2018 Big Lake
Aquatic Weed Control Program

Prepared for

Big Lake LMD #1
Skagit County Public Works
Mount Vernon, Washington

Prepared by

Northwest Aquatic Eco-Systems, Inc.
855 Trosper Road SW #108-313
Tumwater, Washington 98512
Pondweeds@comcast.net
Telephone: (360) 357-3285

December 2018

Project Overview

This was Northwest Aquatic Eco-Systems (NWAE) seventh year of providing aquatic weed control services for the Big Lake LMD #1 district. 2018 proved to be a disappointing year associated with submersed weed control activities. Macrophyte growth had not fully developed at the time of the initial treatment resulting in problematic areas of the lake surfacing late in the season. Low water levels also exposed problematic weed growth areas that typically would have remained submerged. Much of the past historical data included in the previous reports has been incorporated into the 2018 report. The basis for providing this past history is to present a brief historical timeline to interested parties in an effort to fully understand the past efforts and results. Big Lake has been actively involved for at least ten years with an intense program to eradicate noxious aquatic macrophytes from the system. Targeted species include Eurasian watermilfoil, Egeria densa (Brazilian elodea), Nymphaea odorata and yellow flag iris. Densities of Eurasian watermilfoil are currently limited to a few small infestations located along the southwest shoreline of the lake. These same locations have supported sporadic milfoil growth for a number of years. There has been no other milfoil sightings lake wide. As noxious weed species declined throughout the lake, native species have increased their range throughout the lake's littoral zone.

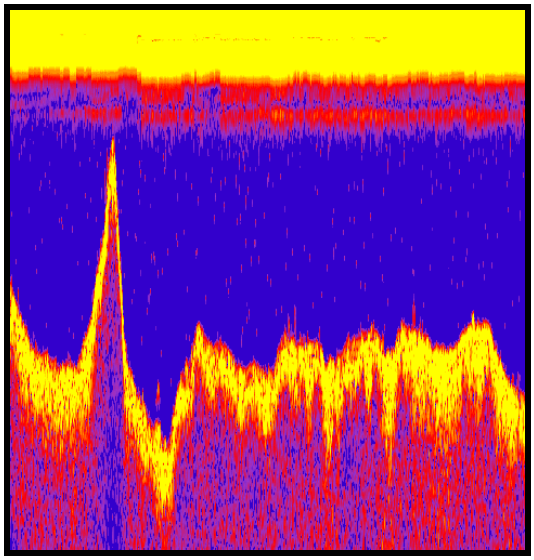
Prior to the 2016 treatment season, weed control activities had been limited to commence after July 15th based on the established fish timing window at that time. The shallow nature of the immediate shoreline area historically produced weed growth that typically reached the waters' surface prior to July 15th. This growth rendered some of those shoreline areas unacceptable during the early summer months of recreational lake use. In an effort to treat earlier, NWAE in conjunction with the LMD, petitioned the state to approve weed control activities to commence prior to July 15th. As a result of this effort the Department of Ecology granted a treatment window modification authorizing treatment after June 15th. This earlier treatment window does provide for a more seasonal friendly treatment schedule resulting in reduced weed associated problems during the early summer months. Depending on weather conditions and late summer favorable temperatures, regrowth within earlier targeted sites is possible.

Survey Protocol

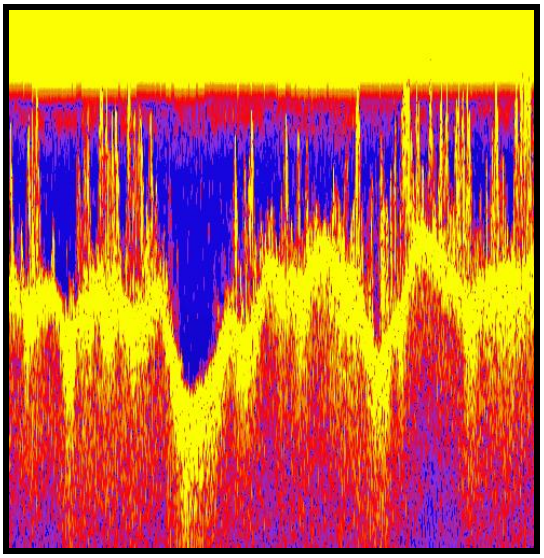
Survey techniques for 2018 once again utilized the new sonar mapping technology initiated during the 2013 treatment season. The current mapping protocol is now an industry standard utilized worldwide. Current mapping technology incorporates sonar technology with on board chart recording. Sonar data is collected on board and processed to produce an on-screen map of the lake bottom as the boat transects the lake. When weeds are no longer observed along the lake bottom, the collection of sonar data is terminated. Once collected, the SD card is uploaded via cloud based technology and the processing of the data is finalized. The resulting product is a color coded map of the lake bottom identifying weed growth areas and plant densities. Not only is a weel-defined map produced, but a sonar log of the survey is saved allowing a complete review and evaluation of the survey to occur in house. This updated protocol encompasses a surface

vehicle transecting the lake along the littoral zone. Boat tracks are designed to be approximately 100 feet apart. To ensure the efficacy of the survey, a bottom sampling rake is thrown from the boat at various locations lake-wide. The rake is then drawn across the lake bottom, brought to the surface and into the boat. Plants attached to the rake are identified and confirmed as being the same species as noted through the structure scan or visually through the water column. The system automatically calculates and stores the position of every transect data point enabling the mapping of thousands of data points on a daily basis.

When individual milfoil plants were identified from the surface, waypoints were added to the transect line.



Weed Free Lake Bottom



Dense Weed Growth Lake Bottom

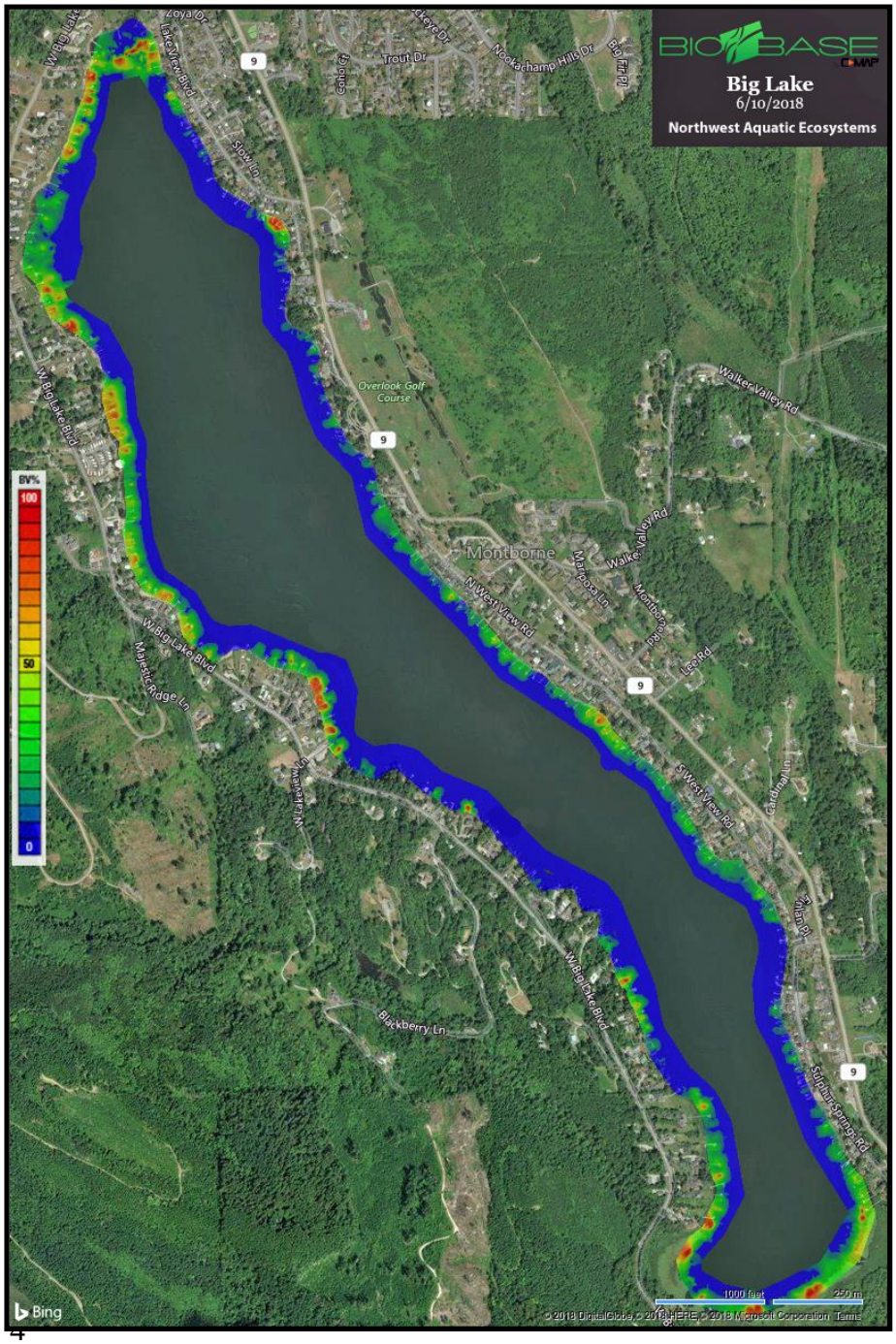
Weed Growth

Big Lake Pre-Treatment Survey Results

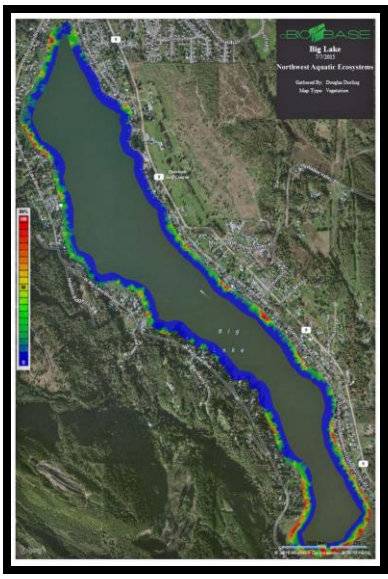
Big Lake was surveyed on June 10, 2018. This date is similar to the interval when the 2017 survey was undertaken. Weed growth was inconsistent from years past. Some lake areas that historically consisted of dense growth were lacking while other lake areas that typically supported decreased densities supported heavy growth. Macrophytes were still present in traditionally treated sections of the lake but not as dense as noted in prior years.

Water temperature fluctuations, lake levels and water clarity all have an impact as to when seed germination occurs and the rate of weed growth. Cooler early seasonal water temperatures impede timely lake wide seed germination often producing inconsistent weed growth. Reduced water clarity impacts the depth to which seeds will germinate. Favorable water clarity increases the depth in which seeds have the ability to germinate.

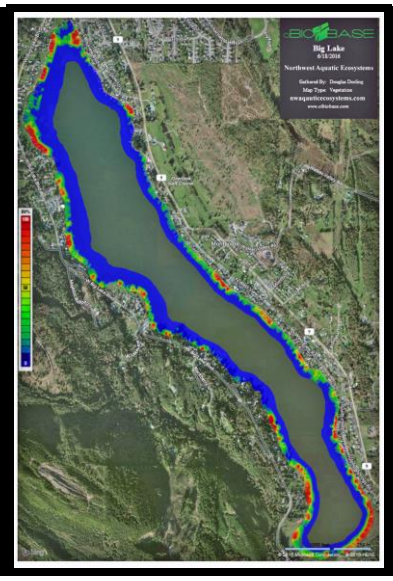
Weed species noted during the 2018 survey are similar to those identified in prior surveys. No new species were recognized. In general, Vallisineria americana, a ribbon like native species continues to be increasing in range throughout the lake proper. Vallisineria is a difficult expensive species to control. Other species noted during the survey include: minor occurrences of P. amplifolius, while most of the native growth included P. richardsonii, P. robbinsii, P. praelongus, P. foliosus and P. epihydrus. Problematic non-pondweed species included Elodea canadensis and Vallisineria americana. Different shoreline sections of the lake were dominated by dissimilar pondweed species.



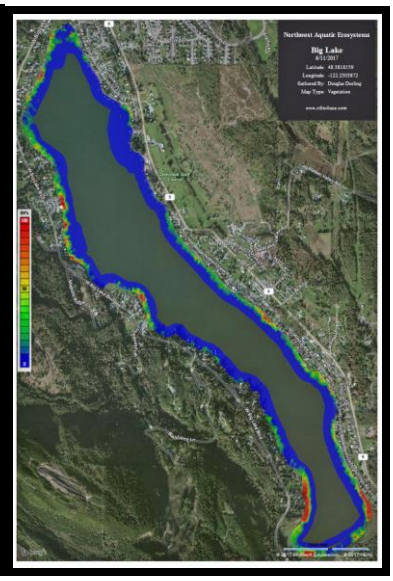
Northwest Aquatic Eco-Systems



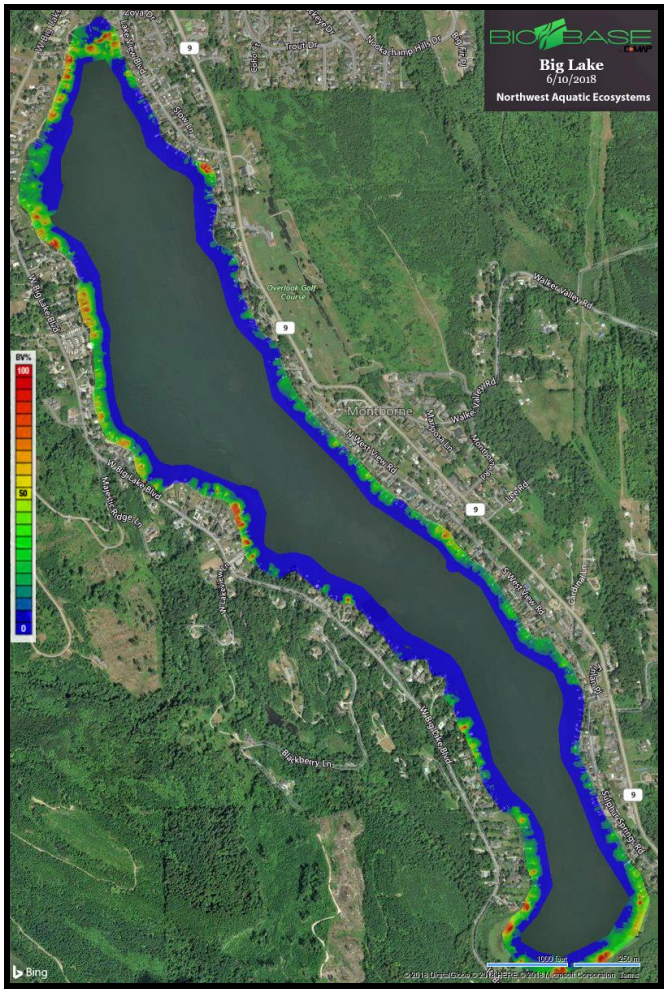
2015 Spring Survey



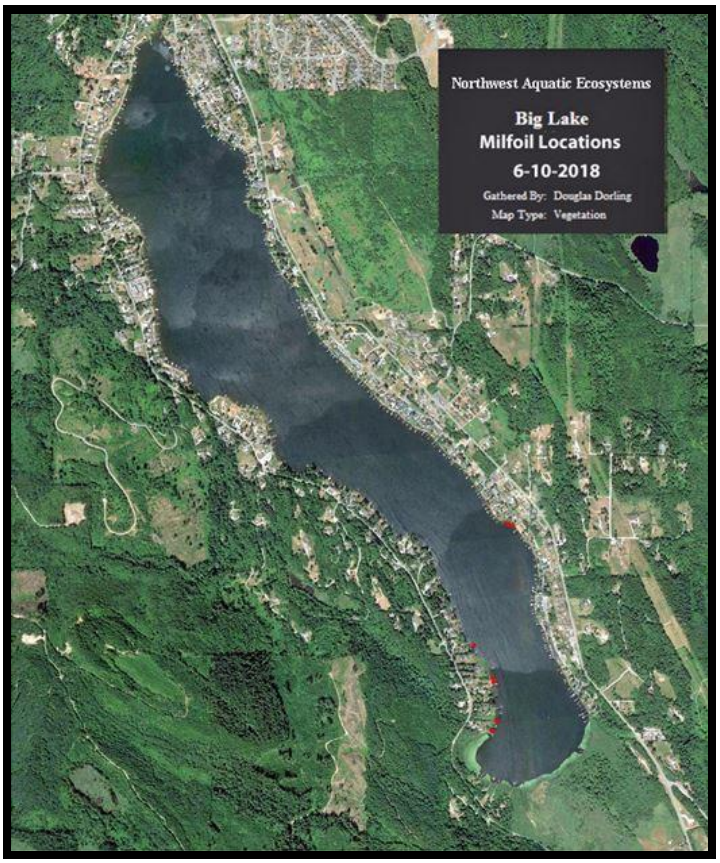
2016 Spring Survey



2017 Spring Survey



2018 Spring Survey



Milfoil Locations

July 11, 2018 Treatment

Under current NPDES guidelines, native macrophyte control is limited to no more than approximately 10,000 feet of the lake shoreline. Noxious weeds can be controlled lake wide having no impact on the 10,000 feet designated for native plant control.

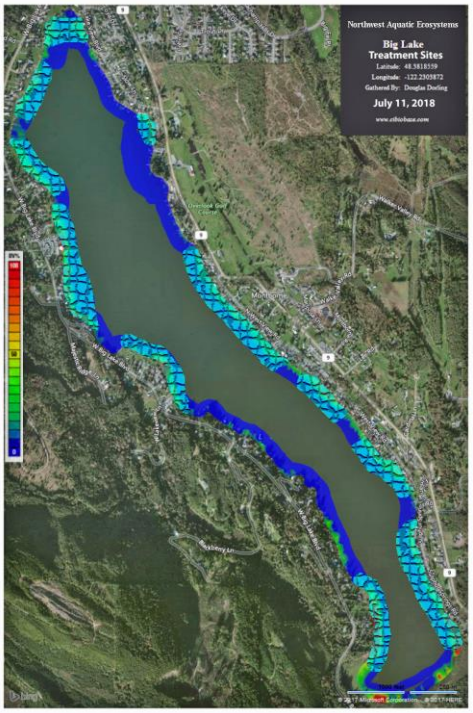
Our approach during 2018 was to continue to provide maximum coverage under the current NPDES guidelines. The 2018 treatment model was designed similar to the prior models expanding treatment outward from the shoreline. Continued use of Glyphosate, Aquathol K, Aquathol K granular, Diquat and Aquathol K/Diquat tank mixes. Recent studies indicate that once only recognized as a contact herbicide, Aquathol K has been found to exhibit systemic herbicide properties related to the ability of the active ingredient to be translocated to the root systems of targeted species. Past use of Aquathol K has increased the efficacy of treatments in those lake areas plagued with shallow rich organic muck bottoms. Although the use of Aquathol K increases material costs considerably, results justify product use. The use of a Diquat/Aquathol K mix is now an industry standard supported by the recent production of this same mixture under the trade name Strike.

Shoreline posting was conducted on July 10. A three person crew comprised of one watercraft completed the posting task within a 10 hour timeframe. Crew members were

off loaded along various sections of the shoreline and posting was completed near a majority of the dock shoreline interfaces. When crew members could no longer transverse the shoreline due to fences or other obstructions the member was picked up and transported beyond d the obstruction. Similar to past treatments the local newspaper was contacted addressing the upcoming treatment. The public boat launch was posted with a large sign requesting that no boating occur during the treatment. The boat launch signage was in place 24 hours prior to treatment. On the day of treatment new signage was posted at the boat launch displaying the areas of the lake that were targeted for treatment and the water restrictions associated with the treatment.

Material was offloaded from a locked container truck and transferred into two 25 gallon spray tanks mounted on the application boat. Containers were triple rinsed on site and returned empty back into the truck. Herbicides, diquat and Aquathol K, were applied utilizing an 18 foot Airgator airboat. Lake water was drawn into the boat through intake ports located in the hull of the boat. Herbicide was then metered into the lake water via an injection manifold. Once the herbicide was injected into the on-board lake water, the lake water/herbicide mixture was then discharged back into the lake. Weighted hoses were used to place the material at the appropriate depth in the water column.

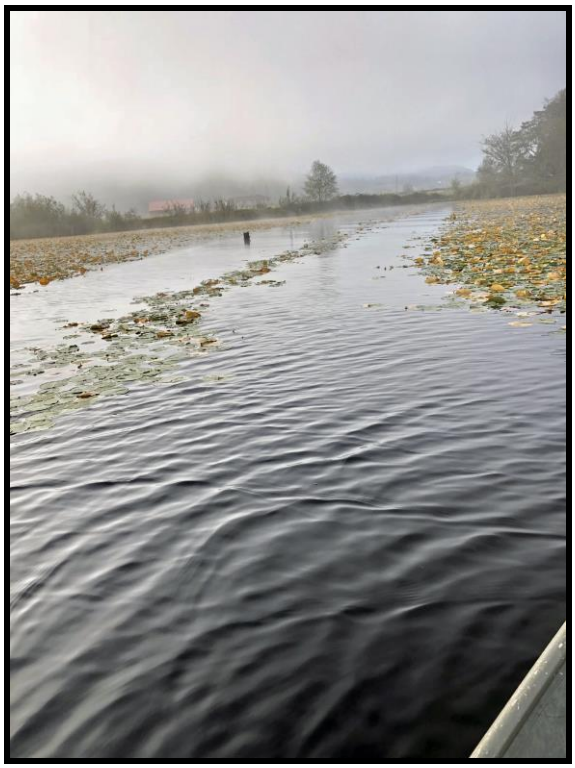
Prior to treatment, a lake treatment map, identifying treatment plots was downloaded into the onboard GPS system. The treatment boat utilized the onboard GPS to identify treatment site boundaries. All of the targeted submersed sites were treated on July 10. Submersed weeds were treated with Diquat at a rate of one to two gallons per surface acre. Aquathol K was applied at a five gallon per acre rate in a tank mix consisting of five gallons of Aquathol K and one - two gallons of diquat. Treatment sites were identical to those established during 2016 & 2017.



As the boat targeting the submersed weeds treated the designated sites, a second boat was then utilized to apply herbicide to the lily pad infestations. Weather conditions posed no problems throughout the day and permitted the entire basin to receive treatment for both lily pads and submersed weeds. For lily pad control, an 18 foot aluminum boat equipped with one 25 gallon spray tank was utilized during this spray event. Use of this smaller maneuverable boat permitted access to the entire lake shoreline. The 25 gallon tank was filled with lake water, herbicide and surfactant. Once mixed, the application boat drove along the shoreline identifying targeted floating plants. The spray mixture was then discharged using a spray gun. When emptied, the tank was refilled and the process was repeated until the entire lake shoreline was covered. Lily pads received a 1.0% solution of glyphosate sprayed directly onto the floating leaves. Similar areas treated during 2016 & 2017 received treatment again during 2018. Plant densities in most of the prior treatment sites have now been eliminated or reduced to considerably smaller patches consisting of only a few floating leaves. Three residents historically have requested no treatment. These same sites continued to receive no treatment.

Additional Lily Pad Treatment

During the 2018 season a new property owner located in the southeast portion of the lake contacted NWAE to have their parcel included in the lily pad control program. This parcel was sprayed twice during the 2018 season. Our approach was to provide to lanes of open water and expand outward in future years.



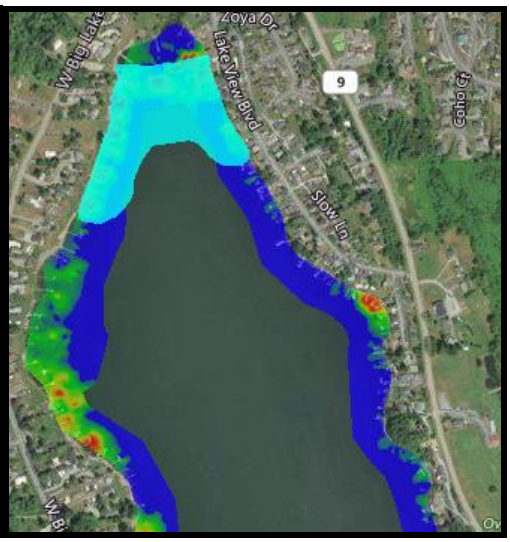
Completed Two Spray Events

New Site Location

August 27, 2018 Treatment

Approximately 15 acres of the extreme northern portion of the lake was treated to control pondweed growth that had surfaced as a result of regrowth and a low water level. The area was retreated with diquat. Posting of the shoreline was completed prior to treatment on the day of application. Notices stated that both submersed weed control with diquat and lily pad control with glyphosate would occur. Treatment consisted of subsurface injection for submersed weed control and surface spraying for floating plant control. In accordance with the NPDES permit issued for this site no subsurface spraying occurred within 400 feet of the outlet.

Buffer Zone



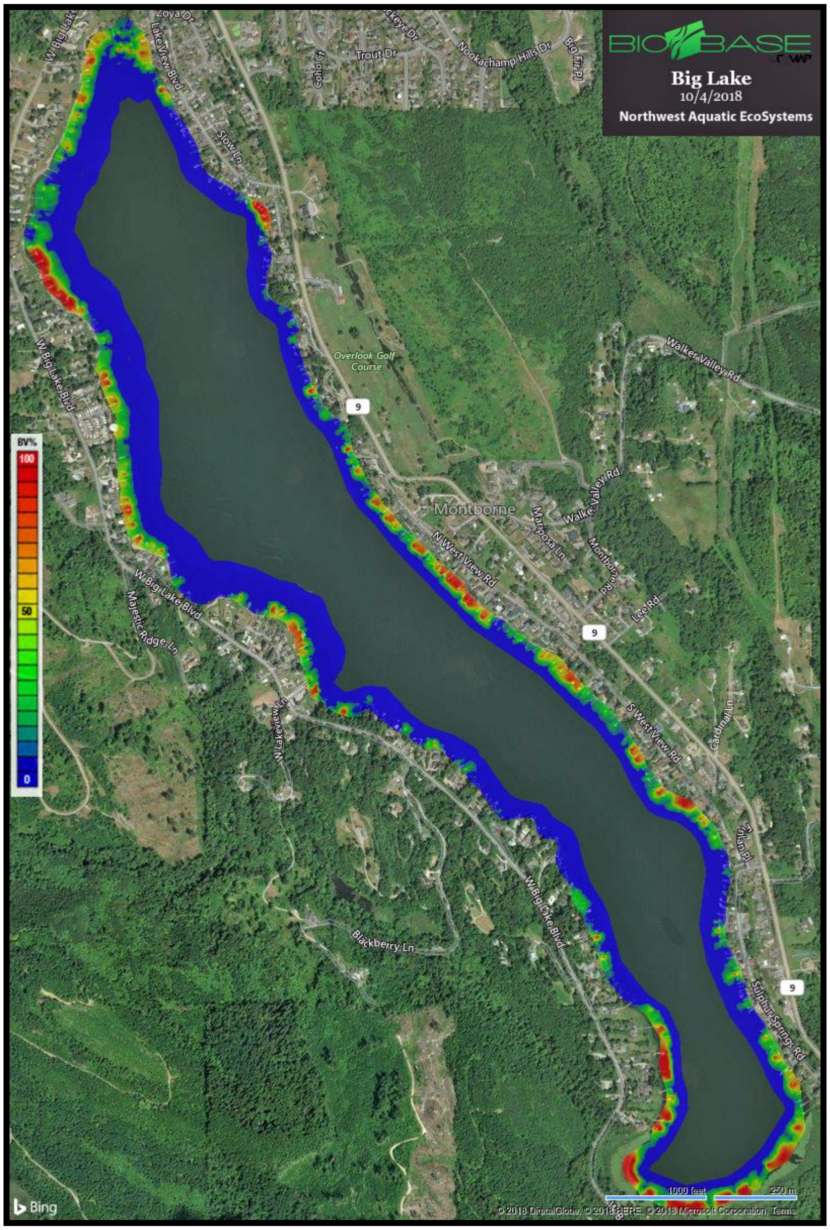
Spot Treatment 8-27-2018

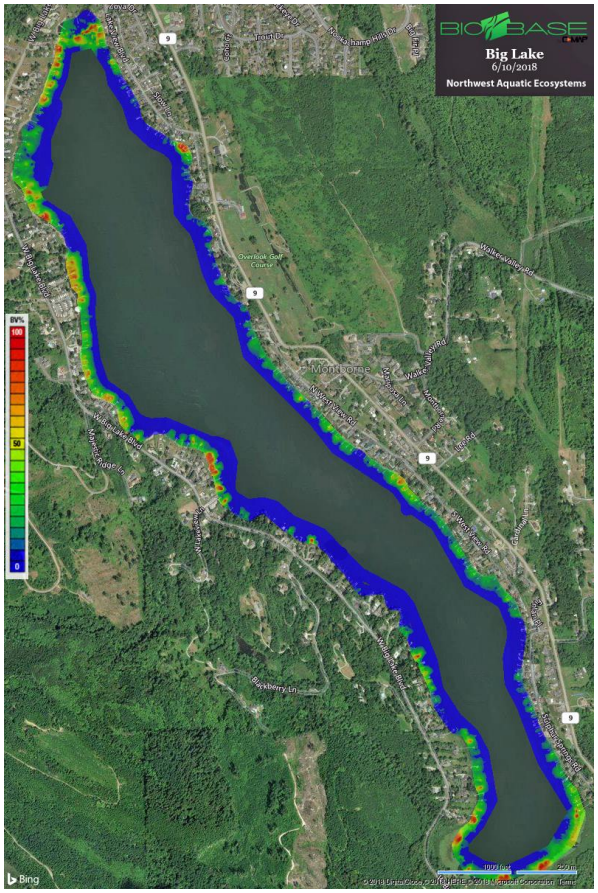
Fall Survey

Our fall survey was performed on October 4, 2018. Results were disappointing with many of the shoreline areas treated earlier in the year supporting plant densities similar to those noted prior to treatment. Some of the discrepancies can be attributed to the lower water level exposing a greater number of plants. Other growth related issues may be attributed to the water clarity. NWAE is unsure of the seasonal water clarity supported at the lake throughout the summer. On our visits to the lake during 2018, we did not observe the green floating algae scum observed in years past. Site appearances were limited in nature and scum presence typically noted in the past existed for a few days to weeks. It is possible that our visits missed the bloom events. As in prior years some of the areas experiencing native pondweed growth were also noted to support dense populations of filamentous algae (nitella) and eel grass. Nitella is a non-targeted plant while eel grass is a very difficult species to control.

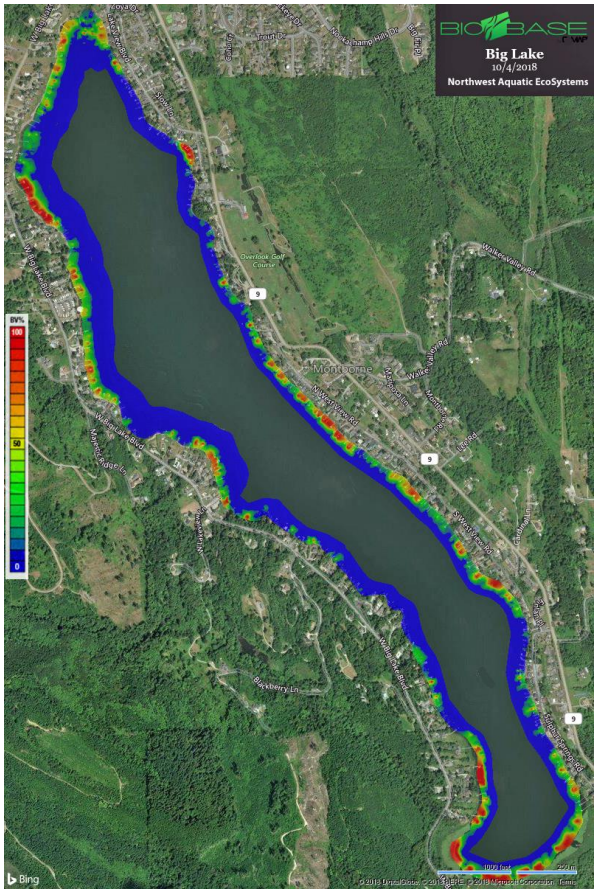
Lake water level had decreased considerably since the pre-treatment survey. Later in the season as water levels decline, macrophyte growth that normally would not prove to be problematic may produce recreational concerns. Survey results from these now shallower growth zones would exhibit different density characteristics from similar deeper water environments experienced earlier in the season.

Lily pad response to treatments during 2018 was once again noted lake-wide. As these patches diminish in size, the observable change is less pronounced. Pad density and size within these smaller infestations continue to decrease. Some of the individual plants were just manually removed. The ability of these smaller infestations to adequately maintain material on the pads' surface immediately following treatment becomes a difficult task.


BIOBASE
Big Lake
10/4/2018
Northwest Aquatic EcoSystems
BV%
100
50
0



Pre-Treatment 2018



Post Treatment 2018

Recommendations

1. Continue the expanded notification to the property owners and local residents through newspaper articles, radio and LMD notifications. Emphasis again needs to be directed at no lake use during the treatment.

2. Lily pad control operations should only be conducted during those hours when wind conditions are minimal. Patches consisting of only a few plants should be cut and removed by the property owners.

3. Noxious species appear to no longer represent the problematic species lake-wide. The range and location of milfoil plants have stabilized; not much expansion has been detected. Plants currently coexist in mixed stands of native species. Milfoil can now seasonally be controlled with either contact herbicides or specifically targeted with systemic materials. How these plants are controlled and what materials should be applied requires evaluation preceding the spring survey. Actions that may or may not be implemented will probably change on a year to year basis.

4. The spring survey should be considered the more important of the two scheduled surveys. This survey will determine what plants are targeted and what materials will

be used during any treatment year. With the now established earlier treatment window, an early August brief electronic inspection should be conducted to determine the need for a smaller late season secondary treatment.

5. A mid-season brief survey was not conducted during 2018 and resulted in poor shoreline weed control late in the season. As a result of the poor year end results noted during 2018, this survey needs to be considered a main component of future efforts. Completing this survey may result in additional late season treatment and expenses but likely will reduce problematic weed growth later in the season.

6. Late season comprehensive electronic summer survey will provide the necessary data and timeline to implement a secondary treatment.

7. Continue use of the contact herbicide Aquathol K. Use of the material has proved to be successful in controlling some pondweeds not susceptible to diquat. Use should also include tank mixes of both diquat and Aquathol K.

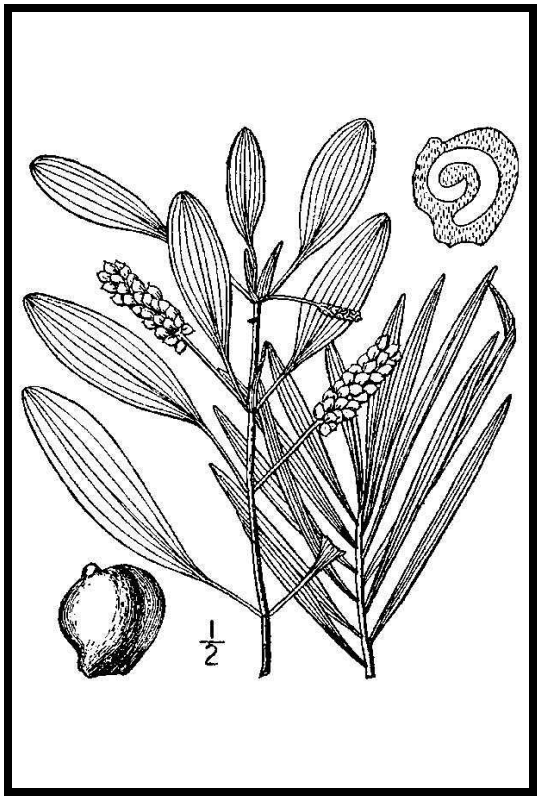
8. Continue use of the granular formulation of Aquathol K within the problematic shoreline area of the lake in conjunction with a late season spraying event within these immediate targeted zones.

9. Utilize a more concentrated Aquathol K mixture to control eel grass. Higher concentrations have been shown to be effective in other lakes throughout Washington State.

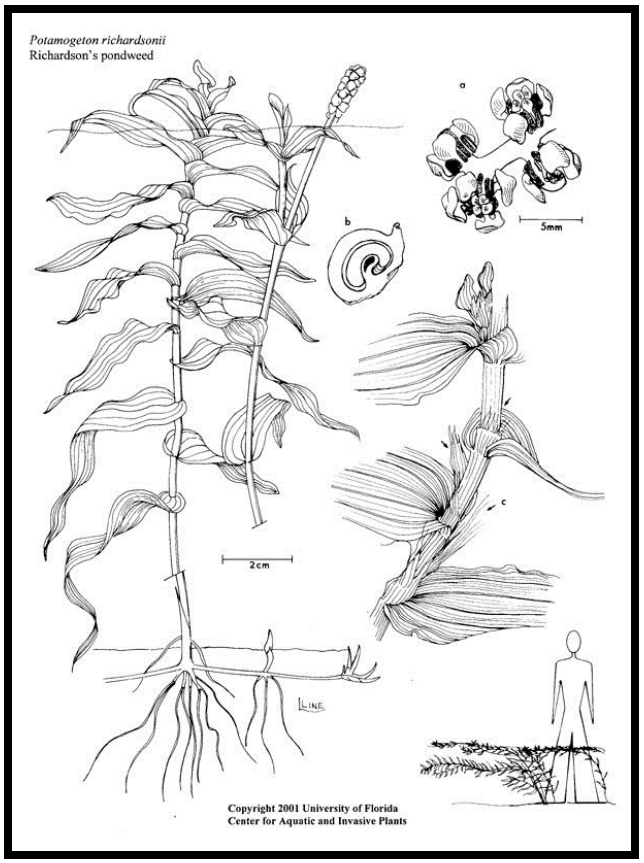
10. Continued use of the new mapping technology. This technology provides an excellent visual evaluation of weed conditions lake-wide. The resulting map can be understood by all users of the lake and requires no in-depth technical background for review. The technology also provides an exceelent reference to visually show a property owner if problematic weeds are present at their parcel.

11. Use knowledge and experience obtained during 2018 related to late seasonal weed growth patterns to fine tune future treatments using Aquathol K and diquat mixtures.

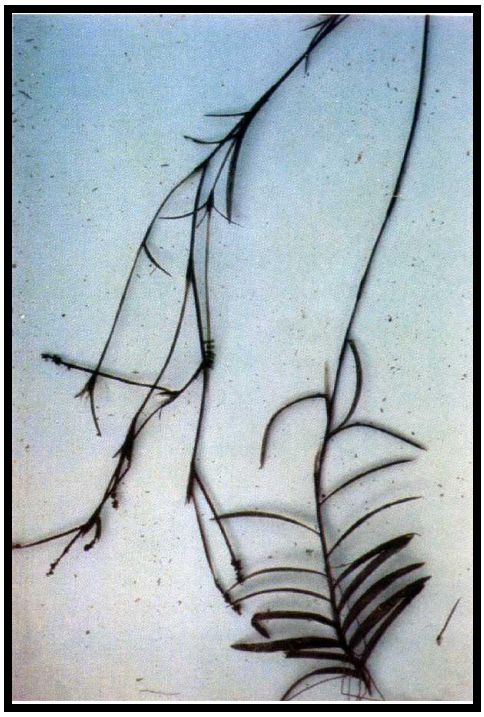
Dominant Submersed Macrophyte Species
Potamogeton epihydrus

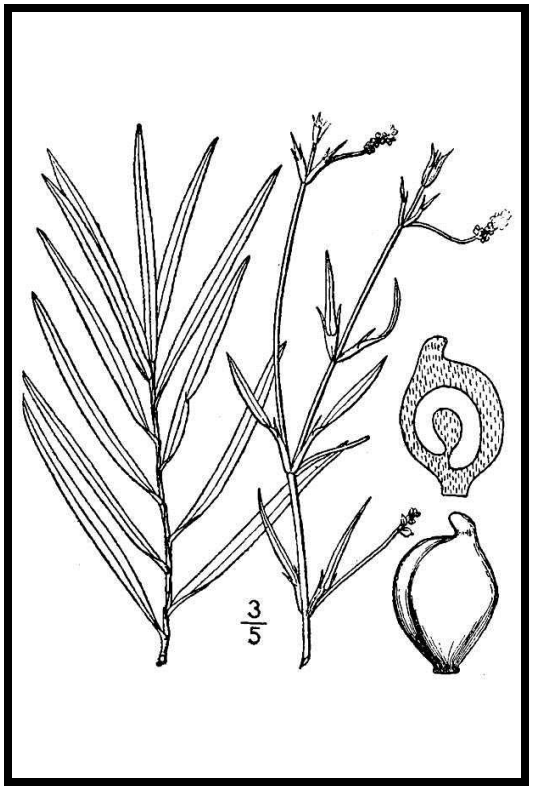


Potamogeton richardonsii

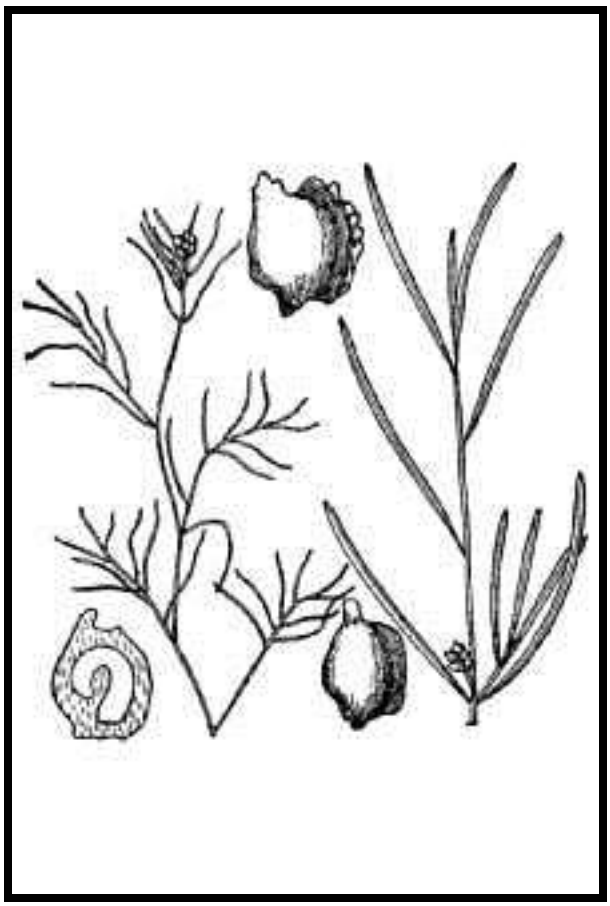


Potamogeton robbinsii

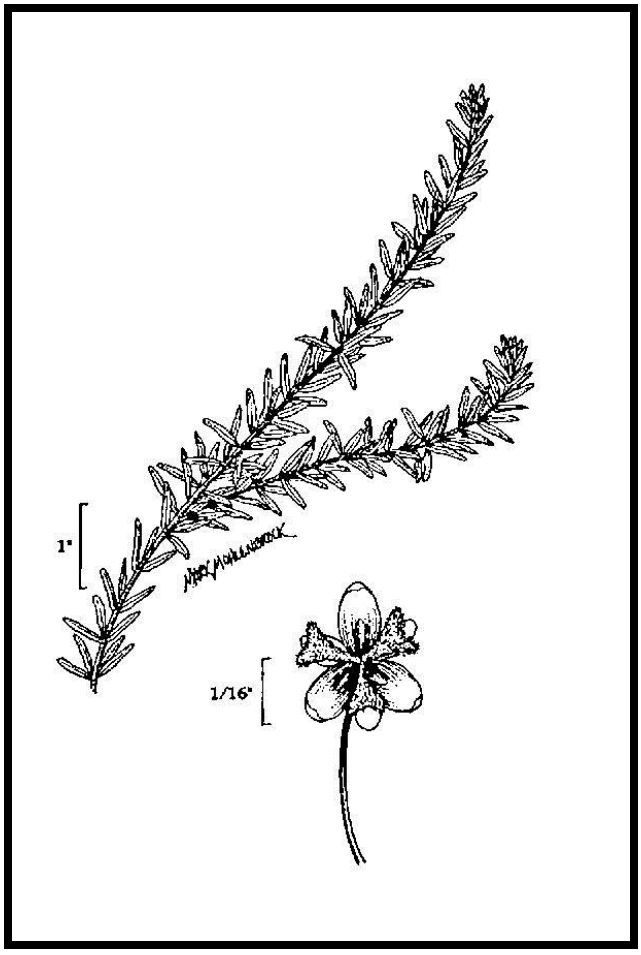




Potamogeton foliosus



Elodea canadensis



Vallisneria americana