1.0 INTRODUCTION

The Unified Lower Eagle River Chain of Lakes Commission (ULERCLC) has been the successful recipient of Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Control Grants since 2007 as they conduct a project aimed at reducing the Eagle River Chain of Lake's (Figure 1). Eurasian watermilfoil (*Myriophyllum spicatum*; EWM) population. This report specifically discusses the monitoring and control activities conducted during 2018. The chain-wide results will be presented first, followed by results from each lake individually. Additional information regarding the management and monitoring actions completed from 2008-2017 can be found in their respective annual reports.

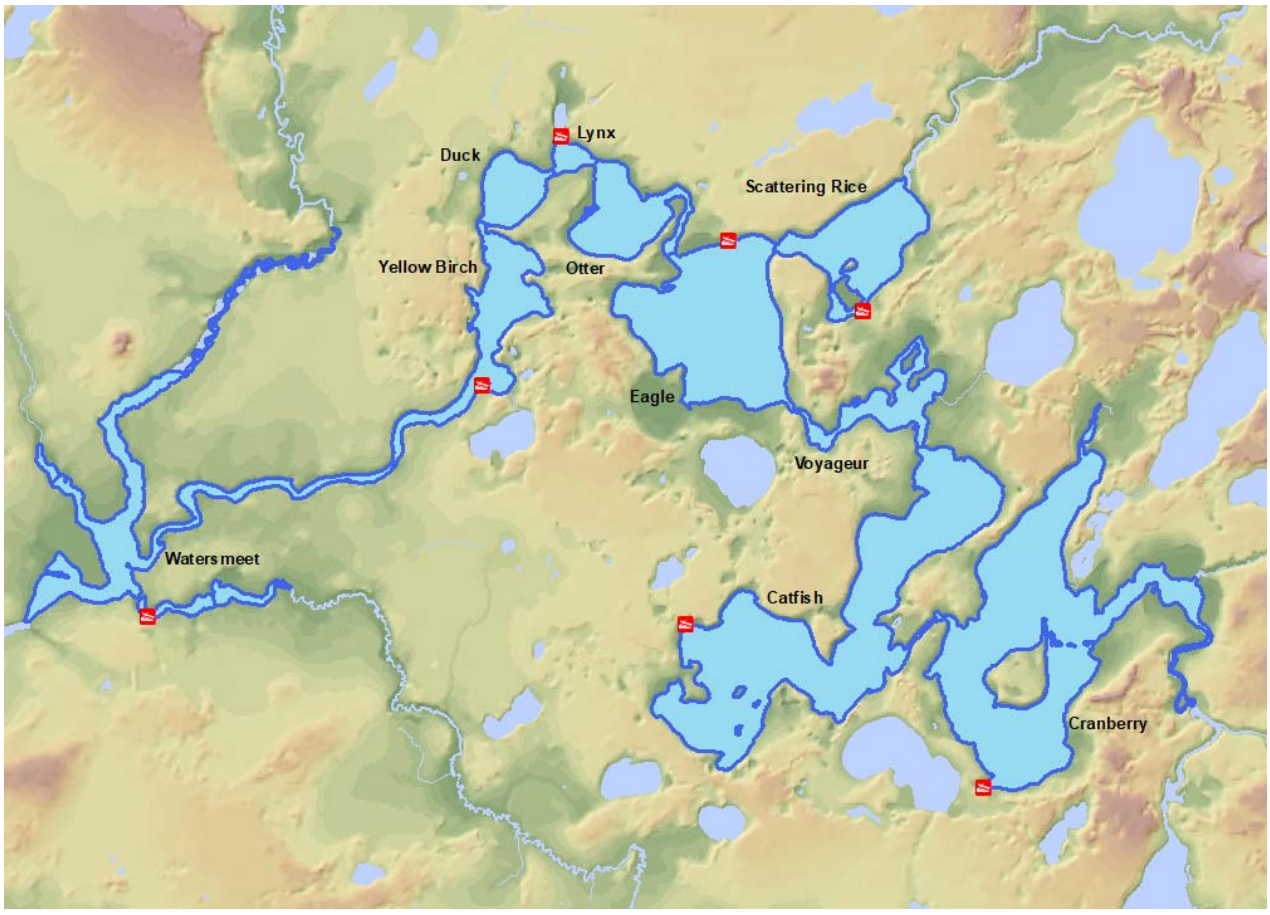


Figure 1. Lower Eagle River Chain of Lakes, Vilas-Oneida Counties.

2.0 2018 CHAIN-WIDE EWM CONTROL STRATEGY RESULTS

Onterra ecologists have conducted annual Late-Season EWM Mapping Surveys on the Eagle River Chain of Lakes since 2005. An objective of this survey is to understand the peak growth (peak-biomass) of the EWM population in the system at a fine enough scale to direct and access management actions. An approach that utilizes a combination of volunteer- and professional-based surveys ensures the entire littoral area of the chain is accessed through visual observations from the boat (Photo 1). Onterra field crews ultimately map all discovered EWM populations using sub-meter GPS technology by using either 1) point-based or 2) area-based methodologies (i.e. colonized EWM). Large colonies >40 feet in diameter are mapped using polygons (areas) and were qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques were applied to AIS locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.

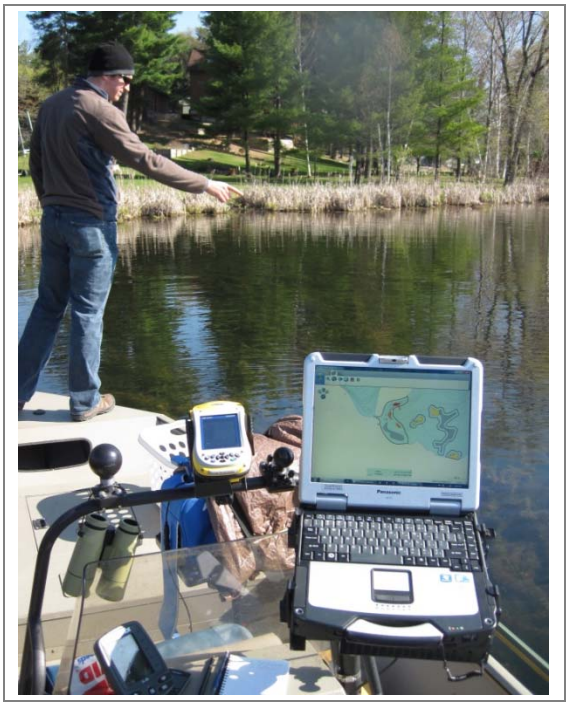


Photo 1. EWM mapping survey on Cloverleaf Lakes, Shawano County. Photo credit Onterra.

Figure 2 shows the acreage of colonized EWM as well as the distribution of each density rating. Please note that this figure only represents only the acreage of mapped EWM polygons, not EWM mapped within point-based methodologies (*single or few plants, clumps of plants,* or s*mall plant colonies*). Over this same timeframe, the ULERCLC has coordinated active management of EWM.

From 2007 to 2010, an aggressive herbicide treatment program occurred consisting of strategically targeted herbicide spot treatments and a few whole-lake or whole-basin herbicide treatments. A more directed herbicide spot treatment strategy occurred from 2011 to 2015, where additional lessens were learned in invasive milfoil management. During this timeframe, the ULERCLC was an active participant in a Cooperative Research and Development Agreement (CRADA) between the WDNR and U.S. Army Corps of Engineers Research and Development Center that coupled field-collected herbicide concentration data with professional monitoring to understand efficacy, selectivity, and longevity of chemical control strategies.

During this project, the ULERCLC found that some of the herbicide treatments during this time period were not as effective as previous control strategies. Ongoing studies stemming from this project indicate that in small spot treatments, the herbicide dissipates too rapidly to cause EWM mortality if traditional weak-auxin systemic herbicides like 2,4-D are used. Even in some cases where larger treatment areas can be constructed, their narrow shape or exposed location within a lake may result in insufficient herbicide concentrations and exposure times for long-term control. With this knowledge, more efficacious herbicide spot treatment strategies were implemented in the latter years of this phase of management. In 2015, the EWM population of the Eagle River Chain of Lakes was arguably at its lowest levels in over a decade, with just over 12 acres of colonized EWM being documented chain-wide (Figure 2).

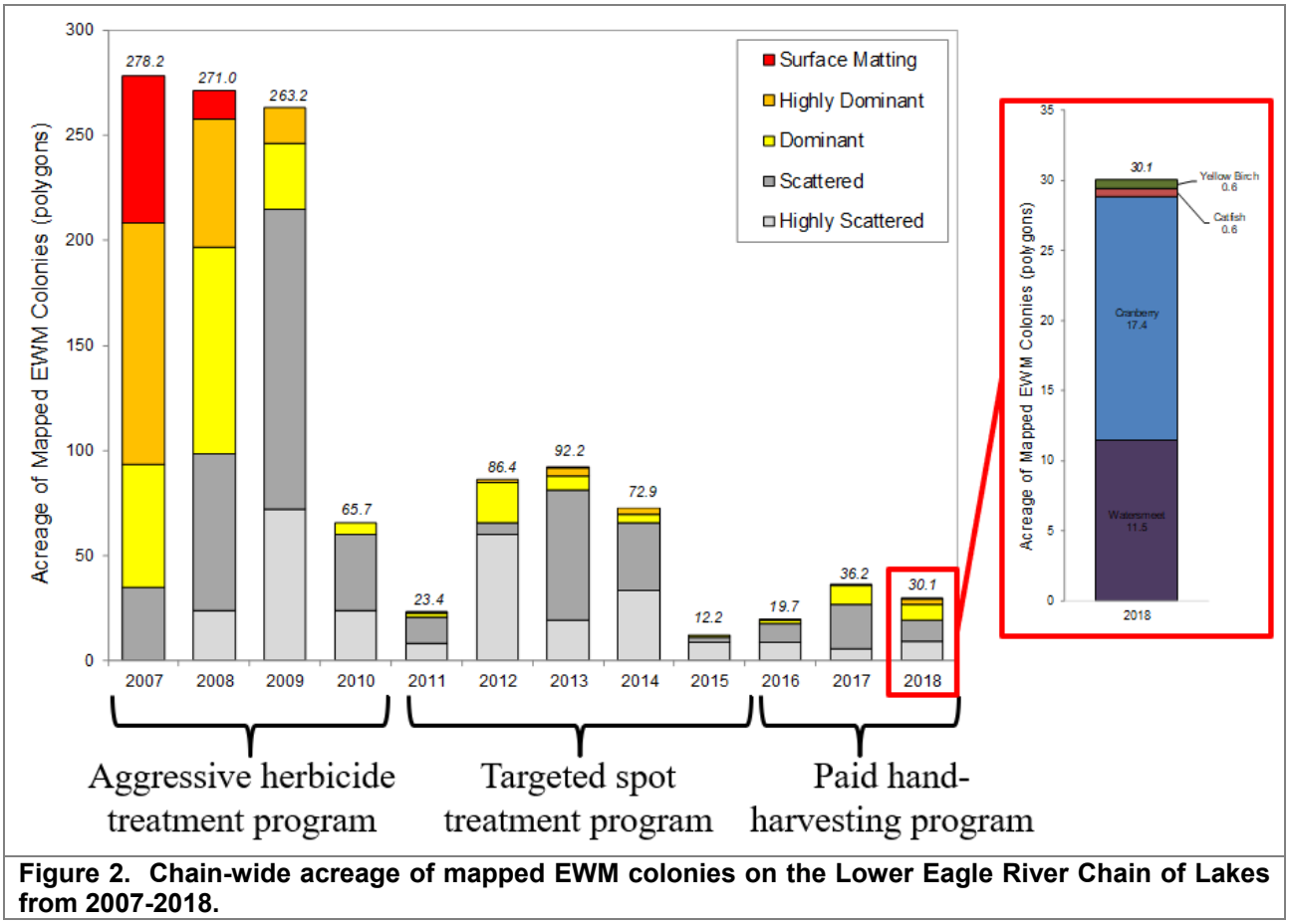


Figure 2. Chain-wide acreage of mapped EWM colonies on the Lower Eagle River Chain of Lakes from 2007-2018.

In approximately 2015, the ULERCLC developed a working treatment strategy where consideration for herbicide application would be given to areas of EWM if they met a specific threshold (i.e. trigger). This evolved benchmark is currently understood as:

> colonized (polygons) areas of EWM, with preference to areas of *dominant* or greater densities, that have a size/shape/location where management is anticipated to be effective

Based upon this established herbicide treatment strategy, no areas of EWM in the Lower Eagle River Chain of Lakes have met this threshold since 2015 and no treatments have occurred since.

The areas of EWM that exist within the chain were too small to be effectively controlled using herbicide spot treatment techniques. These areas are also below levels that cause are believed to cause measurable ecological impacts to the system and below levels that cause impediments to navigation or recreation by lake users. It was important to the ULERCLC to not abandon management completely and simply wait for EWM populations to reach levels that are again applicable for herbicide control. The ULERCLC enacted a strategy that balanced a level of EWM population tolerance while targeting other locations with experimental hand-harvesting approaches.

In 2016, experimental traditional hand-harvesting was implemented by professionals in Voyageur Lake in an effort to control small, low-density colonies of EWM. This initial hand-removal effort in 2016 was largely successful, and this effort was expanded in 2017 to include traditional hand-harvesting in areas of Voyageur and Watersmeet Lakes. Also in 2017, hand-harvesting utilizing a

diver-assisted suction harvesting (DASH) methodology occurred in two areas of Scattering Rice Lake.

Diver Assisted Suction Harvest (DASH) is a form of hand-removal which involves divers removing target plants (i.e. EWM) and feeding them into a suctioned hose for delivery to the deck of the harvesting vessel. They do not simply vacuum the area to remove the plants as that would result in the removal of sediment and non-target native plants which would be considered suction dredging (requires elaborate permitting). The DASH system is thought to be more efficient than manual removal alone as the diver does not have to go to the surface to deliver the pulled plants to someone on a boat. The DASH system also is theorized to cause less fragmentation, as the plants are immediately transported to the surface using the vacuum technology.

Based upon the results observed in 2017, a preliminary DASH strategy was designed over the winter of 2017/2018 for areas of Scattering Rice, Watersmeet, and Yellow Birch lakes for 2018. During the 2018 Early-Season AIS Survey (ESAIS), the mapping of the EWM within proposed hand-harvesting areas were refined and a final hand-harvesting strategy was derived. Onterra provided the hand-harvesting firm with the spatial data from the ESAIS Survey to coordinate the removal efforts. As is discussed specifically within the Yellow Birch, Scattering Rice, and Watersmeet lakes' individual results sections, the hand-harvesting actions occurred over six days in August.

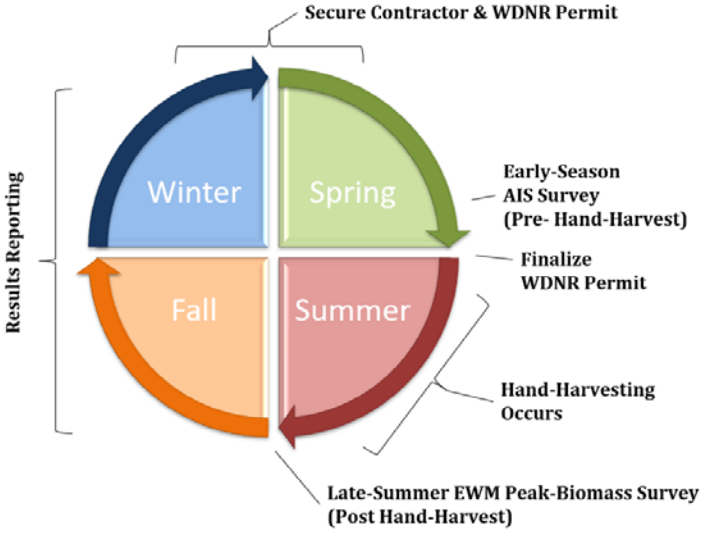


Figure 3. Hand-harvesting project timeline diagram.

Overall, 2018 saw a slight decrease in EWM polygon acreage on a chain-wide basis (Figure 2). While EWM population reductions were observed within a number of the targeted hand-harvesting sites, other areas of the chain that were not actively management also observed EWM population reductions. It has been acknowledged that the conditions of the Eagle River Chain of Lakes, particularly low water clarity, may be more of a driver of the AIS population trajectory in some years than management efforts themselves.

It is believed the decline in water clarity within the Lower Eagle River Chain is the result of a number of years with above-average precipitation since 2010. The increase in precipitation may have resulted in increased phosphorus loading to the chain, increasing algal production and reducing water clarity. The increased precipitation may have also increased the amount of dissolved humic substances within the chain, increasing the stained appearance and decreasing water clarity.

Like in past years, the majority of the EWM acreage mapped in 2018 (96%) was located in Cranberry and Watersmeet Lakes. The EWM within these lakes is largely located in channelized areas where water flow is higher. Past herbicide treatments conducted in these areas revealed it is difficult to achieve the needed concentration and exposure time to achieve EWM mortality. While the 2015

herbicide treatment in the Cranberry Channel achieved control beyond one year, assessments in 2017 and 2018 have revealed EWM rebound within this area.

3.0 2019 PRELIMINARY CHAIN-WIDE EWM CONTROL STRATEGY

The EWM population of the Eagle River Chain of Lakes continues to consist of locations mapped with point-based methods or mapped with low-density colonies. Slightly higher density EWM populations were documented from the upstream section of the Wisconsin River from Watersmeet Lake and the upstream channel leading into Cranberry Lake. The high flows in the Wisconsin River make reaching EWM control goals unlikely unless alternative herbicides that may be more effective in short exposure situations are implemented. At the current size and density of the EWM populations within Watersmeet Lake, moving forward with these more experimental strategies are not being considered.

Based upon the 2018 Late-Season EWM Mapping Survey, the EWM population within the upstream Cranberry Channel exceeded the trigger for conducting the appropriate pretreatment data for potential treatment during the spring of 2019. This included the collection of sub-sample point-intercept aquatic vegetation over this area to serve as a pretreatment dataset.

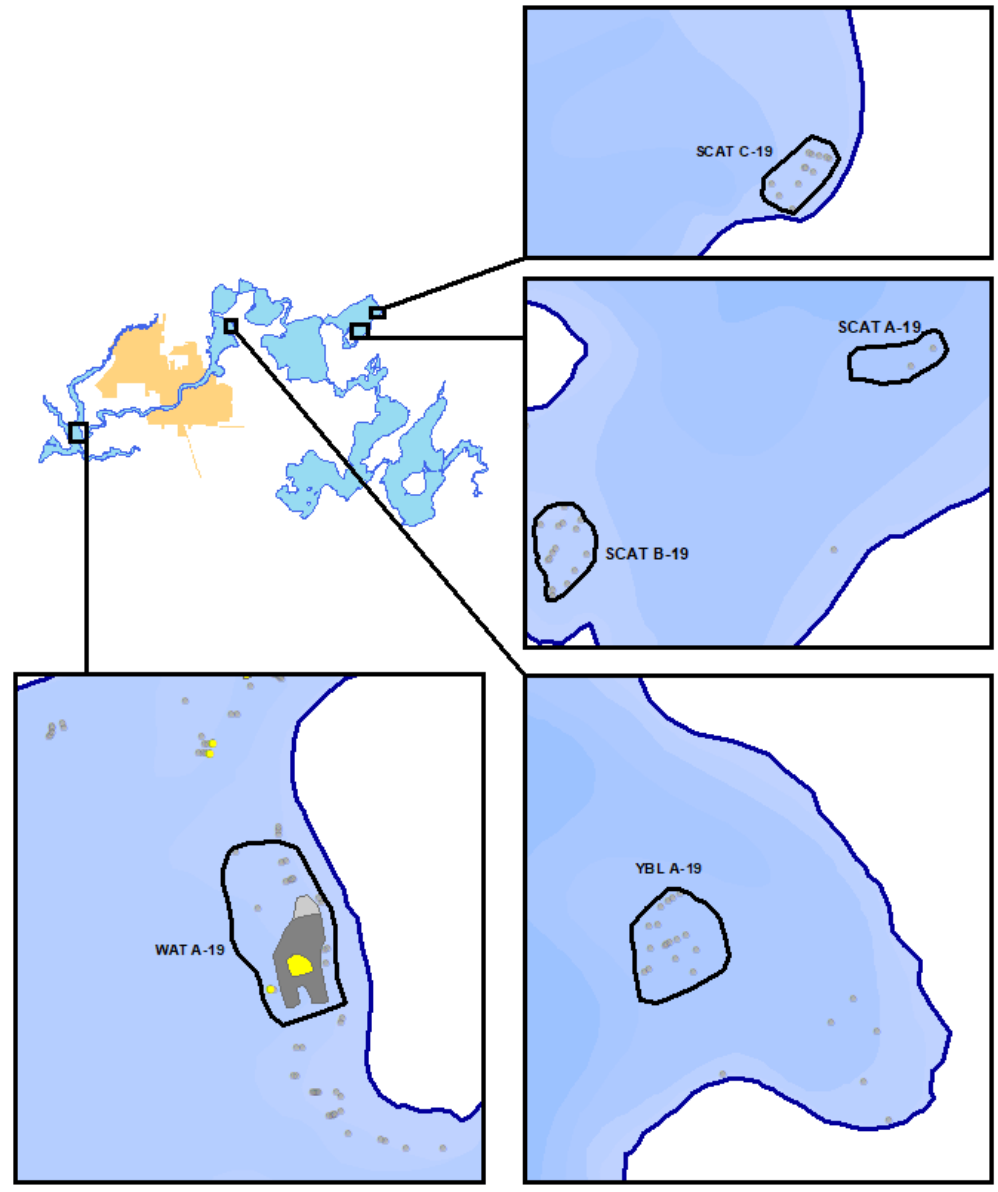
Following a period of review, the ULERCLC has elected not to pursue an herbicide control program in 2019 on this area. While of greater population size and density than the trigger, the EWM population did not increase in density over the past year and remains at a level that ULERCLC believes can be tolerated. The 2015 channel-wide 2,4-D treatment resulted in a reduced EWM population for approximately 3 summers after treatment. It is important to note that an advanced understanding of water flows took place during that treatment, including manipulation of the upstream dam at Burnt Rollways to additionally slow water exchange. In some years, water flows caused by precipitation and snowmelt in the watershed may compromise the ability for a similarly effective treatment to take place.

The ULERCLC may consider herbicides that require short exposure times (diquat, florpyrauxifen-benzyl [ProcellaCOR™], etc.) or herbicide combinations (diquat/endothall, 2,4-D/endothall, etc.) for future treatment of this area to increase the longevity of success. Again in 2019, the ULERCLC will implement the collection of pretreatment sub-sample point-intercept survey data in this location to be aligned for potential herbicide treatment if that option is perused.

No other areas of EWM within the chain meet or exceed the threshold developed for implementing herbicide control actions. Based on the results of the 2018 professional hand-harvesting program, the ULERCLC would like to build upon the positive strides gained in 2018 through increasing the amount of professional hand-harvesting effort devoted to EWM control during the 2019 growing season. The ULERCLC also believes that greater EWM population management strides, particularly in Watersmeet Lake, may be achieved by implementing the strategy earlier in the growing season (early June) when EWM and native plants are at an earlier growth stage.

A preliminary hand-harvesting EWM control strategy for 2019 includes considering all 2018 DASH hand-harvesting sites for implementation again in 2019 (Figure 4). Based upon the results of the Early-Season AIS Survey, areas will be potentially added, omitted, or revised. Onterra will provide the hand-harvesting firm with the spatial data from the early-July survey to aid the removal efforts.

Following the hand removal efforts, a Late-Season EWM Peak Biomass Survey will qualitatively assess the hand harvesting efforts (Figure 3).



EWM Survey Results

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony

Preliminary 2019 DASH Harvesting Areas

Site	Acres	Ave Depth (feet)	Sediment	Obstructions / Notes
SCAT A-19	0.80	6.5	Organic / soft	Moderate native plant abundance
SCAT B-19	1.07	4.0	Organic / soft	Moderate native plant abundance
SCAT C-19	0.68	5.0	Organic / soft	Moderate native plant abundance
WAT A-19	3.53	3.0	Organic / soft	Moderate native plant abundance
YBL A-19	0.92	7.0	Organic / soft	Moderate native plant abundance
Total	**7.00**			

Figure 4. Preliminary 2019 hand-harvesting strategy.

4.0 INDIVIDUAL LAKE SECTIONS

The remainder of this report will focus on 2018 EWM monitoring and control strategy assessments (if applicable) on a lake-by-lake basis. Some of the text may seem redundant if one reads each lake section. However, this is intentional to ensure the information is portrayed to those who just read the chain-wide sections and their individual lake-specific section.

4.1 Cranberry Lake Summary and Conclusions

As has occurred in past years, the EWM population in Cranberry Lake was mapped professionally during Onterra's 2018 Early-Season AIS (ESAIS) and Late-Season EWM Peak-Biomass surveys. During the ESAIS survey, the entire littoral zone of the Lower Eagle River Chain of Lakes was searched for EWM by Onterra field staff. Completion of an ESAIS survey presents numerous advantages. Typically, the water is clearer during the early summer allowing for more effective viewing of submersed plants. While not at their peak growth stage (peak biomass), EWM plants are higher in the water column than most native plants during this time of year which increases the chances that even low-density and isolated EWM occurrences would be located.

The results from the ESAIS survey were loaded onto specific ULERCLC GPS units, and trained volunteers were tasked with searching and mapping EWM in areas where Onterra did not locate it during the ESAIS survey. Prior to the Late-Season EWM Peak-Biomass Survey, the volunteer mapping data were provided to Onterra. During the Late-Season EWM Peak-Biomass Survey, Onterra ecologists revisited and refined areas of EWM mapped during the Early-Season AIS Survey as well as any areas marked by volunteers.

In 2018, the majority of the EWM in Cranberry Lake was mapped within the channel where the 2015 herbicide treatment occurred (Figure 5; Cranberry Lake - Map 1). Other occurrences of *single or few plants, clumps of plants,* and *small plant colonies* were located around Cranberry Lake in many near-shore areas during the 2018 Late-Season EWM Peak-Biomass Survey.

A concerted effort has been made to control the EWM population within the Eagle River inlet to Cranberry Lake. This part of the chain has been targeted for control from 2007-2013, with mostly seasonal control being achieved. Seasonal control is defined within this document to indicate EWM population suppression for a single recreational season, with complete or almost complete rebound by the time of the Late-Season EWM Mapping Survey. Seasonal control is an indication that appropriate concentration and exposure times (CETs) were not achieved to cause EWM mortality, but rather caused plant injury resulting in suppressed growth for the season. In 2014, the decision not to target this part of the lake was made based upon these past efforts.

The development of a study to understand the water flow rate and direction in this area was developed and implemented for the spring of 2015 and is fully discussed within the *2015 EWM Monitoring and Control Strategy Assessment Report*. The study found that water velocities were higher in upstream areas and near the river channel. For the most part, the water flow direction was parallel with the river channel near where the sample was collected. The data also indicated that water movement was much lower on inside bends of the river channel, where most of the EWM exists within this part of the system. Coordination with the Wisconsin Valley Improvement Company (WVIC) was undertaken to lower the flow rate through the Burnt Rollways Dam for the time period surrounding the 2015 herbicide treatment in an effort to increase herbicide exposure times in the targeted area.

Herbicide concentration monitoring data collected in association with the 2015 treatment indicated that the herbicide CETs were likely sufficient to result in control in the treatment areas, and post-treatment surveys conducted during the late-summer of 2015 indicated successful EWM control was achieved during the year-of-treatment. Surveys in 2016 and 2017 indicated the 2015 treatment was successful in achieving longer-term control (Figure 4), and no herbicide treatments occurred in the Cranberry Channel in 2016-2018.

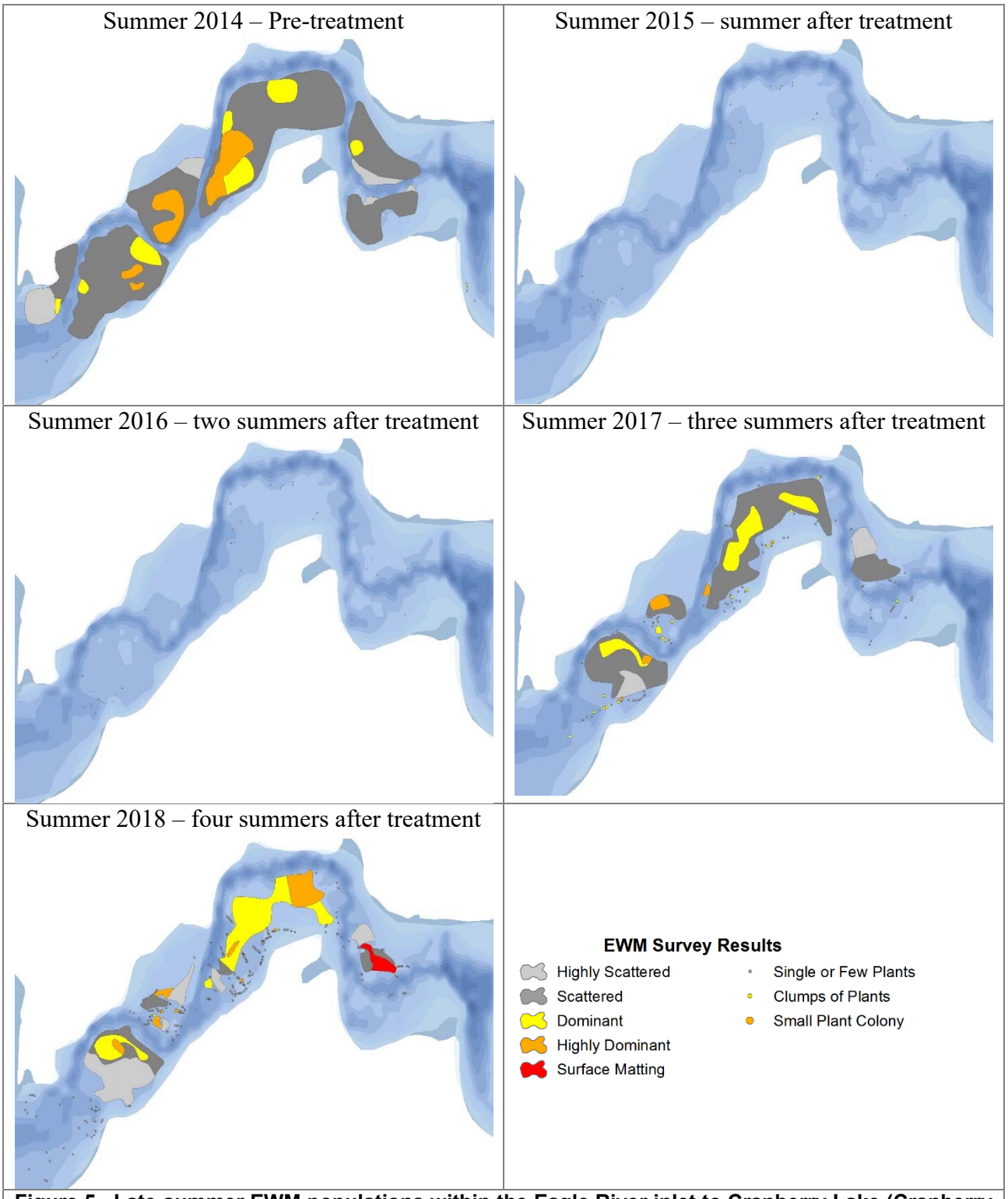


Figure 5. Late-summer EWM populations within the Eagle River inlet to Cranberry Lake (Cranberry Channel).

During the summer of 2018, Onterra field crews also collected data within the upstream Cranberry Lake channel to prepare for potential herbicide management actions during the spring of 2019 (Figure 6). This quantitative evaluation monitoring plan is consistent with Appendix D of the WDNR Guidance Document, *Aquatic Plant Management in Wisconsin* (WDNR 2010). Using a grid of equally spaced points (30 meters), point-intercepts sub-sampling data are collected during the summer before the treatment (pre) and summer following the treatment (post). This allows EWM and native plant population changes to be understood.

While the ULERCLC initiated the collection of this pretreatment data, the decision to postpone herbicide management of this site past spring 2019 was made. The data from this survey will continue to help understand the longer-term trends of the aquatic plant population in this area, providing additional layer of understanding for any future treatment strategy. These data are also helpful in understanding which species are present, as different plant species have varying levels of susceptibility to particular herbicide treatments (Figure 6). If the native plant population consists of a known sensitive plant to that herbicide strategy, an alternative strategy may be discussed.

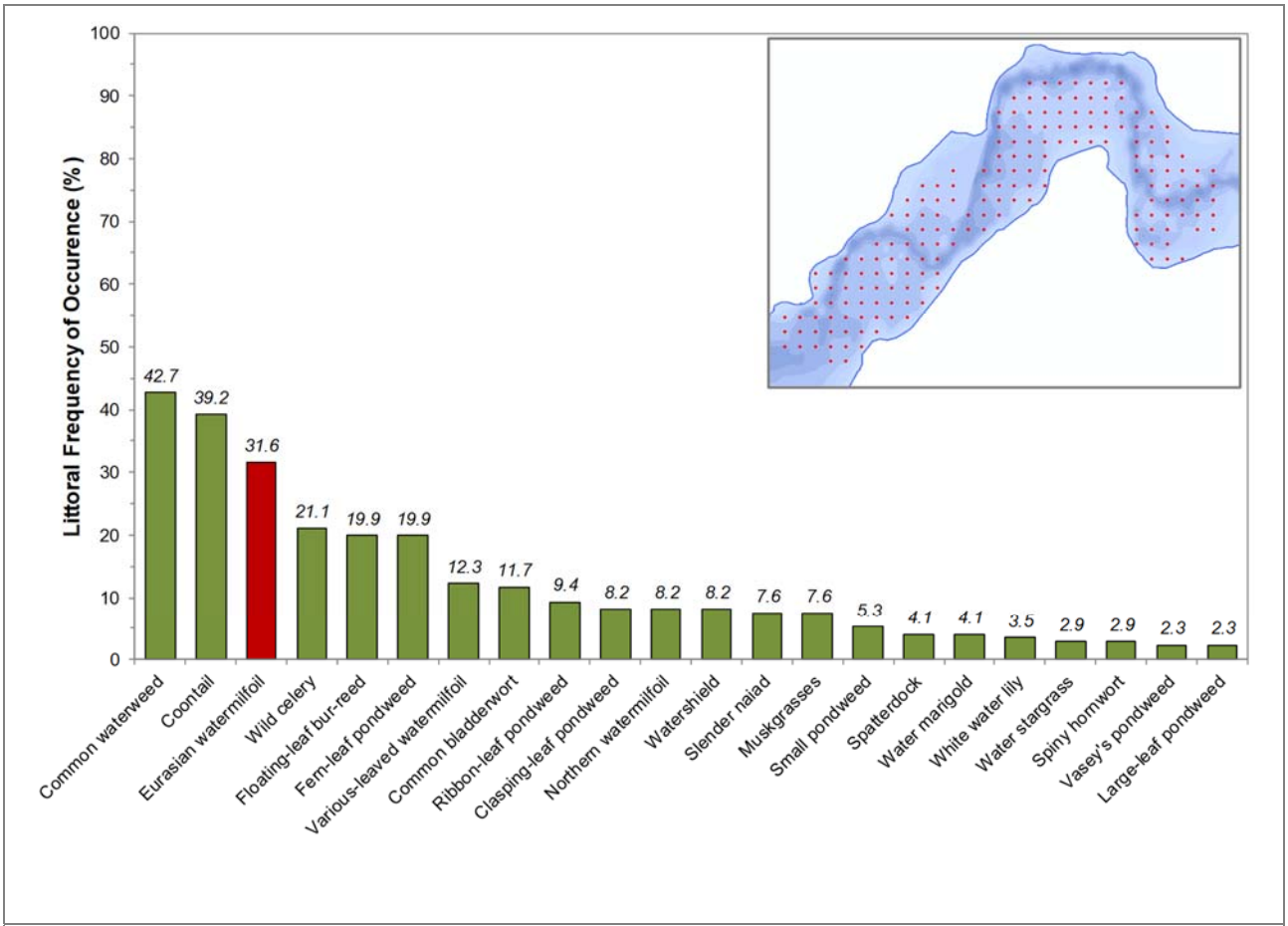
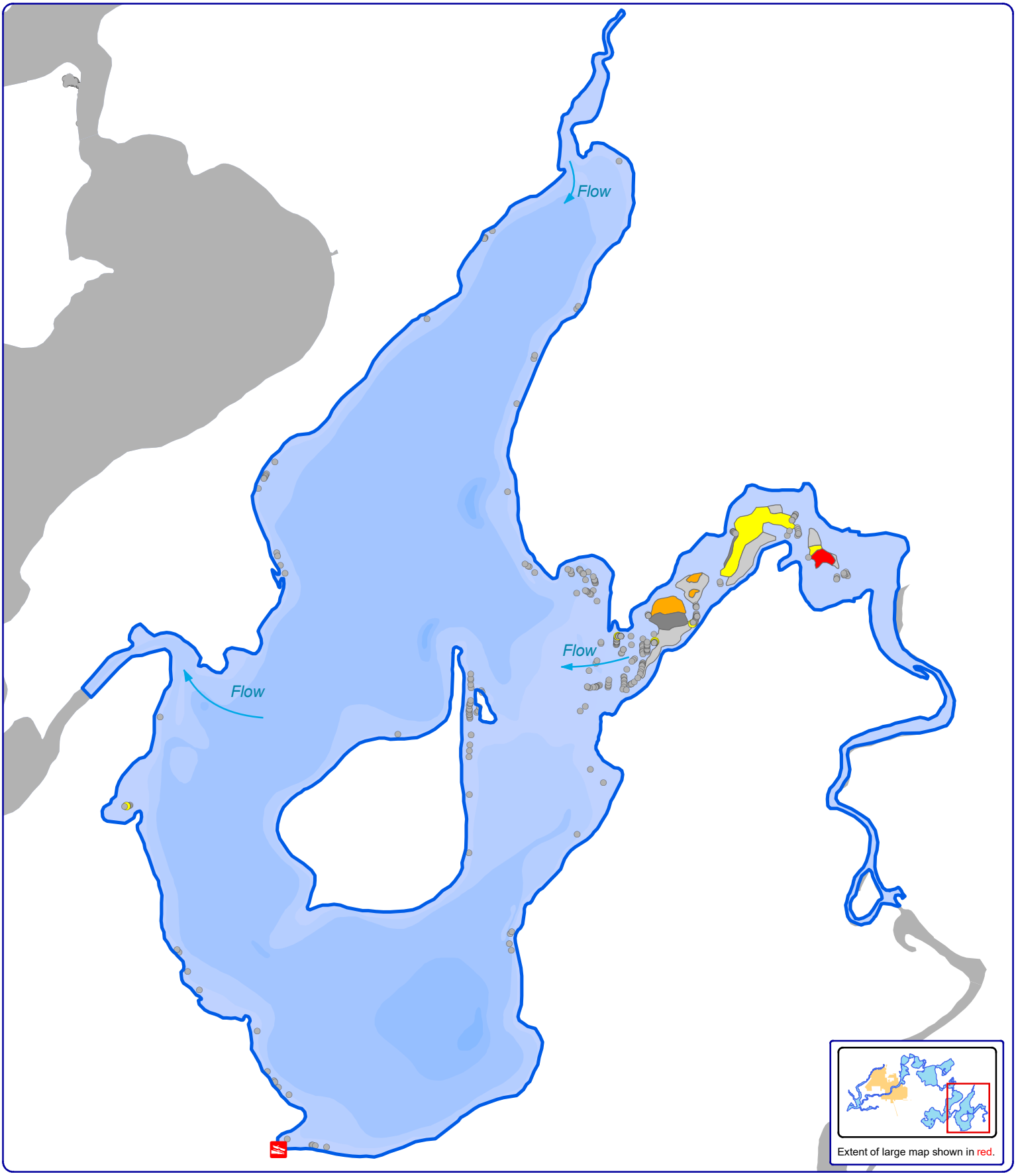


Figure 6. Cranberry Channel 30m sub-sample locations (inset) and 2018 survey data.



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Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, Onterra digitized
Aquatic Plants: Onterra, 2018
Map Date: October 19, 2018
Filename: *Cranberry_EWMPB_2018.mxd*

Legend
2018 EWM PB Survey (September 2018)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony *(None found)*

Cranberry Lake - Map 1

Vilas County, Wisconsin

2018 EWM PB Survey Results