Pike Chain of Lakes

Bayfield County, Wisconsin

Final Report for Wisconsin Department of Natural Resources Grant ACEI-169-15

June 2017

Sponsored by:

Iron River Pike Chain of Lakes Association

WDNR Grant Program

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This report fulfills the final deliverable for Wisconsin Department of Natural Resources Grant ACEI-169-15. It is a compilation of information provided by the Iron River Pike Chain of Lakes Association and reports provided throughout the project by Onterra, LLC.

INTRODUCTION

The Pike Chain of Lakes is comprised of six lake basins located near the Town of Iron River in Bayfield County, Wisconsin (Figure 1). The chain includes nearly 900 acres of surface water, and forms the headwaters of a drainage system that leads to the White River which flows through the Bad River Indian Reservation on its way to Lake Superior. All lakes within the chain are considered Areas of Special Natural Resource Interest (ASNRI) as outstanding or exceptional resource waters per Section 281.15 of Wisconsin Statutes.

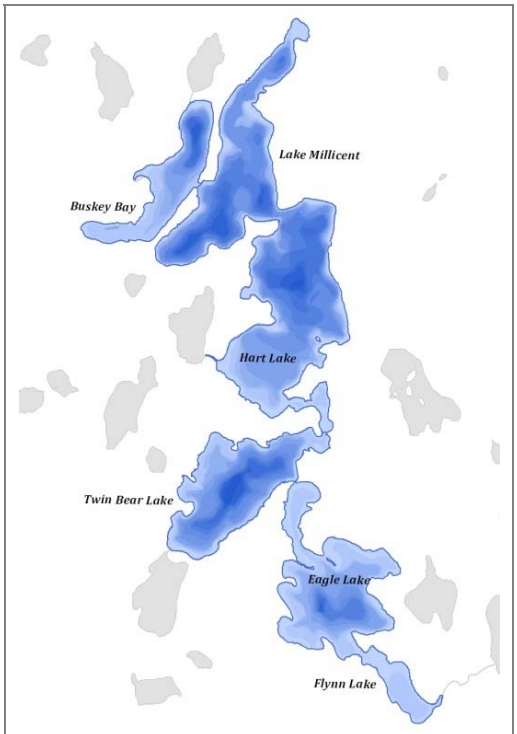


Figure 1. Pike Chain of Lakes, Bayfield County, WI.

Eurasian watermilfoil (*Myriophyllum spicatum,* EWM) was first documented in the Pike Chain of Lakes in 2004, with plants being discovered first in the channel between Twin Bear and Hart Lake. With the help of the Wisconsin Department of Natural Resources (WDNR) and Bayfield County, an Aquatic Invasive Species Rapid Response Grant was awarded to fund a six acre 2,4-D treatment in the Hart Lake channel and small sections of Twin Bear and Hart Lake in June 2005. A second herbicide treatment, funded by the Iron River Pike Chain of Lakes Association (IRPCLA), was conducted in June 2006 of approximately eight to ten acres targeting small colonies along the northwest shore of Twin Bear and colonies in Hart Lake including the Hart Lake channel.

In February 2007, the IRPCLA partnered with Onterra, LLC to complete seven grant applications in hopes of receiving partial funding for the development of a lake management plan for the Pike Chain of Lakes. In April 2007, the IRPCLA was notified that they were successful and would receive over $49,000 in funds. The Pike Chain of Lakes Comprehensive Management Plan was completed in December of 2008. Within the management plan, several management goals were developed by an IRPCLA planning committee and Onterra staff in order to continue managing the ecosystem in a responsible and ecologically sound manner. Among these defined goals was Management Goal 4, which called for the control of aquatic invasive species within the Pike Chain of Lakes. Consistent with the content of this goal, the IRPCLA pursued an Aquatic Invasive Species - Controlling Established Infestations grant (ACEI) through the WDNR. A grant application was submitted in February 2009 which proposed a five year aquatic invasive species control project. The project was approved and funded later that April. A January 2014 ACEI-061-09 Summary Report details the monitoring and control actions taken during the five year project (Cibulka et al. 2014). Overall, it is believed that the efforts were successful in maintaining a relatively low level of EWM within the chain lakes during this time period.

In measuring success in controlling EWM and also to monitor the native plant community, surveys from 2005/2007 were compared with similar data collected in 2013. Specifically, whole-lake point-intercept surveys were completed according to WDNR protocol (Hauxwell et al. 2010). At

the first notice of locating EWM in the Hart Lake / Twin Bear Lake channel, WDNR staff completed the point-intercept surveys on these lakes in 2005. Onterra completed point-intercept surveys on the remaining lakes in 2007 during the management planning project. Community mapping surveys were completed in 2007 and 2013 to map emergent and floating-leaf vegetation communities within the lake. This allowed for the identification of incidental species that were not found during the point-intercept survey, as well as for an assessment in the difference between these valuable communities before and after active management on the system (herbicide treatments to control EWM). An EWM peak biomass survey was completed each late summer to map the density and extent of EWM colonies during their peak growth period. Point-based EWM locations were described as *Single or Few Plants, Clumps of Plants* or as a *Small Plant Colony*. Polygon-based distinctions included *Highly Scattered* and *Scattered* for lightly dense areas, with *Dominant*¸ *Highly Dominant* and *Surface Matted* used to describe denser EWM colonies where distinct colony margins could be delineated.

As previously mentioned, herbicide treatments have been completed on the Pike Chain of Lakes since 2005 in an effort to control EWM. Figure 2 displays the treatment history in terms of acreage of EWM in the Pike Chain of Lakes. All treatments were completed using granular 2,4-D at varying dosages.

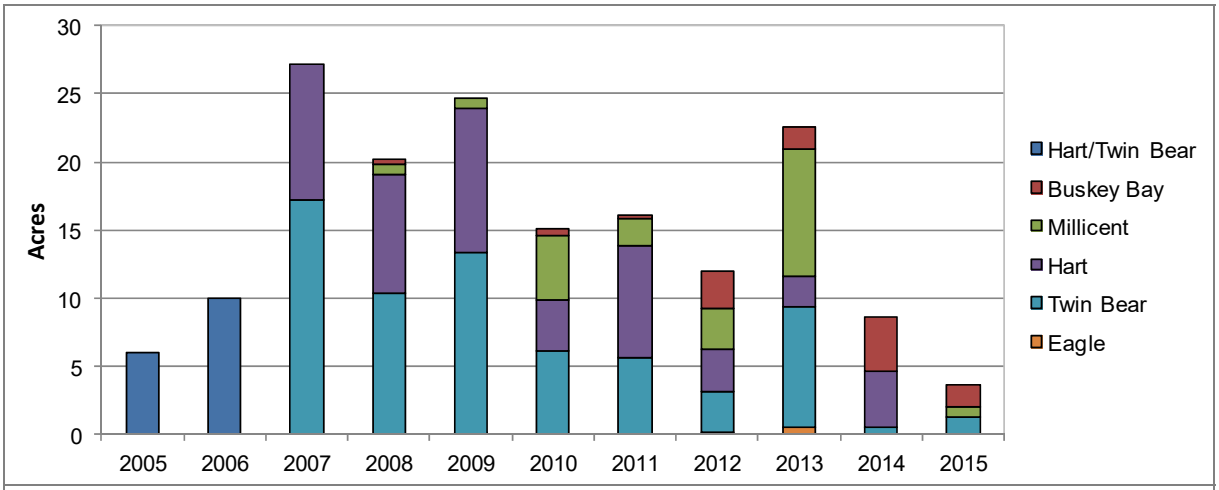


Figure 2. Pike Chain of Lakes annual Eurasian watermilfoil treatment history, 2005-2015. Chart includes acreage of Eurasian watermilfoil treated with granular 2,4-D.

Herbicides that target submersed plant species are directly applied to the water, either as a liquid or an encapsulated granular formulation. Factors such as water depth, water flow, treatment area size, and plant density work to reduce herbicide concentration within aquatic systems. Understanding concentration and exposure times are important considerations for aquatic herbicides. Successful control of the target plant is achieved when it is exposed to a lethal concentration of the herbicide for a specific duration of time. Much information has been gathered in recent years on the environmental fate of herbicides after application and the effectiveness of treatments on target plant colonies. This research couples quantitative aquatic plant monitoring with field-collected herbicide concentration data to evaluate efficacy and selectivity of control strategies implemented on a subset of Wisconsin lakes and flowages. Based on their findings, lake managers have adopted two main treatment strategies; 1) whole-lake treatments, and 2). spot treatments.

Whole-lake treatments are those where the herbicide is applied to specific sites, but when the herbicide reaches equilibrium within the entire volume of water (entire lake, lake basin, or within the epilimnion of the lake or lake basin); it is at a concentration that is sufficient to cause mortality to the target plant within that entire lake or basin. The application rate of a whole-lake treatment is dictated by the volume of water in which the herbicide will reach equilibrium. The depth of the thermocline, or depth where warmer surface water meets colder, deeper water, impacts this calculation as well. At the thermocline, the difference in water density is believed to prevent herbicide from mixing into this lower layer of water. Because exposure time is longer, target herbicide levels for whole-lake treatments are significantly less than for spot treatments.

Spot treatments are a type of control strategy where the herbicide is applied to a specific area (treatment site) such that when it dissipates, its concentrations are insufficient to cause significant impacts outside of that area. Spot treatments typically rely on a short exposure time (often hours) to cause mortality and therefore are applied at a much higher herbicide concentration than whole-lake treatments. This has been the strategy historically used on most Wisconsin lakes; between 2005 and 2015, the treatments completed in the Pike Chain of Lakes would all be considered spot treatments.

With the ACEI-061-09 Summary Report, it was stated that the five year efforts of the IRPCLA were successful in that EWM was held to a low abundance throughout the chain lakes and reduced in littoral frequency of occurrence in Twin Bear, where it was most prevalent during the start of the project. Figure 3 displays the occurrence of EWM in the chain lakes before and after the project. A reoccurring theme in the Pike Chain of Lakes is that the EWM colonies are located often sparsely along the steep slopes of these relatively deep lakes. Therefore, small but dense colonies were often targeted for treatment. During the course of this project, many advances were made in the field of AIS management, particularly with information being gathered on herbicide dissipation within treatment areas and the related efficacy on the target plants. AIS managers currently believe that a spot treatment must be larger in size in order to hold an ample concentration of herbicide for longer than several hours. In a small spot treatment area, the herbicide may dissipate rapidly to the point where herbicide concentration rates do not remain high enough to cause full mortality to the target plant. Instead, a small reduction in plant biomass or only "seasonal" control may be seen instead of longer term (several seasons worth) control. It is believed that in the Pike Chain of Lakes, larger spot treatment areas may have seen good, longer-term success while in relatively small treatment areas, success for one or two seasons may have been more common. Of course, the terms large and small are used here in relative scales – other factors such as water flow and a treatment area's position in the lake (in an isolated bay, in open water, along shore, etc.) play a role in herbicide dissipation from any site.

This information is important to digest if a proper AIS control strategy is to be outlined for the Pike Chain of Lakes; specifically, if longer-term success is to be achieved.

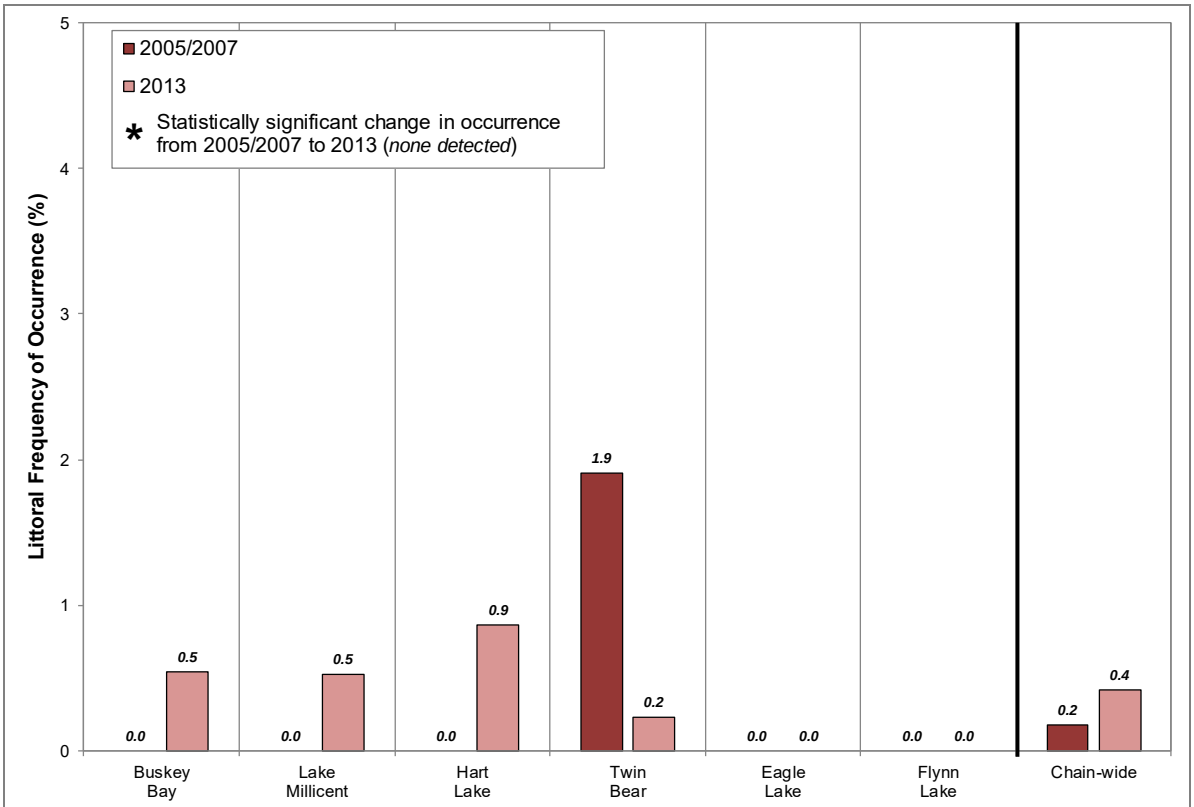


Figure 3. Pike Chain of Lakes Eurasian watermilfoil littoral frequency of occurrence. Created using data from 2005/2007 and 2013 point-intercept surveys. Note that in 2007, when the project began, EWM was known to exist only in the Hart Lake channel and Twin Bear Lake.

2015 Treatment Strategy Development

During an August 20, 2014 peak biomass survey, EWM colonies were found to increase in their extent from that which was observed in 2013. In all, 1.8 acres of EWM was mapped with polygon based methods, an increase from the 0.4 acres mapped in 2013. Numerous *Single or Few Plants, Clumps* and *Small Plant Colonies* were mapped throughout the chain lakes as well (Maps 1-6). It was during this time that a single plant was found in Flynn Lake, representing the first established plant discovered in this lake. Consistent with the treatment strategy outlined in ACEI-061-09, the IRPCLA approved a 2015 preliminary strategy that included 4.2 acres to be treated with granular 2,4-D at a rate of 4.0 acid equivalent (a.e.). A one-year, AIS-Established Population Control grant was obtained by the IRPCLA to partially finance the treatment and associated monitoring. In addition to the prescribed herbicide application, 4.5 acres of EWM were slated for hand-removal by IRPCLA volunteers (Maps 1-6).

2015 Treatment & Monitoring

On May 18, 2015, Onterra staff visited the Pike Chain of Lakes with IRPCLA President Al Bochler to survey the preliminary herbicide treatment areas. The air temperature was 50°F and the skies overcast, with only a light breeze. The water was incredibly clear, with temperatures at 55-56°F near the surface. EWM plants were observed to display recent, green growth in all proposed treatment areas. A pre-treatment survey narrative is provided in Table 1.

Table 1. Pike Chain of Lakes pre-treatment survey results, May 2015.		
Treatment Area	**2015 Pre-Treatment Observations**	**Final Acreage**
A-15	Site was observed to contain much EWM. Area extents were verified with submerged video camera and no alterations to the treatment strategy were recommended	1.5
B-15	Even with excellent viewing conditions, few EWM plants were observed in this area. It was recommended the site be removed from the herbicide treatment plan and targeted for volunteer hand-pulling instead.	0 (*removed)*
C-15	Site was observed to contain much EWM. Area extents were verified with submerged video camera and no alterations to the treatment strategy were recommended	0.8
D-15	Site was expanded to encompass a new substantial small plant colony that was located outside of the pre-existing treatment area. It was recommended that the site be increased from 0.6 to 0.8 acres, with no change in average depth.	0.8
K-15	This site was not included in the preliminary treatment strategy; however, upon inspection of the site at the request of Al Bochler, substantial EWM growth and expansion was observed. A 0.5-acre treatment area was fixed over the observed colonies and included in the final treatment strategy.	0.5

The observations and calculations stemming from the 2015 pre-treatment survey resulted in 3.6 acres of water to be treated with 2,4-D. Sites E-15, F-15, G-15, H-15, I-15, and J-15 were all proposed for hand-removal. These sites were verified for presence of EWM plants and included within the final EWM control strategy.

The Pike Chain of Lakes herbicide treatment was completed by Northern Aquatic Services on June 11, 2015. The applicator reported wind speeds of 0-3 mph and air and water temperatures of 67°F at the time of treatment. Granular 2,4-D (Sculpin G®) was applied to the treatment areas as prescribed, though 40 lbs of herbicide was also applied to an additional 0.15 area near the Buskey Bay – Millicent channel, which the applicator estimated to amount to a 4.0 ppm ae treatment area concentration. This treatment area was determined by the applicator the day of the treatment and was approved by WDNR staff.

To monitor the EWM population from a pre-treatment (summer 2014) to a post treatment (summer 2015) period, quantitative or qualitative monitoring can be completed. Quantitative monitoring involves comparing number data (or quantities) such as plant frequency of occurrence before and after the control strategy is implemented. This has been completed in the past by placing a 20 meter grid of sampling points over treatment areas, and sampling aquatic vegetation at those points with a rake. Due to the small amount of annual treatment acreage, no quantitative analysis was able to be conducted on the Pike Chain of Lakes during a number of treatment years. With a small treatment area, the amount of sampling points placed in that area are often small so the chances of sampling EWM is also small. Additionally, at even a 20-meter spacing, the number of sampling points in a 1-2 acre treatment area are not numerous enough to determine a statistical difference in the pre and post treatment populations.

Qualitative monitoring is completed by comparing visual data such as EWM colony density ratings before and after the treatments. This is completed through collection of point and polygon data and assigning densities to plant beds using the scales previously mentioned on Page 2 of this report. Qualitative data may then be compared pre and post treatment to determine efficacy. A successful treatment (herbicide or hand-removal methods) on a given mapped colony would include a reduction of EWM density as demonstrated by a decrease in one density rating on a 5-tiered density rating scale. In other words, *Dominant* colonies would be reduced to *Scattered, Scattered* to *Highly Scattered*, etc. In terms of a treatment as a whole (lake-wide and chain-wide), at least 75% of the acreage treated that year would decrease by one level of density for an individual site.

2015 Treatment Results

During the summer of 2015, IRPCLA President Al Bochler noted during correspondence a "concerning" amount of EWM being located within the chain, both by himself and IRPCLA members. During Onterra's peak-biomass mapping on August 25, 2015, the entire littoral zone of all six lakes, including herbicide and hand-harvesting sites, were assessed. Maps 1-6 shows the results of this survey. The resurgence described in Mr. Bochler's summer 2015 correspondence was also observed by Onterra staff. In all, 7.5 acres of highly colonized EWM was observed within the chain lakes (Figure 4). As seen in Figure 4, the 7.5 acres represents the largest amount of colonized EWM mapped in the chain since EWM had first been discovered. However, to complete this picture, the 2015 data on Maps 1-6 indicate that many *Clumps* and *Small Plant Colonies* were located within the chain's littoral zone as well. Though these occurrences do not represent true, continuous colonies, their number and distribution around the littoral zones of Buskey Bay, Millicent and Hart Lakes (and the northern shoreline of Twin Bear) raises concern.

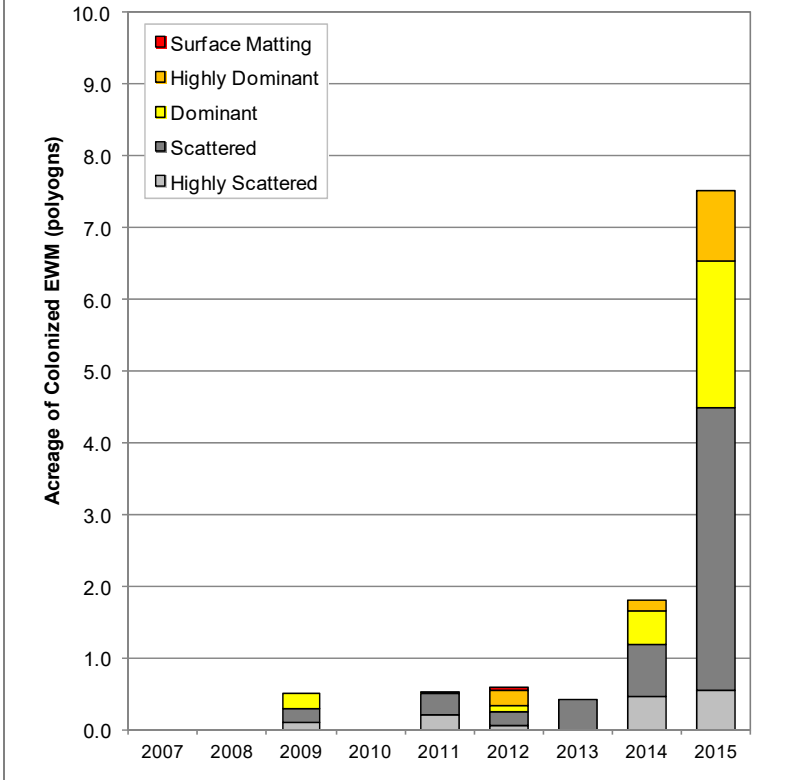


Figure 4. Pike Chain of Lakes Eurasian watermilfoil acreage, 2007-2015. Created using data from late-summer EWM peak biomass surveys.

Despite the unfortunate scenario building around the non-treated areas of the lake, the 2015 treatment areas appeared to hold a limited amount of EWM. A breakdown of each treatment area is presented below in Table 2. In total, EWM was reduced by at least one qualitative density rating in three of the four treatment areas, while the fourth site failed to meet expectations by demonstrating only a small decrease in observed EWM. This does meet the qualitative success criteria outlined in the ACEI-091-06 report. However, it should be noted that at this time it is not

certain if the observed reduction is to be realized for the 2015 season only, or if this reduction will be apparent in 2016 an onward.

Table 2. Pike Chain of Lakes August 2015 survey results and success criteria evaluation.

Treatment Area	Summer 2015 Observations	Annual Qualitative Success Criteria Met?
A-15	Previously held *Scattered* and *Dominant* colonies, with several *Clumps.* No EWM observed within treatment area during August 2015 surveys. Full reduction of EWM within site.	Yes
B-15	Site removed during pre-treatment survey. Was observed to hold two *Scattered* colonies in August 2014, one of these colonies remained in August 2015 along with a *Small Plant Colony*	N/A (not treated)
C-15	During August 2014 survey was found to hold *Highly Dominant* colony, stretching the length of treatment site. No EWM observed within treatment area during August 2015 survey. Full reduction of EWM within site.	Yes
D-15	Previously held a large, *Dominant* colony along with scattered *Single or Few Plants* and a *Small Plant Colony.* Following treatment, no EWM was observed within the treatment area. Full reduction of EWM within site.	Yes
K-15	During August 2014 survey was found to hold a *Small Plant Colony* and other *Clump / Single or Few Plant* occurrences. Site was observed to have increased in density and areal extent during a pre-treatment survey visit to two large *Small Plant Colonies.* Following the treatment, a *Small Plant Colony* and *Clump* Still remained within the site. This demonstrates a limited reduction of EWM within the treatment area	No

Hand-removal efforts were planned to be completed during 2015 by a professional diver, Scott Mitchen, who has a residence on the Pike Chain of Lakes. Mr. Mitchen and IRPCLA President Al Bochler reported over 140 hours of hand pulling in 2014. Unfortunately during the summer of 2015 Mr. Mitchen fell and sustained three broken ribs, which forced him out of diving. Three other experienced and certified divers, John Westmen, Scott Bochler and Logan Neveaux, stepped up to the task of hand removing EWM in the Pike Chain of Lakes. Additionally, a group of about 12 volunteers joined in EWM monitoring and removal in 2015.

Paid divers logged 81 hours and 2,550 lbs of EWM removed from the various hand-removal locations and additional colonies spotted during 2015. Volunteers put in roughly 200 hours worth of time also, removing an estimated 4,000 lbs of EWM from the Pike Chain of Lakes.

FUTURE TREATMENT STRATEGY

While EWM was observed to meet the 75% chain-wide reduction level, the increase in EWM throughout non-treated areas of the chain has come to be quite concerning for the IRPCLA, Onterra, WDNR, and other Pike Chain of Lakes' stakeholders. It is believed that the original threshold strategy outlined in the ACEI-061-09 Summary Report was satisfactory at reducing the densest EWM colonies in the chain in early 2015, but the rebounding of EWM elsewhere was unexpected and presents an interesting dilemma for continued management.

On October 15, 2015, several IRPCLA board members and Onterra ecologist Dan Cibulka met with WDNR Water Resources Management Specialist Pamela Toshner at the WDNR Spooner office. WDNR Water Resources Management Specialists' Scott Provost and Scott Van Egeren joined the meeting through teleconference. The attendees discussed EWM management strategies and funding opportunities for the IRPCLA to explore. The history of EWM management on the Pike Chain of Lakes was examined as was the IRPCLA's current management strategy; specifically, continuing spot treatments on the chain. If this same strategy was to be utilized, it would result in a 27.5 acre spot treatment to occur in Hart Lake. Of course, a spot treatment of that magnitude would result in herbicide mixing into the lake and maintaining a concentration that could impact plants on a lake-wide scale. The committee then discussed a concept that has been used on other Wisconsin lakes; a whole-lake treatment strategy.

This treatment strategy would be planned such that the whole-lake concentration of herbicide would reach relatively low concentrations, but hold for a longer period of time than a spot treatment scenario. With a whole-lake strategy, the IRPCLA understands that all EWM within the whole-treatment lakes would be targeted and thus a better chance of lake-wide success could be had. Additionally, the potential for native impacts on a lake-wide scale could occur with this strategy; therefore, it becomes vital that proper planning and monitoring of the native aquatic plant community is completed to detect any impacts that could occur.

If a whole-lake treatment is to be completed, the aforementioned aquatic plant monitoring must dictate the timing of the treatment. A treatment to this scale would require monitoring through a lake-wide point-intercept survey, like those completed on the chain in 2013. Because the point-intercept survey needs to be completed during the mid-late summer growing season (August), these surveys would be completed a year prior to the treatment and the year after the treatment to assess the full impacts of the treatment on native and non-native plants in the chain lakes. All six lakes would be scheduled for this monitoring regime. The project would include two management objectives:

1. The strategy would result in multiple years of control within the chain lakes; in other words, bring EWM down to an acceptable (low) level in which volunteer hand-removal would be needed at most to control small populations.
2. There would be minimal impacts to native species. Realistically, some small declines could be observed in native plant species the year of treatment with this strategy. However, the treatments would be planned so that these impacts would be minimized. It is anticipated that with the year-after aquatic plant monitoring, managers would be able to document the rebounding of any plant species that had declined the year of the treatments.

The proposed project would include the necessary components to produce an updated Aquatic Plant Management Plan for the Pike Chain of Lakes. This plan would document the issues present, inventories of aquatic plants (historical and current), outline the state of the aquatic plant community using widely accepted analyses, and provide a list of recommendations and alternatives as well as an implementation strategy. A crucial part of this process would be the integration of stakeholders such as the IRPCLA, WDNR, Bayfield County staff along with other members of the general public. A series of meetings and educational initiatives should be included to integrate stakeholder concerns, direct the development of management alternatives and finally inform stakeholders on matters pertaining to aquatic plant management.

The remaining text of this report includes more specific details on the recommended strategies for EWM management in 2016-2018, an outline of a potential funding opportunity, and finally a proposed timeline. It should be noted that as this project would develop, the strategy would be fine-tuned to account for changes in component costs, funding availability, fluctuations in the aquatic plant communities of the chain lakes, and unanticipated weather conditions.

Buskey Bay, Millicent, Hart and Twin Bear EWM Management Strategy

Maps 7-9 and Table 3 outline a potential whole-lake treatment strategy for Buskey Bay, Millicent, Hart and Twin Bear Lakes. With the treatment scenario outlined, the calculated epilimnetic 2,4-D concentration (assuming a thermocline at 17 ft) would be just shy of 0.3 ppm ae in Buskey Bay, Millicent, Hart and Twin Bear Lakes. This is currently the target concentration that AIS managers aim for in whole lake treatments, based upon field studies of other whole lake treatments. At this concentration, it is anticipated that the herbicide will cause significant mortality to the EWM in the lake and that native plant mortality should be limited, but could also occur.

Table 3. Potential Pike Chain of Lakes 2017 whole lake treatment strategy. Strategy outlined pertains to Buskey Bay, Hart, Millicent and Twin Bear Lakes. Treatment areas may be referenced in Maps 7-9.

Whole Lake Treatment Scenario (*assuming 17 ft thermocline*)						
2017 Preliminary EWM Treatment Areas *Liquid 2,4-D*						
Site	**Lake**	**Proposed Acres**	**Ave. Depth (feet)**	**Volume (ac-ft)**	**2,4-D (ppm ae)**	**DMA IV (gallons)**
A-17	Buskey Bay	0.9	4	3.6	4.00	10.3
B-17	Buskey Bay	3.3	6	19.8	4.00	56.6
C-17	Buskey Bay	3.5	7	24.5	4.00	70.1
D-17	Buskey Bay	3.1	6	18.6	3.75	49.9
E-17	Buskey Bay	1.5	4	6.0	4.00	17.2
Subtotal		***12.3***		***72.5***		**204.1**
Site	**Lake**	**Proposed Acres**	**Ave. Depth (feet)**	**Volume (ac-ft)**	**2,4-D (ppm ae)**	**DMA IV (gallons)**
F-17	Millicent	1.7	5	8.5	4.00	24.3
G-17	Millicent	2.8	7	19.6	4.00	56.1
H-17	Millicent	1.1	8	8.8	4.00	25.2
I-17	Millicent	1.7	7	11.9	4.00	34.0
J-17	Millicent	4.9	8	39.2	4.00	112.2
K-17	Millicent	6.2	7	43.4	4.00	124.2
L-17	Millicent	0.4	8	3.2	4.00	9.2
M-17	Millicent	2.2	8	17.6	4.00	50.4
N-17	Millicent	1.2	6	7.2	4.00	20.6
O-17	Millicent	1.4	8	11.2	4.00	32.0
P-17	Millicent	0.4	9	3.6	4.00	10.3
Q-17	Millicent	1.1	9	9.9	4.00	28.3
R-17	Millicent	2.2	6	13.2	4.00	37.8
Subtotal		***27.3***		***197.3***		**564.5**
Site	**Lake**	**Proposed Acres**	**Ave. Depth (feet)**	**Volume (ac-ft)**	**2,4-D (ppm ae)**	**DMA IV (gallons)**
S-17	Hart	1.8	7	12.6	4.00	36.0
T-17	Hart	1.8	8	14.4	4.00	41.2
U-17	Hart	2.8	7	19.6	4.00	56.1
V-17	Hart	1.5	6	9.0	4.00	25.7
W-17	Hart	1.5	7	10.5	4.00	30.0
X-17	Hart	29.4	8	235.2	3.25	546.7
Subtotal		***38.8***		***301.3***		**735.9**
Site	**Lake**	**Proposed Acres**	**Ave. Depth (feet)**	**Volume (ac-ft)**	**2,4-D (ppm ae)**	**DMA IV (gallons)**
Y-17	Twin Bear	4.6	6	27.6	4.0	79.0
Z-17	Twin Bear	2.0	6.0	12.0	4.0	34.3
AA-17	Twin Bear	15.4	7	107.8	4.0	308.4
AB-17	Twin Bear	1.8	5	9.0	4.0	25.7
Subtotal		***23.8***		***156.4***		**447.5**
Grand Total		**102.2**		**727.5**		**1951.9**

Table 3, continued. Potential Pike Chain of Lakes 2017 whole lake treatment strategy. Strategy outlined pertains to Buskey Bay, Hart, Millicent and Twin Bear Lakes. Treatment areas may be referenced in Maps 7-9.

Whole Lake Treatment Scenario (*Buskey Bay, Millicent, Hart and Twin Bear Lakes*)					
2017 Preliminary EWM Treatment Areas - Liquid 2,4-D					
Lake	**Proposed Acres**	**Volume (ac-ft)**	**DMA IV (gallons)**	**Epilimnetic Volume @ 17 ft (ac-ft)**	**Epilimnetic 2,4-D Concentration (ppm)**
Buskey Bay	12.3	72.5	204.1	874	0.299
Millicent	27.3	197.3	564.5	2,429	0.293
Hart	38.8	301.3	735.9	3,214	0.290
Twin Bear	23.8	156.4	447.5	1,931	0.293
Subtotal	***102.2***	***727.5***	***1951.9***		

The whole lake treatments completed in Buskey Bay, Millicent, Hart and Twin Bear Lakes would be assessed through not only the point-intercept survey, but also through the qualitative methods that have been used on the Pike Chain of Lakes for a number of years. Success criteria for these two assessment methods are presented below:

- Qualitative Assessment: determination of treatment success will be completed through the 2017 and 2016 peak-biomass survey results; 2018 peak-biomass survey results may be used to determine success in the form of longevity. The treatment will be declared successful if the there is an observed decrease of a full density rating in all polygon-based occurrences (e.g. *Dominant* to *Scattered).* For point-based occurrences of EWM, it is anticipated that all EWM mapped within the four lakes would be mapped in either *Single or Few Plant* or *Clump* occurrences; no *Small Plant Colonies* should exist following the treatment.
- Quantitative Assessment: a successful treatment should include a statistically significant reduction in EWM frequency following the treatments as exhibited by a 75% decrease in EWM frequency from the 2016 point-intercept and 2018 point-intercept surveys.

During the year of the treatment, the project would include verification and refinement of treatment plan immediately before control strategies are implemented. This potentially would include refinements of herbicide application areas, assessments of growth stage of aquatic plants, and documentation of thermal stratification parameters that will ultimately influence the final dosing strategy. IRPCLA volunteers would be enlisted to provide accurate thermal profile data in the days leading up to the treatment.

With a treatment of this scale, it will be important to monitor the remaining concentration of herbicide in the lake following treatment. Following treatment, IRPCLA volunteers would collect water samples from pre-determined locations, depths and time intervals. These samples would be preserved and sent to the Wisconsin State Lab of Hygiene for 2,4-D analysis. The results would paint a picture of the herbicide movement and concentration in the days and weeks following the treatment. Volunteer-based monitoring of temperature profiles would also be coordinated surrounding the treatment to allow final dosing strategies to accurately represent the herbicide mixing volume of the lake (i.e. epilimnion).

Eagle and Flynn Lake EWM Management Strategy

The situation in Eagle Lake presents an interesting dilemma; the current extent of EWM within the lake does not quite warrant a whole-lake treatment strategy, yet it is at a level that is above that which can be contained by hand-removal methods. Because the whole-lake treatments in the upper four chain lakes are being completed in 2017, with monitoring taking place in 2016 and 2018, the possibility exists that the EWM in Eagle Lake may reach a point in 2017 where a whole lake treatment is warranted. However, it is impossible to know if this could be the case at this point in time. In Eagle Lake and Flynn Lake, it is recommended for 2016-2018 that continued monitoring of the EWM population occur along with volunteer hand-pulling and professional hand-removal or DASH (Diver Assisted Suction Harvest). DASH work locations are depicted on Map 10. All hand removal efforts completed during 2016 should be focused upon Eagle and Flynn Lakes, as a large-scale treatment would take place in 2017 on the upper four lakes in the chain. Hand removal may occur in these upper four lakes during 2017 or 2018 on any remaining EWM plants, however the location and density descriptions of these occurrences should be noted so that lake managers may understand where and to what extent the treatment was unsuccessful.

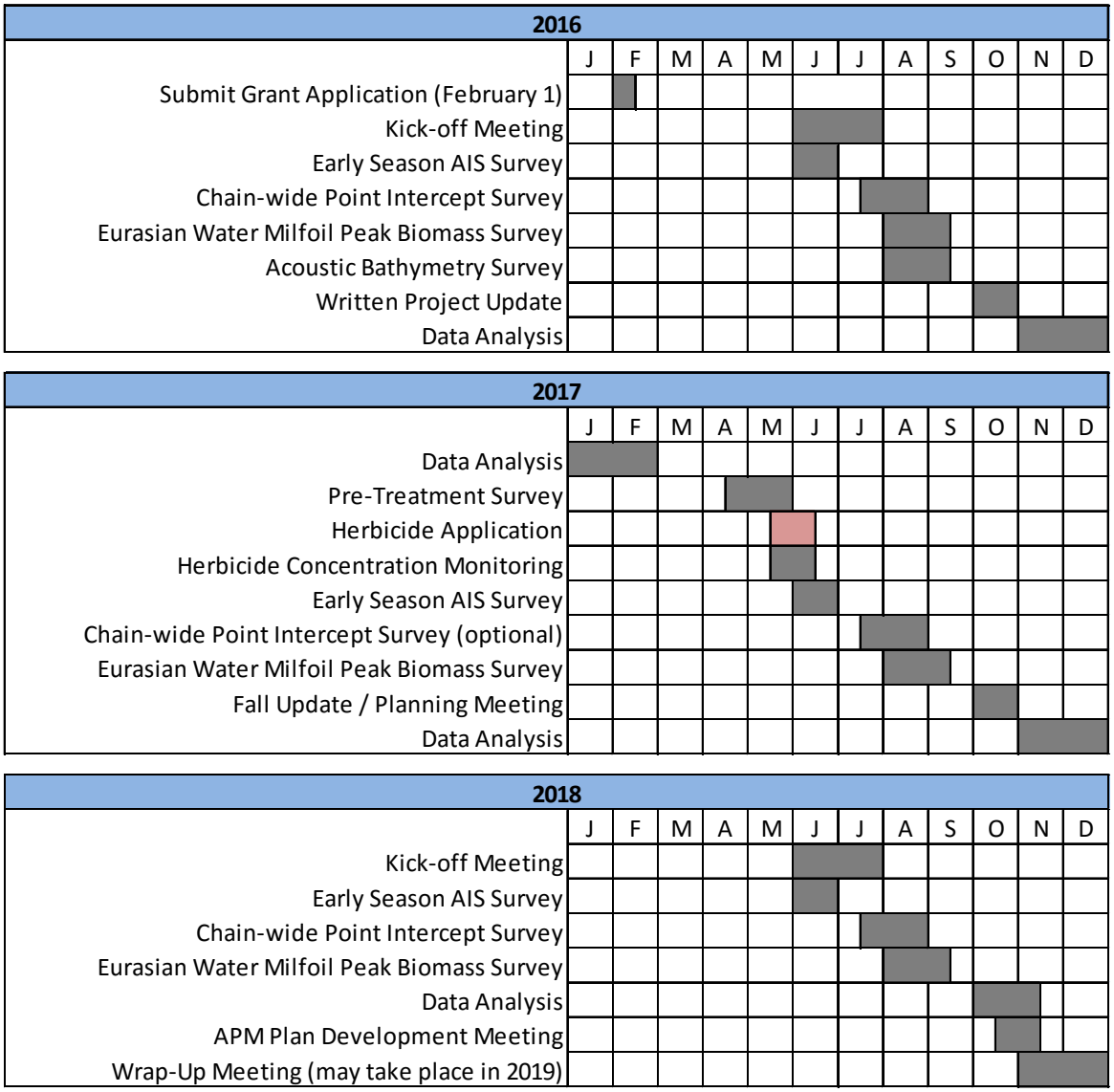
Funding

The aforementioned treatments and associated monitoring would likely have expenses beyond what the IRPCLA could finance alone. To assist in financing this large project, the IRPCLA would apply for funding through the State of Wisconsin's Surface Water Grants Program in the AIS-Established Population Control grant category. This category offers up to a 75% cost match from the state, and in-kind donated time may be used to offset the grant sponsor's out-of-pocket costs

Timeframe

Although some discussion of the timing of this project and its components are presented above, Table 4 below illustrates many of the components this project would include, with their approximate timeframe. While the herbicide application and some field work have specific times in which they must occur, some components, such as project meetings, can be flexible to meet the needs of the IRPCLA members who would be attending.

Table 4. Potential Pike Chain of Lakes 2016-2018 EWM control project outline.



PIKE CHAIN OF LAKES 2015 COMPLIMENTARY AIS EFFORTS

During 2015, several efforts were initiated by the IRPCLA to complement their efforts in reducing the presence of EWM in the chain lakes as well as restoring important native aquatic plant habitat. These efforts consisted of a restorative planting in Hart Lake as well as a complimentary source containment activity involving handing out boat wash vouchers to watercraft visitors. Each of these programs are described below along with work completed by the association in battling purple loosestrife and assisting Lakeland College researchers in aging the chain's bluegill population.

During February 2015, the IRPCLA submitted an AIS-Established Population Control Grant application seeking funding for two years of AIS monitoring and control on the Pike Chain of

Lakes near Iron River, Bayfield County. A portion of the application was funded (ACEI-169-15) which included a one-year component aimed at demonstrating the feasibility and possible success of transplanting native submergent aquatic plants from one are of the chain to another. This report details the work that was completed as a part of that component and the results of the demonstration.

Anecdotal, but reliable accounts of the Pike Chain of Lakes rusty crayfish infestation report an almost total removal of plant biomass within Hart and Twin Bear lakes during the 1990s. Early in the next decade, the population of rusty crayfish had declined and the plant population has begun to recover. Al Bochler, life-long resident of the chain and the association's current President, recalled an area in Hart Lake that contained dense musky cabbage, also known as large-leaf pondweed (*Potamogeton amplifolius*), growth prior to the rusty crayfish infestation. Other *Potamogeton* species, such as Illinois pondweed (*P. illinoensis*) and floating-leaf pondweed (*P. nodosus*) have been successfully transplanted through apical cuttings in Texas reservoirs (Doyle et al. 1997, Smart et al. 1998, Webb et al. 2012); therefore, it was thought that stem cuttings could be used in the same manner to propagate large-leaf pondweed for planting in Hart Lake.

Large-leaf Pondweed Transplanting in Hart Lake

It was the intent of this demonstration project to see if large-leaf pondweed cuttings could be collected from one area of the Pike Chain of Lakes, temporarily planted in pots to foster root production, and then transplanted to Hart Lake in the area that was once established by the species. The processes used and a description of the results are contained below.

Propagation of Apical Cuttings

On May 15, 2015, Onterra ecologists visited the Pike Chain of Lakes to harvest large-leaf pondweed cuttings from a dense population of the plants that exist in the channel between Twin Bear and Hart lakes (Map 11). Approximately 50 cuttings, all from the top of plants, were collected from the area (Photo 1). With the help of Al Bochler, 36 total stem cuttings were replanted for root production in a separate pot each. To weigh the pots down, about two inches of gravel were placed in the bottom of each pot. A single cutting, along with lake bottom sediments collected at the cutting site, were placed in each of the 36 pots (Photo 2). Four plastic bins, each holding nine pots and two large paving bricks for weight, were staked to the lake bottom with rope and metal spikes in approximately two feet of water near shore in Hart Lake (Map 11, Photo 3). In mid-June, a storm event occurred and to protect the plantings, Al Bochler created a wave break in front of the four bins from fence posts and 2x12 boards. No pots were lost as a result of the mid-June storm or others that occurred that summer.

Transplanting of Propagules

On August 24, 2015, approximately 14 weeks after the cuttings were harvested, Onterra staff members returned to Hart Lake and found that of the original 36 cuttings, 25 survived (per bin: 9, 4, 5, 7) and produced roots (Photos 4 and 5). Further, what appeared to be a white water lily and common waterweed also sprouted in two of the containers (they were planted at the site propagating site).

Photo 1. Onterra staff member harvesting apical cuttings at Pike Chain of Lakes.

Photo 2. Propagating equipment.

That same morning, Onterra ecologists decided to expand the demonstration to see if directly planted stem cuttings would establish as well; therefore, 30 stem cuttings were once again collected from the channel between Twin Bear and Hart Lakes.

As described above, Al Bochler recalled an area in the middle southern portion of Hart Lake that once supported a healthy colony of large-leaf pondweed before the lake's plant population was decimated by rusty crayfish. This site (Map 11) was selected for the demonstration because it once supported a population of the same species and because at a depth of approximately 12 feet, the propagules will likely not be disturbed by wind- or boat-induced waves. Further, upon inspection of the site, no large-leaf pondweed was currently growing in the area.

Photo 3. Secured bins, each with nine apical cuttings.

Photo 4. Bins with wavebreak after approximately 14 weeks of cutting growth.

Two approximately 9'x9' sites were marked out adjacent to each other with fiberglass rods. The two plots were located east and west of each other. Hart Lake was relatively rough that day with large waves and as a result, visibility at the site was not ideal, especially considering the clear water conditions that are typically found on the chain. Laying out the plots and subsequently planning the fresh cuttings and the propagules proved to be somewhat difficult because the divers

could not see the rods marking the borders of the plots. The idea of trying to complete the plantings in straight, ordered rows and columns was abandoned and the plants were scattered as evenly among the plots as possible. Soft sediments made planting difficult, but at the time, it appeared that they would stay in place (Photos 6 and 7). Upon finishing the plantings, the west plot contained the 25 plants that were collected in May (all with roots) and the east plot contained 25 stem clippings collected that morning.

Photo 5. Apical cutting with root growth after approximately 14 weeks of propagation.

Photo 6. Planting fresh cuttings and propagated cuttings in Hart Lake.

Inspection of Plantings after One Year

On August 19, 2016, Onterra staff returned to the site to inspect the plants, unfortunately the plots could not be located via scuba diving, so the attempt was abandoned. On September 15, 2016 (55 weeks after planting), the staff returned and with the use of a submersible camera. After several transects, the staff located the two plots about 50 yards northeast of the GPS point that was recorded on the day the planting was completed the previous year. Please note that the GPS point located on Map 11 is the correct location.

Eighteen large-leaf pondweed stems were located in the western plot where the rooted plants were installed. Through inspection, it was determined that many of the plants were actually connected via runners, so it was evident that some of the surviving plants were spreading via rhizomes and creating new plants in the area (Photos 8 and 9). This of course made it impossible to determine which were the original plantings and which were new growth.

In the eastern site that contained the cuttings collected the morning of installation, 38 stems were located within the plot and an additional 10 stems were found to be growing via rhizomes outside the plot from plants within the plot (Photo 10). As with the western plot, determining which of the stems were planted and which were new growth via runners (not including those outside the plot), was impossible.

Photo 7. Planted propagated cutting within western plot at Hart Lake.

Photo 8. Large-leaf pondweed growth 55 weeks after planting within western plot in Hart Lake.

Photo 9. Large-leaf pondweed growth 55 weeks after planting within eastern plot in Hart Lake.

Photo 10. Large-leaf pondweed growth 55 weeks after planting outside of eastern plot in Hart Lake.

Conclusions

The results of this demonstration are encouraging. With moderate effort, live plants were transplanted from one area of a lake to another. The fact that the fresh cuttings did so well the first year is very positive because it removed an entire step from the process. It would be interesting to see if other species of pondweeds and other genera would establish with the same effort and process.

This project was not designed to be an experiment, but instead to demonstrate whether or not submergent aquatic plants could be established with cuttings from one part of a lake to another. However, just having the ability to plant the cuttings in more of an organized grid would have allowed for a basic understanding of which cutting survived and which plants were the result of rhizome spreading. The project was designed relying on the traditionally clear water conditions at the Pike Chain of Lakes. During the day of planting conditions were not ideal, so as mentioned above it was nearly impossible to lay the plantings out in a grid due to limited visibility. In

retrospect, having a simple grid made of PVC pipe would have allowed the plantings to be organized in just about any visibility.

The original plan was to use small kiddie pools to hold the pots during the propagation process; however, knowing that the site that was to be used was on open shoreline of Hart Lake, the bins were chosen so they could be more easily secured to the lake bottom. That aspect of the project worked very well. An improvement could be made by using clay pots, which would likely be heavy enough without the addition of gravel. Further, if the propagating site is in an unprotected area like this one was, setting up a wavebreak from the beginning would be prudent.

Purple Loosestrife Control Efforts

Jack and Al Bochler worked approximately 26 hours each monitoring, cutting flower heads, and applying Rodeo to each cut headstock during the 2015 and 2016 growing seasons. Two visits were made each year to find most heads in bloom. Approximately 150 heads were removed in 2015, which is much lower than the high of 500 removed during 2012. In 2017, the Bochlers' removed approximately 50 heads.

Bluegill Fish Aging

In 2015, Jack and Al Bochler provided 29 Bluegill carcasses (basically, filets removed) to Derek Ogle, Fisheries and Statistics Professor at Northland College in Ashland. Dr. Ogle and his staff measured the length of the carcasses, length from the snout to the end of the opercula (gill flap), and extracted scales (from most fish), dorsal spines, and otoliths (ear bones). They sectioned the otoliths to estimate the age of the fish. Estimating age from the otoliths appeared promising, though the specialists had some difficulties getting consistently good images. Additionally, Dr. Ogle felt that they missed an inner annulus on nearly all of the otoliths. His experience on other area lakes suggested that bluegill would be in the neighborhood of 1-1.5" in length after their first summer and 2.5-4" after their second summer. Dr. Ogle was unsure if this was the case on the Pike Chain of Lakes, because a fisheries report provided by WDNR Fisheries Biologist, Scott Toshner suggested that the first "hump" of fish in 2010 (~2.5-3.5") could be these age-2 fish and age-1 fish were not sampled, likely for fyke nets utilized during the WDNR survey. Based upon the WDNR information, Dr. Ogle concluded that most of the fish they examined were one year older than what they estimated. Furthermore, they found wide variability in lengths-at-age. While this was not rare in Dr. Ogle's experience, the variability was wider than he expected; for example, age-5 fish ranged from just over 4" to just under 8", and approximate 8" fish ranged in estimated age from 5 to 9. He suggested that much of the variability was likely real, though some of it was likely due to issues they had processing otoliths. Dr. Ogle plans to continue communicating with WDNR fishery specialists regarding this matter.

Watercraft Wash Voucher

A complimentary source containment activity was devised to encourage visitors to wash their watercraft when leaving the Pike Chain of Lakes. During Clean Boats Clean Waters (CBCW) inspections at the Pike Chain of Lakes access points, inspectors had the opportunity to hand out vouchers to watercraft users that would entitle them to six minutes of use at a nearby car washing facility (the O'Brien's C-Store & Car Wash, Iron River, Wisconsin). The vouchers, a value of $3.50, were donated to the IRPCLA by the C-Store and were handed out by CBCW inspectors to

watercraft users as they left the Pike Chain of Lakes. CBCW inspectors were instructed to ask questions of the watercraft users on if they were headed to a nearby waterbody in the next week and whether they would use the vouchers or not. This program was believed to provide an incentive for the user to wash their watercraft, which would increase the chances of removing unseen AIS as well as further educate the watercraft user on proper watercraft decontamination methods. This program was initially developed by Onterra and the IRPCLA and was administered by CBCW volunteers with oversight of Bayfield County AIS Coordinator Andrew Teal. Figure 2 displays the voucher slips that were used for this program.

In order to ensure that the program is effective and not abused by those receiving the free watercraft wash opportunity, the program partners outlined the following protocols which were to be followed by all involved in the program's implementation:

1. Vouchers were individually numbered (1-250) for tracking purposes.
2. Vouchers were good for one day only (must be used on the same day).
3. Vouchers were initialed and dated by the CBCW inspector handing them out and by the store employee who received the voucher.
4. Because the washer unit is coin operated, the voucher would be turned into a store employee, who traded the voucher for $3.50 in quarters.
5. The vouchers required a vehicle license plate number. Should a store employee observe a vehicle/watercraft trailer pocketing the $3.50 or washing their car instead of their watercraft, a note would be placed on this voucher. The vehicle license plate number is to act as a deterrent for drivers. No action would be taken for "offenders" – notes of offenders would be compiled and discussed amongst the parties involved in this endeavor for ideas on how this may be avoided in the future.
6. Once turning in a voucher and receiving the $3.50, the watercraft owner would have six minutes of access to the wash station for the purposes of decontaminating their watercraft.

As previously mentioned, 250 vouchers at a $3.50 value would be provided to CBCW inspectors for the program. This equates to $875.00 in funds that the IRPCLA included within a February 1st, 2015 grant application to fund this project.

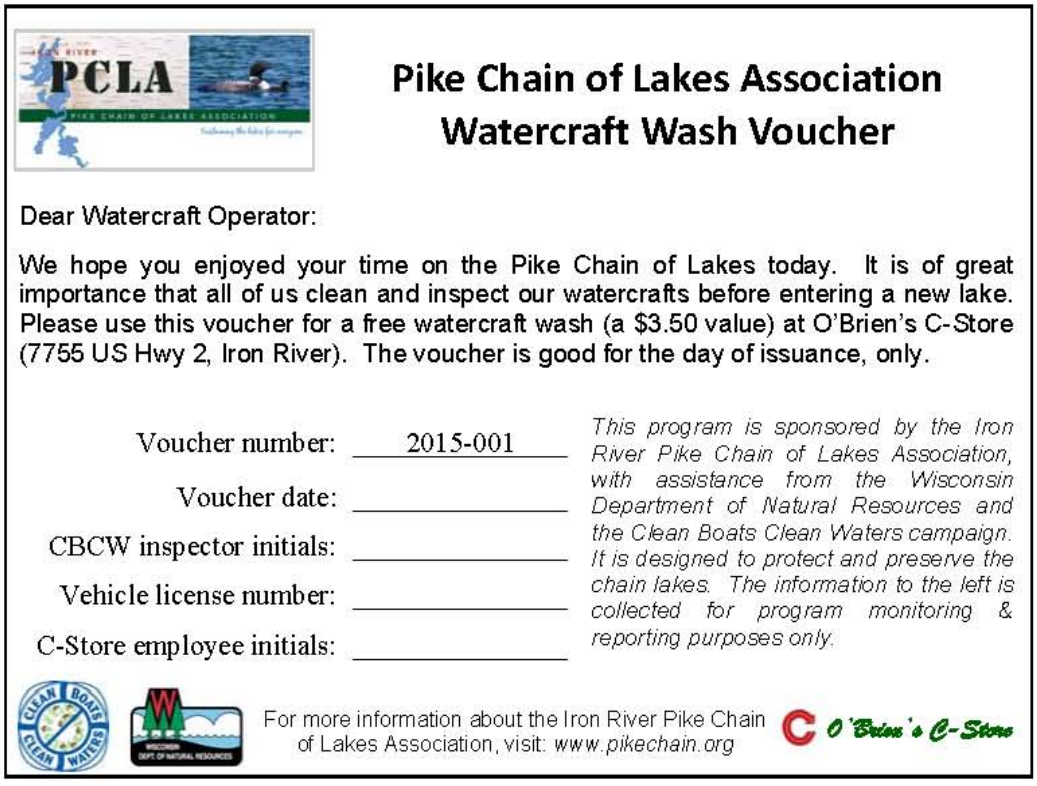


Figure 5. Pike Chain of Lakes Association Watercraft Wash Voucher Example.

Despite the partnership's best efforts with this program, it was not as widely utilized as was hoped. CBCW inspectors reported that although many agreed the concept was good, most watercraft users approached about the opportunity declined the offer. The most common reason for declining the offer was that the individual was not heading in that direction (towards Iron River). Other common responses, as compiled by CBCW inspector Karen Austin, were as follows:

- Too late
- Too busy
- Will wash at home
- Kids are nuts
- Dogs are nuts
- Too crowded at C-Store
- Camping at the local campground, not going into town

It is estimated that 27 vouchers were accepted and used as intended. Several vouchers were handed out but not delivered to the C-Store. It is hypothesized, but not confirmed, by some CBCW inspectors that a line at the car wash may have deterred the watercraft operator from using the voucher which would be why vouchers handed out were not received by C-Store staff.

Overall, the watercraft voucher program is believed to be a good concept but did not prove to be as utilized as was hoped. The program partners believe that if the wash was located closer (Iron River is roughly 6 miles from the Pike Chain of Lakes boat landings) it may have been more heavily utilized. Another recommendation was that if automated coins or an ID number were

provided, the watercraft users may have been more inclined to use the vouchers. This is assuming that taking the voucher inside of the C-Store and trading it for quarters was a deterrent. However, the program was an example of a local business, lake association and County staff coming together and using existing resources to protect Wisconsin lakes and streams. For this effort, the partnership is to be commended for their time, talent, and willingness to try new ideas to prevent the spread of aquatic invasive species.

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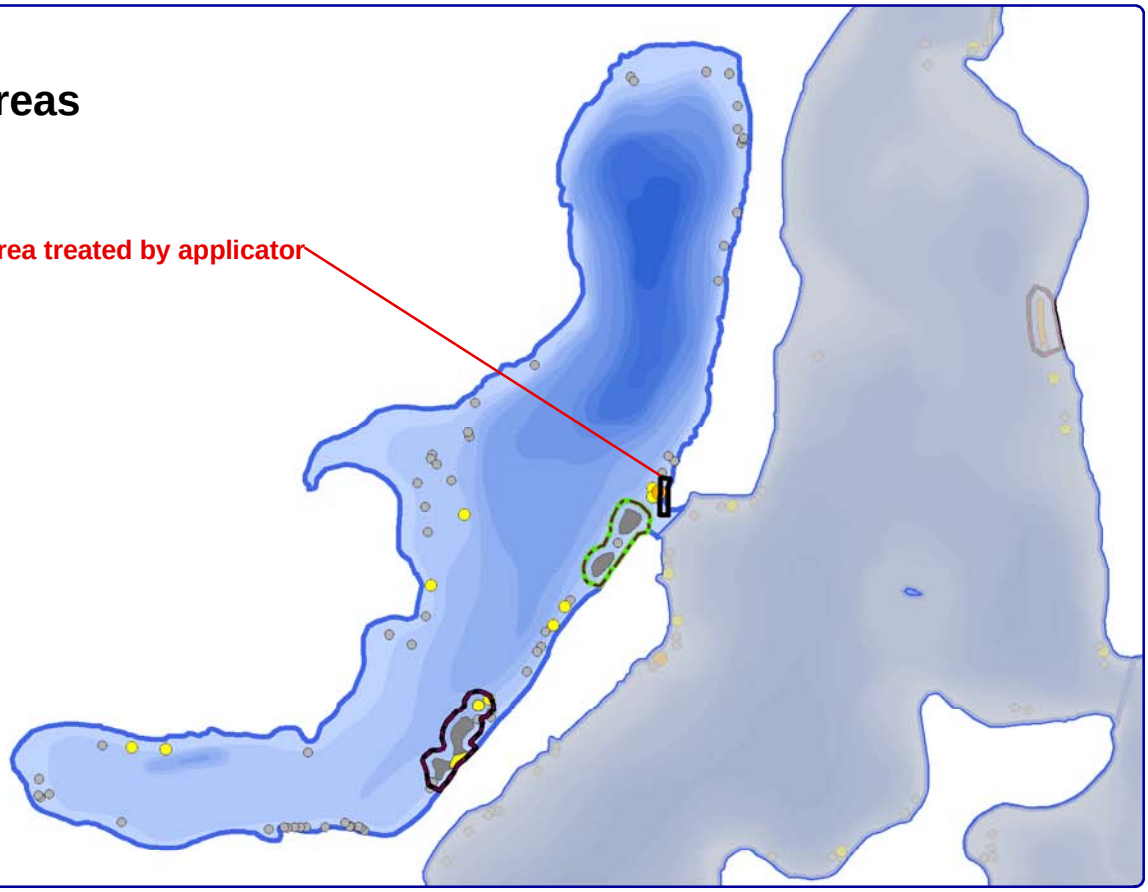
Summer 2014 & 2015 Treatment Areas



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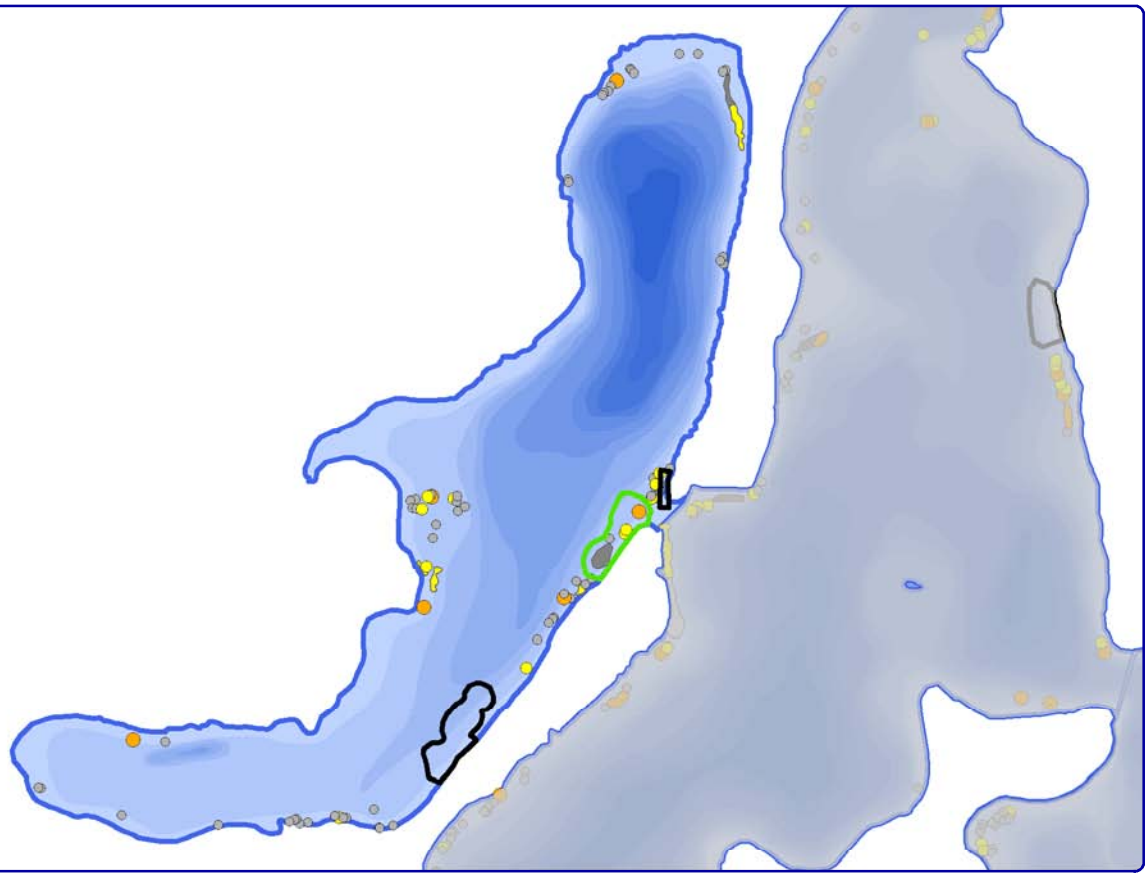


Project Location in Wisconsin

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Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

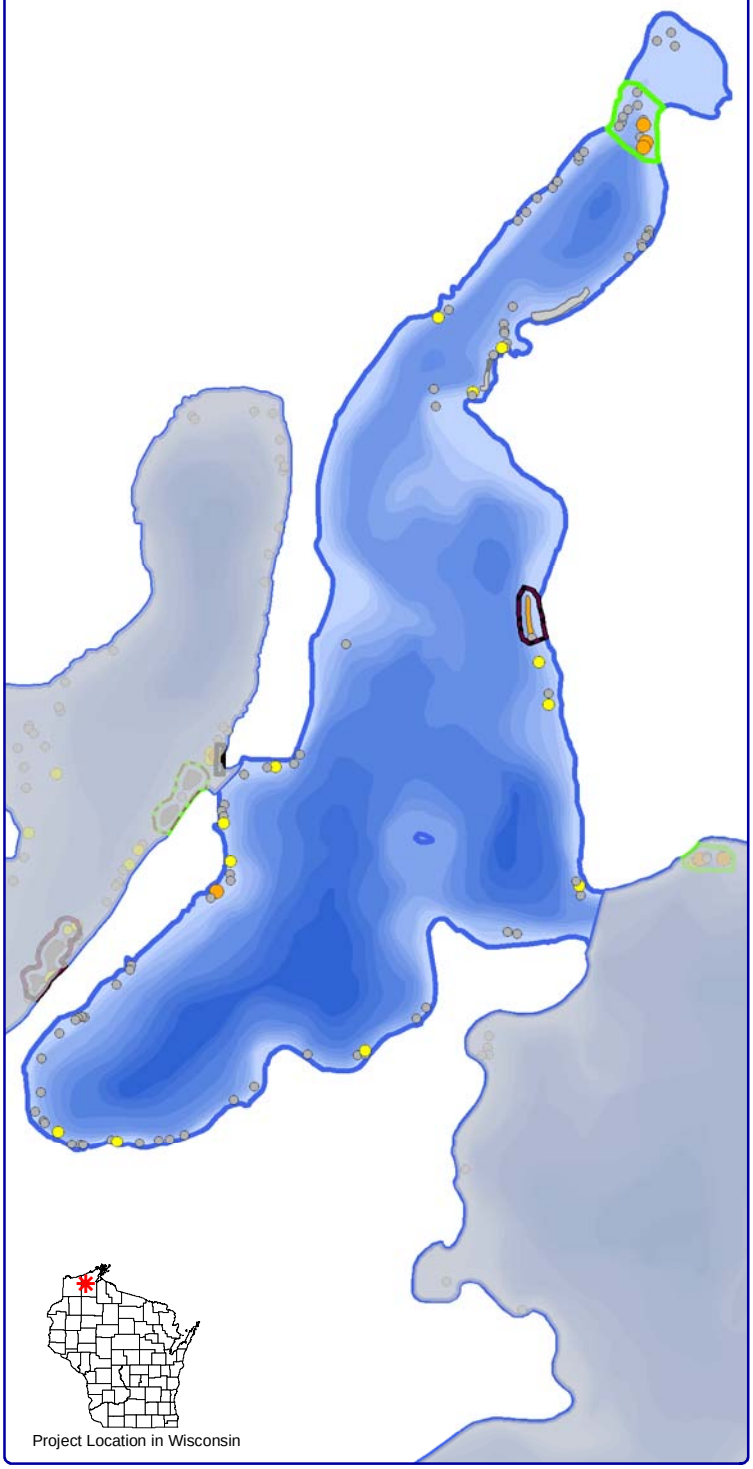
Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
Filename: BuskeyBay_2014PBT2015_2015_PB.mxd

Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

Map 1
Buskey Bay
Bayfield County
2014-2015 EWM Peak Biomass

Summer 2014 & 2015 Treatment Areas



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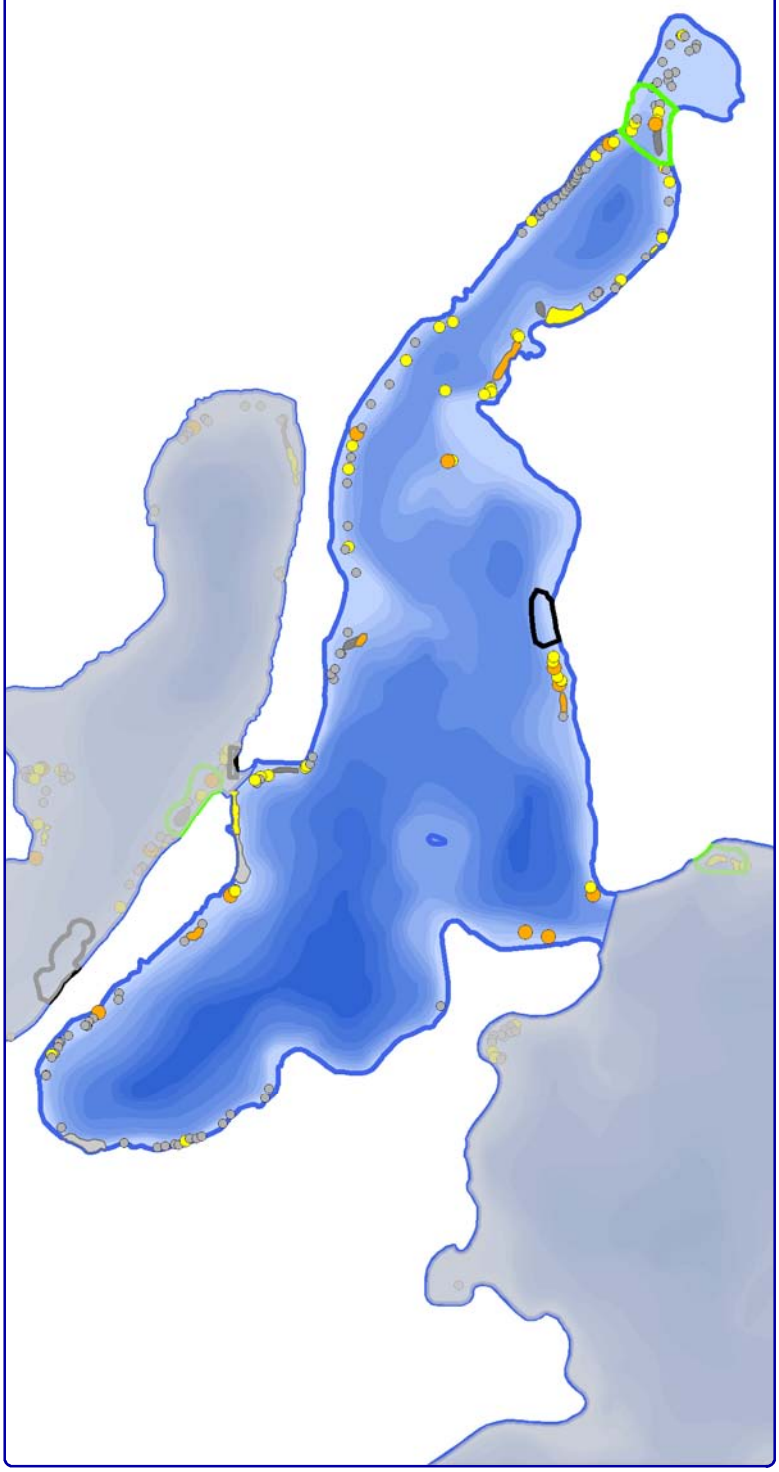
Summer 2015



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Lake Management Planning
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De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
Filename: Millicent_2014PBT2015_2015_PB.mxd

Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

Map 2
Lake Millicent
Bayfield County

2014-2015 EWM Peak Biomass

Summer 2014 & 2015 Treatment Areas

Summer 2015

Project Location in Wisconsin

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Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
Filename: Hart_2014PBT2015_2015_PB.mxd

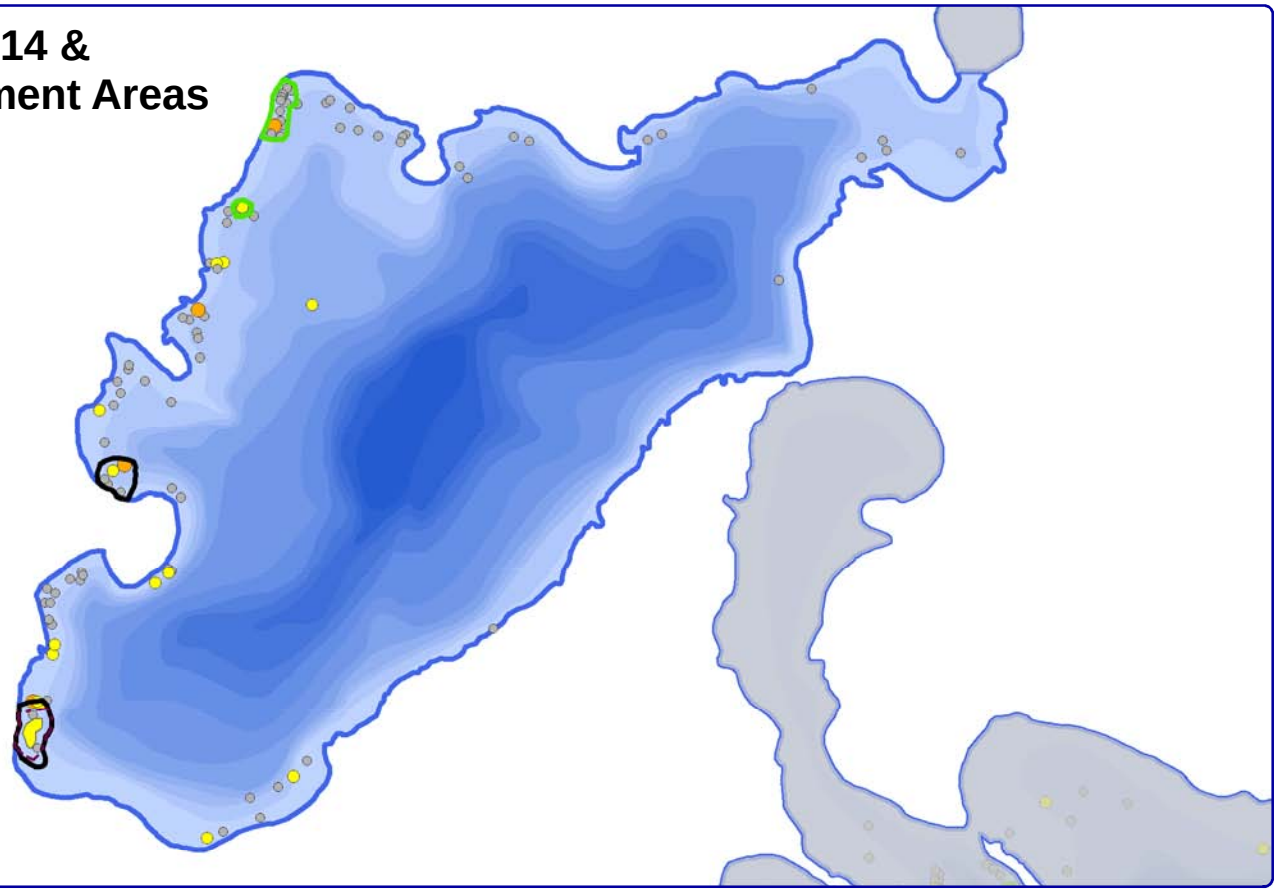
Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

Map 3
Hart Lake
Bayfield County

2014-2015 EWM Peak Biomass

Summer 2014 & 2015 Treatment Areas



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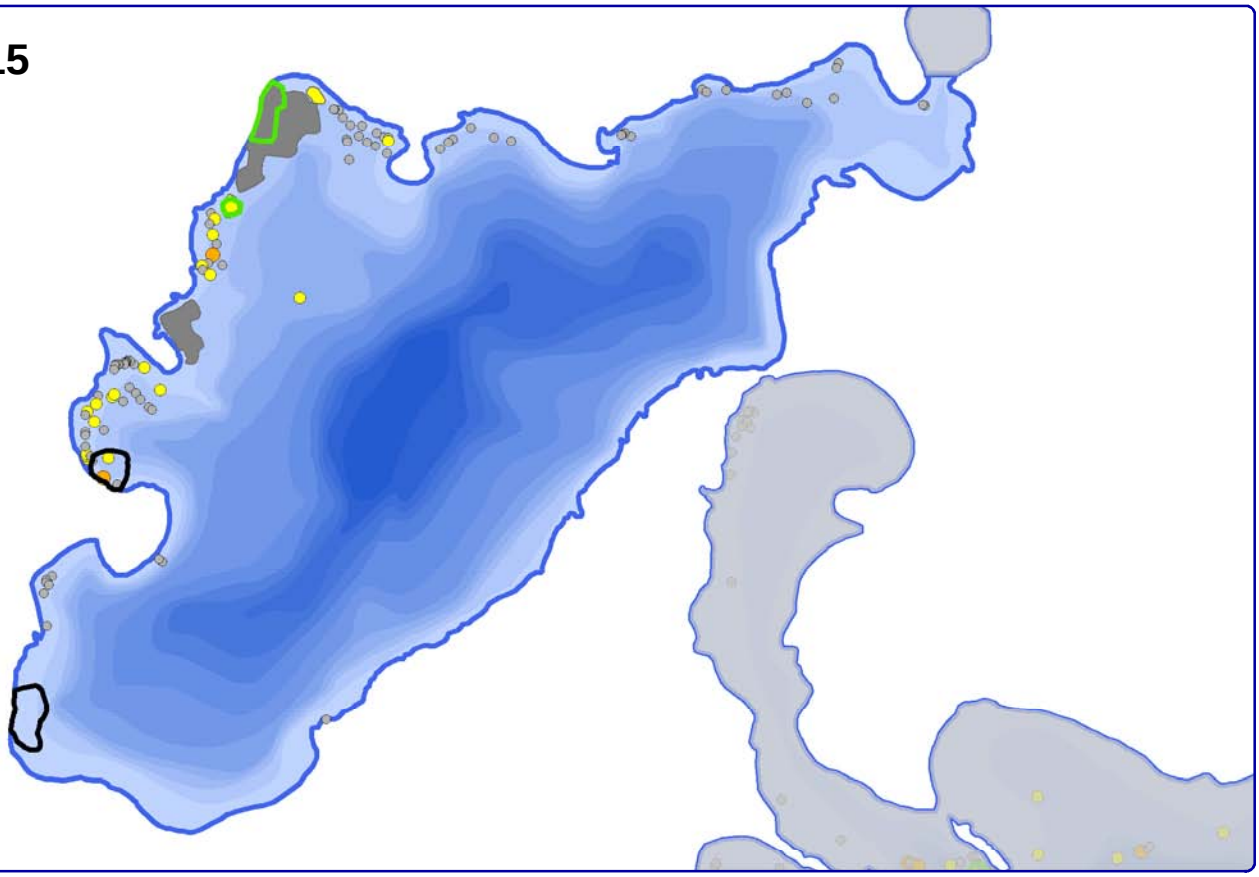

Project Location in Wisconsin

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Onterra LLC
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815 Prosper Road
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920.338.8860
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Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
Filename: TwinBear_2014PBT2015_2015_PB.mxd

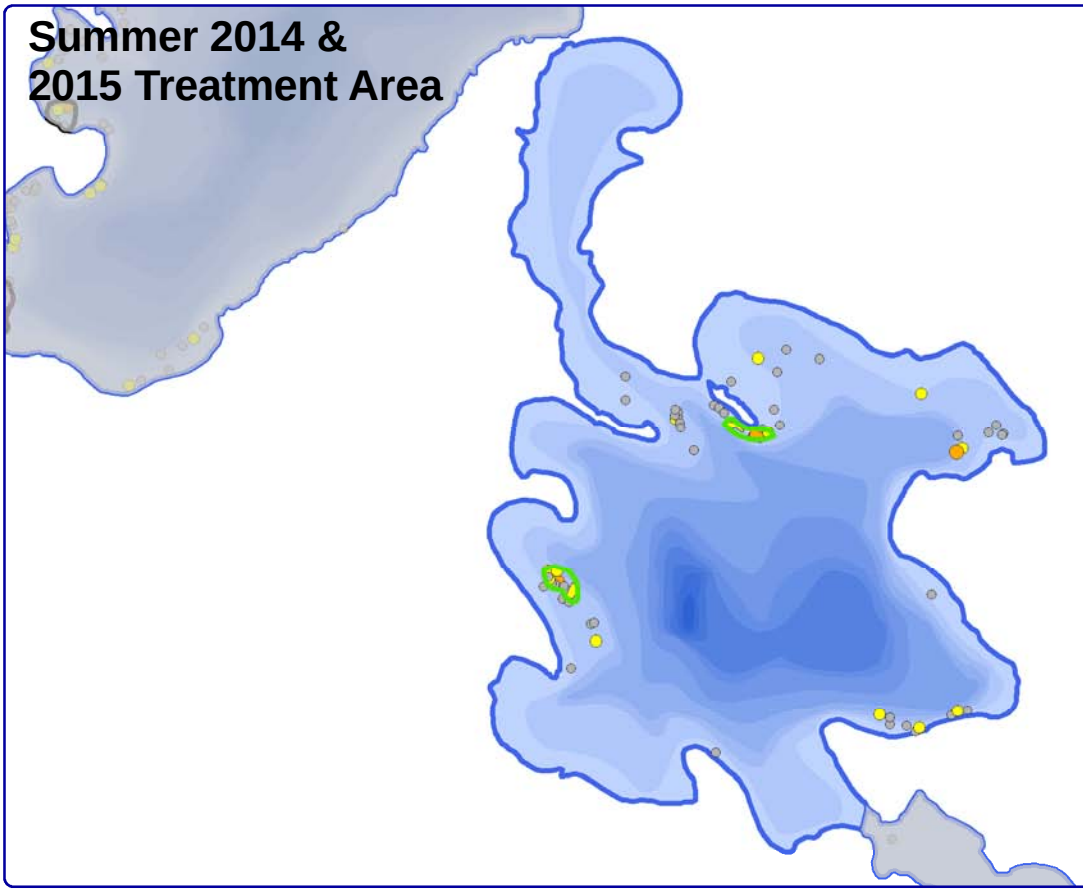
Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

Map 4
Twin Bear Lake
Bayfield County

2014-2015 EWM Peak Biomass

Summer 2014 & 2015 Treatment Area



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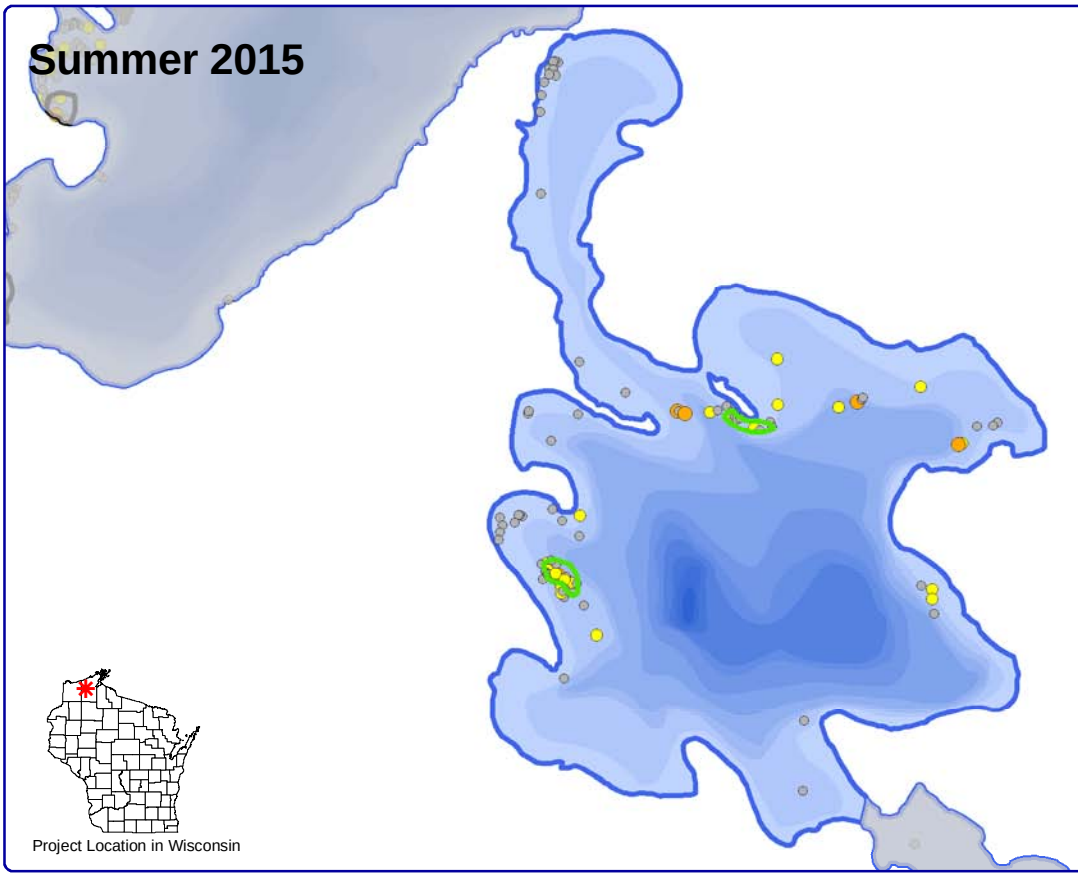

Project Location in Wisconsin

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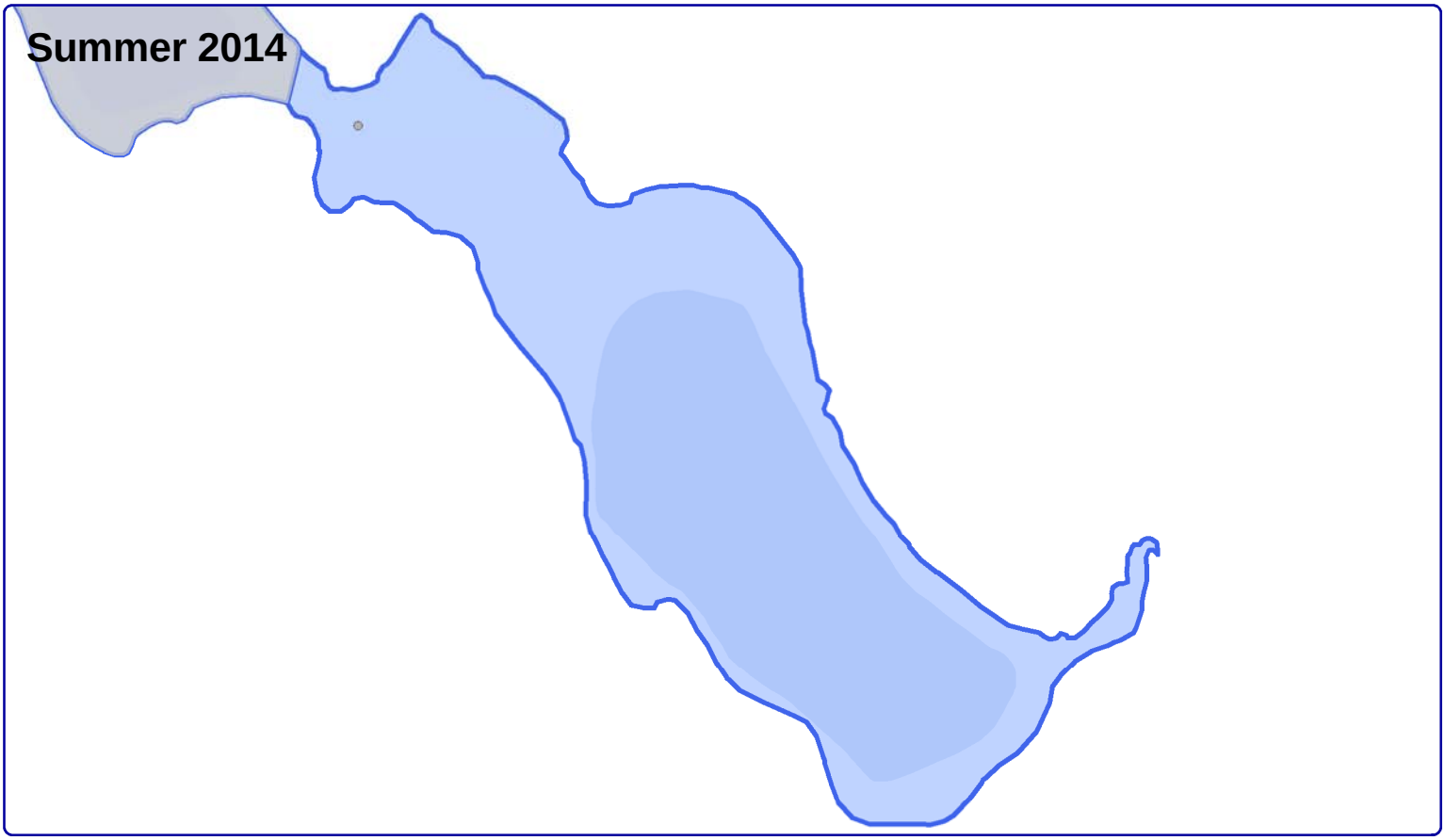
Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
Filename: Eagle_2014PBT2015_2015_PB.mxd

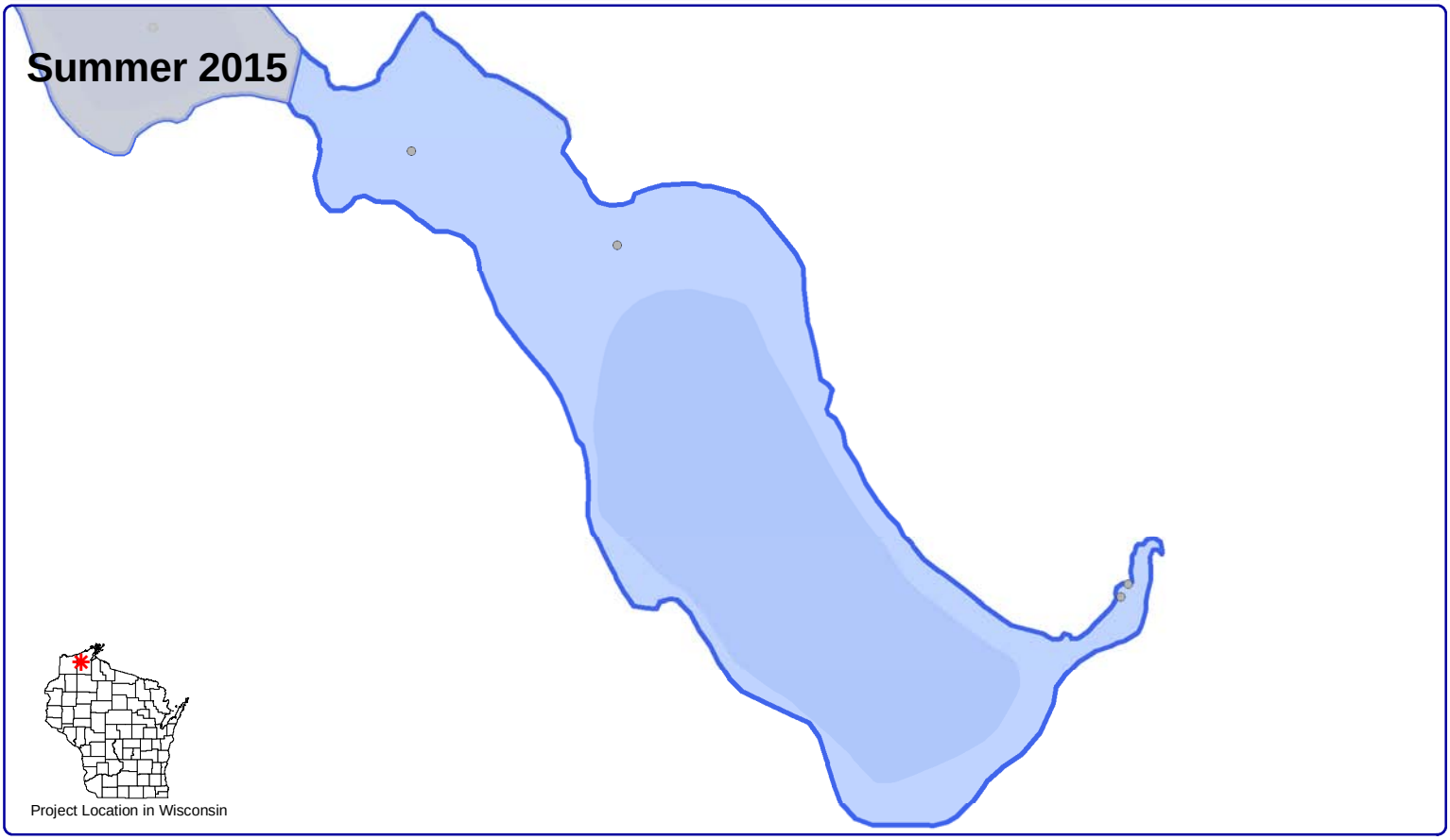
Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

Map 5
Eagle Lake
Bayfield County

2014-2015 EWM Peak Biomass





Project Location in Wisconsin

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Sources:
Roads, Hydro, and Bathymetry: WDNR
Plant Survey: Onterra, 2014-2015
Map Date: December 18, 2015
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Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2015 Cond. Herbicide Treatment Area
- 2015 Final Herbicide Treatment Area
- 2015 Final Hand-Harvest Area

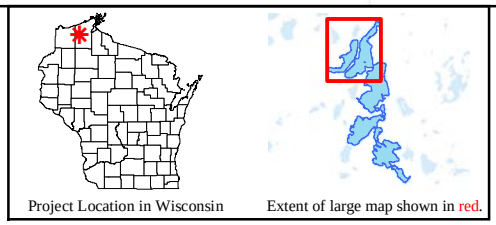
Map 6
Flynn Lake
Bayfield County

2014-2015 EWM Peak Biomass

Whole Lake Treatment Scenario
(*Buskey Bay, Millicent, Hart and Twin Bear Lakes*)

2017 Preliminary EWM Treatment Areas - Liquid 2,4-D

Lake	Proposed Acres	Volume (ac-ft)	DMA IV (gallons)	Epilimnetic Volume @ 17 ft (ac-ft)	Epilimnetic 2,4-D Concentration (ppm)
Buskey Bay	12.30	72.5	204.1	874	0.299
Millicent	27.30	197.3	564.5	2,429	0.293
Hart	38.80	301.3	735.9	3,214	0.290
Twin Bear	23.80	156.4	447.5	1,931	0.293
Subtotal	***102.20***	***727.5***	***1951.9***		



Please Note:
1. Entire area of lake used for fishing.
2. Proposed treatment areas are used for all boating activities.
3. Drainage lakes - flow direction indicated with arrows.

K-17
L-17
M-17
J-17
N-17
C-17
Buskey Bay
I-17
O-17
H-17
D-17
B-17
Lake Millicent
P-17
T-17
Q-17
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S-17
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Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2015
Map Date: December 18, 2015
File Name: TwinBear_T2017_EWM_Prelim1.mxd

Legend

2017 Preliminary Treatment Area

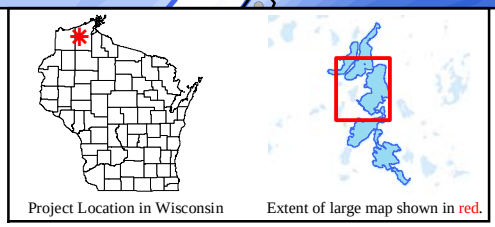
Public boat landing

Map 7
Pike Chain of Lakes
Bayfield County, Wisconsin
2017 Preliminary Herbicide Control Strategy

Whole Lake Treatment Scenario
(Buskey Bay, Millicent, Hart and Twin Bear Lakes)

2017 Preliminary EWM Treatment Areas - Liquid 2,4-D

Lake	Proposed Acres	Volume (ac-ft)	DMA IV (gallons)	Epilimnetic Volume @ 17 ft (ac-ft)	Epilimnetic 2,4-D Concentration (ppm)
Buskey Bay	12.30	72.5	204.1	874	0.299
Millicent	27.30	197.3	564.5	2,429	0.293
Hart	38.80	301.3	735.9	3,214	0.290
Twin Bear	23.80	156.4	447.5	1,931	0.293
Subtotal	***102.20***	***727.5***	***1951.9***		



Please Note:
1. Entire area of lake used for fishing.
2. Proposed treatment areas are used for all boating activities.
3. Drainage lakes - flow direction indicated with arrows.

T-17
U-17
S-17
Hart Lake
V-17
W-17
X-17
Y-17

775
Feet

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Sources:
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Aquatic Plants: Onterra, 2015
Map Date: December 18, 2015
File Name: TwinBear_T2017_EWM_Prelim1.mxd

Legend

2017 Preliminary Treatment Area

Public boat landing

Map 8
Pike Chain of Lakes
Bayfield County, Wisconsin
2017 Preliminary Herbicide Control Strategy

Whole Lake Treatment Scenario
(Buskey Bay, Millicent, Hart and Twin Bear Lakes)

2017 Preliminary EWM Treatment Areas - Liquid 2,4-D

Lake	Proposed Acres	Volume (ac-ft)	DMA IV (gallons)	Epilimnetic Volume @ 17 ft (ac-ft)	Epilimnetic 2,4-D Concentration (ppm)
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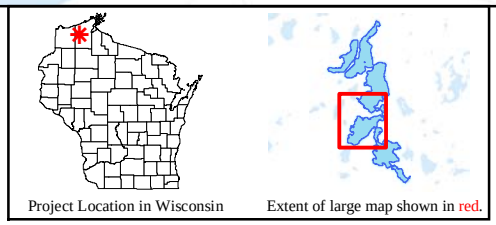
Subtotal	***102.20***	***727.5***	***1951.9***		



Please Note:
1. Entire area of lake used for fishing.
2. Proposed treatment areas are used for all boating activities.
3. Drainage lakes - flow direction indicated with arrows.

W-17
Y-17
Z-17
AA-17
Twin Bear Lake
AB-17

675
Feet

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Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2015
Map Date: December 18, 2015
File Name: TwinBear_T2017_EWM_Prelim1.mxd

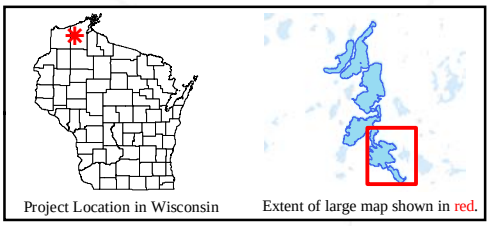
Legend
2017 Preliminary Treatment Area
Public boat landing

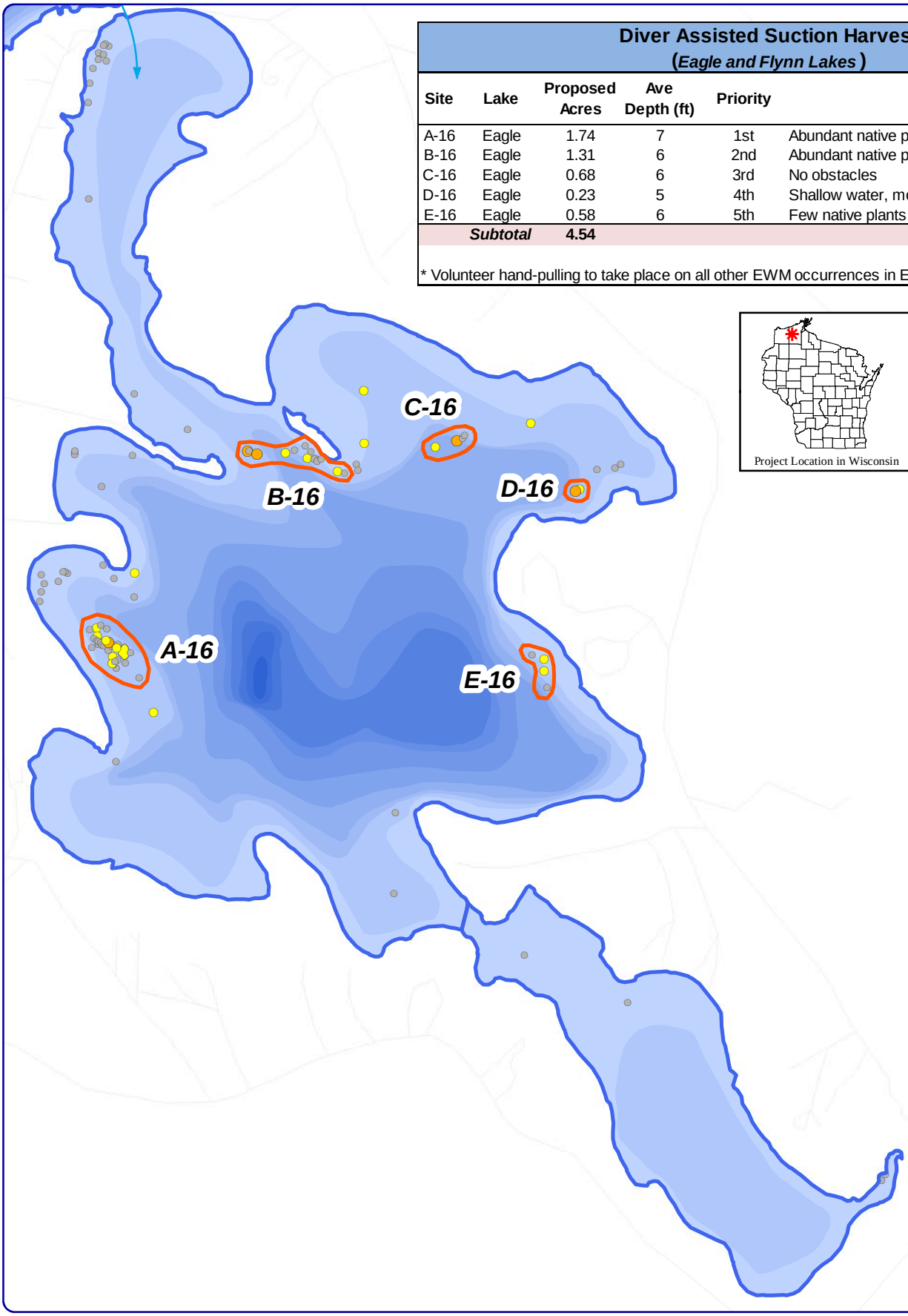
Map 9
Pike Chain of Lakes
Bayfield County, Wisconsin
2017 Preliminary Herbicide Control Strategy

Diver Assisted Suction Harvest
(*Eagle and Flynn Lakes*)

Site	Lake	Proposed Acres	Ave Depth (ft)	Priority	Notes
A-16	Eagle	1.74	7	1st	Abundant native plants
B-16	Eagle	1.31	6	2nd	Abundant native plants
C-16	Eagle	0.68	6	3rd	No obstacles
D-16	Eagle	0.23	5	4th	Shallow water, moderate native plants
E-16	Eagle	0.58	6	5th	Few native plants, steep slope
	Subtotal	**4.54**			

* Volunteer hand-pulling to take place on all other EWM occurrences in Eagle, Flynn Lakes





N
W E
S
700
Feet

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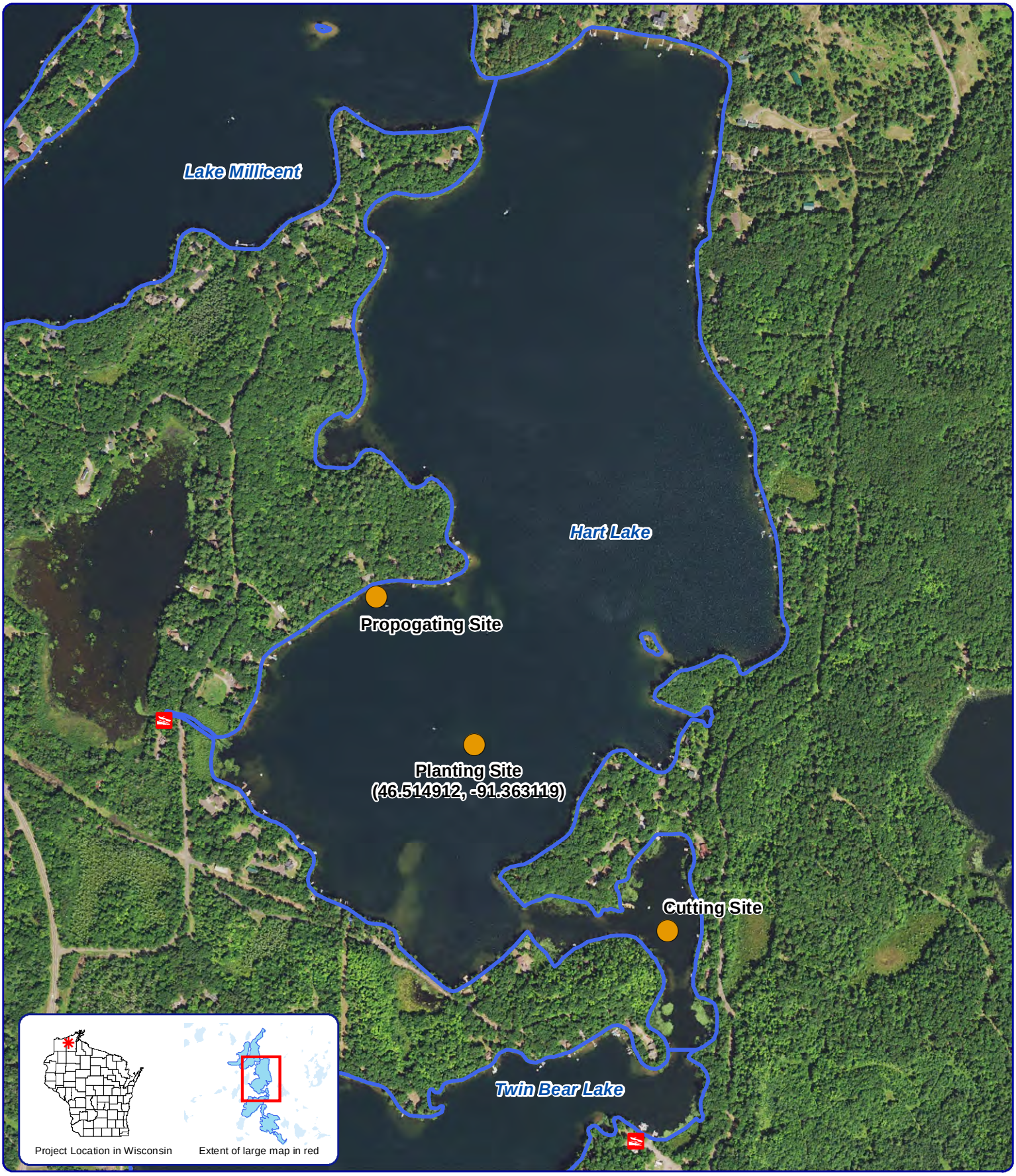
Sources:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2015
Map Date: December 18, 2015
File Name: TwinBear_T2017_EWM_Prelim1.mxd

Legend

2016 Preliminary DASH Removal Area

Public boat landing

Map 10
Pike Chain of Lakes
Bayfield County, Wisconsin
2016 EWM Control Strategy



N
W E
S

750
Feet

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Sources:
Hydro layer: WDNR
Orthophoto: NAIP, 2017
Map Date: April 26, 2018
Filename: PikeChain_SubmergentPlantRestoration_2015.mxd

Legend

- Pike Chain Lake Outline
- Public Access

Map 11

Pike Chain of Lakes

Bayfield County, Wisconsin

Submergent Plant Restoration Demonstration Project