January 30, 2014

Ms. Joanna Bilotta, President
Lake Shirley Improvement Corporation (LSIC)
PO Box 567
Shirley, MA 01464

Re: 2013 Year-End Report for the Aquatic Management Program at Lake Shirley

Dear Joanna:

This report provides an overview and summary of the 2013 Aquatic Management Program at Lake Shirley. A chronology of the 2013 Management Program activities follows:

- *Issuance of License to Apply Chemicals permit from MA DEP .....June 25th*
- *Pre-treatment milfoil I& aquatic plant inspection with LSIC.....May 27th, June 15th*
- *Reward (diquat) Herbicide treatment.....June 27th*
- *Monitoring of microscopic algae and Secchi Disk water clarity .....June – Sept.*
- *Post-treatment, late summer plant inspection..... Aug 12th & Oct 11th*

Pre-Treatment Surveys

Two pre-treatment surveys were performed this past year on the dates shown above. The objective of these surveys was to document the density and distribution of plant species throughout the lake, prior to finalizing the recommended treatment plan. Our pre-treatment plant survey report and a map showing the area of herbicide treatment in 2013 are attached.

Continuing the trend observed over the last couple of years, invasive Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) growth was minimal due to the on-going management program. As indicated in surveys conducted last summer, non-native, spiny naiad (*Najas minor*) and native tapegrass (*Vallisneria americana*) have now emerged as the most common nuisance vegetation and growth of these species was reaching problematic levels in many areas of the lake. All areas of milfoil/curlyleaf pondweed and areas of problematic spiny naiad and tapegrass were the target of this year's herbicide treatment. Approximately 100 acres were treated. This is significantly more than 2012 and 2011, 45 acres and 68 acres, respectively, due to the fact that high use areas of the lake with naiad and tapegrass were now targeted.

Herbicide Weed Treatment

The 2013 Reward herbicide treatment was performed on June 27th. A low dose of copper sulfate was also applied in some of the treatment areas to increase the effectiveness on the often difficult to control tapegrass. As with previous treatments, the lake community and the two towns were notified prior to treatment by LSIC. Several means of notification were utilized: placement of a written notice in the newspaper(s); placement of large, printed signs at major road intersections/locations around the lake and posting of numerous 8.5 inch by 11 inch orange colored, printed signs around the lake shoreline and other means of communication/notification.

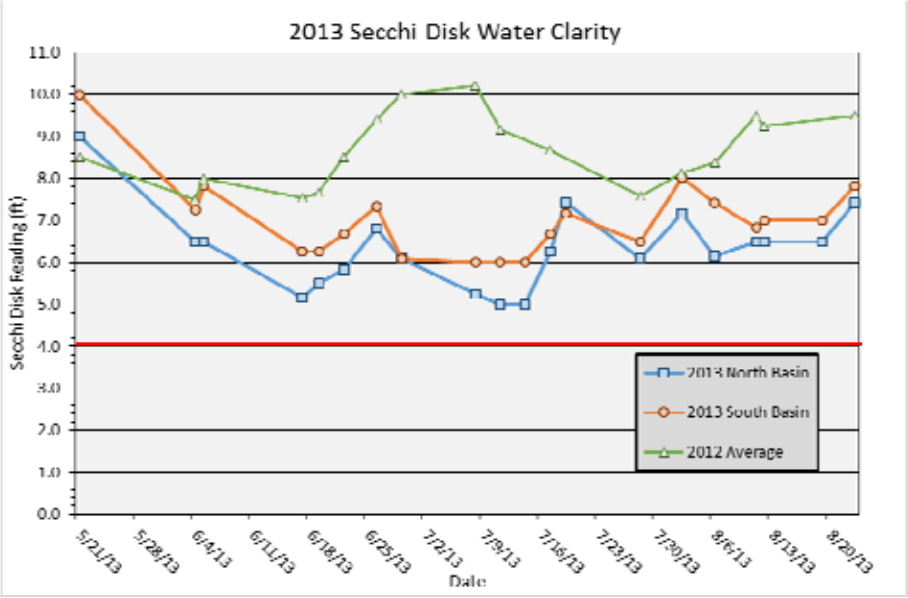
The treatment was performed by an airboat equipped with tank, pump, and sub-surface injection system. By injecting the diluted herbicide sub-surface, it eliminates the potential for aerial drift. GPS guidance was used to monitor the position of the airboat and its relation to the treatment areas.

Post-treatment Well Sampling/Testing for Herbicide Residues

Water samples were collected from two wells (the Bowen & Holman wells) by LSIC at one day and five days post-treatment. The Bowen well is located at 28 Oakridge Road and Holman at 885 Flat Hill Road. These well water samples were analyzed for Diquat (the active ingredient in Reward herbicide) by Granite state Analytical LLC in NH. The test results for the two sample rounds at both wells were below the laboratory detection limit of 0.4 ug/l (0.4 parts per billion).

It is well established in the literature and from testing performed elsewhere, that Diquat is readily bound by soils and does not leach/move into groundwater from surface water applications. To the best of our knowledge, there are no verified occurrences of Diquat ever contaminating well water following an aquatic treatment to the extent that the well was no longer potable. We recommend that LSIC request of the Conservation Commission that the "special condition" (for the Order of Conditions permit for this project) requiring that Diquat analyses be performed post-treatment be dropped.

Algae & Water Clarity Monitoring & Algaecide Treatments



Water clarity was again monitored and measured with a standard Secchi Disk between June and August by a Board Member of the LSIC. Measurements were taken from both the north and south lake basins.

Water clarity was again desirable this past summer. It was not as good as last year's unusually high water clarity, but still considerably better than in prior years. The two basins' average clarity was between five and eight feet throughout the duration of the summer. The south basin, as in the past, had higher water clarity than the north basin. No severe algae blooms were reported or observed this past summer, therefore, no copper sulfate algaecide treatments were warranted or performed at the lake this past summer.

Post-Treatment Surveys

A cursory plant inspection of the lake on August 12th showed that excellent control of the targeted nuisance and invasive species had been obtained.

Continuing the survey methodology that was used in 2012, the post-treatment survey in early October focused on characterizing the relative abundance of the dominant invasive and native plant species in the lake (See Figure 2). The relative abundance reported is based on the combination of percent bottom cover and biomass. Biomass is the relative extent that the plant growth fills the water column. These abundance/cover ratings range from; "sparse or scattered" (<5% cover and/or plants generally close to the bottom); frequent (>5-25% cover and/or plants partially filling the water column but typically not a nuisance to recreation); common (>25-75% cover and plants generally within 2-3 ft., of the surface causing some impairment of recreational use) and; abundant (75-100% cover and plants typically "topped out" or within a foot of the surface, causing an obvious use impairment).

This qualitative assessment lends itself better to the creation of assemblage maps and therefore provides a better gross visual representation of the most frequently encountered and abundant aquatic plants. We believe this approach is useful for the purposes of evaluating the plant community and making decisions regarding aquatic plant management. The more quantitative point plant survey performed annually by Geosyntec Consultants continues to track species composition, percent cover, and biomass at specific established sampling points over time.

During the late summer inspection on October 11th, tapegrass and naiad (both spiny naiad and the native bushy pondweed - *Najas flexilis* species) were co-dominant and widespread but with generally low to moderate biomass throughout the northern basin and portions of the southern basin. The June herbicide treatment worked well to reduce the biomass of these species and minimize recreational impairment. Along the shorelines with sandy and rocky bottom composition, the tapegrass and naiad were noticeably less dense. There was little or no growth of tapegrass observed in water depths of less than about 2-3 feet.

The occurrence of fanwort continues to increase throughout the lake. During last year's survey, fanwort was observed mostly in the northern coves and in the small cove near adjacent to the campground beach (bordered by Fire Road 10 and Flynn Road. This year fanwort was found in frequent to common density in numerous areas of all three lake basins (See Figure 2). Most of the fanwort was observed in water depths of greater than about 5-6 feet.

Winter lake level drawdowns typically provide good control of fanwort in the shallower (less than ~ 6 ft.) near-shore areas. Drawdown has a variable effect on tapegrass and little or no effect on naiad. The rapid expansion of fanwort in recent years in water depths ≥6 feet, warrants additional control measures beyond what can be attained through drawdown alone.

The distribution of stonewort (*Nitella*) which is a macro-algae and a species of native naiad (*Najas flexilis*) were patchy in their distribution but sometimes found in high densities. Fortunately, both species are native and relatively low growing and tend not to be problematic to recreational use. Stonewort and the native naiad were found in both near shore areas as well as in the deeper portions of the lake's basins between the depths of 6 and 9 feet.

Stonewort in particular provides valuable cover for aquatic invertebrates and juvenile fish and also helps to reduce wind-driven and motorboat induced turbidity and the release of nutrients (phosphorus and nitrogen) from the sediments. Where the stonewort forms a dense blanket on the lake bottom it acts somewhat like mulch in a vegetable garden. The stonewort also prevents or at least slows down the spread of non native invasive plants. Fortunately stonewort generally grows low to the bottom and is

generally not affected by the Reward herbicide or the low dose of algaecides that are sometimes applied to the lake.

Other plant species found in sparse or scattered amounts ribbonleaf pondweed (*Potamogeton epihydrus*), clasping leaf pondweed (*Potamogeton perfoliatus*), Robbins pondweed (*Potamogeton robbinsii*) and white waterlilies (*Nymphaea odorata*).

Anticipated Management in 2014

Based on the results of the 2013 late season plant survey, we anticipate seeing continued, minimal growth of watermilfoil and curly-leaf pondweed this summer. This minimal growth allows us to delay the herbicide treatment until somewhat later in June so that the tapegrass and naiad are also at the right growth stage to be targeted.

Reward herbicide alone will provide good control of milfoil, curlyleaf pondweed and naiad. Tapegrass is more difficult to control and we will apply a combination of Reward and a copper based herbicide (Nautique) or algaecide (Captain/copper sulfate) to increase effectiveness and produce more desirable results.

If approved by the LSIC, fanwort would be treated with the Clipper (flumioxazin) herbicide, which was approved by the State this past autumn. Unlike Sonar (fluridone) which has been discussed in the past, Clipper works quickly and can be used effectively to spot-treat relatively small areas of fanwort. The timing for treatment of the fanwort will most likely coincide with the treatment of the other target plants so that everything can be done in one visit.

In order to use Clipper and other forms of copper besides copper sulfate, approval for use of the new products must be sought from the Conservation Commissions. We have provided letters for you to forward to the Conservation Commissions. Additionally, the MA DEP is currently requiring that surveys for freshwater mussels be conducted for lakes treated with Clipper herbicide. This includes an initial presence/absence survey (if needed) followed by pre & post treatment monitoring if mussels are present. The manufacturer has provided some additional information to the DEP and involved parties have petitioned for lifting these restrictions. If required in 2014, the mussel surveys will add a substantial cost component to the fanwort treatment task. The presence/absence survey is expected to cost $1,500-$2,000 while the pre & post treatment monitoring will be in the range of $5,000-$7,000. If mussels are known to be present, there would be no need to conduct the presence/absence survey.

As in the past, early summer plant surveys will be used to gauge the amount of nuisance plant growth and establish areas of the lake which warrant treatment, ether with Reward/Copper for milfoil, curlyleaf pondweed, naiad and tapegrass growth and Clipper for fanwort. Prioritizing treatment areas with LSIC will lead to the optimal use of resources.

The multiple inspections and surveys continue to work well to monitor the lake's plant community and to guide the aquatic herbicide treatment program. Monitoring of water clarity and algal populations (as necessary) as has been performed since 2007, provides timely information to guide algaecide treatments should such treatments be warranted.

We recommend LSIC continue to pursue an integrated approach of in-lake management, utilizing drawdown and herbicide/algaecide treatment as required and appropriate. Naturally, watershed

management and public education are also very important continued as well. We hope this report will be of help to LSIC in planning for 2014 and beyond. Thank you.

Sincerely,

AQUATIC CONTROL TECHNOLOGY

Dominic Meringolo
Senior Environmental Engineer

11 John Road
Sutton, MA 01590

Phone: (508) 865-1000
FAX: (508) 865-1220
e-mail: info@aquaticcontroltech.com
Internet: www.aquaticcontroltech.com

Date: June 17, 2013

To: Joanna Bilotta; President, Lake Shirley Improvement Corporation

From: Gerry Smith, Aquatic Biologist & Dominic Meringolo, Environmental Engineer

Re: **Aquatic Plant Survey/Inspection of June 15th & Management Recommendations – Lake Shirley - 2013**

This memo summarizes the findings of Aquatic Plant Surveys/ Inspections of Lake Shirley performed on May 27th and again on June 15th. I was joined on both surveys by officers or directors from the lake association. On June 15th, the skies were bright and sunny, which allowed for good visibility into the water. The water clarity in the northern basin, however, had diminished markedly from the excellent clarity seen there just a couple of weeks prior, undoubtedly due to the heavy rains that occurred during the previous week. As we traveled through the lake's middle and southern basins, water clarity improved substantially. Overall, conditions allowed for good visibility into the water to identify and locate milfoil and other aquatic plants.

The survey was performed from a Pontoon Boat, while traveling around the entire shoreline and littoral (shallow water) zone of Lake Shirley. Given the overall shallow depth of the lake, additional transects were made across the coves and open-water portions of the lake in order to characterize the distribution of both invasive and native plants. A combination of survey techniques were utilized, including; visual observation and use of a "throw-rake". Milfoil, curlyleaf pondweed, spiny naiad, tapegrass or wild celery and other aquatic plants were noted and recorded.

We observed very little Eurasian watermilfoil with its growth confined primarily to just a 1-2 acre area along the lake's eastern shoreline in the southern lake basin. Invasive Curlyleaf pondweed that was targeted for treatment along with milfoil in 2012 and some prior years was found in limited distribution primarily in the northern lake basin.

The primary nuisance aquatic plants experienced during late summer of 2012 included invasive Spiny naiad along with native tapegrass or wild celery. These two plants are the primary species that will be targeted for treatment in 2013 along with the small amount of invasive Eurasian watermilfoil and Curlyleaf pondweed.

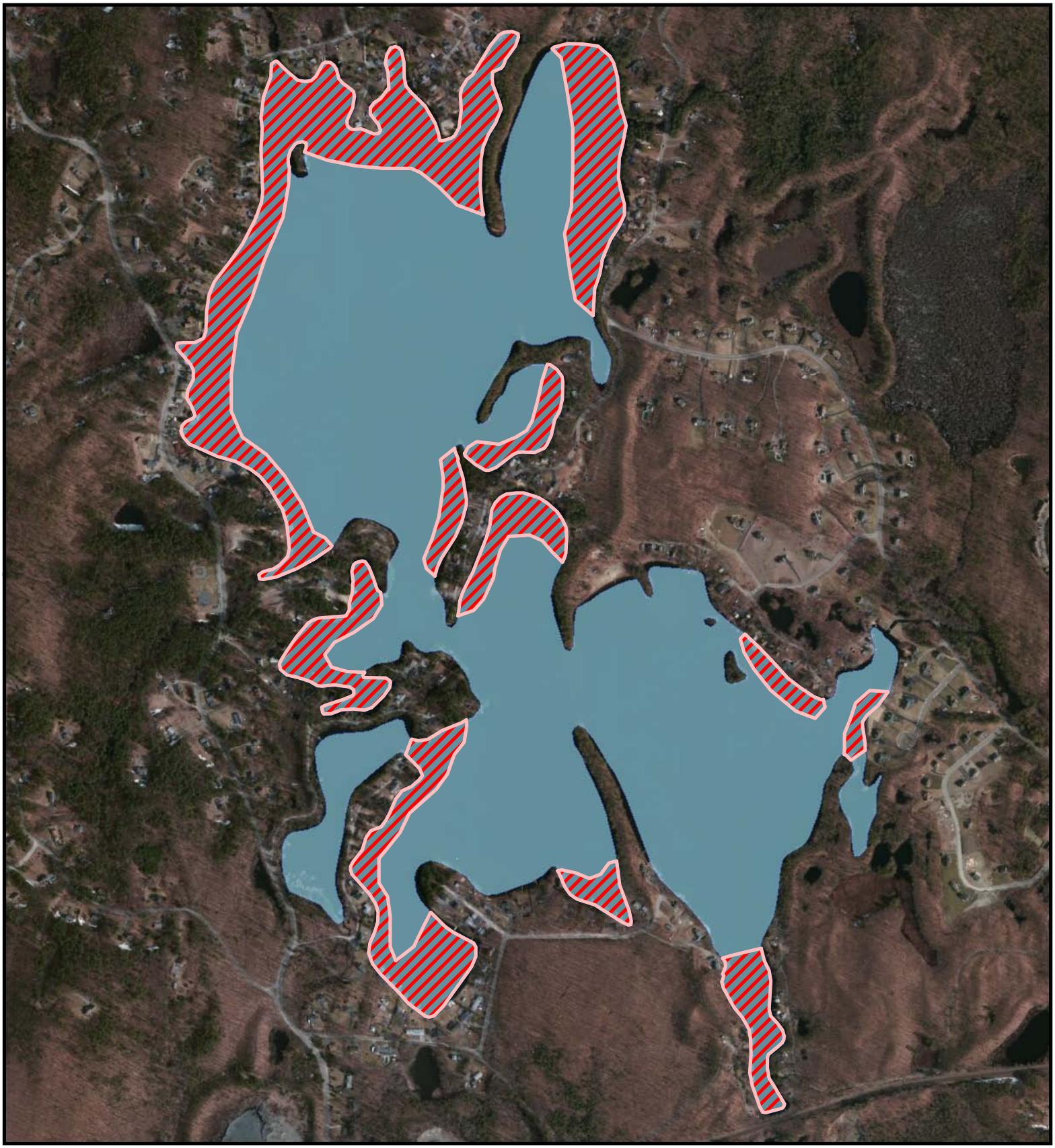
Some of native aquatic plants also observed during the survey, included, coontail, bushy pondweed, ribbon-leaf pondweed, bladderwort, sago pondweed, waterlilies and a macro-alga called muskgrass. The growth of these native species was just beginning and typically lags behind the early season and aggressive growth of milfoil weed.

A map of proposed Treatment Areas is attached. Based upon our survey findings, we recommend chemical treatment of approximately 100-acres. The attached map represents invasive and nuisance plant cover in most treatment areas, of generally between > 10% and 100% and was judged by myself and other participants during the survey to represent an impairment to the recreational uses of Lake

Shirley and management with “hand-pulling” or other non-chemical techniques are not practical or feasible.

We are targeting chemical treatment of Lake Shirley for June 27th. The lake will be closed to all water uses, including swimming, fishing and boating on the day of treatment only. There will be an additional restriction on water use for irrigation, watering livestock and drinking purposes for 5 days. We will be sending you a written “notice of treatment” for you to publish in the local paper(s) and will also mail you printed signs for you to post around the lake shoreline (over the weekend) prior We will be chemically treating with Reward (diquat) at rate of 1-1.5 gal/acre which is substantially less than the maximum label rate of 2.0 gals/acre. Maximum USEPA label rate for Reward is 2.0 gals/acre. The Reward (diquat) will be tank-mixed with a low does of copper based algaecide to enhance uptake and efficacy for control of the tapegrass/wild celery which can be difficult to control.

I hope this information is helpful to LSIC. Feel free to forward this memo to the Conservation Commissions and other appropriate parties. Thank you.



Lake Shirley

Lunenburg/Shirley, MA

2013

Treatment Area

FIGURE:	SURVEY DATE:	MAP DATE:
1	5/27 & 6/15/13	6/17/13

Proposed 2013 Treatment Areas

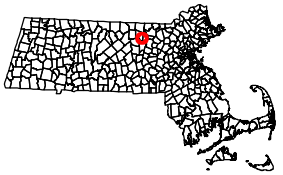
N

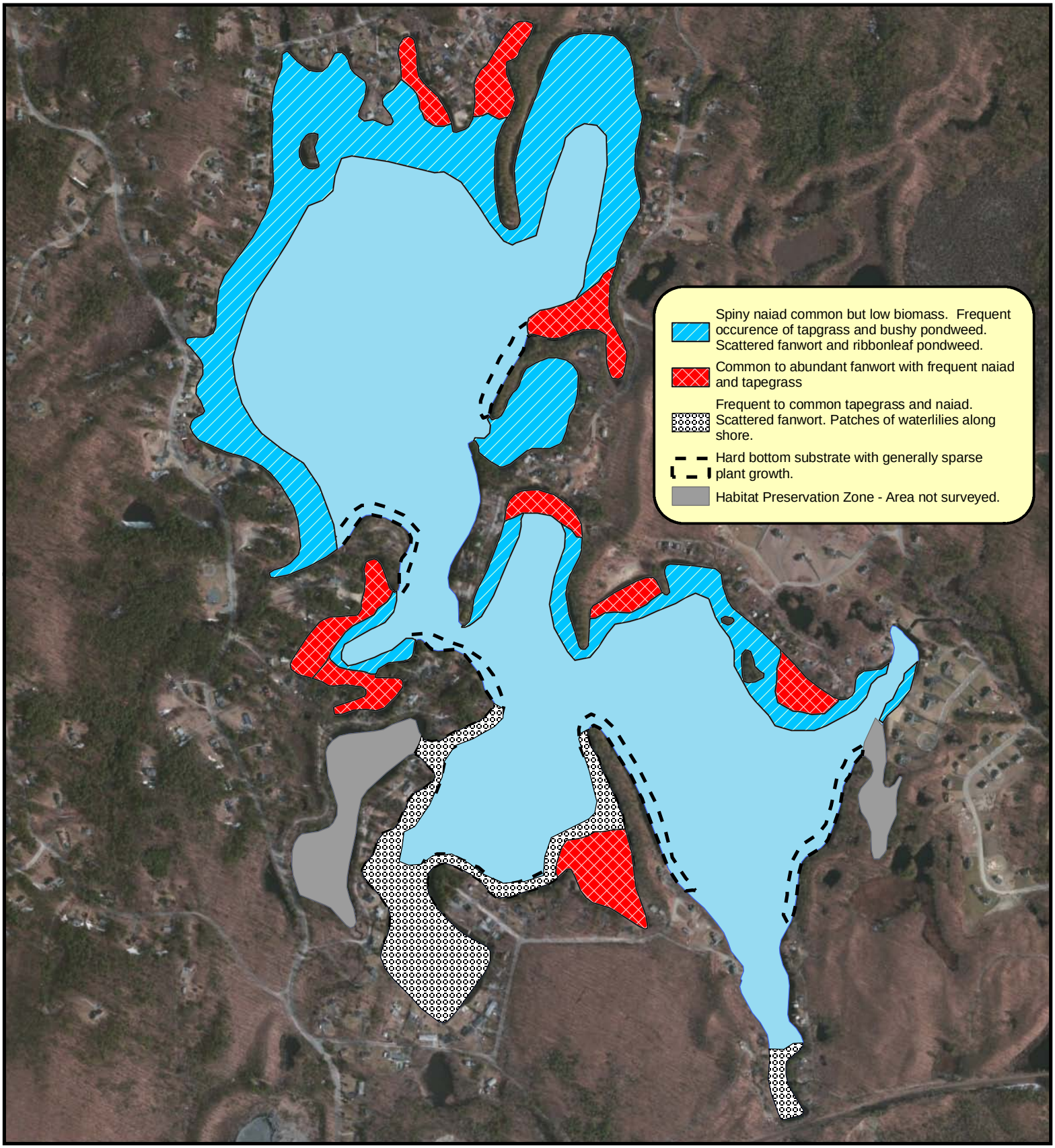
Total Treatment Area: ~100 acres

0 380 760 1,520 2,280 3,040 Feet

AQUATIC CONTROL TECHNOLOGY, INC.

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





Lake Shirley

Lunenburg/Shirley, MA

Late Summer Vegetation Distribution (2013)

FIGURE:	SURVEY DATE:	MAP DATE:
2	10/11/13	1/30/14

Legend:

N

0 520 1,040 1,560 2,080 Feet

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