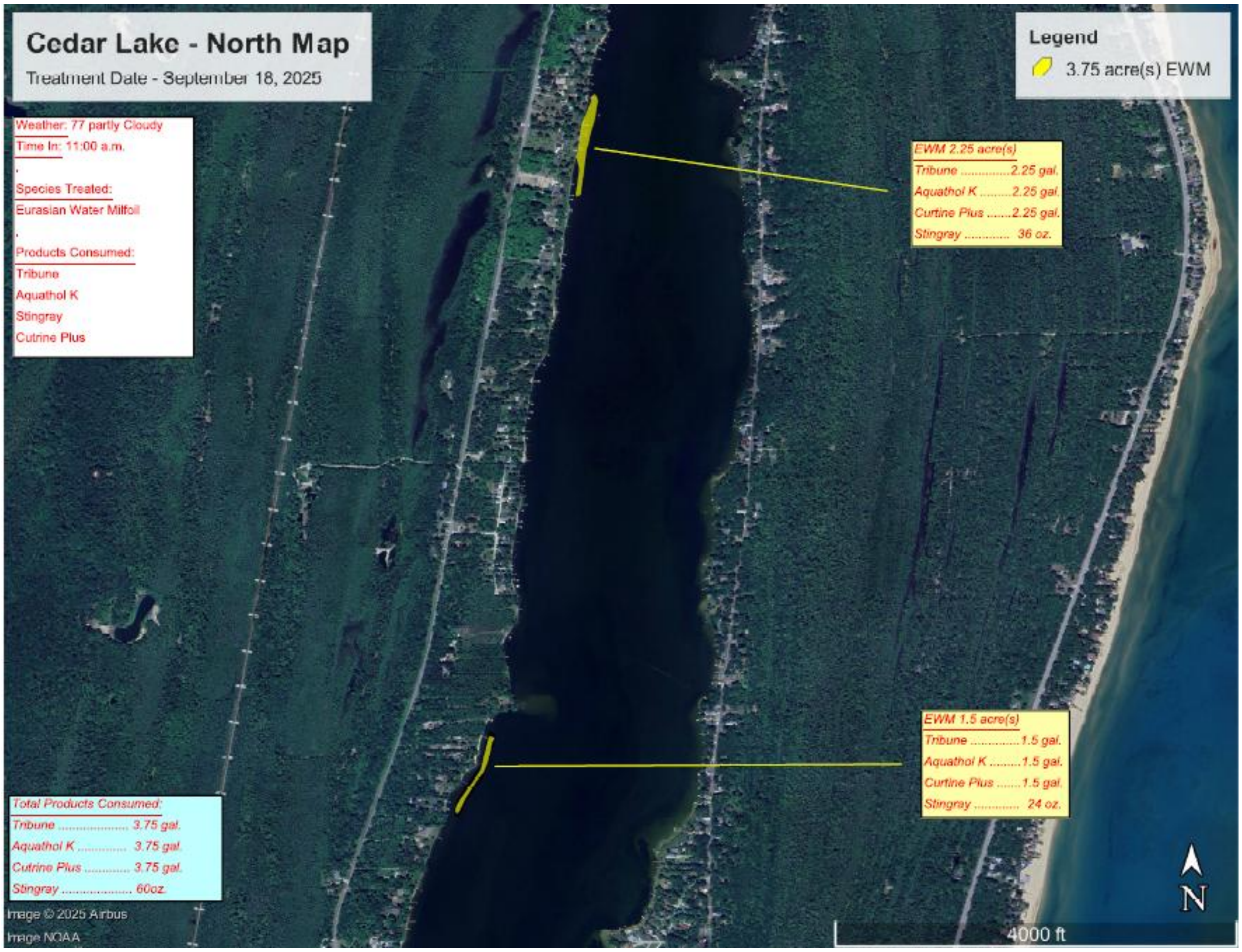


Figure B2. Herbicide applicator map and data provided by SOLitude Lake Management from the Cedar Lake North treatment on September 18, 2025.

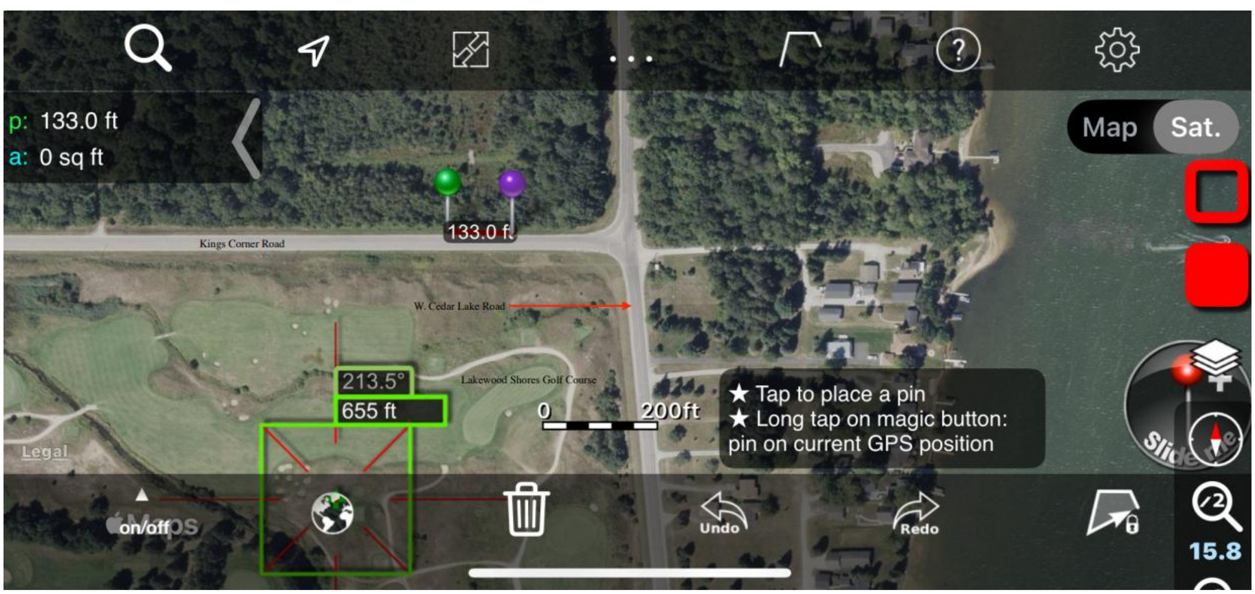


Figure B3. 133 lineal ft of terrestrial Phragmites *treatment area provided by the Cedar Lake Board for treatment on September 18, 2025.*

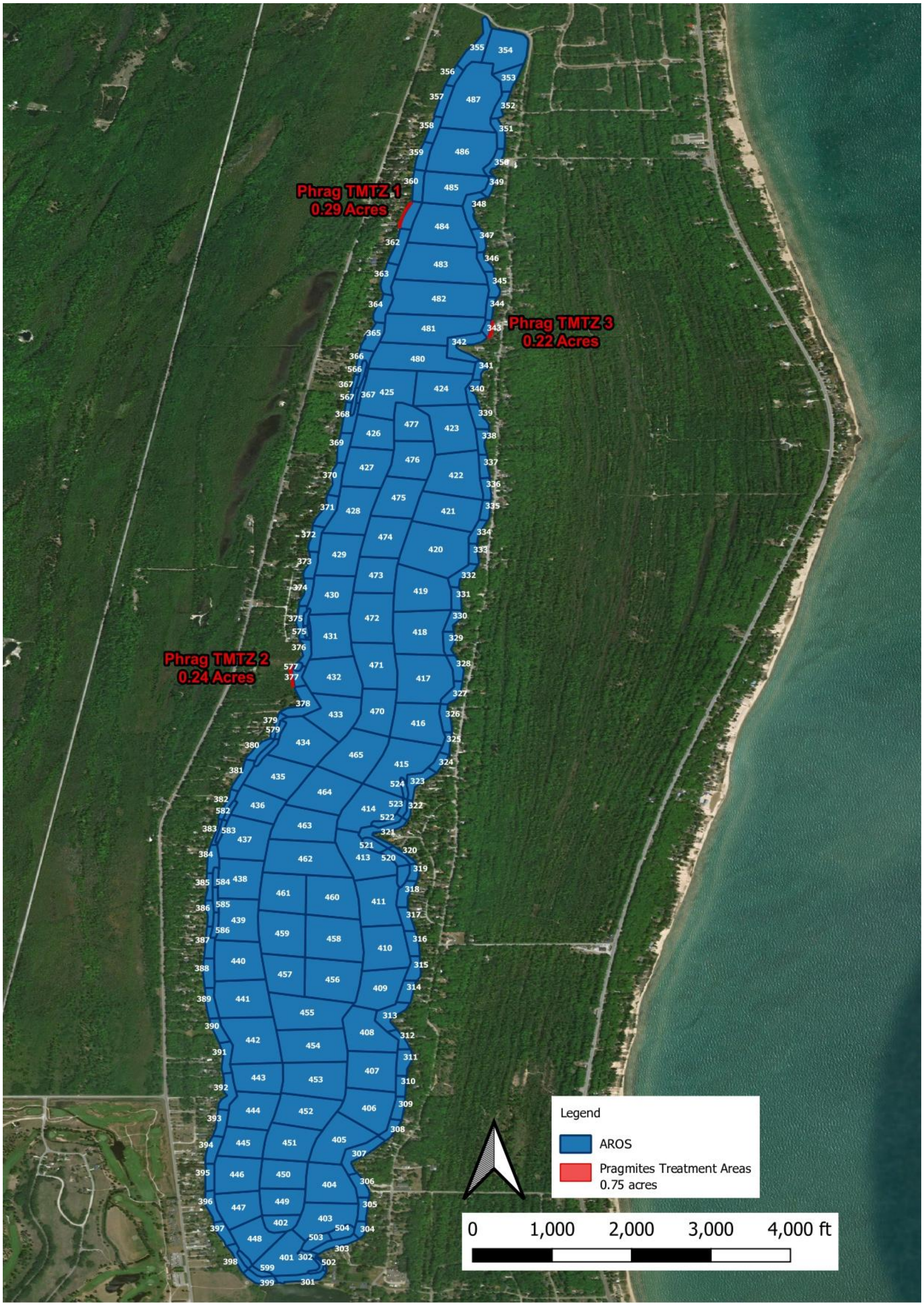


Figure B4. Shoreline Phragmites treatment areas provided by K&A for the Cedar Lake North treatment on September 18, 2025.