AIRR 13313 + AIRR 13413

Curly-leaf pondweed (*Potamogeton crispus*) Meandering Littoral Zone and Bed Mapping Surveys Upper and Middle Eau Claire Lakes WBIC: 2742700 and 2742100 Bayfield County, Wisconsin

CLP from Upper Eau Claire 6/19/20

Upper and Middle Eau Claire Lake Aerial Photos (2015)

Project Initiated by:

The Town of Barnes – Aquatic Invasive Species Committee, and the Wisconsin Department of Natural Resources (Grants AIRR-133/134-13)

Typical low density CLP rake sample on Middle Eau Claire Lake 6/19/20

Surveys Conducted by and Report Prepared by:

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June 19, 2020

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INTRODUCTION:

Upper Eau Claire Lake (WBIC 2742700) is a 1,024 acre oligotrophic stratified drainage lake in southwestern Bayfield County, Wisconsin in the Town of Barnes (T44N R9W S9 SW SE). The lake reaches a maximum depth of 92ft in the hole due west of Three-in-One Island, and has an average depth of approximately 29ft (Figure 1). The bottom is predominately sand and sandy muck, although areas of gravel are located throughout the lake; especially around exposed points, shallow flats, and several sunken islands. Summer Secchi readings from 1986-2019 (the most recent year available) ranged from 12-25ft and averaged 18.0ft (WDNR 2020). This very good clarity produced a littoral zone that reached over 20ft in 2020.

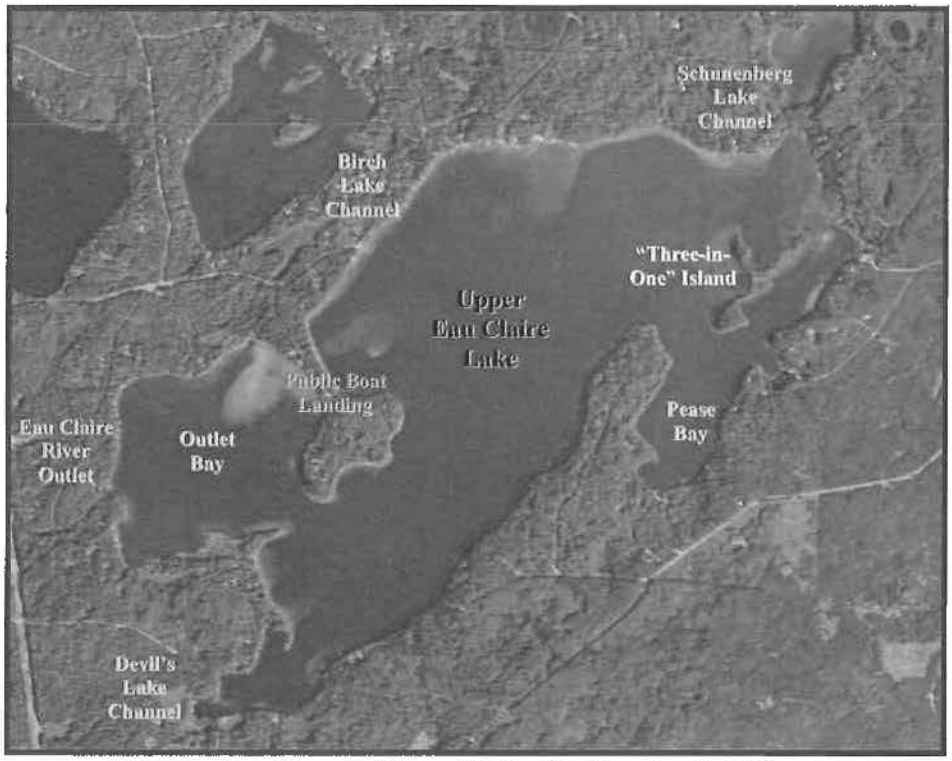

Figure 1: Upper Eau Claire Lake Aerial Photo

Middle Eau Claire Lake (WBIC 2742100) is an 880 acre meso/oligotrophic stratified drainage lake in southwestern Bayfield County, Wisconsin in the Town of Barnes (T44N R9W S19 NW NE). The lake reaches a maximum depth of 66ft in the hole north/northwest of the Eau Claire River Inlet, and has an average depth of approximately 17ft (Figure 2). The bottom is predominately sand and gravel along the shoreline and around the many sunken islands, while muck dominates the deeper basins and bays. Summer Secchi readings from 1987-2019 (the most recent year available) ranged from 11-22ft and averaged 17.8ft (WDNR 2020). This very good clarity produced a littoral zone that reached 20ft in 2020.

Figure 2: Middle Eau Claire Lake Aerial Photo

STUDY OBJECTIVES AND RATIONALE:

In 2005, concern over the spread of Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) into nearby Tomahawk and Sand Bar Lakes prompted members of the Town of Barnes Aquatic Invasive Species Committee (then the Eurasian water-milfoil Committee) and the Eau Claire Lakes Area Property Owners Association to authorize an initial point-intercept survey to look for exotic plant species in the lakes. This survey did **not** find EWM, Curly-leaf pondweed (*Potamogeton crispus*) (CLP), or any other exotic species to be present in either Upper or Middle Eau Claire Lakes (Kudlas et al. pers. comm.).

Along with the 2005 survey, the TOB/ECLAPOA initiated a Clean Boats/Clean Waters monitoring program at the lakes' landings, and trained volunteers as shoreline spotters to look for exotic invasive species. These spotters ultimately discovered CLP in Pease Bay on Upper Eau Claire Lake and in the south bays of Middle Eau Claire Lake during the summer of 2012. In an effort to determine how to deal with the newly found infestation, the TOB applied for and received a rapid response grant that authorized three plant surveys on each lake in 2013: May CLP point-intercept surveys, June CLP bed mapping surveys with a SCUBA habitat assessment, and late July warm-water point-intercept macrophyte surveys.

As these surveys found only small amounts of CLP that were generally minor components within expansive beds of beneficial habitat-forming native vegetation, it was decided to limit control of CLP to manual removal by volunteers. However, when a follow-up CLP bed mapping survey in 2015 found expanding numbers of small beds on Middle Eau Claire Lake, it was decided that suction harvesting using the "Barnes Aquatic Invasive Species Sucker" or BAISS would be employed to increase capacity. Following efforts to this end from 2015-2019, the TOB/ECLAPOA authorized another round of CLP bed mapping surveys on the lakes in 2020 to determine if CLP was expanding, contracting, or staying the same relative to the 2015 survey. This information will be used to guide management moving forward. The following report is the summary analysis of these surveys conducted on June 19, 2020.

METHODS:

CLP Bed Mapping Survey:

We used the 2013 and 2015 CLP bed maps coupled with a meandering littoral zone search to locate and delineate all beds of CLP on the lakes. Normally, a bed is defined as anywhere CLP plants make up greater than 50% of all aquatic plants in the area and has canopied at the surface or is close enough to the surface that it would likely interfere with normal boat traffic. Because CLP continues to be relatively rare on the lakes and because a potential management goal is to eradicate CLP wherever it is found, we broadened this definition and mapped all CLP encountered.

Upon finding a bed, we circled around the perimeter and used a GPS unit (Garmin 76CSx) to record waypoints at regular intervals. We then uploaded these points to ArcMap 9.3.1, created bed shapefiles using the WDNR Forestry Tools Extension, and determined the total acreage of the beds to the nearest hundredth of an acre (Tables 1-3). We also estimated the rake density range and mean rake fullness of the bed (Figure 3), the maximum depth of the bed, whether it was canopied, and the impact it was likely to have on navigation (**none** – easily avoidable with a natural channel around/**minor** – one prop clear to get through or access open water/**moderate** – several prop clears needed to navigate through/**severe** – multiple prop clears and difficult to impossible to row through).

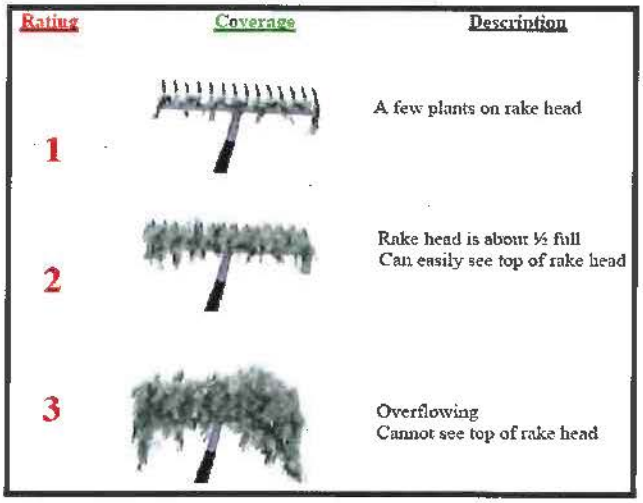

Figure 3: Rake Fullness Ratings (UWEX 2010)

RESULTS:

Upper Eau Claire Lake CLP Bed Mapping Survey:

In 2013, we located and mapped eight small beds totaling 0.11 acres (0.01% of the lake's 1,024 acres) in the channel/bays east of Three-in-One Island (Figure 4) and in Pease Bay (Figure 5) (Appendix I). The biggest was 0.03 acres (Beds 3 and 5) and the smallest was little more than a few 10's of plants covering <0.001 acre (Bed 8) (Table 1).

The 2015 survey found four beds that totaled 0.17 acre with the biggest (Bed 4) being 0.11 acre and the smallest (7B) covering <0.01 acre (Table 1). Collectively, this was an increase of 0.06 acre from the 2013 survey, but this amount was within the error range of the GPS. Each of these beds was canopied, had a low mean rake of 1, and a rake range that varied from 1-2 (low to moderate). Although canopied, because they were so small these beds were easily avoided, and it seemed unlikely that they would cause even minor navigation impairment.

East of Three-in-One Island, we noted that three of the beds we mapped in 2013 (Beds 1, 2, and 5) had completely disappeared after volunteers pulled plants in these areas during the 2014 growing season. We also saw no evidence of CLP in the deep water areas bordering Pease Bay where we mapped Beds 6 and 8 in 2013. At these locations, it may be that CLP, which was never dense, just didn't canopy or even get close enough to the surface that we could see it. It may also be that localized conditions prevented turions from germinating in 2015.

Our 2020 survey found two "beds" totaling 0.04 acre – a 0.13 acre decline (-76.5%) from 2015 (Table 1). Bed 3A east of Three-in-One Island consisted of about 30 total plants most of which we were able to rake remove. Bed 5A also contained only about 20-30 plants, but they were in a tight cluster and covered a much smaller area. We were also able to rake remove most of them although some turions broke off as the plants were beginning to senesce.

Other than a few floating plants that had broken free from the bottom, we saw no evidence of CLP anywhere else in the lake. Following the survey, we were informed that the BAISS boat had already been on the lake in 2020. This suggests that the current management strategy is having great success at both finding and eliminating CLP on the lake.

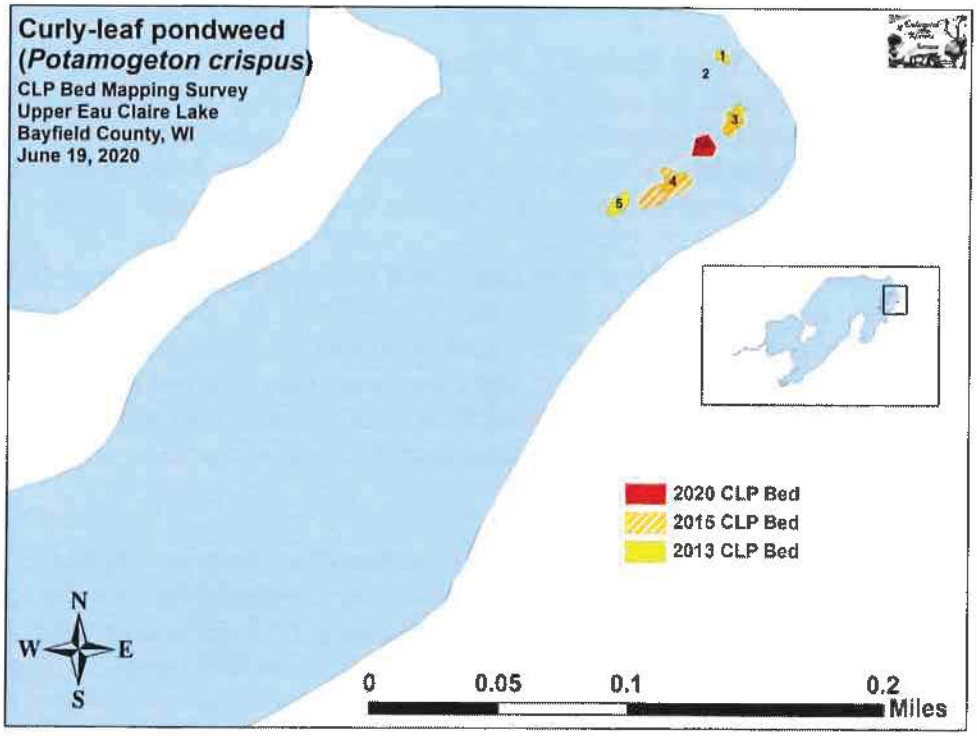

Figure 4: Upper Eau Claire Lake CLP Beds – East of Three-in-One Island 2013, 2015, and 2020

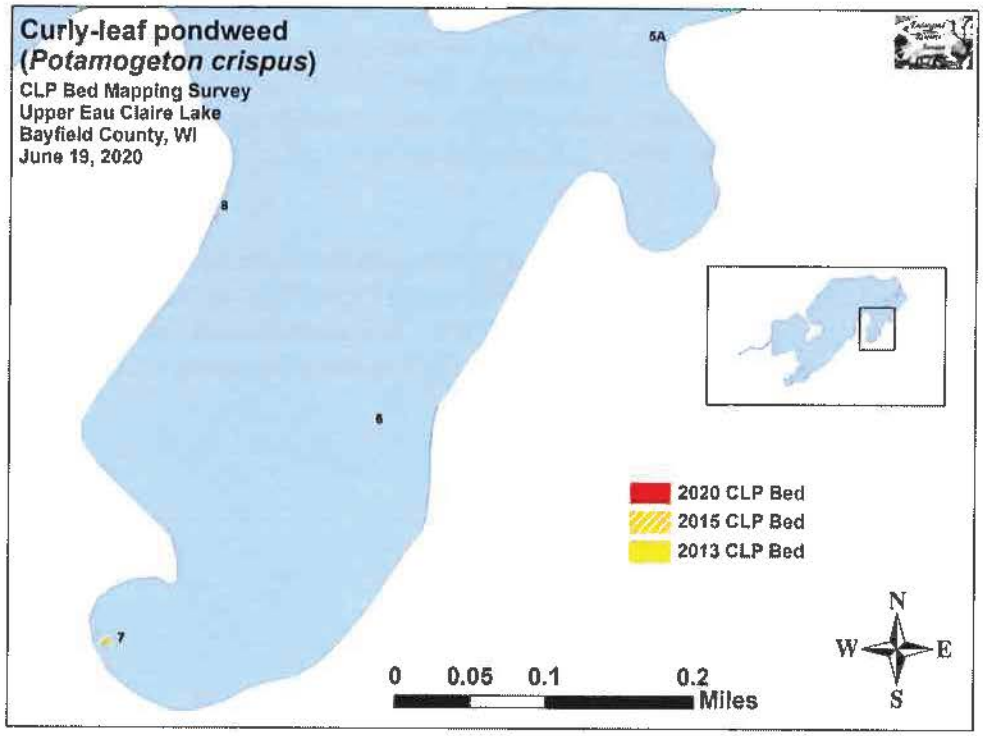

Figure 5: Upper Eau Claire Lake CLP Beds – Pease Bay 2013, 2015, and 2020

Table 1: CLP Bed Summary
Upper Eau Claire Lake, Bayfield County
June 30, 2013, June 16, 2015, and June 19, 2020

Bed Number	2020 Acreage	2015 Acreage	2013 Acreage	2020 Range and Mean Rake Fullness	2015 Range and Mean Rake Fullness	2013 Range and Mean Rake Fullness	Navigation Impairment	2020 Field Notes
1	0	0	0.01	0	0	2-3; mostly 3	None	No CLP plants seen.
2	0	0	<<<0.01	0	0	<1-1; mostly 1	None	No CLP plants seen.
3	0	0.04	0.03	0	1-2; mostly 1	1-2; mostly 2	None	No CLP plants seen.
3A	0.04	0	0	<<1-2; mostly <<1	0	0	None	30 plants – raked out
4	0	0.11	0.02	0	1-2; mostly 1	1-3; mostly 2	None	No CLP plants seen.
5	0	0	0.03	0	0	1-3; mostly 2	None	No CLP plants seen.
5A	<0.01	0	0	<<1-2; mostly 1	0	0	None	Perhaps 20-30 plants.
6	0	0	<0.01	0	0	1-3; mostly 2	None	No CLP plants seen.
7 (A and B)	0	0.02	<<0.01	0	1-2; mostly 1	1-2; mostly 2	None	No CLP plants seen.
8	0	0	<<<0.01	0	0	<1-1; mostly 1	None	No CLP plants seen.
Total Acres	**0.04**	**0.17**	**0.11**					

Middle Eau Claire Lake CLP Bed Mapping Survey:

During our 2013 survey of Middle Eau Claire Lake, despite searching over 21km (13 miles) of transects throughout the lake's visible littoral zone, the only beds found were in the southern third of the lake (Figure 6) (Appendix II). Even in this area, Curly-leaf pondweed was very limited in distribution as the 14 beds mapped totaled just 0.11 acres (0.01% of the lake's 880 acres) with the biggest being 0.03 acres (Beds 1 and 11) and the smallest being nothing more than a few 10's of plants covering <0.001 acre (Bed 12) (Table 2).

Similar to other lakes with CLP in northern Wisconsin, in the spring of 2015 we found a general uptick in distribution and density on Middle Eau Claire Lake. In total, we located 41 beds covering 0.53 acres (Figures 6 and 7). Although this seems like a significant increase, the reality is most of these "beds" were nothing more than a few clusters of plants. As the goal of the suction harvest program is to reduce the species as much as possible, we marked every single CLP plant we found and drew a polygon around it. Because of this, the "real" acreage of CLP beds on the lake was likely significantly less than the stated total of 0.53 acre. The largest true bed was Bed 7 at 0.11 acre with the next largest being Bed N at 0.05. All other beds were <0.04 acre and most were <0.001 acre and consisted of little more than a few 10's of plants.

Of the 14 beds found in 2013, eight of them did not appear to be present in 2015 (Table 2). With the six beds that were found, only Bed 1 where SCUBA divers from Grantsburg High School had removed large amounts of CLP in 2014 showed a decrease in size. In total, the beds in these areas had increase from 0.11 acre to 0.20 acre. However, only the beds that occurred directly out from the boat landing (Beds 11 and 13) could have been considered even a minor navigation impairment, and, in reality, they were easily avoided because of their overall small size.

The 35 new "beds" found in 2015 added 0.33 acre to get to the total of 0.53 acre (Table 3). Twenty-two of them were <0.005 acres meaning they were little more than a few clusters with a handful of plants in each.

In 2020, we searched 27.6km (16.6 miles) of transects on Middle Eau Claire Lake, and this included revisiting all former CLP areas. Despite this, we had difficulty finding any CLP to map. Although we delineated **12 areas with CLP totaling 0.07 acre**, almost all of these had less than 10-20 plants in them, and none were bigger than 0.01 acre (Figure 6). We also didn't locate any beds outside the southern bays (Figure 7). Collectively, this represented a 0.46 acre decline (-86.8%) from 2015.

Of the original 14 beds found in 2013 (Table 2), only Beds 7 and 13 had any visible CLP in them in 2020. In each case, we saw just a few handfuls of plants, and the total acreage with any plants was 0.02 acre (Table 2).

We found surviving CLP in just three out of the 35 beds delineated in 2015. Each was little more than a handful of plants, but we mapped them as there wasn't anything else present to map. Similarly, the seven additional new "beds" found in 2020 were little more than a few scattered plants growing among healthy beds of natives pondweeds.

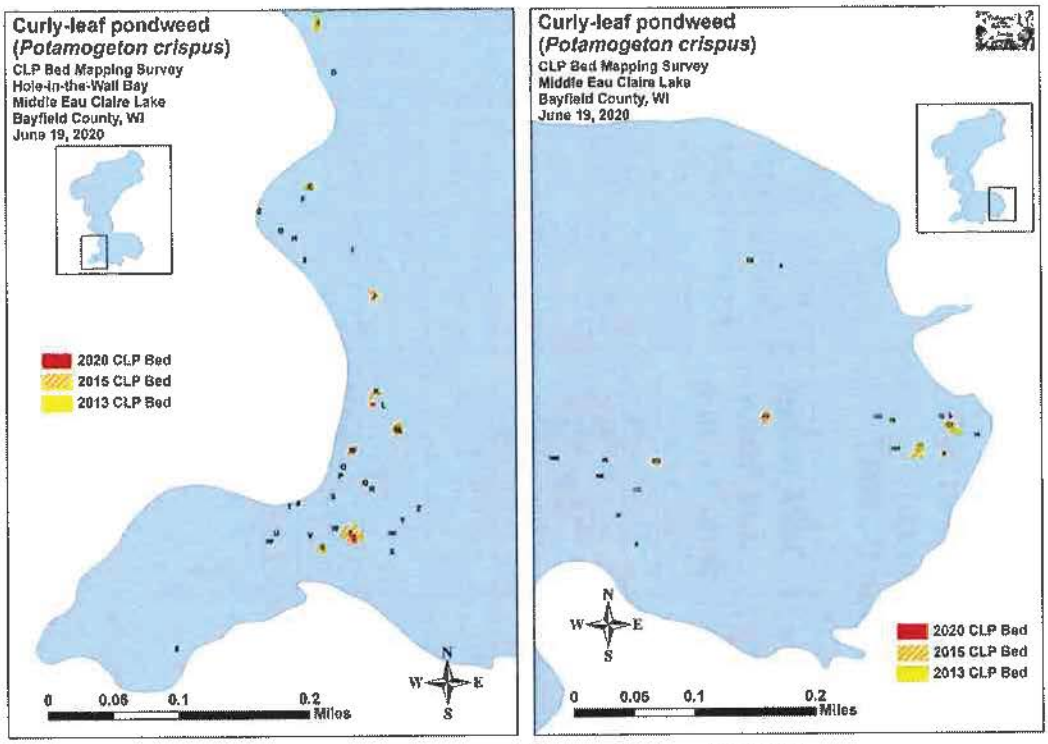

Figure 6: Middle Eau Claire Lake CLP Beds – Hole-in-the-Wall and Boat Landing Bays 2013, 2015, and 2020

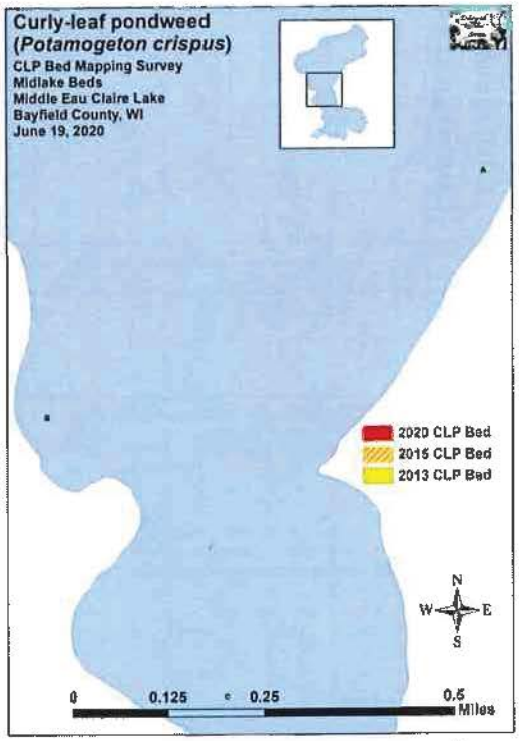

Figure 7: Middle Eau Claire Lake CLP Beds – Midlake 2013, 2015, and 2020

Table 2: Summary of CLP Beds First Identified in 2013
Middle Eau Claire Lake, Bayfield County
June 30, 2013, June 16, 18, 2015, and June 19, 2020

Bed Number	2020 Acreage	2015 Acreage	2013 Acreage	2020 Range and Mean Rake Fullness	2015 Range and Mean Rake Fullness	2013 Range and Mean Rake Fullness	Navigation Impairment	2020 Field Notes
1	0	0.01	0.03	0	1-2; mostly 1	2-3; mostly 3	None	No CLP Found
2	0	0	0.01	0	0	<1-1; mostly 1	None	No CLP Found
3	0	<<0.01	<<0.01	0	2-3; mostly 3	<1-1; mostly1	None	No CLP Found
4	0	0	<<0.01	0	0	<1-1; mostly 1	None	No CLP Found
5	0	0	<<0.01	0	0	<1-1; mostly 1	None	No CLP Found
6	0	0.02	0.01	0	<1-3; mostly 2	2-3; mostly 3	None	No CLP Found
7	0.01	0.11	<0.01	<<<1-1; mostly <<1	<1-3; mostly 2	2-3; mostly 3	None	10 scattered plants
8	0	0	0.01	0	0	3	None	No CLP Found
9	0	0	<<0.01	0	0	<1-1; mostly 1	None	No CLP Found
10	0	0	0.01	0	0	3	None	No CLP Found
11	0	0.03	0.03	0	1-2; mostly 1	2-3; mostly 3	None	No CLP Found
12	0	0	<<<0.01	0	0	<1-1; mostly 1	None	No CLP Found
13	<0.01	0.04	0.02	<1-1; mostly 1	1-2; mostly 1	1-2; mostly 1	None	20+ plants
14	0	0	<<<0.01	0	0	<1-1; mostly 1	None	No CLP Found
Total Acres	**0.02**	**0.20**	**0.11**					

Table 3: Summary of CLP Beds First Identified in 2015 and 2020
Middle Eau Claire Lake, Bayfield County
June 16, 18, 2015 and June 19, 2020

Bed Number	2020 Acreage	2015 Acreage	2020 Range and Mean Rake Fullness	2015 Range and Mean Rake Fullness	Navigation Impairment	2020 Field Notes
A	0	0.03	0	<<<1-2; mostly 1	None	No CLP Found
B	0	<<0.01	0	3	None	No CLP Found
C	0	<0.01	0	2-3; mostly 2	None	No CLP Found
D	0	<<0.01	0	3	None	No CLP Found
E	0	0.02	0	1-3; mostly 2	None	No CLP Found
F	0	<<0.01	0	3	None	No CLP Found
G	0	<0.01	0	2-3; mostly 3	None	No CLP Found
H	0	0.01	0	1-2; mostly 1	None	No CLP Found
I	0	<<0.01	0	3	None	No CLP Found
J	0	0.03	0	2-3; mostly 3	None	No CLP Found
K	<<0.01	0.03	<<<1-1; mostly <1	2-3; mostly 2	None	Scattered clusters mixed with natives
L	0	<<0.01	0	3	None	No CLP Found
M	<<0.01	0.05	<<<1-1; mostly <1	1-3; mostly 2	None	Perhaps 5 plants in microcluster
N	<<0.01	0.03	<<<1-1; mostly <1	<<1-3; mostly 2	None	Perhaps 5 plants in microcluster
O	0	<<0.01	0	3	None	No CLP Found
P	0	<<0.01	0	3	None	No CLP Found
Q	0	0.01	0	2-3; mostly 3	None	No CLP Found
R	0	<<0.01	0	3	None	No CLP Found
S	0	<<0.01	0	3	None	No CLP Found
T	0	<<0.01	0	1	None	No CLP Found
U	0	<<0.01	0	3	None	No CLP Found
V	0	<<0.01	0	3	None	No CLP Found
W	0	<<0.01	0	3	None	No CLP Found
X	0	<<0.01	0	3	None	No CLP Found
Y	0	<<0.01	0	3	None	No CLP Found

Table 3 (cont'): Summary of CLP Beds First Identified in 2015 and 2020
Middle Eau Claire Lake, Bayfield County
June 16, 18, 2015 and June 19, 2020

Bed Number	2020 Acreage	2015 Acreage	2020 Range and Mean Rake Fullness	2015 Range and Mean Rake Fullness	Navigation Impairment	2020 Field Notes
Z	0	<<0.01	0	3	None	No CLP Found
AA	0	<<0.01	0	3	None	No CLP Found
BB	0	<<0.01	0	3	None	No CLP Found
CC	0	<0.01	0	2-3; mostly 3	None	No CLP Found
DD	0	0.03	0	2-3; mostly 3	None	No CLP Found
EE	0	0.16	0	<1-2; mostly 1	None	No CLP Found
FF	0	0.04	0	<1-2; mostly 1	None	No CLP Found
GG	0	<<0.01	0	2-3; mostly 3	None	No CLP Found
HH	0	0.01	0	1-2; mostly 1	None	No CLP Found
II	0	0.01	0	1-2; mostly 1	None	No CLP Found
JJ	<<0.01	0	<<<1-1; mostly <1	0	None	Scattered clusters mixed with natives
KK	<0.01	0	<<1-2; mostly 1	0	None	Low density clusters mixed w/ natives
LL	<<0.01	0	<1-1; mostly 1	0	None	Handful of plants in a microcluster
MM	<<0.01	0	<<<1-1; mostly <1	0	None	Perhaps 5 plants in microcluster
NN	<<0.01	0	<<1-2; mostly 2	0	None	Microbed in carpet of Muskgrass
OO	<<0.01	0	<<<1-1; mostly <1	0	None	Perhaps 5 plants in microcluster
PP	<<0.01	0	1-3; mostly 3	0	None	Dense microbed
Total Acres	**0.05**	**0.33**				

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Curly-leaf pondweed continues to occupy only a minor role in the Eau Claire Lakes Ecosystem. On Upper Eau Claire Lake, CLP's limited distribution coupled with effective "BAISS" harvesting appears to have be effectively keeping the CLP population in check. On Middle Eau Claire Lake, the number and scattered nature of beds has made control more challenging. Despite this, the 2020 survey provided strong evidence that CLP is declining in both area and density. As long as running the harvester is a viable option, it appears to be providing strong control while simultaneously having minimal impact on the native plant community.

In the future, if it isn't possible to get to all of the beds with the time available and the TOB again considers chemical control, we strongly encourage a measured approach that is closely evaluated. CLP is an opportunistic species that can rapidly exploit disturbed areas. If a chemical treatment eliminates native vegetation as well as CLP, it's possible that CLP could reestablish in these areas and ultimately become worse rather than better.

Regardless of the what future active management occurs on the lakes, we remind lakeshore residents that they can help minimize CLP's opportunities to spread by maintaining the lake's native plants. To accomplish this, residents should refrain from removing rooted plants from the lake unless absolutely necessary as these barren patches of substrate not only release nutrients into the water column, but also give CLP a place to establish where it has a competitive advantage. Avoiding motor start ups in water <5ft deep would also help limit CLP's spread by not clipping or uprooting vegetation. This would also work to keep nutrients out of the water column as the lake's soft sediments are easily stirred up by prop wash. Promoting a no-wake-zone and/or a buoyed navigation channel away from the landing on Middle Eau Claire could also aid in preventing substrate disturbance as many of the current and former beds seem to be clustered around high traffic areas leading into/out of the landing bay.

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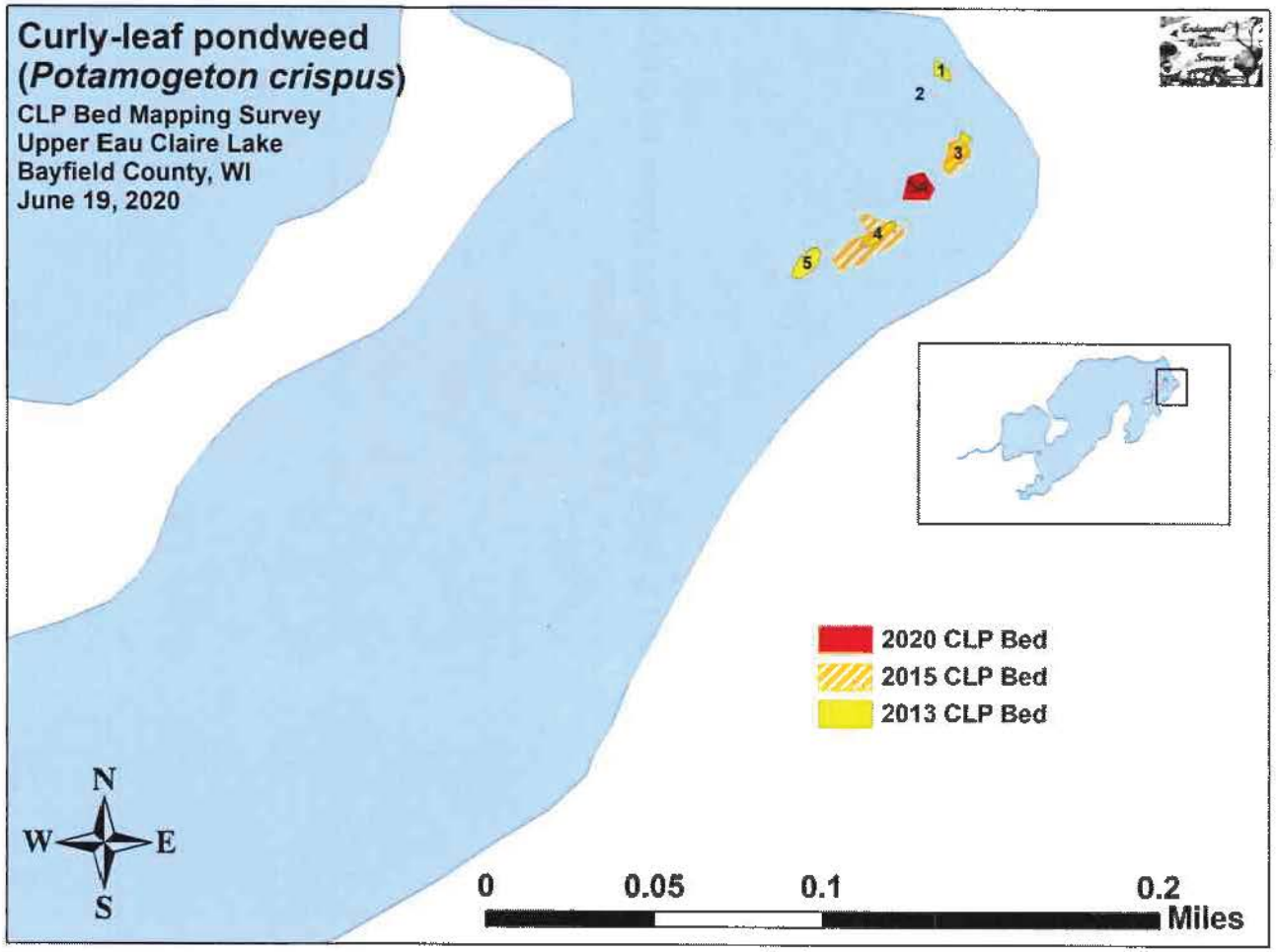
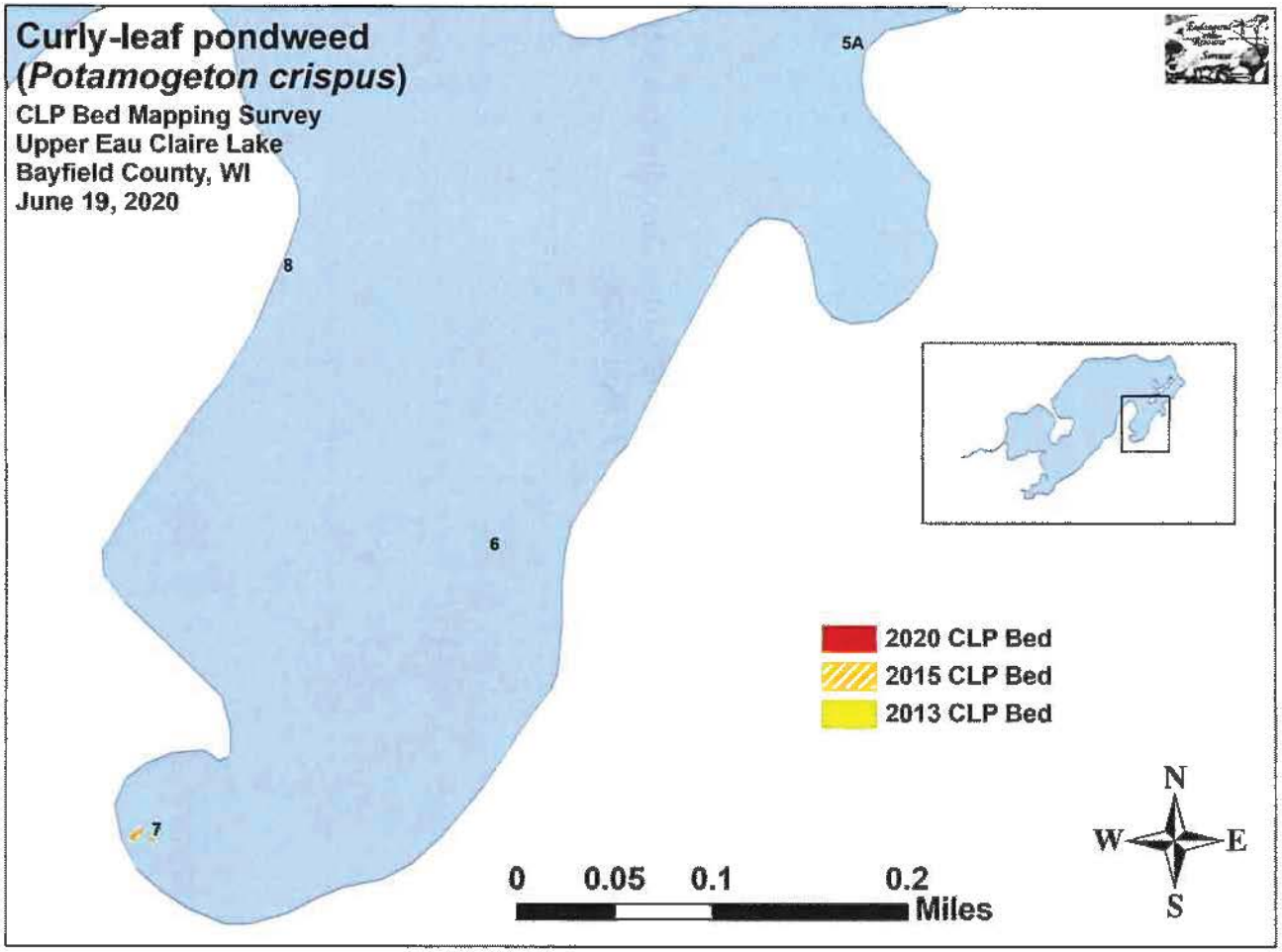
Appendix I: 2013, 2015, and 2020 June Upper Eau Claire Lake CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Upper Eau Claire Lake
Bayfield County, WI
June 19, 2020
1
2
3
4
5
2020 CLP Bed
2015 CLP Bed
2013 CLP Bed
N
W
E
S
0
0.05
0.1
0.2
Miles


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Upper Eau Claire Lake
Bayfield County, WI
June 19, 2020
5A
8
6
7
2020 CLP Bed
2015 CLP Bed
2013 CLP Bed
0 0.05 0.1 0.2
Miles
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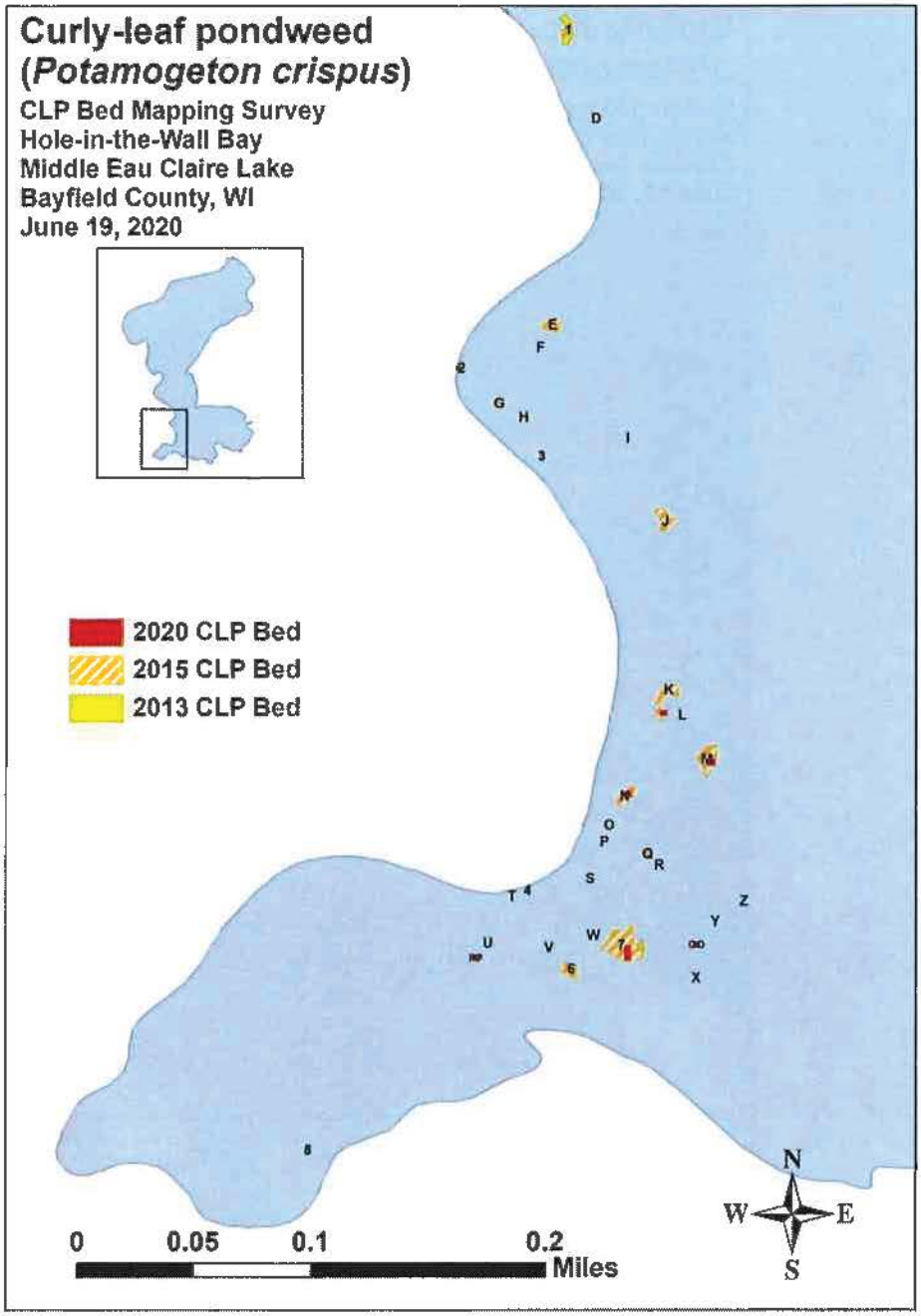
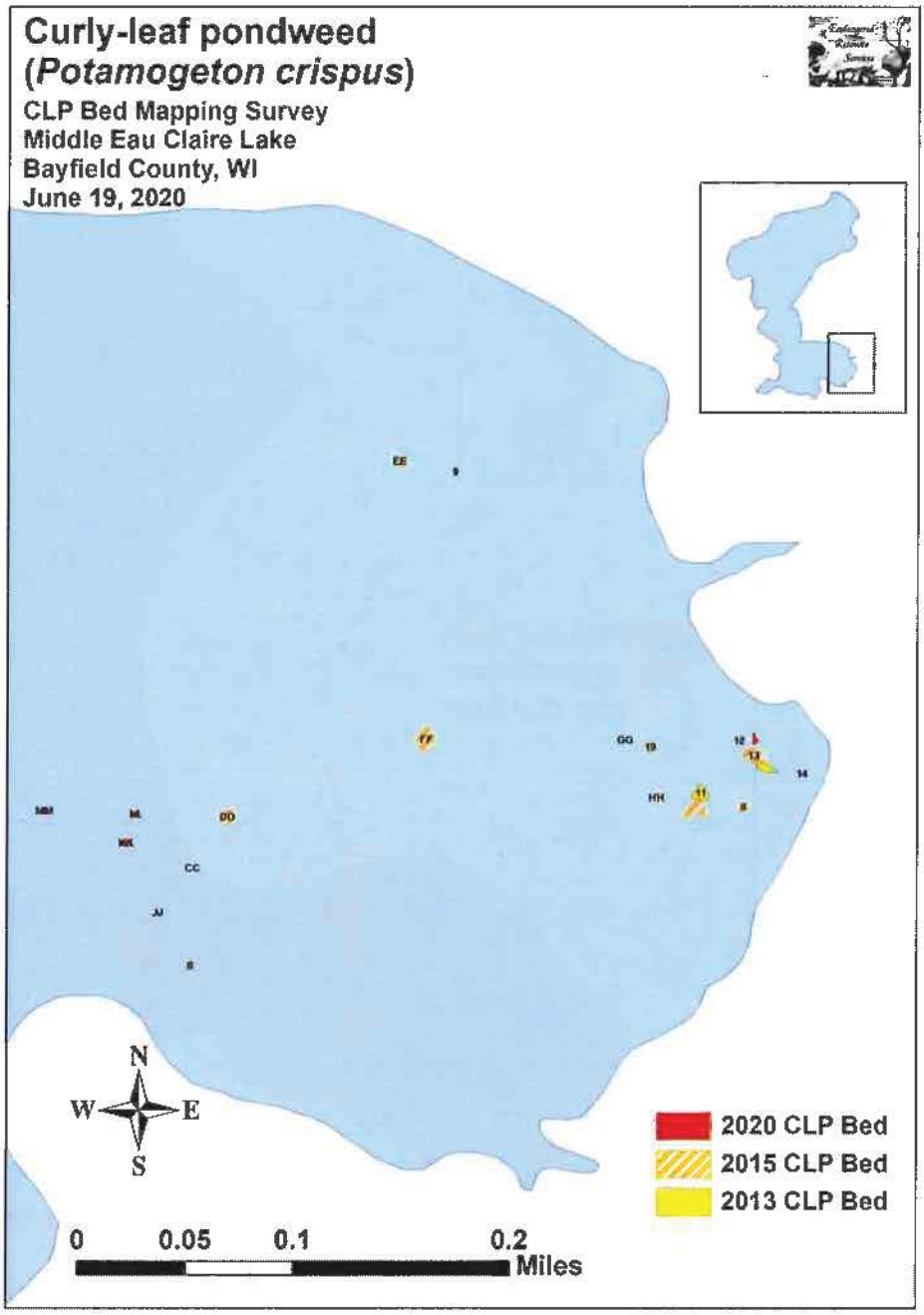
Appendix II: 2013, 2015, and 2020 June Middle Eau Claire Lake CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Hole-in-the-Wall Bay
Middle Eau Claire Lake
Bayfield County, WI
June 19, 2020
2020 CLP Bed
2015 CLP Bed
2013 CLP Bed
0
0.05
0.1
0.2
Miles
N
W
E
S


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Middle Eau Claire Lake
Bayfield County, WI
June 19, 2020
N
W
E
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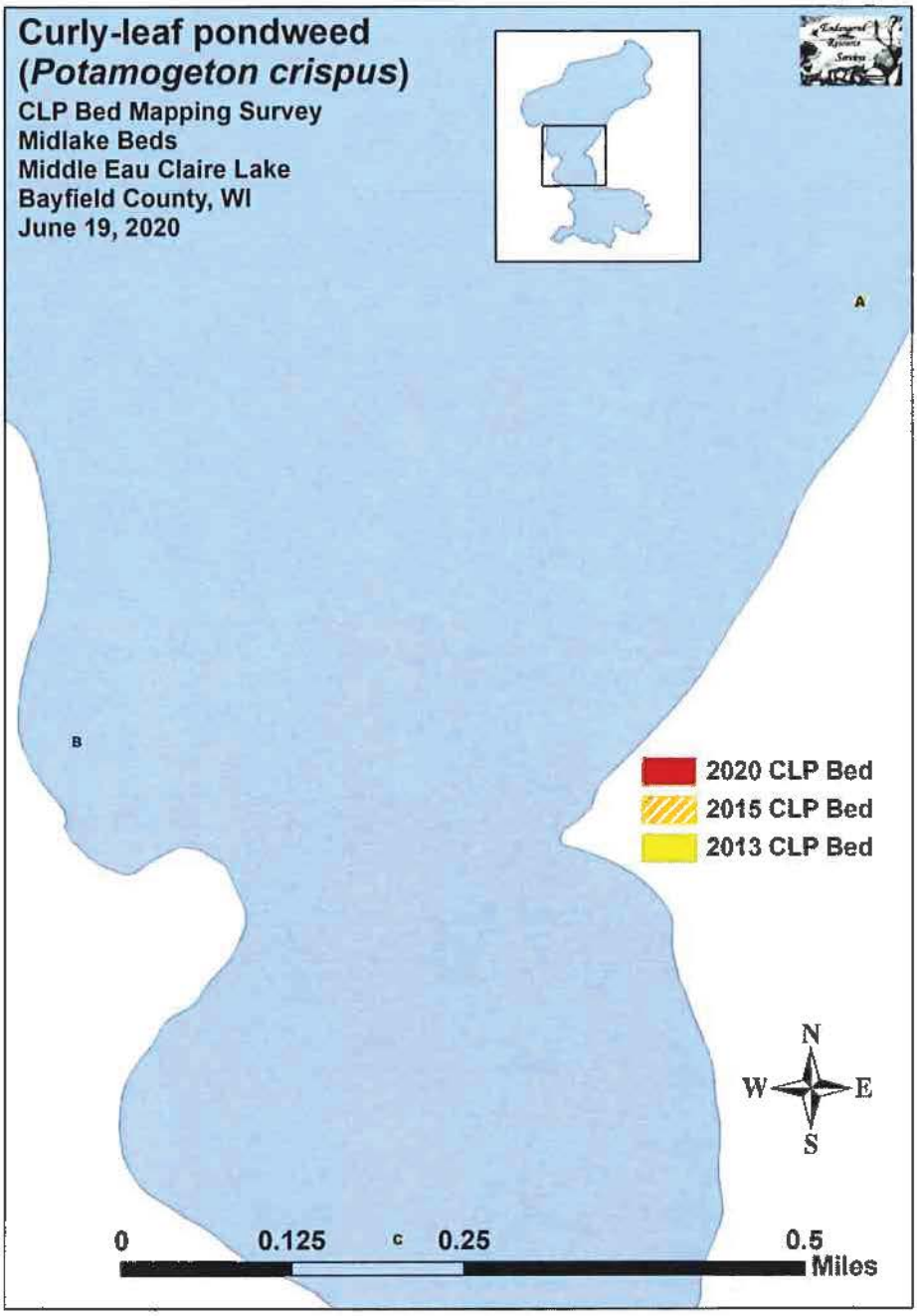
2020 CLP Bed
2015 CLP Bed
2013 CLP Bed
0
0.05
0.1
0.2
Miles

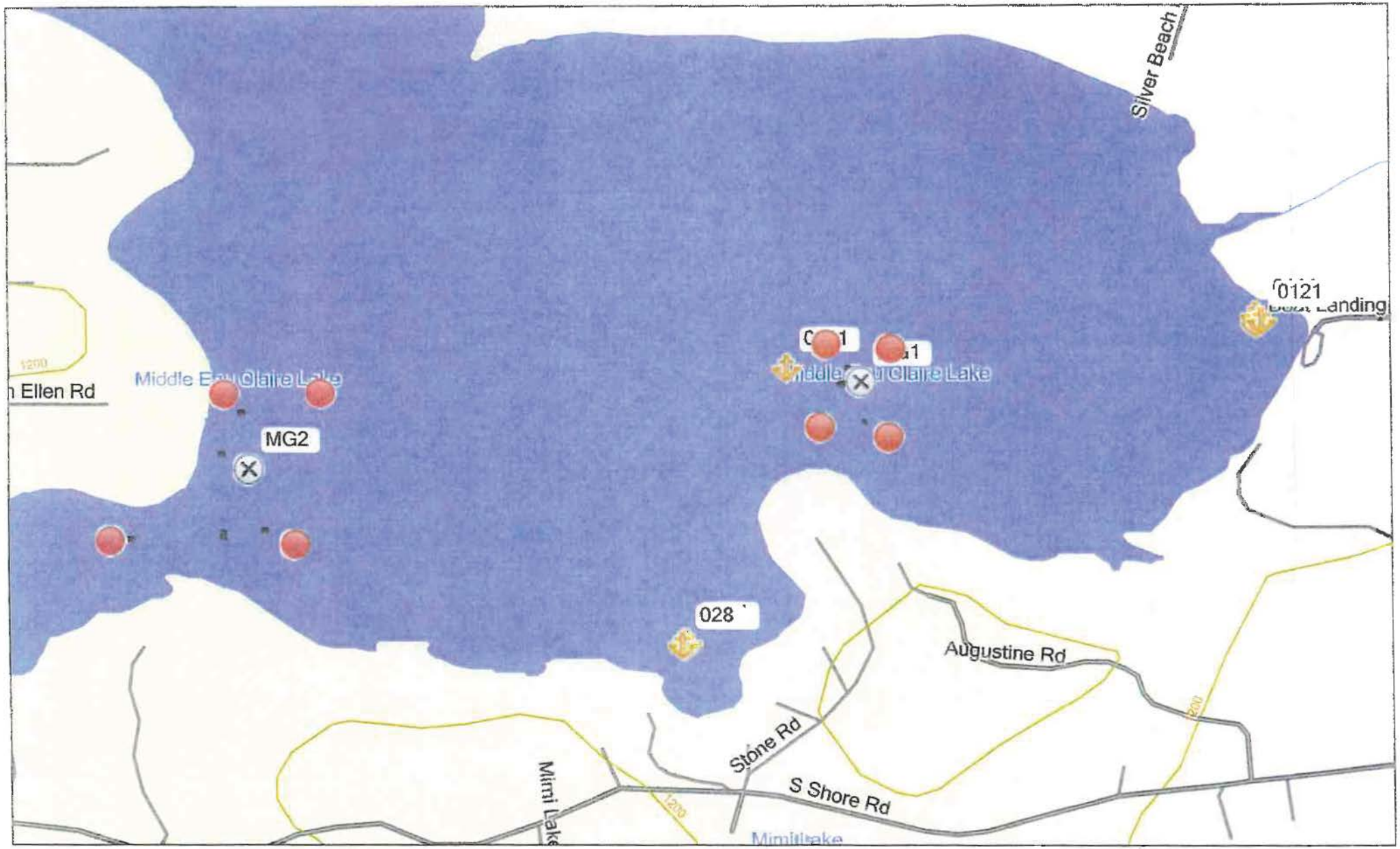

Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Midlake Beds
Middle Eau Claire Lake
Bayfield County, WI
June 19, 2020
A
B
C
2020 CLP Bed
2015 CLP Bed
2013 CLP Bed
N
W
E
S
0
0.125
0.25
0.5
Miles

TopoActive Americas, North 2020.10

0 mi 0.15 mi 0.3 mi 0.45 mi 0.6 mi

Middle2021

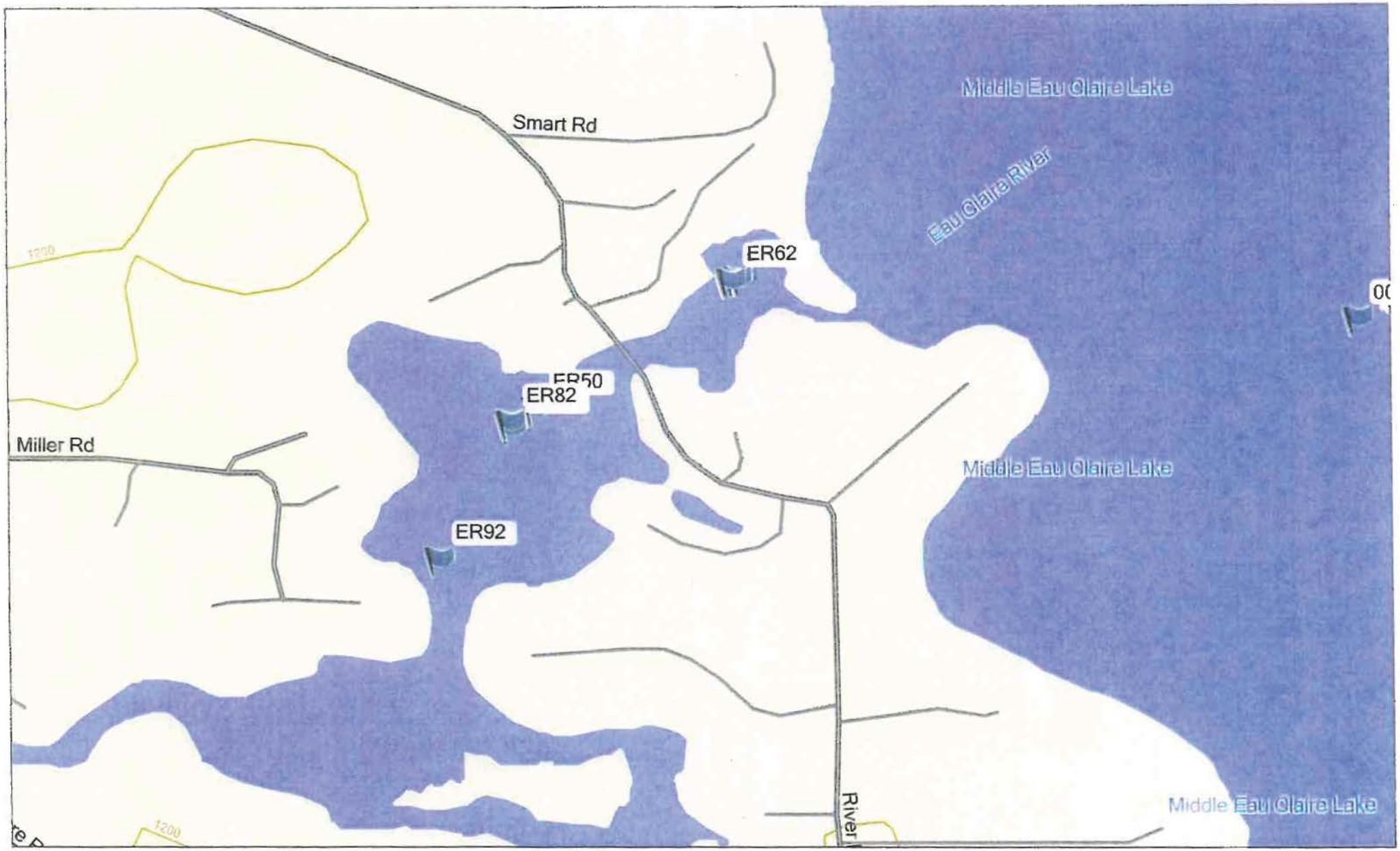
GARMIN.



0 ft 400 ft 800 ft 1200 ft 1600 ft

Middle2021

GARMIN.



0 ft 400 ft 800 ft 1200 ft 1600 ft

Middle2021

GARMIN.