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# Long Lake, Morrison County

## Aquatic Vegetation Management Report

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

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Prepared by:  
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Division of Ecological and Water Resources  
Minnesota Department of Natural Resources

## Project Details

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**Lake:** Long (DOW# 49001500)

**Lake Surface Area:** 125.5 acres

**Littoral Area:** 68.6 acres

**County:** Morrison County

**Survey Type:** Point-intercept

**Date of Survey (most recent):** August 26, 2013

**Observer[s]:** MN DNR Surveyors: 2013: Christine Jurek and Courtney Millaway [(MN DNR-Invasive Species Program (ISP))], 2011: Donna Perleberg and Stephanie Simon (MN DNR-Lake Habitat Program), 2010: Dan Swanson and Matt Pierce (MN DNR-ISP), 2009: Dan Swanson and Ben Burggraaf, 2008: Audrey Kuchinski and Larry Zimmerman (MN DNR-Fisheries) and 2006: Audrey Kuchinski and Larry Zimmerman.

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## Report Details

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## Summary

The purpose of this report is to provide an overview of aquatic plant distribution and the management of invasive aquatic plants in Long Lake, Morrison County. 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

Long Lake is a 125.5- acre lake located near the town of Sullivan in Morrison County. The maximum depth of water in Long Lake is 35 feet, and 54.6% of the lake is classified as littoral (water depths between 0 to 15 feet, where aquatic plants are most likely to grow). According to surveys from the Minnesota Pollution Control Agency (MPCA, 2014), Long Lake is classified as a mesotrophic lake, based on its Trophic State Index (TSI) of approximately 48. 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 [Long Lake water quality](https://webapp.pca.state.mn.us/surface-water/station/49-0015-00-202) on the MPCA website (<https://webapp.pca.state.mn.us/surface-water/station/49-0015-00-202>).

## Management History

The lake has one invasive plant species: curly-leaf pondweed (*Potamogeton crispus*). Invasive aquatic plant management in Long Lake has focused on curly-leaf pondweed using an endothall herbicide. The most recent treatment organized by the Long Lake Homeowner's Association was for curly-leaf pondweed was for 2.5 acres in 2021, (Table 1). Past treatments have ranged from 2.5 to 11.4 acres. The invasive aquatic plant community has varied from year to year. 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 partial lake invasive plant treatments for Long Lake, Morrison County (DOW#49001500). Total acres: 125.5, Littoral acres: 68.6, 15% of Littoral acres: 9.5). Abbreviations are as followed: curly-leaf pondweed (CLP), Professional Lake Management (PLM). Note: Total acres permitted does not reflect the actual treatment or known acreage of the taxa in the lake.

Date	Target Species	Total Acres Permitted	Herbicide	Licensed Commercial Applicator
2005	CLP	5.5	Endothall	PLM
2006	CLP	13.5	Endothall	PLM
2007	CLP	13.5	Endothall	PLM
2008	CLP	12.2	Endothall	PLM
2009	CLP	11.0	Endothall	PLM
2010	CLP	2.0	Endothall	PLM
2011	CLP	14.8	Endothall	PLM
2012	CLP	11.4	Endothall	PLM
2013	CLP	11.4	Endothall	PLM
2014	CLP	9.0	Endothall	PLM
2019	CLP	6.8	Endothall	PLM
2020	CLP	6.8	Endothall	PLM
2021	CLP	2.5	Endothall	PLM




### Survey Objectives

A point-intercept survey was used to assess the distribution of aquatic plants in Long 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.

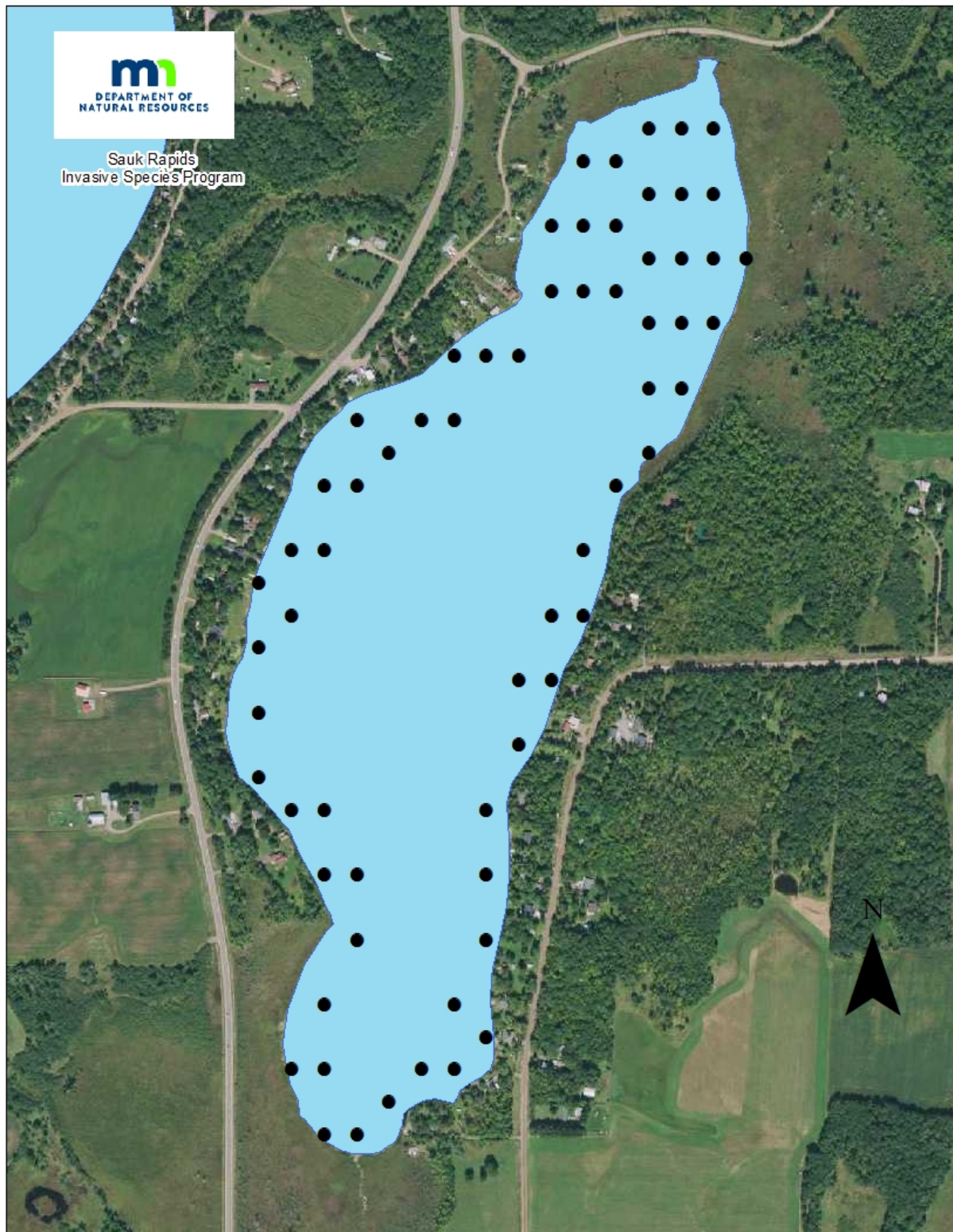
## Survey Methods

We used a point-intercept survey method developed by John Madsen in “Aquatic Plant Control Technical Note MI-02, 1999”. Sampling points were placed 50 meters apart using a Geographic Information System. Actual sampling points varied by year, depth of rooted vegetation and surveyor. The most recent survey was comprised of 60 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 95<sup>th</sup> 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.** 2013 Point-intercept survey grid for Long Lake, Morrison County (DOW#49001500).

## Survey Observations

The most recent aquatic vegetation point-intercept survey of Long Lake (DOW #49001500) occurred on 26 August 2013. Plants were rooted at points from 0.5 to 18 feet. In the littoral zone (water depth from 0 to 15 feet, where aquatic plants are likely to be found), 91% of the points had submersed native vegetation (Table 3) with a mean submersed native taxa per point of 2.72. Long Lake has up to 24 submersed native taxa (Table 4) and one non-native submerged taxa (curly-leaf pondweed). The 2013 point-intercept of Long Lake may underrepresent the floating-leaf and emergent communities due to the points that were not sampled because these points were not accessible.

**Table 3. Point-intercept Metrics.** Summary of point-intercept metrics for Long Lake, Morrison County (DOW#49001500). Shaded values were calculated from littoral depth range (0-15 feet).

Metric	APRIL 2006	AUG 2008	AUG 2009	JULY 2010	AUG 2011	AUG 2013
Surveyor	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR
Total # Points Sampled	160	135	183	120	175	60
Depth Range of Rooted Veg (ft.)	2-16	1-15	1-21	1-14	1-20	0.5-18
# of Points in Max Depth Range	104	120	111	99	86	47
# Points in Littoral (0-15 feet)	127	135	132	117	106	54
% Points w/ Submersed Native Taxa	79	93	77	79	85	91
Mean Submersed Native Taxa/ Point	1.47	2.76	2.23	2.38	2.45	2.72
# Submersed Native Taxa	12	17	17	18	17	16
# Submersed Non-Native Taxa	1	1	1	1	1	1
% Points w/ Submersed Non- native Taxa	23	10	5	24	5	13

Based on the 2013 point-intercept survey, the native plant community in Long Lake was primarily dominated by: coontail (*Ceratophyllum demersum*) at 75.9% (Figure 2), followed by northern watermilfoil (*Myriophyllum sibiricum*) (Figure 3), and flat-stemmed pondweed (*Potamogeton zosteriformis*), (Figure 4). These aquatic plants are central to a healthy fish population, offering shelter and providing food and habitat to wildlife. Long Lake has a diverse native aquatic plant community with a species total of up to 37 taxa (Figure 5).

spatial distribution and species richness (# of species per sample point) of all native submersed species from the most recent point-intercept survey. Long Lake has up to five emergent and eight floating- leaf vegetation. These plants are especially good at preventing shoreline erosion, habitat and providing food sources for waterfowl. Plants also absorb nutrients and reduce algae, thereby improving water quality. The frequency of curly-leaf pondweed in 2013 was 12.9% (Figure 6). Although, due to the timing of the survey in late summer, the percent frequency may not be representative of the peak abundance of this species which occurs in June. Curly- leaf pondweed senescences during late June/ early July so any plants observed later in the summer are typical from new growth.

#### Comparison to previous years

Six aquatic plant survey have occurred on Long Lake between 2006 and 2013. When comparing survey years, it is important to note a few things. One item to take in to account is 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. Also, some plant species may be grouped differently in certain years. For example; Freis' pondweed, very small pondweed, and horned pondweed may be grouped into narrow-leaved pondweed species depending on the surveyor and the time of year.

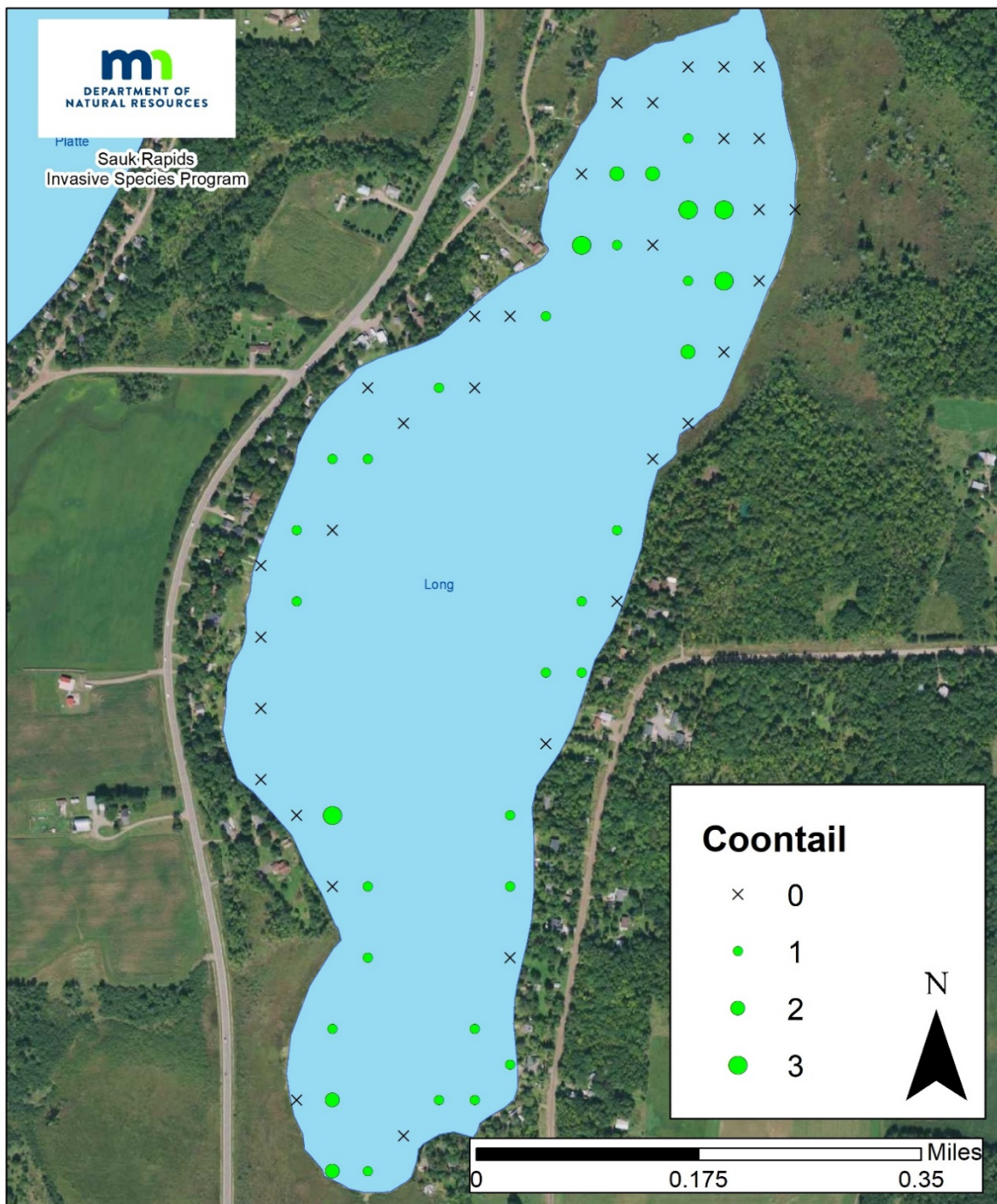
The most commonly found submerged native taxa in Long Lake include coontail, flat-stemmed pondweed and northern watermilfoil. Future surveys are recommended to evaluate both the native and invasive aquatic plant communities.



**Table 4. Plant Frequency of Occurrence.** Percent frequency of occurrence for observed plant species within the depth of rooted vegetation in Long Lake, Morrison County (DOW#49001500).

Taxonomic Name	Common Name	APRIL 2006	AUG 2008	AUG 2009	JULY 2010	AUG 2011	AUG 2013
MN DNR Surveyors		(FSH)	(FSH)	(ISP)	(ISP)	(LHP)	(ISP)
<b>SUBMERSED NON-NATIVE</b>							
<i>Potamogeton crispus</i>	Curly-leaf pondweed	16.4	6.7	3.3	18.8	6.0	12.9
<b>SUBMERSED NATIVE</b>							
<i>Bidens beckii</i>	Water marigold	0	10	1.1	3.1	4.0	0
<i>Ceratophyllum demersum</i>	Coontail	39.3	68.3	48.9	23.4	62	75.9
<i>Chara</i> sp.	Muskgrass species	14.8	28.3	32.2	39.1	30.0	1.7
<i>Drepanocladus</i> sp.	Watermoss	0	0	4.4	0	0	0
<i>Eleocharis</i> sp.	Spikerush species	0	5.0	3.3	0	0	0
<i>Elodea canadensis</i>	Canadian waterweed	18	35	26.7	15.6	20	1.7
<i>Heteranthera dubia</i>	Water stargrass	13.1	16.7	15.6	1.6	26	1.7
<i>Potamogeton freisii</i>	Fries' pondweed	0	0	0	0	2.0	0
<i>Potamogeton</i> spp.	Narrow-leaf pondweed	0	0	0	14.1	4.0	3.4
<i>Potamogeton amplifolius</i>	Large-leaved pondweed	3.3	16.7	0	17.2	6.0	17.2
<i>Potamogeton gramineus</i>	Variable-leaved pondweed	0	1.7	2.2	7.8	6.0	0
<i>Potamogeton illinoensis</i>	Illinois pondweed	0	3.3	10.0	4.7	4.0	6.9
<i>Potamogeton praelongus</i>	White-stem pondweed	6.6	8.3	8.9	9.4	2.0	10.3
<i>Potamogeton pusillus</i>	Very small pondweed	0	0	0	0	0	3.4
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	0	0	0	4.7	0	0
<i>Potamogeton zosteriformis</i>	Flat-stemmed pondweed	14.8	0	2.2	21.9	2.0	37.9
<i>Myriophyllum sibiricum</i>	Northern watermilfoil	19.7	11.7	25.6	53.1	38.0	46.6
<i>Najas flexilis</i>	Bushy naiad	0	21.7	8.9	12.5	4.0	5.2
<i>Nitella</i> sp.	Stonewort species	1.6	0	0	0	0	0
<i>Ranunculus</i> sp.	Buttercup species	0	13.3	21.1	0	18.0	3.4
<i>Stuckenia pectinata</i>	Sago pondweed	1.6	1.7	0	0	0	0
<i>Utricularia vulgaris</i>	Common bladderwort	13.1	33.3	22.2	14.0	32.0	12.1
<i>Vallisneria americana</i>	Wild celery	0	16.7	20.0	9.4	14.0	29.3
<i>Zannichellia palustris</i>	Horned pondweed	0	0	0	0	0	1.7

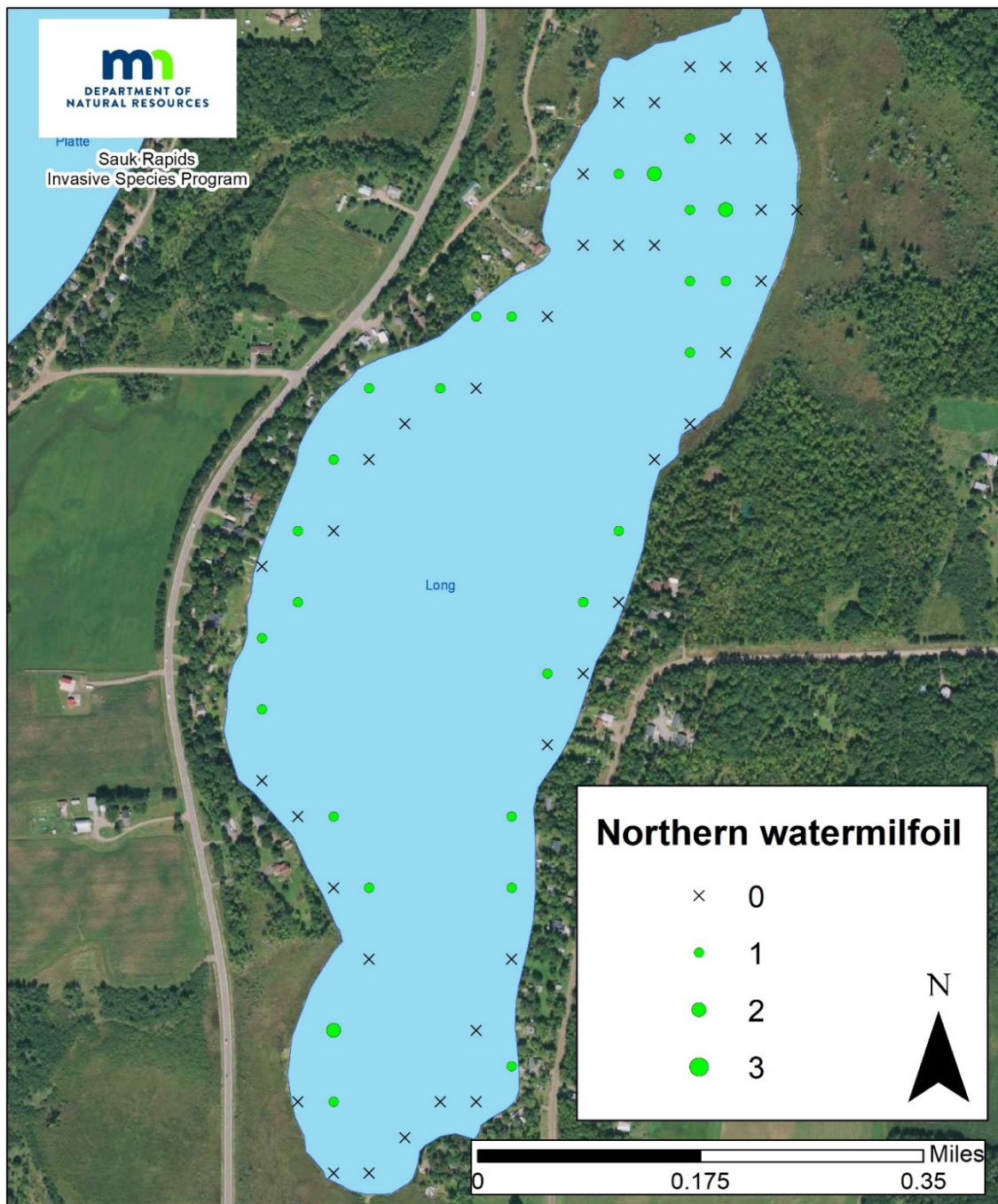
Taxonomic Name	Common Name	APRIL 2006	AUG 2008	AUG 2009	JULY 2010	AUG 2011	AUG 2013
MN DNR Surveyors		(FSH)	(FSH)	(ISP)	(ISP)	(LHP)	(ISP)
<b>EMERGENT</b>		—	—	—	—	—	—
<i>Sagittaria</i> sp.	Arrowhead species	0	5.0	1.1	6.3	0	5.2
<i>Schoenoplectus</i> sp.	Bulrush species	8.2	10.0	5.6	6.3	10.0	1.7
<i>Typha</i> sp.	Cattail species	0	5.0	3.3	0	0	0
<i>Zizania palustris</i>	Wild rice	42.6	71.7	68.6.3	76.6	58.0	27.6
<b>FLOATING LEAF</b>							
<i>Brasenia schreberi</i>	Watershield	0	10.0	7.8	12.5	10.0	3.4
<i>Lemna</i> sp.	Duckweed species	0	0	3.3	28.1	0	0
<i>Lemna trisulca</i>	Star duckweed	32.8	25.0	22.2	0	38.0	0
<i>Nymphaea odorata</i>	White waterlily	1.6	36.7	38.9	32.8	28.0	6.9
<i>Nuphar variegata</i>	Yellow waterlily	3.3	46.7	41.1	57.8	42.0	36.2
<i>Potamogeton natans</i>	Floating-leaf pondweed	0	0	1.1	1.6	0	0
<i>Spirodela polyrhiza</i>	Greater duckweed	0	40.0	2.2	0	18.0	0
<i>Wolffia</i> sp.	Watermeal species	0	30.0	0	0	2.0	0



## Long Lake, Morrison Co. (DOW #49001500)

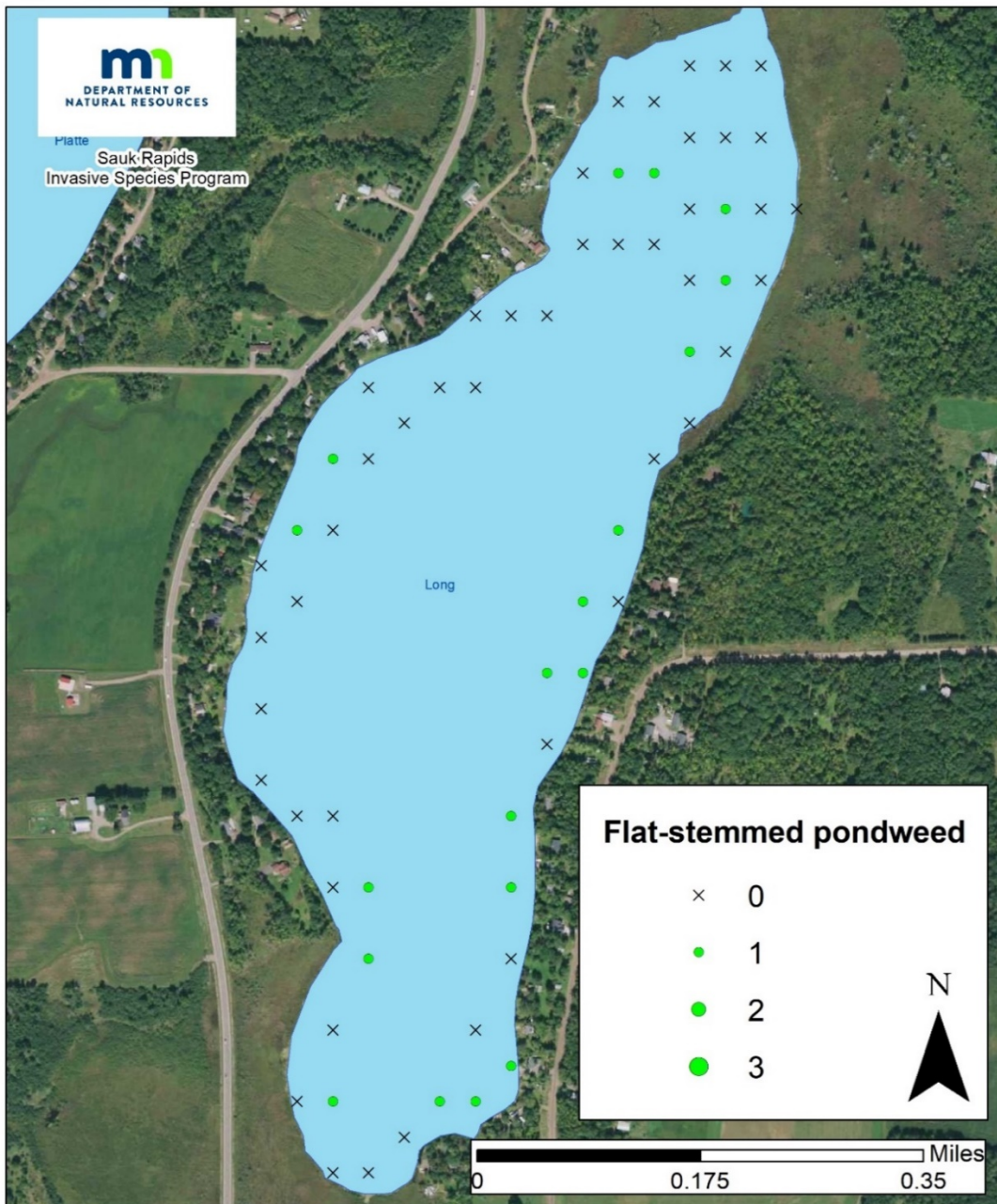
**Figure 2. Coontail Distribution.** Plant distribution from the August 26, 2013 point-intercept survey for coontail in Long Lake, Morrison County (DOW#49001500). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.





Long Lake, Morrison Co. (DOW #49001500)

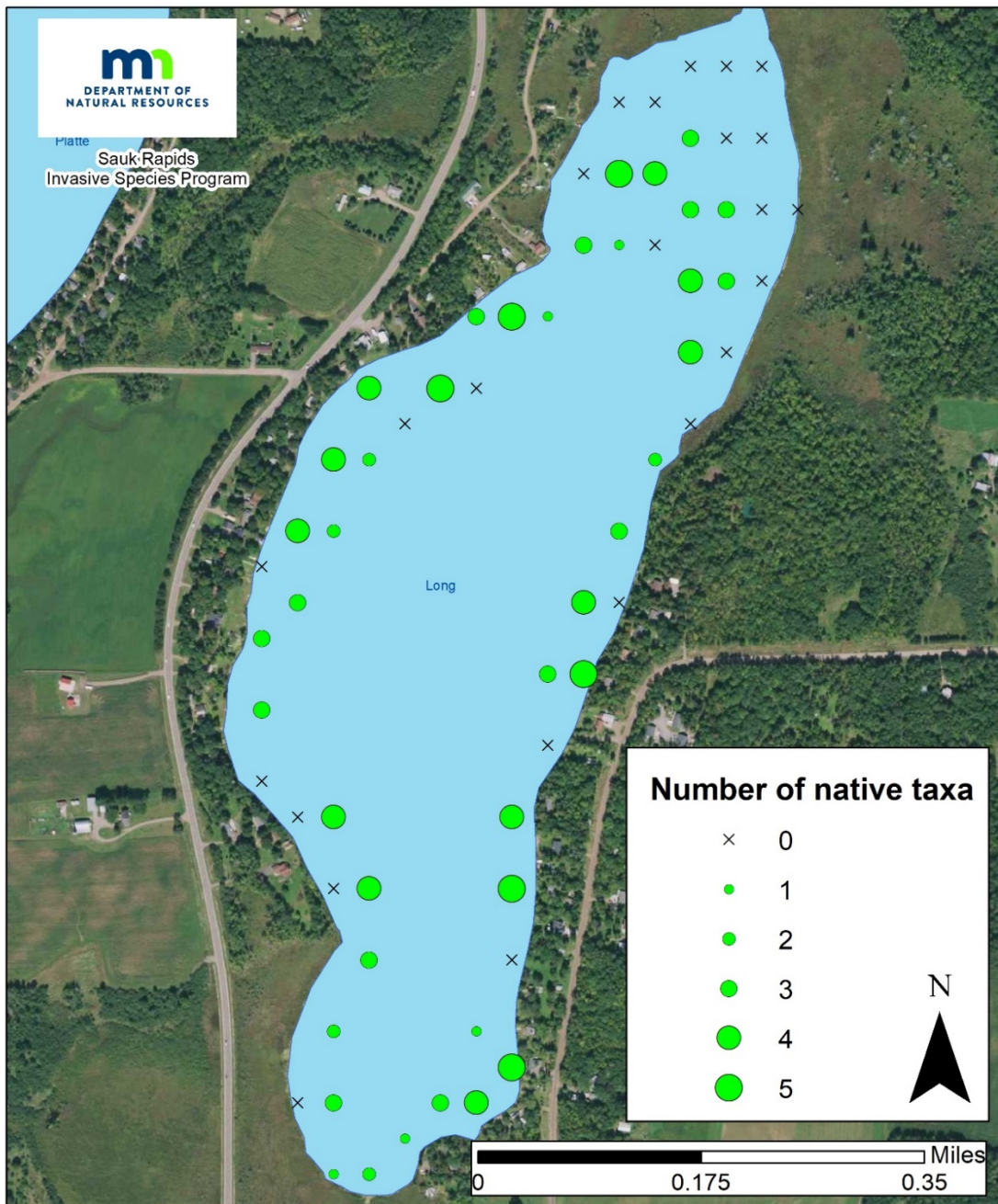
**Figure 3. Northern watermilfoil Distribution.** Plant distribution from the August 26, 2013 point-intercept survey for northern watermilfoil in Long Lake, Morrison County (DOW#49001500). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.



Long Lake, Morrison Co. (DOW #49001500)

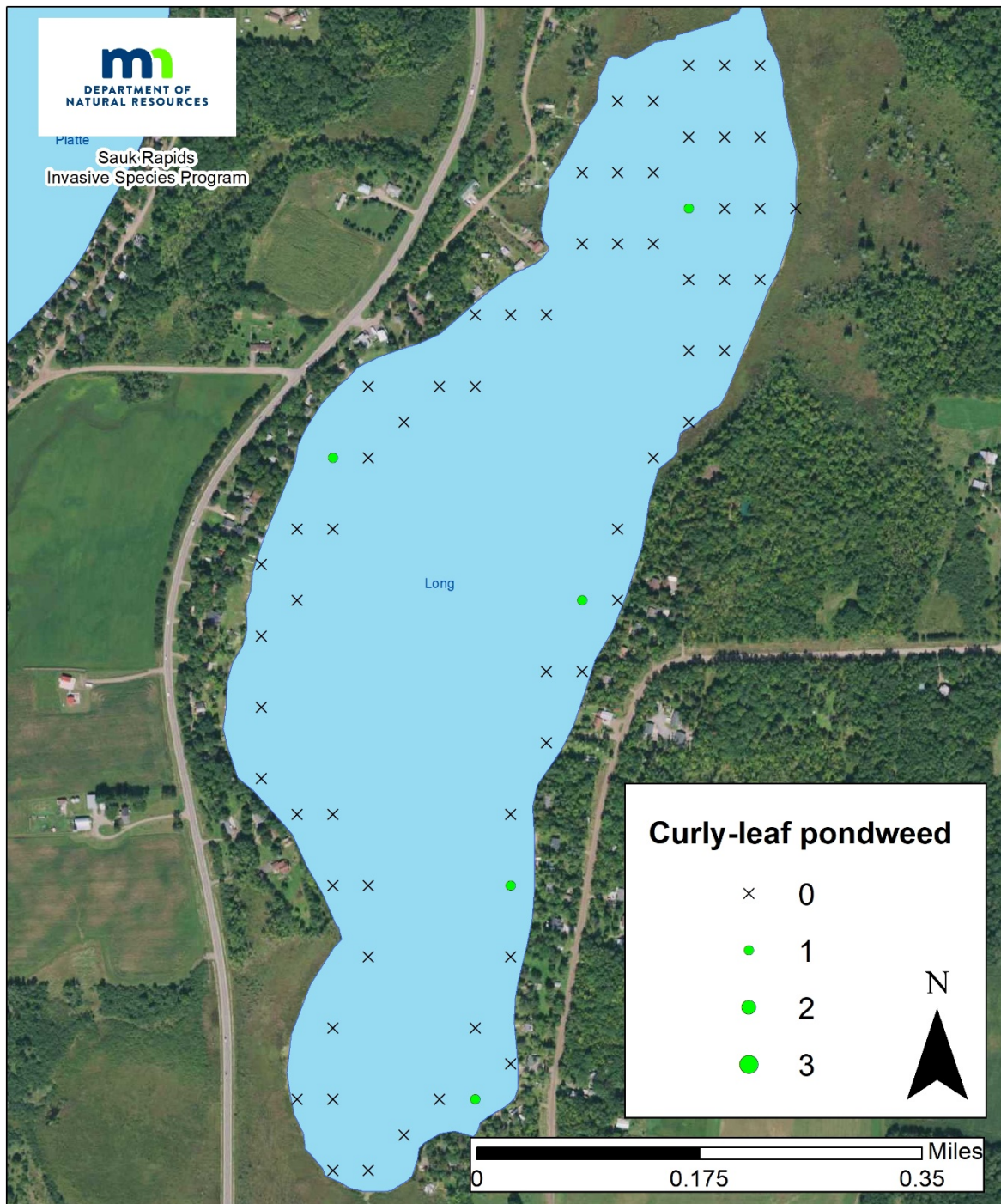
**Figure 4. Flat-stemmed pondweed Distribution.** Plant distribution from the August 26, 2013 point-intercept survey for flat-stemmed pondweed in Long Lake, Morrison County (DOW#49001500). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.





Long Lake, Morrison Co. (DOW #49001500), 2013

**Figure 5. Species Richness Distribution.** Number of species per a sampling point based on the August 26, 2013 point-intercept survey in Long Lake, Morrison County (DOW#49001500).



Long Lake, Morrison Co. (DOW #49001500), 2013

**Figure 6. Curly-leaf pondweed Distribution.** Plant distribution from the 2013 point-intercept survey for curly-leaf pondweed in Long Lake, Morrison County (DOW#49001500). Densities ranged from 0 to 3 at each point, with 3 indicating dense plant presence and 0 indicating no plants.

### 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