2021 Point-Intercept Plant Surveys

At Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake

Prepared for
Valley Branch Watershed District

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Executive Summary

The Valley Branch Watershed District (VBWD) conducts annual aquatic plant surveys to assess the native and invasive plant communities in lakes. As authorized by the VBWD Managers, Barr Engineering Co. (Barr) subcontracted with Matt Berg of Endangered Resource Services LLC to conduct point-intercept aquatic plant surveys at Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake (Figure 1) in June 2021. This report outlines survey methods and results. Tables and figures follow the discussion. Figure 1 shows the locations of the surveyed lakes.

The Minnesota Department of Natural Resources (MNDNR) developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication (excessive nutrients). In 2021, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake met the criteria of the MNDNR Lake Plant Eutrophication IBI, indicating the lakes were not stressed from anthropogenic eutrophication (Table 6, Table 10, Table 14, Table 18, Table 22, and Table 26). However, the MNDNR Lake Plant Eutrophication IBI documented a consistent decline in the number of species in Lake DeMontreville. In 2018 the number of species dropped from 23 to 21. The decline continued through 2021, when only 16 species were found (Table 10). Although the cause of the decline is unknown, it coincides with the period that diquat was used to control Eurasian watermilfoil (EWM). Because diquat kills all plants contacting the herbicide, species may have been removed by the 2018 through 2021 treatments. To protect the lake's native species from harm, Barr recommends that, in the future, the herbicide be applied before the native plant growing season (before the lake's average water column temperature reaches 60°F).

Barr analyzed the plant survey results with historic results to review trends in plant diversity and plant frequency in the lakes.

- **Long Lake**—The plant diversity improved in 2011 and has been sustained since. A significant increase in the frequency of curly-leaf pondweed (CLP) is concerning.
- **Lake DeMontreville**—Although VBWD point-intercept plant surveys have documented good plant diversity in Lake DeMontreville from 2012 through 2021, diversity has consistently declined since 2019. In addition, a few significant changes in plant frequency occurred. The significant increase in small pondweed and significant decline in filamentous algae in 2021 are positive changes for the lake. A significant increase in CLP is unfavorable.
- **Lake Olson**—Plant diversity in Lake Olson from 2012 through 2021 remains good. The Lake Olson plant community was relatively stable between 2020 and 2021, but an increase in EWM is an unfavorable change for the lake, while the increases in small pondweed and large-leaf pondweed and the decline in filamentous algae were favorable.
- **Lake Jane**—Plant diversity has been good throughout the 2012 through 2021 monitoring period. The Lake Jane plant community was relatively stable between 2020 and 2021, but a few significant

changes in plant frequency occurred, including a significant increase in filamentous algae, which is an unfavorable change for the lake.

- **Lake Elmo**—The Lake Elmo plant diversity has been good throughout the 2012 through 2021 monitoring period. There were no significant frequency changes in aquatic plant species between 2020 and 2021.

- **Silver Lake**—Plant diversity in Silver Lake has varied widely during the 2006 through 2021 monitoring period. Causes of the fluctuations include damage to the plant community from the 2007 and 2008 herbicide treatments and subsequent water-quality degradation, as well as positive impacts from recent improvements to the lake's water quality. Plant diversity remained relatively stable in 2021 compared to 2020. The only plant to significantly change in frequency in Silver Lake was EWM.

Lake associations treated EWM in Lake DeMontreville, Lake Olson, and Lake Jane with herbicide and harvested EWM in Lake Elmo. Treatment in Lake Jane also targeted CLP. The Silver Lake Improvement Association (SLIA) treated CLP in Silver Lake with herbicide. A summary of the results of the 2021 EWM and CLP management efforts is as follows. It should be noted that the plant surveys do not identify surviving EWM root crowns in the sediment which may result in plant growth later in the summer. A fall plant survey would be needed to assess the extent of EWM resulting from surviving root crowns.

- **Long Lake**—EWM was not observed in Long Lake-Katherine Abbott Pond in May or June (Table 4 and Figure 3) or Long Lake in May (Table 3). In June, 0.2 acres of EWM were observed in the northeast corner of Long Lake, and all plants were removed by rake (Table 3 and Figure 2).

- **Lake DeMontreville**—The Lake DeMontreville Olson Association treated 13 acres with diquat on June 2 to control EWM (Figure 4). The treatment reduced EWM extent to 2 acres by June 22 (Table 8 and Figure 5).

- **Lake Olson**—The Lake DeMontreville Olson Association treated 9 acres with diquat on June 2 to control EWM (Figure 6). The treatment reduced EWM extent to 8 acres by June 22 (Table 12 and Figure 7).

- **Lake Jane**—The Lake Jane Association treated 13 acres with diquat on May 28 to control CLP and EWM (Figure 8). EWM extent decreased to 0.4 acres by June 24 (Table 16 and Figure 9) but eventually increased to more than 12 acres by fall (Figure 10).

- **Lake Elmo**—The Lake Elmo Association mechanically harvested 21 acres of EWM from May 27 through June 3 (

- Figure 13). Despite the harvesting, EWM extent in the lake increased from 39 acres in June 2020 to 40 acres in June 2021 (Table 20 and Figure 12).

- **Silver Lake—** EWM was not observed during a plant survey by Ramsey County on April 5, but CLP was observed at multiple locations (Figure 13). The SLIA treated a total of 4 acres with diquat in the spring of 2021 (Figure 15). By June 22, the treatment had reduced CLP to only a few plants near the boat landing. However, EWM extent increased to 16 acres by June 22 (Table 24 and Figure 14).

EWM is the aquatic invasive species (AIS) of primary concern in all six lakes. CLP is of particular concern in Silver Lake, but in June 2021 was also present in the other lakes, except Lake Jane (52 locations in Long Lake, seven locations in Lake DeMontreville, three locations in Lake Olson, and one location in Lake Elmo). Based on the June 2021 data, Barr did not consider CLP problematic in Lake DeMontreville, Lake Olson, Lake Elmo, and Silver Lake; however, if CLP extent increases or fails to decline in Long Lake, Barr would recommend management.

Other AIS present in June 2021 are noted below:

- **Reed canary grass** (*Phalaris arundinaceae*) was not observed in Lake Elmo but was present at three locations in Lake Olson and one location in Long Lake, Lake DeMontreville, Lake Jane, and Silver Lake.

- **Purple loosestrife** (*Lythrum salicaria*) was present at a single location in Lake Jane and Silver Lake and not observed in the other four lakes.

- **Narrow-leaved cattail** (*Typha angustifolia*) was present at one location in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, and Silver Lake. It was also found along the western and southern shores of Lake Elmo.

- **Common reed** (*Phragmites australis subspecies australis*) was observed along the southern shore of Lake Elmo and not observed in the other five lakes. Based on the June 2021 data, Barr recommends working with MNDNR staff and the Lake Elmo Lake Association to identify and implement feasible options for managing common reed to prevent its continued spread in the lake.

Barr did not consider reed canary grass, narrow-leaved cattail, or purple loosestrife problematic in any of the lakes during June 2021. However, we recommend initiating management if a documented increase occurs.

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Contents

List of Tables

List of Figures

1 VBWD Scope with Aquatic Plants

1.1 2015-2025 Valley Branch Watershed District Watershed Management Plan

The Valley Branch Watershed District (VBWD) conducts annual aquatic plant surveys to assess the native and invasive plant communities in lakes. The work is consistent with the 2015-2025 VBWD Watershed Management Plan (Plan).

Section 4.1 of the Plan includes details of the VBWD's policies, strategies, and actions related to water quality, including aquatic plants. Policies include, but are not limited to:

- The VBWD will manage all major waterbodies for non-degradation of water quality, with allowance for natural variability.
- The VBWD will monitor the water quality of all major waterbodies (or coordinate such monitoring performed by others).
- The VBWD will analyze water quality monitoring data to identify changes and track trends.
- The VBWD will report water quality monitoring results.
- The VBWD will implement appropriate water quality management/improvement actions to improve or protect water quality, with consideration for new technologies/methods.
- The VBWD will collaborate with other entities in their efforts to manage and prevent the spread of aquatic invasive species (AIS) and support the implementation of best available technology to that end.

Section 4.1.17 of the Plan provides details of the actions the VBWD will take regarding AIS. These actions include collaborating with other governmental units to manage and prevent the spread of AIS, and encouraging lake associations, homeowner associations, and landowners to lead AIS management efforts. The Plan states that the VBWD will perform aquatic plant surveys of high priority waters to identify the extent of AIS presence, and the VBWD will provide technical assistance to lake associations and other groups in their efforts to manage aquatic plants. That assistance may include point-intercept surveys of aquatic vegetation, preparation of lake vegetation management plans, completion of Invasive Aquatic Plant Management Permit applications, design of herbicide treatment programs, participation in meetings with MNDNR staff, and other technical analysis. The VBWD will initiate AIS management projects only in cases where a diagnostic study has demonstrated a negative water quality effects from AIS (e.g., phosphorus loading from curly-leaf pondweed).

1.2 Assessing Lake Health

Barr used two tools to assess the health of the lakes in regards to aquatic plants. The first is called the Lake Plant Eutrophication Index of Biological Integrity (IBI), developed by the MNDNR to measure the response of a lake plant community to eutrophication. The MNDNR uses this tool to identify lakes that are likely stressed from anthropogenic eutrophication.[1] The second tool, the Simpson Diversity Index, is used to assess plant diversity. Both tools are described in greater detail below.

1.2.1 Lake Plant Eutrophication IBI

A healthy aquatic plant community is essential for lakes and provides many important benefits such as nutrient assimilation, sediment stabilization, and fish habitat. Eutrophication may have detrimental effects on a lake, including reductions in the quantity and diversity of aquatic plants. The MNDNR IBI metrics determine the overall health of a lake's plant community and provide important context about water quality, shoreline health, and the fish community.

The Lake Plant Eutrophication IBI includes two metrics: (1) the number of species in a lake and (2) the "quality" of the species, as measured by the floristic quality index (FQI). The MNDNR has determined a threshold for each metric. Lakes that score below the thresholds contain degraded plant communities that are likely stressed from anthropogenic eutrophication. Barr analyzed the 2021 survey results to determine taxa richness and FQI scores and compared them with MNDNR thresholds (a minimum of 12 taxa and an FQI score of at least 18.6).

1.2.2 Plant Diversity—Simpson Diversity Index

The Simpson Diversity Index considers both the number of species present and the evenness of species distribution. The values, from 0 to 1, represent the probability that two individual plants randomly selected from the lake will belong to different species. Increasing values indicate increasing probability that two randomly selected plants will represent different species. Barr analyzed the 2021 survey results to determine Simpson Diversity Index values.

[1] Minnesota Department of Natural Resources. 2016. Lake Plant Eutrophication IBI, June 23, 2016: *An Assessment of Aquatic Plant Community Response to Anthropogenic Eutrophication.*

2 2021 Sample Methods

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, conducted point-intercept plant surveys in six VBWD lakes and Long Lake-Katherine Abbott Pond on June 22, June 24, and June 25, 2021. Figure 1 shows survey locations. Berg located equally spaced preset points in the field with a global positioning system (GPS) and took measurements at each point. His measurements included the following:

1. Individual species present
2. The overall density of plants, as measured by the rake method
3. The density of individual species, as measured by the rake method
4. Water depth
5. Dominant sediment type

Barr's subcontractor, Endangered Resource Services LLC, used a rake (pictured above) to collect plants for the plant surveys. Rake fullness is a measure of plant density.

3 Results

3.1 Long Lake and Long Lake-Katherine Abbott Pond

3.1.1 Eurasian Watermilfoil (EWM) Treatment History and Changes in Post-Treatment EWM Extent

Eurasian watermilfoil (EWM, *Myriophyllum spicatum*) has been documented in Long Lake since May of 2007. By 2010, EWM extent had increased to 52 acres—nearly the entire littoral zone (area of the lake where plants grow[2]). Beginning in 2011 and continuing through 2016, the Friends of Long Lake completed five herbicide treatments to reduce EWM extent in the lake. The treatments were successful, and after the 2016 treatment, EWM extent had been reduced to 0.3 acres. Each of the five treatments involved application of sufficient 2,4-D to attain and sustain a whole-lake concentration that was lethal to EWM. This approach consistently reduced EWM in all lake areas except immediately adjacent to the lake's inlet. Barr hypothesized that dilution from the lake's inflow prevented the herbicide concentration in this area from being sustained long enough to kill the EWM.

In 2018, EWM in Long Lake, pictured above, expanded to an extent of 35 acres, but was reduced to 2 acres by herbicide treatment in 2019. EWM was not observed in the lake in June 2020 or May 2021. A few EWM plants were observed in June 2021 and all were rake removed.

A 2017 VBWD plant survey of Long Lake-Katherine Abbott Pond revealed that EWM was prevalent in the pond and that the pond was a source of EWM in Long Lake. Additions of EWM to Long Lake from Long Lake-Katherine Abbott Pond and the spread within Long Lake caused EWM extent to increase from 0.3 acres in June of 2016 to 20 acres in May of 2018.

The Friends of Long Lake considered using a new herbicide, ProcellaCOR (Florpyrauxifen-benzyl), to treat all of the EWM in Long Lake in 2018. However, the herbicide was expensive, and its use for all 20 acres of EWM was cost-prohibitive. The group applied for an MNDNR permit to treat the lake—including Long Lake-Katherine Abbott Pond—with 2,4-D. They hoped the 2018 treatment would reduce EWM to such a small area that using the new herbicide to treat the remaining areas in 2019 would be affordable. However, the MNDNR did not approve the permit application, suggesting Fluoridone for the 2018 treatment. Although Fluoridone has successfully been used to treat other lakes, the cost was prohibitive (approximately four times more expensive than 2,4-D). Hence, no treatment occurred in 2018, and EWM continued to spread to the extent of 35 acres, documented in July 2018.

[2] The area of Long Lake containing plants in 2010 was 53.71 acres. EWM extent was 52.31 acres which was 97 percent of the plant growth area of the lake.

Some EWM did not survive the winter, reducing EWM in Long Lake to 23 acres by April of 2019. The Friends of Long Lake obtained an MNDNR permit and treated 26 acres with 2,4-D in May of 2019. The treatment reduced EWM to 2 acres in June of 2019.

EWM extent quadrupled in extent from June of 2019 to May of 2020. The Friends of Long Lake treated 8 acres with herbicide in May of 2020 with two different herbicides. Five acres were treated with diquat and 3 acres with ProcellaCOR EC. The treatment was effective, and EWM was not observed in Long Lake during the June 2020 plant survey.

In 2021, EWM was not observed in a May plant survey funded by Friends of Long Lake. In June, 0.2 acres of EWM were found in the lake's northeast corner (Table 3 and Figure 2). All EWM plants observed in June were young plants, and all were removed by rake.

3.1.2 Long Lake-Katherine Abbott Pond

A VBWD plant survey of Long Lake-Katherine Abbott Pond during June of 2017 documented EWM in 98 percent of the pond, while a VBWD survey in May of 2018 documented EWM in 71 percent of the pond. Although no treatment occurred, EWM was not observed in July 2018, May 2019, June 2019, or May 2020 (Table 4). However, 0.05 acres of EWM were observed in June 2020 (Table 4), and diquat was used to treat a 0.22-acre area on August 10, 2020. EWM was not observed in the pond in May or June of 2021 (Table 4 and Figure 3).

Pictured above, Long Lake-Katherine Abbott Pond.

The plant surveys indicate that EWM can become prevalent throughout the pond but can also be naturally reduced. Although the mechanisms for its rise and fall are unknown, the pond should be considered a potential source of EWM for Long Lake and should be surveyed with Long Lake. Future Long Lake herbicide treatments should include Long Lake-Katherine Abbott Pond whenever EWM is present to prevent the pond from infesting the lake with EWM.

3.1.3 Plant Diversity in Long Lake

The initial 2011 herbicide treatment reduced EWM extent and improved plant diversity in Long Lake. Subsequent herbicide treatments have sustained the lake's improved plant diversity. Long Lake diversity index values increased from 0.40, before the initial 2011 treatment, to 0.80 after the treatment. Before the 2011 herbicide treatment, there was a 40 percent probability that two individual plants randomly selected from the lake would belong to different species; after the treatment, there was an 80 percent probability. From 2011 to 2021, diversity fluctuated between 0.77 and 0.85 and was 0.80 in 2021 (Table 5).

3.1.4 Long Lake MNDNR Plant IBI

In 2021, the Long Lake plant community met the MNDNR Plant IBI threshold, indicating that the lake was not stressed from anthropogenic eutrophication. A total of 16 species were observed, 33 percent more than the MNDNR Plant IBI threshold of 12 species. The lake's FQI of 22.8 was 22 percent more than the MNDNR Plant IBI threshold of 18.6 (Table 6).

Long Lake met the MNDNR Plant IBI criteria from 2010 through 2012 and 2015 through 2021 but had low FQI values in 2013 and 2014 (Table 6).

Bearded stonewort, pictured above, was first observed in Long Lake in 2017.

3.1.5 Bearded Stonewort *(Lychnothamnus barbatus)* in Long Lake

Barr's subcontractor observed bearded stonewort *(Lychnothamnus barbatus)* in Long Lake in 2017 (Table 7). This species was not seen in North America until 2012 and not seen in Minnesota until 2015. Few populations have been documented in the world. Long Lake was the third lake in Minnesota and the first lake in Washington County with bearded stonewort. The plant spread along the southeastern shoreline in 2018 and had increased in frequency from 1 percent in 2017 to 2 percent in 2018. The plant frequency remained at 2 percent in 2019 and then increased to 5 percent in 2020 and 7 percent in 2021 (Table 7).

3.1.6 Significant Changes in Long Lake Plant Frequency

The Long Lake plant community was relatively stable between 2020 and 2021, but a few significant changes in plant frequency occurred. Curly-leaf pondweed (CLP, *Potamogeton crispus*) significantly increased in frequency while common waterweed (*Elodea canadensis*) and coontail (*Ceratophyllum demersum*) significantly decreased (Table 7).

3.1.7 Other Aquatic Invasive Species (AIS)

Although EWM is an AIS of primary concern in Long Lake, three other AIS were present in 2021: CLP, reed canary grass (*Phalaris arundinaceae*), and narrow-leaved cattail (Table 1 and Table 2).

In 2021 CLP was collected on the rake at 49 sample locations (41 percent) and observed, but not collected on the rake, near an additional three sample locations (Table 7). Average CLP density in 2021 was light (1 on a scale of 1 to 3, with increasing density indicated by increasing numbers). Although the significant frequency increase in 2021 is concerning, CLP frequency in the lake has fluctuated widely since 2010, ranging from 2 percent to 41 percent. CLP increased from a 2-percent frequency in 2011 to 41 percent in 2012, declined for three years to a 6 percent frequency, and remained relatively low through 2020. Barr recommends management of CLP if frequency increases or fails to decline.

A single instance of reed canary grass has been documented in the lake nearly annually since 2011, although the specific locations have varied (Table 7). In 2021 this AIS was found along the eastern shore. Because the reed canary grass extent has been stable and limited to single locations, Barr did not consider it problematic in 2021.

In 2021, narrow-leaved cattail (*Typha angustifolia*) was observed at a single location in the southwest corner of the lake (Table 7). Single occurrences of either hybrid cattail (*Typha glauca*) or narrow-leaved cattail have been documented in the lake nearly annually since 2012, although the specific locations have varied (Table 7). Because the cattail extent has been stable and limited to single locations (and not observed in 2018 and 2019), Barr did not consider narrow-leaved cattail problematic in 2021.

3.2 Lake DeMontreville

3.2.1 EWM Treatment History and Changes in Post-Treatment EWM Extent

EWM treatment history for Lake DeMontreville can be summarized as follows:

- EWM was first observed in Lake DeMontreville in 2007 and was treated with 2,4-D in 2009. After the 2009 herbicide treatment, it was not observed again until 2011.
- EWM remained at low levels during 2011, but its extent increased by an order of magnitude between June of 2012 and June of 2013.
- Since 2014, the Lake DeMontreville Olson Association (LDO) has funded herbicide treatments to attain seasonal relief from EWM, which has annually increased between June and the following spring. 2,4-D was used for 2014 through 2017 treatments, and diquat was used for 2018 through 2021 treatments. Diquat treatments have resulted in greater reductions in EWM extent; 2,4-D treatments reduced EWM extent to 14 acres by June 2017, while diquat treatments reduced EWM extent to 8 acres by June 2020.
- EWM increased more than 65 percent from June 2020 to May 2021; treatment on June 2, 2021, included 13.2 acres (Figure 4). EWM extent was reduced to 2.4 acres later in June 2021 (Table 8 and Figure 5). (Note: The plant survey did not identify surviving EWM root crowns in the sediment which may result in plant growth later in the summer.)

3.2.2 Plant Diversity

Although VBWD point-intercept plant surveys have documented good plant diversity in Lake DeMontreville from 2012 through 2021, diversity has consistently declined since 2019. Simpson Diversity Index values from 2012 through 2019 have fluctuated between 0.86 and 0.90. They have declined over the last two years—from 0.85 in 2020 to 0.80 in 2021, the lowest value to date (Table 9).

3.2.3 MNDNR IBI

The 2021 Lake DeMontreville plant community met the MNDNR Lake Plant Eutrophication IBI threshold, indicating the lake was not stressed from anthropogenic eutrophication. Sixteen plant species were observed in 2021, 33 percent greater than the MNDNR threshold of 12 species. The lake's 2021 FQI score of 23.5 was 26 percent higher than the MNDNR threshold of 18.6 (Table 10).

From 2012 through 2021, the Lake DeMontreville plant community consistently met the MNDNR Lake Plant Eutrophication IBI criteria (Table 10). However, the number of species consistently declined from 2018 through 2021, a loss of seven species during this period (from 23 species to 16 species). The Floristic

Quality Index (FQI) consistently declined—from 26.6 in 2018 to 23.5 in 2021 (Table 10). Although the cause of the decline is unknown, the decline coincides with the period in which the herbicide diquat was used to control EWM. Because diquat kills all plants contacting the herbicide, species may have been removed by the 2018 through 2021 diquat treatments. To protect the lake's native species, Barr recommends that the herbicide be applied before the native plant growing season—before the lake's average water column temperature reaches 60°F.

3.2.4 Significant Changes in Plant Frequency

The Lake DeMontreville plant community was relatively stable between 2020 and 2021, but a few significant changes in plant frequency occurred. CLP and small pondweed (*Potamogeton pusillus*) significantly increased in frequency, while nitella (*Nitella sp.*), common waterweed, small duckweed (*Lemna minor*), and filamentous algae significantly declined. The significant increase in small pondweed and significant decline in filamentous algae in 2021 are positive changes for the lake (Table 11).

3.2.5 Other AIS

As well as EWM, three other AIS were present in Lake DeMontreville in 2021: CLP, reed canary grass, and narrow-leaved cattail (Table 1 and Table 2).

CLP was collected on the rake at six locations and observed at one additional location in 2021. Average CLP density in 2021 was light (1 on a scale of 1 to 3). CLP frequency in Lake DeMontreville has fluctuated widely since 2012, ranging from not observed to a frequency of 49 percent. Barr did not consider CLP problematic in 2021 because the frequency of 6 percent was lower than most CLP frequencies observed since 2012 (Table 11).

Single occurrences of reed canary grass have been documented annually since 2012, although the specific locations have varied (Table 11). In 2021, reed canary grass was observed along the southeastern shore (Table 11). Because the reed canary grass extent has been stable and limited to single locations, Barr did not consider reed canary grass problematic in 2021.

In 2021, narrow-leaved cattail was observed at a single location in the northwest corner of the lake (Table 11). Either hybrid cattail or narrow-leaved cattail has been observed at this location annually since 2012. Because the cattail extent has been stable and limited to the same location, Barr did not consider narrow-leaved cattail problematic in 2021.

3.3 Lake Olson

3.3.1 EWM Treatment History and Changes in Post-Treatment EWM Extent

EWM treatment history for Lake Olson can be summarized as follows:

- EWM was first observed in Lake Olson in 2012. Between 2012 and 2013, EWM extent doubled from 2 to 4 acres and then rapidly increased to 23 acres by May 2014.
- The Lake DeMontreville Olson Association (LDO) has funded herbicide treatments since 2014 to attain seasonal relief from EWM, which has increased annually between June and the following

spring. 2,4-D was used for the 2014 through 2017 treatments, and diquat was used for the 2018 through 2021 treatments. Diquat treatments have resulted in greater reductions in EWM extent; 2,4-D treatments reduced EWM extent to 21 acres by June 2017, while diquat treatments reduced EWM extent to 0.8 acres by June 2020.

- EWM increased by more than an order of magnitude from June 2020 to May 2021, when treatment included 9.2 acres (Figure 6). EWM extent was reduced to 8.0 acres in June 2021 (Table 12 and Figure 7). (Note: The plant survey did not identify surviving EWM root crowns in the sediment which may result in plant growth later in the summer.)

3.3.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake Olson from 2012 through 2021. Simpson Diversity Index values during this period have fluctuated between 0.84 and 0.92, with a value of 0.86 documented in 2021 (Table 13).

3.3.3 MNDNR IBI

The Lake Olson plant community met the criteria of the MNDNR Lake Plant Eutrophication IBI threshold in 2021, indicating the lake was not stressed from anthropogenic eutrophication. Twenty-three plant species were observed in 2021, 92 percent greater than the MNDNR threshold of 12 species. The 2021 FQI score of 27.7 was 49 percent higher than the impairment threshold of 18.6 (Table 14).

From 2012 through 2021, the Lake Olson plant community has consistently met the MNDNR Lake Plant Eutrophication IBI standard(Table 14).

3.3.4 Significant Changes in Plant Frequency

The Lake Olson plant community was relatively stable between 2020 and 2021, but a few significant changes in plant frequency occurred. Small pondweed, EWM, and large-leaf pondweed (*Potamogeton amplifolius*) significantly increased in frequency, while filamentous algae and aquatic moss significantly declined. The increase in EWM was an unfavorable change for the lake, while the increases in small pondweed and large-leaf pondweed and the decline in filamentous algae were favorable (Table 15).

3.3.5 Bearded Stonewort *(Lychnothamnus barbatus)* in Lake Olson

Barr's subcontractor observed bearded stonewort *(Lychnothamnus barbatus)*, a good plant, in Lake Olson for the first time in 2019 (Table 15) at one location in the southwest corner of the lake. It was observed at the same location in 2020 and 2021. As noted previously, this species was first observed in Long Lake, upstream from Lake Olson, in 2017. It was first observed in North America in 2012 and in Minnesota in 2015.

3.3.6 Other AIS

In addition to EWM, three additional AIS were observed in Lake Olson during 2021: CLP, narrow-leaved cattail, and reed canary grass (Table 1 and Table 2).

In 2021, CLP was collected on the rake at three locations (3 percent frequency) (Table 15). Average CLP density in 2021 was light (1 on a scale of 1 to 3). Barr did not consider CLP problematic in 2021 because the 2021 CLP frequency was within the range of values observed since 2014—from 0 to 7 percent (Table 15).

In 2021, narrow-leaved cattail was observed at a single location in the northeast corner of the lake (Table 15). Although specific locations have varied, single occurrences of either hybrid cattail (*Typha glauca*) or narrow-leaved cattail have been documented since 2012 (with the exception of 2017). Because the cattail extent has been stable and limited to single locations, Barr did not consider narrow-leaved cattail problematic in 2021.

Bearded stonewort, pictured above, was first observed in Lake Olson in 2019.

Reed canary grass has been observed annually since point-intercept surveys began in 2012 but did not spread until 2019 when it went from one to three locations. In 2020 and 2021, it was again found at three locations, and the locations were the same both years (Table 15). Because it was stable and had not spread, Barr did not consider it problematic in 2021. However, Barr recommends initiating management if it spreads to additional locations.

3.4 Lake Jane

3.4.1 EWM Treatment History and Changes in Post-Treatment EWM Extent

The first sighting of EWM occurred in 2012 when a few scattered plants were observed near the east shore (about 0.1 acres). EWM treatment history for Lake Jane can be summarized as follows:

- From 2012 through 2015, EWM extent increased to 44 acres. In May 2015, the Lake Jane Association started its intervention, treating 7.9 acres with 2,4-D, and EWM extent was reduced to 31 acres.
- No treatment occurred in 2016, and EWM extent increased to 69 acres.
- In 2017, 11.1 acres were treated with 2,4-D, and EWM extent was reduced to 26 acres.
- In 2018, 12 acres were treated with ProcellaCOR EC, and EWM extent was reduced to 9 acres.
- In the spring of 2019, 12 acres were treated with ProcellaCOR EC, and the VBWD June 2019 plant survey indicated that most EWM plants were severely burned. However, some individuals showed regrowth from severely burned root crowns. The survey also documented that EWM had tripled in extent between July 2018 and June 2019 (from 9 acres to 27) (Table 16).

EWM, pictured above, increased in extent during the summer of 2021, from 0.4 acres in June to 12 acres by fall.

- A point-intercept survey completed by the University of Minnesota in August 2019 indicated that the majority of EWM observed in June had died, reducing the extent to slightly less than 3 acres (Table 16; University of Minnesota unpublished data, 2019).
- EWM extent increased to slightly more than 3 acres by June 2020. A point-intercept plant survey completed by the University of Minnesota in August 2020 indicated a rapid spread to 20 acres (Table 16; University of Minnesota unpublished data, 2020).
- On September 18, 2020, the Lake Jane Association treated 6.7 acres with ProcellaCOR EC.
- On May 28, 2021, the Lake Jane Association treated 12.8 acres with diquat, targeting both EWM and CLP (Figure 8). The treatment reduced EWM extent to 0.4 acres by June 2021 (Table 16 and Figure 9), and CLP was not observed during the June plant survey (Table 17). However, EWM extent increased to more than 12 acres by the fall of 2021 (Figure 10).

3.4.2 Plant Diversity

Lake Jane plant diversity has been good throughout the 2012 through 2021 monitoring period. Simpson Diversity Index values have ranged from 0.88 to 0.92, and a value of 0.89 was documented in June 2021 (Table 17).

3.4.3 MNDNR IBI

The Lake Jane plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2012 through 2021 (Table 18). A total of 25 plant species were observed in 2021, 108 percent greater than the impairment threshold of 12 species. The 2021 FQI score of 31.0 was 67 percent higher than the impairment threshold of 18.6 (Table 18).

3.4.4 Significant Changes in Plant Frequency

The Lake Jane plant community was relatively stable between 2020 and 2021, but a few significant changes in plant frequency occurred. Large-leaf pondweed and filamentous algae significantly increased in frequency, while Illinois pondweed (*Potamogeton Illinoensis*) significantly decreased (Table 19). The significant increase in filamentous algae was an unfavorable change for the lake.

3.4.5 Other AIS

While EWM is the AIS of primary concern in Lake Jane, three additional AIS were observed during 2021: reed canary grass, purple loosestrife (*Lythrum salicaria*), and narrow-leaved cattail (Table 1 and Table 2).

Except for 2019 and 2020, a single occurrence of reed canary grass has been documented in Lake Jane since monitoring began in 2012 (Table 17)—although the location has changed. In 2021 it was found along the southeastern shoreline. Because it has been stable and limited to single locations, Barr did not consider it problematic in 2021.

A single occurrence of purple loosestrife has been documented at different locations in Lake Jane since point-intercept monitoring began in 2012 (Table 17). In 2021, it was found along the southwestern

shoreline. Because it has been stable and limited to single locations, Barr did not consider it problematic in 2021.

Narrow-leaved cattail has been present at a single location on the southeast side of the lake from 2015 through 2021 (Table 17). Because it has been stable and limited to a single location, Barr did not consider it problematic in 2021.

3.5 Lake Elmo

3.5.1 History of EWM and EWM Removal

Lake Elmo EWM extent has fluctuated over time. EWM extent:

- Declined from 2012 through 2014 (from 71 acres to 51 acres).
- Increased from 2014 to 2016 (from 51 acres to 80 acres).
- Declined from 2016 through 2018 (from 80 acres to 30 acres).
- Increased from 2018 through 2019 (from 30 acres to 49 acres).
- Declined from 2019 through 2020 (from 49 acres to 39 acres).
- Increased from 2020 through 2021 (from 39 acres to 40 acres) (Table 20 and Figure 11).

In 2021, mechanical harvesting removed 20.5 acres of EWM, pictured above.

The Lake Elmo Association conducted small-scale EWM removal projects from 2015 through 2017 and 2019 through 2021:

- A dive team removed less than an acre of EWM in 2015.
- Mechanical harvesting was done in 2016 and 2017; about 10 acres of EWM at the north end of the lake were removed in 2016, and about 4 acres were removed on the east and northeast sides in 2017.
- In 2018, equipment problems with the mechanical harvester prevented removal.
- Mechanical harvesting removed 3 acres in 2019.
- Mechanical harvesting removed 16 acres from the south, east, and west sides of the lake in 2020.
- Mechanical harvesting removed 20.5 acres from May 27 through June 3, 2021: 2.7 acres near the boat landing on the west side of the lake and 17.8 acres on the east side (Figure 12).

3.5.2 Hybrid Milfoil

In 2018, the Minnesota Aquatic Invasive Species Research Center (MAISRC) collected milfoil samples from Lake Elmo and determined that both EWM and hybrid milfoil were present (Newman et al., 2019). Hybrid milfoil is a cross between the native milfoil (*Myriophyllum sibiricum*) and EWM. Hybrid milfoil reproduces by both fragments and seeds, and its seeds are generally viable. Hybrid milfoil is more aggressive and

more resistant to herbicide treatment than EWM. It generally requires a higher dose of herbicide to attain control.

3.5.3 Plant Diversity

Lake Elmo plant diversity has been good throughout the 2012 through 2021 monitoring period. Simpson Diversity Index values have fluctuated between 0.88 and 0.92 during this period, with a value of 0.91 documented in 2021 (Table 21).

3.5.4 MNDNR IBI

The Lake Elmo plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2012 through 2021 (Table 22), indicating that it is not stressed from anthropogenic eutrophication. A total of 25 plant species were observed in 2021, 108 percent greater than the impairment threshold of 12 species. The 2021 FQI score of 25.8 was 39 percent higher than the impairment threshold of 18.6 (Table 22).

3.5.5 Significant Changes in Plant Frequency

The Lake Elmo plant community was stable in 2021. There were no significant frequency changes in species between 2020 and 2021 (Table 23).

3.5.6 Other AIS

In addition to EWM, three additional AIS were observed in in Lake Elmo in 2021: CLP, narrow-leaved cattail, and common reed (*Phragmites australis subspecies australis*) (Table 1 and Table 2).

A few CLP plants were observed near a single sample location on the lake's northwest side in 2019 through 2021. Because CLP has remained stable at a single location since 2019, Barr did not consider CLP problematic in 2021.

Narrow-leaved cattail has been observed in Lake Elmo since monitoring began in 2012. The cattail community is located along the western and southern shores of the lake and has remained relatively stable over the monitoring period. Because of its long-term stability, Barr did not consider it problematic in 2021.

Phragmites australis has been observed in Lake Elmo since 2013—along the southeast shore in 2013 and 2019 and along the southern shore from 2015 through 2021—but was not identified to subspecies until 2020. *Phragmites australis* has two subspecies:

- *americanus* – American common reed, a native species. The plants collected on the rake during the 2020 plant survey were identified as American common reed.

Common reed, pictured above, is an aggressive nonnative wetland grass found in the southern end of Lake Elmo in 2021.

Pictured above, common reed appeared to be outcompeting narrow-leaved cattail in the southern end of Lake Elmo in 2021. Both are aquatic invasive species.

- *australis* - common reed, a nonnative, aggressive wetland grass that outcompetes both native and other nonnative wetland plants. The plants collected on the rake during the 2021 plant survey were identified as common reed.

VBWD's subcontractor observed that common reed appeared to be out-competing another aquatic invasive species, narrow-leaved cattail, in 2021. Because it appears to be spreading and out-competing another species, Barr recommends working with MNDNR and the Lake Elmo Lake Association to identify and implement feasible management options.

3.6 Silver Lake

3.6.1 EWM Treatment History and Changes in Post-Treatment EWM Extent

EWM has been present in Silver Lake since 1992. The Silver Lake Improvement Association (SLIA) has conducted herbicide treatments to control EWM nearly annually since 1995. Most have been small-scale treatments to attain seasonal relief. However, large-scale treatments to attain long-term reduction occurred in 2007 and 2008, and subsequent efforts can be summarized as follows:

- Small-scale treatments to attain seasonal relief occurred from 2012 through 2015 and in 2017.
- Despite no EWM treatment or removal in 2018, EWM extent declined by an order of magnitude—from 30 acres in 2017 to 0.3 acres in 2018. The cause of the decline is unknown.
- Because EWM extent increased from June 2018 to spring 2019, nearly 4 acres of EWM in the south and southwest areas of the lake were treated with diquat in May 2019. Due to the successful treatment, EWM was not found in the treated areas in June but was found in the lake's northwest corner (0.3 acres).
- A delineation plant survey by Ramsey County staff in April 2020 found EWM in approximately the same northwest corner. A total of 6.5 acres were treated with diquat in the spring of 2020 to control both EWM and CLP. Because EWM was only found at the northwest location, most of the treatment targeted CLP. Due to the successful treatment, EWM was not found at the northwest location in June 2020 but was found at the northeast corner and midway on the east side of the lake (0.8 acres).

In 2021, Silver Lake EWM, pictured above, appeared to be hybrid. Some EWM was slightly burned, but most EWM was actively growing.

- A delineation plant survey by Ramsey County staff in April 2021 found no EWM in the lake (Figure 13); however, EWM extent increased to16 acres by June (Table 24 and Figure 14). According to VBWD's subcontractor, all EWM observed in June appeared to be aggressive hybrid milfoil (Section 3.5.2). Some EWM was slightly burned, but most was actively growing. Hybrid generally reproduces by both fragments and seeds, and its seeds are generally viable. The rapid increase in EWM extent between April and June is likely due to growth from seeds.

3.6.2 History of CLP and Treatment

CLP presence in Silver Lake has been documented since 2006. The SLIA has conducted herbicide treatments to control CLP since 2007. These efforts can be summarized as follows:

- Large-scale treatments to attain long-term CLP reduction occurred from 2007 through 2009. Treatments were not needed again until 2013.
- Small-scale treatments to attain seasonal relief occurred in 2013, 2016, and 2017.
- CLP was not observed in 2018 because the plant survey occurred after the natural senescence of CLP.
- CLP was present in the spring of 2019, and 1.75 acres were treated with diquat. Due to this successful treatment, CLP was not observed in Silver Lake during the June 2019 plant survey.
- A delineation plant survey by Ramsey County staff in April 2020 found CLP at multiple locations in the lake. As noted previously, a total of 6.5 acres were treated with diquat in spring 2020 to address both CLP and EWM; however, most of the treatment targeted CLP. Due to the successful treatment, CLP was not observed in Silver Lake in June 2020.
- CLP was present in the spring of 2021, and 4.0 acres were treated with diquat (Figure 15). In June, CLP was found at a single location: the boat access at the north end of the lake. Only a few CLP plants were observed.

3.6.3 Plant Diversity

Plant diversity in Silver Lake has varied widely during the monitoring period. Causes of the fluctuations include damage to the plant community from the 2007 and 2008 herbicide treatments and subsequent water-quality degradation, as well as positive impacts from recent improvements to the lake's water quality. Simpson Diversity Index values have fluctuated between 0.63 and 0.84 during the 2006 through 2021 monitoring period.

Plant diversity in 2018 and 2019 was lower than from 2013 through 2017. This is due to the dominance of coontail in 2018 and filamentous algae in 2019. In 2020, the frequency of coontail and filamentous significantly decreased, and the frequency of several native species increased. These changes improved plant diversity, with the Simpson Diversity Index value increasing from 0.68 in 2019 to 0.75 in 2020. The Simpson Diversity Index value was 0.74 in 2021 (Table 25), indicating that plant diversity had remained relatively stable.

Increased frequency of several native species including muskgrass, pictured above, resulted in improved plant diversity in 2020 and 2021.

3.6.4 MNDNR IBI

The 2021 Silver Lake plant community meets the MNDNR Lake Plant Eutrophication IBI criteria, indicating the lake was not stressed from anthropogenic eutrophication. Seventeen plant species were observed in

2021, 42 percent greater than the impairment threshold of 12 species. The 2021 FQI score of 23.3 was 25 percent higher than the impairment threshold of 18.6 (Table 26).

From 2007 through 2016, the Silver Lake plant community often failed to meet the MNDNR Lake Plant Eutrophication IBI. This is due to CLP and EWP treatments in 2007 and 2008 that significantly damaged the native plant community. The data indicate the plant community met IBI criteria in 2006 but did not meet the criteria from 2007 through 2011, except for August 2009. Over time, the plant community has improved such that Silver Lake met the IBI criteria about half of the time from 2012 through 2016 and fully met the criteria from 2017 through 2021 (Table 26).

3.6.5 Significant Changes in Plant Frequency

The Silver Lake plant community was relatively stable in 2021 and the only plant to significantly change in frequency was EWM. In 2021, EWM increased in frequency by more than an order of magnitude, from 2 percent in 2020 to 23 percent in 2021 (Table 27). The significant increase in EWM frequency was an unfavorable change for the lake.

3.6.6 Other AIS

Although EWM and CLP are the AIS of concern in Silver Lake, the June 2021 plant survey documented three additional AIS in the lake: narrow-leaved cattail, reed canary grass, and purple loosestrife (Table 1 and Table 2).

Narrow-leaved cattail was observed at a single location in the northeast area of the lake first in 2017, then again from 2018 through 2021. Because it has been stable and limited to a single location, Barr did not consider it problematic in 2021.

Reed canary grass was observed at the same location as narrow-leaved cattail—in the northeast area of the lake in 2017 and 2018. It moved to a different northeast location in 2019, 2020, and 2021. In 2020, it was also observed in approximately the middle of the western shore. Because it has been stable and was limited to a single location in 2021, Barr did not consider it problematic.

Purple loosestrife has been observed at a single location in the southwest corner of the lake since 2018. Barr did not consider it problematic in 2021 because it has been found at the same location.

4 References

Cattoor, Kylie. 2019. Email communication from Kylie Cattoor, MNDNR, to Meg Rattei on October 31, 2019.

Newman, RM and RA Thum. 2019. Eurasian and Hybrid Watermilfoil Genotype Distribution in Minnesota. Final Report to the Minnesota Aquatic Invasive Species Research Center. August 2019.

University of Minnesota. 2019. Unpublished data provided to VBWD in an email from Ray Newman to Meg Rattei on August 13, 2020.

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Tables

Description of Tables

Table 1 summarizes the results of the 2021 aquatic plant surveys of six VBWD lakes. The following data are presented:

- **Number of species**—the number of different plant species that were either collected on the rake or observed in the lake (e.g., water lilies or cattail beds not collected on the rake but observed). This number includes both invasive and native species.
- **Number of native species**—the number of native plant species that were either collected on the rake or observed in the lake.
- **Number of native species collected on rake**—only native plants collected on the rake were used for this statistic.
- **Number of invasive species**—the number of invasive plant species that were either collected on the rake or observed in the lake.
- **Maximum depth of plant growth**—the maximum depth that plants were found in the lake.
- **Frequency of occurrence**—the frequency with which plants were found in water shallower than the maximum depth of plant growth.
- **Average rake fullness**—the density of plant growth, as measured by rake fullness on a scale of 1 to 4, where:
  - 1 = less than 1/3 of the rake head full of plants
  - 2 = from 1/3 to 2/3 of the rake head full of plants
  - 3 = more than 2/3 of the rake head full of plants
  - 4 = rake head is full, with plants overtopping
- **Simpson Diversity Index value**—index used to measure plant diversity, which assesses the overall health of the lake's plant communities. With scores ranging from 0 to 1, the index considers both the number of species present and the evenness of species distribution. The scores represent the probability that two individual plants randomly selected from the lake will belong to different species. A high score indicates a more diverse plant community—a higher probability that two randomly selected plants will represent different species.

Table 2 summarizes invasive species data from the six VBWD lakes surveyed in 2021. The table shows the frequency of occurrence for species collected on the rake and includes species that were observed (Present = P) but not collected on the rake.

Tables 3, 4, 8, 12, 16, 20, and 24 summarize Eurasian watermilfoil (EWM) extent for the period of record for Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and 2017 through 2021 for Silver Lake. EWM extent is shown as acres of EWM in the lake and as a percent of the plant-growth area.

Tables 5, 9, 13, 17, 21, and 25 summarize Simpson Diversity Index values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Tables 6, 10, 14, 18, 22, and 26 summarize MNDNR Lake Eutrophication Plant IBI values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Tables 7, 11, 15, 19, 23, and 27 show species frequency for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Table 1 Lake plant survey summary statistics (June 2021)

Lake	Number of Species*	Number of Native Species*	Number of Native Species Collected on Rake*	Number of Invasive Species	Maximum Depth of Plant Growth (feet)	Frequency of Occurrence (%)	Average Rake Fullness	Simpson Diversity Index Value
Jane	29	25	20	4	21	93	2.4	0.89
Olson	28	24	19	4	19	99	2.4	0.86
Elmo	26	22	18	4	19	88	2.5	0.91
Silver	20	15	12	5	10	74	2.0	0.74
DeMontreville	18	14	13	4	20	91	2.0	0.80
Long	18	14	13	4	17	63	1.7	0.80

*Filamentous algae, aquatic moss, and liverworts were not included in number of species.

Table 2 June 2021 invasive species summary—frequency of occurrence at sites shallower than maximum depth of plant growth (percent or observed*)

Lake	*Myriophyllum spicatum* (Eurasian watermilfoil)	*Potamogeton crispus* (curly-leaf pondweed)	*Phalaris arundinacea* (reed canary grass)	*Lythrum salicaria* (purple loosestrife)	*Typha angustifolia* (narrow-leaved cattail)	*Phragmites australis subsp. australis (common reed)*
Elmo	34.25	P	--	--	12	1
Silver	23	P	P	P	1	--
Olson	13	3	P	--	P	--
DeMontreville	3	6	P	--	P	--
Jane	1	--	P	P	P	--
Long	1	41	P	--	P	--

*Observed in the lake but not collected on the rake (Present = P).

Table 3 Long Lake acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.011800)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/15/2010	52.31	53.71	97.39%
8/1/2011	4.89	22.67	21.56%
4/29/2012	2.44	31.47	7.74%
6/18/2012	7.24	21.06	34.39%
5/16/2013 (Partial Survey)	14.28	--	--
6/24/2013	7.88	50.43	15.62%
5/24/2014	9.75	39.94	24.41%
6/25/2014	4.77	47.68	10.00%
5/9/2015	5.5	52.81	10.41%
6/22/2015	0.40	54.72	0.73%
5/1/2016	3.78	50.34	7.51%
6/27/2016	0.33	51.94	0.64%
6/27/2017	5.58	50.24	11.10%
5/20/2018	20.36	46.97	43.33%
7/29/2018	34.71	53.51	64.87%
4/28/2019	23.09	45.21	51.07%
6/29/2019	2.17	47.15	4.60%
5/09/2020	8.33	43.94	18.96%
6/25/2020	0	45.45	0%
5/8/2021	0	34.01	0%
6/25/2021	0.2	45.14	0.44%

Table 4 Long Lake–Katherine Abbott Pond acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/27/2017	2.88	2.93	98.32%
5/20/2018	2.08	2.93	70.80%
7/29/2018	0	2.93	0%
4/28/2019	0	2.93	0%
6/29/2019	0	2.93	0%
5/09/2020	0	2.93	0%
6/25/2020	0.05	2.93	1.71%
5/8/2021	0	2.93	0%
6/25/2021	0	2.93	0%

Table 5 Simpson Diversity Index values for Long Lake, Washington County, MN (DOW 82.011800)

Year	Month	Day	Diversity
2010	June	15	0.40
2011	August	1	0.80
2012	June	18	0.85
2013	June	24	0.81
2014	June	25	0.83
2015	June	22	0.77
2016	June	27	0.78
2017	June	27	0.84
2018	July	29	0.80
2019	June	29	0.82
2020	June	25	0.81
2021	June	25	0.80

Table 6 MNDNR Plant IBI: Long Lake, Washington County, MN (DOW 82.011800)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Long Lake Species Richness**	Percent Difference between MNDNR Criterion and Long Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Long Lake FQI**	Percent Difference between MNDNR Criterion and Long Lake FQI	Does Long Lake Meet MNDNR Plant IBI Criteria?
2010	June	15	≥12	13	8	≥18.6	21.0	13	Yes
2011	August	1	≥12	14	17	≥18.6	20.0	8	Yes
2012	June	18	≥12	13	8	≥18.6	18.9	2	Yes
2013	June	24	≥12	12	0	≥18.6	17.6	-5	No
2014	June	25	≥12	12	0	≥18.6	17.0	-9	No
2015	June	22	≥12	16	33	≥18.6	20.0	8	Yes
2016	June	27	≥12	17	42	≥18.6	21.8	17	Yes
2017	June	27	≥12	16	33	≥18.6	21.8	17	Yes
2018	July	29	≥12	16	33	≥18.6	21.0	13	Yes
2019	June	29	≥12	15	25	≥18.6	20.7	11	Yes
2020	June	25	≥12	15	25	≥18.6	22.0	18	Yes
2021	June	25	≥12	16	33	≥18.6	22.8	22	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae, bearded stonewort, and several emergent species.

Table 7 Percent frequencies of occurrence of plants within vegetated depth range in Long Lake, Washington County, MN (DOW 82.011800)

Year	Month	Day	*Myriophyllum sibiricum*	*Myriophyllum spicatum*	*Ceratophyllum demersum*	*Ranunculus aquatilis*	*Utricularia vulgaris*	*Elodea canadensis*	*Heteranthera dubia*	*Najas flexilis*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton pusillus*	*Potamogeton sp.*	*Potamogeton nodosus*	*Stuckenia pectinata*	*Vallisneria americana*	*Zannichellia palustris*	*Nitella spp.*	*Lychnothamnus bgarbatus*	*Chara spp.*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Filamentous Algae	Aquatic Moss	*Bolboschoenus fluviatilis*	*Eleocharis acicularis*	*Phalaris arundinacea*	*Schoenoplectus acutus*	*Sparganium eurycarpum*	*Typha glauca*	*Typha angustifolia*	*Typha sp.*	*Salix spp.*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Free-float	Free-float	Free-float	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Upland
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Eudicot**
			Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native		Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Hybrid	**Non-Native**		**Non-Native**
2010	06	15	1	92					8	2		6			P								2	2	1					P	1	2	P			1	1
2011	08	1		29	5		P		2	16		2		2								8	P	11			15	3	P	5	P	2					
2012	06	18		29	9				21	26		41		5						2		17	2	5			16		2	2	2	2		2			
2013	06	24		19	5				3	7		25		5								11	2	1			20		1	1	P	1		P			
2014	06	25		10	10			2	2	1		11		14								20		2			17		1	2	P	1		P			
2015	06	22		1	6			26	1	1		6		8		P	P			1		26	1			1	25		P	1	P	P		P			
2016	06	27		1	10	3		31	2	1		10		4		1				1		29	1	1	P		37		P	1	P	P		P			
2017	06	27		14	13	3		28	2		1	17	P	1		2				5	1	31	2	2	2	2	20				P						
2018	07	29		58	28			22	1			7	P	7		3				6	2	31	3		1	3	10	3		P		P					
2019	06	29		6	42			23	4	2		29		3		4				6	2	12		5			19	3	P	1	P	P			P		
2020	06	25			39	P		4	1	3	1	15	1	11		7	1		1		5	25		3			18	2			P			P			
2021	06	25		1	17	1			2	2	P	41	1	8		5	3	1		2	7	16		2			23	2			P				P		

P = Present—Observed but not collected on the sampling rake

Table 8 Lake DeMontreville acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010100)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/18/2012	5.39	137.07	3.93%
6/24/2013	50.88	144.45	35.22%
5/24/2014	53.08	143.93	36.88%
6/28/2014	26.75	146.94	18.20%
5/10/2015	58.01	149.40	38.83%
6/21/2015	20.60	157.29	13.10%
5/1/2016	38.28	156.25	24.50%
6/26/2016	19.04	147.06	12.95%
5/21/2017	44.27	144.49	30.64%
6/25/2017	14.15	146.42	9.66%
7/30/2018	12.74	154.91	8.23%
6/24/2019	2.58	142.69	1.81%
6/25/2020	8.02	151.32	5.30%
6/22/2021	2.43	148.60	1.64%

Table 9 Simpson Diversity Index values for Lake DeMontreville, Washington County, MN (DOW 82.010100)

Year	Month	Day	Diversity
2012	June	18	0.89
2013	June	24	0.90
2014	June	28	0.90
2015	June	21	0.90
2016	June	26	0.86
2017	June	25	0.87
2018	July	30	0.87
2019	June	24	0.89
2020	June	25	0.85
2021	June	22	0.80

Table 10 MNDNR Plant IBI: Lake DeMontreville, Washington County, MN (DOW 82.010100)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake DeMontreville Species Richness**	Percent Difference between MNDNR Criterion and Lake DeMontreville Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake DeMontreville FQI**	Percent Difference between MNDNR Criterion and Lake DeMontreville FQI	Does Lake DeMontreville Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	23	92	≥18.6	27.3	47	Yes
2013	June	24	≥12	24	100	≥18.6	27.6	48	Yes
2014	June	28	≥12	23	92	≥18.6	28.8	55	Yes
2015	June	21	≥12	25	108	≥18.6	29.4	58	Yes
2016	June	26	≥12	20	67	≥18.6	25.5	37	Yes
2017	June	25	≥12	23	92	≥18.6	26.4	42	Yes
2018	July	30	≥12	21	75	≥18.6	26.6	43	Yes
2019	June	24	≥12	20	67	≥18.6	25.5	37	Yes
2020	June	25	≥12	19	58	≥18.6	25.2	36	Yes
2021	June	22	≥12	16	33	≥18.6	23.5	26	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 11 Percent frequencies of occurrence of plants within vegetated depth range in Lake DeMontreville, Washington County, MN (DOW 82.010100)

Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton friesii*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Najas flexilis*	*Najas s guadalupensis*	*Valisneria americana*	*Chara sp.*	*Nitella sp.*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	*Nymphaea odorata*	*Polygonum amphibium*	Filamentous Algae	Aquatic moss	*Eleocharis acicularis*	*Eleocharis palustris*	*Lythrum salicaria*	*Iris Pseudacorus*	*Phalaris arundinacea*	*Sagittaria graminea*	*Schoenoplectus acutus*	*Schoenoplectus tabernaemontani*	*Typha angustifolia*	*Typha latifolia*	*Typha glauca*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Free-float	Free-float	Free-float	Float-leaf	Float-leaf	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	**Dicot**	**Dicot**			Monocot	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
			Native	**Non-Native**	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	**Non-Native**	**Non-Native**	Native	Native	Native	**Non-Native**	Native	Native	**Non-Native**
2012	06	18	38	4	5	4	8	5		4	49		9		41	12	50		2		4	6	11		22		1	3		6	1	1	P	P			1			P	P	P	1
2013	06	24	50	33	12	5	22	7		3	42	1	7		30	26	48	2	2		2	5	3	1	28	1		4	P	33			P		P	P				P	P	1
2014	06	28	61	19	13	3	32	7		3	10	1	7		25	19	39		4	1	7	10	3		17			3	P	14	3	1	P			1						1
2015	06	21	61	17	1	5	30	2	1	6	31		6		18	17	45		6	8	12	13	6		15			3	P	27	6	2	P		P	P		P	P			1
2016	06	26	70	16		3	68	4			2		6		5	4	12		4	18	14	30	11		14			5	1	39	1			P		P		P	P			1
2017	06	25	53	14		5	64	1		1	17		3		13	4	2			17	18	35	10	3	5	3	2	3	P	31	6		P			P		P				P
2018	07	30	49	12			24	1		1			3		24	5	3	P	1	8	21	45	4	3	23		3	4	P	16	2					P	1					P
2019	06	24	25	4			10	1		2	12		4		21	6	3			4	12	48	26	2	14		4	3	1	28	5	1			P	P						1
2020	06	25	8	9			7			5	P		2	P	19	8	P			1	17	60	25	4	20	1	4	3	P	33	4	3			P	P				P		
2021	06	22	8	3						5	6			P	44	9	1		1		16	61	8		11		3	4	1	12	7					P				P		

P = Present—Observed but not collected on the sampling rake

Table 12 Lake Olson acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010300)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/18/2012	2.17	88.03	2.46%
6/24/2013	3.55	89.01	3.99%
5/24/2014	22.96	87.11	26.36%
6/28/2014	23.96	89.02	26.92%
5/9/2015	31.77	89.26	35.59%
6/21/2015	28.13	87.02	32.33%
5/1/2016	53.49	89.26	59.93%
6/26/2016	17.56	89.26	19.67%
5/21/2017	43.61	89.26	48.86%
6/25/2017	21.03	88.80	23.68%
7/30/2018	6.58	89.26	7.38%
6/27/2019	1.43	89.26	1.60%
6/24/2020	0.83	89.26	0.93%
6/22/2021	7.96	89.26	8.91

Table 13 Simpson Diversity Index values for Lake Olson, Washington County, MN (DOW 82.010300)

Year	Month	Day	Diversity
2012	June	18	0.92
2013	June	24	0.91
2014	June	28	0.90
2015	June	21	0.90
2016	June	26	0.85
2017	June	25	0.86
2018	July	30	0.87
2019	June	27	0.88
2020	June	24–25	0.84
2021	June	22	0.86

Table 14 MNDNR Plant IBI: Lake Olson, Washington County, MN (DOW 82.010300)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Olson Species Richness**	Percent Difference between MNDNR Criterion and Lake Olson Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Olson FQI**	Percent Difference between MNDNR Criterion and Lake Olson FQI	Does Lake Olson Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	22	83	≥18.6	26.86	44	Yes
2013	June	24	≥12	22	83	≥18.6	26.22	41	Yes
2014	June	28	≥12	25	108	≥18.6	29.0	56	Yes
2015	June	21	≥12	26	117	≥18.6	30.0	61	Yes
2016	June	26	≥12	24	100	≥18.6	28.4	53	Yes
2017	June	25	≥12	25	108	≥18.6	29.0	56	Yes
2018	July	30	≥12	22	83	≥18.6	27.9	50	Yes
2019	June	27	≥12	23	92	≥18.6	28.8	55	Yes
2020	June	24–25	≥12	23	92	≥18.6	26.2	41	Yes
2021	June	22	≥12	23	92	≥18.6	27.7	49	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae, bearded stonewort, and several emergent species.

Table 15 Percent frequencies of occurrence of plants within vegetated depth range in Lake Olson, Washington County, MN (DOW 82.010300)

Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton gramineus*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Stuckenia pectinata*	*Vallisneria americana*	Chara sp.	*Lychnothamnus barbaratus*	*Nitella sp*	*Lemna trisulca*	*Nymphaea odorata*	*Polygonum amphibium*	Filamentous algae	Aquatic moss	*Calamagrostis canadensis*	*Eleocharis acicularis*	*Eleocharis palustris*	*Iris virginica*	*Iris pseudacorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	Sagittaria graminea	Schoenoplectus acutus	Schoenoplectus Tabernaemontani	Typha angustifolia	Typha glauca
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Float-leaf	Float-leaf	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				Monocot	**Dicot**	**Dicot**			Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
			Native	**Non-Native**	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native		Native	Native	Native	Native	Native	Native	**Native**	Native	Native	Native	Native	**Non-Native**	**Non-Native**	**Non-Native**	Native	Native	Native	Native	**Non-Native**	**Non-Native**
2012	06	18	27	3	12	4	11	16		10	28			23		30	10	19	3			2	25		12	15	1	P	7	18		4	1				1				1	P	
2013	06	24	38	5	10	3	11	12		7	43			17		25	7	21	13		P		10		6	20	1		8	14		3	1				P				1	P	
2014	06	28	57	28	8	2	23	24	1	1	3			13		22	10	17	11	2	P	3	25		4	19	1		19	13		1	1				P				P	P	
2015	06	21	37	28	2	P	23	6		3	5			13	1	6	21	15	8	4	P	5	38		7	11	1		9	15		4	1	P			P	P			P	P	
2016	06	26	50	19		3	67	4			1			8	P	3	8	6	8	4	1	6	53		9	8	1	P	23	13	P	5	P				P		2		P	P	
2017	06	27	58	25		2	58	1		2	5			17	P	2	10	3	2	14	1	10	55		9	3	1	P	18	8	P	2			P		P		2	P	P		
2018	07	30	48	10			30	1		1					P	10	8	4	3	15	1	22	53		6	12	1	P	9	8	P	3			P	P	P		1	P			P
2019	06	27	38	3		1	15	2		1	7			4	1	18	21	3		5		16	53	1	17	13	1		18	11		3		P	P	P	P			P	P		P
2020	06	24-25	22	2			17	1		2	P		3	3	P	20	22	1		3		19	65	1	13	8	1	P	23	15	1	1		P	P	P	1		1	P	1		P
2021	06	22	21	13			19	2		8	3	1	1	1	1	32	24	4		2		16	66	1	8	3	1	P	8	4	P	P		P			P			P	1	P	

P = Present—Observed but not collected on the sampling rake

Table 16 Lake Jane acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010400)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/18/2012	0.10	118.54	0.08%
6/28/2013	1.68	121.82	1.38%
6/27/2014	24.08	112.61	21.38%
5/9/2015	44.16	125.08	35.31%
6/21/2015	31.01	126.77	24.46%
6/27/2016	68.71	131.23	52.36%
6/27/2017	26.26	126.40	20.77%
7/29/2018	9.07	128.01	7.09%
6/24/2019	26.87*	126.45	21.25%
8/07/2019**	2.65	131.17	2.02%
6/24/2020	3.08	127.63	2.41%
8/10/2020**	20.14	126.50	15.92%
6/24/2021	0.35	124.73	0.28%

* Most individual EWM plants were severely burned by herbicide treatment and looked like they could die.

**Plant survey completed by the University of Minnesota.

Table 17 Simpson Diversity Index values for Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	Diversity
2012	June	18	0.92
2013	June	28	0.91
2014	June	27	0.92
2015	June	21	0.92
2016	June	27	0.90
2017	June	27	0.89
2018	July	29	0.89
2019	June	24	0.90
2020	June	24	0.88
2021	June	24	0.89

Table 18 MNDNR Plant IBI: Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Jane Species Richness**	Percent Difference between MNDNR Criterion and Lake Jane Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Jane FQI**	Percent Difference between MNDNR Criterion and Lake Jane FQI	Does Lake Jane Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	28	133	≥18.6	31.6	70	Yes
2013	June	28	≥12	32	167	≥18.6	33.76	82	Yes
2014	June	27	≥12	30	150	≥18.6	33.05	78	Yes
2015	June	21	≥12	27	125	≥18.6	31.56	70	Yes
2016	June	27	≥12	27	125	≥18.6	30.8	66	Yes
2017	June	27	≥12	27	125	≥18.6	30.8	66	Yes
2018	July	29	≥12	29	142	≥18.6	32.7	76	Yes
2019	June	24	≥12	23	92	≥18.6	29.2	57	Yes
2020	June	24	≥12	23	92	≥18.6	27.7	49	Yes
2021	June	24	≥12	25	108	≥18.6	31.0	67	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 19 Percent frequencies of occurrence of plants within vegetated depth range in Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	*Ceratophyllum demersum*	*Bidens beckii*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Elodea canadensis*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton friesii*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton praelongus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Najas flexilis*	*Najas guadalupensis*	*Vallisneria americana*	*Zannichellia palustris*	*Isoetes echinospora*	Chara sp.	*Nitella sp*	*Brasenia schreberi*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Riccia fluitans*	*Wolffia columbiana*	Isoetes echinospora	Aquatic moss	Filamentous algae	*Carex hystericina*	*Carex pellita*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Iris virginica*	*Juncus articus variation balticus*	*Juncus canadensis*	*Juncus effusus*	*Juncus pelocarpus*	*Juncus pilocarpus f. submersus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	*Sagittaria graminea*	*Sagittaria cristata*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha X glauca*	*Polygonum amphibium*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Float-leaf	Free-float	Free-float	Free-float	Free-float	Quillwort	Mosses	Algae	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Submersed or Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	Monocot	Monocot	**Dicot**
			Native	Native	**Non-Native**	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native
			Ceratophyllum demersum	*Bidens beckii*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Elodea canadensis*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton friesii*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton praelongus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Najas flexilis*	*Najas guadalupensis*	*Vallisneria americana*	*Zannichellia palustris*	*Isoetes echinospora*	Chara sp.	*Nitella sp*	*Brasenia schreberi*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Riccia fluitans*	*Wolffia columbiana*	Isoetes echinospora	Aquatic moss	Filamentous algae	*Carex hystericina*	*Carex pellita*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Iris virginica*	*Juncus articus variation balticus*	*Juncus canadensis*	*Juncus effusus*	*Juncus pelocarpus*	*Juncus pilocarpus f. submersus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	*Sagittaria graminea*	*Sagittaria cristata*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha X glauca*	*Polygonum amphibium*
2012	06	18	33		P	22	15	32	7	21	16	1	24		8	14	62	16	1	8	6	6			16		1	6	2	1		1			2			4				P	2		P	P	2			P	P	P	P
2013	06	28	24		2	21	9	17	3	15	12		30		6	21	66	10	1	8	5	2	2	1	15	1	1	2	1	1	P	1			5			7	1		1				2	P	P	3			1	P		
2014	06	27	25		19	20	5	27	7	6	8	2	30	2	7	16	57	14	P	5	13	6	1	1	22		2	2		1			1	2		1	1	1		1	1	P			P	P	4			P		P	
2015	06	21	23	1	23	9	2	30		7	11	2	19	7	7	14	53	12	2	4	17	4			17	2	1	3		7				1	16			3								P	P	3			P	P		
2016	06	27	14		41	3	1	46	P	7	18		18	9	1	9	54	5	1	2	37	5	2	1	18	3		5						10		1	5	1	P	P	P					P	1	1			P	P		P
2017	06	27	17		24		1	62	1	2	17		22	8		3	33	2	P	3	20	11			16	7	1	3		3			1	2			2	1		1	1			P	P	P	1			P	P		P
2018	07	29	14		9		1	59	3	7	1		10	2	1	6	36	1		9	34	17			18	2	1	2	1	10			1	1	4			2	1						1	P	P	2			P	P		P
2019	06	24	13		24			60		3	26		29	6	1	6	40			2	27	12			22	3	1	2		9				3	6			2	1						1	P		2				P		P
2020	06	24	9		4		1	57		6	1		24	8		4	42		P	2	19	16			24	10	1	4		11			1	3	2	P			1	P		P					P	P		P
2021	06	24	11		1		1	44	1	20			2	2	3	7	47	2		2	17	16			27	13	P	7		11				1	9			3		P						P	P			P	P		P

P = Present—Observed but not collected on the sampling rake

Table 20 Lake Elmo acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010600)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/18–19/2012	71.09	112.68	63.09
6/28/2013	52.69	109.61	48.07
6/27/2014	50.58	112.42	44.99
6/21/2015	67.52	113.53	59.47
4/30/2016	58.77	123.62	47.54
6/27/2016	78.58	123.31	63.73
7/29/2016*	80.15	126.60	63.31
6/27/2017	57.32	120.19	47.69
7/30/2018	30.12	116.26	25.91
6/27/2019	49.43	157.19	31.45
6/26/2020	38.85	102.63	37.85
6/24/2021	39.92	109.77	36.37

*July 29, 2016, data collected by the Lake Elmo Association

Table 21 Simpson Diversity Index values for Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	Diversity
2012	June	18–19	0.91
2013	June	28	0.89
2014	June	27	0.88
2015	June	21	0.88
2016	June	27	0.89
2016*	July*	29*	0.88
2017	June	27	0.91
2018	July	30	0.89
2019	June	27	0.90
2020	June	26	0.92
2021	June	24	0.91

*July 29, 2016, data collected by the Lake Elmo Association

Table 22 MNDNR Plant IBI: Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Elmo Species Richness**	Percent Difference between MNDNR Criterion and Lake Elmo Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Elmo FQI**	Percent Difference between MNDNR Criterion and Lake Elmo FQI	Does Lake Elmo Meet MNDNR Plant IBI Criteria?
2012	June	18–19	≥12	31	158	≥18.6	31.1	67	Yes
2013	June	28	≥12	28	133	≥18.6	28.0	51	Yes
2014	June	27	≥12	25	108	≥18.6	25.4	37	Yes
2015	June	21	≥12	27	125	≥18.6	27.3	47	Yes
2016	June	27	≥12	26	117	≥18.6	26.9	45	Yes
2016	July	29	≥12	26	117	≥18.6	26.5	42	Yes
2017	June	27	≥12	29	142	≥18.6	29.2	57	Yes
2018	July	30	≥12	24	100	≥18.6	25.3	36	Yes
2019	June	27	≥12	26	117	≥18.6	26.5	42	Yes
2020	June	26	≥12	24	100	≥18.6	24.3	31	Yes
2021	June	24	≥12	25	108	≥18.6	25.8	39	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 23 Percent frequencies of occurrence of plants within vegetated depth range in Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Utricularia vulgaris*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton friesii*	*Potamogeton gramineus*	*Potamogeton illinoensis*	*Potamogeton natans*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton richardsonii*	*Potamogeton strictifolius*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Stuckenia pectinata*	Chara sp.	*Nitella sp*	*Nymphaea odorata*	*Polygonum amphibium*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Filamentous algae	*Riccia fluitans*	*Ricciocarpus natans*	*Carex comosa*	*Carex hystericina*	*Carex pellita*	*Carex scoparia*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Eleocharis palustris*	*Equisetum fluviatile*	*Iris virginica*	*Juncus canadensis*	*Phalaris arundinacea*	*Phragmites australis*	*Phragmites australis subsp. americanus*	*Phragmites australis subsp. australis*	*Polygonum amphibium*	*Schoenplectus acutus*	*Schoenoplectus pungens*	*Schoenoplectus Tabernaemontani*	*Sparganium eurycarpum*	*Typha angustifolia*	*Typha glauca*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Float-leaf	Free-float	Free-float	Free-float	Free-float	Algae	Liverwort	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
			Native	Native	**Non-Native**	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native or **Non-Native**	Native	Non-Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	**Non-Native**	**Non-Native**
2012	06	18-19	29	8	44	1	7	1		P	3	P	P		13	12		1	P	1	7	1	28	5	37	1	12	P	1				5			P			3	1	3	P			4					4	P	5	P	17	
2013	06	28	26	3	37	P	4	1			P		1		7	9		P	P		3	1	21	1	33	1	13		4				8		P	P		1	1		1	P	P	1		1	1				3	P	4	P	16	
2014	06	27	43	5	34		1	P			P		P		4	9			P		4	4	18	1	31		9	P	1		1		14			P		1	P		1	P	P			3	P				5	P	3			16
2015	06	21	41	3	45	P	3	1	1	P	P				4	13		1			7		12	3	35		13	P	5		7		11	3						3	P	P	P		P	P				3	P	3		17	
2016	06	27	43	8	43		6	P	3	P	1				9	10		1			6	P	23	1	34		18	P	4	1	3		8		1						P	P			1	P				5	P	P		15	1
2016	07	29	40	8	39		3	P	3	P	P				11	10	P				4	1	28	3	29		11	P	3		1		3							1	P	P				P				5	P	3		1	15
2017	06	27	42	6	32		9	3	1	P	3				13	10	1	P			4		29	6	21	1	14		4	4	5	4	4	P					1			P				P			P	3	P	P		13	1
2018	07	30	43	5	25			P	P	3					9	12	P				9		35	8	14		16	P	1	3	3		5			1				P	1		P		1		P			P	4	P	P		16	
2019	06	27	33	4	29		1	3	1	1	1				8	9		P			3		20	5	13		13		6	4	6	5	19						P			P				P			P	3	P	P		13	
2020	06	26	32	9	32		1	1	1	3	P				10	10					7		14	4	22		16		6	3	9	7	7				P	P			1						1			4	P	P		19	
2021	06	24	44	4	34		3	1		P	P			4	12	11		3	P		12		14	14	18		11		4	3	8	5	10														1		5	P	P		12	

P = Present—Observed but not collected on the sampling rake

July 29, 2016, data collected by the Lake Elmo Association

Table 24 Silver Lake acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 62.000100)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/25/2017	30.43	69.78	43.61
7/29/2018	0.32	68.99	0.46
4/29/2019	0.30	--	--
6/24/2019	0.31	69.03	0.45
6/24/2020	0.78	67.34	1.16
6/22/2021	16.04	70.09	22.89

Table 25 Simpson Diversity Index values for Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	Diversity
2006	June	7	0.84
2006	July	26	0.79
2007	June	11	0.79
2007	August	13	0.66
2008	June	23	0.67
2008	August	24	0.83
2009	June	2	0.72
2009	August	9	0.74
2011	August	1	0.79
2012	July	20	0.63
2013	August	13	0.83
2014	August	5	0.79
2015	August	20	0.77
2016	August	9	0.80
2017	June	25	0.82
2018	July	29	0.67
2019	June	24	0.68
2020	June	24	0.75
2021	June	22	0.74

Table 26 MNDNR Plant IBI: Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Silver Lake Species Richness**	Percent Difference between MNDNR Criterion and Silver Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Silver Lake FQI**	Percent Difference between MNDNR Criterion and Silver Lake FQI	Does Silver Lake Meet MNDNR Plant IBI Criteria?
2006	June	7	≥12	19	58	≥18.6	25.9	39	Yes
2006	July	26	≥12	15	25	≥18.6	21.9	18	Yes
2007	June	11	≥12	12	0	≥18.6	18.5	-1	No
2007	August	13	≥12	12	0	≥18.6	18.5	-1	No
2008	June	23	≥12	9	-25	≥18.6	16.7	-10	No
2008	August	24	≥12	11	-8	≥18.6	19.3	4	No
2009	June	2	≥12	12	0	≥18.6	18.5	-1	No
2009	August	9	≥12	14	17	≥18.6	19.2	3	Yes
2010	June	16	≥12	8	-33	≥18.6	13.8	-26	No
2010	August	6	≥12	9	-25	≥18.6	14.0	-25	No
2011	August	1	≥12	11	-8	≥18.6	16.6	-11	No
2012	July	20	≥12	9	-25	≥18.6	15.3	-18	No
2013	August	13	≥12	13	8	≥18.6	18.6	0	Yes
2014	August	5	≥12	11	-8	≥18.6	15.7	-16	No
2015	August	20	≥12	14	17	≥18.6	19.0	2	Yes
2016	August	9	≥12	11	-8	≥18.6	16.0	-14	No
2017	June	25	≥12	20	67	≥18.6	23.9	29	Yes
2018	July	29	≥12	18	50	≥18.6	22.9	23	Yes
2019	June	24	≥12	18	50	≥18.6	24.5	32	Yes
2020	June	24	≥12	20	67	≥18.6	25.5	37	Yes
2021	June	22	≥12	17	42	≥18.6	23.3	25	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth);
**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 27 Percent frequencies of occurrence of plants within vegetated depth range in Silver Lake, Washington County, MN (DOW 62.000100)

Year	Month	Day	Surveyor	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton nodosus*	*Potamogeton richardsonii*	*Potamogeton robbinsii*	*Potamogeton sp.*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Najas sp.*	*Stuckenia pectinata*	Zanichellia palustris	Chara sp.	*Nitella*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
				Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Free-float	Free-float	Free-float	Free-float	Free-float	Mosses	Algae	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
				Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot
				Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	Native	**Non-Native**	
2006	06	7	VBWD	97	49	70	3		6		12	12	21		1			1	1	1	22	25					1	2		3		14							1							
2006	07	26	VBWD	97	41	56	10		1		14	10	1						1		1	29					3	1		2		9														
2007	06	11	Fortin	81	56	48	3					6	2							12		11						1		2	1	28														1
2007	08	13	Fortin	96	32	8							1							5		7										34														
2008	6	23	U of M	53	18						1				1							1					5			8		14						2							
2008	8	24	U of M	15	17						3	1			4	1						1					5			7		3						5							
2009	6	2	U of M	3	33						2		2													4	29	2		5	1	1			1			2							1
2009	8	9	U of M	1	35	1					8	2			2							2			2		47			9	1							3							3
2010	6	17	MnDNR		17	4	1	P			1		50												7				44																
2010	8	6	MnDNR	3	25	16					4	1	1			2									3		34																		
2011	8	1	MnDNR	2	13	42	4				3		5	10	2										2		21			6														3
2012	7	20	MnDNR		4	70	9						8	1	1										1		24			4														3
2013	8	13	MnDNR	10	2	11	19						3	2	1							2			2		2	30		7								2						
2014	8	5	MnDNR	22	2	63					1		38			13						4			4			44		5								1						
2015	8	20	MnDNR	39	2	7	1	1			7		2	6							1			5	1			47	8									1						
2016	8	9	MnDNR	46	3	19					4		17		1									8	2			29	8									2						

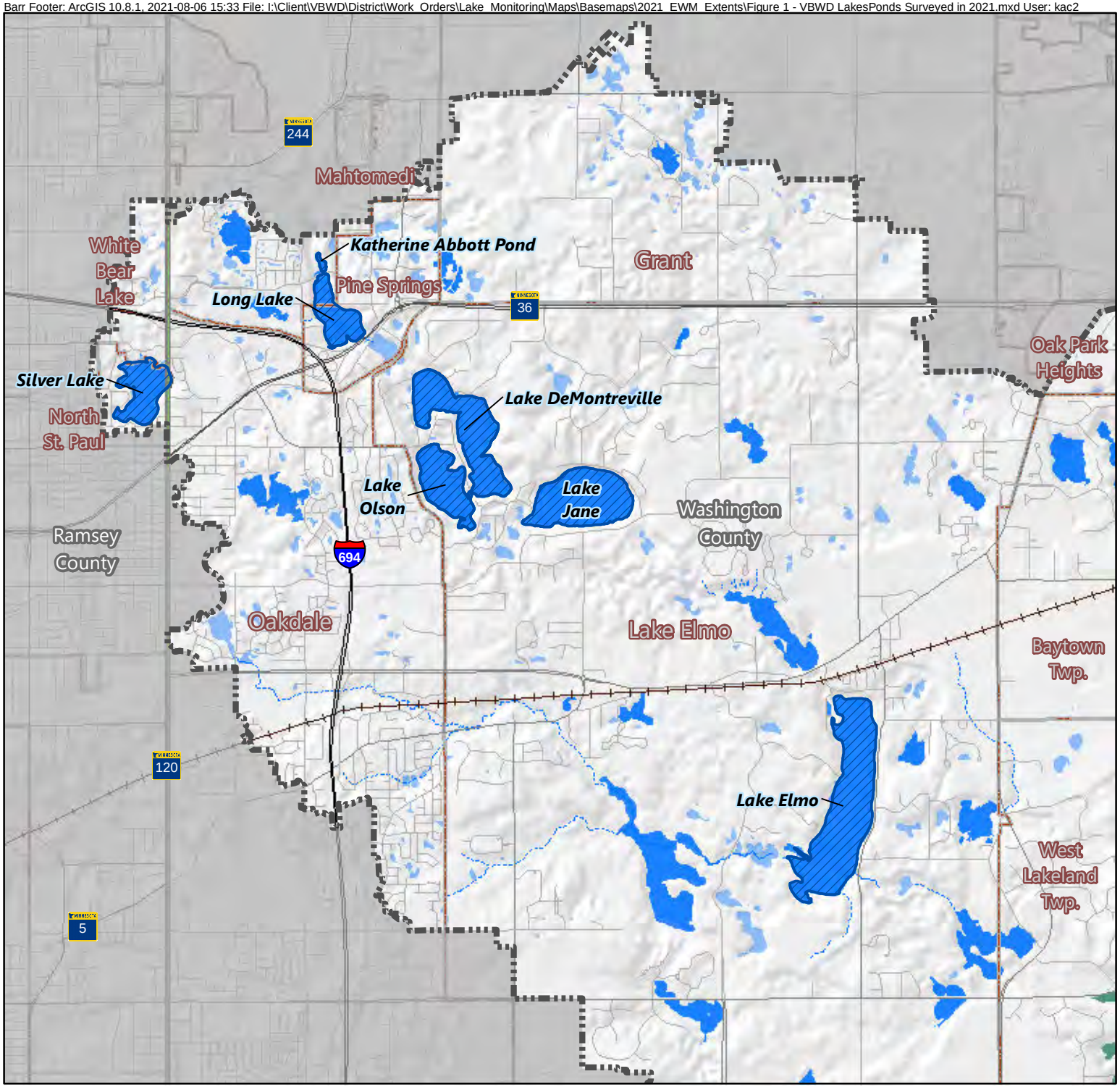
Table 27 (continued): Percent frequencies of occurrence of plants within vegetated depth range in Silver Lake, Washington County, MN (DOW 62.000100)

Year	Month	Day	Surveyor	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton nodosus*	*Potamogeton richardsonii*	*Potamogeton robbinsii*	*Potamogeton sp.*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Najas sp.*	*Stuckenia pectinata*	Zanichellia palustris	Chara sp.	*Nitella*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
				Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Free-float	Free-float	Free-float	Free-float	Mosses	Algae	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
				Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				**Dicot**	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot
				Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	Native	**Non-Native**	
				Ceratophyllum demersum	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton nodosus*	*Potamogeton richardsonii*	*Potamogeton robbinsii*	*Potamogeton sp.*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Najas sp.*	*Stuckenia pectinata*	Zanichellia palustris	Chara sp.	*Nitella*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
2017	06	25	VBWD	26	3	31		P			P		32	P	P	1	P				1	1			P		40			5	4	1	3	2		29		2		P			P		1	
2018	07	29	VBWD	64	1	1					4			P		2	1				P	4					30			9	3	2	2	2	1	19		2		P		P	P	P	1	
2019	06	24	VBWD	57		1					3	P				2	1				P		1				38			6	3	2	3	3	1	89	1	2		P	P	P	P	P	1	
2020	06	24	VBWD	37	1	2				1	4	P				2	1				4		1				40			9	3	2	2	2	4	45	1	2		P		P	P	P	1	
2021	06	22	VBWD	34		23					1	P	P			2	1				1	1	1				52			10		3	1		3	37		2		P		P	P	P	1	

P = Present—Observed but not collected on the sampling rake

Figures

Barr Footer: ArcGIS 10.8.1, 2021-08-06 15:33 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 1 - VBWD LakesPonds Surveyed in 2021.mxd User: kac2



Lake/Pond Surveyed in 2021
Major Waterbody
Stormwater Pond
District Legal Boundary
Municipal Boundary
County Boundary

N

Miles
0 1 2

Figure 1

VBWD LAKES/PONDS SURVEYED IN 2021
Ramsey & Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2021-08-06 15:44 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 2 -Long Lake June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

Feet

0 125 250 500

Figure 2

LONG LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Long Lake (82011800)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1. 2021-08-06 15:45 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 3 - Long Lake-Katherine Abbott Pond June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

N

Feet

0 30 60 120

Figure 3

LONG LAKE-KATHERINE ABBOTT POND EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Long Lake-Katherine Abbott Pond
Washington County
Valley Branch Watershed District

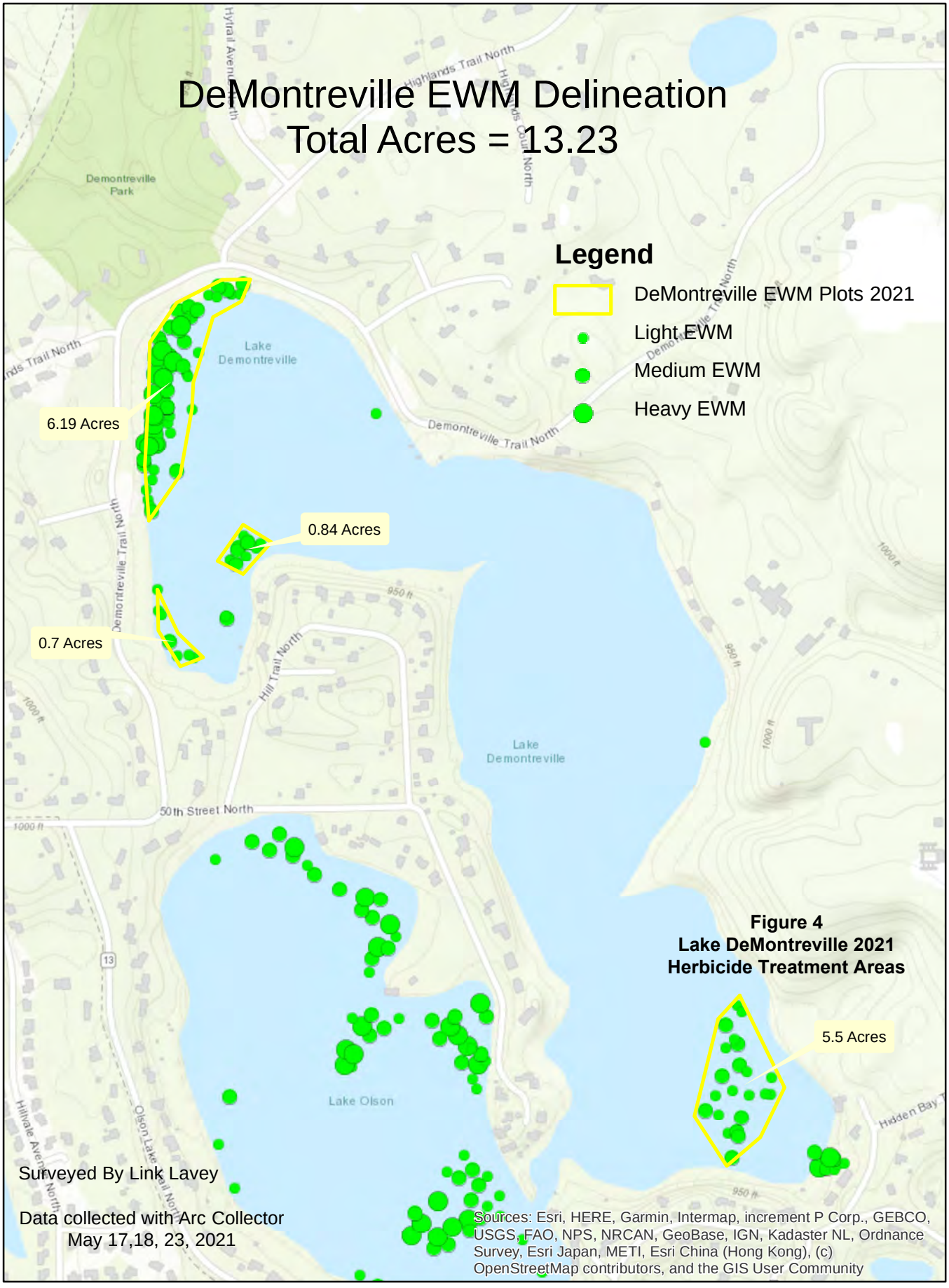
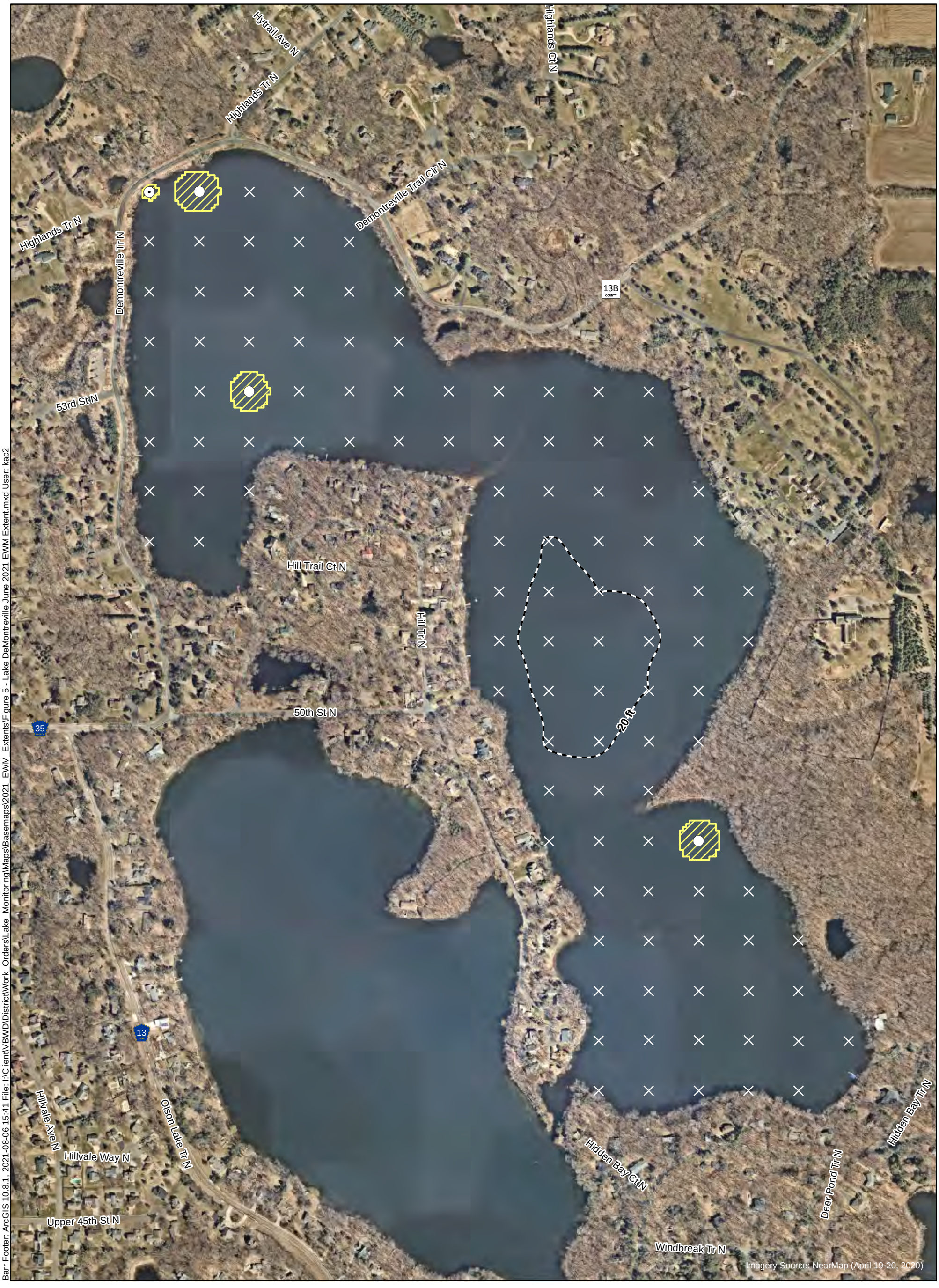


Figure 4
Lake DeMontreville 2021
Herbicide Treatment Areas



Barr Footer: ArcGIS 10.8.1, 2021-08-06 15:41 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 5 - Lake DeMontreville June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

Feet

0 225 450 900

Figure 5

LAKE DEMONTREVILLE
EURASIAN WATERMILFOIL
EXTENT, JUNE 2021
Lake DeMontreville (82010100)
Washington County
Valley Branch Watershed District

Figure 6

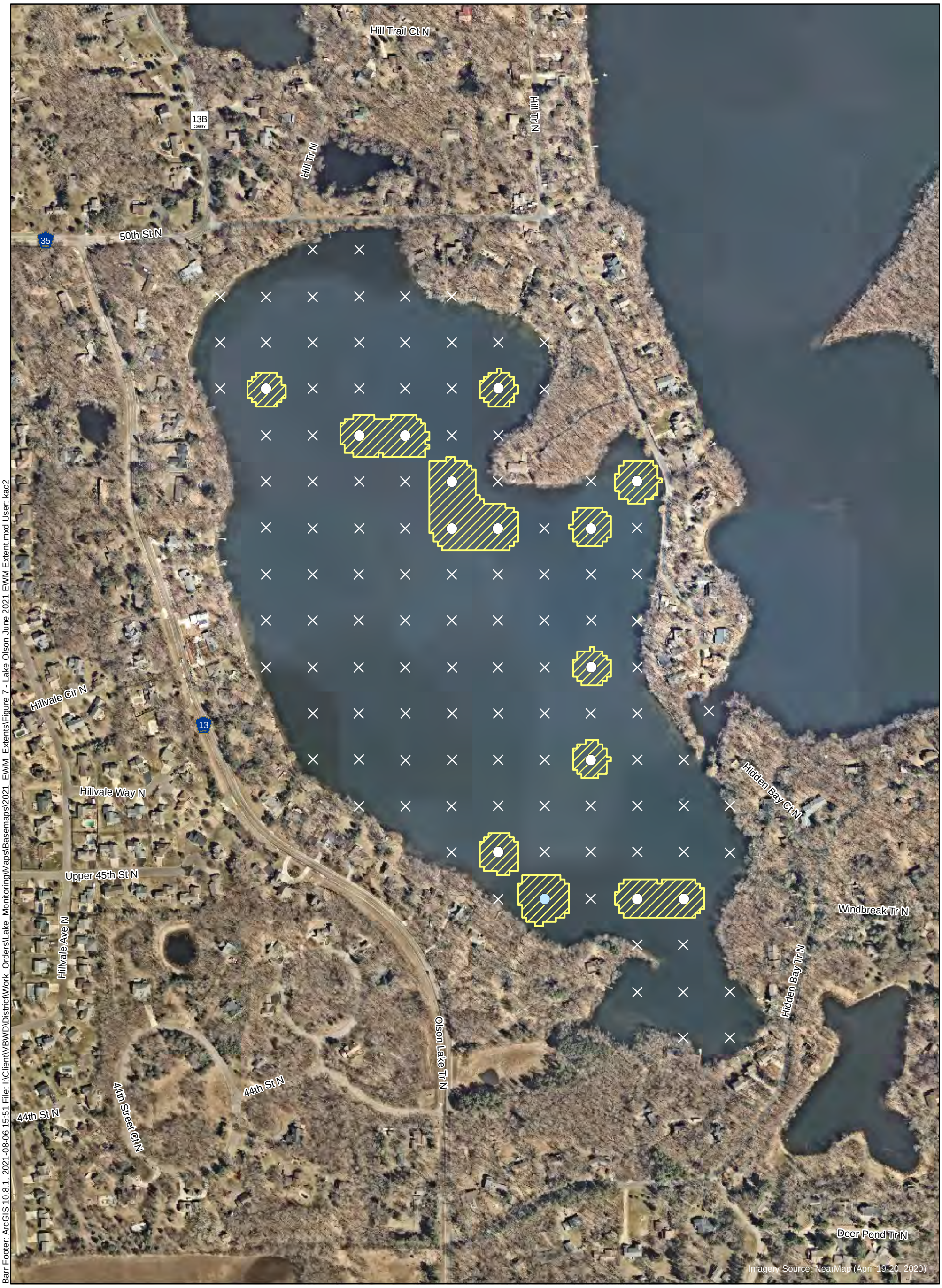
Lake Olson 2021
Herbicide Treatment Areas

Project Name: Lake DeMontreville & Olson Assoc. EWM	**Resource:** Olson (82010300)
County: Washington	**Total 9.2 Acres**

Metro:
1511 Maras Street
Shakopee, MN 55379

Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



Barr Footer: ArcGIS 10.8.1, 2021-08-06 15:51 File: I:\Client\VBWD\DistrictWork Orders\Lake Monitoring\Maps\Basemaps\2021 EWM Extents\Figure 7 - Lake Olson June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

N

Feet

0 175 350 700

Figure 7

LAKE OLSON EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Lake Olson (82010300)
Washington County
Valley Branch Watershed District

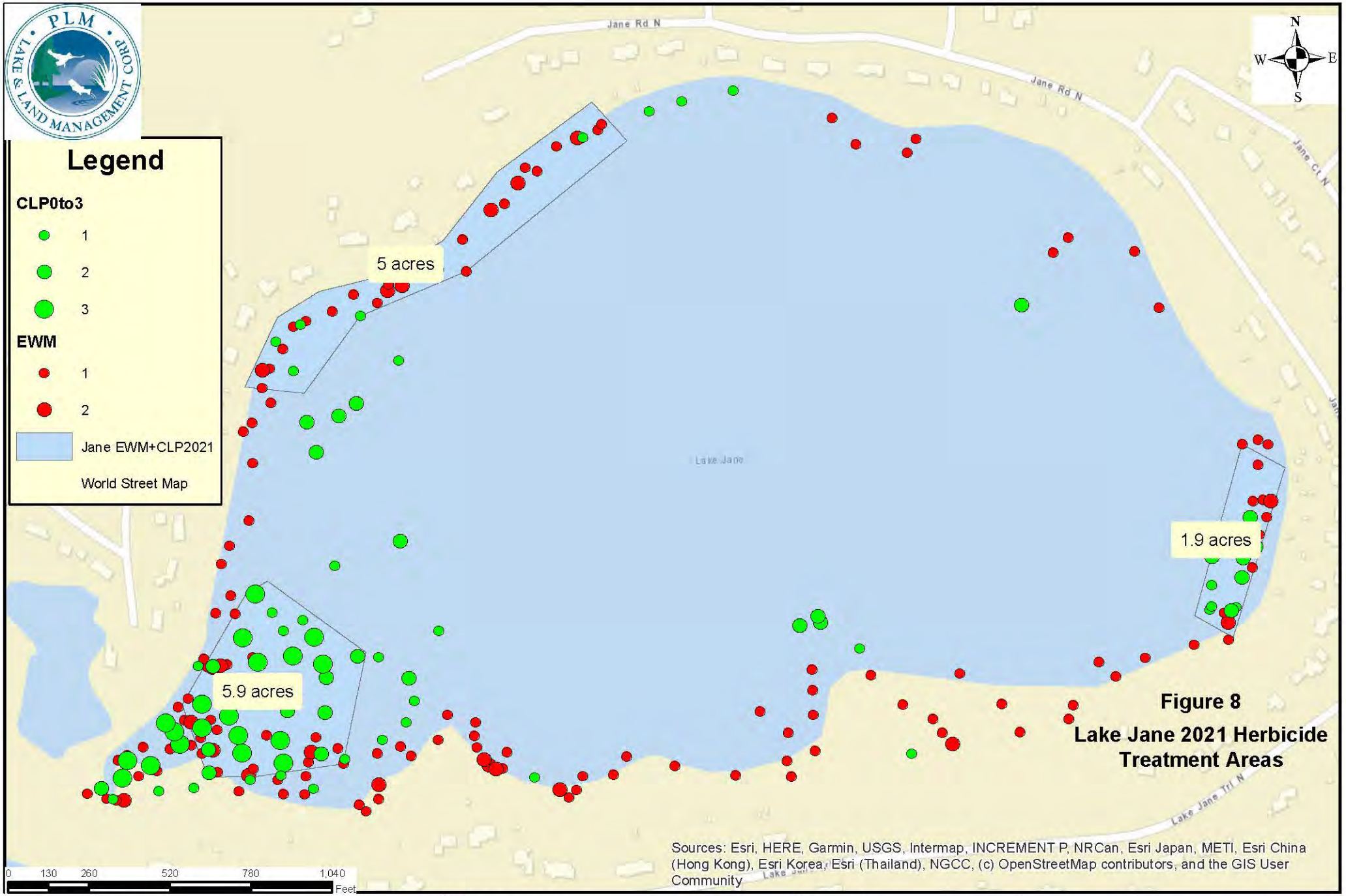


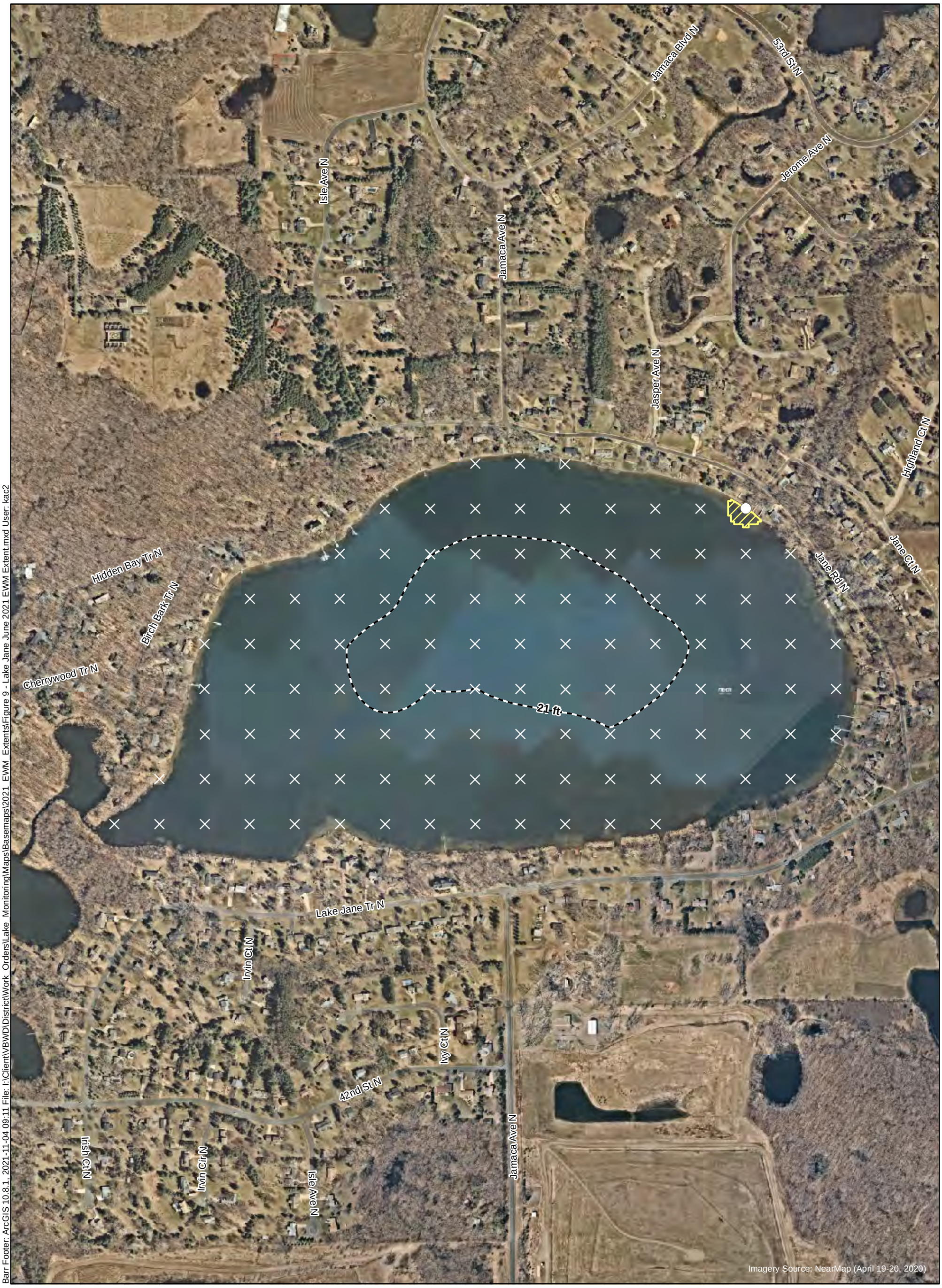
Figure 8
Lake Jane 2021 Herbicide Treatment Areas

Project Name:	Resource:	County:	12.8 acres
Lake Jane AIS	Jane (82010400)	Washington	

Metro:
1511 Maras Street
Shakopee, MN 55379

Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



Barr Footer: ArcGIS 10.8.1, 2021-11-04 09:11 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 9 - Lake Jane June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

Feet

0 250 500 1,000

Figure 9

LAKE JANE EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Lake Jane (82010400)
Washington County
Valley Branch Watershed District

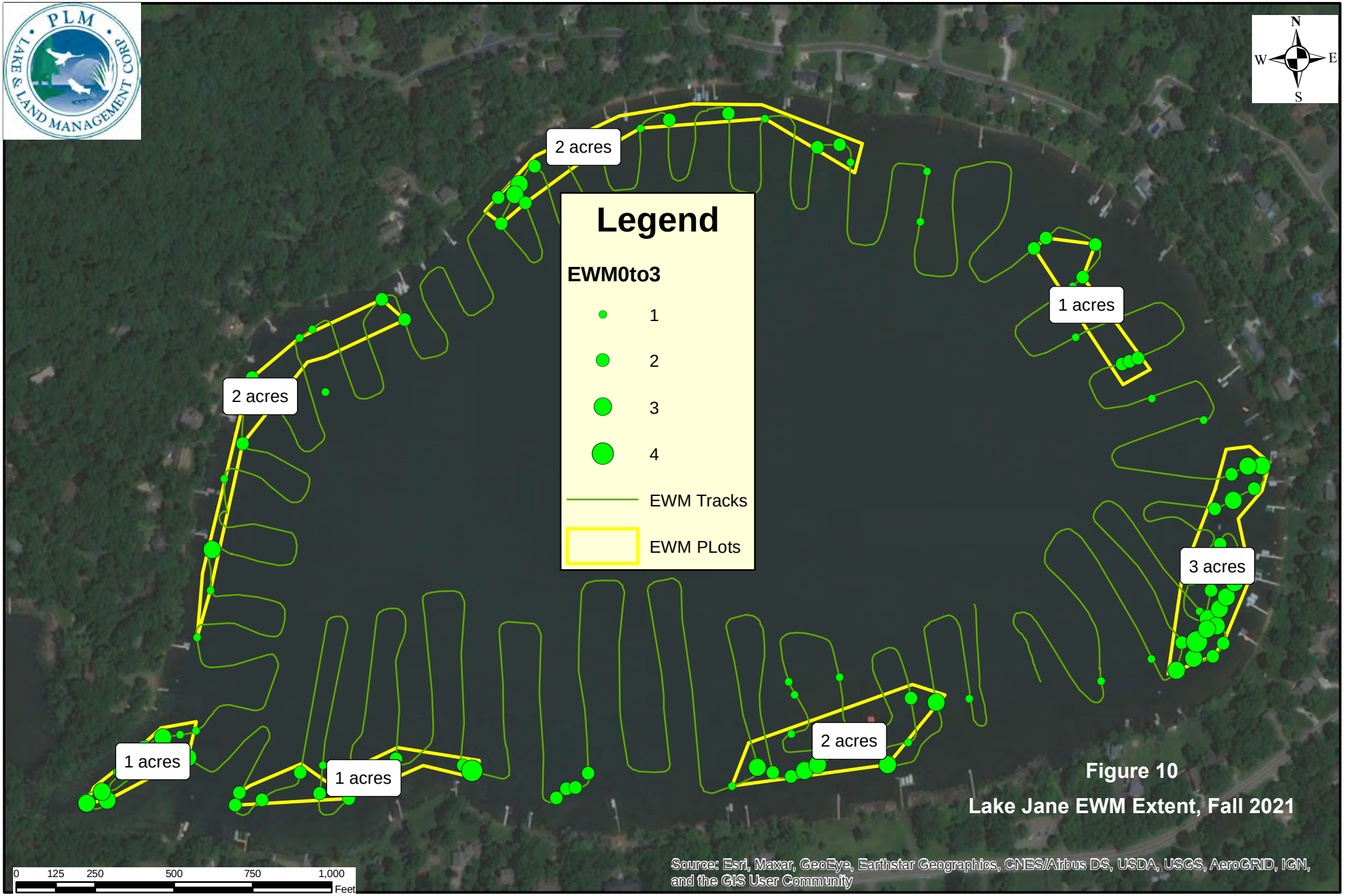


Figure 10

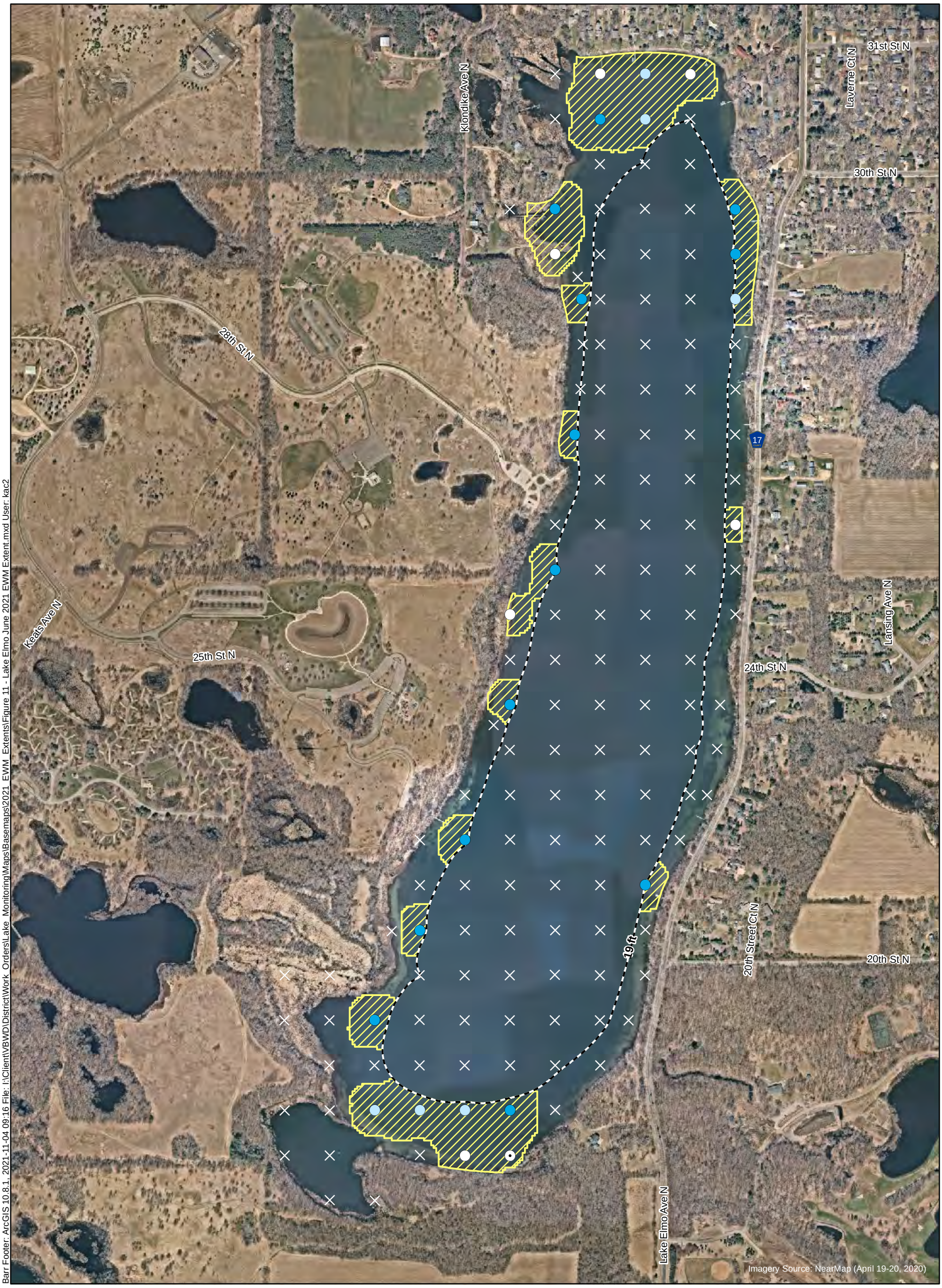
Lake Jane EWM Extent, Fall 2021

Project Name:	Resource:	County:	Watershed:
Lake Jane AIS	Jane (82010400)	Washington	Lower St. Croix River

Metro:
1511 Maras Street
Shakopee, MN 55379

Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



Barr Footer: ArcGIS 10.8.1, 2021-11-04 09:16 File: I:\Client\VBWD\District\Work Orders\Lake Monitoring\Maps\Basemaps\2021 EWM Extents\Figure 11 - Lake Elmo June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

- Approximate Extent of EWM
- Maximum Depth of Plant Growth

N

Feet
0 300 600 1,200

Figure 11

LAKE ELMO EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2021-11-12 15:04 File: I:\Client\W\BW\D\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 12 - Lake Elmo EWM Harvested Areas 2021.mxd User: kac2

EWM Harvested Areas

- Area 1 (2.7 acres)
- Area 2 (10.4 acres)
- Area 3 (7.4 acres)

N

Feet

0 300 600 1,200

Figure 12

LAKE ELMO EURASIAN WATERMILFOIL HARVESTED AREAS, 2021
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District

RAMSEY COUNTY
Parks & Recreation

Figure 13
Silver Lake EWM/CLP
April 5, 2021, Inspection Report

Aquatic Invasive Species Inspection Report

Lake: **Silver (DOW# 62000100)**

Inspection Date: **04/05/2021**

County: **Ramsey**

Surveyors: **Chakong Thao, Justin Townsend**

Water Temp (F): **54.6**

Secchi Depth (ft): **10.0**

Report Author: **Auto Generated**

Report Date: **04/06/2021**

Search Time: **2hr 4min**

Search Distance (mi): **4.0**

Ramsey County Soil & Water Conservation staff performed an inspection of Curly-leaf Pondweed (*Potamogeton crispus*) and Eurasian Watermilfoil (*Myriophyllum spicatum*) on Silver Lake on 04/05/2021. A total of 76 inspection points was targeted using a double-tine rake. In addition, multiple rake-throws were made in the northwest and southwest ends of the lake (Figure 1), which produced no observations of Curly-leaf Pondweed (CLP) or Eurasian Watermilfoil (EWM). Curly-leaf Pondweed was observed at 20 out of 76 (26.3%) targeted sample points (Figure 2). Curly-leaf Pondweed was found at depths ranging from 2.9 – 7.7 feet, but was found growing most commonly around 5 feet deep. On a 0-3 point density rating scale, the most common density of sites with CLP was 1, which is generally characterized as Sparse/Scattered (see Table 1). Eurasian Watermilfoil was observed at 0 out of 76 (0%) targeted sample points, along with no observations where multiple rakes were thrown (Table 2; Figure 3). It is possible this inspection was conducted too early to observe EWM. The following aquatic plants were also observed throughout sampling points at various densities: Muskgrass (*Chara spp*.), Big-leaf Pondweed (*Potamogeton amplifolius*), Coontail (*Ceratophyllum demersum*), Northern Watermilfoil (*Myriophyllum sibiricum*), Star Duckweed (*Lemna trisulca*), Canada Waterweed (*Elodea canadensis*), and Filamentous Algae (*Spirogyra/Cladophora spp*.). Photographs of plant samples can be found in the Appendix.

Table 1. Summary of rake rating with points containing Curly-leaf Pondweed.

Rake Rating	# of Obs.	Percent
1: Sparse/Scattered	19	95.0%
2: Common	1	5.0%
3: Abundant	0	0.0%

Table 2. Summary of rake rating with points containing Eurasian Watermilfoil.

Rake Rating	# of Obs.	Percent
1: Sparse/Scattered	0	0.0%
2: Common	0	0.0%
3: Abundant	0	0.0%

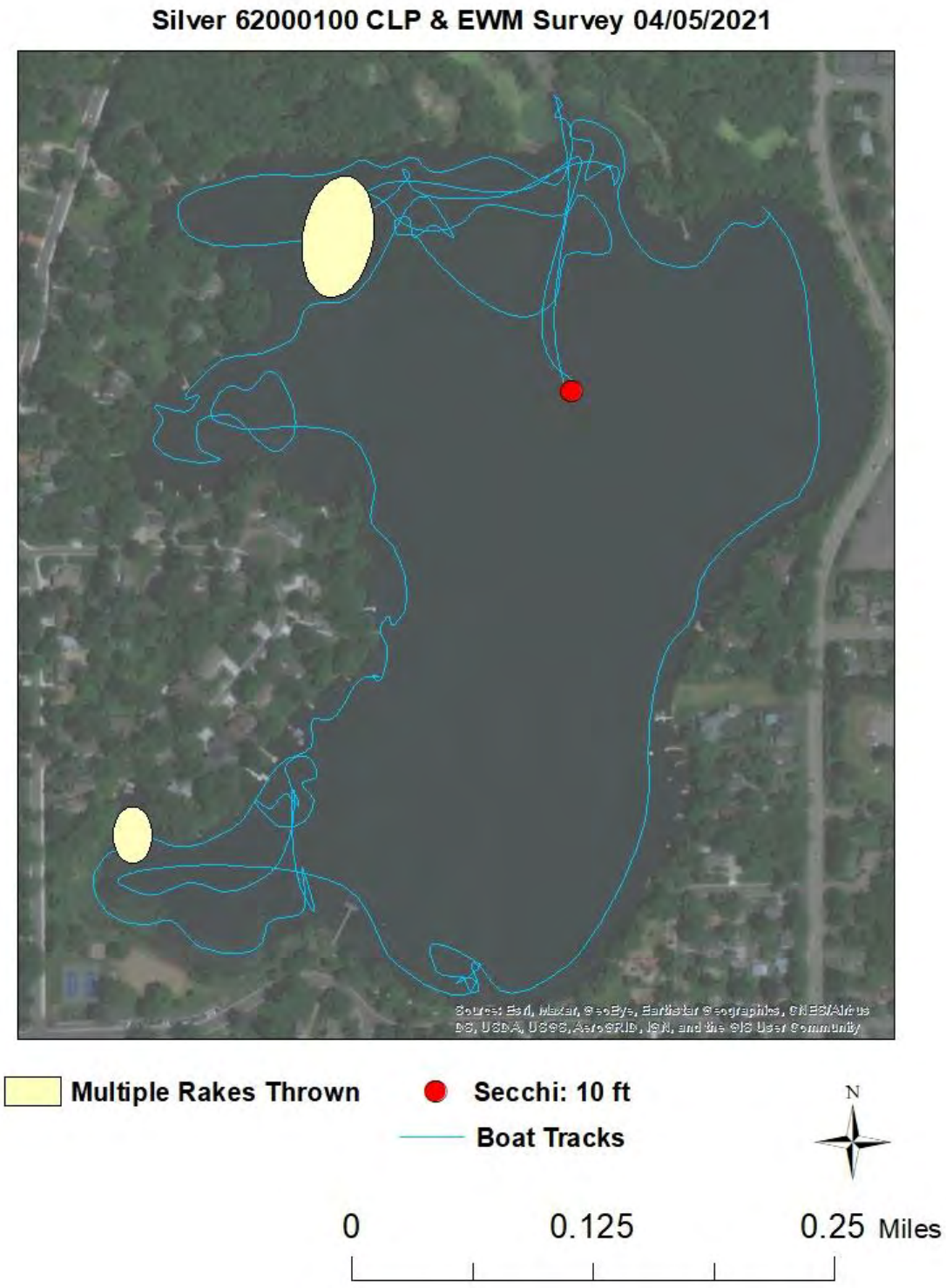


Figure 1. Silver Lake AIS inspection. Shaded areas in the northwest and southwest indicate where the sampling rake was thrown multiple times. No CLP or EWM was observed.

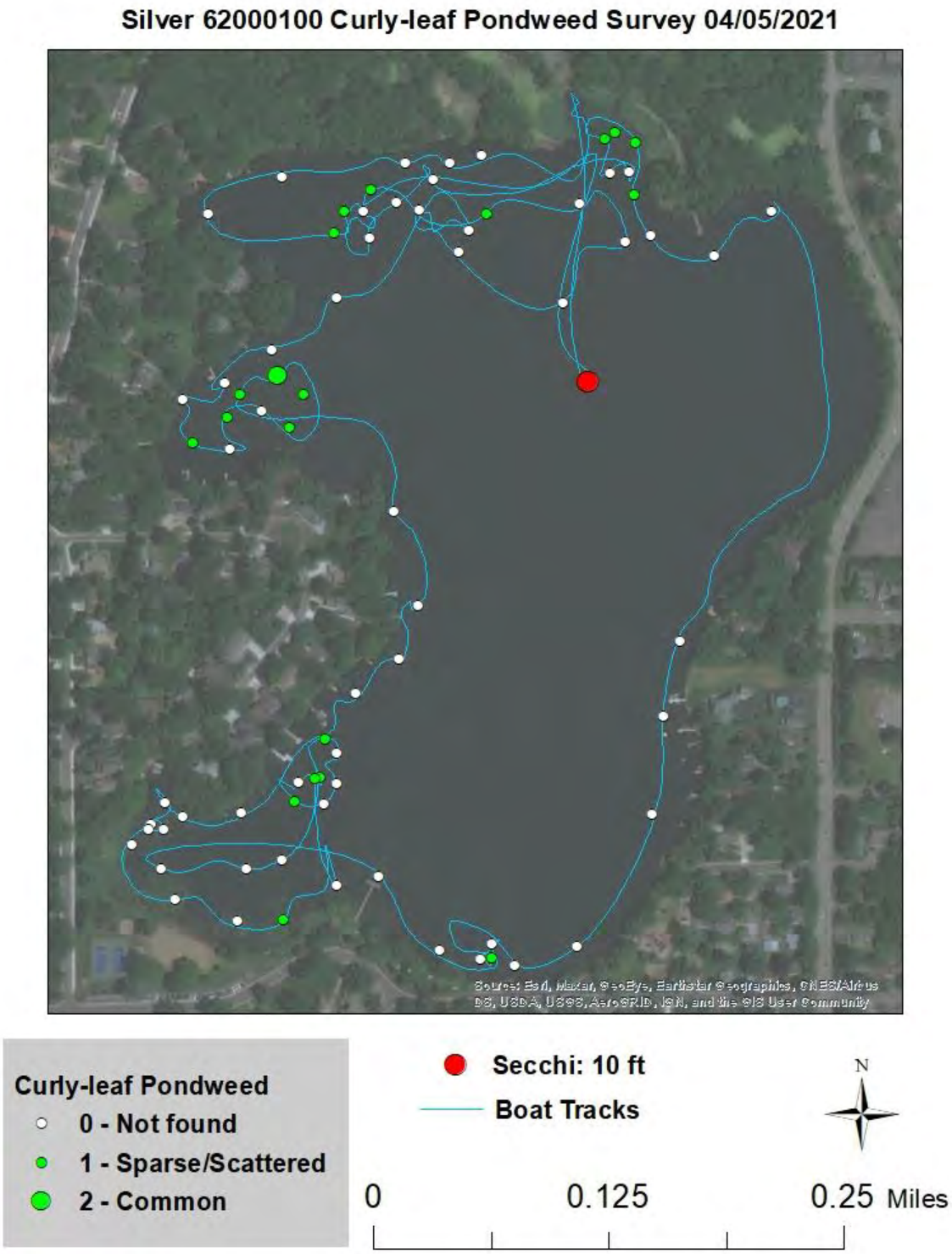


Figure 2. Curly-leaf Pondweed density at sampling points (n=76) at Silver Lake. CLP was observed at 20 of 76 points.

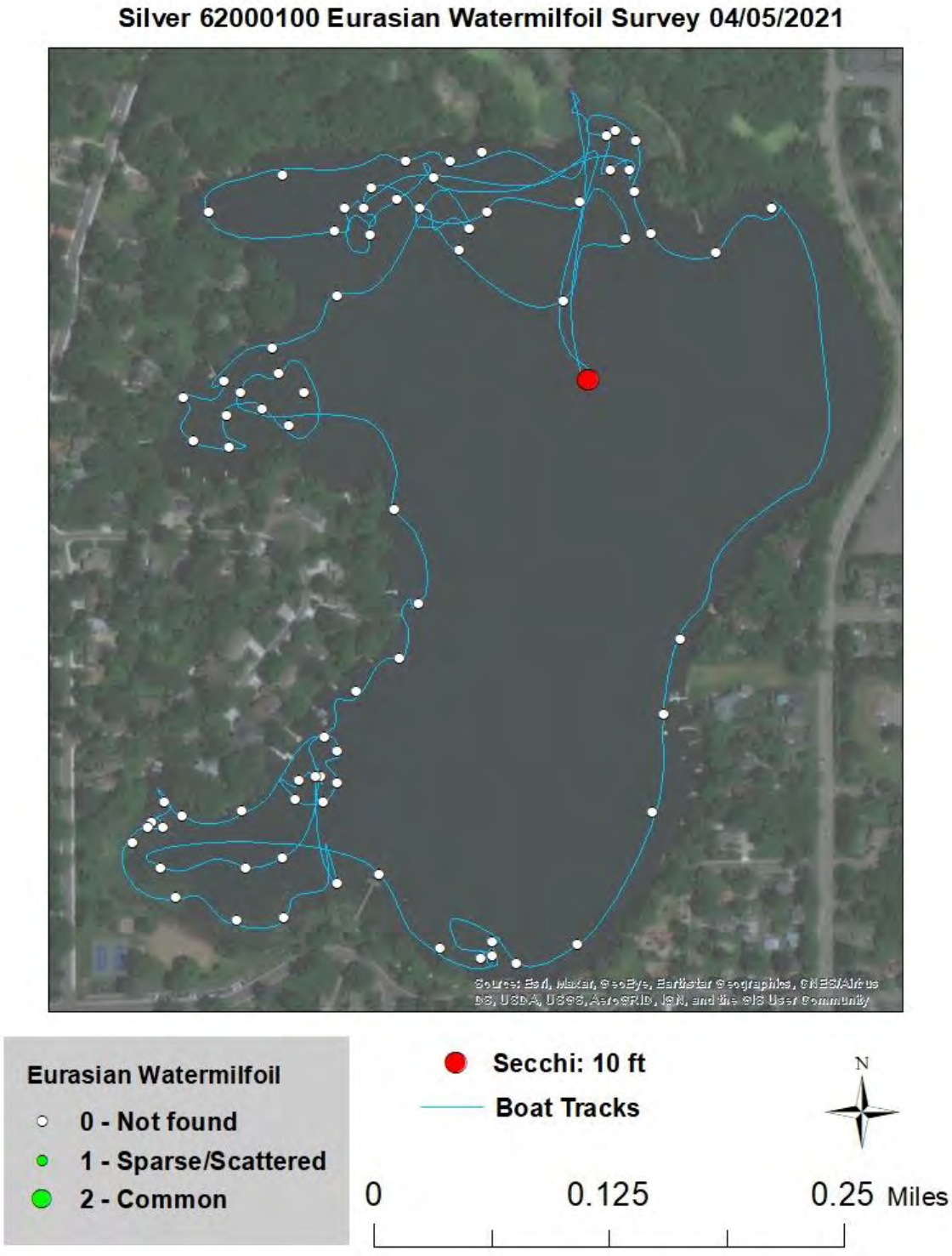


Figure 3. Eurasian Watermilfoil density at sampling points (n=76) at Silver Lake. EWM was observed at 0 of 76 points.

Appendix: photos of aquatic plant samples at Silver Lake on 4/5/21.

Muskgrass

CLP

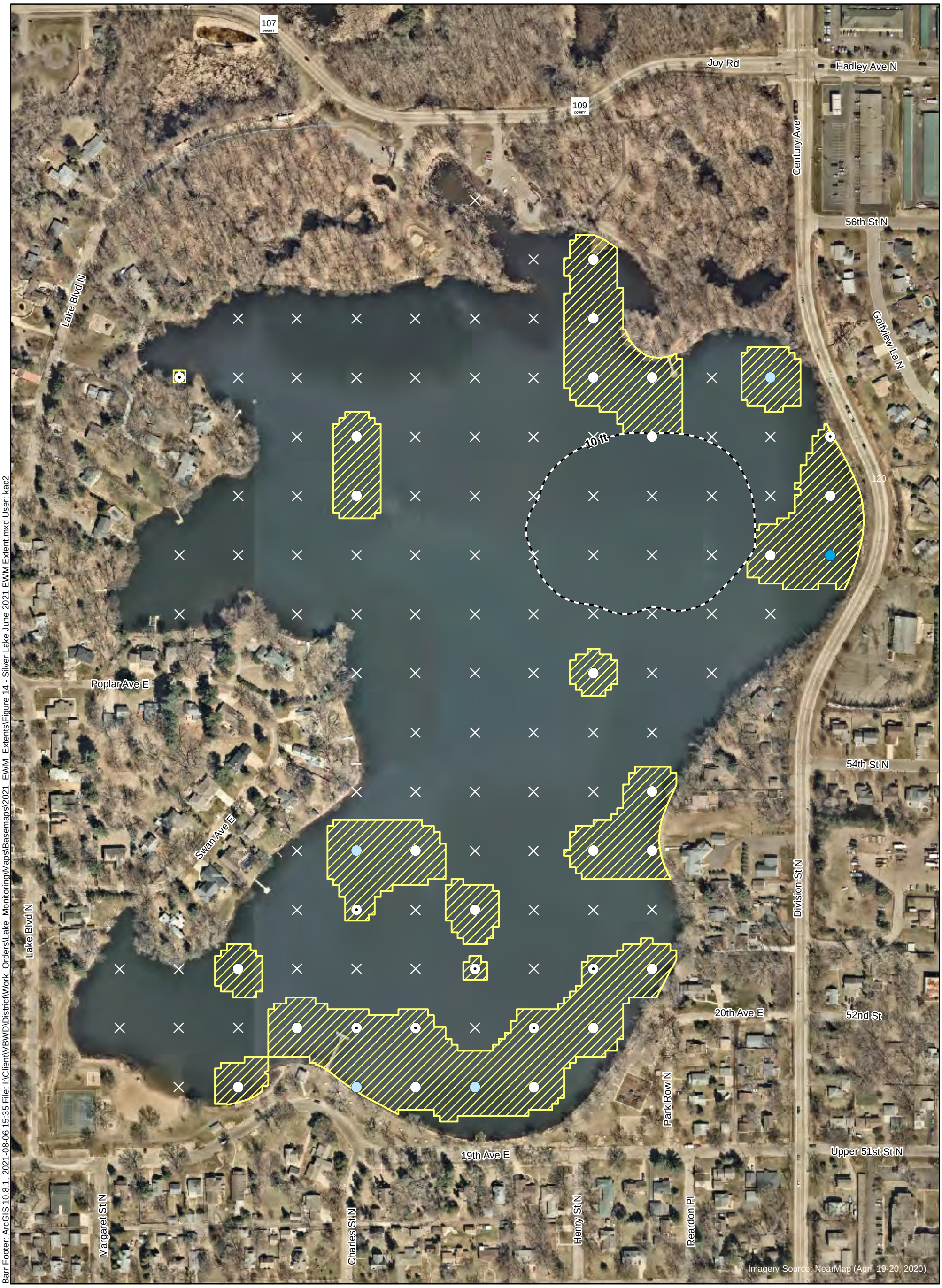
Muskgrass, CLP

CLP, Coontail, Muskgrass, Filamentous Algae

CLP

Coontail

Northern Watermilfoil



Barr Footer: ArcGIS 10.8.1, 2021-08-06 15:35 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2021_EWM_Extents\Figure 14 - Silver Lake June 2021 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

- Approximate Extent of EWM
- Maximum Depth of Plant Growth

N

Feet

0 125 250 500

Figure 14

SILVER LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2021
Silver Lake (62000100)
Ramsey County
Valley Branch Watershed District

Silver Lake, Ramsey County 2021 CLP Approved Diquat Areas

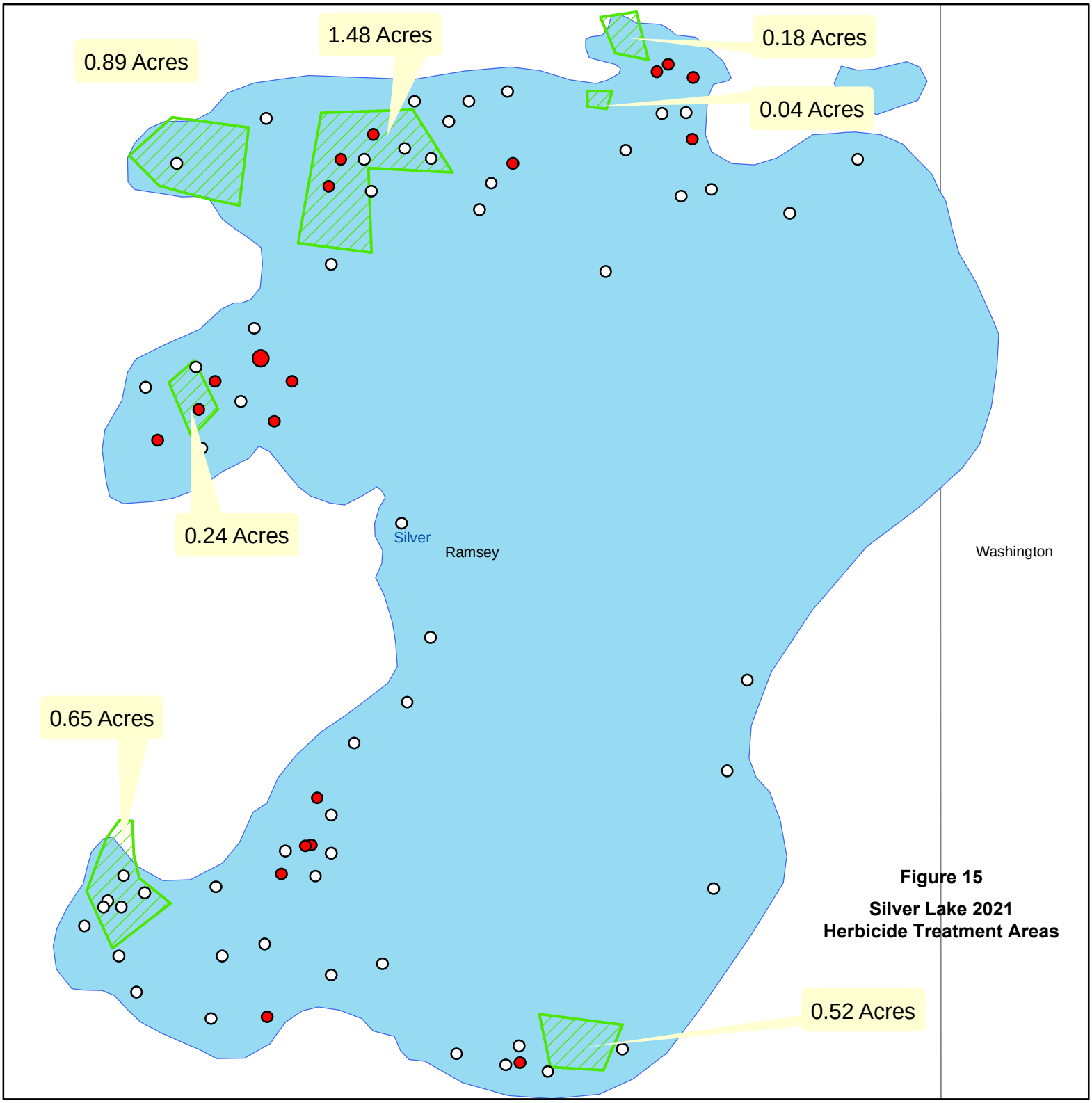


Figure 15

Silver Lake 2021
Herbicide Treatment Areas

0 0.035 0.07 0.14 Mi
0 0.05 0.1 0.2 Km

Legend

- 0 - Not Found
- 1 - Sparse/Scattered
- 2 - Common

Treatment Areas (CHECKED_OUT)

- <all other values>

Permit Status

- Approved (4 Acres)
- Proposed

N
W E
S

DEPARTMENT OF NATURAL RESOURCES

Survey Date: April 5, 2021
Surveyor: Ramsey County (Justin Townsend)

Zoomed to Data Extent Volume Source: N/A