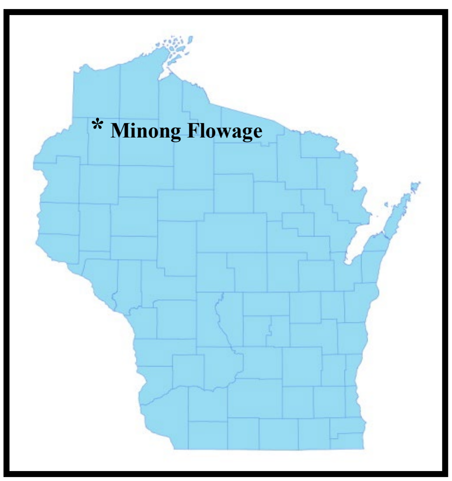
Eurasian water milfoil (*Myriophyllum spicatum*) Pre/Post Herbicide and Bed Mapping Surveys Minong Flowage (WBIC: 2692900) Washburn and Douglas Counties, Wisconsin

2011 EWM Treatment Areas

Project Initiated by:

Wisconsin Department of Natural Resources,
Minong Flowage Association and
Short Elliott Hendrickson Inc.



EWM in Serenity Bay

Survey Conducted by and Report Prepared by:

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May 14-15, July 3-4, and October 8, 2011

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INTRODUCTION:

The Minong Flowage (WBIC 2692900) is a 1,564-acre eutrophic/mesotrophic, stratified drainage lake located in north-central Washburn County and south-central Douglas County, Wisconsin in the Towns of Minong and Wascott (T42N R13W S13 SW NE). It reaches a maximum depth of 21.5ft near the dam on the far south end and has an average depth of approximately 9ft. The bottom is predominately sand and sandy muck in the south basin and organic muck in the northern bays. Water clarity is very poor to poor with average Secchi readings of no more than 3-6ft under normal summer conditions (WDNR 2011).

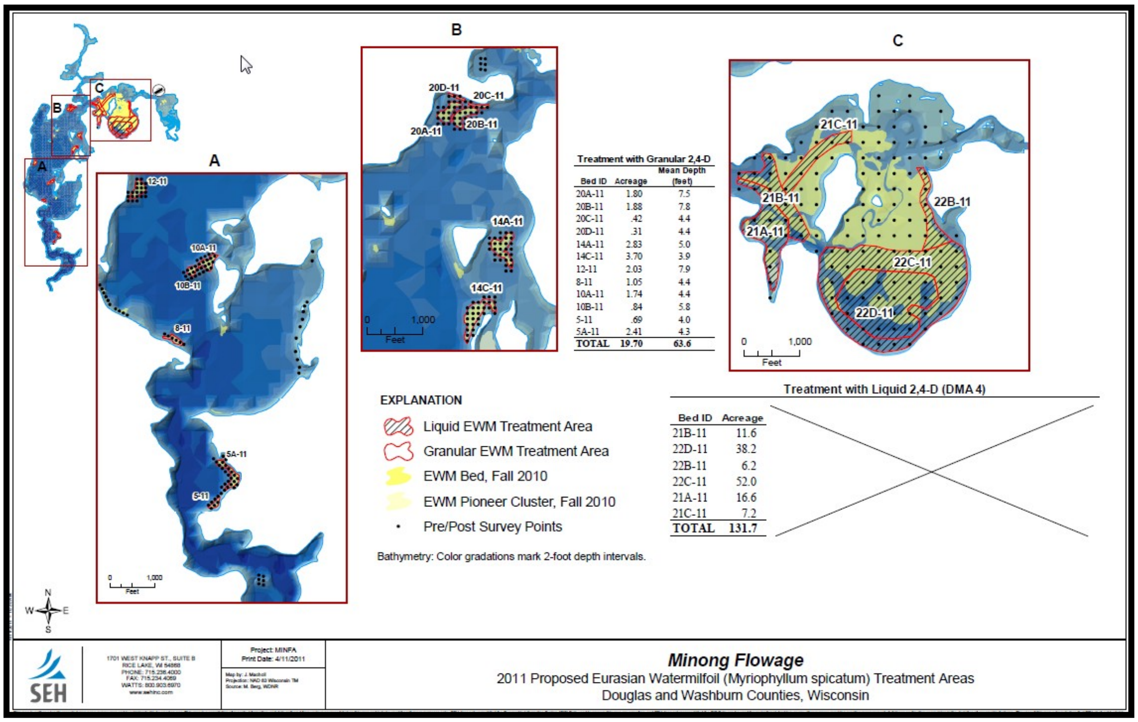


Figure 1: Proposed 2011 Spring EWM Treatment Areas

Eurasian water milfoil (*Myriophyllum spicatum*) was first identified in the Minong Flowage in 2002. Since 2009, the Minong Flowage Association, under the direction of Short, Elliot, Hendrickson, Inc. (SEHI), has been actively managing the infestation using herbicide treatments as outlined in the flowage's WDNR approved Aquatic Plant Management Plan (APMP). SEHI's evaluation of the 2010 fall bed mapping survey identified Beds 5, 5A, 8, 10A, 10B, 12, 14A, 14C, 20A, 20B, 20C, 20D, 21A, 21B, 21C, 22B, 22C, and 22D as candidates for chemical treatment in 2011. All combined, these 18 areas totaled 151.39 acres or 9.7% of the flowage's surface area (Figure 1).

On May 14th and 15th, we conducted a pretreatment survey to gather baseline data from the scheduled treatment areas and to allow SEHI biologists to finalize treatment plans. Following the June 7th and 8th herbicide application, we conducted a July 3rd and 4th posttreatment survey to evaluate the effectiveness of the treatment. We also conducted an October 8th EWM bed mapping survey to determine where EWM control should be considered in 2012. This report is the summary analysis of these three field surveys.

METHODS:
Pre/Post Herbicide Survey:
SEHI biologists generated pre/post survey points based on the size and shape of the proposed treatment areas at a resolution of 30m. Because Beds 21 and 22 (Area A) were so big, the original 85 meter resolution points from the 2008 point intercept survey grid created by Michelle Nault (WDNR) were used. Thirty-four additional exploratory points in Beds 1, 7, 7A, 9, 9A and 24 were also added bringing the total to 375 points for both the pre and posttreatment surveys (Figure 2) (Appendix I).

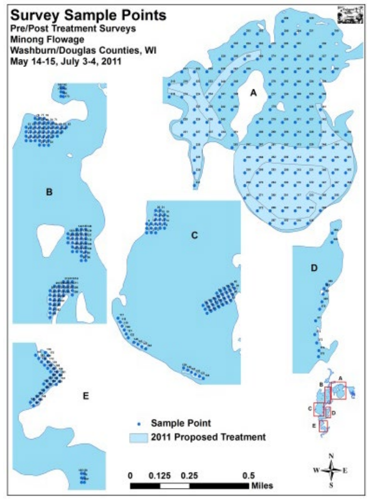


Figure 2: EWM Pre/Post Survey Points

We located each survey point using a handheld mapping GPS unit (Garmin 76CSx) and used a rake to sample an approximately 2.5ft section of the bottom. All plants on the rake were assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 3). Visual sightings of EWM and Vasey's pondweed (*Potamogeton vaseyi*), a WI species of special concern, were noted if they occurred within 6ft of the point. We also recorded depth and bottom substrate. All data collected was entered into the standard APM spreadsheet (Appendix II) (UWEX 2011). Data was analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX 2011). Pre/post treatment differences were determined to be significant at $p < .05$, moderately significant at $p < .01$ and highly significant at $p < .005$.

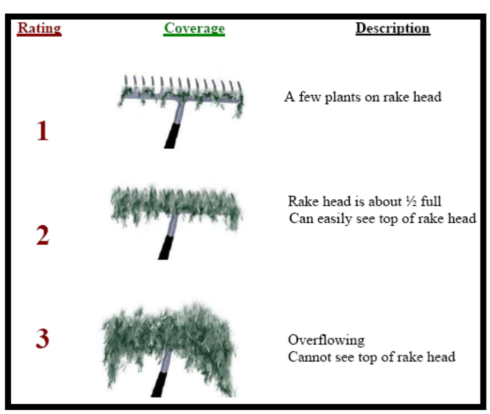


Figure 3: Rake Fullness Ratings

Fall Eurasian Water Milfoil Bed Mapping:

On October 8th, we searched the entire visible littoral zone of the flowage and mapped all known beds of EWM. A "bed" was determined to be any area where we visually estimated that EWM made up >50% of the area's plants and was generally continuous with clearly defined borders. After we located a bed, we motored around the perimeter of the area, took GPS coordinates at regular intervals, and estimated the average rake fullness rating of EWM within the bed. Using the WDNR's Forestry Tool's Extension to ArcGIS 9.3.1, we used these coordinates to generate bed shapefiles. Acreage was determined to the nearest hundredth of an acre and perimeter to the nearest meter for each bed.

RESULTS AND DISCUSSION:

Finalization of Treatment Areas:

Initial expectations were to treat 18 beds totaling 151.39 acres with either liquid or granular 2, 4-D. However, following the pretreatment survey, it was decided to only use granular 2, 4-D (Navigate). It was also determined that Beds 1, 9 and 9A had enough EWM to treat, but Beds 5, 5B, 10, 10A, 12, 14C, 20A, and 20D did not. Large parts of Beds 21 and 22 were also excluded due to low EWM density. (Figure 4). This resulted in the treatment areas being decreased to 87.08 acres or 5.6% of the flowage's surface area. This decline of 62.86 acres represented an over 41% reduction from initial expectations (Table 1) (Appendix I).

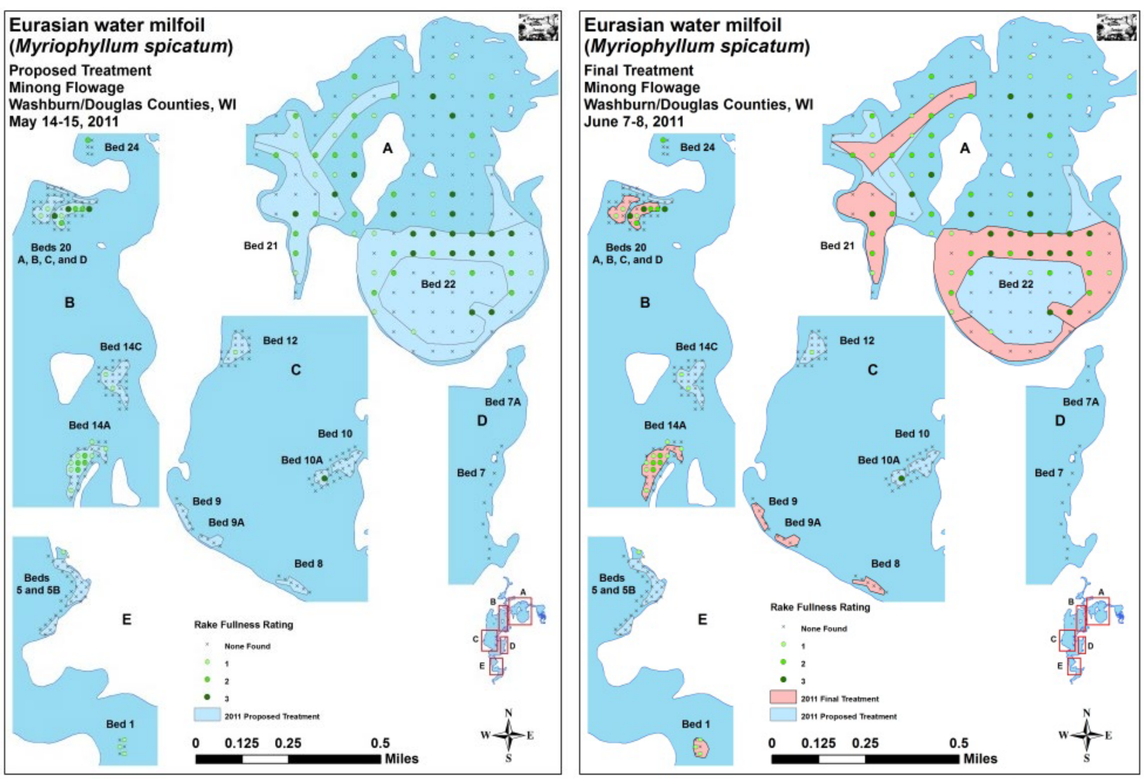


Figure 4: 2011 Proposed and Final Treatment Areas

Table 1: Spring EWM Treatment Summary
Minong Flowage - May 14-15, 2011

Bed Number	Proposed Acreage	Final Acreage	Difference +/-
1	0	1.07	1.07
5 and 5B	3.10	0	-3.10
7 and 7A	0	0	0
8	1.05	1.05	0
9 and 9A	0	1.76	1.76
10 and 10A	2.58	0	-2.58
12	2.03	0	-2.03
14A and 14C	6.53	3.70	-2.83
20 A, B, C, and D	4.41	3.68	-0.73
21 A, B, and C	35.36	23.86	-11.50
22B, C, and D	96.33	51.96	-42.92
24	0	0	0
Total Acres	**151.39**	**87.08**	**-62.86**

EWM Pre/Post Herbicide Survey:

Eurasian water milfoil was found growing at a maximum of 8.0 ft during the pretreatment survey and 7.5ft during the posttreatment survey. Mean and median depths for all plants were 5.0ft and 5.2 ft respectively during the pretreatment survey, before declining slightly to 4.6ft and 4.5ft in the posttreatment survey (Table 2). Most EWM was established over thick organic muck or firm sand (Figure 5) (Appendix III).

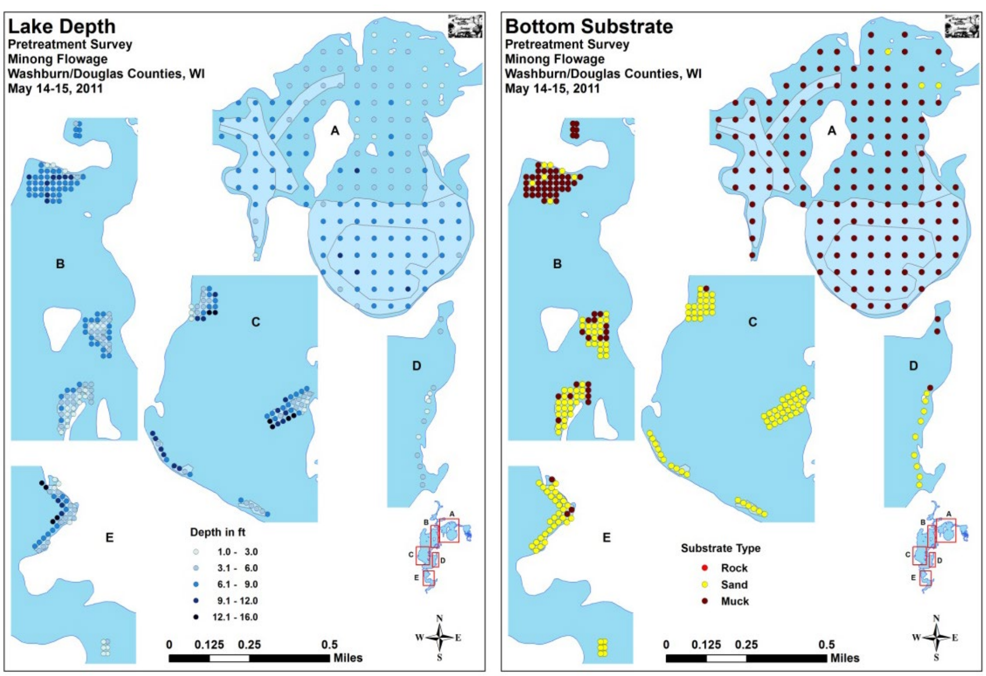


Figure 5: Treatment Area Depths and Bottom Substrate

Table 2: Pre/Post Survey Summary Statistics
Minong Flowage, Washburn and Douglas Counties
May 14-15 and July 3-4, 2011

Summary Statistics:	Pre	Post
Total number of points sampled	375	375
Total number of sites with vegetation	209	145
Total number of sites shallower than the maximum depth of plants	328	295
Frequency of occurrence at sites shallower than maximum depth of plants	63.72	49.15
Simpson Diversity Index	0.84	0.88
Maximum depth of plants (ft)	8.50	8.00
Number of sites sampled using pole rake (P)	375	375
Average number of all species per site (shallower than max depth)	1.27	1.06
Average number of all species per site (veg. sites only)	1.99	2.16
Average number of native species per site (shallower than max depth)	0.91	0.95
Average number of native species per site (veg. sites only)	1.74	1.99
Species richness	24	28
Mean depth of plants (ft)	5.2	4.6
Median depth of plants (ft)	5.0	4.5
Mean rake fullness (veg. sites only)	2.01	1.77

Diversity within the beds was moderately high with an initial Simpson Diversity Index of 0.84 and a posttreatment value of 0.88. Mean native species richness at sites with vegetation was only 1.74/site pretreatment, but increased slightly to 1.99/site posttreatment (Figure 6). Total rake fullness declined from a moderate 2.01 pretreatment to a low/moderate 1.77 posttreatment (Figure 7) (Appendix IV).

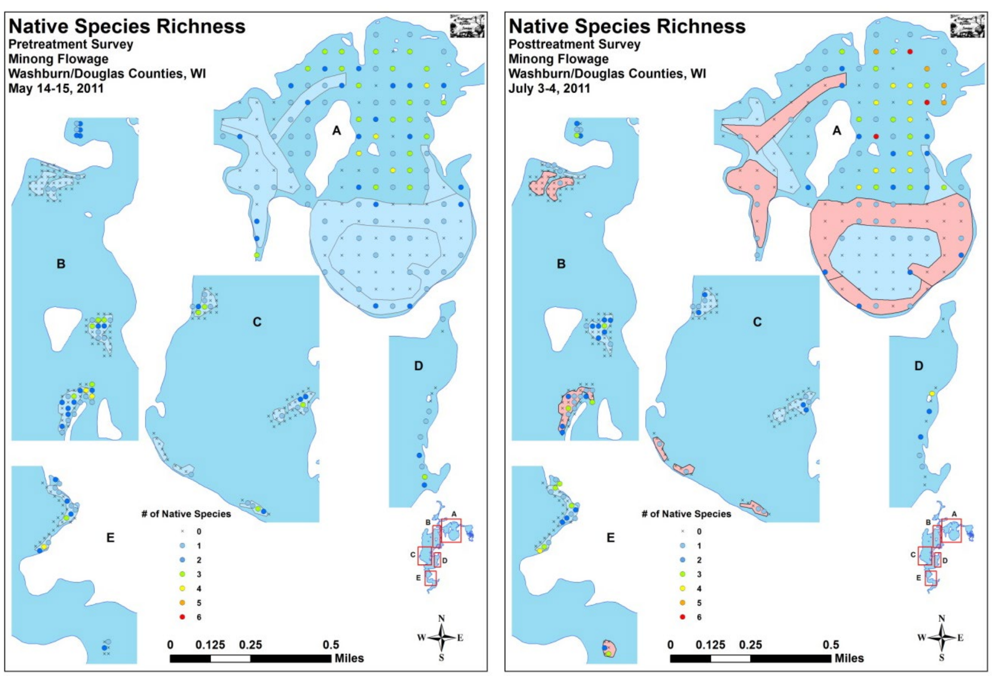


Figure 6: Pre/Post Native Species Richness

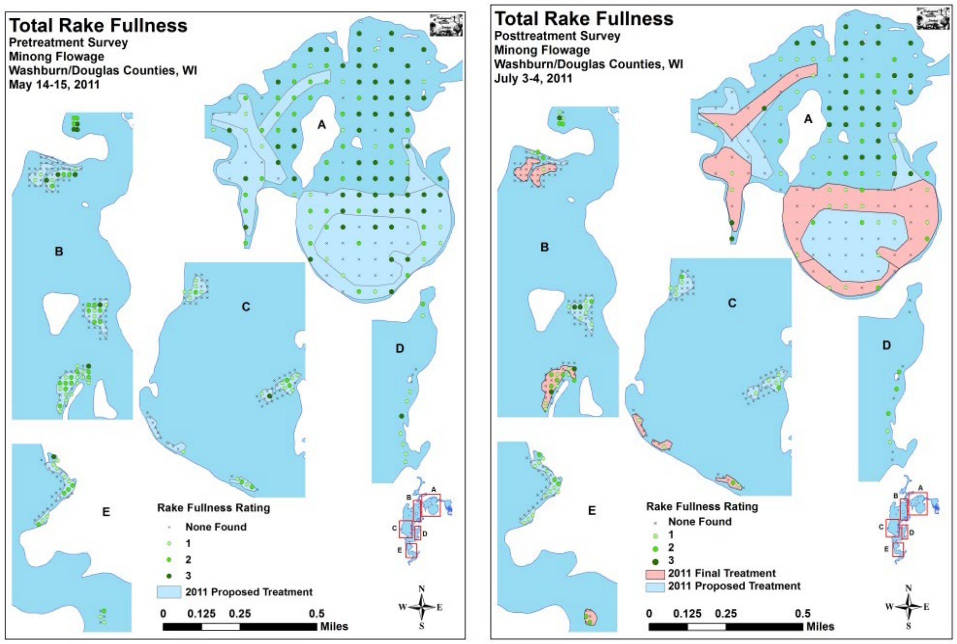


Figure 7: Pre/Post Total Rake Fullness

We found EWM at 95 total sites during the pretreatment survey. Of these, 24 had a rake fullness rating of 3, 32 rated a 2, and 39 a 1. During the posttreatment survey, we found EWM at only 22 total sites. Only one rated a 3, 10 rated a 2, and 11 rated a 1 with one additional visual sighting (Figure 8) (Appendix V). Our findings demonstrated a highly significant reduction of total EWM, as well as rake fullness 3, 2, and 1 (Figure 9). These results were even more impressive when considering only one of the posttreatment EWM locations occurred within an actual treatment area.

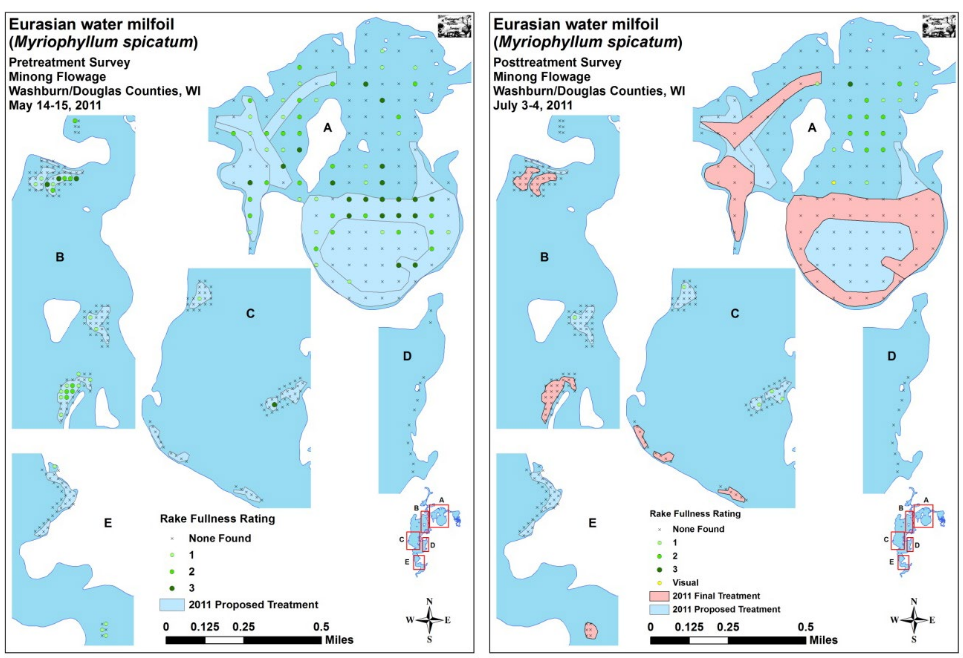
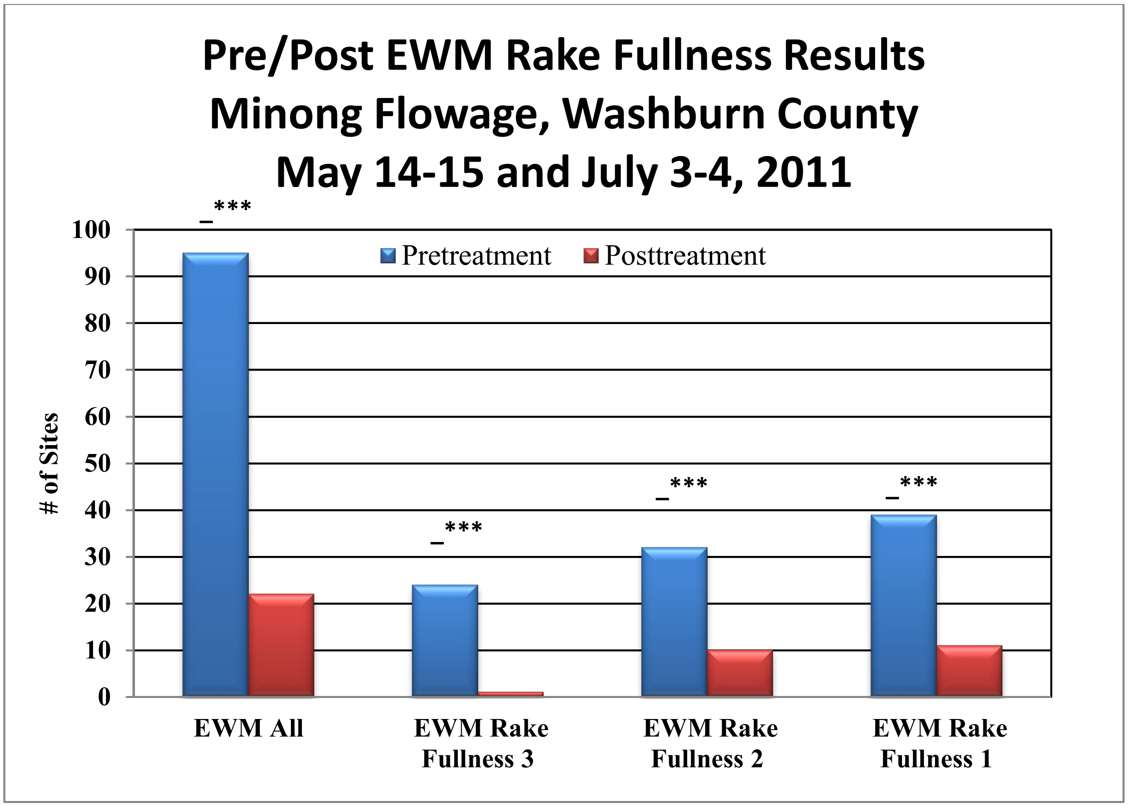


Figure 8: Pre/Post EWM Density and Distribution



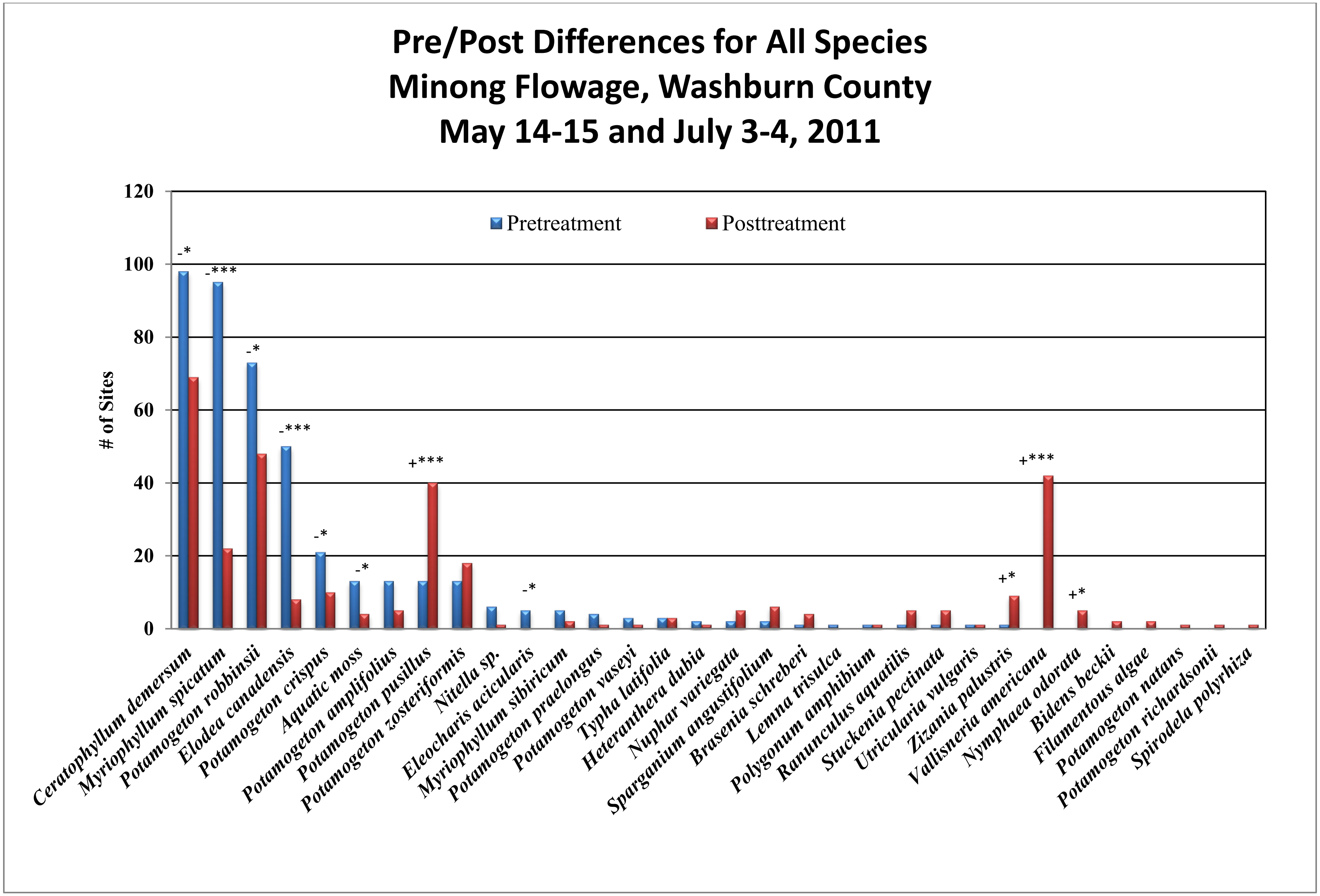
Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 9: Pre/Post Changes in EWM Rake Fullness

Curly-leaf pondweed (*Potamogeton crispus*), another exotic species, also showed significant declines in the treatment areas (Figure 10). During the pretreatment survey, we found it at 21 sites of which eight rated a 2 and 13 a 1. It was still present at 10 sites in July with two rating a 3, and four each rating a 2 and a 1. Although this reduction was significant, it is likely due to normal June senescence for this species rather than the herbicide treatment (Appendix V).

Coontail (*Ceratophyllum demersum*) and Fern pondweed (*Potamogeton robbinsii*) were the most common native species in both the pre and posttreatment surveys (Tables 3 and 4). Both species showed significant declines posttreatment (Figure 10). This was especially evident in Serenity Bay where they were both almost completely eliminated from the treatment areas (Figures 11 and 12).

Other native species showing significant declines included Common waterweed (*Elodea canadensis*), Aquatic moss, and Needle spikerush (*Eleocharis acicularis*). We also documented significant increases in Small pondweed (*Potamogeton pusillus*), Northern wild rice (*Zizania palustris*), Wild celery (*Vallisneria americana*), and White water lily (*Nymphaea odorata*). All four of these species are late growing, do not normally overwinter, and regrow from seeds, roots or turions. Maps for all species from the pre and posttreatment surveys are available in Appendices VI and VII.



Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 10: Pre/Post Macrophyte Changes

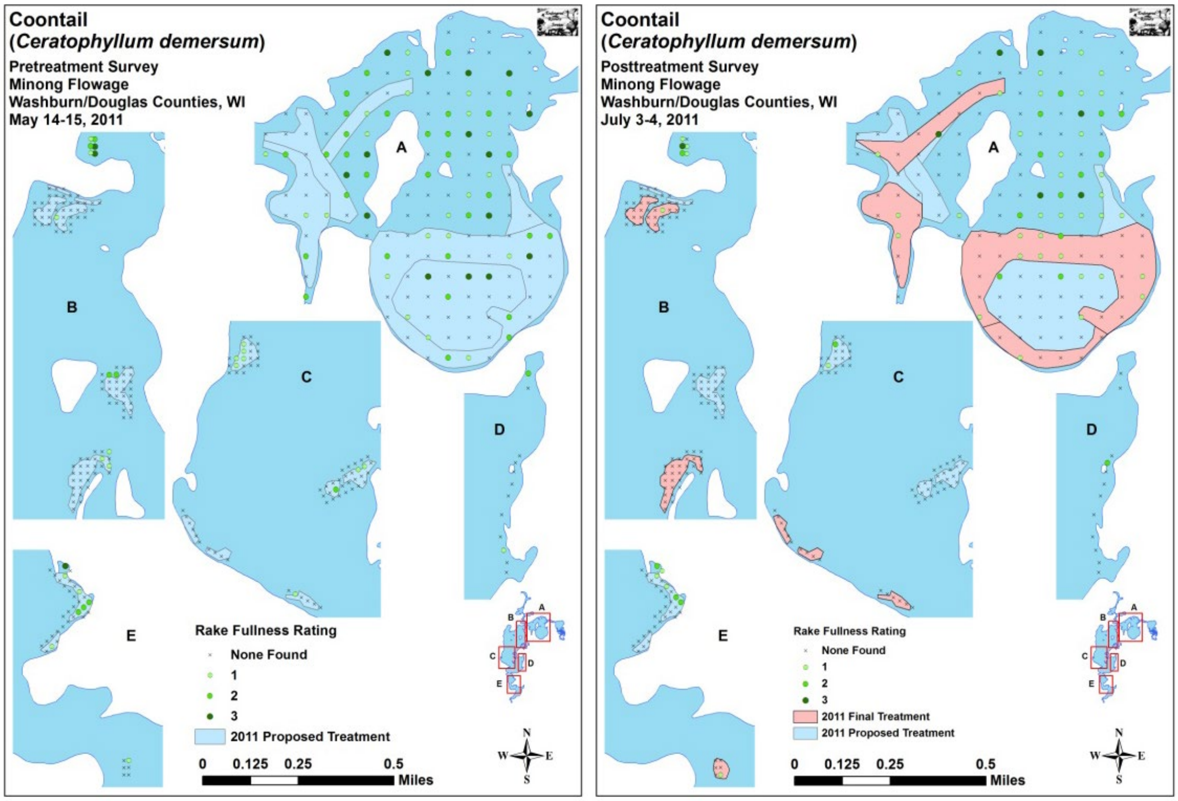


Figure 11: Pre/Post Coontail Density and Distribution

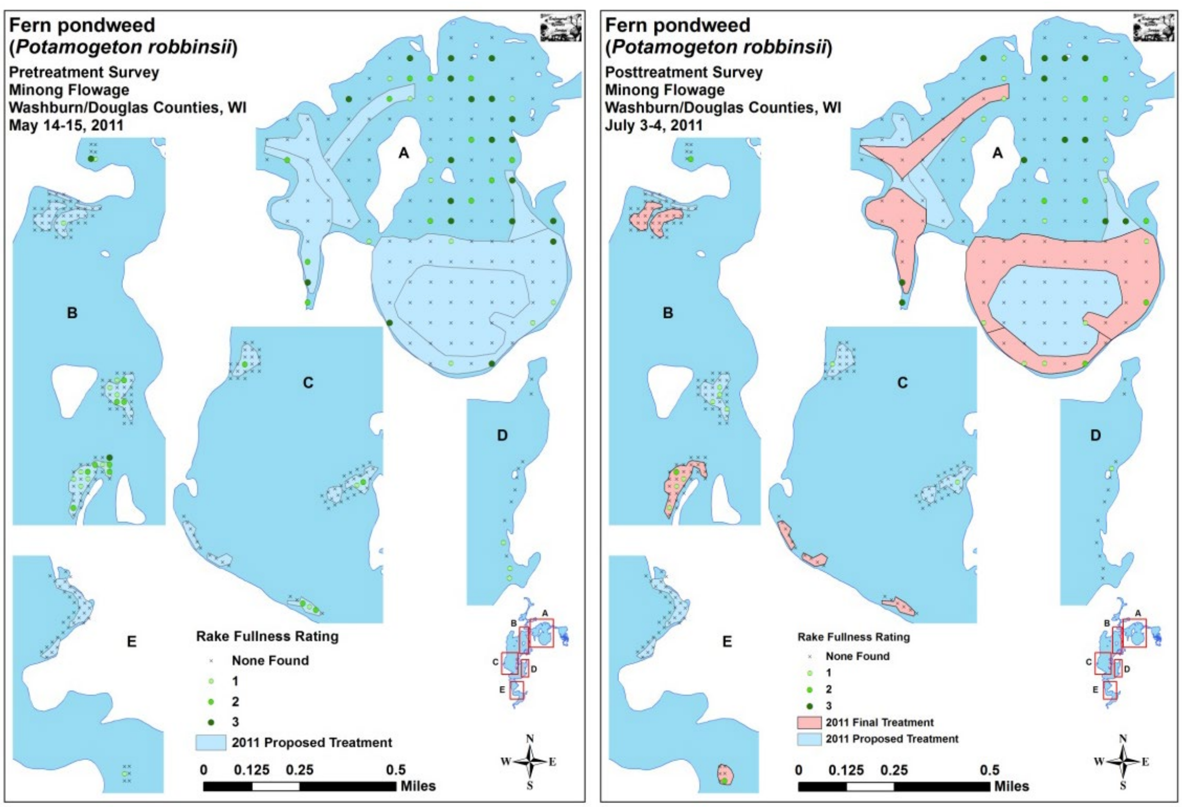


Figure 12: Pre/Post Fern Pondweed Density and Distribution

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey Minong Flowage, Washburn and Douglas Counties
May 14-15, 2011

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Ceratophyllum demersum	Coontail	98	23.61	46.89	29.88	1.78
Myriophyllum spicatum	Eurasian water milfoil	95	22.89	45.45	28.96	1.84
Potamogeton robbinsii	Fern pondweed	73	17.59	34.93	22.26	1.93
Elodea canadensis	Common waterweed	50	12.05	23.92	15.24	1.16
Potamogeton crispus	Curly-leaf pondweed	21	5.06	10.05	6.40	1.38
Potamogeton amplifolius	Large-leaf pondweed	13	3.13	6.22	3.96	1.31
Potamogeton pusillus	Small pondweed	13	3.13	6.22	3.96	1.23
Potamogeton zosteriformis	Flat-stem pondweed	13	3.13	6.22	3.96	1.23
	Aquatic moss	13		6.22	3.96	1.08
Nitella sp.	Nitella	6	1.45	2.87	1.83	1.17
Eleocharis acicularis	Needle spikerush	5	1.20	2.39	1.52	1.00
Myriophyllum sibiricum	Northern water milfoil	5	1.20	2.39	1.52	1.20
Potamogeton praelongus	White-stem pondweed	4	0.96	1.91	1.22	1.75
Potamogeton vaseyi	Vasey's pondweed	3	0.72	1.44	0.91	1.00
Typha latifolia	Broad-leaved cattail	3	0.72	1.44	0.91	3.00
Heteranthera dubia	Water star-grass	2	0.48	0.96	0.61	1.00
Nuphar variegata	Spatterdock	2	0.48	0.96	0.61	1.50
Sparganium angustifolium	Narrow-leaved bur-reed	2	0.48	0.96	0.61	1.50
Brasenia schreberi	Watershield	1	0.24	0.48	0.30	1.00
Lemna trisulca	Forked duckweed	1	0.24	0.48	0.30	1.00
Polygonum amphibium	Water smartweed	1	0.24	0.48	0.30	2.00
Ranunculus aquatilis	White water crowfoot	1	0.24	0.48	0.30	1.00
Stuckenia pectinata	Sago pondweed	1	0.24	0.48	0.30	1.00
Utricularia vulgaris	Common bladderwort	1	0.24	0.48	0.30	1.00
Zizania palustris	Northern wild rice	1	0.24	0.48	0.30	1.00

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes Posttreatment Survey Minong Flowage, Washburn and Douglas Counties July 3-4, 2011

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Ceratophyllum demersum	Coontail	69	22.04	47.59	23.39	22.04
Potamogeton robbinsii	Fern pondweed	48	15.34	33.10	16.27	15.34
Vallisneria americana	Wild celery	42	13.42	28.97	14.24	13.42
Potamogeton pusillus	Small pondweed	40	12.78	27.59	13.56	12.78
Myriophyllum spicatum	Eurasian water milfoil	22	7.03	15.17	7.46	7.03
Potamogeton zosteriformis	Flat-stem pondweed	18	5.75	12.41	6.10	5.75
Potamogeton crispus	Curly-leaf pondweed	10	3.19	6.90	3.39	3.19
Zizania palustris	Northern wild rice	9	2.88	6.21	3.05	2.88
Elodea canadensis	Common waterweed	8	2.56	5.52	2.71	2.56
Sparganium angustifolium	Narrow-leaved bur-reed	6	1.92	4.14	2.03	1.92
Nuphar variegata	Spatterdock	5	1.60	3.45	1.69	1.60
Nymphaea odorata	White water lily	5	1.60	3.45	1.69	1.60
Potamogeton amplifolius	Large-leaf pondweed	5	1.60	3.45	1.69	1.60
Stuckenia pectinata	Sago pondweed	5	1.60	3.45	1.69	1.60
	Aquatic moss	4		2.76	1.36	
Brasenia schreberi	Watershield	4	1.28	2.76	1.36	1.28
Typha latifolia	Broad-leaved cattail	3	0.96	2.07	1.02	0.96
Bidens beckii	Water marigold	2	0.64	1.38	0.68	0.64
	Filamentous algae	2		1.38	0.68	
Myriophyllum sibiricum	Northern water milfoil	2	0.64	1.38	0.68	0.64
Heteranthera dubia	Water star-grass	1	0.32	0.69	0.34	0.32
Nitella sp.	Nitella	1	0.32	0.69	0.34	0.32
Polygonum amphibium	Water smartweed	1	0.32	0.69	0.34	0.32
Potamogeton natans	Floating-leaf pondweed	1	0.32	0.69	0.34	0.32

Table 4 cont': Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey Minong Flowage, Washburn and Douglas Counties
July 3-4, 2011

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton praelongus	White-stem pondweed	1	0.32	0.69	0.34	0.32
Potamogeton richardsonii	Clasping-leaf pondweed	1	0.32	0.69	0.34	0.32
Potamogeton vaseyi	Vasey's pondweed	1	0.32	0.69	0.34	0.32
Ranunculus aquatilis	White water crowfoot	1	0.32	0.69	0.34	0.32
Spirodela polyrhiza	Large duckweed	1	0.32	0.69	0.34	0.32
Utricularia vulgaris	Common bladderwort	1	0.32	0.69	0.34	0.32

Fall EWM Bed Mapping Survey:

Despite the total acreage decline in 2010, by the October bed mapping survey, an expanded littoral zone (apparently due to improved water clarity throughout the growing season) had allowed EWM to expand into many areas where it had not previously been seen (Beds 20B, 20C, etc.). Following a winter with deep snow cover and a return to more "normal" clarity on the flowage throughout the 2011 growing season, EWM disappeared from most of the areas it had newly colonized the previous fall. It also showed a marked pull back along the littoral edges of historic beds regardless of whether they were treated with herbicide in 2011 or not.

On October 8th, 2011, we located and mapped a total of 28 beds on the flowage ranging in size from 0.05 acre (Beds 17A, 18 and 18B) to a combined 77.22 acres (Beds 21 and 22) (Figure 13) (Appendix VIII). In total, these beds covered 80.95 acres (Table 5). This represented a decline of 82.79 acres over 2010's 163.74 acres and a total decline of 244.80 acres over 2008's initial 325.75 total acres. In other words, three year's treatments have resulted in an approximately 75% reduction in the total EWM bed acreage on the flowage. Despite this continued positive change, it should be kept in mind that at least some of this reduction must be attributed to 2011 growing conditions.

In the south basin, Bed 1 continues to act as a colander by straining out passing fragments and providing suitable habitat for EWM to establish on. The bed is filling in from the north side moving southward, and it likely deserves treatment consideration again in 2012. Beds 5, 5A, and 5B continue to be mixed with natives and are borderline between an EWM bed and just a "high density area". However, treating them may eliminate one of the last source populations in the area. The same could be said for Beds 7B, 7D, 10, 10A, 15, 17, and 17A – small EWM beds that, although not significant on their own, continue to source out fragments to surrounding areas.

Similar to Bed 1, Beds 11, 12, 14A, 14B, 14C, and 18 seem to trap fragments and reestablish each year. These areas all deserve treatment consideration in 2012. Outside of the aforementioned beds, the rest of the southern basin was essentially EWM free.

In Serenity Bay, we again noted inward shrinkage of the "super bed" in July following treatment with most of these areas remaining clear into the fall. With another treatment in Bed 21 west of the island in 2012, EWM could conceivable be eliminated (at least in bed form) west of the bay. On the downside, EWM continues to expand into the rice on the northeast end of Bed 21B. Also of concern, clusters of EWM that we noted in July had begun to merge along the majority of the south and southeast shoreline of the bay (Beds 22A, 22C-F). Although not dense or truly continuous, we believe they will likely require treatment in 2012 based on past growth patterns of EWM in this area.

East of Smith's Bridge, we found a handful of plants in the core of the former Bed 23C. The rest of the area seemed to have been cleared of EWM by the fall 2010 herbicide treatment, and we didn't see any fragments floating anywhere east of the bridge. Although anecdotal, we also noted this reduction in floating fragments throughout the flowage. In the past, numerous fragments have been encountered throughout the south basin in the fall, but we only noticed a handful in 2011. Outside of Serenity Bay, the little finger bay that formerly contained Bed 21C, and near the CTH T Bridge, we saw little to no evidence of EWM fragmentation.

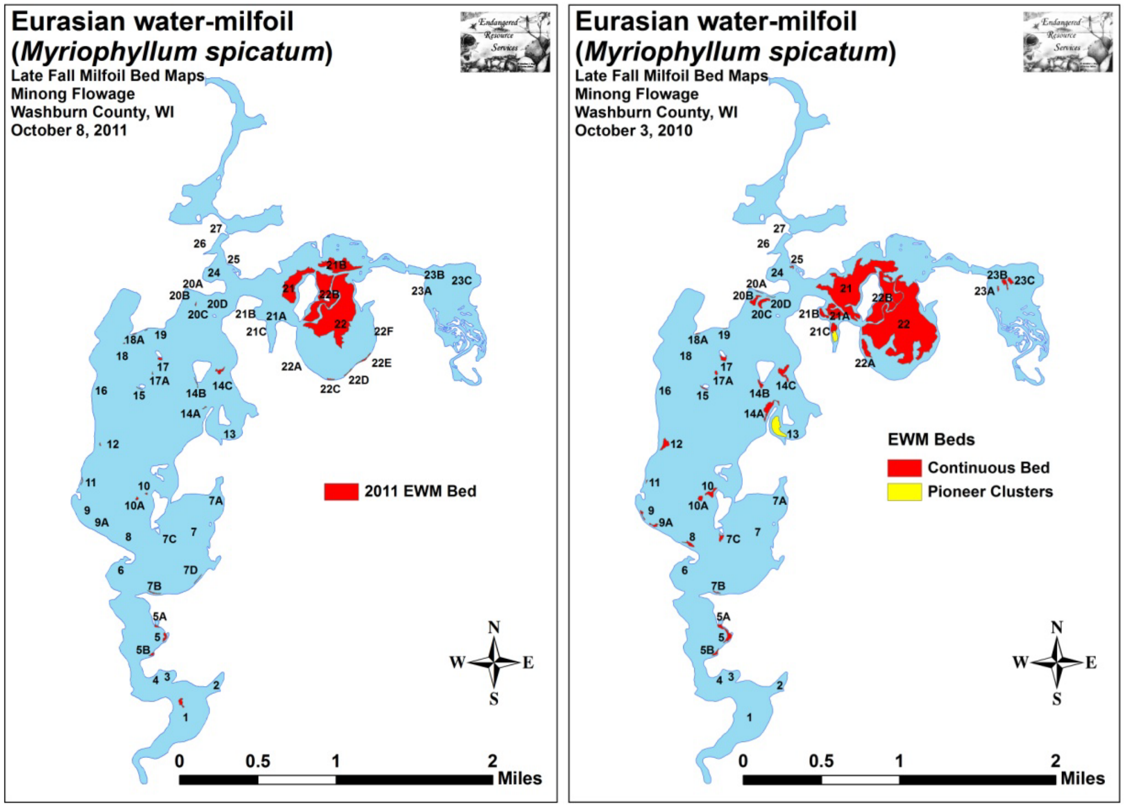


Figure 13: 2011 and 2010 Fall EWM Bed Maps

Table 5: Fall Eurasian Water Milfoil Bed Mapping Summary
Minong Flowage, Washburn and Douglas Counties
October 8, 2011

Bed Number	2011 Area in Acres	2010 Area in Acres	2009 Area in Acres	2011 Change in Acreage	Estimated 2011 Mean Rakefull	2011 Bed Characteristics/Field Notes
1	0.64	0	2.11	0.64	<1-2	Recolonizing on north end of the bed; otherwise scattered
2	0	0	0	0	<1	Handful of plants along the north shore of bay.
3	0	0	0	0	0	Almost no plants found.
4	0	0	0	0	0	Almost no plants found.
5A and 5	0.70	1.55	1.08	-0.85	<1-1	EWM/NWM mixed; patchy but continuous.
5B	0.24	0.36	0	-0.12	<1-1	Canopied ribbon of NWM with EWM mixed in
6	0	0	0	0	0	Found 3 total plants in bay by the county park.
7	0	0	1.26	0	0	Almost no EWM plants left anywhere along east shoreline.
7A	0	0	1.19	0	0	We did not see a single plant in the finger bay.
7B	0.24	0.17	0	0.07	<1-1	Very narrow, low density, but monotypic ribbon
7C	0	0.52	0	-0.52	0	Found 2 total plants on this point.
7D	0.12	0	0	0.12	<1-1	Very narrow, low density, but monotypic ribbon
8	0	0.58	0	-0.58	0	We saw 1 EWM plant in entire bed; rest celery to 4ft. only
9 and 9A	0	0.66	0	-0.66	0	We did not see an EWM plant in the entire area
10	0.07	1.05	0	-0.98	1-2	No EWM deeper than 4ft – Only celery outside polygon.
10A	0.16	0.51	0	-0.35	2-3	Small but dense bed – littoral zone has shrunk sig. since ‘10
11	0.09	0.06	0	0.03	1-2	5-10m wide strip in 2-4ft of water only.
12	0.07	1.26	0.17	-1.19	2	Plants in 4ft of water only. Dense and treatable.
13	0	2.89	2.89	-2.89	0-<1	The back bay by the boat landing had only a handful of ind.
14A	0.09	2.15	0	-2.06	1	EWM low density and sickly-covered with filamentous; <5ft.
14B	0.11	0.54	0	-0.43	<1-2	Highly variable - <5ft. Potentially treatable
14C	0.63	1.83	0	-1.2	<1-2	Highly variable - <5ft. Potentially treatable
15	0.06	0.20	0	-0.14	1-2	EWM in 4ft or less.
16	0	0	0	0	0	Almost no plants found.

Table 5 cont': Fall Eurasian water-milfoil Bed Mapping Data
Minong Flowage, Washburn and Douglas Counties
October 8, 2011

Bed Number	2011 Area in Acres	2010 Area in Acres	2009 Area in Acres	2011 Change in Acreage	Estimated 2011 Mean Rakefull	2011 Bed Characteristics/Field Notes
17	0.22	0.58	0	-0.36	<1-1	Highly variable bed around island; lots of natives mixed in.
17A	0.05	0.22	0	-0.17	1-2	Restricted to 4ft of water.
18	0.05	0	0.94	0.05	2	Reestablishing on former bed; treatable.
18A	0.08	0.09	0	-0.01	2-3	Shallow bed; dense and nearly monotypic – treatable.
18B	0.05	0	0	0.05	2-3	Shallow bed; dense and nearly monotypic – treatable.
19	0	0.04	0	-0.04	0	Almost no plants found.
20A	0	0.09	0	-0.09	0	Handful of EWM; Dominated by Clasp-leaf pond/celery.
20B	0	1.11	0	-1.11	0	Nothing visible or found in random rake samples.
20C	0.08	1.23	0	-1.15	<1-2	7ft; Mostly <1; EWM monotypic; sickly/barely alive/dying.
20D	0	0.07	0	-0.07	0	Few widely scattered plants in 3ft.
21+22	77.22	144.35	211.49	-67.13	<1-3	Highly variable; EWM in 21B expanding to NE into rice bed
23A, B, and C	0	1.46	4.95	-1.46	0	A few scattered EWM plants at the core of 23A.
24	0	0	1.71	0	0	Few rooted plants but EWM frags common to CTH Bridge
25	0	0.17	0	-0.17	0	Few scattered plants; nothing on outer litteral ½ of 2010 bed.
26	0	0	0	0	0	Almost no plants found.
27	0	0	0	0	0	Almost no plants found.
Total	**80.95**	**163.74**	**227.79**	**-82.79**		

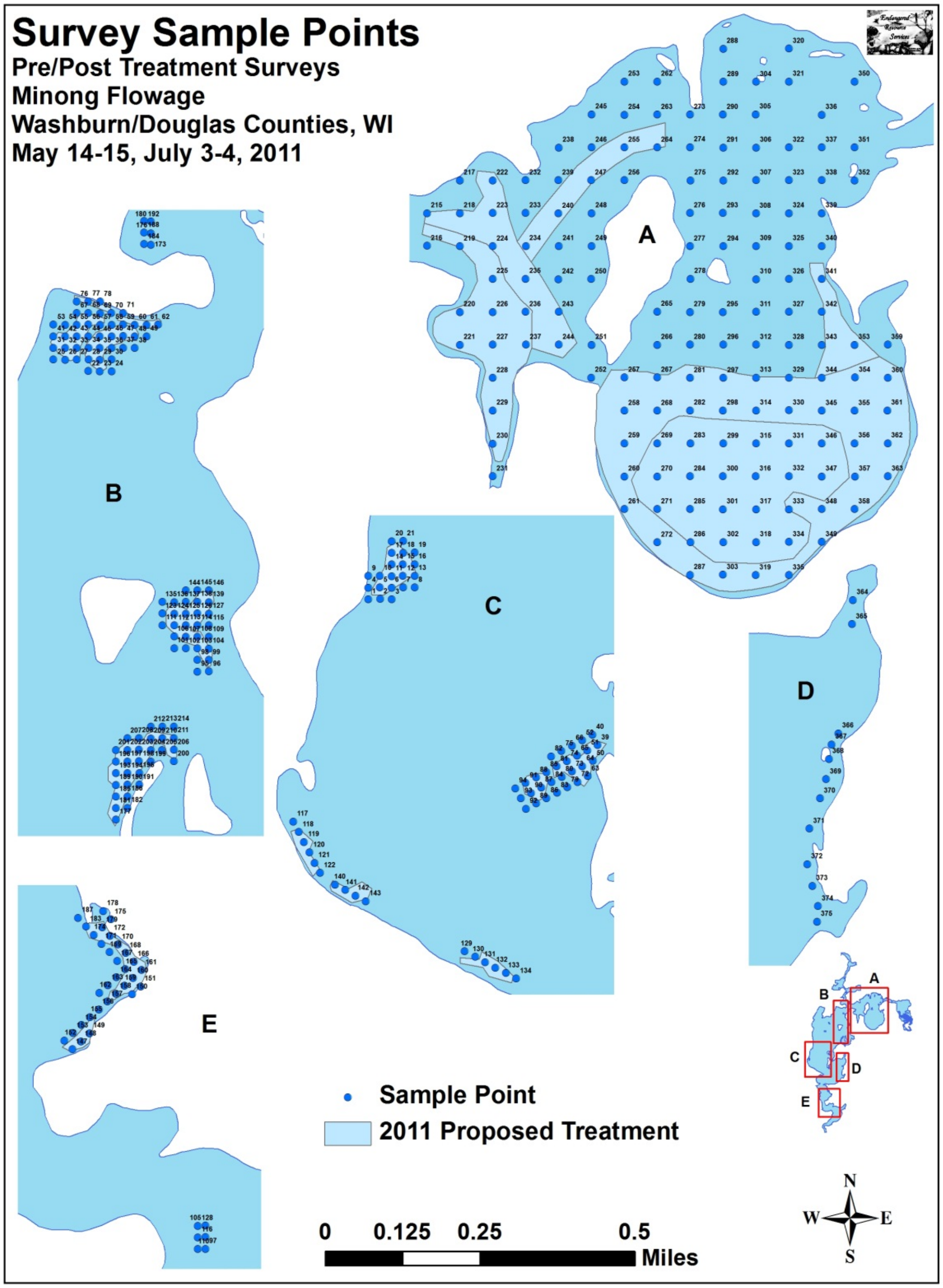
LITERATURE CITED

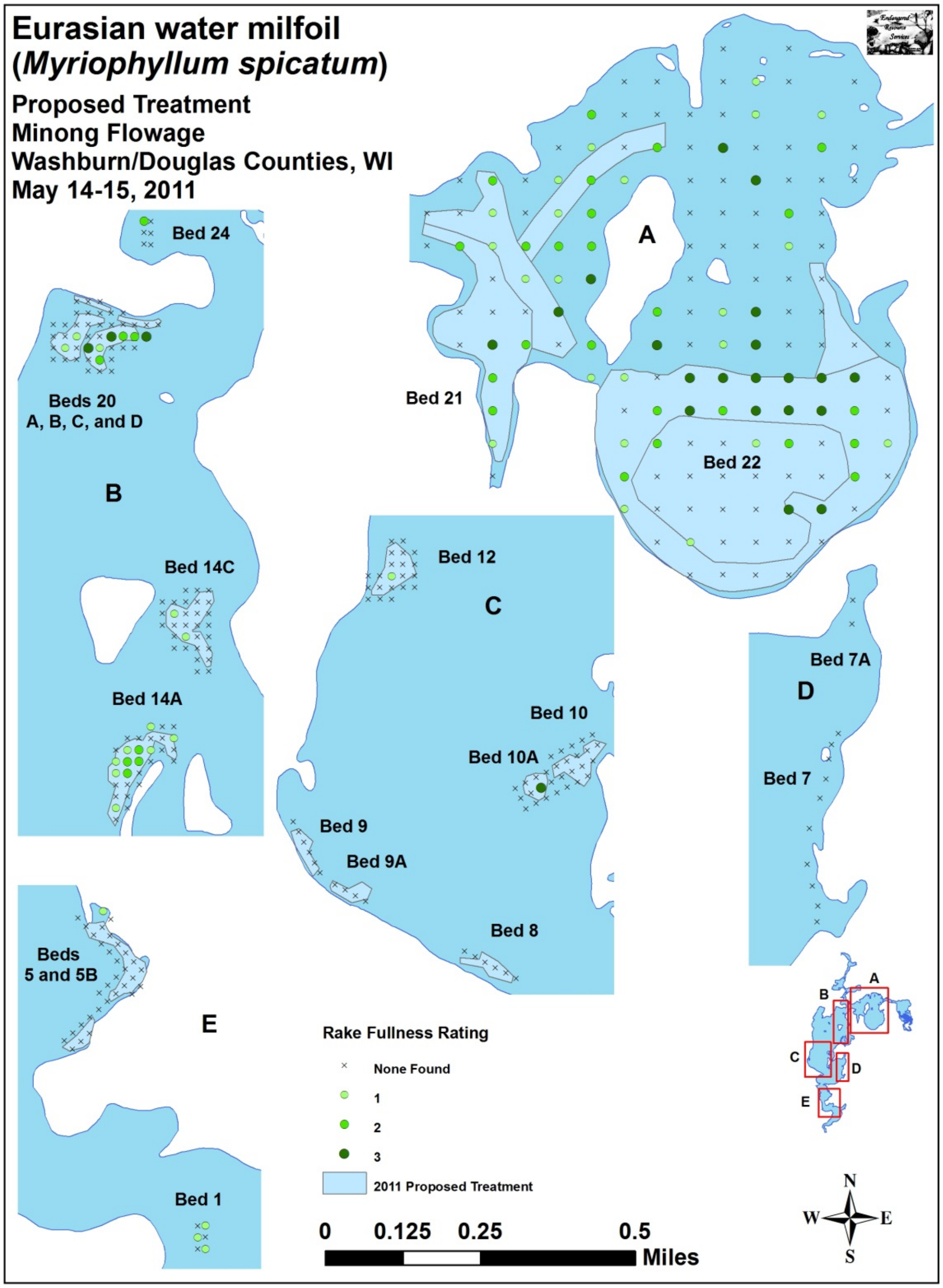
UWEX Lakes Program. [online]. 2011. Aquatic Plant Management in Wisconsin. Available from http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp (2011, November).

UWEX Lakes Program. [online]. 2011. Pre/Post Herbicide Comparison. Available from http://dnr.wi.gov/org/water/fhp/lakes/PrePostEvaluation.pdf (2011, November).

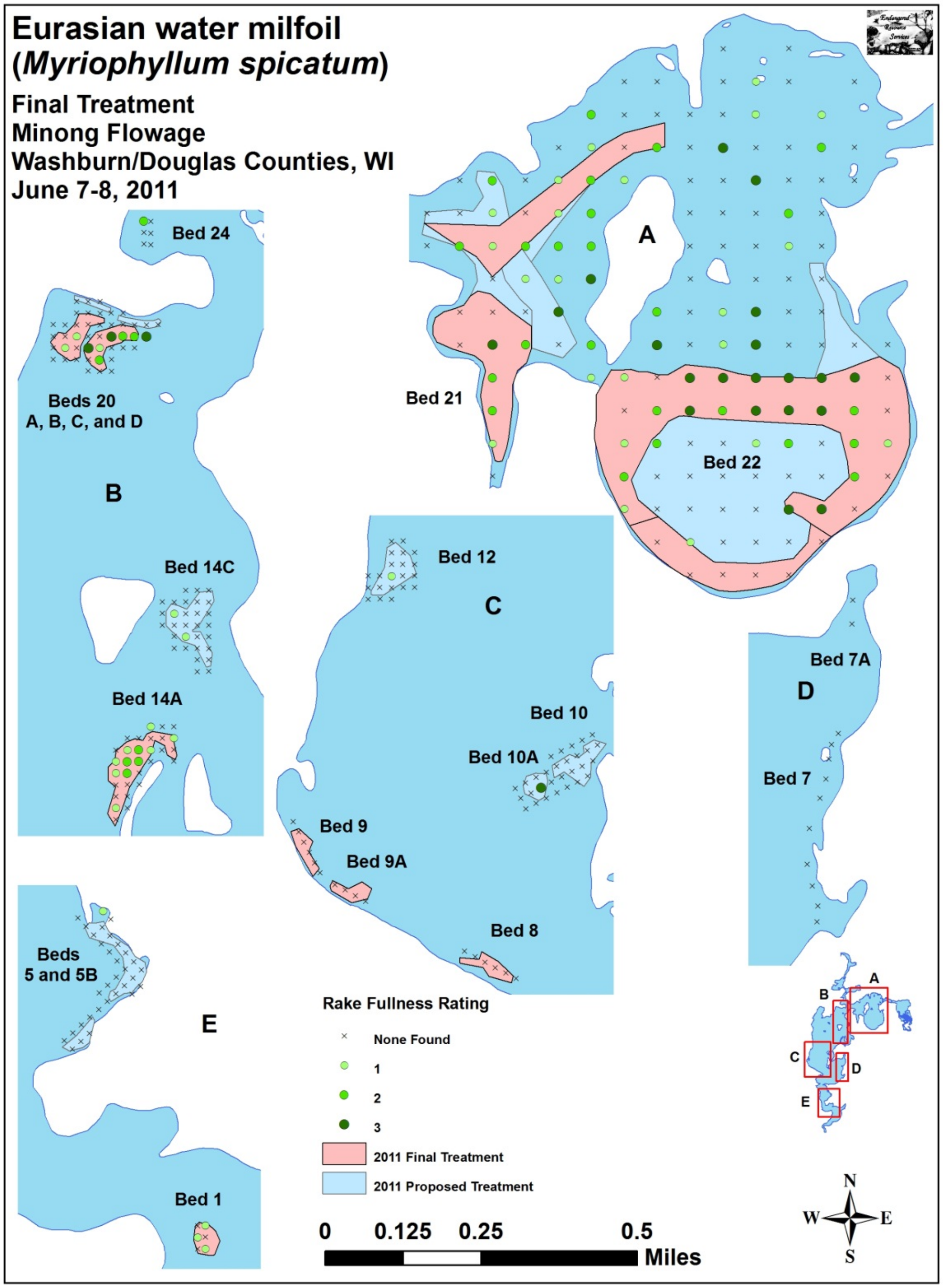
WDNR. [online]. 2011. Citizen Monitoring Lake Water Quality Database. Available from http://dnr.wi.gov/lakes/CLMN/Station.aspx?id=163247 (2011, November).

Appendix I: Survey Sample Points and EWM Treatment Areas


Survey Sample Points
Pre/Post Treatment Surveys
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, July 3-4, 2011
A
B
C
D
E
Sample Point
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W



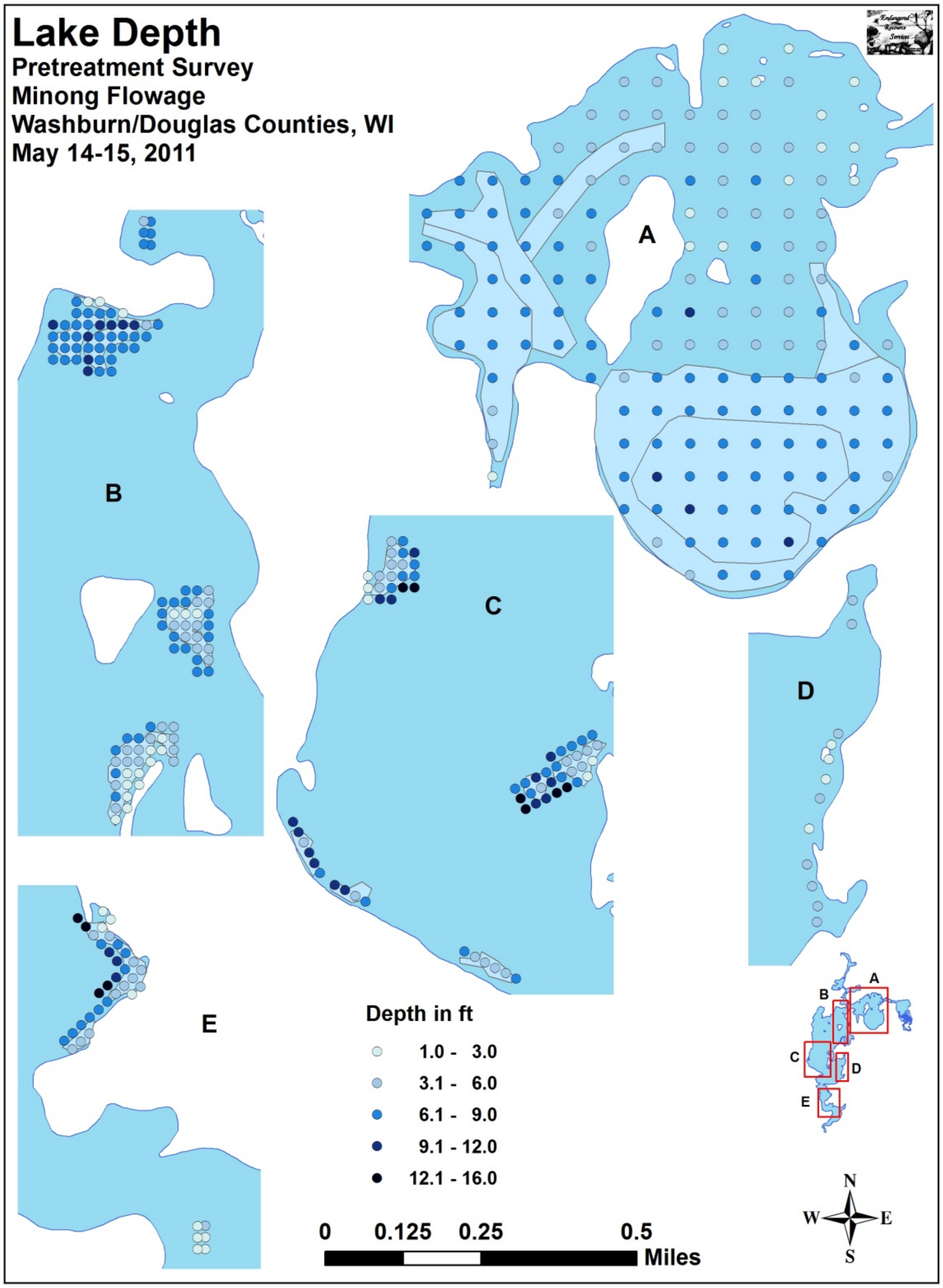
Eurasian water milfoil
(*Myriophyllum spicatum*)
Proposed Treatment
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Bed 24
Beds 20
A, B, C, and D
Bed 21
Bed 22
Bed 14C
Bed 14A
Bed 12
Bed 10
Bed 10A
Bed 9
Bed 9A
Bed 8
Bed 7A
Bed 7
Beds
5 and 5B
Bed 1
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

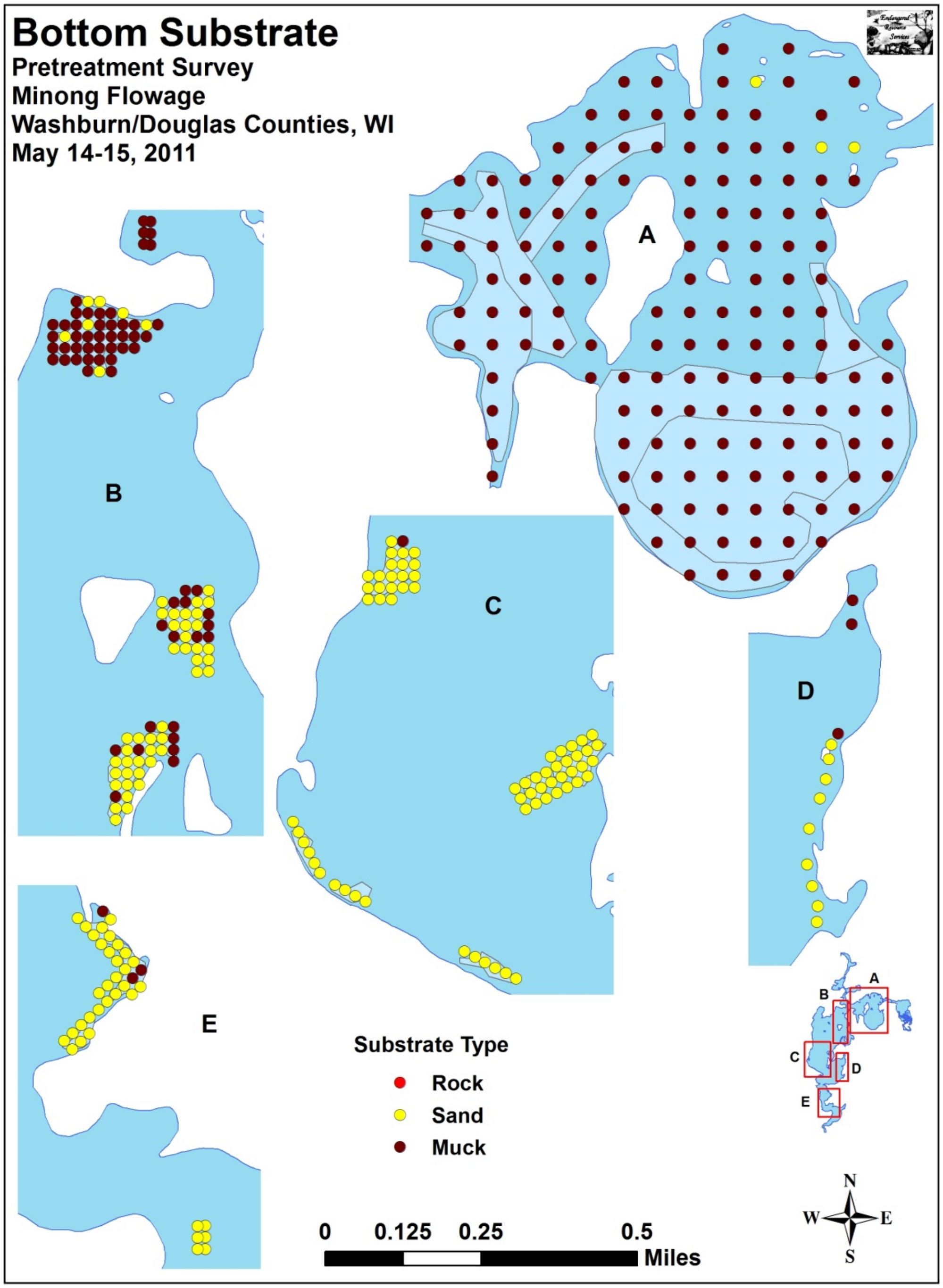

Eurasian water milfoil
(Myriophyllum spicatum)
Final Treatment
Minong Flowage
Washburn/Douglas Counties, WI
June 7-8, 2011
Bed 24
Beds 20
A, B, C, and D
B
Bed 14C
Bed 14A
A
Bed 21
Bed 22
Bed 12
C
Bed 10
Bed 10A
Bed 9
Bed 9A
Bed 8
Bed 7A
D
Bed 7
Beds
5 and 5B
E
Bed 1
Rake Fullness Rating
None Found
1
2
3
2011 Final Treatment
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

Appendix II: Vegetative Survey Data Sheet

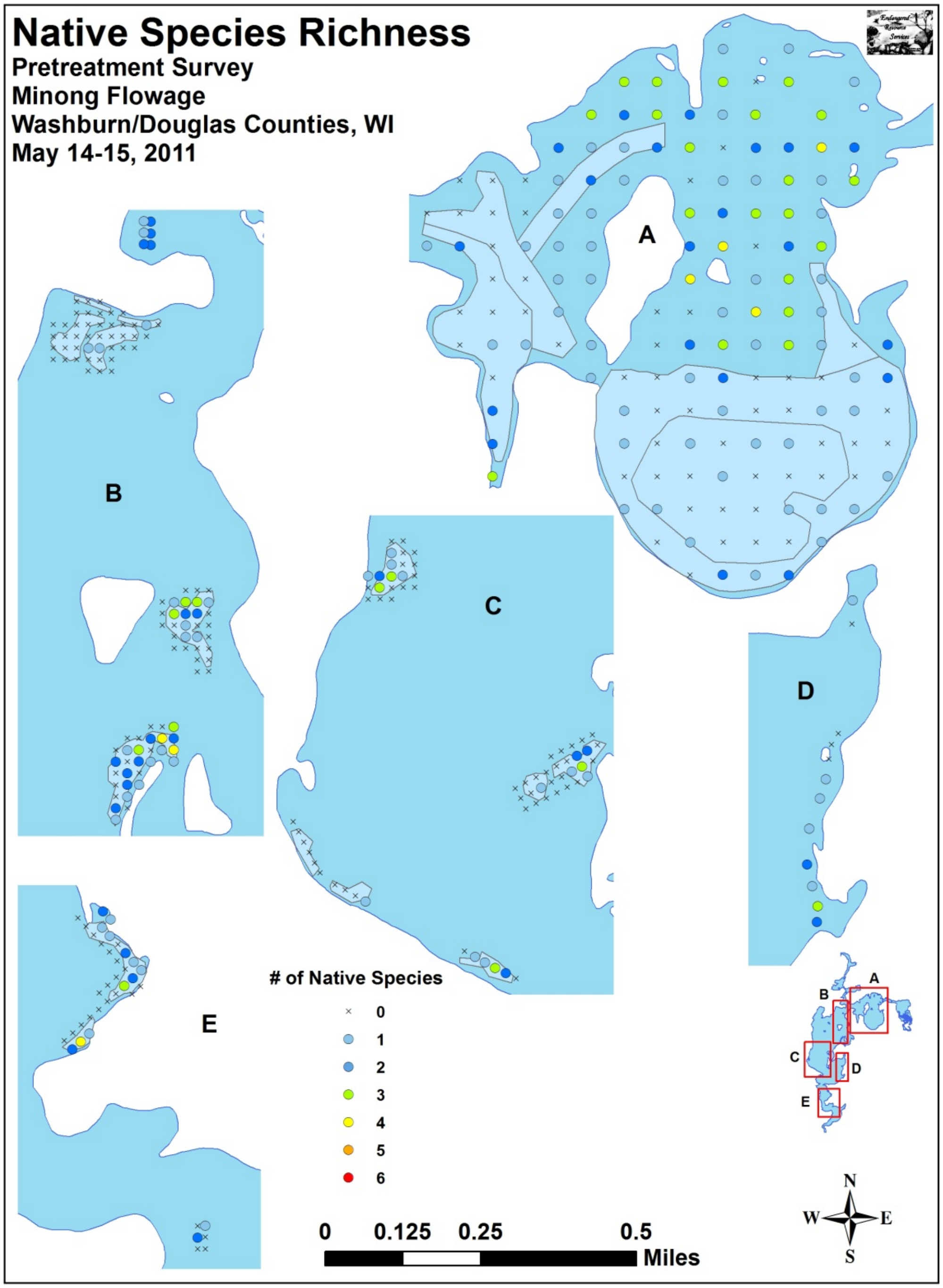
Observers for this lake: names and hours worked by each:																									
Lake:									**WBIC**									**County**						**Date:**	
Site #	**Depth (ft)**	**Muck (M), Sand (S), Rock (R)**	**Rake pole (P) or rake rope (R)**	**Total Rake Fullness**	**EWM**	**CLP**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									
20																									

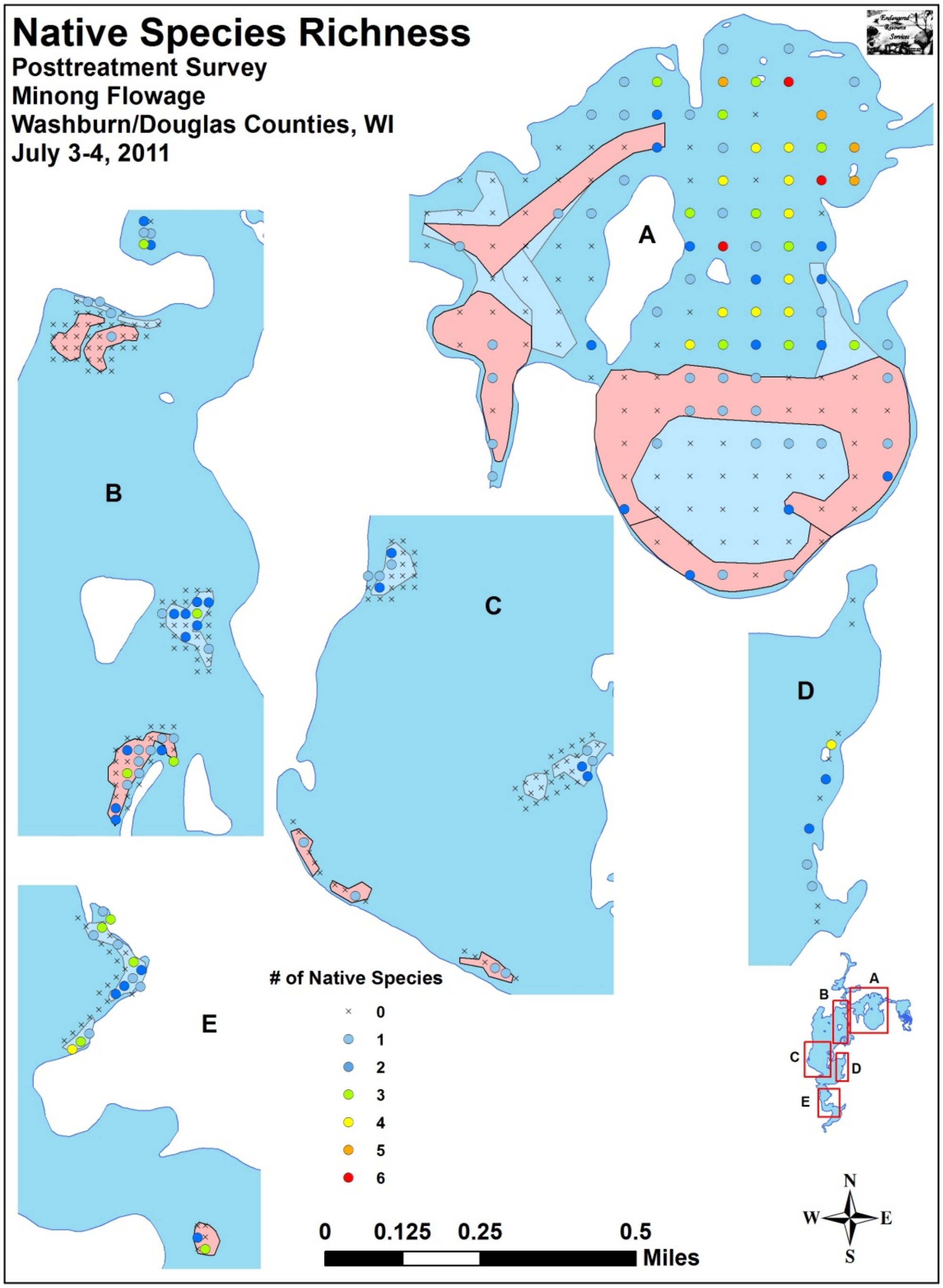
Appendix III: Pre/Post Habitat Variable Maps

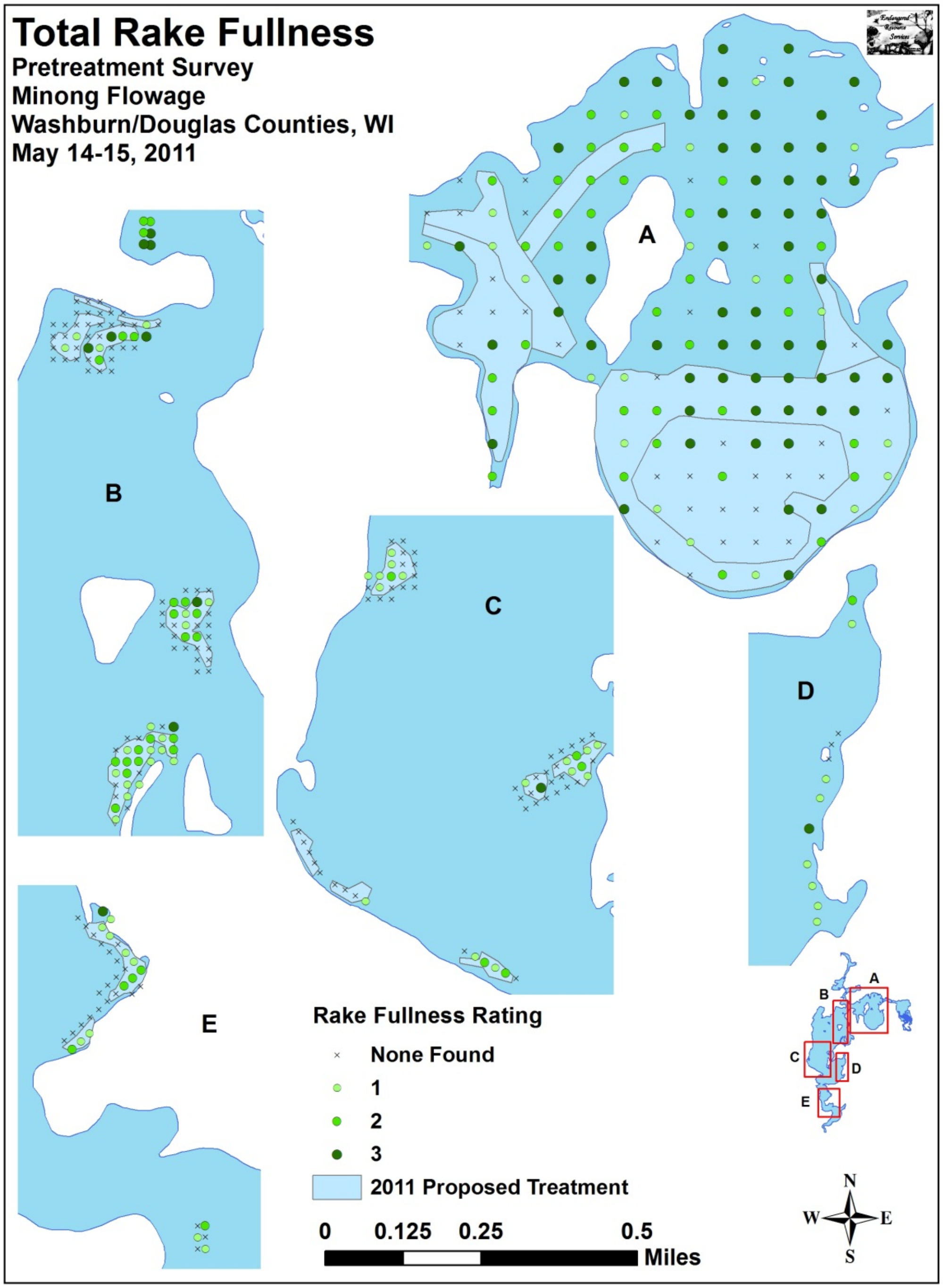

Lake Depth
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Depth in ft
1.0 - 3.0
3.1 - 6.0
6.1 - 9.0
9.1 - 12.0
12.1 - 16.0
0
0.125
0.25
0.5
Miles
N
W
E
S

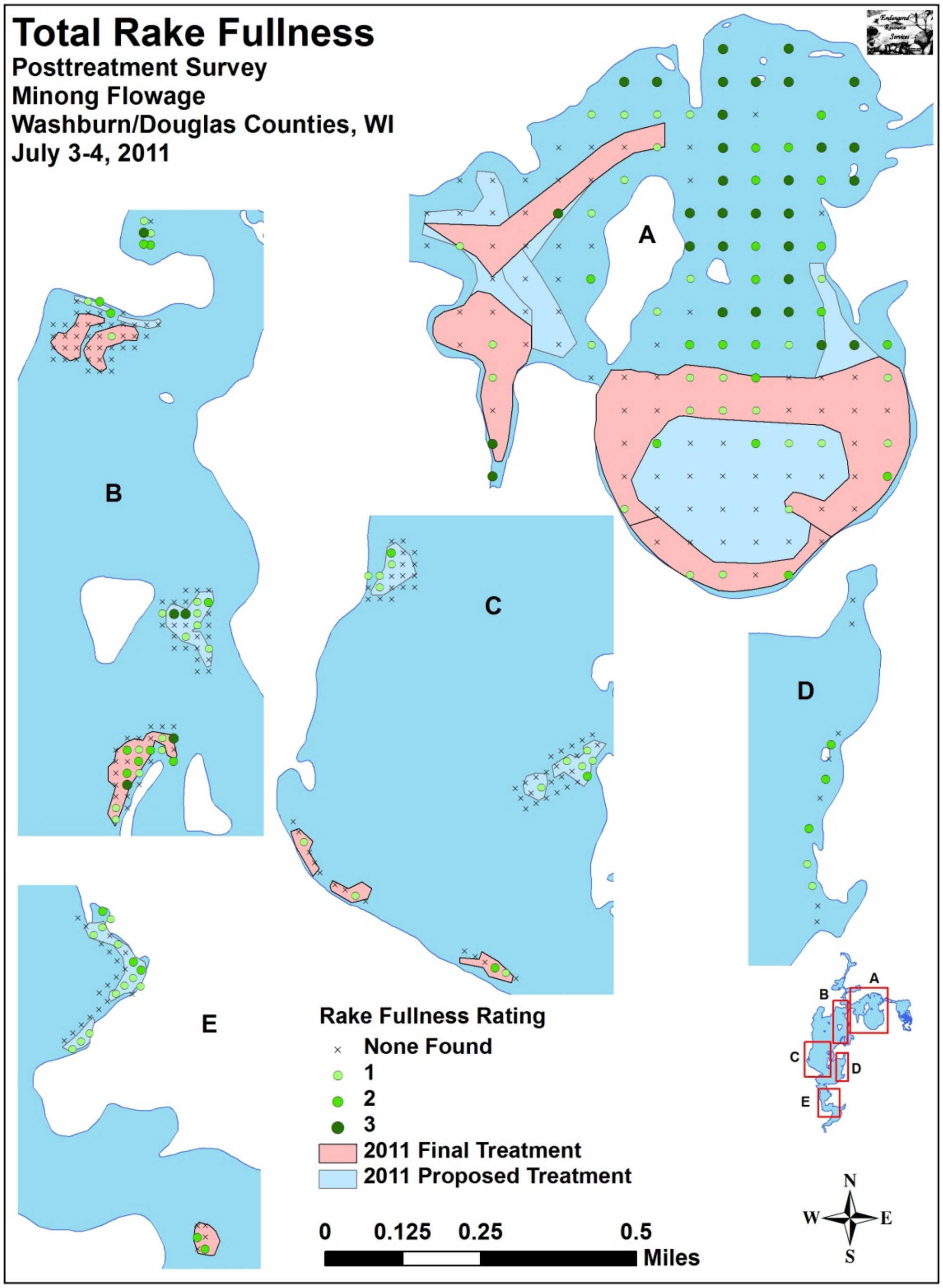

Bottom Substrate
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Substrate Type
Rock
Sand
Muck
0
0.125
0.25
0.5
Miles
N
W
E
S

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


Native Species Richness
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
# of Native Species
0
1
2
3
4
5
6
0
0.125
0.25
0.5
Miles
N
W
E
S

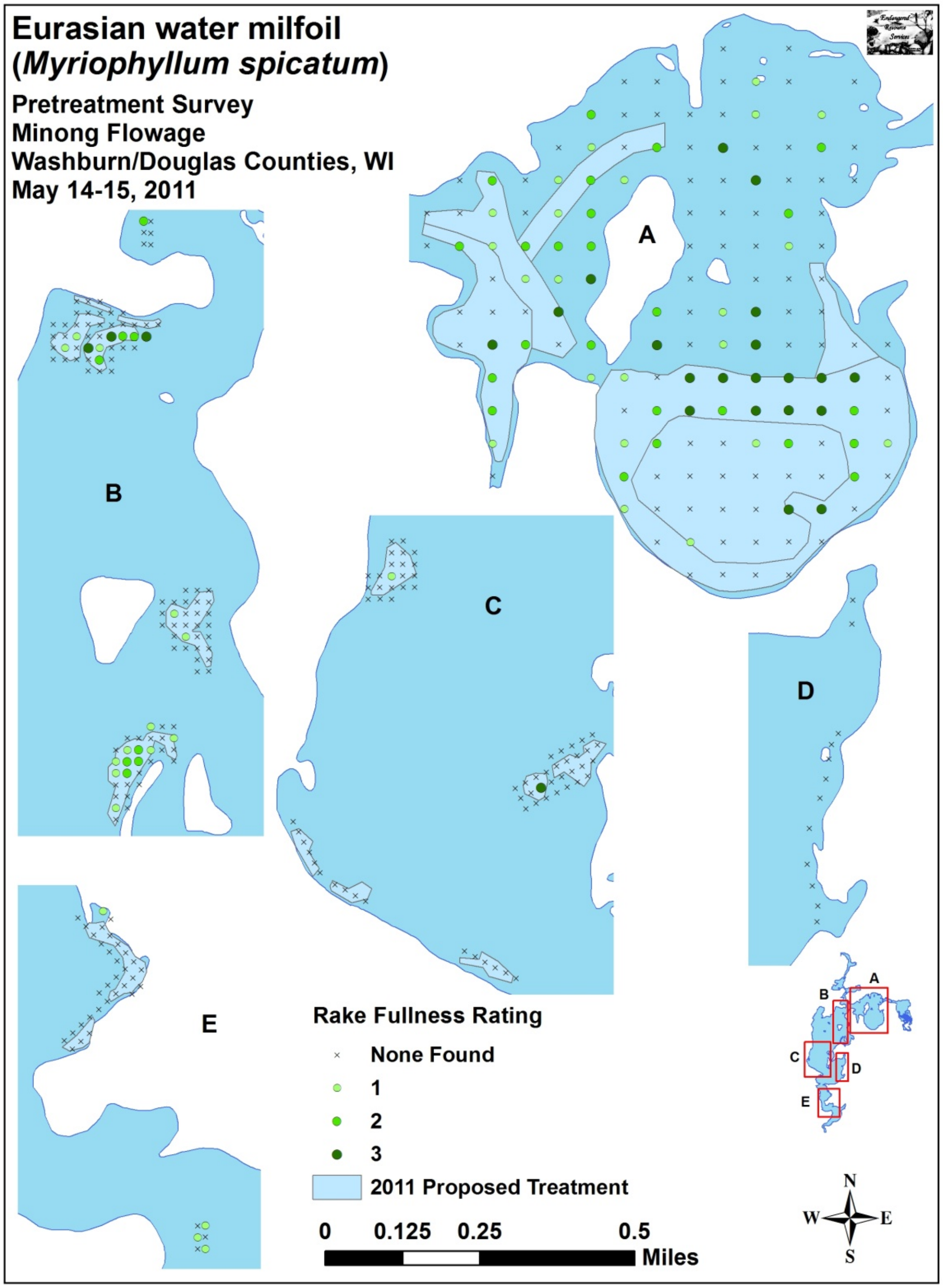

Native Species Richness
Posttreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
July 3-4, 2011
A
B
C
D
E
# of Native Species
0
1
2
3
4
5
6
0
0.125
0.25
0.5
Miles
N
W
E
S


Total Rake Fullness
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W

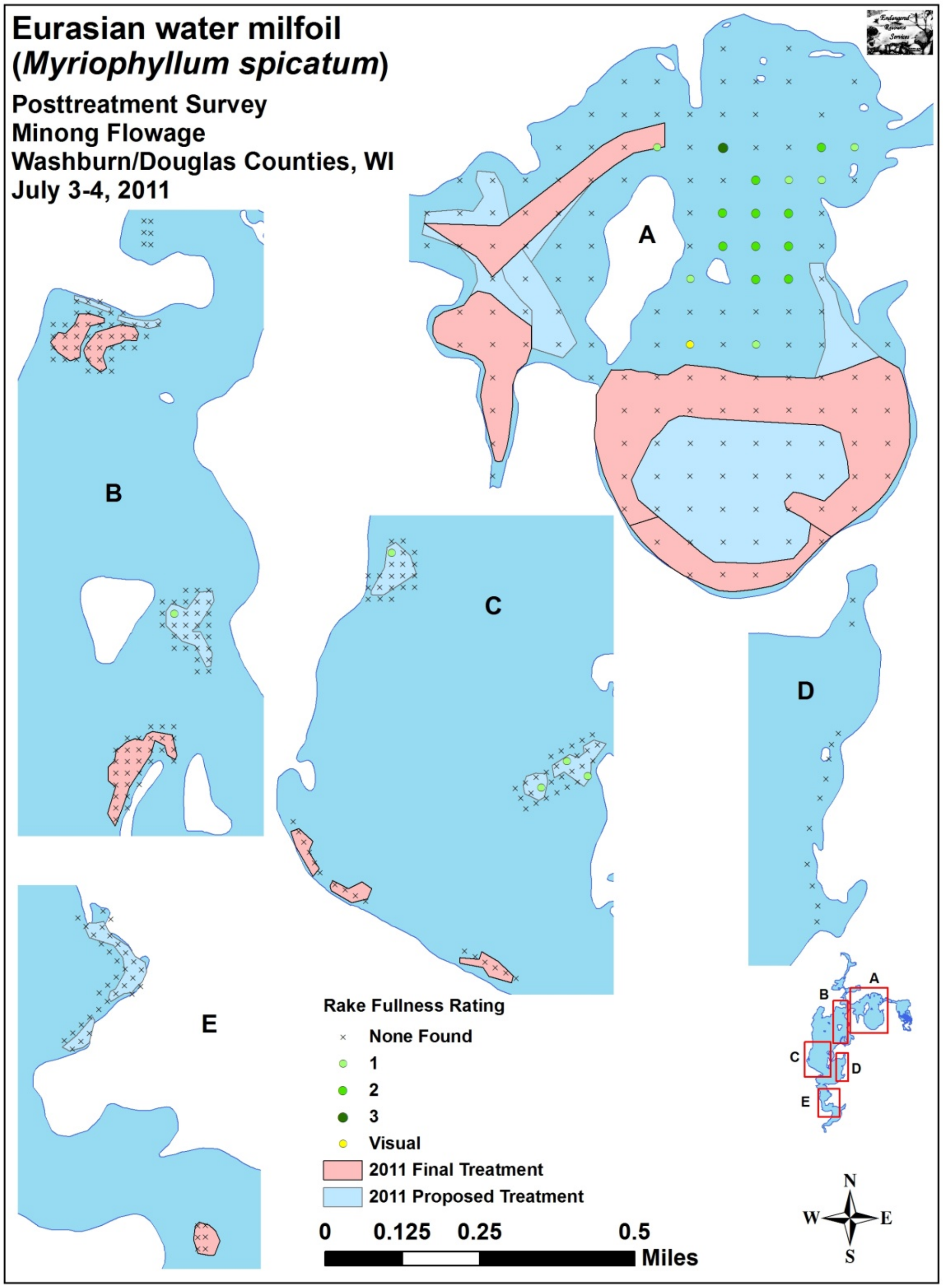


Total Rake Fullness
Posttreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
July 3-4, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Final Treatment
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

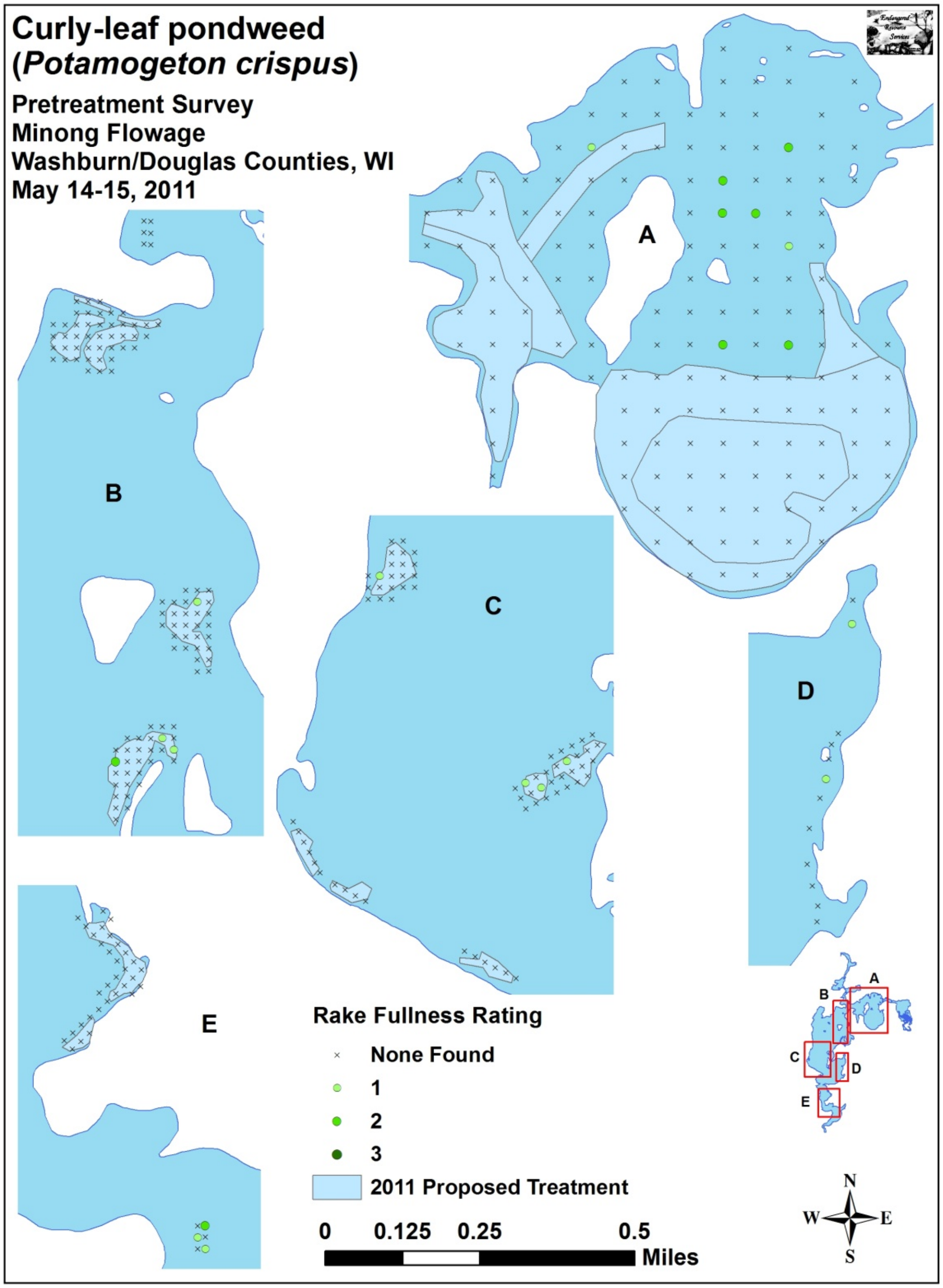
Appendix V: EWM and CLP Pre/Post Density and Distribution

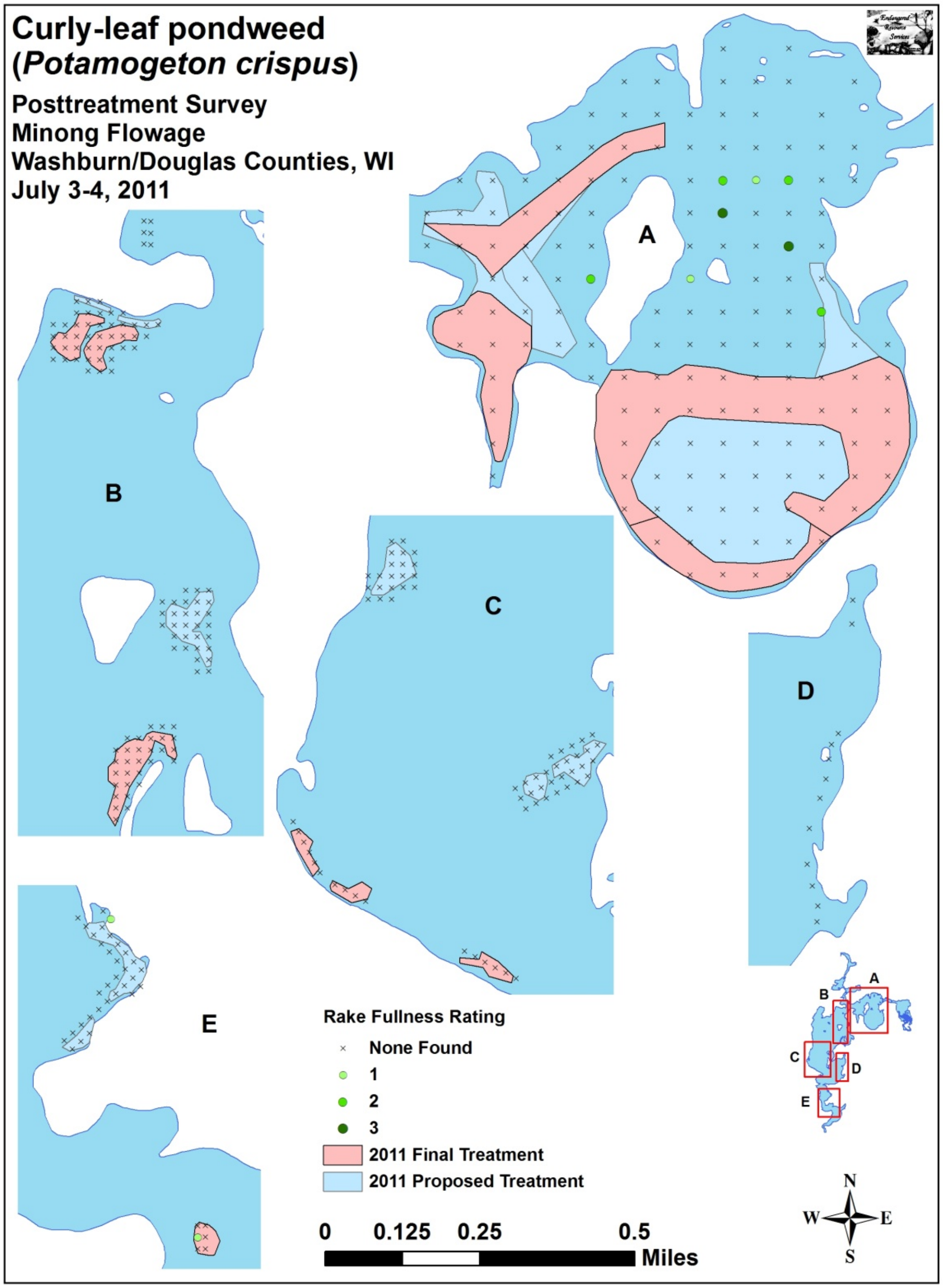


Eurasian water milfoil
(*Myriophyllum spicatum*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S



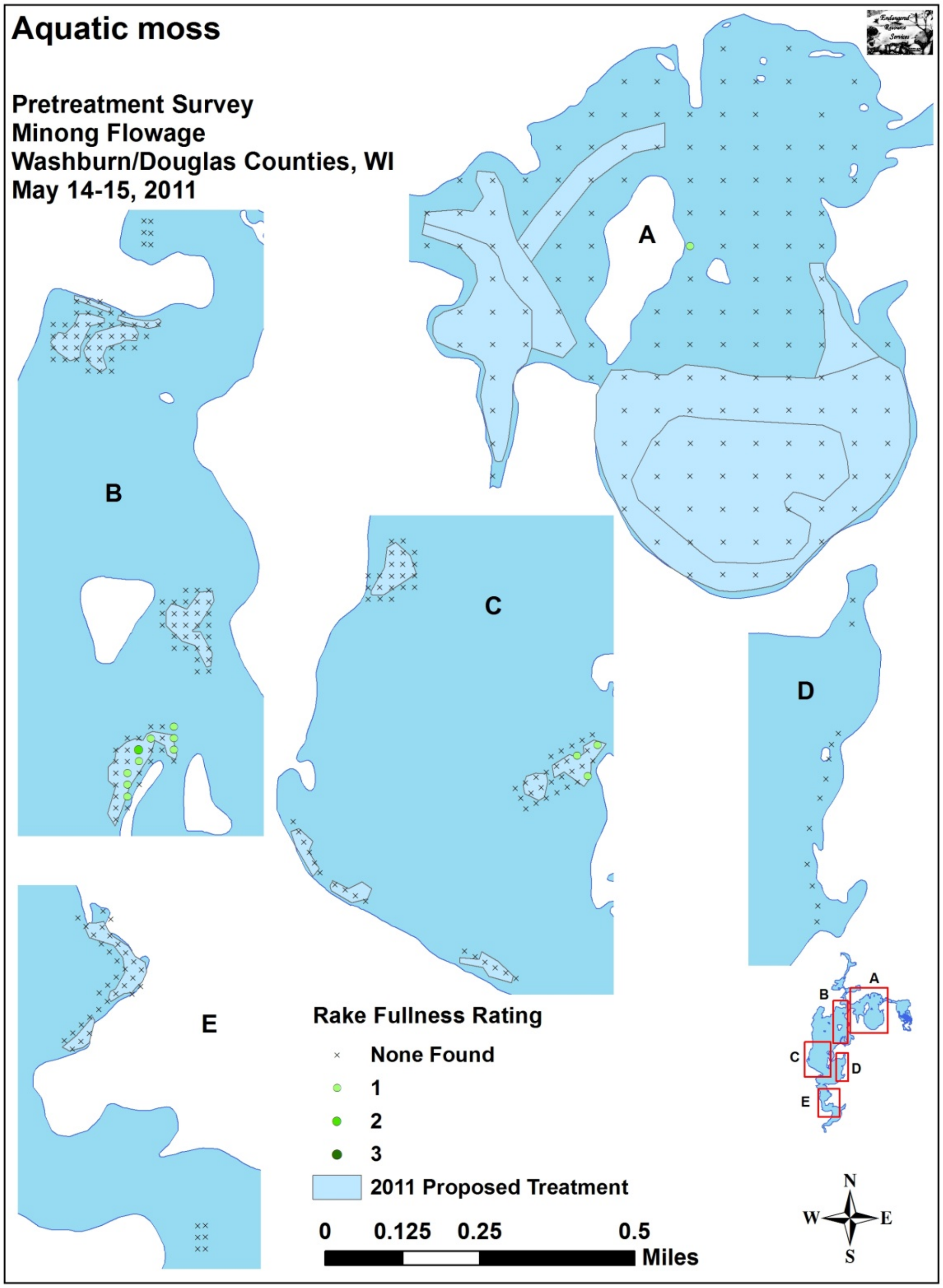
Eurasian water milfoil
(*Myriophyllum spicatum*)
Posttreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
July 3-4, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
Visual
2011 Final Treatment
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S

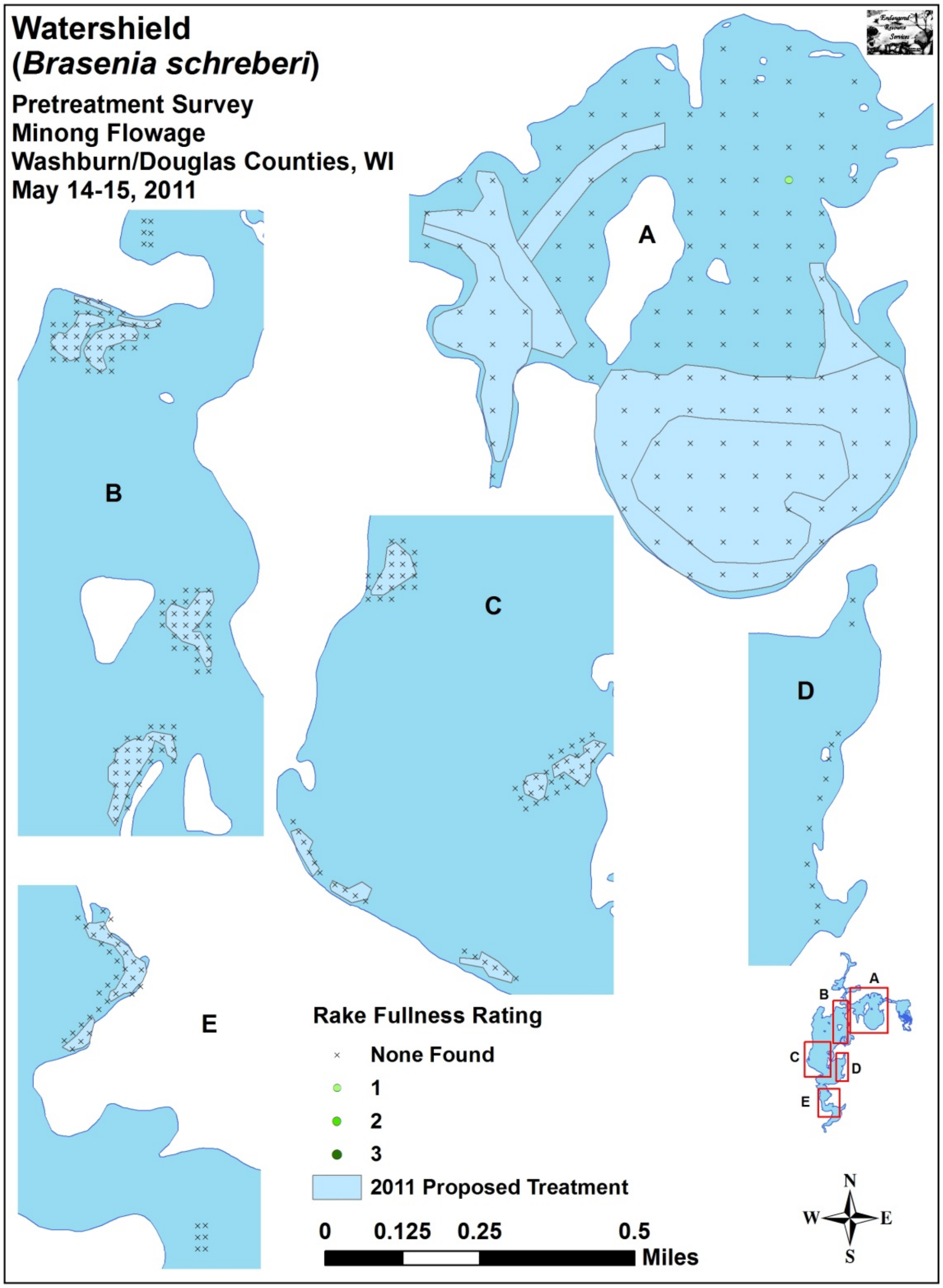

Curly-leaf pondweed
(Potamogeton crispus)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

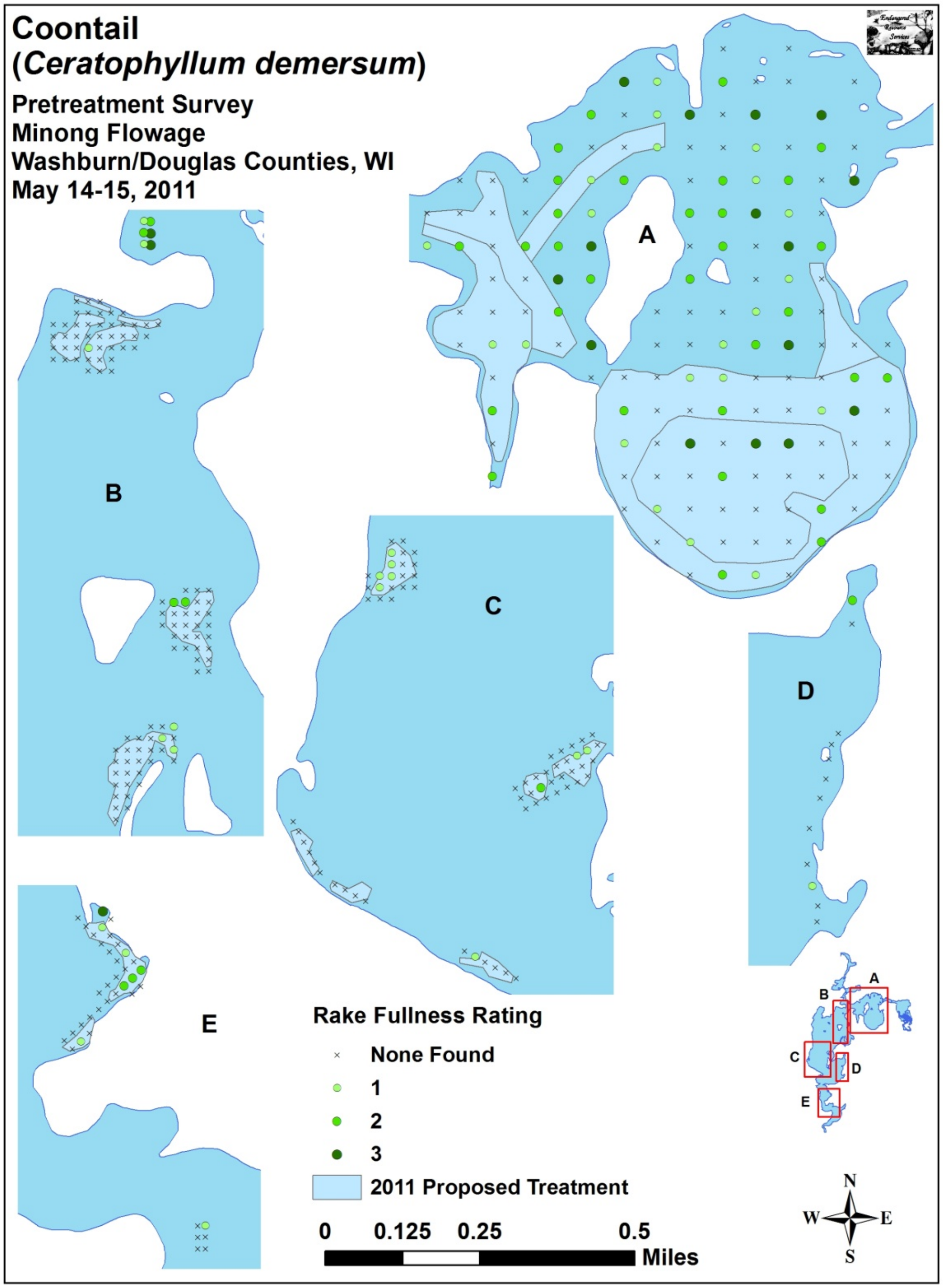


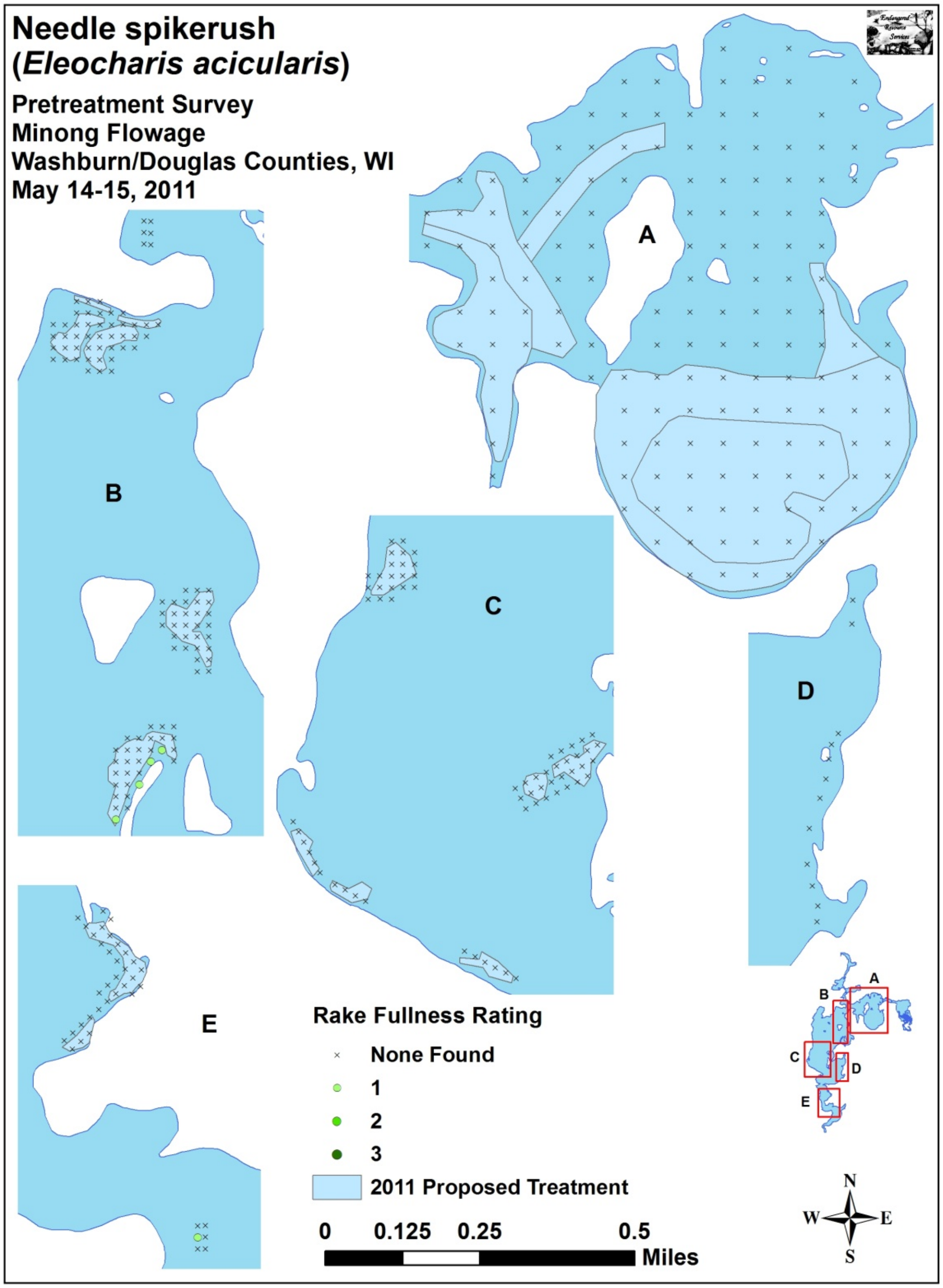
Curly-leaf pondweed
(*Potamogeton crispus*)
Posttreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
July 3-4, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Final Treatment
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W

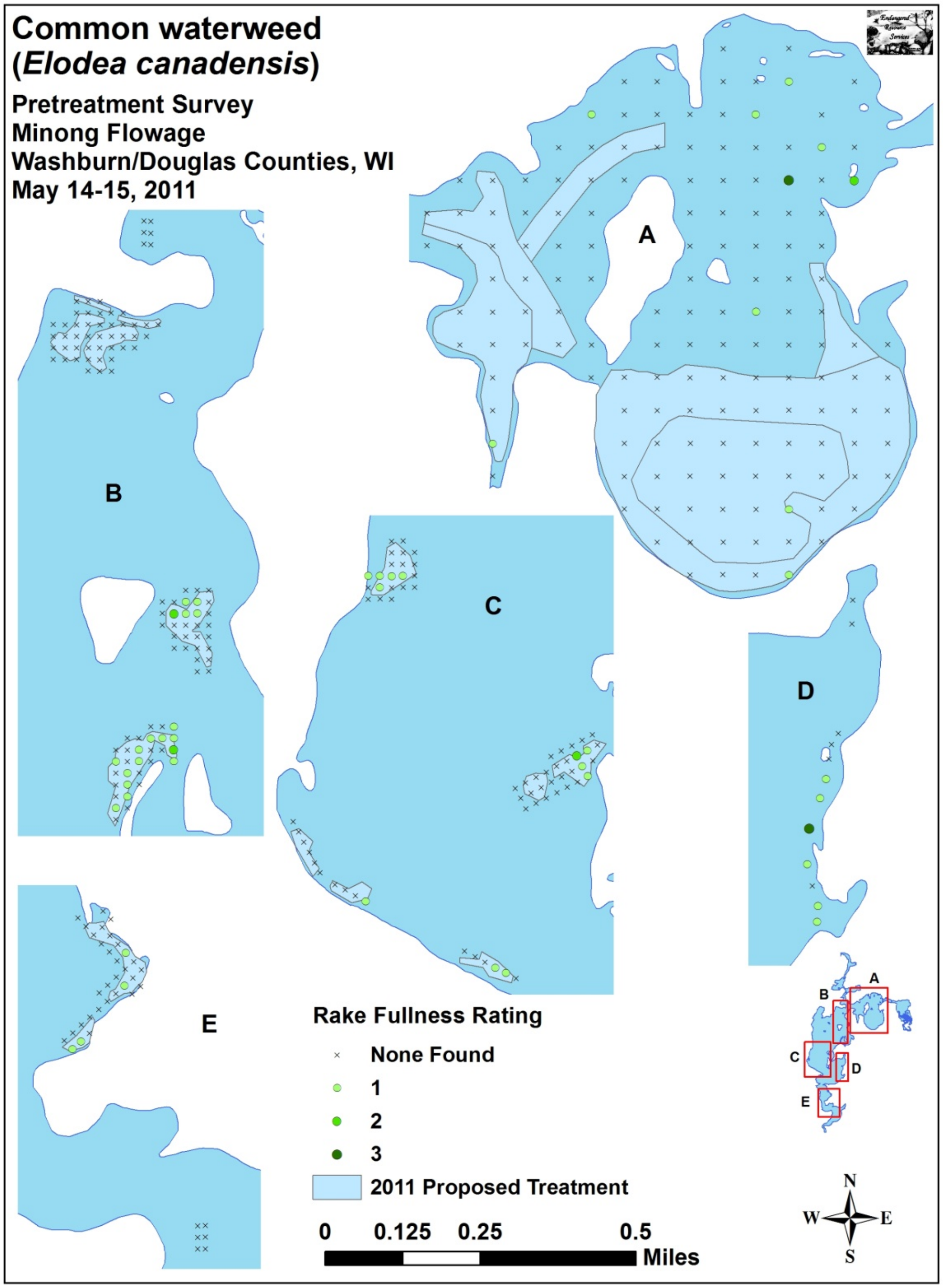
Appendix VI: Pretreatment Native Species Density and Distribution


Aquatic moss
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W

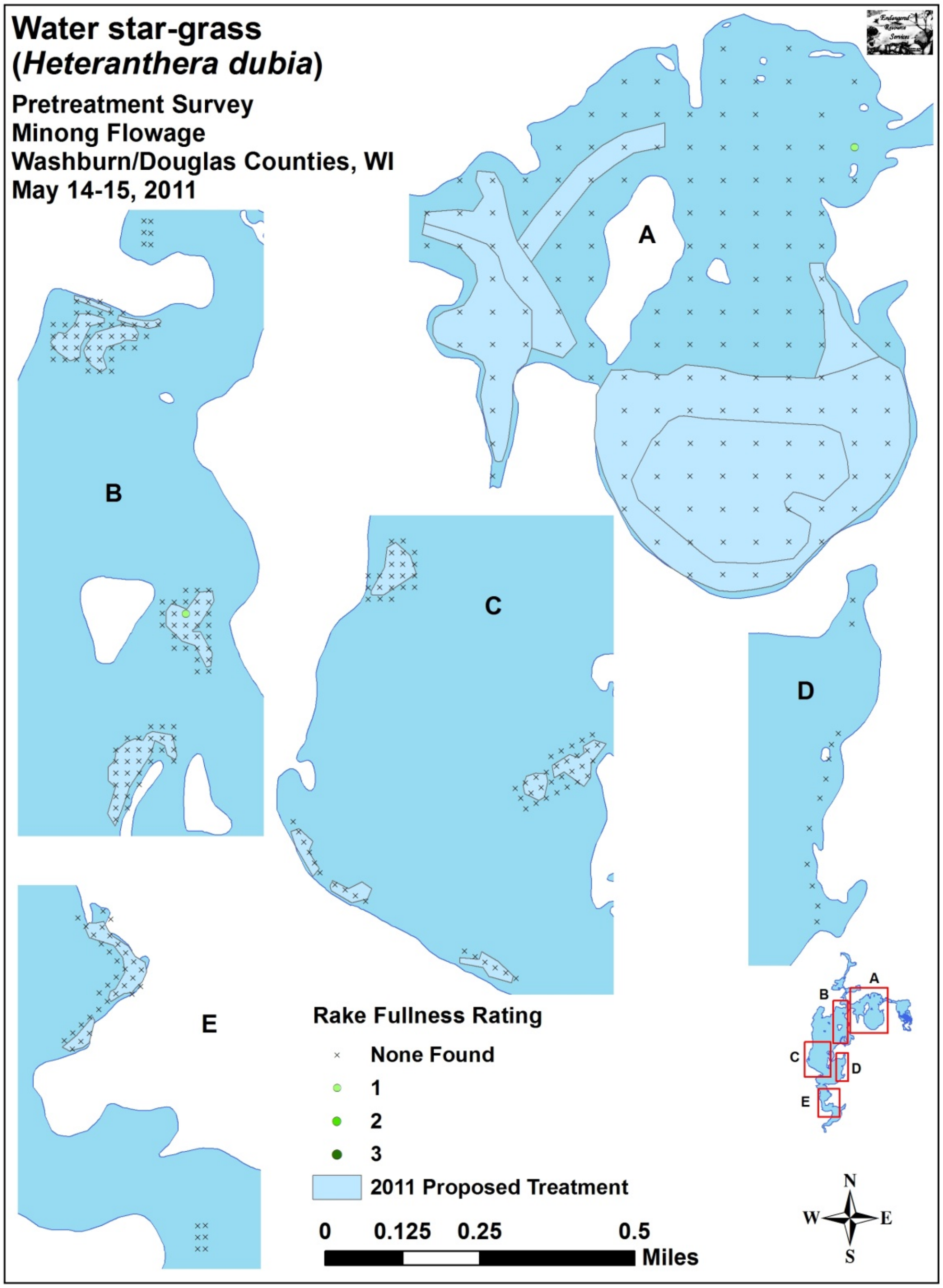

Watershield
(*Brasenia schreberi*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S

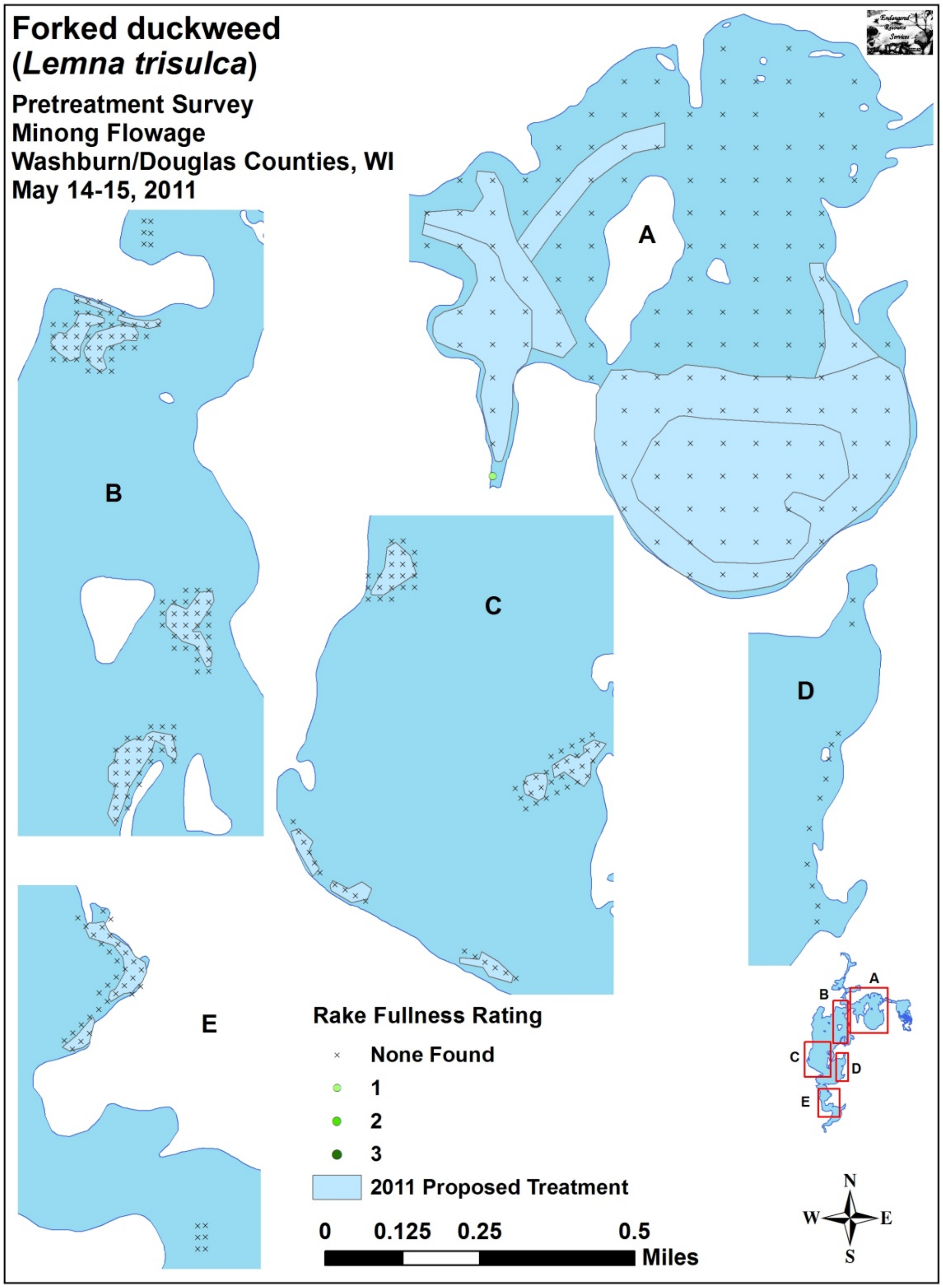

Coontail
(Ceratophyllum demersum)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S

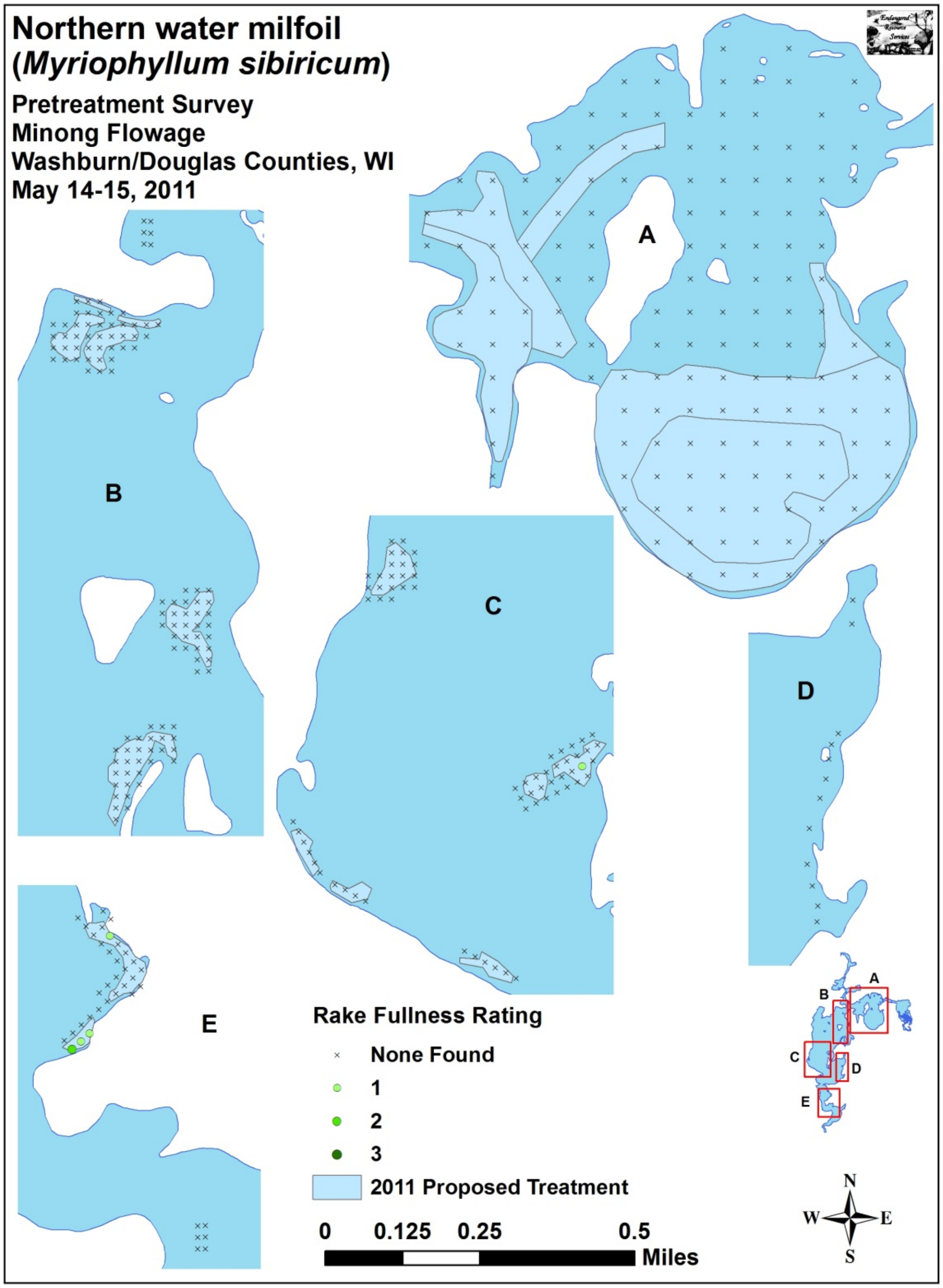

Needle spikerush
(Eleocharis acicularis)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S



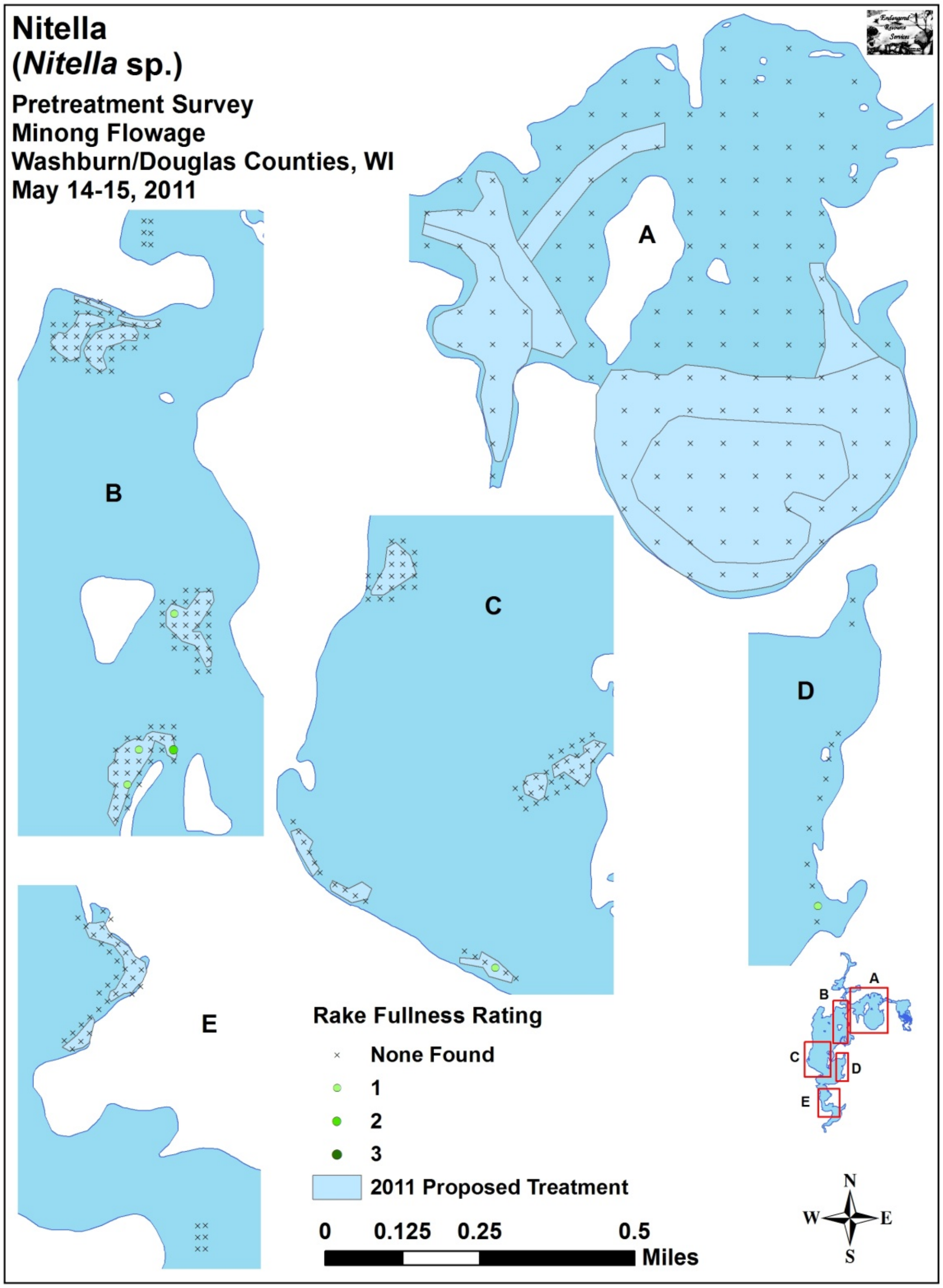
Common waterweed
(Elodea canadensis)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

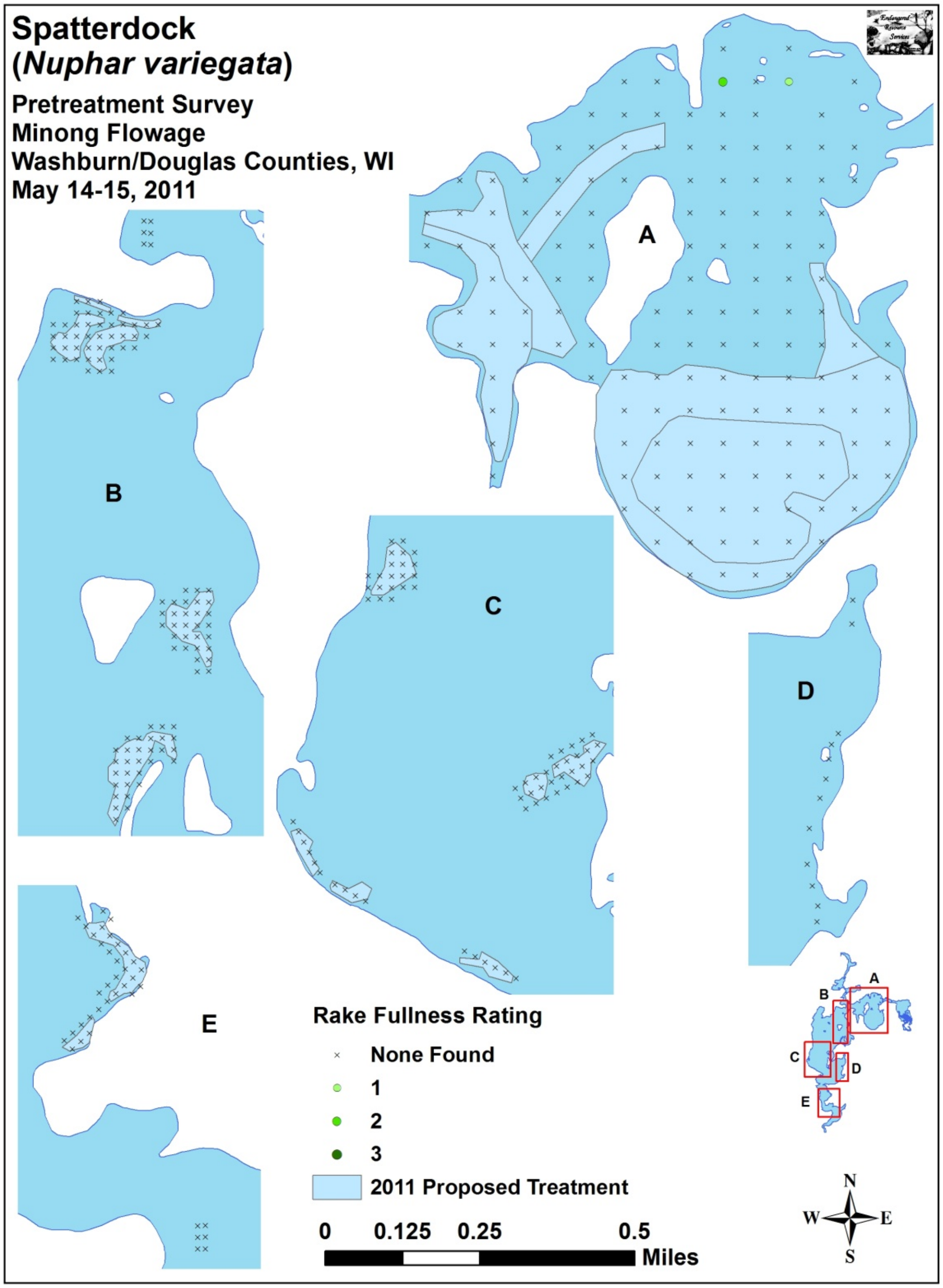

Water star-grass
(Heteranthera dubia)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

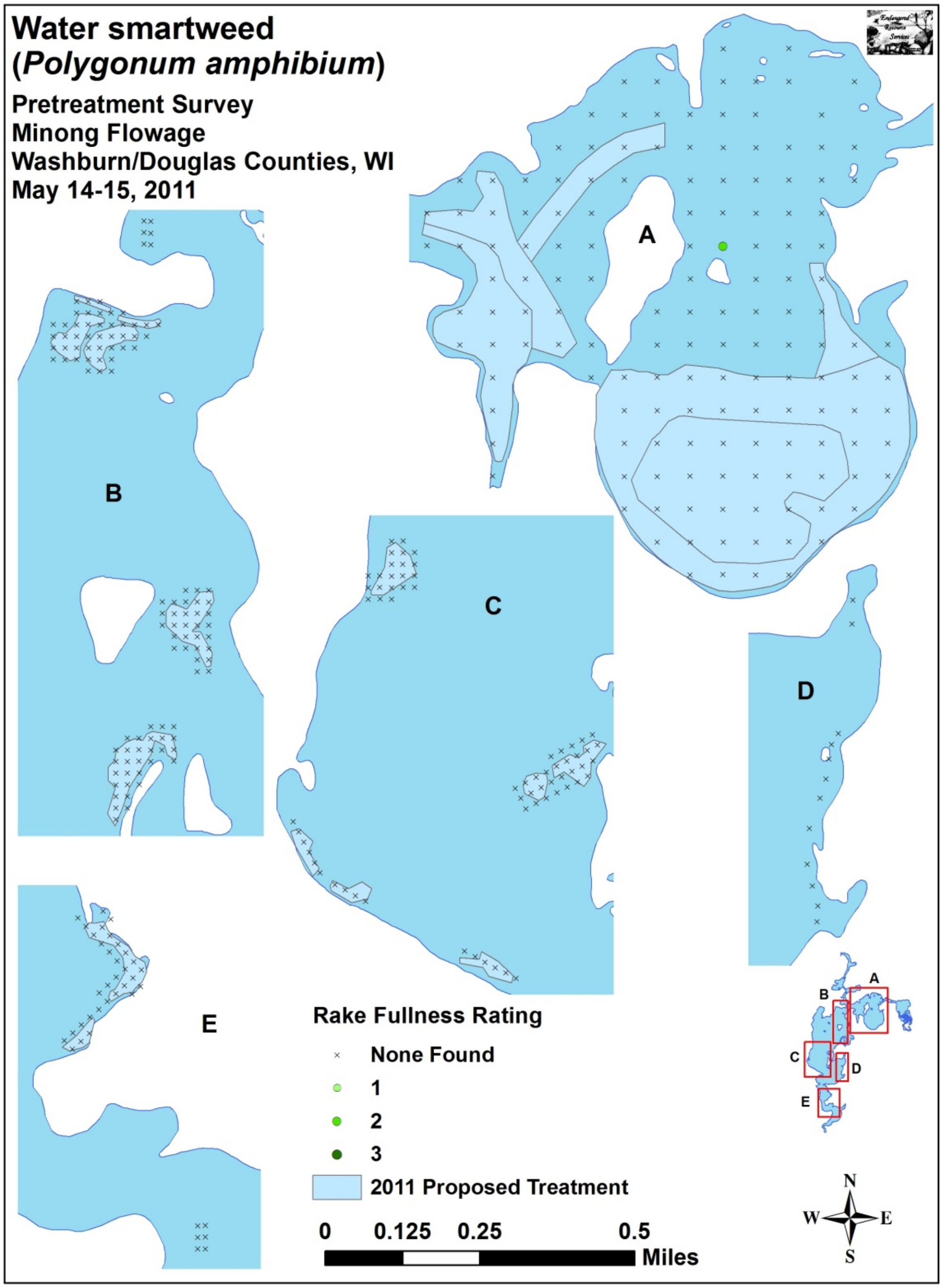

Forked duckweed
(Lemna trisulca)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S



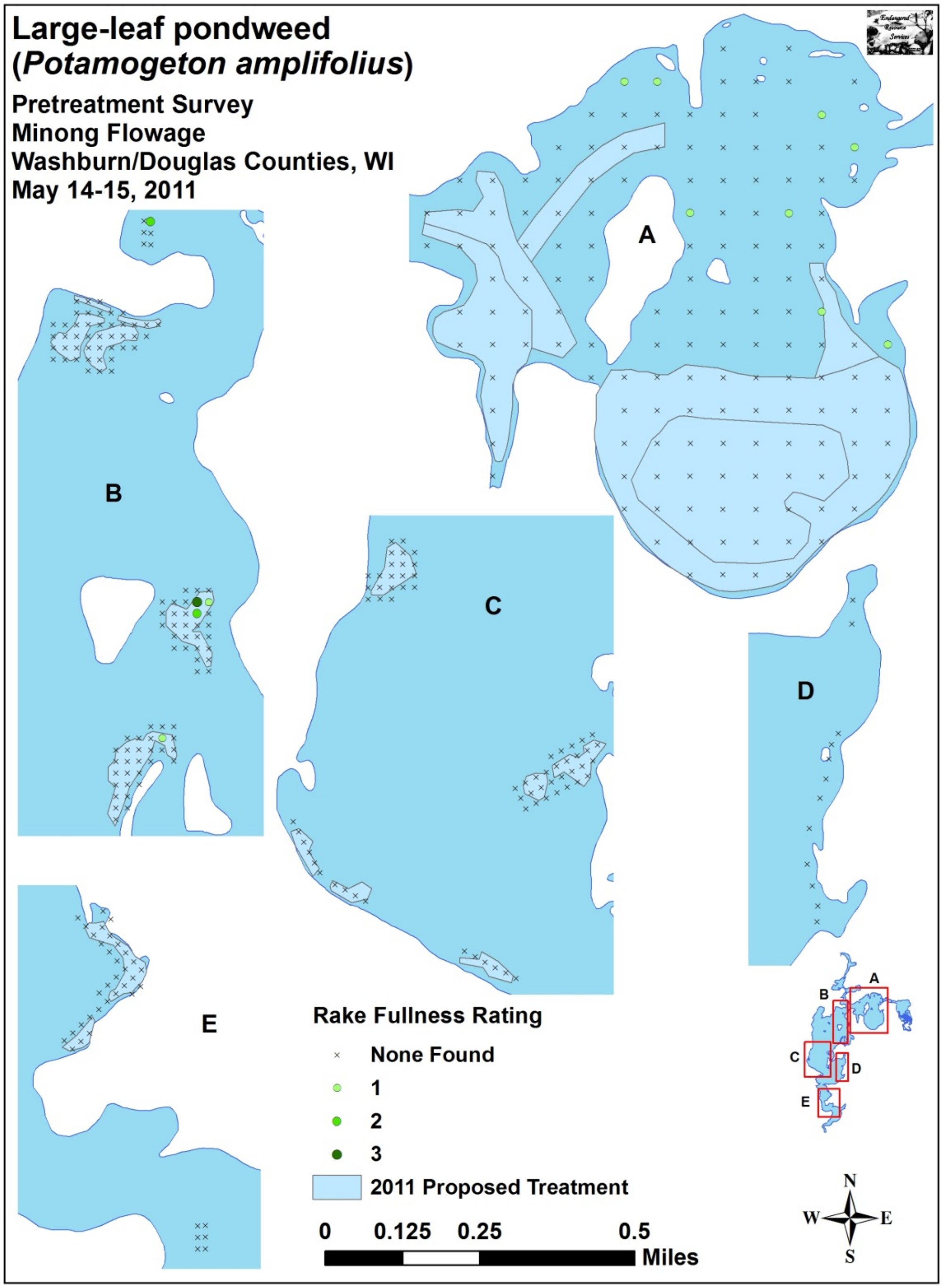
Northern water milfoil
(*Myriophyllum sibiricum*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S

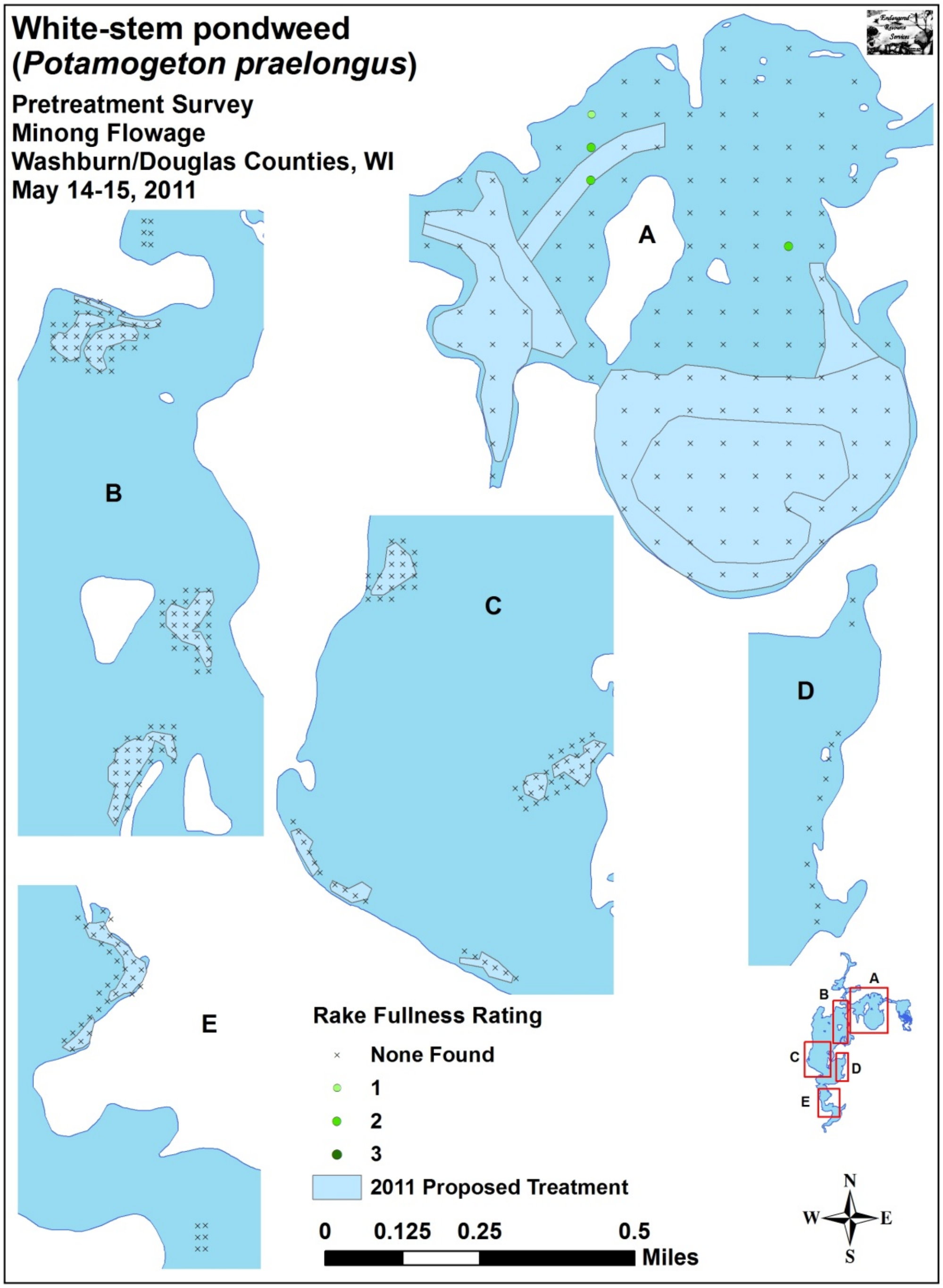

Nitella
(*Nitella* sp.)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

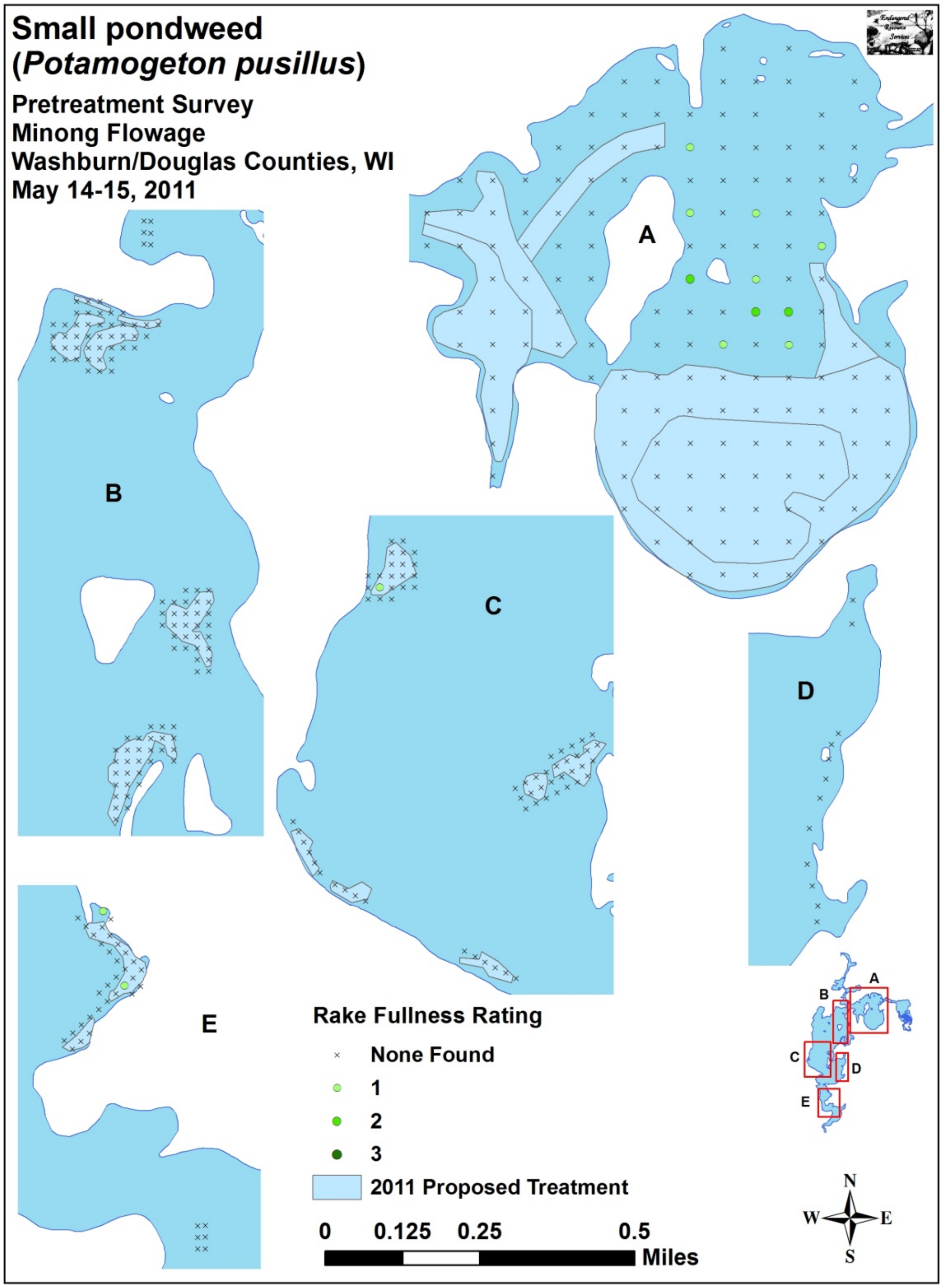

Spatterdock
(*Nuphar variegata*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S



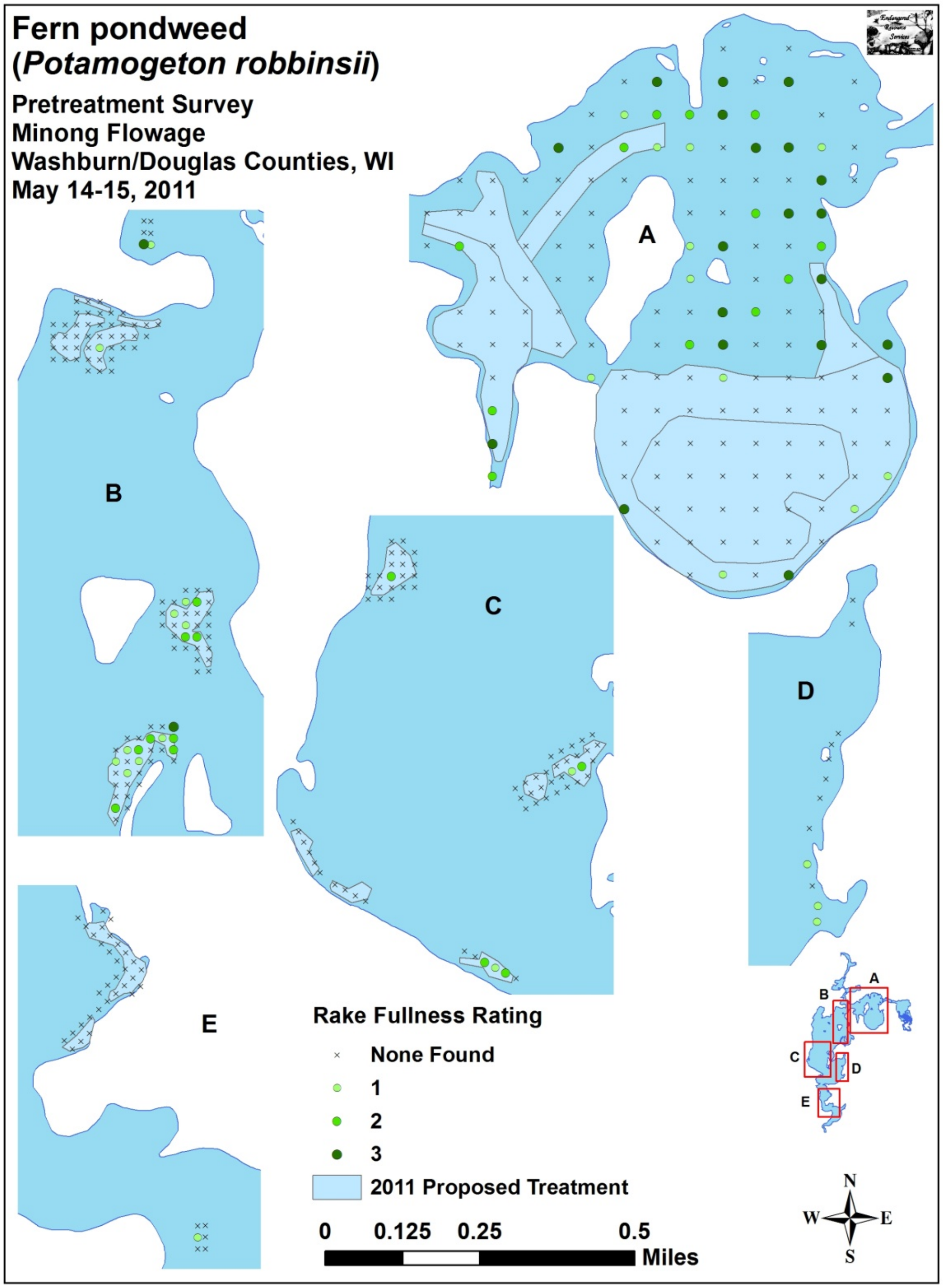
Water smartweed
(*Polygonum amphibium*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

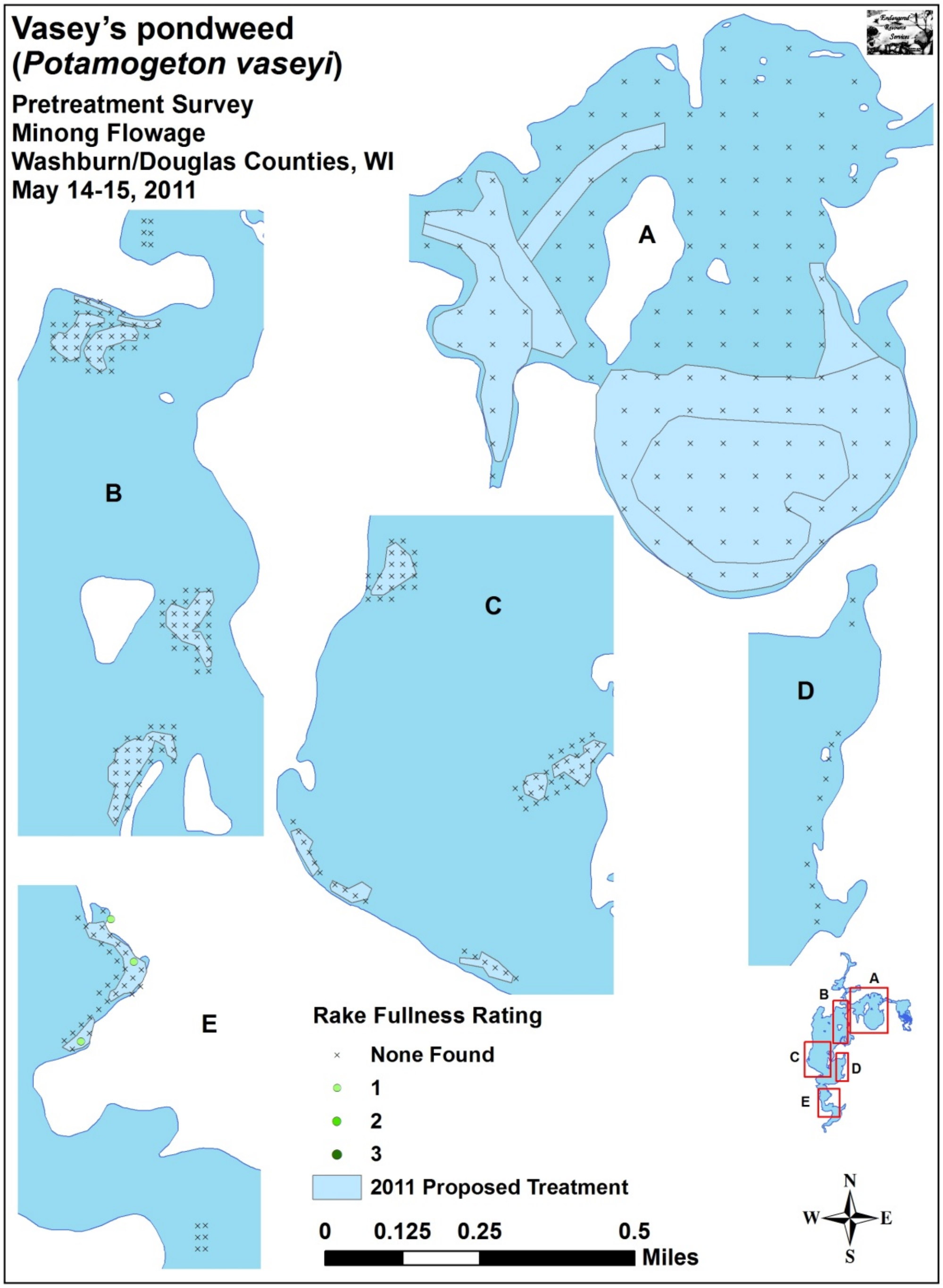

Large-leaf pondweed
(*Potamogeton amplifolius*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

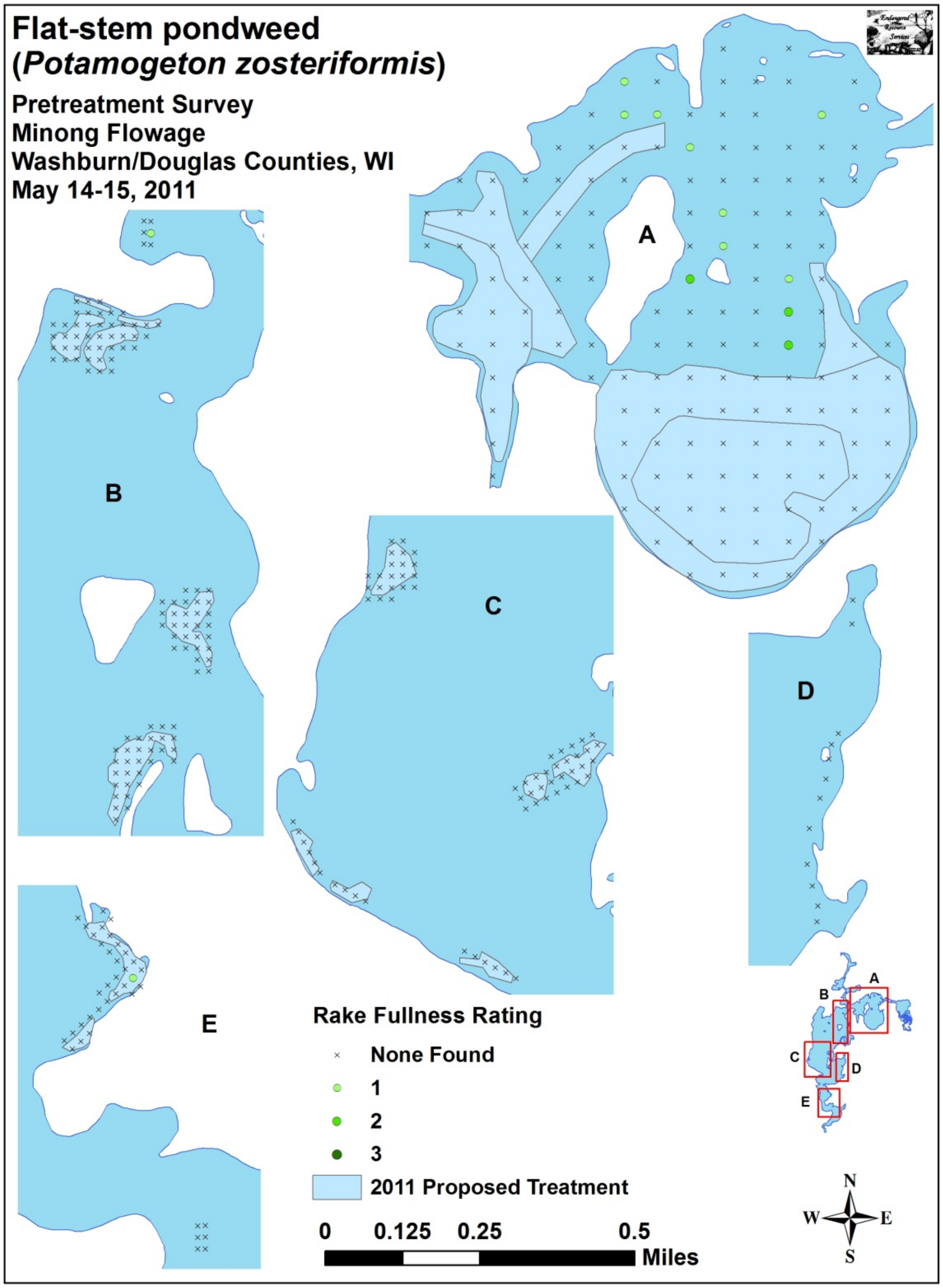

White-stem pondweed
(Potamogeton praelongus)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S



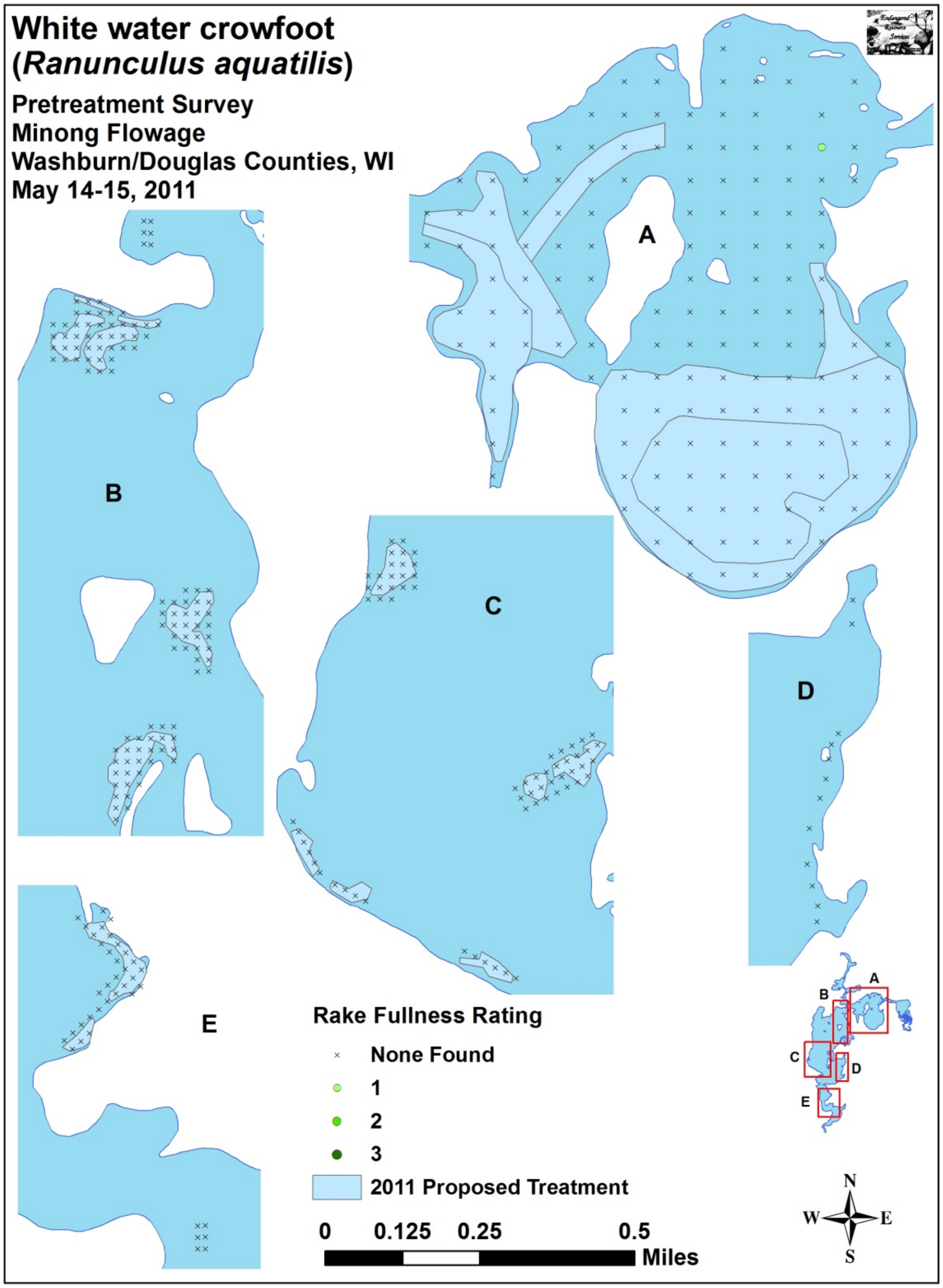
Small pondweed
(*Potamogeton pusillus*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

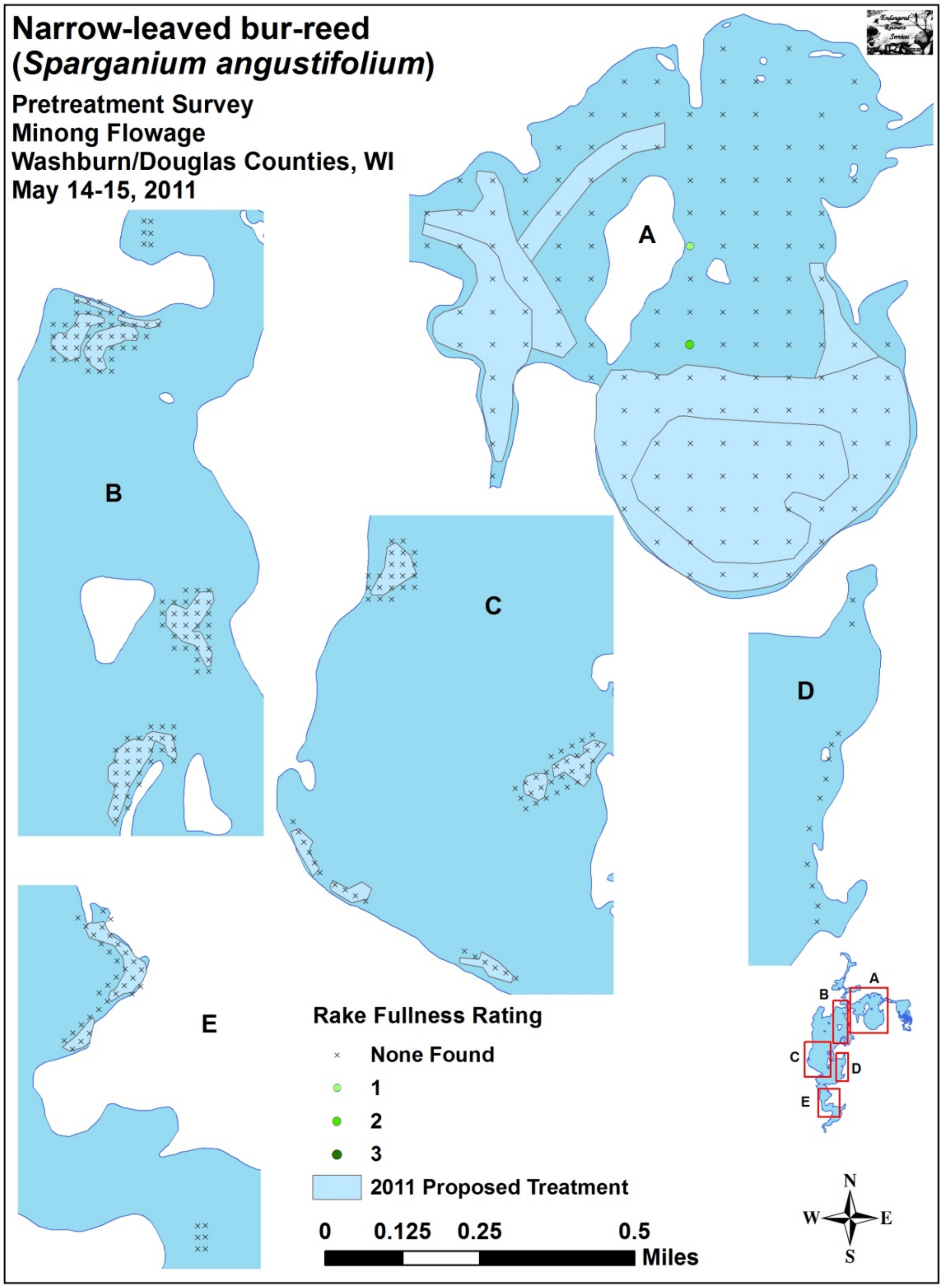

Fern pondweed
(*Potamogeton robbinsii*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

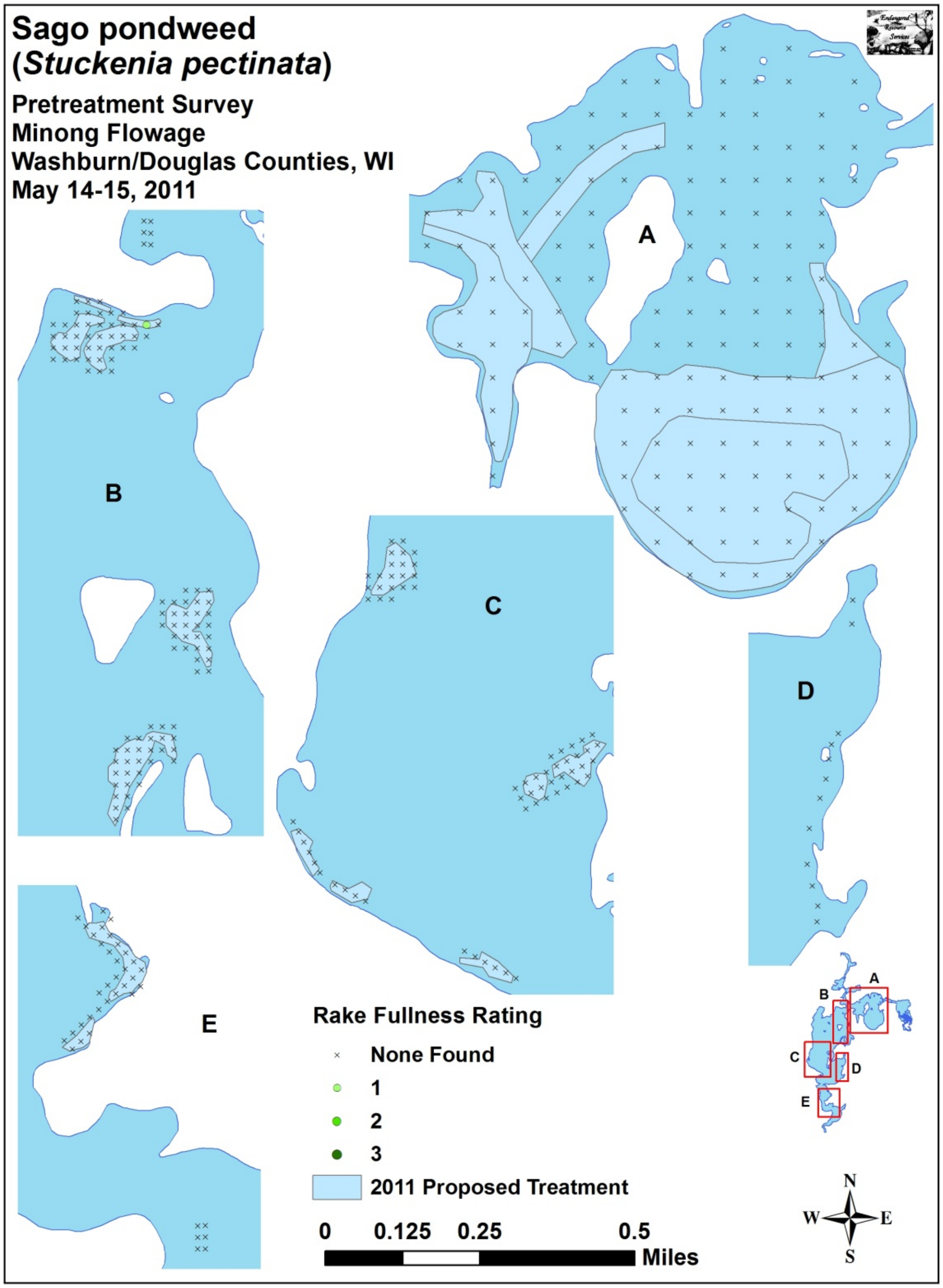

Vasey's pondweed
(Potamogeton vaseyi)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S

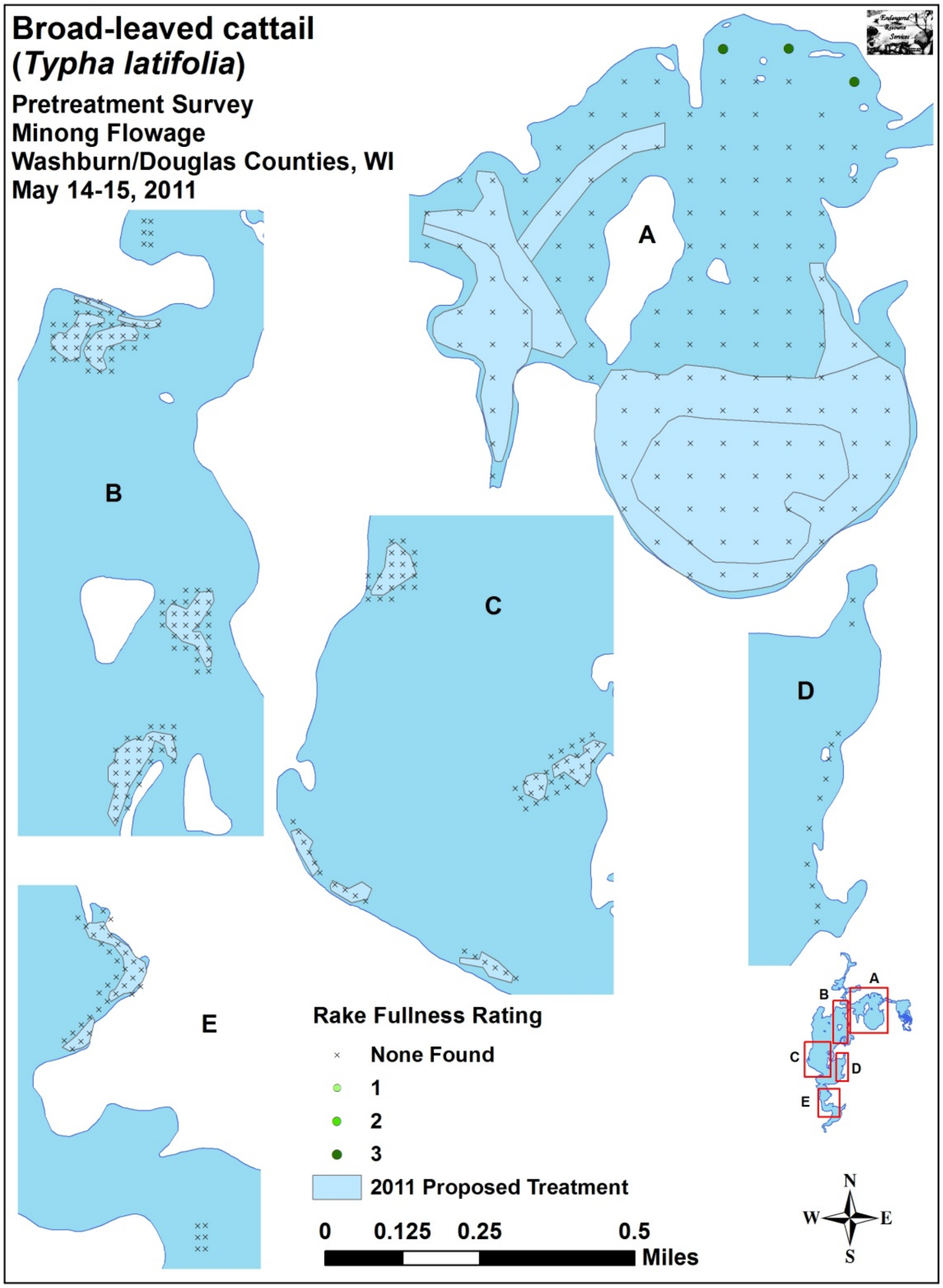


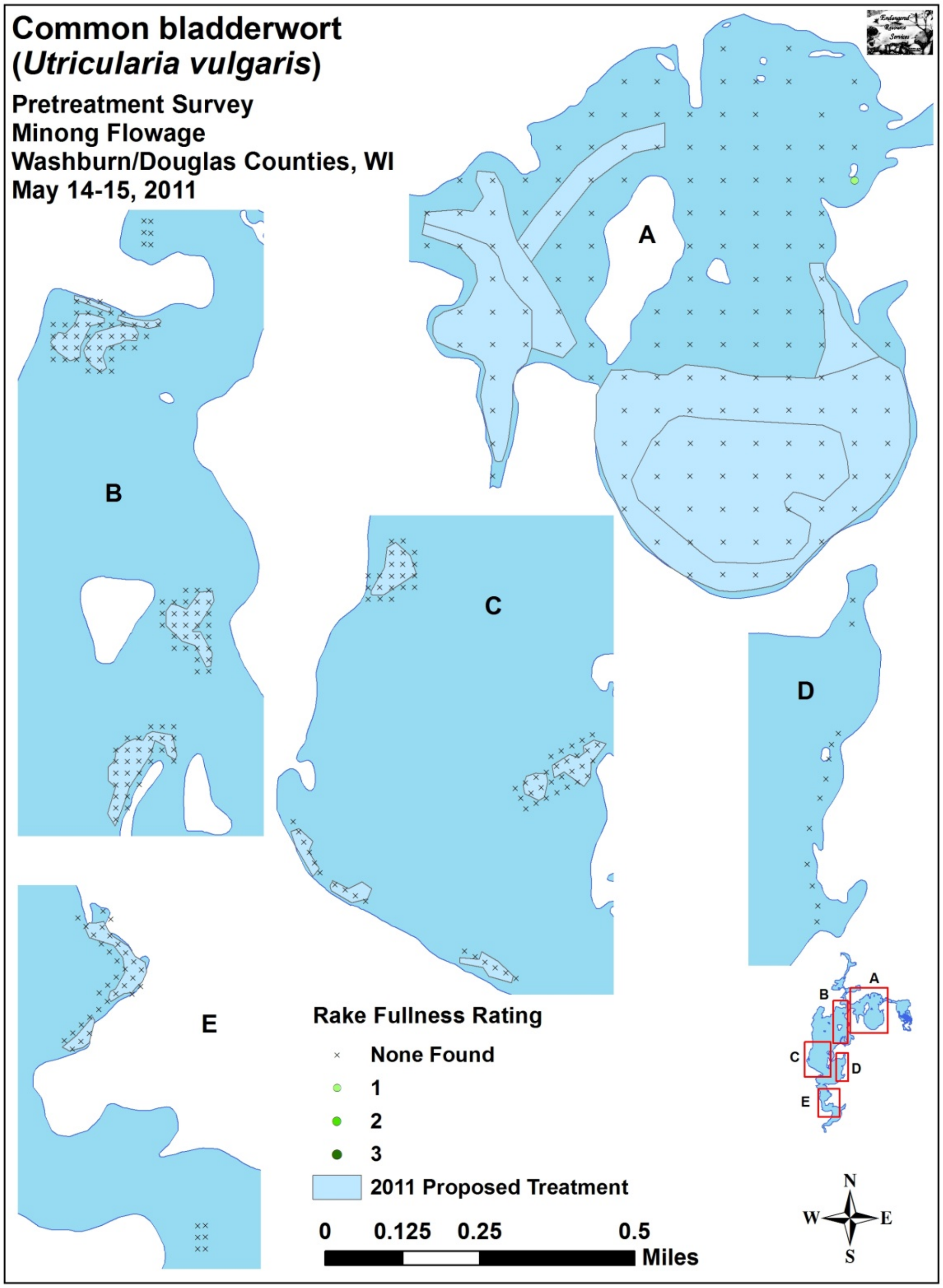
Flat-stem pondweed
(Potamogeton zosteriformis)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W

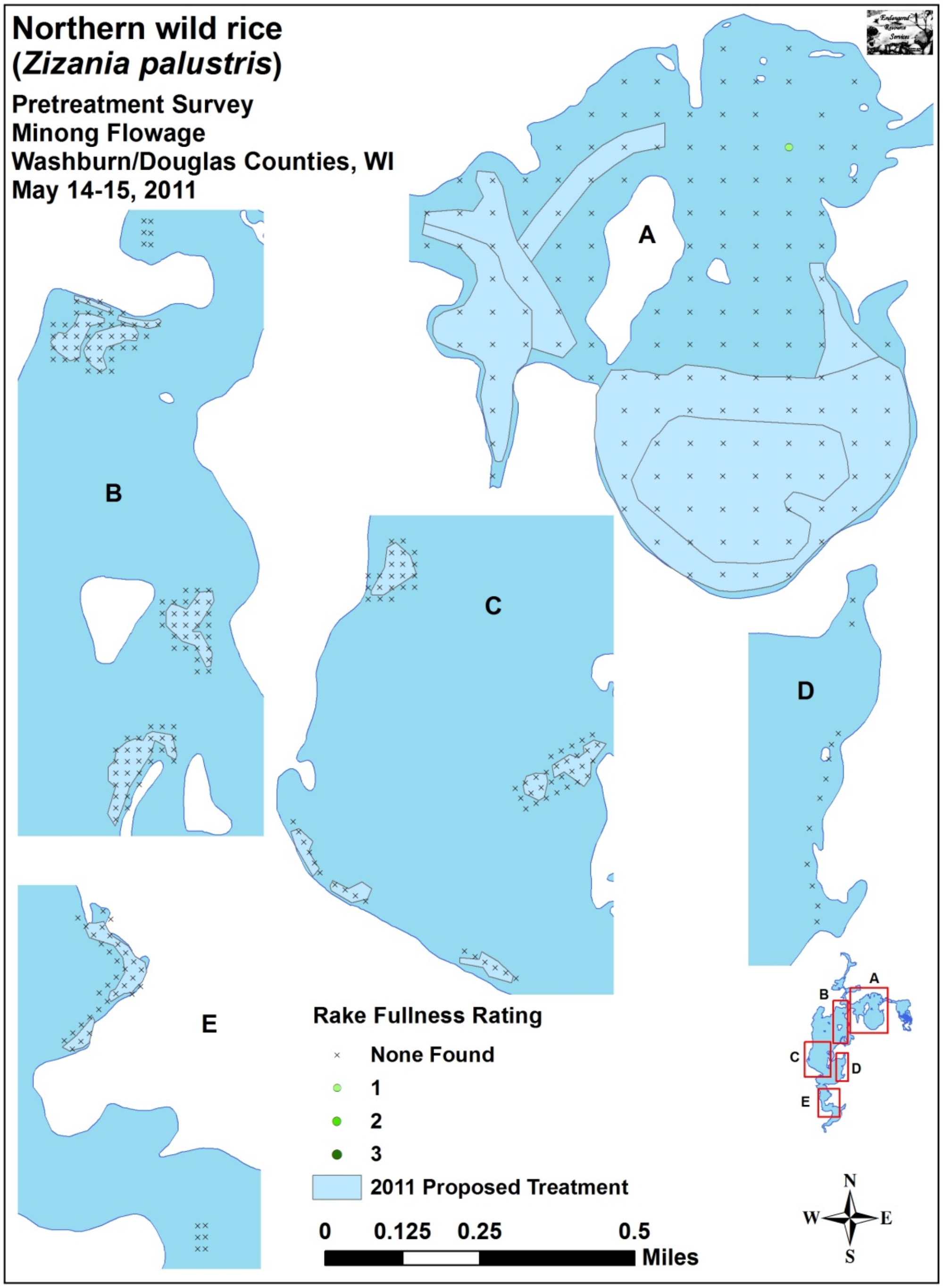

White water crowfoot
(Ranunculus aquatilis)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S


Narrow-leaved bur-reed
(Sparganium angustifolium)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S


Sago pondweed
(*Stuckenia pectinata*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S


Broad-leaved cattail
(*Typha latifolia*)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
S
E
W


Common bladderwort
(Utricularia vulgaris)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0 0.125 0.25 0.5
Miles
N
W
E
S


Northern wild rice
(Zizania palustris)
Pretreatment Survey
Minong Flowage
Washburn/Douglas Counties, WI
May 14-15, 2011
A
B
C
D
E
Rake Fullness Rating
None Found
1
2
3
2011 Proposed Treatment
0
0.125
0.25
0.5
Miles
N
W
E
S