Golden Lake Waukesha and Jefferson Counties, WI

August, 2023 Amendment to the Golden Lake

2017 Aquatic Plant Management Plan

SOLitude Lake Management
N173 W21440 Northwest Passage
Jackson, WI 53037
(262) 674-1783
www.solitudelakemanagement.com

Introduction:

Since 2013, the Golden Lake Association (GLA) has been actively managing aquatic invasive species, including Eurasian watermilfoil (EWM) and Curly-leaf pondweed (CLP). The methods of control listed in Golden Lake's 2017 Management Plan include herbicide treatment, hand removal, and Diver Assisted Suction Harvesting (DASH).

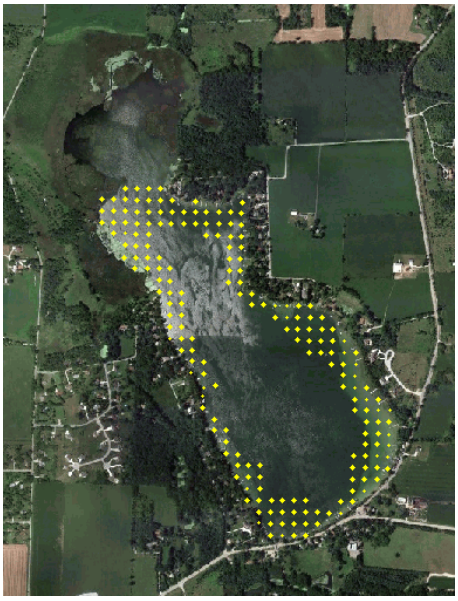
Monitoring the lake for the presence of invasive species has been a major component of the overall control strategy. Since 2013 surveys have been conducted on Golden Lake using a combination of Full and Partial Point-Intercept (PI) Surveys. The survey type (Full or Partial) and years conducted are listed below:

Full PI: May and August 2013, August 2014, September 2017 August 2020 and August 2023.
Partial PI: October, 2015, and August of 2016, 2018-19, 2021-22

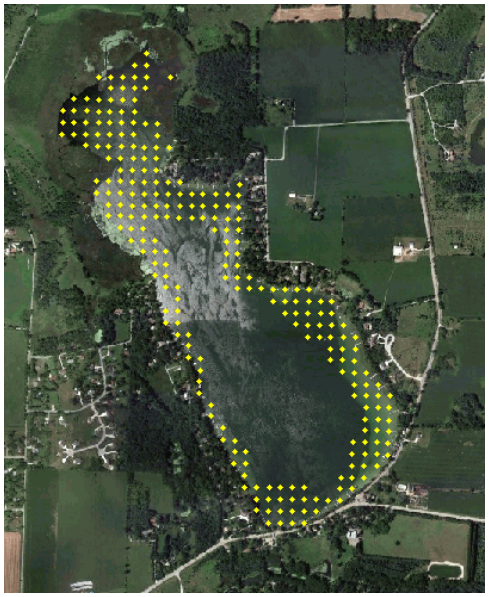
* Surveys conducted in 2013/14 conducted by WI DNR staff, remaining years by Marine Biochemists

Maps detailing the location of the data collection points for the Full and Partial PI Surveys are shown in Figure 1 below. Data collection for the surveys consisted of navigating to each point using a Lowrance Hook 9 GPS. At each point, data on the presence/absence of EWM/Hybrid was collected, either by using a Rake on a Pole (depths < 10 ft.), or a Rake on a Rope (depths > 10 feet). Finally, in clear waters less than 3 feet in depth with a largely sand bottom, visual identifica-tion was utilized. This made for a much more efficient means of collecting data where vegetative growth was absent. After visiting each site, data on water depth, absence/presence of Milfoil, and if present, rake fullness was recorded, along with the sampling method (P for Pole, R for Rope or V for Visual) used.

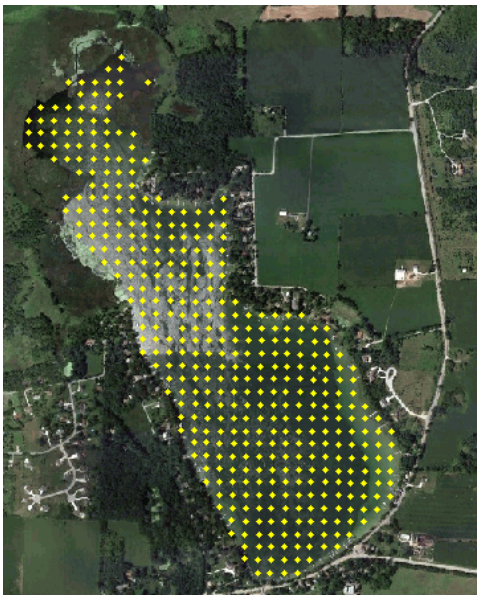
Figure 1
Partial PI Survey Points for Oct., 2015 (left) and August, 2016 , 2018-19, 2021-22 (center) and Full PI Surveys (right)



No. of Points: 191



No. of Points: 250



No. of Points: 565

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Summary of Results

Figure 2 (following page) is a map detailing the distribution of EWM in Golden Lake during the 2023, 2022 and 2021 surveys. Data for earlier surveys is located on Figure 3 (page 4). Data collection points are color-coded according to Rake Fullness (relative amount of EWM present), including Visual observations.

The August 2023 Point Intercept Survey, EWM was collected at 48 sites and 4 additional visual sites for a total of 52 sites. This is more than double the August 2022 survey sites.

The August 2022 survey, EWM was collected with a Rake at 23 sites, and was observed at another 5, for a total of 28 sites. This is the lowest number of sites with EWM since the August, 2016 survey (24 sites, 25 with Visuals).

This contrasts significantly from the 56 sites (77 with Visuals) sampled in 2021, which was the highest ever recorded. The previous high, 54 sites (60 with Visuals) was recorded during the Full PI survey conducted in September, 2017.

For additional perspective, during the May, 2013 Full PI Survey, EWM was found at 118 sites. AMap of 2013 EWM occurrence is located in the Appendix.

EWM data collected during prior surveys is provided for comparison in Tables 1-3 (page 5).

Additional discussion of control zones and methods begins on page 6.

Forward Looking Plans for Golden Lake AIS Control

Golden Lake's 2017 Aquatic Plant Management Plan lists herbicide application, hand pull and DASH as the control methods. These methods will be used for 2024-2026 control as well.

Herbicide application control will be used on the south and west shores for the lake. Diver hand pull will be used in the sensitive area and other areas of the lake with small clusters of AIS. DASH will be used primarily in the sensitive area. Other areas of the lake ith large AIS beds will be considered for DASH control.

Mechanical harvesting is a control option to maintain navigational access, control of floating plant debris and vegetative mats on the surface.

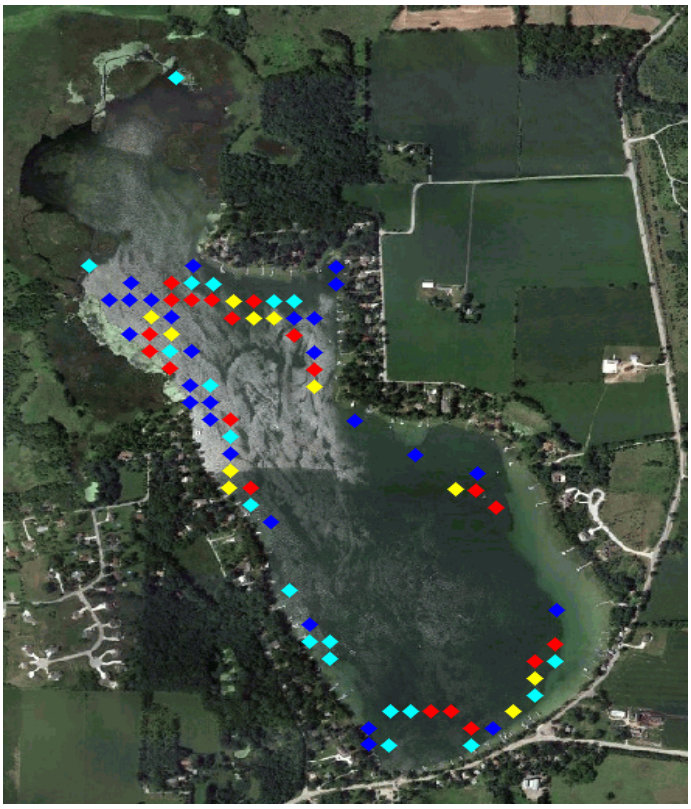
Other methods of control used on other lakes (i.e. biological) are not conducive for Golden Lake AIS control or are not cost effective.

Figure 2
Golden Lake—Waukesha and Jefferson Counties, WI
Point-Intercept Points with Eurasian/Hybrid
Watermilfoil Partial and Full PI Surveys—August, 2021,
2022 and 2023

August, 2022

No. of Sites: 23 (28 including Visuals)

August, 2021



No. of Sites: 56 (77 including Visuals)

August 2023 Full P/I
48 Sites, 52
including visual

Key
Blue = Rake Fullness of 1
Red = Rake Fullness of 2
Yellow = Rake Fullness of 3
Aqua = Visual

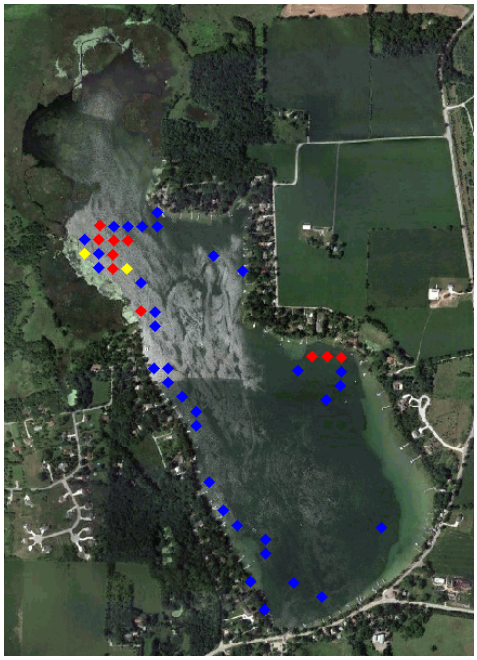
Figure 3

Golden Lake—Waukesha and Jefferson Counties, WI

Point-Intercept Points with Eurasian/Hybrid Watermilfoil

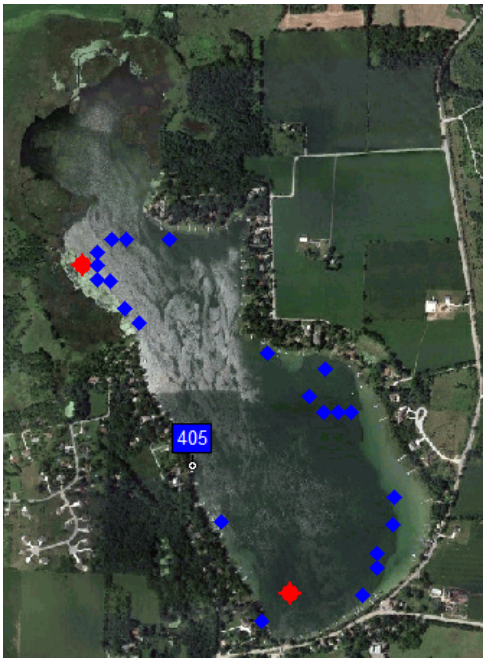
Partial PI Surveys October, 2015 through August, 2019 & Full PI Surveys, Sept., 2017 & Aug., 2020

October, 2015



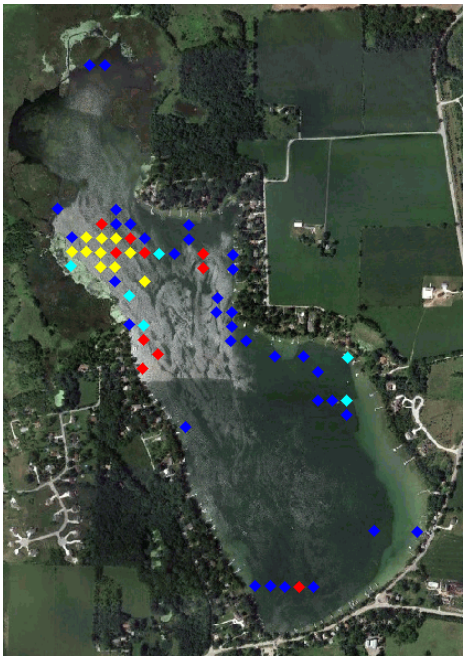
No. of Sites: 46

August, 2016



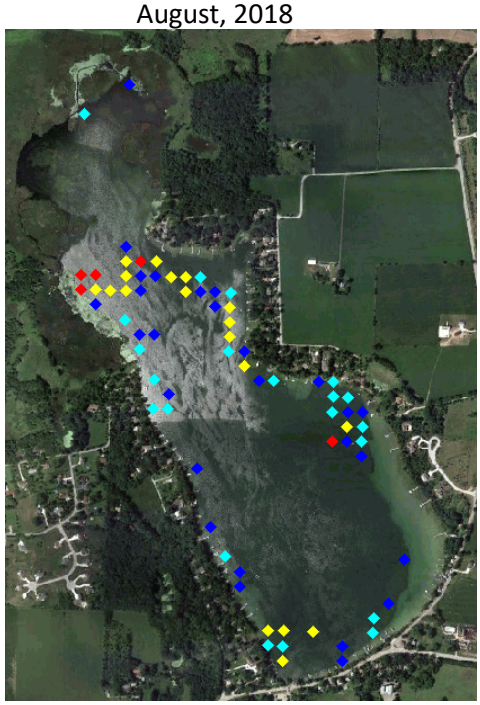
No. of Sites: 24 (25 including Visuals)

September, 2017 (Full PI)



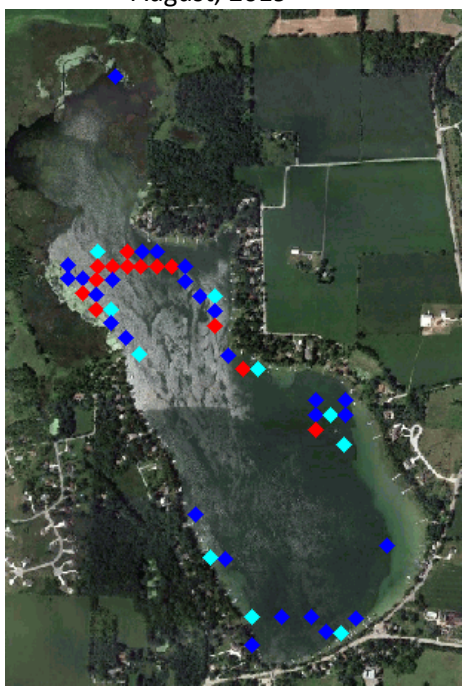
No. of Sites: 54 (60 including Visuals)

August, 2018



No. of Sites: 50 (71 including Visuals)

August, 2019



No. of Sites: 40 (50 including Visuals)

August, 2020 (Full PI)

No. Sites Present: 36

Key

Blue = Rake Fullness of 1

Red = Rake Fullness of 2

Yellow = Rake Fullness of 3

Aqua = Visual

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Summary of Results, cont'd

Table 1

# of PI Points with EWM/Hybrid Milfoil - May, 2013 thru August, 2023

Full Point-Intercept Surveys

Survey	# Sites Visited	# Sites w EWM
May, 2013	366	118
Aug., 2013	367	72
Sept., 2014	342	70
Sept., 2017	442*	54**
August, 2020	427	36
August 2023	422	48******

Partial Point-Intercept (EWM only) Surveys

Survey	# Sites Visited	# of Sites w EWM	# Sites, inc. Visuals
Oct., 2015	191	46	na
Aug., 2016	250	24	25
Aug., 2018	250	50	71
Aug., 2019	250	40	50
Aug., 2021	250	56	77
Aug., 2022	250	23	28

* Includes # sites where depth was recorded.

60, inc. Visuals * ***52 Visuals

Table 2

Freq of Occurrence and Rake Fullness Data for all Surveys (2013-2022)

Note: Full PI Survey Years in Blue, Partial Surveys in Black

Parameter	May, 2013	Aug. 2013	Sept. 20'14	Oct. 2015	Aug., 2016	Sept., 2017	Aug., 2018	Aug., 2019	Aug., 2020	Aug., 2021	Aug. 2022
Freq. of occurrence within vegetated areas (%)*	44.70	24.22	25.26	23.5	9.6	16.22	20.00	16.00	13.38	22.86	9.2
Freq. of occurrence @ sites shallower than max. depth of plants**	33.62	20.53	21.88	na	na	12.02	na	na	11.5	na	na
Relative Frequency (%)**	21.6	8.7	8.1	na	na	6.0	na	na	5.6	na	na
Relative Frequency (squared)	0.05	0.01	0.01	na	na	0.0	na	na	0.0	na	na
Average Rake Fullness	1.36	1.2	1.25	1.36	1.08	1.56	1.56	1.33	1.28	1.68	1.17

Table 3

Comparison of EWM Presence Among (32) PI Points in Sensitive Area of Golden Lake

Statistic	May,'13	Aug.,'13	Sept.,'14	Oct.,'15	Aug.,'16	Sept.,'17	Aug.,'18	Aug., '19	Aug., '20	Aug., '21	Aug., "22
# with EWM	27	17	19	16	9	19	15	14	11	16	10
Avg. Rake Fulness	1.48	1.18	1.21	1.63	1.11	2.21	1.94	1.5	1.64	1.63	1.2

Discussion

Since 2013 a variety of control methods have been used, including chemical herbicide application, diver hand removal, and Diver Assisted Suction Harvesting (DASH). A brief summary of the EWM response to control efforts in each geographical lake

"Zones" between the August 2018/19-2023 surveys is provided below. Figure 4 (following page) shows the location of each "Zone", along with locations where EWM was found.

Zone 1: Sensitive Area

In August of 2022, a total of (12) sites within the DNR designated Sensitive Area contained EWM, including (2) Visuals. Since 2013 the average number of sites with EWM (collected by Rake and Visual) has averaged 16.2 annually, ranging from a low of (9) in August, 2016, to a high of 19 Sites (2014 , 2017, 2019), including Visuals. The density of EWM within the Sensitive Area in 2022 declined considerably, with an average Rake Fullness of 1.17, as compared to 1.68 in 2021. DASH was conducted within this area in since 2016. In 2021, 2022 and 2023, 47.5, 63.5 and 66.5 dive-hours respectively were conducted.

Zone 2: West Shore

A portion of the west shore has been treated with 2,4-D in 2018, 2019, 2020 and 2023. No treatment occurred in either 2021 or 2022. DASH was performed in this area in 2022 and 2023 for 7 and 14 dive harvesting hours, respectively.

A total of (4) points, including one Visual, contained EWM in 2022. This compares to a total of (17) in 2021, including (7) Visuals. Six sites contained EWM in 2020 (no Visuals), and (3), including (2) Visuals in 2019.

Zone 3: South Shore

The south shore was last treated (along with the west shore) on June 2, 2020. Only (4) sites had EWM in 2022, (no Visuals), as compared to (15) sites, including (6) Visuals in 2021, (6) sites in 2020 (no Visuals), and (5) , including (1) Visual, in 2019.

Zone 4: South of Rhino Point/Kruger Rd.

In 2022 EWM was found at (4) Sites, including (1) Visual. A total of (7) sites (including one Visual) had EWM during the August, 2021 survey. This compares within (5) in 2020, (9), (including 3 Visuals) in 2019, and (15), including (7) Visuals in 2018.

The area immediately south of the tip Rhino Point received approximately 10 hours 2023, 20.5 hours in 2022 and 15 hours in 2021.

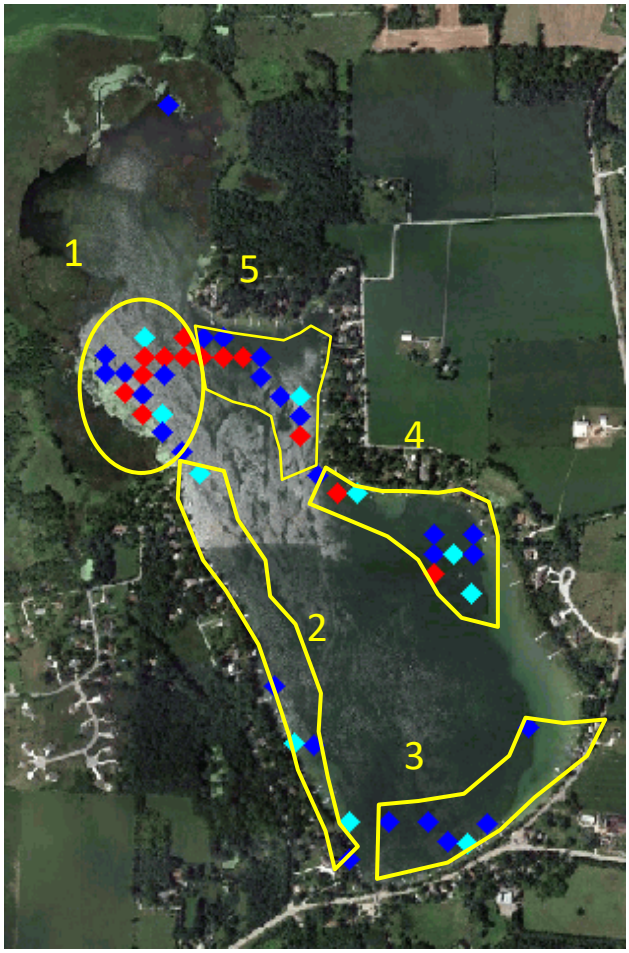
Zone 5: Rhino Point & North

EWM was found at (4 sites, including (1) Visual in 2022. This compares with (19) points in August, 2021, including (4) Visuals. (8) in 2020, and (12) in 2019 (including 1 Visual).

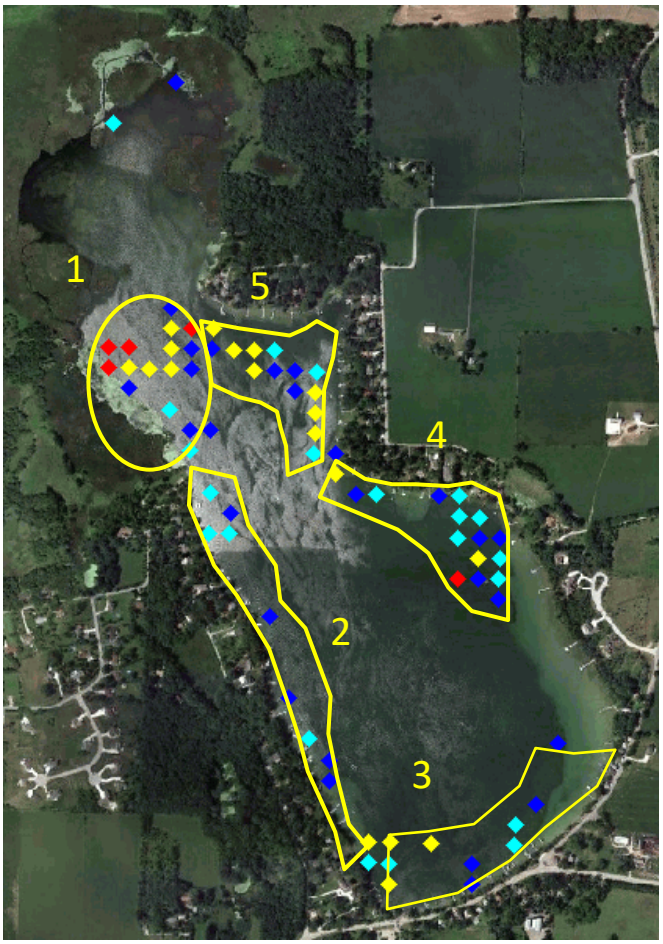
The area immediately north (and east) of the tip of Rhino Point received 14 hours of DASH in June, 2021. DASH was not conducted within this area during 2022 or 2023.

Figure 4
Golden Lake EWM Zones
Comparison of EWM Presence

August, 2019 Survey (Partial PI)



August, 2018 Survey (Partial PI)



Key
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Red = Rake Fullness of 2
Yellow = Rake Fullness of 3
Aqua = Visual

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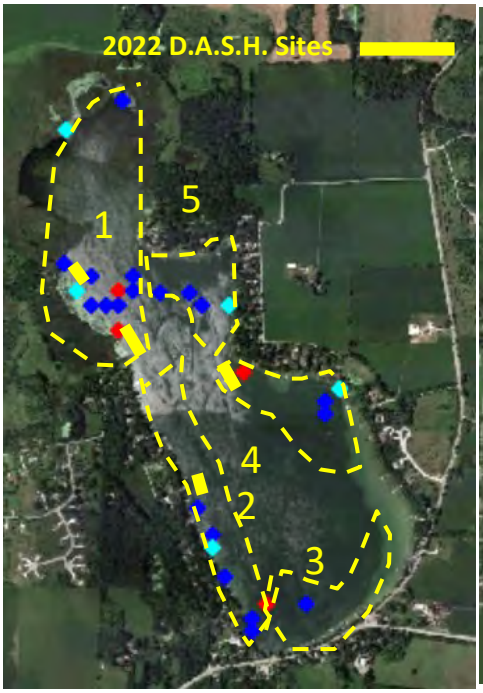
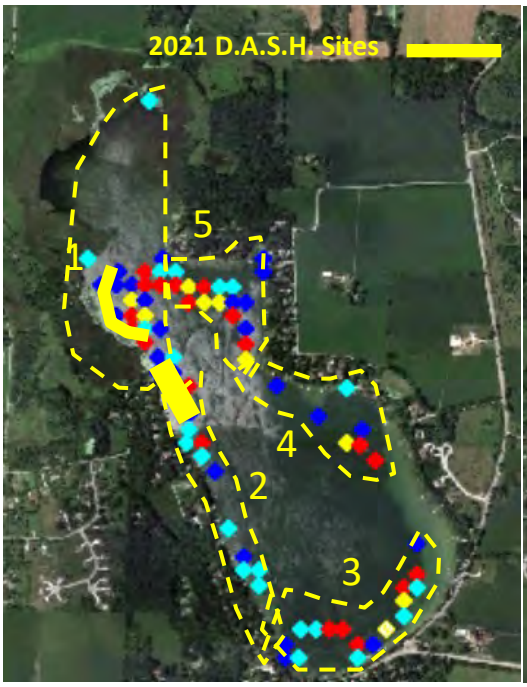
Figure 5
Golden Lake EWM Zones
DASH Removal Sites
Indicated.

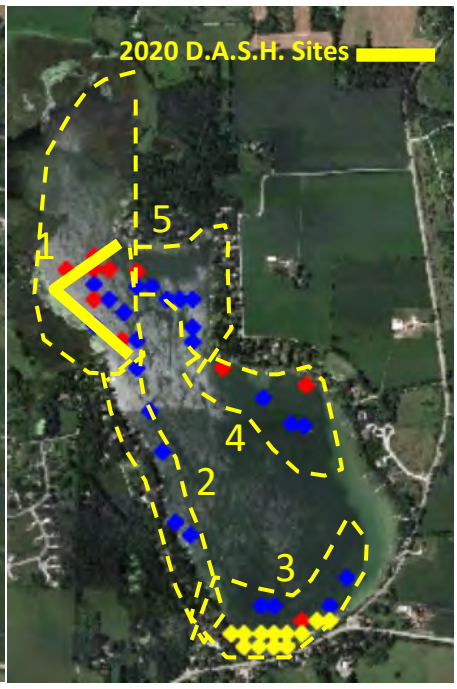
August, 2022 Survey (Partial PI)



August, 2021 Survey (Partial PI)

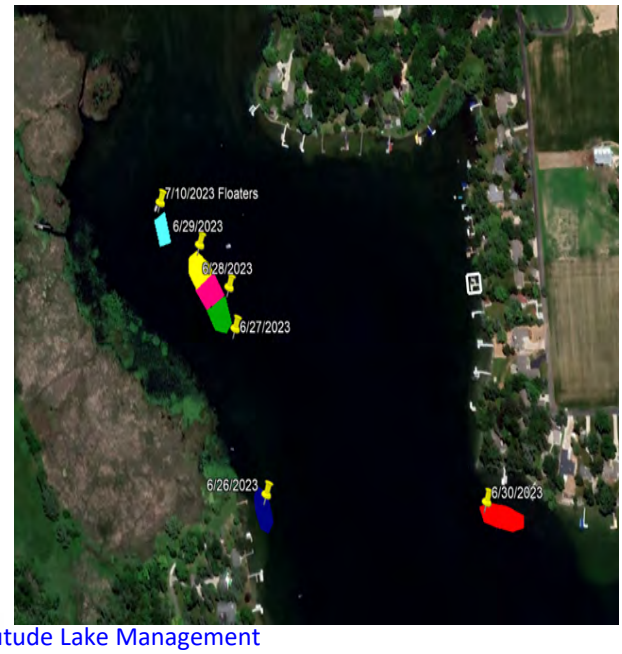


August, 2020 Survey (Full PII)



Golden Lake
DASH Locations 2022
-Riese Aquatics, LLC

Golden Lake
DASH Locations 2023
Riese Aquatics,LLC



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Appendix

Contents

I. Illustration of Rake Fullness

II. Original (May, 2013) PI Survey Map of EWM in Golden Lake

III. 2023 PI Summary Stats, Floristic Quality Index and Plant Data.

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Attachment I.

Aquatic Plant Fullness Ratings

Fullness Rating	Coverage	Description
1		Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer.
2		There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines.
3		The rake is completely covered and tines are not visible.

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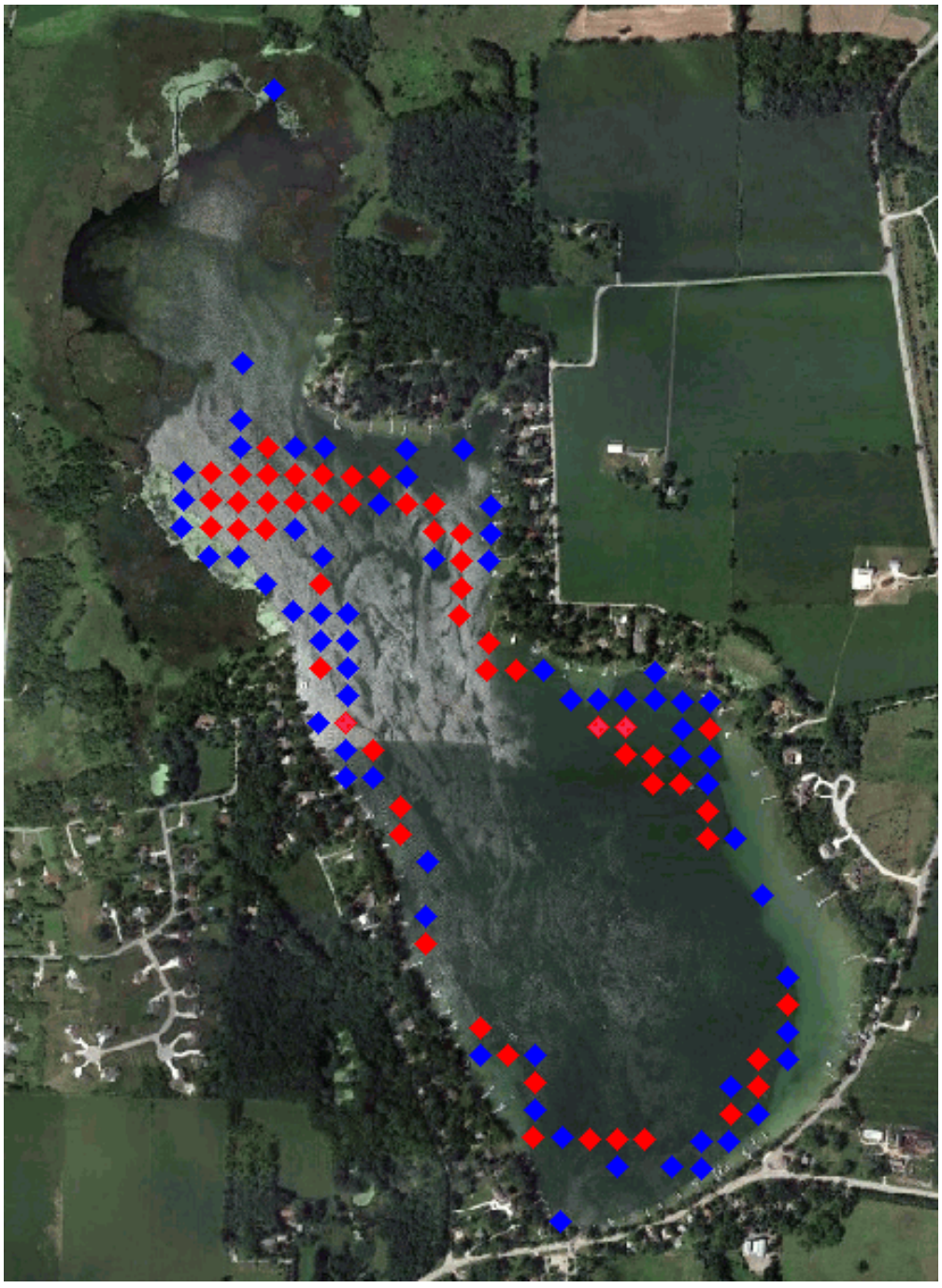
Attachment II

EWM/Hybrid Distribution in Golden Lake

May, 2013 Point-Intercept Survey*

*Data collection by WI DNR staff



Total # Points where EWM Present: 118

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2023 P/I Summary Stats

SUMMARY STATS:	
Total number of sites visited	422
Total number of sites with vegetation	264
Total number of sites shallower than maximum depth of plants	322
Frequency of occurrence at sites shallower than maximum depth of plants	81.99
Simpson Diversity Index	0.90
Maximum depth of plants (ft)**	29.00
Number of sites sampled using rake on Rope (R)	102
Number of sites sampled using rake on Pole (P)	222
Average number of all species per site (shallower than max depth)	2.10
Average number of all species per site (veg. sites only)	2.57
Average number of native species per site (shallower than max depth)	1.93
Average number of native species per site (veg. sites only)	2.43
Species Richness	24
Species Richness (including visuals)	27
**SEE "MAX DEPTH GRAPH" WORKSHEET TO CONFIRM	

Table 1

# of PI Points with EWM/Hybrid Milfoil - May, 2013 thru August, 2023

# of PI Points with EWM/Hybrid Milfoil - May 2013 thru August 2022

Partial Point-Intercept (EWM only) Surveys

Survey	# Sites Visited	# of Sites w EWM	# Sites, inc. Visuals
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**60, inc. Visuals . ***52 with Visuals

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Floristic Quality Index

Golden Lake - Waukesha/Jefferson

Counties August, 2023 Survey

Species	Common Name	C	species present=1	
Brasenia schreberi	Watershield	6	1	6
Ceratophyllum demersum	Coontail	3	1	3
Chara	Muskgrasses	7	1	7
Elodea canadensis	Common waterweed	3	1	3
Myriophyllum sibiricum	Northern water-milfoil	6	1	6
Najas flexilis	Slender naiad	6	1	6
Nitella	Nitella	7	1	7
Nuphar variegata	Spatterdock	6	1	6
Nymphaea odorata	White water lily	6	1	6
Potamogeton amplifolius	Large-leaf pondweed	7	1	7
Potamogeton foliosus	Leafy pondweed	6	1	6
Potamogeton friesii	Fries' pondweed	8	1	8
Potamogeton gramineus	Variable pondweed	7	1	7
Potamogeton illinoensis	Illinois pondweed	6	1	6
Potamogeton natans	Floating-leaf pondweed	5	1	5
Potamogeton praelongus	White-stem pondweed	8	1	8
Potamogeton richardsonii	Clasping-leaf pondweed	5	1	5
Potamogeton zosteriformis	Flat-stem pondweed	6	1	6
Stuckenia pectinata	Sago pondweed	3	1	3
Utricularia vulgaris	Common bladderwort	7	1	7
Vallisneria americana	Wild celery	6	1	6
N			21	
mean C				5.90476
FQI				27.059

CITATION: **Nichols, SA. 1999. Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications. Journal of Lake and Reservoir Management, 15**

CITATION: **University of Wisconsin-Madison, 2001. Wisconsin Floristic Quality Assess-**

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Summary of Golden Lake 2023 PI Survey Plant Data

Common Name	Species	Freq. of Occurrence within vegetated areas (%)	Average Rake Fullness	# sites where species found (does not include visuals)	# of visual sightings
Eurasian Watermilfoil	*Myriophyllum spicatum*	18,18	1.48	48	4
Curlyleaf Pondweed	*Potamogeton crispus*	0.3	1.0	2	0
Watershield	*Brasenia schreberi*	0.38	1.14	1	2
Coontail	*Ceratophyllum demersum*	7.95	1.24	21	0
Muskgrasses	*Chara*	23.7	1.85	161	1
Common waterweed	*Elodea canadensis*	1.89	1.6	5	0
Water star-grass	*Heteranthera dubia*	-	-	-	-
Northern water-milfoil	*Myriophyllum sibiricum*	0.38	1.0	1	0
Whorled water-milfoil	*Myriophyllum verticillatum*	-	-.	-	-
Slender naiad	*Najas flexilis*	28.03	1.24	74	1
Southern naiad	*Najas guadalupensis*	-	-.	-	-
Spiny naiad	*Najas marina*	2.27	1.5	6	0
Nitella	*Nitella*	12.5	1.21	33	0
Spatterdock	*Nuphar variegata*	1.14	2.0	3	6
White water lily	*Nymphaea odorata*	3.41	1.33	9	9
Pickerelweed	*Pontederia cordata*	0	0	0	1
Large-leaf pondweed	*Potamogeton amplifolius*	10.23	1.26	27	3
Leafy pondweed	*Potamogeton foliosus*	1.14	1.0	3	0
Fries' pondweed	*Potamogeton friesii*	0.38	1.0	1	0
Variable pondweed	*Potamogeton gramineus*	10.61	1.14	26	1
Illinois pondweed	*Potamogeton illinoensis*	6.44	1.06	17	6
Floating-leaf pondweed	*Potamogeton natans*	21.97	1.07	56	6
Long-leaf pondweed	*Potamogeton nodosus*	-	-	-	-
White-stem pondweed	*Potamogeton praelongus*	5.30	1.0	14	5
Small pondweed	*Potamogeton pusillus*	-	-	-	-
Clasping-leaf pondweed	*Potamogeton richardsonii*	6.44	1.88	`17	4
Fern pondweed	*Potamogeton robbinsii*	0.75	1.0	2	0
Flat-stem pondweed	*Potamogeton zosteriformis*	12.88	1.74	34	0
Hardstem bullrush	*Schoenoplectus acutus*	0	0	0	14
Sago pondweed	*Stuckenia pectinata*	12.12	1.03	32	11
Cattail	*Typha sp.*	0	0	0	5
Common bladderwort	*Utricularia vulgaris*	5.3	1.29	14	0
Wild celery	*Vallisneria americana*	25.76	1.21	68	2