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

Cedar Lake South

Iosco County

2019 DATA AND ANALYSIS SUMMARY REPORT

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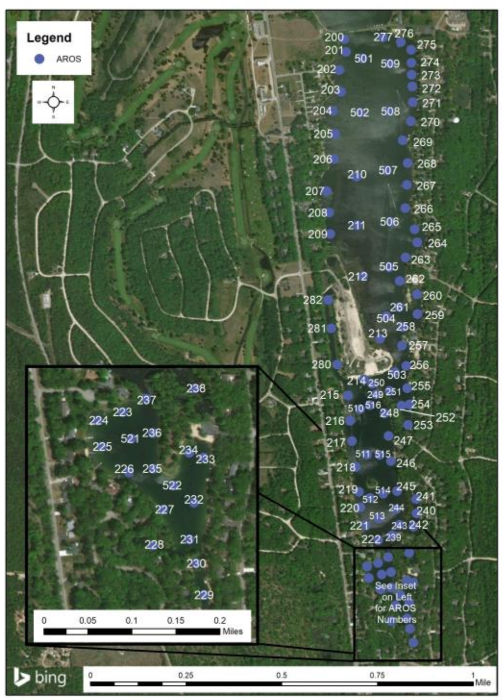

LakeScan™

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Introduction

Preface: Lakes are complicated systems. There is no simple way to consider all of the interacting systems within a lake and the impact of watersheds and invasive species invasions on these precious resources. LakeScan™ is a comprehensive system of analysis that is necessary to properly consider conditions in a lake and make reasonable, scientific and empirically based recommendations for management and improvement of lake ecosystems. This report is only the "tip of the iceberg". All recommendations are based on the comprehensive record of the data.

Background: The LakeScan™ program provides an analysis of lake conditions as well as management recommendations based on data and observations collected over multiple lake surveys. Each survey includes a comprehensive mapping of aquatic vegetation present in the lake. Surveys may also collect additional data such as water quality samples, dissolved oxygen profiles, and temperature profiles. A LakeScan™ analysis takes the data collected during these surveys and calculates a series of metrics representative of the health of the lake ecosystem, as well as the nuisance threat presented by invasive and weedy species. In addition to providing a snapshot of lake health, these metrics allow for a comparison of lake conditions on a year-to-year basis as well as a comparison with other lakes. Survey data and the maps generated from it are used to provide treatment and intervention recommendations, when necessary. Recommendations are made keeping in mind that they should always result in improvements and ensure no further degradation of the lake ecosystem.

Data Collection Methods: A LakeScan™ analysis involves collecting data over two vegetation surveys. These surveys are based on a system where the lake is first divided into biological tiers (Table 1 and Figure 2) and then further subdivided into Aquatic Resource Observation Sites (AROS; Figure 1). 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 present nuisance conditions. 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 10 days of early summer treatments to best observe treatment-targeted and non-targeted vegetation. However, this scheduling is subject to weather and times of increased boat activity.

Table 1 - Biological Tier Descriptions

Tier	Description
2	Emergent Wetland
3	Near Shore
4	Off Shore
5	Off Shore, Drop-Off
6	Canals
7	Around Islands and Sandbars
9	Off Shore Island Drop-Off

Vegetation Survey Observations: The primary goal of aquatic plant management in Cedar Lake (South), Iosco County, MI, is to preserve, protect, and if possible, improve the biodiversity of the flora and fauna of the lake. Key findings from the June 20th and August 26th, 2019 intensive LakeScan™ vegetation surveys of Cedar Lake (South) include:

- Overall, Cedar Lake (South) exhibited high biodiversity and good plant growth during both the early-season and late-season surveys.
- Native and non-nuisance species observed include beneficial, low-growing chara (*Chara sp*.), moderate to low patches of Richardsons pondweed (*Potamogeton richardsonii)*, Sago pondweed (*Stuckenia sp.*), and hybrid pondweed (*Potamogeton Hybrid*) throughout all Tiers AROS.
- Ecological nuisance species observed include Ebrid watermilfoil (*Myriophyllum spicatum x sibiricum)* and starry stonewort (*Nitellopsis obtusa)*. Ebrid watermilfoil was detected in low levels near the Shoreview Dr. peninsula and the southern end of the lake. Starry stonewort was only detected in the late-season survey in AROS 255 and 503.

The following sections describe the lake and watershed characteristics, field water quality measurements, results of the aquatic vegetation surveys and aquatic vegetation management activities and recommendations.

Category 100 – Lake and Watershed Characteristics

This section provides an overview of physical and geopolitical characteristics of the lake and its watershed, as well as illustrations of AROS (Figure 1) and tier layouts (Figure 2) used for vegetation surveys.

Location

County: Iosco

Township: Oscoda

Township/Range/Section(s): T25N, R9E Sections: 3 & 10

GPS Coordinates: N 44°29.79996' W 83°20.04684

Morphometry

Total Area: 78 acres

Shoreline Length: 20, 583 feet

Maximum Depth: 12 feet

Watershed Factors

Tributaries: Residential property runoff

Outlet type: Channel at northern end of lake

Administrative Management

Management Authority: Cedar Lake Improvement Board

Years in LakeScan™ Program: 2003 to present

First Year of Monitoring Program: 2002

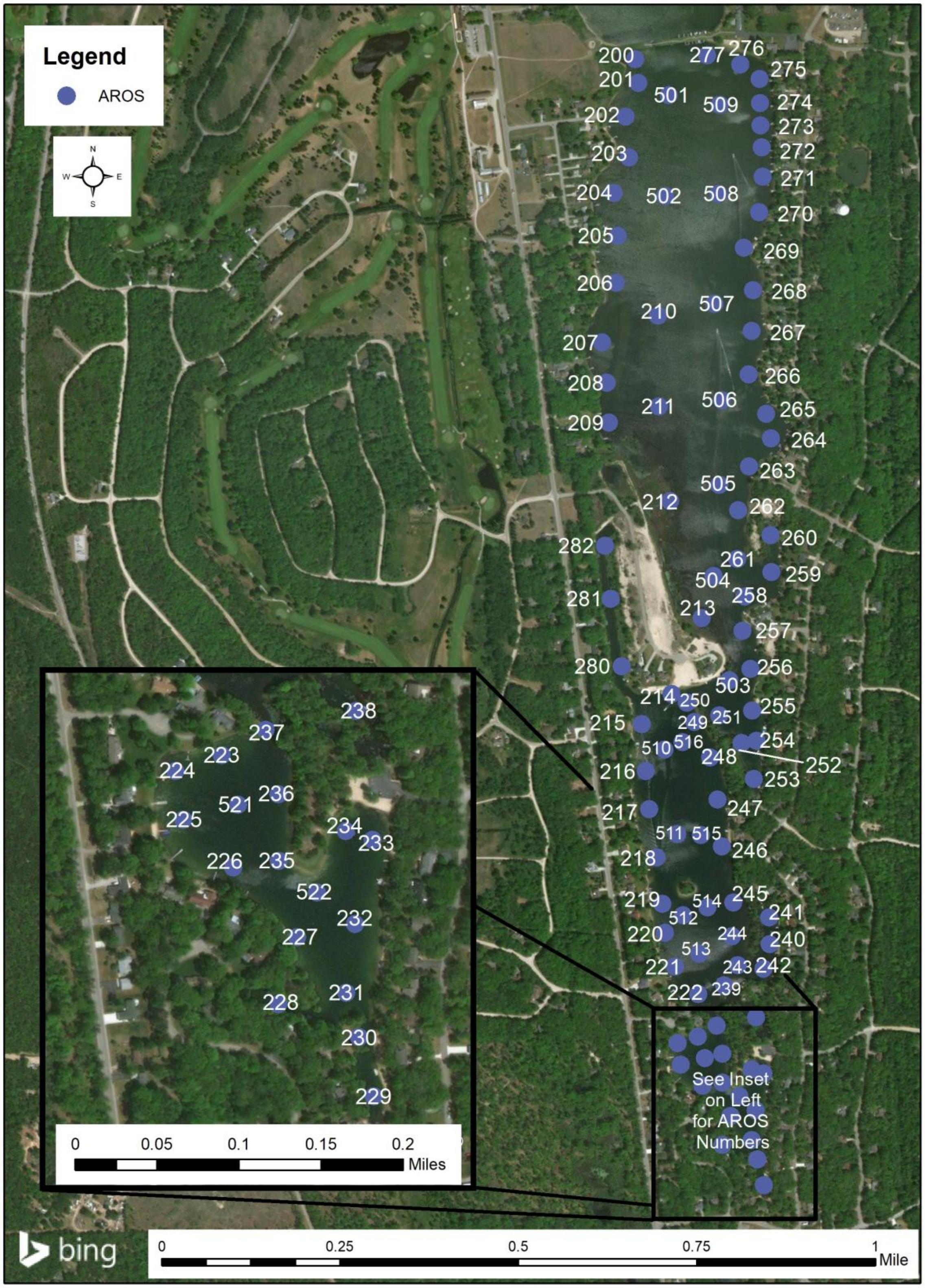


Figure 1 - Map of Aquatic Resource Observation Sites (AROS).

Figure 2 - Map of biological Tiers.

Category 200 – Water Quality

Secchi depth, dissolved oxygen and temperature data were collected from the deepest point in the lake during each vegetation survey (Figures 3 and 4). 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 (USGS, 2012). It is important to note that established populations of zebra mussels in a lake can significantly increase water clarity, thus resulting in greater Secchi disk readings.

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. Oxygen depletion can occur in deeper, unmixed bottom waters during warmer summer months in highly productive lakes. Increased algal growth associated with additional nutrients in the lake can lead to severe decreases in DO in lake bottom waters. This decrease in oxygen is due, in part, to dead algae and other organic matter, such as rooted plant material broken away from shoreline areas and leaves, grass and other plant debris washed in from shoreline lawns and storm drains settling to the bottom of the lake and decaying. This decay process is performed by organisms that consume oxygen and by chemical reactions in the sediment. The DO impacts are most often observed in bottom waters during periods of temperature stratification in warmer summer months and, to a lesser degree, under winter ice cover conditions.

Dissolved oxygen levels and temperature were measured using a YSI ProODO dissolved oxygen meter, calibrated prior to use. Michigan water quality standards for surface waters designated for warm water fish and aquatic life call for a DO of at least 5 mg/L (MDEQ, 2006).

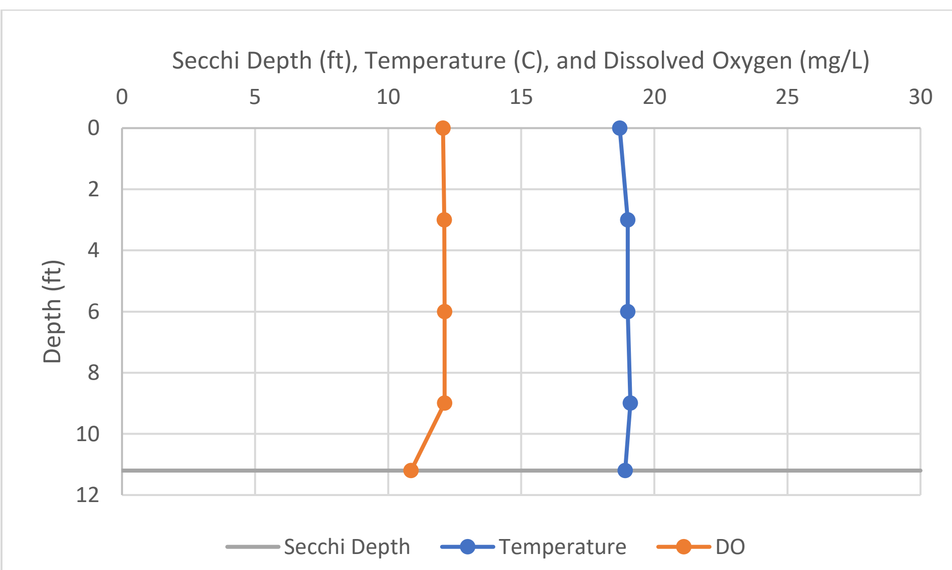


*Figure 3 - Early season survey (June 20) dissolved oxygen and temperature profiles with Secchi depth, taken at the deepest point in the lake in AROS 515 (Coordinates: 44.48629397, -83.33491059). *Note: Bed of Chara* (Chara sp.) *on bottom.*

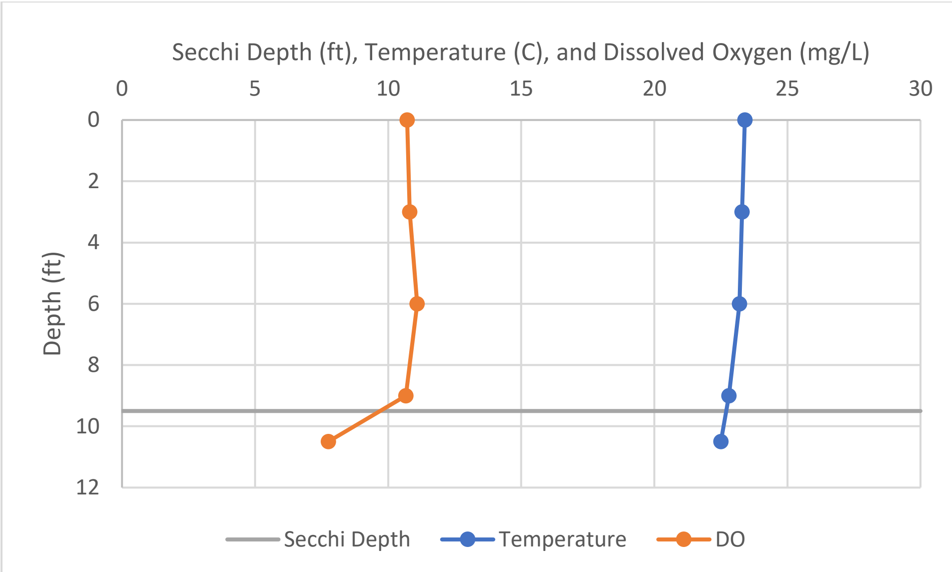


*Figure 4 - Late season survey (August 26) dissolved oxygen and temperature profiles with Secchi depth, taken at the deepest point in the lake in AROS 515 (Coordinates: 44.48629397, -83.33491059). *Note: Bed of Chara on bottom.*

Category 700 – Aquatic Vegetation

This section details findings from the two vegetation surveys that were conducted on the lake. This includes observations, aquatic vegetation mapping, and LakeScan™ analysis metrics as discussed below and presented in Tables 2-5 and Figures 5-14. Maps in Figures 5 and 6 show results from early and late season surveys, respectively, combining results for all species. Figures 9-14 show maps of key nuisance plant species.

Early-Season Survey:

The early-season LakeScan™ vegetation survey of Cedar Lake (South), Iosco County, MI was conducted on June 20th, 2019. Weather conditions were 72°F and clear to partly cloudy with calm to moderate winds. Visibility through the water column was good.

Overall, Cedar Lake exhibited great biodiversity with no recreational nuisance species. Native species detected during the early-season survey include dense patches of chara, with Richardsons pondweed, variable pondweed, sago pondweed, and hybrid pondweeds distributed throughout all Tier AROS. Green/variable watermilfoil was also detected and did not pose recreational nuisance conditions (Figure 11).

Ebrid watermilfoil was the only ecological nuisance species detected during the early-season survey (Figure 9). This species was detected at low to moderate levels and found primarily near the Lakeview Dr. peninsula and the southern-most Tier AROS.

Late-Season Survey:

The late-season LakeScan™ vegetation survey of Cedar Lake (South) was conducted on August 26th, 2019. Weather conditions were 75°F with partly cloudy skies. Winds were high which made visibility through the water column difficult.

Biodiversity remained relatively high for the late-season survey. Chara densities remained high from the early-season to late-season survey. Most of the native pondweed densities and distributions decreased from the June survey. However, hybrid pondweed remained at the same levels and posed recreational nuisance conditions throughout much of the Tier 3 AROS. Wild celery (*Vallisneria americana),* while detected in small density and distribution in the early-season survey, increased significantly throughout the middle portion of the lake in the late-season survey. Green/variable watermilfoil density was consistent with the early-season findings but was distributed more on the northwest side of the lake in the late-season survey (Figure 12).

Ecological nuisance species detected during the late season survey include ebrid watermilfoil and starry stonewort. Ebrid watermilfoil density and distribution remained consistent with early-season survey findings (Figure 10). Starry stonewort was only detected in AROS 255 and 503 at moderate density and distribution (Figure 14).

The maps below (Figures 5 and 6) depict results of the vegetation surveys. Data on all combined species are represented using three-dimensional density, which reflects a combination of vegetation density, distribution and height observations.

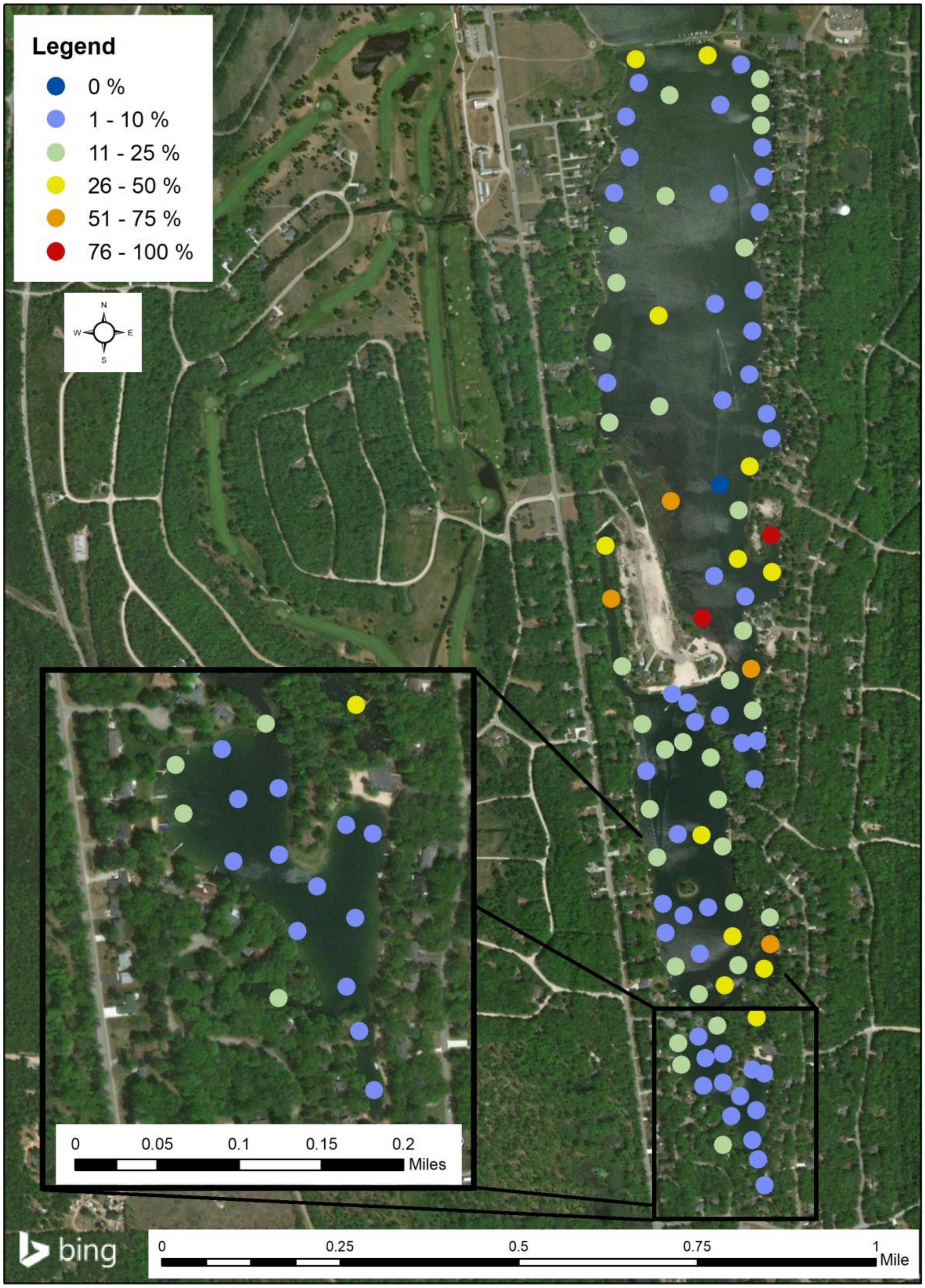


Figure 5 - Early season survey (June 20) vegetation 3D Density (a function of observed vegetation coverage, and height of all vegetation species).

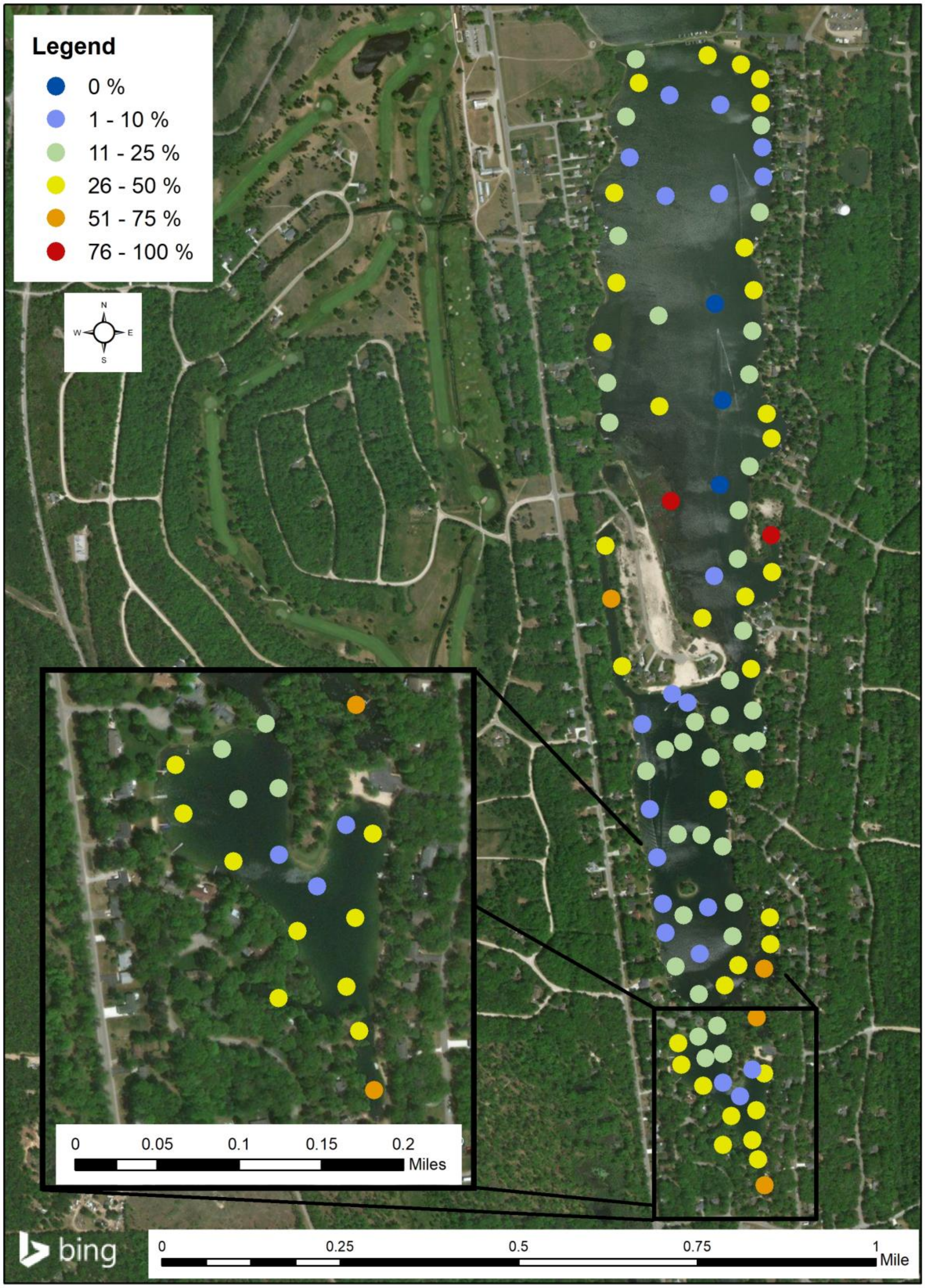


Figure 6 - Late season survey (August 26) vegetation 3D Density (a function of observed vegetation coverage, and height of all vegetation species).

Six important lake characteristics for defining aquatic plant conditions are presented here for the 2019 annual findings on lake health (Table 2). 'Richness' metrics are counts of either species or morphology (plant structure) types that were observed in the lake. 'Index' metrics are scores indicative of different aspects of lake health. The range of possible index scores is 1 to 100 with a higher score indicating better conditions in relation to management goals assigned for your lake. Annual metrics are also compared here to last year's metrics and include:

- Species Richness – the number of species present in the lake
- BioD60 T2+ Index – a measure of the health of the plant community in your lake
- Morphological Richness – the number of morphology types present in the lake
- MorphoD26 Index – reflects the habitat value of vegetation for fish and other aquatic animals
- Vegetation Quality Index – examines the lake coverage of desirable versus undesirable species
- PNL Index2 – provides a value depicting the density and distribution of nuisance vegetation in your lake

Table 2 – 2019 LakeScan™ Metric Results

LakeScan™ Metric	Score Category	Useful in Describing Conditions For:	2019 Score	2018 Score	Management Goal
Species Richness	Biodiversity	Ecosystem Health	25	17	-
BioD60 T2+ Index	Biodiversity	Ecosystem Health	82	53	50
Morphological Richness	Structural Diversity	Fish Habitat	14	14	-
MorphoD26 Index	Structural Diversity	Fish Habitat	83	78	50
Vegetation Quality Index	Nuisance Condition	Ecosystem Health	54	48	50
PNL Index2	Nuisance Condition	Recreation	91	86	50

(Red scores indicate improvements are needed; yellow indicate marginal conditions; green are desirable)

Table 3, below, shows how the same six metrics have changed over previous years.

Table 3 – LakeScan™ Metrics Results History

Year	Species Richness	BioD60 T2+	Morpho. Richness	MorphoD26	Veg. Quality Index	PNL Index2
2019	25	82	14	83	54	91
2018	17	53	14	78	48	86
2017	16	43	11	52	55	88
2016	16	43	12	54	55	71
2015	15	44	12	64	52	N/A

(Red scores indicate improvements are needed; yellow indicate marginal conditions; green are desirable)

Species present in the lake are shown in Table 4. 'T Value' is a value ranging from 1 to 4 that is assigned to each species, where 1 represents a species highly likely to require treatment and 4 represents a species highly unlikely to require treatment. ‘Morpho. Type’ is the category of plant shape describing the species. 'Frequency' represents the percentage of survey sites (AROS) where a given species was found. 'Dominance' represents the degree to which a species is more numerous than its competitors. ‘PNL’ is a value that ranges from 0 to 3 that incorporates plant species and plant height in the water column with in-field observations of species location within the lake and in-lake structures.

Table 4 – Aquatic Plant Species Observed in 2019

Common Name	Scientific Name	T Value	Morpho. Type	Frequency	Dominance	PNL*
Eurasian Watermilfoil Hybrid	*Myriophyllum spicatum x sibiricum*	1	1	15.2%	1.2%	1 or 3
Green/Variable Watermilfoil	*Myriophyllum verticillatum L. or Myriophyllum heterophyllum Michaux*	2	1	32.3%	3.0%	0 or 2
Other Watermilfoils	*Myriophyllum sp.*	4	1	1.0%	0.1%	0 or 2
Common Bladderwort	*Utricularia vulgaris L.*	3	3	36.4%	1.6%	0 or 2
Elodea	*Elodea sp.*	2	5	6.1%	0.7%	0 or 2
Naiad	*Najas sp.*	2	7	62.6%	7.4%	0 or 2
Chara	*Chara sp.*	4	8	93.9%	34.3%	0 or 2
Starry Stonewort	*Nitellopsis obtusa (Desv.) J.Groves*	1	8	2.0%	0.3%	1 or 3
Flat Stem Pondweed	*Potamogeton zosteriformis Fern.*	2	10	7.1%	1.1%	0 or 2
Water Star Grass	*Zosterella dubia (Jacq.) Small*	2	10	4.0%	0.1%	0 or 2
Purple Loosestrife (sub)	*Lythrum salicaria L.*	3	10	2.0%	0.0%	1 or 3
Richardsons Pondweed	*Potamogeton richardsonii (Benn.) Tydb.*	2	11	60.6%	4.6%	0 or 2
Variable Pondweed	*Potamogeton graminius L.*	3	13	29.3%	2.7%	0 or 2
Hybrid Pondweed	*Potamogeton Hybrid*	2	13	94.9%	16.3%	0 or 2
Weedy Broad Leaf Pondweed	*Potamogeton amplifolius Hybrid*	2	14	1.0%	0.0%	0 or 2
Sago Pondweed	*Stuckenia sp.*	2	16	51.5%	3.2%	0 or 2

Thin Leaf Pondweed	*Potamogeton sp.*	4	16	10.1%	1.0%	0 or 2
Waterwort	*Elatine sp.*	4	10	3.0%	0.0%	0 or 2
Wild Celery	*Vallisneria americana Michaux*	2	17	39.4%	3.8%	0 or 2
Spikerush	*Eleocharis sp.*	4	19	2.0%	0.5%	0 or 2
Rush	*Juncus pelocarpus Meyer [f. submersus Fassett]*	4	19	36.4%	1.9%	0 or 2
Waterlily	*Nymphaea sp.*	2	21	66.7%	14.2%	0 or 2
Spadderdock	*Nuphar sp.*	2	21	12.1%	1.3%	0 or 2
Water Shield	*Brasenia schreberi J.F. Gmel.*	3	21	1.0%	0.1%	0 or 2
Floating Leaf Pondweed	*Potamogeton sp.*	3	15	8.1%	0.5%	0 or 2

**PNL can either be one number or the other for each species in each survey site (AROS) and this value depends on plant height in the water column and location within the waterbody*

Figure 7, below, shows the distribution of aquatic plant coverage by T Value over different surveys. The Combined Annual (VS S) analysis represents a combination of the seasonal surveys, both the early season survey (VS 3) and the late season survey (VS 5). T - 1 species are usually very weedy and create the greatest nuisance conditions and are therefore most likely to be targeted for suppression by a variety of means. T - 2 species are occasional nuisance species and may be targeted for control or suppression in some circumstances. T - 3 species are not targeted for control but occasionally require treatment for some growth management. T - 4 species are protected from impact from any management activity.

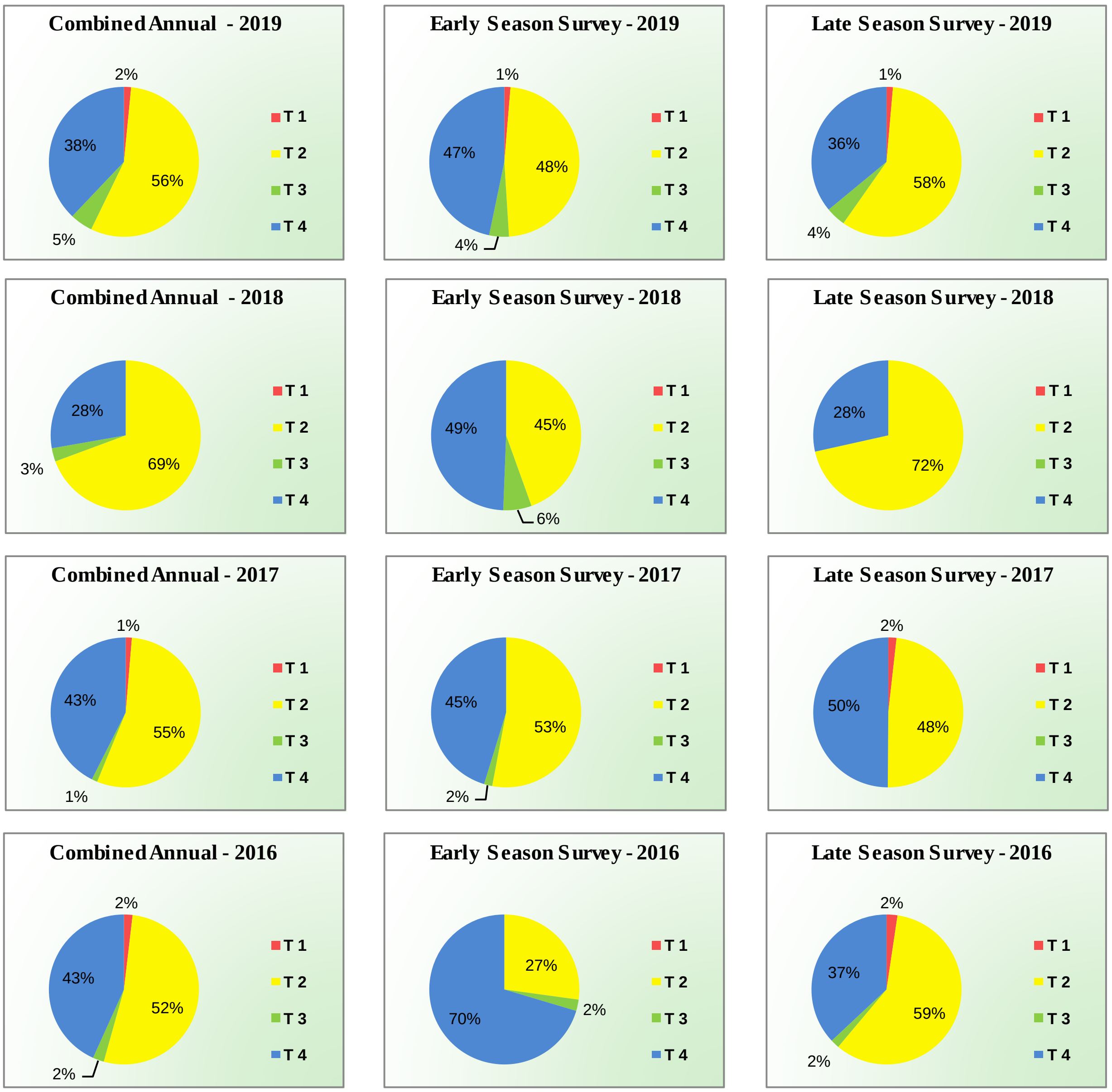


Figure 7 – Distribution of aquatic plant coverage by T Value comparing combined, early-season, and late-season surveys from 2016 – 2019.

Category 750 – Lake Management

There are several species that typically become a nuisance in Michigan's inland lakes (See Appendix B). These species are usually targeted for very selective control to prevent them from becoming an aesthetic or recreational nuisance and to protect desirable plants that are part of lake floras. This section includes an analysis on nuisance conditions in the lake, as well as a description of any management actions that were taken. Information on the extent and locations of nuisance species are included in Figures 8 – 14.

The southern end part of Cedar Lake provides a highly varied range of habitats that are critical for the support of biodiversity and ecosystem stability in the system. Nuisance conditions in the south end of Cedar Lake are considered to be minimal when compared to most other Michigan inland lakes. Variable watermilfoil has emerged as a widely scattered nuisance in many parts of the southern end of Cedar Lake and has responded very well to treatment. The plant is treated when it appears that it might flower near the water surface or grow tall enough to interfere with boating. Aquest and Aquatic Services have developed a special mixture of herbicides and algaecides that can control variable watermilfoil growth in a treated area for up to three years after a single treatment. Treatment areas will vary from year to year depending upon previous treatments and spread and scatter of the plant.

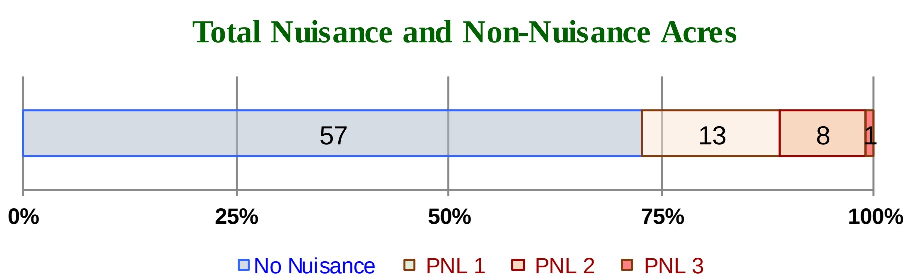
Hybrid pondweeds grow to nuisance levels areas that are relatively small and located in most of the bays in the south end of Cedar Lake. These areas are generally close enough to shore that nuisance growth can be treated with herbicides by MI EGLE permit. Treatment outcomes have been excellent in enclosed areas but since these plants are typically herbicide tolerant, outcomes in more open areas have been good, but not excellent. Nuisance levels vary from year to year and it is difficult to predict if problems might appear in 2020 nor is possible to predict where treatment might occur. Each year is different. An early season inspection is done in late May each year and treatment areas are often identified at that time (Figure 15).

Starry stonewort has been observed in Cedar Lake in some years, but not others since the mid 2000's. It can become a serious nuisance in some inland lakes in Michigan but does not seem to be capable of growing to those levels in Cedar Lake. It is also difficult to find when it is not growing and unequivocal nuisance levels because it can be found intermingled with other, very similar looking, charoid species. Hence the total area covered by starry stonewort in the south end of Cedar lake may be underestimated. It was observed in AROS 255 and 503 in 2019 and will be treated wherever it is found in 2020. It is an exotic invasive species and MI EGLE permits allow treatment wherever it is found.

Perceived nuisance level (PNL) is determined at each AROS during vegetation surveys and is summarized in Table 5 below. PNL is a value that ranges from 0 to 3 that incorporates plant species and plant height in the water column with in-field observations of species location within the lake and in-lake structures (i.e. surrounds a dock, within the ski lane, in front of the public boat launch). Before a PNL is assigned, a species is determined to be either an ecological nuisance, a recreational nuisance, or both. An ecological nuisance is identified as a species that is invasive or non-native to Michigan that seriously threatens the biodiversity of the plant community, ecosystem functions, and overall stability of the lake ecosystem. Recreational nuisance is assigned to species that may impair or inhibit boat traffic or swimming ability at the time of the survey. Recreational nuisance can be assigned to both native and invasive/non-native species. PNL 0 is assigned to plant species that are native and do not create a recreational nuisance. PNL 1 indicates ecological nuisance species that do not pose a recreational nuisance. PNL 2 describes native plant species that are a recreational nuisance. PNL 3 indicates ecological nuisance species that also create a recreational nuisance. The maximum PNL value that is found at each AROS during all seasonal LakeScan™ surveys is used for this analysis. The total number of AROS acres is summed for each of the 3 PNL levels and the "no nuisance" AROS (PNL 0). The first column is the percentage of the total AROS acres that are assigned each PNL value. Total and species-specific PNL summaries are presented in Figure 8 below.

Table 5 – AROS Perceived Nuisance Level Summary

% Total AROS Acres	PNL Level	Perceived Nuisance Level Description	Total AROS Acres
73%	PNL 0	No Nuisance	57
16%	PNL 1	Ecological Nuisance	13
10%	PNL 2	Equivocal Nuisance	8
1%	PNL 3	Obvious Nuisance	1



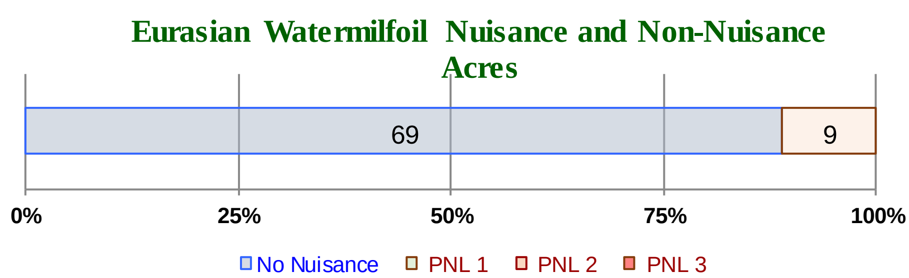


Figure 8 – Total and Species-specific Perceived Nuisance Levels

Mapped data on nuisance species are reported individually below in Figures 9 - 14 using coverage, a combination of density and distribution observations from the vegetation surveys.

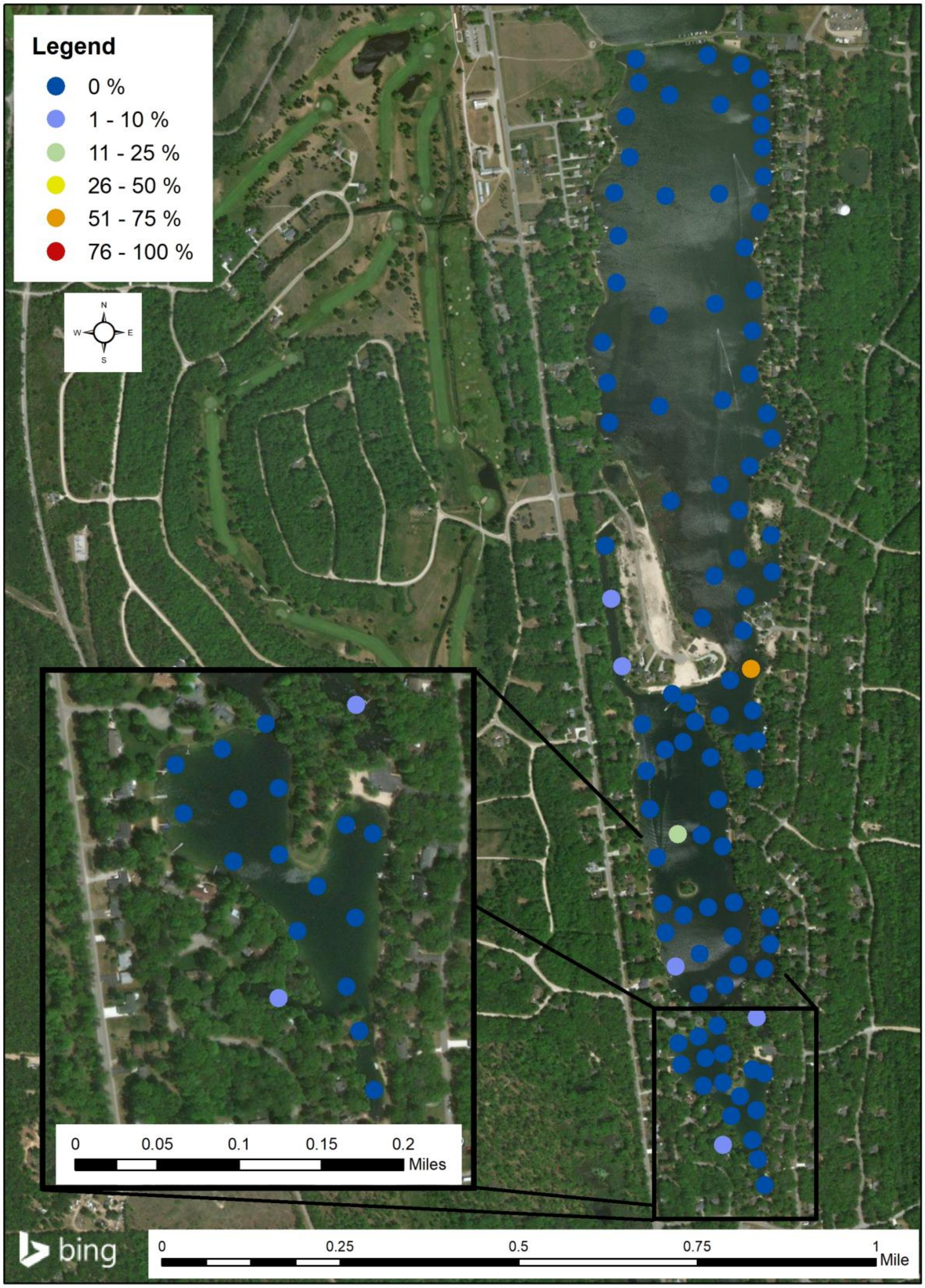


Figure 9 - Early season (June 20) Eurasian Watermilfoil and Hybrids coverage (a combination of the LakeScan™ density and distribution observations).

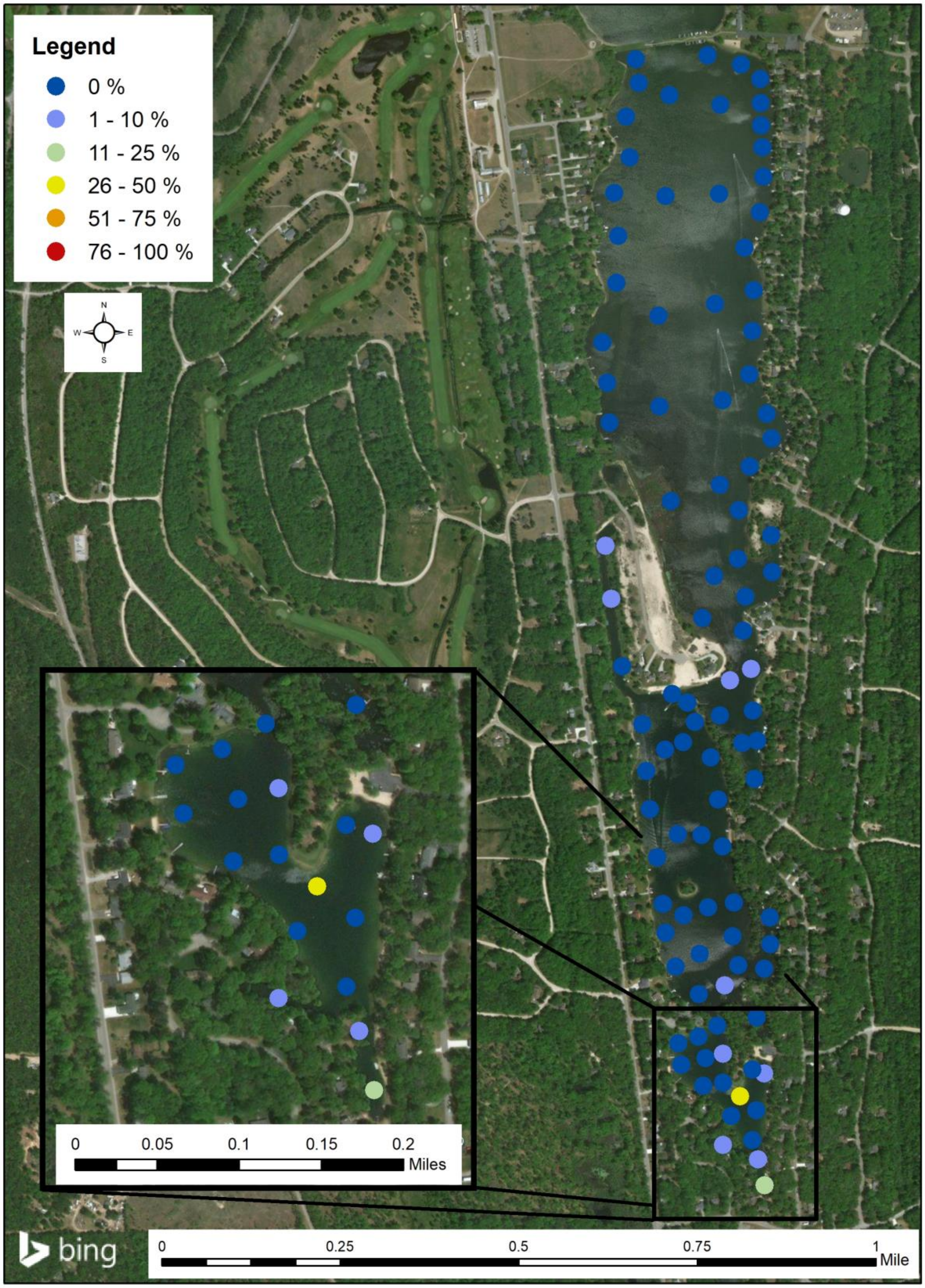


Figure 10 - Late season (August 26) Eurasian Watermilfoil and Hybrids coverage.

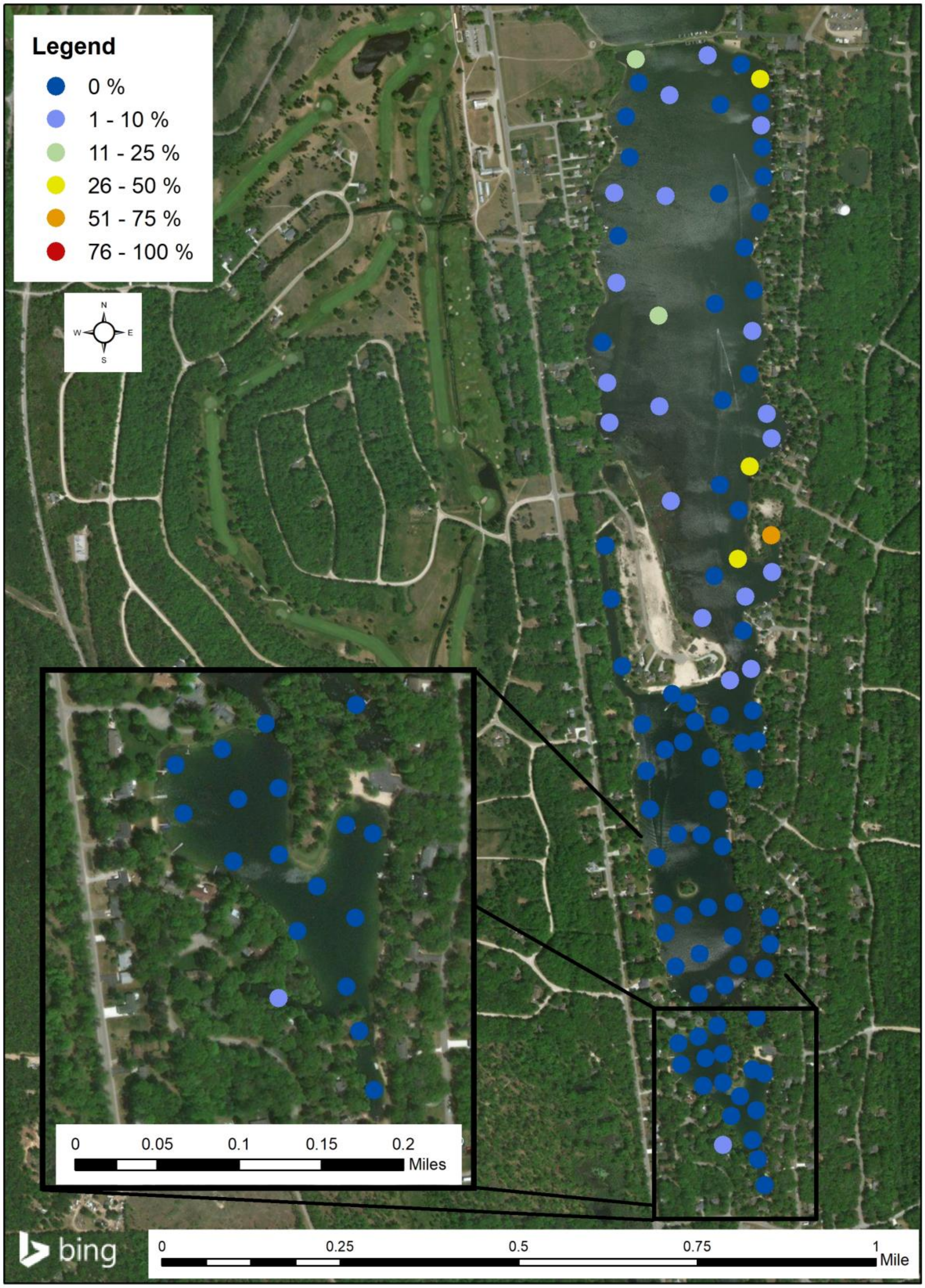


Figure 11 - Early season (June 20) Variable Watermilfoil coverage.

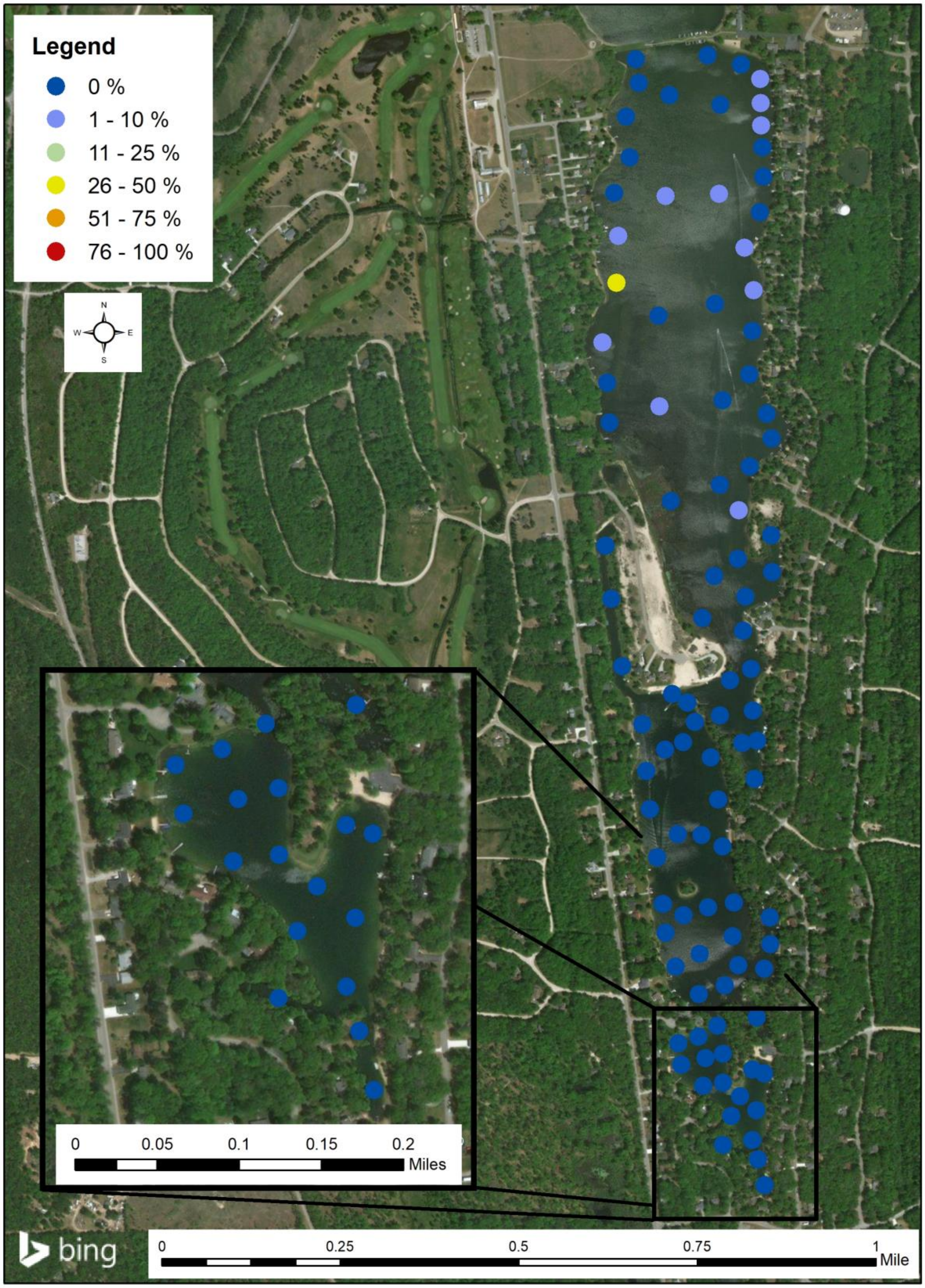


Figure 12 - Late season (August 26) Variable Watermilfoil coverage.

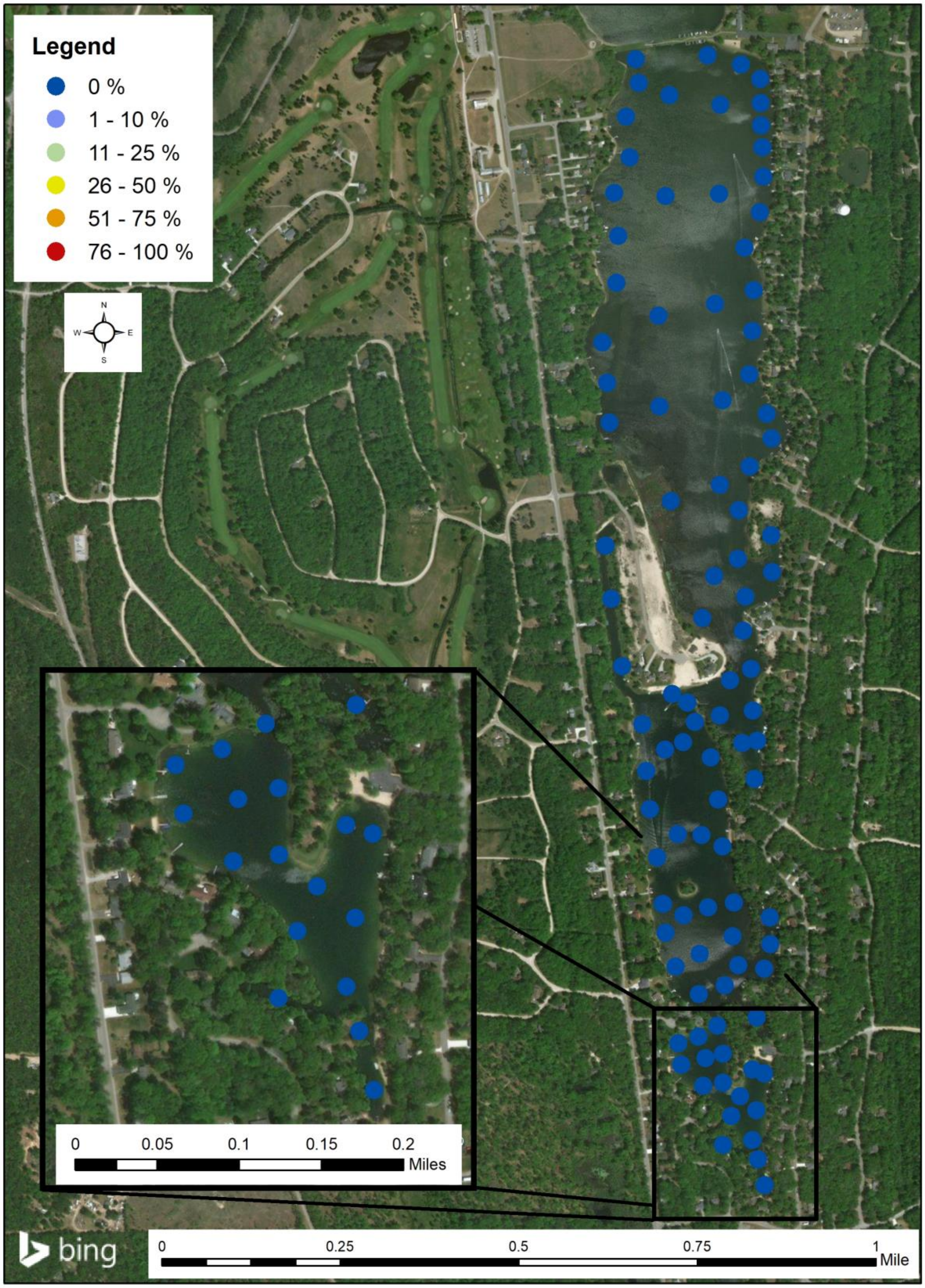


Figure 13 - Early season (June 20) Starry Stonewort coverage.

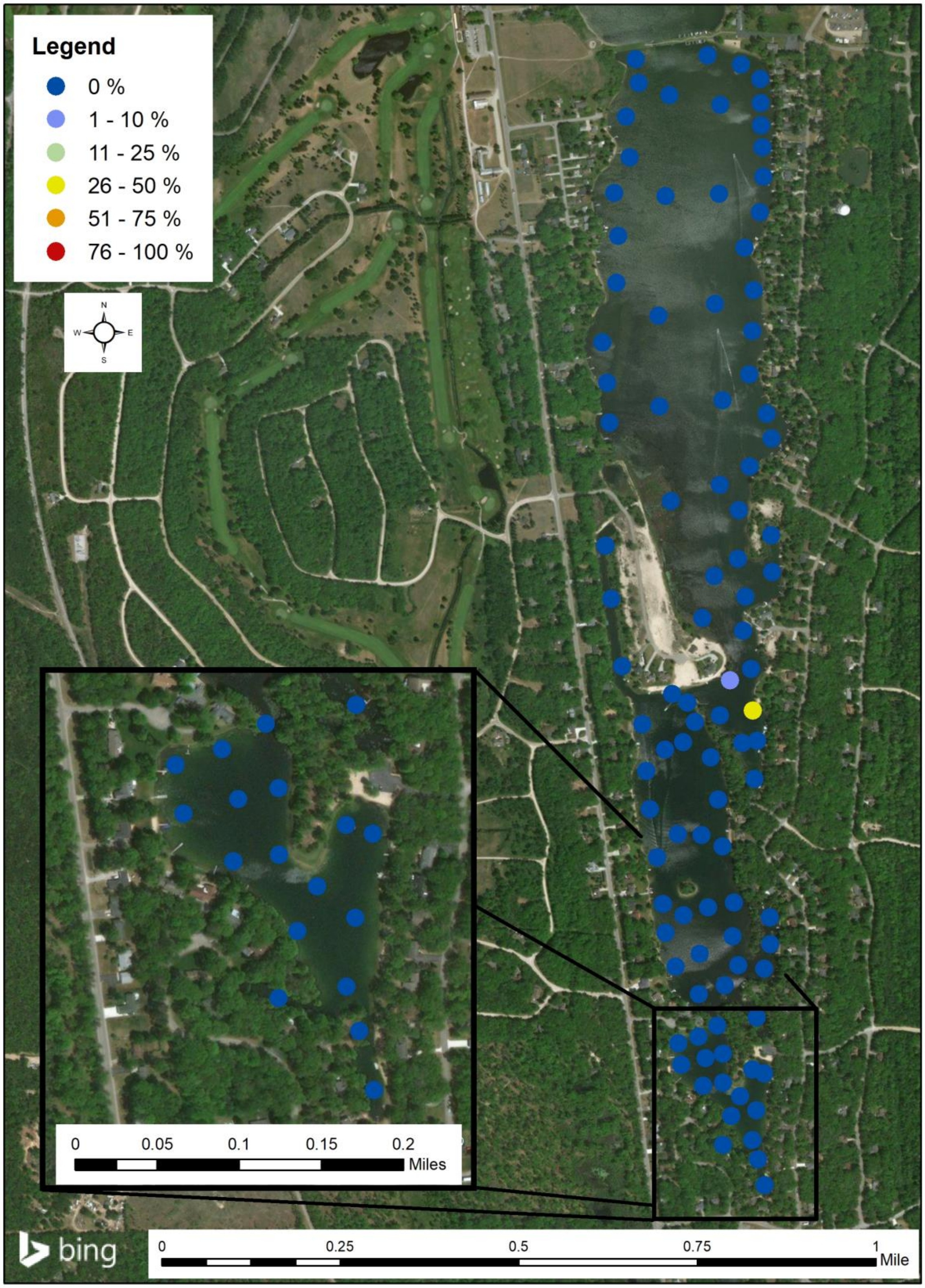


Figure 14 - Late season (August 26) Starry Stonewort coverage.

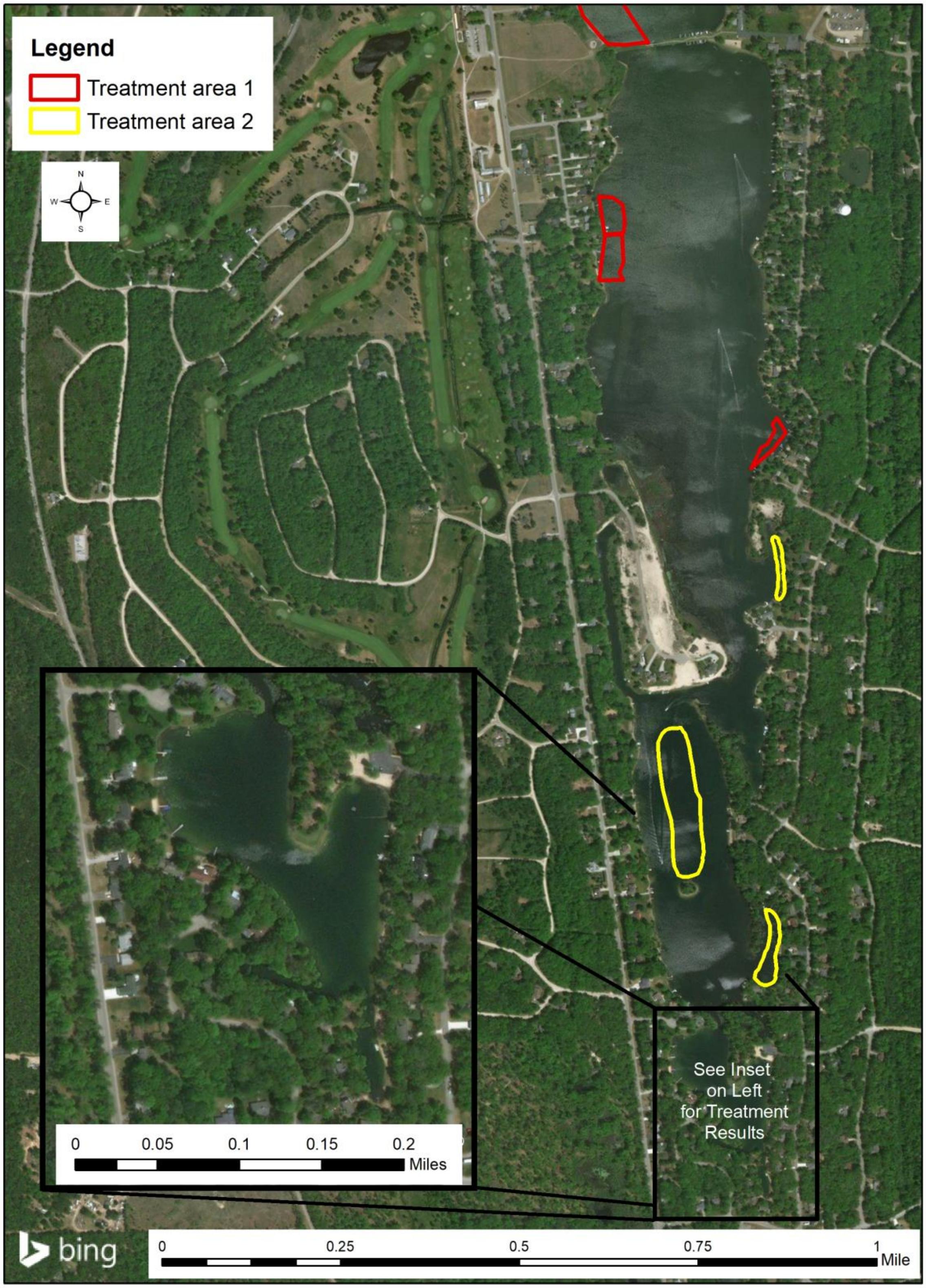


Figure 15. 2019 Treatment Map.

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Appendices

Appendix A: Blue Green Algae

Blue green algae blooms are becoming increasingly common in Michigan. 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 (Figure A1). Blue green algae 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; however, the spread and impact of zebra mussels has been closely associated with blooms of blue green algae.

Figure A1 - Example blue green algae images from the 2019 LakeScan™ field crew.

Blue green algae are really a form of bacteria known as cyanobacteria. They are becoming an important issue for lake managers, riparian property owners and lake users because 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. Blue green algae can have both direct and indirect negative impacts on fisheries. Persons can be exposed to the phytotoxins by ingestion or dermal absorption (through the skin). They can also be exposed to toxins by inhalation of aerosols created by overhead irrigation, strong winds, and boating activity.

Approximately one half of blue green algae blooms contain phytotoxins, and this is determined through lab testing. It is recommended that persons not swim in waters where blue green algae blooms are conspicuously present. Specifically, persons 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 from tainted water. Since blue green algae 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 in areas where persons may be exposed to it.

Blue green algae are not very good competitors with other, more desirable forms of algae. They 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 (but not rooted plants, i.e. seaweed). 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.

Free Carbon Dioxide: All plants, including algae, use carbon dioxide in photosynthesis. Alkalinity, pH, temperature, and the availability of free carbon dioxide are all closely related and inter-regulated in what can be referred to as a lake water buffering system. Concentrations of these key water constituents will shift to keep pH relatively constant. Carbon dioxide is not very soluble (think about the bubbles of carbon dioxide that escape soda pop). The availability of this essential substance can be in short supply in lake water. Many blue green algae contain gas “bubbles” that allow them to float upward in the water column toward the water surface where they can access carbon dioxide from the atmosphere. Consequently, blue green algae that can float have a competitive advantage in lakes where carbon dioxide is in low supply in the water. This is also why blooms form near the surface of the water.

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. This is one of the most disturbing factors associated with the invasion and proliferation of zebra mussel. Lakes that are full of zebra mussel may not support the production of “good” algae and experience a partial collapse of the system of “good” algae that are necessary to support the fishery.

Appendix B: Common Species of Concern

Eurasian Watermilfoil and Hybrids (Ebrids):

Background: Anecdotal evidence suggests that hybrid milfoil has been found in Michigan inland lakes for a long time (since the late 1980’s). University of Connecticut professor Dr. Don Les was the first to determine that there were indeed, Eurasian watermilfoil and northern watermilfoil hybrids in Michigan based on samples sent to his Connecticut lab by Dr. Douglas Pullman, Aquest Corp. in 2003. Experience has proven that it is usually not possible to determine whether the milfoil observed is either Eurasian or hybrid genotype (Figure B1). However, because they play such similar roles in lake ecology, they are simply “lumped together” and referred to collectively as ebrid milfoil. Ebrid milfoil is a very common nuisance in many Michigan inland lakes.

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 ebriid milfoil. Ebrid milfoil is an ever-present threat to the stable biological diversity of the lake ecosystem. Species selective, systemic herbicide combinations have been used to successfully suppress the nuisance production of ebrid milfoil and support the production of a more desirable flora. However, it is becoming much more resistant to all herbicidal treatment. This resistance can be easily defeated with the use of microbiological system treatments. This is done with only a minor increase in cost. Milfoil community genetics are dynamic, not static, and careful monitoring is needed to adapt to the expected changes in the dominance of distinct milfoil 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.

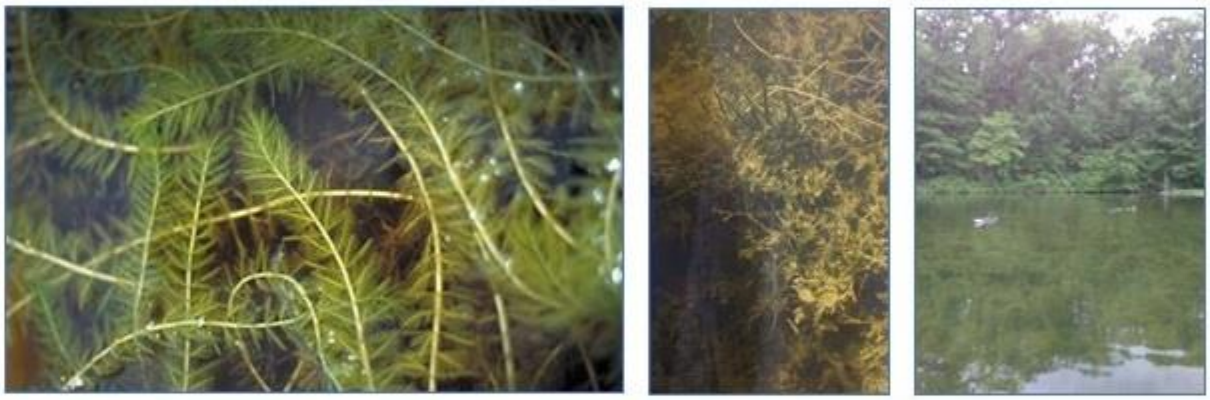

Figure B1 - Example Eurasian Watermilfoil and Hybrids images from the 2019 LakeScan™ field crew.

Starry Stonewort

Background: Starry stonewort invaded North American inland lakes after becoming established in the St. Lawrence Seaway/Great Lakes system. It has probably been present in Michigan's inland lakes since the late 1990's but was not positively identified until 2006 by Aquest Corporation in Lobdell Lake, Genesee County, MI. Since then, it has been discovered in lakes all over Michigan. It is truly an opportunistic species that will bloom AND crash and impose a very significant and deleterious impact on many ecosystem functions. Bloom and crash events are unpredictable and can happen at any time of the year. In some years starry stonewort can become a horrendous nuisance while it can be inconspicuous in others. It can comingle with other similar species and be very difficult to find when it is not blooming (Figure B2).

Management: Starry stonewort is capable of growing to extreme nuisance levels. It is easy to kill, but very difficult to treat. It grows so rapidly that mechanical methods of control are strongly discouraged. First, starry stonewort can regrow so rapidly after cutting that it can be nearly impossible to keep up with the nuisance production of this fast-growing plant. Mechanical controls can also help to disperse and spread starry stonewort throughout inland lakes when the plant is fragmented. It is even more disturbing that desirable plant species are more susceptible to mechanical control strategies than starry stonewort and mechanical controls can thereby select for the dominance of starry stonewort over a much more desirable flora. Starry stonewort is susceptible to most selective algaecides, but 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.

Figure B2 - Example starry stonewort images from the 2019 LakeScan™ field crew.