11. CPA PROJECT APPLICATION FORM

[CPC Use Only: Date Received ________________ By: ____________________
Assigned CPC #2022- 07]

If possible, use word processor to fill out form. Please answer all questions, use "N/A" if not applicable.

1. a.) Applicant Name and Organization: Last Anderson First Robert
Organization(s) (if appropriate) co-applicant: Great Pond Advisory Committee. support: Groton Lakes Assoc.

b.) Regional Project: Yes ☐ or No X☐ If Yes, Town/Organization: ____________

2. Submission Date: 1/11/2021

3. Applicant Address: St. 270 Whiley Road
City/ State: Groton/MA ZIP: 01450

4. Ph. # 978-273-4051 Email: bobandersongroton@me.com

5. CPA Purpose. Check all that apply:
Community Housing ☐ (Affordable Housing: ☐ Historic Preservation*: ☐ Open Space: ☐X
Recreation ☐X

** As per MA General Law Chapter 44B, proposed historic projects that are not on the structures listed on the state's registry of historic places require a determination by the Groton Historic Commission that the proposed project is of historic significance.*

6. Town Committee or boards participating: Great Pond Advisory Committee as co-applicant/sponsor.

7. Project Location/Address: Duck Pond, Groton (between Whiley Road and Duck Pond Drive)

8. Project Name: Duck Pond Restoration & Preservation, Phase 2

9. Additional Responsible Parties (If applicable):

Role (specify)	Name	Address	Ph. (w) (cell)	Email
Property/Site Owner	Town of Groton (land easement & pond responsibility)	173 Main Street	978-448-1111	townmanager@grotonma.gov
Project Manager	Robert Anderson	270 Whiley Road	978-273-4051	bobandersongroton@me.com
Lead Architect				
Project Contractor	Kara Sliwoski, District Manager Solitude Lake Management	590 Lake Street, Shrewsbury, MA 01545	508-865-1000	ksliwoski@solitudelake.com
Project Consultants				
Other:				
Other				

10. As appropriate, indicate if proposal requires P&S agreement N Deed N
Option agreement N Other-describe: ____________

11. a.) Assessor info. (map/ block/ lot id.(s)): 131/72/0 (lot w/easement) b.) Tax classification type: R/A

12. Permits required: Zoning: _____ Historic Preservation: _____ Other : Conservation Commission approval is still current.

13. Historic Commission Approval signoff (when required): N/A Date: ________

14. Funding: a.)Project Cost: $ 20,000. Estimate: $ Professional Quote: $ based on Phase1 GELD/Solitude
b.) Requested from CPC: $ 20,000. c.) Committed from other sources:$ Phase 1 incl. $13K of neighbor donations
d.) Annual anticipated total income :$ N/A e.) Annual anticipated total expense: $ N/A
f.) Anticipated net income (loss): $ N/A g.) Estimator name/company:

15. CCP Objectives - use codes from **Section 5** to indicate all that apply: 5.3, OSRP 2.3

16. Project Timelines: Proposed Start Date: July 2021 Projected Complete Date: June 2024

17. Estimated Delivery Date of Completion Report to CPC: July 2024

18. Project description and explanation (attach additional sheets as needed):

Duck Pond Restoration & Preservation Project, Phase 2 is a three-year continuation of the restoration and preservation work in Phase 1 (CPC 2019-08). See page 3 for description and explanation.

19. Feasibility: Feasibility of the oxygenation process has been proven over the past three years and in many other studies. However, two summers were insufficient to prove the benefit of adding aerobic bacteria, so that process has been excluded from Phase 2.

20. List of attachments: Pg. 3: Project Description; Pg. 4: Budget; Pg. 5: Ownership Approval; Pg. 6: Management Plan, Risk Analysis; Pg. 7 Maintenance vs. Preservation; Pg. 8 CPC Scoring Criteria; Pg. 10 Appendix Contents; Page A1: Photos; Pages A2-A16: Solitude Lake Management 2020 Duck Pond Report

21. Additional Information: CPC approved this project as "appropriate" at the 11/9/2020 meeting, pending subsequent approval of full proposal by CPC and at Town Meeting. However, there was discussion about whether the monthly GELD invoices constituted "maintenance" or "preservation", and the CPC requested that the proposal address that subject. See page 7.

22. Management Plan: See Page 6.

23. Applicant Signature: *Robert E. Anderson* Date: *1/11/2021*

Co Applicant Signature: *J. W. Luening, GPAC* Date: *1/11/2021*

Co Applicant Signature: ______ Date: ______

Duck Pond Restoration & Preservation Project, Phase 2
Project Description and explanation

The Duck Pond Environmental Restoration Project addressed environment degradation in Duck Pond, a 26-acre Great Pond in Groton used for fishing, canoeing, kayaking, Stand-Up Paddle-boarding (SUP), & hiking on the abutting trails on Conservation Commission and Groton Conservation Trust land that includes about 2/3 of the total pond shoreline. Decades of decaying algae, leaves, and weeds created a thick layer of sediment ("muck") that provides a nutrient-rich environment that leads to more weed growth each year. The quicksand-like muck and the thick weeds also are a safety hazard to anyone falling off or out of an SUP, canoe, or kayak. Decreasing water quality and the accumulating biomass also impact fish and other wildlife.

The three-year Project (CPC 2019-08) installed a Compressor and ten Diffusers located throughout the pond (see map). Air is pumped through the hoses to the Diffusers where bubbles rise to the surface and spread out. The resulting circular water pattern brings oxygen-rich surface water to the bottom (benthic) layer to keep aerobic bacteria alive to digest organic matter, and to prevent formation of anaerobic bacteria that can cause odors and toxic cyanobacteria blooms. The project also included the application of aerobic bacteria to increase the impact on the rate of muck growth (only years 2 and 3).

The project is working well as measured by the water quality testing and the sufficient level of Dissolved Oxygen (DO) throughout the water column. Fishermen have returned (photos) and there has been more open water for recreation because the water circulation pushes floating weeds toward the shore. Two summers have not been sufficient time to reliably measure whether the muck depth is decreasing (see Solitude's "2020 Duck Pond Report" in the appendix) so that process has been eliminated from Phase 2.

Phase 2 of the project proposed here provides three years of funds for electricity to operate the Compressor (8 months/year), three water quality tests per year, periodic muck-depth measurements ("polling"), and a written final report. See Budget Page 5.

Duck Pond Restoration Preservation Project, Phase 2 Budget

Spring 2021 costs have been reserved in Phase 1 but some Phase 2 funds may be needed

Item	Cost 2021	2022	2023	2024	Total
1. GELD Electricity (8 mos/yr.)	$ 1,575	$ 2,100	$ 2,100	$ 525	$ 6,300
	July-Nov	Apr-Nov	Apr-Nov	Apr -May	
2. Tests, Analyses	$ 2,000	$ 3,000	$ 3,000	$ 1,000	$ 9,000
(2-4 sites, 3x/year)	July/Oct	May/July/Oct	May/July/Oct	May	
Dissolved Oxygen, pH, Conductivity, Muck Thickness, Phosphorus-Total, Phosphorus-Ortho, Nitrates					
3. Sediment polling, system tasl	$ 1,500	$ 1,500	$ 1,500		$ 4,500
	May-Oct	May-Oct	May-Oct		
4. Contingency					$ 200
				Total:	$ 20,000

From: David Doneski <DDoneski@k-plaw.com>
Date: March 12, 2018 at 6:36:30 PM EDT
To: 'Mark Haddad' <mhaddad@townofgroton.org>
Subject: RE: Owner approval of Duck Pond Restoration

Mark,

Per our telephone conversation of March 8, I am writing in regard to how the matter of ownership of Duck Pond in the Town of Groton may be treated for purposes of an application to the Community Preservation Committee (CPC) for Community Preservation Act funding to perform weed control/restoration activities in the pond. The issue was identified in your e-mail to me of February 6, 2018, copied below. That message included Robert Anderson's February 5 e-mail to you, describing that although Duck Pond appears to exceed the size requirement for a Great Pond, it has not been so classified by the Department of Environmental Protection (DEP) pursuant to a 'Great Pond List' project undertaken in 1996. You previously informed me that you had signed the owner authorization portion of the funding application, on behalf of the Town. In my view, this is the better approach at present.

Although it may be possible to have the DEP list amended to include Duck Pond, I would expect that the exercise could be a time consuming process and would not likely be completed in sufficient time to allow for the restoration work at Duck Pond to take place this year. I would take the view that having the Town act as the owner (or "for" the owner, presuming that Duck Pond does legally constitute a Great Pond under the ownership of the Commonwealth) is consistent with the protections afforded Great Ponds and the authority of the Town as a municipality and political subdivision of the Commonwealth.

The term Great Pond is defined in Chapter 131 of the General Laws (dealing with inland fisheries, game and natural resources) as "a natural pond the area of which is twenty acres or more." G.L. c.131, §1. Chapter 91 of the General Laws, dealing with "waterways," and the implementing regulations of the DEP at 310 CMR 9.00 define Great Ponds as ponds containing more than ten acres of land in their natural state. See G.L. c. 91, §35. Section 35 also states that such great ponds "shall be subject to any rights in such ponds which have been granted by the commonwealth." Id."With limited exceptions, the waters of a great pond and the land that comprises the bed of the pond to the natural low water mark belong to the Commonwealth, and the ponds are held in trust for certain public uses." Opinion of the Justices to the Senate, 474 Mass. 1201, 1203 (2016).

Since colonial times, the courts have recognized the authority of both the Commonwealth and the municipalities in which Great Ponds lie to regulate the public use of Great Ponds without reference to the fee ownership of the ponds. See West Roxbury v. Stoddard, 89 Mass. 158, 7 Allen 158, 170-171 (1863). Ownership rights of any abutters would extend only to the natural low water mark. See e.g., ***Potter* v. *Howe*, 141 Mass. 357, 359 (1886)**, cited in Opinion of the Justices, supra, 474 Mass. at 1207. See also G.L. c. 131, §45, which provides that "any city or town in which the whole or any portion of any great pond not exceeding five hundred acres in extent is situated may, as to so much thereof, as is located within its boundaries, make and enforce rules and regulations relative to hunting, fishing and boating thereon." Where the purpose of the proposed work at Duck Pond is to preserve it from weed activity which can reduce oxygen within the pond and lead to eutrophication, it is my view that the Town acting as and/or for the Commonwealth in authorizing the application to the CPC is consistent with the long acknowledged public purpose of preserving Great Ponds to the use and good of the public.

Please contact me if you have any further questions on this matter.

David J. Doneski, Esq.

KP | LAW
101 Arch Street, 12th Floor
Boston, MA 02110
O: (617) 556 0007

Duck Pond Restoration & Preservation Project, Phase 2
Management Plan, Risk Analysis

Management Plan:

The tasks required and timing of those tasks are listed on the Budget.

Bob Anderson will manage the project, as he did in Phase 1. For Phase 1, he researched and designed the details of the Project, raised over $13K of non-CPA funding, drafted the narrative for the Conservation Commission Notice of Intent and presented at Conservation Commission meetings, resolved the Duck Pond ownership issue with an opinion from Town Counsel, and obtained quotes from multiple potential vendors.

After approval of the CPA application, he scheduled and supervised the site preparation by a Contractor, Electrician, and GELD, evaluated and recommended selection of the Lake Management Company vendor, supervised installation, approved invoices, and scheduled and supervised water quality treatments and periodic tests/analyses. He provided periodic reports to the CPC and the Conservation Commission. Mr. Anderson has extensive management experience as a former entrepreneur, a former CEO of a public technology company, and an Advisor to Technology Company CEOs for over 20 years.

Phase 2 represents a continuation of the same quotation, purchase order, invoice approval and vendor oversight processes used in Phase 1.

Vendor Risk Analysis:

Phase 2 uses the same vendors of electricity (GELD) and pond testing (Solitude) as Phase 1. There are no new measurements or other actions required so the risk is much smaller than it was in Phase 1. The Town of Groton also has extensive experience with the proposed lake management company at other Great Ponds.

Duck Pond Restoration & Preservation Project, Phase 2
"Maintenance" vs. "Preservation"

"Maintenance" means actions to keep a manually created product functioning as intended when created. Examples include repairing and updating a computer, replacing a house roof, and tending cultivated land by mowing a lawn and weeding a garden.

"Preservation" means actions to slow or stop the natural decay of a product or resource. Examples include freezing food, temperature/light control for ancient documents, and **slowing eutrophication of ponds**.

The Duck Pond Restoration and Preservation Project, Phase 1 and 2, are preservation projects for one of Groton's Great Ponds.

CPC Scoring Criteria

12.1.2 CPA Project Application Criteria (applicant's view)

1. Submitted on Form: Yes
2. By deadline: Yes
3. Fits criteria: Yes
4. Historic Preservation: N/A
5. Site control: Yes. Continuation of Phase 1. See Ownership Pg. 5.
6. Management Plan: Yes. Continuation of proven Phase 1 management.
7. Professional Quote: Yes. Continuation of existing Phase 1 quotations.
8. Non-CPA Funds: Yes. Total neighborhood donations made relative to total costs of both phases ($13K donations toward combined phases total cost of $82K or 16%).

12.2 Scoring (applicant's view)

12.2.1 Function

1. Goals/Objectives in latest Open Space & Recreation Plan [Score: 5]

OSRP pages 45, 69, 104:

Lakes and Ponds

Groton has or shares several Great Ponds, totaling 417 acres of surface water. [22] The largest of these is Lost Lake (the town's only lake), whose 205 acres include adjoining Knops Pond. Two more of the Great Ponds are located near the Lake: Whitney or Cow Pond (37 acres) and Duck Pond (26 acres). The other Great Ponds located entirely within Groton, Baddacook Pond (80 acres) and Martins Pond (22 acres), are located east of Town Center. Groton shares 42 acres of pond area with neighboring communities, including Massapoag Pond (111 acres total shared with Dunstable and Tyngsborough) and Long Pond (46 acres total shared with Ayer). An additional 37 acres of smaller natural and artificial ponds located throughout town range in size from less than one acre to approximately 10 acres.

For recreational purposes, public access is provided via protected open space to all Great Ponds located entirely in Groton except Martins Pond. There is limited or no public access to Long and Massapoag Ponds,

7) Ground and Surface Water Pollution

The water quality management program proposed for Lost Lake and Knops Pond consists of monitoring, resident education, development of new BMPs, such as localized rain gardens and other improvements to existing drainage and stormwater infrastructure. Aeration is being used to slow down eutrophication at Duck Pond.

2.3 Evaluate and implement strategies for water resource surface water quality and invasive plant control. Funding sources: • Volunteer and	• Encourage development of comprehensive lake management plans for Great Ponds, particularly Lost Lake/ Knops and Baddacook Ponds.	Select Board, Great Ponds Advisory Committee, Conservation, NRWA
	• Monitor where nutrients are coming from that contribute to aquatic plant overgrowth.	Great Ponds Advisory Committee, Health, Conservation

2. Multiple funding sources: [Score: 2, considering total neighborhood donations made relative to total costs of both phases ($13K donations toward combined phases total cost of $82K or 16%), or 1 considering just Phase 2 (no new donations)]

12.2.2 Value:

1. Application quality: [Score 5]
2. Degree of urgency: [Score 4; so progress to date isn't lost]
3. Community support: [Score 4; Many individuals and organizations on Phase 1, and Phase 2 is a continuation; only asked GPAC and GLA specifically for Phase 2.]
4. Ease of execution: [Score 5; simple continuation of past three years work]
5. Level of risk: [Score 5; demonstrated results for three years]
6. Active applicant: [Score 5; three years of responsiveness demonstrated].

Total Score = Function + Value = 32 or 33

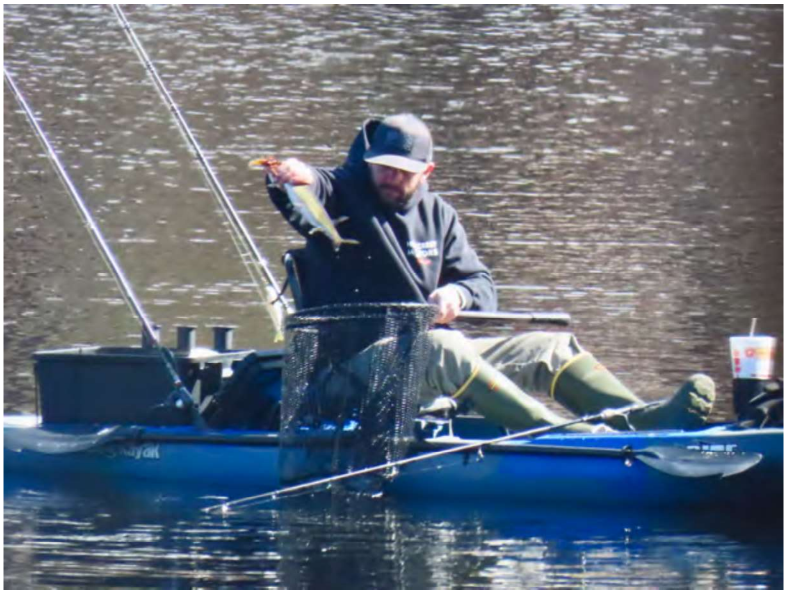
Appendix

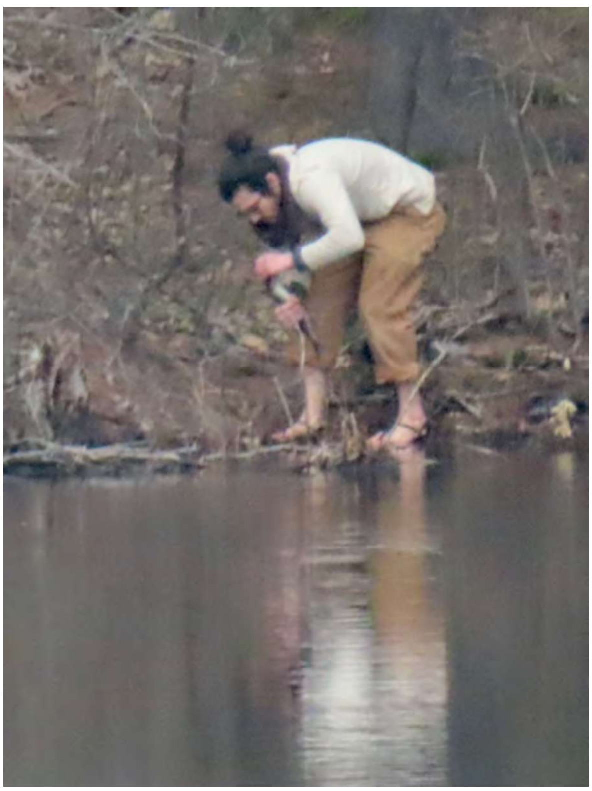
Page A1: Photos of fishing and photo of air bubbles rising from submersed diffuser.

Pages A2-A16: Solitude “2020 Duck Pond Report”

The initial 15 pages: The Report narrative, test result charts, and three maps from Appendix. The complete report, including over 50 pages of water quality and sediment depth sampling data and laboratory reports, is available online at this Dropbox link: https://www.dropbox.com/s/90w3a32vi4z4kju/Duck%20Pond%202020%20Report%20-%20Final%20-%20All.pdf?dl=0

Fishing and aeration photos





2020 Duck Pond Report

SOLITUDE
LAKE MANAGEMENT
590 Lake Street
Shrewsbury, MA 01545

TABLE OF CONTENTS

Introduction

Duck Pond is a 28-acre waterbody located in Groton, Massachusetts. The Town has contracted SOLitude Lake Management since 2018 to evaluate and implement various restoration techniques. Under the oversight of Mr. Bob Anderson, a multifaceted management program was developed to meet the restoration goals, including regular water quality sample collection and analysis, installation and maintenance of a submersed bottom diffuser aeration system, sediment depth sampling, and monthly bacteria augmentation applications.

The following report summarizes this year's completed tasks as well as results at Duck Pond.

Water Quality

Three rounds of water quality sampling have been performed annually since 2018 in April/May, July, and October. Water column profiles of dissolved oxygen, temperature, pH, and conductivity measurements were collected at four sampling locations (**Figure 1**). In addition, water quality samples are collected, where six parameters including Total Phosphorus, Orthophosphorus, Total Kjeldahl Nitrogen (TKN), Ammonia, Nitrate, Nitrite, and composite algal samples are collected at two of four predetermined locations. Water quality and algal samples were brought to MA-certified laboratories.

Water quality sample bottles without a preservative were rinsed with pond water prior to collection and submersed into the water elbow deep. Samples were then placed into a cooler with ice and immediately brought to the laboratory. Results of the laboratory reports were entered into an excel spreadsheet and sent to Bob Anderson after each sampling event.

Results of the water quality sampling events are summarized in the following paragraphs. Charts 1 & 2 provided at the end of the water quality section provide visual aids in identifying patterns or elevations of each parameter. Please refer to **Appendix B** for 2018-2020 water quality data tables and lab reports.

Nitrogen

Ammonia is a measure of two constituents, NH_3 and NH_4^+, and is a transitional product in the breakdown of organic nitrogen (from plants, waste, etc) into nitrate. It is typically short-lived in the pond environment except under conditions of low dissolved oxygen. Water Bodies that have a high pH and temperature are susceptible to high ammonia concentration; the higher the pH, the more ammonia will be present within the water column. External sources of ammonia include: fertilizers, wastewater effluent discharge, animal waste, and runoff from agricultural lands. High levels of ammonia are toxic to the aquatic environment, notably fish, and typically indicate a eutrophic pond. Levels higher than 0.100 mg/L can be problematic for aquatic biota, however available dissolved oxygen, pH, and temperature are key factors in 'toxic' levels. *At sample site 1-D, ammonia remained generally un-detected between 2018-2020; however, there was an increase in ammonia during the July sampling event in all three years. At sample site 4-A, ammonia remained below detectable levels, aside from a single event in July of 2018.*

Nitrite is a form of nitrogen commonly identified as a nutrient released in sewage and sanitary wastes, and can become elevated in areas of disturbance, such as heavy development or even fertilization (farms). Regarding human health, the presence of nitrite is concerning for drinking water, where infants are primarily affected. Nitrite interferes with the blood's ability to carry oxygen, which is vital for motor and neuro-function. The levels within a recreational waterbody are less concerning but may still cause illness if water is consumed through recreational activities. Levels of Nitrite (as N) are ideal at <0.020 mg/L, and a maximum of 0.1 mg/L nitrite (as N) is suggested for recreational water bodies. *Nitrite levels remained undetected during all sampling events at both sample sites 1-D & 4-A.*

Nitrate is a form of nitrogen found in the water column. Nitrate is usually the most prevalent form of inorganic nitrogen in the water and results from such things as natural aerobic bacterial activity, fertilizer use, and air-water exchange. It is also the form that is most readily available for plant and algae growth. Levels of Nitrate (as N) are ideal at <0.30 mg/L. A maximum of 10 mg/L (ppm) is set for EPA drinking water standards. *All three sampling years at both samples sites 1-D & 4-A were below or at detectable levels of <0.05 mg/L.*

Total Kjeldahl Nitrogen (TKN) is a measure of the nitrogen contained in organic compounds, such as proteins and amino acids; the summation of ammonia and organic and reduced nitrogen. It is created from biological growth and decomposition. A concentration of 1.0 mg/l or below is considered desirable. *All sampling events at both sample sites, 1-D & 4-A, were below the suggested threshold of 1.0 mg/L.*

Phosphorus

Total Phosphorus measures all forms of phosphorus in the water column (particulate, dissolved, phosphate). Generally, a total phosphorus concentration over 30 parts per billion (ppb, or 0.03 mg/L) is the threshold at which algae blooms or excessive plant growth can be stimulated. Aquatic systems <12 ppb are considered nutrient poor and oligotrophic; 12-24 ppb contain a moderate amount of nutrients and mesotrophic; 25-96 ppb are nutrient rich and eutrophic; >96 ppb contain excessive nutrients and hypereutrophic. *Generally speaking, total phosphorus results at sample site 1-D remained at desirable levels throughout the three year-sampling period; however, compared to all other sampling events, there was a minor spike identified in July of 2019. Regardless, this spike did not surpass the suggested threshold of 0.03 mg/L. At sample site 4-A, total phosphorus concentrations remained well-below the suggested threshold during the three-year sampling period.*

Orthophosphorus is the measure of the phosphate molecule within the sample, and is often considered interchangeable with Reactive Phosphorus. You can have both dissolved and suspended orthophosphate. Dissolved phosphorus is the form of phosphorus that is readily taken up by plants. Produced by natural processes and also found in sewage – a high measurement of orthophosphate can indicate effluent or contaminated runoff. *Orthophosphorus concentrations at both sample sites 1-D & 4-A remained at desirable or undetectable levels (0.05 mg/L).*

Algae

Algae species, both natural algae and cyanobacteria species were present at some level throughout the three-year sampling period; however, overall algae cell counts remain relatively low. Both algae and cyanobacteria occur naturally in freshwater systems and therefore, their presence does not mean a waterbody is "unhealthy" or that the habitat is threatened. Cyanobacteria cells remained well below the World Health Organization's (WHO) national cyanobacteria guidelines of 70,000 cells/mL.

Depth Profile

Dissolved oxygen is a crucial component of aquatic systems supporting aquatic fauna; organisms such as fish and zooplankton breath the water containing dissolved oxygen for survival. Oxygen enters the water through flow, atmosphere, and photosynthesizers (plants and algae). And, fluctuations in oxygen will occur based on the amount of photosynthesizers present in the water (more sunlight = more oxygen). However, with high volumes of plant and algae decay, dissolved oxygen is consumed and causes oxygen deficient environments (eutrophy, anoxia, etc). Dissolved oxygen is also inversely related to temperature, where high temperatures coincide with low dissolved oxygen. Somewhat predictable levels of oxygen are available throughout the water column, where the dissolved oxygen can be measured vertically from surface to bottom for a profile. This profile can identify waterbody stratification or habitat availability for aquatic wildlife. Values above 5.0 mg/L are desirable for most aquatic life, including most fish species, however lower values commonly occur near the sediment layer where oxygen and nutrient exchange is at a minimum. *Generally speaking, the April/May & October oxygen levels remain at desirable levels (above 5 mg/L); however the July oxygen levels decline at most of the sample sites. Although the July oxygen levels hover around 4-5 mg/L, oxygen levels do not go completely anoxic. The ten bottom diffusers aid in keeping oxygen levels present throughout the water column at all sampling sites.*

<u>Temperature</u> is one of the limiting factors for algae and plant growth; as temperature increases, biological activity (photosynthesis, respiration, and decomposition) increases to a point. Temperature is directly related to the amount of available dissolved oxygen, where warmer water holds less oxygen. In deeper water bodies, temperature stratification occurs; a thermocline occurs at depth where the top layer is warmer and actively exchanges nutrients with the air. The bottom layer is distinctly cooler and isolated from surface impacts. *All temperature profiles were relatively consistent throughout the years, displaying seasonal patterned temperature profiles. Duck Pond's coldest recorded temperature was in 2018 at WQ site 3-B at 7.6°C (45.6°F) and warmest temperature was also in 2018 at WQ site 1-D at 28.5°C (83.3°F).*

<u>pH</u> Ranges from 0-14, where zero is extremely acidic, seven is neutral, and 14 is most basic. pH represents the concentration of hydrogen ions (h+) in solution. There is no 'perfect pH' value or definitive range for all aquatic life; normal ranges are specific to various biota. For example, a range of 5.5-8.5 is typically best for maintaining a healthy fishery. Within this range, there are specific ranges for fish species, which can be appropriated to environmental regions and water chemistry. Therefore, a stable pH (± 1) is also important – fluctuations can adversely affect water chemistry and pond biota (fish, snails, plankton, plants, etc.). *pH ranges generally remained within desirable levels; however, 2018 at all four sites in October displayed more acidic pH levels than in 2019 & 2020 (<6 pH units). July 2018 at WQ site 1-D also displayed more acidic levels than the other WQ sites (<6 pH units).*

<u>Conductivity</u> is a measure of the water's ability to conduct electricity and is related to the quantity of dissolved minerals that are present in the water. Conductivity increases with salinity. Most natural waters have conductivity readings between 50 and 500 µmhos/cm, where significant changes in conductivity over time can be an indication of impairment. Conductivity remained within the stable range suggested above, and

was recorded between 85.6 mhos/cm and 197.7 mhos/cm throughout the three-year sampling period.

Chart 1: Water quality sample site 1-D 2018-2020 results

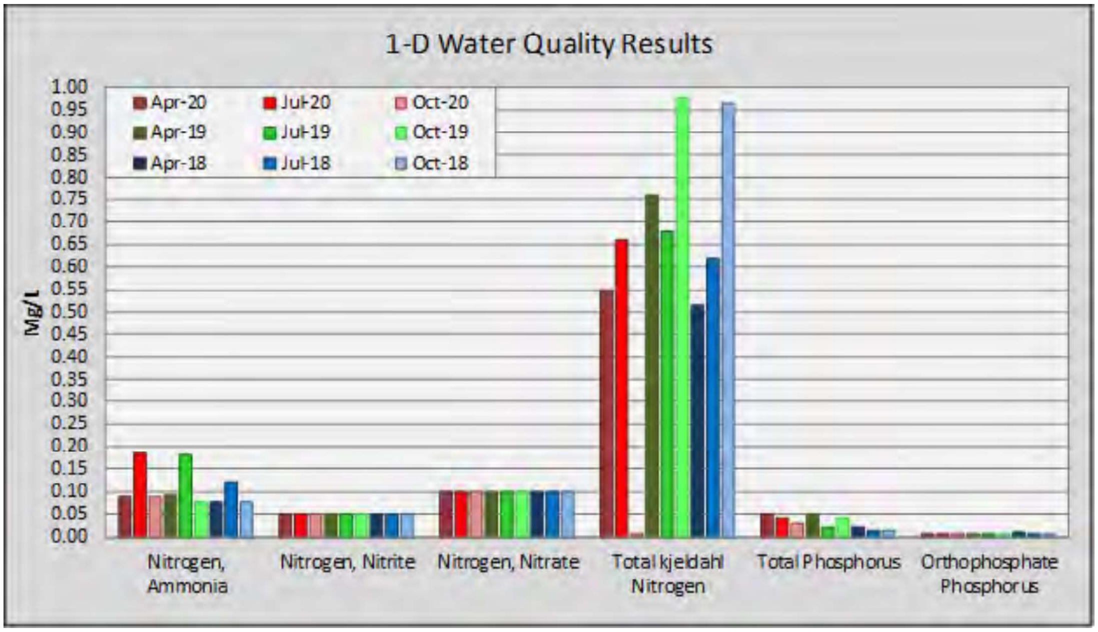
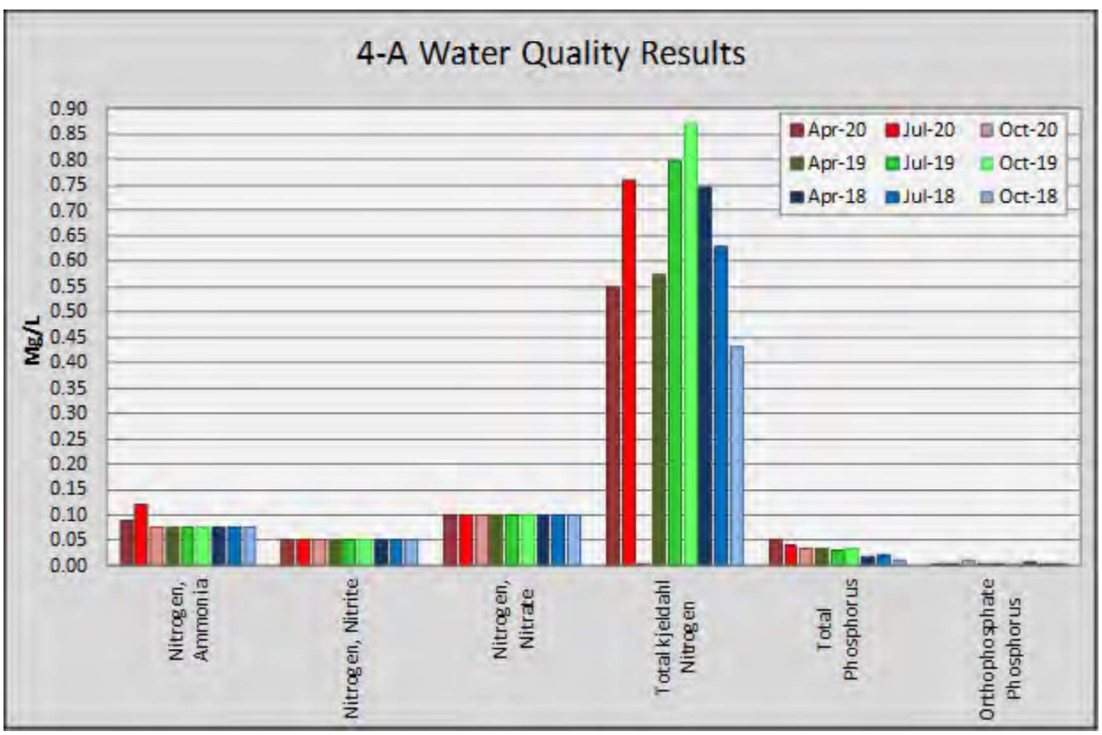


Chart 2: Water quality sample site 4-A 2018-2020 results



Aquatic Vegetation

Annual submersed aquatic vegetation surveys were performed during the July visit every year during this program. The vegetation survey was performed from a canoe or a 10-foot jon-boat. A hand-held Garmin GPS was used to collect GIS-referenced data points where vegetation occurred. A throw-rake and aqua-scope were used to collect the plant species from the bottom of the pond where visual identification was difficult. Plant species were identified down to species and a general map was created to display vegetation throughout the 3-year program. Table 2 below lists the vegetation species present in Duck Pond between 2018-2020.

Table 1: Submersed aquatic plants present in Duck Pond between 2018-2020

Common Name	Scientific Name	2018	2019	2020
Yellow Waterlily	Nuphar variegata	X	X	X
White Waterlily	Nymphaea odorata	X	X	X
Watershield	Brasenia schreberi	X	X	X
Ribbon-leaf Pondweed	Potamogeton epihydrus	X	X	X
Thin-leaf Pondweed	Potamogeton pusillus	X		X
Long-leaf Pondweed	Potamogeton natans		X	X
Leafy Pondweed	Potamogeton foliosus	X	X	X
Purple Bladderwort	Utricularia purpurea	X	X	X
Common Bladderwort	Utricularia vulgaris	X	X	X
Floating Bladderwort	Utricularia radiata	X	X	X
Humped Bladderwort	Utricularia gibba	X	X	X
Spineless Hornwort	Ceratophyllum echinatum			X
Floating Burreed	Sparganium fluctuans		X	X
Pickerelweed	Pontederia cordata	X	X	X
Mermaidweed	Proserpinaca palustris		X	X

Aeration System Maintenance / Bacteria Augmentation Applications

In 2018, an aeration system utilizing ten bottom diffusers was installed in the pond (**Figure 3**) to increase dissolved oxygen for the benefit of aquatic life, while also reducing excess nutrients, the build up of organic matter on the bottom and suspended particles. In 2019, an added management approach of aerobic bacteria augmentation was implemented. Duck Pond was visited monthly by a SOLitude Environmental Scientist for these aerobic bacteria augmentation applications. This application utilizes bacteria as a natural way to maintain and improve open water habitat by breaking down organic material that may be suspended in the water or building up on the bottom and reducing pond depth. Aerobic bacteria is used in contrast to anaerobic bacteria because this type of bacteria uses up oxygen to break down organic material more quickly. This aerobic bacteria is designed to supplement the existing bacteria in the pond's bottom sediment. Additional oxygen created by the bottom diffusers assists the natural cycle of the waterbody to continually provide oxygen throughout the water column during times when warm water temperatures and drought conditions might deplete the available oxygen.

Over time, beavers and other forces have undoubtedly taken their toll in damaging the hoses which feed the bottom diffusers, reducing efficiency or disconnecting them all together. For this reason, requests were made throughout the 2020 season when damaged sections of the aeration bottom hoses were identified. All damaged hoses were located, spliced and returned to full operation. In addition to these repairs, an extension was added to a section of hoses to reroute it's path to be less vulnerable to potential damage as it had become exposed along the shoreline as a result of the local drought experienced through the season.

Sediment Depth Sampling

Sediment depth sampling has been performed twice per year (April & October) in 2019 & 2020 at 20-predetermined GPS locations (Figure 1). In addition, two separate sediment depths were collected in April & October (#50 & 51) (Figure 1). Sediment depth sampling coincides with the bacteria applications and determines the efficacy of the bacteria applications. Sediment depth sampling is performed on the water in a jon-boat with a 10-foot pole measured in intervals of one (1) foot. The pole is placed vertically into the water where the water depth is measured first. As soon as the sediment is reached, the pole is pushed downwards into the sediment and measured by one (1) foot intervals until the pole reaches bedrock. Data collected at each GPS point includes water depth, sediment depth, and sediment type.

There are three types of sediment: organic matter, sand, and a combination of both (organic matter/sand). Bacteria specifically works to break down organic matter and does not affect the depth or texture of sand. Four (4) of the twenty (20) sites are sand and therefore, did not display much difference. All other sites have organic matter or a combination of both. Please refer to the appendix for data associated with sediment depth sampling.

The two-year sediment depth sampling data displayed variable results that did not confirm positive decline in organic matter from the bacterial applications nor determined the bacterial applications ineffective. Several natural factors influence organic matter depth and can potentially counteract Duck Pond's management plan. Factors such as aquatic vegetation life-cycles which contribute to the organic matter annually, terrestrial organic matter such as leaf-litter and erosion, and rainfall which influences the water depth, clarity, and temperature. This management strategy will require several more years of data collection to confirm sufficient evidence of effectiveness. The bacteria may be functioning as anticipated, but instead of a visible decrease in sediment depth, could be causing the sediment to become less consolidated, and thus appear deeper; unfortunately, there is no measurable way to confirm if this may be occurring or not. This year's lower water levels due to local drought could have also influenced how the bottom sediment was distributed, as well as any of the air leaks from the damaged hoses (if they were located in close proximity to the sediment depth sample locations).

Summary

- Oxygen levels have increased throughout the pond due to the aeration bottom diffuser systems.
- Considering nutrient level, depth of organic matter, and presence of algal species, Duck Pond is considered to be in a eutrophic state.
- Nutrient levels within the pond are very common for ponds similar to Duck Pond in Massachusetts.
- Due to the shallow nature of Duck Pond, aquatic vegetation flourishes throughout the pond.
- The aeration systems and bacteria applications have not altered the density or distribution of aquatic vegetation.
- Results of the sediment depth sampling are inconclusive.

Conclusion & Recommendations

Although the results of the sediment depth sample data are inconclusive, overall conditions within Duck Pond are not worsening. Water quality data has remained relatively stable, with slight fluctuations since 2018 but is still within a range that is similar to many waterbodies in Massachusetts. The aeration system is still providing sufficient dissolved oxygen throughout the pond to not only benefit the overall aquatic ecosystem, but to be coupled with the bacteria augmentation applications.

Continuation of the program is not anticipated to further impair Duck Pond; based on the ongoing management goals for the pond by the Town of Groton , we recommend continuing with operation of the submersed aeration system and coupling that effort with bacterial augmentation. Consistent use of bacteria products will only benefit the pond as time progresses; however, due to variable conditions not only from site to site, but year to year, for any waterbody, the specific amount of time it will require to observe and/or document a noticeable difference in sediment levels varies and is truly unknown. As such, the length of time to continue and degree of bacterial application for Duck Pond in future years can be at the discretion of the Town and any additional constraints they may have.

We enjoyed working with Bob Anderson & the Town of Groton on the restoration of Duck Pond. We look forward to working with you again in the future.

Appendix A

- Maps
- Water Quality & Sediment Depth Sampling Data
- Laboratory Reports

Figure 1: Duck Pond Sediment and Water Quality Sample Sites

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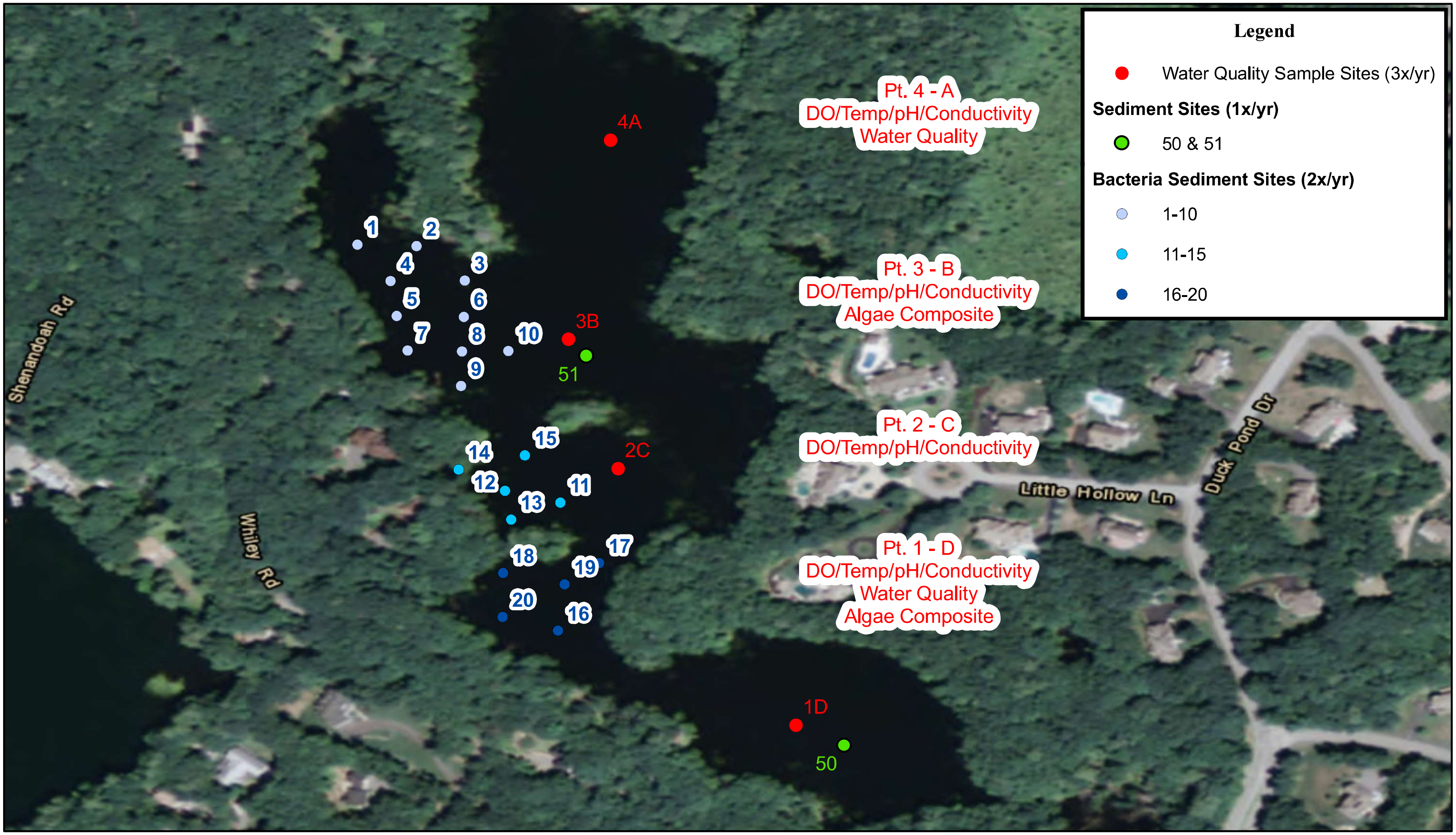
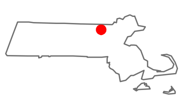


Duck Pond
Groton, MA



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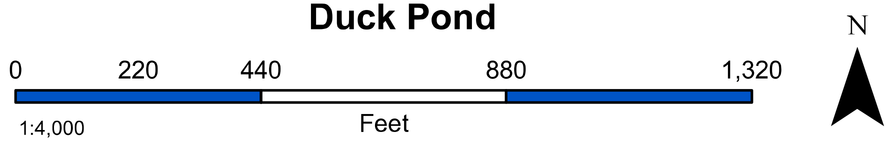

Map Date: 08/02/2019
Prepared by: ALM
Office: Shrewsbury, MA

Figure 2: Submersed & Floating Aquatic Vegetation in Duck Pond

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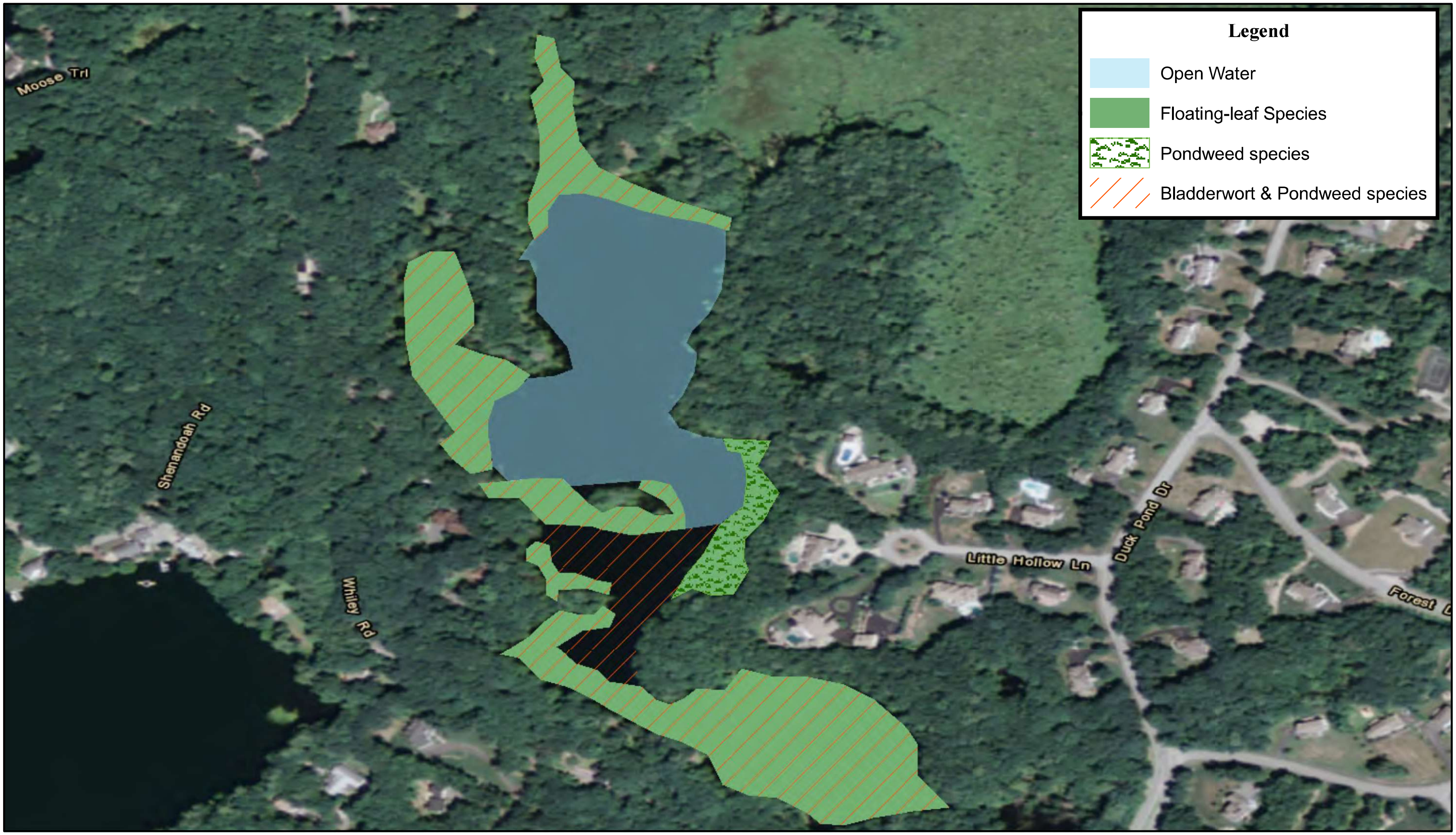
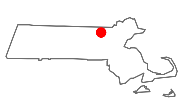
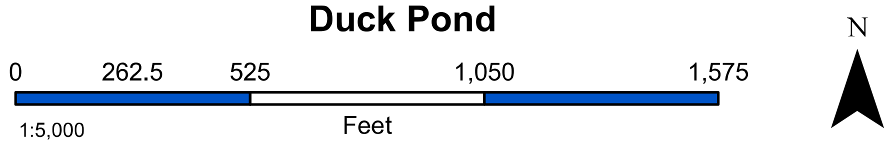


Duck Pond
Groton, MA



Duck Pond



Map Date: 01/06/21
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Figure 3: Submersed Aeration Unit Sites

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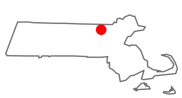
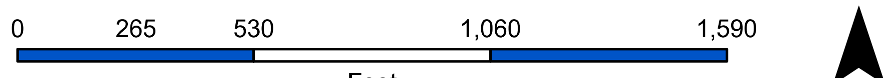
Duck Pond
Groton, MA



Duck Pond



Map Date: 01/06/21
Prepared by: ALM
Office: Shrewsbury, MA