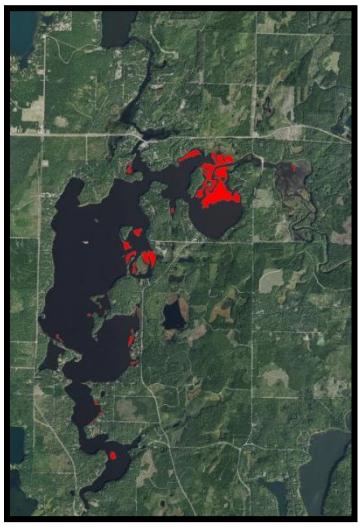
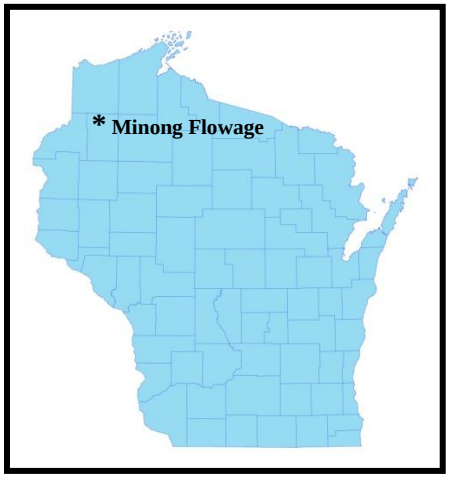
Eurasian Water-milfoil (*Myriophyllum spicatum*)
August Bed Mapping Survey
Minong Flowage - (WBIC: 2692900)
Washburn and Douglas Counties, Wisconsin

EWM in the Totagatic Inlet – blackened stems with only a few live leaflets 8/14/19



August 2019 EWM Beds

Project Initiated by:
Minong Flowage Association, Lake Education and Planning Services, LLC and the Wisconsin Department of Natural Resources



Open water along the south shoreline of Serenity Bay

Survey Conducted by and Report Prepared by:

Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin
August 14, 2019

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INTRODUCTION:

The Minong Flowage (WBIC 2692900) is a 1,564 acre eutrophic/mesotrophic 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. Secchi disc readings from 1994-2018 (the most recent year available) have ranged from 2-6ft and averaged 4.1ft (WDNR 2019). This poor to very poor clarity produced a littoral zone that extended to a maximum of 7ft in 2019.

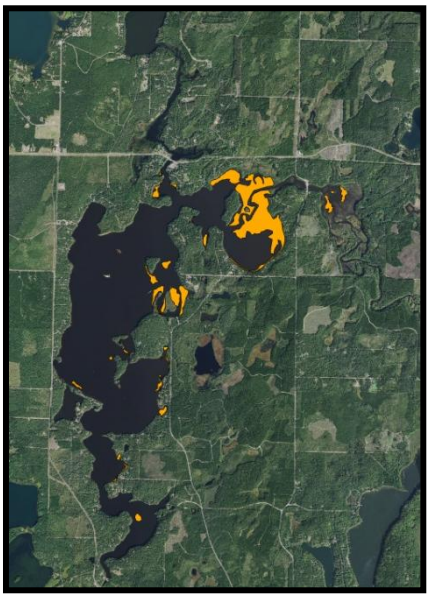


Figure 1: 2018 Fall EWM Beds

BACKGROUND AND STUDY RATIONALE:

Eurasian water-milfoil (*Myriophyllum spicatum*) (EWM) was first identified in the Minong Flowage in 2002. From 2009-2011, the Minong Flowage Association (MFA), under the direction of Dave Blumer (Lake Education and Planning Services, LLC - LEAPS), actively managed the infestation using herbicide treatments and manual removal as outlined in the flowage's Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP). Chemical treatments were suspended in 2012, but the 5ft drawdown to repair the dam in spring 2013 and extended period of freezing over the winter appeared to have killed all surviving terrestrial EWM beds. The subsequent refill in spring 2014 also eliminated most surviving aquatic individuals as the flowage's stained water prevented sufficient light penetration to allow these plants to survive.

Unfortunately, following the drawdown, EWM quickly began recolonizing shallow habitats that were now largely devoid of any native plants/competition. During our fall 2014 bed mapping survey, we found and mapped ten EWM beds totaling 14.02 acres; and, by fall 2015, this had grown to 11 beds covering 90.36 acres. In 2016, the MFA used herbicides to treat a single EWM bed that covered 26.90 acres in the WDNR boat landing bay on the flowage's east side. Although this area remained clear throughout the

rest of the growing season, our 2016 fall mapping survey found 24 EWM beds covering 125.58 acres scattered throughout the rest of the flowage. This total jumped to 27 beds but shank to 112.88 acres in 2017 before ballooning to 31 beds covering 141.88 acres in 2018 (9.07% of the flowage's surface area) (Figure 1). As in 2018, because most of these beds occurred in the northeast bays, it was ultimately decided **NOT** to do any active management on the flowage in 2019. However, in order to track EWM's expected continued expansion and to determine if levels would justify another drawdown, LEAPS, the MFA, and the WDNR requested an earlier than normal EWM bed mapping survey on August 14, 2019. This report is the summary analysis of that survey.

METHODS:

During the bed mapping survey, we searched the flowage's visible littoral zone. By definition, a "bed" was determined to be any area where we visually estimated that Eurasian water-milfoil 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. We also mapped "High EWM Density Areas" that fell slightly below this threshold as, once established, these pioneer areas tend to become beds the following year. Once located, we motored around the perimeter of the area 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 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 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.

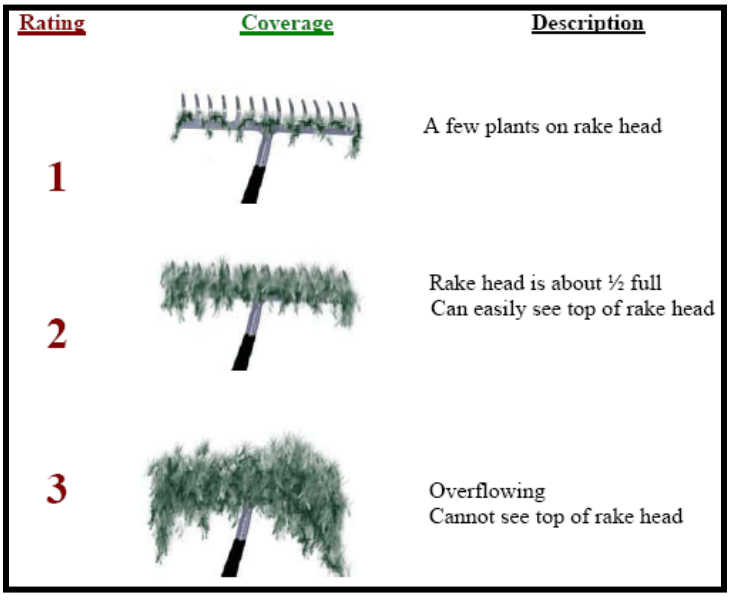


Figure 2: Rake Fullness Ratings

RESULTS AND DISCUSSION:

August Eurasian Water-milfoil Bed Mapping Survey:

During the August 2019 survey, we located and mapped 25 Eurasian water-milfoil beds that covered 85.27 acres or 5.45% of the flowage's surface area (Figure 3) (Appendix I). This was a decrease of 56.61 acres (-39.90%) from the 2018 fall survey when we mapped 31 beds totaling 141.88 acres (9.07% coverage) (Table 1); it was also the lowest total since 2014 (Table 2). As no active management occurred on the flowage in 2019, the reason for this decline is likely tied to annual growing conditions although we did not notice any obvious changes. Most EWM plants seemed dormant or nearly so, and we didn't notice many floating fragments in the flowage. Especially in the northeast bays and river inlet, plants appeared black, spindly, and generally unhealthy. Rake sampling often produced root crowns with a single live stem and many decomposing stems that were lying on the bottom. In general, we documented a significant pullback along the deepwater edges of beds and a thinning within the remaining bed area.

Despite the decline in total acreage, many of the flowage's EWM beds are likely continuing to cause at least minor and occasionally moderate impairment to watercraft (Table 1). Fortunately, most of the worst areas occur among the stump fields in the northeast bays or along shorelines that have few residents. In the southern basin, most beds continue to have low densities, and we noted that few seemed likely to significantly impair navigation. Perhaps the biggest concern we can think of with a continued policy of "no active management" is in the WDNR landing bay as there is a real danger that the flowage will continue to be a source populations for new infestations on nearby lakes if visiting boaters miss a milfoil fragment on their trailer.

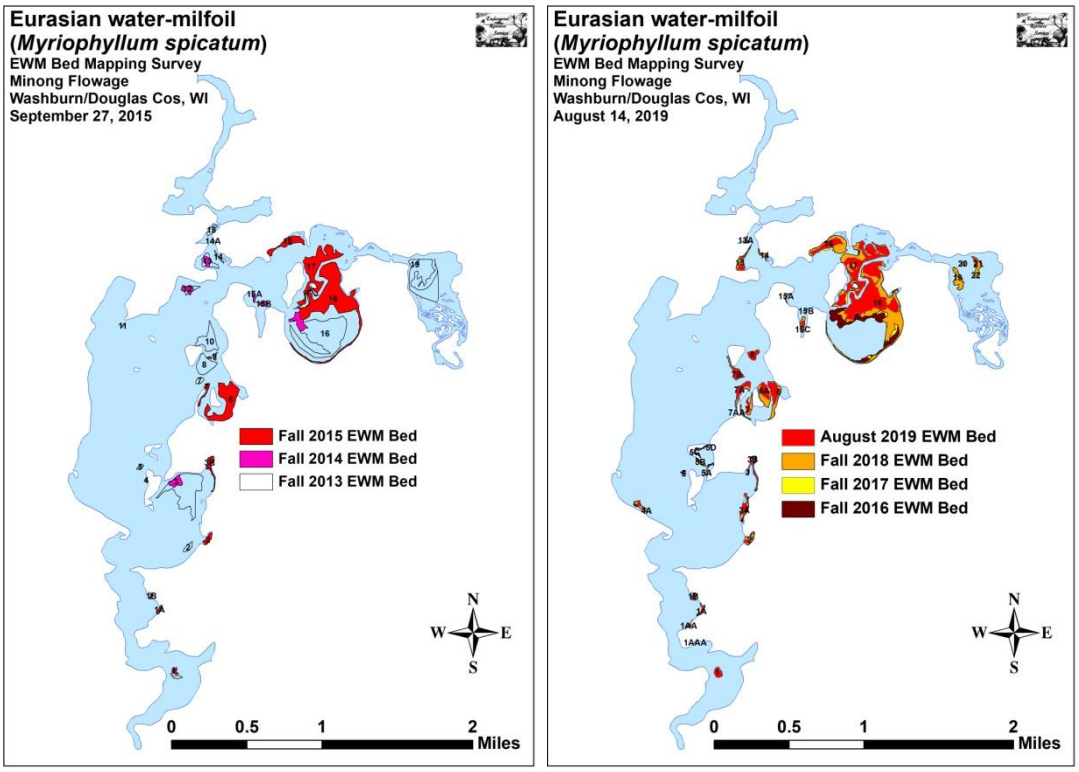


Figure 3: Fall 2013/2014/ 2015 and Fall 2016/2017/2018/2019 EWM Beds

Table 1: Late Summer/Fall Eurasian Water-milfoil Bed Mapping Summary
Minong Flowage, Washburn and Douglas Counties
August 14, 2019

Bed Number	2019 Area in acres	Fall 2018 Area in acres	Change in Acreage	Est. Rake Range/ Mean Rake Full.	Depth Range/ Mean Depth	Navigation Impairment	2019 Field Notes
1	1.71	1.72	-0.01	1-3; 2	2-5; 4	Moderate	Thickening and expanding into deeper water
1AAA	0.07	0	0.07	<<<1-1; <1	2-4; 3	None	More of a HDA; but plants nearly continuous
1AA	0.31	0.32	-0.01	<1-2; 1	3-5; 4	Minor	Mixed with Coontail and NWM
1A	0.50	0.56	-0.06	<1-2; 1	3-5; 4	Minor	Mixed with Coontail and NWM
1B	0.47	0.68	-0.21	<1-3; 2	1-5; 4	Moderate	Mixed with Coontail and NWM
2	0.63	1.77	-1.14	<1-3; 2	2-5; 4	Moderate	Mixed with Coontail
3 and 3B	0.97	1.27	-0.30	<<1-2; 1	2-4; 3	Minor	Monotypic except in the bay – natives mixed in
3A and 3AA	1.84	1.47	0.37	<1-2; 1	2-4; 3	Minor	Nearly monotypic
4	0	0	0	0	-	None	No EWM found.
4A	0.62	1.14	-0.52	<<<1-3; 1	3-5; 4	Minor	Monotypic regular towers
5	0.30	0.42	-0.12	1-3; 2	3-5; 4	Minor	Monotypic; too narrow to be moderate impairment
5A, B, C, D	0.29	0.66	-0.37	<1-3; 1	2-5; 3	Minor	Regular towers; also Coontail
6 and 6A	6.84	11.50	-4.66	<<<1-2; <1	2-5; 4	Minor	Many EWM plants prop-clipped; also Coontail
7 and 7AA	1.34	2.19	-0.85	<<<1-1; <<1	2-4; 3	None	More of a High Density Area; regular towers
7A	2.38	3.48	-1.10	<<1-2; 2	1-5; 4	Minor	Monotypic; too close to shore to be an issue
7B	2.48	2.73	-0.25	<<1-2; 2	2-5; 4	Minor	Nearly monotypic; some Wild celery
8	2.13	2.10	0.03	1-3; 2	3-6; 4	Moderate	Mixed with Coontail
9, 10, and 11	0	0	0	0	-	None	No EWM found.
12	0	0	0	0	-	None	No EWM found.
13	1.53	2.56	-1.03	<<<1-2; 1	2-7; 4	Minor	Patchy with Coontail/scattered pondweeds
13A	0	0.31	-0.31	<<<1	2-6; 5	None	Only a handful of EWM plants seen
14	0	0.67	-0.67	<<<1	2-5; 4	None	Only a handful of EWM plants seen
15	0	0	0	<<<1	2-5; 4	None	No EWM found.
15A	0	0.22	-0.22	<<<1	2-4; 3	None	Only widely-scattered towers; mixed with natives
15B and 15C	0.56	1.49	-0.93	<<1-1; <<1	2-5; 4	None	More of a HDA; dominated by Coontail
16 and 16A/B	32.80	58.54	-25.74	<<<1-3; 2	2-7; 5	Moderate	Solid 3 at core – very fragmented on shoreline
17	21.99	29.05	-7.05	<<1-3; 2	2-5; 4	Moderate	Stump field – mixed with natives
18 and 18A	4.68	10.73	-6.05	<<<1-3; 2	2-5; 4	Moderate	Fragmented in deeper water; mixed with Coontail
19	0.12	3.21	-3.09	<<1-2; 1	2-4; 3	Minor	Sickly EWM scattered among rice/other natives
20, 21, and 22	0.70	3.10	-2.40	<<<1-3; <1	2-4; 3	Minor	Scattered EWM within and around rice
Total	**85.27**	**141.88**	**-56.61**				

Table 2: Late Summer/Fall EWM Bed Mapping Summary
Minong Flowage, Washburn and Douglas Counties
2014-2019

Bed Number	2019 Area in Acres	2018 Area in Acres	2017 Area in Acres	2016 Area in Acres	2015 Area in Acres	2014 Area in Acres	2019 Change in Acreage
1	1.71	1.72	1.62	1.40	0.50	0.32	-0.01
1AAA	0.07	0	0	0	0	0	0.07
1AA	0.31	0.32	0.23	0.33	0	0	-0.01
1A	0.50	0.56	0.22	0.81	0.58	0	-0.06
1B	0.47	0.68	0.47	0.48	0.31	0	-0.21
2	0.63	1.77	1.66	1.80	1.40	0	-1.14
3 and 3B	0.97	1.27	1.27	2.55	1.96	4.10	-0.30
3A and 3AA	1.84	1.47	1.93	2.06	0	0	0.37
4	0	0	0	0	0	0	0
4A	0.62	1.14	0.09	1.05	0	0	-0.52
5	0.30	0.42	0.15	0.30	0	0	-0.12
5A, B, C, D	0.29	0.66	0.27	1.49	0	0	-0.37
6 and 6A	6.84	11.50	1.06	0	16.39	0	-4.66
7 and 7AA	1.34	2.19	0	0	1.23	0	-0.85
7A	2.38	3.48	2.41	0.75	0	0	-1.10
7B	2.48	2.73	1.50	1.46	0	0	-0.25
8	2.13	2.10	1.55	0.76	0.18	0	0.03
9, 10, and 11	0	0	0	0	0	0	0
12	0	0	0	0	0	1.90	0
13	1.53	2.56	3.11	0.85	0	1.57	-1.03
13A	0	0.31	0.45	0	0	0	-0.31
14	0	0.67	0.47	0.31	0	0.05	-0.67
15	0	0	0	0	0	0	0
15A	0	0.22	0.18	0.10	0	0.57	-0.22
15B and 15C	0.56	1.49	0.88	0.09	0	0.85	-0.93
16 and 16A/B	32.80	58.54	54.45	75.32	43.08	4.58	-25.74
17	21.99	29.05	26.05	24.27	19.43	0	-7.05
18 and 18A	4.68	10.73	8.00	7.61	5.30	0	-6.05
19	0.12	3.21	3.51	1.80	-----	0.10	-3.09
20	0	0.31	0.14	0	0	0	-0.31
21 and 22	0.70	2.79	1.23	0	0	0	-2.09
Total	**85.27**	**141.88**	**112.88**	**125.58**	**90.36**	**14.02**	**-56.61**

Descriptions of Current and Former Eurasian Water-milfoil Beds:

Bed 1 – Eurasian water-milfoil has recolonized the entire sandbar near the dam and appeared to be unchanged from 2018.

Beds 1AAA, 1AA, 1A, and 1B – EWM in these southern side bays was patchy and mixed with native species; especially Northern water-milfoil (*Myriophyllum sibiricum*) and Spiral-fruited pondweed (*Potamogeton spirillus*).

Bed 2 – We found moderate amounts of EWM and Coontail (*Ceratophyllum demersum*) throughout much of this very shallow bay. Unlike in the past, most EWM was in the deeper areas as opposed to being found throughout.

Beds 3A and 3B – Very low density EWM continues to survive in much of the immediate shoreline area. We again found that it was radiating out into 4ft+. In the northeast bay, there was little EWM mixed in with the Spatterdock (*Nuphar variegata*) and White water lily (*Nymphaea odorata*) beds near shore.

Beds 4 and 4A – EWM was not present on either side of the southernmost island, but there continues to be a narrow low-density bed just north of the county park and campground.

Beds 5 and 5A-D – We found mostly low-density EWM scattered throughout these beds. Other than Bed 5, none of them were likely to have more than a minor impact on navigation as they were small, narrow, and near the shoreline.

Beds 6, 6A, 7, and 7AA – EWM was scattered around the island in the WDNR landing bay. Many plants were prop-clipped, but the majority of the bay was dominated by native pondweeds outside of the main navigation channel leading away from the dock toward the Swift Nature Camp. Southwest of the island, Bed 7A was really just a "High Density Area" with only scattered EWM towers present.

Beds 7A, 7B, and 8 – Beds 7A and 7B both withdrew slightly from shallow water along shore, but were otherwise unchanged. Bed 8 was also almost unchanged in area. It continues to have prop trails through it as boaters, who are potentially visiting the flowage and don't know the bed exists, tend to motor right through it on their way out from the WDNR landing.

Beds 9, 10, 11, 12, 15, and 15B – We found no EWM in these former beds in 2017, 2018 or 2019.

Bed 13 –EWM was extremely patchy near shore in areas that had been solid in the past – presumably due to winterkill. Although plants were regular in the 3-4ft range, the bed quickly broke up at depths over 5ft.

Bed 13A – For whatever reason, EWM almost disappeared from this bay southwest of Pogo's. The plant community was dominated by Coontail and native pondweeds.

Bed 14 – After finding hybrid water-milfoil (leaflets that were stiffer than true EWM and had counts from 24-26) in this area for the first time last year, we saw almost no EWM at all in this area. The bay was dominated by Coontail and other native pondweeds.

Beds 15A and 15C – EWM all but disappeared from Bed 15A as we noted only a few widely scattered plants. In the "Thumb Bay", Coontail continued to be the dominant plant, and we found most EWM was now located in a narrow central area. Even here, plants were barely continuous making it more of a "High Density Area".

Bed 16 – EWM was absent from the majority of the south shoreline of Serenity Bay. On the south end of the main bed in the center of the bay, plants were much more scattered than in 2018, and we notice a general retreat towards shallow water. Even among the stumps where EWM has often formed a solid canopied mat in the past, most areas had only patchy plants and native species were noticeably more common.

Bed 17 – After having expanded to the west and northwest in 2018, this bed pulled back to 2016 levels.

Bed 18 – After having almost merged with Bed 17 in 2018, we had a hard time finding any EWM plants in water over 4ft deep during the 2019 survey. EWM also disappeared from most nearshore areas.

Bed 19 – For unknown reasons, we were unable to find EWM in the majority of this formerly large bed. Those plants we did find were sickly looking, almost black, showed no recent growth, and appeared to be just clinging to life with only a few leaflets near the surface (see cover page of this report).

Bed 20 – We saw no evidence of EWM in this former microbed.

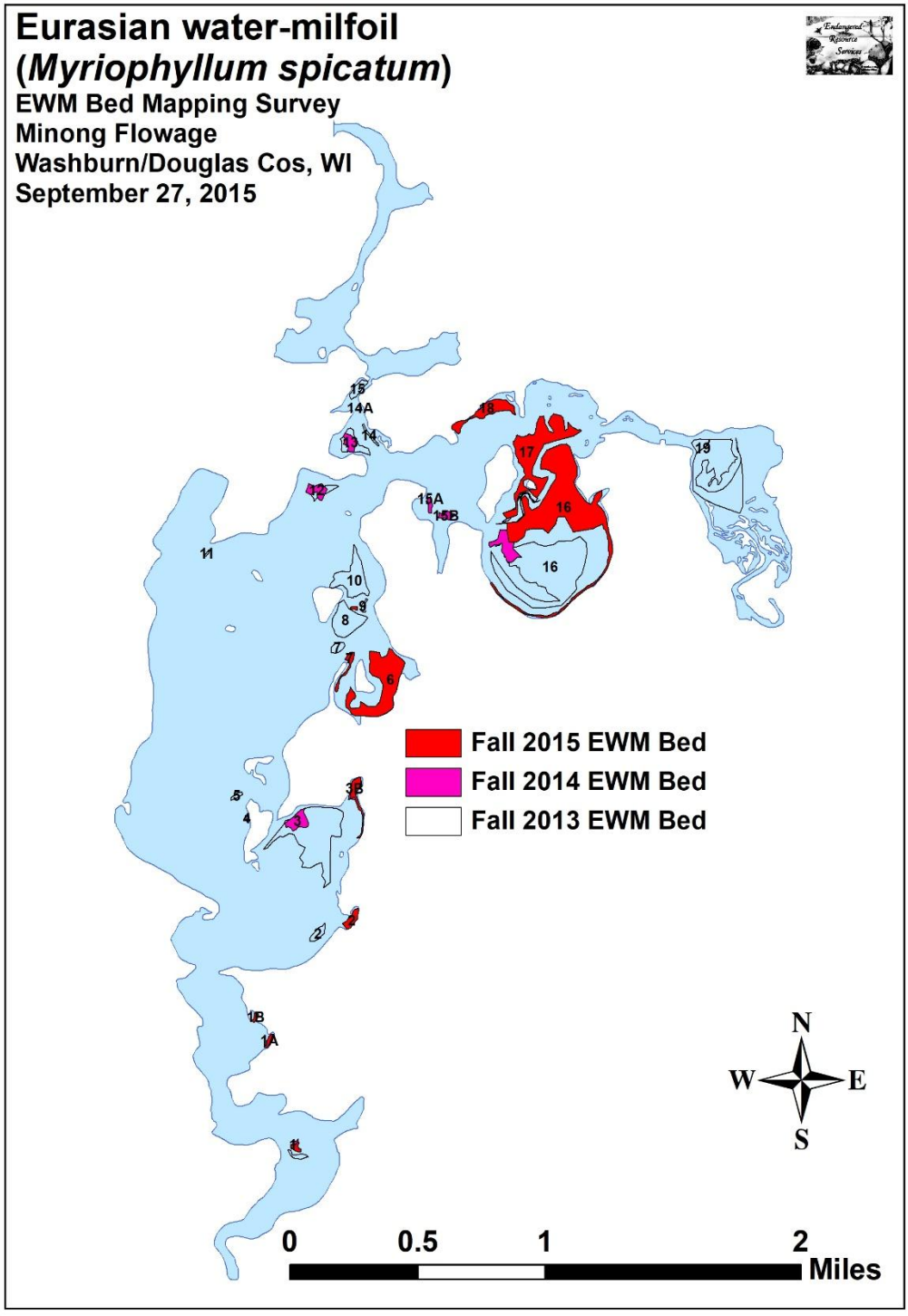
Beds 21 and 22 – Similarly to the majority of Bed 19 and Bed 20, we found only scattered sickly EWM plants in the area adjacent to the channel in Bed 21. In Bed 22, we were unable to locate any EWM at all.

LITERATURE CITED

Pokorny, N., C. Busch, L. Sather, and C. Holt. [online]. 1966. Minong Flowage Map. Available from http://dnr.wi.gov/lakes/maps/DNR/2692900a.pdf (2019, November).

WDNR. [online]. 2019. Minong Flowage - Citizen Lake Water Quality Monitoring Database. Available from http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2692900&page=waterquality (2019, November).

Appendix I: 2015-2019 Late Summer/Fall Eurasian Water-milfoil Bed Maps


Eurasian water-milfoil
(Myriophyllum spicatum)
EWM Bed Mapping Survey
Minong Flowage
Washburn/Douglas Cos, WI
September 27, 2015
Fall 2015 EWM Bed
Fall 2014 EWM Bed
Fall 2013 EWM Bed
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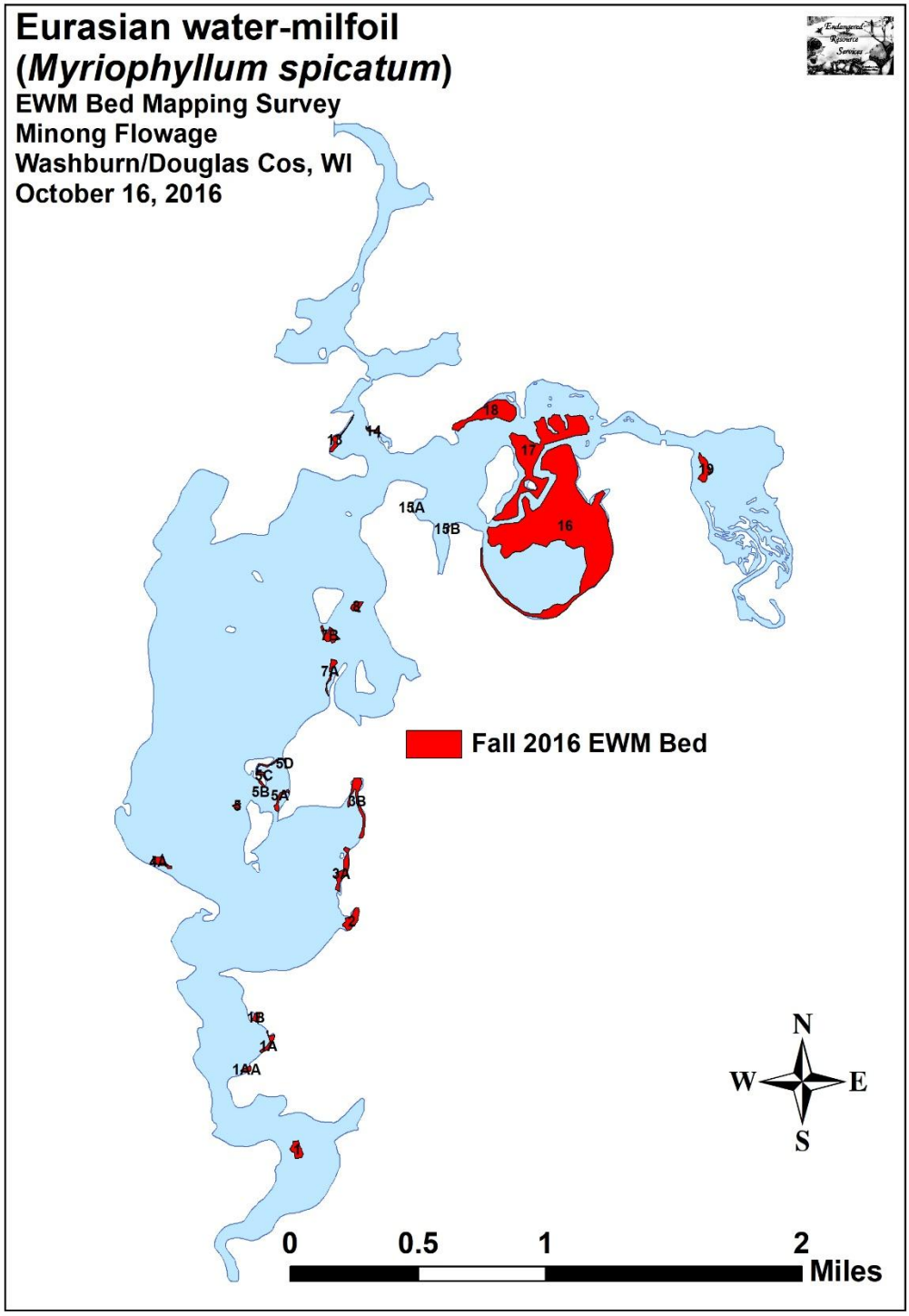
Eurasian water-milfoil
(Myriophyllum spicatum)
EWM Bed Mapping Survey
Minong Flowage
Washburn/Douglas Cos, WI
October 16, 2016
Fall 2016 EWM Bed
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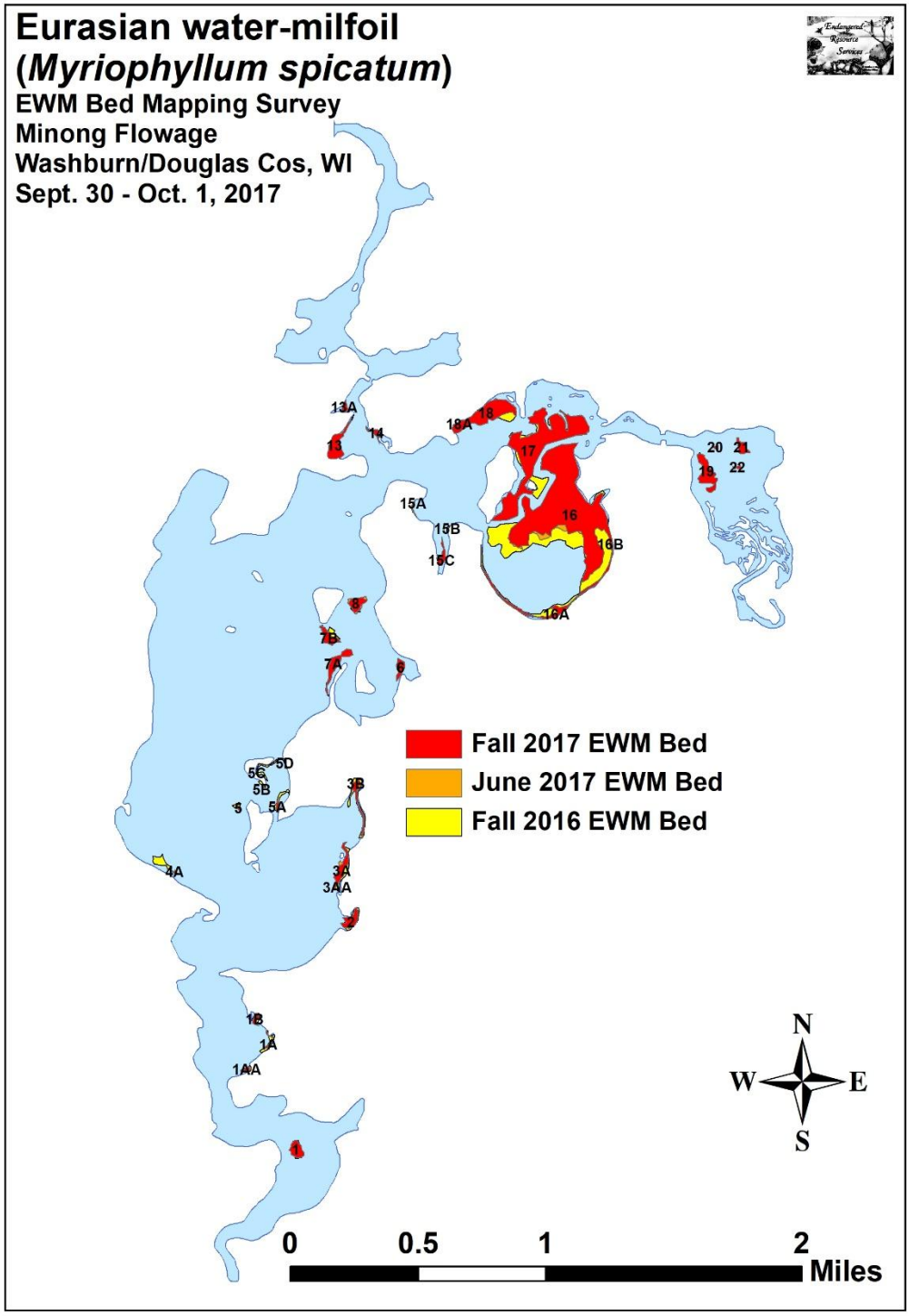
Eurasian water-milfoil
(Myriophyllum spicatum)
EWM Bed Mapping Survey
Minong Flowage
Washburn/Douglas Cos, WI
Sept. 30 - Oct. 1, 2017
Fall 2017 EWM Bed
June 2017 EWM Bed
Fall 2016 EWM Bed
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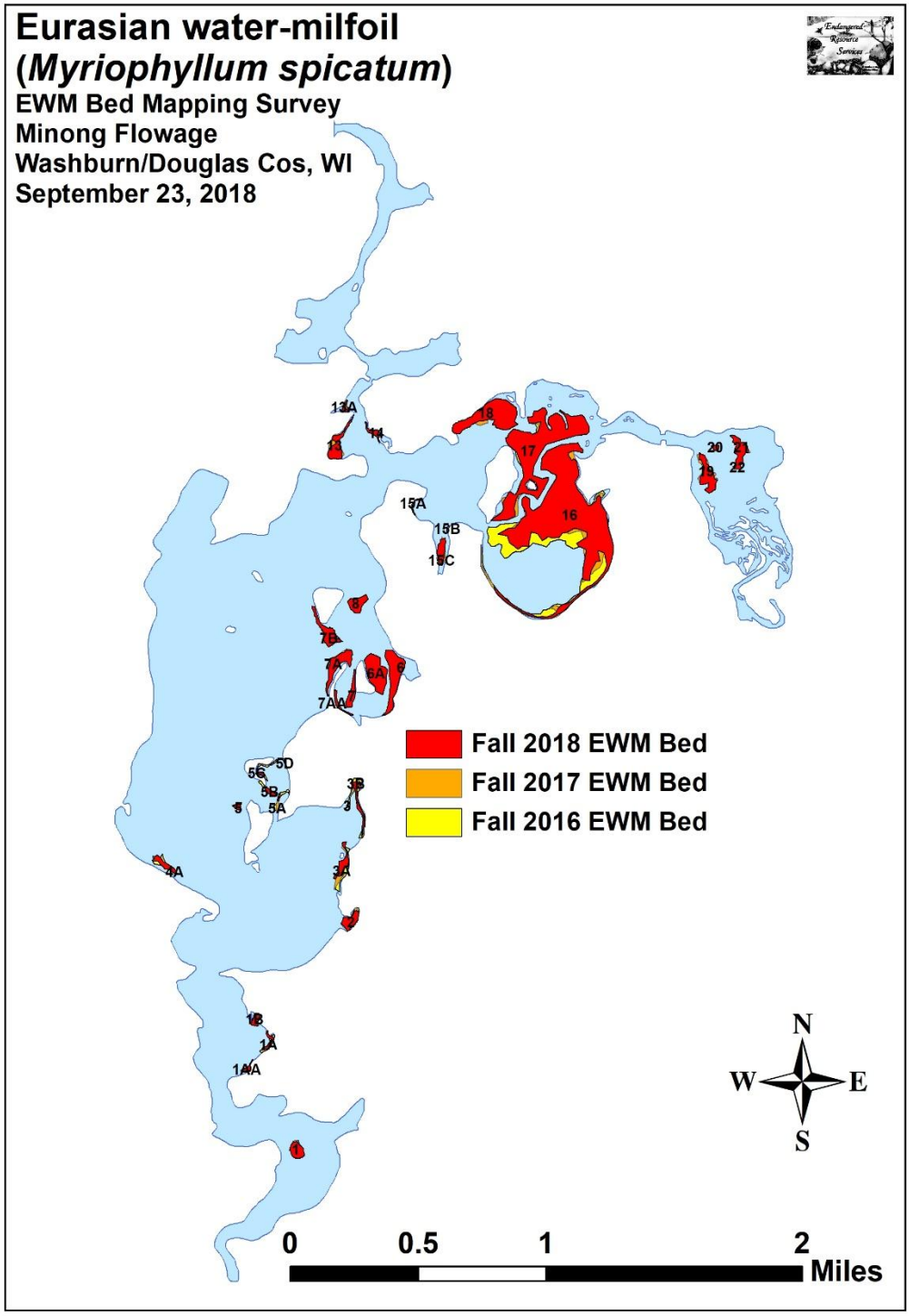
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(Myriophyllum spicatum)
EWM Bed Mapping Survey
Minong Flowage
Washburn/Douglas Cos, WI
September 23, 2018
Fall 2018 EWM Bed
Fall 2017 EWM Bed
Fall 2016 EWM Bed
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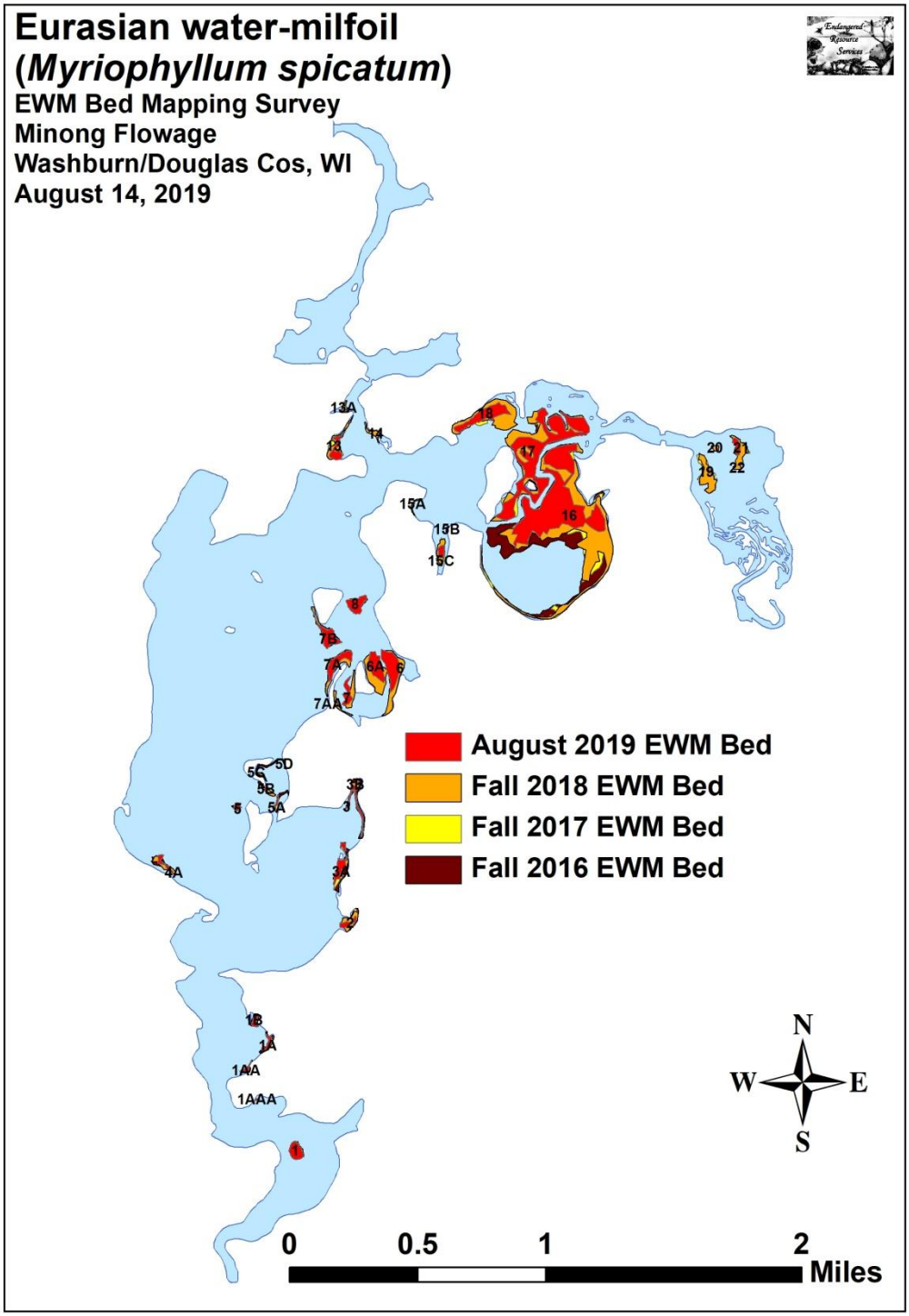
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