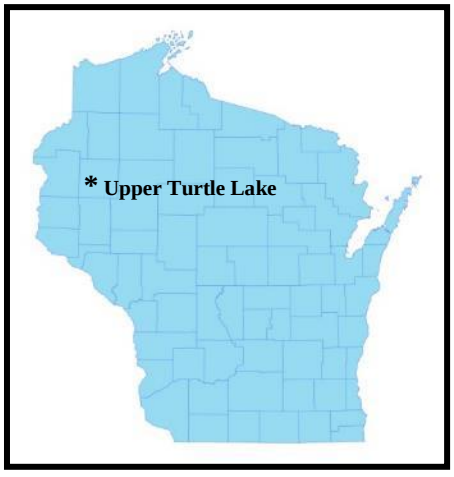
Curly-leaf Pondweed (*Potamogeton crispus*) Pre/Post Herbicide and Bed Mapping Surveys Upper Turtle Lake - WBIC: 2079800 Barron County, Wisconsin

Upper Turtle Lake 2018 treatment area

Dying 4-5ft tall Curly-leaf pondweed plant from north bay with no turions 6/18/18

Project Initiated by:

The Upper Turtle Lake Association, the Wisconsin Department of Natural Resources, and Lake Education and Planning Services, LLC



Surviving CLP in treatment bay and typical CLP in sw bay midlake 6/18/18

Surveys Conducted by and Report Prepared by:

Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin
May 12 and June 18, 2018

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INTRODUCTION:

Upper Turtle Lake (WBIC 2079800) is a 427 acre, stratified, drainage lake located in the Town of Almena in west-central Barron County (T34N R14W S27 NE NW). It reaches a maximum depth of 25ft in the central basin and has an average depth of 14ft (Figure 1) WDNR 2018). The lake is eutrophic in nature with Secchi readings from 1994-2017 averaging 5.8ft; however, in 2017 the summer average was only 2.8 – the lowest value during this span (no data was available for 2018) (WDNR 2018). This poor water clarity produced a littoral zone that reached approximately 14.0ft throughout the 2018 growing season. The lake's bottom substrate is predominantly organic muck in the north, south, and western bays as well as the majority of the main basin with a narrow ring of sand/rock occurring along most of the eastern shore and on scattered exposed points (Bush et al. 1966).

Figure 1: Upper Turtle Lake with 2018 CLP Treatment Area

BACKGROUND AND STUDY RATIONALE:

In 2010, the Upper Turtle Lake Association (UTLA) and the Wisconsin Department of Natural Resources (WDNR) authorized a series of full-lake plant surveys as a prerequisite to developing the lake's initial Aquatic Plant Management Plan (APMP). Although those surveys found that the exotic invasive species Curly-leaf pondweed (*Potamogeton crispus*) (CLP) occurred throughout the lake, it was decided that the generally low growth levels did not justify active management at that time. However, following several years of high CLP density on the lake that resulted in severe navigation impairment for many residents, mats of rotting vegetation, and poor summer water quality (UTLA board, pers. comm.), the UTLA decided to authorized follow-up plant surveys in 2017 so they could update their APMP in 2018 and revisit active management.

Using the information gained from the 2017 bed-mapping survey that quantified CLP's dramatic increase on the lake, the UTLA, under the direction of Dave Blumer - Lake Education and Planning Services, LLC (LEAPS), decided to conduct a small-scale trial herbicide treatment in the thumb bay in the northwest corner of the lake's southern basin. Totaling 9.88 acres (approximately 2.31% of the lake's total surface area), it was one of the worst CLP areas on the lake in 2017, and, because it was shallow and surrounded by land on three sides, herbicide dissipation and dispersal were less of a concern than they would have been treating narrow beds adjacent to deep water (Figure 1). All of these considerations made it a logical choice to see how both CLP and native plants would respond to a herbicide treatment on the lake.

On May 12th, we conducted a pretreatment survey within the bed to document spring CLP densities and to finalize treatment plans. Following the herbicide application on May 22nd, we completed a June 18th posttreatment survey to evaluate the effectiveness of this control effort. We also searched the lake's visible littoral zone and mapped all CLP beds found. These maps will be used to help plan for future management in 2019. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

LEAPS provided treatment area shapefiles, and we generated pre/post survey points based on the size and shape of the proposed treatment area. The 66 point sampling grid at 25m resolution approximated to 8 pts/acre - double the minimum of 4 pts/acre required by WDNR protocol for pre/post treatment surveys (Appendix I).

These points were uploaded to a handheld mapping GPS (Garmin 76CSx) and located on the lake. At each point, we recorded the depth and bottom substrate and used a rake to sample an approximately 2.5ft section of the bottom. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2), and we also recorded visual sightings of CLP within six feet of the sample point. Because visual sightings are not calculated into the pre/post statistical formulas, we only assigned a rake fullness value for non-CLP plants. A cumulative rake fullness value was also noted.

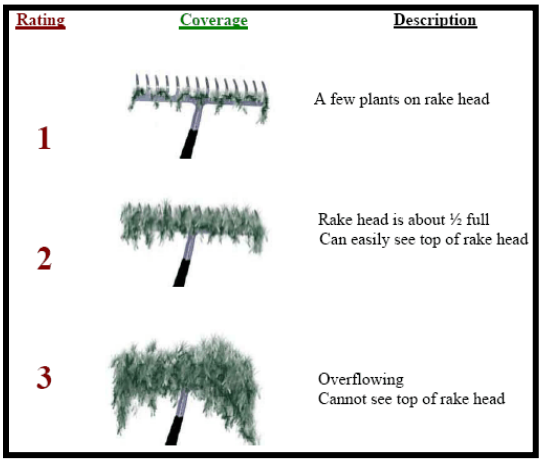


Figure 2: Rake Fullness Ratings

We entered all data collected into the standard APM spreadsheet (Appendix II). Data was analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX 2010). For pre/post differences of individual plant species as well as count data, we used the Chi-square analysis on the WDNR pre/post survey worksheet. For comparing averages (mean species/point and mean rake fullness/point), we used t-tests. Differences were determined to be significant at $p<0.05$, moderately significant at $p<0.01$ and highly significant at $p<0.001$.

CLP Bed Mapping Survey:

During the bed-mapping survey, we searched the lake's entire visible littoral zone. By definition, a "bed" was determined to be any area where we visually estimated that CLP made up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied or close enough to being canopied that it would likely interfere with boat traffic. After we located a bed, we motored around the perimeter taking GPS coordinates at regular intervals. We also estimated the rake density range and mean rake fullness of the bed (Figure 2), the range and mean 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 or narrow enough to motor through/**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). These data were then mapped using ArcMap 9.3.1, and we used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre. The resulting data will be used to help determine if, where, and how to manage CLP in 2019.

RESULTS AND DISCUSSION:

Finalization of Treatment Areas:

The proposed treatment areas covered 9.88 acres or approximately 2.31% of the lake's 427 total acres. Because the May 12th pretreatment survey found CLP plants were present throughout the entire survey area and there were few native plants present, it was decided to continue with treatment as initially proposed (Table 1) (Figure 3) (Appendix I).

Treatment occurred on May 22nd, 2018 with Northern Aquatic Services (Dale Dressel - Dresser, WI) applying Aquathol K (Endothall) at a rate of 1.5ppm (62.2 total gallons). The reported water temperature at the time of treatment was 60°F, while the air temp was 73°F. Wind speeds were reported to be calm.

Table 1: 2018 Spring CLP Treatment Summary
Upper Turtle Lake, Barron County
May 22, 2018

Bed Number	Proposed Bed Area (acres)	Final Bed Area (acres)	Change in Acreage (+/-)	Chemical, Rate, and Total Gallons
1	9.88	9.88	0.00	Aquathol K – 1.5ppm – 62.2 gal.
	9.88	**9.88**	**-0.00**	

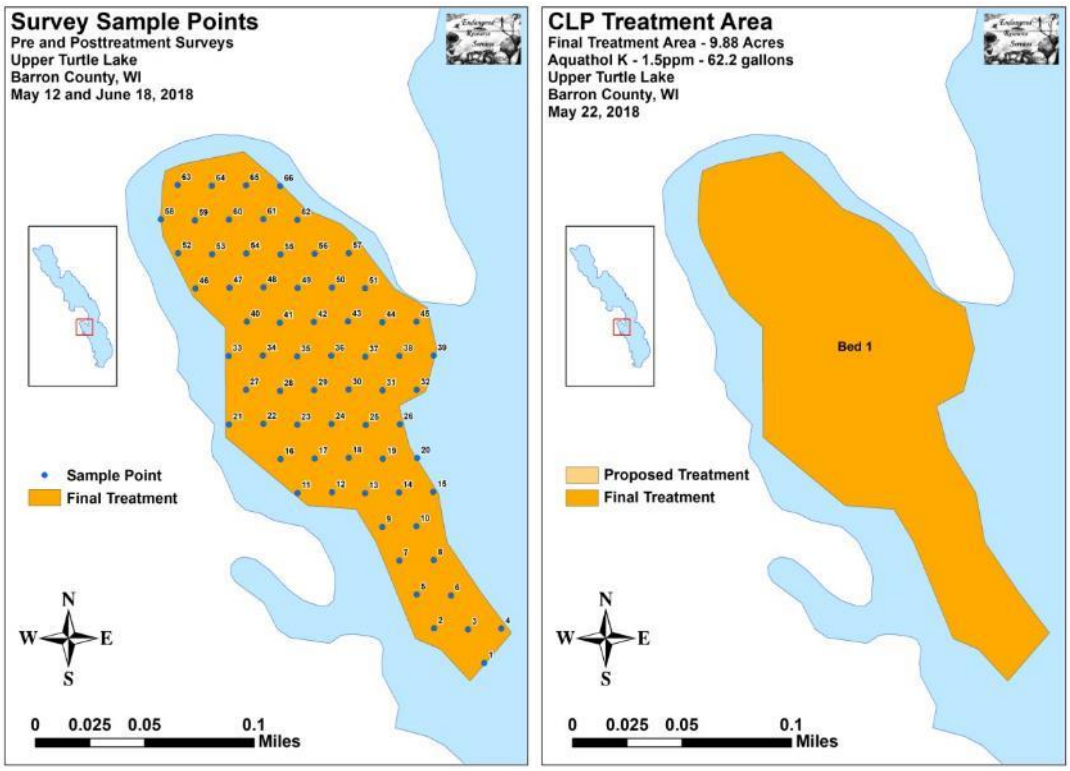


Figure 3: 2018 Pre/Post Survey Points and CLP Treatment Areas

CLP Pre/Post Herbicide Survey:

All survey points occurred in areas between 2.5ft and 14.0ft of water. Within the bed, plants grew at a mean and median depth of 7.1ft and 7.0ft respectively during the pretreatment survey. This fell sharply to a mean of 5.5ft and a median of 5.0ft during the posttreatment survey – presumably due to the elimination of Curly-leaf pondweed which dominated the majority of deepwater points (Table 2). Most CLP was established over nutrient-rich organic muck, but we also found CLP in the sandy/rocky areas on the outer rim of the bay, albeit at lower densities (Figure 4) (Appendix III).

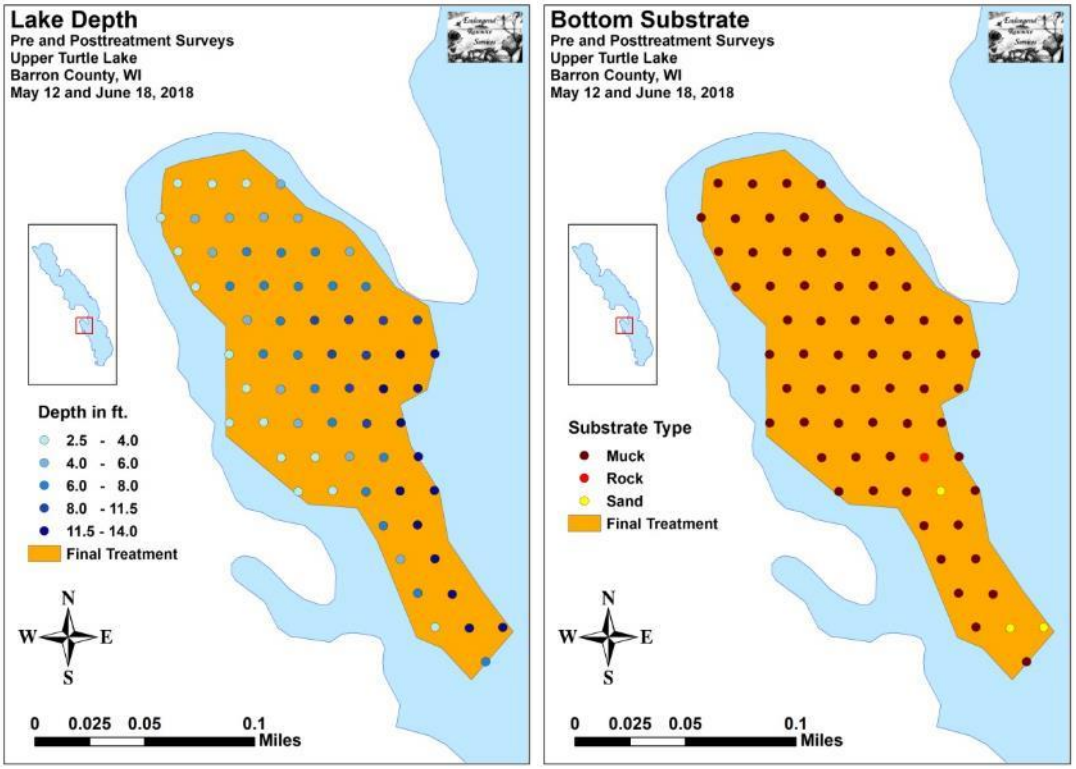


Figure 4: Treatment Area Depths and Bottom Substrate

The littoral zone was essentially unchanged at 14.0ft pretreatment and 13.5ft posttreatment; however, the frequency of occurrence dropped sharply from 92.4% pretreatment to 48.4% posttreatment (Figure 5) (Appendix IV). Total richness was unchanged with seven species found during each survey. The Simpson's Diversity Index increased from a moderate pretreatment value of 0.59 to a moderately high posttreatment value of 0.76. The Floristic Quality Index (another measure of native plant community health) fell slightly from 15.5 pretreatment to 13.9 posttreatment.

Table 2: Pre/Posttreatment Surveys Summary Statistics
Upper Turtle Lake, Barron County
May 12 and June 18, 2018

Summary Statistics:	Pre	Post
Total number of points sampled	66	66
Total number of sites with vegetation	61	31
Total number of sites shallower than the maximum depth of plants	66	64
Freq. of occur. at sites shallower than max. depth of plants (in percent)	92.4	48.4
Simpson Diversity Index	0.59	0.76
Mean Coefficient of Conservatism	6.3	5.7
Floristic Quality Index	15.5	13.9
Maximum depth of plants (ft)	14.0	13.5
Mean depth of plants (ft)	7.1	5.5
Median depth of plants (ft)	7.0	5.0
Average number of all species per site (shallower than max depth)	1.41	0.59
Average number of all species per site (veg. sites only)	1.52	1.23
Average number of native species per site (shallower than max depth)	0.58	0.42
Average number of native species per site (sites with native veg. only)	1.27	1.29
Species Richness	7	7
Mean Rake Fullness (veg. sites only)	1.79	1.23

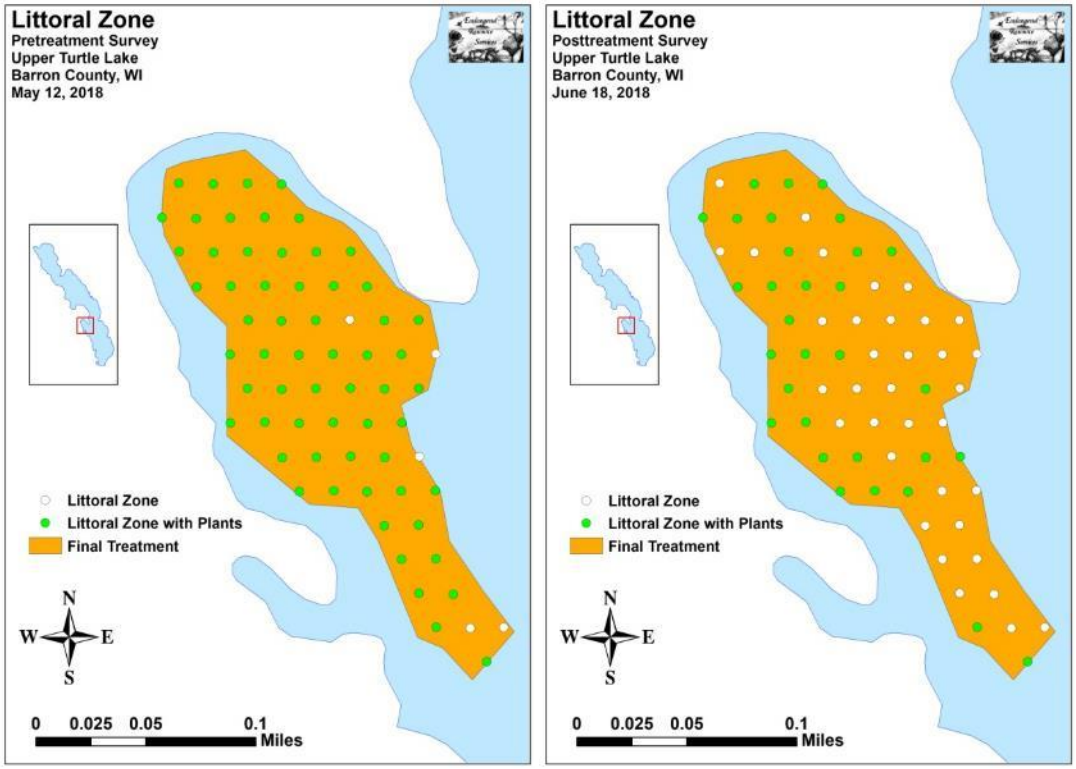


Figure 5: Pre/Posttreatment Littoral Zone

Mean native species richness at points with native vegetation was almost unchanged from 1.27 species/point pretreatment to 1.29 species/point posttreatment (Figure 6). Total mean rake fullness experienced a highly significant decline **($p<0.001$)** from a low/moderate 1.79 pretreatment to a very low 1.23 posttreatment (Figure 7) (Appendix IV).

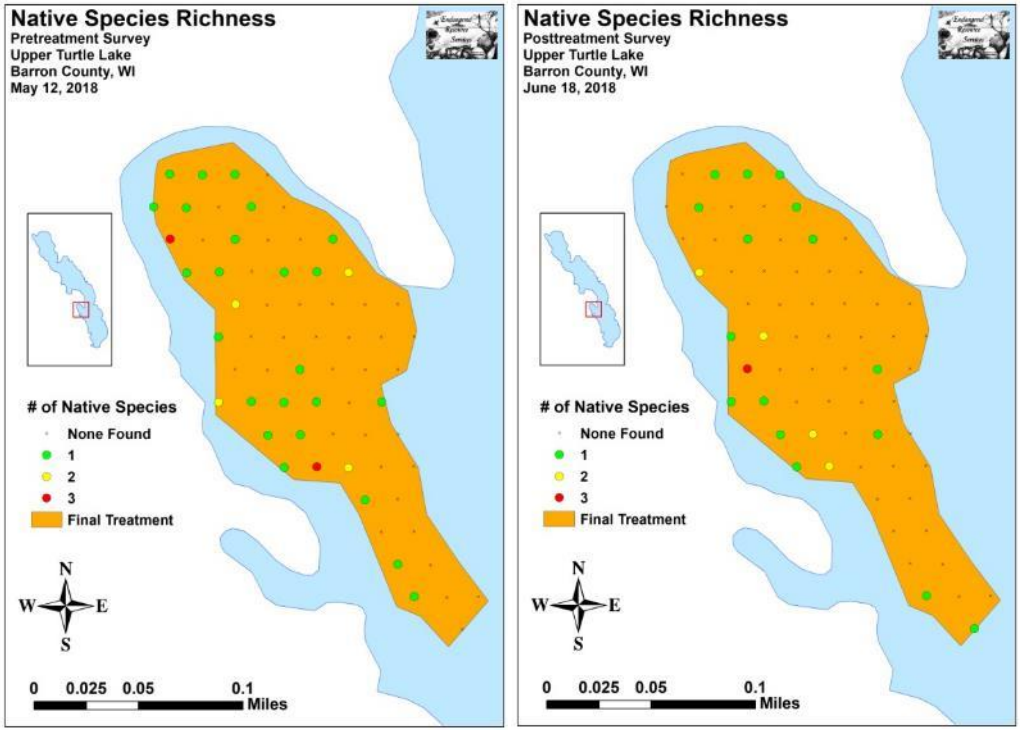


Figure 6: Pre/Posttreatment Native Species Richness

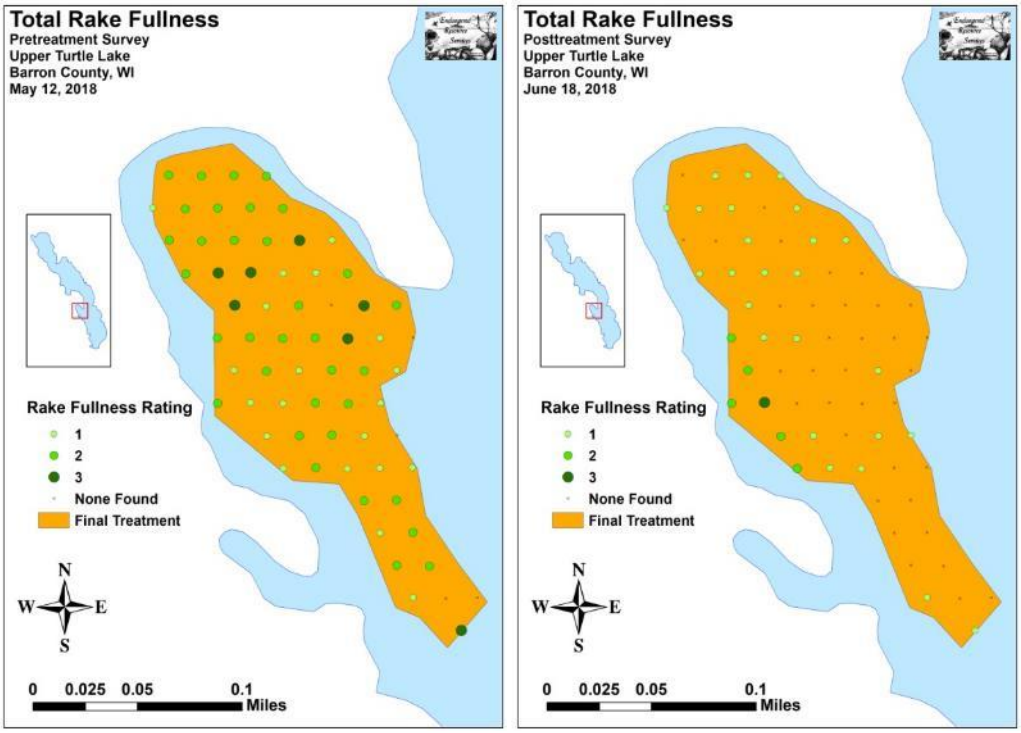


Figure 7: Pre/Posttreatment Total Rake Fullness

We found Curly-leaf pondweed at 55 of 66 sites during the pretreatment survey (83.3% coverage) (Figure 8). Of these, seven had a rake fullness rating of 3, 29 rated a 2, and the remaining 19 were a 1. This produced a mean rake fullness of 1.78 and suggested that 54.5% of the treatment area had a significant infestation (rake fullness 2 and 3). During the posttreatment survey, we found CLP at 11 points (16.7%) all of which rated a 1. Each of these detections was a plant that was only a couple of inches tall making it likely they it sprouted after the chemical treatment (see cover page). **Our results demonstrated a highly significant decline in total CLP as well as rake fullness 2; and a moderately significant decline in rake fullness 3** (Figure 9) (Appendix V).

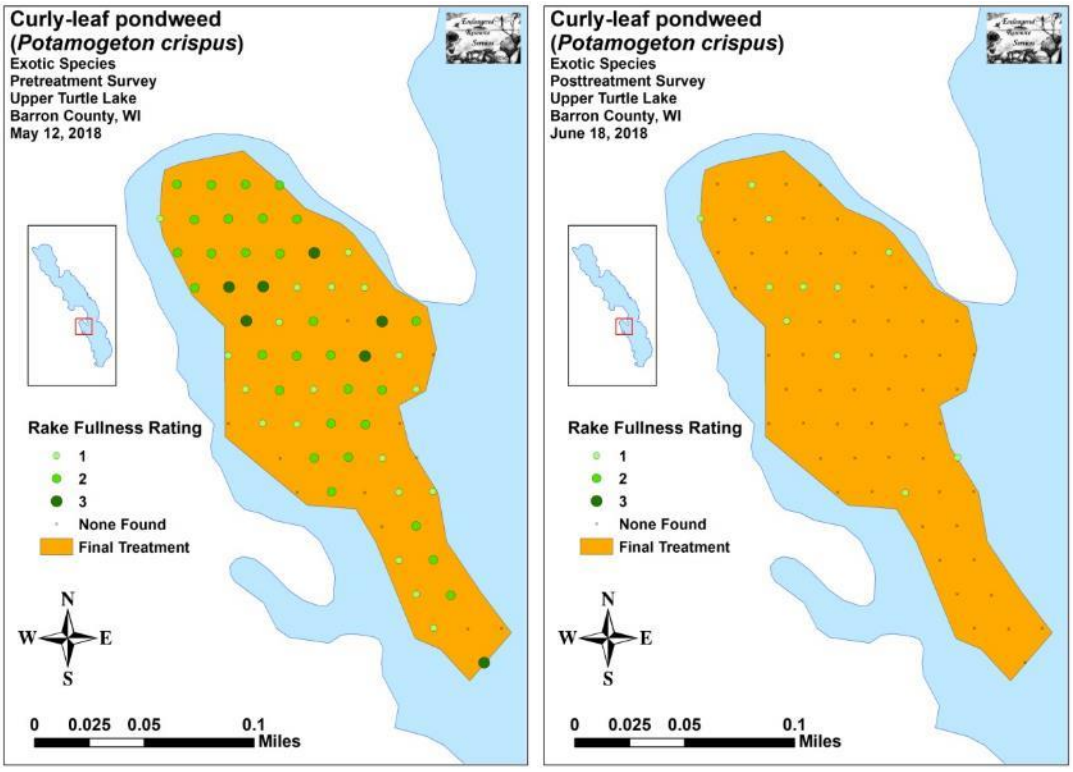
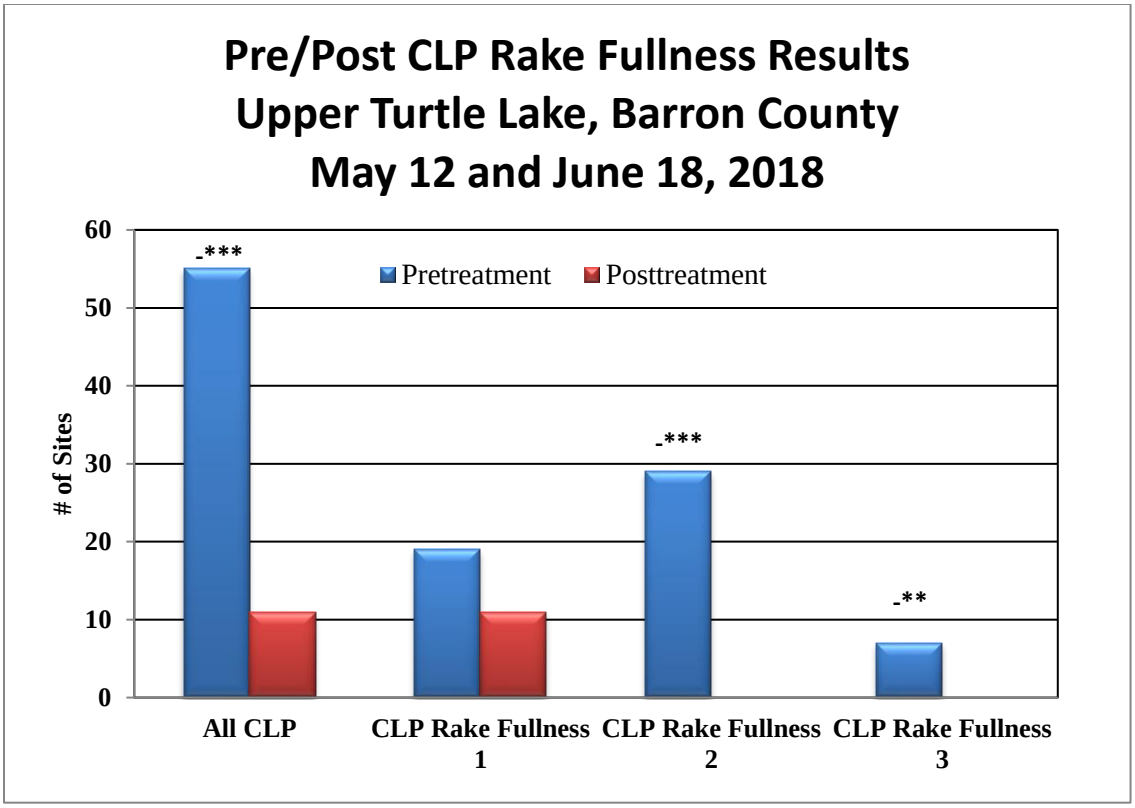


Figure 8: Pre/Posttreatment CLP Density and Distribution



Significant differences = * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Figure 9: Changes in CLP Rake Fullness

Coontail (*Ceratophyllum demersum*) was the most widely distributed native species in both the pretreatment and posttreatment surveys (Figure 10) (Tables 3 and 4). Although it declined from 21 sites with a mean rake fullness of 1.19 pretreatment to 14 sites with a mean rake of 1.07 posttreatment, neither the contraction in distribution (p=0.17) nor the loss in density (p=0.15) was significant.

Conversely, Small pondweed (*Potamogeton pusillus*), the second most common species in the pretreatment survey (8 sites/mean rake 1.13) and a species known to be highly sensitive to Endothall, appeared to have been eliminated from the treatment area as we didn't find it in the rake or see it inter-point anywhere posttreatment (Figure 11). Statistically, this represented a moderately significant decline in distribution **(p=0.004)** and a highly significant decline in density **(p<0.001)**.

Other than CLP and Small pondweed, no other species showed a significant change in distribution posttreatment (Figure 12) (Maps for all native species from the pre and posttreatment surveys can be found in Appendixes VI and VII).

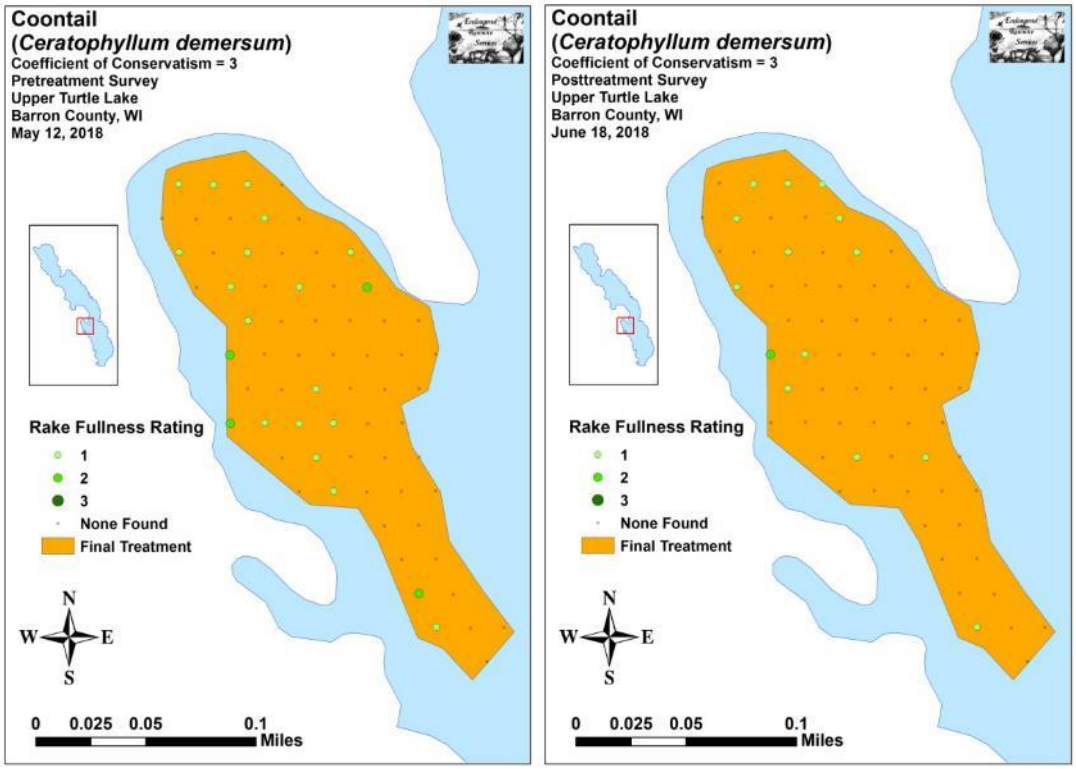


Figure 10: Pre/Posttreatment Coontail Density and Distribution

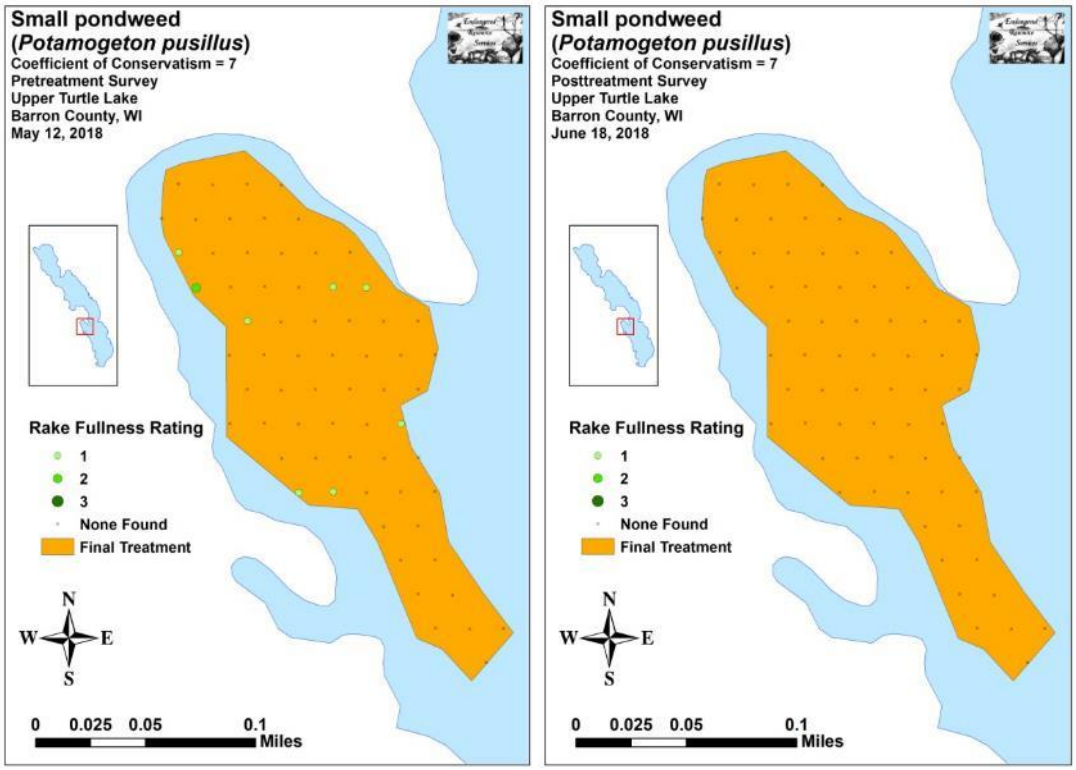


Figure 11: Pre/Posttreatment Small Pondweed Density and Distribution

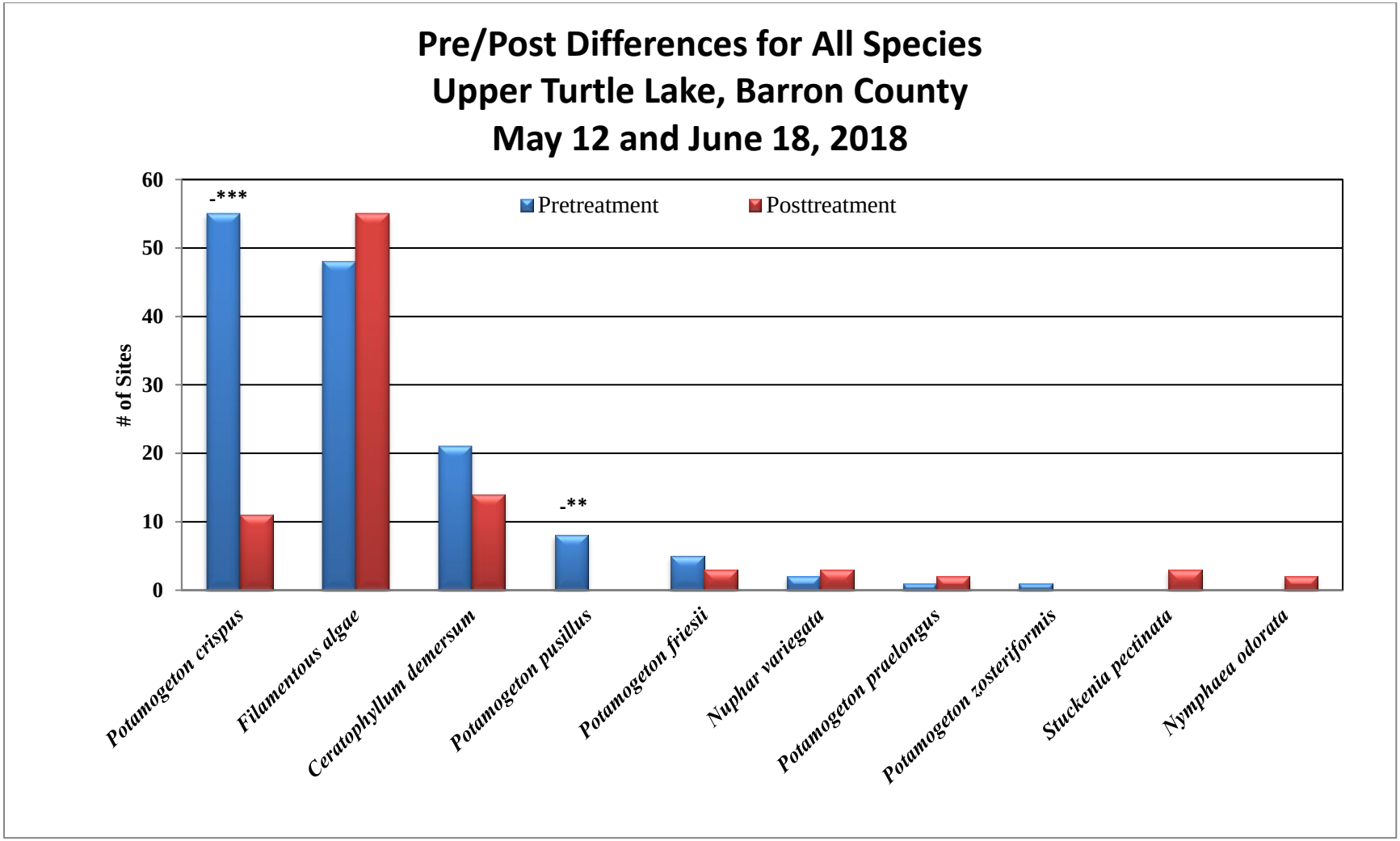
Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey - Upper Turtle Lake, Barron County
May 12, 2018

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	55	59.14	90.16	83.33	1.78
	Filamentous algae	48	*	78.69	72.73	1.54
Ceratophyllum demersum	Coontail	21	22.58	34.43	31.82	1.19
Potamogeton pusillus	Small pondweed	8	8.60	13.11	12.12	1.13
Potamogeton friesii	Fries' pondweed	5	5.38	8.20	7.58	1.20
Nuphar variegata	Spatterdock	2	2.15	3.28	3.03	1.50
Potamogeton praelongus	White-stem pondweed	1	1.08	1.64	1.52	1.00
Potamogeton zosteriformis	Flat-stem pondweed	1	1.08	1.64	1.52	2.00

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey - Upper Turtle Lake, Barron County
June 18, 2018

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
	Filamentous algae	55	*	177.42	85.94	1.44
Ceratophyllum demersum	Coontail	14	36.84	45.16	21.88	1.07
Potamogeton crispus	Curly-leaf pondweed	11	28.95	35.48	17.19	1.00
Nuphar variegata	Spatterdock	3	7.89	9.68	4.69	2.33
Potamogeton friesii	Fries' pondweed	3	7.89	9.68	4.69	1.00
Stuckenia pectinata	Sago pondweed	3	7.89	9.68	4.69	1.00
Nymphaea odorata	White water lily	2	5.26	6.45	3.13	1.50
Potamogeton praelongus	White-stem pondweed	2	5.26	6.45	3.13	1.00

* Excluded from Relative Frequency Analysis



Significant differences = * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Figure 12: Pre/Posttreatment Macrophyte Changes

2017 CLP Bed Mapping Survey:

The spring of 2017 brought near record early ice-out in late March and early April followed by prolonged cool weather that kept lake temperatures in the 40's and 50's through May. These conditions appeared to benefit Curly-leaf pondweed, and we found high levels on many of the lakes we surveyed that spring. On Upper Turtle Lake, CLP formed a nearly continuous canopied mat that ringed the entire lake and covered the north bay. We divided this "super bed" into 11 different areas based on their mean density and potential for navigation impairment. Totaling 132.4 acres (31.0% coverage), it represented a 124.57 acre increase (+1,590%) over the 33 small beds mapped in 2010 that totaled 7.83 acres (1.83% of the lake) (Figure 13) (Table 5).

Table 5: Curly-leaf Pondweed Bed Summary
Upper Turtle Lake, Barron County – June 21, 2017

Bed Number	2017 Acreage	2017 Rake Range	2017 Mean Rake Fullness	2017 Depth Range of CLP	2017 Mean Depth of CLP	2017 Potential Navigation Impairment Level
1	24.62	<1-3	2	3-13	10	Moderate
2	2.12	<1-3	3	2-13	10	Minor
3	3.24	<1-3	2	5-13	10	Minor
4	0.69	<1-2	1	4-12	9	Minor
5	79.13	<1-3	3	4-14	11	Severe
6	0.40	<1-3	2	5-13	11	Minor
7	3.17	<1-3	2	3-13	10	Moderate
8	3.12	<<1-3	1	4-13	10	Minor
9	1.06	1-3	3	4-13	9	Moderate
10	3.81	<<1-3	2	4-13	9	Moderate
11	11.00	<1-3	2	3-13	10	Moderate
Total Acres	**132.40**					

Descriptions of 2017 CLP Beds:

Bed 1 – The southwestern shoreline was ringed by native vegetation dominated by floating-leaf species. In areas beyond 3ft of water, Curly-leaf pondweed thickened into a bed that, due to its width, likely resulted in at least moderate navigation impairment. In the northwest "thumb" bay, that impairment potentially bordered on severe although regular in and out boat traffic was keeping a channel open.

Beds 2, 3, and 4 – Although CLP was occasionally dense along the central-western shoreline, the narrowness of the bed due to sharp drop-offs into 20ft+ likely meant the beds were just a minor impairment. The exception to this was on the outer edges of the bays in Beds 3 and 4 where residents were cutting visible trails through the plants to gain access. Even here, beds were still narrow enough that the impairment probably wasn't severe.

Bed 5: The majority of the north bay would likely have been almost impassible in early June. By the time we surveyed, most plants in water over 11ft were dying, and we had to rake to find the outer edge of the bed in 13ft+ of water. Giant mats of dead CLP, some more than an acre in size, were everywhere, and the prevailing southerly winds had created a ring of plant debris on the north end of the bay that was making it almost impossible for residents to get through our around to open water.

Beds 6 and 8: Similar to the midlake western shoreline, CLP in these areas was patchy as the sharp drop-offs from a shoreline that was mostly sand and rock created poor growing conditions. Because of this, for most residents, CLP was likely only a minor inconvenience.

Bed 7: CLP in the northeast bay midlake was moderately dense, although we noted there were significant numbers of submerged native plants mixed in. Because of this, we found the bed was difficult to navigation, but patchy enough that it wasn't impassible. However, similar to the north bay, residents were forced to rake out "haystacks" of dead CLP that the winds were blowing into shore.

Bed 9: Further to the southeast, we found the bed thickened as the substrate transitioned to muck. This area had the potentially to be a moderate impairment to navigation, but, with no residences along this piece of shoreline, it is likely not a management priority.

Beds 10 and 11: The beds along the southeast shoreline weren't especially wide, but they likely posed at least a moderate impairment to navigation. At the time of the survey, we estimated they averaged a mean rake of 2, but this was likely higher earlier in the growing season based on the volume of boat traffic to and from this heavily developed shoreline.

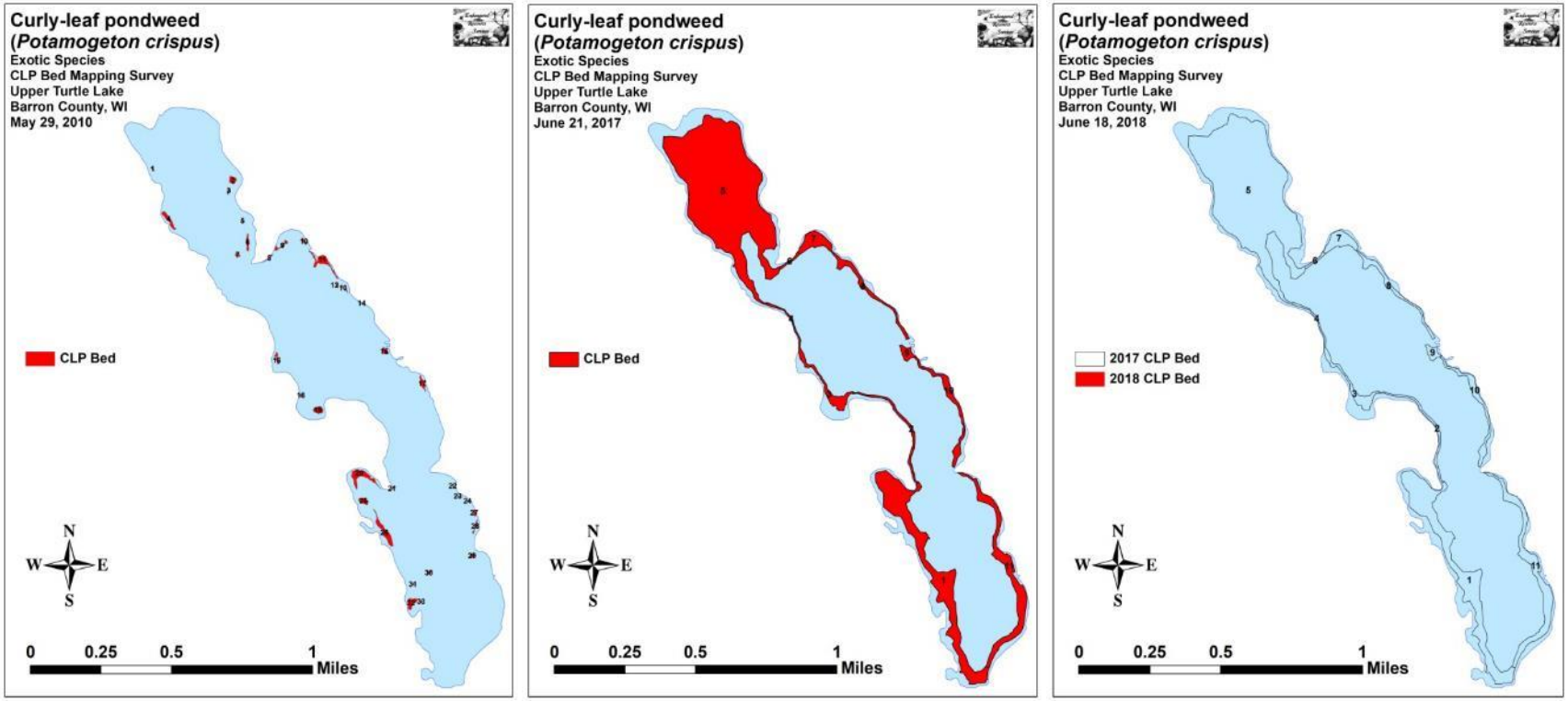


Figure 13: 2010, 2017, and 2018 Early-season Curly-leaf Pondweed Bed Maps

2018 CLP Bed Mapping Survey:

The spring of 2018 brought more extreme weather with near record **late** ice-out followed by a dramatic stretch of warm weather that boosted lake temperatures from frozen to the upper 60's in less than two weeks. These conditions did not appear to favor Curly-leaf pondweed as, despite searching over 10.8km (6.7miles) throughout the visible littoral zone and within areas that supported canopied CLP in 2017, **we did not find any canopied beds anywhere in the lake in 2018** (Figure 13) (Appendix VIII). By randomly raking within the former beds, we also discovered CLP plants were sparse and only widely distributed. Most of the plants we did find were either only a couple inches to a couple of feet tall if they were in water <5ft deep, or they were 2-4ft tall if they were in water >6ft deep. In these deeper areas, CLP plants looked unhealthy as they were a pale lime green color, and many were falling over and dying without setting turions (see front cover of the report).

Just as dramatic as the lack of canopied plants was the reduction in floating dead vegetation. During the 2017 survey, we found the north bay and central basin were dominated by mats of filamentous algae and "haystacks" of rotting Curly-leaf pondweed. As these mats washed ashore, residents were forced to rake them out. In 2018, these same areas in the central basin were completely clear (Figure 14). Similarly, the north bay was free of canopied vegetation away from the lilypad and Coontail beds at the immediate shoreline (Figure 15).

Figure 14: Mounds of Raked CLP 6/21/2017 - No CLP 6/18/2018

Figure 15: Open Water in the North Bay at the Creek Entrance 6/18/18

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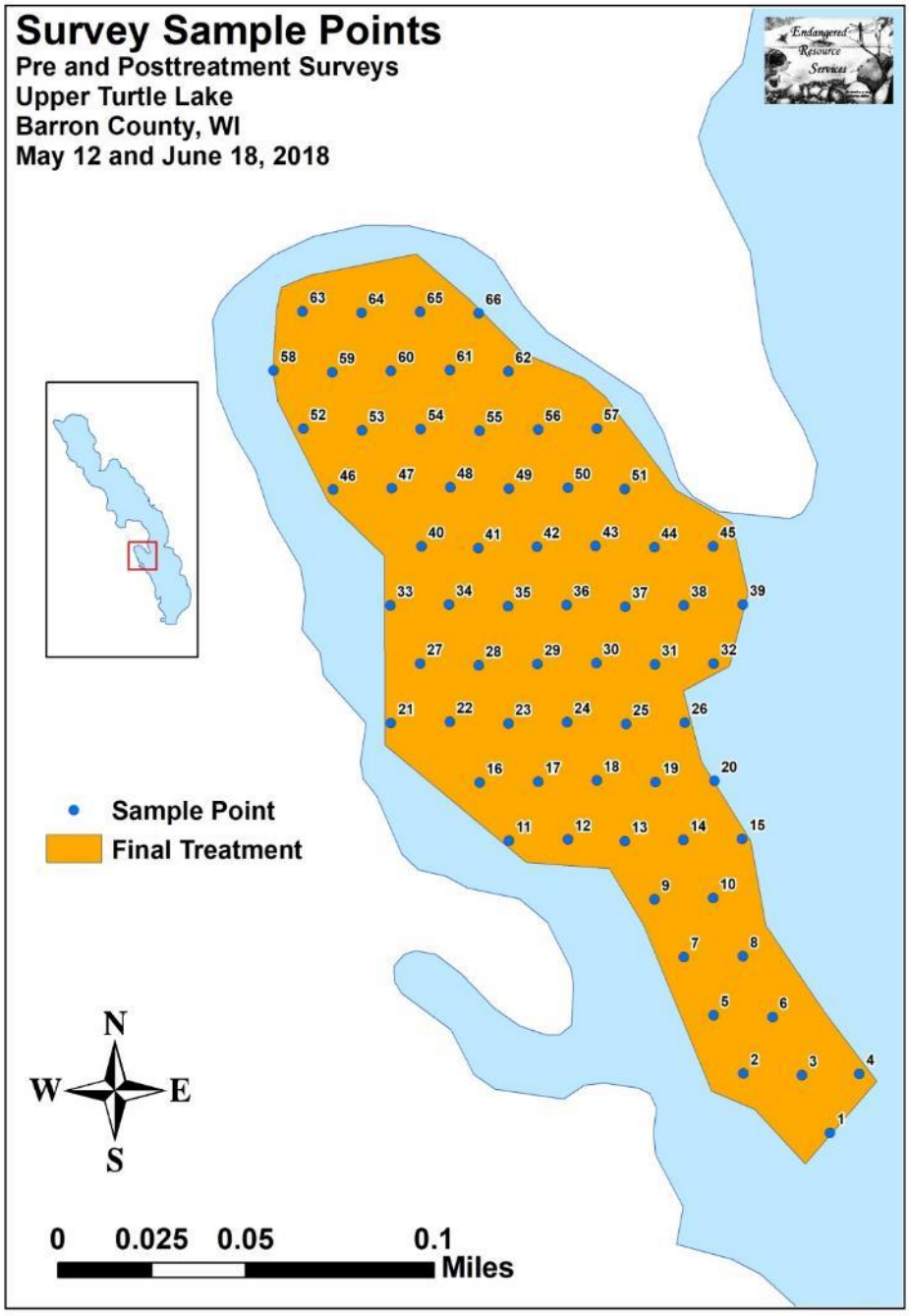
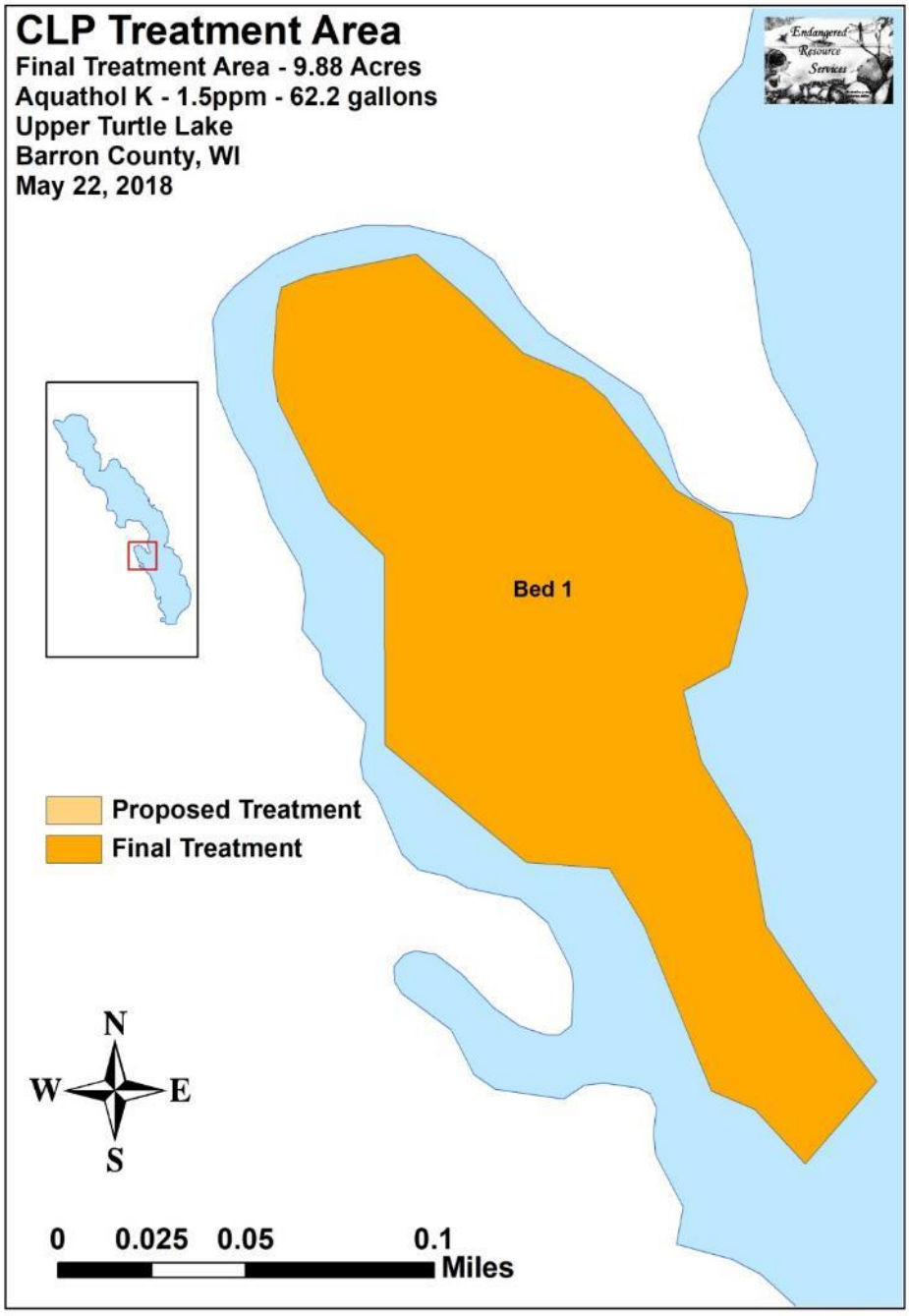
Appendix I: CLP Pre/Post Survey Sample Points and Treatment Areas


Survey Sample Points
Pre and Posttreatment Surveys
Upper Turtle Lake
Barron County, WI
May 12 and June 18, 2018
Endangered Resource Services
63 64 65 66
58 59 60 61 62
52 53 54 55 56 57
46 47 48 49 50 51
40 41 42 43 44 45
33 34 35 36 37 38 39
27 28 29 30 31 32
21 22 23 24 25 26
16 17 18 19 20
11 12 13 14 15
9 10
7 8
5 6
2 3 4
1
Sample Point
Final Treatment
N
W E
S
0 0.025 0.05 0.1
Miles


CLP Treatment Area
Final Treatment Area - 9.88 Acres
Aquathol K - 1.5ppm - 62.2 gallons
Upper Turtle Lake
Barron County, WI
May 22, 2018
Endangered Resource Services
Bed 1
Proposed Treatment
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

Appendix II: Vegetative Survey Datasheet

Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	CLP	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																									
2																									
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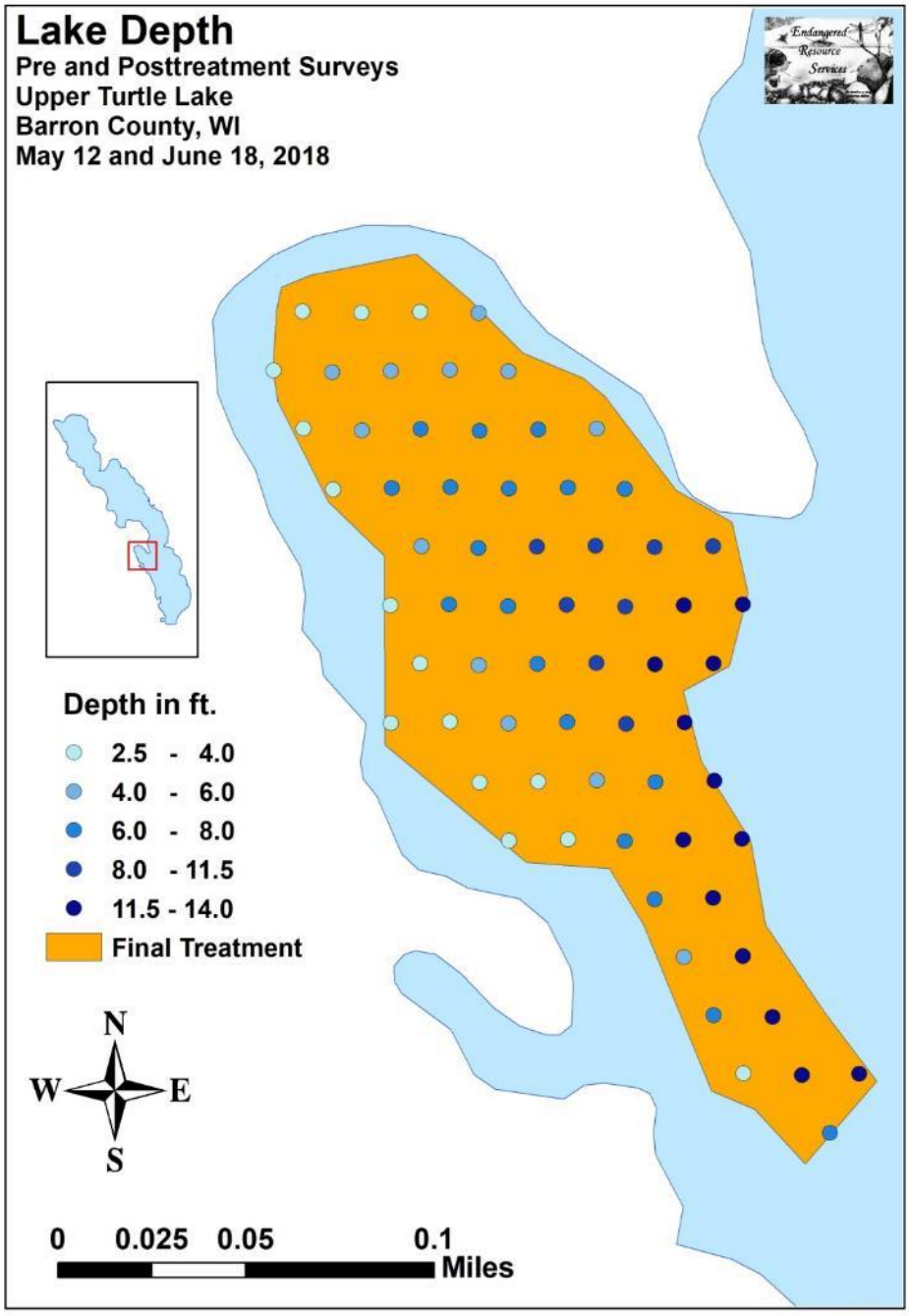
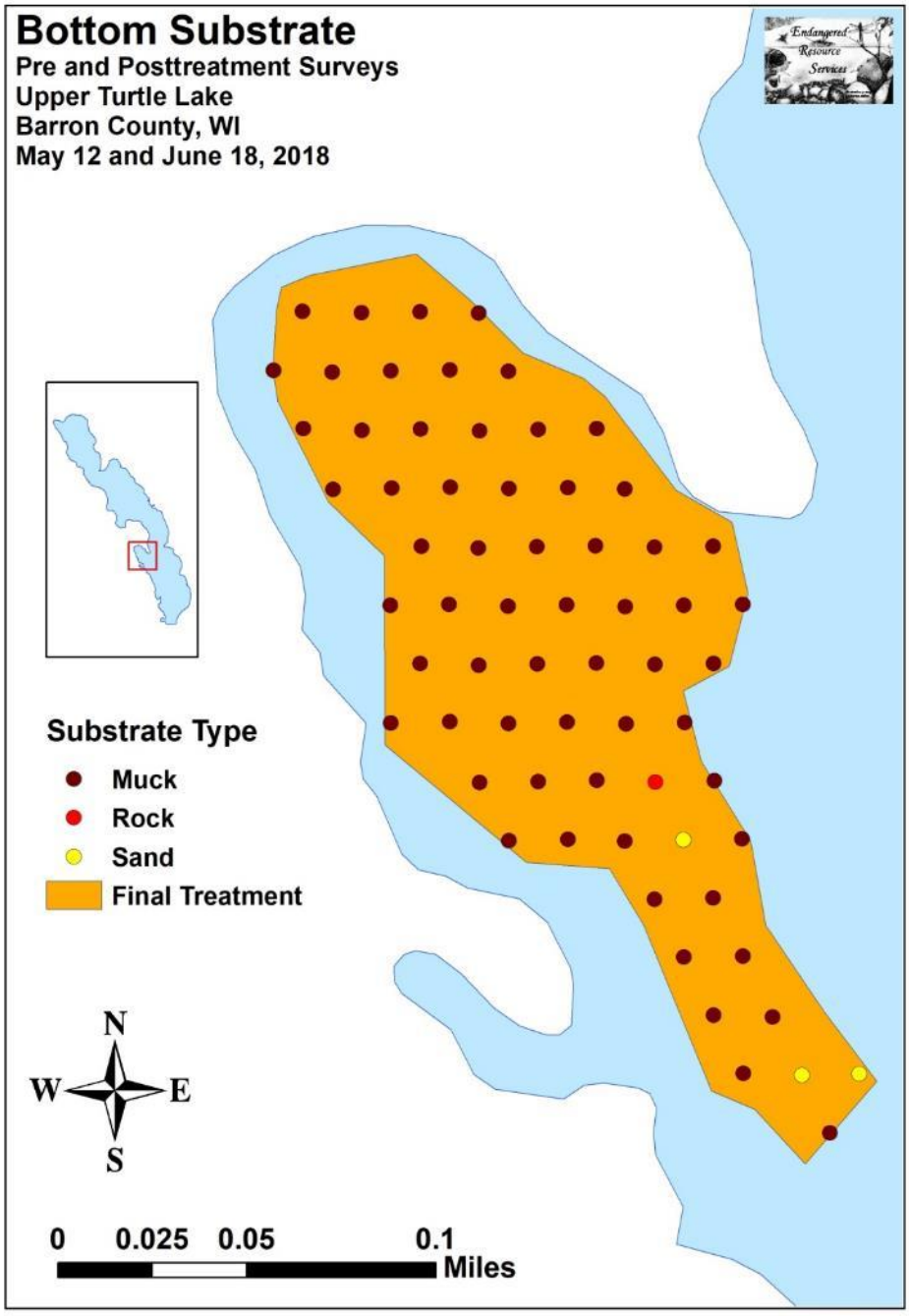
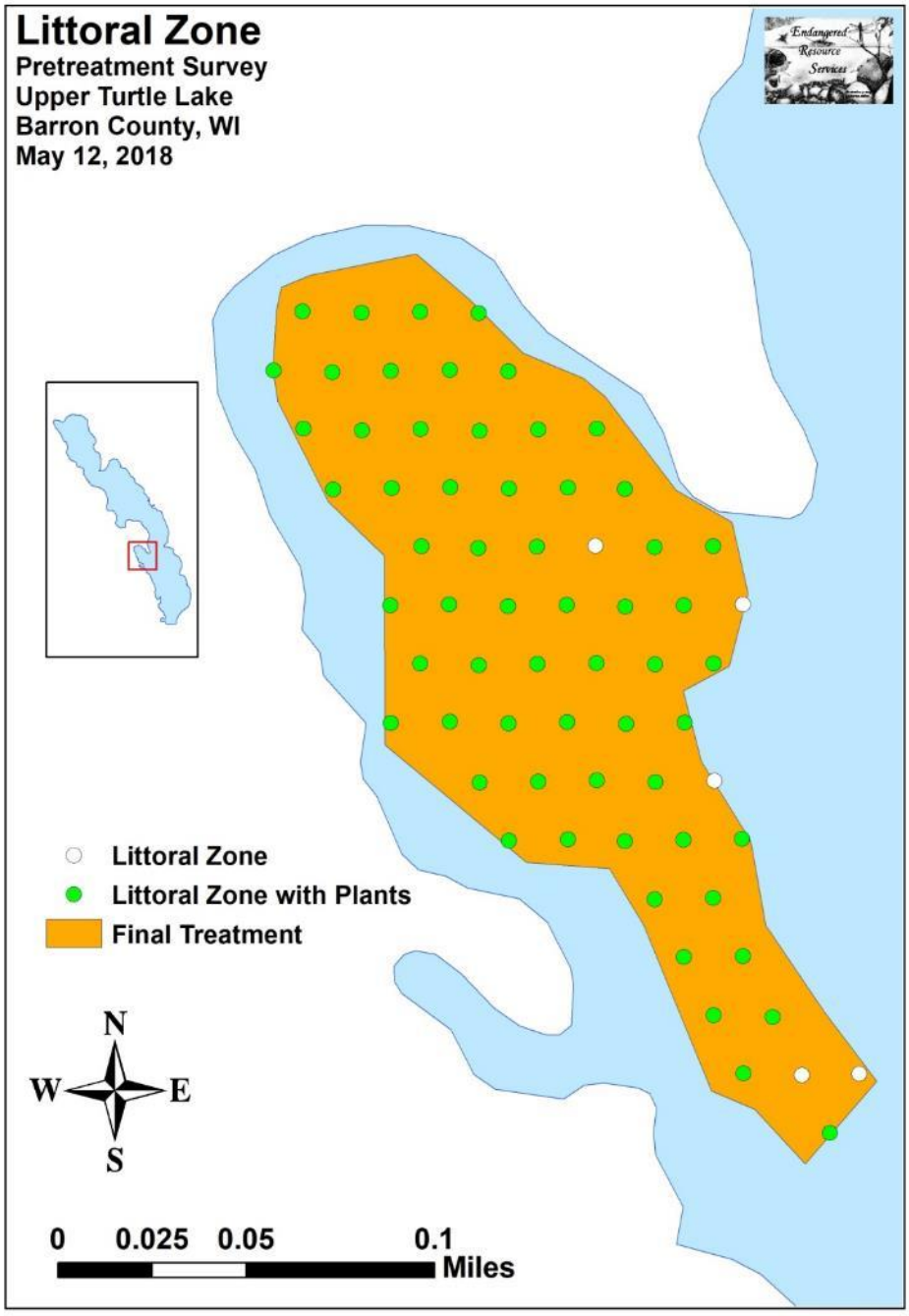
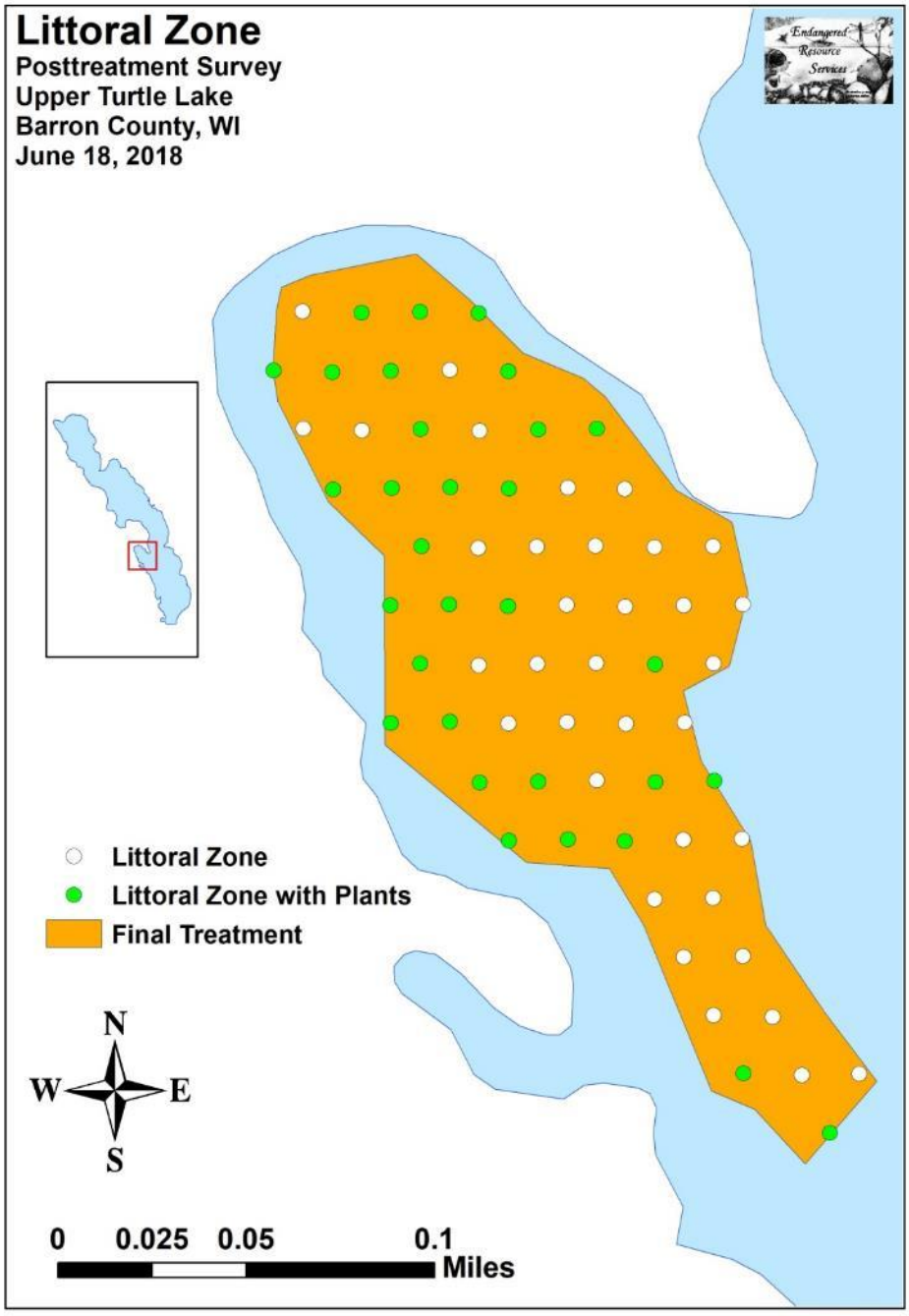
Appendix III: Pre/Post Habitat Variables

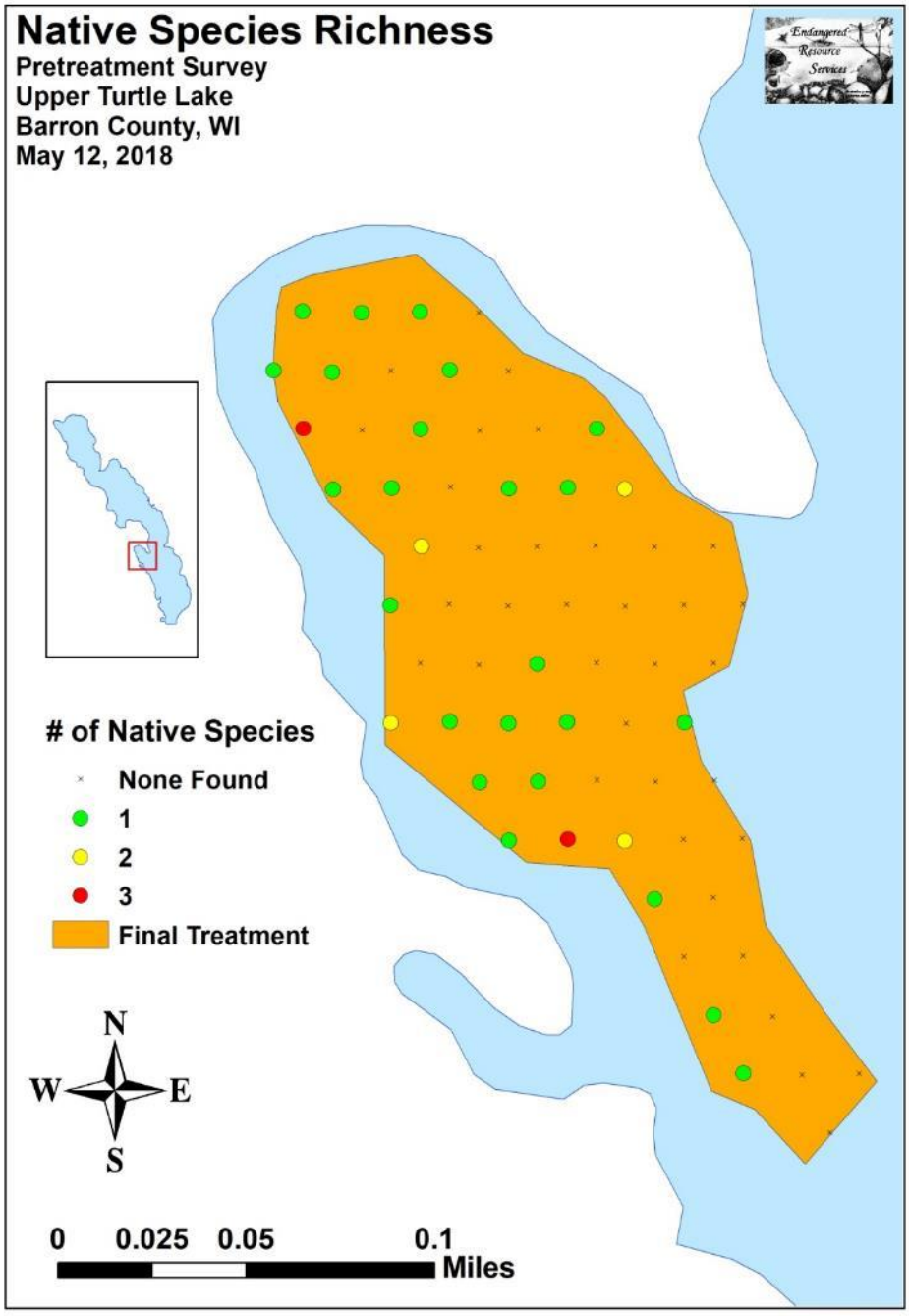

Lake Depth
Pre and Posttreatment Surveys
Upper Turtle Lake
Barron County, WI
May 12 and June 18, 2018
Endangered Resource Services
Depth in ft.
2.5 - 4.0
4.0 - 6.0
6.0 - 8.0
8.0 - 11.5
11.5 - 14.0
Final Treatment
N
W
E
S
0 0.025 0.05 0.1
Miles

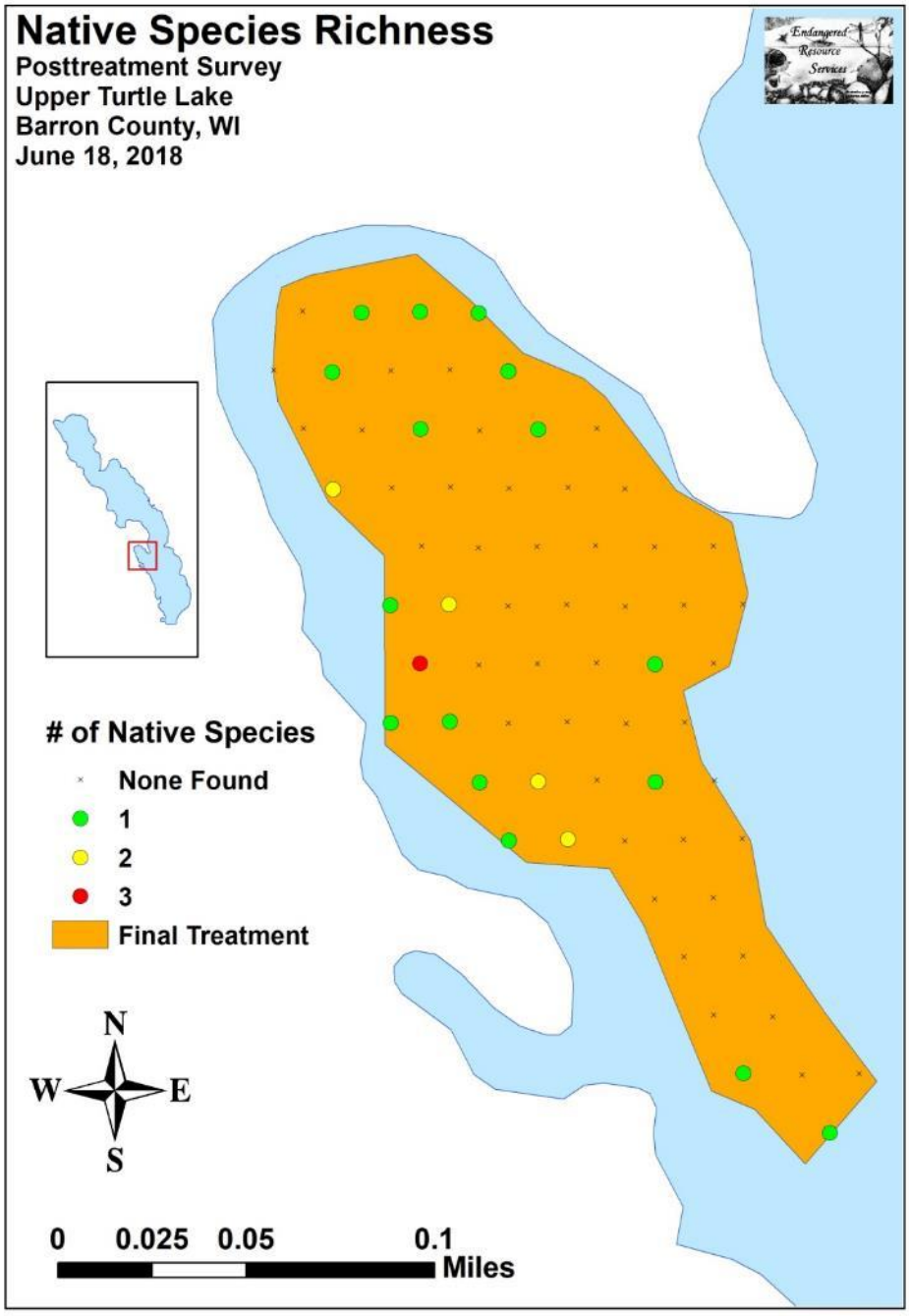

Bottom Substrate
Pre and Posttreatment Surveys
Upper Turtle Lake
Barron County, WI
May 12 and June 18, 2018
Endangered Resource Services
Substrate Type
Muck
Rock
Sand
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

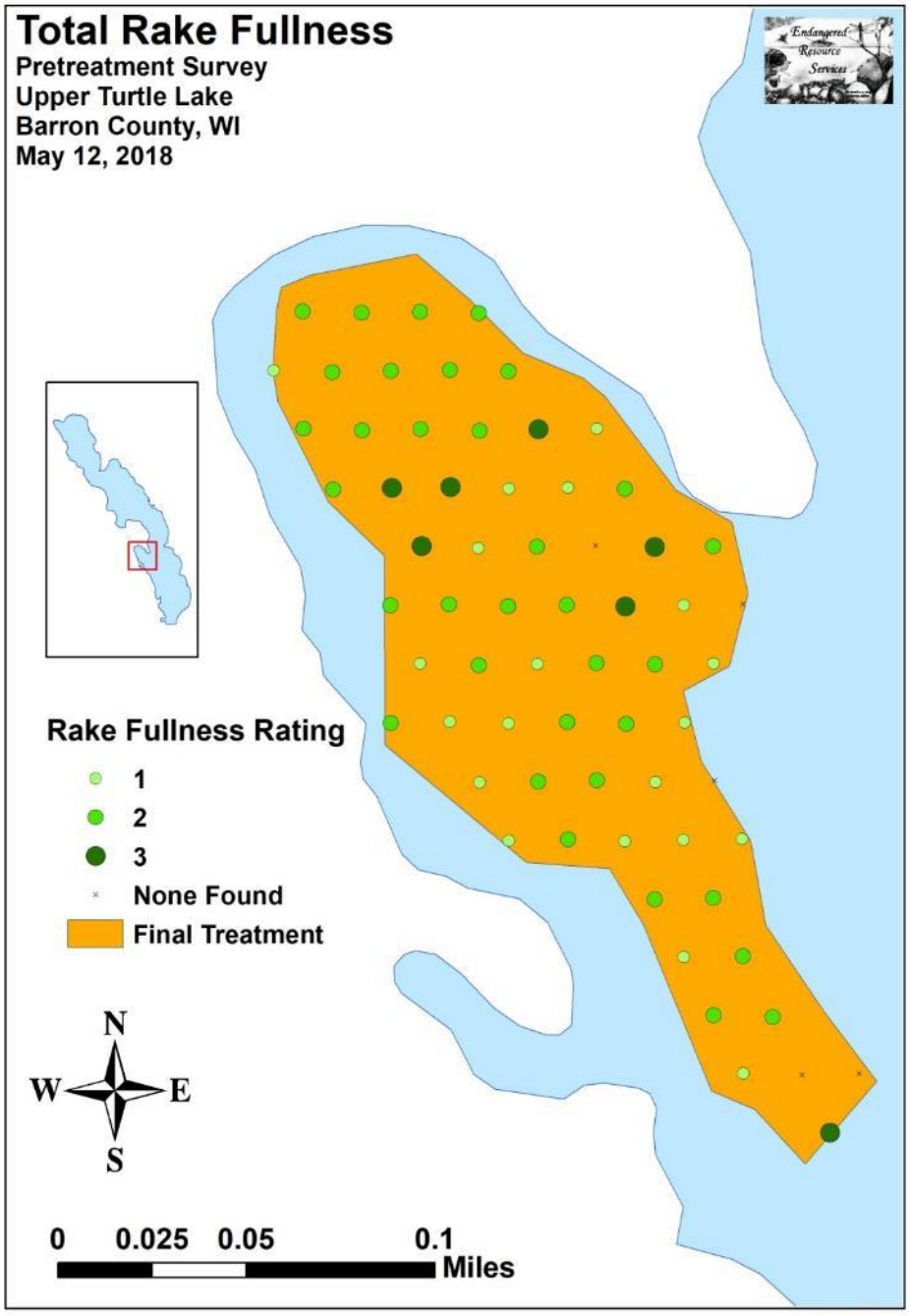
Appendix IV: Pre/Post Littoral Zone, Native Species Richness and Total Rake Fullness

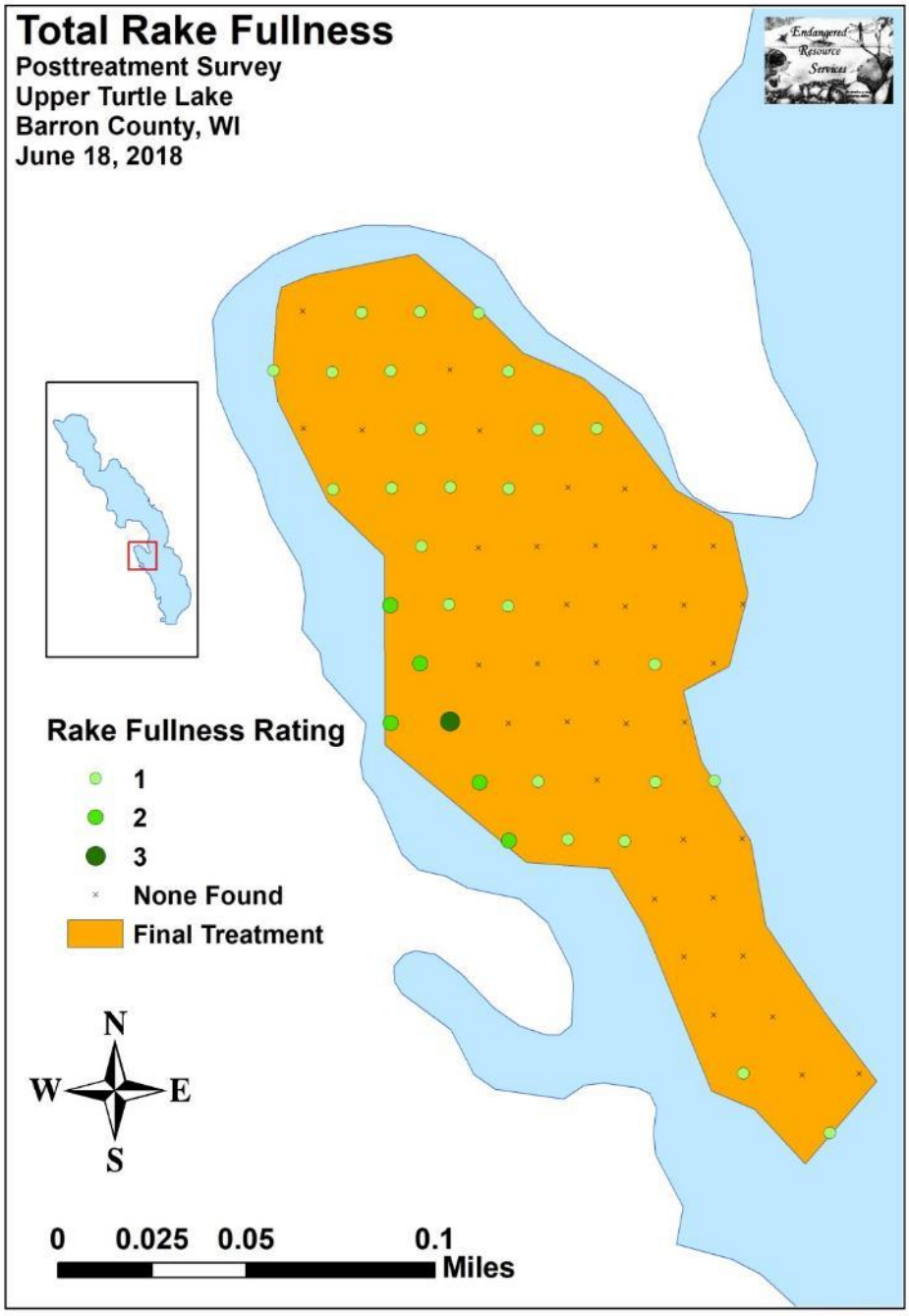

Littoral Zone
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles


Littoral Zone
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Littoral Zone
Littoral Zone with Plants
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

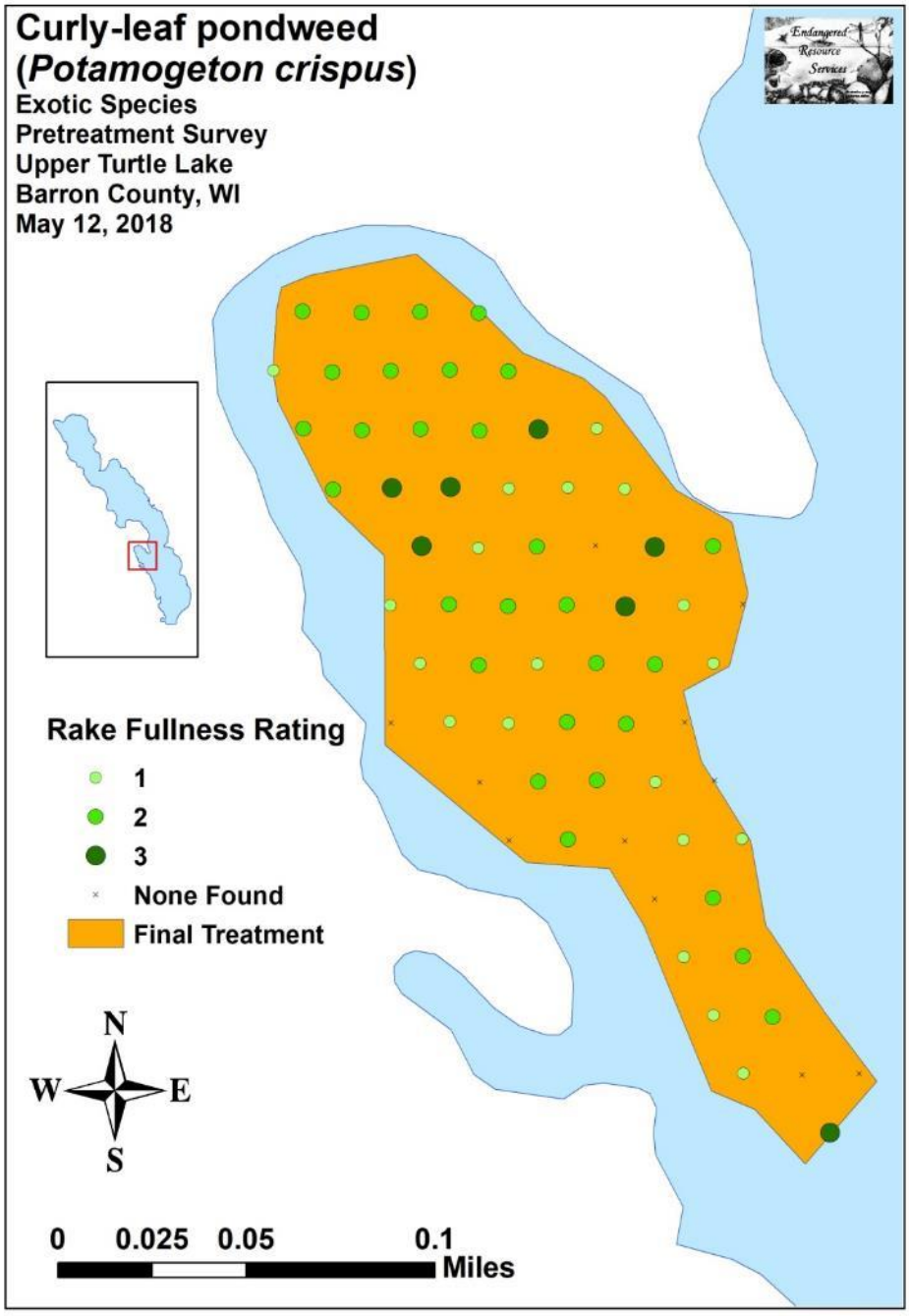

Native Species Richness
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
# of Native Species
None Found
1
2
3
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

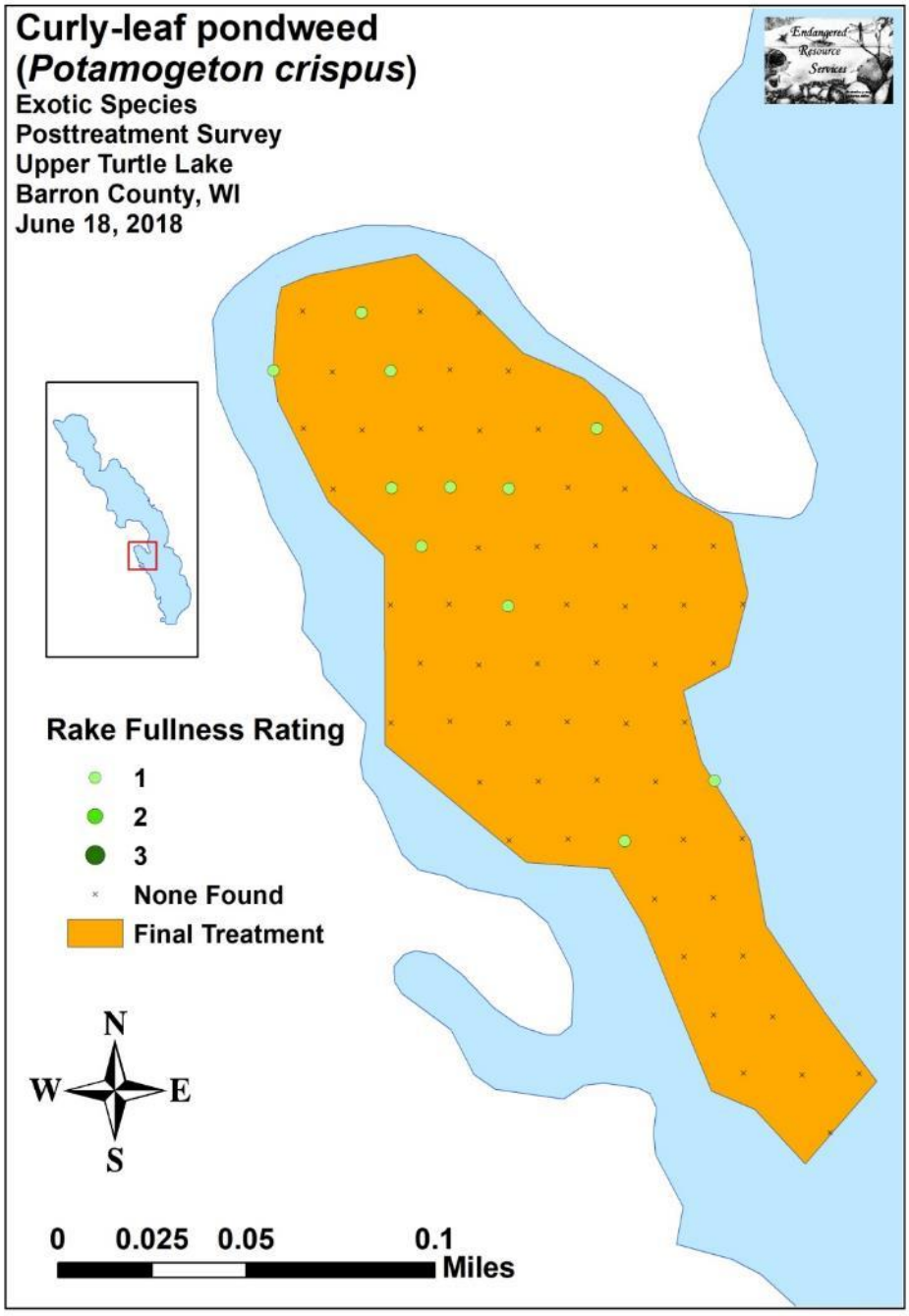

Native Species Richness
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
# of Native Species
None Found
1
2
3
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles


Total Rake Fullness
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

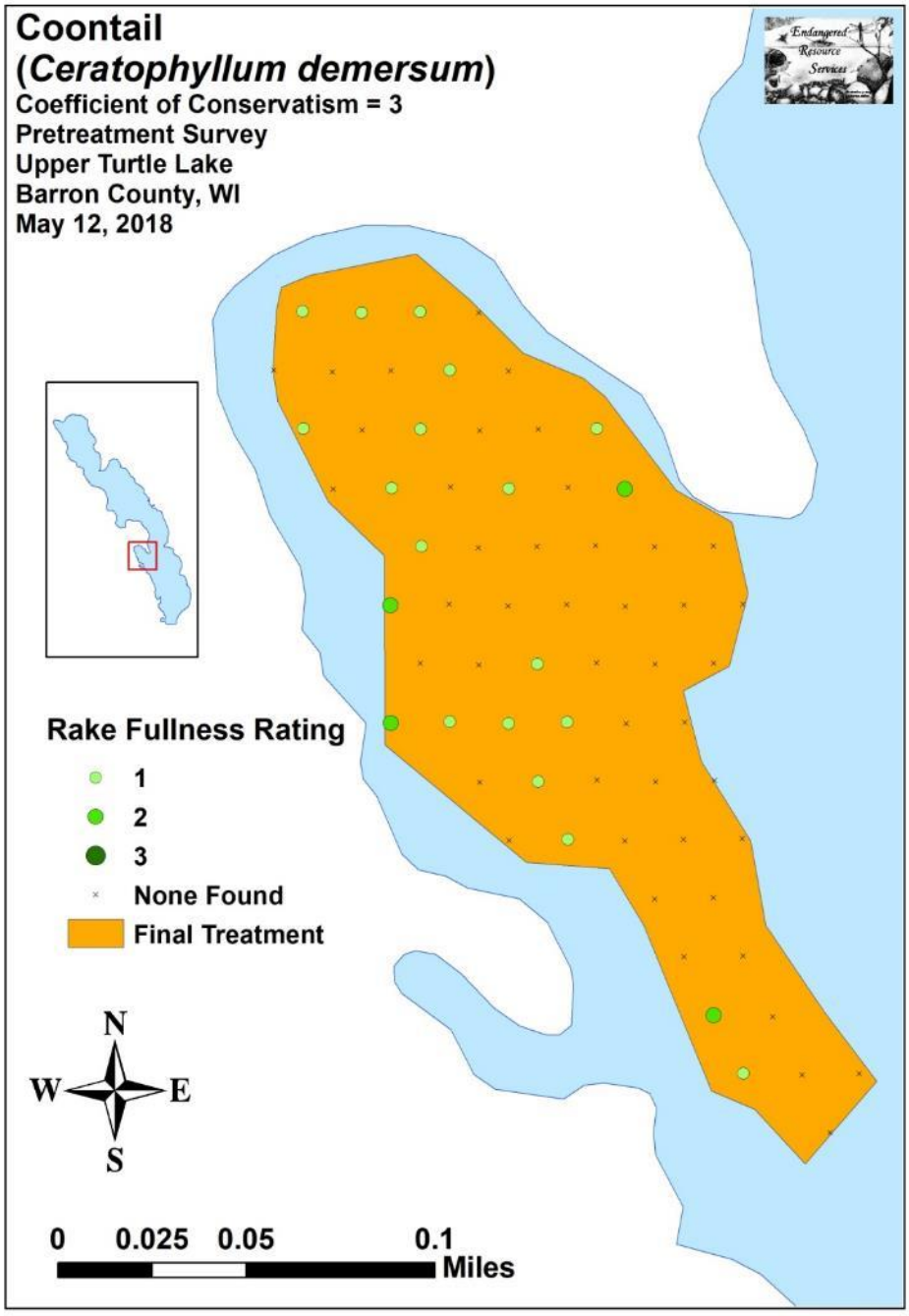

Total Rake Fullness
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

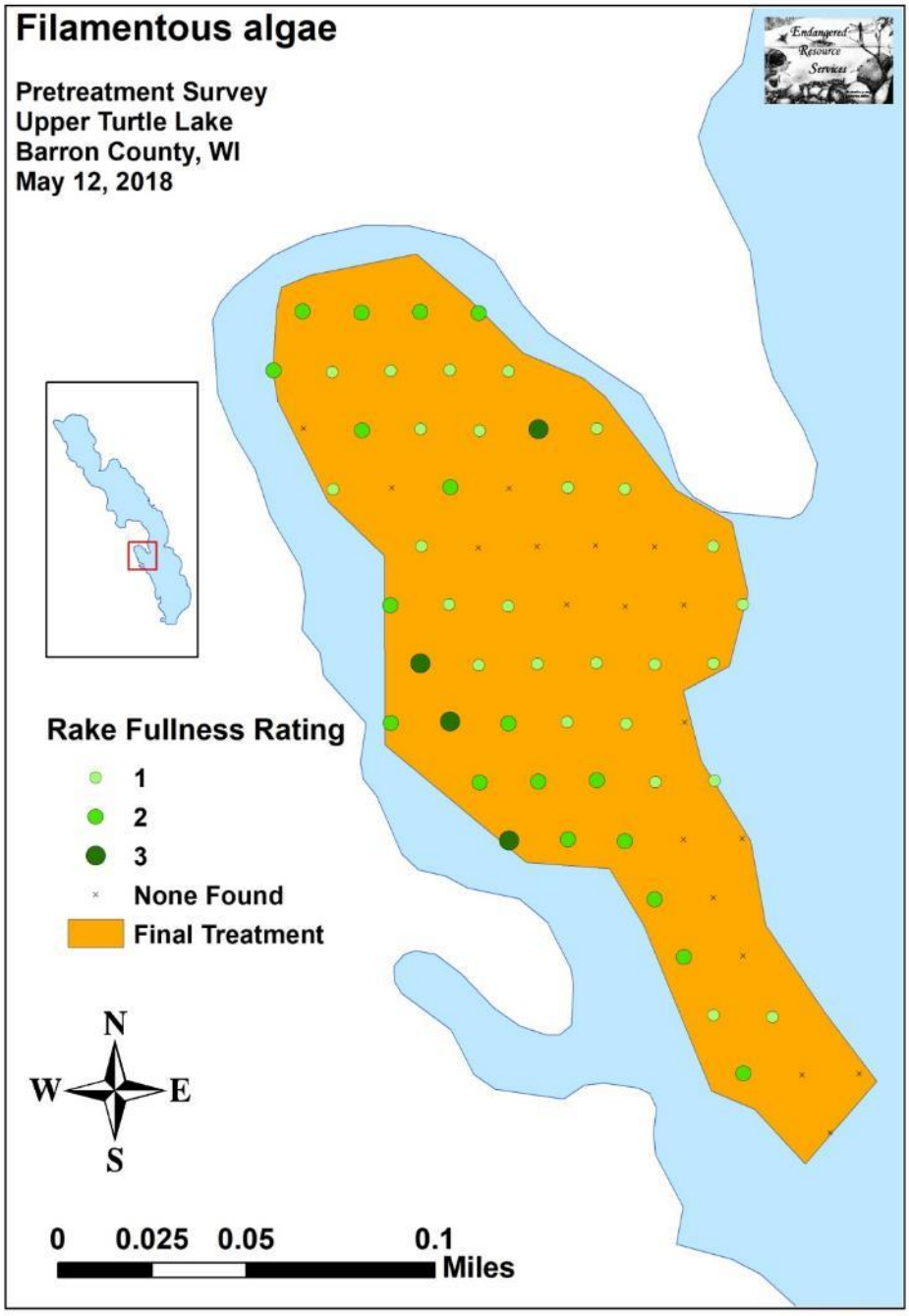
Appendix V: CLP Pre/Posttreatment Density and Distribution

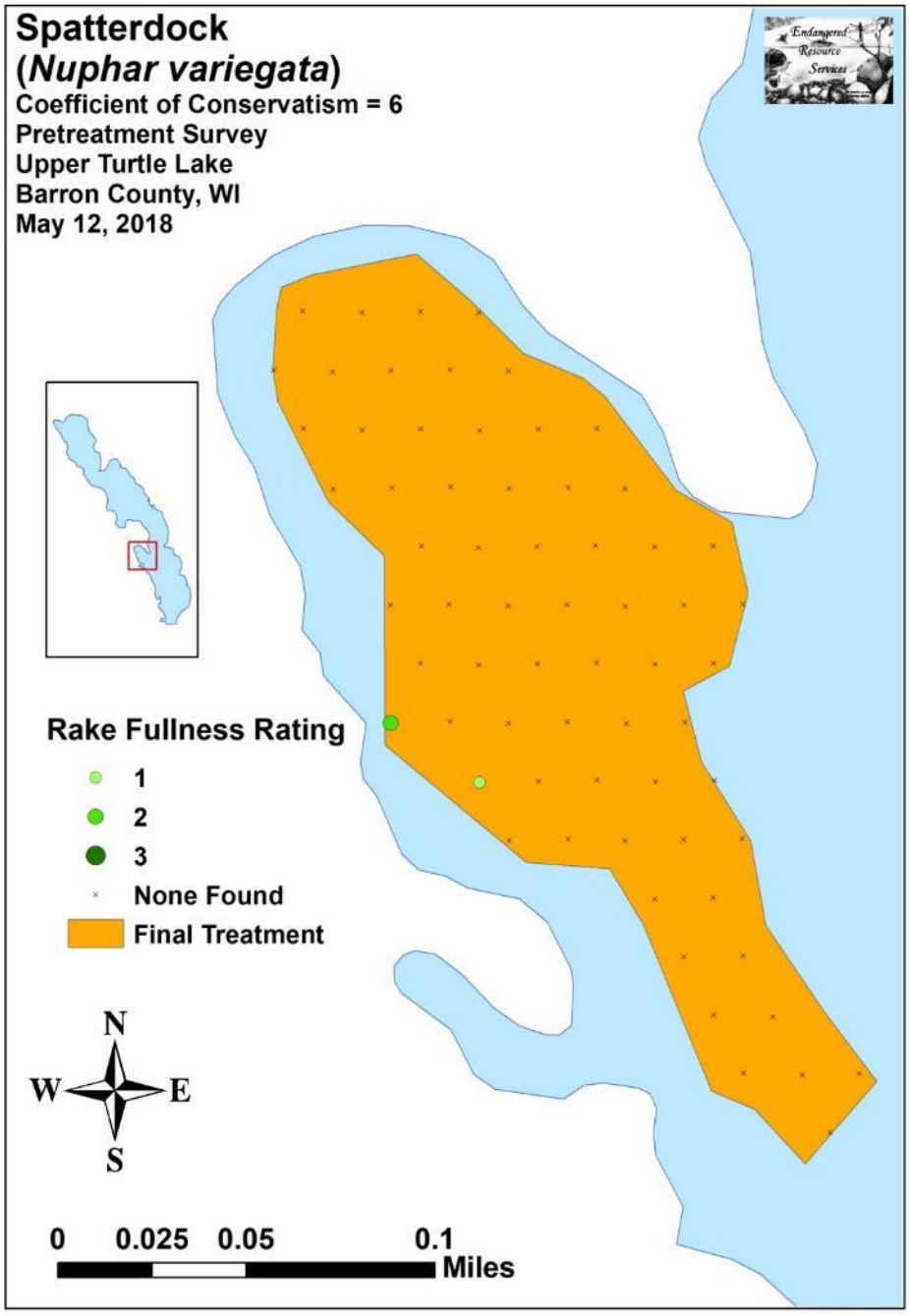

Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

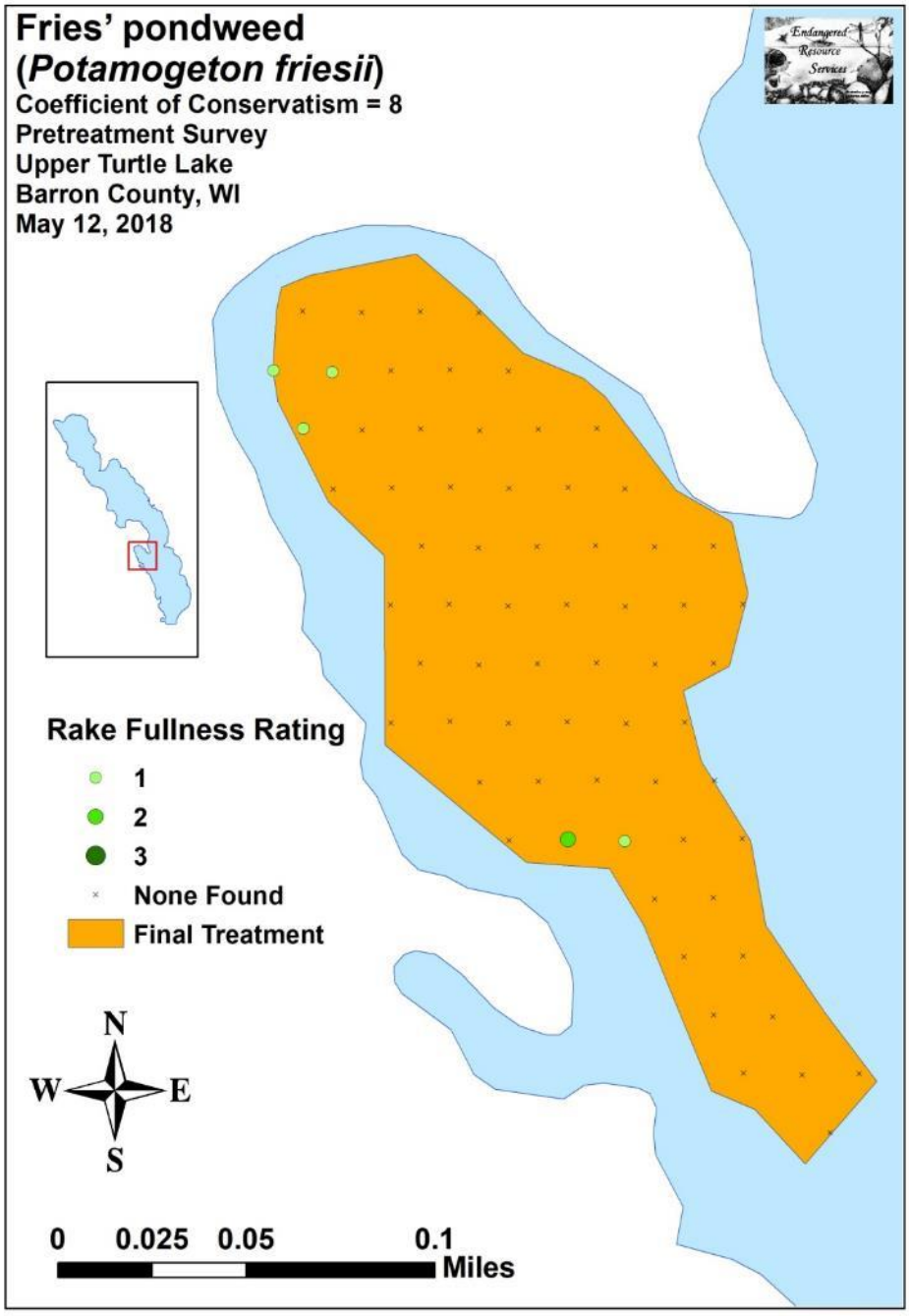

Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

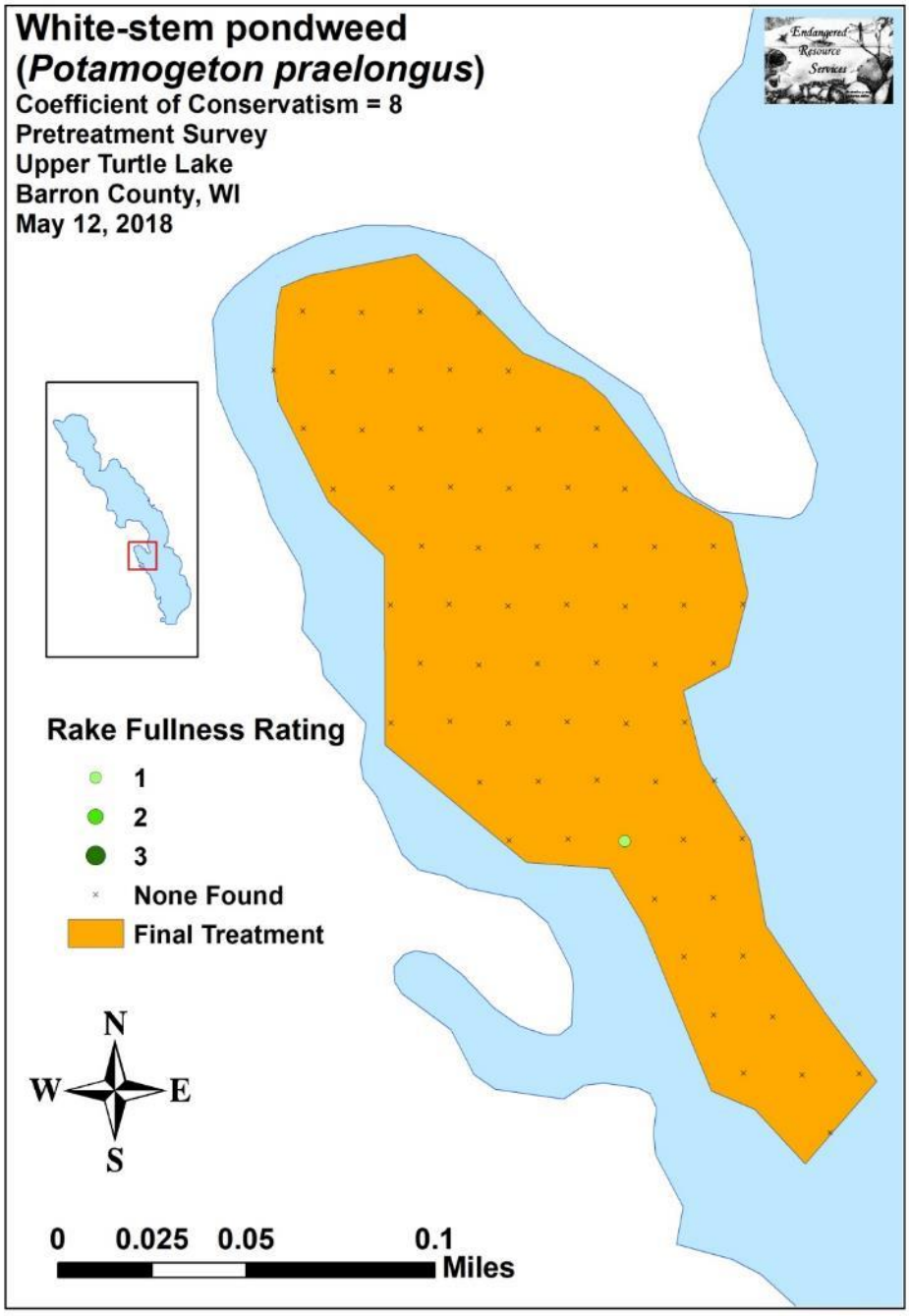
Appendix VI: Pretreatment Native Species Density and Distribution

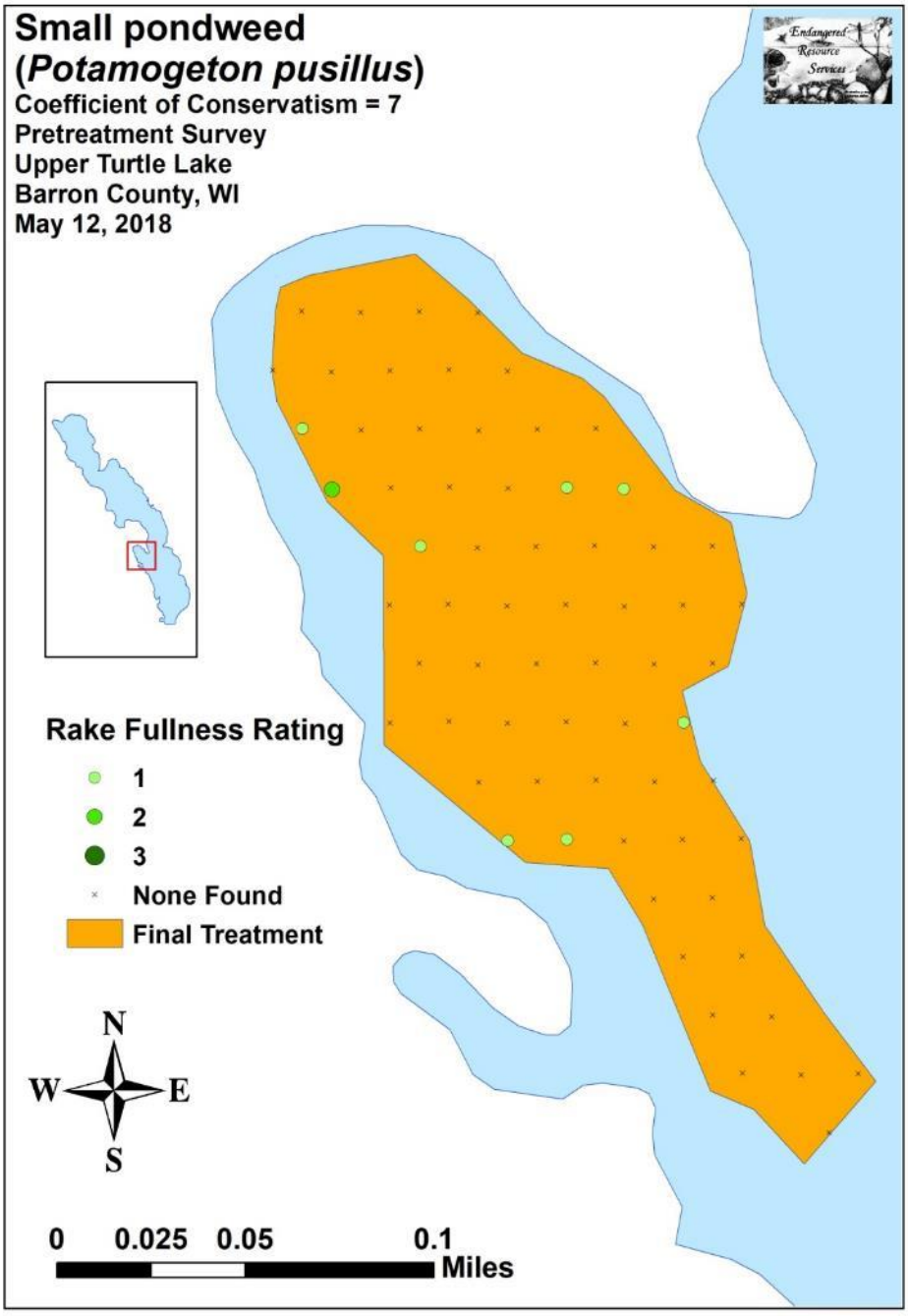

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

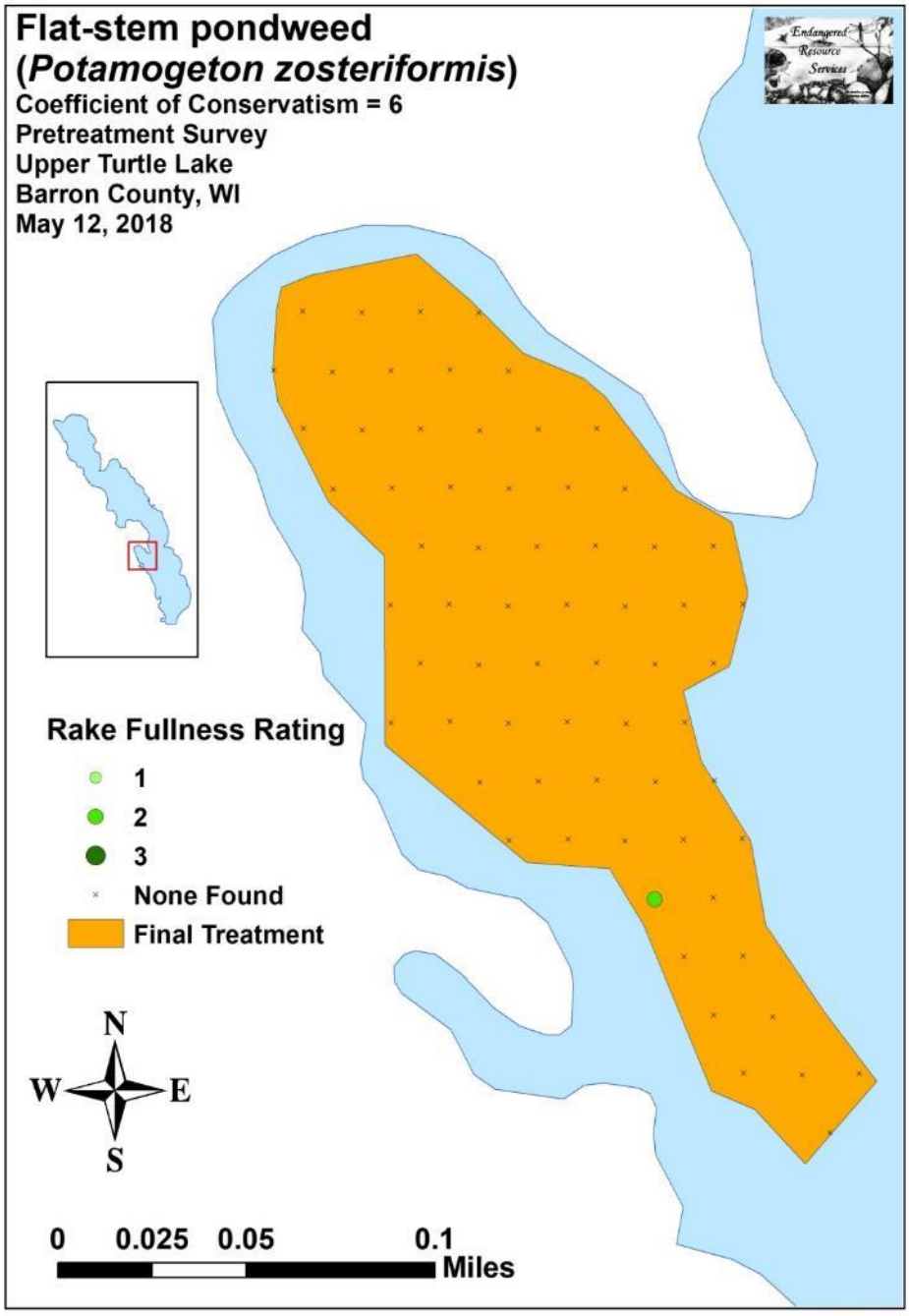

Filamentous algae
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

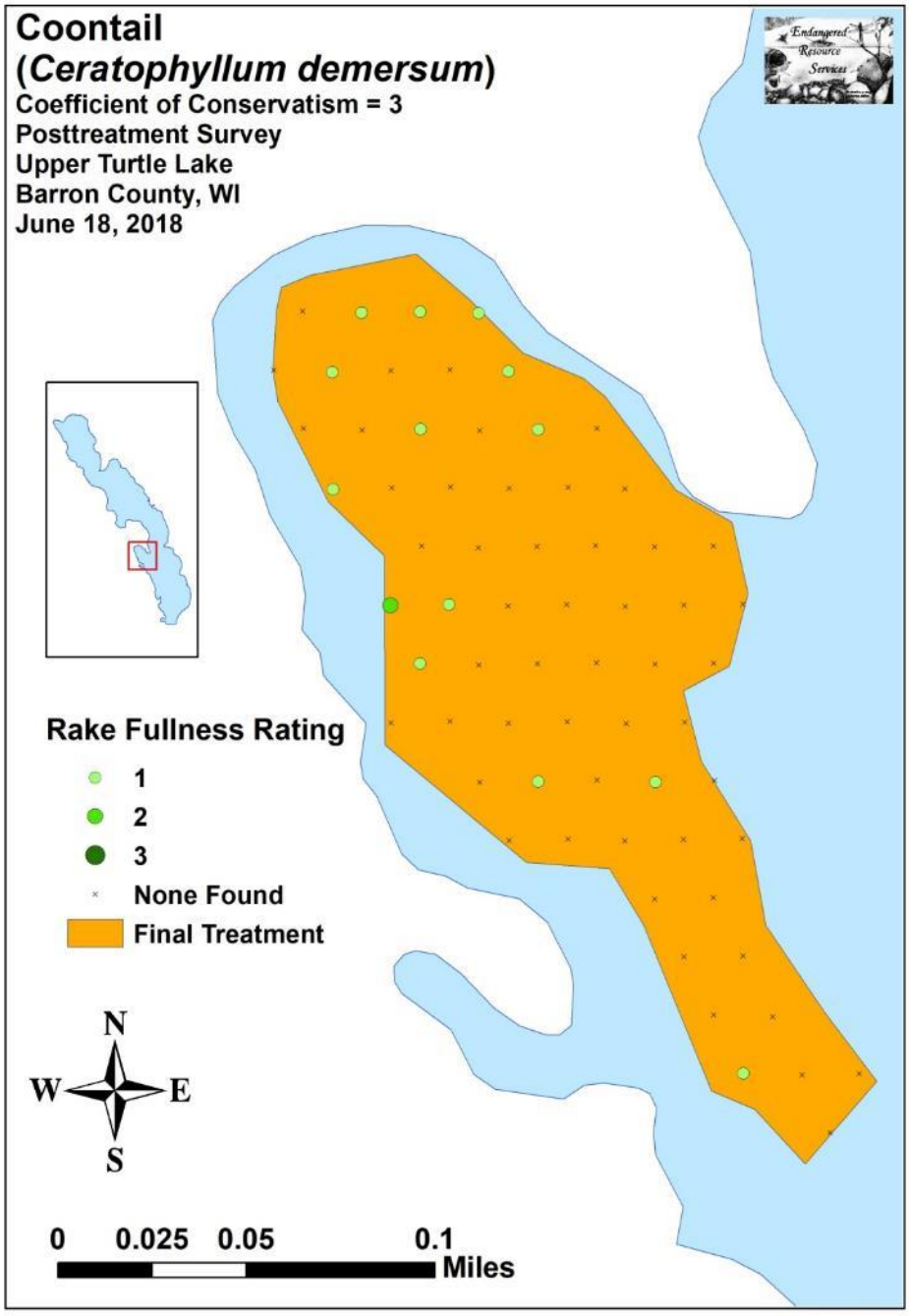

Fries' pondweed
(Potamogeton friesii)
Coefficient of Conservatism = 8
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

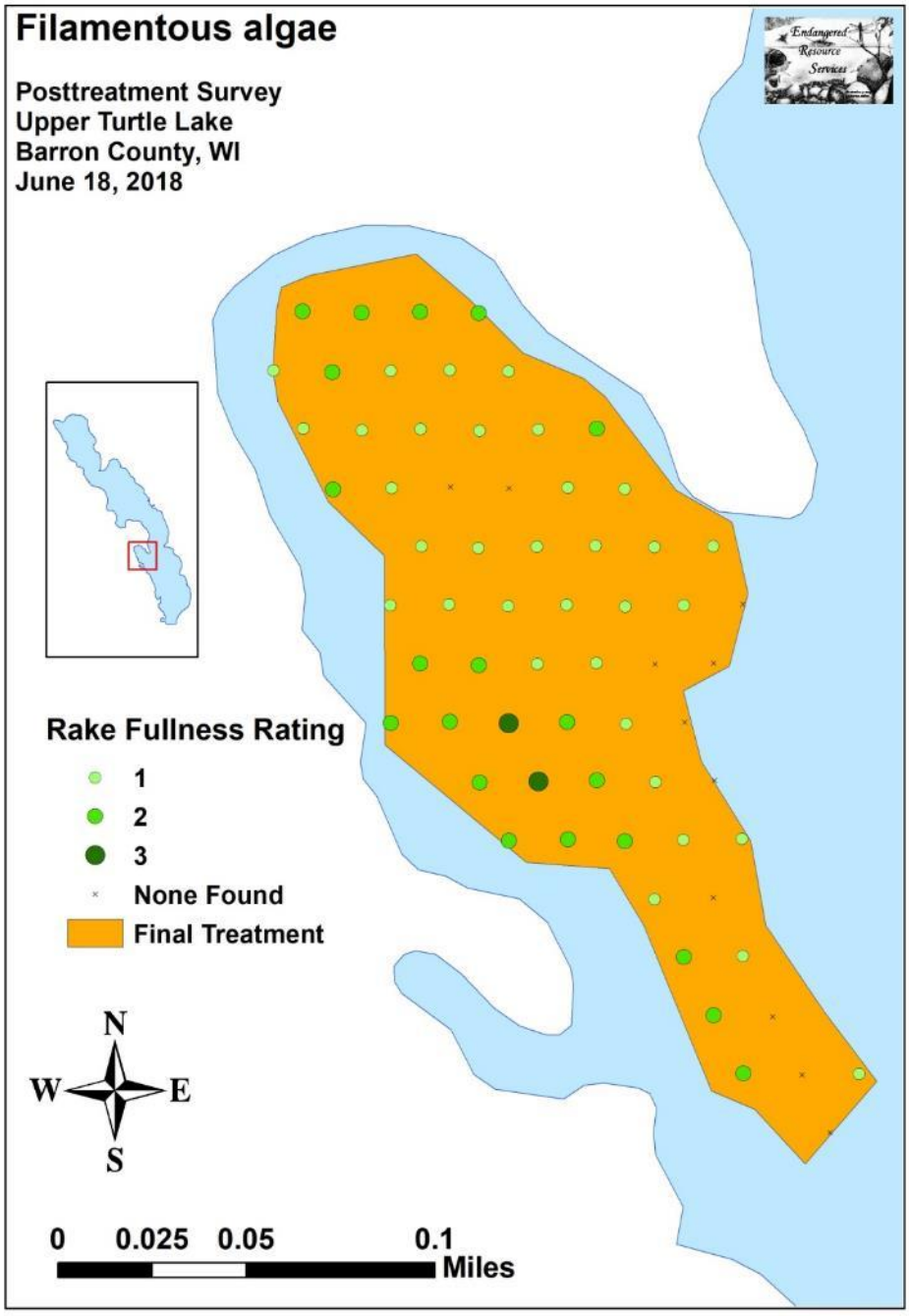

White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

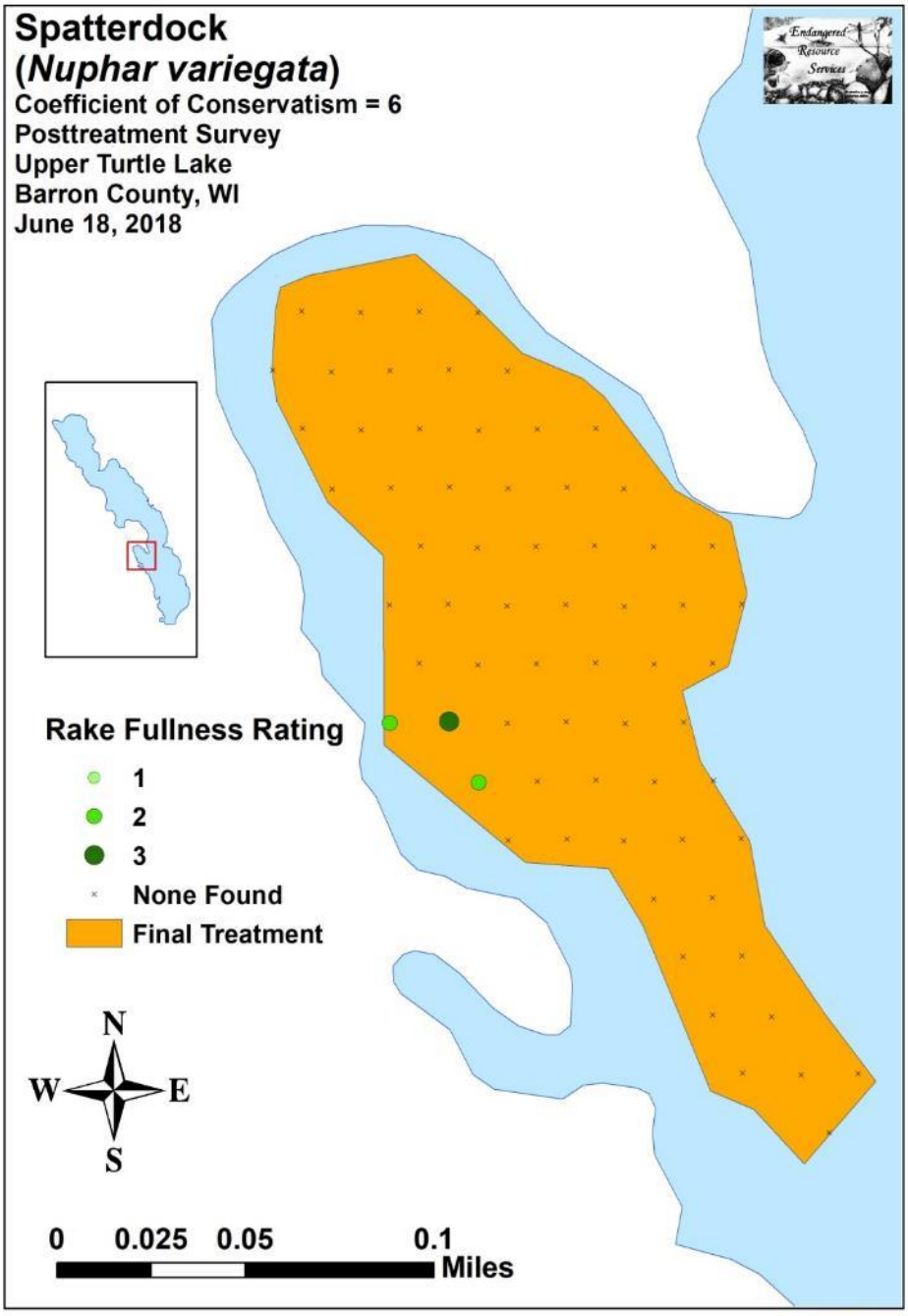

Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

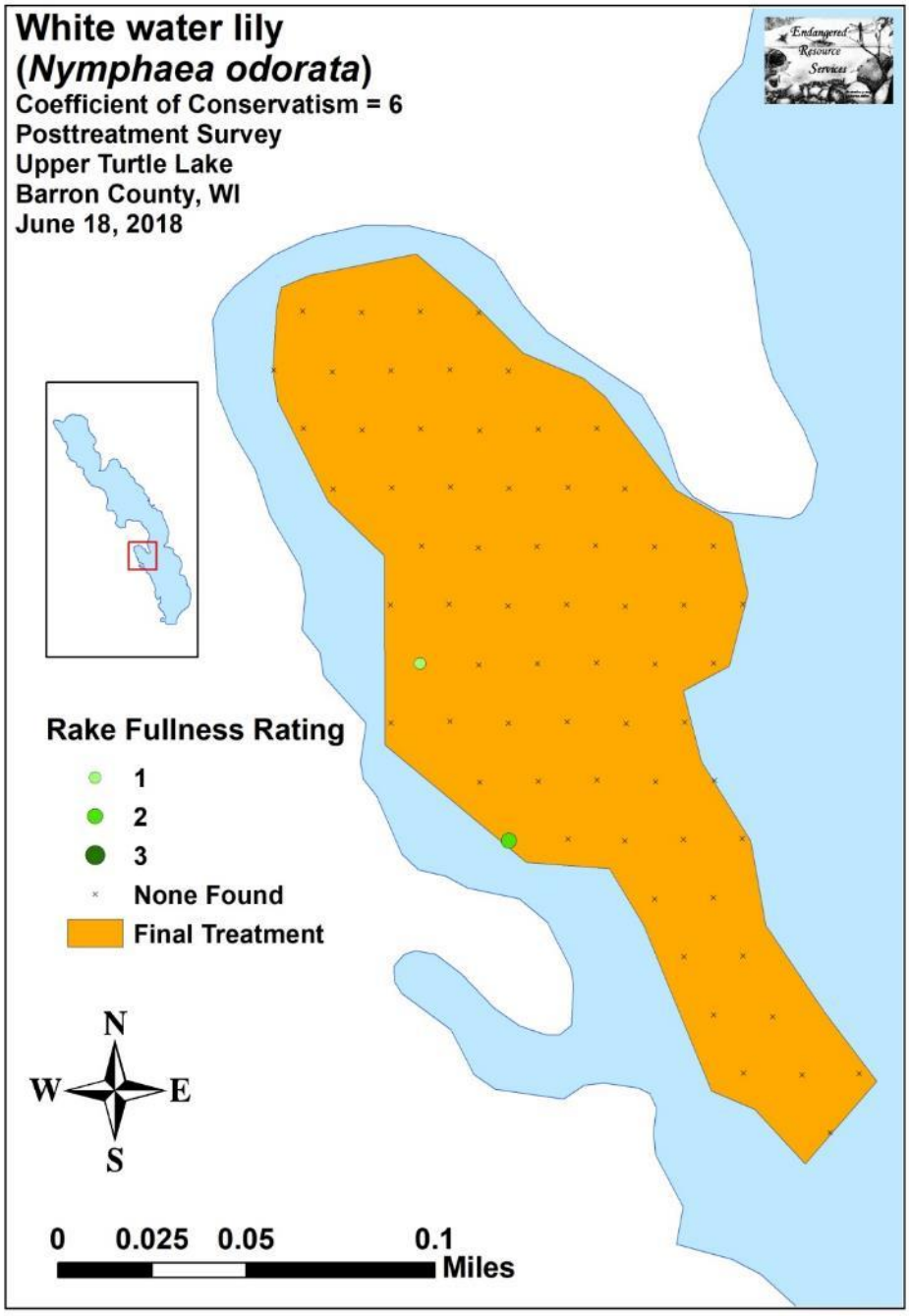

Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Pretreatment Survey
Upper Turtle Lake
Barron County, WI
May 12, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

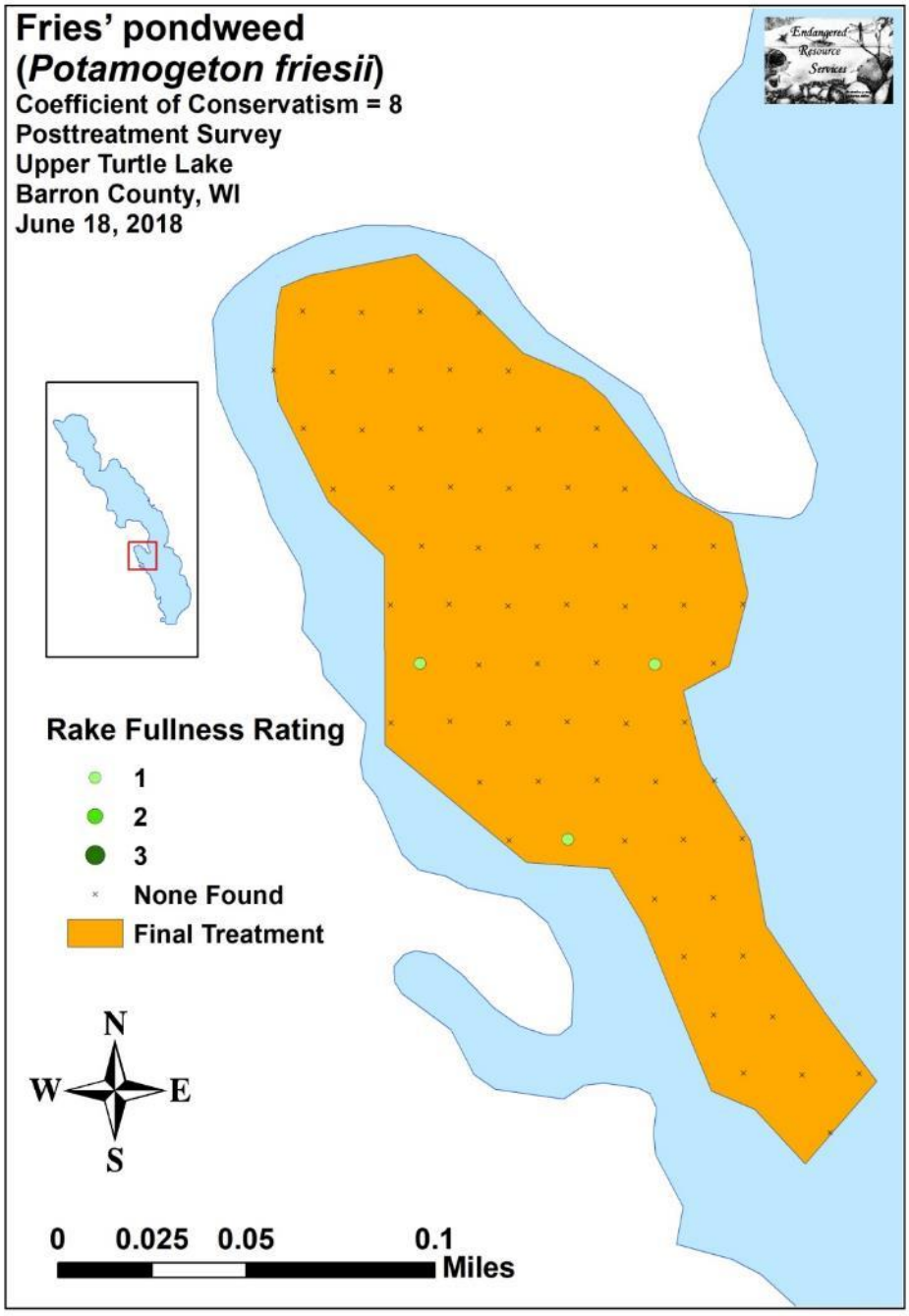
Appendix VII: Posttreatment Native Species Density and Distribution

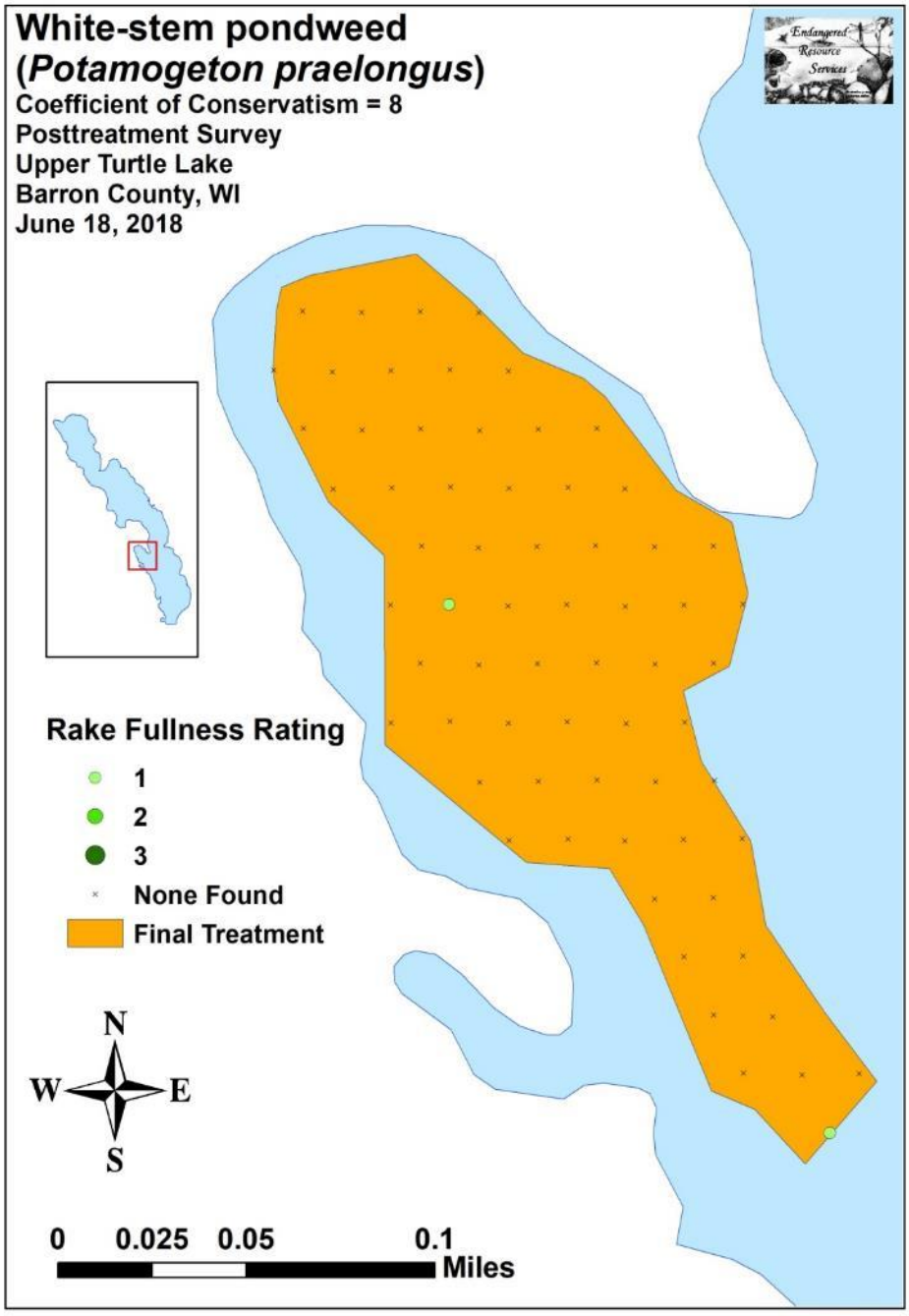

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

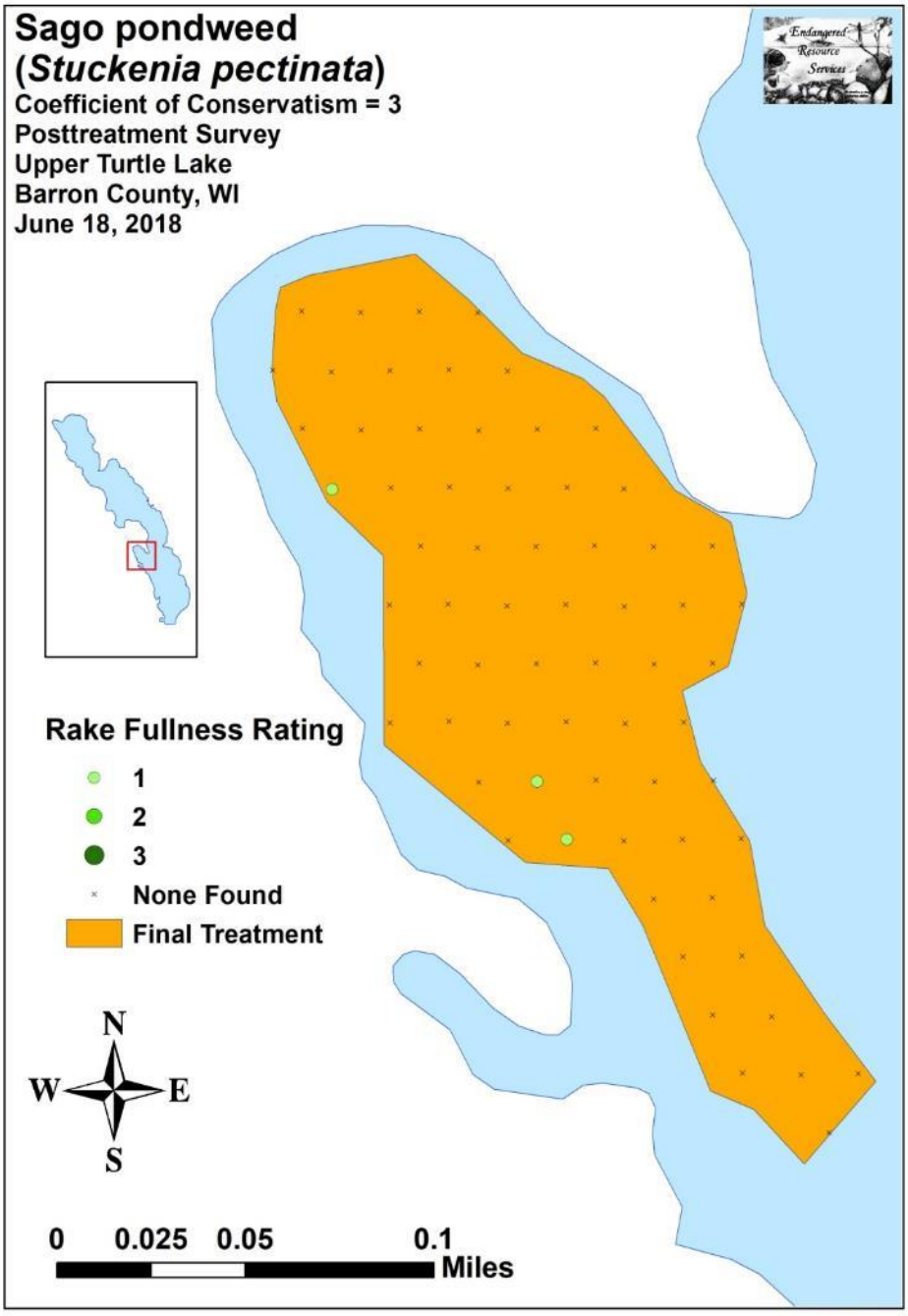

Filamentous algae
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles


Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

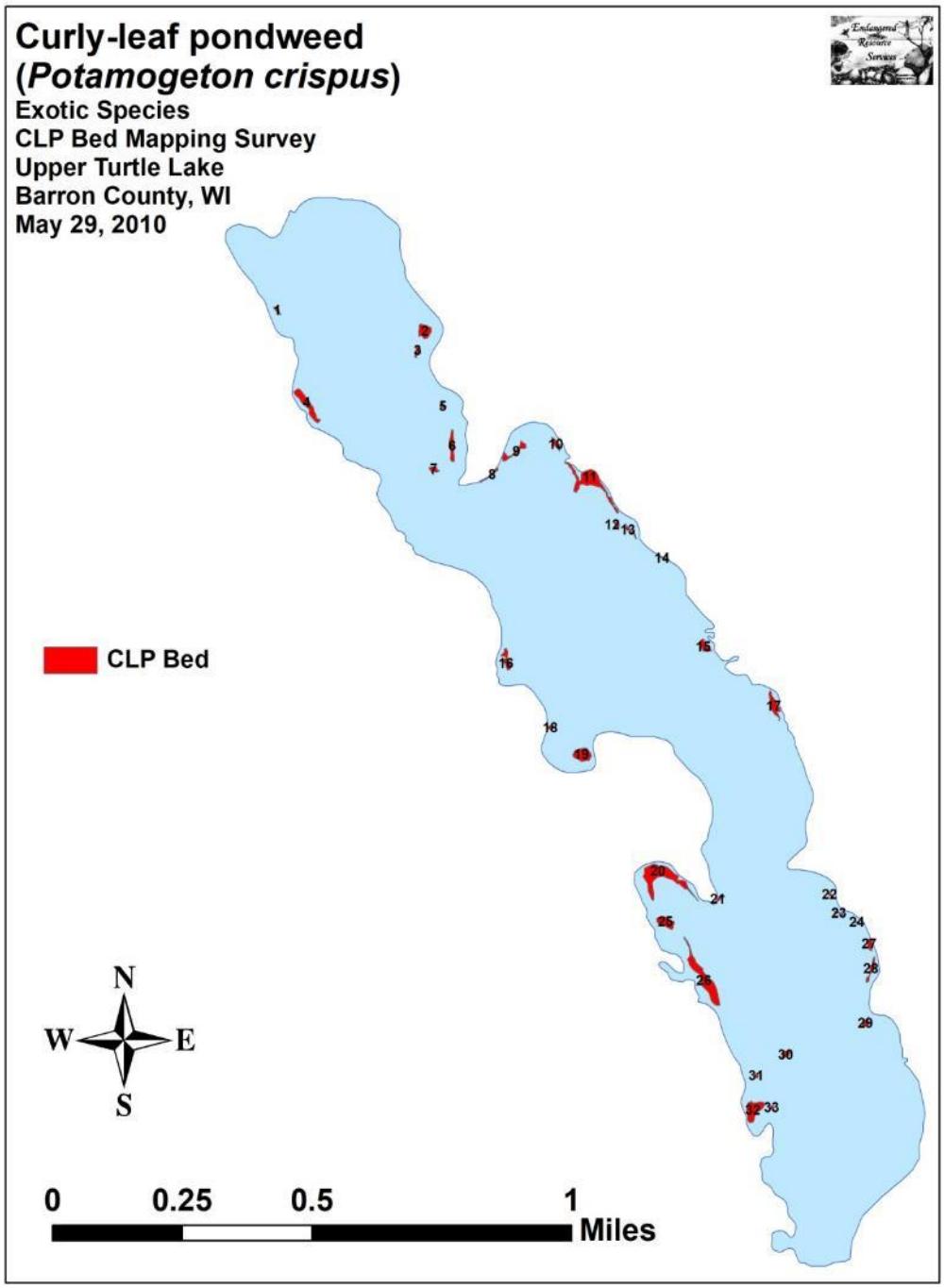

White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

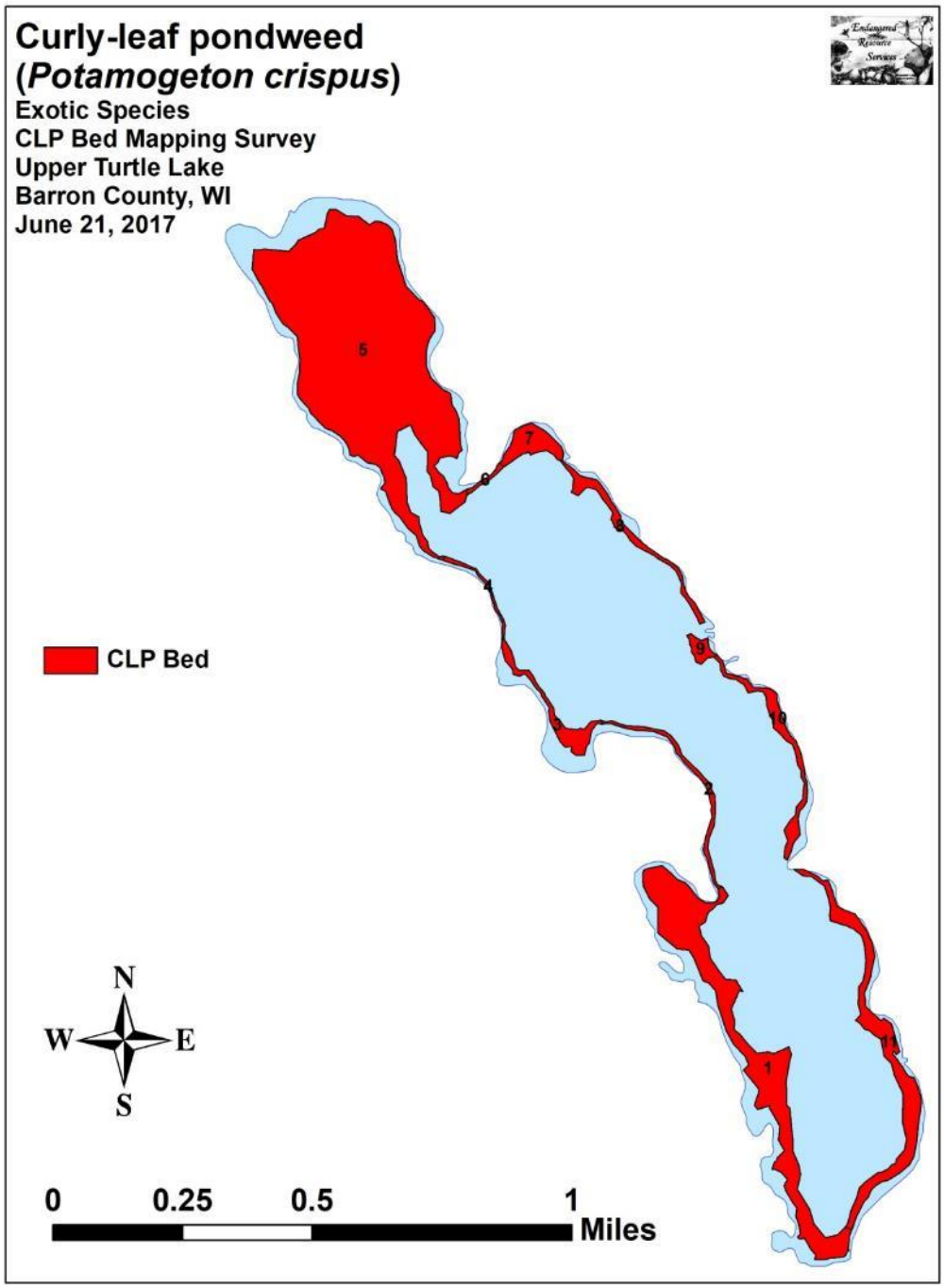

Fries' pondweed
(Potamogeton friesii)
Coefficient of Conservatism = 8
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

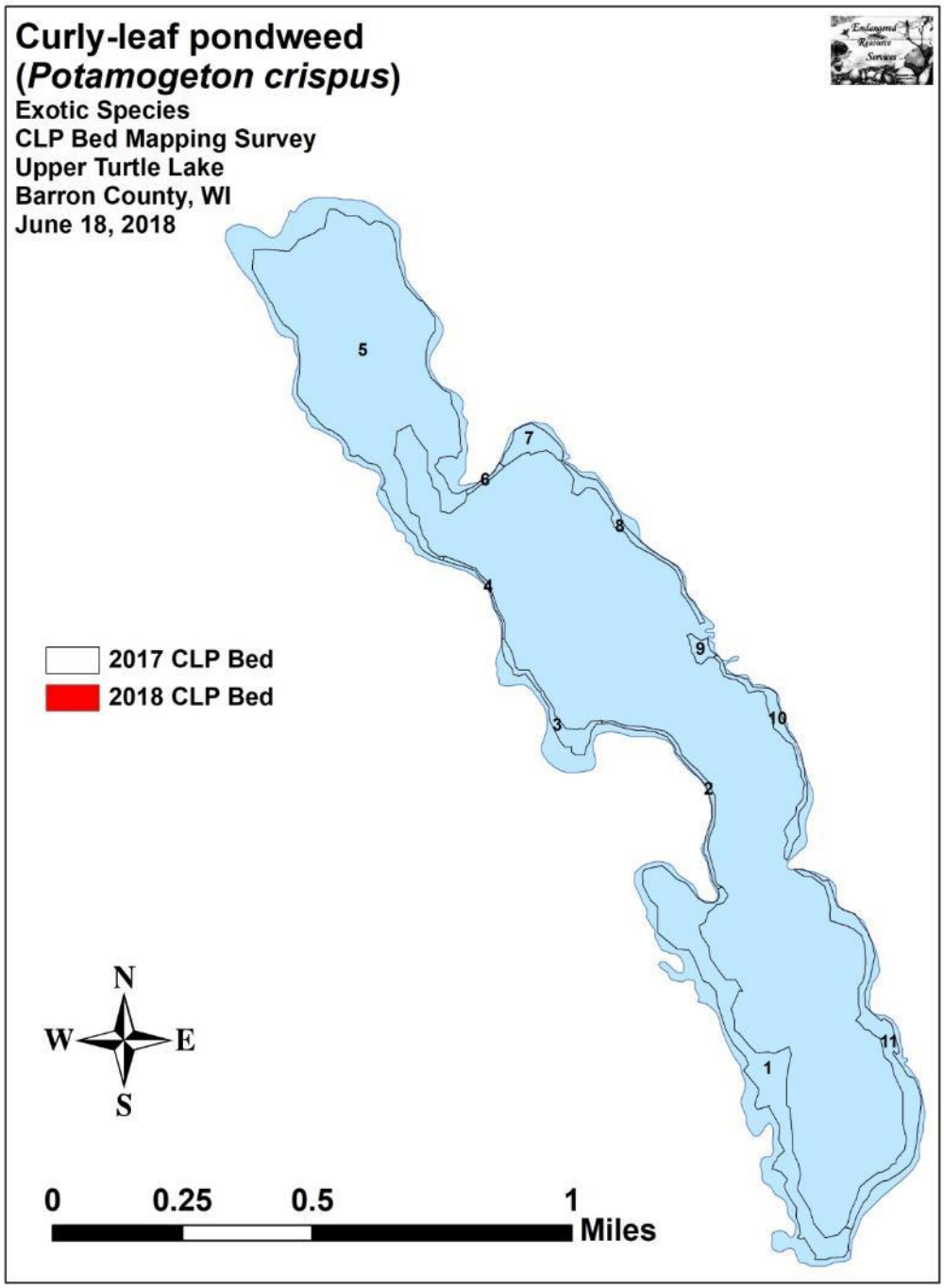

White-stem pondweed
(Potamogeton praelongus)
Coefficient of Conservatism = 8
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles


Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Posttreatment Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
Endangered Resource Services
Rake Fullness Rating
1
2
3
None Found
Final Treatment
N
W
E
S
0
0.025
0.05
0.1
Miles

Appendix VIII: 2010, 2017, and 2018 Spring CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Bed Mapping Survey
Upper Turtle Lake
Barron County, WI
May 29, 2010
CLP Bed
N
W
E
S
0
0.25
0.5
1
Miles


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Bed Mapping Survey
Upper Turtle Lake
Barron County, WI
June 21, 2017
CLP Bed
N
W
E
S
0
0.25
0.5
1
Miles


Curly-leaf pondweed
(Potamogeton crispus)
Exotic Species
CLP Bed Mapping Survey
Upper Turtle Lake
Barron County, WI
June 18, 2018
2017 CLP Bed
2018 CLP Bed
N
W
E
S
0
0.25
0.5
1
Miles
1
2
3
4
5
6
7
8
9
10
11