
DIAMOND LAKE, HENNEPIN COUNTY: 2024 AQUATIC VEGETATION REPORT

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

Lake: Diamond (DOW# 27012500)

Lake Surface Area: 405 acres

Littoral Area: 405 acres

County: Hennepin

Survey Type: Point-intercept

Date of Survey (most recent): July 18, 2024

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2024 Summary:

The most recent aquatic vegetation point-intercept survey of Diamond Lake (DOW #27012500) was completed on July 18, 2024. Submersed plants were identified to a maximum depth of 2.0 meters (6.7 feet). Within the littoral zone (area in the lake from the 0 – 15-foot depth range [0 – 4.5 meters]), 81% of sampled points contained native submersed plants. The average number of native submersed taxa per sample point was 1.66. Seven native submersed plant species were observed during the 2024 survey. Whole lake fluridone treatments were conducted every year from 2019 – 2022 targeting curly-leaf pondweed in early spring, but Diquat was used to spot-treat in 2023 and 2024.

Summary Table. Summary of aquatic submersed plants in Diamond Lake, Hennepin County, Minnesota (DOW# 27012500) as indicated by the results of point-intercept surveys. Values were calculated from the littoral depth range (0 – 15 feet).

YEAR	Treatment Date	CLP* Acres Treated	PI Survey Date	Max Depth of Growth in feet [95%] [†]	% Points w/ Native Submersed Taxa	Mean Native Submersed Taxa/ Point	# Submersed Taxa	AVG Secchi Depth [m]
2011	NA	0	JUN 30	6.9	69	1.5	6	1.7
	NA	0	SEPT 09	6.9	82	1.3	5	
2012	NA	0	MAY 18	6.7	62	1.2	4	1.2
	NA	0	AUG 31	6.4	79	1.3	6	
2018	MAY	60	JUN 28	6.9	50	0.8	6	0.8
			SEPT 4	4.6	26	0.4	3	
2019	MAY	405	MAY 30	7.0	36	0.5	6	1.3
			JUL 8	5.5	34	0.6	12	
2020	APR	405	JUN 3	6.9	46	0.5	6	0.6
			JUL 7	4.9	27	0.4	6	
2021	APR	405	SEPT 29	5.0	10	0.1	5	0.6
2022	MAY	405	JUN 7	1.2	4	0.1	4	0.9
2023	MAY	45.1	AUG 2	5.7	90	2.34	11	1.1
2024	APR	59.7	JUL 18	6.7	81	1.66	8	-

*CLP is short for curly-leaf pondweed

[†]95th percentile calculated based on all vegetated sampling points

Taxa refers to groups of submersed aquatic plant species or genera

AVG – average Secchi depth (water clarity measurement) from May – September

Lake Description:

Diamond Lake is a 405-acre shallow lake located near Rogers, Minnesota. The lake contains one invasive aquatic plant: curly-leaf pondweed (*Potamogeton crispus*, abbreviated as CLP). The maximum depth of water is 2.4 meters (8 feet). Diamond Lake has a long history of water quality impairments possibly due to nutrient loading, rough fish, or an overabundance of CLP. Three Rivers Parks District (TRPD) plans to continue monitoring the water quality for the Elm Creek Watershed Management Commission. For more information on Diamond Lake water quality see: <https://webapp.pca.state.mn.us/surface-water/impairment/27-0125-00>. Diamond Lake is currently impaired for water quality: <https://arcgis.dnr.state.mn.us/ewr/whaflakes/scale/major/id/20>.

Management History:

Invasive plant treatments have been organized by the Diamond Lake Improvement Association (DLIA; see below **Table 2 – Invasive Plant Management Summary** for a complete history of herbicide treatments). A variance to treat more than 15% of Diamond Lake’s littoral area was granted in 2019 – 2022 to allow for whole lake control of curly leaf pondweed (CLP) using fluridone. Low-dose fluridone was applied to approximately 405 acres shortly after ice-out in the spring of each year. Fluridone for CLP control is generally applied early in the growing season when native plants aren’t actively growing, and subsequent bump treatments are necessary to maintain concentrations and exposures (4 – 5 parts per billion for up to 30 days). Declines in native submersed plant frequency were noted post fluridone treatments (2019 – 2022), including coontail showing signs of degradation during the first year of treatment. After four consecutive years treating at a lake-wide level with fluridone coupled with the observation of declining native aquatic plants, the DLIA and the Minnesota Department of Natural Resources opted to spot treat CLP in 2023 and 2024 with Diquat. Evaluations of repeated fluridone treatments will be needed to determine the efficacy of CLP management and potential effects on the native plant community.

Table 2 – Invasive Plant Management Summary. Characteristics and history of herbicide treatments for Diamond Lake, Hennepin County, Minnesota (DOW# 27012500, total acres: 419, littoral acres: 405, 15% littoral acres: 60.75).

Date	Treatment [W,P,N]	Target Species	Total Acres Treated	Herbicide	Licensed Commercial Applicator
2013	P	CLP	60.5	Endothall	Clarke Aquatic Services
2014	P	CLP	60.5	Endothall	Lake Restoration Inc.
2015	P	CLP	60.5	Endothall	Lake Restoration Inc.
2016	P	CLP	60.5	Endothall	Lake Restoration Inc.
MAY 2017	P	CLP	60.5	Endothall	Lake Restoration Inc.
MAY 2018	P	CLP	60	Endothall & Diquat	Lake Restoration Inc.
MAY 2019*	W	CLP	405	Fluridone (Sonar AS)	PLM Lake and Land Mgmt Corp
APR 2020*	W	CLP	405	Fluridone (Sonar AS)	PLM Lake and Land Mgmt Corp
APR 2021*	W	CLP	405	Fluridone (Sonar AS)	PLM Lake and Land Mgmt Corp
MAY 2022	W	CLP	405	Fluridone (Sonar AS)	PLM Lake and Land Mgmt Corp
MAY 2023	P	CLP	45.1	Diquat	PLM Lake and Land Mgmt Corp
APR 2024	P	CLP	59.7	Diquat	PLM Lake and Land Mgmt Corp

*LVMP year

Treatment: W (whole lake), P (partial lake), N (no treatment)

CLP is an abbreviation for curly-leaf pondweed

Survey Objectives:

Point-intercept surveys were used to assess the distribution of aquatic plants in Diamond 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). Moreover, this survey will help the Minnesota Department of Natural Resources (MNDNR) and our partners monitor native plant communities and evaluate possible responses to invasive aquatic plant management efforts. It is important to note that distributions of aquatic plants may vary from year to year due to effects such as differences in weather, as well as the effects from plant and water quality management.

Survey Methods:

We used a point intercept survey method developed by John Madsen in [“Aquatic Plant Control Technical Note MI-02, 1999”](#). Survey points were placed approximately 122 meters apart using a Geographic Information System (GIS), allowing for the placement of 105 total points. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point for approximately 3 meters. Plant samples were assessed on the boat to determine plant species, and rake fullness was used as a surrogate for density (scale of zero [no plants] to 3 [dense plants] was used in 2018 and beyond [MNDNR survey] while a zero to 5 scale was used prior to 2017 [Three Rivers Park District]). Frequency of occurrence percentages (i.e., how often a plant species was found in the lake) were calculated based on the littoral zone (the portion of the lake that is less than 15 feet in depth).



Survey Observations:

The maximum depth of rooted vegetation observed has ranged between 0.4 and 2.1 meters (1.2 – 7 feet) from spring 2011 to summer 2024. Native submersed plant diversity and frequency of occurrence (FOO) ranged from 0.1 – 2.3 of mean submersed native taxa/point and 4 – 90% respectively during the same timeframe (**Table 3 – Point Intercept Metrics**, for historical point-intercept survey calculations). Native plant species have ranged from 3 to 11 since 2011, with the lowest observation in the 2018 survey, and the highest in 2019. While the percentage of points with submersed native taxa was the lowest in the summer 2022 survey (4 native taxa), only one year later 90% of points contained native submersed taxa (**Table 3**). Results from 2024 indicate species richness and frequency of occurrence was slightly lower than 2023, but the max depth of growth of 6.7 feet hasn't been observed in a point intercept survey of Diamond Lake since at least 2011.

During the four full-lake treatment years, species richness decreased as well as frequency of occurrence for coontail and elodea but has recently rebounded. Conversely, native plant frequencies and species richness rebounded during the summer 2023 survey (**Photos 1 & 2**). In the 2024 survey, seven native submersed aquatic plant species were observed. Since the start of surveying on Diamond Lake, Canadian waterweed and flat-stem pondweed were observed at their highest frequencies in 2024. Naiads and straight-leaved pondweed, were first observed in 2023 but were not detected in the 2024 survey.

In 2023, curly-leaf pondweed summer growth was the highest it had been in over ten years (42%; **Table 3**), likely due to ideal late summer conditions for sprouting turions. In 2024, summer curly-leaf pondweed frequencies were found at 1% of survey sites which is expected given it senesces around the Fourth of July each year (**Table 3**). Management of curly-leaf pondweed may be influenced by treatment timing and seasonal changes in environmental conditions. Continued sampling of Diamond Lake will be necessary to understand which factors influence successful curly-leaf pondweed management the most. Limited spring data is available upon request.

Table 3 – Point Intercept Metrics. Summary of summer point intercept metrics for Diamond Lake, Hennepin County, Minnesota (DOW# 27012500). Shaded values were calculated from the littoral depth range (0 – 15 feet). Three Rivers Park District (3RPD) surveyed in 2011, 2012 and 2018. Additional spring data is available upon request.

Survey Metrics	SEPT 9 2011	AUG 31 2012	SEPT 4 2018	JUL 8 2019	JUL 7 2020	SEPT 29 2021	JUL 7 2022	AUG 2 2023	JUL 18 2024
Treated (Y/N)	N	N	Y	Y	Y	Y	Y	Y	Y
Surveyor	3RPD	3RPD	3RPD	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR	MN DNR
Total # Points Sampled	105	106	105	105	105	104	105	99	79
Max Depth of Growth (95%)	6.9	6.4	4.6	5.5	4.9	5	1.2	5.7	6.7
# Point in Max Depth Range	96	92	39	57	56	37	29	92	74
# Points in Littoral (0-15 feet)	105	106	105	105	104	104	105	99	79
% Points w/ Submersed Native Taxa	82	79	26	34	27	10	4	90	81
Mean Submersed Native Taxa/ Point	1.3	1.3	0.4	0.6	0.4	0.1	0.1	2.3	1.7
# Submersed Native Taxa	4	5	3	11	7	4	4	10	7
# Submersed Non-Native Taxa	1	1	1	1	1	1	-	1	1

Table 4 – Plant Frequency Occurrence. Historic percent frequency of occurrence for summer submersed vegetation within the littoral zone (0 – 15 feet). Three Rivers Park District (3RPD) surveyed in 2011, 2012 and 2018. Additional spring data is available upon request. Diamond Lake, Hennepin County, Minnesota (DOW# 27012500).

Taxonomic Name	Common Name	SEPT 9 2011	AUG 31 2012	SEPT 4 2018	JUL 8 2019	JUL 7 2020	SEPT 29 2021	JUL 7 2022	AUG 2 2023	JUL 18 2024
SUBMERSED PLANTS										
<i>Potamogeton crispus</i> *	Curly-leaf pondweed*	2	4	-	14	3	1	-	42	1
<i>Ceratophyllum demersum</i>	Coontail	50	58	18	29	12	5	-	44	56
<i>Chara and Nitella spp.</i>	Macroalgae	-	-	-	4	10	1	1	5	1
<i>Elodea canadensis</i>	Canadian waterweed	2	67	18	7	1	-	-	36	77
<i>Naiad spp.</i>	Naiad	-	-	-	-	-	-	-	15	-
<i>Potamogeton foliosus</i>	Leafy pondweed	3	-	-	1	6	-	2	79	9
<i>Potamogeton pusillus</i>	Very small pondweed	-	1	-	-	-	-	-	18	6
<i>Potamogeton strictifolius</i>	Straight-leaved pondweed	-	-	-	-	-	-	-	6	-
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	-	-	-	1	2	-	1	7	11
<i>Stuckenia pectinata</i>	Sago pondweed	1	3	1	9	12	3	2	16	5
<i>Zannichellia palustris</i>	Horned pondweed	-	-	-	8	8	4	-	7	-

Floating, free-floating & emergent plants observed: *Nymphaea odorata* (white water lily), *Lemna trisulca* (forked duckweed), *Spirodela polyrhiza* (great duckweed), *Wolffia columbiana* (Columbian watermeal)

Less common (< 5% frequency) submersed vegetation observed: *Heteranthera dubia* (water stargrass), *Utricularia gibba* (creeping bladderwort), and *Utricularia minor* (lesser bladderwort) in 2019.

*Denotes invasive aquatic plant



Photos 1 – 2. (1): High abundance of native aquatic plants observed on a sampling rake during the 2024 survey. **(2):** Surface matting of Elodea during the 2024 point intercept survey. Diamond Lake, Hennepin County, Minnesota (DOW# 27012500).

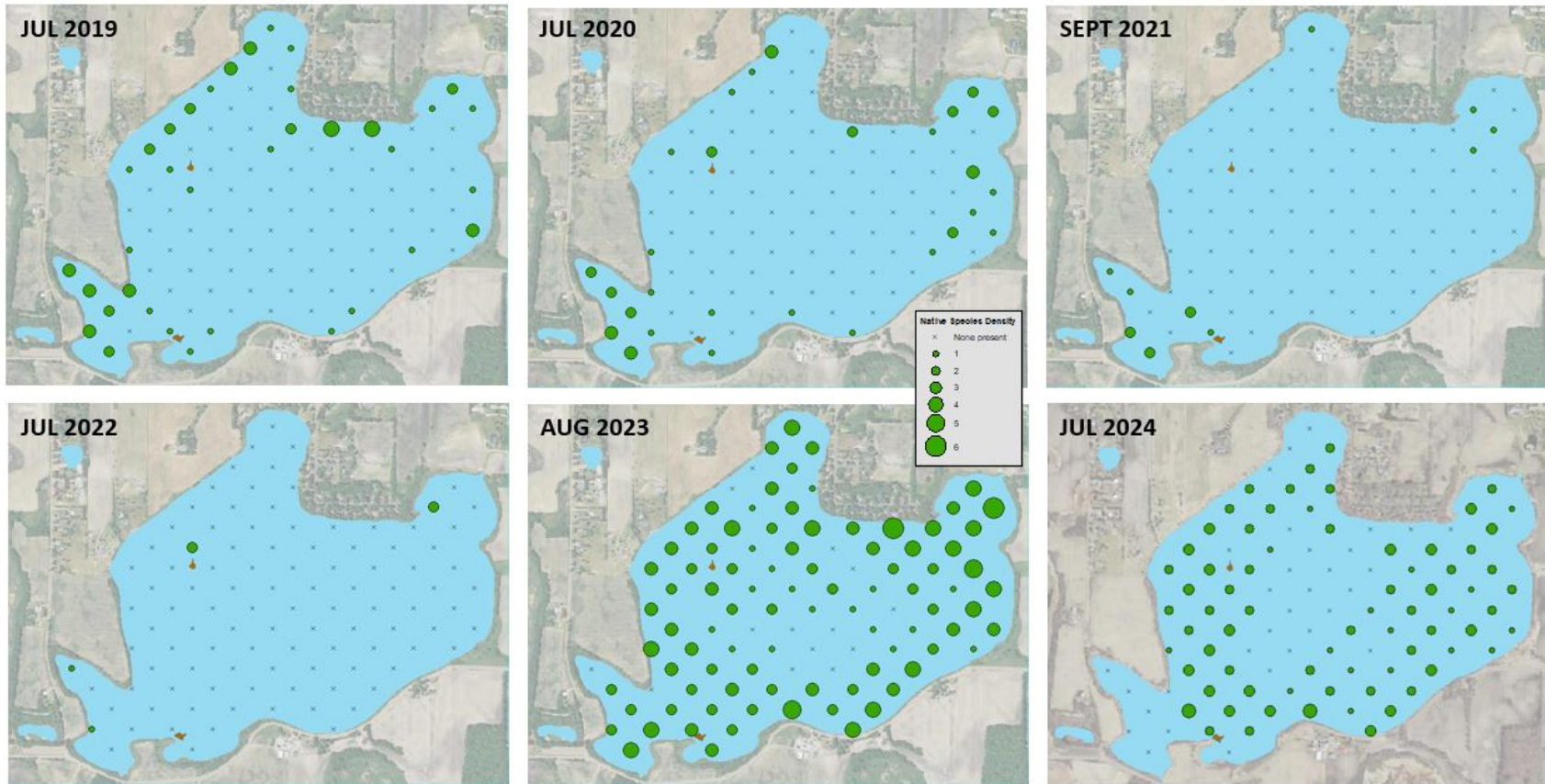


Figure 1 – Native Species Density. Spatial distribution and species richness (# of native submersed taxa per sample point) for summer point intercept surveys. Surveys were conducted by the Minnesota Department of Natural Resources (MNDNR). Diamond Lake, Hennepin County, Minnesota (DOW # 27012500)

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