

Highlands Forge Lake Macrophyte Monitoring Report

*2023 Aquatic Plant Inventory and Management Program
Report for Highlands Forge Lake, Willsboro, NY*



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2023 Aquatic Macrophyte Inventory Report

Introduction

SOLitude Lake Management (SLM) was contracted by Highlands Forest LLC to assess the existing macrophyte growth conditions within Highlands Forge Lake with a special concern for Eurasian watermilfoil (*Myriophyllum spicatum*). A Point-intercept survey was conducted to evaluate the aquatic vegetation. This report will discuss the survey methodology, vegetation assemblage, survey analysis and management recommendations. Associated raw data and vegetation maps can be found in Appendices A and B, respectively.

Summary of Findings

- Macrophytes occurred at 49 of the 54 survey points in the littoral zone.
 - Overall aquatic vegetation cover was 91%.
 - Overall target vegetation cover was 78%.
- 22 aquatic macrophytes (including filamentous algae) were documented during the survey.
- Eurasian watermilfoil was the dominant macrophyte, followed by big-leaf pondweed (*Potamogeton amplifolius*) and southern naiad (*Najas guadalupensis*).

Methodology

The Point-Intercept Method (PIM) of macrophyte sampling is designed to determine the extent of aquatic growth in a lake. The total number of sample locations is typically based on the total acreage of the lake, where one sample location per acre is surveyed at a given site, restricted to the littoral zone. Generally, deeper water areas (total depth greater than 20 feet) are not surveyed due to the lack of aquatic macrophyte growth caused by poor light penetration. 76 sample locations were selected before the survey on ArcGIS Pro mapping software (**Figure 1**). A handheld Garmin GPS unit was used to locate each data point in the field.

During the survey, each predetermined georeferenced point was accessed by boat in a feasible order. At each point, the plant species and densities were assessed visually and with a single rake toss. The following data was collected for each rake toss: depth of the survey point (**Figure 2**), overall aquatic plant biomass (**Figure 3**), percent coverage of all aquatic vegetation (**Figure 4**), percent coverage of invasive vegetation

(**Figure 5**), relative abundance for each species per sample site (**Figure 6a & Figures 7a-d**), and any other pertinent field notes regarding the sample location.

The Rake Toss Methodology, developed by the US Army Corps of Engineers and modified by Cornell University was used for this survey. The abundance scale defined by this methodology was used to categorize the observed macrophyte growth for each rake toss:

Zero = (Z, no plants on rake)

Trace = (T, fingerful on rake)

Sparse = (S, handful on rake)

Medium = (M, rakeful of plants)

Dense = (D, difficult to bring into boat)

Any macrophyte specimen requiring further identification was collected and identified offsite.

Documenting the presence of aquatic plants at species surveyed locations is an unbiased measure of how the aquatic plant assemblage changes from year to year, while also accounting for viability of the environment and limitations of sampling methods available.

Point-intercept surveys do not always accurately represent invasive species distribution. See **Figure 6a** for Eurasian watermilfoil density at Point-intercept locations. To correct this, additional GPS points for visual observations were recorded and displayed in a map to create a more detailed spatial representation of the Eurasian watermilfoil distribution (**Figure 6b**). This visual survey identifies areas of growth that may be misrepresented or missed by the data point survey results alone.

Results

A total of 76 sites were surveyed on July 31, 2023 by two Solitude Biologists. Due to concerns about accuracy, the survey was redone on September 26. For the purpose of data representation, the predetermined points that were outside of the littoral zone (found to be approximately 15 ft at the most) were excluded in the final data tables and analysis. 6 points were on shore and 16 points were deeper than 15 ft, leaving 54 analyzed survey points. The excluded points are crossed out in the table in **Appendix A**. For future surveys, new points will be made to replace excluded points and to satisfy survey requirements. 22 aquatic macrophytes (including filamentous algae) were identified during the survey (**Table 2**). Eurasian watermilfoil was found at more than half

of the predetermined points and in the littoral zone outside of the points. The distribution of native aquatic species is displayed in **Figures 7a, 7b, 7c, and 7d**. Raw data and distribution maps can be found in Appendices A and B, respectively.

Table 1. Intercept points in Highlands Forge Lake

Sample Point	Latitude (NAD83)	Longitude (NAD83)	Depth (ft)	Biovolume	Richness	Overall Abundance	Percent Cover
1	44.41461635	-73.43833963	2.2	1	4	S	40
2	44.41397436	-73.43747749	1.3	4	5	S	35
3	44.41398638	-73.4383564	4.9	4	3	D	80
4	44.41335642	-73.43837317	11.1	3	2	S	35
6	44.41303788	-73.43809426	2.2	4	2	S	30
7	44.41272645	-73.43838994	9	4	4	S	40
8	44.41183631	-73.4388368	3.5	4	4	M	60
9	44.41147854	-73.43930234	10.2	4	2	D	85
10	44.41075296	-73.43955392	9.5	4	4	S	40
11	44.41023061	-73.44021471	9.7	4	4	S	40
12	44.4104874	-73.43981446	6.5	4	6	M	70
13	44.40966271	-73.44143668	8.2	4	2	S	35
15	44.40929724	-73.44222907	9.5	4	4	M	50
17	44.40906006	-73.44234141	8	4	4	D	90
18	44.40898691	-73.44255119	13.5	0	0	Z	0
19	44.40837669	-73.44290143	4.1	4	4	M	60
20	44.40873151	-73.4427213	14	3	1	S	30
21	44.40784209	-73.44405883	12.1	4	5	D	75
23	44.4068838	-73.44508531	4.5	4	4	D	75
26	44.40511723	-73.44862606	2.6	4	1	D	100
28	44.4055548	-73.44941481	2	3	3	D	100
29	44.40504203	-73.44781255	2.6	4	5	D	90
30	44.40529862	-73.4482577	3.5	4	2	D	100
31	44.40465671	-73.44739558	NA	4	1	D	100
32	44.40466865	-73.44827436	NA	4	3	D	100
33	44.40531056	-73.44913648	3.6	4	2	D	100
34	44.40573368	-73.44990328	NA	4	4	D	100
35	44.40556304	-73.44871446	5.3	4	2	D	100
37	44.4072124	-73.44996535	7.1	3	5	D	100
38	44.4082175	-73.44930356	3	3	1	S	30
39	44.40846041	-73.44905323	9	4	2	D	95
40	44.40897925	-73.4486906	5	4	4	D	100
41	44.40970841	-73.44814108	5.3	3	2	S	45
44	44.41118398	-73.44663532	13.3	3	4	M	65
46	44.41189998	-73.44567884	7.8	4	2	S	40

Sample Point	Latitude (NAD83)	Longitude (NAD83)	Depth (ft)	Biovolume	Richness	Overall Abundance	Percent Cover
47	44.41219242	-73.44543777	2	0	0	Z	0
48	44.41218045	-73.44455889	10	2	2	S	40
53	44.41389191	-73.44187583	1.5	0	0	Z	0
54	44.41402241	-73.44099313	6	0	0	Z	0
55	44.41401041	-73.44011422	13.9	1	2	S	30
56	44.4139984	-73.43923531	12.5	2	2	S	40
58	44.41462836	-73.43921855	4	3	2	M	50
C1	44.40678391	-73.44574822	11	4	2	D	80
C2	44.40746925	-73.44431158	14.8	0	0	Z	0
C6	44.41014081	-73.4405968	9.4	4	5	S	35
N1	44.41440794	-73.43966778	4.1	4	4	D	100
N3	44.41245934	-73.43859117	7.4	4	2	M	50
N4	44.41217115	-73.43864022	2	4	4	S	40
N5	44.41435157	-73.43860236	3	4	2	D	75
N6	44.41117849	-73.43937292	5.2	4	4	S	45
S1	44.40505664	-73.44695784	3.5	2	3	M	60
S3	44.40627215	-73.4503667	NA	4	3	D	100
S4	44.40693765	-73.45023262	6.5	4	2	M	50
S5	44.40776373	-73.44956468	7.5	4	3	M	50

Table 2. Percent occurrence of species in Highlands Forge Lake

Aquatic Macrophyte	Total		Trace		Sparse		Moderate		Dense	
	Sites	FOO* %	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites = 54	49	91%	0	0%	18	37%	10	20%	21	43%
%Cover Total	42	78%	1	2%	25	60%	7	17%	9	21%
Eurasian watermilfoil	42	78%	1	2%	25	60%	7	17%	9	21%
Filamentous algae	1	2%	0	0%	1	100%	0	0%	0	0%
Macroalgae	6	11%	0	0%	4	67%	1	17%	1	17%
Big-leaf pondweed	21	39%	10	48%	9	43%	2	10%	0	0%
Illinois pondweed	9	17%	4	44%	5	56%	0	0%	0	0%
Clasping-leaf pondweed	8	15%	1	13%	6	75%	1	13%	0	0%
Flat-stemmed pondweed	1	2%	1	100%	0	0%	0	0%	0	0%
Ribbon-leaf pondweed	1	2%	0	0%	1	100%	0	0%	0	0%
Grassy pondweed	12	22%	6	50%	6	50%	0	0%	0	0%
Sago false pondweed	1	2%	1	100%	0	0%	0	0%	0	0%
Southern naiad	18	33%	3	17%	11	61%	2	11%	2	11%

Aquatic Macrophyte	Total		Trace		Sparse		Moderate		Dense	
	Sites	FOO*	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites = 54										
Common waterweed	4	7%	0	0%	4	100%	0	0%	0	0%
Coontail	1	2%	0	0%	1	100%	0	0%	0	0%
Tape Grass	3	6%	1	33%	2	67%	0	0%	0	0%
Water stargrass	4	7%	4	100%	0	0%	0	0%	0	0%
White waterlily	4	7%	3	75%	0	0%	0	0%	1	25%
Yellow waterlily	2	4%	0	0%	2	100%	0	0%	0	0%
Arrowhead	2	4%	1	50%	1	50%	0	0%	0	0%
Spikesedge	2	4%	0	0%	1	50%	1	50%	0	0%
Bur-reed	1	2%	1	100%	0	0%	0	0%	0	0%
Cat tail	3	6%	0	0%	1	33%	0	0%	2	67%
Common reed	1	2%	0	0%	1	100%	0	0%	0	0%

Red indicates an invasive species.

* FOO = frequency of occurrence

Analysis and Discussion

The Frequency of Occurrence (FOO) is a number that describes how often certain species are observed out of all survey points. FOO can be a good indicator of species distribution and density. Overall macrophyte balance can be basically understood through dominance and commonality of each species. Naturally, dominance is often spread across multiple species within an aquatic system, which can infer a level of macrophyte/richness health. Having few dominant species can indicate unbalanced growth. If the survey methods are replicated year after year, changes in the vegetation assemblage can be seen over time.

Overall aquatic macrophytes were observed at 91% of the points, and invasive Eurasian watermilfoil was found at 78% of the points (**Table 2**). Of the points with vegetation, 86% of them had Eurasian watermilfoil. More than half of the points with Eurasian watermilfoil had sparse abundance. Less than a quarter of those points had dense abundance. The results from the visual survey in addition to the PIM show Eurasian watermilfoil growing along much of the littoral zone (**Figure 6b**).

After Eurasian watermilfoil, the overall macrophyte community was dominated by big-leaf pondweed, present at 39% of sites. Southern naiad was the next most abundant species within the lake at 33% of the sample locations.

Only one other non-native species was documented at Highlands Forge Lake. A sparse amount of common reed (*Phragmites australis*) was observed at one site.

Management Recommendations

The management of Eurasian watermilfoil in Highlands Forge Lake requires a comprehensive and strategic approach to maintain the ecological balance and recreational value of the lake. The invasive nature of Eurasian watermilfoil has led to increased abundance, necessitating the adoption of an effective management plan. The recommendation for the upcoming year is the incorporation of ProcellaCOR EC into the lake management strategy.

ProcellaCOR EC, a selective and environmentally-friendly herbicide, is recommended as a key component of the lake management plan for controlling Eurasian watermilfoil. ProcellaCOR EC specifically targets the invasive species while minimizing adverse effects on non-target plants and aquatic organisms. Its mode of action disrupts the plant's ability to photosynthesize, providing an effective and targeted control method.

In addition to a potential herbicide program, surveys should continue utilizing the same methods and points as previous years. This helps assess growth, distribution and abundance of annual trends of both native and invasive species.

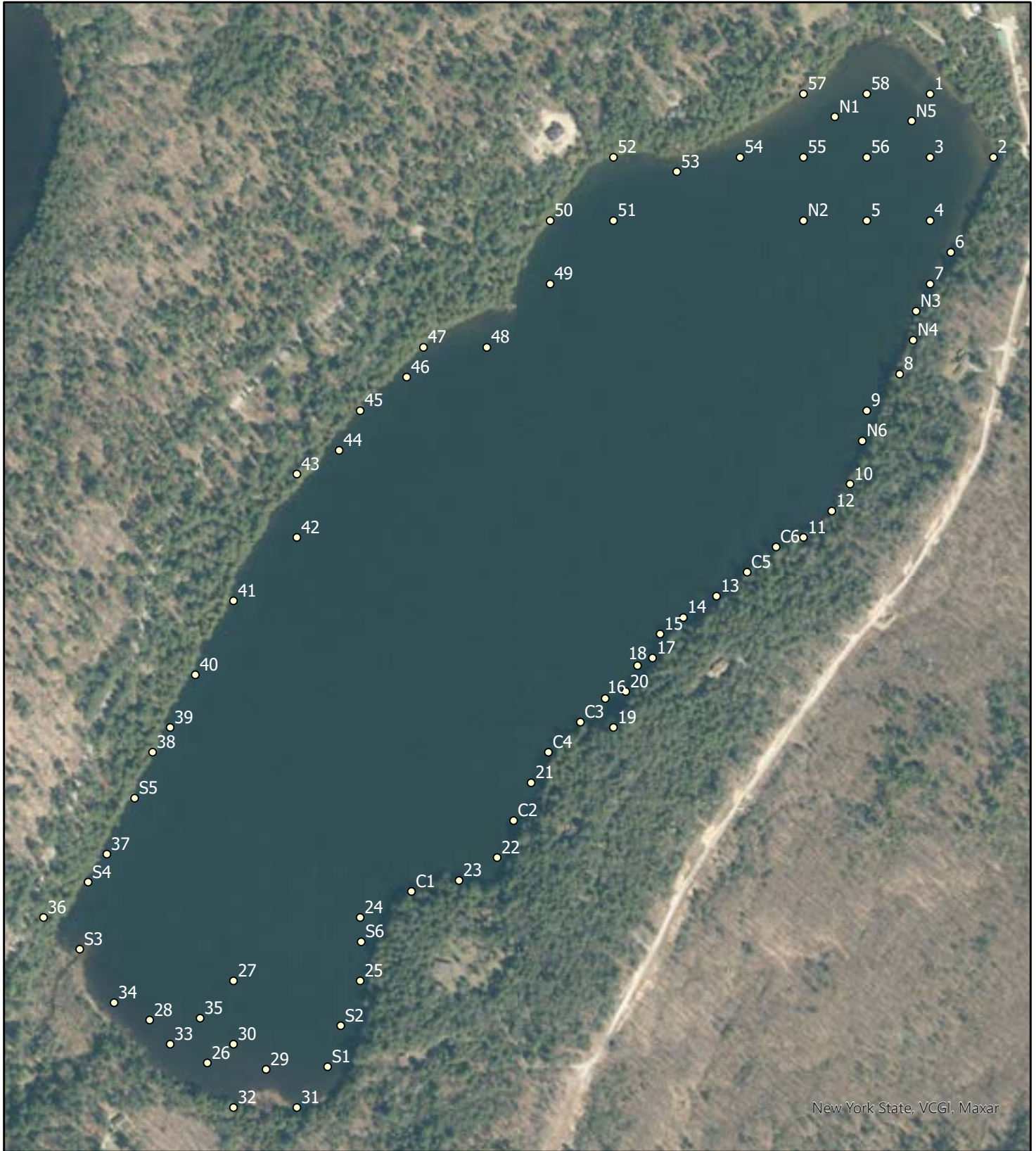
Although common reed was only found in low abundance during the 2023 season, it should be closely monitored in the 2024 season and further.

Appendix A: Raw Data

Note: Excluded points are crossed out

Appendix B: Distribution Maps

FIGURE 1: 2023 Highlands Forge Lake Revised Point-Intercept Locations



New York State, VCGI, Maxar

Highlands Forge Lake
Willsboro, NY



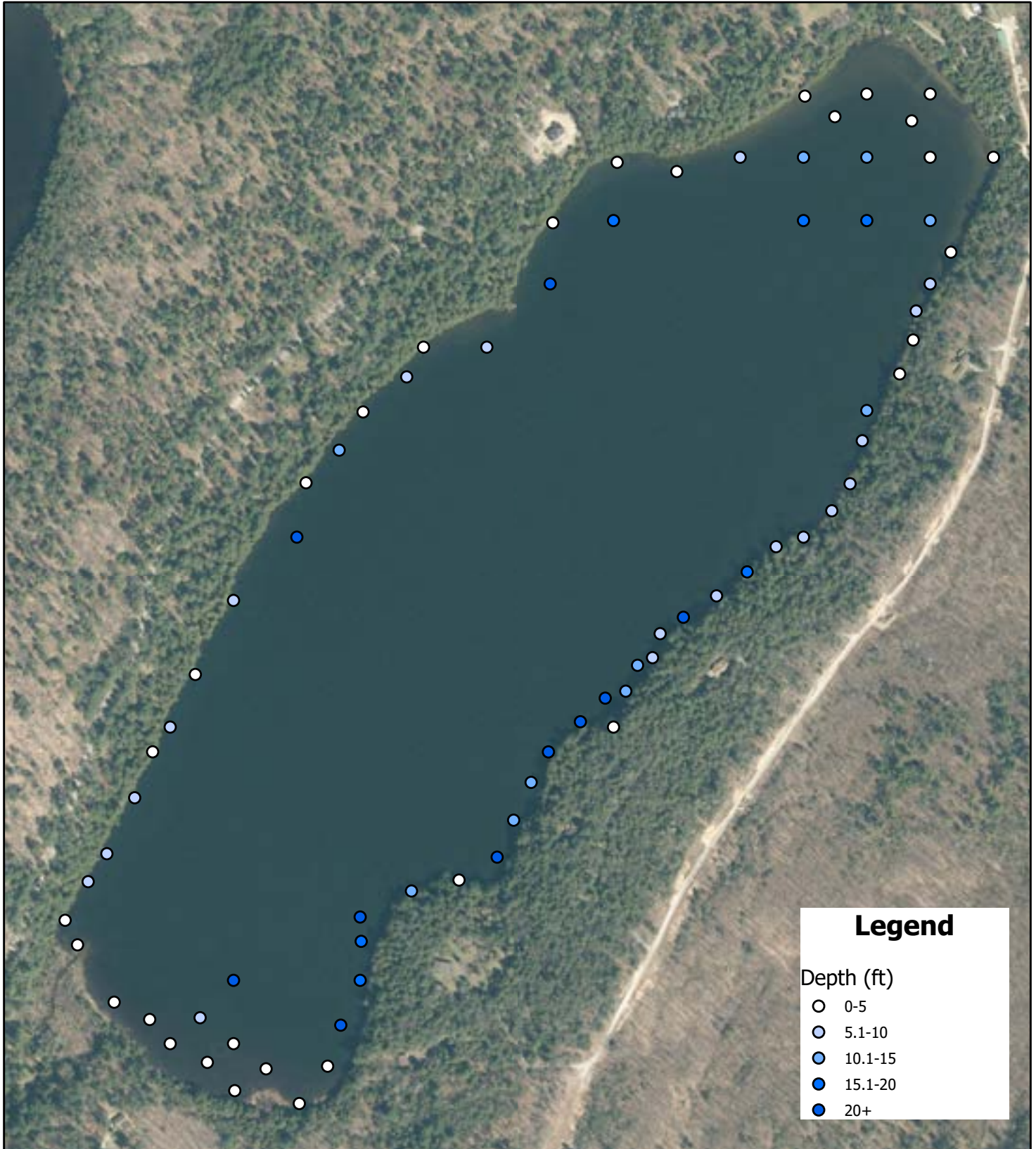
Highlands Forge Lake

1:5,877

0 150 300 600
Feet

Map Date: 10/5/2023
File: HighlandsForge23_REV.PI
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 2: Depth of Point-Intercept Locations



Highlands Forge Lake
Willsboro, NY

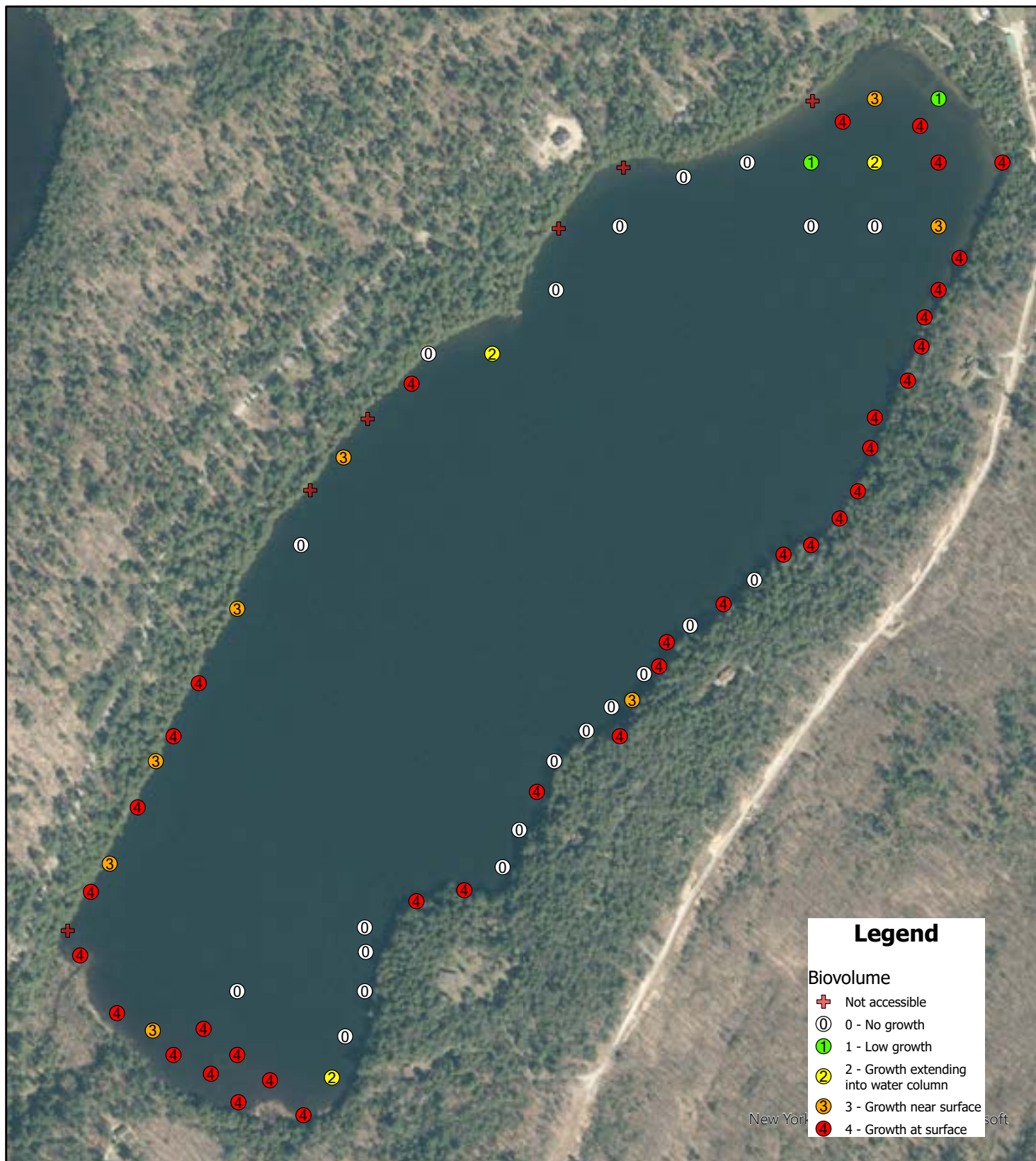


Highlands Forge Lake

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0 150 300 600
Feet

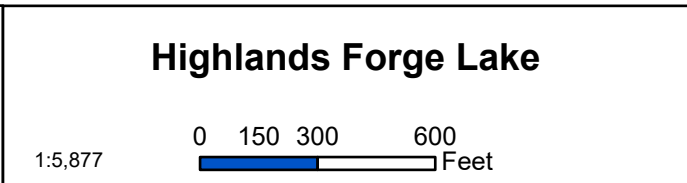
Map Date: 10/5/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 3: Biovolume of Point-Intercept Locations



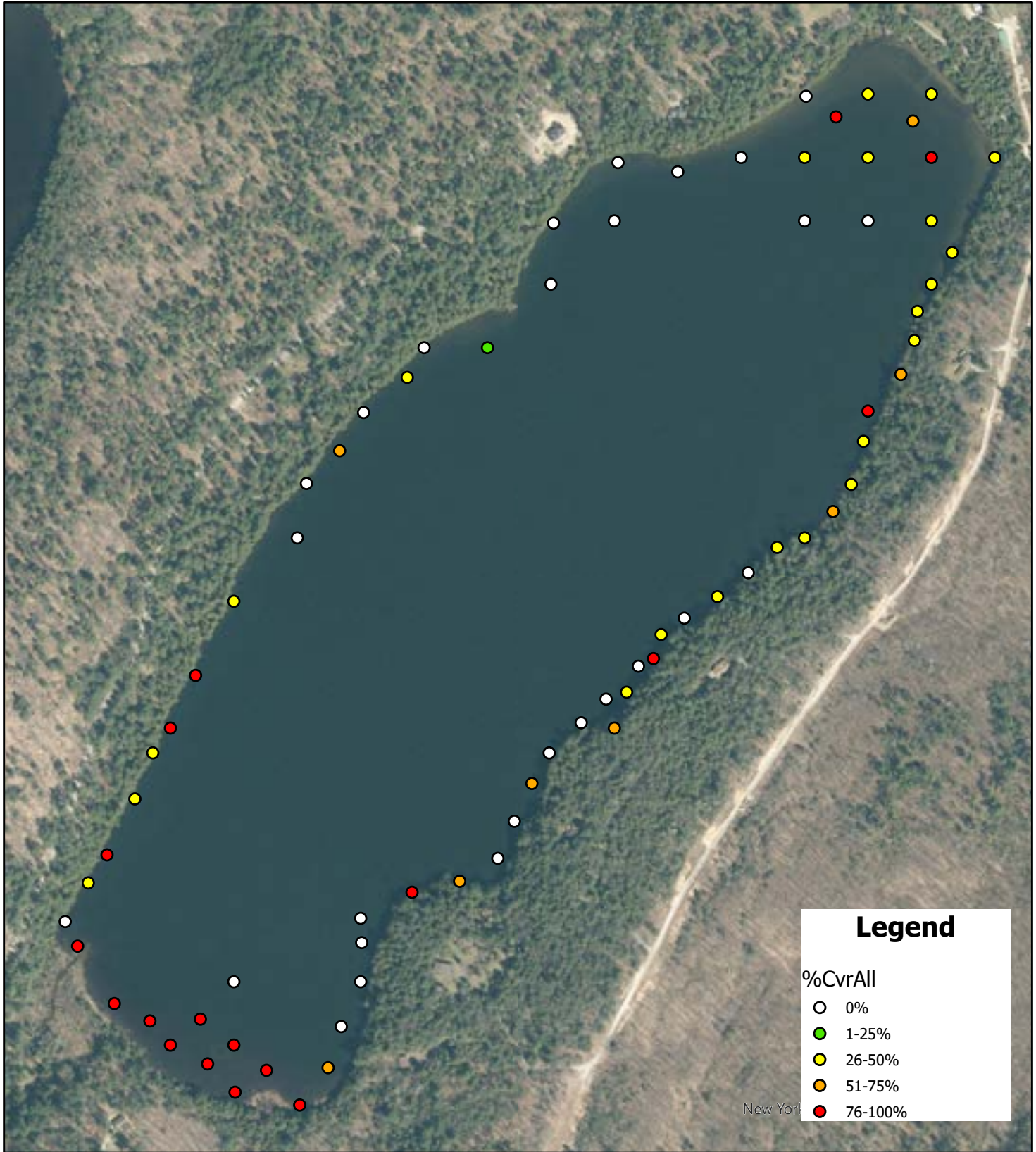
Highlands Forge Lake
Willsboro, NY

N



Map Date: 10/5/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 4: Percent Coverage of All Aquatic Vegetation at Point-intercept Locations



Highlands Forge Lake
Willsboro, NY

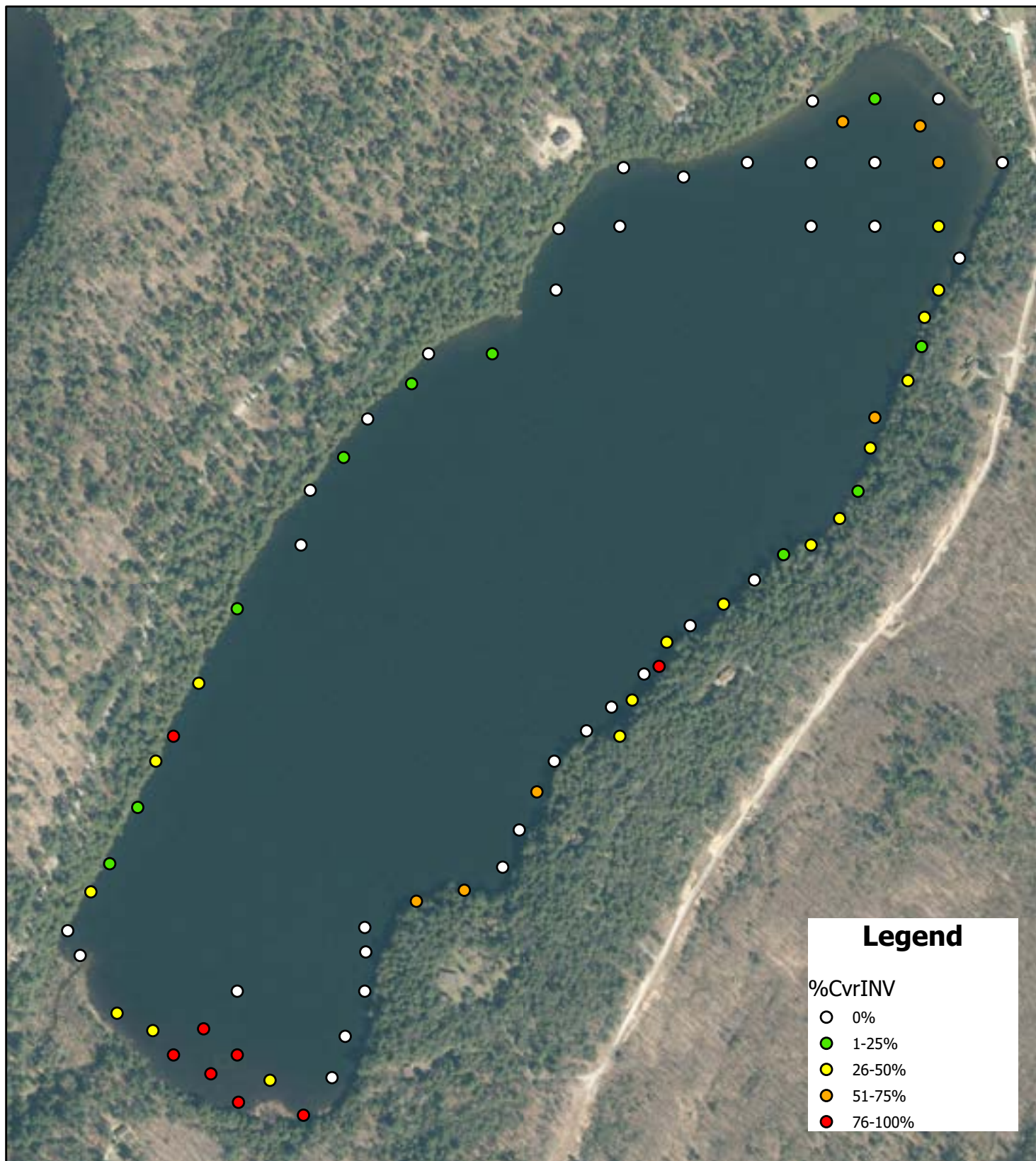


Highlands Forge Lake

1:5,877
0 150 300 600
Feet

Map Date: 10/5/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 5: Percent Coverage of Invasive Aquatic Vegetation at Point-intercept Locations



Highlands Forge Lake
Willsboro, NY



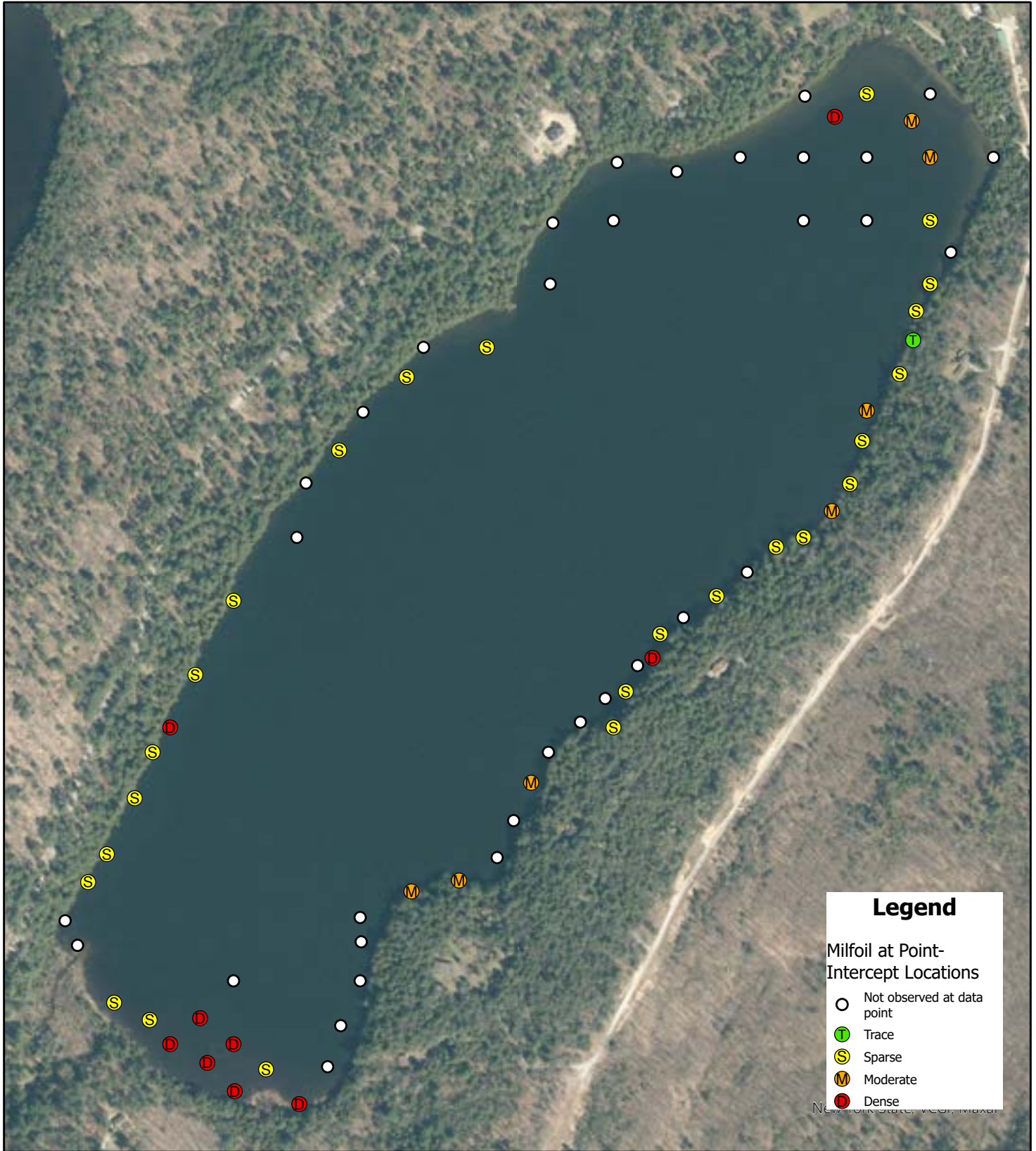
Highlands Forge Lake

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0 150 300 600
Feet

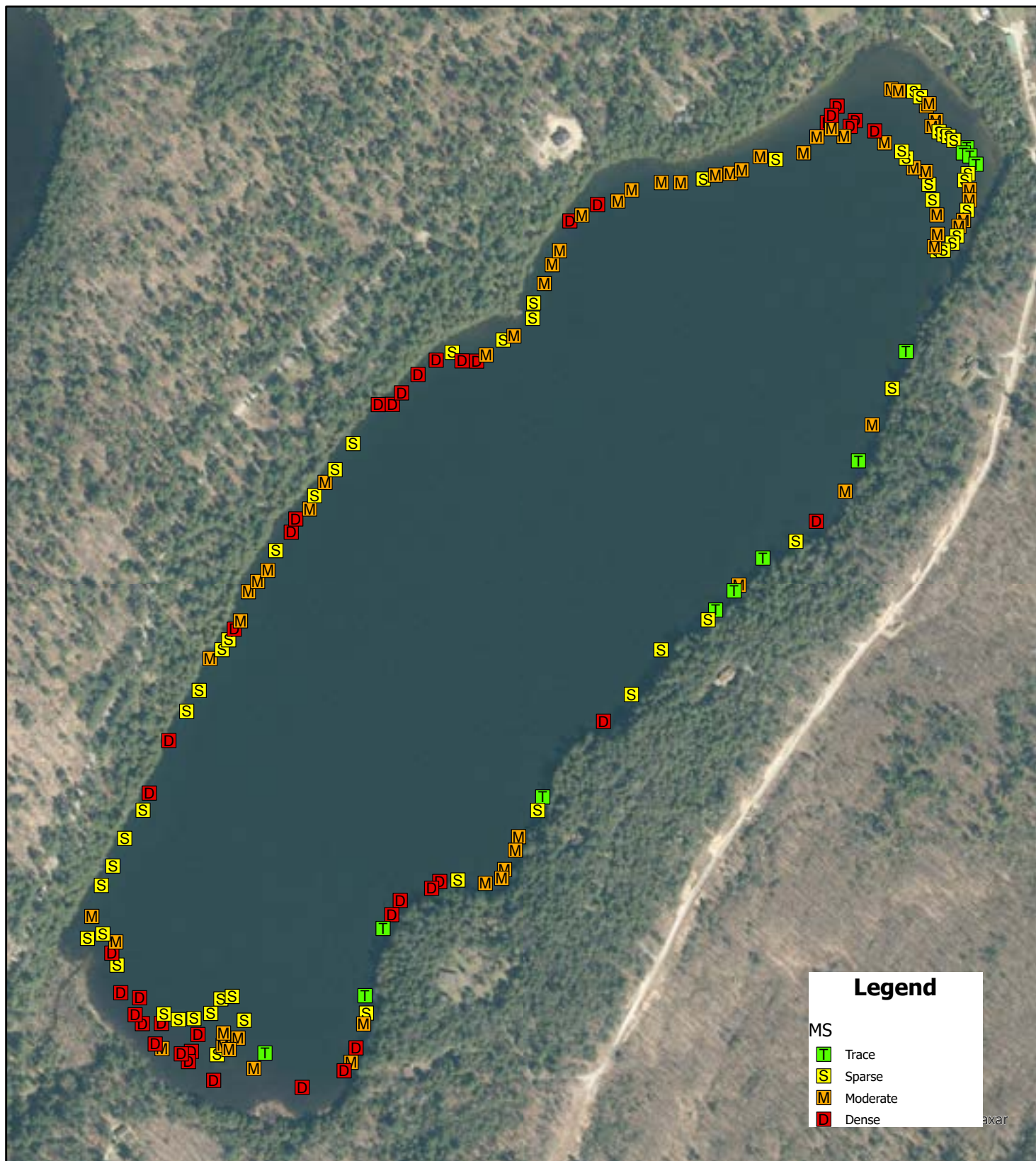
Map Date: 10/5/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 6a: Density and Distribution of Eurasian Watermilfoil at Point-intercept Locations



<p>Highlands Forge Lake Willsboro, NY</p> <p style="text-align: center;">N ▲</p>	<p style="text-align: center;">Highlands Forge Lake</p> <p style="text-align: center;">0 150 300 600 Feet</p> <p>1:5,877</p>	<p>Map Date: 10/5/2023 Survey Date: 09/26/2023 Prepared by: KV Office: Shrewsbury, MA</p>
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FIGURE 6b: Density and Distribution of Eurasian Watermilfoil
Visual Observations - Points



Legend

MS
■ Trace
■ Sparse
■ Moderate
■ Dense

Highlands Forge Lake
Willsboro, NY

N

Highlands Forge Lake

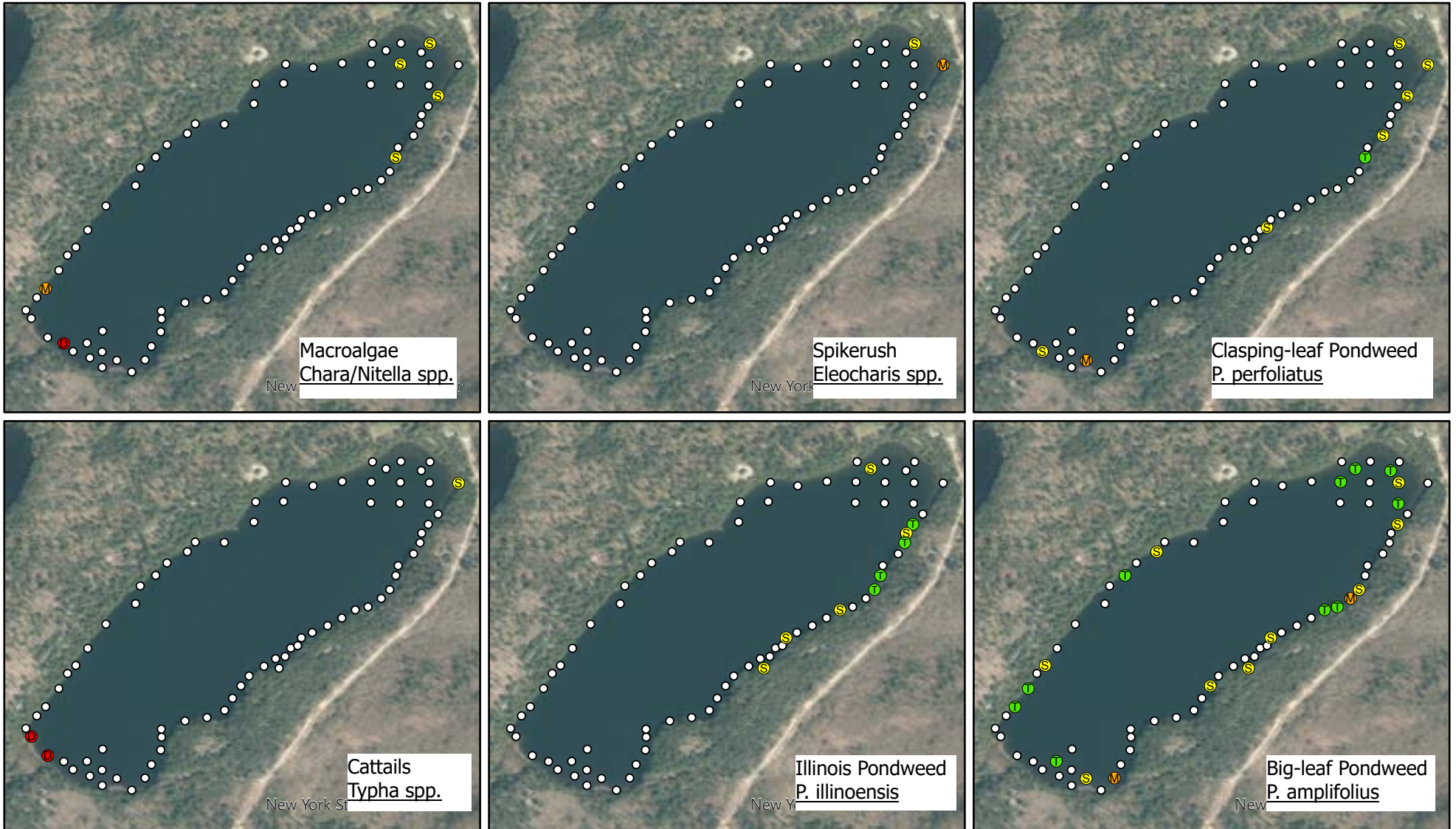
0 150 300 600

 Feet

1:5,877

Map Date: 10/5/2023
 Survey Date: 09/26/2023
 Prepared by: KV
 Office: Shrewsbury, MA

FIGURE 7a: Density and Distribution of Native Vegetation at Point-Intercept Locations (1 of 4)



Highlands Forge Lake
Willsboro, NY



Highlands Forge Lake

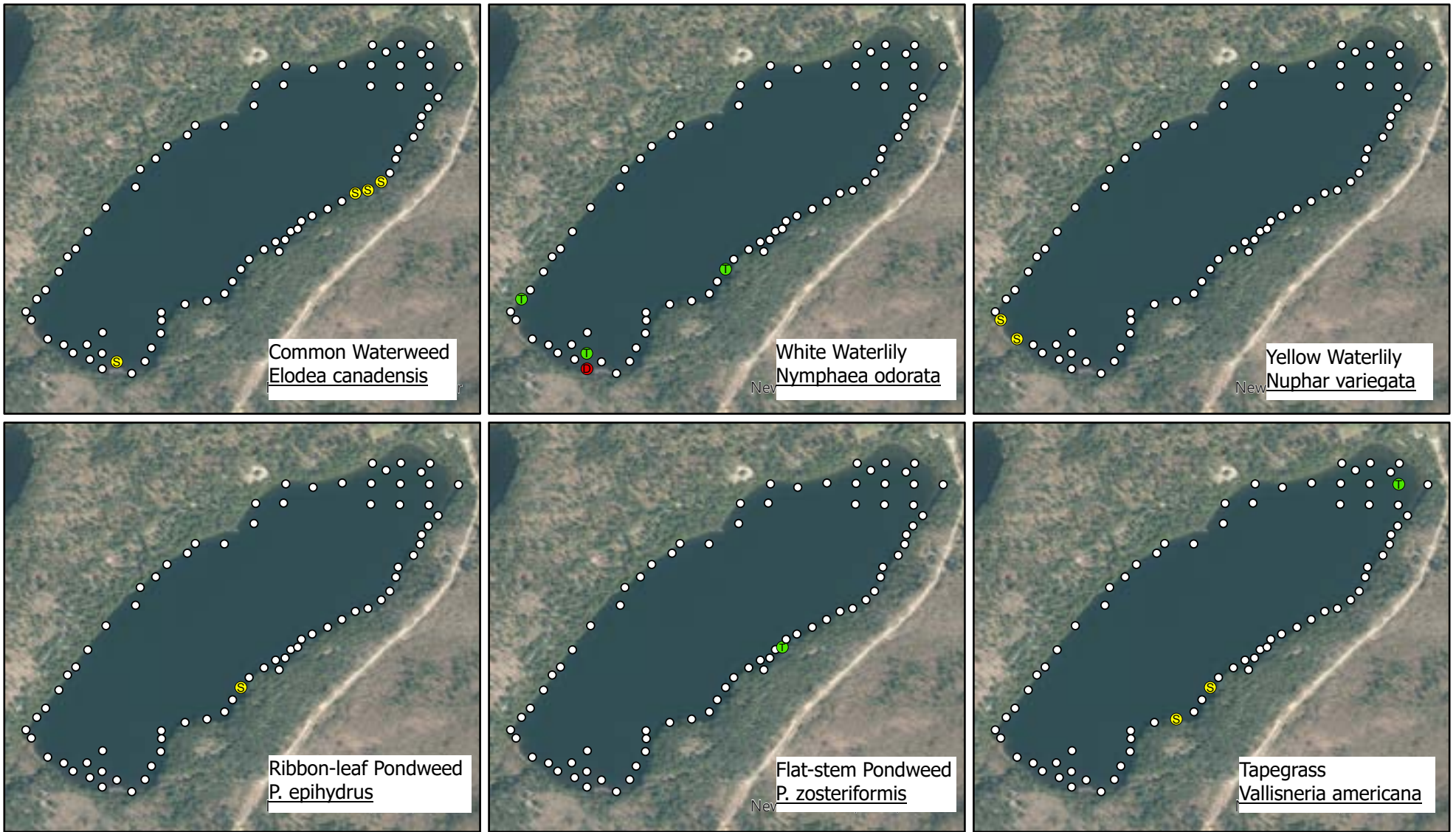
0 500 1,000 2,000
Feet

Legend

- Not present
- Trace
- Sparse
- Moderate
- Dense

Map Date: 10/05/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 7b: Density and Distribution of Native Vegetation at Point-Intercept Locations (2 of 4)



Highlands Forge Lake
Willsboro, NY

Highlands Forge Lake

N
▲
1:18,783

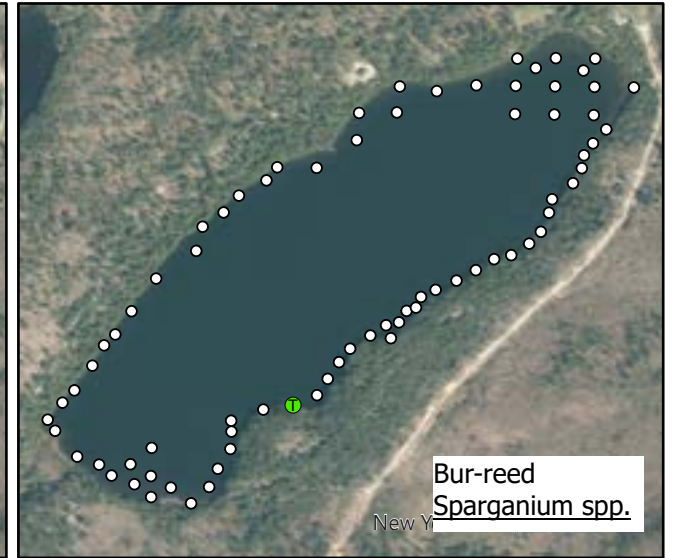
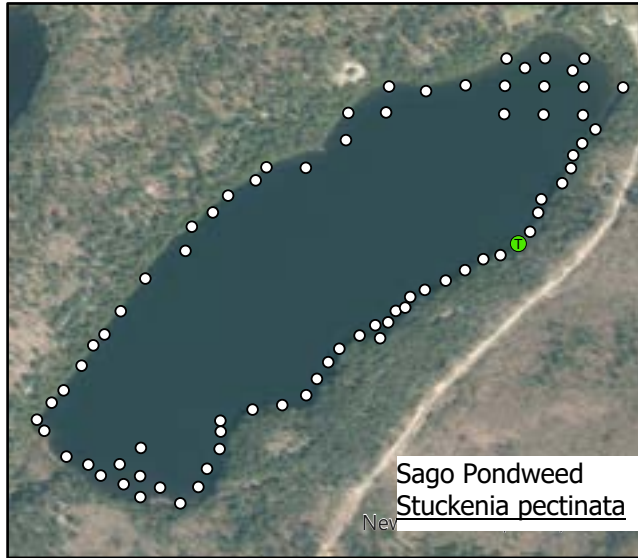
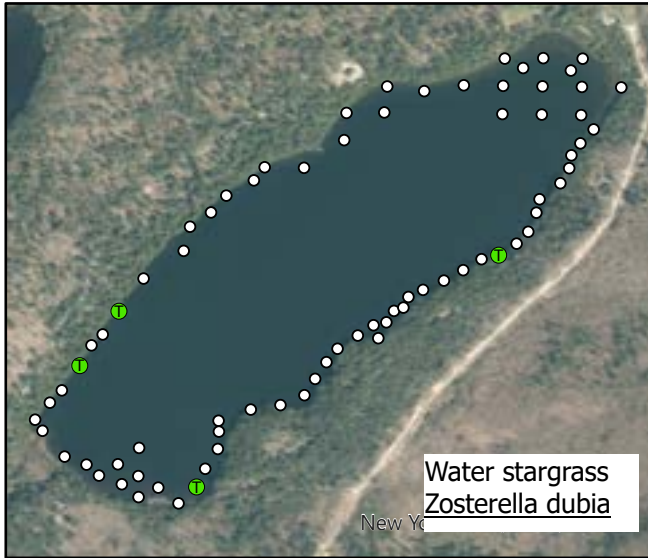
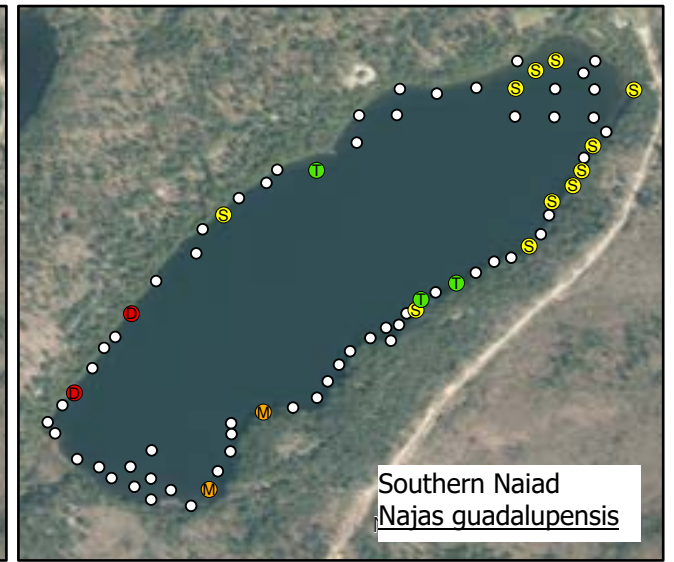
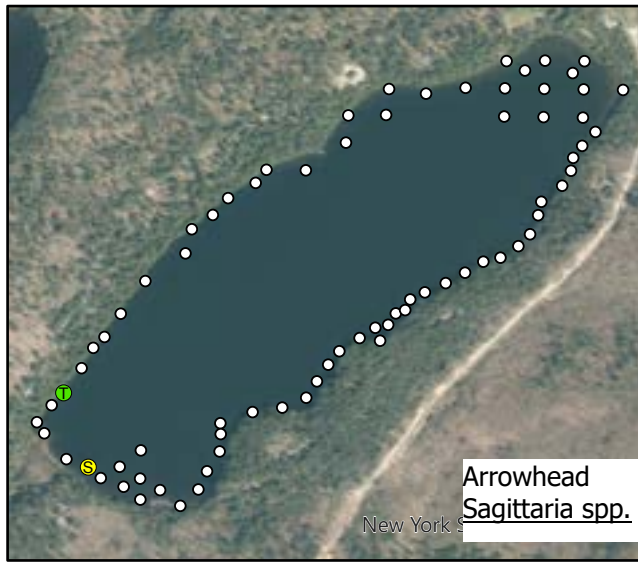
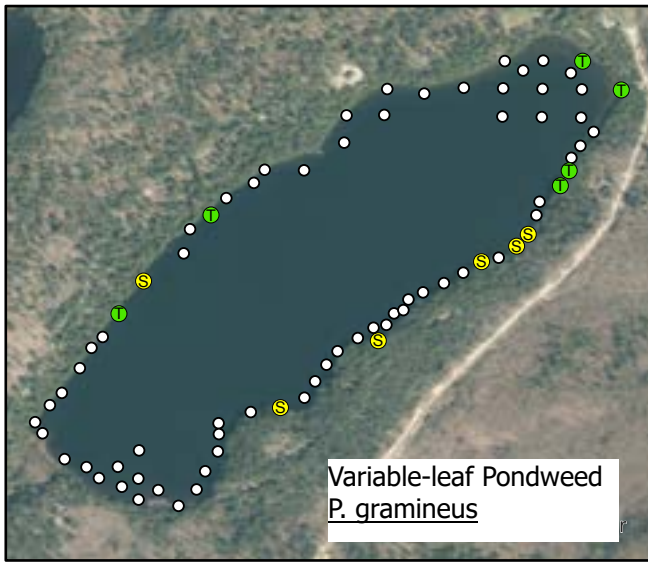
0 500 1,000 2,000
Feet

Legend

○ Not present	● Moderate
● Trace	● Dense
● Sparse	

Map Date: 10/05/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

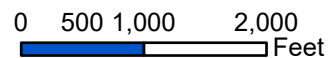
FIGURE 7c: Density and Distribution of Native Vegetation at Point-Intercept Locations (3 of 4)



Highlands Forge Lake
Willsboro, NY



Highlands Forge Lake

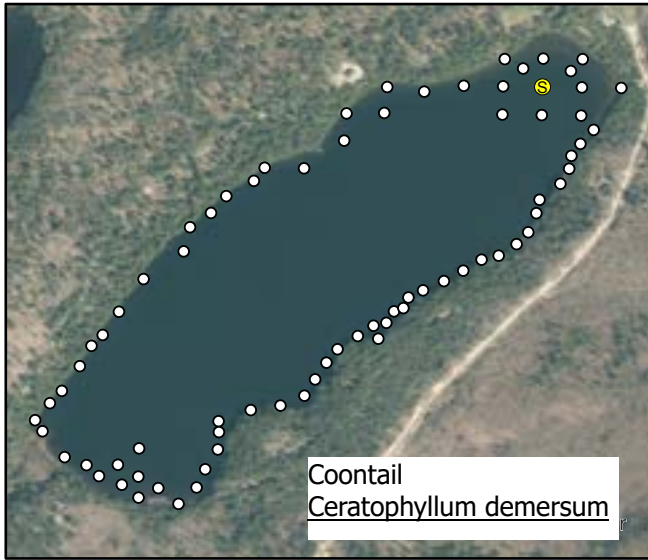


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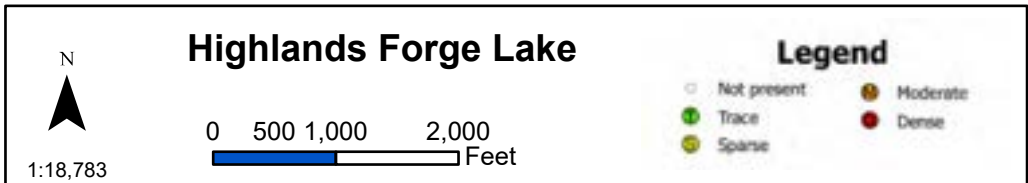
- Not present
- Trace
- Sparse
- Moderate
- Dense

Map Date: 10/05/2023
Survey Date: 09/26/2023
Prepared by: KV
Office: Shrewsbury, MA

FIGURE 7d: Density and Distribution of Native Vegetation at Point-Intercept Locations (4 of 4)



Highlands Forge Lake
Willsboro, NY



Map Date: 10/05/2023
Survey Date: 09/26/2023
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