

PINE RIVER POND

Aquatic Plant Management Report

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PREPARED FOR:

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1.0 INTRODUCTION

In 2026, SÖLitude Lake Management was contracted by the Pine River Pond Association to conduct a comprehensive macrophyte survey of Pine River Pond in East Wakefield, New Hampshire. The primary objective was to monitor and document the growth of native whorled watermilfoil (*Myriophyllum verticillatum*) that was first observed during the 2014 growing season. Additionally, the goal was to assess the overall species composition and abundance of aquatic vegetation within the littoral zone.

All macrophyte species encountered during the survey were identified and georeferenced. Spatial data was compiled to produce detailed distribution maps illustrating species presence and density across the pond's littoral habitat.

This report presents a technical summary of the survey findings, including species-level data, spatial distribution patterns, and comparative analysis with prior years to identify trends and inform future management strategies.

Key Survey Findings

- No invasive species found.
- 20 native species were observed.
- No new species observed.
- Three historical species absent in the past year(s) returned.

1.1 Lake Description

Pine River Pond is a 570-acre waterbody located in East Wakefield, New Hampshire, with a mean depth of 15 feet and a maximum depth of 55 feet, as reported by the New Hampshire Fish and Game Department. The shoreline is moderately developed, comprising a mix of seasonal and permanent residences. This development contributes to nutrient loading through surface runoff, septic leachate, and other anthropogenic inputs, potentially influencing aquatic plant proliferation and overall trophic dynamics.

Hydrologically, the lake receives input from multiple sources, including tributary streams, direct surface runoff, and groundwater discharge. Its primary outflow is via the Pine River, which ultimately drains into Ossipee Lake. Water level regulation is managed by the Arthur H. Fox Memorial Dam, constructed in 1977, which plays a critical role in maintaining hydrologic stability and supporting the ecological integrity of the lake system.

The lake lies within an 8,200-acre watershed, characterized predominantly by undeveloped, forested uplands. This limited land-use intensity contributes to the lake's mesotrophic condition by minimizing external nutrient loading. The relatively low nutrient influx helps suppress the frequency and severity of algal blooms and constrains excessive macrophyte growth—both key considerations in aquatic ecosystem management.

Ecologically, Pine River Pond supports a diverse array of aquatic habitats, particularly in the vicinity of its 15 islands and in shallow littoral zones where macrophyte beds are established. These vegetated areas provide essential habitat for fish, macroinvertebrates, and other aquatic organisms. Substrate composition across the lake is primarily sand and rock, with localized deposits of organic matter and fine sediments (muck), which influence macrophyte colonization and spatial distribution. Macrophyte growth is most prevalent in shallow zones with stable substrates, where light penetration and anchorage conditions are favorable.

A comprehensive understanding of the lake's physical, chemical, and biological characteristics—including nutrient dynamics, substrate heterogeneity, and bathymetric variation—is fundamental to informed aquatic plant management and long-term ecological stewardship.

2.0 AQUATIC VEGETATION SURVEY

2.1 Methods

The macrophyte survey of Pine River Pond was conducted on July 21, 2026, spanning the morning and afternoon. Survey efforts focused on the littoral zone, defined on-site using a Lowrance depth and biovolume unit, which allowed for precise determination of the vegetated areas within the pond. A 17-foot boat was used for navigation throughout the survey.

Vegetation growth in terms of plant density was assessed visually where possible, with areas of submersed macrophyte growth further evaluated using a throw-rake to sample species not visible from the surface (Image 1). All macrophytes observed were identified to the most specific taxon possible, typically at the species level, using morphological characteristics and field guides. Each species (see Table 1) was recorded along with its relative location, which was documented using a hand-held GPS unit to ensure accurate spatial representation in the final report.

Submersed Aquatic Plant Density



Trace



Medium



Sparse



Dense

SOLITUDE
LAKE MANAGEMENT

2.2 Survey Results

The aquatic macrophyte survey revealed few shifts in species composition, density, and distribution compared to previous years (Table 2).

No new species were recorded in 2026. All species observed were recorded in a previous year at Pine River Pond. Several historically documented species were not observed this year, including aquatic moss, creeping bladderwort, filamentous algae, floating bladderwort, inflated bladderwort, horned bladderwort, longleaf pondweed, macro algae, pipewort, robbin's pondweed, slender naiad, southern naiad, tapegrass, water-starwort, and waterweed. These changes can be attributed to year to year fluctuations in populations due to variable conditions such as competition for nutrients and sunlight.

Large-leaf pondweed showed a decline in density, potentially indicating competitive suppression, herbivory, or environmental stressors such as sediment disturbance or reduced light availability. White waterlily increased density in some areas. Other macrophytes showed relatively consistent densities.

Table 1. 2026 Pine River Pond Aquatic Plant Composition and Density

Common Name	Scientific Name	Observed Plant Density
Arrowhead	<i>Sagittaria spp.</i>	Trace to Sparse
Bur-reed	<i>Sparganium spp.</i>	Trace to Moderate
Cattail	<i>Typha spp.</i>	Moderate
Common Bladderwort	<i>Utricularia vulgaris</i>	Trace to Sparse
Evening Primrose	<i>Ludwigia spp.</i>	Trace to Sparse
Flat-leaved Bladderwort	<i>Utricularia intermedia</i>	Trace to Sparse
Floating Pondweed	<i>Potamogeton natans</i>	Trace to Sparse
Grassy Pondweed	<i>Potamogeton gramineus</i>	Trace
Large-leaf Pondweed	<i>Potamogeton amplifolius</i>	Trace
Mare's Tail	<i>Hippuris vulgaris</i>	Trace to Moderate
Northern Naiad	<i>Najas flexilis</i>	Sparse
Purple Bladderwort	<i>Utricularia purpurea</i>	Trace to Sparse
Ribbon-leaf Pondweed	<i>Potamogeton epihydrus</i>	Trace to Sparse
Spike-rush	<i>Eleocharis spp.</i>	Trace to Dense
Small Pondweed	<i>Potamogeton pusillus</i>	Trace to Sparse
Snail-seed Pondweed	<i>Potamogeton bicupulatus</i>	Trace
Watershield	<i>Brasenia schreberi</i>	Trace

Common Name	Scientific Name	Observed Plant Density
White Waterlily	<i>Nymphaea odorata</i>	Trace to Dense
Whorled Watermilfoil	<i>Myriophyllum verticillatum</i>	Sparse to Dense
Yellow Waterlily	<i>Nuphar variegata</i>	Trace to Sparse

Table 2. Six-Year Species Absence and Presence (2021-2026)

*Red indicates invasive species

Common Name	Year					2026
	2021	2022	2023	2024	2025	
American Tapegrass	x		x	x		
Aquatic Moss	x	x	x			
Arrowhead	x		x		x	x
Bur-reed	x	x	x	x	x	x
Cattail					x	x
Common Bladderwort	x	x	x	x	x	x
Creeping/Humped Bladderwort	x	x	x		x	x
Evening Primrose				x	x	x
Filamentous Algae				x	x	
Flat-leaved Bladderwort	x	x	x	x	x	x

Common Name	Year					2026
	2021	2022	2023	2024	2025	
Floating Bladderwort				x		
Floating Pondweed	x	x	x			x
Grassy/Variable-leaf Pondweed	x	x	x	x	x	x
Horned Bladderwort	x					
Inflated Bladderwort			x	x		
Large-leaf/ Big-leaf Pondweed	x	x	x	x	x	x
Long-leaf Pondweed				x		
Macro Algae	x	x	x		x	
Mare's Tail			x		x	x
Northern Naiad				x	x	x
Pipewort	x	x	x	x		
Purple Bladderwort	x	x	x			x
Ribbon-leaf Pondweed	x	x	x	x	x	x
Robbin's Pondweed		x	x	x	x	

Common Name	Year					2026
	2021	2022	2023	2024	2025	
Slender Naiad	x	x	x	x		
Small Pondweed	x	x	x	x	x	x
Snail-seed Pondweed	x					x
Southern Naiad	x	x	x			
Spike-rush	x	x	x	x	x	x
Water-Starwort	x			x		
Watershield				x	x	x
Waterweed	x	x	x			
Whorled Watermilfoil	x	x	x	x	x	x
White Waterlily				x	x	x
Yellow Waterlily	x	x	x	x	x	x

3.0 RECOMMENDATIONS

To preserve the ecological integrity and long-term sustainability of Pine River Pond, SŌlitude Lake Management still recommends a strategic, science-based approach to aquatic plant and nutrient management. These strategies can enrich data collection and analysis, as well as enhance the long term management of the lake.

1. Implement Annual Point-Intercept Surveys

We strongly recommend transitioning to a comprehensive point-intercept survey methodology. This standardized approach involves sampling aquatic vegetation at georeferenced grid points across the lake, allowing for:

- Quantitative analysis of species abundance and distribution
- Year-over-year comparisons to detect ecological trends
- High-resolution mapping of plant communities and density zones
- Early detection of invasive species and nuisance growth

The resulting dataset supports robust statistical analysis and visual outputs (e.g., heat maps, trend graphs), providing a powerful tool for guiding management decisions and communicating findings to stakeholders. This method also enhances the scientific rigor of the lake's monitoring program and aligns with best practices in aquatic ecosystem assessment.

2. Expand the Weed Watcher Program

The continued success of the Weed Watcher program depends on sustained volunteer engagement and training. We recommend:

- Expanding volunteer recruitment to increase lake coverage
- Providing annual training workshops focused on species identification, GPS use, and data recording
- Integrating volunteer observations with professional survey data to improve spatial resolution and seasonal tracking

This citizen science initiative empowers the community, fosters stewardship, and enhances the lake's surveillance capacity—particularly valuable for spotting early signs of invasive species or unusual growth patterns.

3. Maintain Diver Hand-Pulling as a Primary Control Method if Invasive Species Arise

For localized infestations of nuisance or invasive plants, diver hand-pulling remains the preferred management technique. It offers:

- Precision removal with minimal disturbance to native vegetation
- Effectiveness in sensitive habitats, such as the quaking bog
- Avoidance of chemical inputs, preserving water quality and biodiversity

We advise continued coordination with the NH Wetlands Bureau to ensure regulatory compliance and recommend documenting all removal efforts to evaluate efficacy over time.

4. Address Nutrient Enrichment Through Watershed-Based Strategies

The recurring presence of filamentous algae and macro-algae (e.g., *Nitella*) indicates ongoing nutrient loading, particularly phosphorus. To mitigate this, we recommend a suite of watershed management practices:

a. Nutrient Management

- Establish and maintain vegetative buffer zones along the shoreline
- Promote native, low-maintenance landscaping to reduce fertilizer use
- Educate residents on responsible lawn care and phosphorus-free products

b. Septic System Maintenance

- Encourage routine inspections and pump-outs
- Support upgrades to advanced treatment systems where feasible
- Provide educational materials on septic impacts to lake health

c. Stormwater Control

- Install rain gardens, infiltration trenches, and permeable surfaces
- Retrofit existing infrastructure to slow and filter runoff
- Prioritize stormwater planning in areas of new development

These interventions reduce external nutrient inputs, improve water clarity, and support the recovery of submerged vegetation, ultimately enhancing the lake's ecological resilience.

In summary, Pine River Pond remains a biologically rich and ecologically valuable system that needs proactive management for early detection of significant changes and introduced species. By adopting a comprehensive point-intercept survey, expanding community monitoring, and implementing watershed-based nutrient controls, the Association can safeguard the lake's health for future generations. SÖlitude Lake Management is committed to supporting these efforts and looks forward to continued collaboration in the 2027 season.

Figure 1. 2026 Aquatic Vegetation - Floating/Floating-Leaf Species
Pine River Pond

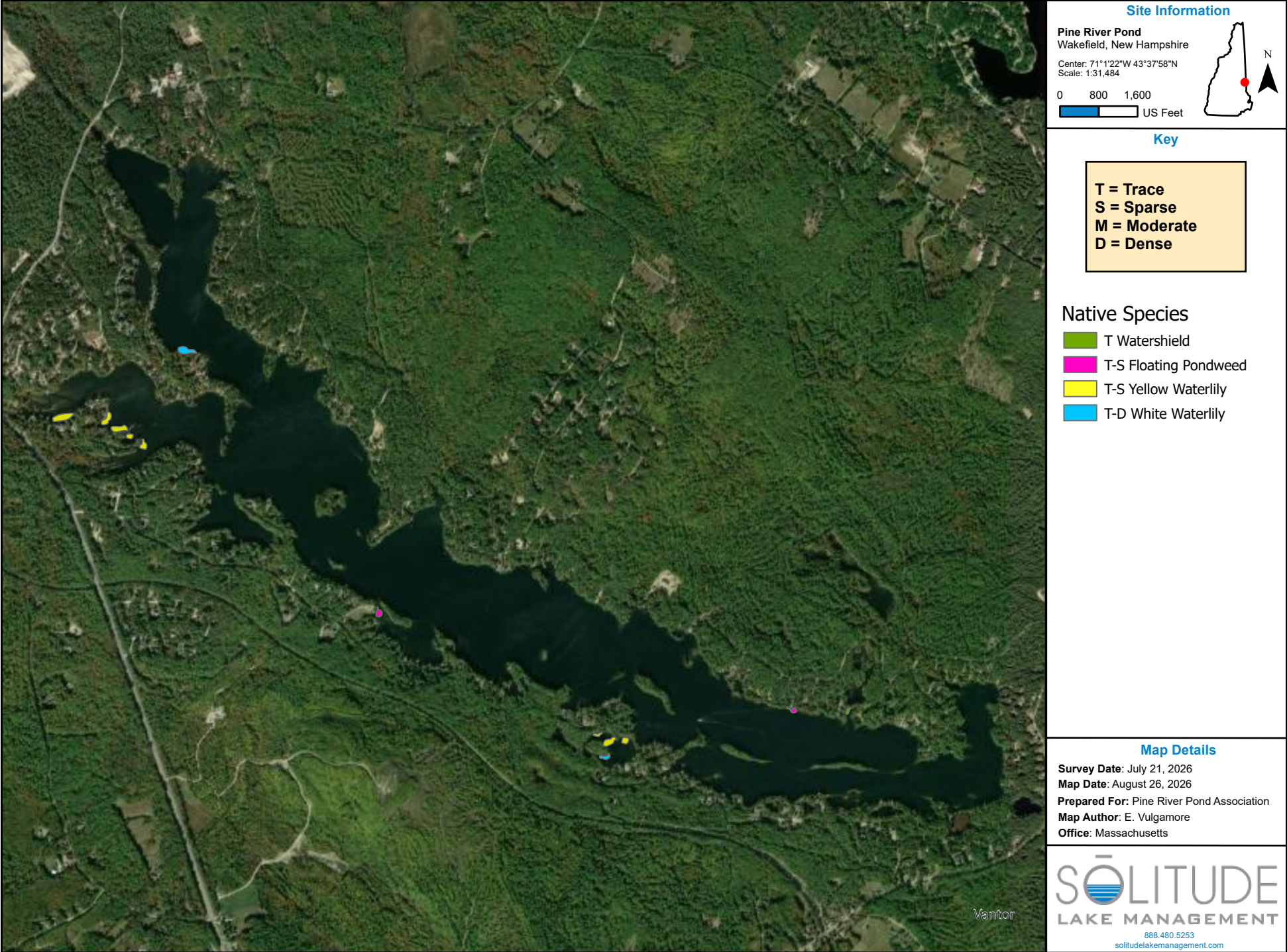


Figure 2. 2026 Aquatic Vegetation - Submersed Species
Pine River Pond

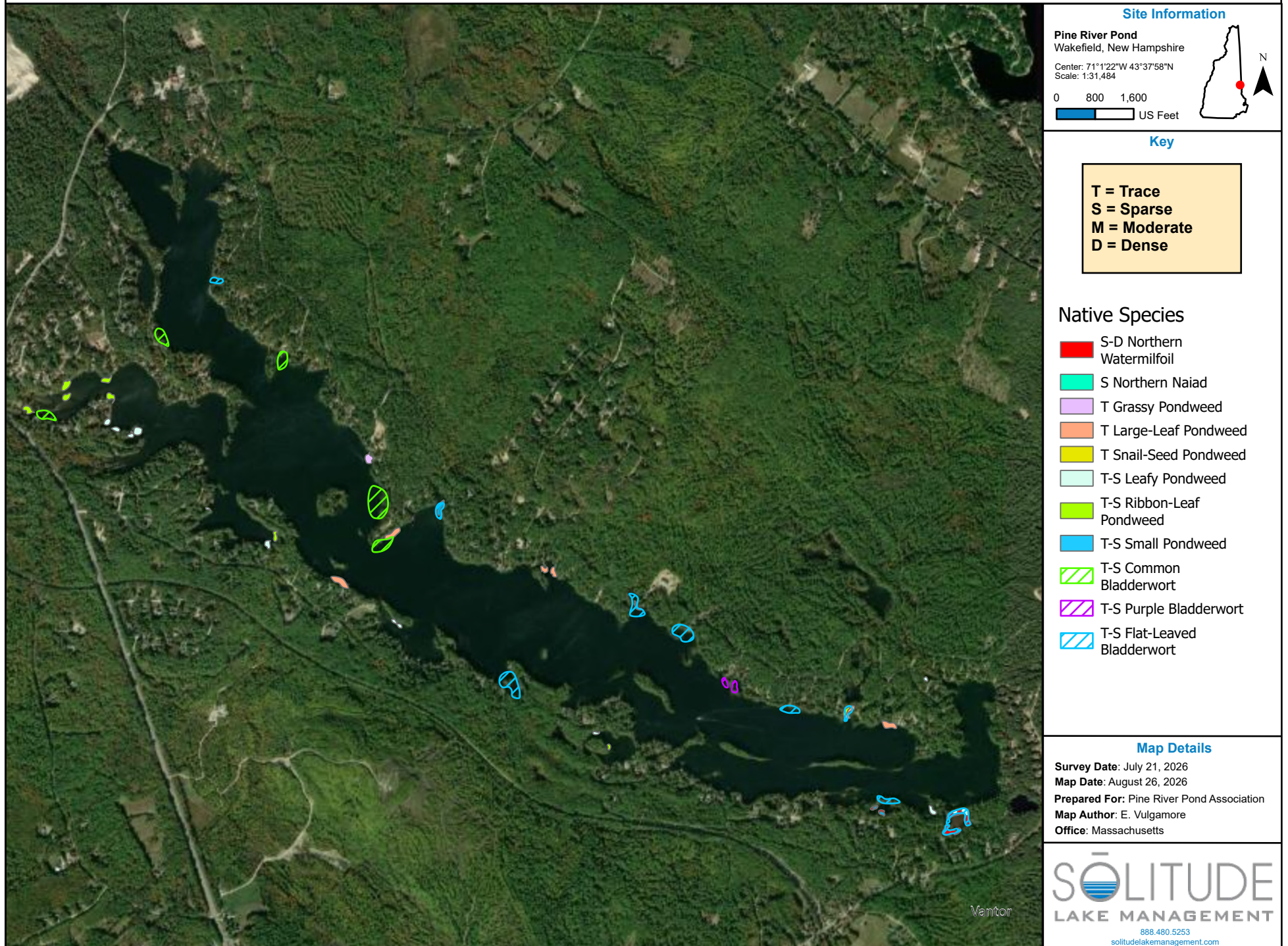


Figure 3. 2026 Aquatic Vegetation - Emergent Species
Pine River Pond

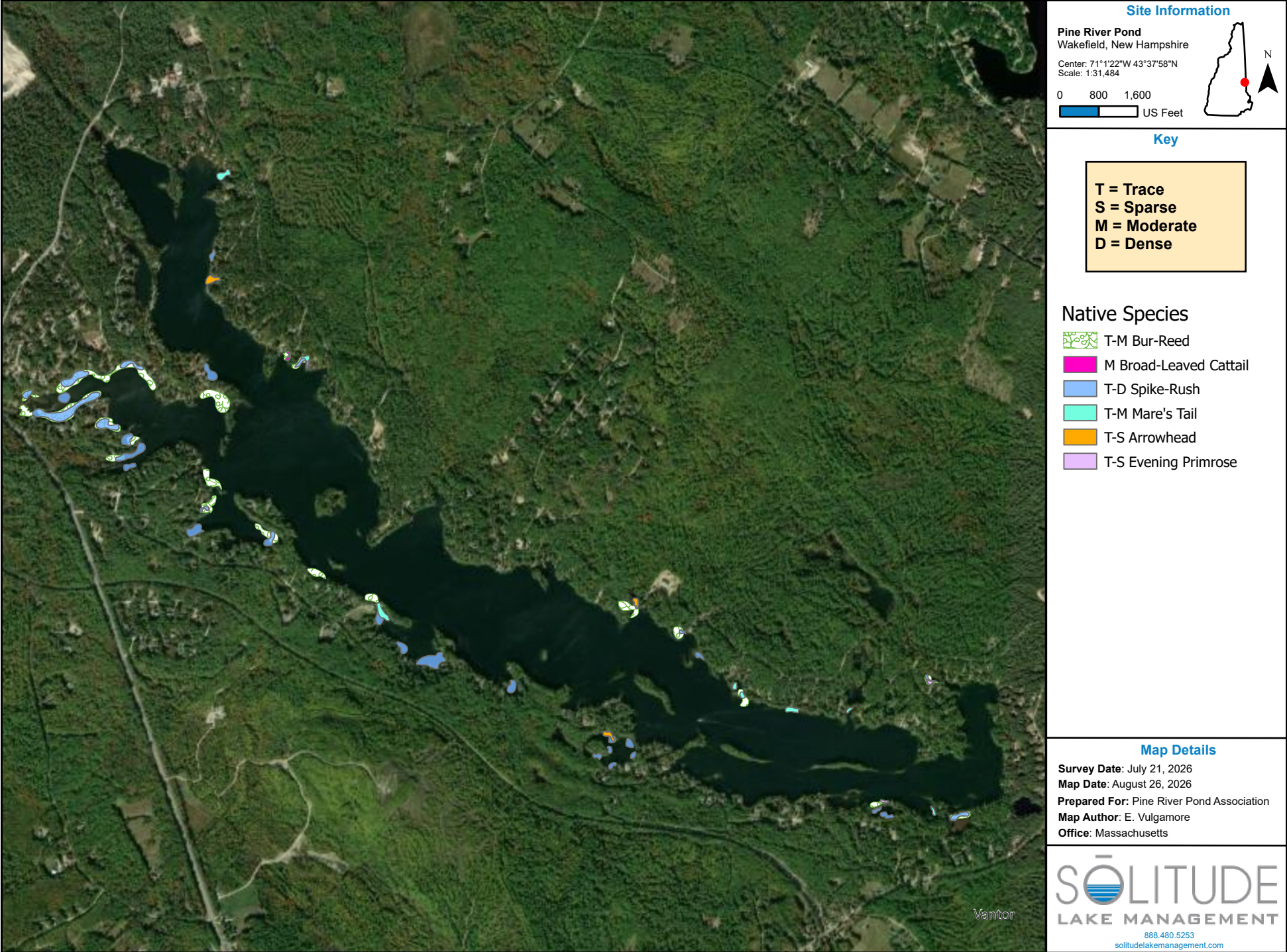


Figure 4. 2026 Aquatic Vegetation - Northern Watermilfoil
Pine River Pond

