

March 10, 2015

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

Re: 2014 Year-End Report for the Aquatic Management Program at Lake Shirley

Dear Joanna:

This report provides an overview and summary of the 2014 Aquatic Management Program at Lake Shirley. A chronology of the program activities is as follows:

- ◆ Issuance of License to Apply Chemicals permit from MA DEPJune 14th
- ◆ Pre-treatment milfoil I& aquatic plant inspection with LSIC June 14th & June 20th
- ◆ Reward (diquat) Herbicide treatment July 1st
- ◆ Monitoring of microscopic algae and Secchi Disk water clarityMay-August
- ◆ Algae inspection and samplingAugust 19th
- ◆ Advisory Issued - Lake Closed August 22nd
- ◆ Post-treatment, late summer plant inspectionOctober 6th
- ◆ Advisory Lifted October 16th

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 2014 are attached.

Continuing the trend observed over the last several years, invasive Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) growth was limited 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*) continue to be 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 91 acres were designated for treatment, which is slightly less than last year (~100 acres) but significantly more than in 2011-2012 due to the fact that high use areas of the lake with naiad and tapegrass are now included as target growth.

Herbicide Weed Treatment

The 2014 Reward herbicide treatment was performed on July 1st following the treatment area designations presented in the pre-treatment report. 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.

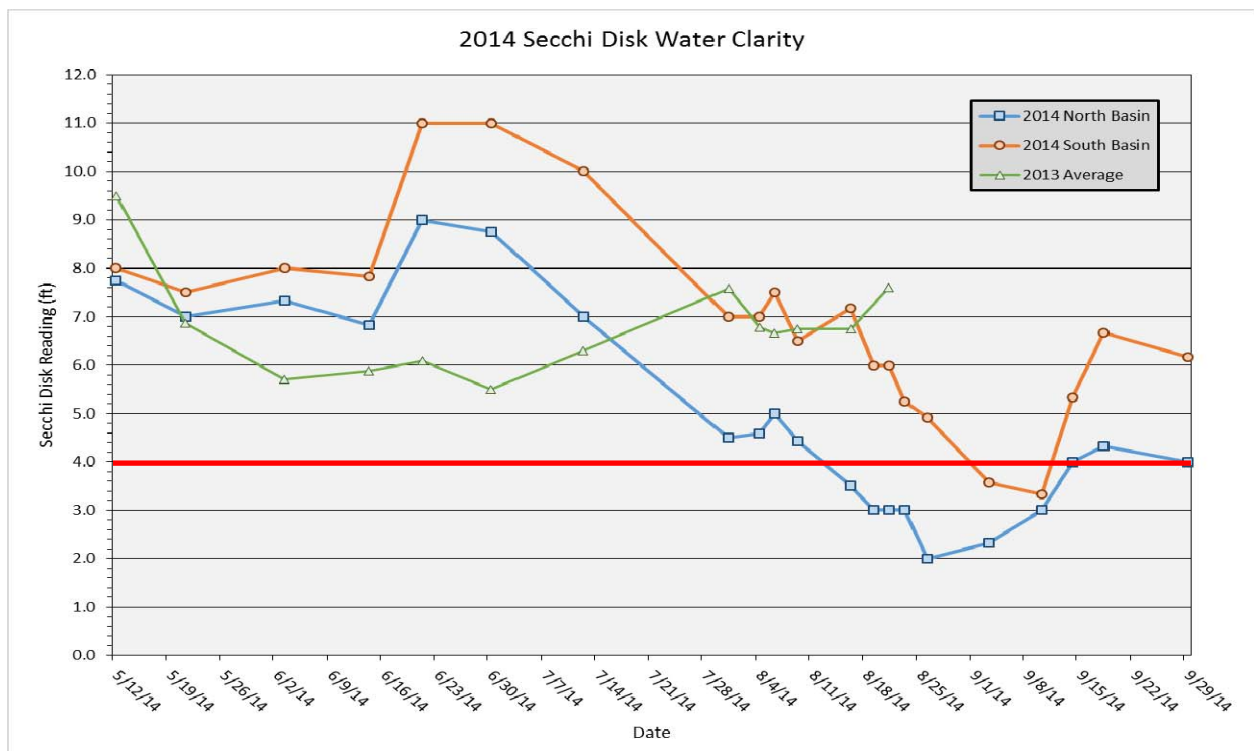
The treatment was performed by an airboat equipped with tank, pump, and sub-surface injection system. By injecting the diluted herbicide sub-surface, it eliminates the potential for aerial drift. GPS guidance was used to monitor the position of the airboat and its relation to the treatment areas.

Post-treatment Well Sampling/Testing for Herbicide Residues

Per discussions with the Shirley and Lunenburg Conservation Commissions, the post-treatment well sampling requirements were lifted for 2015. No herbicide had been detected in any of the previous post-treatment well sampling conducted over the last seven years.

Algae & Water Clarity Monitoring

After exhibiting higher than average water clarity in late May, throughout June and the early part of July, algae growth increased substantially in late July and water clarity dropped, especially in the North Basin (see water clarity graph – below). Upon receiving reports from the Association on August 18th, ACT staff inspected the lake and collected a water sample on August 19th.



The results of the 8/19 samples showed an elevated count of blue-green algae (cyanobacteria) in both basins, which exceeded both the Massachusetts Department of Health (MADPH) guidelines as well as the MassDEP limits for conducting an algaecide treatment. These results were confirmed by MA DPH sampling and a Closure Advisory was issued for the Lake. Unfortunately, this algae bloom and advisory persisted into early October and no algaecide treatments were allowed during that time period.

Post-Treatment Surveys

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 periodically 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 6th, 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 (See Figure 2). The frequency of tapegrass decreased and the proportion of naiad increased with depth. The early July 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.

After an increase in fanwort observed last year, fanwort was again present in most of the same areas of the lake but was considerably less dense. Again growth was observed mostly in water depths greater than 5-6 feet as the winter lake level drawdowns typically provide good control of fanwort in the shallower (less than ~ 6 ft.) near-shore areas. Fanwort growth may have been affected by the poor water clarity in the lake this summer.

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 2015

Based on the results of the 2014 late season plant survey, we anticipate seeing continued, minimal growth of watermilfoil and curly-leaf pondweed this coming 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, areas of fanwort would be treated with the Clipper (flumioxazin) herbicide, which was registered by the State last year. 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. The on-going issue with the use of Clipper is that under current regulations, the same areas of the lake can only be treated once every 4 years unless it's in the immediate vicinity of a high-use area such as a beach or boat launch. While it's possible this condition may be lifted in the future, for it will be necessary to either rotate the areas treated with Clipper or treat subsections of larger areas of fanwort over the course of multiple years.

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. This process was initiated last year but was not concluded due to other issues.

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, normally provides timely information to guide algaecide treatments should such treatments be warranted. Unfortunately, this past summer, the rapid increase in algae growth was not identified in time to prevent levels from exceeding thresholds restricting algaecide treatment and resulting in closure of the lake for contact recreation. Moving forward, it will be of paramount importance to ensure that

the water clarity monitoring is conducted at least weekly and that results are provided to ACT so that algaecide treatments are scheduled in a timely manner.

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 2015 and beyond. Thank you.

Sincerely,

AQUATIC CONTROL TECHNOLOGY



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Senior Environmental Engineer

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Date: June 23, 2014
To: Joanna Bilotta; President, Lake Shirley Improvement Corporation
From: Gerry Smith, Aquatic Biologist & Dominic Meringolo, Environmental Engineer
Re: **Aquatic Plant Surveys/Inspections of June 14th & June 20th and Management Recommendations – Lake Shirley - 2014**

This memo summarizes the findings of Aquatic Plant Surveys/ Inspections of Lake Shirley performed by me on June 14th and again on June 20th. Two surveys of the lake were necessary this year in view of the late spring and cool water temperatures which acted to delay the growth of the aquatic plants. The growth of Spiny naiad and tapegrass had just begun in most areas of the lake at the time of our first survey. I was joined on both surveys by Jay Simoneau from the lake association. The weather during both surveys was good with partly or mostly sunny skies. Secchi Disk visibility in all three lake basins was estimated to be in excess of 6-7 feet. Overall, conditions allowed for good visibility into the water to identify and locate the aquatic plants.

The two surveys were 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 some of 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". Invasive watermilfoil, curlyleaf pondweed, spiny naiad and fanwort, along with the native but nuisance forming tapegrass/ wild celery and other aquatic plants, were noted and recorded.

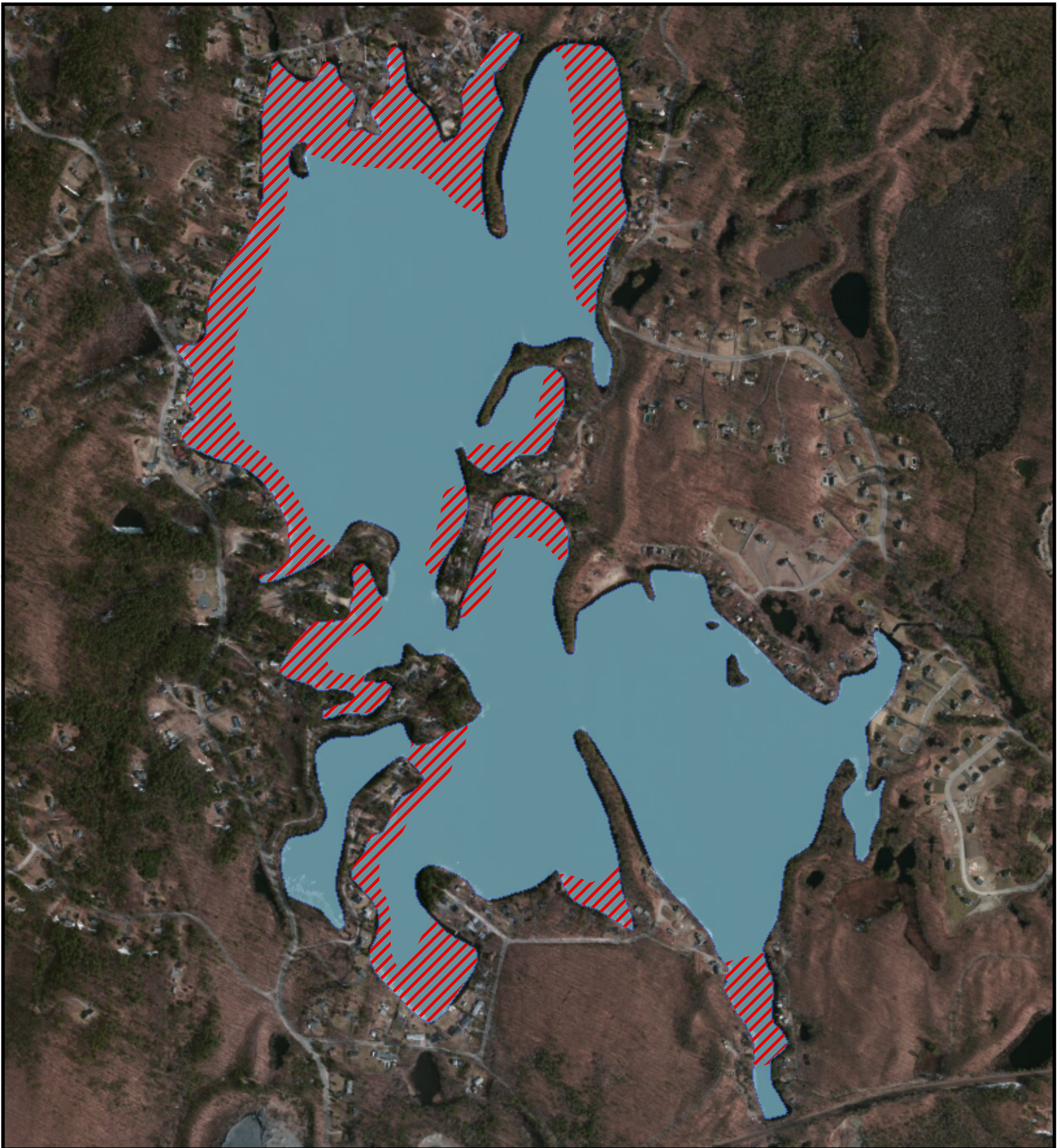
We observed very little Eurasian watermilfoil, with its growth confined primarily to just an approximate two acre area along the lake's eastern shoreline in the southern lake basin. Invasive Curlyleaf pondweed that was targeted for treatment (along with milfoil in 2012 and also in some prior years) was found in limited but somewhat increasing distribution. The higher density areas of Curlyleaf pondweed were primarily found throughout the north central area of the northern lake basin. Consideration should be given to chemically treating a larger area of the northern basin in 2015. Doing so may require two separate treatments for optimal effectiveness and control of these two plants; 1) the first treatment in late May/early June that would target growth of curlyleaf pondweed and 2) the second treatment in late June that primarily targets the Spiny Naiad and tapegrass - the latter two plants that grow/develop more slowly than does the pondweed. Hopefully, permits will also be in place for "Clipper" (Flumioxazin) herbicide and additional funding available to initiate treatment of the invasive fanwort (Cabomba) weed. The fanwort becomes a nuisance in a number of the lake's coves in water depths greater than about 5.5 ft., which we understand is the maximum limit/depth the lake can be lowered during the winter "drawdown".

The primary nuisance aquatic plants experienced during 2012 and prior to treatment last year were the invasive Spiny naiad along with native tapegrass or wild celery. These two plants are once again the primary species that will be targeted for treatment in 2014.

Some other 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 or chara.

A map of Proposed Treatment Areas is attached. The specific areas of treatment and total acreage are quite similar to last year. Based upon our survey findings, we recommend chemical treatment of approximately 91 acres. The attached map represents invasive and nuisance plant cover in most treatment areas, of generally between > 10% and 100% and was judged during the survey to represent a probable impairment to the recreational uses of Lake Shirley come mid/late summer. Management with "hand-pulling" or other non-chemical techniques are either not cost/effective, practical or feasible over such large areas of abundant weed growth.

We are targeting chemical treatment of Lake Shirley for Tuesday, July 1st. 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 prior to treatment. We will again 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) may be tank-mixed with a low dose of copper based algaecide to enhance uptake and efficacy for control of the tapegrass/wild celery. 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

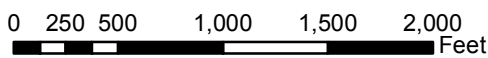
2014

Treatment Area

FIGURE:	SURVEY DATE:	MAP DATE:
1		6/23/14

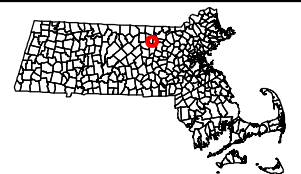


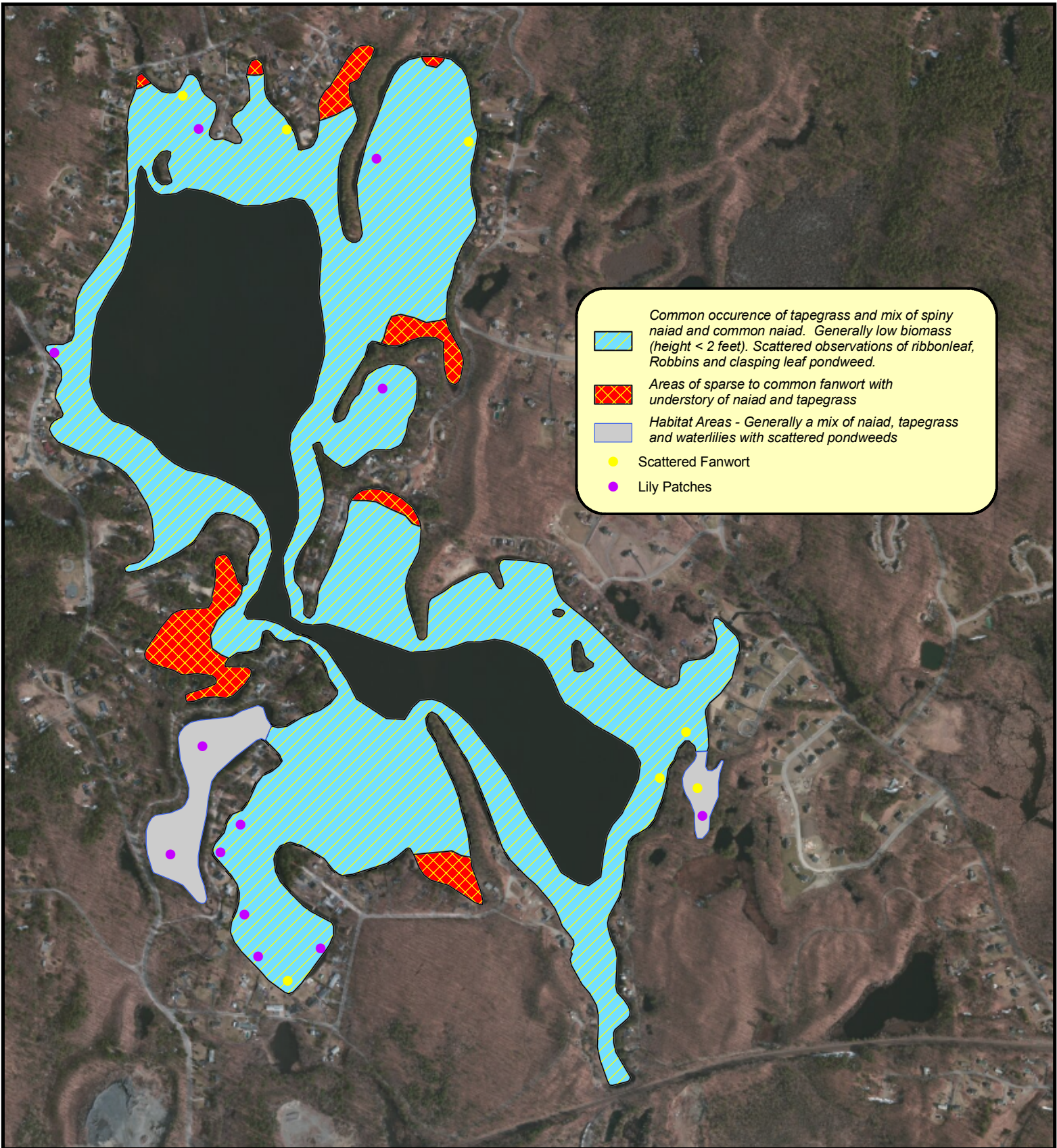
Proposed 2014 Treatment Areas - 91 ac



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Common occurrence of tapegrass and mix of spiny naiad and common naiad. Generally low biomass (height < 2 feet). Scattered observations of ribbonleaf, Robbins and clasping leaf pondweed.

Areas of sparse to common fanwort with understory of naiad and tapegrass

Habitat Areas - Generally a mix of naiad, tapegrass and waterlilies with scattered pondweeds

Scattered Fanwort

Lily Patches

Lake Shirley
Lunenburg/Shirley, MA

Late Summer Vegetation Distribution (2014)

FIGURE:	SURVEY DATE:	MAP DATE:
2	10/6/14	3/2015

Legend:

N
↑

0 355 710 1,420 2,130 2,840 Feet

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