SPY POND

2021 Aquatic Management Program

SOLITUDE LAKE MANAGEMENT

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Introduction

This report will serve to document the herbicide treatment program and summarize results from the vegetation surveys performed at Spy Pond during the 2021 season. Attached to this report are figures depicting vegetation distribution.

2021 Treatment Summary

Management Activity	Date
Received License to Apply Chemicals (#WM04-0000515)	May 25, 2021
Early-season point-intercept survey	May 3, 2021
Initial Curly-Leaf Pondweed Treatment (Diquat)	May 20, 2021
Interim Vegetation Survey	August 4, 2021
Follow-up treatment for Spiny Naiad (Diquat)	September 3, 2021
Late-season point-intercept survey	September 23, 2021

Based on the management history of Spy Pond and the early onset of invasive curl-leaf pondweed (CLP) growth and initial spot application of Tribune (diquat) was conducted. A total of approximately 20 acres were treated across six designated treatment areas around the pond (See 2021 Spring CLP Distribution Map). This treatment provided very effective control of the target

Based on reports and observation from an interim survey conducted in early August, it was determined that a follow-up Tribune herbicide (diquat) was required to control the late season growth of non-native Spiny Naiad (*Najas minor*). Based on the observed distribution and consultation with members of the Spy Pond Committee, a total of about 25 acres were treated for the control of Spiny Naiad. Although this treatment provided good control of the targeted invasive plant growth, it did result in some impact to non-target plant species. Phytoplankton growth following treatment notably increased, which may have been exacerbated by the corresponding plant decomposition and release of nutrients.

No other herbicide or algaecide treatment events took place at Spy Pond in 2021.

2021 Vegetation Monitoring

The point-intercept method was utilized during the pre- and post-management surveys. Point-intercept surveys of Spy Pond were based on a 100-m grid within the littoral zone which resulted in a total of 87 data points. These point-intercept surveys were supplemented with an inspection of the entire littoral zone to identify beds of the target species. This 'bed identification' method, detailed below, was employed each time SOLitude visited the pond so that any new growth of the target species may be identified and targeted for management as soon as possible.

Survey Methodology

Point Intercept Method

SOLitude Lake Management's biologists surveyed the water body using the aforementioned survey points uploaded to a GPS unit. The following data was collected at each of the survey points:

Water Depth	Species Present
Relative Abundance of each species	Total Percent Cover of All Species
Biovolume Index	Total Percent Cover of Target Species

Species Identification

The rake toss method, based on protocols developed by Cornell University, was used to retrieve submersed aquatic vegetation from either side of the survey vessel. Two rake tosses were carried out at each point; one on either side of the survey vessel. Each species found on the rake was identified and recorded. Plant species observed in the immediate area, but not found on either rake toss, were also recorded. Any species not readily identified *in situ* was placed into a plastic bag labeled with the data point number and preserved for further analysis. Once all species were recorded, the most prevalent species was noted as dominant for later use in presence/absence maps.

Relative Abundance

The abundance scale, developed by the US Army Corps of Engineers and modified by Cornell, was used to categorize total growth.

Notation	Description
Z	Zero: no plants on rake
T	Trace: fingerful on rake
S	Sparse: small handful on rake
M	Moderate: large handful on rake
D	Dense: difficult to bring into boat

Percent Cover

Percent cover was defined as the percent of bottom sediments obscured by vegetation. In general, an area in which no sediments are visible was classified at 100% cover; at times, however, bottom sediments are not visible due to water clarity, regardless of vegetative growth. These points will be given a null (ø) designation, for data recording purposes.

Biomass Index

The biomass for each data point was recorded on a scale from zero to four:

0	No biomass	No plants
1	Low biomass	Very low growth
2	Moderate biomass	Growth extending up, into water column
3	High biomass	Growth in water column and possibly to surface, may be considered a recreational or habitat nuisance
4	Very high biomass	Growth filling the water column and covering the surface

Percentage of Target Species

The immediate area around the boat was observed for growth of *P. crispus, M. spicatum, Trapa natans,* and any other target species. Each point will be assigned the appropriate percentage.

Target Species Bed Identification

In order to identify target species bed perimeters, a boat was used to navigate around the pond while surveyors recorded the visual density of each bed. A GPS unit was used to track the boat as it moved around plant beds. This GPS track was uploaded to a GIS-based mapping program (ArcMap) and used to develop a pre-management map detailing the overall invasive/nuisance species situation, including relative densities and acreage of beds.

Early Season Point-intercept Survey

The early-season point-intercept survey was conducted on May 3, 2021 by a SOLitude biologist. A 10-foot Jon boat was used to tour the waterbody, locating the data points via a hand-held Garmin GPS. A throw-rake and under-water camera (Aqua-view) was used to observe submersed aquatic vegetation at each data point.

At the time of the survey, two submersed aquatic plants, one macro-alga, and filamentous algae were identified. Curly-leaf pondweed was the dominant species, present at 21 points (24%), followed by filamentous algae (18%), stonewort (17%), and thin-leaf pondweed (11%). The average depth of data points during the May survey was 10.7 feet with an average biovolume (height of plants in the water column) of 1. The average percent cover (or overall abundance) of plant cover was 24% with an overall abundance of target species present at 23%. No Eurasian watermilfoil was observed at the time of the survey.

Late Season Point-intercept Survey

The late-season point-intercept survey was conducted on September 23, 2021 by a SOLitude biologist. The same survey protocol as the early season survey was followed.

Only one species of vegetation was observed; stonewort (macro-alga) was observed at 8% of points. The average depth of data points during the September survey was 10.67 feet with an average biovolume of <1. The average percent cover of plant cover was <1% with an overall abundance of target species present at 0%. No Eurasian watermilfoil or curly-leaf pondweed was observed at this time.

Table 1. Species List and Frequency of Occurrence

Macrophyte Species	Common Name	May	September
Potamogeton crispus	Curly-leaf Pondweed	24%	0%
Potamogeton pusillus	Thin-leaf pondweed	11%	0%
Nitella spp.	Stonewort	17%	8%
Benthic Filamentous Algae		18%	0%

Table 2. Average percentages of parameters		
	May	September
Total Percent Cover of All Species	24%	8%
Total Percent Cover of Target Species	23%	<1%
Total Biovolume of Data Points	1	<1
Depth of Data Points	10.7ft	10.67ft

Management Recommendations

In recent history Spy Pond has not supported a diverse macrophyte assemblage, in fact, since 2016 the plant assemblage has consisted of no more than 4-5 individual species, and of those 4-5 species, only 1 or 2 of them have been native on average. Clearly Spy Pond suffers from multiple management issues (invasive plant growth, low native plant diversity & richness, Harmful Algal Blooms - HABs, etc.) that make effective long-term management complicated and difficult. However, it is important to note that under such conditions even low to moderate level annual management can sometimes have negative ramifications on the long-term restoration of the aquatic ecosystem. Therefore, based on recent trends and the observed results of 2021, we recommend that the Town consider, at a minimum, no active vegetation management in 2022. Although this will result in the proliferation of non-native plants, it will hopefully also allow a more robust establishment of the historically dominant native plant species, which should be the goal of any aquatic vegetation management program. For this reason, we recommend that the Town take the following steps in 2022.

- Conduct thorough early and late season (early to mid June) vegetation surveys to identify and map all of the aquatic plant growth.
- Conduct water quality sampling for a variety of parameters (clarity, temperature, dissolved oxygen, pH, alkalinity, total phosphorus, dissolved phosphorus, Nitrogen series, etc) throughout the growing season (April-October) in order to establish seasonal trends. Seasonal fluctuations in nutrients may help guide the timing of future plant control that will have the lowest potential impact on water quality conditions.
- Using available plant growth information, develop a Zone-based management plan. Given that true eradication of the non-native species in Spy Pond is likely not an attainable goal, we believe that reducing the level of annual management pressure in the future by establishing a threshold of acceptable non-native plant growth will also be an important step in establishing and sustainably maintaining a more balanced system. Establishing these detailed management criteria will help inform the when, where, and how much vegetation control should be conducted.

Effective and detailed monitoring of both vegetation growth and water quality will be the cornerstone of an effective and sustainable management program at Spy Pond

moving forward. Therefore, at a minimum, annual early and late season monitoring of the vegetation growth should be performed.

We hope that you find this information useful in making future management decisions for Spy Pond. If you have any questions or would like to discuss anything in more detail please do not hesitate to contact our office.

Appendix A: Treatment and Point-intercept Maps

Figure 1: Point-Intercept Data Points

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Spy Pond
Arlington, MA

Spy Pond

0 510 1,020

1:7,006 Feet

N

Map Date: 11/17/21
Prepared by: KV
Office: SHREWSBURY, MA

Figure 2: Depth (feet)

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Spy Pond
Arlington, MA

Spy Pond
0 540 1,080
1:7,370 Feet

N

Map Date: 11/17/21
Prepared by: KV
Office: SHREWSBURY, MA

Figure 3: Percent Cover of All Submersed Aquatic Vegetation

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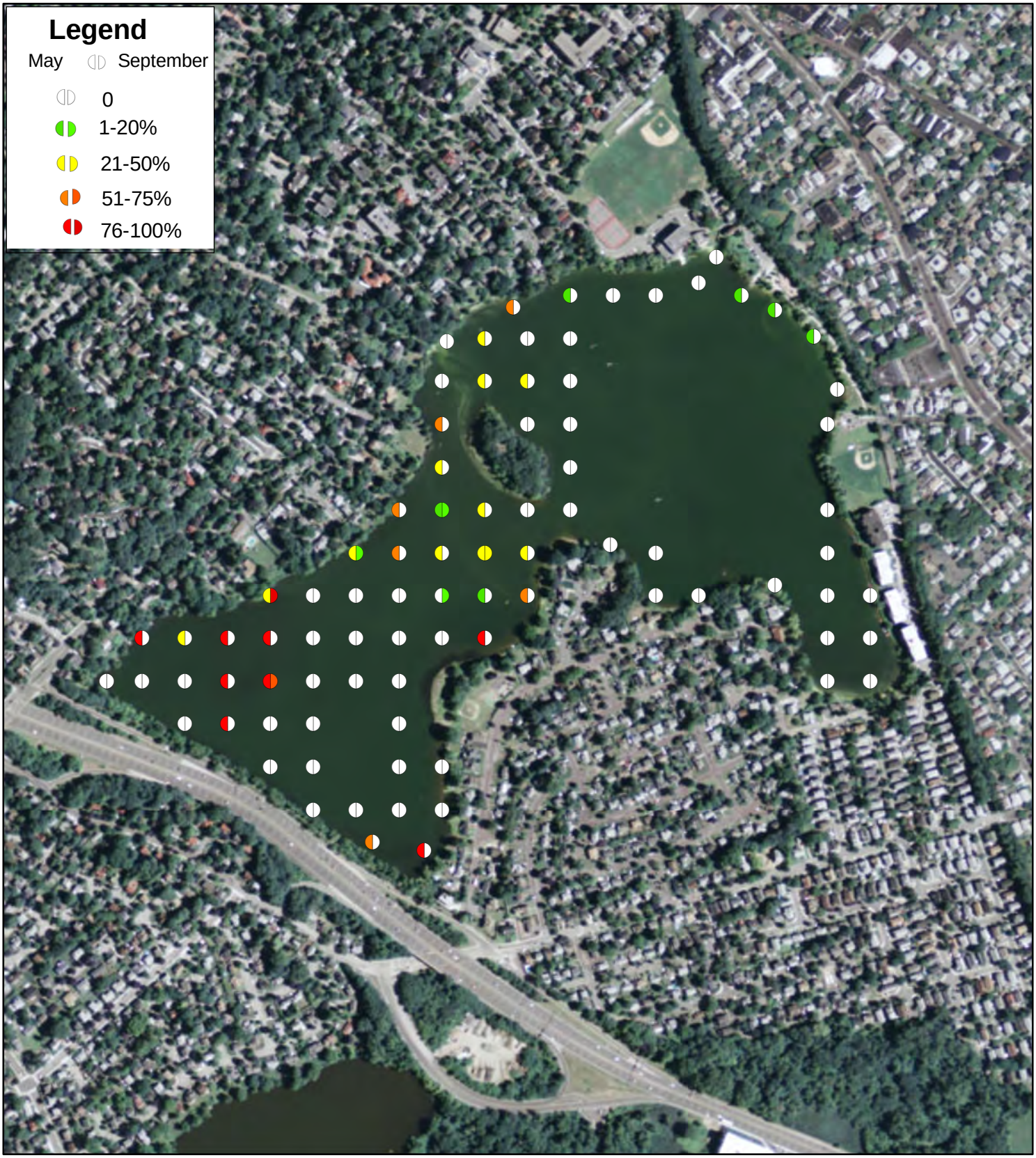

Spy Pond
Arlington, MA

Spy Pond
0 540 1,080
1:7,370 Feet

N

Map Date: 11/17/21
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Figure 4: Percent Cover of Target Species

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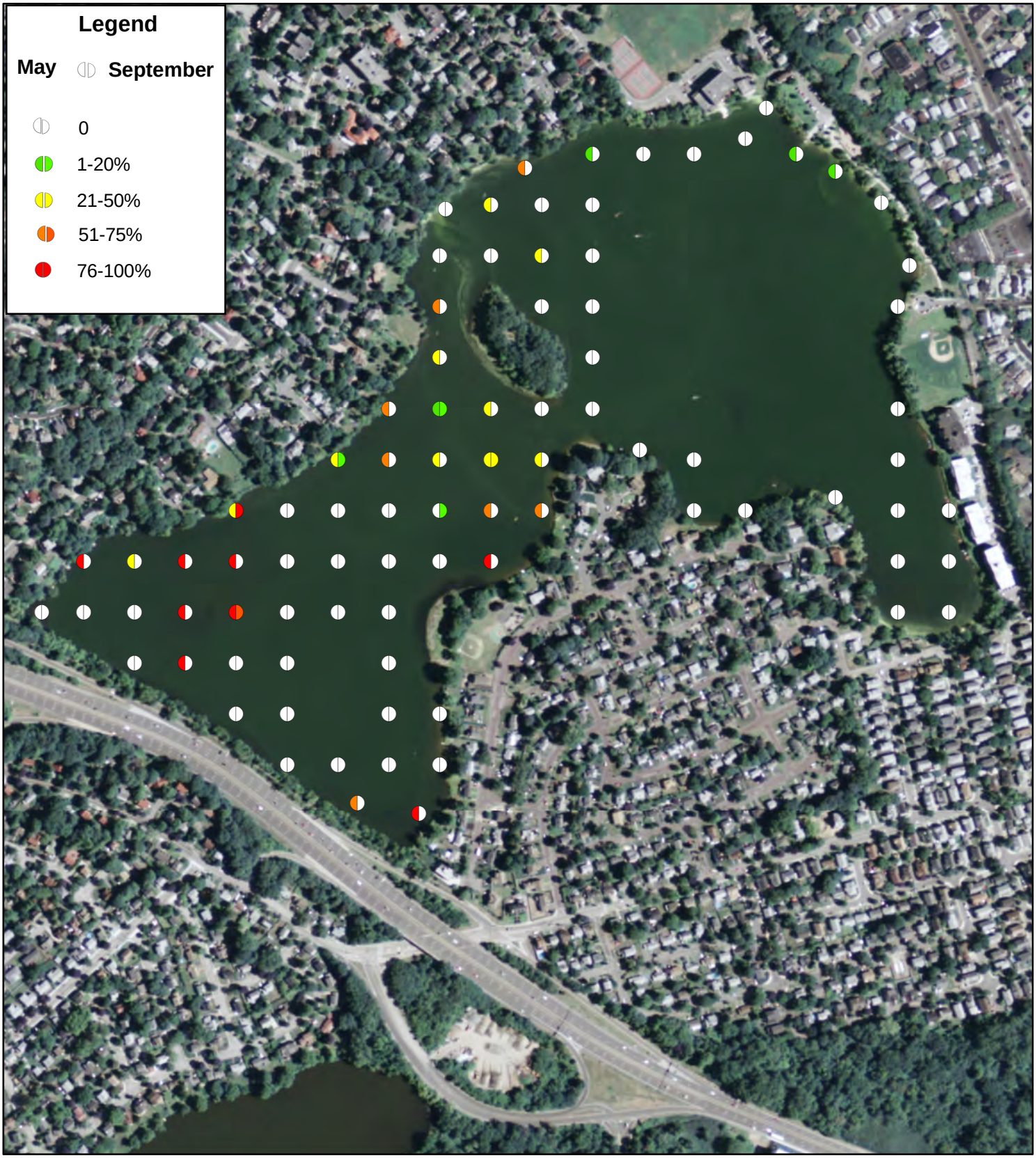

Spy Pond
Arlington, MA

Spy Pond
0 450 900
1:6,202 Feet

N

Map Date: 11/17/21
Prepared by: KV
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Figure 5: Biovolume of Data Points

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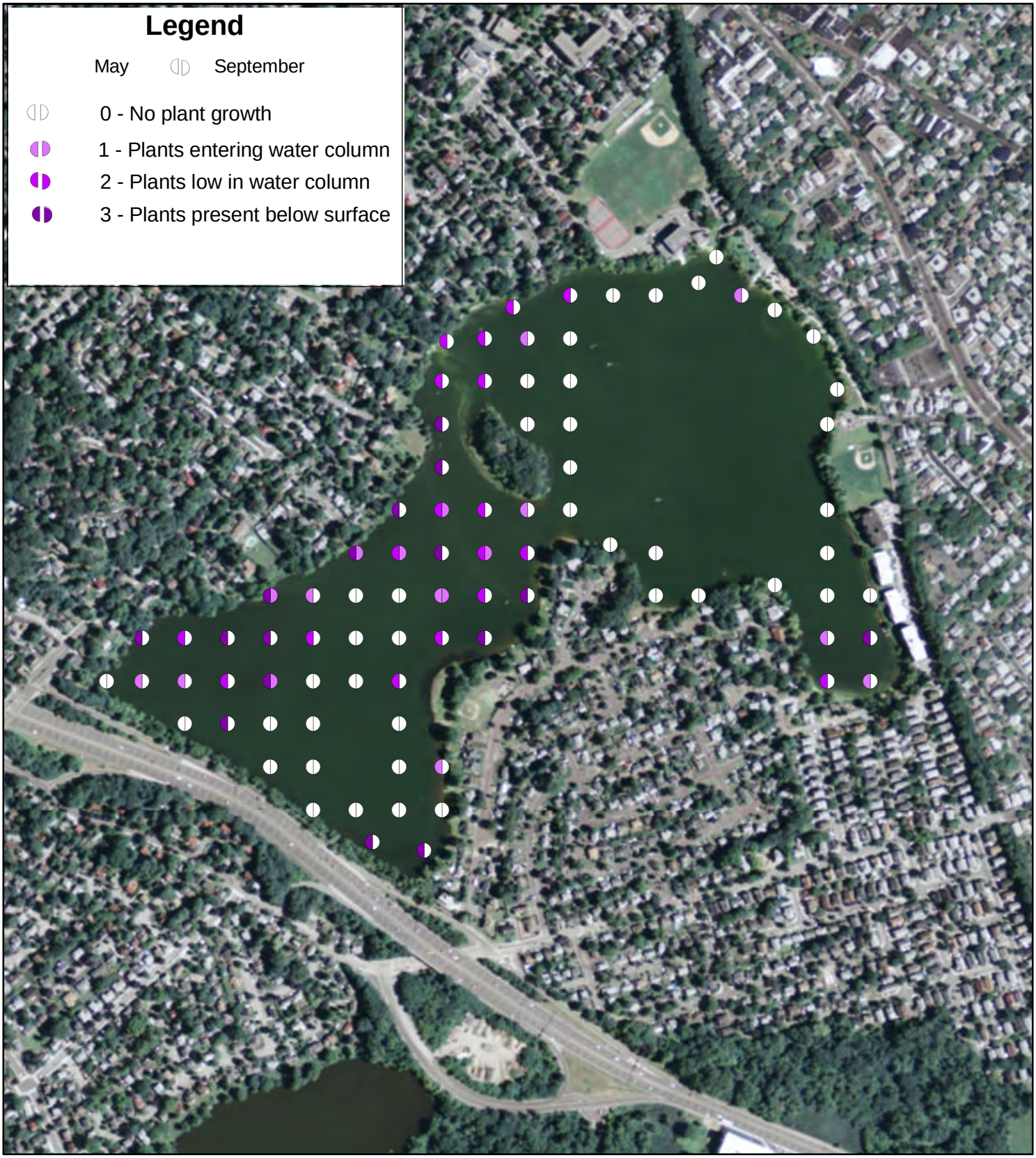

Spy Pond
Arlington, MA

Spy Pond
0 540 1,080
1:7,370 Feet
N

Map Date: 11/17/21
Prepared by: KV
Office: SHREWSBURY, MA

Figure 6: Relative Abundance of Curly-leaf Pondweed *(P. crispus)*

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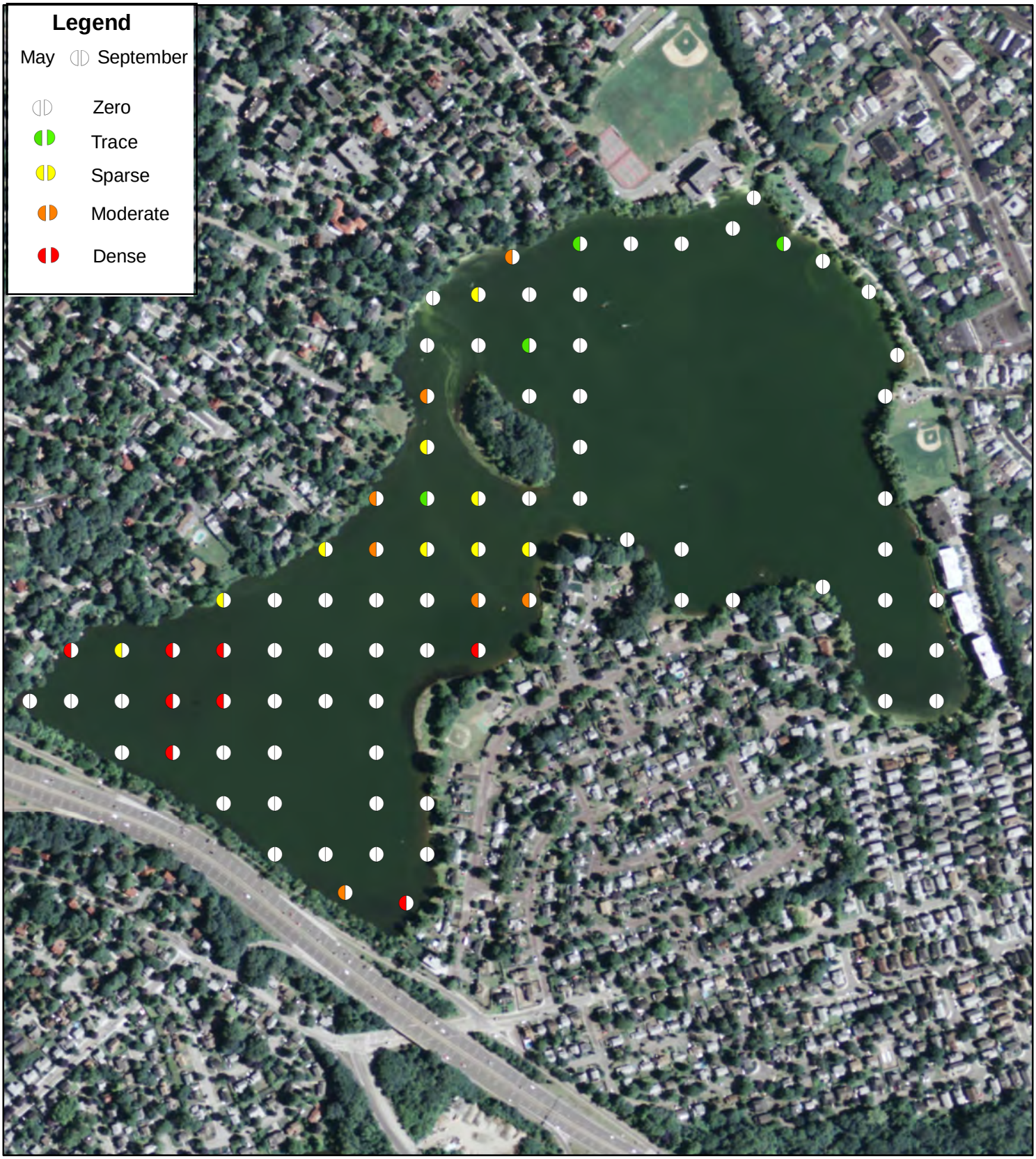

Spy Pond
Arlington, MA

Spy Pond

0 450 900

1:6,202 Feet

N

Map Date: 11/17/21
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Figure 7: Relative Abundance of Thin Leaf Pondweed *(P. pusillus)*

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Spy Pond
0 450 900
1:6,202 Feet
N

Map Date: 11/17/21
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Figure 8: Relative Abundance of Stonewort *(Nitella spp.)*

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Arlington, MA

Spy Pond
0 450 900
1:6,202 Feet
N

Map Date: 11/17/21
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Figure 9: Relative Abundance of Filamentous Algae

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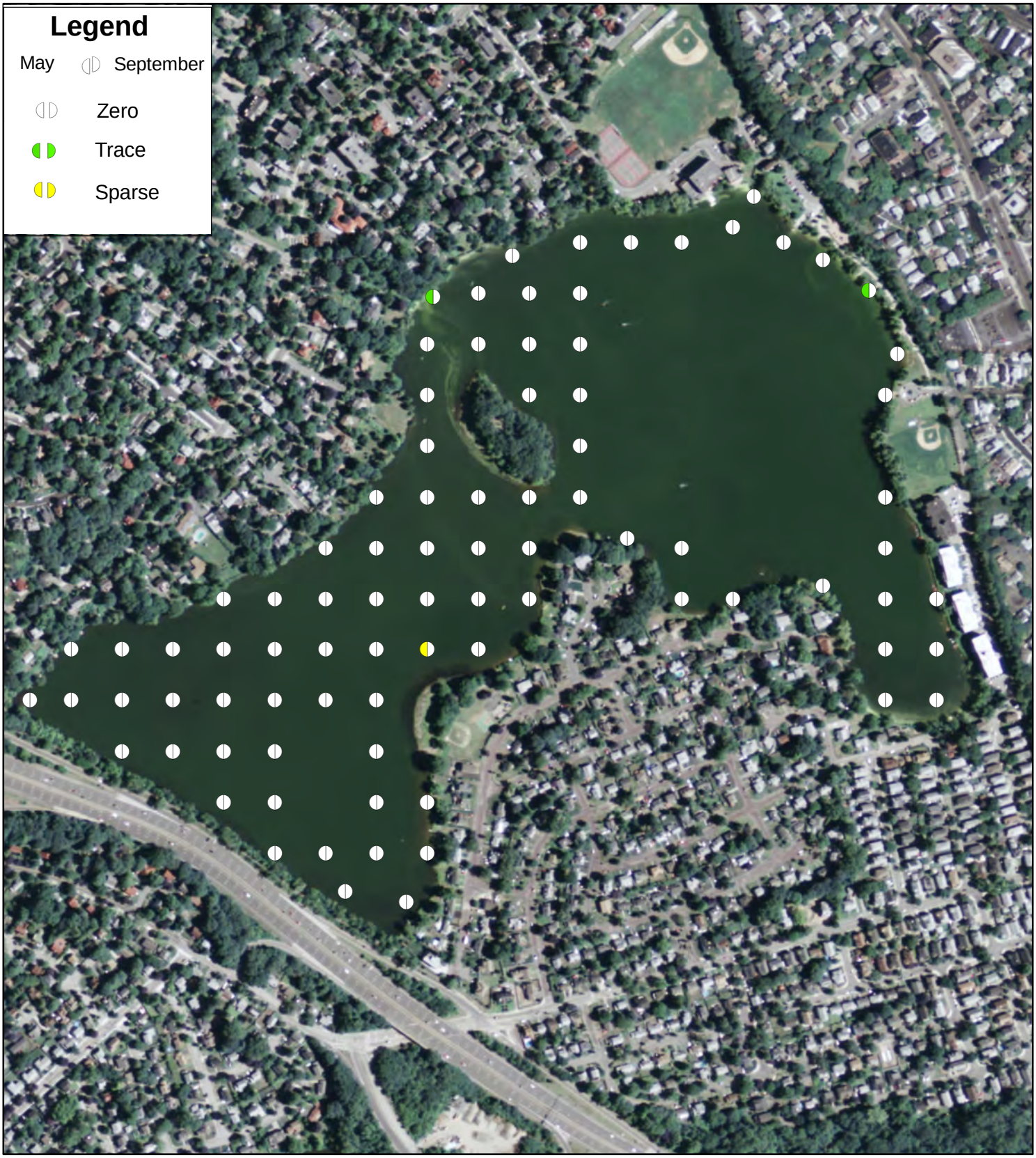

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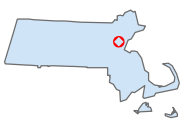
Arlington, MA



Spy Pond
0 450 900
1:6,202 Feet
N

Map Date: 11/17/21
Prepared by: KV
Office: SHREWSBURY, MA

Appendix B: Raw Data

Point ID	Latitude	Longitude	Depth	Biovolume	Percent Cover of All Species	Percent Cover of Target Species	Curly-leaf Pondweed	Thin-leaf Pondweed	Stonewort	Filamentous Algae
1	42.410968	-71.151236	8.3	1	10%	0%	T	0	0	0
2	42.410785	-71.150675	12.4	0	0%	0%	T	0	0	0
3	42.410451	-71.150017	11.9	0	0%	0%	0	0	0	0
4	42.409784	-71.149618	4.5	0	0%	0%	0	0	0	0
5	42.409343	-71.149788	10.1	0	0%	0%	0	0	0	0
6	42.408263	-71.149794	21.5	0	0%	0%	0	0	0	0
7	42.407723	-71.149797	18.9	0	0%	0%	0	0	0	0
8	42.407180	-71.149071	10.1	0	0%	0%	0	0	0	0
9	42.406640	-71.149074	5.2	3	55%	55%	0	0	0	0
10	42.406100	-71.149077	4.3	1	10%	10%	0	0	0	0
11	42.406102	-71.149806	3.5	2	45%	45%	0	0	0	P
12	42.406642	-71.149803	13.8	1	15%	15%	0	0	0	0
13	42.407183	-71.149800	26.8	0	0%	0%	0	0	0	0
14	42.407321	-71.150695	24.2	0	0%	0%	0	0	0	0
15	42.407189	-71.151986	9.5	0	0%	0%	0	0	0	0
16	42.407191	-71.152715	9.5	0	0%	0%	0	0	0	0
17	42.407732	-71.152712	25.6	0	0%	0%	0	0	0	0
18	42.407833	-71.153490	12.2	0	0%	0%	0	0	0	0
19	42.408276	-71.154167	21.9	0	0%	0%	0	0	0	P
20	42.408278	-71.154896	3.4	1	10%	10%	0	0	T	0
21	42.408280	-71.155625	5.6	2	15%	10%	S	0	T	0
22	42.408283	-71.156354	5.2	2	25%	25%	T	T	T	0

23	42.408285	-71.157082	5.5	3	90%	90%	M	0	0	P
24	42.407747	-71.157814	5.1	3	75%	75%	S	0	0	0
25	42.407745	-71.157085	6.8	2	60%	60%	M	0	0	0
26	42.407742	-71.156356	5.8	3	80%	80%	S	0	0	0
27	42.407740	-71.155628	6.2	2	55%	55%	S	0	T	0
28	42.407738	-71.154899	5.1	2	45%	25%	S	T	T	0
30	42.407198	-71.154902	4.2	3	35%	35%	M	0	T	P
31	42.407200	-71.155631	5.8	2	50%	35%	0	T	T	P
32	42.407202	-71.156359	15.4	1	10%	0%	0	T	0	0
33	42.407204	-71.157088	14.3	0	0%	0%	0	0	0	0
34	42.407207	-71.157817	14.3	0	0%	0%	0	0	0	0
35	42.407209	-71.158546	12.6	1	10%	10%	0	0	0	P
36	42.407211	-71.159275	6.2	3	100%	100%	S	0	0	0
37	42.406677	-71.161464	4.5	3	90%	90%	D	0	0	0
38	42.406675	-71.160736	6.2	2	55%	50%	S	0	T	0
39	42.406673	-71.160007	5.0	3	95%	95%	D	0	0	0
40	42.406671	-71.159278	6.0	3	100%	100%	D	0	0	0
41	42.406669	-71.158549	5.3	2	50%	50%	0	0	T	0
42	42.406667	-71.157820	16.7	0	0%	0%	0	0	0	0
43	42.406664	-71.157091	16.6	0	0%	0%	0	0	0	0
44	42.406662	-71.156362	6.5	2	65%	65%	0	T	T	0
45	42.406660	-71.155633	4.2	3	60%	60%	D	0	0	P
46	42.406124	-71.157094	6.3	2	10%	10%	0	0	T	0
47	42.406126	-71.157823	17.9	0	0%	0%	0	0	0	0
48	42.406129	-71.158552	17.0	0	0%	0%	0	0	0	0
49	42.406131	-71.159281	6.0	3	80%	80%	D	0	0	0
50	42.406133	-71.160010	4.4	2	15%	15%	D	0	0	0
51	42.406135	-71.160738	9.7	1	5%	5%	0	0	0	P
52	42.406137	-71.161467	13.6	1	10%	10%	0	0	0	P
53	42.406139	-71.162063	2.0	0	0%	0%	0	0	0	P

54	42.405595	-71.160741	14.9	0	0%	0%	0	0	0	0
55	42.405593	-71.160012	5.4	3	30%	30%	D	0	0	0
56	42.405591	-71.159284	16.3	0	0%	0%	0	0	0	0
57	42.405588	-71.158555	21.2	0	0%	0%	0	0	0	0
58	42.405584	-71.157097	17.8	0	0%	0%	0	0	0	0
59	42.405042	-71.156371	5.8	1	5%	0%	0	0	T	0
60	42.405044	-71.157100	17.0	0	0%	0%	0	0	0	0
61	42.405048	-71.158558	25.8	0	0%	0%	0	0	0	0
62	42.405050	-71.159287	12.6	0	0%	0%	0	0	0	0
63	42.404508	-71.158561	13.2	0	0%	0%	0	0	0	0
64	42.404506	-71.157832	11.3	0	0%	0%	0	0	0	0
65	42.404504	-71.157103	15.5	0	0%	0%	0	0	0	0
66	42.404502	-71.156374	3.0	0	0%	0%	0	0	0	P
67	42.403988	-71.156680	3.5	3	75%	75%	D	0	0	0
68	42.404101	-71.157556	4.0	3	100%	100%	M	0	0	P
69	42.408823	-71.156351	7.0	3	80%	80%	S	0	0	0
70	42.409363	-71.156348	4.3	3	60%	60%	M	0	0	P
71	42.409359	-71.154890	15.1	0	0%	0%	0	0	0	0
72	42.409356	-71.154161	26.4	0	0%	0%	0	0	0	0
73	42.408816	-71.154164	11.2	0	0%	0%	0	0	0	0
74	42.409897	-71.154158	23.8	0	0%	0%	0	0	0	0
75	42.409899	-71.154887	12.6	0	0%	0%	T	0	0	0
76	42.409901	-71.155616	6.3	2	40%	40%	0	S	S	0
77	42.409903	-71.156345	7.9	2	55%	45%	0	T	T	P
78	42.410406	-71.156259	8.3	2	20%	10%	0	T	T	0
79	42.410441	-71.155613	5.9	2	70%	70%	S	0	0	0
80	42.410439	-71.154884	5.9	1	10%	5%	T	T	0	0
81	42.410437	-71.154155	14.8	0	0%	0%	0	0	0	0
82	42.410837	-71.155124	4.3	2	30%	30%	M	T	0	0
83	42.410977	-71.154152	7.3	2	35%	35%	T	0	0	P

84	42.410975	-71.153423	10.8	0	0%	0%	0	0	0	P	
85	42.410972	-71.152694	17.3	0	0%	0%	0	0	0	0	
86	42.411131	-71.151964	13.3	0	0%	0%	0	0	0	0	
87	42.411460	-71.151662	5.9	0	0%	0%	0	0	0	0	

Point ID	Latitude	Longitude	Depth	Biovolume	Percent Cover of All Species	Percent Cover of Target Species	Stonewort
1	42.410968	-71.151236	1	0	0	0	
2	42.410785	-71.150675	12	0	0	0	
3	42.410451	-71.150017	4	0	0	0	
4	42.409784	-71.149618	8	0	0	0	
5	42.409343	-71.149788	6	0	0	0	
6	42.408263	-71.149794	5	0	0	0	
7	42.407723	-71.149797	20	0	0	0	
8	42.407180	-71.149071	7	0	0	0	
9	42.406640	-71.149074	7	0	0	0	
10	42.406100	-71.149077	5	0	0	0	
11	42.406102	-71.149806	5	0	0	0	
12	42.406642	-71.149803	14	0	0	0	
13	42.407183	-71.149800	24	0	0	0	
14	42.407321	-71.150695	27	0	0	0	
15	42.407189	-71.151986	5	0	0	0	
16	42.407191	-71.152715	17	0	0	0	
17	42.407732	-71.152712	26	0	0	0	
18	42.407833	-71.153490	17	0	0	0	
19	42.408276	-71.154167	28	0	0	0	
20	42.408278	-71.154896	1	0	0	0	
21	42.408280	-71.155625	6	0	0	0	
22	42.408283	-71.156354	6	1	5	0	T

23	42.408285	-71.157082	5	0	0	0	
24	42.407747	-71.157814	5	1	5	0	T
25	42.407745	-71.157085	8	1	5	0	T
26	42.407742	-71.156356	6	0	0	0	
27	42.407740	-71.155628	6	1	10	0	T
28	42.407738	-71.154899	5	0	0	0	
30	42.407198	-71.154902	5	0	0	0	
31	42.407200	-71.155631	6	0	0	0	
32	42.407202	-71.156359	7	1	10	0	T
33	42.407204	-71.157088	14	0	0	0	
34	42.407207	-71.157817	13	0	0	0	
35	42.407209	-71.158546	8	0	0	0	
36	42.407211	-71.159275	5	1	15	0	T
37	42.406677	-71.161464	5	0	0	0	
38	42.406675	-71.160736	7	0	0	0	
39	42.406673	-71.160007	5	0	0	0	
40	42.406671	-71.159278	6	0	0	0	
41	42.406669	-71.158549	9	0	0	0	
42	42.406667	-71.157820	16	0	0	0	
43	42.406664	-71.157091	16	0	0	0	
44	42.406662	-71.156362	7	0	0	0	
45	42.406660	-71.155633	5	0	0	0	
46	42.406124	-71.157094	15	0	0	0	
47	42.406126	-71.157823	17	0	0	0	
48	42.406129	-71.158552	13	0	0	0	
49	42.406131	-71.159281	5	1	15	0	T
50	42.406133	-71.160010	6	0	0	0	
51	42.406135	-71.160738	10	0	0	0	
52	42.406137	-71.161467	14	0	0	0	
53	42.406139	-71.162063	4	0	0	0	

54	42.405595	-71.160741	15	0	0	0	
55	42.405593	-71.160012	8	0	0	0	
56	42.405591	-71.159284	15	0	0	0	
57	42.405588	-71.158555	20	0	0	0	
58	42.405584	-71.157097	17	0	0	0	
59	42.405042	-71.156371	3	0	0	0	
60	42.405044	-71.157100	16	0	0	0	
61	42.405048	-71.158558	22	0	0	0	
62	42.405050	-71.159287	16	0	0	0	
63	42.404508	-71.158561	15	0	0	0	
64	42.404506	-71.157832	14	0	0	0	
65	42.404504	-71.157103	17	0	0	0	
66	42.404502	-71.156374	3	0	0	0	
67	42.403988	-71.156680	4	0	0	0	
68	42.404101	-71.157556	6	0	0	0	
69	42.408823	-71.156351	5	0	0	0	
70	42.409363	-71.156348	5	0	0	0	
71	42.409359	-71.154890	17	0	0	0	
72	42.409356	-71.154161	25	0	0	0	
73	42.408816	-71.154164	19	0	0	0	
74	42.409897	-71.154158	23	0	0	0	
75	42.409899	-71.154887	13	0	0	0	
76	42.409901	-71.155616	8	0	0	0	
77	42.409903	-71.156345	10	0	0	0	
78	42.410406	-71.156259	9	0	0	0	
79	42.410441	-71.155613	5	0	0	0	
80	42.410439	-71.154884	6	0	0	0	
81	42.410437	-71.154155	14	0	0	0	
82	42.410837	-71.155124	4	0	0	0	
83	42.410977	-71.154152	7	0	0	0	

84	42.410975	-71.153423	10	0	0	0		
85	42.410972	-71.152694	20	0	0	0		
86	42.411131	-71.151964	18	0	0	0		
87	42.411460	-71.151662	5	0	0	0		