Big Lake, Sherburne County
2022 Aquatic Vegetation Management Report

Report by the Invasive Species Program - Division of Ecological and Water Resources
Minnesota Department of Natural Resources

Prepared by:

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Project Details

Lake: Big (DOW# 71008200)

Lake Surface Area: 254 acres

Littoral Area: 116 acres

County: Sherburne County

Survey Type: Point-intercept

Date of Survey (most recent): June 13, 2022

Observer[s]:

MN DNR, Invasive Species Program (ISP): Chris Jurek and Emelia Hauck Jacobs (2022), Chris Jurek, Emelia Hauck Jacobs, Emelia Holman (2019), Chris Jurek and Courtney Millaway (2013). Rich Rezanka and Luke Peluso (2009), Markina Edvokimoff (2022)

MN DNR, Lake Ecology Unit (LEU): Stephanie Simon, Donna Perleberg, Zach Van Dyne and Nick Whichello (2010), Nicole Brown and Josh Knopik (2004).

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Report Details

Summary

The purpose of this report is to provide an overview of aquatic plant distribution and the management of invasive aquatic plants in Big Lake, Sherburne County between 2004 and 2022. Historical data on water quality, invasive aquatic plant management permits and point-intercept surveys are all summarized in this report. These summaries will guide future invasive aquatic plant control projects and can evaluate changes in native plant communities.

Lake Description

Big Lake is a 254- acre lake located in the City of Big Lake, Sherburne County, MN. The maximum depth of water in Big Lake is 48 feet, and 46% of the lake is classified as littoral (areas of water depth between 0 to 15 feet, where aquatic plants are most likely to grow). As of 2021, water clarity during the summer averaged 10.4 feet, with an improving water clarity at this lake of approximately 1.3 feet per decade (MPCA, 2022). According to surveys from the Minnesota Pollution Control Agency (MPCA, 2022), Big Lake is classified as a mesotrophic lake, based on its Trophic State Index (TSI) of approximately 44. Mesotrophic lakes are lakes with an intermediate level of productivity and are typically clear water lakes with some summer algal blooms. The three parameters that are factored into the trophic state index are total phosphorus (nutrients in the water), chlorophyll-a (measure of the amount of algae growing in the water) and Secchi depths (water transparency). For more information on water quality, go to the Big Lake water quality data on the MPCA website:

(https://cf.pca.state.mn.us/water/cmp/resultDetail.cfm?siteid=71-0082-00-205).

Management History

The lake has two invasive plant species: curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*). Invasive aquatic plant management in Big Lake has focused on both curly-leaf pondweed using endothall herbicide and auxin-mimic herbicides for Eurasian watermilfoil (Table 1). The most recent treatment for curly-leaf pondweed was in 2015 for 4 acres, organized by the City of Big Lake, although past treatments have ranged from 0 to 69 acres. Curly-leaf pondweed had significantly decreased after three years of whole-lake treatments (2009-2011), although is still present in the lake. Eurasian watermilfoil treatments

had varied from 6 to 29 acres, with the most recent treatment of 15 acres in 2022. Pre-treatment survey data (i.e. point-intercept surveys or lake-wide delineations that can be repeatable), collected over time, would be a recommended course of action for analyzing plant abundance and distribution trends into the future.

Table 1-Invasive Plant Management Summary. Characteristics and history of whole (2009-2011) and partial lake invasive aquatic plant treatments (2012- 2019) for Big Lake, Sherburne County (DOW#71008200). Total acres: 254, Littoral acres: 116, 15% of Littoral acres: 17.4). Abbreviations are as followed: curly-leaf pondweed (CLP) and Eurasian watermilfoil (EWM). Note: Total acres permitted does not reflect the actual treatment or known acreage of the taxa in the lake. Acreage is rounded to the nearest whole number.

Year	Target Species	Total Acres Permitted	Herbicide	Licensed Commercial Applicator
2009	CLP	69	Endothall	Lake Restoration
2010	CLP	39	Endothall	Lake Restoration
2011	CLP	15	Endothall	Lake Restoration
2012	CLP	15	Endothall	Lake Restoration
2013	CLP	2	Endothall	Lake Restoration
2014	CLP	4	Endothall	Lake Restoration
2015	CLP	4	Endothall	Lake Restoration
2009	EWM	29	Triclopyr	Lake Restoration
2010	EWM	7	Triclopyr	Lake Restoration
2011	EWM	18	Triclopyr	Lake Restoration
2012	EWM	25	2,4-D	Lake Restoration
2013	EWM	6	DMA	Lake Restoration
2014	EWM	6	Auxin-mimic	Lake Restoration
2015	EWM	11	Auxin-mimic	Lake Restoration
2016	EWM	10	Auxin-mimic	Lake Restoration
2017	EWM	14	2,4-D	Lake Restoration
2018	EWM	14	Auxin-mimic	Lake Restoration
2019	EWM	14	Auxin-mimic	Lake Restoration
2020	EWM	16.7	2,4-D	Lake Restoration
2021	EWM	15	Auxin-mimic	Lake Restoration
2022	EWM	15	Auxin-mimic	Lake Restoration

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Survey Objectives

A point-intercept survey was used to assess the distribution of aquatic plants in Big Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and over time, 2) compare year to year plant variation (in plant presence and spatial location) and 3) track invasive aquatic plants. Moreover, this survey will help the DNR and our partners to monitor native plant communities and evaluate possible responses to invasive aquatic plant management via herbicide control. It is important to note that distributions and occurrences of aquatic plants may vary from year to year due to natural variations (water clarity, snow cover, water temperatures, and natural fluctuation in plant species) or human induced alterations, such as, herbicide and shoreline management activities.

Survey Methods

We used a point-intercept survey method developed by John Madsen in "Aquatic Plant Control Technical Note MI-02, 1999". Sampling points were placed 65 meters apart using a Geographic Information System. Actual sampling points varied by depth of rooted vegetation and surveyor. The most recent survey was comprised of 155 points on a grid (Figure 1). Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. All plant taxa (submerged, floating-leaf, emergent and free floating) were recorded to species or genera during the survey following Crow and Hellquist (2000). Plant samples were assessed on the boat to determine species presence-absence and abundance. The abundance rake rating are as follows: 1: sparse, 2: common/ frequent/ occasional, and 3: abundant/matted (Table 2). Frequencies of occurrence percentages (i.e., how often a plant species was sampled in the lake) were calculated based on the littoral zone. Maximum depths were calculated at the 95th percentile for all vegetated sampling points.

Table 2 - Quantitative rake abundance ranking (0-3) used to estimate plant abundance for each species based on rake coverage and/or visual observation (MN DNR). A zero (0) ranking indicates no target plants were retrieved or observed in a sample.

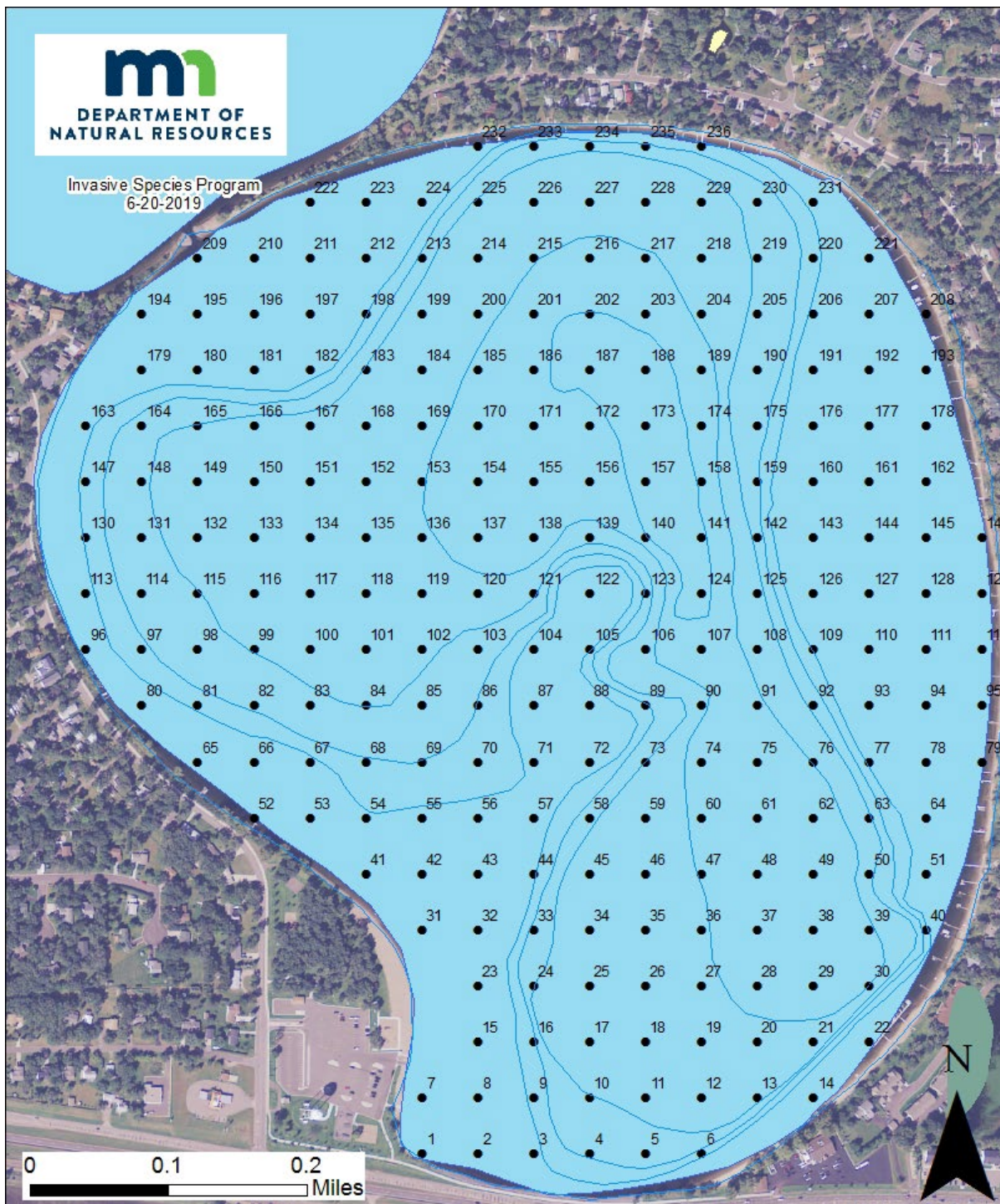| Abundance Ranking	Rake Coverage	Description
1		Sparse; plants covering <25% of the rake head
2		Common; plants covering 25%-75% of the rake head
3		Abundant; plants covering >75% of the rake head

Figure 1 – Point-intercept Survey Grid. Point-intercept survey grid for Big Lake, Sherburne County (DOW#71008200). Point-intercept survey included 117 points, 65 meters apart. Based on the depth of rooted vegetation, not all points were sampled.

Survey Observations

The most recent aquatic vegetation point-intercept survey of Big Lake (DOW # 71008200) occurred on June 13, 2022. Plants were rooted to a maximum depth (95%) of 15.0 feet, with depths ranging from 2.0 to 19 feet. In the littoral zone (water depth from 0 to 15 feet, where aquatic plants are likely to be found), 92% of the points had submersed native vegetation (Table 3) with a mean submersed native taxa per point of 2.9. Big Lake has up to 15 submersed native taxa (Table 4) and two non-native submerged taxa (curly-leaf pondweed and Eurasian watermilfoil), comprising of 45% of the littoral area.

Table 3 - Point-intercept Metrics. Summary of point-intercept metrics for Big Lake, Sherburne County (DOW#71008200). Shaded values were calculated from littoral depth range (0-15 feet).

Metric	JUNE 2004	AUG 2009	AUG 2010	SEPT 2013	JUNE 2019	JUNE 2022
Surveyor	MN DNR (LEU)	MN DNR (ISP)	MN DNR (LEU)	MN DNR (ISP)	MN DNR (ISP)	MN DNR (ISP)
Total # Points Sampled	98	91	160	60	117	128
Depth Range of Rooted Veg (ft.)	4- 21	2- 13	3- 15	2-15	2-19	2-18
Max Depth of Growth (95%)	n/a	n/a	n/a	15.8	17.3	15
# of Vegetated Points in Max Depth Range	69	85	85	47	100	105
# Points in Littoral (0-15 feet)	63	91	101	52	99	105
% Points w/ Submersed Native Taxa	94	98	89	94	86	92
Mean Submersed Native Taxa/ Point	2.5	1.9	2.6	3.1	2.4	2.9
# Submersed Native Taxa	11	13	13	10	14	15
# Submersed Non-Native Taxa	1	2	1	1	2	2
% Points w/ Submersed Non- native Taxa	43	7	3	4	45	38

Based on the 2022 point-intercept survey, the native plant community within the littoral area in Big Lake was primarily dominated by narrow-leaf pondweed (*Potamogeton* spp.; Figure 2), followed by northern watermilfoil (*Myriophyllum sibiricum;* Figure 3), muskgrass (*Chara*; Figure 4) and coontail (*Ceratophyllum demersum*). Curly-leaf pondweed occupied 32% of the sampling sites in 2022 and Eurasian watermilfoil (15%). Overall, Big Lake has a diverse aquatic plant community. Aquatic plants are central to a healthy fish population, offering shelter and providing food and habitat to wildlife. Big Lake has very few emergent and floating- leaf plants due to shoreline development and destruction. It would be recommended to restore the shoreline to prevent continued shoreline erosion, provide better habitat and food sources for

wildlife, including waterfowl. Plants also absorb nutrients and reduce algae, thereby improving water quality.

Table 4 - Plant Frequency of Occurrence. Percent frequency of occurrence for observed plant species within the littoral zone (0-15 feet) in Big Lake, Sherburne County (DOW#71008200).

Taxonomic Name	Common Name	JUNE 2004	AUG 2009	AUG 2010	SEPT 2013	JUNE 2019	June 2022
MN DNR Surveyors		(LEU)	(ISP)	(LEU)	(ISP)	(ISP)	(ISP)
SUBMERSED NON-NATIVE							
Potamogeton crispus	curly-leaf pondweed	24	4	0	0	40	32
Myriophyllum spicatum	Eurasian watermilfoil	0	2	3	4	18	15
SUBMERSED NATIVE							
Ulricularia sp.	bladderwort species	0	0	0	0	0	1
Bidens beckii	water marigold	0	0	2	0	0	3
Ceratophyllum demersum	coontail	33	38	42	56	32	39
Chara sp.	muskgrass	56	33	39	33	30	39
Elodea canadensis	Canadian waterweed	0	8	14	2	4	1
Heteranthera dubia	water star-grass	5	0	15	0	8	8
Myriophyllum sibiricum	northern water-milfoil	33	9	20	52	34	42
Nitella sp.	nitella species	0	11	0	0	1	0
Najas sp.	naiad species	37	40	69	44	20	13
Potamogeton epihydrus	ribbon-leaf pondweed	0	8	0	0	0	0
Potamogeton gramineus	variable pondweed	21	0	0	8	1	15
Potamogeton illinoensis	Illinois pondweed	13	0	8	42	24	21
Potamogeton praelongus	white-stem pondweed	3	2	0	0	2	14
Potamogeton richardsonii	clasping-leaved pondweed	0	2	1	10	21	28
Potamogeton strictrifolius	straight- leaved pondweed	0	0	2	0	0	0
Potamogeton robbinsii	Robbin's pondweed	0	1	0	0	0	0
Potamogeton spp.	narrow-leaf pondweed*	16	1	0	0	57	60
Potamogeton zosteriformis	flat-stemmed pondweed	10	19	0	0	5	5
Stuckenia pectinata	sago pondweed	3	14	30	37	0	3
Vallisneria americana	wild celery	0	0	18	17	1	0
EMERGENT							
Sagittaria sp.	arrowhead species	0	0	1	0	1	0

* Narrow-leaf pondweeds may include several species of *Potamogeton*, including *P. foliosus* and *P. strictifolius.* Surveyors used this group to record narrow-leaf pondweed (*Potamogeton* spp.) that were not identified to the species level. Sampling depths by year: 2004 (25 feet); 2009: (15 feet); 2010: (25 feet); 2013 and 2019: (20 feet)

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Comparison to previous years

When comparing survey years, it is important to note when the survey was conducted. For example, curly- leaf pondweed peak abundance is June, although for most native aquatic plants, mid to late summer is the best time to evaluate native aquatic plant communities. Over time, the submersed native plant community has remained stable (Table 3). Over the past 10 years, muskgrass (*Chara* sp.) has shown a decrease, although there has been an increase in clasping-leaved pondweed. Increases in both curly- leaf pondweed and Eurasian watermilfoil have been observed over the 10 year period (Figures 5 and 6), with 38% of the sampling sites in the littoral area occupied with an invasive aquatic plant in the 2022. Overall, the native aquatic plant community is most dominant in Big Lake with invasive aquatic plants coexisting among native aquatic plants.
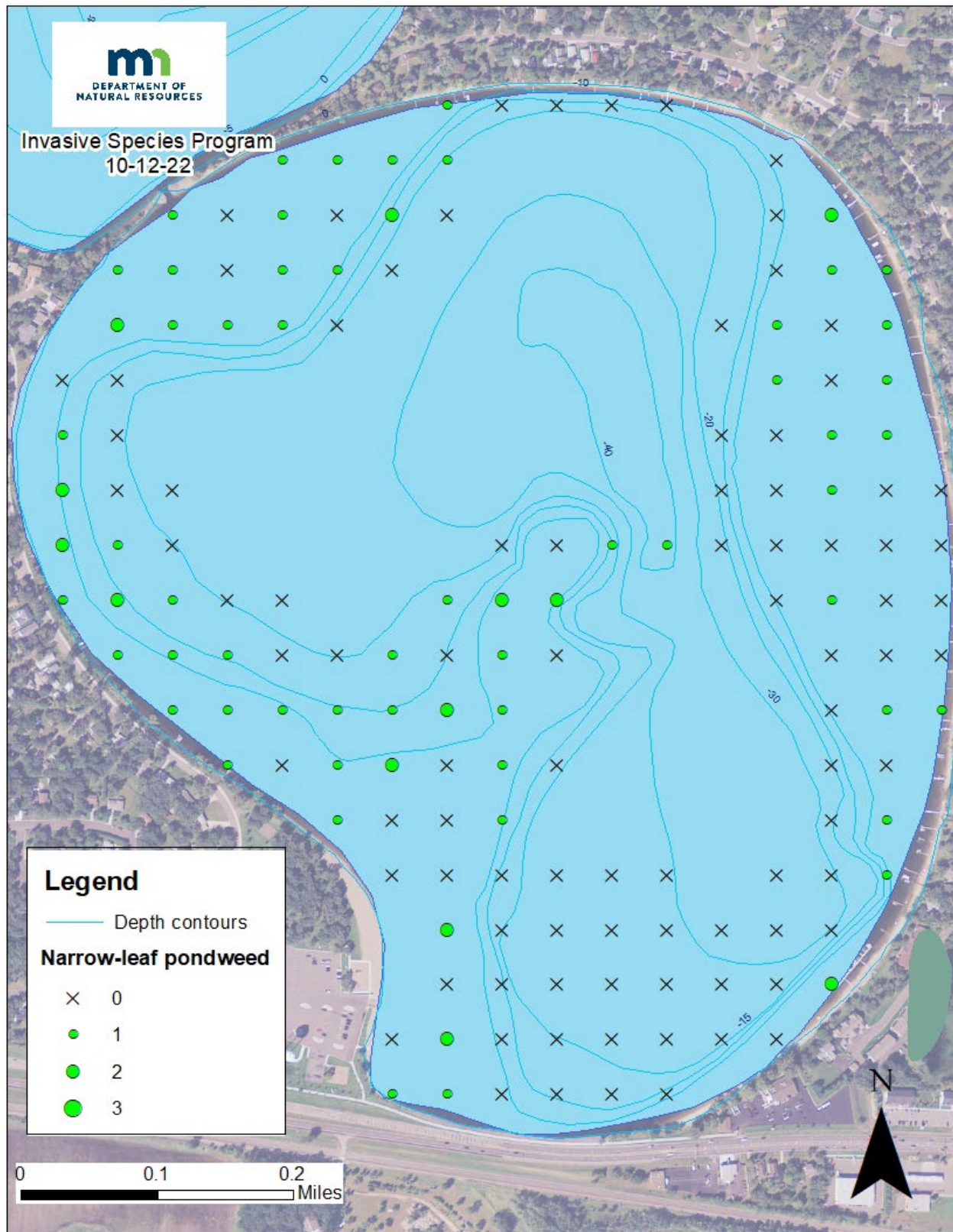
Figure 2 – Narrow-leaf pondweed Distribution. Plant distribution from the 2022 point-intercept survey for narrow-leaf pondweeds in Big Lake, Sherburne County (DOW#71008200). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.
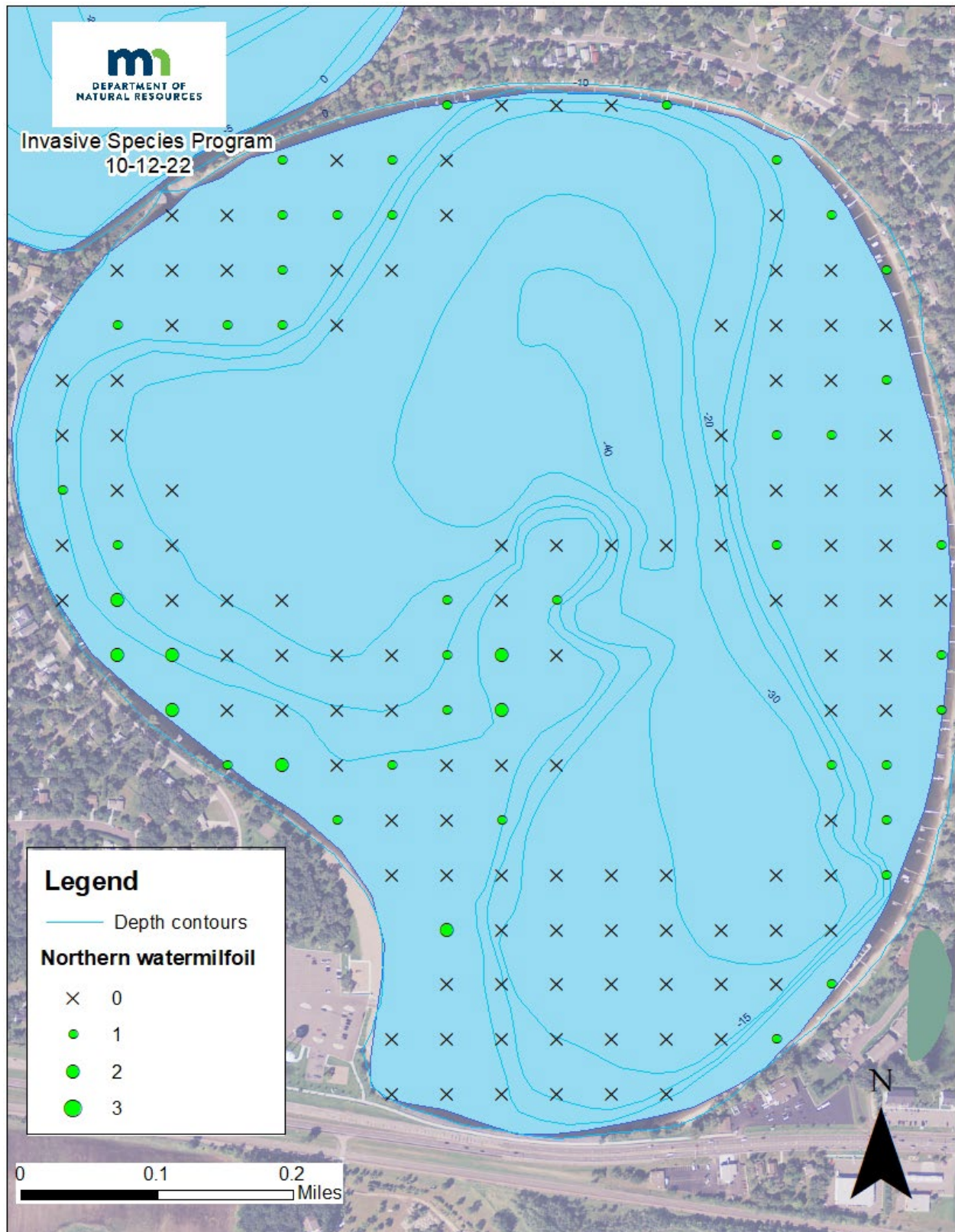
Figure 3 – Northern watermilfoil Distribution. Plant distribution from the 2022 point-intercept survey for northern watermilfoil in Big Lake, Sherburne County (DOW#71008200). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.
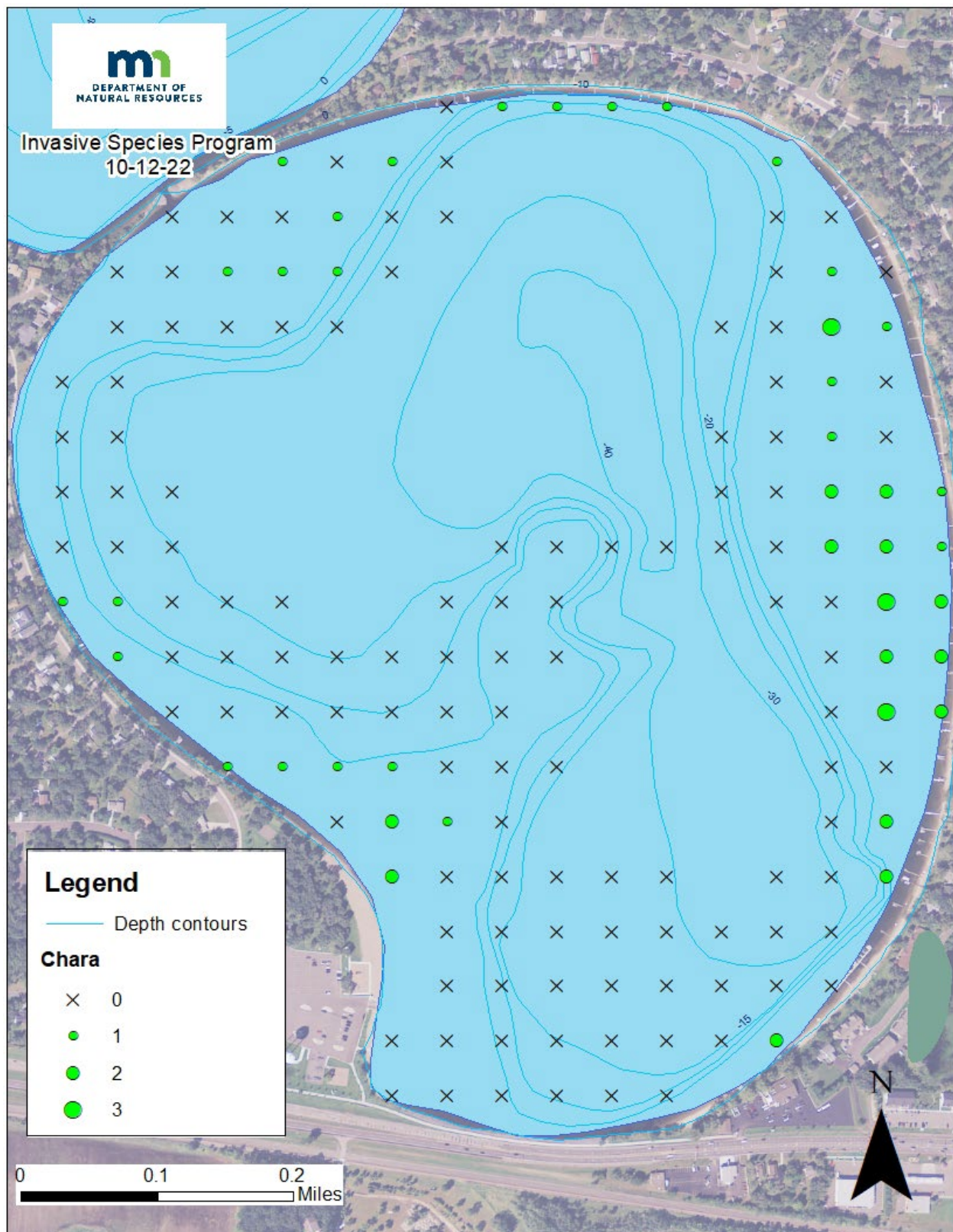
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Figure 4 – Chara Distribution. Plant distribution from the 2022 point-intercept survey for chara in Big Lake, Sherburne County (DOW#71008200). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.
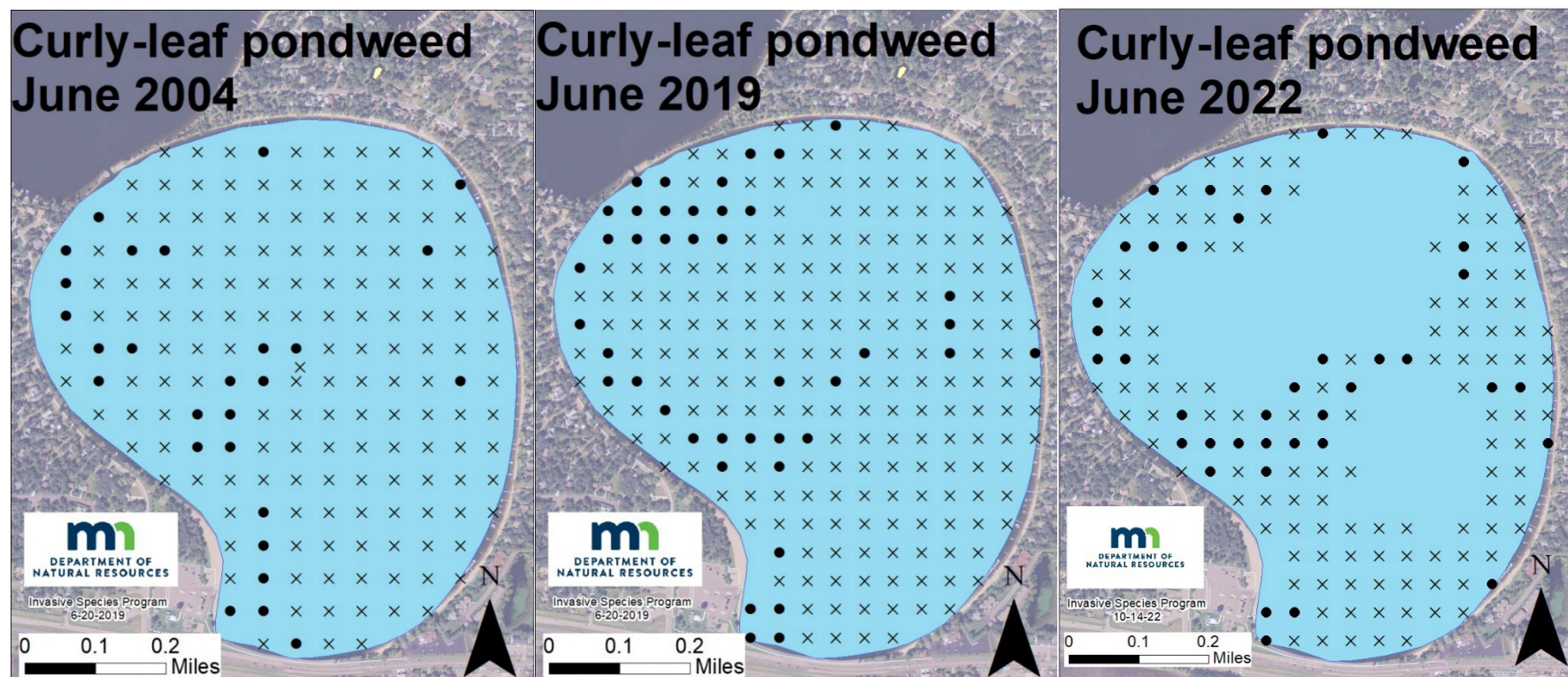
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Figure 5 – Curly-leaf pondweed Distribution. Plant distribution from the 2004, *2019,* and 2022 point-intercept surveys for curly-leaf pondweed in Big Lake, Sherburne County (DOW#71008200). An "X" indicates that no curly-leaf pondweed was present and a black circle indicates that curly-leaf pondweed was present.
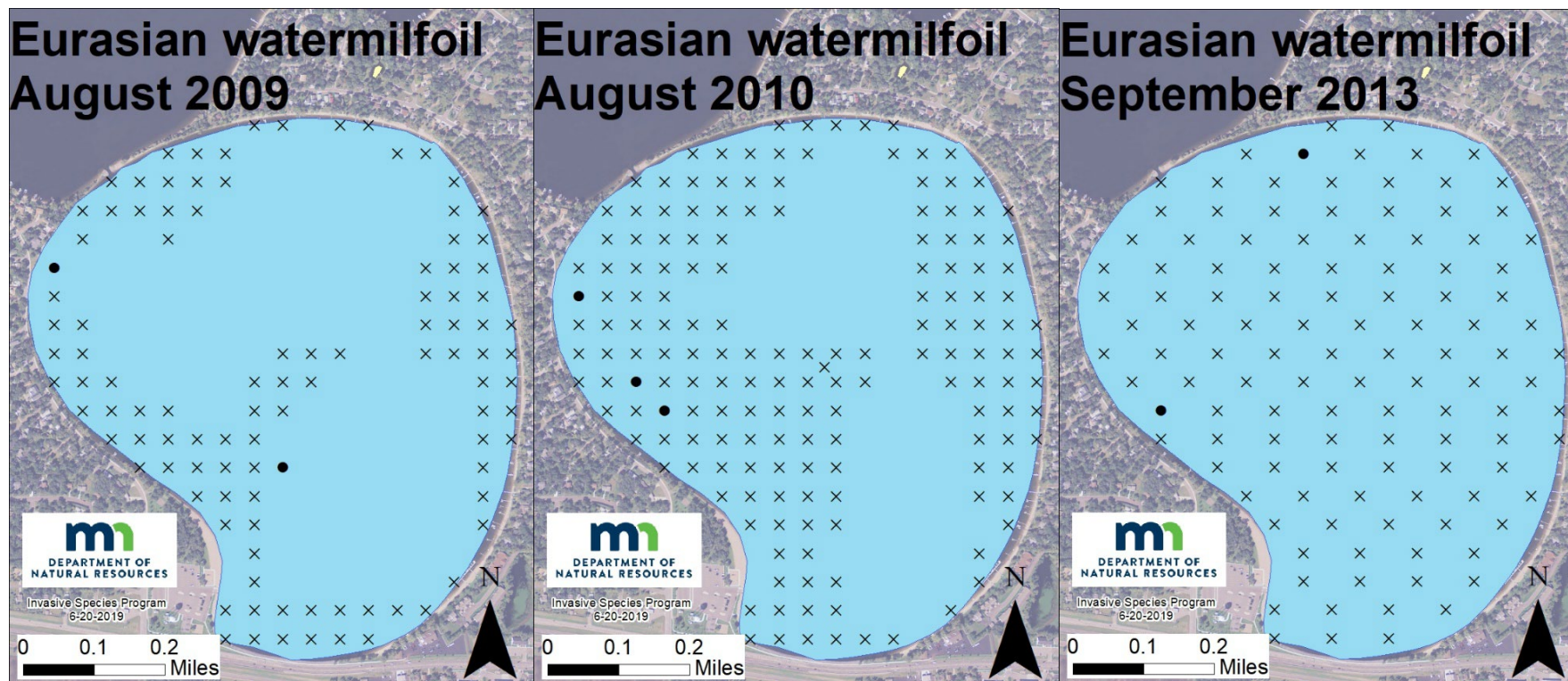
Figure 6 – Eurasian watermilfoil Distribution. Eurasian watermilfoil distribution maps from the 2009, 2010, and 2013 point-intercept surveys in Big Lake, Sherburne County (DOW#71008200). An "X" indicates that no Eurasian watermilfoil was present and a black circle indicates that Eurasian watermilfoil was present.

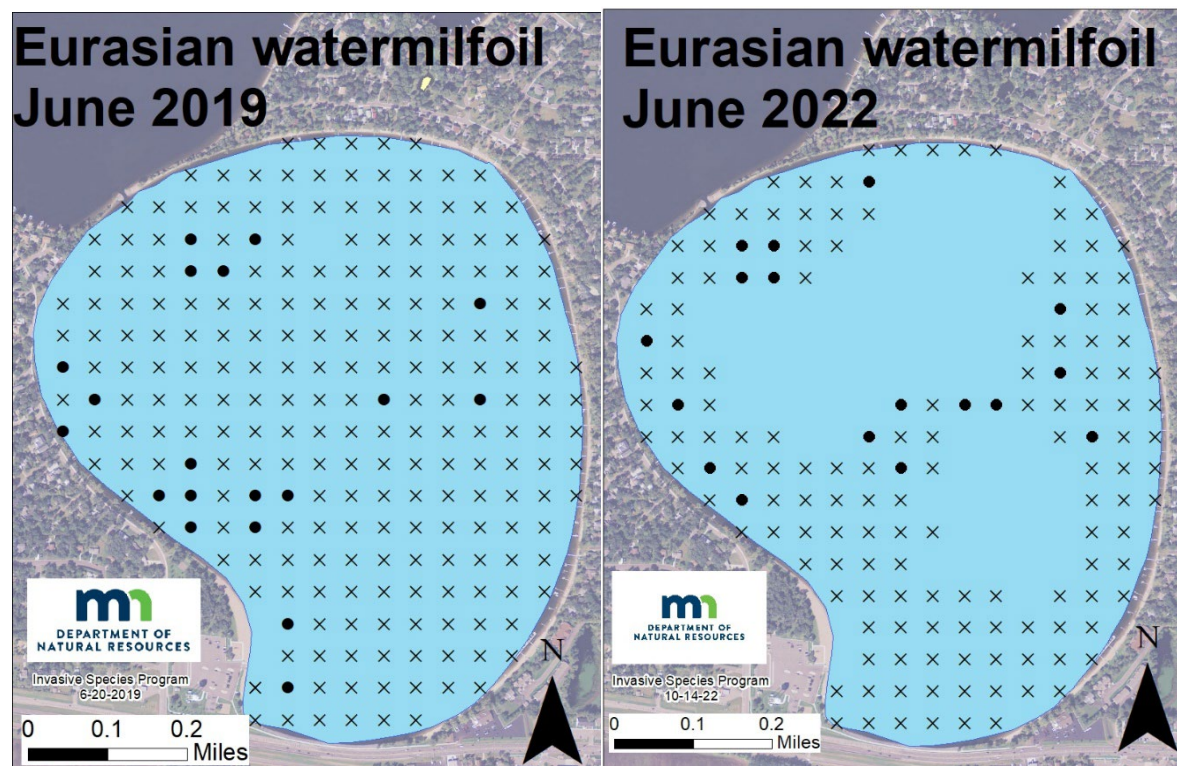Big Lake, Sherburne County: 2022 MN DNR Aquatic Vegetation Management Report

Figure 7 – Eurasian watermilfoil Distribution. Eurasian watermilfoil distribution maps from the 2019 and 2022 point-intercept surveys in Big Lake, Sherburne County (DOW#71008200). An "X" indicates that no Eurasian watermilfoil was present and a black circle indicates that Eurasian watermilfoil was present.

Literature Cited

Crow, G.E. and C.B. Hellquist. (2000). *Aquatic and wetland plants of Northeastern North America*. (Vols. 1 & 2). Madison, WI: The University of Wisconsin Press.

Madsen, J. (1999). *Point-intercept and line intercept methods for aquatic macrophytes management.* APCRP Technical Notes Collection (TN APCRP-M1-02). Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Perleberg, D. and S. Simon. 2011. Aquatic vegetation of Big Lake (ID# 71-0082-00) and Mitchell Lake (ID#71-0081-00), Sherburne County, Minnesota, 2004, 2009 and 2010. Minnesota Department of Natural Resources, Division of Ecological and Water Resources, Lakes and Rivers Program. 1601 Minnesota Drive, Brainerd, MN 56401. 28 pp.