11. CPA Project Application Form

[CPC Use Only: Date Received 12/27/19 By: SAMMIE KUL
Assigned CPC #2021- 02]

If possible, use word processor to fill out form. Please answer all questions, use "N/A" if not applicable.

1. a.) Applicant Name and Organization: Last Woodle First Alexander
   Organization(s) (if appropriate) Great Pond Advisory Committee, Groton Lakes Association
   b.) Regional Project: Yes ☑? or No? ☐ If Yes, Town/Organization: _____
2. Submission Date: 01/02/2020
3. Applicant Address: St. 20 Highland Road
   City/ State: Groton, MA 01450 ZIP: _____
4. Ph. # 978-7323224 Email: alexander.woodle@gmail.com
5. CPA Purpose. Check all that apply:
   Community Housing ☐ (Affordable Housing ☐) Historic Preservation*: ☐ Open Space: ☐
   Recreation ☐

   ** As per MA General Law Chapter 44B, proposed historic projects that are not on the structures listed on the state's registry of historic places require a determination by the Groton Historic Commission that the proposed project is of historic significance.*
6. Town Committee or boards participating: Great Ponds Advisory Committee
7. Project Location/Address: Knops Pond/Lost Lake
8. Project Name: Open space and Recreational Restoration of Knops Pond/Lost Lake
9. Additional Responsible Parties (If applicable):

Role (specify)	Name	Address	Ph. (w) (cell)	Email
Property/Site Owner	Town of Groton	173 Main St.		
Project Manager	Alex Woodle	20 Highland Rd	978-7323224	alexander.woodle@gmail.com
Lead Architect				
Project Contractor				
Project Consultants				
Other:				
Other				

10. As appropriate, indicate if proposal requires P&S agreement IN Deed IN
    Option agreement IN Other-describe: N/A
11. a.) Assessor info. (map/ block/ lot id.(s)): N/A b.) Tax classification type: N/A
12. Permits required: Zoning: N/A Historic Preservation: N/A Other: _____
13. Historic Commission Approval signoff (when required): _____ Date: _____
14. Funding: a.) Requested from CPC: $ 95,000 b.) Committed from other sources: $ 0
    c.) Annual anticipated total income: $ N/A d.) Annual anticipated total expense: $ 95,000
    d.) Anticipated net income (loss): $ 0 e.) Estimator name/company: Alex Woodle
15. CCP Objectives - use codes from **Section 5** to indicate all that apply: 5.3
16. Project Timelines: Proposed Start Date: 04/01/2020 Projected Complete Date: Dec. 31, 202(
17. Estimated Delivery Date of Completion Report to CPC: 01/31/2021

18. Project description and explanation (attach additional sheets as needed): Please see attached docum

19. Feasibility: Fanwort treatment with Sonar is a common solution to infestation in lakes and ponds.

20. List of attachments: Attached are several annotated photographs taken in Knops Pond and Lost Lake, a photo showing the relationship of the watershed to the lakes, a photo depicting the major inlets to Lost Lake, https://www.youtube.com/watch?v=XnXQb9Yahzo, this video depicts Cabomba infestation in Knops Pond,

21. Additional Information: A memory stick with seven minute video of what damage unchecked non-native weed growth can do to the lakes. Also a map of Groton with drainage basin clearly outlined. Finally, a copy of report in 2013 revealing how successful treatment was

22. Management Plan: See attached document

23. Applicant Signature: Alexander Woodside Date: Dec. 20, 2019

Co Applicant Signature: _____ Date: _____

Co Applicant Signature: _____ Date: _____

Open Space and Recreational Restoration of Knops Pond/Lost Lake

Background

Groton is blessed with natural resources due to the effects glaciation had on its topography. Isolated wetland pockets, forests, glacial ponds provide unique niches for plants and animals. The largest of these features is Knops Pond and Lost Lake, over 200 acres of freshwater teeming with fish, inhabited by mammals, reptiles and birds of all kinds; from eagles to pileated woodpeckers, and from great blue herons to humingbirds.

The waters were impounded twice over time to accommodate the needs of Man. The first dam raised the level of Knops Pond in the mid-19th century for ice harvesting. An icehouse and haul road can still be seen. The second impoundment around the beginning of the 20th century created Lost Lake from Cow Pond Meadows. The water being used for processing in a local industry.

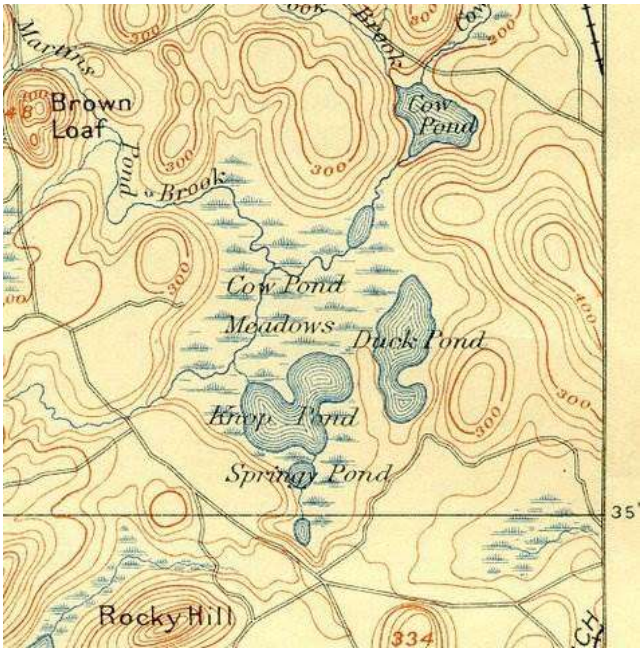


Figure 1Before Impoundment

Over sixty years ago, The American Baptist Churches of America purchased a large parcel of land bordering Lost Lake from Dr. Peter Thompson and established Grotonwood. Grotonwood provides a wide variety of year-round camping opportunities for inner city youth, adults with special needs, family camps, conferences and retreats to name a few activities. Their beach is a large focal point for their many summer activities and water quality is an important element in making their mission a success. Grotonwood and the Groton Lakes Association have had a close, supportive relationship over the years.

In the 1970s, a private boat ramp became public when it was gifted to the Commonwealth of Massachusetts. Finally, years later, an eighteen-acre parcel of land taken by the Groton Conservation Committee was turned into Sargisson Beach for the recreational use by the community.

Today, Knops Pond/Lost Lake, is the centerpiece in Groton for year-round outdoor recreation in the form of fishing, swimming, kayaking, canoeing sailing, powerboating, and skiing, and in the winter, fishing, snowmobiling, skating and cross-country skiing. Unfortunately, with increased use come other issues that can negatively impact water quality, aquatic plant life and recreation.

Many limnological studies have been conducted on the lake to provide guidance to the Town for best management principles to protect the lakes from degradation. The Groton Lakes Association (GLA) has usually taken the lead to fund these studies. The most recent study performed in 2016 gave greater clarity to the issues challenging the well-being of the lake.

Groton's thirty-two square miles is not isolated from the rest of the world, so, unfortunately, it is exposed to infestation from non-native plants and animals which can wreak havoc on our resources. The Invasive Weed Committee now studies the terrestrial pests. Similarly, the GLA, has monitored and treated non-native aquatic weed species. The biggest problems facing the lakes is Cabomba caroliniana (fanwort) and Myrophyllum heterophyllum (variable milfoil).

Figure 2 Cabomba in Bloom


Figure 4 Cabomba caroliniana

These invasives plague lakes throughout the country and indeed the world. They have no natural predators and can take over our native aquatic plants very quickly.

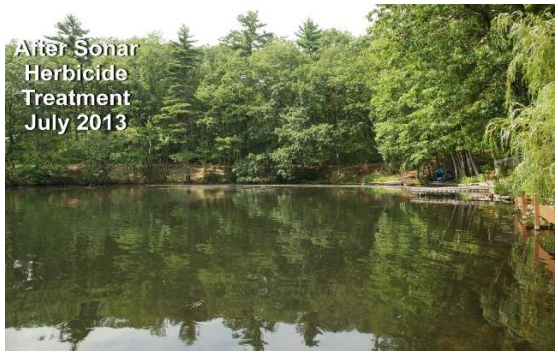
Where do they come from? Seeds from these plants can be carried by the wind, piggyback on land animals, birds and Man. Man, inadvertently, increases weed infestation by transporting them on boat trailers, boats and motors. An un-infested lake can quickly become an infested one through these means. The whole ecosystem becomes stressed, native aquatic plants suffer, fish populations decrease, recreational activities are curtailed and swimming in weed clogged waters becomes dangerous.

Project Description

The main lesson we have learned from these infestations is that mechanical means (harvesting by hand or machine), benthic barriers, and/or winter drawdowns do not work effectively. What does work is attacking the plant with systemic herbicides; herbicides that break down and do no harm to animal life; herbicides that have been used safely in drinking water reservoirs for thirty years.

Cabomba growth in Knops Pond/Lost Lake has reached a tipping point. Our consultant has recommended a complete restoration through a whole lake treatment with the herbicide Fluoridone (Sonar). It is effective on Cabomba as it attacks the roots of the plant. It is impossible to kill 100% of these noxious weeds, but with annual spot treatments, the Cabomba growth can be retarded for years

.



The treatment will actually be a three-step process throughout the summer to maximize the plant eradication. Native plants will be affected as well, but not long term. They will rebound the following year providing the needed cover for the fish population.

Long Term Management

The most recent study of the lakes included its rather expansive watershed. The watershed is fourteen times larger than the lakes and contain some 800 residences, commercial property and some farmland.

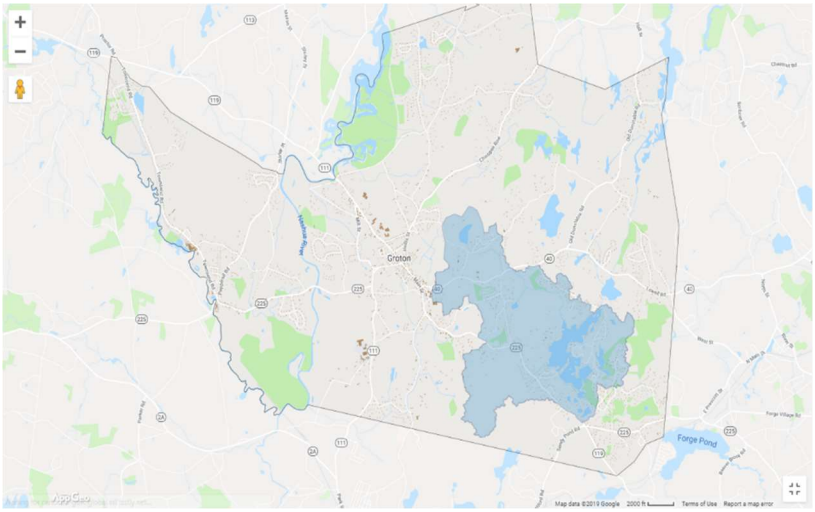


Figure 7 Knops Pond/Lost Lake Watershed

This watershed contributes about two-thirds of the Phosphorus, the nutrient fueling plant and algal growth, coming into the lake through its two inlets. Most of this infiltration is along Martin's Pond Brook. A large amount comes from non-point sources such as stormwater runoff.

In addition to weed infestation, we are seeing increases in algae and cyanobacteria due to an excess of phosphorus in the lakes. Cyanobacteria is toxic to animals and can cause illness in humans. These worsening conditions reinforce the need to reduce the phosphorus budget coming into our lakes from the surrounding watershed. The GLA and GPAC plan to fund a water quality testing program to monitor the health of the lakes.

Figure 8 Blue-Green Algae

In order to sustain the success of a whole lake treatment, these sources must be identified and best managed practices be used to reduce the Phosphorus entering the lakes. There are many such sites along roads and private properties as well. An educational brochure was produced from the last study and distributed to every residence in the watershed.

The GLA and the Great Ponds Advisory Committee (GPAC) are taking the lead in securing future funding to 1) identify the non-point sources; and 2) implement best management practices to curb or slowdown the Phosphorus pollution. Less Phosphorus will improve the lake quality; reduce the nutrients plants require and preserve the lake for future generations.

Figure 9 Late Summer Algal Bloom

In addition, the GLA will use its membership funds following the restoration for spot treatments in subsequent years as needed. GPAC is working with the Town to secure long-term financing for future treatments that will be needed to maintain this outstanding water resource for the whole community.

Attachments


Lost Lake & Knops Pond Watershed Ma


Inlets & Outlets Map from ESS Groton Lost

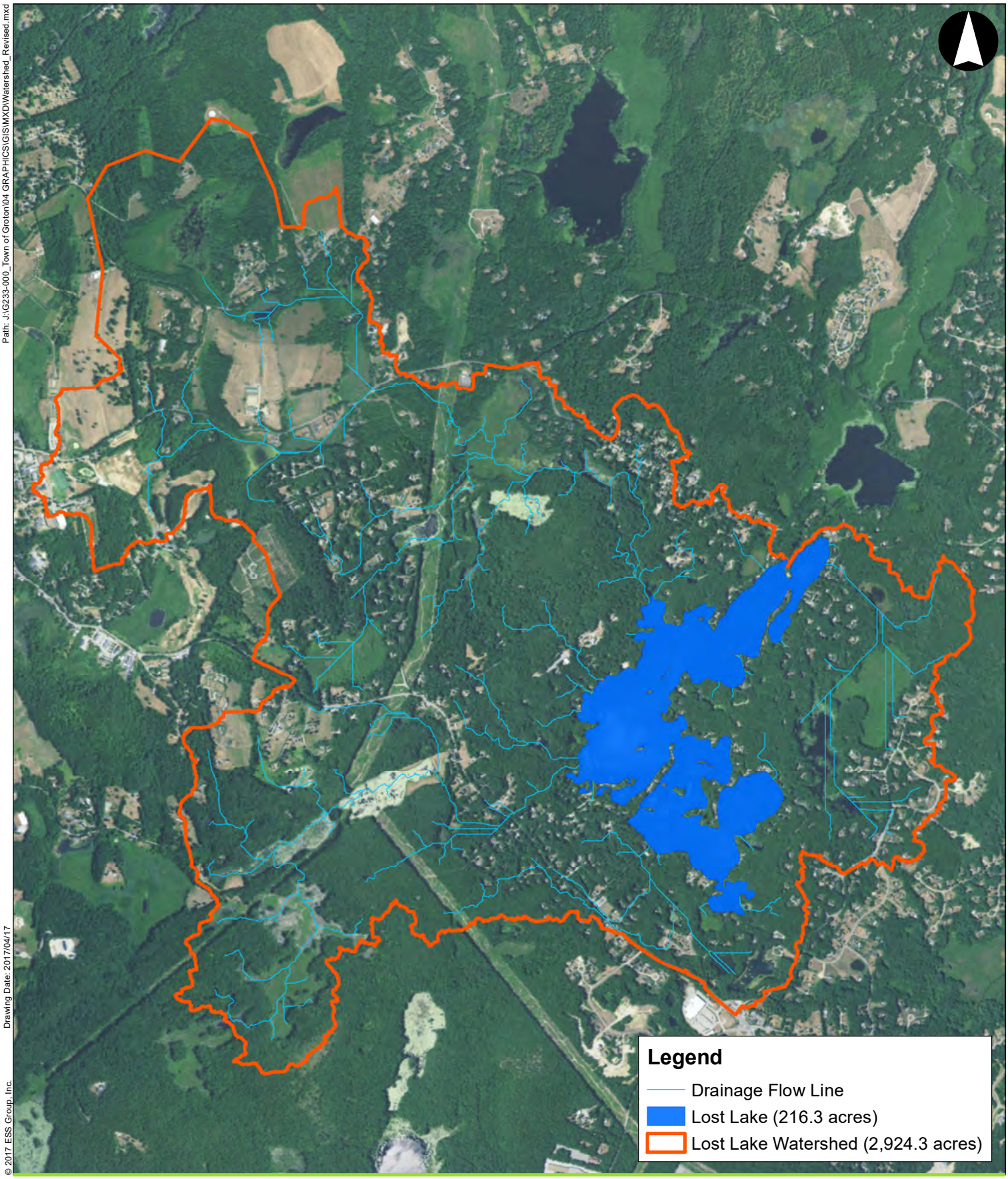

Year End Report LLKP_2013_compiled


CPC p.1 Application.pdf


CPC p.2 Application.pdf

https://www.youtube.com/watch?v=yYGgHoGwlaU&feature=youtu.be

https://www.youtube.com/watch?v=XnXQb9Yahzo



Path: J:\G233-000_Town of Groton\04 GRAPHICS\GIS\MXD\Watershed_Revised.mxd

Drawing Date: 2017/04/17

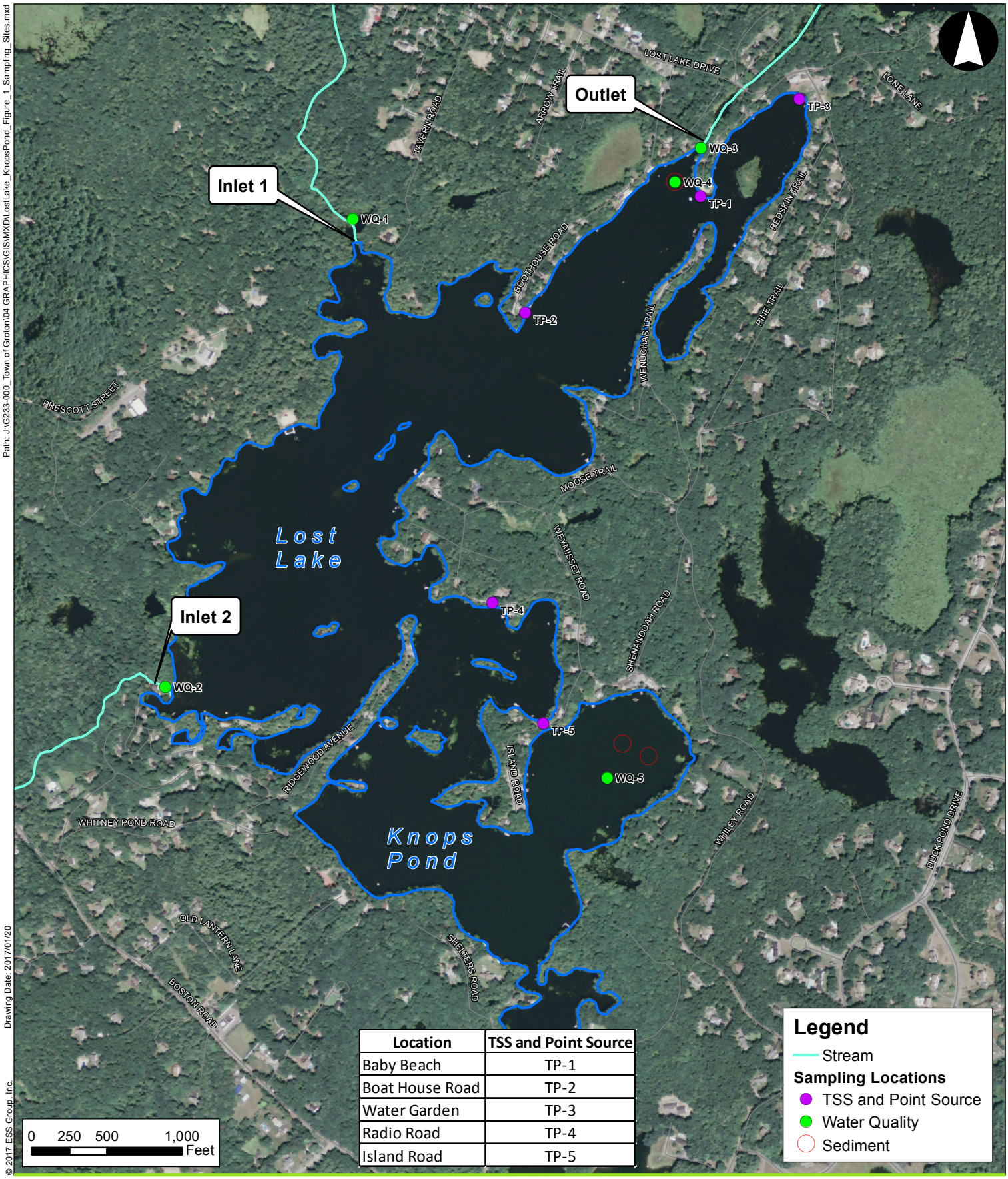
Lost Lake and Knops Pond
Groton, Massachusetts

1 inch = 2,200 feet

0 1,100 2,200 Feet

Source: 1) ESRI, World Imagery, 2013
2) FEMA, Merrimack River, Nashua River LIDAR, 2012,2011
3) EOT, Roads, 2009 4) MassGIS, Town Boundaries, 2002

Lost Lake Watershed



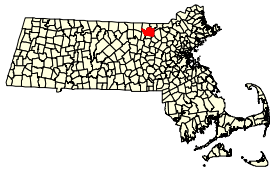
Location	TSS and Point Source
Baby Beach	TP-1
Boat House Road	TP-2
Water Garden	TP-3
Radio Road	TP-4
Island Road	TP-5

ess group
environmental consulting & engineering services

Lost Lake and Knops Pond
Groton, Massachusetts

1 inch = 850 feet

Source: 1) USDA, NAIP Ortho Imagery (1m), 2014
2) USGS, MA Hydrography, 2014
3) Aquatic Control Technologies, Depth, 2011
4) EOT, Roads, 2009



Sampling Locations

Figure 1

LOST LAKE AND KNOPS POND
AQUATIC VEGETATION MANAGEMENT PROGRAM
2013 ANNUAL REPORT

October 2013

Prepared for:
Groton Lakes Association
And the Town of Groton
c/o Mr. Art Prest
8 Weymisset Road
Groton, MA 01450

Prepared by:
Aquatic Control Technology
11 John Road
Sutton, MA 01590

AQUATIC CONTROL TECHNOLOGY
POND AND LAKE MANAGEMENT SPECIALISTS

TABLE OF CONTENTS

INTRODUCTION

A comprehensive program to control invasive aquatic plants species was initiated at Lost Lake and Knops Pond in 2011. During a 2011 inspection of the pond, five submersed invasive plants were observed: fanwort (*Cabomba caroliniana*), variable milfoil (*Myriophyllum heterophyllum*), Eurasian milfoil (*Myriophyllum spicatum*), spiny naiad (*Najas minor*), and curlyleaf pondweed (*Potamogeton crispus*). In 2011 an estimated 130 acres (greater than 60 percent of the surface area) of the 204 acre waterbody were inundated with nuisance-level growth of submersed invasive non-indigenous plant species. After considering the extent of the infestation and the limited number of management options available for such a wide-scale infestation, a decision was made to pursue funding and permit approval for an herbicide treatment program. Sonar (active ingredient fluridone) was selected as the herbicide of choice due to its proven efficacy at controlling the invasive species in Lost Lake and Knops Pond and its favorable toxicology. Over the course of 2011 and 2012 The Groton Lakes Association worked to secure the funding and with the help of Aquatic Control Technology completed the permitting process for a management program. An approved Order of Conditions permit was issued during the fall of 2012 and planning efforts continued for a spring 2013 treatment.

Lost Lake and Knops Pond was successfully treated with Sonar herbicide during the 2013 season. The following report summarizes the results of the 2013 treatment program and details findings from the late summer comprehensive aquatic plant survey. Recommendations for ongoing milfoil management efforts at Lost Lake and Knops Pond are also provided. The treatment and survey work in 2013 was performed by Aquatic Control Technology (ACT) for the Lost Lake and Knops Pond Association and its project partner, the Town of Groton Board of Selectmen.

HERBICIDE TREATMENT PROGRAM - 2013

Program Chronology

A chronology of the 2013 treatment program is provided below:

Date	Task	Notes
4/08/13	Pre-treatment inspection	Invasives actively growing. Variable milfoil growth extensive and appeared to be overwintering 2012 growth. Dense filamentous algae mats observed in several locations in Lost Lake
4/24/13	Initial Sonar herbicide treatment	Applied 25 ppb of Sonar One in fanwort infested areas; 7ppb of Sonar One in Eurasian milfoil infested areas
5/14/13	FasTEST sampling	2.25 ppb average surface sample concentration
5/22/13	Follow-up Sonar herbicide treatment	Applied 15 ppb Sonar One in fanwort infested areas; 3 ppb Sonar One in Eurasian milfoil infested areas; 5 ppb Genesis lake-wide
6/03/13	FasTEST sampling	8.9 ppb average concentration
6/20/13	FasTEST sampling	6.75 ppb average concentration
6/30/13	FasTEST sampling (2 samples only)	8 ppb average concentration
7/9/13	Final Sonar herbicide application	Applied 4 ppb of Sonar Genesis lake-wide
7/25/13	FasTEST sampling	4.4 ppb; irrigation restriction lifted
8/23/13	Comprehensive late season survey	No viable EWM found

Pre-Treatment Inspection

On 8 April 2013, the entire shoreline littoral area of the lake was surveyed by Aquatic Control Technology to determine the stage of milfoil growth and to make adjustments to the 2013 treatment scope. Fanwort plants appeared to be showing less than one foot of new active growth. Eurasian milfoil and curlyleaf pondweed had reached heights of 2-3 feet in the water column. Variable milfoil growth was high in the water column and at the surface in many locations. Due to the brown color and rigidity of the plants the variable milfoil growth appeared to be overwintered growth from 2012. Water temperatures were greater than 10 °C (50 °F) throughout the majority of the water column and the water level was favorably low. A mutual decision was reached to schedule and perform the initial Sonar herbicide application on 24 April 2013.

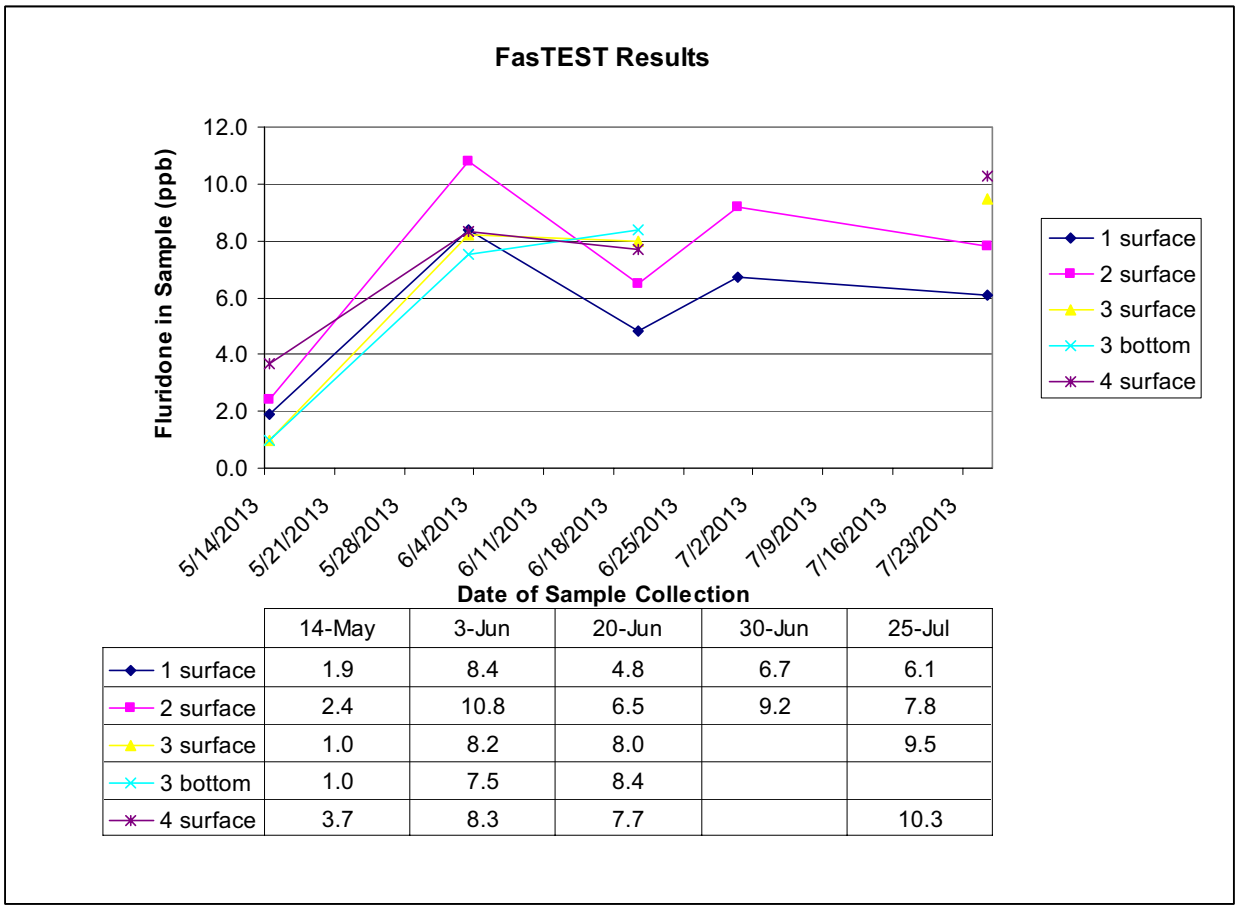
Details of 2013 Treatment Program

The recommended treatment plan was to initiate treatment early in the growing season and utilize Sonar One, a time-release pellet formulation of fluridone. The proposed treatment protocol was to apply an initial application of 25 parts per billion (ppb) of Sonar One throughout the fanwort and variable milfoil infested acres and 7 ppb of Sonar One throughout the areas only infested with Eurasian milfoil. The targeted placement of the pellets and time-release of the active ingredient was intended to maintain higher fluridone concentrations around the less sensitive fanwort and variable milfoil plants. This approach was also favored to limit the lake-wide dose being applied and reduce the chance for downstream transport of herbicide. A booster treatment (second application) with 15 ppb of Sonar One throughout the fanwort and variable milfoil infested acres and 3 ppb of Sonar One throughout the areas only infested with Eurasian milfoil was planned approximately 4-6 weeks after the initial treatment. A second booster treatment (third application) was planned for as a contingency. Herbicide concentration sampling was planned approximately two to three weeks after each application to determine timing of booster treatments.

The initial Sonar One application was scheduled and performed on 24 April 2013. The treatment was performed in accordance with the Groton Order of Conditions (DEP: 169-1086) and the annual DEP License to Apply Chemicals (#13058). Weather conditions on the day of treatment were favorable, with partly sunny skies and an air temperature of roughly 60° F. There was no significant wind at the time of the treatment and the water surface was calm. Surface water temperature was approximately 12.8° C with a dissolved oxygen concentration of 9.5 mg/L. The treatment was conducted using an 18 foot Airboat outfitted with a calibrated cyclone spreader system. The Sonar One pellets were loaded into the spreader and evenly applied throughout pre-determined treatment sectors. A GPS unit was used to ensure that an even application was made within the targeted treatment areas. The State boat ramp located in the northeastern cove of Lost Lake was used as the base of operations. Approximately 4.0 hours were required to evenly apply the 940 pounds of Sonar One herbicide. The only challenge encountered during the initial application was the low water level limited mobility into a couple of the small coves on the southern shore of Lost Lake. We are confident that Sonar concentrations moved into these coves due to the solubility of the herbicide.

On May 14th approximately two weeks after the initial application, water samples were collected from four in-lake locations located within the treatment area and one sample was collected below the thermocline using a Van Dorn collection bottle (Figure A_1 in Appendix A). There was no outflow from the lake, so downstream fluridone sampling was not performed. The in-lake concentrations were uniform and still below the targeted lake-wide concentration, so plans were made to proceed with the second application immediately.

Table 1: FastTEST sampling results (concentrations reported in ppb)



	14-May	3-Jun	20-Jun	30-Jun	25-Jul
1 surface	1.9	8.4	4.8	6.7	6.1
2 surface	2.4	10.8	6.5	9.2	7.8
3 surface	1.0	8.2	8.0		9.5
3 bottom	1.0	7.5	8.4		
4 surface	3.7	8.3	7.7		10.3

The second herbicide application was scheduled and performed on May 22nd. Again an Airboat equipped with a bow-mounted cyclone seeder/spreader was used for the Sonar One herbicide application. Sonar Genesis was applied using an on-board 100 gallon calibrated spray tank and herbicide was applied directly to the plants through weighted hoses. Treatment proceeded systematically around the lake applying the targeted 15 ppb of Sonar One to the fanwort and variable milfoil infested areas and 3 ppb of Sonar One to the areas infested with only Eurasian watermilfoil. Additionally, 5 ppb of liquid Sonar Genesis was applied lake-wide. Weather conditions were again favorable with partly cloudy skies, a 75° F air temperature and a light variable wind. The surface water temperature had increased to 20.5° C and the dissolved oxygen concentration was still approximately 11.10 mg/L. A total of 560 pounds of Sonar One and 48 gallons of Sonar Genesis were applied. The treatment took about 3.5 hours to complete. The areas in the southern portion of Lost Lake that were not accessible during the initial treatment were accessible during the booster application. A hand blower and small pump were used to boost the herbicide concentrations in these areas. Eurasian milfoil and fanwort plants were already showing visible signs of chlorosis, bleaching symptomatic of exposure to fluridone, and curlyleaf pondweed plants had lost rigidity and were covered in periphytic algae.

FasTEST samples were collected from the four in-lake surface stations on June 3rd and June 20th. The average in-lake concentration increased to 8.9 ppb on June 3rd and to 6.75 ppb on June 20th. On June 30th two additional surface samples were collected with an average concentration of 8 ppb. The increase in concentrations between June 20th and June 30th may have indicated that fluridone was still releasing off of the clay pellets several weeks after the herbicide was applied. During the June 30th sample collection it was noted that curlyleaf pondweed and Eurasian milfoil plants were completely controlled in the majority of locations; fanwort was highly chlorotic and

the leaves were stripped from base of the stems; variable milfoil however was still up in the water column in places. Due to the fact that both fanwort and variable milfoil had not been completely controlled a final booster application was scheduled for July 9th.

The final application of Sonar was performed on July 9th. Sonar Genesis was applied using the 18 foot airboat and on-board 100 gallon calibrated spray tank. Herbicide was applied directly to the plants through weighted hoses. Treatment proceeded systematically around the lake applying the targeted 4 ppb of liquid Sonar Genesis lake-wide. Weather conditions consisted of light rain and a 70°F air temperature and a light variable wind. A total of 30 gallons of Sonar Genesis were applied. The treatment took about 3 hours to complete.

A final round of FasTEST samples were collected on July 25th. Only surface samples were collected during the final sampling round. The average Sonar concentration during the July 25th sampling round was 8.4 ppb. Given the length of time that the herbicide was held at this level in the water column and the efficacy observed on the plants, it was determined that no further treatment would be necessary in 2013.

2013 LATE SEASON COMPREHENSIVE AQUATIC VEGETATION SURVEY

Survey Methods

The comprehensive aquatic vegetation surveys performed at Lost Lake and Knops Pond on 23 August 2013 used the same methods as the September 2011 survey, which are described below:

Using ArcView software, 81 points along 20 transects were created and superimposed over the lake's littoral zone. Points were distributed across both Lost Lake and Knops Pond so as to create an accurate representation of the vegetation in the waterbody (figure 1).

Data points were navigated to by boat using a Garmin 76Cx GPS unit. At each data point vegetation was identified using an AquaVu underwater camera, collection with a throw-rake, and visual identification.

Vegetation was classified by overall cover/density ranging from 0 to 100% and biomass ranging from 1-4. Vegetation cover/density was classified based on overall cover of all plants at a particular data point. Overall biomass was estimated based on the relative volume (height of plant growth in the water column) at each data point. The index ranges from 0-4 according to the following breakdown: 0 – no plants, 1 – plants generally low-growing within a foot of the bottom, 2 – plants generally half-way through the water column, 3 – plants within 1-2 feet of the surface, 4 – plants just below or at the surface.

Findings

Consistent with the 2011 surveys, all plant species present at each data point were recorded during the comprehensive late-season survey. This allows for some quantitative comparison of the pre and post-treatment conditions.

A total of 10 species of native macrophytes were observed following treatment in 2013.

Table 2: Aquatic Plant Species and Frequency of Occurrence

Species	Common Name	2011 Frequency of Occurrence (%)	2013 Frequency of Occurrence (%)
Cabomba caroliniana	Fanwort	52	1
Myriophyllum heterophyllum	Variable milfoil	47	22
Myriophyllum spicatum	Eurasian milfoil	46	1
Najas minor	Spiny naiad	5	0
Ceratophyllum demersum	Coontail	15	4
Potamogeton robbinsii	Robbins pondweed	53	59
Potamogeton pusilus	Thinleaf pondweed	0	1
Potamogeton zosterformis	Flatstem pondweed	1	0
Potamogeton natans	Floating-leaf pondweed	5	0
Potamogeton diversifolius	Variable-leaf pondweed	2	0
Utricularia vulgaris	Common bladderwort	6	2
Utricularia purpurea	Purple bladderwort	2	1
Utricularia gibba	Humped bladderwort	0	5
Isoetes sp.	Quillwort	1	0
Elodea canadensis	Waterweed	0	1
Eleocharis sp.	Spike rush	7	0
Valisneria americana	Tapegrass	25	0
Nymphaea odorata	White waterlily	11	2
Brassenia schreberi	Watershield	11	0
Nymphoides cordata	Little floating heart	1	0
Nuphar variegatum	Yellow waterlily	4	1
Lemna sp.	Duckweed	5	0
Wolfia sp.	Watermeal	5	0
Chara sp	stonewort	2	4

As expected there were significant year-of-treatment impacts to the non-native aquatic plant community in Lost Lake and Knops Pond. The most noteworthy change is the almost complete control of the fanwort (*Cabomba caroliniana*), Eurasian milfoil (*Myriophyllum spicatum*), spiny naiad (*Najas minor*) and curlyleaf pondweed (*Potamogeton crispus*). Eurasian milfoil and fanwort were only observed at one point each. At both points, chlorosis was apparent and only five percent of the bottom was covered with invasives. Spiny naiad was completely controlled with the treatment. Curlyleaf pondweed typically scenses prior to August and as a result did not show up in either of the point surveys. That said, curlyleaf pondweed had dropped out of the water column by late May, well before natural senescence. Variable milfoil coverage was reduced by greater than fifty-percent in the year-of-treatment. The variable milfoil growth remaining at the end of the season was brown, de-foliated in places and covered in periphytic algae. Given these observations we expect only minimal re-growth of variable milfoil in 2014.

Impacts to several native aquatic plants were expected due to their sensitivity to fluridone. These species are usually impacted during the year-of-treatment, but typically begin active recovery the year-after-treatment. Among the species the native species observed after the treatment program Robbin's Pondweed was the most dominant. Robbin's Pondweed is a desirable native plant species because it creates a dense bottom cover of native plants, which helps to shade out non-native competitors. Additionally due to its low growing nature Robbin's Pondweed rarely negatively impacts recreational use.

SUMMARY AND DISCUSSION

The Sonar herbicide treatment program performed at Lost Lake and Knops Pond in 2013 provided exceptional control of the non-native plant species. The effectiveness of the 2013 treatment program is believed to be most attributable to the early start date and the lack of outflow from the lake throughout the duration of the treatment program. Reductions in the native plant population were observed, but the species that were impacted are usually the most sensitive to fluridone herbicide during the year-of-treatment. Additional recovery of the native plant population is anticipated in 2014 and in subsequent years.

It is difficult to predict the duration of control that will be achieved following a fluridone herbicide treatment program. Given our observations during the late season survey we remain optimistic that excellent carryover control will persist into the 2014 season and beyond. Evidence from other lakes treated with fluridone in the Northeast suggests that plants will eventually recover from surviving root or stem tissue and possibly from seeds. The longer that recovering plants are allowed to grow unmanaged, the more expansion of the root crowns will occur, which will make the plant that much more difficult to control in the future. Diligent monitoring and immediate management of regrowth will help to slow the rate of re-colonization.

ONGOING MANAGEMENT RECOMMENDATIONS

Invasive aquatic plant management is unfortunately an ongoing process. The 2013 fluridone herbicide treatment provided the initial control of the invasive plants in Lost Lake and Knops Pond. Despite the control achieved, recovery will occur; it is only a question of when and where. It would not be surprising to see some mild recovery during the 2014 season because there may be root or shoot structures that were not completely controlled by the fluridone in 2013. There is also a chance for recovery from an existing seed bank. Either way, most lakes that have been treated with fluridone in the Northeast, exhibit some mild recovery within one to three years following treatment. That is not to say that we anticipate the plants to reach pre-management densities in the year following treatment, but rather that in some locations small patches of non-native plants may begin to recover.

We anticipate that the first non-native plants to begin to recover will be curly-leaf pondweed and variable milfoil and as such spot treatment of these plants in select areas with the contact herbicide diquat is recommended in 2014 to prevent further recovery. In particular, based on the amount of variable milfoil biomass observed remaining in Springy Cove at the end of the 2013 treatment program, we recommend treatment with diquat in this cove early in the spring of 2014 to stave off potential re-growth.

In 2013, signs of increased blue-green algal densities were noted in a few locations. We understand the concern of the GLA regarding the potential for blue-green algae blooms. Although the native plant population will continue to recover in 2014, there is potential that the nutrients in the water no longer being utilized by non-native plants will be utilized by algae populations and as such algal blooms may occur. It would be advisable to secure permit approval on the local and state level for algal control measures in the winter of 2013/2014. This will allow for a quick response to algal bloom conditions should they occur. Over the summer of 2014 the GLA may want to consider implementing an algae monitoring program. Triggers for treatment would be best based upon a combination of a drop Secchi disk water clarity readings, observation of visual signs of blue-green algae blooms, or potentially the results of rapid sample analysis of algal species utilizing an outside laboratory. ACT would be happy to help the GLA find an appropriate lab for this analysis.

APPENDIX A

Treatment Information and FasTEST Monitoring Data

- Application 1 Report (4/24/13)
- Application 2 Report (5/22/13)
- Application 3 Report (7/9/13)
- FasTEST Sample Location Map (Figure 1)
- FasTEST Laboratory Reports (5/14, 6/3, 6/20, 6/30, 7/25)
- Photo-documentation of treatment program

Lost Lake / Knops Pond
2013 Sonar Herbicide Treatment Program

Date: 4/24/2013

Activity: First Herbicide Application

Secchi Disk Reading: 9 *feet*
2.74 *meters*

Temperature / Dissolved Oxygen Profile:

Depth (m)	*Temp (Deg C)*	*(Deg F)*	*DO (mg/l)*
Surf	12.8	55.0	9.52
1	12.3	54.1	9.10
2	11.8	53.2	8.95
3	18.7	65.7	9.81
3.5 bottom	11.8	53.2	9.29

Treatment Summary:

Product Applied: Sonar One (EPA Reg. No. 67690-45)

Quantity: 940 lbs

Target Concentration: 25 ppb in fanwort infested areas (100 acres)
7 ppb in Eurasian watermilfoil infested areas (114 acres)

Application Time: 10:30 PM start - 2:30 PM finish; 4.0 hours of application time

Equipment Used: 18 foot Airboat; calibrated cyclone spreader

Weather Conditions: partly sunny skies; air temperature ~60 F; Wind none significant water surface calm to small ripple

Problems Encountered: None

Notes:

1) No outflow, 30 inches of freeboard at dam
2) Eurasian watermilfoil showing most active growth 1-3 foot tall plants
3) Variable milfoil appeared to mostly remaining stems from last year's growth
4) Fanwort was just beginning to show active growth on the bottom
5) Filamentous algae most evident in boat launch cove; some on bottom in Lost Lake; not much seen in Knops Pond

Lost Lake / Knops Pond
2013 Sonar Herbicide Treatment Program

Date: 5/22/2013

Activity: Second Herbicide Application

Secchi Disk Reading: 10 *feet*
3.05 *meters*

Temperature / Dissolved Oxygen Profile:

Depth (m)	*Temp (Deg C)*	*(Deg F)*	*DO (mg/l)*
Surf	20.5	68.9	11.10
1	20.4	68.7	11.00
2	19.9	67.8	11.80
3	19.6	67.3	4.70

Treatment Summary:

Product Applied: Sonar One (EPA Reg. No. 67690-45)
Sonar Genesis (EPA Reg. No. 67690-54)

Quantity: Sonar One :560lbs
Sonar Genesis:48 gal

Target Concentration: 15 ppb in fanwort infested areas (100 acres)
3 ppb in Eurasian watermilfoil infested areas (114 acres)
5 ppb Genesis lake-wide

Application Time: 100 PM start - 430 PM finish; 3.5 hours of application time

Equipment Used: 18 foot Airboat; calibrated cyclone spreader and calibrated on board 100 gal spray tank

Weather Conditions: partly cloudy skies; air temperature 75 F; light variable wind
water surface calm to small ripple

Problems Encountered: None

Notes:

1) No outflow,18 inches of freeboard at dam
2) Eurasian watermilfoil showing most active growth 4-5 foot tall plants
3) Variable milfoil appeared to mostly remaining stems from last years growth -4-5 foot tall with flowering spikes
4) Fanwort showing the most evident chlorosis
5) Filamentous algae again most evident in boat launch cove; some mats in Lost Lake;
not much seen in Knops Pond

Lost Lake / Knops Pond
2013 Sonar Herbicide Treatment Program

Date: 7/9/2013

Activity: Third Herbicide Application

Secchi Disk Reading: not collected prior to third application

Temperature / Dissolved Oxygen Profile: not collected prior to third application

Treatment Summary:

Product Applied: Sonar Genesis (EPA Reg. No. 67690-54)

Quantity: Sonar Genesis:30 gal

Target Concentration: 3-4ppb lake-wide

Application Time: 1230 PM start - 330 PM finish; 3 hours of application time

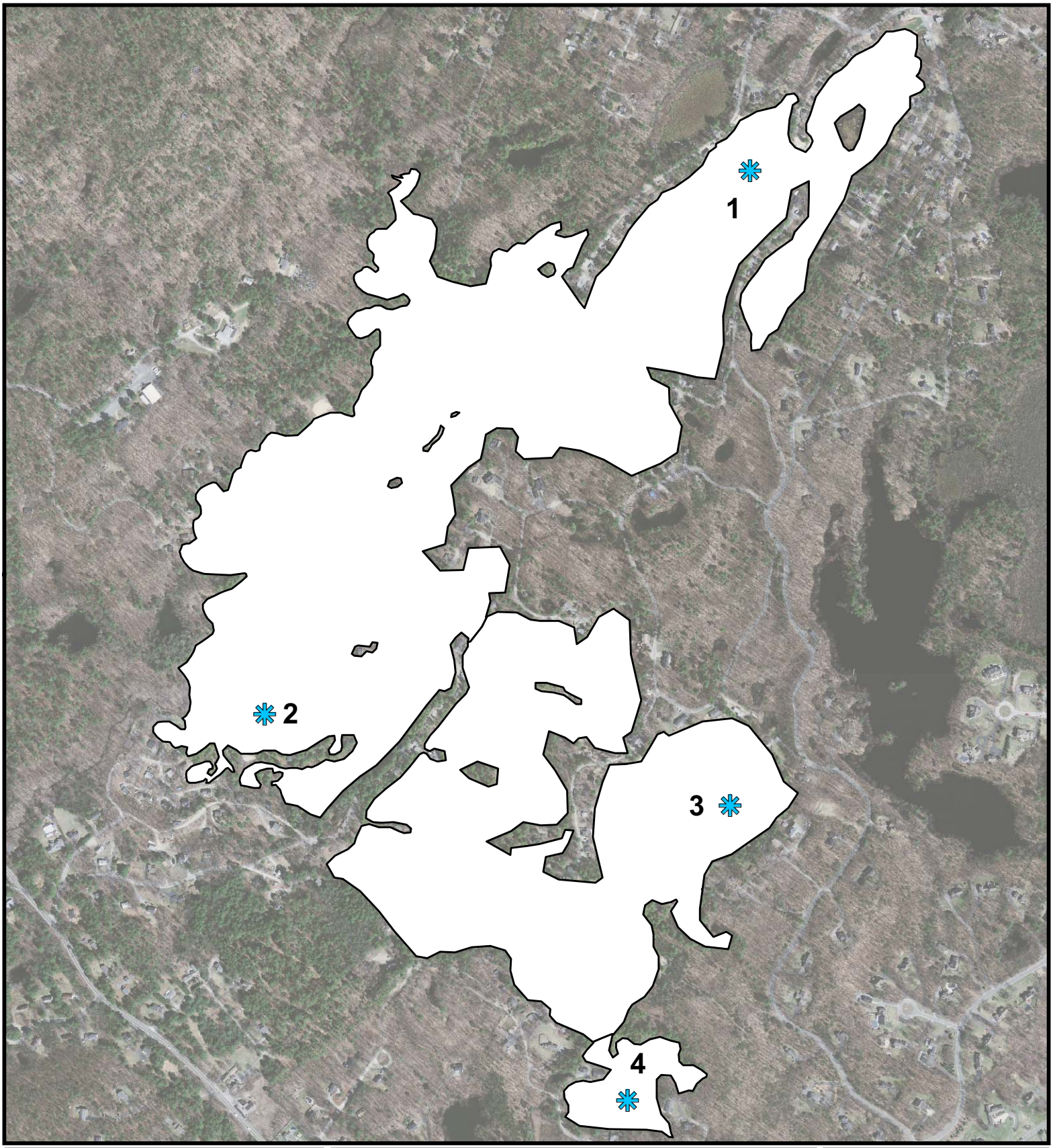
Equipment Used: 18 foot Airboat; calibrated on board 100 gal spray tank

Weather Conditions: light rain; air temperature 70 F; light variable wind
water surface ripple

Problems Encountered: None

Notes:

1) No outflow,
2) Eurasian watermilfoil showing stong signs of herbicide efficacy. Dropped out of the water collumn in most locations. Covered in periphytic algae where observed
3) Variable milfoil 4-5 foot tall with flowering spikes leaflets brown and disintegrating. Stems red.
4) Fanwort showing the most evident chlorosis. Lower leaflets stripped
5) Filamentous algae clear in boat launch cove; some mats in Lost Lake
not much seen in Knops Pond



Lost Lake and Knops Pond

Groton MA
FasTEST Sample Site Locations

FIGURE:	SURVEY DATE:	MAP DATE:
--	9/9 &12/11	10/24/11

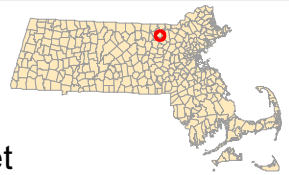
Legend

FasTEST Sample Location

N

0 500 1,000 2,000 Feet

AQUATIC CONTROL TECHNOLOGY, INC.
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-1220
WEB: WWW.AQUATICCONTROLTECH.COM



SePRO Research & Technology Campus
16013 Watson Seed Farm Road, Whitakers, NC 27891

LABORATORY REPORT

Chain of Custody: 2013-08335-00

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Gerald N Smith
E-Mail Address: gnsmith@aquaticcontroltech.com
Phone:
Fax:

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
22477	1			05/14/2013		
		Sonar/Fluridone (µg/L)	**1.9**			
22478	2			05/14/2013		
		Sonar/Fluridone (µg/L)	**2.4**			
22479	3 SURFACE			05/14/2013		
		Sonar/Fluridone (µg/L)	**< 1.00**			
22480	3 THERODINE			05/14/2013		
		Sonar/Fluridone (µg/L)	**< 1.00**			
22481	4			05/14/2013		
		Sonar/Fluridone (µg/L)	**3.7**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2013-08335-00**

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 05/15/2013
Time Received: 10:00
Date Results Sent: 05/16/2013

Sample Preparation Date: 05/15/2013
Date Analysis Performed: 05/16/2013

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

Original

SePRO Research & Technology Campus
16013 Watson Seed Farm Road, Whitakers, NC 27891

LABORATORY REPORT

Chain of Custody: 2013-09473-00

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
23870	1			06/03/2013		
		Sonar/Fluridone (µg/L)	**8.4**			
23871	2			06/03/2013		
		Sonar/Fluridone (µg/L)	**10.8**			
23872	3			06/03/2013		
		Sonar/Fluridone (µg/L)	**8.2**			
23873	3 DEEP			06/03/2013		
		Sonar/Fluridone (µg/L)	**7.5**			
23874	4			06/03/2013		
		Sonar/Fluridone (µg/L)	**8.3**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2013-09473-00**

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/05/2013
Time Received: 10:00
Date Results Sent: 06/06/2013

Sample Preparation Date: 06/05/2013
Date Analysis Performed: 06/06/2013

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

Original

SePRO Research & Technology Campus
16013 Watson Seed Farm Road, Whitakers, NC 27891

LABORATORY REPORT

Chain of Custody: 2013-10818-00

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
24558	1			06/20/2013		
		Sonar/Fluridone (µg/L)	**4.8**			
24559	2			06/20/2013		
		Sonar/Fluridone (µg/L)	**6.5**			
24560	3			06/20/2013		
		Sonar/Fluridone (µg/L)	**8.0**			
24561	3 DEEP			06/20/2013		
		Sonar/Fluridone (µg/L)	**8.4**			
24562	4			06/20/2013		
		Sonar/Fluridone (µg/L)	**7.7**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2013-10818-00**

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	**Results**	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/25/2013
Time Received: 10:00
Date Results Sent: 06/26/2013

Sample Preparation Date: 06/25/2013
Date Analysis Performed: 06/26/2013

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

Original

SePRO Research & Technology Campus
16013 Watson Seed Farm Road, Whitakers, NC 27891

LABORATORY REPORT

Chain of Custody: 2013-11211-00

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
24735	1			06/30/2013		
		Sonar/Fluridone (µg/L)	**6.7**			
24736	2			06/30/2013		
		Sonar/Fluridone (µg/L)	**9.2**			

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 07/02/2013
Time Received: 10:00
Date Results Sent: 07/03/2013

Sample Preparation Date: 07/02/2013
Date Analysis Performed: 07/03/2013

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

Original

SePRO Research & Technology Campus
16013 Watson Seed Farm Road, Whitakers, NC 27891

LABORATORY REPORT

Chain of Custody: 2013-12683-00

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Lost Lake - MA Waterbody Size (acres): 000 Depth Average: 000

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
25420	1			/ /		
		Sonar/Fluridone (µg/L)	**6.1**			
25421	2			/ /		
		Sonar/Fluridone (µg/L)	**7.8**			
25422	3			/ /		
		Sonar/Fluridone (µg/L)	**9.5**			
25423	4			/ /		
		Sonar/Fluridone (µg/L)	**10.3**			

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 07/30/2013
Time Received: 10:00
Date Results Sent: 07/31/2013

Sample Preparation Date: 07/30/2013
Date Analysis Performed: 07/31/2013

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

Original

Lost Lake and Knops Pond – Groton, MA

Dense Fanwort and Eurasian milfoil cover September 2011

A mix of 2012 growth and an understory of 2013 growth of Eurasian milfoil. April 2013 (Pre-treatment)

Dense Eurasian milfoil matted to the surface September 2011

2012 growth of variable milfoil remaining in the water column in April 2013 (Pre-treatment)

Lost Lake and Knops Pond – Groton, MA

Progression of chlorosis in fanwort and variable milfoil on May 7, 2013

Dying Eurasian milfoil covered in periphytic algae

Chlorosis of Fanwort visible from the surface June 20 2013

Healthy bottom cover of low growing native Robbins pondweed August 23, 2013

Lost Lake and Knops Pond – Groton, MA

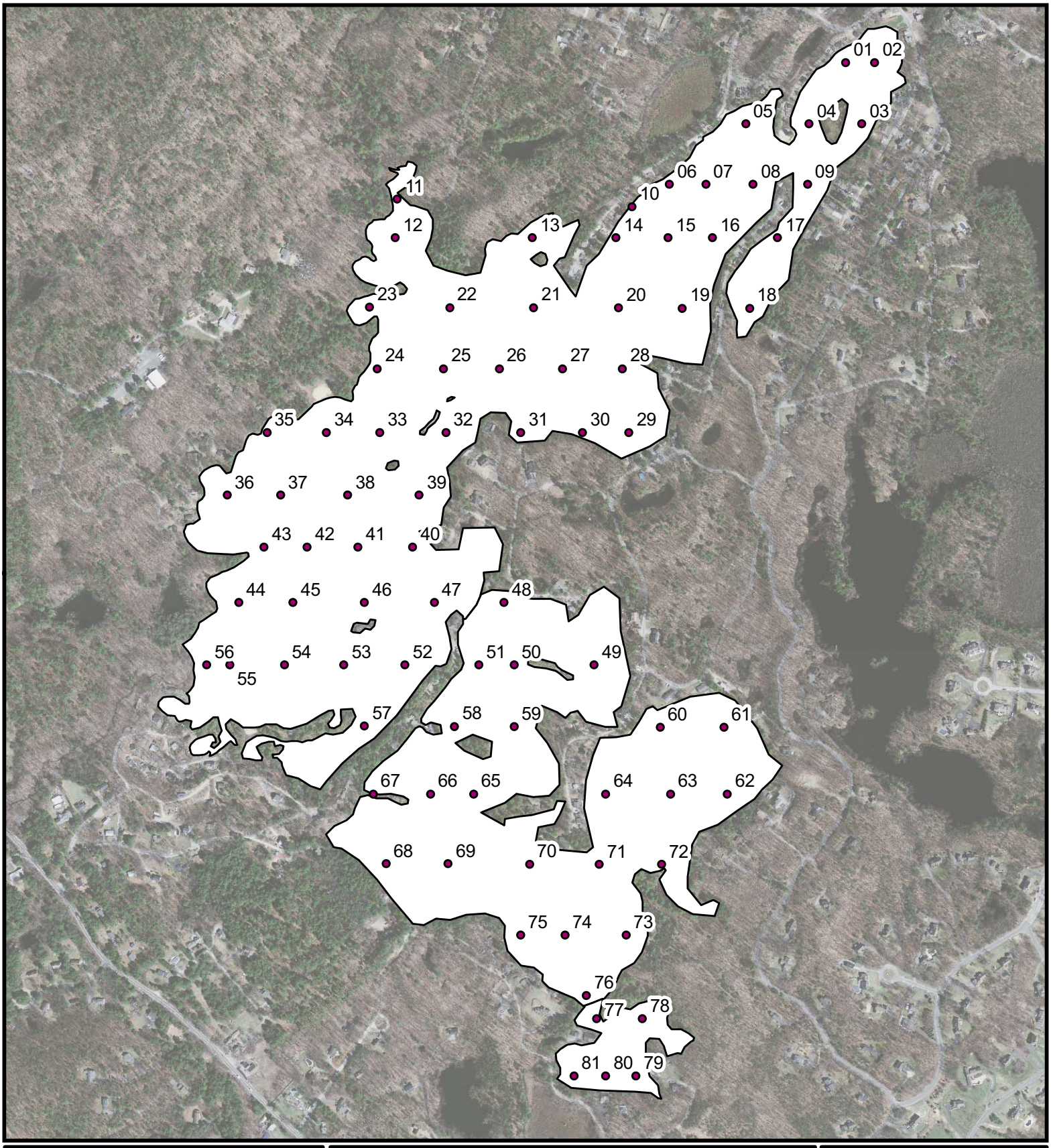
Before Lake Restoration Project. Photo taken by the Groton Lakes Association

After Lake Restoration Project. Photo taken by the Groton Lakes Association

APPENDIX B

Comprehensive Aquatic Vegetation Survey Information

- Data Point Sampling Locations
- Field Data Table 2011
- Field Data Table 2013



Lost Lake and Knops Pond

Groton MA
Transect Point Locations

FIGURE:	SURVEY DATE:	MAP DATE:
--	--	--

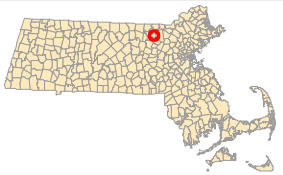
Legend

- Transect Point Location

N

0 500 1,000 2,000 Feet

AQUATIC CONTROL TECHNOLOGY, INC.
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-1220
WEB: WWW.AQUATICCONTROLTECH.COM



Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover	Plant Species Percent Cover																					
							Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Isoetes sp.	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
1	7	4	muck	4	100	90	50	30	10			10																
2	5.5			2	100	80	20	5	5	50		5				1				5	5	5						
3	7	3	muck	3	100	38	20	10	5	3		60											1					
4	7			3	100	90	20	60	10			10																
5	11			1	80	10	10					70																
6	8			1	100	0						100																
7	9.5	13	muck	1	100	10	10				10	80																
8	11			1	100	0						100																
9	7.5	3.5	muck	2	100	70	8	60	2			20																
10	8			1	100	0						100																
11	3.5	2	muck/sand	3	60	50	30		20												8				1	1		
12	4			4	70	60	40		20																5	5		
13	6	0.33	muck/sand	3	100	30			15	15		60								10								
14	8			1	100	0						100																
15	8.5	3.5	muck	1	100	0																						
16	9			3	90	5			5		40	45																
17	6.5	3	muck	4	70	51	40	10	1			15										4						
18	5.5			4	100	66	60	6			1	30										3						
19	11	>2	muck	1	100	0						100																
20	8			2	100	5			5		10	85																
21	7.5	4	muck	2	100	10			10		5	85																
22	8			2	100	10			10		10	80													5	5		
23	6	1.5	muck/rock	4	100	15	5		10		5	60	2							10		5		3				
24	7			3	100	10			10			70								20								
25	8.5	3.5	muck	2	100	20			20		40	40																
26	10			2	100	20			20		20	60																
27	8	4.0	muck	2	100	10			10		30	60																
28	7			2	80	0						30								50								
29	7	3.0	muck	2	100	10			10			85								5								
30	7.5			2	100	10			10		20	70																
31	7.5	4.0	muck	2	100	10			10		90																	
32	8			2	85	10			10			70								5								

Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover	Plant Species Percent Cover																					
							Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Isoetes sp.	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
33	10	>3	muck	3	90	30			30			60																
34	8			3	100	70	20	10	40			30																
35	8	2.0	muck/sand	4	100	40		10	30			45									10	5						
36	8			3	100	90	70	10	10			5								5								
37	8	3.0	muck	3	100	40	10	10	20			40																
38	7.5			2	90	10			10			80																
39	8	4.0	muck	3	100	20			20			60								20					10	10		
40	7.5			3	100	10	5		5			30								60								
41	7	5.0	muck	1	100	0						100																
42	8			2	100	30		10	20																			
43	4	0.0	rock/sand	1	5	0												5										
44	7			4	100	80	10	60	10			18		2														
45	7	4.0	muck	3	100	15		10	5							5				80								
46	7			2	100	2		1	1			48								50								
47	7.5	2.5	muck	2	95	15		10	5			10								70								
48	7			4	100	90	50	40													10							
49	6.5	2.5	muck	4	100	45	20	20	5					5						10	10	20						
50	6.5			3	100	30	20	10											30		20	20						
51	7.5	5.5	muck	3	100	40		40				15			15					30								
52	7			2	100	10		5	5			30								60								
53	7	4.0	muck	2	100	20		20				80																
54	7			3	100	100	80	20																				
55	6.5	2.5	muck	4	100	90	90													5				5				
56	4			4	100	30	5	5		20										20	10	5		5				30
57	7	1.5	muck/sand	3	100	80	70	10												20								
58	6			2	60	50	30	20							5				5									
59	4	0.0	rock/sand	0	0	0																						
60	>15			1	5	5	5																					
61	>18			0	0	0																						
62	>15			0	0	0																						
63	>20			0	0	0																						
64	>15			0	0	0																						

Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover	Plant Species Percent Cover																					
							Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Isoetes sp.	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
65	10.5			3	90	90	80	10																				
66	9			2	90	90	10	80																				
67	6	4.0	muck	4	100	100	90	10																				
68	10			2	95	90	80	10								5												
69	>15			2	50	50	50																					
70	13		rock	3	40	40	20	20																				
71	>15			1	10	10	10																					
72	4.5	0.0	sand	3	90	60	20	40						10						20								
73	13			3	80	80	80																					
74	>15			2	60	55	40	15								5												
75	14			2	50	50	50																					
76	6	0.0	sand	1	95	5	5																					
77	6	0.5	sand	1	100	80	40	40								10			10									
78	7			4	100	30	20	10									20		20		10							20
79	13.5			2	70	60	20	40													10							
80	14			2	20	10		10											10									
81	5.5	2.5	muck	4	100	60	30	30						10			10		10			10						

Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover		Plant Species Percent Cover																										
								Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton pusilus	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Utricularia gibba	Isoetes sp.	Elodea	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
1	7	4	muck	2	75	25			25				50																					
2	5.5			1	50	5			5					40				5																
3	7	3	muck	1	75	0							75																					
4	7			1	25	0							20					5																
5	11			2	100	0						25	75																					
6	8			1	100	0							100																					
7	9.5	13	muck	1	75	0							75																					
8	11			2	20	0							20																					
9	7.5	3.5	muck	1	75	0							75																					
10	8			1	100	0							100																					
11	3.5	2	muck/sand	2	20	5		5					15																					
12	4			1	10	0							10																					
13	6	0.33	muck/sand	1	75	0							75																					
14	8			1	100	0							100																					
15	8.5	3.5	muck	1	30	0							30																					
16	9			1	30	0						10	20																					
17	6.5	3	muck	1	25	0						5	20																					
18	5.5			1	25	0							25																					
19	11	>2	muck	1	100	0							100																					
20	8			2	25	0							25																					
21	7.5	4	muck	1	100	0							100																					
22	8			1	100	0							100																					
23	6	1.5	muck/rock	1	75	0							75																					
24	7			1	100	0							100																					
25	8.5	3.5	muck	1	100	5				5			95																					
26	10			1	100	0							100																					
27	8	4.0	muck	1	100	0							100																					
28	7			1	100	0							100																					
29	7	3.0	muck	1	100	0							95									5												
30	7.5			1	100	0							100																					
31	7.5	4.0	muck	1	100	0							100																					
32	8			1	100	0							100																					
33	10	>3	muck	1	100	0							100																					
34	8				0	0																												
35	8	2.0	muck/sand		0	0																												
36	8			2	20	20			20																									
37	8	3.0	muck	1	100	0							100																					
38	7.5			1	100	0							100																					
39	8	4.0	muck	1	100	0							100																					
40	7.5			1	100	0							100																					

Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover		Plant Species Percent Cover																										
								Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton pusilus	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Utricularia gibba	Isoetes sp.	Elodea	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
41	7	5.0	muck	1	100	0							100																					
42	8			2	100	5			5				95																					
43	4	0.0	rock/sand	2	45	15			15																									30
44	7			1	100	20			20				80																					
45	7	4.0	muck	1	100	0							100																					
46	7			1	100	0							100																					
47	7.5	2.5	muck	1	100	5			5				95																					
48	7			0	0	0																												
49	6.5	2.5	muck	1	20	20			20																									
50	6.5			0	0	0																												
51	7.5	5.5	muck	0	0	0																												
52	7			1	100	0							100																					
53	7	4.0	muck	1	100	0							100																					
54	7			1	100	5			5				95																					
55	6.5	2.5	muck	2	100	10			10				90																					
56	4			3	60	0													15						30			5				10
57	7	1.5	muck/sand	2	40	20			20				20																					
58	6			0	0	0																												
59	4	0.0	rock/sand	1	100	0																												100
60	>15			0	0	0																												
61	>18			0	0	0																												
62	>15			0	0	0																												
63	>20			0	0	0																												
64	>15			0	0	0																												
65	10.5			1	50	0							10							40													
66	9			1	40	10			10											30													
67	6	4.0	muck	1	40	10			10											30													
68	10			0	0	0																												
69	>15			0	0	0																												
70	13		rock	0	0	0																												
71	>15			0	0	0																												
72	4.5	0.0	sand	4	20	0																			20									
73	13			0	0	0																												
74	>15			0	0	0																												
75	14			0	0	0																												
76	6	0.0	sand	0	0	0																												
77	6	0.5	sand	1	50	10			10											40													
78	7			3	50	50			50																									
79	13.5			4	50	50			50																									
80	14			3	100	100			100																									

Point Number	Water Depth	Sediment Depth	Sediment Type	Biomass	Percent Cover	Invasive Species Percent Cover		Plant Species Percent Cover																									
								Cabomba caroliniana	Myriophyllum heterophyllum	Myriophyllum spicatum	Najas minor	Ceratophyllum demersum	Potamogeton robbinsii	Potamogeton pusilus	Potamogeton zosterformis	Potamogeton natans	Potamogeton diversifolius	Utricularia vulgaris	Utricularia purpurea	Utricularia gibba	Isoetes sp.	Elodea	Eleocharis sp.	Valisneria americana	Nymphaea odorata	Brassenia schreberi	Nymphoides cordata	Nuphar variegatum	Lemna sp.	Wolfia sp.	Chara sp
81	5.5	2.5	muck	4	60	60			60																								

Annual Report
2019 Aquatic Vegetation Management Program
Lost Lake & Knops Pond
Groton, Massachusetts

Prepared on: December 13, 2019

Prepared for: Groton Lakes Association
& Town of Groton
c/o Mr. Brad Harper
bradharper4@gmail.com

INTRODUCTION

In accordance with the existing aquatic plant management contract between SŌLitude Lake Management and the Groton Lake Association and the Town of Groton, the following document serves to provide this year's treatment and survey results and the management recommendations for next season. The objective of the management program is to control invasive vegetation species within the waterbody, specifically, Curly-leaf Pondweed (*Potamogeton crispus*), Variable Milfoil (*Myriophyllum heterophyllum*) and Fanwort (*Cabomba caroliniana).* Due to the increased expansion of fanwort in recent years, it was mutually decided not to treat it this season in anticipation of a whole lake treatment with fluridone in 2020.

All management activities were consistent with the Order of Conditions (DEP File #169-1086) and the License to Apply Chemicals issued by the MA DEP – Office of Watershed Management (#19202).

A chronology of the 2019 management program and brief description of events follows.

- Submit DEP License to Apply Chemicals.....6/1/2019
- Pre-Treatment Survey 5/13/2019
- DEP License to Apply Chemicals Issued.....6/11/2019
- Curly-leaf Pondweed & Milfoil Treatment 06/11/2019
- Interim Survey 7/30/2019
- Post-Treatment Survey.....9/16/2019

2019 HERBICIDE TREATMENT PROGRAM

Early-Season Survey

The early-season survey of Lost Lake and Knops Pond was performed on May 13th by a SOLitude Biologist. During the survey, the entire waterbody was toured with a 10-ft jonboat. A throw-rake and underwater camera were used to gain

view of the entire water column. Aquatic plant species were identified and general distribution of species type, density, and location were recorded. The table below details the species observed during both the early- and late-season surveys.

Table 1: Aquatic Vegetation Species Present

Origin	Common Name	Scientific Name
Native	Robbin's pondweed	*Potamogeton robbinsii*
	Tape grass	*Vallisneria americana*
	Ribbon-leaf pondweed	*Potamogeton epihydrus*
	Common bladderwort	*Utricularia vulgaris*
	Purple bladderwort	*Utricularia purpurea*
	Floating bladderwort	*Utricularia minor*
	White water lily	*Nymphaea odorata*
	Yellow water lily	*Nuphar lutea*
	Water-shield	*Brasenia schreberi*
	Arrowhead	*Sagittaria sp.*
Non-native, invasive	Variable watermilfoil	*Myriophyllum heterophyllum*
	Fanwort	*Cabomba caroliniana*
	Curly-leaf pondweed	*Potamogeton crispus*

During the early-season survey, Robbin's Pondweed was the most common species observed followed by curly-leaf pondweed and water lily. Curly-leaf Pondweed was observed in moderate to sparse areas throughout both Lost Lake and Knops Pond (see **Figure 1**). Only a few small patches of variable watermilfoil were observed. Due to its late growth habits, fanwort was not observed at this time.

Curly-leaf Pondweed has rapidly dispersed along much of the shoreline of Lost Lake and is creeping into Knops Pond; the most dominant beds are in the southern end of Lost Lake. Curly-leaf pondweed has multiple methods of reproduction, including fragmentation, turions, and seeds. This species begins its new growth during the fall of the prior year and reaches maturity by late May into June. It then drops winter buds known as turions and then begins to senesce. The adult plant drops from the water column through July and August when the water temperature is at its warmest. Due to its multiple reproductive methods, curly-leaf pondweed has the ability to spread quickly, out-competing native species, contributing large amounts of biomass to the organic layer and therefore, contributes to the nutrients present in a waterbody. With that said, management of curly-leaf pondweed at Lost Lake/Knops Pond should remain aggressive.

Initial Herbicide Application:

Originally, separate treatments for curly-leaf pondweed and milfoil were planned however based on the plant growth observed during the survey and available budgets, a single treatment was scheduled on June 11th. Notifications of the treatments were published and signs displaying water use restrictions were posted around the shoreline by the Groton Lakes Association and Town. This treatment focused on areas of curly-leaf pondweed and milfoil identified during the pre-treatment survey.

The treatment was applied using specially designed 18-foot Jon boat equipped with a low-pressure pump and a calibrated spraying system. The herbicide was diluted with lake water in an onboard mixing tank and evenly applied sub-surface to

the target treatment areas using weighted hoses. Treatment area boundaries were pre-loaded onto a GPS unit that was used for real-time navigation to ensure that the herbicide was evenly applied throughout the designated areas.

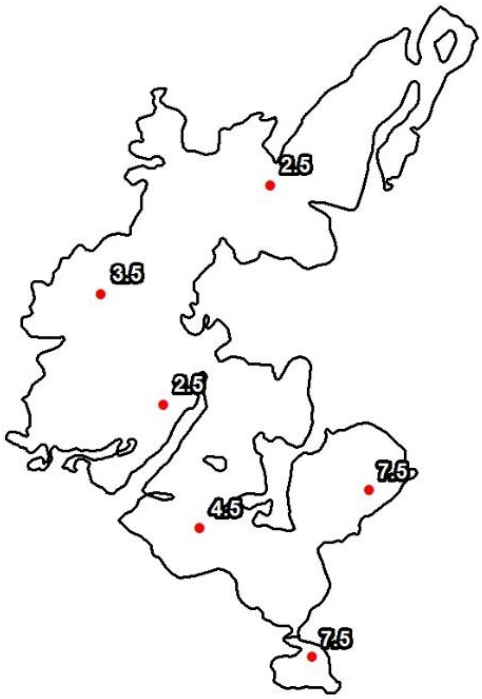
The treatments were completed by SOLitude Lake Management's state certified aquatic applicators and were conducted in accordance with the product label directions. At no time during the treatment program were fish mortalities or significant non-target impacts to other aquatic organisms or wildlife either observed or reported.

Interim Survey:

An interim survey was conducted on July 30th by a SOLitude Biologist. At the time of the survey, fanwort was high in the water column (see **Figure 2**) in several areas of the lake, but was heavily concentrated in the northern half of Knops Pond and the northern, eastern, and southern coves of Lost Lake. Variable watermilfoil was present in moderate to trace patches in Knops Pond and a small, isolated, southern cove of Lost Lake. No curly-leaf pondweed was observed at this time.

During the July survey, it was noted that the water clarity was very turbid and occasional observations of cyanobacteria blooms were observed. With the poor clarity observations, the biologist on site decided to collect several secchi disk readings to determine exact clarity. Six readings were collected, three in Lost Lake and three in Knops Pond. Please refer to **photo 1** below for locations and depths. Readings < 4.0 feet are considered poor clarity. As seen in the photo below, four of the six readings were considered to have poor clarity. Poor clarity can be caused by heavy weather events, wind & wave action, buildup of organic matter, and algal blooms. Further testing is needed to determine cyanobacteria/algae levels.

Photo 1: Secchi clarity depths & locations



Late-Season Survey

A late-season survey was performed on September 16th. Survey methodologies replicated techniques of the early-season and interim surveys. All species mentioned in Table 1 were present during the post-treatment survey, aside from curly-leaf pondweed. Areas of sparse to moderate growth of late-season Fanwort growth was observed, intermittently, along the shorelines of both Lost Lake and Knops Pond. A total of approximately 40 acres was observed during the September survey. Milfoil density was greatly reduced within the treatment areas. New growth within the same growing season is typical, and was observed in sparse to moderate densities occurring as new shoots with bright green crowns growing from below the area affected by the treatment. The greatest density of variable watermilfoil growth was found in the large, shallow, north-western area of Knops Pond (see **Figure 3**).

Similar to the early-season survey, Robbins Pondweed (*P. robbinsii)* and tapegrass (*Vallisneria americana)* were the most abundant species detected in Lost Lake and Knops Pond. The shallow nature of this waterbody allows for ample growth of these two submerged species. Three bladderwort species, common bladderwort (*U. vulgaris)*, purple bladderwort (*U. purpurea)*, and floating bladderwort (*U. minor)* were commonly found in varying densities growing in coves, with the most significant growth occurring throughout Knops Pond among large masses of filamentous algae, white water lilies (*Nymphaea odorata*) were populating prior areas of growth, primarily coves with neighboring growth of yellow water lily (*Nuphar lutea*) and common water-shield (*Brasenia schreberi*). Please refer to **Figure 4** for distribution of native submersed aquatic species.

RECOMMENDATIONS FOR ONGOING MANAGEMENT

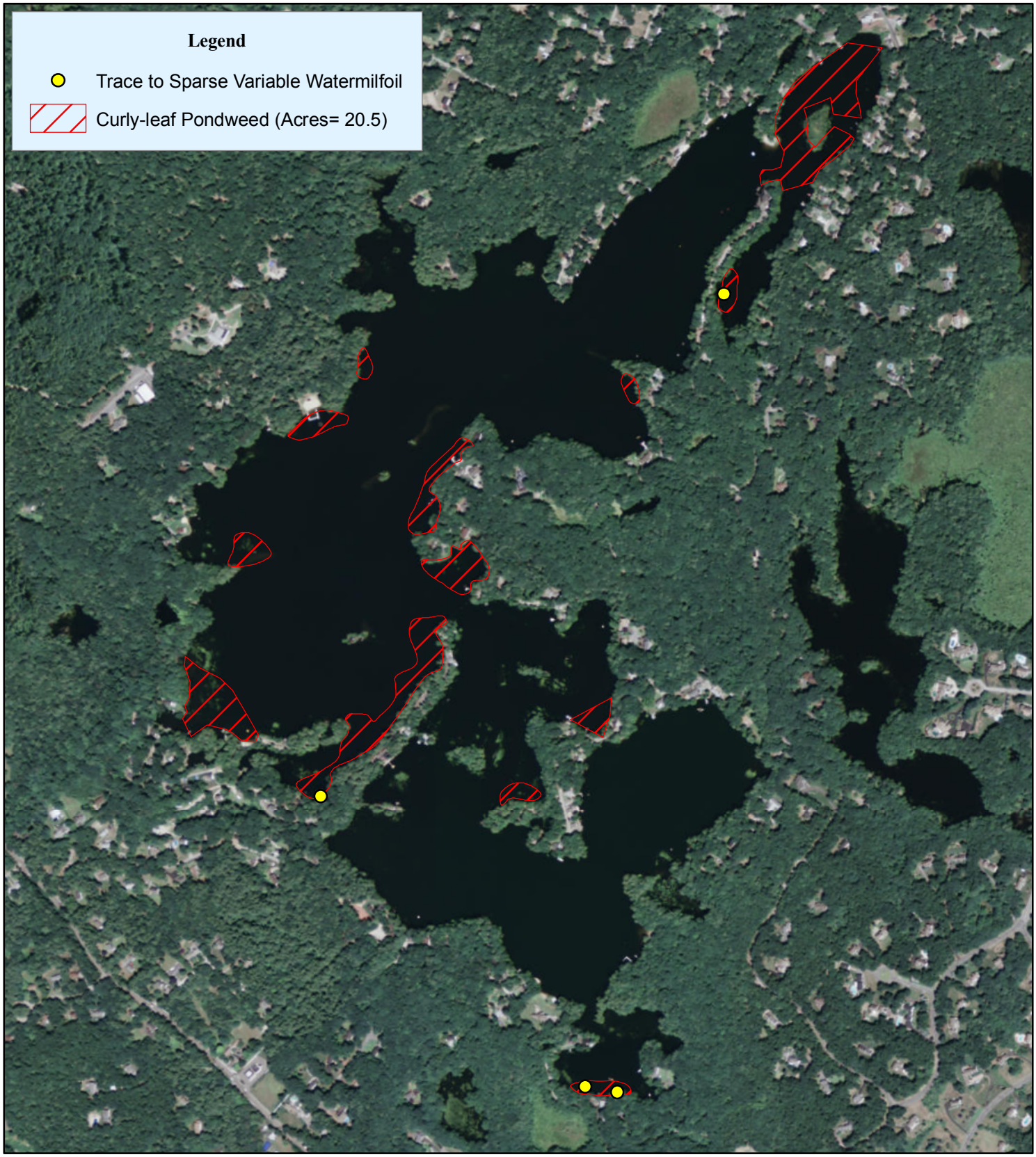
Since the previous whole-lake treatment with fluridone herbicide in 2013, spot-treatments with both systemic and contact herbicides have helped to extend its duration of fanwort control, however, substantial growth in 2018 and 2019 has exceeded the level where continued partial lake treatments are advisable.

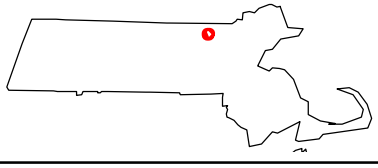
We would recommend conducting another full lake, low-dose treatment approach using a combination of Sonar formulations (pellet and liquid) to reset the system before the Fanwort continues to take off in different locations. This approach would also manage both the Variable Milfoil and Curly-leaf Pondweed.

We will plan to work with the Town and Association to further develop the fanwort management plan for 2020. For budget purposes, if the Town and Association were to go the route of a full lake Sonar application [such as that of 2013, which gave excellent results (Fanwort was not observed until 2017)], the cost would range from $80,000 - $100,000. This cost would be inclusive of everything (permitting, surveys, reports, FasTEST sampling, chemical, equipment and labor).

Due to the cyanobacteria observations over the summer, it is suggested that algae and water quality samples be collected throughout the 2020 management season in multiple areas of the two basins. Water quality samples such as phosphorus and nitrogen will provide us with a snapshot of the current nutrient availability throughout the summer. When nutrient levels hit a certain threshold, algae, and specifically, cyanobacteria, can utilize those available nutrients to multiply. We can estimate that Lost Lake/Knops Pond is a mesotrophic to eutrophic waterbody due to the amount of aquatic vegetation present and the clarity of the water; however, understanding the exact nutrient levels within the lake will allow us to properly classify the trophic state of the waterbody and therefore, will aid in determining the proper management approaches.

Figure 1: May Distribution of Curly-leaf Pondweed and Variable Watermilfoil





Lost Lake-Knops Pond

0 750 1,500

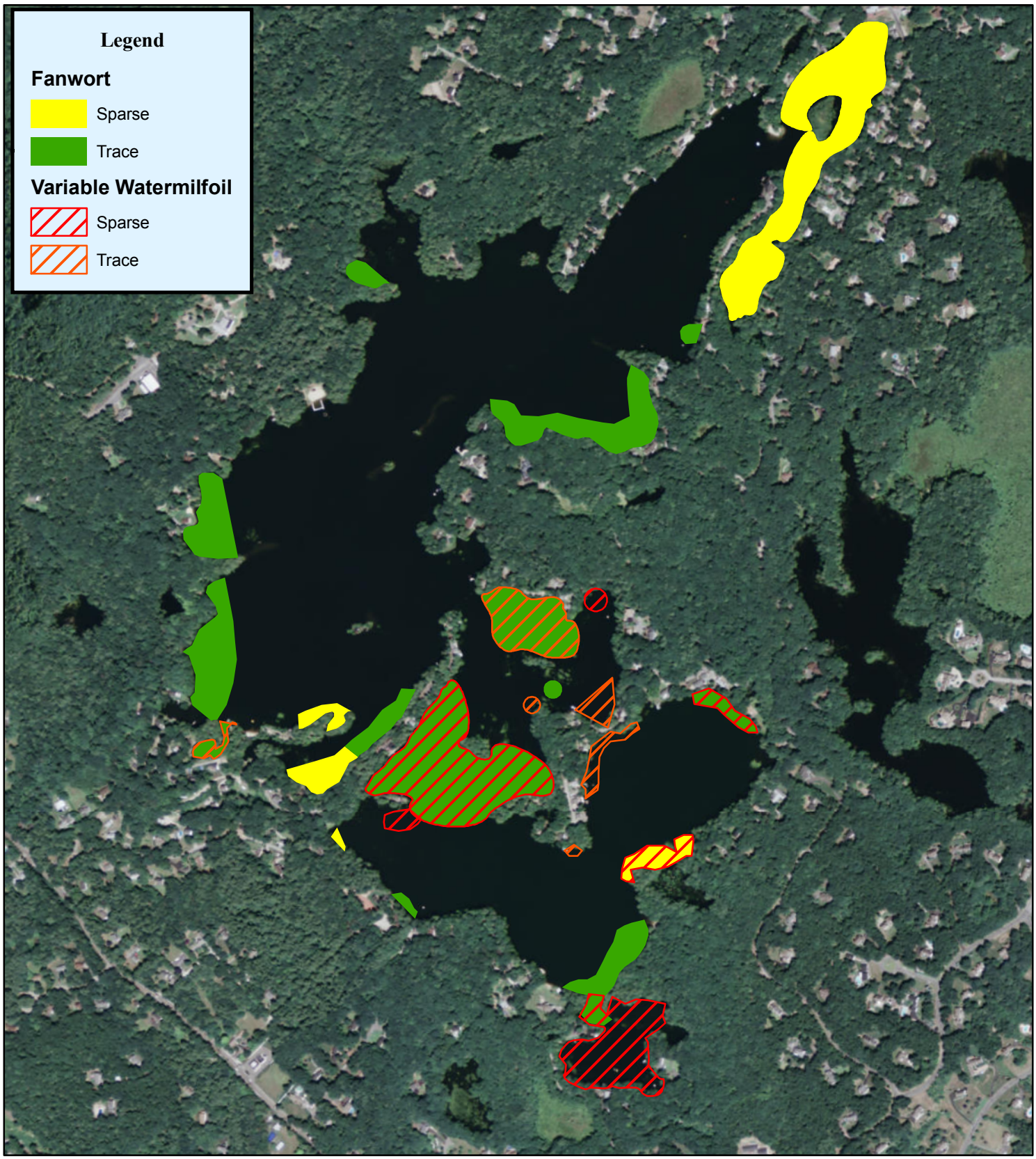
1:9,606 Feet

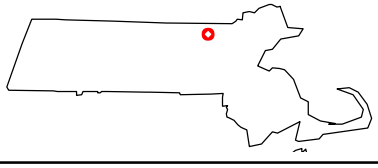
N

SOLitude Lake Management
888.480.5253
solitudelakemanagement.com

Figure 2: July Density & Distribution of Target Aquatic Vegetation

SOLITUDE
LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com





Lost Lake-Knops Pond

0 750 1,500

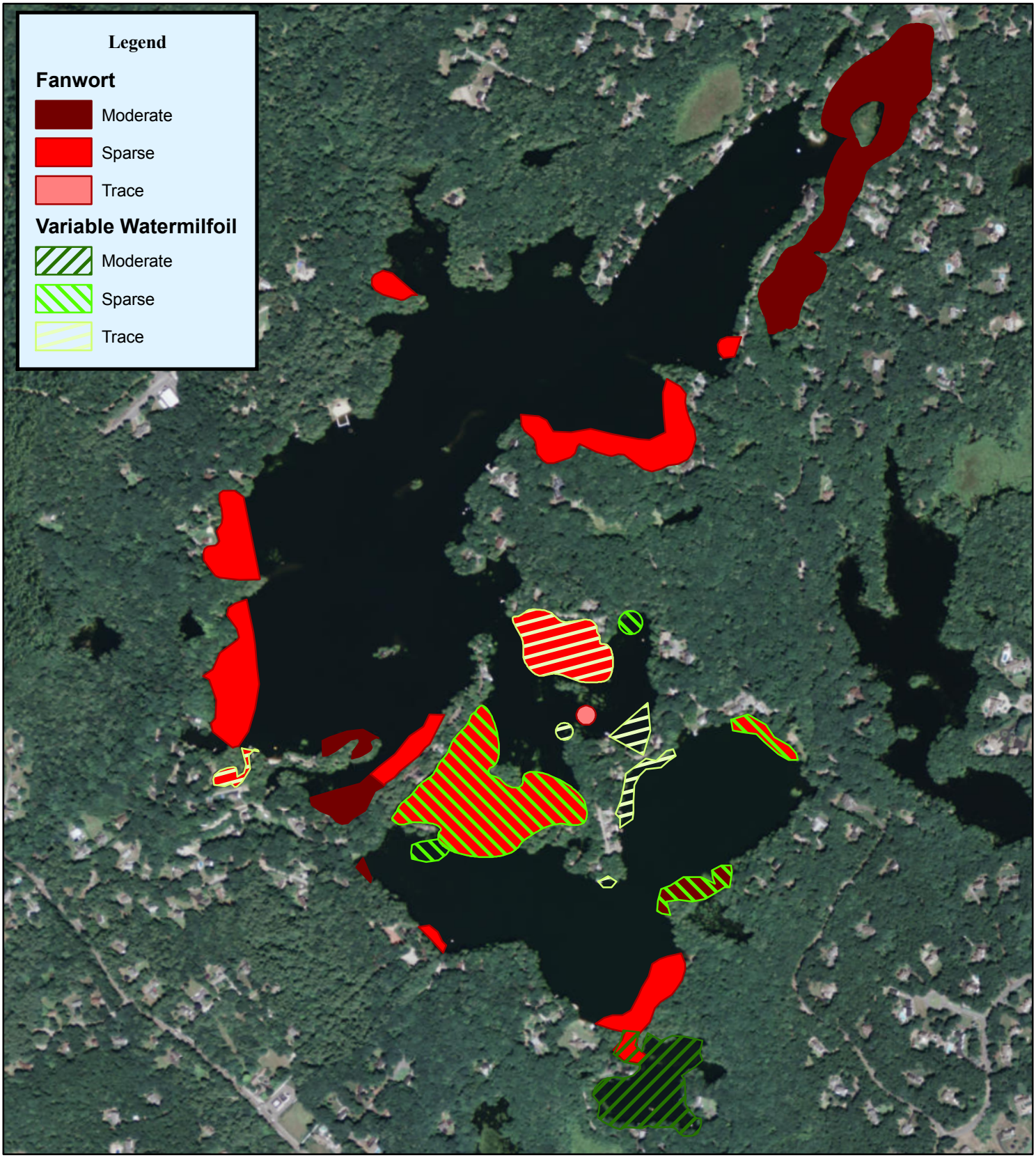
1:9,606 Feet

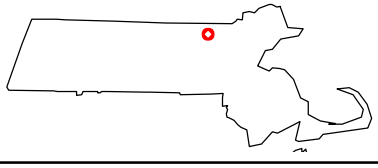
N

Map Date: 08/01/2019
Prepared by: ALM
Office: Shrewsbury, MA

Figure 3: September Density & Distribution of Target Species

SOLITUDE
LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com





Lost Lake-Knops Pond

0 725 1,450

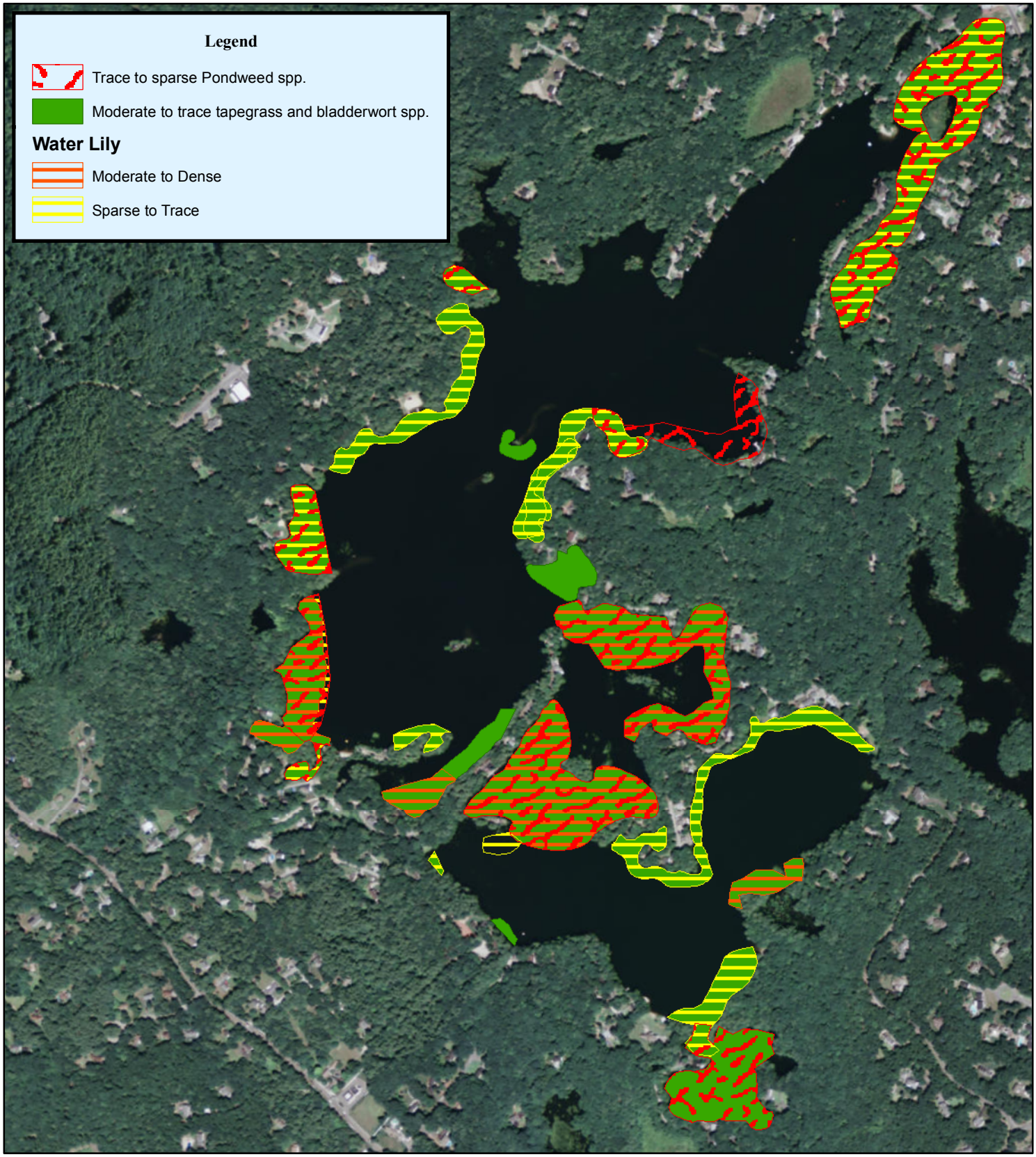
1:9,300 Feet

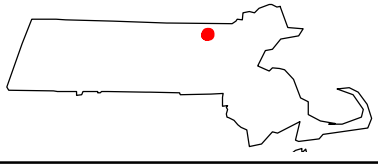
N

Map Date: 08/01/2019
Prepared by: ALM
Office: Shrewsbury, MA

Figure 4: September Distribution of Native Aquatic Vegetation

SOLITUDE
LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com





Lost Lake-Knops Pond

0 725 1,450

1:9,300 Feet

N

Map Date: 12/20/2019
Prepared by: ALM
Office: Shrewsbury, MA