



Year-End Report for the 2019 Management of: Baddacook Pond

Groton, MA



Submitted: December 12, 2019
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Introduction

Below is a summation of the Baddacook Pond 2019 aquatic management program. This report details all aspects of this program including: surveys, harvesting/hydro-raking data, and ArcGIS mapping of the management areas. This project was performed for and funded by the Town of Groton, with the objective of reducing plant biomass and restoring open-water areas throughout the littoral zone of Baddacook Pond.

Pre-Management Assessment

The Pre-Management Assessment was performed on July 12th, 2019 by a SOLitude Aquatic Specialist. The waterbody's littoral zone was surveyed using two techniques: throw-rake tosses and hydro-acoustic sonar. Throw-rake tosses were performed periodically to assess the distribution and density of the aquatic vegetation assemblage. Hydro-acoustic sonar provides the ability to determine the extent of growth within the pond. The submersed macrophyte community was co-dominated by two invasive species, variable water milfoil (*Myriophyllum heterophyllum*) and fanwort (*Cabomba carolinana*). Other beneficial native species included large-leaf pondweed (*Potamogeton amplifolius*), with stonewort (*Nitella* sp.) and other pondweed species (*Potamogeton* sp.) less frequently encountered. Shallow areas of the pond, with water depths less than 4-feet, and a mucky substrate were densely populated with white waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variagata*), and watershield (*Brasenia schreberi*) that were beginning to have surface leaves. Please refer to Figure 1, for a map of the Pre-management acoustic sonar map, exhibiting the biovolume data within Baddacook Pond.

Mechanical Harvesting Plan and Operations

Prior to harvesting operations, SOLitude Lake Management (SOLitude) applied for a Special Use Permit to use the boat launch during operations. Once this was obtained (Permit #13329), it was determined that mechanical harvesting would begin the week of July 15, 2019. To that end, on July 15th, the dump truck rental an operator was also employed at the Baddacook Pond Boat Launch and operations commenced **utilizing the town's aquatic weed harvester**.

The first harvesting event consisted of 11.25 days (90 hours) of mechanical harvesting beginning on July 15th and concluding on August 21st. This event experienced delays in production due to equipment failure. During operations, all collected material was off-loaded into dump truck at the designated off-loading area. The plant material was then transported to the local landfill/composting site.



During operations the harvester operator started south and then proceeded around the pond in a counterclockwise fashion, focusing on invasive species removal and recouping open water space. Please refer to Figure 2 for a map of the harvested areas during this management period. The first harvesting event removed a total of 59 loads of material from the waterbody, each load was approximately 4 cubic yards in volume, totaling 236 cubic yards.

The second harvesting event began after the hydro raking on September 30th and consisted of 10 days (80 hours). During this time period 62 loads of aquatic vegetation was removed from the water body, equating to 248 cubic yards. MassWildlife Natural Heritage and Endangered Species Division (NHESP) made a finding that given the likely presence of Blanding's Turtle hatchlings in the Pond, the Division requires that the harvester (and hydro-rake) operations remain 50 feet from the water's edge between September 15 and April 15 in order to avoid adverse effects to the actual Resource Area habitats of state listed wildlife species (310 CMR 10.59) and to avoid prohibited take of state-listed species (321 CMR 10.18 (2)(a)). Due to restrictions set forth by Natural Heritage, the harvester was limited to areas 50 feet away from the shoreline for the second harvesting event. In sum, the 2019 harvesting effort totaled 170 hours and collected a total of 121 dump truck loads equating to 484 cubic yards of plant material. The plant biomass was a combination of invasive fanwort and variable milfoil.

Mechanical Hydro-raking Plan and Operation

Mechanical hydro-raking services commenced after the first harvest starting on September 3, 2019. Nineteen days (150 hours) of mechanical hydro-raking ensued, concluding on September 27, 2019. During operations, the hydro-rake off-loaded the collected organic material onto the harvester conveyor. Once full the harvester operator transported the material to the designated off-loading site. From there, the same process took place as the previous harvesting operation.

Hydro-raking services were performed on select areas of Baddacook Pond, including both common areas as well as private shoreline areas. Please refer to Figure 3 for a map of the designated hydro-raking areas, as well as Appendix A for a chart of the areas hydro-raked each day. The collected organic material comprised of a combination of accumulated organic matter, floating islands, emergent vegetation, floating-leaf vegetation, and submersed vegetation.

In sum, the 2019 hydro-raking effort totaled 150 hours and collected a total of 217 dump truck loads equating to 868 cubic yards of plant material, root systems and organic matter.



Post Management Survey Summary

The Post-Management Survey was performed by a SOLitude Aquatic Specialist on October 25, 2019. A similar survey methodology to the Pre-Management Assessment was performed utilizing throw-rake tosses and hydro-acoustic sonar. While variable watermilfoil and fanwort continued to be the co-dominant vegetation observed in the waterbody, neither species were topped-out; both were commonly observed 1-2 feet below the water's surface. The most prevalent areas of growth were close to shoreline. Again, large-leaf pondweed was the most common native species, growing along the western shoreline. Other species observed in trace and sparse densities included stonewort, coontail (*Ceratophyllum demersum*), and other pondweed species. Floating-leaf species growth was senescing, but significant reductions were observed along the portions of the shoreline and high-use areas of the pond. Please refer to Figure 4 for a map of the collected hydro-acoustic data. As shown, the majority of hydro-raked areas showed a significant decrease in collected biovolume in the post management survey. The most prominent reductions were shown in the western and eastern cove. These areas contained 90-100% biovolume in the pre-management survey which reduced to about 30-40% in the post management survey. There were some portions of the pond that still had significant density levels, in particular a portion of the southern cove, due to the 50-foot shoreline buffer put into place by Natural Heritage.

Summary and Ongoing Management Recommendations

Overall the 2019 management program effectively maintained Baddacook Pond reducing a total of 1,352 cubic yards of plant biomass/organic matter within the open water space. The harvesting effort successfully controlled the variable watermilfoil and fanwort infestation, with the plants still shown 1 to 2 feet under the water's surface in the post management survey at the end of October. The hydro-raking effort also showed positive results as shown in the attached biovolume maps. Our objectives of reducing plant biomass and restoring open-water areas throughout the littoral zone of Baddacook Pond were achieved.

Over the last three years, there has been significant plant biomass reduction. However, the targeted plants are invasive species which have the ability to spread and grow rapidly. It is important that continuous management be done in order to continue to reduce the plant densities. Mechanical harvesting is a moderate cost method to keep eutrophication at bay, improving water quality and slowing the



growth. Hydro-raking has proven to be effective, clearing dense areas that the harvester could not reach. It has the ability to create depth and remove the root systems. However, the hydro rake is unable to effectively cover a large distance that the harvester can. Hydro-raking is not as cost-effective as harvesting for the town, however if used in the same areas for multiple years it is likely there will be a significant decrease in plant density due to the ability to remove the root systems, and restore depth.

Keeping the objectives of this project in mind, SOLitude is recommending a similar management approach next year encompassing both mechanical harvesting and hydro-raking methods. Looking ahead to 2020, SOLitude recommends to continue to coordinate the pre-management survey in close proximity to the commencement of the mechanical harvesting efforts; this will enhance the accuracy of the data regarding the success of the harvesting efforts. It would be beneficial to test run the harvester at the beginning of the season to ensure there are no mechanical issues that would delay the project. Preventing delays will allow us to complete most of the management before the restriction by Natural Heritage goes into effect. In retrospect, the locations that the hydro-rake targeted changed throughout the three-year management plan. The change of the location each year hinders the ability to test the hydro-rake's effectiveness over a three-year period. Going forward, implementing the hydro rake in the same location from year to year would allow us to see if this would have more of an impact.

Please contact us if you have any questions or require additional information.

Sincerely,

Lauren Sullivan

Lauren Sullivan

Project Coordinator



Appendix A:

Hydro Raking Log- 2019:

Date	Operation hours	# of Harvester Loads	# of Loads to Transfer station	Areas Hydro-raked (in general)	Issues or Repairs
8/29/2019	2			Area 1 (Not correct location)	Piston Blew
8/30/2019					Piston Blew
9/2/2019				Holiday	
9/3/2019	8	9	9	Area 1 (not correct location)	
9/4/2019	10	11	11	Area 1 (Not correct location)	
9/5/2019	10	21	21	Area 2	
9/6/2019	10	21	21	Area 2 & 3	
9/9/2019	8	9	9	Area 1	
9/10/2019	10	11	11	Area 3	
9/11/2019	10	11	11	Area 3	
9/12/2019	4	5	5	Area 3	Dump Truck Driver down
9/13/2019	10	11	11	Area 5 & Area 4	



9/16/20 19	8	17	17	Area 2	
9/17/20 19	10	21	21	Area 2	
9/18/20 19	10	21	21	Area 2	
9/19/20 19	10	16	16	Area 2 & 3	
9/20/20 19	10	11	11	Area 3 & 4	
9/23/20 19	3	3	3	Area 4	Seal blew
9/24/20 19	10	11	11	Area 2	
9/25/20 19					Keith out Sick
9/26/20 19	7	8	8	Area 2	
9/27/20 19					Demob



Appendix B: Mechanical Harvesting Log: First Harvest

7/15/2019		1	1	1	
7/16/2019	8				Harvesting down Fuel filter and line issue. Hours spent on repairing
7/17/2019	8				Harvesting down Fuel filter and line issue. Hours spent on repairing
7/18/2019	8				Harvesting down Fuel filter and line issue. Hours spent on repairing
7/19/2019	6				Harvesting down Fuel filter and line issue. Hours spent on repairing
7/22/2019					
7/23/2019	7	1	1	1	Harvester Down
7/24/2019	5	3	2	2	Harvester Down
7/25/2019	3				Harvester Down
7/26/2019		2	2	2	
7/29/2019		1	2	2	
7/30/2019					Harvester Down
7/31/2019					Harvester Down
8/1/2019					Harvester Down
8/2/2019					Harvester Down



8/5/2019		8	6	6	
8/6/2019		4	3	3	
8/7/2019	8				Repair Conveyer belt
8/8/2019	5	3	2	2	Harvester Stall, Garret repair light
8/9/2019		8	6	6	
8/12/2019		8	6	6	
8/13/2019		8	6	6	
8/14/2019		5	4	4	Harvester down fuel filter issue
8/15/2019		8	6	6	
8/16/2019		8	6	6	
8/19/2019		8	6	6	
8/20/2019		8	6	6	
8/21/2019		8	6	6	

Appendix B: Mechanical Harvesting Log: Second Harvest

9/30/2019		10	14	14	Area 2	
10/1/2019		10	10	10	Area 1, 2 & 4	
10/2/2019		10	9	9	4 (Area 4), 1 (Area 2), 2 (Section 1 &3), 2 (section 3 and water dept)	
10/3/2019		10	7			



10/4/2019	4					Cutter Teeth Replacement
10/7/2019		6	5	5	Clockwise around pond, looking and picking up anything he saw	
10/8/2019	4	6	4	4	Clockwise around pond, looking and picking up anything he saw	Removing links out of conveyer track
10/9/2019		10	5	5	Clockwise around pond, looking and picking up anything he saw	
10/10/2019		10	5	5	Clockwise around pond, looking and picking up anything he saw	
10/11/2019		8	3	3	Clockwise around pond, looking and picking up anything he saw	



THE COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF FISH AND GAME

OFFICE OF FISHING AND BOATING ACCESS

One Rabbit Hill Rd

Westborough, MA 01581

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2019 SPECIAL USE PERMIT

Summer

Event Date Monday, July 1, 2019

Permit # 13329

End Date Friday, September 27, 2019

Waterbody Baddacook Pond

Location Groton

Organization Solitude Lake Management

Type of Event: Mechanical Removal Of Aquatic Weeds

Arrival Time 7:00 AM

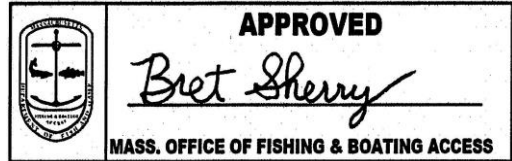
Start Time 7:00 AM

Return Time 4:00 PM

Max Vehicles 0

Max. Boats 0

Environmental Police Officer Required No



Comments / Special Conditions

This Permit Is For Launching And Retrieving Equipment And Loading Harvested Weeds Onto Trucks. The Ramp Shall Not Be Blocked Or Closed To The General Public For The Duration Of The Project.

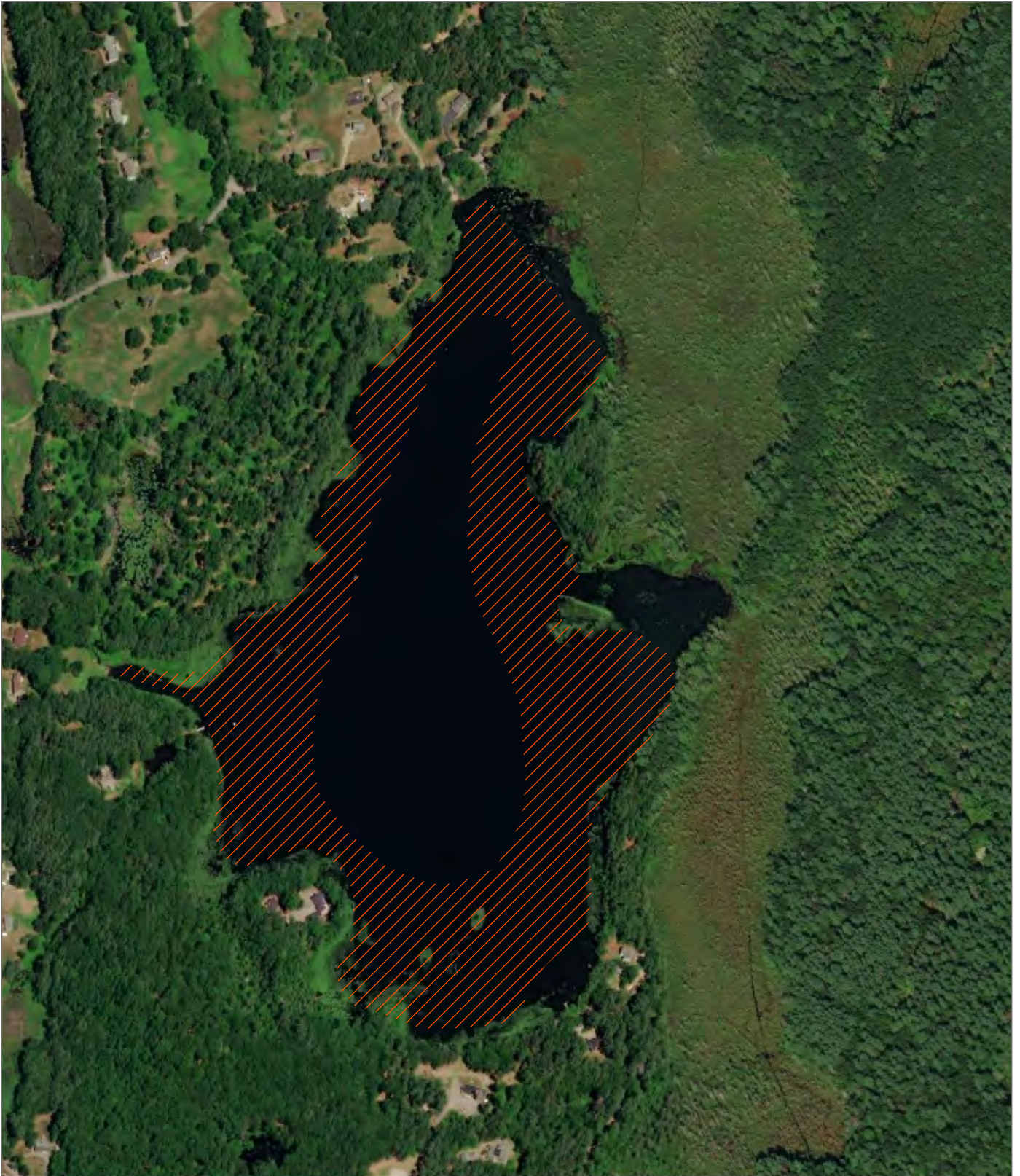
STOP the spread off nuisance aquatic plants and animals. REMOVE all plants and animals from boat, trailer and equipment.

DISPLAY THIS PERMIT IN YOUR VEHICLE WINDSHIELD

cut along this line

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Figure 1: Harvesting Area



Baddacook Pond
Groton, Massachusetts



Map Prepared: 11/06/19
Basemap © 2013 Esri

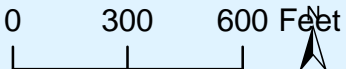
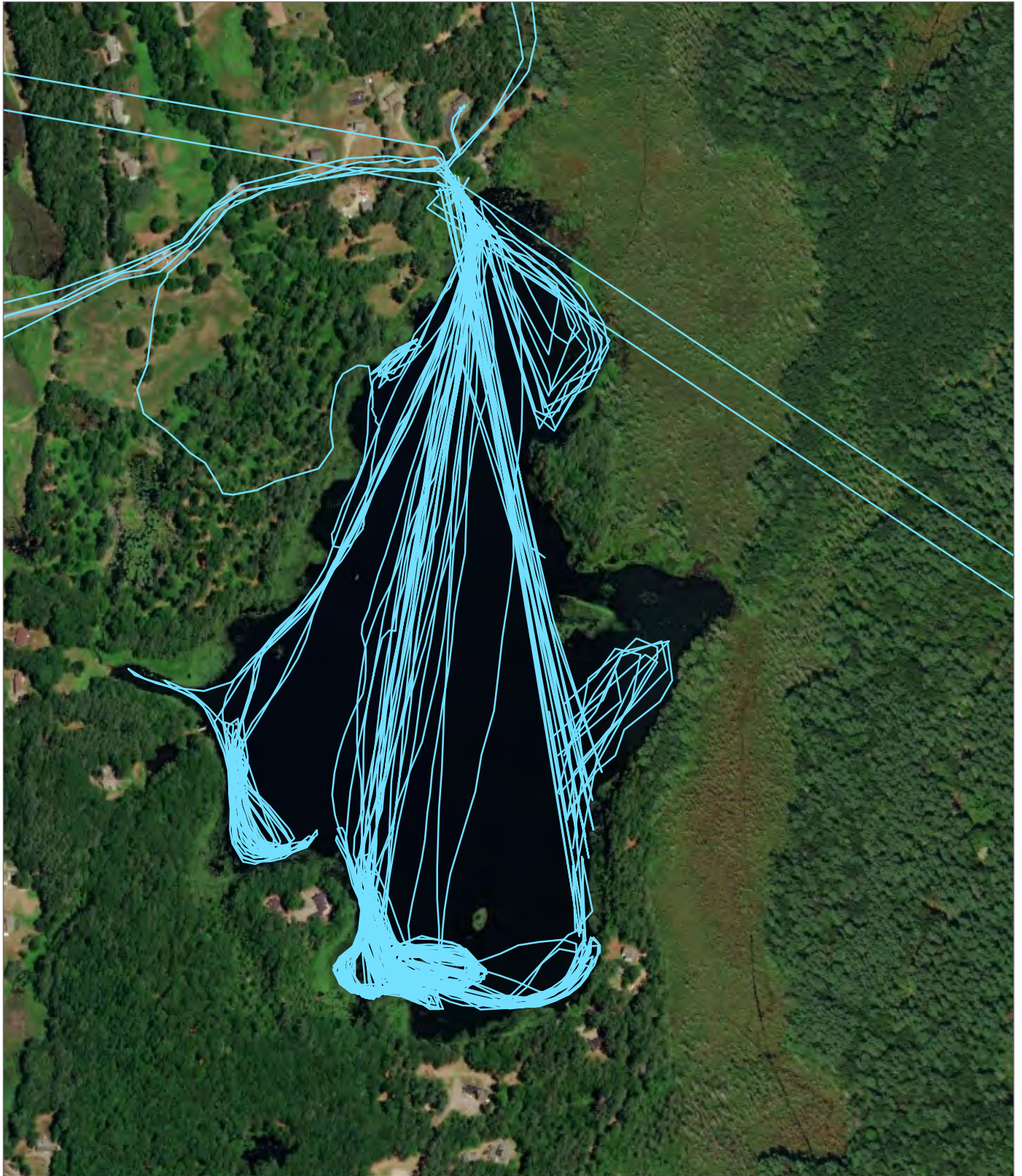


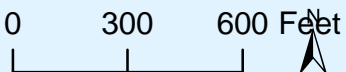
Figure 2: Harvester GPS Tracks



Baddacook Pond
Groton, Massachusetts

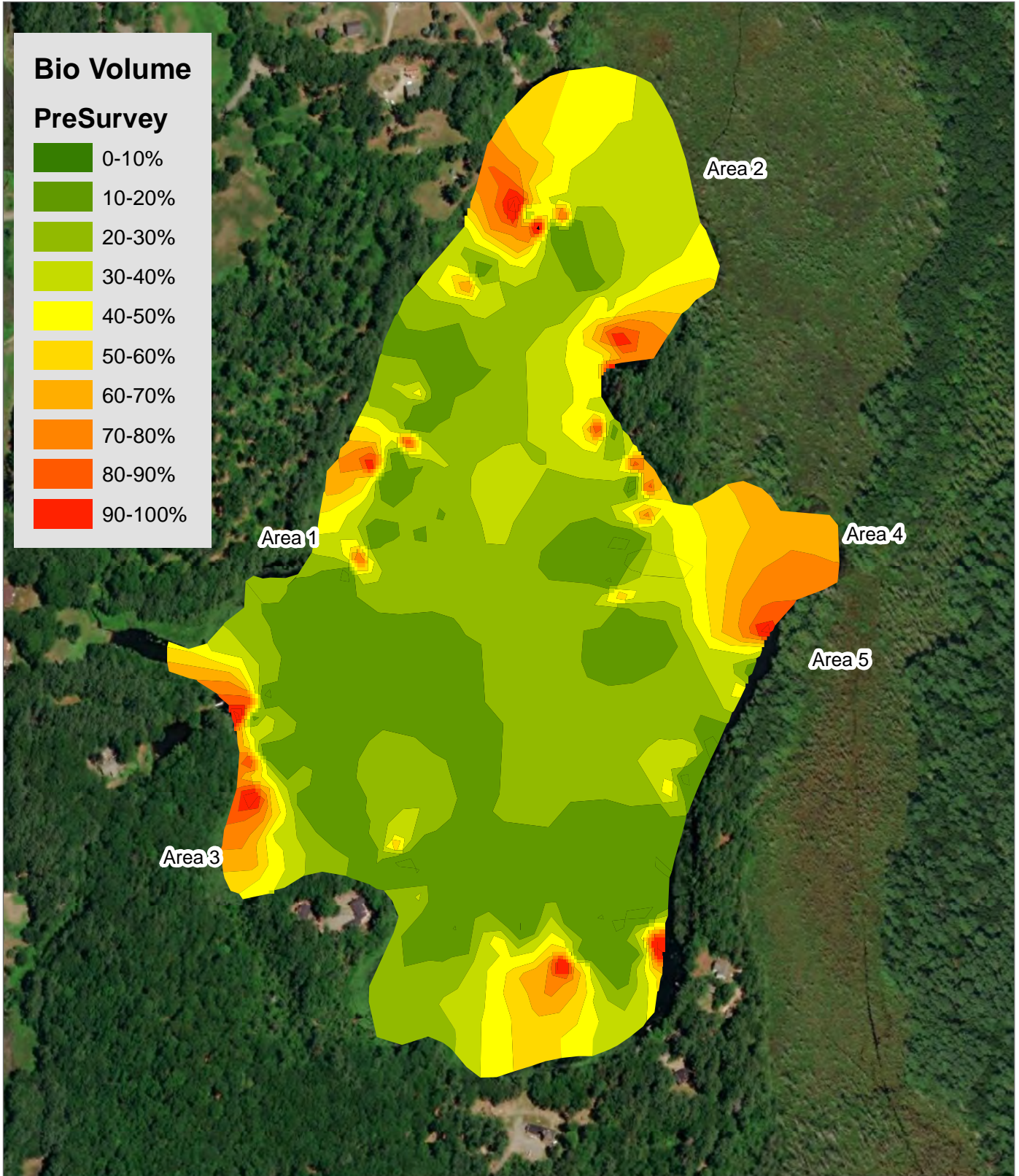


Map Prepared: 11/06/19
Basemap © 2013 Esri



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Figure 3: 2019 Pre Survey BioVolume



Baddacook Pond
Groton, Massachusetts

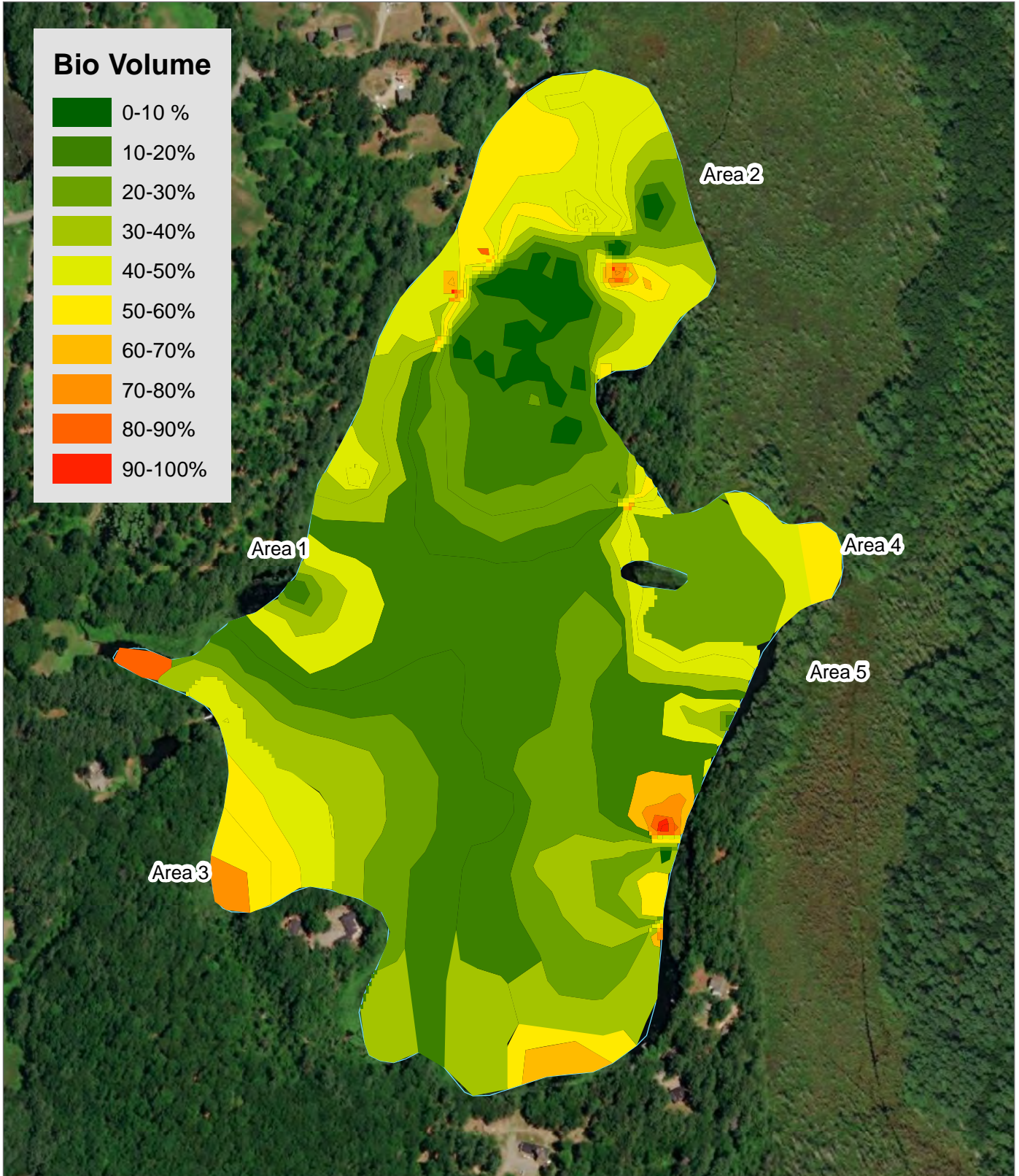
Map Prepared: 12/11/19
Basemap © 2013 Esri

0 250 500
1:5,132 Feet



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Figure 4: Post Mgmt Biovolume



Baddacook Pond
Groton Massachusetts

Map Prepared: 12/11/2019
Basemap © 2013 Esri

0 250 500
1:0 Feet



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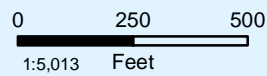
Figure 5: 2019 Hydro-raked Areas



**Baddacook Pond
Groton
Massachusetts**



Map Prepared: 12/11/19
Basemap © 2013 Esri



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