



2015 Lakes and Ponds Monitoring Report

Westford, Massachusetts



PREPARED FOR
Town of Westford
55 Main Street
Westford, Massachusetts 01886

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
INTRODUCTION.....	1
APPROACH	1
Bathymetry Survey.....	1
Water Quality Sampling	1
Aquatic Plant Survey.....	1
Zooplankton and Phytoplankton Assessment.....	3
RESULTS.....	3
Keyes Pond	3
Bathymetry.....	3
Water Quality	3
Aquatic Plants	5
Phytoplankton and Zooplankton	7
Burge's Pond	9
Bathymetry.....	9
Water Quality	9
Aquatic Plants	12
Phytoplankton and Zooplankton	12
Grassy Pond	15
Bathymetry.....	15
Figure 10	16
Water Quality	17
Aquatic Plants	17
Phytoplankton and Zooplankton	19
Old Mill/Graniteville Pond	20
Bathymetry.....	20
Water Quality	20
Aquatic Plants	22
Phytoplankton and Zooplankton	27
Kennedy Pond	28
Bathymetry.....	28
Water Quality	28
Aquatic Plants	30
Phytoplankton and Zooplankton	32
Summary of Overall Pond Conditions	33
RECOMMENDATIONS.....	34
REFERENCES.....	35



TABLES

Table A	Water Quality Results at Keyes Pond
Table B	Aquatic Plants Observed at Keyes Pond
Table C	Summary of Phytoplankton Results at Keyes Pond
Table D	Summary of Zooplankton Results at Keyes Pond
Table E	Water Quality Results at Burge's Pond
Table F	Aquatic Plants Observed at Burge's Pond
Table G	Summary of Phytoplankton Results at Burge's Pond
Table H	Summary of Zooplankton Results at Burge's Pond
Table I	Water Quality Results at Grassy Pond
Table J	Aquatic Plants Observed at Grassy Pond
Table K	Summary of Phytoplankton Results at Grassy Pond
Table L	Summary of Zooplankton Results at Grassy Pond
Table M	Water Quality Results at Old Mill/Graniteville Pond
Table N	Aquatic Plants Observed at Old Mill/Graniteville Pond
Table O	Summary of Phytoplankton Results at Old Mill/Graniteville Pond
Table P	Summary of Zooplankton Results at Old Mill/Graniteville Pond
Table Q	Water Quality Results at Kennedy Pond
Table R	Aquatic Plants Observed at Kennedy Pond
Table S	Summary of Phytoplankton Results at Kennedy Pond
Table T	Summary of Zooplankton Results at Kennedy Pond
Table U	Comparison of Lake and Pond Water Quality Conditions, 2014 and 2015
Table V	Comparison of Lake and Pond Vegetation Conditions, 2014 and 2015
Table W	Summary of Recommended Management Actions

FIGURES

Figure 1	Water Quality Sampling Locations
Figure 2	Aquatic Plant Cover, Keyes Pond
Figure 3	Water Quality Profile, Keyes Pond
Figure 4	Variable-leaf Milfoil, Keyes Pond
Figure 5	Aquatic Plant Biovolume, Keyes Pond
Figure 6	Aquatic Plant Cover, Burge's Pond
Figure 7	Water Quality Profile, Burge's Pond
Figure 8	Variable-leaf Milfoil, Burge's Pond
Figure 9	Aquatic Plant Biovolume, Burge's Pond
Figure 10	Aquatic Plant Cover, Grassy Pond
Figure 11	Aquatic Plant Biovolume, Grassy Pond
Figure 12	Aquatic Plant Cover, Old Mill/Graniteville Pond
Figure 13	Water Quality Profile, Old Mill/Graniteville Pond
Figure 14	Fanwort, Old Mill/Graniteville Pond
Figure 15	Variable-leaf Milfoil, Old Mill/Graniteville Pond
Figure 16	Curly-leaf Pondweed, Old Mill/Graniteville Pond
Figure 17	Aquatic Plant Biovolume, Old Mill/Graniteville Pond
Figure 18	Aquatic Plant Cover, Kennedy Pond
Figure 19	Water Quality Profile, Kennedy Pond
Figure 20	Aquatic Plant Biovolume, Kennedy Pond

APPENDICES

Appendix A	Laboratory Reports
Appendix B	Glossary of Limnological Terms



INTRODUCTION

ESS Group, Inc. (ESS) was contracted by the Town of Westford (the Town) to conduct annual monitoring of five Town-managed lakes and ponds as part of the Town's Monitoring Program. The water bodies included in the program were Keyes Pond, Burge's Pond, Grassy Pond, Old Mill/Graniteville Pond, and Kennedy Pond. The 2015 Monitoring Program was completed in line with recommendations from the 2014 *Westford Lakes and Ponds Management and Preservation Program Plan* with the purpose establishing pre-management baseline conditions and updating recommendations, as needed, for each water body.

Acknowledgments

Funding for this report was provided through the Westford Community Preservation Act.

APPROACH

ESS completed field work for the Monitoring Program in August 2015. The field visit was timed to be consistent with sampling conducted in 2014 as part of the *Westford Lakes and Ponds Management and Preservation Program Plan*. The monitoring methods used for each pond are described in the following sections.

Bathymetry Survey

A bathymetry survey was included in this year's monitoring program, to provide critical information on lake volume and water body morphometry. This was necessary given the lack of prior bathymetric data or outdated prior bathymetric maps (i.e., more than ten years old).

ESS conducted a bathymetry survey of each pond using defined transects within each of the five ponds. Survey locations along each transect were spaced to provide contour interval mapping tailored to the physical characteristics of each pond. Water depth measurements were collected using a sonar module (for deep, open water) and a graduated rod (for shallow, weedy water). Each water depth measurement location was recorded with a DGPS receiver capable of sub-meter accuracy. Survey results were used to develop bathymetric contours and produce maps for each of the five ponds.

Water Quality Sampling

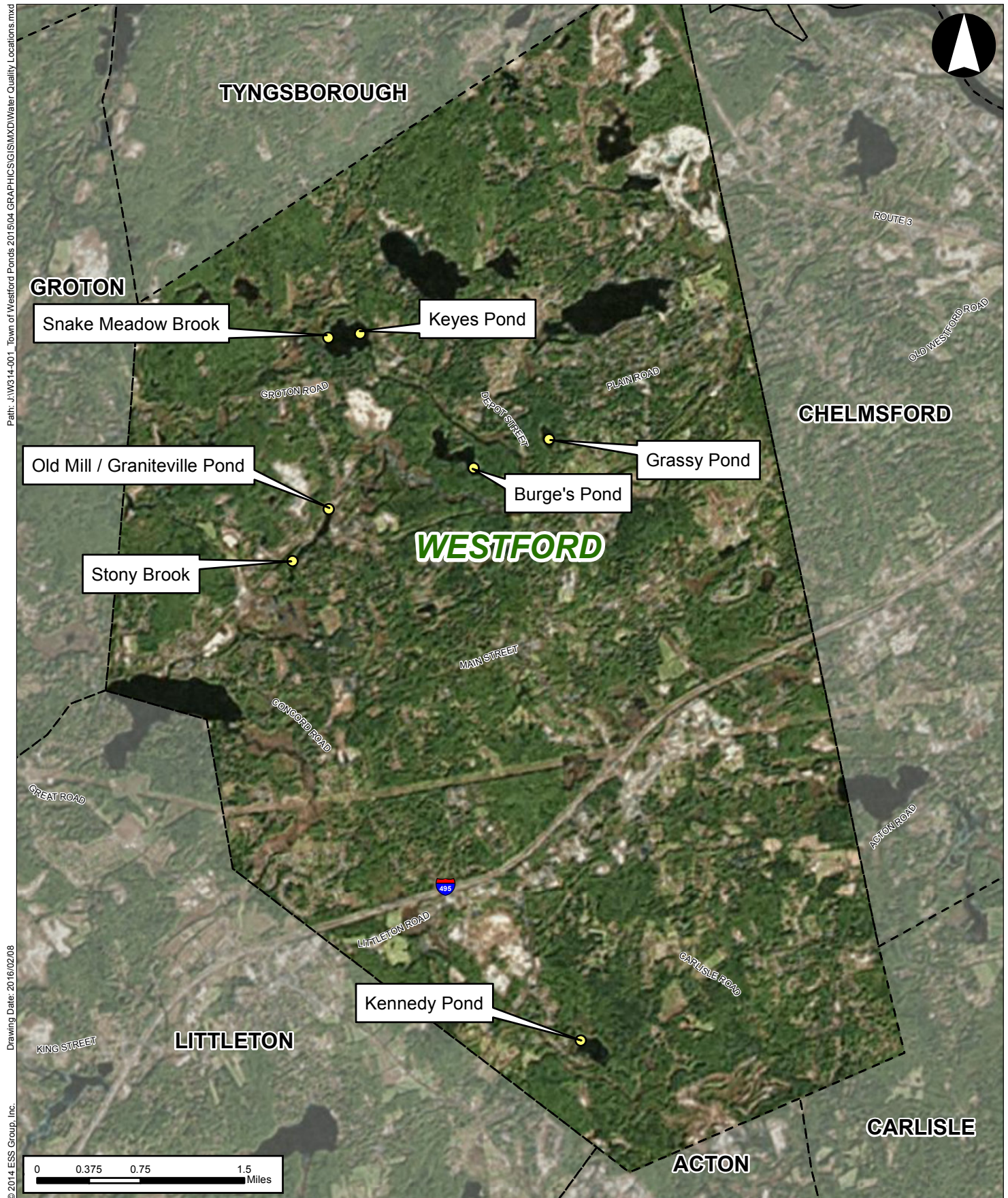
ESS conducted water quality sampling at each of the five ponds. Water quality sampling locations were established within each pond at the deep hole and at the mouth of selected major perennial tributaries for a total of seven locations (Figure 1).

At each water quality sampling location, ESS measured the following water quality parameters: dissolved oxygen, temperature, pH, conductivity, turbidity, total depth, and Secchi depth. Additionally, ESS conducted a water quality profile at the deep hole location of each pond, which measured dissolved oxygen, temperature, and conductivity at regular vertical intervals through the water column.

ESS also collected a surface water sample at each water quality sampling location for analysis by a state-certified laboratory for the following analytes: total nitrogen and total phosphorus.

Aquatic Plant Survey

ESS conducted aquatic vegetation surveys at each of the five ponds at the time of peak development. Aquatic vegetation survey locations identified in 2014 were re-visited at each pond to provide year-to-year consistency. Additional survey locations were included to capture the distribution of new species or expansion of beds.



Aquatic plants were surveyed by making direct observations from the survey vessel, using an underwater video camera and/or active sampling with a plant rake. At each survey location, ESS identified observed species of submerged, floating, and emergent aquatic plants, determined the extent of any invasive plant infestations, and assigned the location an overall cover and biovolume classification. Data were recorded with a DGPS receiver capable of sub-meter accuracy and used to generate maps of invasive plant extent, as well as overall plant biovolume and cover. These data are critical for monitoring the success of management actions and adjusting management recommendations for the coming year.

Zooplankton and Phytoplankton Assessment

ESS collected one phytoplankton and one zooplankton sample from the deep hole sampling location of each pond. Phytoplankton samples were collected as a grab sample from the mixed surface layer of each pond. Zooplankton samples were collected using a fine (64- μ m) mesh plankton net which was lowered vertically through the water column of each pond. Due to shallow water depths at Grassy Pond, the plankton net was skimmed horizontally over the surface of the pond.

Phytoplankton and zooplankton samples were preserved in the field and returned to ESS's office for identification and qualitative analysis under the microscope by a qualified taxonomist.

RESULTS

Keyes Pond

Bathymetry

Keyes Pond consists of a single basin with a shallow slope to the pond bottom on the western and northern sides of the pond (Figure 2). Most of the pond is less than 15 feet deep. However, steeper contours were encountered on the eastern and southern margins of the pond, where water depths increased to nearly 20 feet.

Water Quality

Water quality results for Keyes Pond and its primary tributary, Snake Meadow Brook, are presented in Table A.

Table A. Water Quality Results at Keyes Pond

Site ID	In-Pond	Snake Meadow Brook
Date	8/20/2015	8/20/2015
Time	11:30	10:00
Temperature (°C)	28.3	27.5
Dissolved Oxygen (mg/L)	6.50	5.24
Dissolved Oxygen (%)	88.1	67.4
Specific Conductance (μ S/cm)	235	235
pH (SU)	7.1	6.8
Turbidity (NTU)	0.49	1.49
Secchi Depth (m)	1.7	bottom
Apparent Color (PCU)	75	55
Nitrite/Nitrate (mg/L)	0.019*	0.019*
TKN (mg/L)	0.784	0.758
Total Phosphorus (mg/L)	0.018	0.027

*= Non-detect. Value represents method detection limit.



Key highlights of the results are as follows:

- Dissolved oxygen at the pond surface was supportive of aquatic life but declined to anoxic levels below 1.5 meters (Figure 3)
- Secchi disk transparency (water clarity) was low and accompanied by moderately high apparent color

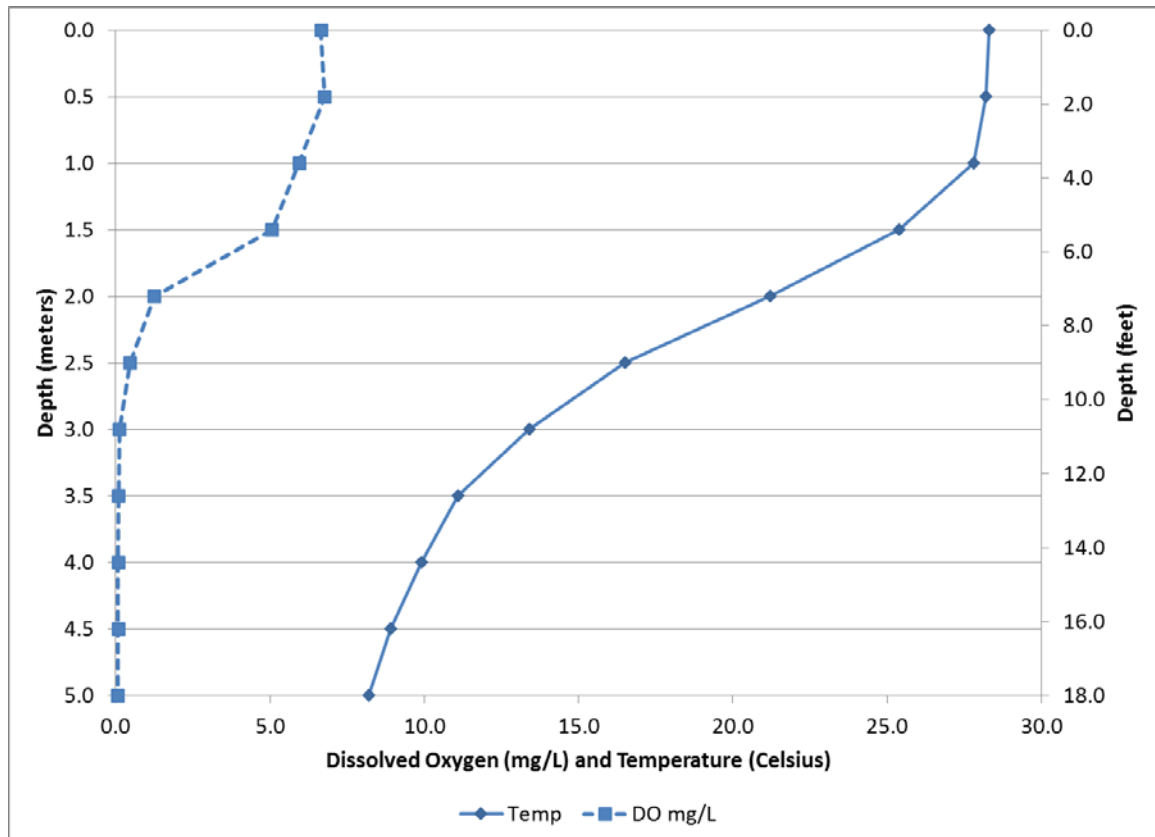


Figure 3. Water Quality Profile, Keyes Pond

- Snake Meadow Brook may be contributing to some of the water quality issues in Keyes Pond, as evidenced by depressed dissolved oxygen levels and higher phosphorus concentrations in the brook than the pond

Aquatic Plants

Eighteen species of aquatic plants were observed in Keyes Pond (Table B). As in 2014, variable-leaf milfoil (*Myriophyllum heterophyllum*) was the only invasive aquatic plant species detected in Keyes Pond. The variable-leaf milfoil infestation in Keyes Pond was found to be patchy to dense along most of the shoreline of the pond (Figure 4). Native species, such as coontail (*Ceratophyllum demersum*), water lilies (*Nuphar lutea variegata* and *Nymphaeodes odorata*), certain pondweeds (*Potamogeton epihydrus* and *P. robbinsii*) and humped bladderwort (*Utricularia gibba*) were often associated with variable-leaf milfoil.

Two emergent invasive species, common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*), were also occasionally found growing on the shoreline of the pond.

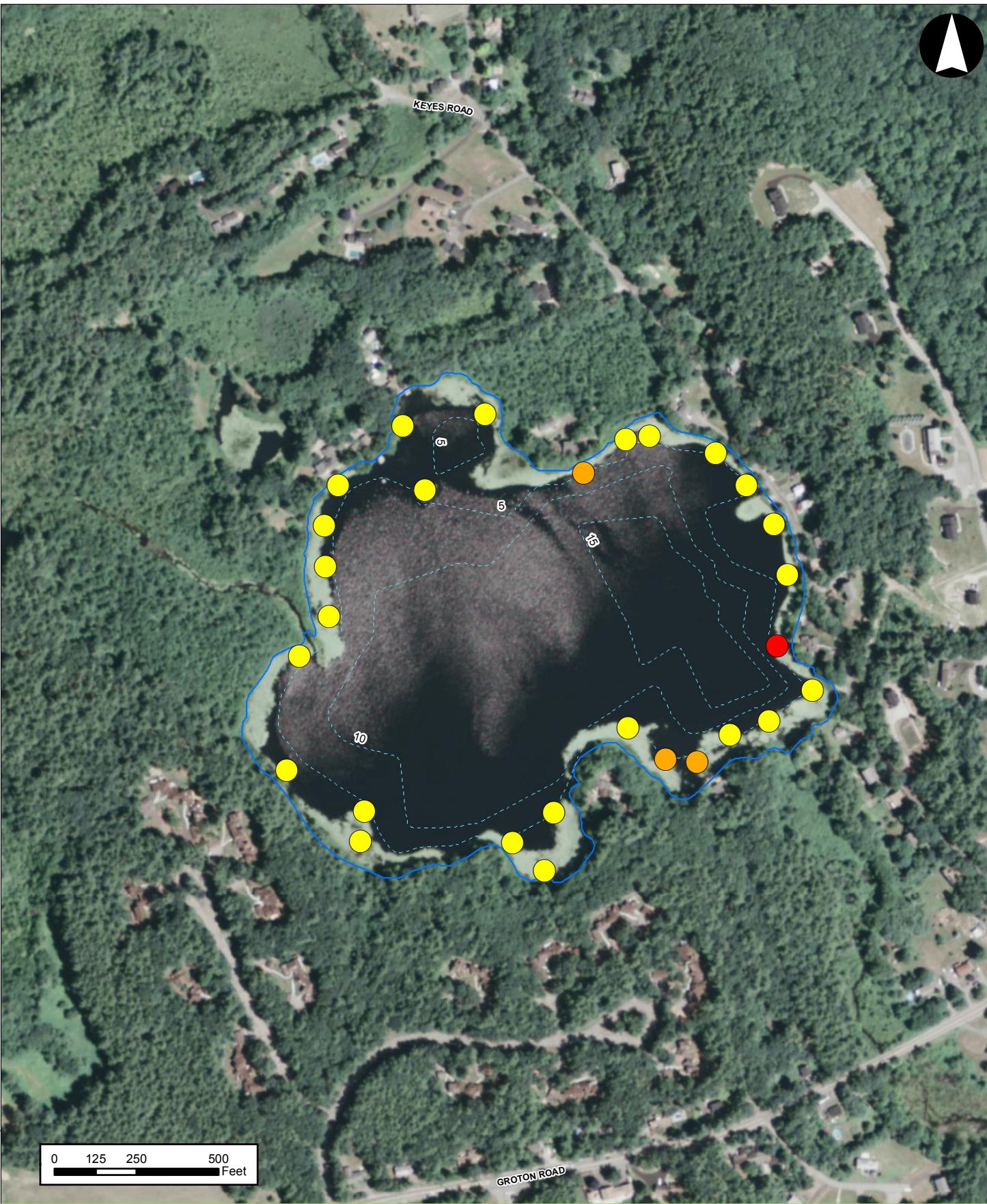


Table B. Aquatic Plants Observed at Keyes Pond

Common Name	Scientific Name	Native or Exotic
Watershield	<i>Brasenia schreberi</i>	Native
Coontail	<i>Ceratophyllum demersum</i>	Native
Waterwort	<i>Elatine sp.</i>	Native
Spikerush	<i>Eleocharis sp.</i>	Native
Western Waterweed	<i>Elodea nuttallii</i>	Native
Variable-leaf Milfoil	<i>Myriophyllum heterophyllum</i>	Exotic
Bushy Naiad	<i>Najas flexilis</i>	Native
Yellow Water Lily	<i>Nuphar lutea variegata</i>	Native
White Water Lily	<i>Nymphaea odorata</i>	Native
Pickernelweed	<i>Pontederia cordata</i>	Native
Floating-leaf Pondweed	<i>Potamogeton epihydrus</i>	Native
Thinleaf Pondweed	<i>Potamogeton pusillus</i>	Native
Robbins' Pondweed	<i>Potamogeton robbinsii</i>	Native
Humped Bladderwort	<i>Utricularia gibba</i>	Native
Flat-leaf Bladderwort	<i>Utricularia intermedia</i>	Native
Common Bladderwort	<i>Utricularia macrorhiza</i>	Native
Purple Bladderwort	<i>Utricularia purpurea</i>	Native
Little Floating Bladderwort	<i>Utricularia radiata</i>	Native

Aquatic plant cover was very dense along most of the shoreline of Keyes Pond (Figure 2). Plant cover declined rapidly away from shore with little to no plant growth where water depth exceeded five feet. It is possible that the low water clarity in Keyes Pond significantly limits the depth to which plants can grow.

Plant biovolume was also high along the shoreline of the pond, particularly in the southern coves and where variable-leaf milfoil was present (Figure 5). Biovolume reached nuisance levels (i.e., >50%) over 5.3 acres of the pond.

Phytoplankton and Zooplankton

Phytoplankton

Phytoplankton were found at modest cell densities with no visible sign of an algae bloom (Table C). However, as in 2014, cyanobacteria were the most common group observed. The cyanobacteria taxa observed in 2015 are known to be potential producers of toxins under the right conditions. Other phytoplankton taxa were also observed at very low densities.



Table C. Summary of Phytoplankton Results at Keyes Pond*

Type	Taxon	Abundance
Cyanobacteria	<i>Aphanizomenon</i>	rare
	<i>Dolichospermum</i>	occasional
	<i>Microcystis</i>	absent
	<i>Oscillatoria</i>	absent
Charophytes	<i>Staurostrum</i>	rare
Diatom	<i>Tabellaria</i>	rare
Dinoflagellate	<i>Ceratium</i>	absent
Euglenoids	<i>Euglena</i>	rare
Golden-brown	<i>Dinobryon</i>	absent
Green	<i>Chlorobotrys</i>	absent
Synurophytes	<i>Mallomonas</i>	rare

*Taxa present in 2014 but not in 2015 remain listed but are classified as “absent”

Zooplankton

The zooplankton community was characterized by a low abundance of small- to medium-bodied individuals (Table D). Copepod nauplii (larvae) were the most commonly encountered organisms. The small rotifers *Kellicottia longispina* and *Polyarthra sp.* were also common. Other taxa, including various copepods and small- to medium-bodied cladocerans, were also present and more common than in 2014.

Table D. Summary of Zooplankton Results at Keyes Pond

Taxon	Relative Abundance	Size
<i>Bosmina longirostrum</i>	Rare	Small
Chydoridae	Rare	Medium
Calanoid copepods	Occasional	Small
Cyclopoid copepods	Rare	Small
Copepod nauplii	Abundant	Small
<i>Kellicottia longispina</i>	Occasional	Small
<i>Holopedium gibberum</i>	Occasional	Medium
<i>Polyarthra sp.</i>	Occasional	Small

Burge's Pond

Bathymetry

Burge's Pond consists of three distinct basins; the largest occupies the northwestern half of the pond, and is separated by a broad, shallow shelf from a slightly smaller basin in the east-central portion of the pond (Figure 6). The third basin is small, but deep, and occupies the southeastern extreme of the pond. All three basins are of similar maximum depth, reaching nearly 20 feet deep.

Water Quality

Water quality results for Burge's Pond are presented in Table E.



Table E. Water Quality Results at Burge's Pond

Site ID	In-Pond
Date	8/19/2015
Time	11:00
Temperature (°C)	28.2
Dissolved Oxygen (mg/L)	6.95
Dissolved Oxygen (%)	87.8
Specific Conductance (µS/cm)	5.1
pH (SU)	6.7
Turbidity (NTU)	0.05
Secchi Depth (m)	4.2
Apparent Color (PCU)	20
Nitrite/Nitrate (mg/L)	0.019*
TKN (mg/L)	0.518
Total Phosphorus (mg/L)	0.004

*= Non-detect. Value represents method detection limit.

Key highlights of the results are as follows:

- Dissolved oxygen was supportive of aquatic life over most of the pond's volume, with the exception of waters deeper than 3.5 meters, where anoxic conditions prevailed (Figure 7)

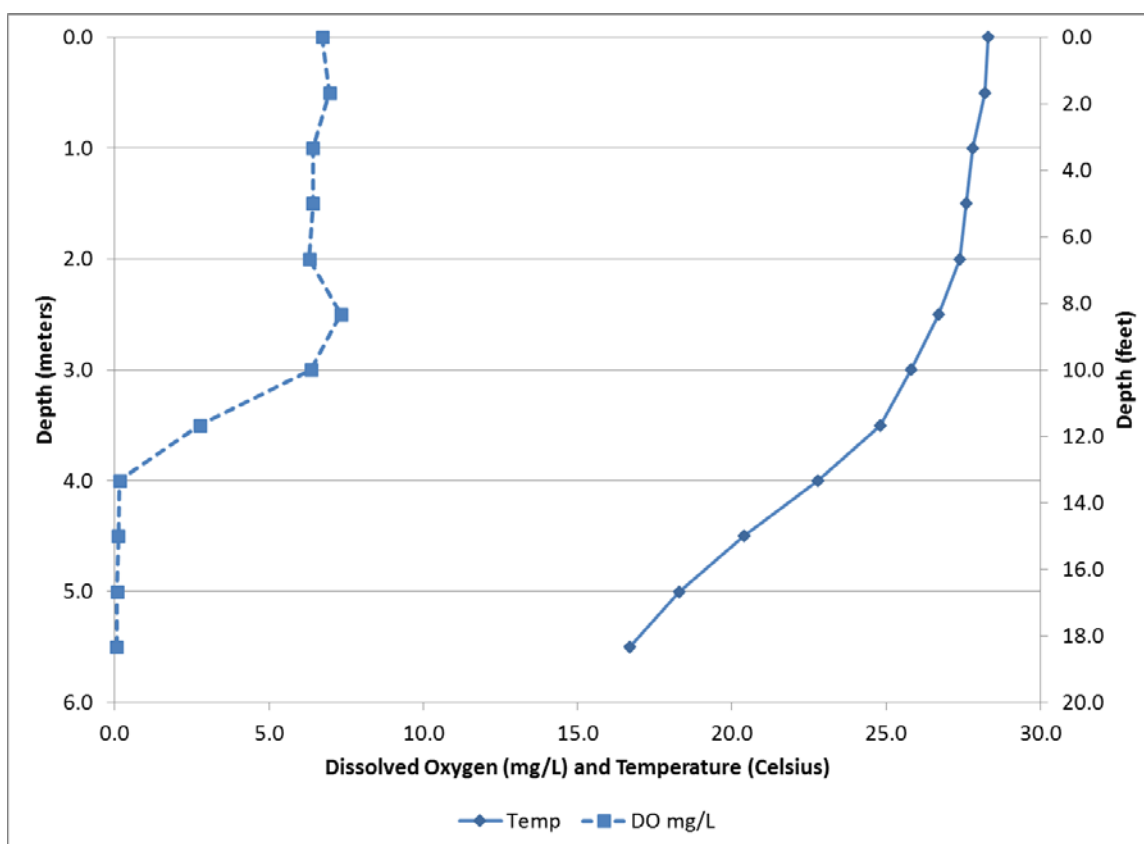


Figure 7. Water Quality Profile, Burge's Pond

- Specific conductance was very low, indicating minimal dissolved salts from human sources
- Water clarity was the highest of all five ponds
- Total phosphorus concentrations were very low

Aquatic Plants

Twelve aquatic plant species were observed at Burge's Pond (Table F). Of these, variable-leaf milfoil was the only invasive species detected. This species was found in dense stands in many areas along the shoreline of the pond, but was especially prevalent along the northwestern shoreline of the pond (Figure 8). Variable-leaf milfoil was most frequently associated with white water lily.

Plant cover was dense along most of the Burge's Pond shoreline and in the central "neck" of the pond that divides the northwestern basin from the other two (Figure 6).

Plant biovolume was low to moderate over most of the pond with heavier growth relegated to the northwestern cove of the pond (Figure 9). Biovolume reached nuisance levels (i.e., >50%) over 0.6 acres of the pond.

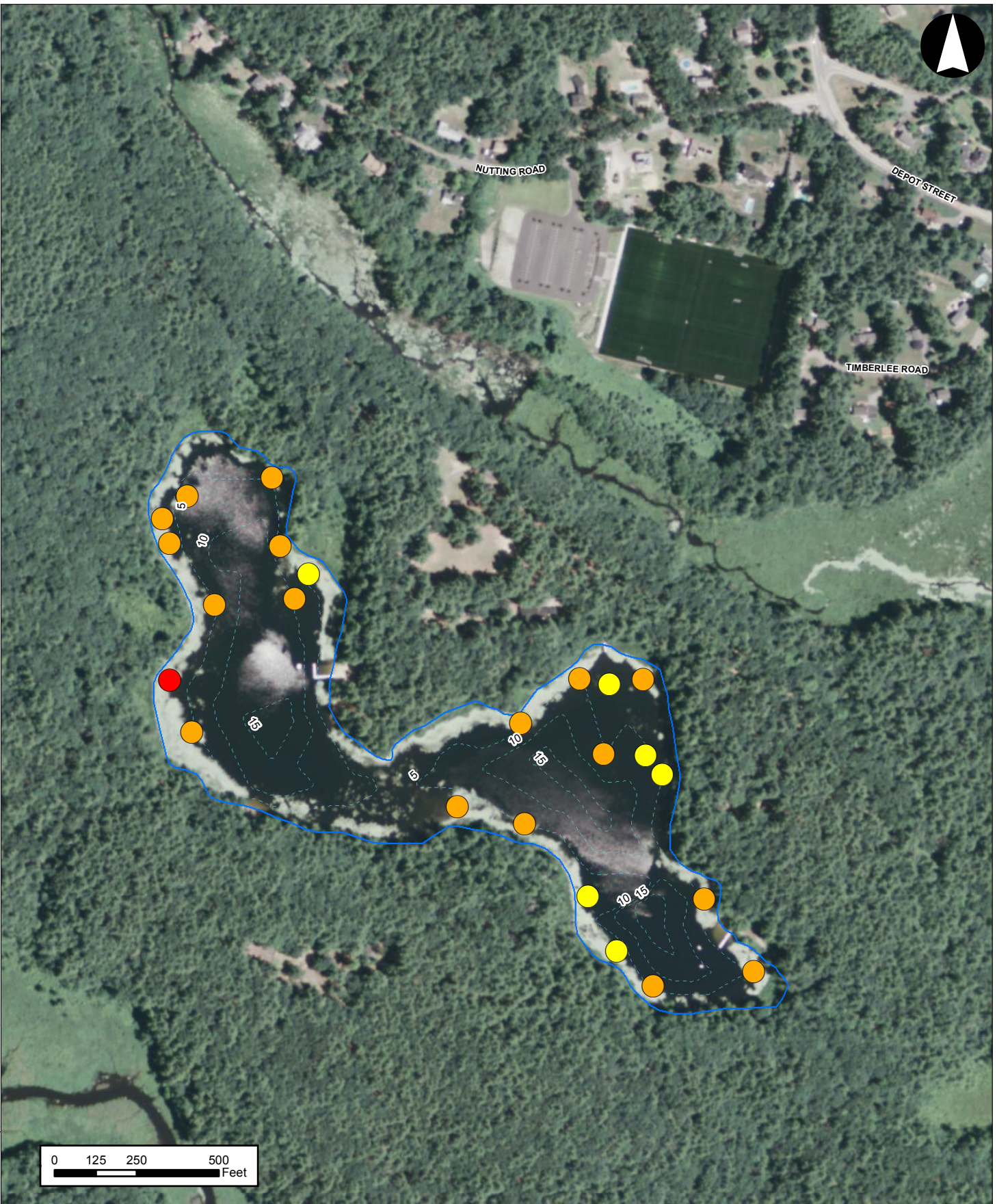
Table F. Aquatic Plants Observed at Burge's Pond

Common Name	Scientific Name	Native or Exotic
Watershield	<i>Brasenia schreberi</i>	Native
Waterwort	<i>Elatine sp.</i>	Native
Spikerush	<i>Eleocharis sp.</i>	Native
Golden Hedge-hyssop	<i>Gratiola aurea</i>	Native
Variable-leaf Milfoil	<i>Myriophyllum heterophyllum</i>	Exotic
Yellow Water Lily	<i>Nuphar lutea variegata</i>	Native
White Water Lily	<i>Nymphaea odorata</i>	Native
Bigleaf Pondweed	<i>Potamogeton amplifolius</i>	Native
Humped Bladderwort	<i>Utricularia gibba</i>	Native
Common Bladderwort	<i>Utricularia macrorhiza</i>	Native
Little Floating Bladderwort	<i>Utricularia radiata</i>	Native
Water Celery	<i>Vallisneria americana</i>	Native

Phytoplankton and Zooplankton

Phytoplankton

The phytoplankton community was characterized by low overall abundance and dominated by the charophytes, with *Docidium* the most abundant taxon observed. (Table G). Charophytes are non-harmful algae and many species are associated with nutrient-poor waters. The only cyanobacteria taxon observed was *Dolichospermum*. Although *Dolichospermum* is a potentially toxigenic species, it was present at very low levels. Notably, the most common phytoplankton taxon observed in 2014 (*Glenodinium*), was not observed in 2015. However, large interseasonal or interannual variation in abundance is common among individual taxa in the phytoplankton community.





Plant Biovolume

- 0% (11.3 Acres)
- 1-25% (13.2 Acres)
- 26-50% (2.0 Acres)
- 51-75% (0.6 Acres)

Table G. Summary of Phytoplankton Results at Burge's Pond

Type	Taxon	Abundance
Charophyceae	<i>Cosmarium</i>	Rare
	<i>Desmidium</i>	Occasional
	<i>Docidium</i>	Common
	<i>Mougeotia</i>	Rare
	<i>Penium</i>	Occasional
	<i>Staurastrum</i>	Rare
Cyanobacteria	<i>Dolichospermum</i>	Rare
Diatom	Various benthic species	Rare
Dinoflagellate	<i>Glenodinium</i>	Absent
Green	<i>Scenedesmus</i>	Rare

*Taxa present in 2014 but not in 2015 remain listed but are classified as "absent"

Zooplankton

The zooplankton community was characterized by moderate abundances of small- to medium-bodied individuals (Table H). The most abundant zooplankters were *Diaphanosoma* and *Holopedium gibberum*, followed by calanoid copepods. Larval copepod nauplii were also present.

Among the cladocerans, *Holopedium gibberum* is a highly efficient grazer at low phytoplankton densities (such as those observed in Burge's Pond) and may dominate the zooplankton community under these conditions (Balcer et al. 1984). *Diaphanosoma* is known to be a selective herbivore, preferring smaller green algae and diatoms.

Table H. Summary of Zooplankton Results at Burge's Pond

Taxon	Relative Abundance	Size
<i>Diaphanosoma</i>	Common	Small
Calanoid copepods	Occasional	Medium
Cyclopoid copepods	Rare	Medium
Copepod nauplii	Occasional	Small
<i>Holopedium gibberum</i>	Common	Medium

Grassy Pond

Bathymetry

Grassy Pond is a very shallow water body with a maximum depth of just over two feet at ordinary water levels (Figure 10). The pond is split into two basins, including a smaller basin near the northern end of the pond and a larger basin that occupies the southern two-thirds of the water body. Changes in bathymetry are generally very gradual, although the presence of emergent vegetation and a peaty muck on the pond bottom sometimes result in complex local microtopography.



Drawing Date: 2016/02/08
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Water Quality

Water quality results for Grassy Pond are presented in Table I.

Table I. Water Quality Results at Grassy Pond

Site ID	In-Pond
Date	8/19/2015
Time	15:15
Temperature (°C)	32.8
Dissolved Oxygen (mg/L)	7.56
Dissolved Oxygen (%)	102.3
Specific Conductance (µS/cm)	11.3
pH (SU)	5.2
Turbidity (NTU)	16.41
Secchi Depth (m)	0.61 (bottom)
Apparent Color (PCU)	65
Nitrite/Nitrate (mg/L)	0.019*
TKN (mg/L)	1.21
Total Phosphorus (mg/L)	0.085

*= Non-detect. Value represents method detection limit.

Key highlights of the results are as follows:

- Water temperature was very high for a New England pond. This was relate to the very shallow water depth and dark, peaty substrate of the pond.
- Dissolved oxygen was fully supportive of aquatic life, despite the high water temperature
- Specific conductance was very low, indicating minimal contribution of dissolved salts from human sources
- Total phosphorus concentration was the highest of the five ponds but this is consistent with past observations and appears to be the natural condition of the pond

Aquatic Plants

Eight species of native aquatic plants were documented at Grassy Pond, which remains free of invasive, non-native aquatic plant species (Table J). Watershield (*Brasenia schreberi*) was the most commonly observed aquatic plant species, although spikerush (*Eleocharis* sp.) and white water lily (*Nymphaea odorata*) were also frequently encountered.

Although variation in species composition was observed from location to location within the pond, overall plant cover i was high throughout (Figure 10).

Plant biovolume was low to moderate throughout most of the pond, except in the south-central portion, where it approached nuisance levels (Figure 11).



Table J. Aquatic Plants Observed at Grassy Pond

Common Name	Scientific Name	Native or Exotic
Watershield	<i>Brasenia schreberi</i>	Native
Water Starwort	<i>Callitriche heterophylla</i>	Native
Spikerush	<i>Eleocharis</i> sp.	Native
White Water Lily	<i>Nymphaea odorata</i>	Native
White Floating Heart	<i>Nymphoides cordata</i>	Native
Longleaf Pondweed	<i>Potamogeton nodosus</i>	Native
Humped Bladderwort	<i>Utricularia gibba</i>	Native
Common Bladderwort	<i>Utricularia macrorhiza</i>	Native

Phytoplankton and Zooplankton

Phytoplankton

Phytoplankton in Grassy Pond were present at moderate densities overall (Table K). The community was dominated by the charophyte *Mougeotia*, which is probably incidental, as this taxon forms large filaments and is not typically planktonic. Given the shallow water depths in the pond, the presence of non-planktonic species in a surface water sample is not surprising. As at Burge's Pond, the most common phytoplankton taxon observed in 2014 (*Glenodinium*), was not observed in 2015.

Table K. Summary of Phytoplankton Results at Grassy Pond

Type	Taxon	Abundance
Charophytes	<i>Mougeotia</i>	common
Cryptophytes	<i>Cryptomonas</i>	rare
Diatom	Various benthic species	absent
Dinoflagellate	<i>Ceratium</i>	occasional
	<i>Gleodinium</i>	absent
Euglenophytes	<i>Euglena</i>	rare
	<i>Phacus</i>	occasional
Golden-brown	<i>Dinobryon</i>	rare
Green	<i>Chlorobotrys</i>	rare
Synurophytes	<i>Synura</i>	occasional

*Taxa present in 2014 but not in 2015 remain listed but are classified as "absent"

Zooplankton

The zooplankton community was characterized by high abundances of individuals over a wide spectrum of body sizes (Table L). As in 2014, the most abundant zooplankter was the small rotifer *Keratella*, although copepod nauplii (also small-bodied) were also common. The primary predatory species observed was the cladoceran *Polyphemus pediculus*, which is especially common where rotifers, such as *Keratella*, are present in abundance (Bosak 2013).

Table L. Summary of Zooplankton Results at Grassy Pond

Taxon	Relative Abundance	Size
<i>Bosmina longirostris</i>	Absent	Small
Calanoid copepods	Rare	Large
Cyclopoid copepods	Rare	Small
Copepod nauplii	Common	Small

Taxon	Relative Abundance	Size
<i>Keratella</i>	Common	Small
Ostracoda	Rare	Large
<i>Polyphemus pediculus</i>	Common	Medium

*Taxa present in 2014 but not in 2015 remain listed but are classified as "absent"

Old Mill/Graniteville Pond

Bathymetry

Old Mill/Graniteville Pond consists of two primary sub-basins, divided by Bridge Street and connected by a culvert (Figure 12). The upper, southern basin is larger in area but shallow (less than five feet deep). A meandering channel of varying width contains the deepest water in the southern basin. The lower, northern basin is significantly deeper, reaching greatest water depth (15.5 feet) near the spillway at its northern end.

Water Quality

Water quality results for Old Mill/Graniteville Pond are presented in Table M.

Table M. Water Quality Results at Old Mill/Graniteville Pond

Site ID	In-Pond	Stony Brook
Date	8/18/2015	8/18/2015
Time	12:20	10:00
Temperature (°C)	27.2	24.4
Dissolved Oxygen (mg/L)	7.25	2.14
Dissolved Oxygen (%)	93.3	27.6
Specific Conductance (µS/cm)	393	622
pH (SU)	7.6	6.9
Turbidity (NTU)	1.38	0.75
Secchi Depth (m)	2.25	Bottom
Apparent Color (PCU)	45	50
Nitrite/Nitrate (mg/L)	0.019*	0.061
TKN (mg/L)	0.493	0.489
Total Phosphorus (mg/L)	0.022	0.032

*= Non-detect. Value represents method detection limit.

Key highlights of the results are as follows:

- Dissolved oxygen at the pond surface was supportive of aquatic life but declined to anoxic levels below approximately 1.5 meters (Figure 13)
- Secchi disk transparency (water clarity) was low



- Stony Brook may affect water quality in Old Mill/Graniteville Pond, as evidenced by depressed dissolved oxygen and higher specific conductance (dissolved salts) and phosphorus in the brook than the pond (Table M)

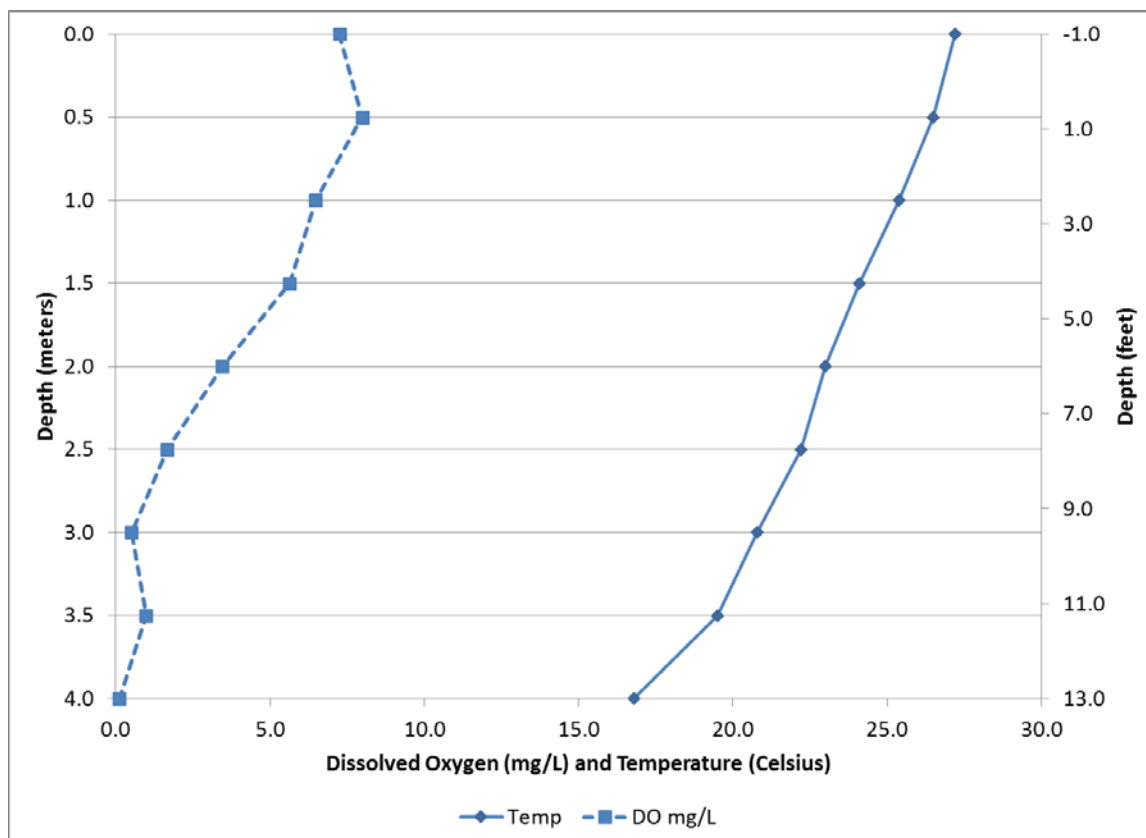


Figure 13. Water Quality Profile, Old Mill/Graniteville Pond

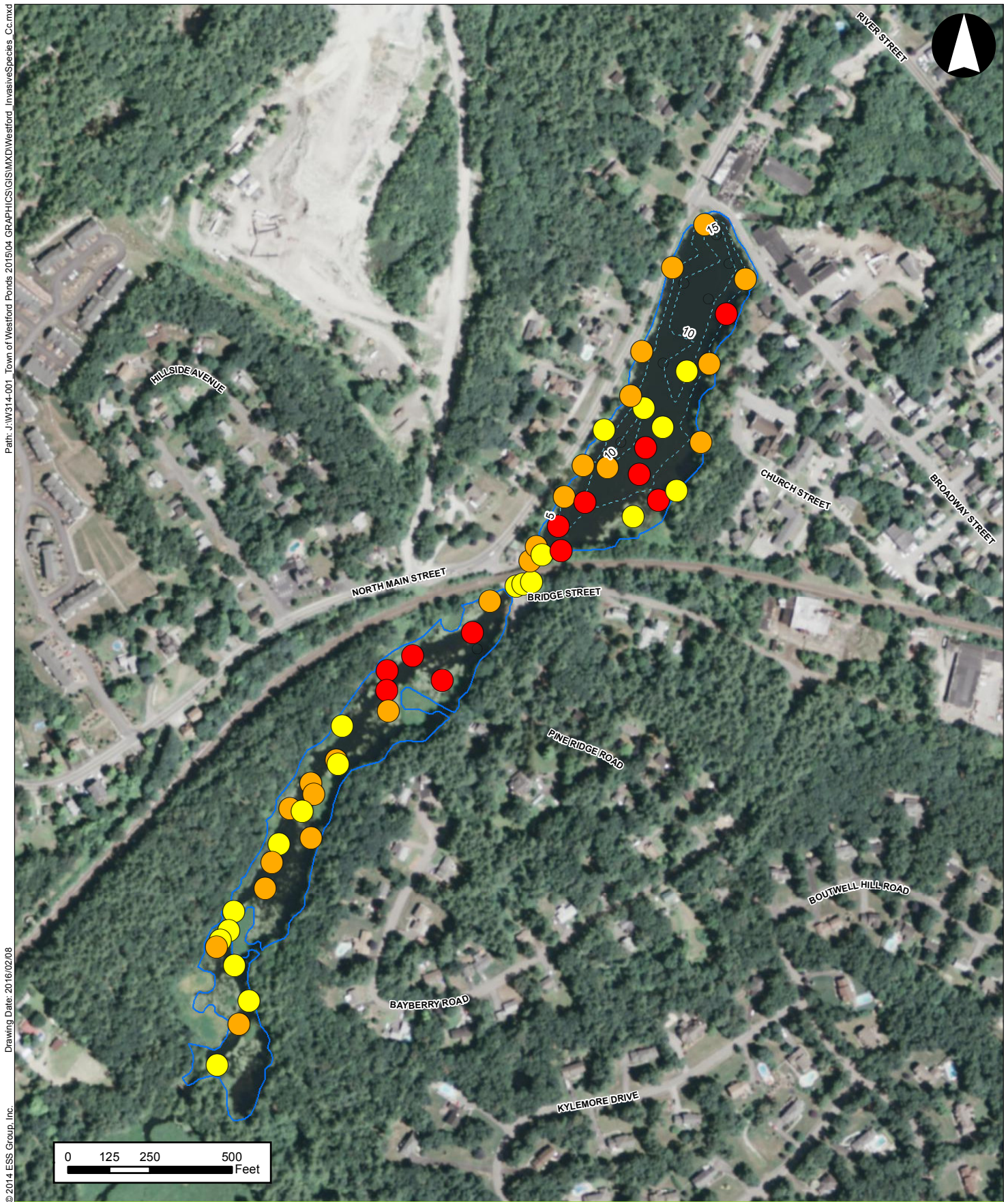
Aquatic Plants

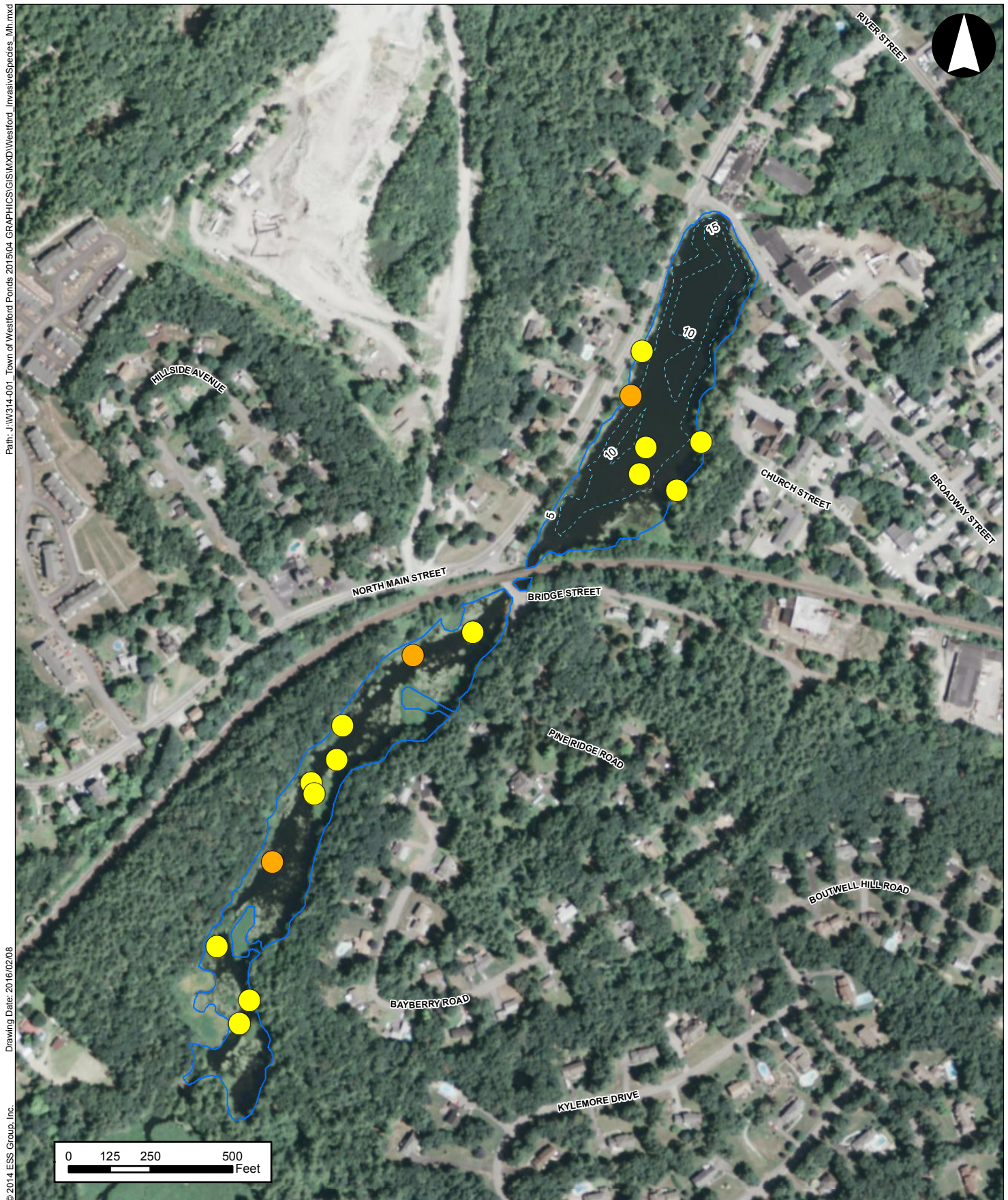
Twenty-five species of aquatic plants were observed at Old Mill/Graniteville Pond, making it the most taxonomically rich of the five study ponds (Table N). However, Old Mill/Graniteville Pond continues to be the only waterbody in which more than one aquatic invasive plant species was detected. The most extensive and dense beds were associated with fanwort (*Cabomba caroliniana*), which was documented almost everywhere in the pond, except for the deepest and shallowest waters (Figure 14).

Other aquatic invasive species observed include variable-leaf milfoil, which was growing sparsely at a few non-contiguous locations (Figure 15). Similarly, growth of exotic curly-leaf pondweed (*Potamogeton crispus*) was also sparse and found only at a few non-contiguous locations in the pond (Figure 16).

Plant cover was very high throughout all of the upper basin but varied more in the upper basin, where it was low or absent in waters greater than approximately eight feet (Figure 12). This limitation in plant growth with depth is likely due to the low water clarity.

With the exception of the deeper channel and heavily shaded or sandy areas, plant biovolume was excessive throughout the upper basin (Figure 17). In the lower basin, biovolume reached nuisance levels near the mouth of Boutwell Brook and in most areas where water depth was less than five feet.





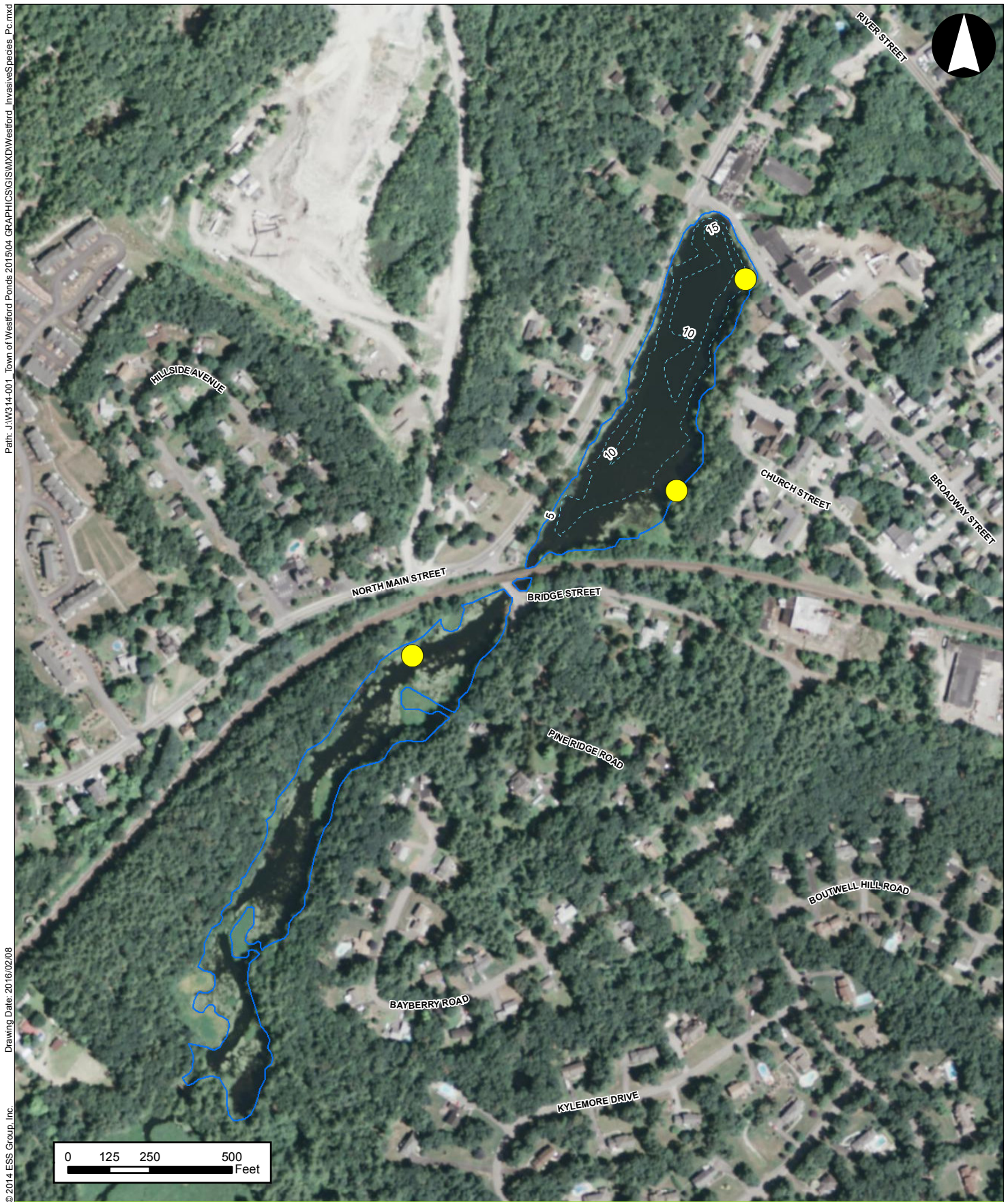




Table N. Aquatic Plants Observed at Old Mill/Graniteville Pond

Common Name	Scientific Name	Native or Exotic
Fanwort	<i>Cabomba caroliniana</i>	Exotic
Water Starwort	<i>Callitriche heterophylla</i>	Native
Coontail	<i>Ceratophyllum demersum</i>	Native
Spikerush	<i>Eleocharis sp.</i>	Native
Canadian waterweed	<i>Elodea canadensis</i>	Native
Duckweed	<i>Lemna minor</i>	Native
Marsh Seedbox	<i>Ludwigia palustris</i>	Native
Variable-leaf Milfoil	<i>Myriophyllum heterophyllum</i>	Exotic
Bushy Naiad	<i>Najas flexilis</i>	Native
Stonewort	<i>Nitella sp.</i>	Native
Yellow Water Lily	<i>Nuphar lutea variegata</i>	Native
White Water Lily	<i>Nymphaea odorata</i>	Native
Water Smartweed	<i>Polygonum amphibium</i>	Native
Pickерelweed	<i>Pontederia cordata</i>	Native
Curly-leaf Pondweed	<i>Potamogeton crispus</i>	Exotic
Floating-leaf Pondweed	<i>Potamogeton epihydrus</i>	Native
Longleaf Pondweed	<i>Potamogeton nodosus</i>	Native
Robbins' Pondweed	<i>Potamogeton robbinsii</i>	Native
Spiral Pondweed	<i>Potamogeton spirillus</i>	Native
Arrowhead	<i>Sagittaria sp.</i>	Native
Bur-reed	<i>Sparganium sp.</i>	Native
Common Bladderwort	<i>Utricularia macrorhiza</i>	Native
Little Floating Bladderwort	<i>Utricularia radiata</i>	Native
Water Celery	<i>Vallisneria americana</i>	Native
Water Star-grass	<i>Zosterella dubia</i>	Native

Phytoplankton and Zooplankton

Phytoplankton

Phytoplankton growth in Old Mill/Graniteville Pond was characterized by low diversity (Table O). *Euglena* was the most common taxon encountered but was present below bloom densities. Only three other taxa were documented from the 2015 sample.

Table O. Summary of Phytoplankton Results at Old Mill/Graniteville Pond

Type	Taxon	Abundance
Cryptophyte	<i>Cryptomonas</i>	absent
Cyanobacteria	<i>Aphanothece</i>	absent
Diatom	Various benthic species	absent
Dinoflagellate	<i>Ceratium</i>	rare
Euglenoids	<i>Euglena</i>	occasional
Synurophytes	<i>Synura</i>	absent

*Taxa present in 2014 but not in 2015 remain listed but are classified as "absent"

Zooplankton

The zooplankton density in Old Mill/Graniteville Pond remained elevated in 2015 and the community was characterized by small to medium-bodied taxa (Table P). As in 2014, the most abundant zooplankton was the cladoceran *Holopedium gibberum*, a grazing species that is able to effectively compete for limited phytoplankton food resources (Balcer et al. 1984), such as those encountered at Old Mill/Graniteville Pond. Other species, including copepods, other cladocerans, and rotifers were also present but in much lower abundances

Table P. Summary of Zooplankton Results at Old Mill/Graniteville Pond

Taxon	Relative Abundance	Size
<i>Bosmina longirostris</i>	Absent	Small
Chydoridae	Rare	Medium
Cyclopoid copepods	Rare	Small
Copepod nauplii	Occasional	Small
<i>Diaphanosoma</i>	Rare	Medium
<i>Holopedium gibberum</i>	Abundant	Medium
<i>Keratella</i>	Occasional	Small

*Taxa present in 2014 but not in 2015 remain listed but are classified as "absent"

Kennedy Pond

Bathymetry

Kennedy Pond consists of a single bowl-shaped basin that is steeply sloped on its western end, where depths reach a maximum of approximately 30 feet (Figure 18). The eastern half of the pond consists of a shallow shelf interrupted by occasional islands; depths in this part of the pond are typically less than five feet.

Water Quality

Water quality results for Kennedy Pond are presented in Table Q.

Table Q. Water Quality at Kennedy Pond

Site ID	In-Pond
Date	8/26/2015
Time	11:00
Temperature (°C)	27.0
Dissolved Oxygen (mg/L)	7.65
Dissolved Oxygen (%)	96.9
Specific Conductance (µS/cm)	151
pH (SU)	8.1
Turbidity (NTU)	0.89
Secchi Depth (m)	3.7
Apparent Color (PCU)	50
Nitrite/Nitrate (mg/L)	0.019*
TKN (mg/L)	1.31
Total Phosphorus (mg/L)	0.010

*= Non-detect. Value represents method detection limit.



Plant Cover

- 0% (4.8 Acres)
- 1-25% (3.3 Acres)
- 26-50% (5.6 Acres)
- 51-75% (3.6 Acres)

Key highlights of the results are as follows:

- Dissolved oxygen at the pond surface was supportive of aquatic life but declined to anoxic levels below approximately 4.0 meters (Figure 19)
- Secchi disk transparency (water clarity) was good
- Total Kjeldahl nitrogen (TKN) was elevated
- Total phosphorus was low

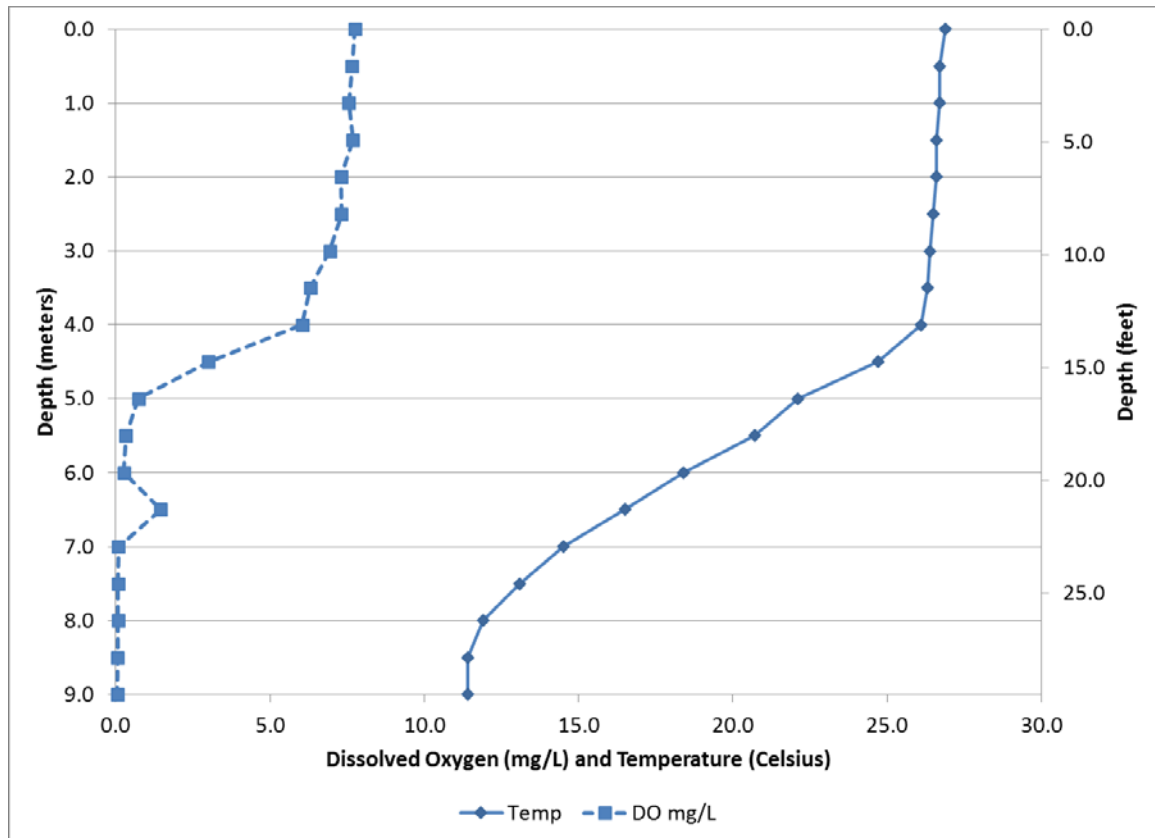


Figure 19. Water Quality Profile, Kennedy Pond

Aquatic Plants

Ten species of aquatic plants were documented at Kennedy Pond (Table R), and it was found to be free of aquatic invasive plant species, although sporadic growth of emergent common reed and purple loosestrife were visible along the shoreline of the pond.

Plant cover was relatively low in most of Kennedy Pond but locally dense along the northwestern and southwestern shorelines of the pond (Figure 18).

Plant biovolume was low throughout the pond, due primarily to dominance by low-growing native plants (Figure 20). A few larger plants, such as the pondweeds (*Potamogeton* spp.) were occasionally encountered but do not grow at nuisance levels.



Table R. Aquatic Plants Observed at Kennedy Pond

Common Name	Scientific Name	Native or Exotic
Muskwort	<i>Chara sp.</i>	Native
Waterwort	<i>Elatine sp.</i>	Native
Spikerush	<i>Eleocharis sp.</i>	Native
Golden Hedge-hyssop	<i>Gratiola aurea</i>	Native
Quillwort	<i>Isoetes sp.</i>	Native
Bushy Naiad	<i>Najas flexilis</i>	Native
Stonewort	<i>Nitella sp.</i>	Native
Floating-leaf Pondweed	<i>Potamogeton epihydrus</i>	Native
Clasping-leaf Pondweed	<i>Potamogeton perfoliatus</i>	Native
Thinleaf Pondweed	<i>Potamogeton pusillus</i>	Native

Phytoplankton and Zooplankton

Phytoplankton

The phytoplankton community at Kennedy Pond was characterized by moderate overall density and dominated by non-harmful green algae (Table S). The most common taxa were the green algae *Chlamydomonas* and *Crucigenia*. As at Burge's Pond and Grassy Pond, the most common phytoplankton taxon observed in 2014 (*Glenodinium*), was absent in 2015.

Table S. Summary of Phytoplankton Results at Kennedy Pond

Type	Taxon	Abundance
Charophytes	<i>Staurostrum</i>	occasional
Cyanobacteria	<i>Chroococcus</i>	absent
Diatoms	<i>Navicula</i>	rare
Dinoflagellates	<i>Ceratium</i>	occasional
	<i>Glenodinium</i>	absent
Green	<i>Chlamydomonas</i>	common
	<i>Coenocystis</i>	rare
	<i>Crucigenia</i>	common
	Unidentified flagellated unicells	rare
	<i>Quadrigula</i>	rare
Synurophytes	<i>Synura</i>	absent
Various	Other flagellates	rare

Zooplankton

The zooplankton community was very similar to that observed in 2014 and characterized by moderate abundance of small- to large-bodied individuals from multiple taxa (Table T). As in 2014, the cladoceran *Holopedium gibberum* and the rotifer *Kellicottia longispina* were co-dominant species.

The primary change was an increase in relative abundance of the cladoceran *Daphnia* and a decrease in copepods and the small-bodied cladoceran *Bosmina longirostris*.

Table T. Summary of Zooplankton Results at Kennedy Pond

Taxon	Relative Abundance	Size
<i>Bosmina longirostris</i>	Absent	Small
Calanoid copepods	Rare	Large
Copepod nauplii	Rare	Small
<i>Daphnia</i> sp.	Common	Large
<i>Holopedium gibberum</i>	Abundant	Medium
<i>Kellicottia longispina</i>	Abundant	Small

Summary of Overall Pond Conditions

Pond conditions were classified based on water quality and vegetation.

The four water quality classes were determined as follows. Plankton data were used to support the interpretation of water quality data:

1. Excellent – No negative factors
2. Good – One negative factor but no severe problems
3. Fair – Multiple negative factors but no severe problems
4. Poor – Multiple negative factors and at least one severe problem

Likewise, the vegetation classes were determined as follows:

1. Excellent – No invasive species observed
2. Good – No aquatic invasive species established, although one or more shoreline invasives may be present
3. Fair – Aquatic invasive species established but do not occupy majority of the water body. One or more shoreline invasives may also be present.
4. Poor – Aquatic invasive species established and dominant over a majority of the water body. One or more shoreline invasives may also be present.

A summary of the condition and trend of each pond's water quality is presented in Table U. Vegetation conditions are summarized in Table V.

Table U. Comparison of Lake and Pond Water Quality Conditions, 2014 and 2015

Water Body	Water Quality Condition		Direction of Change	Reason for Change
	2014	2015		
Keyes Pond	Fair	Fair	=	• No change
Burge's Pond	Fair	Good	↑	• Increased water clarity • Decreased phosphorus
Grassy Pond	Fair	Fair	=	• No change
Old Mill/Graniteville Pond	Fair	Fair	=	• No change
Kennedy Pond	Excellent	Good	↓	• Increased nitrogen

Table V. Comparison of Lake and Pond Vegetation Conditions, 2014 and 2015

Pond	Invasive Species Condition		Direction of Change	Factors Impacting Condition
	2014	2015		
Keyes Pond	Fair	Fair	=	• No change
Burge's Pond	Fair	Fair	=	• No change
Grassy Pond	Excellent	Excellent	=	• No change
Old Mill/Graniteville Pond	Poor	Poor	=	• No change
Kennedy Pond	Good	Good	=	• No change

RECOMMENDATIONS

Management Program

ESS recommends that the Town proceed with the management program previously developed (ESS 2014), as refined over the course of 2015 through collection of additional data and discussion with representatives from the Westford Healthy Lakes and Ponds Committee and Town officials. The recommended management program is summarized, by pond, in Table W.

Table W. Summary of Recommended Management Actions

Management Action	Keyes Pond	Burge's Pond	Grassy Pond	Old Mill/Graniteville Pond	Kennedy Pond
Chemical Treatment*	V	V	-	F, V	-
Hand Harvesting	V, P	V, P	-	F, V, C, P	P
Biological Control	P	P	-	P	-
Bottom Sealing	V	V	-	F, V, C	-
Algaecide/Low-dose Alum Treatment	A	A	-	A	-

V = Variable-leaf milfoil; F = Fanwort; C = Curly-leaf pondweed; P = Purple loosestrife; A = Algae (if needed)

*Fluridone recommended as systemic herbicide for fanwort and milfoil control
Diquat as contact herbicide for milfoil control

Monitoring Program

Continuation of a standardized base monitoring program is recommended at all five ponds for 2016, particularly the ponds that are currently slated for implementation of extensive in-pond management efforts (Keyes, Burge's and Old Mill/Graniteville Ponds). Additional elements may be added, as needed, for permit compliance or to address special projects or management issues that arise over the course of the year.

At a minimum, monitoring should consist of the following elements:

Water Quality – At least one in-pond sampling location with surface and bottom samples collected. A vertical profile (at 0.5 to 1.0 m intervals) of temperature and dissolved oxygen should be measured at this location. Tributary and outlet samples should also be collected on the same day, where applicable.

Aquatic Vegetation – Survey should include identification of species in the plant community and measurement of vegetative cover and biovolume. Special attention should be given to quantifying the intensity and extent of any aquatic invasive or other target species infestations.

Plankton – At least one representative in-pond sample analyzed for species composition and density or abundance of organisms. The sample should be depth-integrated to include the entire water column from the surface to at least the Secchi disk depth.

Professional Evaluation of Condition – Data should be professionally reviewed by a Certified Lake Manager to evaluate the condition of the pond, assess trends, and update recommendations for monitoring and management.

REFERENCES

- Balcer, M. D., N. L. Korda and S. I. Dodson. 1984. *Zooplankton of the Great Lakes: A Guide to the Identification and Ecology of the Common Crustacean Species*. Madison, WI: University of Wisconsin Press.
- Bosak, A. 2013. *Zooplankton of the Great Lakes: Polyphemus pediculus*. Central Michigan University. Accessed online on September 15, 2015.
<http://people.cst.cmich.edu/mcnau1as/zooplankton%20web/Polyphemus/Polyphemus.html>
- ESS Group, Inc. 2014. *Lakes and Ponds Management and Preservation Program Plan*. Prepared for the Town of Westford.
- Haney, J. F. 2013. *An Image-based Key to the Zooplankton of North America*. Version 5.0. University of New Hampshire Center for Freshwater Biology. Accessed online on September 15, 2015.
<http://cfb.unh.edu>
- Thorp, J. H. and A. P. Covich. 2010. *Ecology and Classification of North American Freshwater Invertebrates*. Burlington, MA: Academic Press.

Appendix A

Laboratory Reports





ANALYTICAL REPORT

Lab Number:	L1520317
Client:	ESS Group Incorporated 10 Hemingway Dr. 2nd Fl East Providence, RI 02915
ATTN:	Matt Ladewig
Phone:	(401) 330-1204
Project Name:	TOWN OF WESTFORD PONDS 2015
Project Number:	W314-001.01
Report Date:	08/31/15

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Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), VA (460195), MD (348), IL (200077), NC (666), TX (T104704476), DOD (L2217), USDA (Permit #P-330-11-00240).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1520317-01	STONY BROOK	WATER	WESTFORD, MA	08/18/15 10:00	08/21/15
L1520317-02	OLD MILL POND	WATER	WESTFORD, MA	08/18/15 12:20	08/21/15
L1520317-03	SHIPLEY	WATER	WESTFORD, MA	08/18/15 14:40	08/21/15
L1520317-04	BURGES POND	WATER	WESTFORD, MA	08/19/15 11:00	08/21/15
L1520317-05	GRASSY POND	WATER	WESTFORD, MA	08/19/15 15:15	08/21/15
L1520317-06	KEYOS POND (WEST TRIBUTARY)	WATER	WESTFORD, MA	08/20/15 10:00	08/21/15
L1520317-07	KEYOS-DEEP SPOT-SW	WATER	WESTFORD, MA	08/20/15 11:30	08/21/15

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY

For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Phosphorus, Total

The WG816251-4 Laboratory Duplicate RPD (32%), performed on L1520317-07, is above the acceptance criteria; however, the sample and duplicate results are less than five times the reporting limit. Therefore, the RPD is valid.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:



Lura L Troy

Title: Technical Director/Representative

Date: 08/31/15

INORGANICS & MISCELLANEOUS

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-01
Client ID: STONY BROOK
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/18/15 10:00
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	0.061	J	mg/l	0.10	0.019	1	-	08/26/15 22:41	30,4500NO3-F	MR
Total Nitrogen	0.49		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.489		mg/l	0.300	0.093	1	08/22/15 09:46	08/24/15 23:17	30,4500N-C	AT
Phosphorus, Total	0.032		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:10	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015**Lab Number:** L1520317**Project Number:** W314-001.01**Report Date:** 08/31/15**SAMPLE RESULTS**

Lab ID: L1520317-02
Client ID: OLD MILL POND
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/18/15 12:20
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:42	30,4500NO3-F	MR
Total Nitrogen	0.49		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.493		mg/l	0.300	0.093	1	08/22/15 09:46	08/24/15 23:18	30,4500N-C	AT
Phosphorus, Total	0.022		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:11	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-03
Client ID: SHIPLEY
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/18/15 14:40
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	0.10		mg/l	0.10	0.019	1	-	08/26/15 22:43	30,4500NO3-F	MR
Total Nitrogen	0.74		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.637		mg/l	0.300	0.093	1	08/24/15 17:45	08/25/15 21:19	30,4500N-C	AT
Phosphorus, Total	0.009	J	mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:12	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-04
Client ID: BURGESS POND
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/19/15 11:00
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:45	30,4500NO3-F	MR
Total Nitrogen	0.52		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.518		mg/l	0.300	0.093	1	08/24/15 17:45	08/25/15 21:20	30,4500N-C	AT
Phosphorus, Total	0.004	J	mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:13	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-05
Client ID: GRASSY POND
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/19/15 15:15
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:46	30,4500NO3-F	MR
Total Nitrogen	1.2		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	1.21		mg/l	0.300	0.093	1	08/24/15 17:45	08/25/15 21:21	30,4500N-C	AT
Phosphorus, Total	0.085		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:14	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-06
Client ID: KEYOS POND (WEST TRIBUTARY)
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/20/15 10:00
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:47	30,4500NO3-F	MR
Total Nitrogen	0.76		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.758		mg/l	0.300	0.093	1	08/24/15 17:45	08/25/15 21:24	30,4500N-C	AT
Phosphorus, Total	0.027		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:15	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

SAMPLE RESULTS

Lab ID: L1520317-07
Client ID: KEYOS-DEEP SPOT-SW
Sample Location: WESTFORD, MA
Matrix: Water

Date Collected: 08/20/15 11:30
Date Received: 08/21/15
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:48	30,4500NO3-F	MR
Total Nitrogen	0.78		mg/l	0.30	0.30	1	-	08/28/15 16:42	41,-	JO
Nitrogen, Total Kjeldahl	0.784		mg/l	0.300	0.093	1	08/24/15 17:45	08/25/15 21:25	30,4500N-C	AT
Phosphorus, Total	0.018		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:16	30,4500P-E	TE



Project Name: TOWN OF WESTFORD PONDS 2015

Lab Number: L1520317

Project Number: W314-001.01

Report Date: 08/31/15

Method Blank Analysis Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-02 Batch: WG814628-1										
Nitrogen, Total Kjeldahl	0.128	J	mg/l	0.300	0.031	1	08/22/15 09:46	08/24/15 23:03	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 03-07 Batch: WG815129-1										
Nitrogen, Total Kjeldahl	ND		mg/l	0.300	0.031	1	08/24/15 17:45	08/25/15 21:02	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 01-07 Batch: WG815946-1										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	0.019	1	-	08/26/15 22:26	30,4500NO3-F	MR
General Chemistry - Westborough Lab for sample(s): 01-07 Batch: WG816251-1										
Phosphorus, Total	ND		mg/l	0.010	0.003	1	08/27/15 12:15	08/28/15 11:01	30,4500P-E	TE

Lab Control Sample Analysis**Batch Quality Control****Project Name:** TOWN OF WESTFORD PONDS 2015**Project Number:** W314-001.01**Lab Number:** L1520317**Report Date:** 08/31/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 Batch: WG814628-2								
Nitrogen, Total Kjeldahl	86		-		78-122	-		
General Chemistry - Westborough Lab Associated sample(s): 03-07 Batch: WG815129-2								
Nitrogen, Total Kjeldahl	94		-		78-122	-		
General Chemistry - Westborough Lab Associated sample(s): 01-07 Batch: WG815946-2								
Nitrogen, Nitrate/Nitrite	102		-		90-110	-		20
General Chemistry - Westborough Lab Associated sample(s): 01-07 Batch: WG816251-2								
Phosphorus, Total	96		-		80-120	-		

Matrix Spike Analysis

Batch Quality Control

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG814628-4 QC Sample: L1520265-01 Client ID: MS Sample												
Nitrogen, Total Kjeldahl	0.578	8	7.61	88		-	-		77-111	-		24
General Chemistry - Westborough Lab Associated sample(s): 03-07 QC Batch ID: WG815129-4 QC Sample: L1520275-01 Client ID: MS Sample												
Nitrogen, Total Kjeldahl	0.629	8	7.63	88		-	-		77-111	-		24
General Chemistry - Westborough Lab Associated sample(s): 01-07 QC Batch ID: WG815946-4 QC Sample: L1520312-01 Client ID: MS Sample												
Nitrogen, Nitrate/Nitrite	0.22	4	4.3	102		-	-		80-120	-		20
General Chemistry - Westborough Lab Associated sample(s): 01-07 QC Batch ID: WG816251-3 QC Sample: L1520317-07 Client ID: KEYOS-DEEP SPOT-SW												
Phosphorus, Total	0.018	0.5	0.524	101		-	-		75-125	-		20

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Duplicate Analysis

Batch Quality Control

Lab Number: L1520317
Report Date: 08/31/15

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02 QC Batch ID: WG814628-3 QC Sample: L1520265-01 Client ID: DUP Sample						
Nitrogen, Total Kjeldahl	0.578	0.603	mg/l	4		24
General Chemistry - Westborough Lab Associated sample(s): 03-07 QC Batch ID: WG815129-3 QC Sample: L1520275-01 Client ID: DUP Sample						
Nitrogen, Total Kjeldahl	0.629	0.580	mg/l	8		24
General Chemistry - Westborough Lab Associated sample(s): 01-07 QC Batch ID: WG815946-3 QC Sample: L1520312-01 Client ID: DUP Sample						
Nitrogen, Nitrate/Nitrite	0.22	0.20	mg/l	10		20
General Chemistry - Westborough Lab Associated sample(s): 01-07 QC Batch ID: WG816251-4 QC Sample: L1520317-07 Client ID: KEYOS-DEEP SPOT-SW						
Phosphorus, Total	0.018	0.013	mg/l	32	Q	20

Project Name: TOWN OF WESTFORD PONDS 2015**Project Number:** W314-001.01**Lab Number:** L1520317**Report Date:** 08/31/15**Sample Receipt and Container Information**

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA**Cooler Information Custody Seal****Cooler**

A Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1520317-01A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-02A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-03A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-04A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-05A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-06A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)
L1520317-07A	Plastic 500ml H2SO4 preserved	A	<2	3.3	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3/NO2-4500(28),TNITROGEN(28)

*Values in parentheses indicate holding time in days

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensation Product".
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

Report Format: DU Report with 'J' Qualifiers



Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

Data Qualifiers

- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- G** - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- J** - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- ND** - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Project Name: TOWN OF WESTFORD PONDS 2015
Project Number: W314-001.01

Lab Number: L1520317
Report Date: 08/31/15

REFERENCES

- 30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.
- 41 Alpha Analytical Labs Internally-developed Performance-based Method.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Certification Information

Last revised December 16, 2014

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility

EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.

EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.

EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene, 1,4-Diphenylhydrazine.

EPA 625: 4-Chloroaniline, 4-Methylphenol.

SM4500: Soil: Total Phosphorus, TKN, NO₂, NO₃.

EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility

EPA 8270D: Biphenyl.

EPA 2540D: TSS

EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water

EPA 200.8: Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Ni, Se, Tl; **EPA 200.7:** Ba, Be, Ca, Cd, Cr, Cu, Na; **EPA 245.1:** Mercury;

EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500CI-D, SM2320B, SM2540C, SM4500H-B**

EPA 332: Perchlorate.

Microbiology: SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.

Non-Potable Water

EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, Tl, Zn;

EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, Ti, Tl, V, Zn;

EPA 245.1, SM4500H-B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, EPA 350.1: Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**

EPA 624: Volatile Halocarbons & Aromatics,

EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045:** PCB-Oil.

Microbiology: SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

PAGE 1 OF 1

320 Forbes Blvd
Mansfield, MA 02048
Tel: 508-822-9300

Client: ESS Group, Inc.
Address: 10 Hemingway Drive
East Providence, RI 02915
Phone: 401-838-8158
Email: Jtracy@essgroup.com

Project Name: Town of Westford Ponds 2015

Project Location: Westford, MA

Project #: W 314-001.01

Project Manager: Matt Ludwig

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due:

Additional Project Information:

* Note low detect request for phosphorus: 0.010 mg/L or better, and report MDL

Date Rec'd in Lab: 8-21-15

ALPHA Job #: L1520317

Report Information - Data Deliverables

☐ ADEx ☐ EMAIL

Same as Client info	PO #:
---	-------

Billing Information

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed Program Criteria

[illegible]

Container Type

P= Plastic
A= Amber glass
V= Vial
G= Glass
B= Bacteria cup
C= Cube
O= Other
E= Encore
D= BOD Bottle

Preservative

A= None
B= HCl
C= HNO₃
D= H₂SO₄
E= NaOH
F= MeOH
G= NaHSO₄
H = Na₂S₂O₃
I= Ascorbic Acid
J = NH₄Cl
K= Zn Acetate
O= Other

Container Type

Preservative

Relinquished By:

Date/Time

Received By:

Date/Time

All samples submitted are subject to Alpha's Terms and Conditions.
See reverse side.

FORM NO: 01-01 (rev. 12-Mar-2012)



ANALYTICAL REPORT

Lab Number:	L1520813
Client:	ESS Group Incorporated 10 Hemingway Dr. 2nd Fl East Providence, RI 02915
ATTN:	Matt Ladewig
Phone:	(401) 330-1204
Project Name:	WESTFORD PONDS
Project Number:	W314
Report Date:	09/08/15

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), VA (460195), MD (348), IL (200077), NC (666), TX (T104704476), DOD (L2217), USDA (Permit #P-330-11-00240).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1520813-01	KENNEDY POND	WATER	WESTFORD, MA	08/26/15 11:00	08/27/15

Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY

For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:

 Lura L Troy

Title: Technical Director/Representative

Date: 09/08/15

INORGANICS & MISCELLANEOUS

Project Name: WESTFORD PONDS

Project Number: W314

Lab Number: L1520813

Report Date: 09/08/15

SAMPLE RESULTS

Lab ID: L1520813-01

Client ID: KENNEDY POND

Sample Location: WESTFORD, MA

Matrix: Water

Date Collected: 08/26/15 11:00

Date Received: 08/27/15

Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	08/28/15 22:25	30,4500NO3-F	MR
Total Nitrogen	1.3		mg/l	0.30	--	1	-	09/01/15 14:30	41,-	JO
Nitrogen, Total Kjeldahl	1.31		mg/l	0.300	--	1	08/27/15 18:00	08/31/15 22:48	30,4500N-C	AT
Phosphorus, Total	ND		mg/l	0.010	--	1	09/03/15 10:00	09/04/15 13:04	30,4500P-E	SD



Project Name: WESTFORD PONDS

Lab Number: L1520813

Project Number: W314

Report Date: 09/08/15

Method Blank Analysis Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG816333-1										
Nitrogen, Total Kjeldahl	ND		mg/l	0.300	--	1	08/27/15 18:00	08/31/15 22:36	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG816722-1										
Nitrogen, Nitrate/Nitrite	ND		mg/l	0.10	--	1	-	08/28/15 21:20	30,4500NO3-F	MR
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG818315-1										
Phosphorus, Total	ND		mg/l	0.010	--	1	09/03/15 10:00	09/04/15 12:57	30,4500P-E	SD

Lab Control Sample Analysis

Batch Quality Control

Project Name: WESTFORD PONDS

Project Number: W314

Lab Number: L1520813

Report Date: 09/08/15

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG816333-2								
Nitrogen, Total Kjeldahl	98		-		78-122	-		
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG816722-2								
Nitrogen, Nitrate/Nitrite	98		-		90-110	-		20
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG818315-2								
Phosphorus, Total	92		-		80-120	-		

Matrix Spike Analysis

Batch Quality Control

Project Name: WESTFORD PONDS

Project Number: W314

Lab Number: L1520813

Report Date: 09/08/15

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG816333-4 QC Sample: L1520592-01 Client ID: MS Sample												
Nitrogen, Total Kjeldahl	7.41	8	11.3	49	Q	-	-		77-111	-		24
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG816722-4 QC Sample: L1520813-01 Client ID: KENNEDY POND												
Nitrogen, Nitrate/Nitrite	ND	4	3.7	92		-	-		80-120	-		20
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG818315-3 QC Sample: L1520867-01 Client ID: MS Sample												
Phosphorus, Total	4.59	0.5	5.36	154	Q	-	-		75-125	-		20

Lab Duplicate Analysis Batch Quality Control

Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG816333-3 QC Sample: L1520592-01 Client ID: DUP Sample						
Nitrogen, Total Kjeldahl	7.41	6.88	mg/l	7		24
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG816722-3 QC Sample: L1520813-01 Client ID: KENNEDY POND						
Nitrogen, Nitrate/Nitrite	ND	ND	mg/l	NC		20
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG818315-4 QC Sample: L1520867-01 Client ID: DUP Sample						
Phosphorus, Total	4.59	4.37	mg/l	5		20

Project Name: WESTFORD PONDS**Project Number:** W314**Lab Number:** L1520813**Report Date:** 09/08/15**Sample Receipt and Container Information**

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA**Cooler Information Custody Seal****Cooler**

A Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1520813-01A	Plastic 500ml H2SO4 preserved	A	<2	2.7	Y	Absent	TKN-4500(28),TPHOS- 4500(28),NO3/NO2- 4500(28),TNITROGEN(28)

*Values in parentheses indicate holding time in days

Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensation Product".
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

Report Format: Data Usability Report



Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

Data Qualifiers

- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- G** - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- ND** - Not detected at the reporting limit (RL) for the sample.

Project Name: WESTFORD PONDS
Project Number: W314

Lab Number: L1520813
Report Date: 09/08/15

REFERENCES

- 30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.
- 41 Alpha Analytical Labs Internally-developed Performance-based Method.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Certification Information

Last revised December 16, 2014

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility

EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.

EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.

EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene, 1,4-Diphenylhydrazine.

EPA 625: 4-Chloroaniline, 4-Methylphenol.

SM4500: Soil: Total Phosphorus, TKN, NO₂, NO₃.

EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility

EPA 8270D: Biphenyl.

EPA 2540D: TSS

EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water

EPA 200.8: Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Ni, Se, Tl; **EPA 200.7:** Ba, Be, Ca, Cd, Cr, Cu, Na; **EPA 245.1:** Mercury;

EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500CI-D, SM2320B, SM2540C, SM4500H-B**

EPA 332: Perchlorate.

Microbiology: SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.

Non-Potable Water

EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, Tl, Zn;

EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, Ti, Tl, V, Zn;

EPA 245.1, SM4500H-B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, EPA 350.1: Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**

EPA 624: Volatile Halocarbons & Aromatics,

EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045:** PCB-Oil.

Microbiology: SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.



CHAIN OF CUSTODY

PAGE 1 OF 1

8 Walkup Drive
Westboro, MA 01581
Tel: 508-898-9220

320 Forbes Blvd
Mansfield, MA 02048
Tel: 508-822-9300

Client Information

Client: ESS Group

Address: 16 Hemmingway Lane
East Providence RI

Phone:

Email: mladen@essgroup.com

Additional Project Information:

Project Information

Project Name: Westford Ponds

Project Location: Westford MA

Project #: W314

Project Manager: MATT LADEWIG

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due:

Date Rec'd in Lab:

8/27/15

ALPHA Job #: 21520813

Report Information - Data Deliverables

☒ ADEx ☐ EMAIL

Billing Information

☐ Same as Client info ☐ PO #:

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed Program _____ Criteria _____

ANALYSIS		SAMPLE INFO	
VOC: ☐ 8260 ☐ 624 ☐ 524.2	SVOC: ☐ ABN ☐ PAH	Filtration	
METALS: ☐ MCP 13 ☐ MCP 14 ☐ RCP 15	EPH: ☐ RCRA5 ☐ RCRA8 ☐ PP13	☐ Field	
VPH: ☐ Ranges & Targets ☐ Ranges Only	☐ PCB ☐ PEST	☐ Lab to do	
TPH: ☐ Quant Only ☐ Fingerprint	Total Phos.	Preservation	
Total Nitrogen		☐ Lab to do	
		Sample Comments	

TOTAL # BOTTLES

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection		Sample Matrix	Sampler Initials
		Date	Time		

20813 -01 Kennedy Pond 8/26/15 11:00 SW JT

Container Type

P= Plastic
 A= Amber glass
 V= Vial
 G= Glass
 B= Bacteria cup
 C= Cube
 O= Other
 E= Encore
 D= BOD Bottle

Preservative

A= None
 B= HCl
 C= HNO₃
 D= H₂SO₄
 E= NaOH
 F= MeOH
 G= NaHSO₄
 H= Na₂S₂O₃
 I= Ascorbic Acid
 J= NH₄Cl
 K= Zn Acetate
 O= Other

Container Type

Preservative

Relinquished By:

Date/Time

Received By:

Date/Time

Appendix B

Glossary of Limnological Terms





APPENDIX B - GLOSSARY OF LIMNOLOGICAL TERMS

Abiotic: A term that refers to the nonliving components of an ecosystem (e.g., sunlight, physical and chemical characteristics).

Algae: Typically microscopic plants that may occur as single-celled organisms, colonies or filaments.

Anoxic: Greatly deficient in oxygen.

Aquifer: A water-bearing layer of rock (including gravel and sand) that will yield water in usable quantity to a well or spring.

Aquatic plants: A term used to describe a broad group of plants typically found growing in water bodies. The term may generally refer to both algae and macrophytes, but is commonly used synonymously with the term macrophyte.

Bacteria: Typically single celled microorganisms that have no chlorophyll, multiply by simple division, and occur in various forms. Some bacteria may cause disease, but many do not and are necessary for fermentation, nitrogen fixation, and decomposition of organic matter.

Bathymetric Map: A map illustrating the bottom contours (topography) and depth of a lake or pond.

Best Management Practices: Any of a number of practices or treatment devices that reduce pollution in runoff via runoff treatment or source control.

Biomass: A term that refers to the weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Biomass is often measured in grams per square meter of surface.

Biovolume: Analogous to biomass but expressed in terms of volume rather than mass.

Biota: All living organisms in a given area.

Chlorophyll a: A pigment used by higher plants and certain algae for photosynthesis. Measuring the level of this pigment in surface water is one way of describing the productivity of a pond and determining its trophic state (see Eutrophic).

Cultural Eutrophication: The acceleration of the natural eutrophication process caused by human activities, occurring over decades as opposed to thousands of years.

Ecosystem: An interactive community of living organisms, together with the physical and chemical environment they inhabit.

Endangered/Threatened Species: An animal or plant species that is in danger of extinction and is recognized and protected by state or federal agencies.

Erosion: A process of breakdown and movement of land surface that is often intensified by human disturbances.

Eutrophic: A trophic state (degree of eutrophication) in which a lake or pond is nutrient rich and sustains high levels of biological productivity. Dense macrophyte growth, fast sediment accumulation, frequent algae blooms, poor water transparency and periodic oxygen depletion in the hypolimnion are common characteristics of eutrophic lakes and ponds.

Eutrophication: The process, or set of processes, driven by nutrient, organic matter, and sediment addition to a pond that leads to increased biological production and decreased volume. The process occurs naturally in all lakes and ponds over thousands of years.

Exotic Species: Species of plants or animals that occur outside of their normal, indigenous ranges and environments. Populations of exotic species may expand rapidly and displace native populations if natural

predators, herbivores, or parasites are absent or if conditions are more favorable for the growth of the exotic species than for native species.

Filamentous: A term used to refer to a type of algae that forms long filaments composed of individual cells.

Groundwater: Water found beneath the soil surface and saturating the layer at which it is located.

Habitat: The natural dwelling place of an animal or plant; the type of environment where a particular species is likely to be found.

Herbicide: Any of a class of chemical compounds that produce mortality in plants when applied in sufficient concentrations.

Hypoxic: Lacking sufficient dissolved oxygen to support all but the most tolerant species.

Infiltration Structures: Any of a number of structures used to treat runoff quality or control runoff quantity by infiltrating runoff into the ground. Includes infiltration trenches, dry wells, infiltration basins, and leaching catch basins.

Invasive: Spreading aggressively from the original site of planting.

Isopach Map: A map illustrating the thickness of sediments within a lake or pond.

Limnology: The study of lakes.

Littoral Zone: The shallow, highly productive area along the shoreline of a lake or pond where rooted aquatic plants grow.

Macroinvertebrates: Aquatic insects, worms, clams, snails and other animals visible without aid of a microscope. They supply a major portion of fish diets and are important consumers of detritus and algae.

Macrophytes: Macroscopic vascular plants present in the littoral zone of lakes and ponds.

Morphometry: A term that refers to the depth contours and dimensions (topographic features) of a lake or pond.

Nonpoint Source: A source of pollutants to the environment that does not come from a confined, definable source such as a pipe. Common examples of nonpoint source pollution include urban runoff, septic system leachate, and runoff from agricultural fields.

Nutrient Limitation: The limitation of growth imposed by the depletion of an essential nutrient.

Nutrients: Elements or chemicals required to sustain life, including carbon, oxygen, nitrogen and phosphorus.

pH: An index derived from the inverse log of the hydrogen ion concentration that ranges from zero to 14 indicating the relative acidity or alkalinity of a liquid.

Photosynthesis: The process by which plants use chlorophyll to convert carbon dioxide, water and sunlight to oxygen and cellular products (carbohydrates).

Phytoplankton: Algae that float or are freely suspended in the water.

Pollutants: Elements and compounds occurring naturally or man-made introduced into the environment at levels in excess of the concentration of chemicals naturally occurring.

Secchi disk: A black and white or all white 20 cm disk attached to a cord used to measure water transparency. The disk is lowered into the water until it is no longer visible (Secchi depth). Secchi depth is generally proportional to the depth of light penetration sufficient to sustain algae growth.

Sediment: Topsoil, sand, and minerals washed from the land into water, usually after rain or snowmelt.

Septic system: An individual wastewater treatment system that includes a septic tank for removing solids, and a leachfield for discharging the clarified wastewater to the ground.

Siltation: The process in which inorganic silt settles and accumulates at the bottom of a lake or pond.

Stormwater Runoff: Runoff generated as a result of precipitation or snowmelt.

Temperature Profile: A series of temperature measurements collected at incremental water depths from surface to bottom at a given location.

Thermal Stratification: The process by which a lake or pond forms several distinct thermal layers. The layers include a warmer well-mixed upper layer (epilimnion), a cooler, poorly mixed layer at the bottom (hypolimnion), and a middle layer (metalimnion) that separates the two.

Thermocline: A term that refers to the plane of greatest temperature change within the metalimnion. Often used interchangeably with metalimnion.

TKN: Total Kjeldahl nitrogen, essentially the sum of ammonia nitrogen and organic forms of nitrogen.

TSS: Total suspended solids, a direct measure of all suspended solid materials in the water.

Turbidity: A measure of the light scattering properties of water; often used more generally to describe water clarity or the relative presence or absence of suspended materials in the water.

Vegetated Buffer: An undisturbed vegetated land area that separates an area of human activity from the adjacent water body; can be effective in reducing runoff velocities and volumes and the removal of sediment and pollutant from runoff.

Water Column: Water in a lake or pond between the interface with the atmosphere at the surface and the interface with the sediment at the bottom.

Water Quality: A term used to reference the general chemical and physical properties of water relative to the requirements of living organisms that depend upon that water.

Watershed: The surrounding land area that drains into a water body via surface runoff or groundwater recharge and discharge.

Zooplankton: Microscopic animals that float or are freely suspended in the water.