Technical Status Memorandum
For
Lakes Limerick and Leprechaun 2013
Aquatic Plant Management

December 2013

Prepared for
Lake Committee
Lake Limerick Country Club


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Contents

Introduction

The goal of the 2013 lake management year at Lake Limerick Country Club was to continue the management program for Lake Limerick and Lake Leprechaun that began in 2005. Aquatic plant surveys of each lake were taken in June to determine aquatic plant treatment needs for the 2013 season in order to maintain ecologically balanced and aesthetically pleasing lakes. The presence of aquatic plants is important for fisheries habitats as well as to prevent toxic cyanobacteria blooms that could occur if no plants were present; however, too many plants could impede on the lake's beneficial uses such as boating, aesthetics, recreation and aquatic habitat. It is the balance of a healthy aquatic environment that enables both open water quality, and littoral aquatic plant communities that prevent negative impacts such as high nutrient concentrations leading to algal blooms, and low dissolved oxygen concentrations that limit other aquatic life such as fish. Negative impacts could also be seen downstream of these systems. Nutrients (phosphorus and nitrogen) from the lake's sediment are recycled throughout the lake and are taken up by plants and algae, creating perfect conditions for excessive plant and algae growth. For this reason, a lake management and monitoring plan at these two lakes is important.

The plant community within Lakes Limerick and Leprechaun during the past couple of years is moving toward an equilibrium state. Plant communities have changed from non-native species (Brazilian Elodea) to more native species that also require management. Since the beginning of the lake management program in 2005, plant species have remained managed with low and high doses of differing and combined herbicides applied on a four year cycle, in order to ensure that Limerick and Leprechaun maintain their valuable recreational and aesthetic uses, as well as, to maintain and enhance aquatic habitat for fish and other aquatic life.

In 2013, a monitoring program was started in order to gather data on water quality conditions that can aide in future lake management decisions.

The following report describes the history of the Lake Limerick and Lake Leprechaun monitoring programs and the two lake's statuses after the 2013 management year.

Lake Limerick

The aquatic plant control program for Lake Limerick in 2013 continued to build upon the efforts started in 2005 with the intensive 2005 herbicide treatment followed by the high-beneficial use annual treatments in 2006 through 2013. In 2013 the objective of management actions were designed to continue to control non-natives, but also to reduce the adverse impact of native plant's density and coverage of the lake bottom. At the same time the plant community was encouraged to develop in a sustained manner to promote habitat structure and direct competition to phytoplankton for nutrient uptake. In addition to the herbicide treatment, a water quality monitoring program was started during 2013.

Aquatic Plants

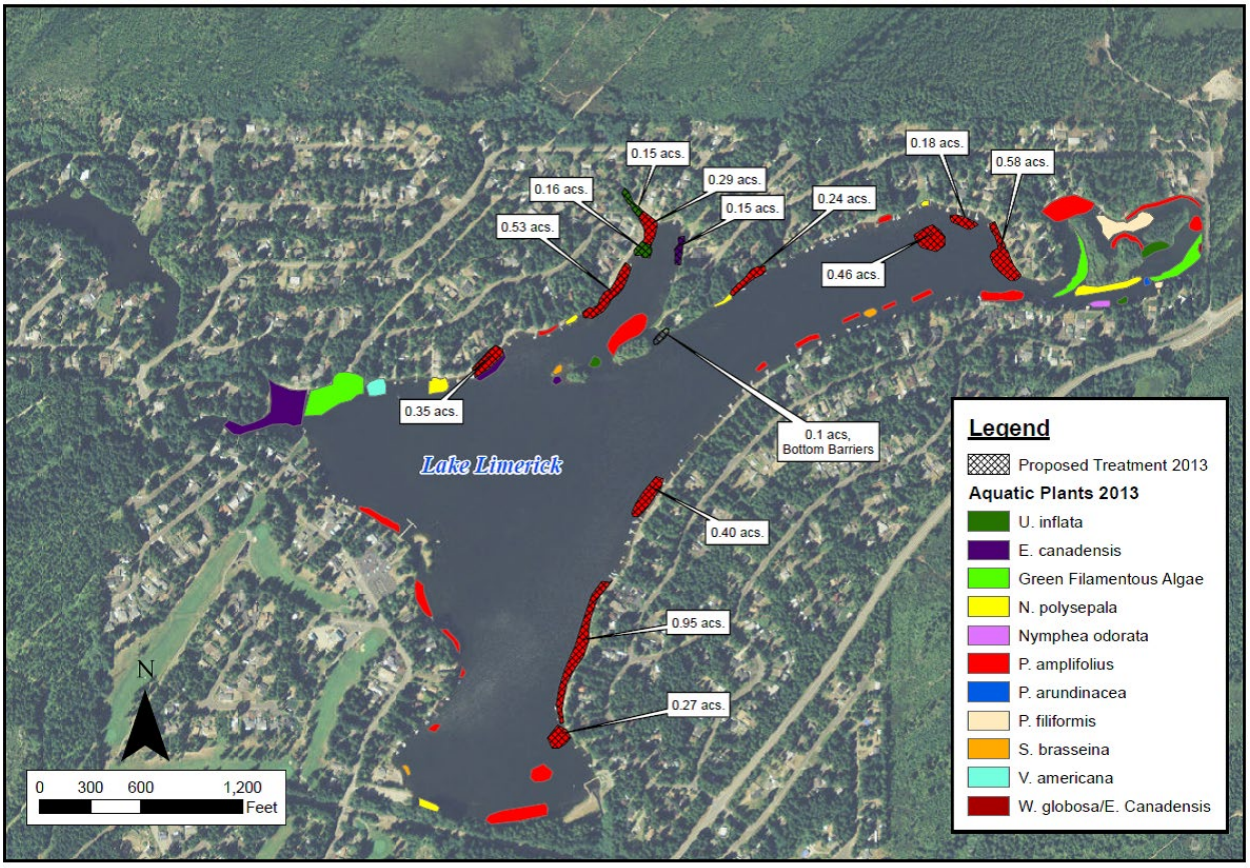
The area treated in 2013 was considered a small treatment compared to past treatments. Less than 5 acres were treated in order to limit the increasing growth of the native plant call pond weed (*Potamogeton amplifolius*). The original intent of the aquatic plant management program was to control the non-native Brazilian elodea (*Egeria densa*). This plant dominance of the aquatic plant community has been greatly reduced since the 1990's and early 2000's and was not found during the 2013 aquatic plant survey.

A total of 4.8 acres were treated in 2013 by AquaTechnex, LLC. The first treatment was with the contact herbicide Diquat conducted on August 5th. The follow-up treatment was the week of August 19th and at that time the systemic herbicide Sonar PR was used. The purpose of the contact herbicide was to weaken the dominate plants within the target area and then to allow these same plants to start to regrow (10 to 14 days after the contact herbicide treatment) so that the systemic herbicide will kill non-native plants in the area and limit the regrowth and over production of the pond weeds (native plants) in the following summer. This is the same objective as the 2012 treatment efforts.

Figure 1 illustrates the locations and type of plant communities within Lake Limerick during the June 2013 survey. Figure 1 also shows the red hatched areas where treatment took place in 2013. Figure 2 shows the decrease in *P. amplifolius* after the 2013 herbicide treatment.

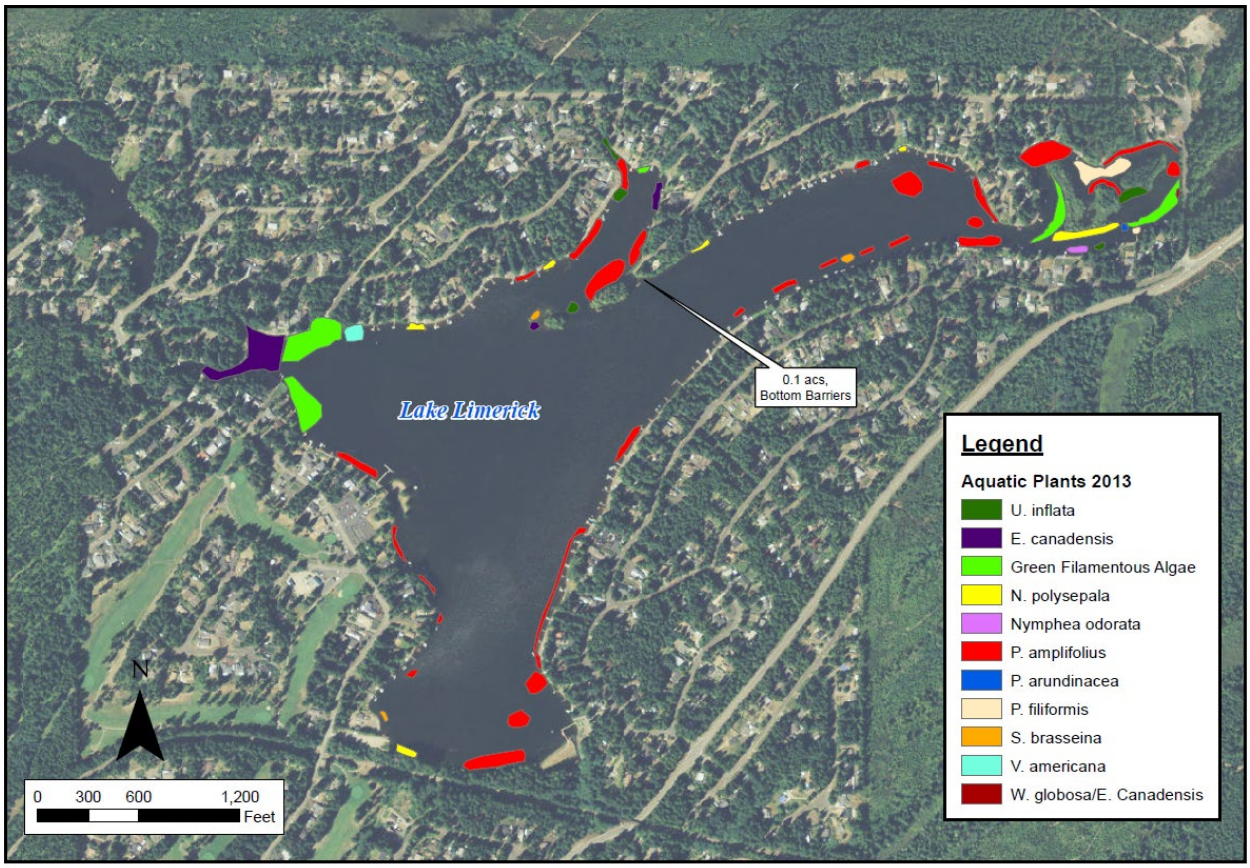
Figure 3 illustrates the locations and type of plant communities within Lake Limerick as of the June 2012 survey. Figure 3 also shows the red hatched areas where treatment took place in 2012.

Figure 4 shows the 2011 aquatic plant map for Lake Limerick and the proposed treatment plan. Figures 5-6 depict plant surveys and proposed treatment zones for 2008-2010. The aquatic plant treatment program has been reduced from a total of 32 acres to not more than 12 acres in 2010 and less than 5 in 2011, 2012, and 2013.



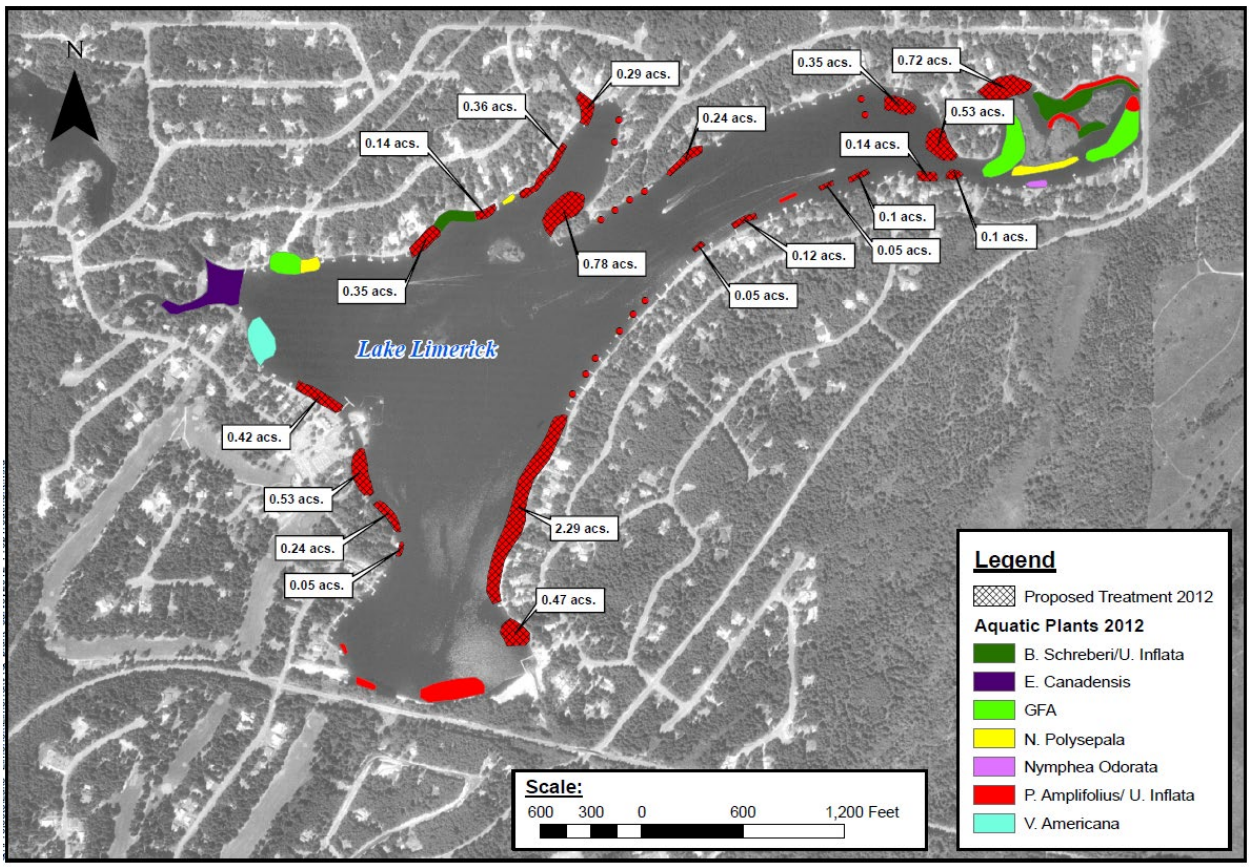
2013 Lake Limerick Aquatic Plants & Proposed Treatment

Figure 1. Lake Limerick plant map and treatment areas for 2013 as proposed and treatment applied.



2013 Lake Limerick Post-Treatment Aquatic Plants

Figure 2. Lake Limerick post-treatment aquatic plant map



Lake Limerick Aquatic Plant & Proposed Treatment 2012

Figure 3. Lake Limerick plant map and treatment areas for 2012 as proposed and treatment applied.

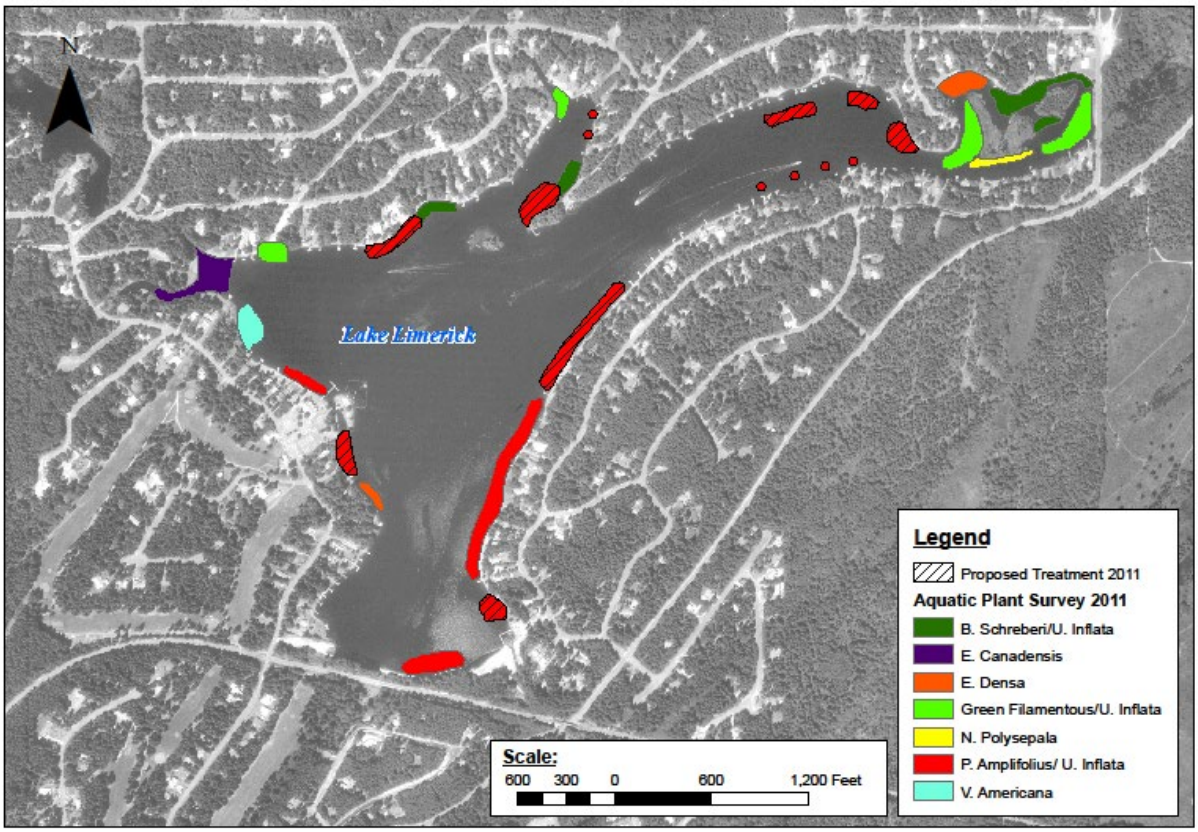
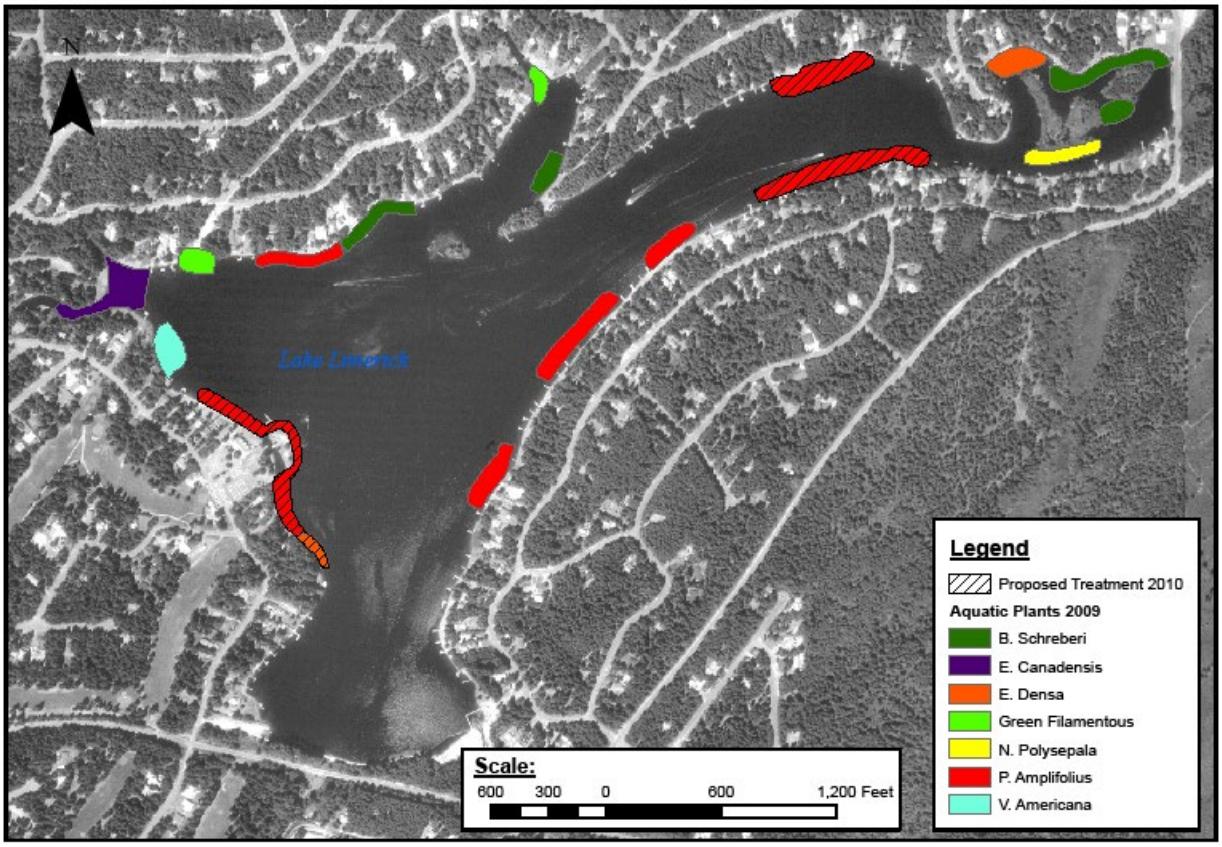


Figure 4. Lake Limerick plant map and treatment areas for 2011 as proposed and treatment applied.



Lake Limerick Aquatic Plant Map 2009 Proposed Treatment 2010

Figure 5. Lake Limerick aquatic treatment map for 2010

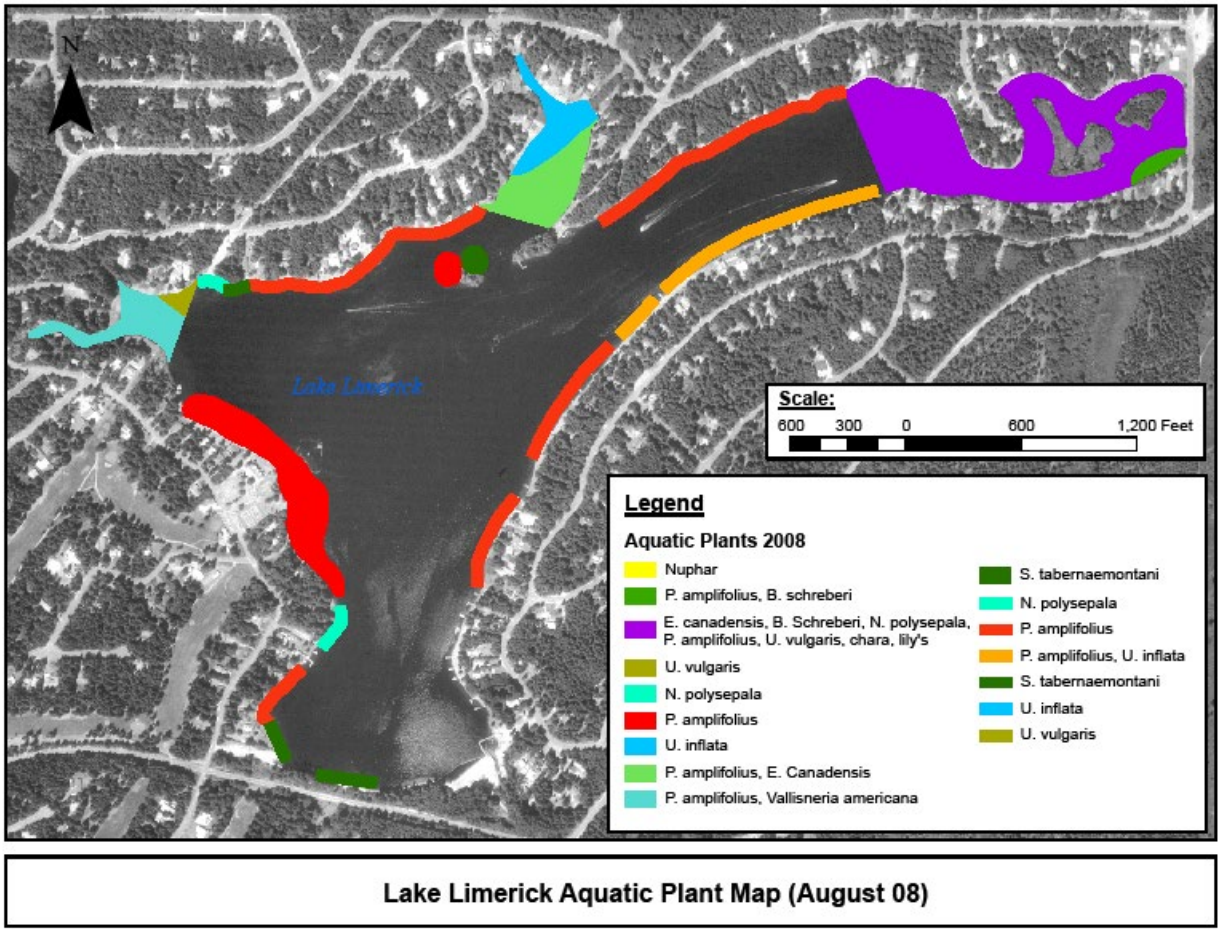


Figure 6. Lake Limerick aquatic plant coverage in August 2008

Water Quality

During the 2013 management year, level loggers were installed at two locations in Lake Limerick; below the dam and at the country club dock. These level loggers provide accurate lake level data in 60 minute intervals (Note lake level measurements for 2014 will be made in 15 minute interval to better inform as to wind and precipitation impacts on water levels) in order to determine how the lake reacts to precipitation events or drought, and to aide in the development of a mass balance model. The lake level fluctuations from May through November 2013 with corresponding precipitation can be seen below in Figures 7 and 8. Water quality samples and secchi disk measurements were collected from August through October at five different locations throughout the lake; at the dam, Banbury, King Cove, Tipperary, and Cranberry. The water quality monitoring sites are shown below in Figure 9. Water quality samples were analyzed for Total Phosphorus (TP), Soluble Reactive Phosphorus (SRP), Chlorophyll *a,* and phytoplankton.

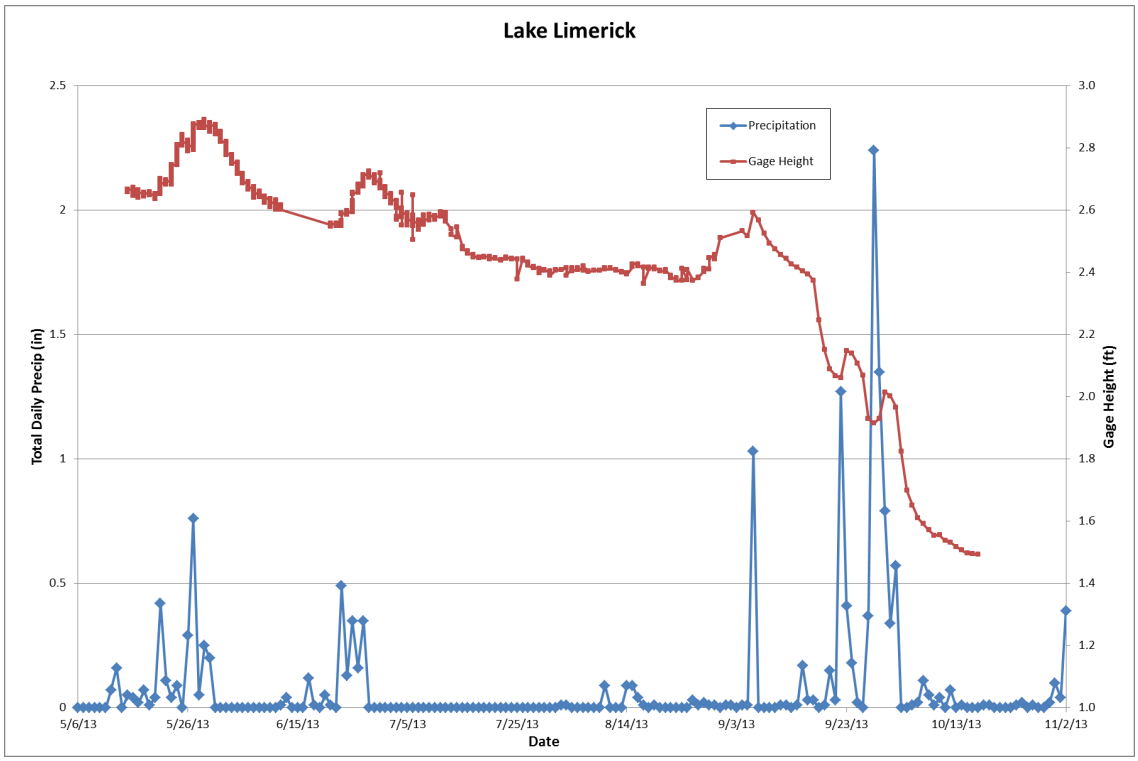


Figure 7. Lake Limerick level logger data and daily precipitation from May through November 2013.

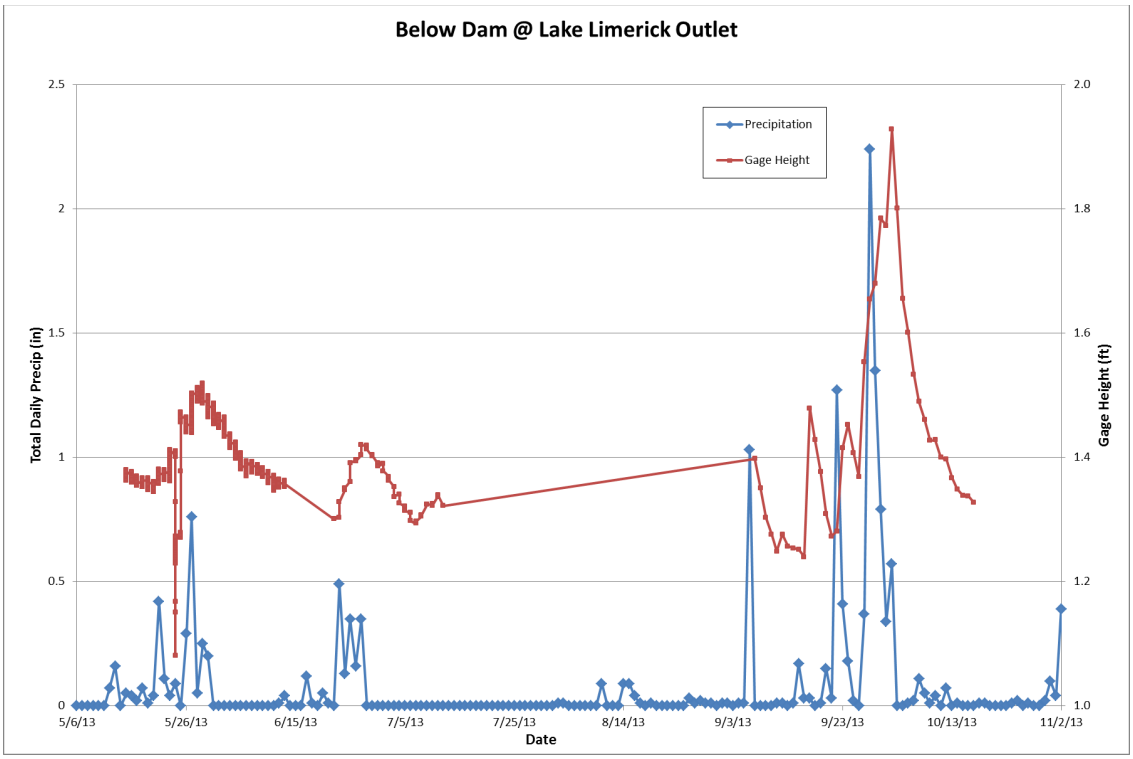


Figure 8. Lake Limerick below the dam level logger data and corresponding daily precipitation for May through November 2013.

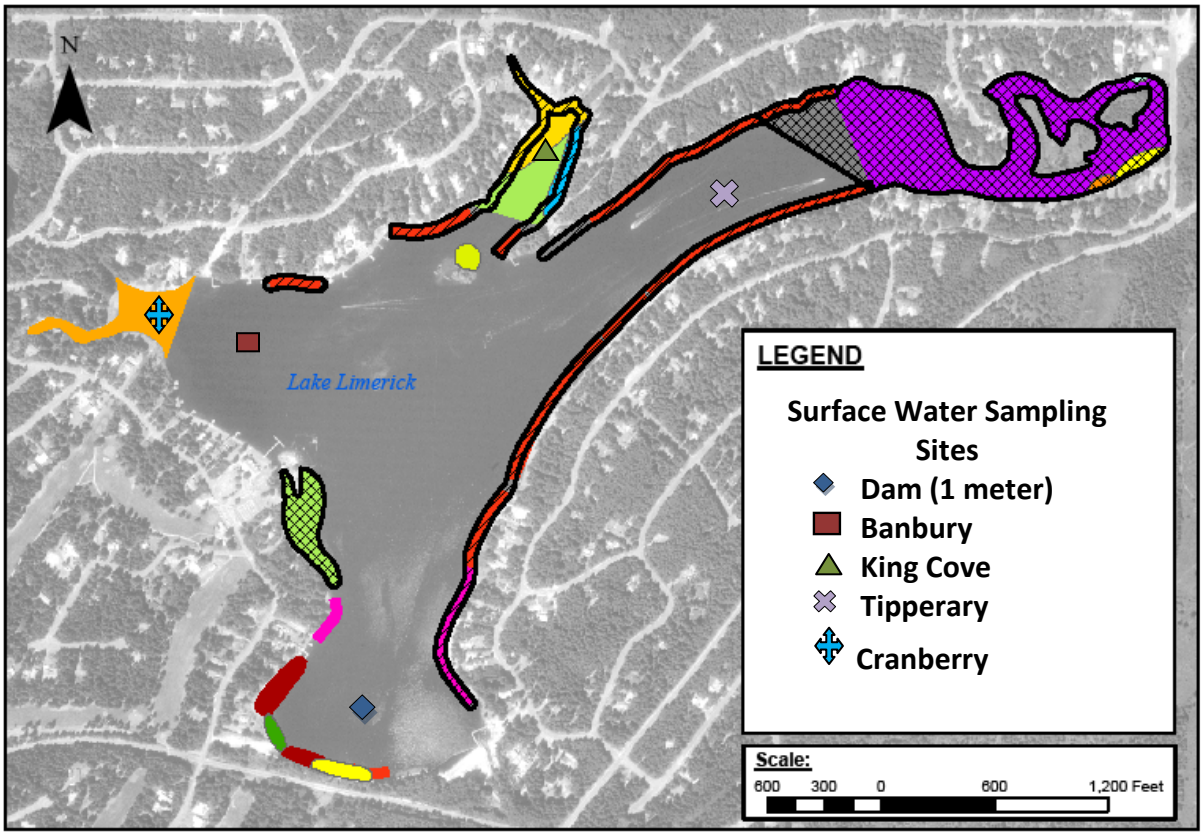


Figure 9. 2013 Lake Limerick water quality monitoring sites.

Figure 10 shows TP results for Lake Limerick during the summer of 2013. TP concentrations averaged around 10-15 µg/L, with a jump in TP to 84 µg/L at the Cranberry site in early October. This is probably reflecting the large storm event that occurred. Fortunately, the lake TP concentration remained low. A summer time TP concentration goal would be for a mean concentration of 15 µg/L or less with peak lake average TP of 25 µg/L or less at any given time. At these levels the occurrence of nuisance algal blooms and potential HABs (Harmful Algal Blooms) would be rare events if at all. Figure 11 shows SRP concentrations from August through October. SRP concentrations averaged 0-1 µg/L. The level of SRP reflects good water quality conditions. Chlorophyll *a* concentrations are shown in Figure 12, and ranged from 0-2.5 µg/L. this low level of algal productivity is reflective of oligotrophic conditions (low algal productivity) and is a reflection of the TP concentration in the water column. The chlorophyll *a* management goal is to keep it below 4 µg/L for the summer average and below 8 µg/L during a periodic lake wide event. Also, the low TP and Chlorophyll *a* concentrations are a function of the nutrient competition that exists from the aquatic macrophytes and periphyton (rooted aquatic plants and the algae attached to the lake bottom and rooted plant structures) within the lake. Hence, maintaining a balance of primary production between the rooted aquatic plant community and phytoplanktonic community will help maintain good water quality conditions in the lake. Continuing a water quality monitoring plan in the future will help to increase the Lake Limerick data set, monitor changes, and create a mass balance model.

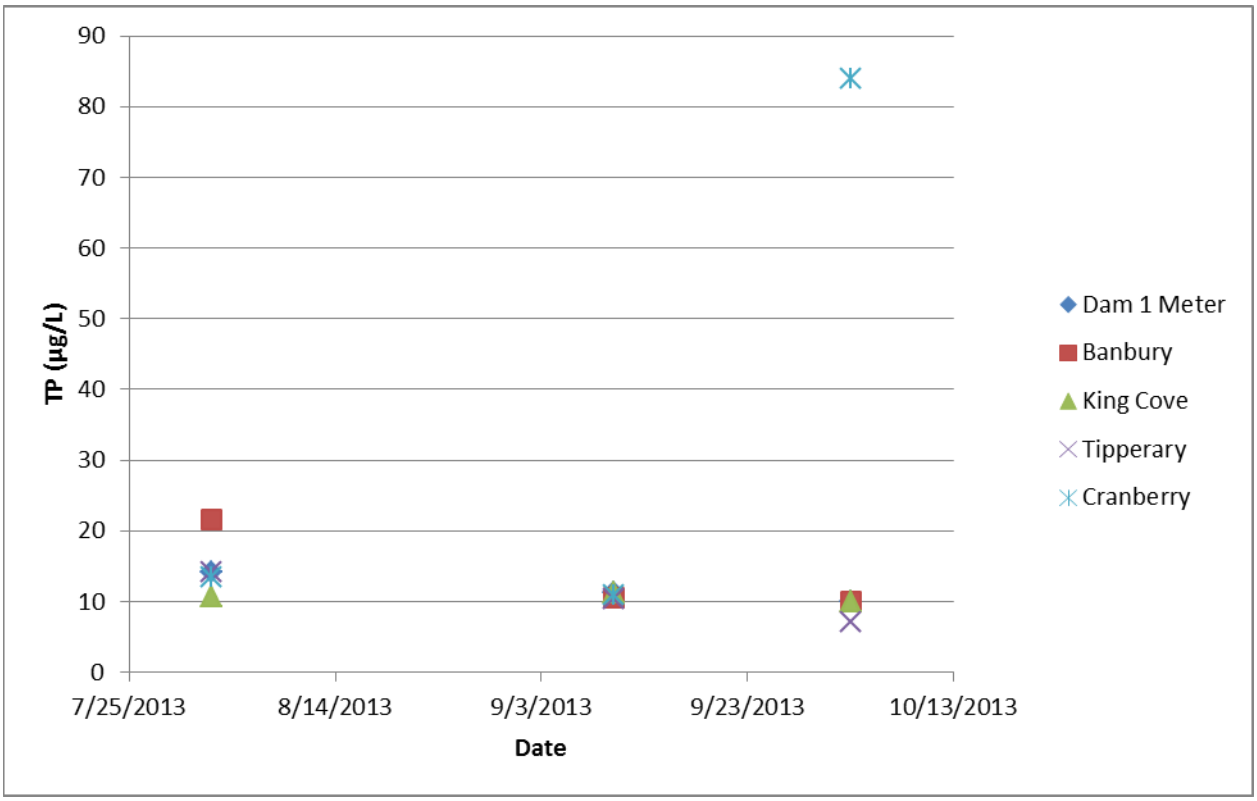


Figure 10. TP concentrations for Lake Limerick from August-October 2013.

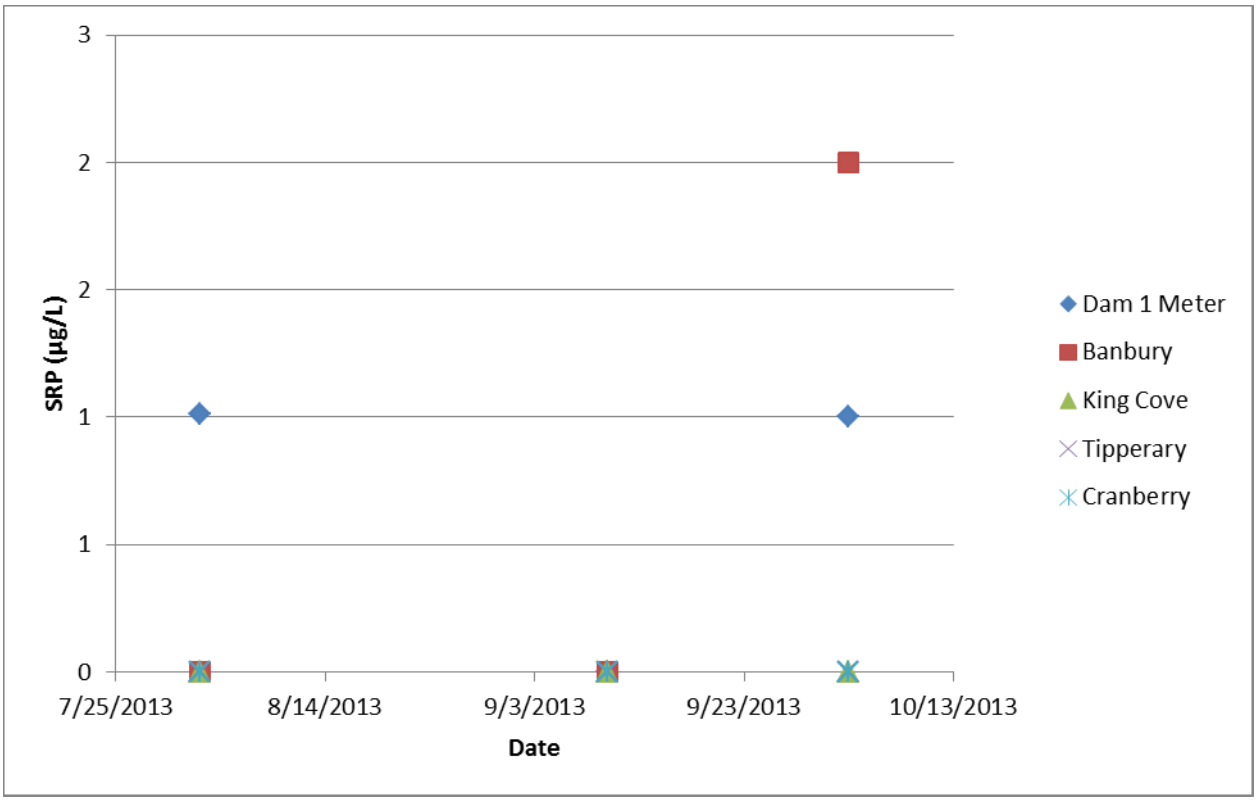


Figure 11. SRP concentrations for Lake Limerick from August-October 2013.

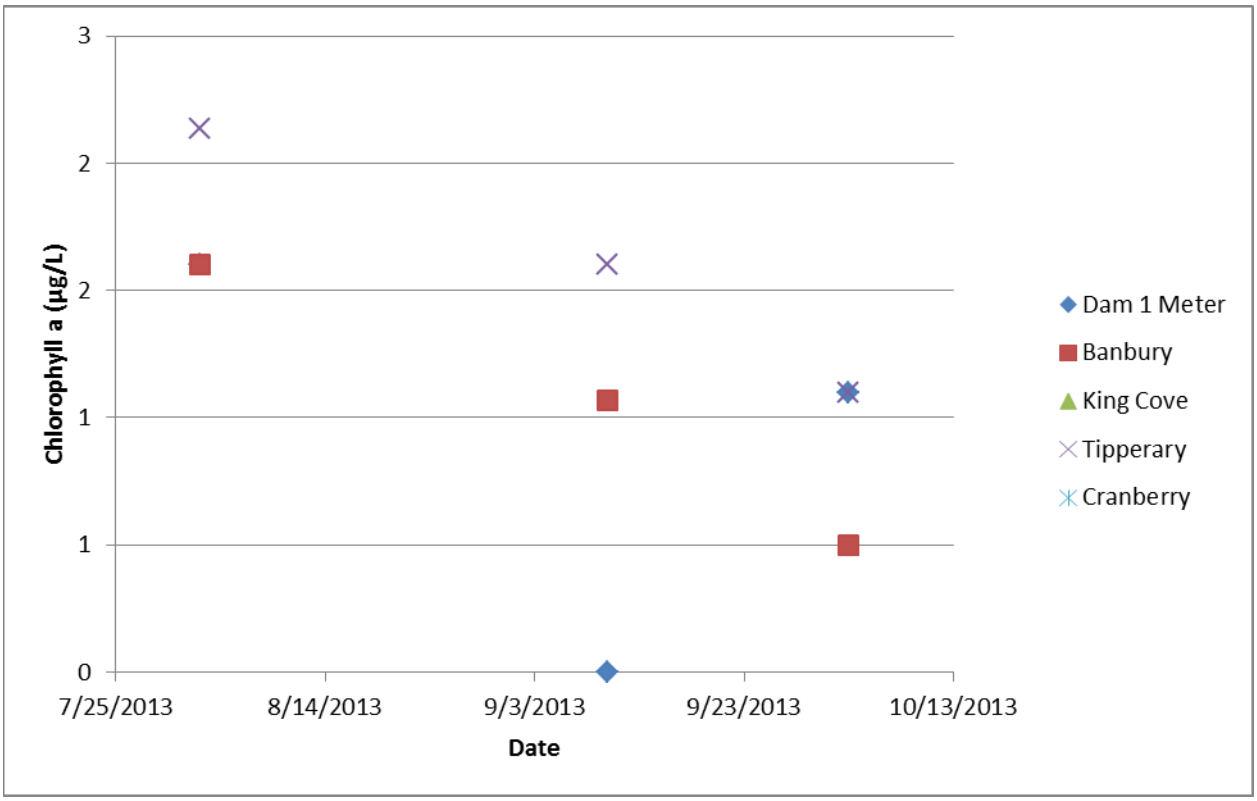


Figure 12. Chlorophyll a concentrations for Lake Limerick from August-October 2013.

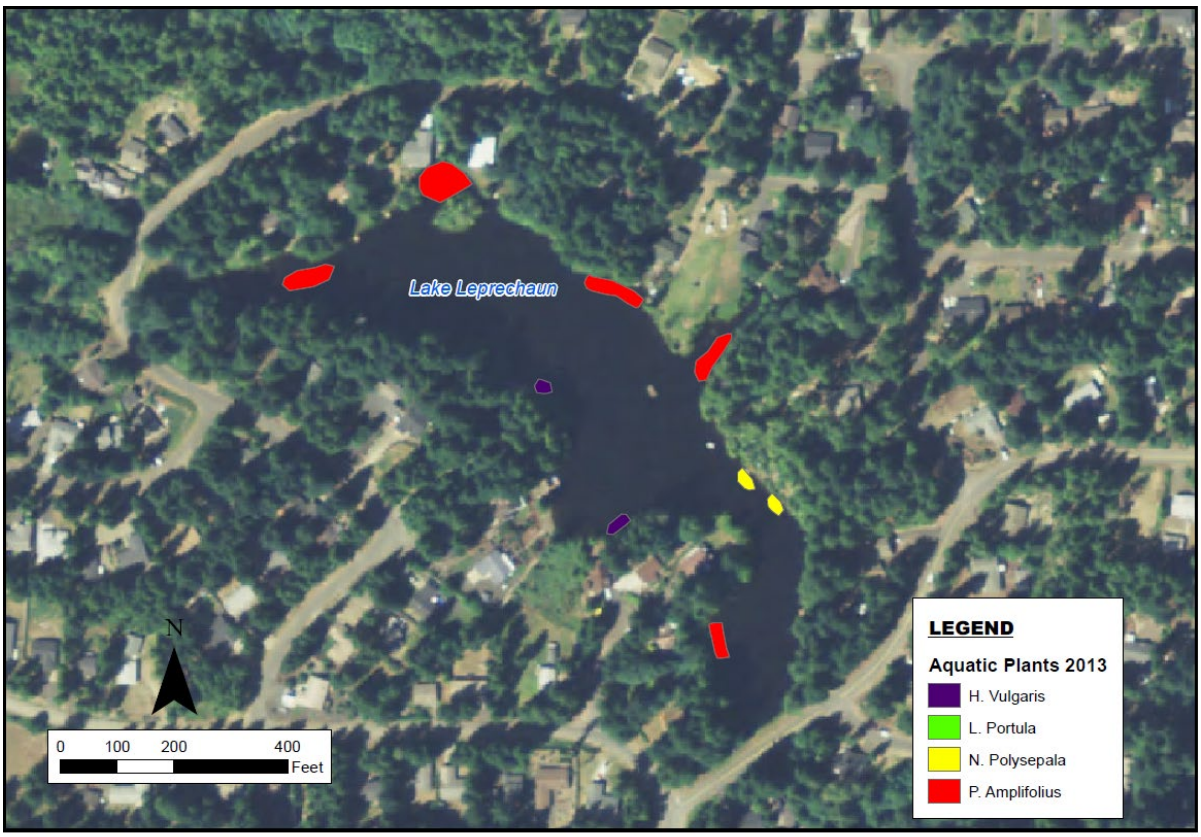
Lake Leprechaun

Contrary to 2012, Lake Leprechaun was not treated in 2013. The effects from the 2012 herbicide treatment to knock down large densities of *Potamogeton amplifolius* carried over into the 2013 season, and after a thorough aquatic plant mapping in June 2013, it was decided that no treatment would be needed for the 2013 year. A water quality monitoring plan was also put into place for Lake Leprechaun during 2013.

Aquatic Plants

There were no areas of treatment for the 2013 year. Although no treatments were performed in 2013, it is recommended that a permit for grass carp be obtained (renewed) so that grass carp can be added to Lake Leprechaun as a biocontrol for managing the aquatic plants. Since Lake Leprechaun is shallow, light is able to reach the bottom of the lake throughout, and plants can easily grow and fill in the lake. With a maintained population of grass carp the density of plants can be managed to avoid excess growth. Figure 13 shows the 2013 plant communities with the same protocol used in Lake Limerick on the same dates. Figure 14 shows the previous aquatic plant map and treatment zones from 2012.

In 2012 total of 1.51 acres was treated to control the expanding growth of big leaf pond weed. The dominate plants observed in Lake Leprechaun in the past are listed in Table 1 and shown in Figure 15, which is a map of the relative coverage or those dominate plants within the lake during 2007. Figure 16 shows a map of the aquatic plant survey from 2009.



2013 Lake Leprechaun Aquatic Plant Survey

Figure 13. 2013 Lake Leprechaun aquatic plant survey.

Table 1. List of dominant aquatic plants observed in Lake Leprechaun in 2007.

Species Name	Common Name
Hippuris vulgaris	Common mares tail
Myriophyllum sibericum	Northern milfoil
Potamogeton amplifolius	Big leaf pond weed

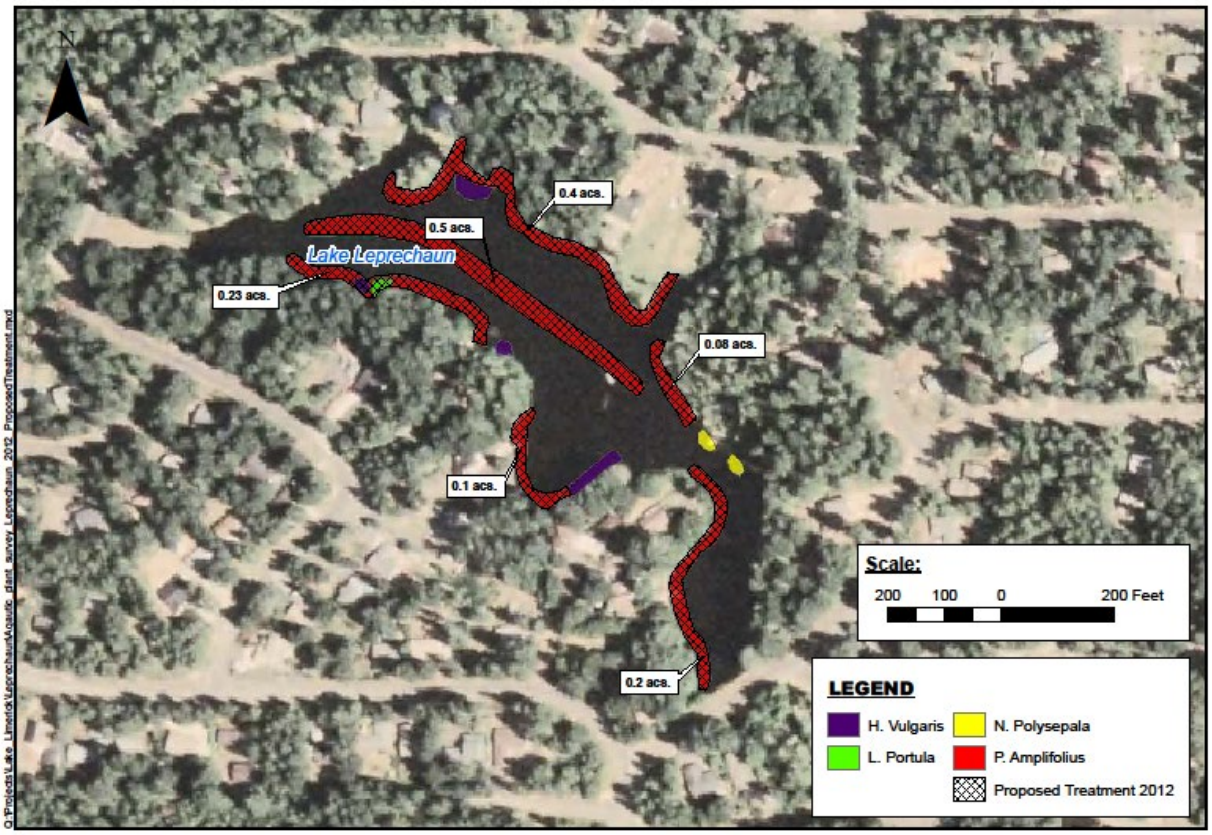


Figure 14. The 2012 Aquatic plant map of Lake Leprechaun showing treatment areas.

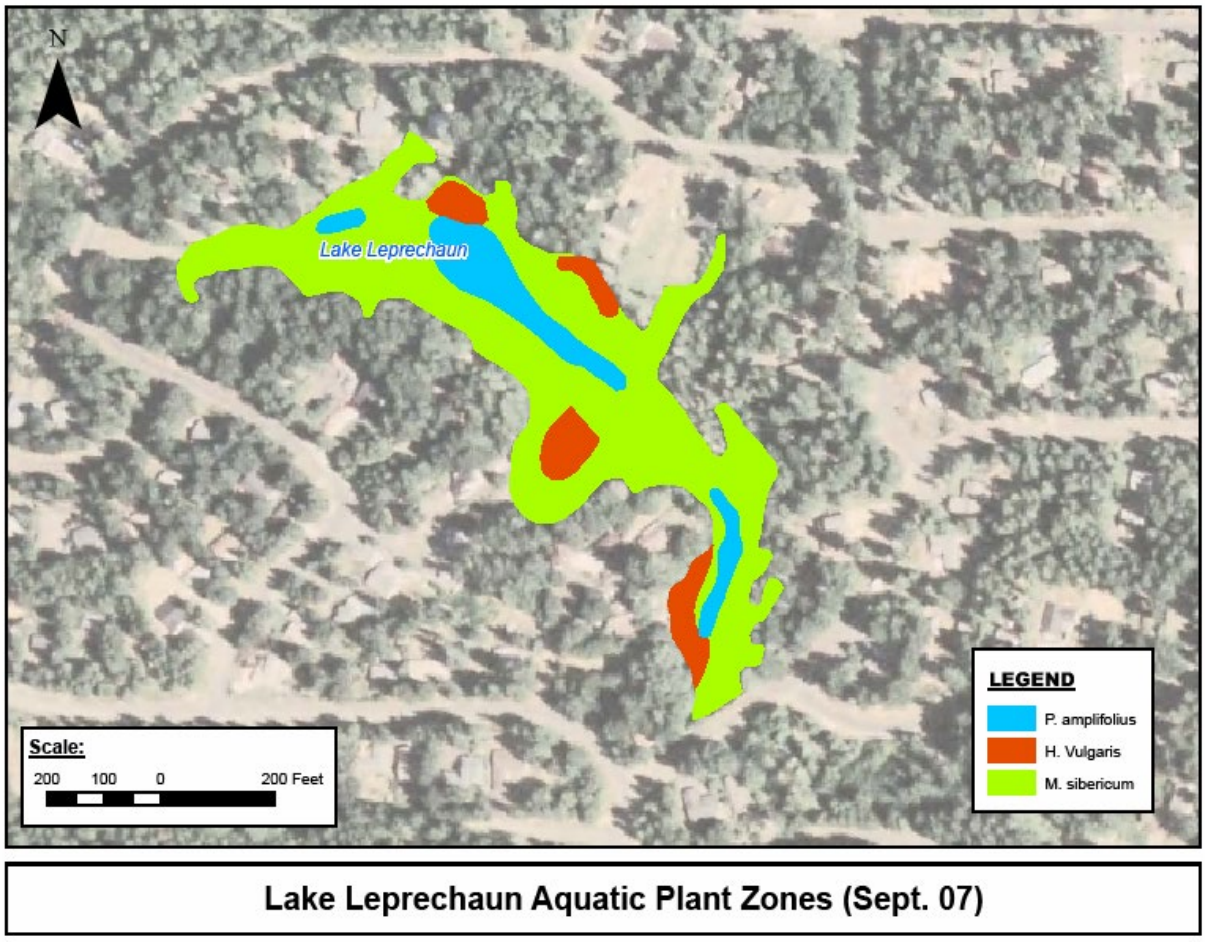


Figure 15. Aquatic Plant Map of dominant plants in Lake Leprechaun, 2007.

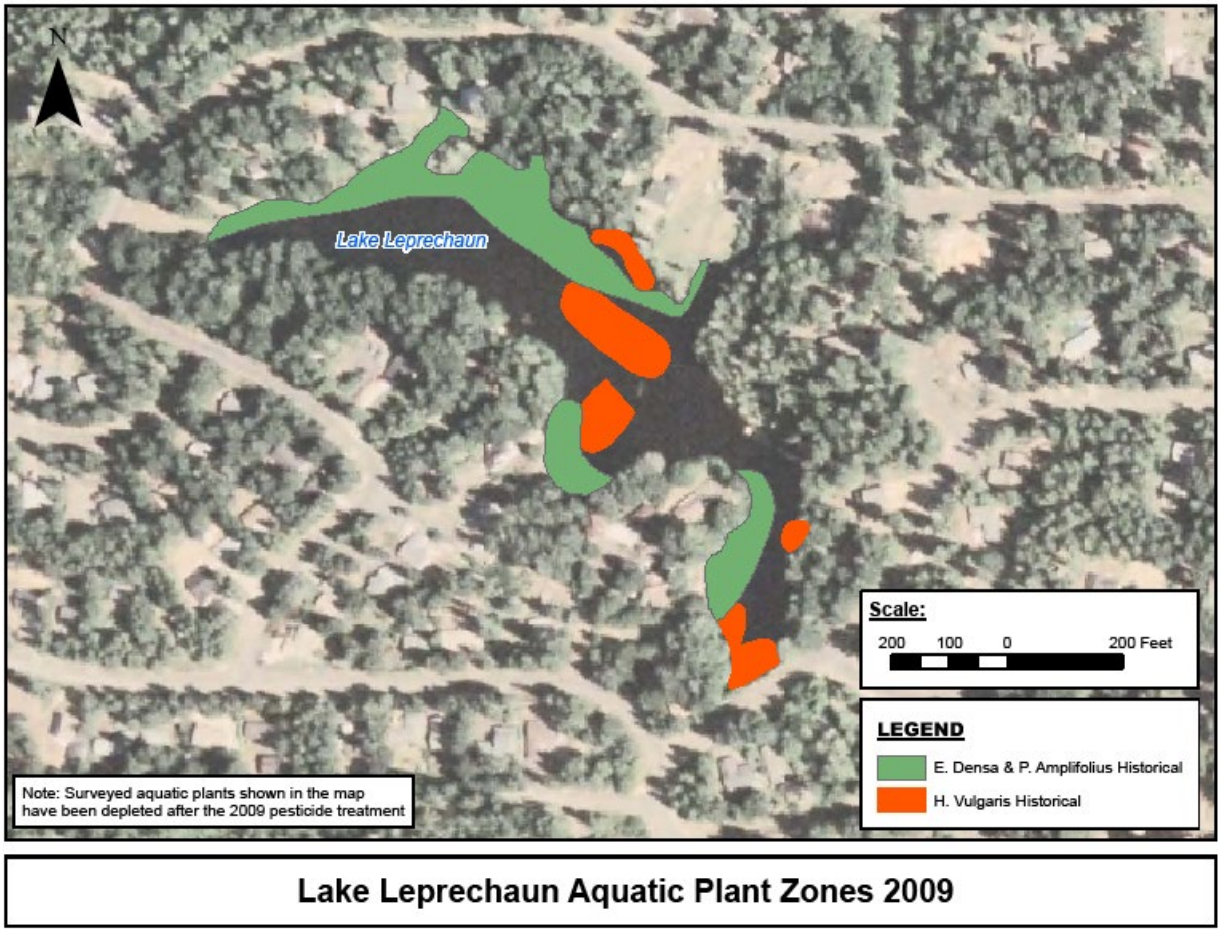
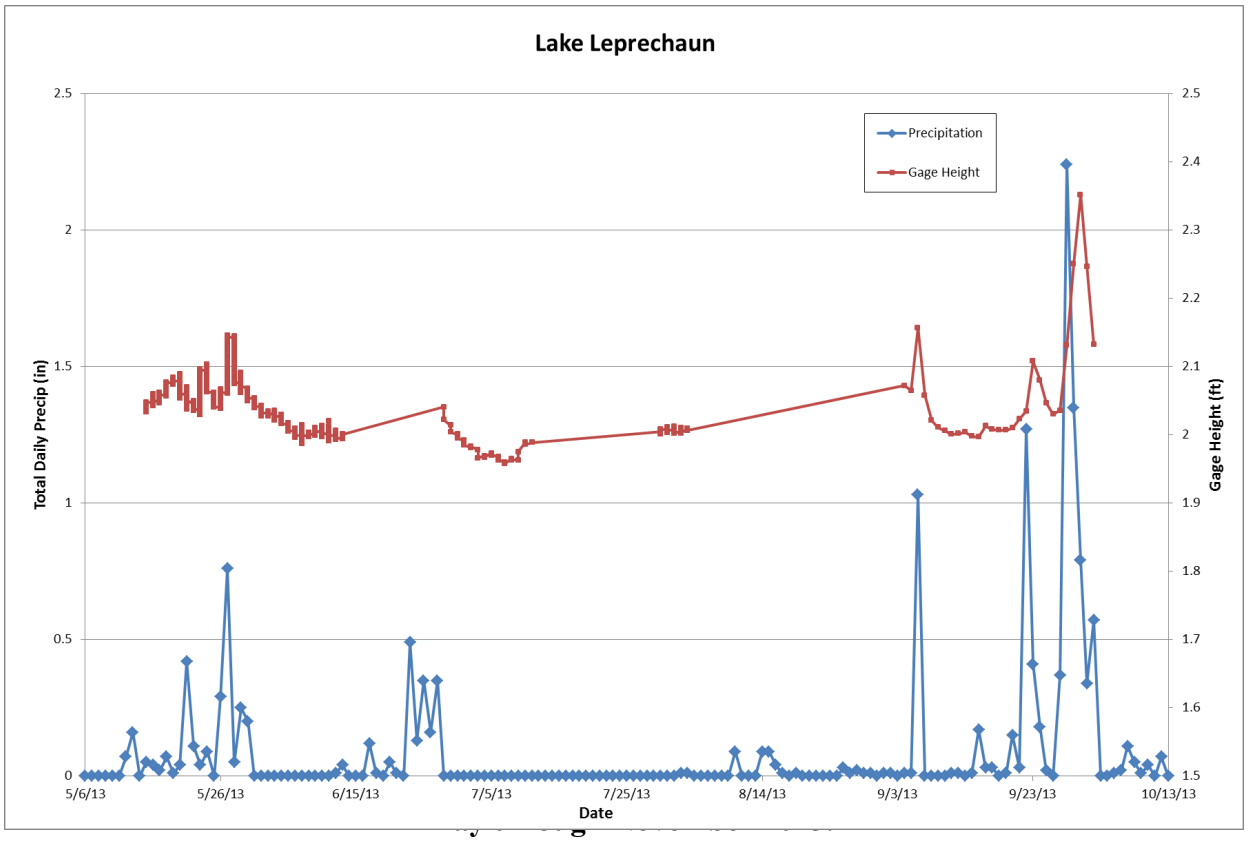


Figure 16. 2009 Aquatic plant map of plants showing to summer 2009 treatment areas.

Water Quality

A water quality monitoring program was implemented at Lake Leprechaun during the summer of 2013. A level logger was installed near the outlet of Lake Leprechaun. Figure 17 shows lake level and corresponding daily precipitation. Water samples and secchi disk transparency was collected from August-September at the outlet location as well. The water quality sampling site for Lake Leprechaun for 2013 is shown below in Figure 18. Water samples were analyzed for TP, SRP, Chlorophyll *a* and phytoplankton. Figure 19 depicts TP concentrations for Lake Leprechaun for the summer 2013. Concentrations ranged from 10-14 µg/L. Figure 20 shows SRP concentrations. SRP concentrations were approximately 1.5 µg/L during the sampling season. Chlorophyll *a* concentrations are shown in Figure 21 and ranged from 1-1.5 µg/L. Similarly, Lake Leprechaun's water quality reflects good water conditions that also exist in Lake Limerick for similar reasons. The water quality goals are also the same as Lake Limerick. However, Lake Leprechauns is shallower and hence, the integrated management of aquatic macrophytes has to be such that it allows a slightly higher level of production than in Lake Limerick in order to maintain relative clear water and prevent HABs.


Lake Leprechaun
Precipitation
Gage Height
Total Daily Precip (in)
Gage Height (ft)
Date
2.5
2
1.5
1
0.5
0
2.4
2.3
2.2
2.1
1.9
1.8
1.7
1.6
1.5
5/6/13
5/26/13
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8/14/13
9/3/13
9/23/13
10/13/13

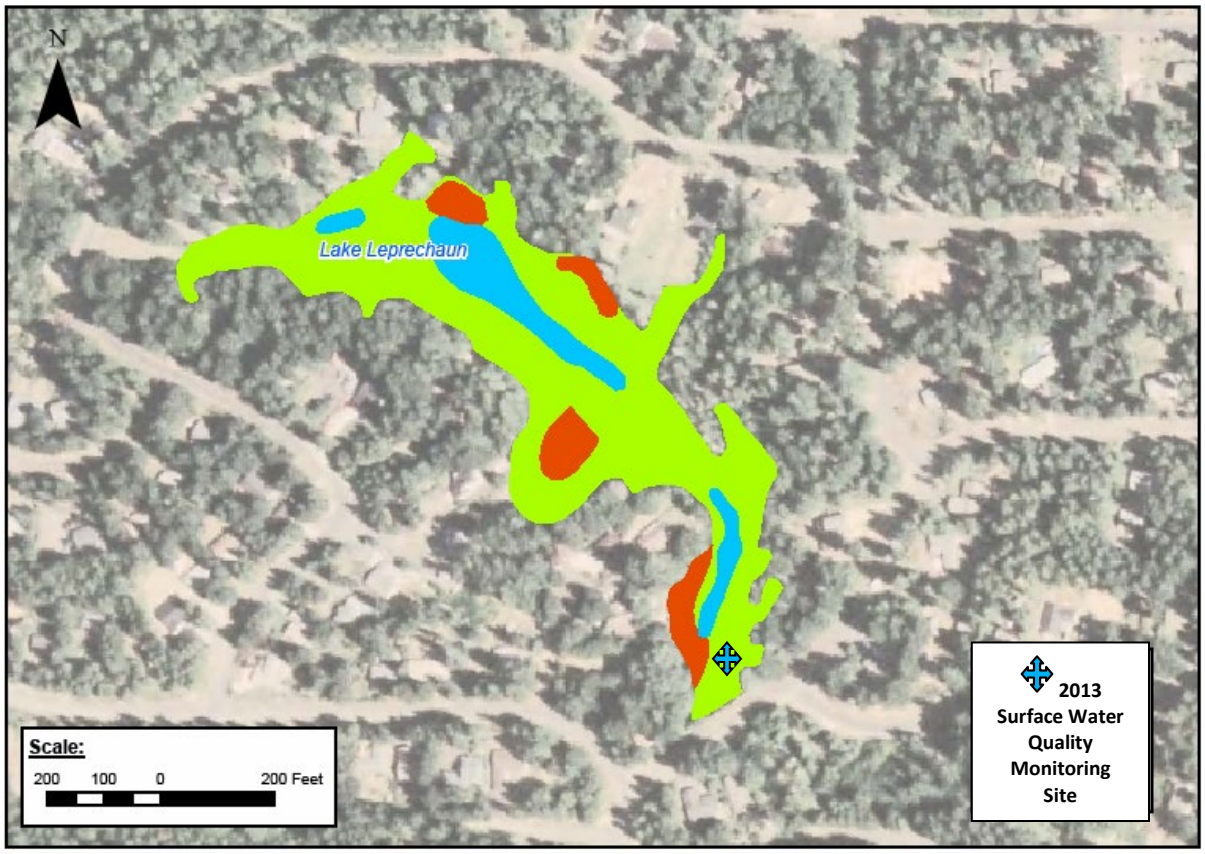

Figure 18. 2013 Water quality monitoring site for Lake Leprechaun.

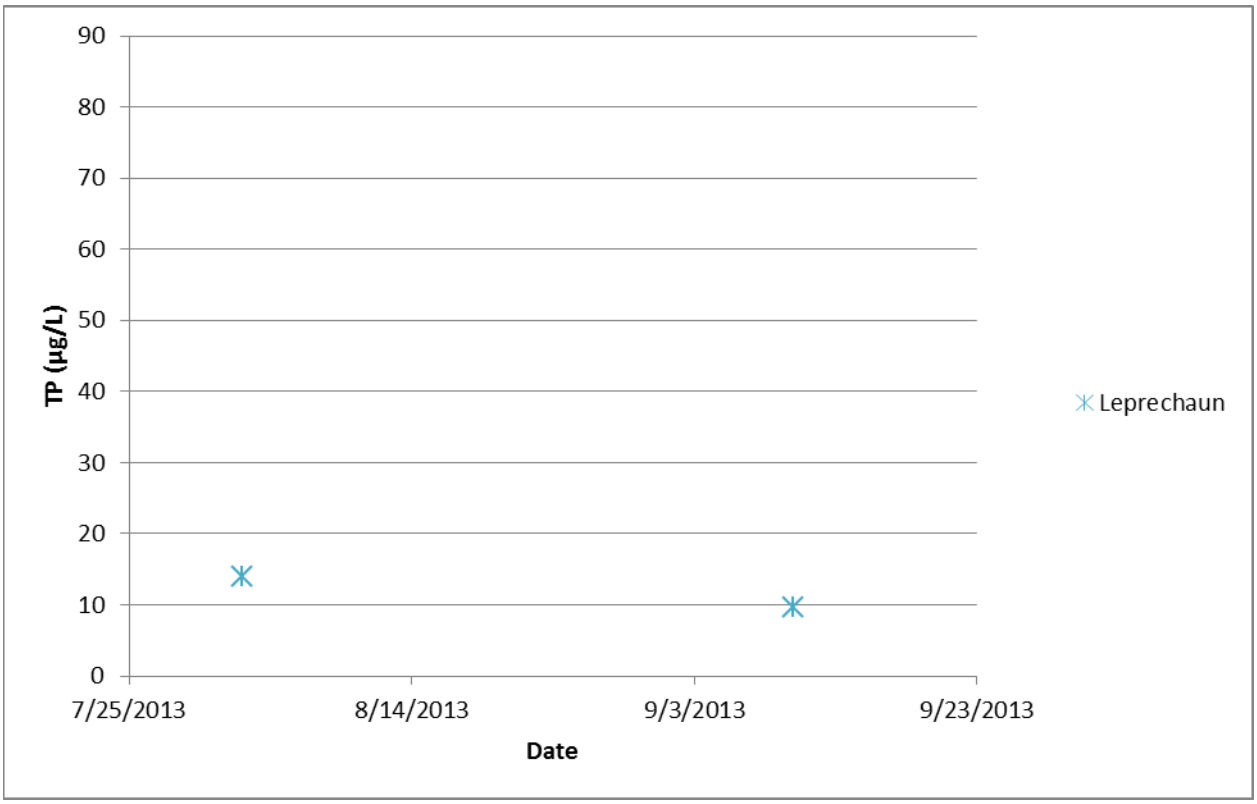

Figure 19. TP concentrations for Lake Leprechaun from August-September 2013.

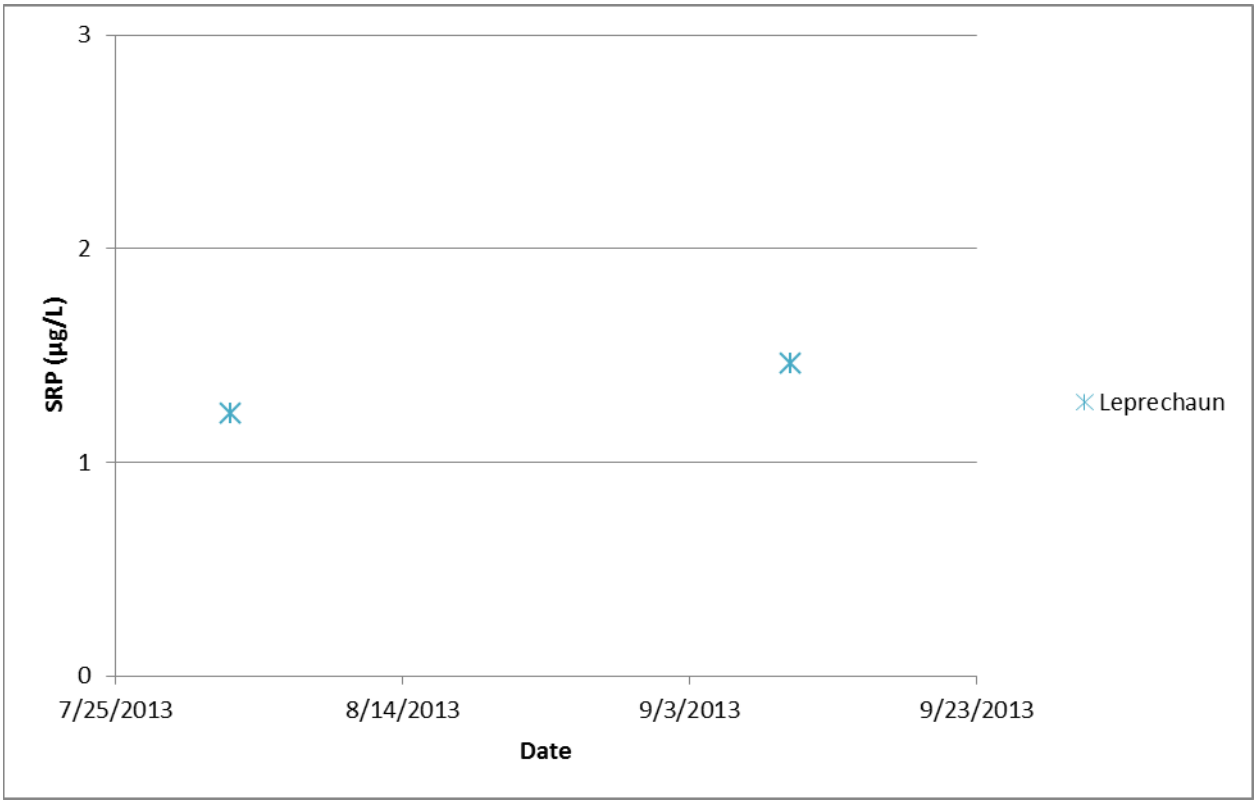

Figure 20. SRP concentrations for Lake Leprechaun from August- September 2013.

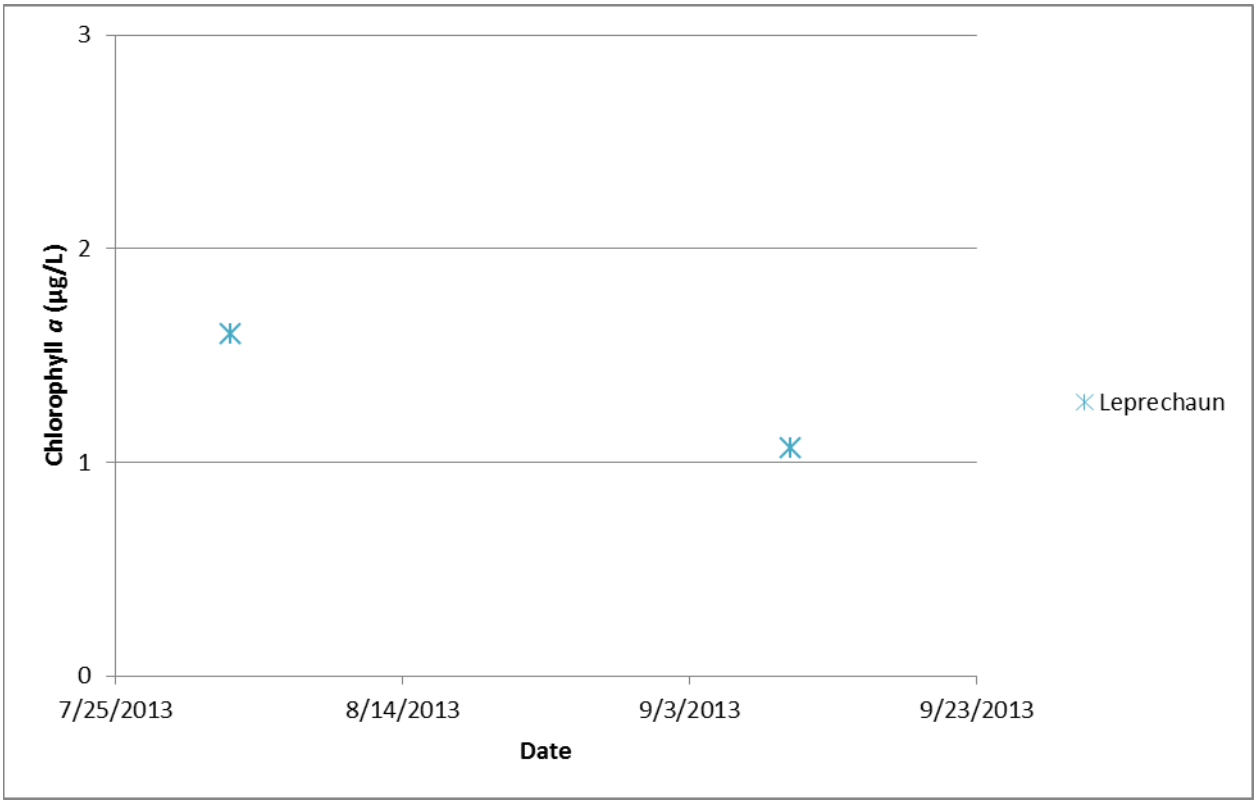

Figure 21. Chlorophyll a concentrations for Lake Leprechaun from August to September 2013.

Permit Status

The herbicide permit through the Ecology was transferred to AquaTechnex (herbicide applicator) in 2011 and will continue to be administered by them in the future.

2014 Recommendations

- Aquatic plant mapping should be continued at both Lakes Limerick and Leprechaun in June 2014 to establish treatment zones and strategy for both lakes. An additional plant mapping should be conducted in September 2014 to assess the treatment effectiveness of the summer control activities to plan for the efforts that will be needed in 2014.
- Based upon the aquatic plant mapping and input for citizen observations LLCC should continue with it integrated adaptive aquatic plant management strategy to limit non-native species and control excess growth of native aquatic macrophytes. This needs to be done while maintaining a plant community structure and density that provides for both a healthy aquatic habitat and good water quality conditions. This is important not only for in-lake aquatic and fisheries habitat in Lakes Limerick and Leprechaun but also for habitat and water quality conditions downstream as well.
- It is recommended that a permit for grass carp introduction and maintenance to Lake Leprechaun be obtained (or renewed if appropriate) in order to aide in the management of aquatic plants in the lake in a more passive yet consistent way.

- It is also recommended that LLCC maintain their water quality monitoring program to build a database and development of a phosphorus mass balance model for future lake management decisions.