

## 1.0 INTRODUCTION

Anvil Lake, Vilas County, is an approximate 357-acre mesotrophic seepage lake with a maximum depth of 30 feet (measured in 2014) and a mean depth of 19 feet (Figure 1). The lake harbors a high-quality native aquatic plant community with 37 native species, 22 of which have a coefficient of conservatism of 7 or higher. Anvil lake also contains a population of Vasey's pondweed (*Potamogeton vaseyi*), a native aquatic plant listed as special concern in Wisconsin due to its relative rarity. The lake has high water clarity, with an average summer Secchi disk depth of 12 feet.

The non-native, invasive aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*; EWM) was discovered in Anvil Lake in the summer of 2012 by Great Lakes Indian Fish and Wildlife Commission (GLIFWC) staff. After being made aware of GLIFWC's discovery, the Wisconsin Department of Natural Resources (WDNR)

completed a whole-lake aquatic plant point-intercept survey that same summer which confirmed additional occurrences of EWM within the lake's approximate 25-acre northern bay (North Bay). The Anvil Lake Association (ALA) contracted with Onterra, and Onterra ecologists mapped the EWM in Anvil Lake in August of 2012 with guidance from ALA volunteer monitoring locations. The 2012 WDNR point-intercept survey indicated that the EWM population was small, with a littoral frequency of occurrence of just 0.5%. Similarly, Onterra's 2012 mapping survey found that the EWM population was mainly isolated to North Bay and largely comprised of single-plant occurrences.

### 1.1 Historic AIS Management

Following discussions on how to manage the newly-discovered EWM population, the ALA elected to move forward with a non-herbicide control strategy. Since 2013, the ALA has been implementing traditional (non-mechanical) hand-harvesting using volunteers and professionally-operated diver-assisted suction harvesting (mechanical; DASH) to remove EWM from Anvil Lake. While these control efforts have likely slowed the pace of the spread and expansion of the EWM population, they have been unable to maintain or reduce the level of EWM in Anvil Lake. Professional monitoring surveys completed annually from 2012-2016 showed that most of the EWM expansion has occurred within North Bay. Sub-sample point-intercept survey data collected within North Bay showed that the occurrence of EWM increased from 4% to 57% from 2012-2016. The inability to maintain or reduce the level of EWM in Anvil Lake is not the result of deficient hand-harvesting methodology but is an indication that the rate of expansion of the EWM population is exceeding the pace of removal efforts.

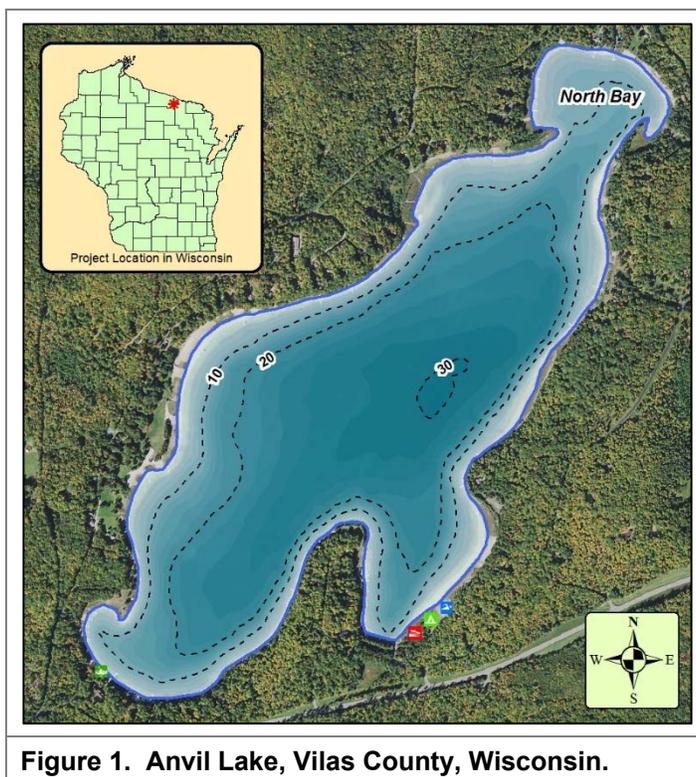


Figure 1. Anvil Lake, Vilas County, Wisconsin.

In 2014, the ALA was awarded a WDNR AIS-Education, Planning and Prevention (EPP) Grant to aid in funding a project aimed at updating the Anvil Lake comprehensive management plan developed in 2011. While the management planning update project involved the collection of a wide variety of data to gain a more holistic understanding of the Anvil Lake ecosystem, one of the primary objectives of the project was to reassess the ALA's EWM management strategy and develop a long-term monitoring and management strategy for AIS.

During this project, discussions about the use of aquatic herbicides to target the EWM population took place between the WDNR, Onterra, and the ALA Planning Committee (a committee comprised of ALA representatives). Current knowledge and research regarding aquatic herbicide use strategies including known and unknown impacts were presented to the ALA Planning Committee. Following these discussions, the ALA Planning Committee felt that the use of herbicides on Anvil Lake were not yet appropriate as Anvil Lake had never been exposed to aquatic herbicides and a segment of ALA members expressed opposition to herbicide use following the initial discovery of EWM. The ALA Planning Committee felt that alternative control strategies should be exhausted first prior to the consideration of the use of aquatic herbicides.

The management planning update project led to the development of a more aggressive EWM hand-harvesting control strategy for Anvil Lake. The strategy developed involved a three-year trial program from 2017-2019 to evaluate the effectiveness of using a combination of paid and volunteer DASH and traditional hand-removal implemented at a higher level of effort than what had been conducted from 2013-2016. The trial program proposed implementing a total of 350 hours of EWM harvesting each year with annual revisions being made to the amount of time allocated to DASH versus traditional hand-harvesting based on the level of EWM.

The ALA was awarded a WDNR AIS-EPP grant in 2016 to aid in funding the professional monitoring and control strategy development from 2017-2019. The ALA was also awarded a WDNR-Established Population Control (EPC) Grant in 2017 to aid in funding the hand-harvesting expenses from 2017-2019. The objective of this project is not to eradicate EWM from Anvil Lake as that is thought to be impossible with current tools and techniques. The objective of this project is to determine whether or not this increased level of hand-harvesting effort can reduce and maintain an EWM population to a level which exerts little to no detectable impact on the lake's ecology, recreation, and aesthetics.

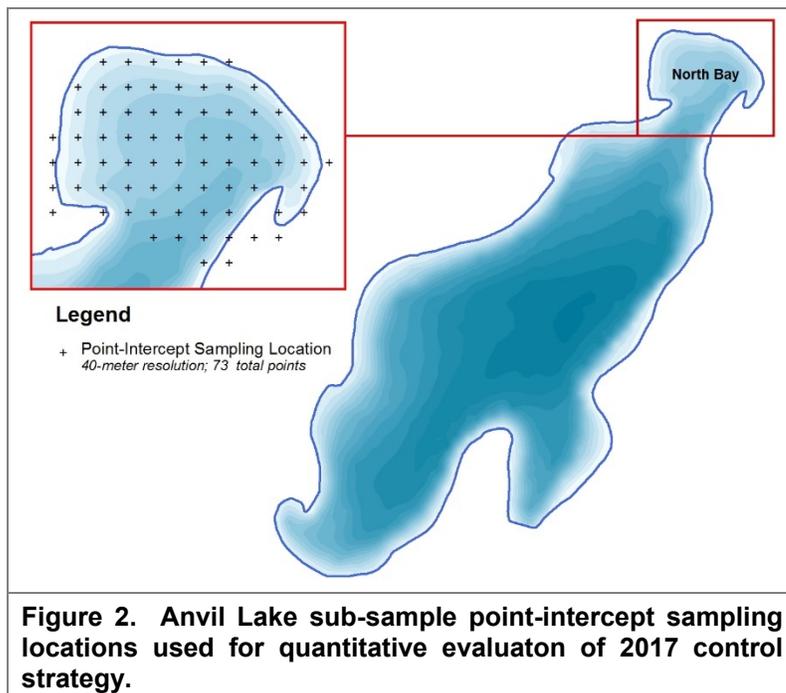
In addition to monitoring Anvil Lake's EWM population and developing control strategies, this project also includes continued monitoring of the lake's non-native curly-leaf pondweed (*Potamogeton crispus*; CLP) population from 2017-2019. Curly-leaf pondweed was discovered in Anvil Lake in 2013, and its population has since remained small. Continued monitoring of the CLP population will yield information on its dynamics in Anvil Lake and allow for active management techniques to be developed in the event the population expands. This report serves as the 2017 annual report for the 2017-2019 AIS monitoring and control project and discusses the monitoring and effectiveness of the AIS control efforts implemented in 2017.

## 1.2 AIS Monitoring Strategy

Eurasian watermilfoil population management programs (mainly with herbicides) incorporate both established qualitative (EWM mapping) and quantitative (sub-sample point-intercept survey) evaluation methodologies. Qualitative evaluation was completed using sub-meter GPS technology to map EWM

locations with either 1) point-based or 2) area-based methodologies. Point-based techniques were applied to EWM locations that were considered as *Small Plant Colonies* (< 40 feet in diameter), *Clumps of Plants*, or *Single or Few Plants*. Large colonies >40 feet in diameter were mapped using polygons (areas) and were qualitatively attributed a density rating based upon a five-tiered scale: *Highly Scattered* < *Scattered* < *Dominant* < *Highly Dominant* < *Surface Matting*. The EWM population in Anvil Lake was mapped in the late-summer of 2016 (pre-harvest), late-May of 2017 (pre-harvest), and early-September 2017 (post-harvest).

Quantitative evaluation methodologies followed WDNR protocols in which point-intercept data were collected within the harvested areas (North Bay) in the summer prior to hand-harvesting (2016) and in the summer immediately following hand-harvesting (2017). In Anvil Lake, quantitative evaluation was made through the collection of data at 73 point-intercept sub-sample locations within North Bay (Figure 2). These sampling locations are a sub-set of locations used during whole-lake point-intercept surveys on Anvil Lake. At these locations, EWM and native aquatic plant species presence and rake-fullness were documented. This quantitative survey aims to determine if statistically valid differences in the occurrence of EWM and native aquatic plant species occur following hand-harvesting implementation.



**Figure 2. Anvil Lake sub-sample point-intercept sampling locations used for quantitative evaluation of 2017 control strategy.**

Qualitatively, the 2017 hand-harvesting effort would be considered successful if the EWM colonies designated with a density rating of *dominant* or greater were reduced by at least one density rating (e.g. *dominant* to *scattered*). Quantitatively, the 2017 hand-harvesting effort would be considered successful if the sub-sample point-intercept survey data show a reduction in the occurrence of EWM and this reduction was statistically valid (Chi-square  $\alpha = 0.05$ ).

## 2.0 2017 EWM POPULATION MANAGEMENT STRATEGY

The ALA's *Comprehensive Management Plan for Anvil Lake* (January 2018) outlines criteria for initiating the various levels of hand-harvesting within Anvil Lake:

- Using EWM findings from the most recent Peak-Biomass Survey, professional ecologists will work with the ALA to delineate priority areas within the North Bay over the winter months. Those areas containing EWM populations of *dominant* density or greater would be targeted first by the DASH operations as they exert the greatest ecological strain and are the largest sources for future spread. Volunteer-based efforts using snorkelers would occur in the shallow margins of the lake.
- The isolated EWM occurrences outside of the North Bay would be categorized based upon the level of EWM within each area. Sites containing *small plant colonies* would be classified as areas requiring the greatest need for hand-removal, or primary focus sites, while areas containing *clumps of plants* and only *single or few plants* would be classified as secondary and tertiary focus sites, respectively.

Based upon the September 2016 EWM Mapping Survey, an approximately 34-acre hand-harvesting area comprising the entirety of the North Bay was delineated for removal with DASH methodologies (Map 1, Site A-17). EWM occurrences outside of the North Bay were noted as possible areas for volunteer-based hand-harvesting to occur.

### 2.1 2017 Early-season AIS Survey (Pre-Hand-Harvesting)

On May 30 and 31, 2017 Onterra ecologists conducted the Early-Season AIS (ESAIS) Survey on Anvil Lake. This spring meander-based survey was conducted to locate and map areas of EWM so these data could be relayed to the ALA to finalize the hand-harvesting strategy. This provides the hand-harvesters with the most up-to-date and accurate information regarding locations of EWM within the lake. In addition, the hand-harvesters could better allocate their time to removing EWM rather than searching the lake for suitable areas to conduct hand-removal.

The areas and densities of EWM mapped during the 2017 ESAIS survey were relatively similar to what was mapped during the 2016 Late-Summer EWM Peak-Biomass Survey (Maps 1 and 2). Approximately 22 acres of colonized EWM were mapped in North Bay during the ESAIS survey, with 5.6 acres delineated with a density of rating of *dominant* or greater. The hand-harvesting site encompassing these areas (A-17) was divided into five sub-harvesting sites to help with tracking the hand-harvesting effort. A 0.5-acre colony of *highly scattered* EWM was also mapped along the southern shore of the lake. A 1.7-acre site (B-17) was added to the strategy to target the *highly scattered* colony of EWM and adjacent single-plant occurrences within the southern portion of the lake.

The results of the ESAIS Survey were provided to the ALA in the form of electronic maps and the data were digitally formatted into a basemap that was loaded onto the association's GPS unit for their use.

Because CLP reaches its peak growth in early summer, locations of this plant were also mapped during the 2017 ESAIS survey on Anvil Lake. During this survey, a handful of single-plant occurrences and one clump were located just south of North Bay (Map 2). A single CLP plant was also located in the southeastern area of the lake. The CLP population in 2017 appeared to be smaller than what was

observed during the 2016 ESAIS survey were numerous single plants were observed in and just outside of North Bay along with some clumps and a small plant colony. Conditions in 2016 and/or 2017 may have been less favorable for the survival or germination of CLP turions which resulted in a smaller population.

## 2.2 2017 ALA Scuba Diver Hand-harvesting Implementation

The ALA reported that the DASH unit was operated for a total of 129 hours in 2017 removing a total of approximately 23,740 pounds of EWM from the permitted areas. The primary diver removed 16,580 lbs of EWM, primarily from the North Bay (Figure 3). No EWM was removed from A4-17. The additional divers removed 7,160 lbs of EWM, with effort split between B-17 and A2-17. This was the first full year of implementing the ALA-owned DASH boat. Additional details are included in Appendix A.

In addition to DASH, ALA volunteers and paid divers also completed traditional hand-removal of EWM within and outside of the 2017 DASH permit areas (Figure 3). Volunteer harvest logs indicate that volunteers spent 150.7 hours of traditional hand-harvesting of EWM in Anvil Lake in 2017.

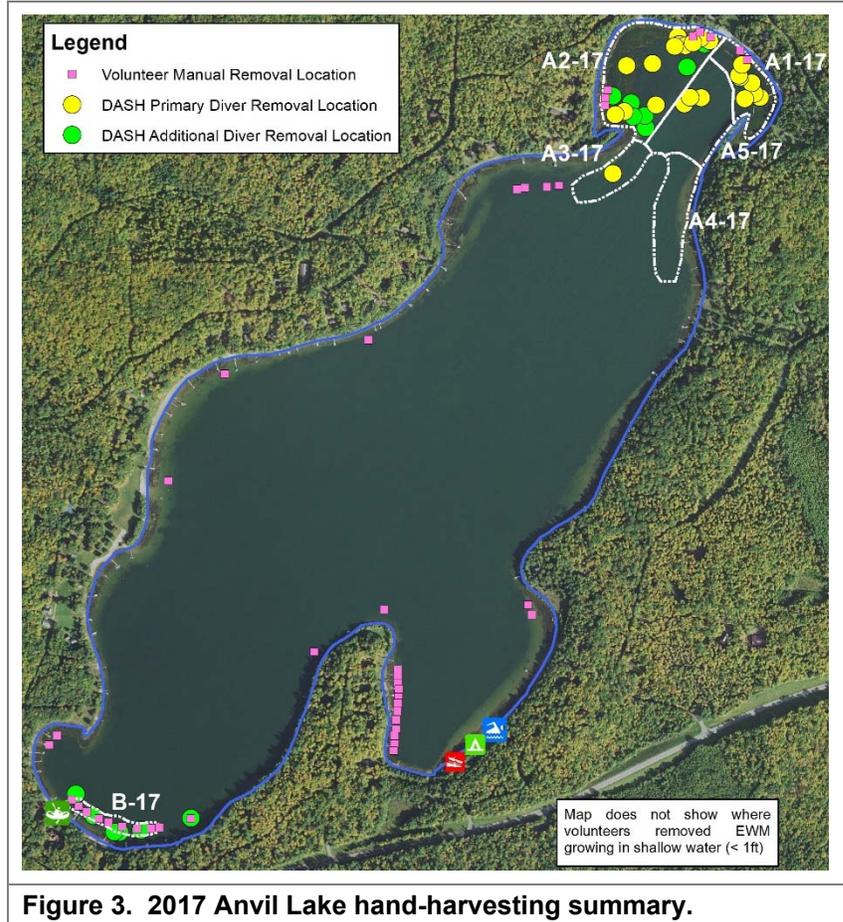


Figure 3. 2017 Anvil Lake hand-harvesting summary.

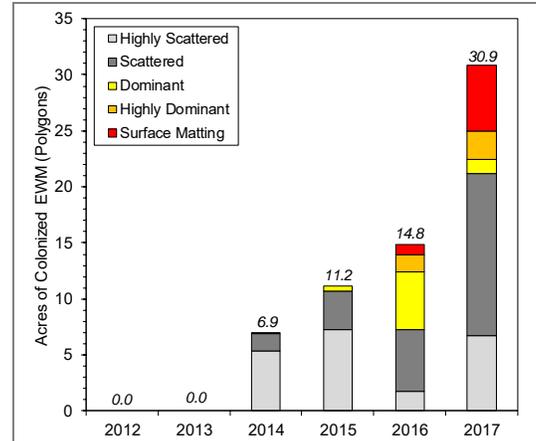
With water levels rising in Anvil Lake, EWM fragments were often found tangled and starting to take root in shallow waters (< 1ft) along the margins of the lake. ALA volunteers would walk the shorelines and remove these shallow water occurrences.

## 2.3 Post Hand-Harvesting Monitoring Results

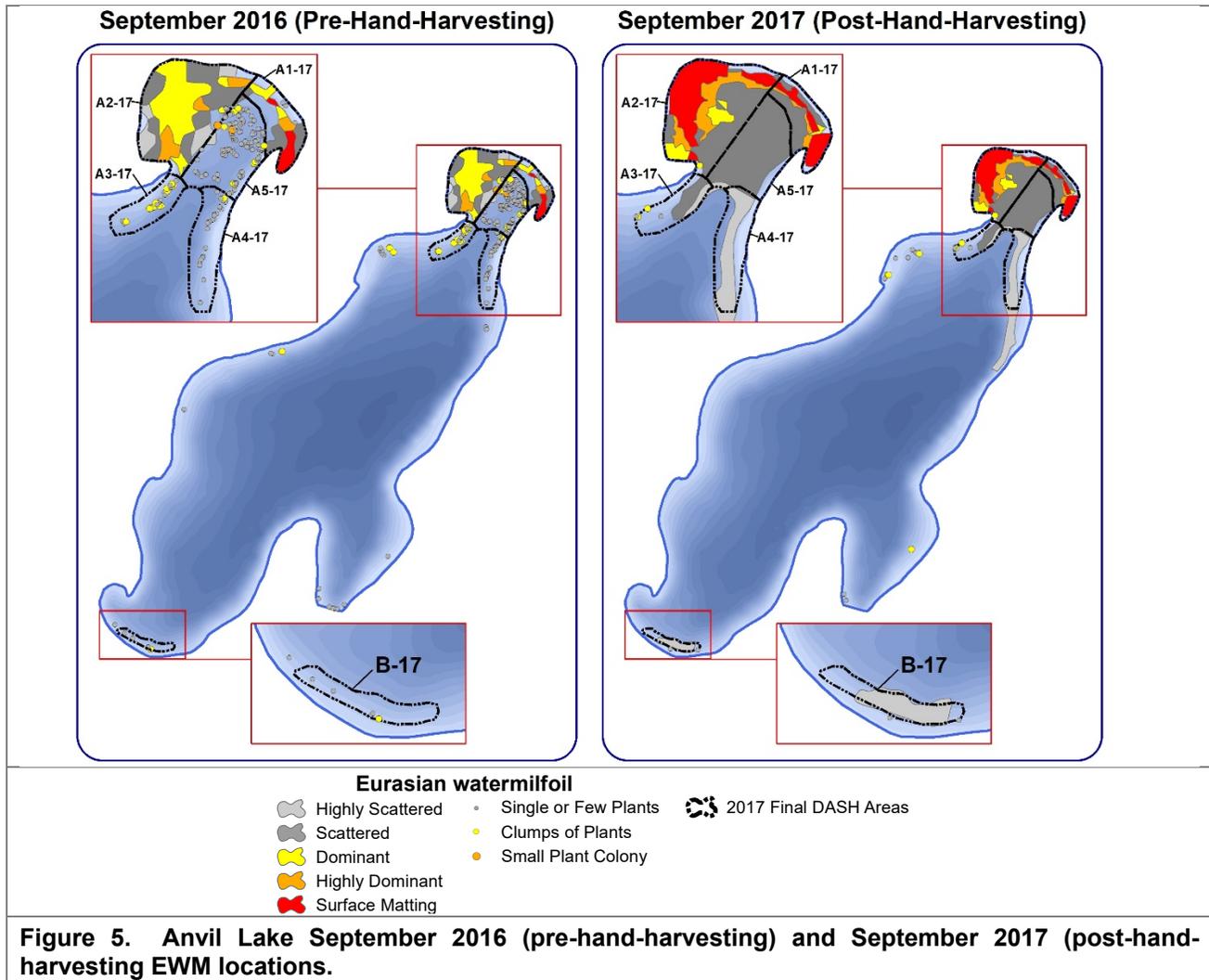
### Qualitative Monitoring Results (EWM Mapping Data)

On September 6, 2017, Onterra ecologists conducted the Late-Season EWM Peak-Biomass Survey on Anvil Lake to assess the hand-harvesting areas and map EWM throughout the lake (Map 3). Like the ESAIS Survey, this survey is a meander-based survey of the lake’s littoral zone designed to locate and map occurrences of EWM. To evaluate the control strategy, comparison between the 2016 late-summer EWM mapping survey (pre) and the 2017 late-summer EWM mapping survey (post) are most appropriate, at they represent the EWM population at its peak growth stage for the given year (Figure 5).

The 2017 Late-Season EWM Peak-Biomass survey completed on Anvil Lake showed that the EWM population continued to expand. The acreage of colonized EWM increased from 14.8 acres in 2016 to 30.9 acres in 2017 – an increase of over 16 acres. Most of this gain in acreage is attributed to the deeper area within North Bay that was delineated as *scattered*. The acreage of EWM delineated as *dominant* or greater increased by over 2.0 acres in 2017 when compared to 2016. In addition, these areas also increased in density with 61% of the *dominant* or greater acreage being comprised of *surface matted* EWM in 2017 (Figure 4). The EWM growing immediately south of North Bay also increased in density while the *highly scattered* colony in the southern portion of the lake remained largely unchanged from the 2017 ESAIS survey. From the five-year period from 2012-2017, colonized acreage of EWM in Anvil Lake has increased from 0 acres in 2012 to 30.9 acres in 2017 (Figure 4).



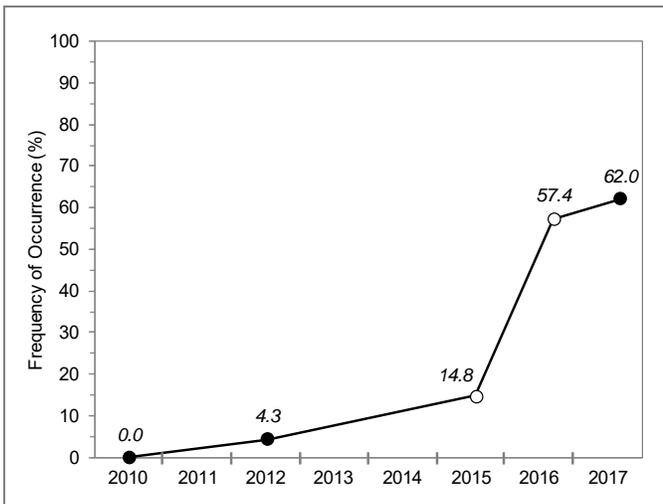
**Figure 4. Anvil Lake acreage of colonized EWM (polygons) from 2012-2017.** Created using data from 2012-2017 late-summer EWM mapping surveys.



**Figure 5. Anvil Lake September 2016 (pre-hand-harvesting) and September 2017 (post-hand-harvesting EWM locations).**

EWM population increase from late-summer 2016 to late-summer 2017 was observed within both permitted DASH locations (A-17 from the North Bay, B-17 in the southern part of the lake). However, the Late-Season EWM Peak-Biomass survey results did indicate that the traditional hand-harvesting effort was largely successful. Eurasian watermilfoil was not able to be located in most of the areas that saw traditional hand-harvesting (pink squares in Figure 3). The removal of these small, initial infestations of EWM likely slowed the expansion of EWM in areas outside of North Bay. With the large amount of volunteer-based EWM removal efforts conducted along the western shore within the bay containing the boat landing, this area will be focused on during the 2018 Early Season AIS Survey to determine if sufficient EWM exists to add to the DASH strategy.

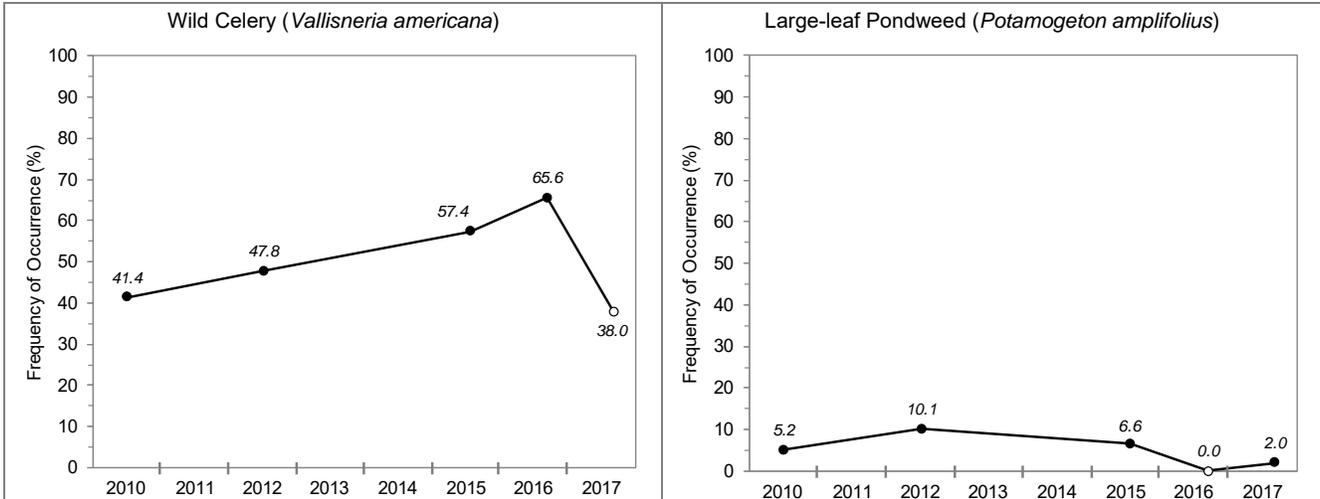
**Quantitative Monitoring Results (Point-intercept Sub-Sample Data)**



**Figure 6. Anvil Lake EWM frequency of occurrence within North Bay.** Open circle indicates statistically valid change in occurrence from previous survey (Chi-square  $\alpha = 0.05$ ). 2010 N = 58; 2012 N = 69; 2015 N = 61; 2016 N = 61; 2017 N = 50.

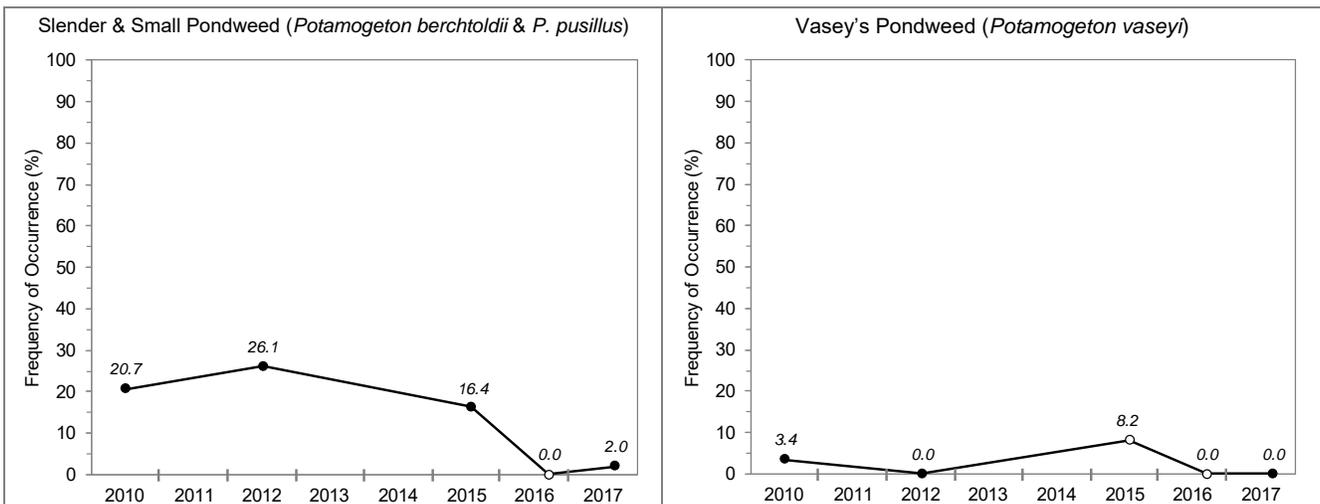
On September 6, 2017, Onterra ecologists also completed the sub-sample point-intercept survey within North Bay of Anvil Lake. (Figure 2). These data show that EWM had a frequency of occurrence of 62% in 2017 and was the most frequently-encountered aquatic plant species during this survey. The 2017 frequency was not statistically different from its 2016 (Figure 6). However, 13 sampling locations in the northwest portion of North Bay were “unreachable” due to dense, surface matted EWM. Had these locations been sampled, the occurrence of EWM likely would have been near 70%, representing a statistically valid increase in occurrence from 2016. The 2017 data indicate that the frequency of occurrence of EWM within North Bay has increased by nearly 320% in the three-year period from 2015-2017.

At the management planning wrap-up meeting in August 2017, many Anvil Lake stakeholders indicated that they believed the expanding EWM population in North Bay was displacing native species, most notably large-leaf pondweed and wild celery. The sub-sample point-intercept data do indicate that large-leaf pondweed and wild celery along with three other native aquatic plant species in North Bay have seen statistically valid reductions in their occurrence in recent years (Figure 7). The occurrence of wild celery declined from an occurrence of 66% in 2016 to an occurrence of 38% in 2017, representing a statistically valid reduction in occurrence of 42%. Large-leaf pondweed ranged from 5% to 10% prior to 2016 and has since declined to 0% and 2% in 2016 and 2017, respectively.



**Figure 7. Frequency of occurrence of select native aquatic plant species in North Bay of Anvil Lake from 2010-2017.** Open circle indicates statistically valid change in occurrence from previous survey (Chi-square  $\alpha = 0.05$ ). 2010 N = 58; 2012 N = 69; 2015 N = 61; 2016 N = 61; 2017 N = 50.

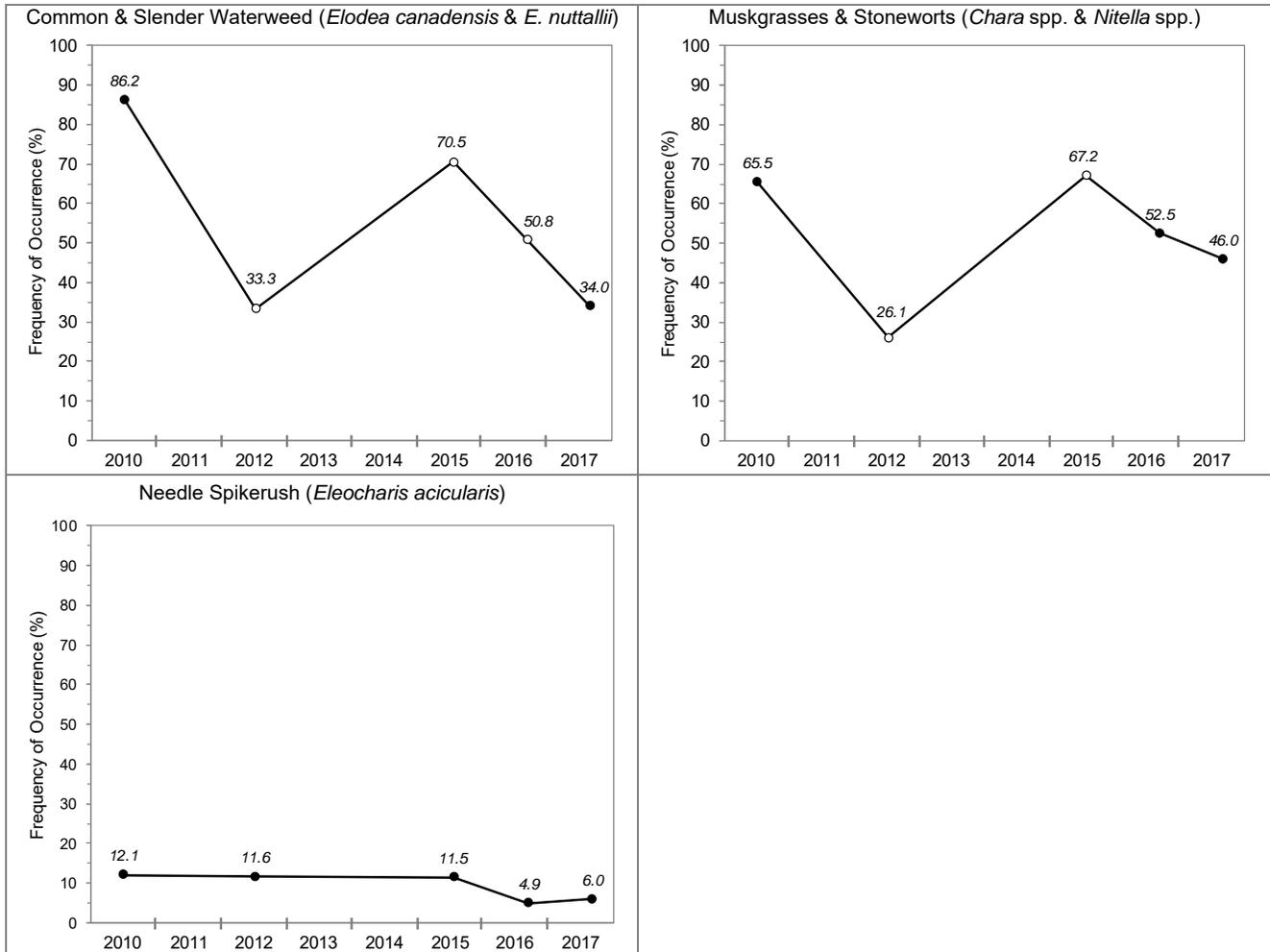
The occurrences of small/slender pondweed, and Vasey’s pondweed all exhibited statistically valid declines in their occurrence in North Bay between 2015 and 2016 corresponding with a 200% increase in the occurrence of EWM (Figure 8). Prior to 2016, the occurrence of small/slender pondweed ranged from 16% to 26% and has since declined to occurrences of 0% and 2% in 2016 and 2017, respectively. The special concern species Vasey’s pondweed had an occurrence of 8% in 2015 and was not recorded during the 2016 and 2017 surveys. Onterra’s experience is that Vasey’s pondweed populations can fluctuate greatly in some lakes, potentially being sensitive to natural changes in water levels and/or water clarity.



**Figure 8. Frequency of occurrence of select native aquatic plant species in North Bay of Anvil Lake from 2010-2017.** Open circle indicates statistically valid change in occurrence from previous survey (Chi-square  $\alpha = 0.05$ ). 2010 N = 58; 2012 N = 69; 2015 N = 61; 2016 N = 61; 2017 N = 50.

While the occurrence of common/slender waterweed has been highly variable in North Bay, it declined from an occurrence of 71% in 2015 to an occurrence of 34% in 2017. Likewise, the occurrence of muskgrasses/stoneworts has been variable in North Bay, but it has declined in recent years from an

occurrence of 67% in 2015 to an occurrence of 46% in 2017 (Figure 9). It is difficult to determine if these native species declines are the result of displacement from an expanding EWM population, bycatch during hand-harvesting, natural changes in environmental conditions, or a combination of these. If these declines were largely the result of bycatch during hand-harvesting, it would be expected that these declines would have occurred between 2016-2017 corresponding with the increased level of hand-harvesting effort. However, most of the statistically valid reductions in occurrence of native species occurred between 2015-2016 prior to the increased hand-harvesting effort and corresponding with the largest increase in occurrence (200%) of EWM.



**Figure 9. Frequency of occurrence of select native aquatic plant species in North Bay of Anvil Lake from 2010-2017.** Please note that only those species with an occurrence of at least 5% in one of the five surveys are displayed. Open circle indicates statistically valid change in occurrence from previous survey (Chi-square  $\alpha = 0.05$ ). 2010 N = 58; 2012 N = 69; 2015 N = 61; 2016 N = 61; 2017 N = 50.

The point-intercept survey data from 2010, 2012, and 2015 indicate that the populations of large-leaf pondweed and small/slender pondweed were found in deeper areas of North Bay in 7 to 14 feet of water, while wild celery was found growing across all depths. The data from 2015-2017 indicate that these deeper areas of North Bay saw the largest increase in the occurrence of EWM. This adds weight to the idea that these reductions in native species occurrence may be the result of displacement from the

expanding EWM population and not a result of bycatch from increased hand-harvesting in 2017. The 2017 sub-sample point-intercept survey data showed that EWM is now the most abundant aquatic plant in North Bay.

### 3.0 CONCLUSIONS AND DISCUSSION

The DASH strategy employed on Anvil Lake in 2017 was unable to reduce the occurrence and density of EWM in North Bay, indicating the effort of 129 diver hours was unable to keep pace with the expansion of the EWM population. EWM is currently the dominant plant in the North Bay with a frequency of occurrence of 62%. Qualitative mapping indicated that the acreage of colonized EWM in Anvil Lake increased from 14.8 acres in 2016 to 30.9 acres in 2017. In addition, the majority of the acreage delineated with a density rating of *dominant* or greater in 2017 was designated with the highest density rating of *surface matting*. However, while DASH harvesting was unable to reduce EWM in the North Bay, the traditional hand-harvesting effort conducted by ALA volunteers was largely successful as no EWM could be located at the majority of the locations that were harvested. Their efforts have likely abated the spread and expansion of EWM in areas of Anvil Lake outside of North Bay.

Given the large, dense population of EWM in North Bay, it is not believed that DASH can achieve the original goal of reducing (or maintaining) the EWM population in North Bay. As discussed earlier, the ALA has elected to explore non-herbicide EWM control strategies over the remaining course of this project in 2018 and 2019. However, it is recommended that the aim of the project be re-directed from a goal of reducing the EWM population in North Bay to a project with the following objectives for 2018:

- Utilize DASH in the North Bay to maintain open lanes of navigation from shore to open water through dense areas of EWM
- Utilize DASH in areas of less dense EWM in southern portion of lake in an effort to reduce its expansion
- Utilize traditional hand-harvesting to harvest areas with small, initial infestations of EWM outside of North Bay.

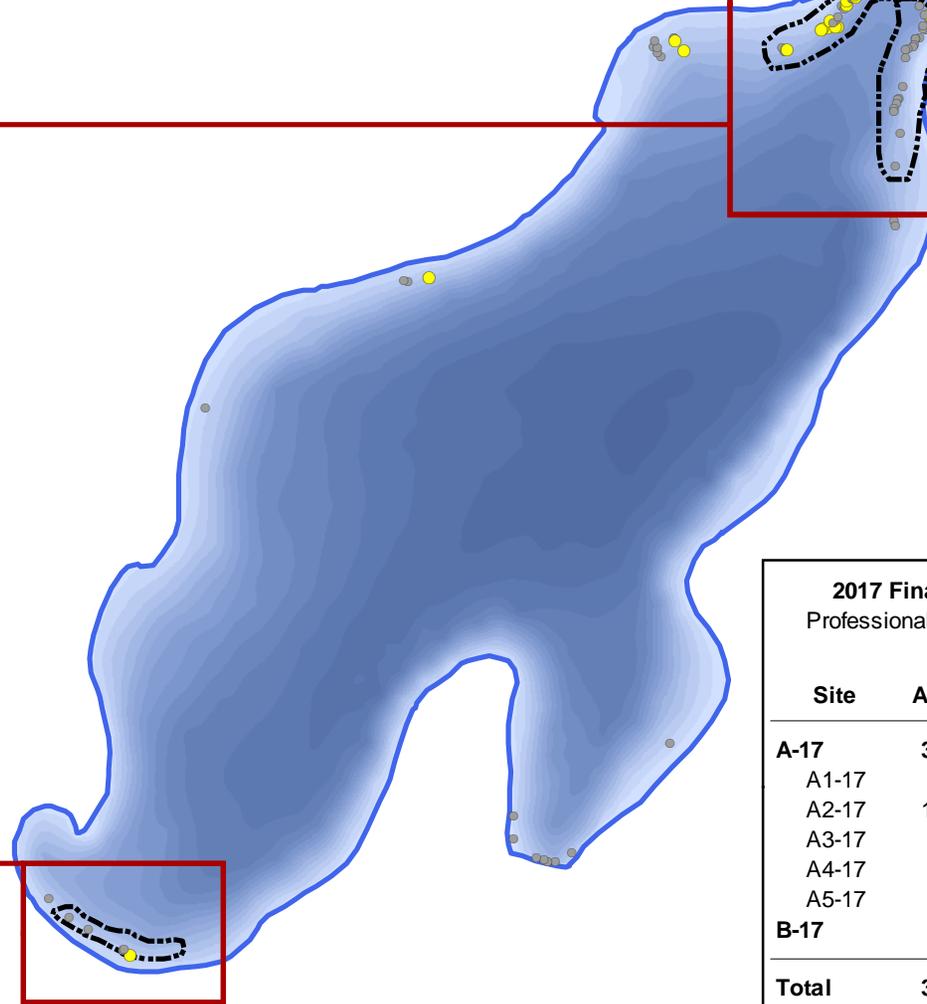
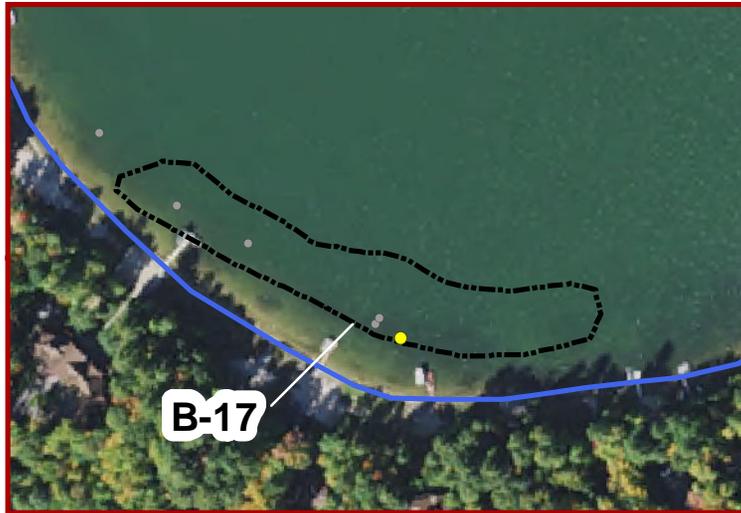
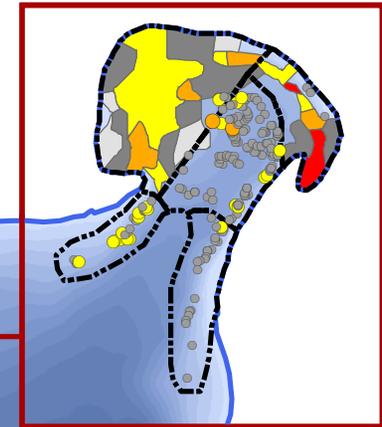
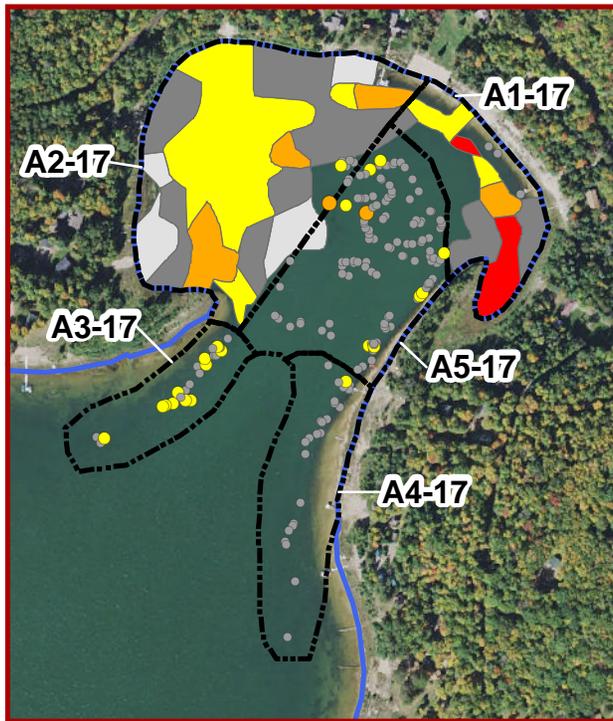
Most of the EWM in shallower, near-shore areas of North Bay was found to be extremely dense and matted at the surface in 2017, making navigation from docks to open water in these areas highly difficult. It is proposed that the DASH divers focus their efforts on maintaining open lanes of navigation through this dense EWM to ease navigation for riparians from docks to open water. Map 4 illustrates the proposed locations for these navigational lanes which extend from riparian docks to deeper water beyond surface-matted EWM. These navigational lanes are 15 feet wide and total approximately 0.6 acres in area. The entirety of North Bay has been proposed to be designated as a DASH hand-harvest area, allowing for lanes to be expanded or their locations to be adjusted as needed.

If the DASH harvesters are able to maintain these open lanes of navigation and have additional time to harvest elsewhere, priority hand-harvesting sites have been created (Map 4). As mentioned earlier, it is recommended that after the navigational lanes have been maintained, priority DASH harvesting should be given to the low-density EWM population in the southern portion of the lake (A-18) in an effort to control the expansion and establishment of EWM in this area. If DASH harvesters are able to successfully remove EWM from A-18, their priority could then focus to B-18. Site B-18 encompasses low-density EWM immediately south of North Bay, and the goal would be to prevent further expansion of this EWM into Anvil Lake proper. If DASH harvesters are able to maintain open navigation lanes

and harvest the majority of EWM from sites A-18 and B-18, they should then focus their efforts on removing EWM from C-18, or North Bay. The total proposed area for potential DASH harvesting is 36.1 acres (Map 4). Like in 2017, the ALA will need to submit a Mechanical Harvesting Permit to the WDNR outlining the proposed DASH areas.

The traditional hand-harvesters should again focus their efforts harvesting small, initial infestations of EWM around Anvil Lake. These small EWM populations include *clumps of plants* and *single or few plant* occurrences. Onterra's 2018 ESAIS Survey will provide an updated picture of where these small EWM occurrences are located and will provide initial focus areas for the traditional hand-harvesters. A map containing the ESAIS survey results will be provided to the ALA for their use along with data for their Garmin GPS unit to aid in their hand-harvesting efforts. Once these initial areas have been harvested, the volunteers can search other areas for occurrences of EWM that were not marked during the Early-Season AIS Survey or aid in harvesting the low-density EWM populations in sites A-18 and B-18.

While the results of the DASH harvesting in the North Bay in 2017 did not meet desired expectations, the ALA will see this non-herbicide control program through to its end in 2019. Following completion of this project, the ALA will be distributing a stakeholder survey to assess lake users in their level of support for control techniques for EWM, including both non-herbicide and herbicide control strategies. In 2018, the primary focus should be on maintaining open lanes of navigation in North Bay and reducing the expansion of EWM in areas of Anvil Lake outside of North Bay.



**2017 Final Control Strategy**  
Professional Hand-Harvest (DASH)

Site	Acres	Avg. Depth (feet)
<b>A-17</b>	<b>33.8</b>	<b>8.5</b>
A1-17	4.5	7.0
A2-17	13.1	8.5
A3-17	3.2	8.0
A4-17	5.4	11.0
A5-17	7.6	8.0
<b>B-17</b>	<b>1.7</b>	<b>8.0</b>
<b>Total</b>	<b>35.5</b>	



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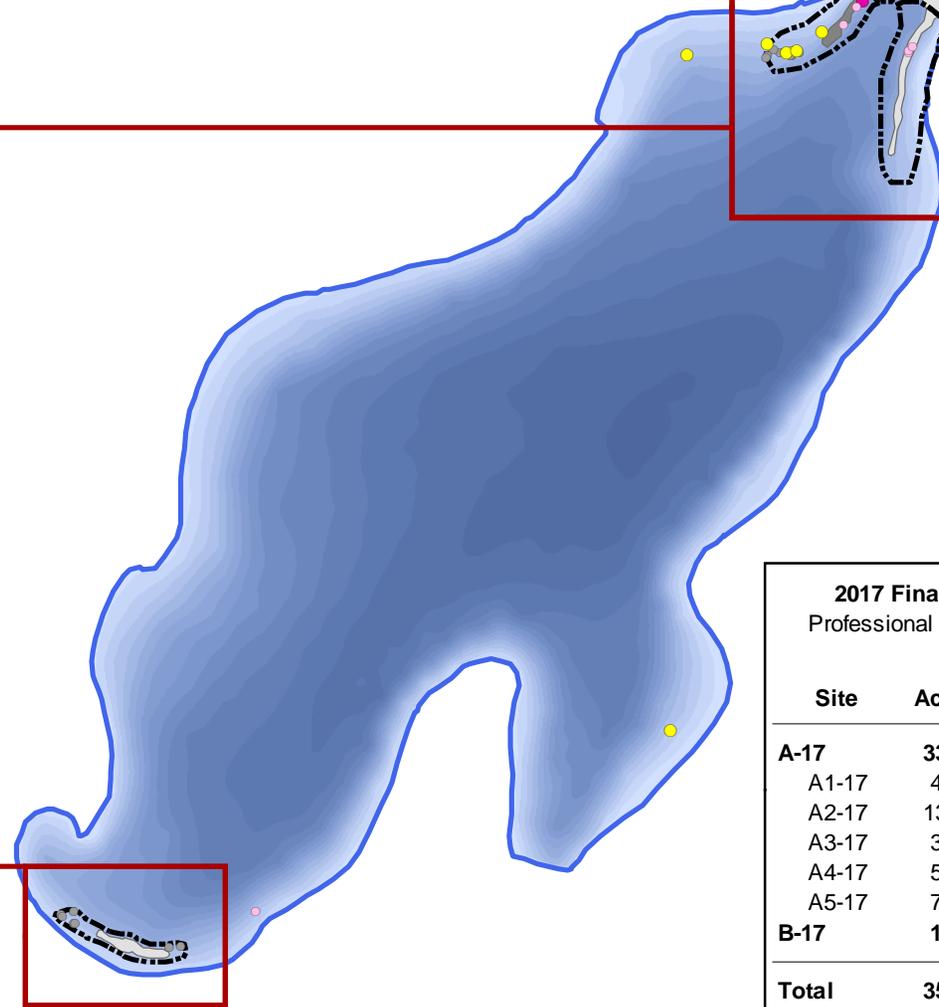
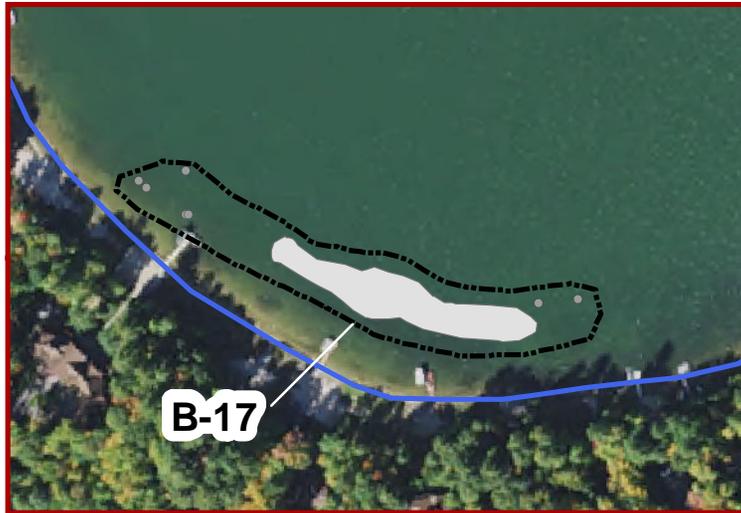
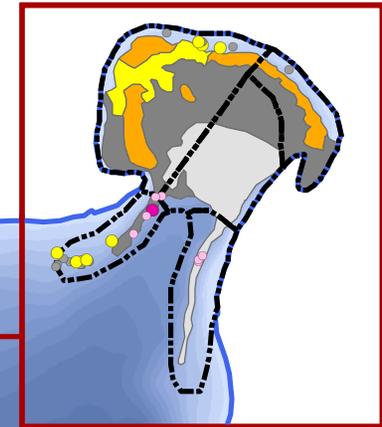
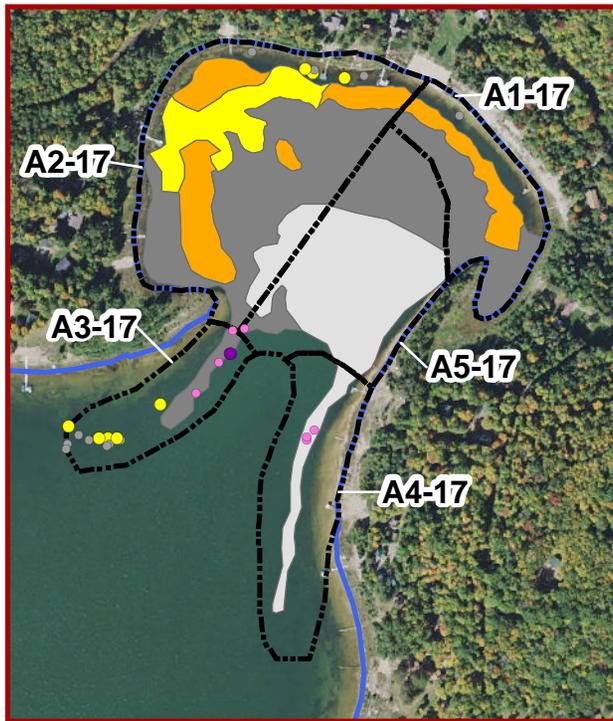
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Data: Roads and Hydro: WDNR  
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Aquatic Plants: Onterra Sept. 2016  
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Map Date: December 22, 2017



**Legend**

- Eurasian Watermilfoil**
- Highly Scattered
  - Scattered
  - Dominant
  - Highly Dominant
  - Surface Matting
  - Single or Few Plants
  - Clumps of Plants
  - Small Plant Colony
  - 2017 Final Hand-Harvest Area

Map 1  
**Anvil Lake**  
Vilas County, Wisconsin  
**Sept. 2016 EWM Locations  
& 2017 Hand-Harvest Areas**



2017 Final Control Strategy Professional Hand-Harvest (DASH)		
Site	Acres	Avg. Depth (feet)
<b>A-17</b>	<b>33.8</b>	<b>8.5</b>
A1-17	4.5	7.0
A2-17	13.1	8.5
A3-17	3.2	8.0
A4-17	5.4	11.0
A5-17	7.6	8.0
<b>B-17</b>	<b>1.7</b>	<b>8.0</b>
<b>Total</b>	<b>35.5</b>	



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Sources:  
 Data: Roads and Hydro: WDNR  
 Bathymetry: Onterra 2014  
 Aquatic Plants: Onterra May 2017  
 File Name: Map2\_Anvil\_EWM\_May 17.mxd  
 Map Date: December 22, 2017

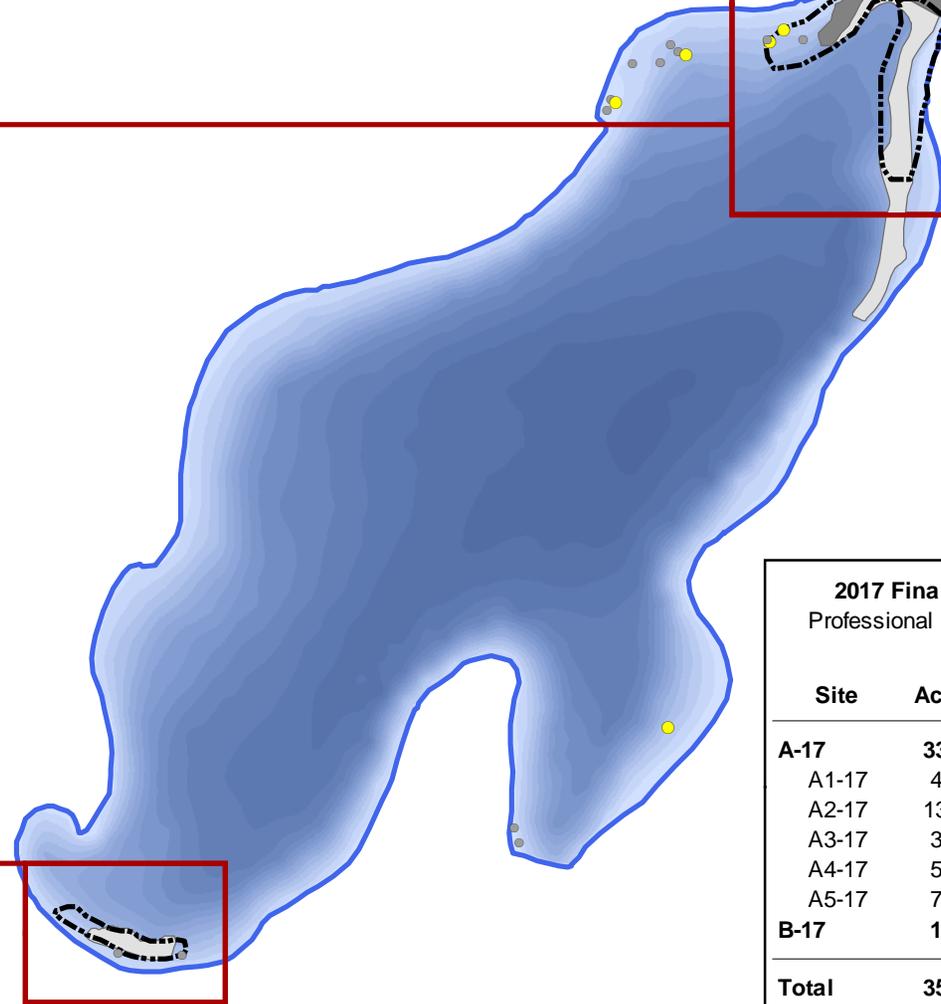
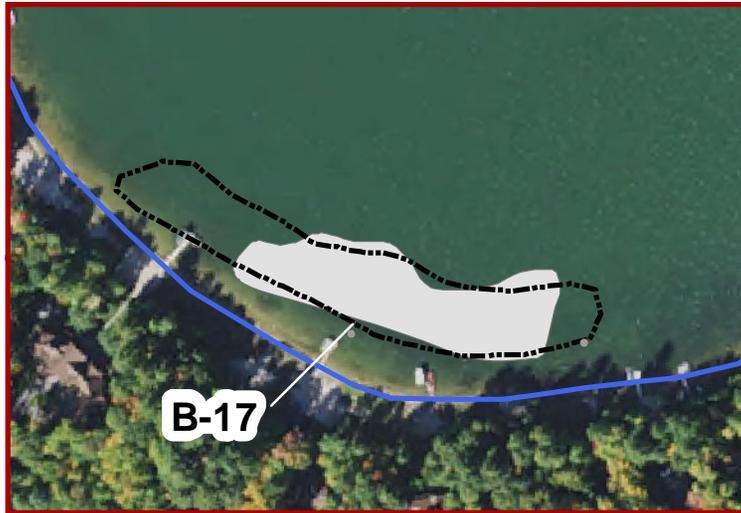
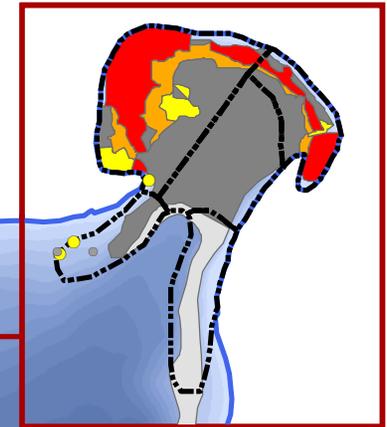
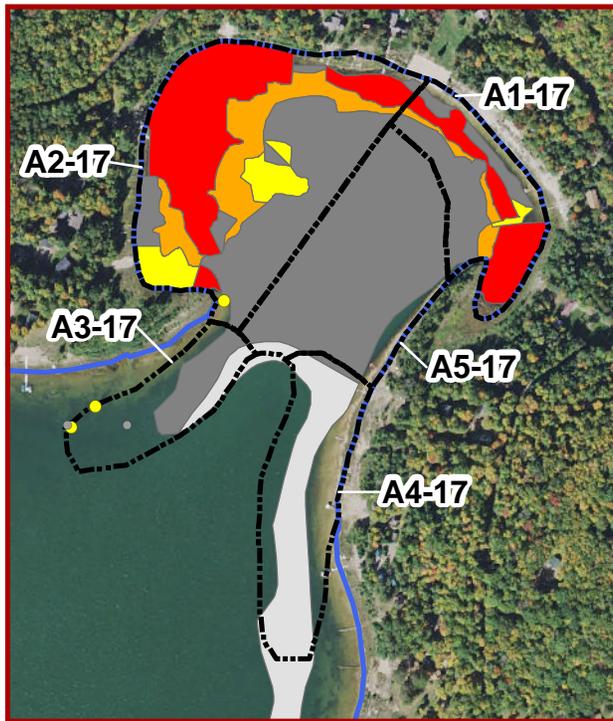


Project Location in Wisconsin

**Legend**

- |                  |                              |                      |
|------------------|------------------------------|----------------------|
| Highly Scattered | Single or Few Plants         | Single or Few Plants |
| Scattered        | Clumps of Plants             | Clumps of Plants     |
| Dominant         | Small Plant Colony           | Small Plant Colony   |
| Highly Dominant  | 2017 Final Hand-Harvest Area |                      |
| Surface Matting  |                              |                      |

Map 2  
 Anvil Lake  
 Vilas County, Wisconsin  
**May 2017 EWM & CLP  
 Locations & Hand-Harvest Areas**



2017 Final Control Strategy Professional Hand-Harvest (DASH)		
Site	Acres	Avg. Depth (feet)
<b>A-17</b>	<b>33.8</b>	<b>8.5</b>
A1-17	4.5	7.0
A2-17	13.1	8.5
A3-17	3.2	8.0
A4-17	5.4	11.0
A5-17	7.6	8.0
<b>B-17</b>	<b>1.7</b>	<b>8.0</b>
<b>Total</b>	<b>35.5</b>	



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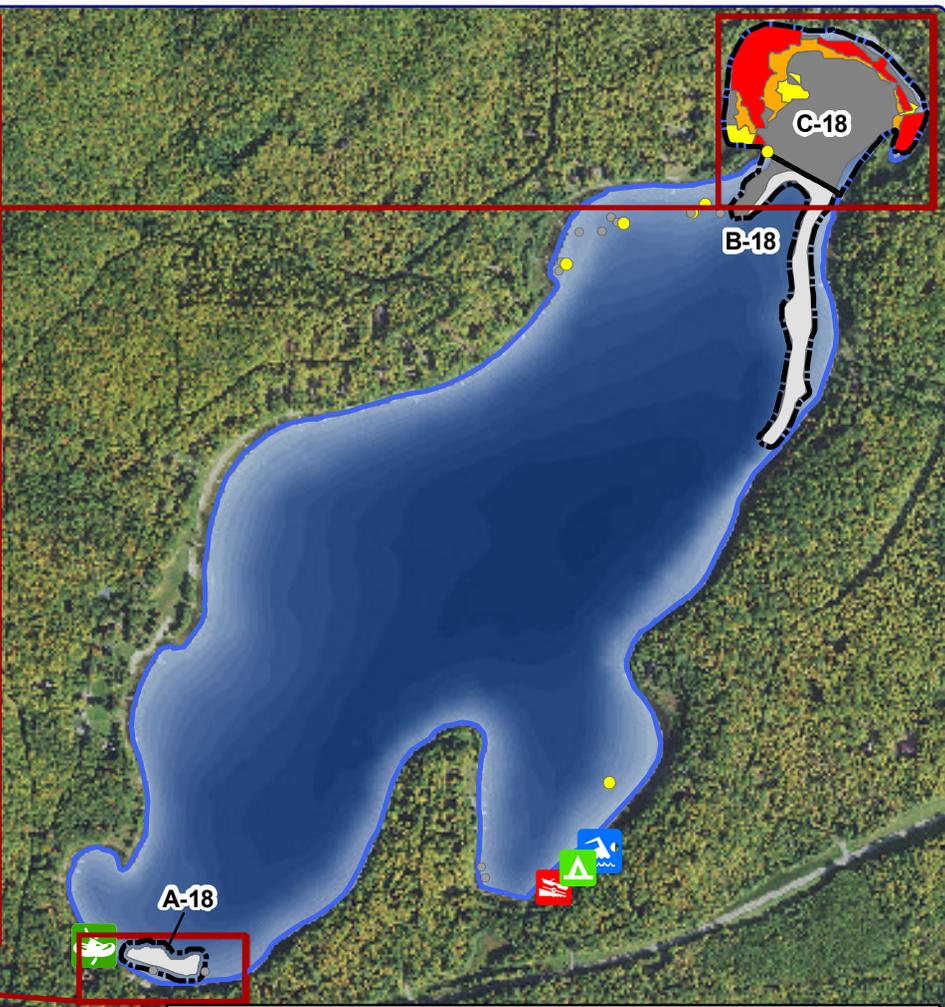
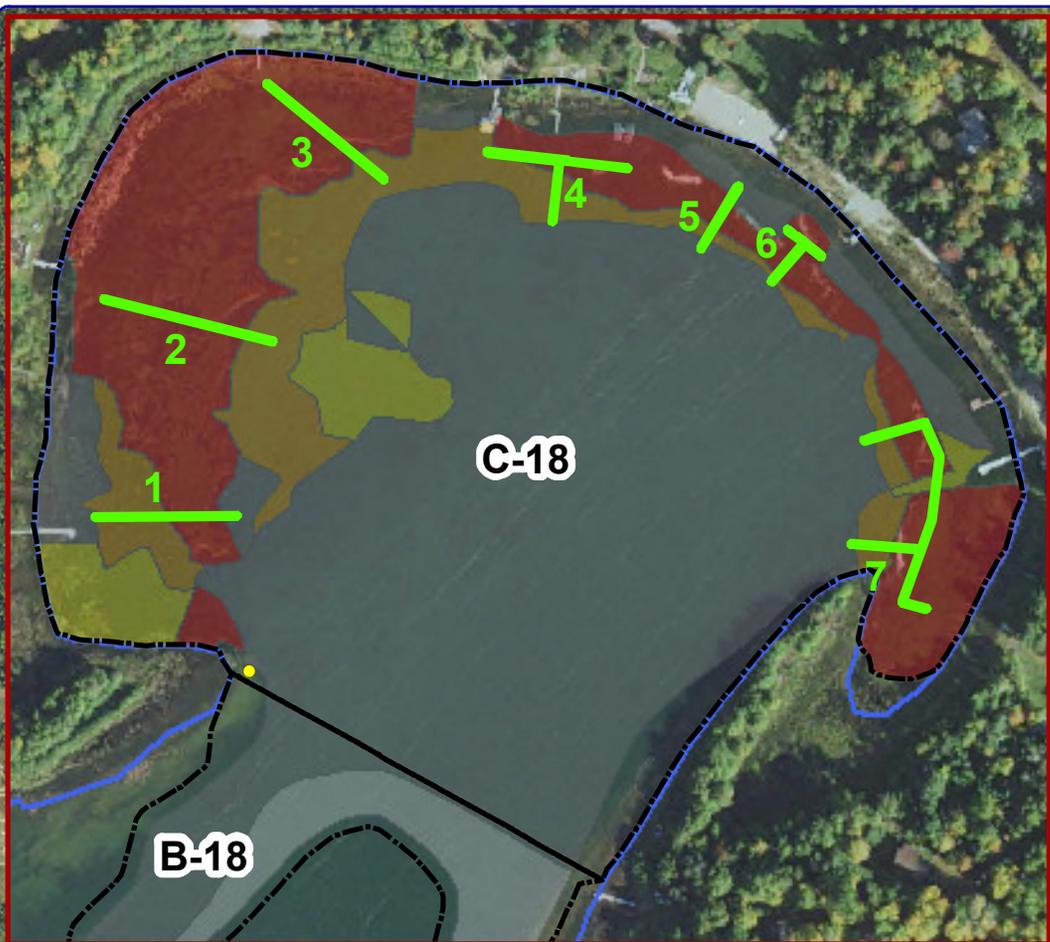
Sources:  
Data: Roads and Hydro: WDNR  
Bathymetry: Onterra 2014  
Aquatic Plants: Onterra Sept. 2017  
File Name: Map3\_Anvil\_EWM\_Sept17.mxd  
Map Date: December 22, 2017



### Legend

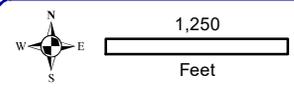
- |                  |                      |                              |
|------------------|----------------------|------------------------------|
| Highly Scattered | Single or Few Plants | 2017 Final Hand-Harvest Area |
| Scattered        | Clumps of Plants     |                              |
| Dominant         | Small Plant Colony   |                              |
| Highly Dominant  |                      |                              |
| Surface Matting  |                      |                              |

Map 3  
Anvil Lake  
Vilas County, Wisconsin  
**Sept. 2017 EWM Locations  
& Hand-Harvest Areas**



**2018 Preliminary Control Strategy: DASH Hand-Harvest**

Site	Priority after Nav. Lanes	Preliminary Acres	Ave Depth (feet)	Sediment	Obstructions
A-18	1 <sup>st</sup>	2.4	7 (3-12)	Organic	No Physical, Low Density Native Plants
B-18	2 <sup>nd</sup>	9.0	9 (4-14)	Heavy Organic, Sandier Near Shore	No Physical, Heavy Native Plants Later in Growing Season
C-18	3 <sup>rd</sup>	24.7	8 (2-14)	Heavy Organic, Sandier Near Shore	No Physical, Heavy Native Plants Later in Growing Season
<b>Total</b>		<b>36.1</b>			



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Sources:  
 Data: Roads and Hydro: WDNR  
 Bathymetry: Onterra 2014  
 Aquatic Plants: Onterra Sept. 2017  
 File Name: Map4\_Anvil\_2018\_DASH.mxd BTB  
 Map Date: March 20, 2018



- Eurasian Watermilfoil (Sept. 2017)**
- Highly Scattered
  - Scattered
  - Dominant
  - Highly Dominant
  - Surface Matting
  - Single or Few Plants
  - Clumps of Plants
  - Small Plant Colony

- Legend**
- 2018 Preliminary DASH Hand-Harvest Area
  - 2018 DASH Navigation Lanes (15' wide; 0.6 acres)

Map 4  
 Anvil Lake  
 Vilas County, Wisconsin  
**2018 Preliminary Control Strategy v.1**

# A

## APPENDIX A

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**2017 Eurasian Watermilfoil Harvest Report – Submitted by the ALA**

# **2017 Eurasian Watermilfoil Harvest Report**

## **Anvil Lake Association**

Submitted to:

Anvil Lakes Association and Wisconsin Department of Natural Resources

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Submitted by:

Gene Welhoefer

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November 5, 2017

## **Introduction:**

The Anvil Lake Association invested in the components to build a Diver Assisted Suction Harvesting (DASH) unit for use on Anvil Lake in 2016. This summer was the first summer the DASH was available for the entire summer. The DASH unit was used to manage Eurasian watermilfoil (EWM) in the North Bay of the lake and other approved areas. A permit was granted to the Anvil Lake Association on June 2017 by the Wisconsin Department of Natural Resources to allow mechanical harvesting on 12 acres in the north bay of the lake and other selected areas. The DASH unit remained on Anvil Lake for the harvest season.

## **Dive Methods:**

The divers have had several years of experience hand-harvesting EWM from Anvil Lake. Three main divers utilized the unit during the 2017 harvest season. During harvest, one or two people were present on the DASH boat deck to handle the boat duties and bagging system. The addition of the DASH unit has improved the efficiency of EWM removal from the North Bay. To begin the work with the DASH unit a general overall plan was developed to work along the entrance of the bay in a general depth of 7-10 feet and other areas where clusters were present. The approach allowed the harvest team to work one area from a fixed beginning point and systematically move from that location. Additional sites, outside this depth, were determined based upon identification of emergent plants. In general, the boat was anchored in one location and the diver was able to harvest within the 50-foot radius of the boat during one harvest session.

The DASH unit was most effective in areas when the EWM was concentrated. In these locations the divers were able to hover above the plants or descend to the lakebed to remove the EWM plant and root. The mass was then feed through the suction hose and into the bagging system located on the DASH pontoon boat. The plants were either fed into the suction hose by the root ball or top of the plant. The plant moves through the suction hose and is "caught" in bags. The bagging system used 40-pound mesh bags, typically sold for storage of onions or potatoes. The boat is designed to allow for the discharge hose to be pivoted between two mesh bags. When one bags is filled the discharge hose is pivoted to the second bag. While the second bag is being filled the full bag is tied, remove from the stand, and moved to a storage section of the pontoon. An empty bag is place in the collection station. This process continues throughout harvest. During the harvest a sample bags is used to determine the quality of the harvest. This sample is weighed, and separated into EWM and non-EWM material. At the end of the harvest day, the bags are removed from the DASH pontoon and loaded on a trailer. The collected materials are taken to a local farmer who is testing the application of EWM as a source of fertilizer.

## **Harvest Summary:**

A total of 129 hours were clocked on the water utilizing the DASH unit. During this time the divers removed approximately 23,740 pounds of EWM. The harvest sample indicated the overall season percent harvest of EWM to be near 95%. Two harvest data logs are attached to the report.



## Anvil Land DASH Harvest Data

Date	Location	GPS Waypoints	Dive Time hrs.	EWM (lbs)	Native Vegetation (lbs)	Incidental Harvest of Native Vegetation	Total Harvest (lbs)	Local Conditions Temperature, Wind Waves, Depth, Water Clarity
6/2/17	A2-17	N45-57.056; S89-03.393	12		SAMPLE	0		Water 60; Air 77; light breeze; full sun
7/5/17	>	N45° 57.074'	4					Water 70° Air 70° overcast windy
"	>	W 089° 03, 406'						
7/6/17	>	N45° 57.041'	4					Water 70° Air 66° overcast calm
		W 089° 03 379'						
7/10/17	>	N45° 57 057'	4					Water 73° Air 75° calm
		W 089° 03.380'						
7/12/17	-	N45.935443 W 89.07237	3				60 lbs	Sunny Breezy Air water
7/24/17		N45.93541 W 89.073206	3				90 lbs	sunny, calm water air
7/24/17	AM	N45.936253 W 89.074387	4				90 lbs	sunny, calm, water air
7/24/17	PM	N45° 56.124' W 89° 04.302'						" " " "
7/31/17	AM	N45 57 056 W 089 03 410	4					Sunny calm 75° Water
8/5		samples 7/21	3				70 lbs	Partly sunny calm 75°
8/12	PM	Hedges & Ginnels	3				75 lbs	Partly sunny slight breeze, 10' good clarity
8/23	AM	N45° 57 083 W 89° 03 440 N 94.57 150	3	399		21	420	PARTLY CLOUDY, 65°, 10-15 W, no
8/28	9AM	W 089-03, 267	3	504.5		56.0	560.5	CLOUDY 65, WIND

HARVEST

