The Connecticut Agricultural Experiment Station

123 Huntington Street

New Haven, CT 06511

June 2, 2023

West Lake

Guilford, CT

Aquatic Vegetation Survey

Water Chemistry

2022

Summer E. Stebbins

Gregory J. Bugbee

Department of

Environmental Science & Forestry

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

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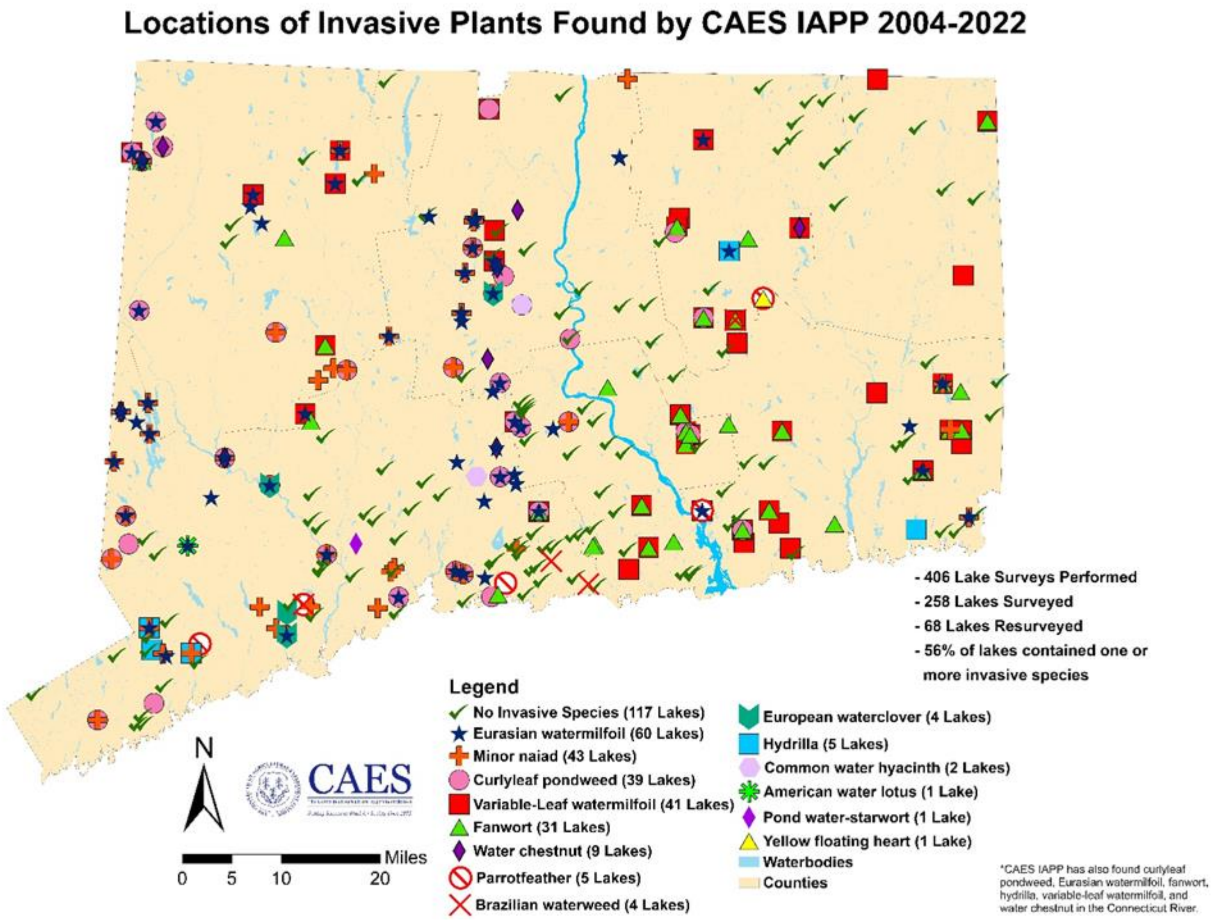

Figure 1. Locations of invasive aquatic plants found by CAES IAPP from 2004 - 2022.

Introduction:

Since 2004, the Connecticut Agricultural Experiment Station (CAES) Invasive Aquatic Plant Program (IAPP) has surveyed or resurveyed aquatic vegetation and monitored the water chemistry of nearly 300 Connecticut lakes, ponds, and rivers (Figure 1). Approximately 56% of the lakes and ponds contain invasive (non-native) plant species that can cause rapid deterioration of aquatic ecosystems, recreational opportunities, and real estate values. The presence of invasive species is related to water chemistry, public boat launches, random events, and climate change (Rahel and Olden, 2008). CAES IAPP provides an online database where stakeholders can view digitized vegetation maps, detailed transect data, temperature and dissolved oxygen profiles, and water test results for clarity, pH, alkalinity, conductivity, total phosphorus, and total nitrogen (portal.ct.gov/caes-iapp). This information allows citizens, government officials, and scientists to view past conditions, compare them with current conditions, and make educated management decisions. In 2022, CAES IAPP performed the fourth survey of West Lake and updated the CAES IAPP database.

West Lake is a 52-acre waterbody located in Guilford, CT. It has a maximum depth of 17 feet with a mucky/organic substrate. The lake is in the Branford River watershed and has an outlet connecting to Clear Lake. It is a private lake with five lake associations and a West Lake Health Committee that works to coordinate lake protection activities. Shoreline development consists of many homes on small lots to the southwest and northeast with larger homes situated further from the lake elsewhere. In these areas most of the shoreline remains forested.

Nuisance aquatic vegetation in West Lake has been managed with herbicides by All Habitat LLC. In 2019, part of the lake was treated with diquat in June and glyphosate in August. In July 2020, only diquat was used. In June 2021, both diquat and glyphosate were used. No treatments occurred in 2022 over concern that excessive vegetation was removed in 2021 which resulted in excessive algal blooms.

Objectives:

- Perform a fourth survey of West Lake for aquatic vegetation and quantify water chemistry. Previously surveyed by CAES IAPP in 2005, 2010, and 2021.
- Compare with previous surveys and add vegetation maps and water chemistry information to the CAES IAPP website.

Materials and Methods:

Aquatic Plant Surveys and Mapping:

Figure 2. Performing visual aquatic plant survey on Lake Quonnipaug in Guilford, CT.

We surveyed West Lake for aquatic vegetation on August 1, 2022. The survey utilized methods established by CAES IAPP. Surveys were conducted from 16 and 18-foot motorized boats traveling over areas that supported aquatic plants (Figure 2). Plant species were recorded using a meandering method based on visual observation or collections with a long-handled rake or grapple. Lowrance® Hook 5 and HDS 5 sonar systems ground truthed with grapple tosses were used to identify vegetated areas in deep water. Special attention was focused in wetland areas where the state-listed globe-fruited false loosestrife may be found. Quantitative information on plant abundance was obtained by resurveying six transects that were initially positioned perpendicular to the shoreline in 2005. Transect locations represented the variety of habitats in the lake. Transects were located using either a Trimble ProXT or Trimble® R1 GNSS global positioning system with sub-meter accuracy. Sampling data points were taken along each transect at points 0, 5, 10, 20, 30, 40, 50, 60, 70, and 80 m from the shore. We measured depth with a rake handle, drop line, or digital depth finder, and sediment type was estimated. Abundances of species present at each point were ranked on a scale of 1 – 5 (1 = very sparse, 2 = sparse, 3 = moderately abundant, 4 = abundant, 5 = very abundant). When field identifications of plants were questionable, samples were brought back to the lab for review using the taxonomy of Crow and Hellquist (2000*a*, 2000*b*). One specimen of each species collected was dried and mounted in the CAES IAPP aquatic plant herbarium. Digitized mounts can be viewed online (portal.ct.gov/caes-iapp).

Plant species are referred to by common name in the text of this report. Scientific names can be found in Table 1. We post-processed the GPS data in Pathfinder® 5.85 (Trimble Navigation Limited, Sunnyvale, CA) and then imported it into ArcGIS® Pro 3.0.3 (ESRI Inc., Redlands, CA). Data were then overlaid onto recent high-resolution aerial imagery for the continental United States made available by the USDA Farm Services Agency.

Water Analysis:

Water was analyzed from a deep part of the lake (approximately 18 feet) in the same place as our previous surveys. Water temperature and dissolved oxygen were measured 1.5 feet beneath the surface and at 3-foot intervals to the bottom. Water was tested for temperature and dissolved oxygen using an YSI 58® meter. Water clarity was measured by lowering a six-inch diameter black and white Secchi disk into the water and determining to what depth it could be viewed (Figure 3). In 2010, no temperature, dissolved oxygen, or clarity data was taken.

Figure 3. Checking water clarity with Secchi disk.

Water samples for pH, alkalinity, conductivity, total phosphorus, and total nitrogen testing were obtained from 1.5 feet beneath the surface and 1.5 feet above the bottom. The samples were stored at 38°F until testing. A Fisher AR20® meter was used to determine pH and conductivity, and alkalinity (expressed as mg/L $CaCO_3$) was quantified by titration with 0.016 N H_2SO_4 to an end point of pH 4.5. We determined total phosphorus using the ascorbic acid method preceded by digestion with potassium persulfate (APHA, 1995). Phosphorus was quantified using a Milton Roy

Table 1. Plants present in West Lake during CAES IAPP surveys in 2005, 2010, 2021, and 2022. Present indicates the species was present in the lake while Frequency of Occurrence (FOQ) indicates presence of a species on transects.

West Lake									
Species (invasives in bold)		2005		2010		2021		2022	
Common Name	**Scientitic Name**	**Present**	**FOQ** (%/point)	**Present**	**FOQ** (%/point)	**Present**	**FOQ** (%/point)	**Present**	**FOQ** (%/point)
Arrowhead	*Sagittaria* species	X	0.0%	X	0.0%	X	0.0%	X	0.0%
Berchtold's pondweed	*Potamogeton berchtoldii*					X	0.0%	X	0.0%
Clasping-leaf pondweed	*Potamogeton perfoliatus*			X	0.0%				
Common bladderwort	*Utricularia macrorhiza*	X	21.7%	X	6.7%	X	13.3%	X	1.7%
Eelgrass	*Vallisneria americana*			X	1.7%				
Hiddenfruit bladderwort	*Utricularia geminiscapa*							X	1.7%
Humped bladderwort	*Utricularia gibba*	X	8.3%	X	0.0%	X	5.0%		
Large-leaf pondweed	*Potamogeton amplifolius*	X	5.0%	X	11.7%	X	5.0%	X	1.7%
Leafy pondweed	*Potamogeton foliosus*	X	0.0%	X	3.3%				
Lesser bladderwort	*Utricularia minor*					X	1.7%		
Little floating heart	*Nymphoides cordata*	X	0.0%	X	0.0%	X	0.0%	X	0.0%
Low watermilfoil	*Myriophyllum humile*			X	0.0%				
Minor naiad	***Najas minor***	**X**	**13.3%**	**X**	**5.0%**			**X**	**0.0%**
Pickerelweed	*Pontederia cordata*			X	0.0%	X	1.7%	X	1.7%
Primrose-willow	*Ludwigia* species	X	0.0%	X	5.0%	X	1.7%	X	3.3%
Purple bladderwort	*Utricularia purpurea*	X	10.0%	X	3.3%	X	3.3%		
Quillwort	*Isoetes* species	X	0.0%						
Robbins' pondweed	*Potamogeton robbinsii*	X	31.7%	X	26.7%	X	30.0%	X	10.0%
Sevenangle pipewort	*Eriocaulon aquaticum*	X	1.7%					X	0.0%
Small pondweed	*Potamogeton pusillus*			X	1.7%			X	18.3%
Snailseed pondweed	*Potamogeton bicupulatus*			X	0.0%			X	0.0%
Southern naiad	*Najas guadalupensis*	X	18.3%	X	5.0%	X	18.3%	X	1.7%
Spikerush	*Eleocharis* species	X	0.0%	X	0.0%	X	3.3%	X	3.3%
Spineless hornwort	*Ceratophyllum echinatum*	X	10.0%	X	31.7%	X	18.3%	X	0.0%
Swamp loosestrife	*Decodon verticillatus*			X	0.0%	X	0.0%	X	0.0%
Water smartweed	*Polygonum amphibium*			X	6.7%	X	0.0%	X	0.0%
Watershield	*Brasenia schreberi*	X	0.0%	X	6.7%	X	5.0%	X	5.0%
Waterwort	*Elatine* species	X	0.0%	X	0.0%				
White water lily	*Nymphaea odorata*	X	23.3%	X	28.3%	X	26.7%	X	25.0%
Yellow water lily	*Nuphar variegata*	X	5.0%	X	1.7%	X	26.7%	X	20.0%
Total Species Richness	29	19	11	25	15	19	14	21	12
Total Native Species Richnesss	28	18	10	24	14	19	14	20	12
Total Invasive Species Richness	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**0**

Spectronic 20D® spectrophotometer with a light path of 2 cm and a wavelength of 880 nm.

Results and Discussion:

General Aquatic Plant Surveys and Transects:

In 2022, West Lake had a diverse aquatic plant community comprised of 20 native species and one invasive (minor naiad) (Table 1). Vegetation occurred to depths of approximately 9 feet (2.5 m) which corresponds to all shoreline areas except for the southeast third of the lake where much of the bottom had plants

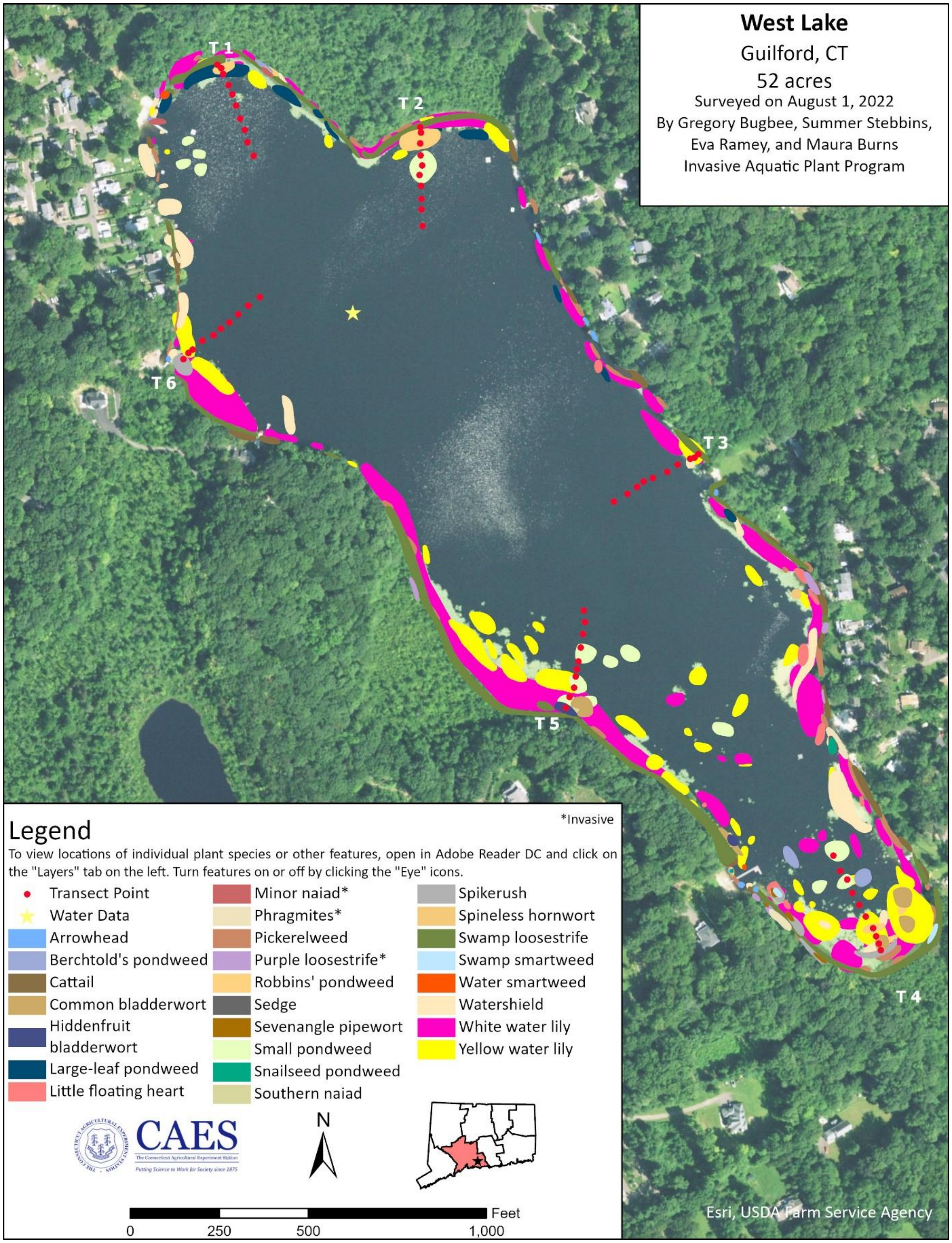

Figure 4. 2022 aquatic plant survey map of West Lake in Guilford, CT. State-listed globe-fruited false loosestrife has been removed from the map for protection.

(Figure 4). Swamp loosestrife occurred along much of the immediate shoreline. As depth increased a progression from water lilies and watershield to submerged plants such as native pondweeds (largeleaf, Robbin's, small) was common (Figure 5). Minor naiad was not found in 2021 but reappeared in 2022. This was likely a result of its sensitivity to the herbicide applied prior to the 2021 survey. Its locations in 2022 included the northern beach, near transect 1, and on the southeastern shoreline. Because minor naiad is an annual produced from herbicide resistant seeds, this is not unusual. Minor naiad rarely becomes a sufficient nuisance to require management other than manual removal in key areas such as beaches. Phragmites and purple loosestrife are two invasive wetland species we observed in various locations along the shoreline. Because they are not true aquatic plants, they are not included in our aquatic plant analysis. Detailed information on all the native plants is beyond the scope of this report but is available at USDA "About PLANTS" (https://plants.usda.gov/about_plants.html).

Figure 5. Dense swamp loosestrife and water lilies along the southeast shoreline.

Native species found in 2022 appeared to be only slightly impacted by past herbicide treatments. Twenty native species were found in 2022 compared to 19 in 2021, 24 in 2010, and 18 in 2005. Plants found in all four CAES IAPP surveys (2005, 2010, 2021 and, 2022) include arrowhead, common bladderwort, large-leaf pondweed, little floating heart, primrose-willow, Robbins' pondweed, southern naiad, spikerush, spineless hornwort, watershield, white water lily, and yellow water lily (Table 1). Species not found in 2022 that were found in previous surveys include clasping-leaf pondweed, eelgrass, humped bladderwort, leafy pondweed, lesser bladderwort, low watermilfoil, purple bladderwort, quillwort, and waterwort. Vegetation was roughly as abundant in 2022 as 2021, but less abundant than in 2010 and much less abundant than 2005 (Figure 4, see appendix for previous years' survey maps). The difference in vegetation from 2005 and 2010 from 2022 is mainly due to a large decrease in submersed vegetation such as minor naiad and pondweeds. Suppression of these pondweeds and other species from the past herbicide applications may cease without future management resulting in them becoming a nuisance. The CAES IAPP website contains digitized survey maps where individual plant layers can be viewed separately (portal.ct.gov/caes-iapp).

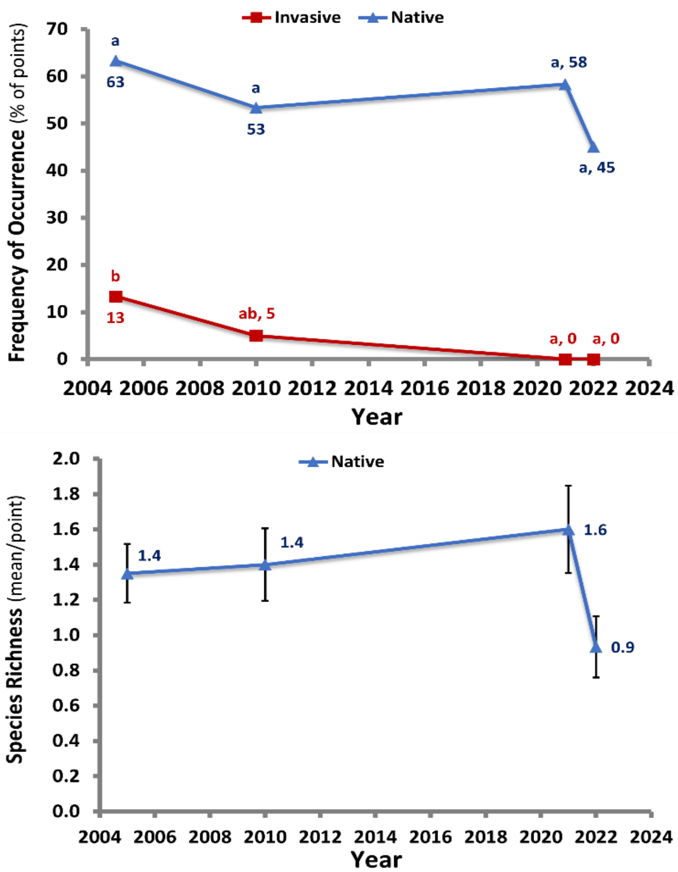

Figure 6. Frequency of occurrence (FOQ) of native and invasive aquatic plants (top) and native species richness (bottom) on transects in West Lake in 2005, 2010, 2021and 2022.

Frequency of occurrence (FOQ) refers to how often species are found on transect points. Comparisons of FOQ from each survey year found a decrease in native species from 58% in 2021 to 45% in 2022; however, the decrease was not statistically significant (Tukey $p \leq 0.05$) (Figure 6, top). While the highest FOQ of natives was in 2005 (63%) and the lowest was in 2022 (45%), there were no statistically significant changes over the survey years. In 2022, white water lily (25%), yellow water lily (20%), and small pondweed (18.3%) were the most frequently found native species (Table 1). Other commonly found plants were Robbins' pondweed (10%), watershield (5%), spikerush (3%), and primrose-willow (3%). FOQ of invasive species refers solely to minor naiad, as it was the only invasive aquatic plant found. While minor naiad was found in a few locations in 2022, it was not found on transect points for the second survey in a row. This is a statistically significant decrease from 13% FOQ in 2005.

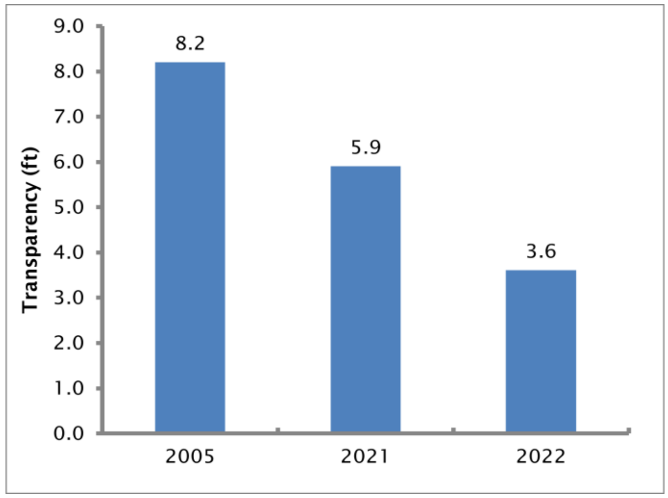

Figure 7. Water clarity in West Lake during CAES IAPP surveys.

Species richness refers to the average number of species per transect point. A higher species richness indicates more species found. Since only one invasive species was found in each survey year, species richness was only calculated for native species. Species richness of native species was 0.9 in 2022, the lowest of all years (1.4 in 2005 and 2010, 1.6 in 2021) (Figure 6, bottom). While this is a statistically significant decrease (one standard error of the mean), this only applies to transect points. Overall, 20 native species were found in 2022 compared to 19 in 2021, but many of the native species found were not located on transect points. Additional transects could alleviate this discrepancy but are beyond the scope of this work.

Water Chemistry:

CAES IAPP has found that the occurrence of invasive plants in lakes can be attributed to specific water chemistries (June-Wells et al. 2013). For instance, lakes with higher alkalinities and conductivities are more likely to support Eurasian watermilfoil, minor naiad, and curlyleaf pondweed while lakes with lower values support fanwort and variable-leaf watermilfoil. Water clarity in Connecticut's lakes ranges from 1-33 feet with an average of 7 feet (CAES IAPP, 2023). West Lake had a water

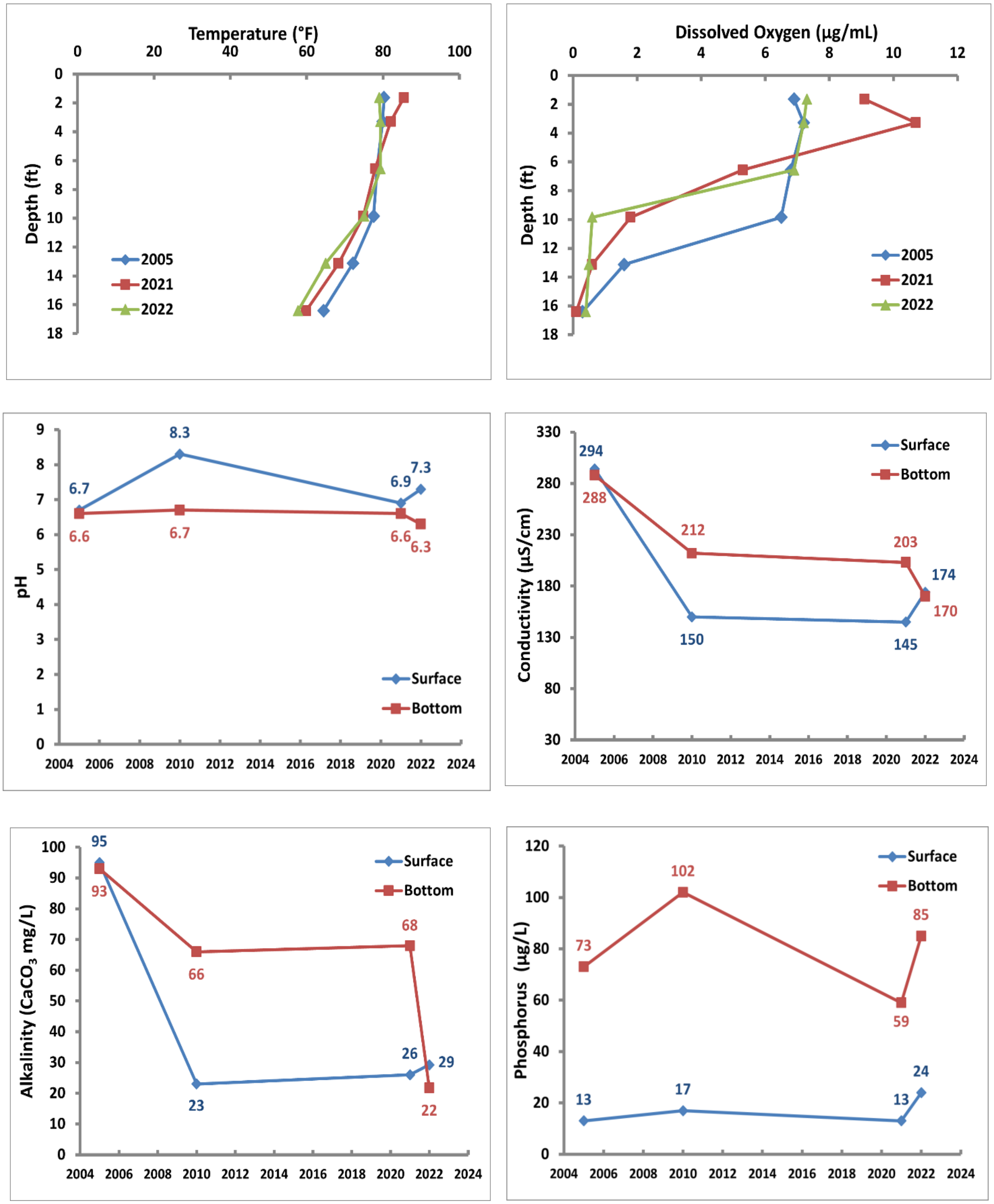

Figure 8. Water chemistry data for West Lake in 2005, 2010, 2021, and 2022.

clarity of 3.6 feet in 2022 compared to 5.9 ft in 2021, and 8.2 feet in 2005 (Figure 7). Differences among years may be attributed to natural variation and decaying plants from the herbicide treatments that can increase tannins and promote algae.

In all survey years, the temperature profile was similar, starting around 80°F near the surface and declining to around 65°F near the bottom (Figure 8). Dissolved oxygen responded similarly, with highly oxygenated water near the surface and a rapid depletion to near 0 mg/L below. West Lake's pH has shown slight variations throughout the years ranging from 6.7 - 8.3 at the surface and 6.3 - 6.7 at the bottom. Fluctuations in surface pH are common as changes caused by removal of carbon dioxide by plant and algal photosynthesis raises pH during sunny days. West Lake's surface and bottom alkalinity have decreased since 2005. There was a sharp decrease in bottom alkalinity from 68 mg/L $CaCO_3$ in 2021 to 22 mg/L $CaCO_3$ in 2022 which could be related to a wind-driven mixing event. In addition, 2021 was an extremely wet summer while 2022 was abnormally dry. These alkalinities are moderate for Connecticut lakes which can range from <5 to as high as >170 mg/L $CaCO_3$ (CAES IAPP, 2023). Low alkalinity waterbodies are more prone to pH change due to outside influences such as watershed activities and acid rain. Conductivity is an indicator of dissolved ions that come from natural and man-made sources (mineral weathering, organic matter decomposition, fertilizers, septic systems, road salts, etc.). Connecticut waterbodies have conductivities that range from 50 - 250 µS/cm. West Lake's conductivity of 174 µS/cm at the surface and 170 µS/cm at the bottom in 2022 was similar to 2010 and 2021. The moderate conductivity of West Lake compared to other CT lakes, suggests it might be susceptible to most invasive aquatic plant invasive species.

A key parameter used to categorize a lake's trophic state is phosphorus (P) in the water column. High levels of P can lead to nuisance or toxic algal blooms (Frink and Norvell 1984, Wetzel 2001). Rooted macrophytes are less dependent on P from the water column as they obtain most of their nutrients from the hydrosoil (Bristow and Whitcombe 1971). Lakes with P levels from 0 - 10 µg/L are considered nutrientpoor or oligotrophic. When P concentrations reach 15 - 25 µg/L, lakes are classified as moderately fertile or mesotrophic and when P reaches 30 - 50 µg/L they are considered fertile or eutrophic (Frink and Norvell, 1984). Lakes with P concentrations >50 µg/L are categorized as extremely fertile or hypereutrophic. West Lake's P concentration in 2022 was 24 µg/L at surface and 85 µg/L near the bottom. This is a slight increase from 2021 and indicates fertile conditions; however, water samples from one part of the lake during one time of the year is only a snapshot of the overall nutrient profile of the system. We tested total nitrogen (TN) for the first time in 2021 and found 535 µg/L at the surface and 1842 µg/L near the bottom (Figure 9). From 2021 to 2022, TN decreased at the surface to 371 µg/L and decreased considerably near the bottom to 449 µg/L. Although nitrogen is likely less limiting to the growth of aquatic plants and algae compared to terrestrial plants, it may play a role in lake productivity. Frink and Norvell (1984) found TN in Connecticut lakes ranged from 193 - 1830 µg/L and averaged 554 µg/L.

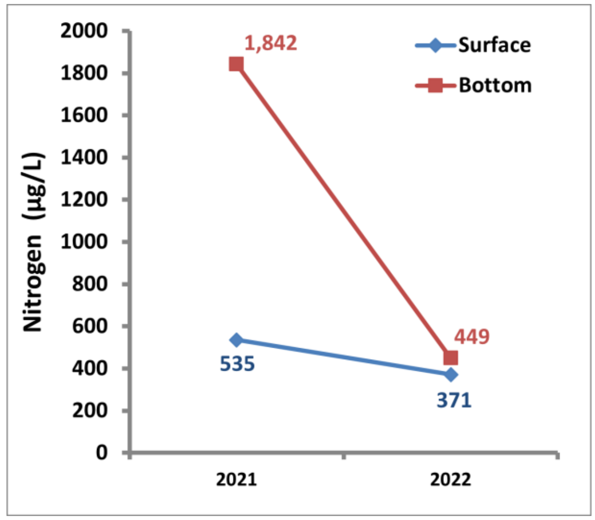

Figure 9. Total nitrogen (TN) for West Lake from 2021 to 2022.

Conclusions:

West Lake has a diverse aquatic plant community consisting of 20 native and one invasive species (minor naiad). After herbicide treatments in 2019, 2020, and 2021, vegetation in West Lake decreased throughout the waterbody in 2021. Minor naiad was found in 2022 after not being found in 2021likley because it propagates each year from herbicide resistant seeds. Minor naiad rarely becomes a sufficient nuisance to require management other than manual removal in key areas such as beaches. Most of the shoreline had a dense abundance of waterlilies and swamp loosestrife with submerged vegetation including several native pondweeds common at depths to about 9 feet. Suppression of these pondweeds and other species from the past herbicide applications may cease without future management resulting in them becoming a nuisance. Our 2022 survey was consistent with 2021, with vegetation around the shoreline of the lake and throughout the middle of the southern section. Little change to was evident in frequency of occurrence and species richness. Aquatic plant monitoring should continue to ensure waterlilies and other plants do not become a nuisance.

Acknowledgments:

The technical assistance of Calanthe Cavadini, Adam Pakalnis, Roslyn Reeps (Selsky), and Sunayna Wahi is gratefully acknowledged.

Funding:

This project was funded through grants from the Control of Aquatic Invasive Species administered by the Connecticut Department of Energy and Environmental Protection (DEEP), and the United States Department of Agriculture under Hatch CONH00783.

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Appendix

Invasive Plant Description

Najas minor

Common names:
Minor naiad
Brittle waternymph
Spiny leaf naiad
Eutrophic waternymph

Origin:
Europe

Key features:
Plants are submersed

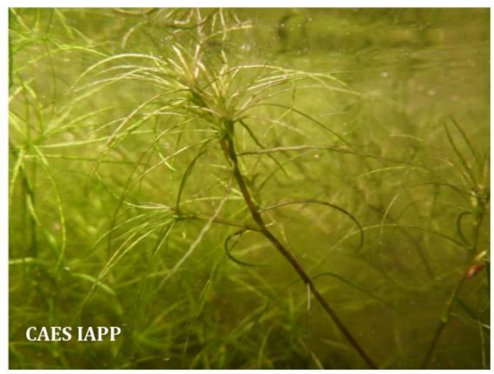
Stems: Branched stems can grow up to 4-8 inches (10-20 cm) long

Leaves: Opposite and lance shaped on branched stems with easily visible toothed leaf edges and leaves appear curled under, basal lobes of leaf are also serrated, 0.01-0.02 inches (0.3-0.5 mm)

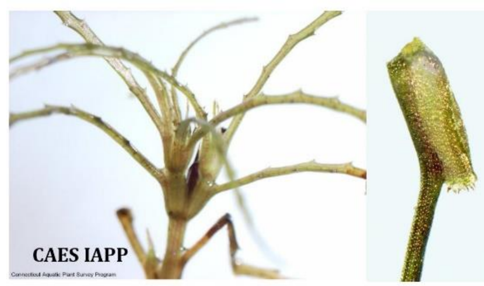
Flowers: Monoecious (male and female flowers on same plant)

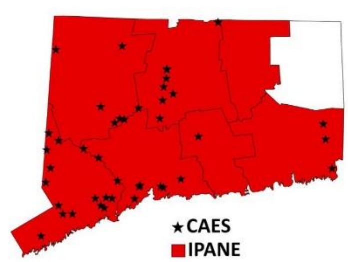
Fruits/Seeds: Fruits are purple-tinged and seeds measure 0.03-0.06 inches (1.5-3 mm)

Reproduction: Seeds and fragmentation

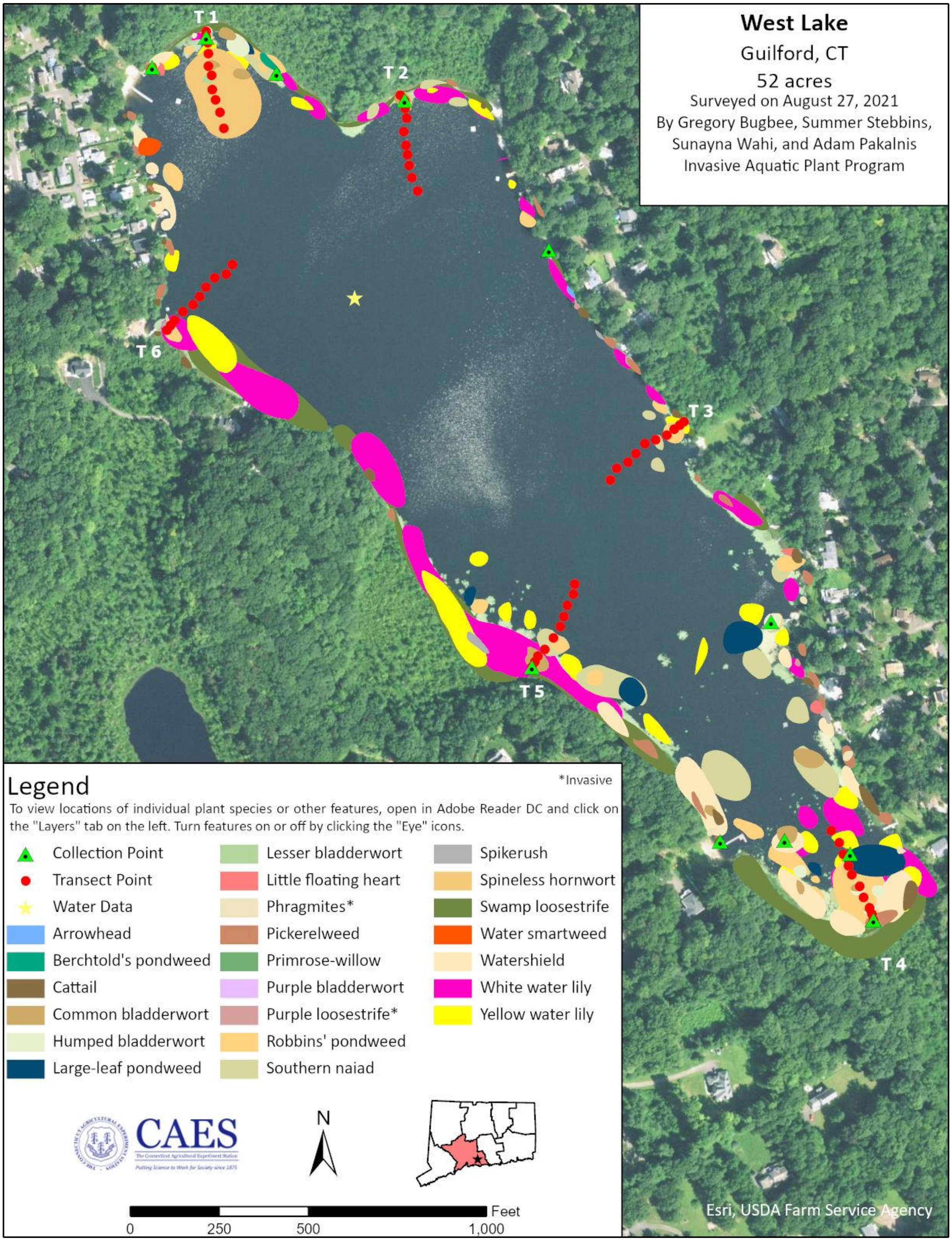


Easily confused species:
Other naiads (native): *Najas* spp.





Previous Years' Aquatic Plant Survey Maps



West Lake
Guilford, CT
52 acres
Surveyed on August 27, 2021
By Gregory Bugbee, Summer Stebbins, Sunayna Wahi, and Adam Pakalnis
Invasive Aquatic Plant Program
T 1
T 2
T 3
T 4
T 5
T 6
Legend
*Invasive
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab on the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Arrowhead
Berchtold's pondweed
Cattail
Common bladderwort
Humped bladderwort
Large-leaf pondweed
Lesser bladderwort
Little floating heart
Phragmites*
Pickerelweed
Primrose-willow
Purple bladderwort
Purple loosestrife*
Robbins' pondweed
Southern naiad
Spikerush
Spineless hornwort
Swamp loosestrife
Water smartweed
Watershield
White water lily
Yellow water lily
CAES
N
Feet
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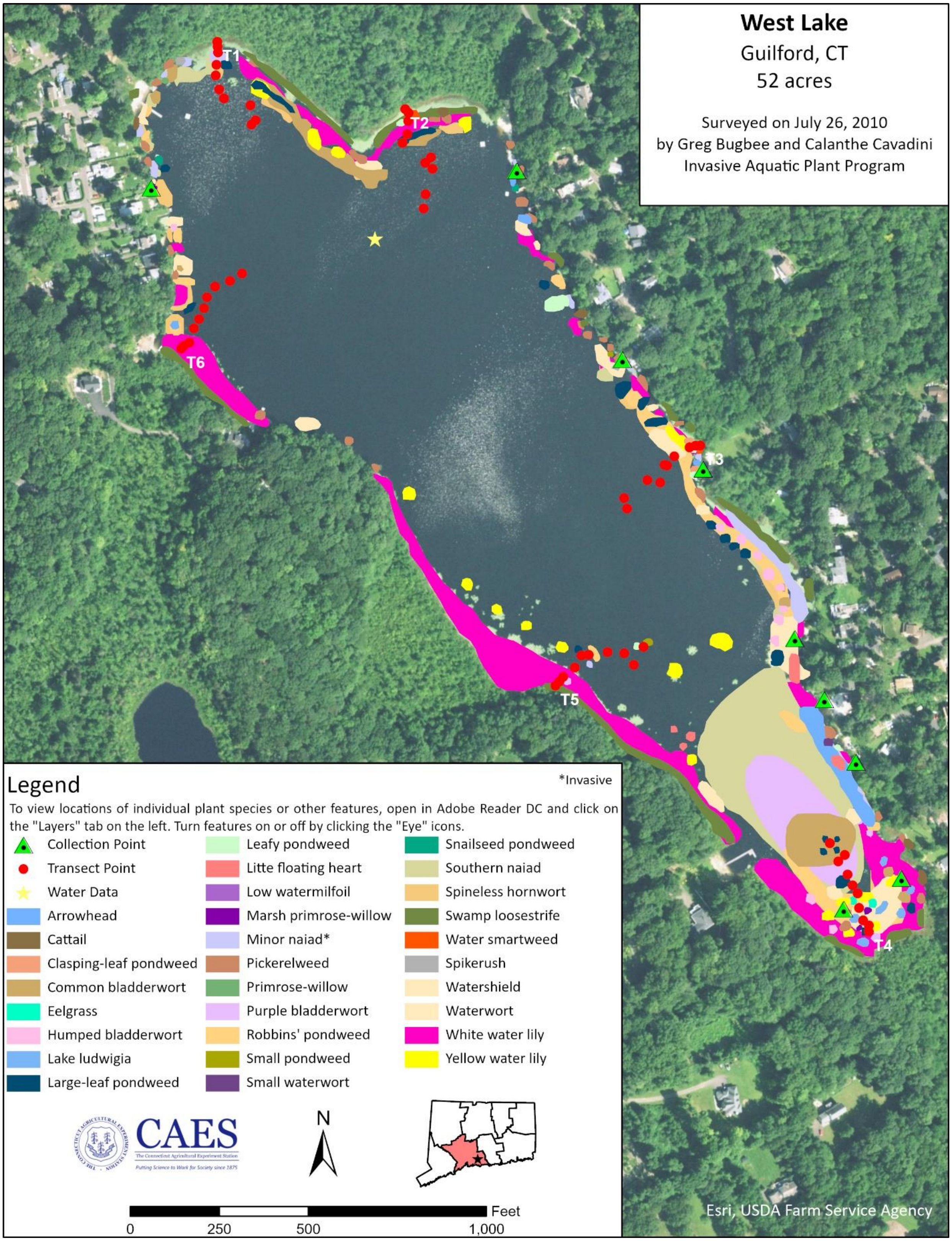
1,000
Esri, USDA Farm Service Agency


West Lake
Guilford, CT
52 acres
Surveyed on July 26, 2010
by Greg Bugbee and Calanthe Cavadini
Invasive Aquatic Plant Program
T1
T2
T3
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T6
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Collection Point
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Lake ludwigia
Large-leaf pondweed
Leafy pondweed
Litte floating heart
Low watermilfoil
Marsh primrose-willow
Minor naiad*
Pickerelweed
Primrose-willow
Purple bladderwort
Robbins' pondweed
Small pondweed
Small waterwort
Snailseed pondweed
Southern naiad
Spineless hornwort
Swamp loosestrife
Water smartweed
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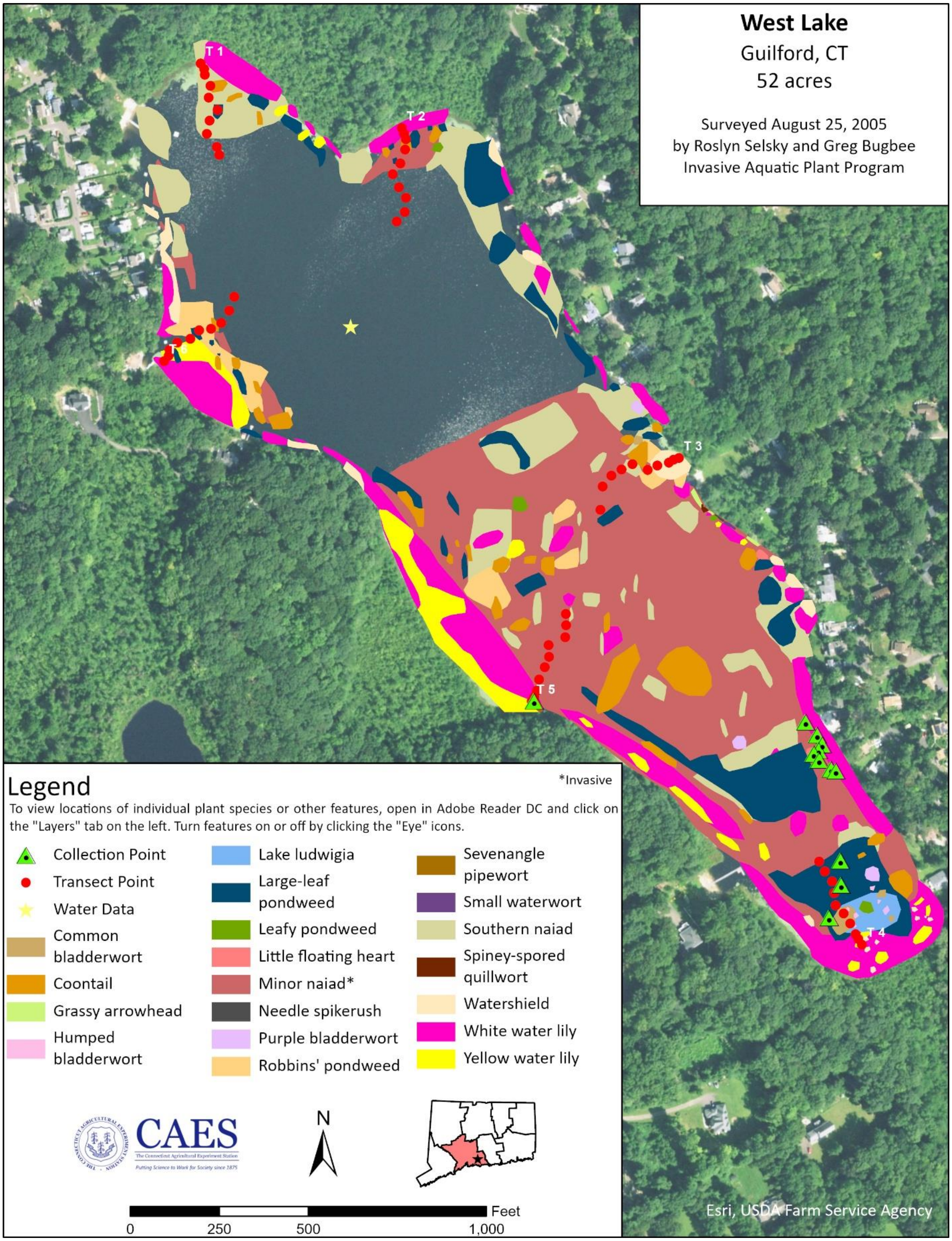
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Guilford, CT
52 acres
Surveyed August 25, 2005
by Roslyn Selsky and Greg Bugbee
Invasive Aquatic Plant Program
T 1
T 2
T 3
T 4
T 5
Legend
*Invasive
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab on the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Common bladderwort
Coontail
Grassy arrowhead
Humped bladderwort
Lake ludwigia
Large-leaf pondweed
Leafy pondweed
Little floating heart
Minor naiad*
Needle spikerush
Purple bladderwort
Robbins' pondweed
Sevenangle pipewort
Small waterwort
Southern naiad
Spiney-spored quillwort
Watershield
White water lily
Yellow water lily
CAES
N
0
250
500
1,000
Feet
Esri, USDA Farm Service Agency

Transect Data

Appendix West Lake Transect Data (1 of 2)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Notes	Brasch	EleSpp	LudSpp	NajGua	NupVar	NymOdo	PonCor	PotAmp	PotPus	PotRob	UtrGem	UtrMac
1	1	0.5	Greg Bugbee	41.34100	-72.73564	8/1/2022	0.2	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
1	2	5	Greg Bugbee	41.34097	-72.73560	8/1/2022	1.2	Muck	Algae	0	0	0	0	0	2	0	0	0	2	0	0
1	3	10	Greg Bugbee	41.34093	-72.73558	8/1/2022	1.7	Muck	Algae	0	0	0	0	0	2	0	0	0	0	0	0
1	4	10	Greg Bugbee	41.34084	-72.73552	8/1/2022	2.0	Muck	Algae	0	0	0	0	0	0	0	0	0	0	0	0
1	5	30	Greg Bugbee	41.34077	-72.73549	8/1/2022	2.1	Muck	Algae	0	0	0	0	0	0	0	0	0	0	0	0
1	6	40	Greg Bugbee	41.34068	-72.73545	8/1/2022	2.2	Muck	Charaphyte	0	0	0	0	0	0	0	0	0	0	0	0
1	7	50	Greg Bugbee	41.34058	-72.73541	8/1/2022	2.6	Muck	Charaphyte	0	0	0	0	0	0	0	0	0	0	0	0
1	8	60	Greg Bugbee	41.34050	-72.73536	8/1/2022	2.6	Muck	Charaphyte	0	0	0	0	0	0	0	0	0	0	0	0
1	9	70	Greg Bugbee	41.34040	-72.73533	8/1/2022	2.9	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
1	10	70	Greg Bugbee	41.34030	-72.73527	8/1/2022	3.2	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0.5	Greg Bugbee	41.34052	-72.73357	8/1/2022	0.3	Muck	Charaphyte	0	0	0	0	0	5	0	0	0	0	0	0
2	2	5	Greg Bugbee	41.34048	-72.73356	8/1/2022	2.0	Muck	Charaphyte	0	0	0	0	0	2	0	2	0	2	0	0
2	3	10	Greg Bugbee	41.34039	-72.73357	8/1/2022	2.2	Muck	Charaphyte	0	0	0	0	0	0	0	0	0	2	0	0
2	4	20	Greg Bugbee	41.34030	-72.73356	8/1/2022	2.4	Muck	Charaphyte	0	0	0	0	0	0	0	0	1	0	0	0
2	5	10	Greg Bugbee	41.34022	-72.73355	8/1/2022	2.5	Muck	Charaphyte	0	0	0	0	0	0	0	0	2	0	0	0
2	6	40	Greg Bugbee	41.34015	-72.73357	8/1/2022	2.5	Muck	Charaphyte	0	0	0	0	0	0	0	0	2	0	0	0
2	7	50	Greg Bugbee	41.34007	-72.73356	8/1/2022	3.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
2	8	60	Greg Bugbee	41.33996	-72.73355	8/1/2022	3.5	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
2	9	70	Greg Bugbee	41.33988	-72.73356	8/1/2022	3.8	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
2	10	80	Greg Bugbee	41.33976	-72.73354	8/1/2022	3.8	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	1	0.5	Greg Bugbee	41.33800	-72.73072	8/1/2022	0.5	Muck		0	0	0	0	2	4	0	0	0	0	0	0
3	2	5	Greg Bugbee	41.33797	-72.73076	8/1/2022	1.5	Muck		0	0	0	0	3	2	0	0	0	0	0	0
3	3	10	Greg Bugbee	41.33796	-72.73080	8/1/2022	1.8	Muck		2	0	0	0	3	0	0	0	0	0	0	0
3	4	20	Greg Bugbee	41.33792	-72.73094	8/1/2022	2.3	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	5	30	Greg Bugbee	41.33786	-72.73104	8/1/2022	3.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	6	40	Greg Bugbee	41.33781	-72.73119	8/1/2022	3.5	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	7	50	Greg Bugbee	41.33779	-72.73128	8/1/2022	3.7	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	8	60	Greg Bugbee	41.33774	-72.73135	8/1/2022	4.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	9	70	Greg Bugbee	41.33769	-72.73145	8/1/2022	4.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
3	10	80	Greg Bugbee	41.33763	-72.73159	8/1/2022	4.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
4	1	0.5	Greg Bugbee	41.33418	-72.72886	8/1/2022	0.1	Muck		2	2	2	0	0	5	2	0	0	0	0	0
4	2	5	Greg Bugbee	41.33423	-72.72888	8/1/2022	1.0	Muck		2	0	0	0	4	2	0	0	0	2	0	1
4	3	10	Greg Bugbee	41.33428	-72.72890	8/1/2022	1.5	Muck		0	0	0	0	4	2	0	0	0	0	0	0
4	4	20	Greg Bugbee	41.33435	-72.72894	8/1/2022	1.5	Muck		0	0	0	0	2	2	0	0	0	4	0	0
4	5	30	Greg Bugbee	41.33444	-72.72901	8/1/2022	1.8	Muck		0	0	0	0	2	0	0	0	0	0	0	0
4	6	40	Greg Bugbee	41.33452	-72.72908	8/1/2022	1.8	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
4	7	50	Greg Bugbee	41.33462	-72.72915	8/1/2022	2.2	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
4	8	60	Greg Bugbee	41.33472	-72.72920	8/1/2022	2.5	Muck		0	0	0	0	1	0	0	0	1	0	0	0
4	9	70	Greg Bugbee	41.33479	-72.72927	8/1/2022	2.5	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
4	10	80	Greg Bugbee	41.33491	-72.72934	8/1/2022	2.6	Muck		0	0	0	0	0	0	0	0	1	0	0	0
5	1	0.5	Greg Bugbee	41.33605	-72.73208	8/1/2022	0.5	Muck		0	0	0	1	0	5	0	0	1	2	1	0
5	2	5	Greg Bugbee	41.33613	-72.73204	8/1/2022	1.0	Muck		0	0	0	0	0	4	0	0	1	0	0	0
5	3	10	Greg Bugbee	41.33620	-72.73199	8/1/2022	2.0	Muck		0	0	0	0	2	3	0	0	1	0	0	0
5	4	20	Greg Bugbee	41.33629	-72.73198	8/1/2022	1.8	Muck		0	0	0	0	2	0	0	0	1	0	0	0
5	5	30	Greg Bugbee	41.33634	-72.73197	8/1/2022	2.5	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
5	6	40	Greg Bugbee	41.33640	-72.73195	8/1/2022	2.6	Muck		0	0	0	0	0	0	0	0	1	0	0	0
5	7	50	Greg Bugbee	41.33651	-72.73193	8/1/2022	2.8	Muck		0	0	0	0	0	0	0	0	2	0	0	0
5	8	60	Greg Bugbee	41.33661	-72.73190	8/1/2022	2.8	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
5	9	70	Greg Bugbee	41.33671	-72.73188	8/1/2022	3.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
5	10	80	Greg Bugbee	41.33680	-72.73190	8/1/2022	3.4	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0

Appendix West Lake Transect Data (2 of 2)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Notes	Brasch	EleSpp	LudSpp	NajGua	NupVar	NymOdo	PonCor	PotAmp	PotPus	PotRob	UtrGem	UtrMac
6	1	0.5	Greg Bugbee	41.33873	-72.73599	8/1/2022	1.2	Muck		0	2	2	0	0	3	0	0	0	0	0	0
6	2	5	Greg Bugbee	41.33878	-72.73594	8/1/2022	1.2	Muck		0	0	0	0	2	3	0	0	0	0	0	0
6	3	10	Greg Bugbee	41.33881	-72.73589	8/1/2022	1.8	Muck		0	0	0	0	2	0	0	0	0	0	0	0
6	4	20	Greg Bugbee	41.33887	-72.73580	8/1/2022	2.3	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	5	30	Greg Bugbee	41.33892	-72.73568	8/1/2022	3.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	6	40	Greg Bugbee	41.33897	-72.73561	8/1/2022	3.6	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	7	50	Greg Bugbee	41.33901	-72.73552	8/1/2022	3.8	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	8	60	Greg Bugbee	41.33908	-72.73543	8/1/2022	4.3	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	9	70	Greg Bugbee	41.33914	-72.73532	8/1/2022	4.3	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0
6	10	80	Greg Bugbee	41.33921	-72.73521	8/1/2022	5.0	Muck	Nothing	0	0	0	0	0	0	0	0	0	0	0	0