INTRODUCTION

The Big Sand Lake Property Owners Association (BSLPOA) successfully applied for an Aquatic Invasive Species (AIS) Control Grant in February of 2010 to control Eurasian water milfoil (EWM) in 2010 and 2011. Due to a level of high success in 2010, a smaller than expected 2011 treatment allowed for remaining funds to be used in 2012. This report discusses the monitoring and events that unfolded around the 2012 spring EWM herbicide treatment. Additional information regarding previous treatments may be found in those respective reports.

Following the 2011 peak-biomass survey, a conditional treatment permit map was created proposing 9.8 acres of treatment in 2012 (Map 1). The large-scale treatment conducted in 2010 was shown to be extremely successful, with EWM decreasing in occurrence by over 90% within the lake based upon whole-lake point-intercept survey data. To continue the success of reducing EWM on Big Sand Lake, spot-treatments of remaining EWM colonies were conducted in 2011 and proposed for 2012. The 2012 treatment was proposed to be completed using a liquid formulation of 2,4-D at a concentration of 3.0 ppm ae. On May 2, 2012, Onterra staff visited Big Sand Lake to survey the proposed treatment areas and refine their boundaries. During the survey, a temperature, dissolved oxygen, and pH profile was collected in approximately 30 feet of water due south of the boat landing. The surface water temperature was around 52°F with a pH of 8.2 at mid-depth (Figure 1).

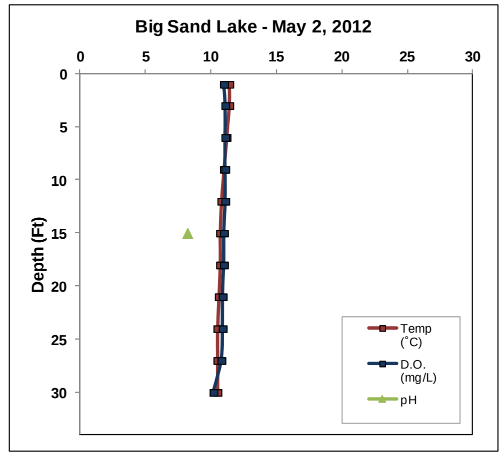


Figure 1. Temperature, dissolved oxygen, and pH profile on Big Sand Lake. .

Due to an expanding population found between sites B-12 and C-12, these two treatment areas were merged together. Additionally, new growth was observed along the shoreline at location G-12, so this site was added to the 2012 treatment strategy (Map 1). A final strategy of 12.3 acres was approved by the BSLPOA and Wisconsin Department of Natural Resources (WDNR). On May 18, 2012, the final treatment areas were treated with liquid 2,4-D by Clean Lakes Inc. Using a hand-held meter, the applicator reported an ambient air temperature of 78°F and south winds at approximately 9.8 miles per hour at the time of application. Clean Lakes, Inc. conducted the treatment using their LittLine® NextGen Technology – an application system that reportedly minimizes herbicide diffusion by delivering the herbicide closer to the target plant's root system where plant biomass is greatest.

2012 TREATMENT MONITORING

The objective of an herbicide treatment strategy is to maximize target species (EWM) mortality while minimizing impacts to valuable native aquatic plant species. Monitoring herbicide treatments and defining their success incorporates both quantitative and qualitative methods. As the name suggests, quantitative monitoring involves comparing number data (or quantities) such as plant frequency of occurrence before and after the control strategy is implemented. Quantitative evaluation methodologies follow WDNR protocols in which point-intercept data are collected within treatment areas both the summer before and the summer immediately following the treatments take place. Due to the small amount of treatment acreage, no quantitative analysis was able to be conducted on Big Sand Lake in 2012.

Qualitative monitoring is completed by comparing visual data such as EWM colony density ratings before and after the treatments. Using sub-mater GPS technology, EWM locations are mapped each year during the late-summer when this plant is at its peak-biomass and/or had a chance to rebound following an early-spring herbicide treatment. EWM populations are mapped lake-wide by using either 1) point-based or 2) area-based methodologies. Large colonies over 40 feet in diameter are mapped using polygons (areas) and are qualitatively attributed a density rating based upon a 5-tiered scale from *Highly Scattered* to *Surface Matting*. Point-based techniques are applied to EWM locations that are considered as small colonies (< 40 feet in diameter), clumps of plants, or single/few plants.

Qualitative monitoring of herbicide treatments includes comparing spatial data reflecting EWM locations and densities in late-summer, prior to, and immediately following the treatment when the plant is assumed to be at or near its peak growth. Comparisons of the survey results are used to qualitatively evaluate the herbicide treatment on Big Sand Lake. Qualitatively, a successful treatment on a particular area would include a reduction of EWM density as demonstrated by a decrease in density rating (e.g. highly dominant to dominant). In terms of a treatment as a whole (lake-wide), at least 75% of the acreage treated that year would decrease by one level of density as described above for an individual site.

2012 TREATMENT RESULTS

Post treatment surveys were completed by Onterra on September 5, 2012. Map 2 shows the results of the mid-September 2012 peak-biomass survey. Mixed results were obtained from the 2012 treatment, as determined from a pre and post assessment of the treatment areas. Sites such as A-12, D-12 and G-12 were successfully treated based upon the pre-determined qualitative success criteria (a reduction in EWM by one density level). Roughly half of the acreage of B-12 displayed a reduction in density, while the other half of the site still contained dominant and highly dominant EWM as it had the previous summer (2011). Sites E-12 and F-12 were not treated successfully, as E-12 contained denser EWM than it had the previous summer and the density within F-12 remained the same. Overall, the lake-wide success criteria of 75% of the treated acres experiencing a reduction was not met, as slightly over 50% of these acres were shown to be reduced in density.

2013 TREATMENT STRATEGY

While it was understood that eradication of EWM from Big Sand Lake was highly unlikely, those involved, including the association, WDNR, Onterra, and the applicator, were anticipating greater EWM impacts from the 2012 treatment strategy. Some of this may be attributed to the exceptional growing conditions Wisconsin lakes experienced in 2012. An early ice-off, followed by a very warm summer provided ideal conditions for EWM (and native aquatic plant) growth. These conditions are believed to be what helped EWM rebound in numerous other areas of the lake, as depicted in Map 2. The 2012 peak-biomass survey results indicated that numerous areas within the Big Sand Lake littoral zone contain EWM, either as single plants, clumps, or in a colonized form.

Factors such as water depth, water flow, treatment area size, and plant density work to dilute herbicide concentration within aquatic systems. Understanding concentration-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, largely as a result of a joint research project between the WDNR and US Army Corps of Engineers (USACE). Based on their preliminary 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 (of the 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 whole-lake treatments is dictated by the volume of water in which the herbicide will reach equilibrium with. Because exposure time is so much greater, target herbicide levels for whole-lake treatments are significantly less than for spot treatments. This was the strategy that was utilized on Big Sand Lake in 2010. Whole-lake treatments are typically conducted when the target plant is spread throughout much of the lake.

Spot treatments are a type of control strategy where the herbicide is applied to a specific area (treatment site) such that when it dilutes from that area, its concentrations are insufficient to cause significant effects 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 is the strategy that was implemented in 2011 and 2012 on Big Sand Lake. A newly adopted term, micro-treatments are small spot treatments (working definition is less than 5 acres) and because of their small size, the herbicide dilutes from these sites so fast that they are very difficult to predict whether they will be effective, and most of the time they are not. Larger and broader treatment areas tend to be able to hold effective concentrations for a longer time.

Some rebound of EWM following the 2010 large-scale treatment was expected, and this is what was observed in 2011 and then again in 2012 (Map 2). During the winter of 2012/2013, Onterra staff proposed several EWM treatment scenarios to BSLPOA members. The options presented included:

- **Conduct another whole-lake treatment in 2013 –** EWM control has been demonstrated on Big Sand Lake utilizing this technique, but there likely isn’t sufficient EWM in the lake to justify such an all-encompassing treatment strategy.

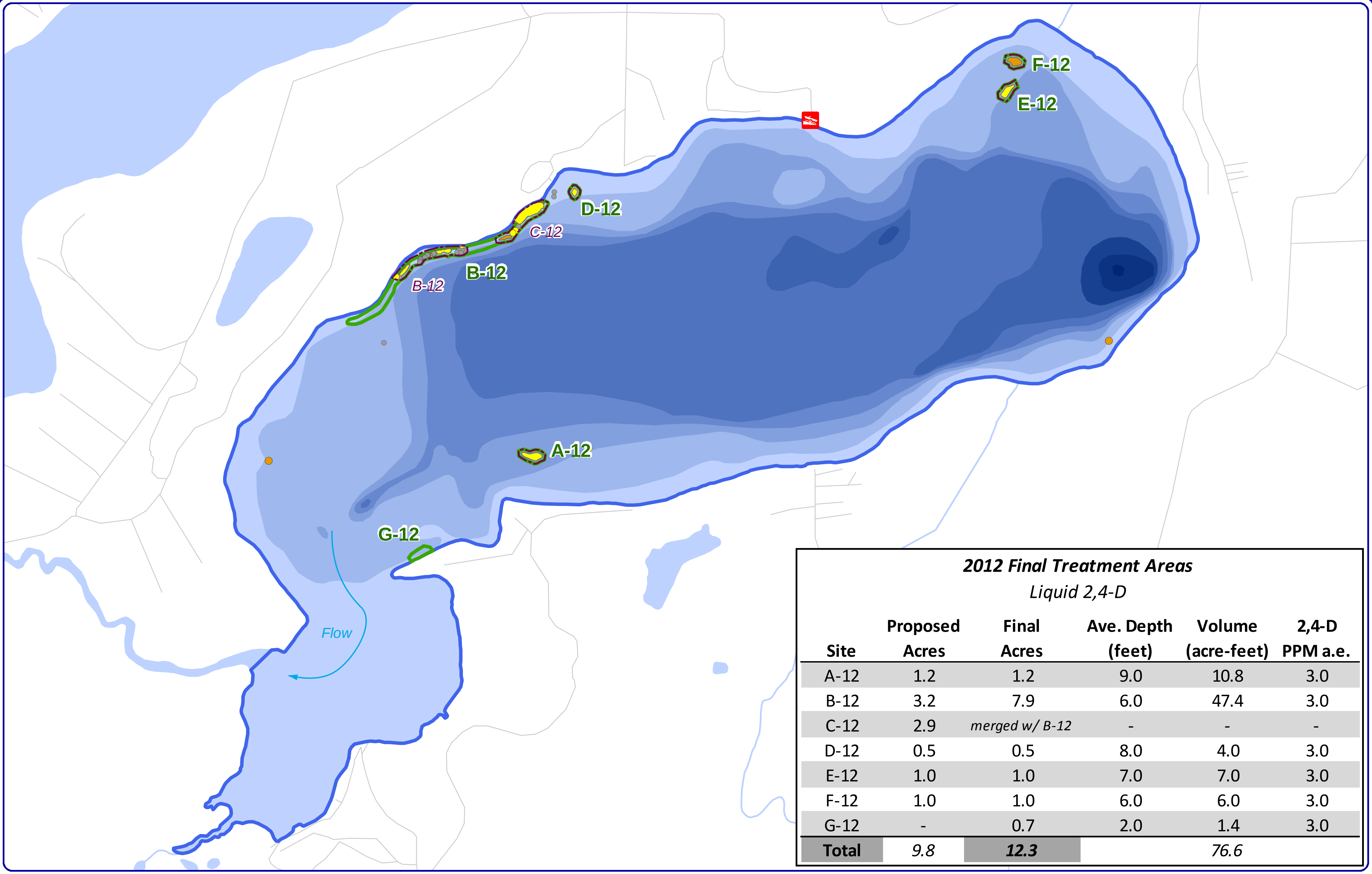
- **No Treatment in 2013, continue monitoring EWM Population –** The EWM population on Big Sand Lake has been significantly reduced over the course of the multi-year project. There probably isn’t enough EWM to warrant another whole-lake treatment (bullet point above). Furthermore, there are some concerns that the small-scale spot treatment may be ineffective due to rapid dilution (bullet point below). For these reasons, it may be appropriate to not conduct a treatment in 2013. Obviously there are concerns that this option might allow the EWM to regain a foothold in the lake – but the EWM population may stay the same or spread slowly. Perhaps the initiation of a whole-lake treatment strategy in 2014 or 2015 when the EWM population expands and gets slightly denser may be a viable management strategy at that time.

- **Conduct a spot treatment targeting the colonized areas of EWM in 2013 –** Unlike the whole-lake treatment strategy that relies on a low-dose liquid 2,4-D application to be sustained for a long period of time, this spot-treatment strategy would target specific EWM colonies with a high dose of 2,4-D. If all the colonized areas of EWM are targeted for control, including a 40-foot buffer around the mapped polygons, this would total approximately 70 acres (425 acre-feet) and cost around $37,000-$40,000. Because a spot treatment of approximately 70 acres is relatively large compared to the area of the lake, there would be some whole-lake implications (0.087 ppm ae), but at less than a third the levels if a whole-lake strategy is planned. Some concerns exist regarding the small size and narrow shape of many of the potential treatment sites and that the herbicide may move off site too quickly to provide EWM control.

The EWM population is currently at a low level and is not causing ecological or recreational issues; therefore, the long-term AIS control goals of Big Sand Lake are not in jeopardy if an herbicide treatment is not conducted in 2013. While Onterra does not have strong opposition to the BSLPOA moving forward with a spot treatment in 2013, it is believed that the lake group would be better served if they postponed conducting a treatment in 2013. Continued monitoring of the EWM population is recommended. Based upon the results of a 2013 late-summer EWM survey on Big Sand Lake, a control strategy may be developed for 2014 that could include implementation of a whole-lake treatment strategy such as was successfully conducted in 2010.

In order to properly monitor the success (EWM control) and selectivity (native plant impacts) of a whole-lake treatment, a lake-wide point-intercept survey needs to occur during the late-summer of the year prior to the treatment being conducted (pretreatment) as well as the late-summer following the treatment (post treatment). The 2013 EWM density-based mapping should occur in early August, with a map of the survey results being provided to the BSLPOA by mid August. Based upon those results, the BSLPOA should decide whether or not to move forward with planning a whole-lake treatment strategy for 2014. If that strategy is decided upon a lake-wide point-intercept survey must be completed before the end of August 2013. This is obviously, a tight schedule. The BSLPOA may also need to seek additional WDNR funds during the February 2014 grant cycle to dovetail with the funds remaining from their current grant to cover additional treatment and monitoring costs brought on by extending the project to include the potential 2014 whole-lake treatment.

At some point in the near future (likely starting in 2014), the BSLPOA needs to consider updating its lake management plan to reflect the success and limitations learned. Along with establishing new thresholds (triggers) of when specific herbicide treatment strategies warrant implementation, the lake management planning process could include a holistic understanding of the Big Sand Lake ecosystem involving assessments of the water quality, watershed, shoreline condition, and stakeholder perceptions of Big Sand Lake.



2012 Final Treatment Areas

Liquid 2,4-D

Site	Proposed Acres	Final Acres	Ave. Depth (feet)	Volume (acre-feet)	2,4-D PPM a.e.
A-12	1.2	1.2	9.0	10.8	3.0
B-12	3.2	7.9	6.0	47.4	3.0
C-12	2.9	*merged w/ B-12*	-	-	-
D-12	0.5	0.5	8.0	4.0	3.0
E-12	1.0	1.0	7.0	7.0	3.0
F-12	1.0	1.0	6.0	6.0	3.0
G-12	-	0.7	2.0	1.4	3.0
Total	*9.8*	***12.3***		*76.6*	

N W E S

1,800

Feet

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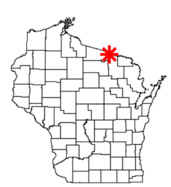
Sources:
Hydro and Roads: WDNR
Aquatic Plant Survey: Onterra, 2011-12
Map Date: May 3, 2012
Filename: Map1_BigSand_EWM_T2012.mxd



Project Location in Wisconsin

Legend

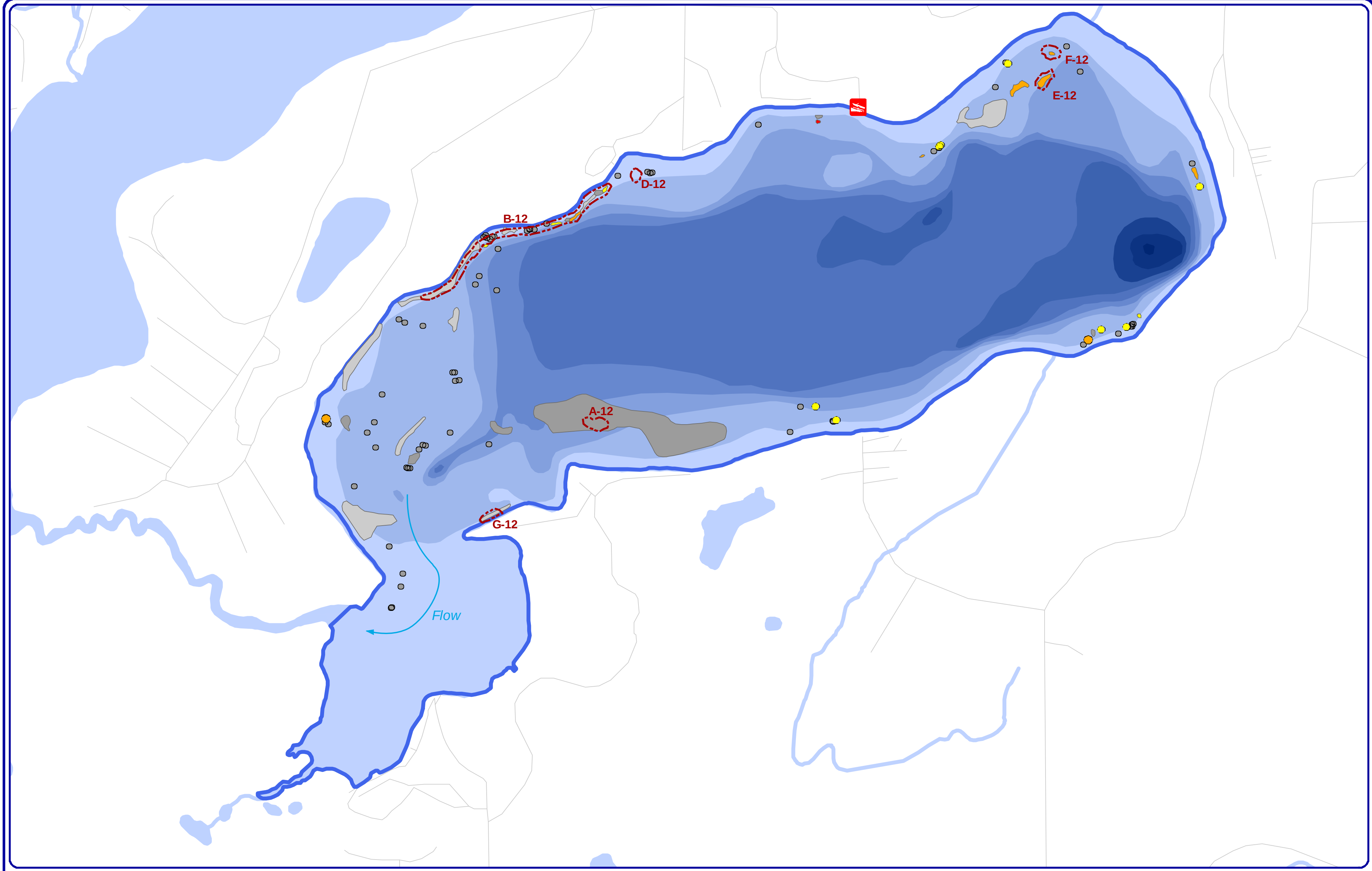
- Highly Scattered *(None)*
- Scattered *(None)*
- Dominant
- Highly Dominant
- Surface Matting *(None)*
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2011 Final Treatment Area
- 2012 Proposed Treatment Area

Map 1

Big Sand Lake

Vilas County, Wisconsin

2011 EWM Locations & 2012 Final Treatment Areas



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Feet

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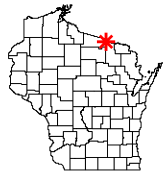
Sources:
Hydro and Roads: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plant Survey: Onterra, 2012
Map Date: October 4, 2012
Filename: Map2_BigSand_EWM_T2013_Cond1.mxd



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- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- 2012 Final Treatment Area

Map 2
Big Sand Lake
Vilas County, Wisconsin
2012 EWM Survey Results