

Final

**Post-Treatment Assessment for
Aquatic Plant Control ERDC
Demonstration Project
Wells College Bay, Cayuga Lake
Aurora, New York**

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Prepared for:



**US Army Corps
of Engineers®**
Buffalo District
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ACRONYMS AND ABBREVIATIONS

ERDC	Engineer Research and Development Center
HPLC	high-performance liquid chromatography
Hydrilla	<i>Hydrilla verticillata</i>
JV	Environmental Assessment Services, LLC, and Ecology and Environment, Inc. (member of WSP) Joint Venture
NYSDEC	New York State Department of Environmental Conservation
ppb	parts per billion
Project	Wells College Bay, Cayuga Lake Hydrilla Demonstration Project
SePRO	SePRO Corporation
SLM	SOLitude Lake Management, LLC
USACE	United States Army Corps of Engineers (Buffalo District)

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1 INTRODUCTION

The Wells College Bay, Cayuga Lake, Aurora, New York, Hydrilla Demonstration Project (the Project) is a field-scale demonstration of a technology developed under the United States Army Corps of Engineers – Buffalo District’s (USACE’s) Aquatic Plant Control Research Program to manage monoecious hydrilla (*Hydrilla verticillata*; Hydrilla) in a high-water exchange environment.

This report contributes to the Year 6 post-treatment monitoring and assessment of herbicide efficacy on Hydrilla by summarizing field conditions during the treatment, summarizing herbicide treatment methodology and contact time, and identifying lessons learned to benefit future work.

1.1 Background

Hydrilla is a very aggressive, submerged aquatic plant. The Cayuga Lake Floating Classroom first discovered this invasive plant in Wells College Bay of Cayuga Lake in September 2016. In 2016, the only other Hydrilla infestation documented in Cayuga Lake had been discovered in late summer 2011 near Ithaca, New York. Since then, two other small infestations have been found at Don’s Marina in Genoa, New York, and at the Finger Lakes Marine Service in Lansing, New York. The majority of the Hydrilla treated as a part of the first year (2017) of the Project was identified within a 30-acre portion of Wells College Bay, with several small patches observed in the adjacent 29-plus acres. The monitoring area for the second year (2018) of the Project was extended from 59 acres to 120 acres to monitor for the spread of small patches of Hydrilla in areas adjacent to the areas treated during the first year at water depths ranging from 0 to 18 feet. For the third and fourth years (2019 and 2020) of the Project, the 30-acre treatment area remained largely the same, and 120 total acres were monitored. In the fifth year (2021), a total of approximately 49.7 acres was initially identified for treatment, and 125 total acres were monitored, and for the sixth year, a combined 192.7-acre area was treated, and 437.9 total acres were monitored. The increase in acreage for the 2022 efforts represents combined efforts between USACE and the New York State Department of Environmental Conservation (NYSDEC).

During the sixth year of treatment to control and eradicate Hydrilla, USACE collaboratively implemented the Project with NYSDEC. USACE treated approximately 69.4 acres, divided into two treatment blocks, and NYSDEC treated approximately 123.3 acres, divided into four treatment blocks. Hydrilla was identified in the areas treated by NYSDEC following the 2021 season and after USACE had secured funding for its portion of the Project. Thus, NYSDEC led the efforts to manage the additional 123.3 acres. These six blocks were treated with fluridone (Sonar® H4C) during the 2022 season as follows (see **Figure 1-1**):

USACE Treatment Blocks

- **Northern Shallow Sonar® H4C treatment block:** An approximately 58.1-acre area between Little Creek north to approximately Gully Road.
- **Northern Deep Sonar® H4C treatment block:** An approximately 11.3-acre area between the Wells College Boathouse north to Lafayette Road.

NYSDEC Treatment Blocks

- **Southern Shallow Sonar® H4C treatment block:** An approximately 89-acre area north of Poplar Ridge Road south to Long Point State Park.
- **Southern Deep Sonar® H4C treatment block:** An approximately 31.5-acre area north of Poplar Ridge Road to approximately 1,600 feet south of State Route 90.

- **Little Creek Sonar® H4C treatment block:** An approximately 0.2-acre area near the mouth of Little Creek.
- **Long Point Sonar® H4C treatment block:** An approximately 2.7-acre area south of Long Point State Park.

USACE delineated the treatment blocks using aquatic plant survey data from 2021.

Given the ease with which this plant spreads by fragments, its proximity to the Erie Canal, and the heavy use of the waterway, this infestation has caused urgent concern regarding spread to other areas of Cayuga Lake, the Finger Lakes, the Erie Canal system, and, potentially, the Great Lakes. These concerns provided the impetus for implementation of the Project.

Implementation of the Project has been a collaborative effort between the USACE Engineer Research and Development Center (ERDC); the USACE Buffalo District; Environmental Assessment Services, LLC – Ecology and Environment, Inc. (member of WSP) Joint Venture (JV); NYSDEC; the Village of Aurora; the Cayuga County Health Department; the Wells College water treatment plant; the Finger Lakes Partnership for Regional Invasive Species Management; the Cayuga Lake Watershed Network; and the applicator, SOLitude Lake Management, LLC (SLM). Although USACE was not required to obtain an Article 15, New York Code of Rules and Regulations, Part 327, aquatic pesticide permit for the Project, reasonable measures were taken to meet the intent and conditions that would be associated with such a permit.

1.2 Purpose and Scope

The purpose of the Project is to perform a field-scale demonstration of a technology developed under the Aquatic Plant Control Research Program to evaluate the effectiveness of aquatic herbicides to manage monoecious Hydrilla in high-water exchange environments. USACE is also funding a separate research project titled “Improving Chemical Control in High Water Exchange Environments in Northern Waters,” which has been ongoing since 2010. This method and the underlying concepts are being tested against monoecious Hydrilla for the Tonawanda Creek/Erie Canal Demonstration Project in Western New York and the Stewart Park Demonstration Project in Ithaca, New York, as well as for the Project.

The findings in this program will provide valuable information for developing future guidance on how to manage this invasive aquatic plant that is expanding in high-water exchange systems throughout the northeastern United States.

This post-treatment report includes a summary of the herbicide treatment methodology, including quantity of herbicide used and total acreage treated, a discussion of herbicide contact time and dispersion through the system, and a discussion of the monitoring that accompanied the herbicide application. Lastly, the report provides conclusions in the form of lessons learned to help shape future treatment projects. This report is specific to the USACE efforts and does not summarize NYSDEC treatments or water monitoring; those are summarized in Appendix A.

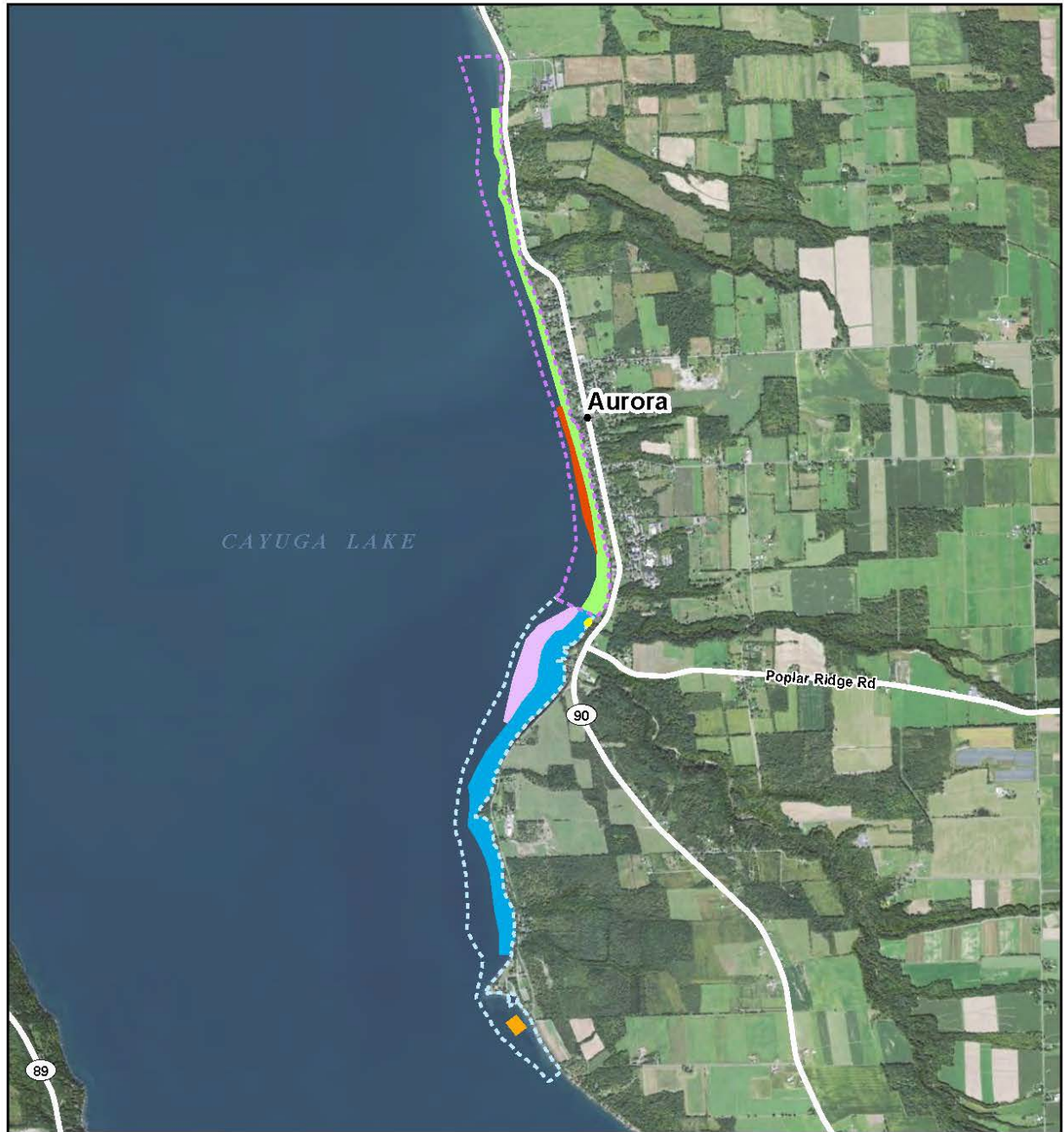


Figure 1-1 Aurora Hydrilla Treatment Areas- Summer 2022
Cayuga Lake, Cayuga County, New York



Figure 1-1 Aurora Hydrilla Treatment Areas – Summer 2022

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2 OVERVIEW OF HERBICIDE TREATMENT AND MONITORING

Treatment of Hydrilla for the Project focused on the application of the aquatic herbicide fluridone (Sonar[®] 4HC) within Wells College Bay. The following sections outline the public notification that preceded treatment; field conditions before, during, and after treatment; herbicide treatment methodology; and quantity of herbicide used.

2.1 Public Notification

Public awareness and understanding of the Project were important to successful implementation. USACE and its interagency partners conducted outreach activities to potentially affected users in advance of treatment. Outreach and notification activities associated with USACE treatment near Aurora included:

- Collaboration with stakeholders was conducted regarding the development of treatment plans for 2022 by conference call and virtual meetings.
- Dates for the initial treatments were provided to NYSDEC, the Cayuga County Health Department, the Village of Aurora, and the Wells College water treatment plant, and email reminder notifications were sent out 24 hours prior to each treatment.
- Written notifications were sent by certified mail approximately 21 days prior to the first fluridone treatment to all riparian owners/users within the 0.5-mile buffer (north and south) of the treatment areas, and all municipal water supply customers, including those that receive water delivery by truck.
- Agency notification letters were distributed via email approximately 14 days prior to the first fluridone treatment.
- Yellow warning signs were deployed and maintained at public access points along the lakeshore at the commencement of each treatment. The signs indicated applicable water use restrictions regarding irrigation and drinking, culinary, or food processing purposes. The signs also displayed water use restrictions that were in effect for the duration of the treatment or until testing determined that the threshold concentration had been met.

The JV posted and maintained yellow warning signs (as described above) to meet the intent of permit requirements. Application dates and times were updated on the signs prior to each of the fluridone treatments. Newspaper notifications were not required for the treatments.

2.2 Herbicide Treatment Methodology

The aquatic herbicide fluridone was applied in the northern shallow treatment block of Cayuga Lake during ten treatment events between June and September (see **Table 2-1**). Fluridone was applied in the northern deep treatment block during eight events between June and August. SLM completed the herbicide applications in accordance with the *Performance Work Statement or Contract Aquatic Plant Control ERDC Demonstration Project Wells College Bay, Cayuga Lake, Aurora, New York*, dated April 2022 (USACE 2022).

Table 2-1 In-lake Fluridone Herbicide Application Summary by Treatment Date for Wells College Bay, Cayuga Lake Demonstration Project

Date	Treatment Area/Block	Application Rate (ppb)	Total Pounds of Sonar® H4C
6/29/2022	Northern Shallow	20.00	784
	Northern Deep	10	166
7/6/2022	Northern Shallow	20.00	784
	Northern Deep	10	166
7/13/2022	Northern Shallow	13.75	539
	Northern Deep	10	166
7/20/2022	Northern Shallow	13.75	539
	Northern Deep	10	166
7/27/2022	Northern Shallow	13.75	539
	Northern Deep	8.75	145
8/3/2022	Northern Shallow	13.75	539
	Northern Deep	8.75	145
8/10/2022	Northern Shallow	13.75	539
	Northern Deep	8.75	145
8/17/2022	Northern Shallow	13.75	539
	Northern Deep	8.75	145
8/24/2022	Northern Shallow	13.75	539
9/7/2022a	Northern Shallow	13.75	539
Total Pounds			7,124

Notes:

^a Treatment was scheduled for 8/31/2022 but was delayed due to unsafe lake conditions
ppb = parts per billion

The water depths in the shallow treatment area range from approximately 0 – 12 feet with an average depth of approximately 6.7 feet depending on location. The water depths in the deep treatment area range from approximately 12 – 18 feet with an average depth of 14.6 feet depending on location. Due to the location of the deeper treatment area further offshore coupled with its deeper depths, it was hypothesized that mixing in this area would be less than within the shallower treatment area. Thus, USACE tested an application that used a lower application rate over a shorter time to see if an effective treatment could be achieved using a well-timed treatment with less herbicide in this deeper area.

2.2.1 Herbicide Transfer

SLM used a Kasco granular spreader for the fluridone treatments and a 20-foot skiff for the applications. Herbicide transfer occurred at the Long Point State Park Boat Launch, where the chemical delivery truck was able to park so that access to the boat launch by other users was maintained during the herbicide transfer process. The fluridone was delivered in 40-pound buckets. The empty buckets were triple-rinsed on site and recycled at the SLM Cortland office location through Casella Waste Management. SLM staff wore personal protective equipment during the transfer from the truck to the treatment system.

2.2.2 Herbicide Application

SLM used a Kasco granular spreader throughout the treatment season. The boats were equipped with a global positioning system navigation system with all of the treatment sectors preloaded, and treatment passes were made parallel to the shoreline. The quantity of herbicide needed for each section was determined by the total acreage and volume of the treatment areas. All product was applied to each section before moving to the next adjacent section. Section 2.3 details the herbicide used in each treatment area.

SLM staff arrived at the Long Point State Park Boat Launch between 7:00 a.m. and 8:00 a.m. on each scheduled treatment day, launched the boat, and began assembling treatment systems. After the staff had their onsite meetings, the herbicide transfer began. The treatment crew on the boats consisted of a lead applicator and an assistant/technician. Treatment typically started around 8:00 a.m. each week. Aside from brief breaks when the boats stopped to re-load herbicide, the treatments continued uninterrupted until the lake treatment areas were completed—within 2 to 3 hours from the start time. There was one deviation from the treatment schedule due to unsafe lake conditions. The treatment originally scheduled for August 31, 2022, occurred September 7, 2022, due to high winds over several days.

2.3 Quantity of Herbicide Used and Total Area Treated

As indicated in Section 1.1, the Project was divided into two treatment blocks: northern shallow and northern deep (see **Figure 1-1**). Each block is discussed separately below, with respect to the quantity of herbicide used and the total area treated. To develop the treatment plan for each treatment area, USACE and partners monitored the sprouting dynamics of Hydrilla tubers and condition of plants prior to and several weeks after treatment to determine optimal timing of treatment, length of exposure, and concentration of herbicide required for effective control of Hydrilla.

2.3.1 Northern Shallow

Ten fluridone treatments were scheduled for the approximately 58.1-acre area between Little Creek north to approximately Gully Road during summer 2022. The treatment plan specified that the first two treatments would consist of application of fluridone at the rate of 20 parts per billion (ppb), and the third through tenth treatments would achieve a target concentration of 13.75 ppb (see **Table 2-1**), for a total of 150 ppb. The goal was to maintain a concentration of 1 to 3 ppb over the course of the treatment, as the target concentration of fluridone in the water column for effective control of Hydrilla is 1 to 3 ppb. Sonar H4C is a slow-release, pellet formulation, of fluridone. Therefore, application rates are higher than the target concentration for the water column. All application rates are in accordance with approved herbicide product label. Treatments occurred approximately seven days apart.

2.3.2 Northern Deep

Eight fluridone treatments were scheduled for the estimated 11.3-acre area between the Wells College Boathouse north to Lafayette Road during summer 2022. The treatment plan specified that the first four treatments would consist of fluridone applications at the rate of 10 ppb, and the fifth through eighth treatments at the rate of 8.75 ppb (see **Table 2-1**). As indicated in Section 2.3.1, the goal was to maintain a concentration of 1 to 3 ppb over the course of the treatment, as the target concentration of fluridone in the water column for effective control of Hydrilla is 1 to 3 ppb. Sonar H4C is a slow-release, pellet formulation of fluridone. Therefore, application rates are higher than the target concentration for the water column. All application rates are in accordance with approved herbicide product label. Treatments occurred approximately seven days apart.

2.4 Water Quality Sampling Methodology

The JV performed weekly in-lake water quality sampling to determine the fluridone concentrations and dispersion of herbicide between July 1 and September 8, 2022. USACE also performed water quality sampling to determine fluridone concentrations and herbicide dispersion at 15 sites on three dates during the season: July 14, August 9, and September 7, 2022. The samples collected by USACE are used to increase the understanding of the concentration of fluridone that was maintained during the course of the treatment.

Additionally, the Cayuga County Health Department performed weekly drinking water sampling between July 1 and September 9, 2022, and sampling at the public bathing beach on August 29 and September 9, 2022. The public bathing beach had been closed throughout the summer due to a lack of funding for lifeguards and therefore, sampling only occurred at the end of the season.

2.4.1 JV Sampling

The JV collected nine in-lake water samples across the two treatment blocks following each of the scheduled fluridone treatment events (see **Table 2-2** and **Figure 2-1** for sample locations). The full set of samples was taken all 10 weeks of treatment although only the northern shallow treatment block was treated during treatments nine and 10. The purpose of the overall sampling was to determine the fluridone concentrations just prior to the next planned treatment event so that herbicide application could be refined, if necessary, to maintain the proper concentrations throughout each event (i.e., to ensure follow-up applications would not exceed approved rates/concentrations). The sampling events were weather-dependent and scheduled so that results from each event were available for review by the Project team prior to the next application (i.e., there was a 48-hour turnaround time for sample analyses that factored into planning each sampling event). Weekly sampling events occurred approximately two days after each application, with the exception of the final sampling event.

Table 2-2 In-Lake Water Fluridone JV Sample Collection Sites Wells College Bay, Cayuga Lake Hydrilla Demonstration Project

Treatment Areas	Sample Location	Latitude ^a	Longitude ^a
N/A	LakeN	42.78090000000	-76.71460000000
N/A	LakeS	42.70740000000	-76.70060000000
Northern Deep	TreatND1	42.74720000000	-76.70220000000
Northern Deep	TreatND2	42.75350000000	-76.70450000000
Northern Shallow	TreatNS1	42.74230000000	-76.70090000000
Northern Shallow	TreatNS2	42.74930000000	-76.70220000000
Northern Shallow	TreatNS3	42.75570000000	-76.70480000000
Northern Shallow	TreatNS4	42.76330000000	-76.70850000000
Northern Shallow	TreatNS5	42.77350000000	-76.71130000000
N/A	Finished Drinking Water Sampling Location	42.743587	-76.699700
N/A	Beach Sampling Location	42.745189	-76.700581

Note:

^a Latitude and longitude are provided in decimal degrees (WGS84).

N/A = not applicable

The JV collected samples with a stainless-steel Kemmerer bottle sampler at the nine in-lake sampling locations as follows (see **Figure 2-1**):

- Seven samples within the treatment areas – five samples within the northern shallow treatment area and two within the northern deep treatment area;
- One sample approximately 0.5-miles north of the northern shallow treatment area (LakeN); and
- One sample approximately 0.5miles south of the southernmost NYSDEC treatment area (LakeS).

Samples from each sample location listed in **Table 2-2** were collected approximately at lake bottom to be representative of the fluridone concentrations where the plants are actively growing. The depth at each sample location was determined from the boat using a weighted tape to determine depth to bottom.

For 2022, the JV sampling methodology was revised to be consistent with USACE methodology to facilitate a more accurate comparison of sample results. For each sample, the tubing intake was attached to a weighted tape and dropped down to the bottom to determine depth to bottom. The pump was turned on as it was lowered and was lowered until sediment could be seen in the water flowing out of the end of the tubing, ensuring that the pump was on the lake bottom. Once on the bottom, the pump was raised slightly. When water in the tubing cleared of sediment, the sample was taken and the depth of the tubing was recorded. The sample was retrieved and transferred into a brown high-density polyethylene 30-milliliter sample bottle provided by the laboratory. All samples were stored to avoid light exposure and shipped in coolers to the SePRO Corporation (SePRO) in Whitakers, North Carolina, for analysis.

The JV analyzed in-lake fluridone water samples using a high-performance liquid chromatography (HPLC) method specific for fluridone. The standard operating procedure for measuring fluridone is a proprietary HPLC method developed by SePRO. The laboratory reported results for fluridone at a reporting limit of 1 ppb (micrograms per liter). Quality control samples were collected in the field during the post-application sampling period and consisted of field duplicate sample pairs collected at the same location at the rate of 5%.

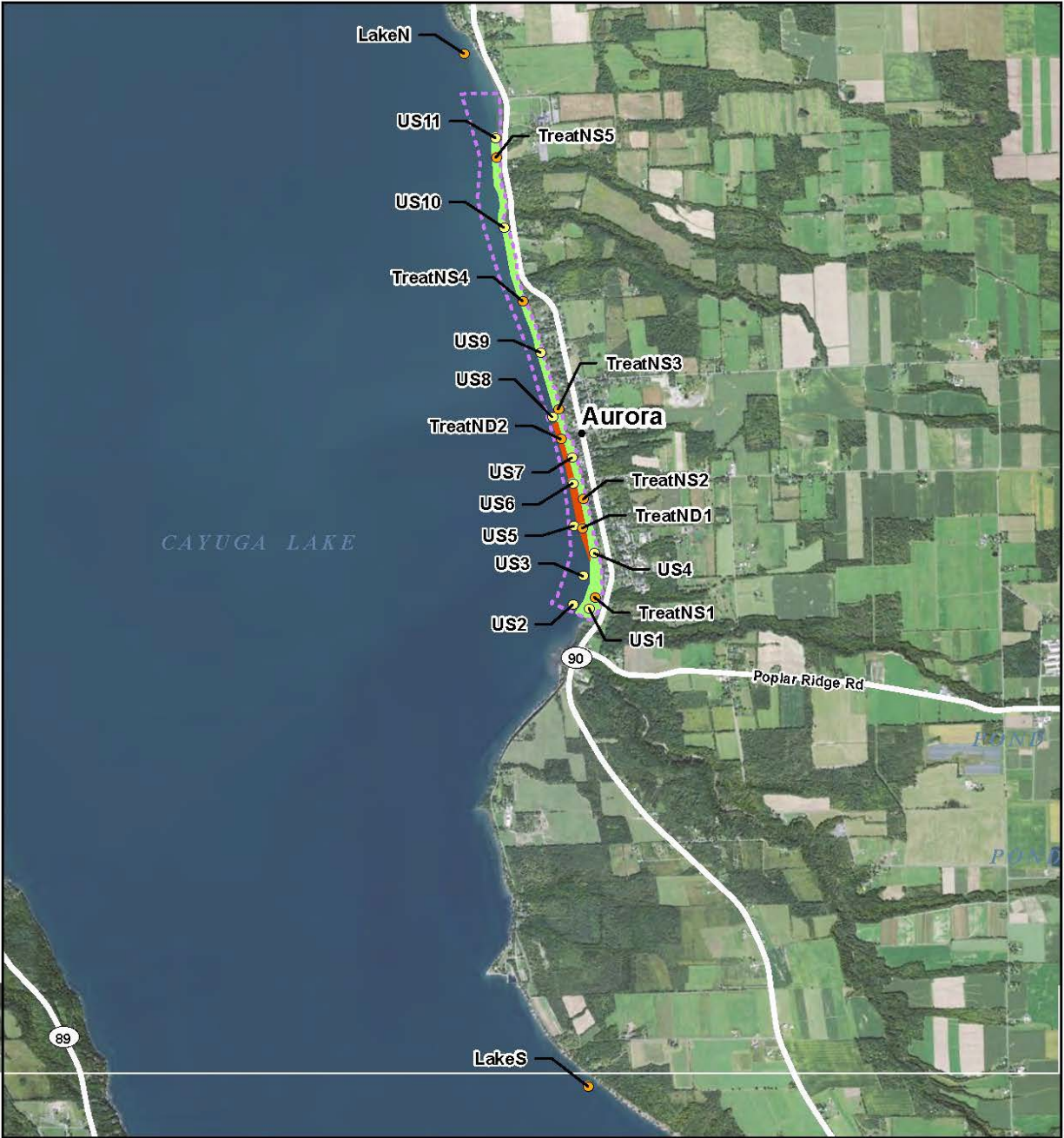


Figure 2-1 2022 In-lake and Drinking Water Sample Locations
Cayuga Lake, Cayuga County, New York

- | | |
|----------------------------------|--|
| Fluridone Treatment Areas | ● USACE Fluridone Sample Sites |
| ■ Northern Deep (11.3 acres) | ● EAS E&E Joint Venture Fluridone Sample Sites |
| ■ Northern Shallow (58.1 acres) | ■ Monitoring Area |

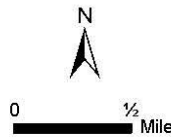


Figure 2-1 2022 In-lake and Drinking Water Sample Locations

2.4.2 USACE Sampling

USACE collected samples at 11 locations on three dates following the fluridone treatments. Sampling events occurred on July 14, August 9, and September 7, 2022 (see **Figure 2-1** and **Table 2-3**). Samples were collected from within and adjacent to the two treatment blocks (see **Figure 2-1**). Two samples were collected at each location with a water pump lowered to appropriate depth in the water column. One sample was collected in the middle of the water column, and one was collected at the lake bottom to determine dilution and spread of herbicide. Because of the granular nature of fluridone, sampling in the middle and bottom of the water column is more likely to pick up herbicide residues than sampling at the water’s surface.

USACE samples were analyzed by the Community Science Institute in Ithaca, New York, using the RaPID assay (enzyme-linked immunosorbent assay) method (RaPID Assay Fluridone Test Kit). The laboratory reported results for fluridone to a lower reporting limit of 0.5 ppb and an upper reporting limit of 10.0 ppb.

Table 2-3 In-Lake Water Fluridone USACE Sample Collection Sites Wells College Bay, Cayuga Lake Hydrilla Demonstration Project

Treatment Areas	Sample Location	Latitude ^a	Longitude ^a
Northern Shallow	US1	42.74150000000	-76.70140000000
N/A	US2	42.74170000000	-76.70300000000
N/A	US3	42.74380000000	-76.70210000000
Northern Shallow	US4	42.74540000000	-76.70100000000
N/A	US5	42.74730000000	-76.70310000000
Northern Deep	US6	42.75040000000	-76.70330000000
Northern Shallow	US7	42.75230000000	-76.70340000000
N/A	US8	42.75510000000	-76.70540000000
Northern Shallow	US9	42.75970000000	-76.70670000000
Northern Shallow	US10	42.76850000000	-76.71040000000
N/A	US11	42.77490000000	-76.71140000000

Note:

^a Latitude and longitude are provided in decimal degrees (WGS84).

N/A = not applicable

2.4.3 Cayuga County Department of Health Sampling

The Wells College water treatment plant shut down operations during each treatment application until each application was complete. The Cayuga County Health Department collected finished drinking water samples at the Wells College treatment plant (see **Figure 2-1**); the finished drinking water samples denote samples that went through the water treatment plant for processing prior to sampling. The Cayuga County Health Department collected finished drinking water samples 5 days after each treatment to determine if the treatment had an impact on drinking water. Additionally, the Cayuga County Health Department collected lake water at the Wells College Dock at the bathing beach on only two dates, August 29 and September 9, during the 2022 season due to beach closure from lack of funding for lifeguards.

Finished drinking water samples were collected from a sink tap within the Wells College maintenance building by a Cayuga County Health Department staff member. The staff member collected the sample by filling a clean high-density polyethylene container with tap water and then transferring the tap water into separate brown high-density polyethylene 30-milliliter sample bottles (including split samples).

The JV collected one finished drinking water split sample of the Cayuga County Health Department samples at a rate of 10 percent (i.e., one sample). The split sample was stored, protected from light, and

shipped via FedEx Priority Overnight in coolers to SePRO for analysis. SePRO used a proprietary HPLC to determine fluridone concentrations to a method detection limit of 1 ppb. The purpose of the split sample was to compare the fluridone concentrations in samples collected using the two different test methods (i.e., the RaPID assay method, and the SePRO proprietary HPLC method). The RaPID assay is considered a screening method, whereas the HPLC method is considered a definitive method. Any significant detection by RaPID assay would require confirmation by HPLC. There were no significant differences in detections between the Cayuga County Health Department finished drinking water sample and the JV split sample taken on August 12, 2022 (see **Table 2-6** in **Section 2.5.3**).

2.5 Results

Table 2-4 presents the results for the JV in-lake fluridone water samples; non-treatment block samples are also included for comparison. **Table 2-5** provides the results from the USACE in-lake sampling. The following subsections provide additional analysis of the results.

Table 2-4 JV In-Lake Water Sampling Results for Fluridone

Date	Sample Location	Sample Depth (feet and inches)	Fluridone Concentration (ppb) ^{a,b}
7/01/2022	LakeN	9.9	<1
	LakeS	10.4	<1
	TreatND1	15.0	1.1
	TreatND2	10.9	<1
	TreatNS1	5.4	1.7
	TreatNS2	7.0	<1
	TreatNS3	4.9	1.2/1.4
	TreatNS4	6.4	3.2
	TreatNS5	5.6	2.2
7/08/2022	LakeN	8.1	<1
	LakeS	14.2	<1/<1
	TreatND1	14.2	3.5
	TreatND2	11.7	1.2
	TreatNS1	5.7	2.8
	TreatNS2	8.2	3.7
	TreatNS3	4.2	<1
	TreatNS4	6.0	<1
	TreatNS5	4.1	1
7/15/2022	LakeN	9.7	<1
	LakeS	17.9	<1
	TreatND1	14.4	5.6
	TreatND2	12.1	1.8
	TreatNS1	5.7	<1
	TreatNS2	7.6	<1
	TreatNS3	3.9	<1/<1
	TreatNS4	4.9	<1
	TreatNS5	4.2	<1

Wells College Bay Post-Treatment Assessment Report

Date	Sample Location	Sample Depth (feet and inches)	Fluridone Concentration (ppb)^{a,b}
7/22/2022	LakeN	8.7	<1
	LakeS	11.0	<1
	TreatND1	14.3	6.6
	TreatND2	12.0	2.4
	TreatNS1	5.5	7.8
	TreatNS2	6.8	1.7
	TreatNS3	4.3	<1
	TreatNS4	4.0	<1
	TreatNS5	3.6	<1
7/29/2022	LakeN	9.2	<1
	LakeS	17.2	<1
	TreatND1	14.9	16.2
	TreatND2	12.4	1.5
	TreatNS1	5.4	3.4
	TreatNS2	7.0	1.7
	TreatNS3	4.3	1.3
	TreatNS4	4.9	<1
	TreatNS5	4.5	<1
8/5/2022	LakeN	8.8	<1
	LakeS	12.3	<1
	TreatND1	14.0	2.4
	TreatND2	11.9	2.9/3.0
	TreatNS1	4.7	1.2
	TreatNS2	6.6	1.7
	TreatNS3	4.6	1.2
	TreatNS4	5.0	1.7
	TreatNS5	3.6	<1
8/12/2022	LakeN	9.7	<1
	LakeS	16.7	<1
	TreatND1	14.3	<1
	TreatND2	13.4	2.2
	TreatNS1	5.2	2.6
	TreatNS2	5.9	1.3
	TreatNS3	3.8	<1
	TreatNS4	4.6	<1
	TreatNS5	4.2	1

Wells College Bay Post-Treatment Assessment Report

Date	Sample Location	Sample Depth (feet and inches)	Fluridone Concentration (ppb) ^{a,b}
8/19/2022	LakeN	9.6	<1
	LakeS	13.8	<1
	TreatND1	14.9	1.9
	TreatND2	11.8	<1
	TreatNS1	5.4	2.5
	TreatNS2	6.0	2.1
	TreatNS3	4.0	1.5
	TreatNS4	4.8	<1
	TreatNS5	4.3	1.1/1
8/26/2022	LakeN	10.0	<1
	LakeS	15.1	<1
	TreatND1	14.7	7.9
	TreatND2	11.0	1.4
	TreatNS1	5.2	2.7
	TreatNS2	6.9	2.0
	TreatNS3	3.9	1.6
	TreatNS4	4.8	<1
	TreatNS5	4.4	<1
9/8/2022	LakeN	10.7	<1
	LakeS	14.6	<1
	TreatND1	14.7	1.3
	TreatND2	12.9	1.1
	TreatNS1	5.6	1.3
	TreatNS2	6.7	<1
	TreatNS3	4.4	<1
	TreatNS4	5.1	<1
	TreatNS5	3.9	1.4

Notes:

^a Two reported results in a single cell indicate an instance where a field duplicate sample was collected.

^b Bold values denote positive detections.

ppb = parts per billion

Table 2-5 USACE In-Lake Water Sampling Results for Fluridone^a

Sample Location	Fluridone Concentration (ppb)		
	7/14/2022	8/9/2022	9/7/2022
US1 Mid	1.9	2.0	<0.5
US1 Bottom	2.2	2.2	<0.5
US2 Mid	<0.5	2.3	<0.5
US2 Bottom	<0.5	1.4	<0.5
US3 Mid	0.6	0.7	<0.5
US3 Bottom	<0.5	0.9	<0.5
US4 Mid	3.5	2.2	<0.5
US4 Bottom	5.2	<0.5	<0.5
US5 Mid	0.5	2.8	<0.5
US5 Bottom	<0.5	0.9	<0.5
US6 Mid	0.9	2.0	<0.5
US6 Bottom	1.5	2.2	<0.5
US7 Mid	1.9	2.8	<0.5
US7 Bottom	1.7	1.6	<0.5
US8 Mid	<0.5	0.7	<0.5
US8 Bottom	<0.5	<0.5	<0.5
US9 Mid	2.9	1.6	1.4
US9 Bottom	2.8	1.4	1.7
US10 Mid	1.6	11	1.0
US10 Bottom	1.6	0.7	0.7
US11 Mid	<0.5	0.8	<0.5
US11 Bottom	<0.5	0.8	<0.5

Notes:

^a Bold denotes sample location within application area, as well as positive sample detections.

MID = middle of water column; ppb = parts per billion; USACE = United States Army Corps of Engineers

2.5.1 JV Sampling

Fluridone concentrations at locations approximately 0.5 miles outside of treatment areas (LakeN and LakeS) remained below the reporting limit (<1 ppb) for all samples taken for the duration of the monitoring period between July 1 and September 8, 2022. For samples taken within the treatment areas, fluridone concentrations ranged from <1.0 ppb to 16.2 ppb, with the highest concentration, 16.2 ppb, occurring within the northern deep treatment area (TreatND1) on July 29, 2022. Within the northern deep treatment area, sample location TreatND1 evidenced the greatest variation in herbicide concentration throughout the season within that treatment area and across both treatment areas, ranging from <1.0 ppb to 16.2 ppb. Herbicide concentrations at sample location TreatND2 ranged from <1 to 3.0 ppb. The difference in concentrations between those two locations may have been that concentrations at TreatND1 were influenced by the NYSDEC treatment areas, which were adjacent to the southernmost ends of the northern deep and northern shallow treatment areas, and westward herbicide movement out of the northern shallow

treatment area. With the exception of the first week of sampling, sample points TreatNS4 and TreatNS5 had the lowest concentrations across both treatment areas, ranging from <1 to 3.2 ppb. This may be explained by the fact that these are the most northern of the sample locations within treatment areas and are farthest away from the potential influence of adjacent treatment areas. In addition, sample points TreatNS4 and Treat NS5 are more exposed to the influence of the open lake than the southern portions of the treatment areas in Wells College Bay.

Within treatment areas, herbicide concentrations varied on some sampling dates. Within the northern deep treatment area, the two sampling locations (TreatND1 and TreatND2) varied greater than 1.5 ppb on five of the ten sampling dates. On those dates, the difference in fluridone concentrations between the sample locations ranged from 2.3 to 14.7 ppb (see **Table 2-4**). Again, as discussed above, this may have been due to the influence of the NYSDEC treatment areas on the concentrations at TreatND1. For the northern shallow treatment area, concentrations varied across the five sampling points (TreatNS1 through TreatNS5) within that area from 0.4 to 2.7 ppb on nine of the sampling dates. On July 15, 2022, there was no variation in any of the samples; all were <1 ppb. Sampling results from September 8, 2022, which occurred one day after the final herbicide application, for the northern deep treatment area and northern shallow treatment area, were all 1.4 ppb or less.

2.5.2 USACE Sampling

Slight variation in herbicide residues was detected within the water column, as evidenced by differences in fluridone concentration between middle and bottom samples taken at the same collection location. However, bottom samples were not always higher than middle samples, even though concentrations would be expected to be highest at the bottom, given the granular nature of the herbicide.

Overall, concentrations were within the target range for fluridone in the water column for effective control of Hydrilla (1 to 3 ppb) for sample sites within treatment areas. The highest concentration was 5.2 ppb at sample location US4 taken on July 14, 2022. This location is within the northern shallow treatment area (see **Figure 2-1**). At all five sample locations outside the treatment areas, concentrations above the detection limit were reported for the August 8, 2022; values above the detection limit were reported for the bottom and/or middle samples. Concentrations ranged from 0.7 up to 2.8 ppb. This may indicate that currents were moving herbicide offshore, out of the treatment areas. Additionally, in the results from samples taken on July 14, 2022, concentrations at US3 and US5 were slightly above the detection limits (0.6 and 0.5 ppb, respectively). By the final sampling conducted on September 7, 2022, all samples were below the detection limit except those taken at US9 and US10, which ranged from 0.7 to 1.7 ppb. These are located in the upper half of the northern shallow treatment area.

In general, the fluridone concentrations in the samples collected by USACE and the JV were consistent. The fluridone concentrations for the JV samples ranged from <1 up to 16.2 ppb. The average concentration for JV samples taken within the treatment area was 2.1 ppb. As indicated above, the fluridone concentrations for the USACE samples ranged from 0.7 to 2.8 ppb, with an average of 1.9 ppb.

2.5.3 Cayuga County Department of Health Sampling

All finished drinking water samples were below the reporting limit of 0.5 ppb (see **Table 2-6**). As previously noted, there were no significant differences in detections between the Cayuga County Health Department finished drinking water sample and the JV split sample taken on August 12, 2022. The beach water samples collected on August 29 and September 9, 2022, were above the detection limits (0.6 and 1.3 ppb, respectively).

Table 2-6 Drinking Water and Beach Sampling Results for Fluridone (ppb)

Date	Sample Site	Fluridone Concentration (ppb)	
		Cayuga County Health Department	JV
7/1/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS
7/11/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS
7/20/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS
7/25/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS
8/1/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	<0.5	NS
8/8/2022	Wells College Maintenance Building	<0.5	<1
	Wells College Dock	0.6	NS
8/12/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS
8/22/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	NS	NS

Date	Sample Site	Fluridone Concentration (ppb)	
		Cayuga County Health Department	JV
8/29/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	0.6	NS
9/9/2022	Wells College Maintenance Building	<0.5	NS
	Wells College Dock	1.3	NS

NS = not sampled

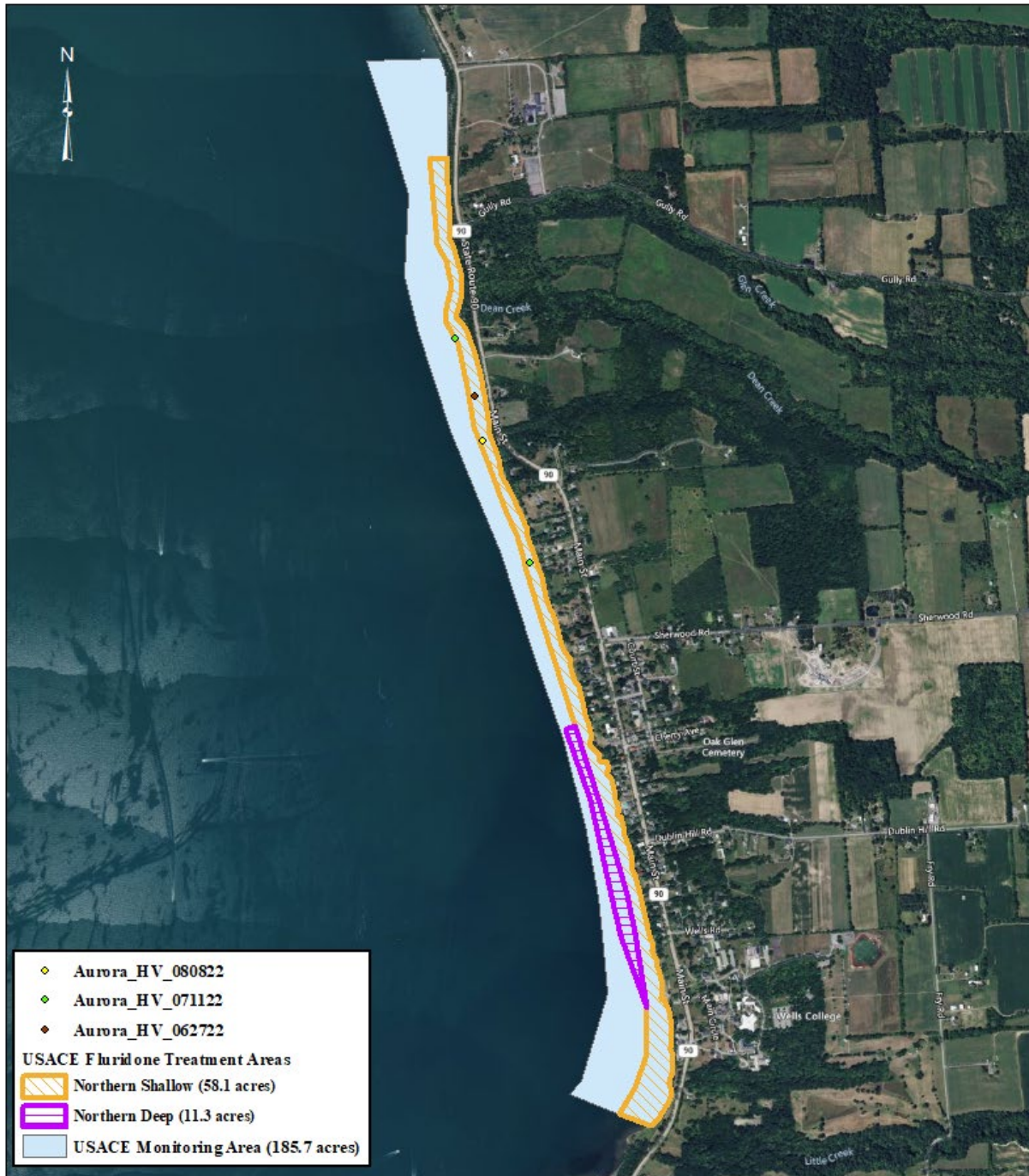
2.6 Vegetative Monitoring and Treatment Summary

The USACE conducted point intercept surveys within all fluridone treatment locations on four dates [June 27th (pre-treatment), July 11th & August 8th (during treatment), and October 3rd (post-treatment)] throughout the growing season to determine Hydrilla distribution and treatment efficacy. The USACE found Hydrilla at four separate locations within the first three-point intercept surveys. All four of the Hydrilla patches detected were within the two USACE treatment areas where herbicide was applied this year (Figure 2-2). Comparing pre- and post-treatment point intercept surveys demonstrates that treatment was largely successful at eliminating known patches of Hydrilla within targeted treatment plots (Figure 2-3). Overall, Hydrilla decreased in percent occurrence from 1.6% in 2021 to 0.5% in 2022. However, Hydrilla patches were also found in areas farther north than Hydrilla has been recorded in previous years. Additional effort was performed during summer and fall 2022 to delineate the extent of new Hydrilla patches; methods included point intercept surveys, visual observations where possible, and diver assisted surveys (Figure 2-4). The extent of the area where Hydrilla patches are now found is approximately 240-acres in size which includes all of the areas that were treated this year (~ 70-acre area by USACE and 124-acre area by NYSDEC). This 240-acre area extends north along an additional 2.1 miles of shoreline from the northernmost extent identified last year. This area will be studied further to determine an appropriate treatment to stop spread from this area to other areas within Cayuga Lake.

Despite there being an observed drop in abundance of plants within treatment areas, diversity of native plants was maintained from the previous year with five of the eight dominant species in the point intercept survey being native plants. Sago pondweed (*Stuckenia pectinata*) and eelgrass (*Vallisneria americana*) had similar percent occurrence to last year while Coontail (*Ceratophyllum demersum*) decreased in occurrence but was one of the top three dominant plants. Curly-leaf pondweed increased in percent occurrence and was the dominant invasive plant with the other two invasive species, Eurasian watermilfoil (*Myriophyllum spicatum*) and Starry stonewort (*Nitellopsis obtusa*) decreasing significantly in percent occurrence since 2021 (see **Table 2-7**).

Table 2-7 Summary of Dominant Species Percent Occurrence in Point Intercept Surveys

Species	Native/Invasive	Percent Occurrence 2022	Increase/Decrease over 2021
Sago pondweed (<i>Vallisneria americana</i>)	Native	22.7	Decrease
Eelgrass (<i>Zostera</i>)	Native	16.7	Decrease
Coontail (<i>Ceratophyllum demersum</i>)	Native	12.2	Decrease
Curly-leaf pondweed (<i>Potamogeton crispus</i>)	Invasive	9.8	Increase
White-stem pondweed (<i>Potamogeton praelongus</i>)	Native	8.5	Decrease
Starry stonewort (<i>Nitellopsis obtuse</i>)	Invasive	7.6	Decrease
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	Invasive	5.1	Decrease
Muskgrass (<i>Chara vulgaris</i>)	Native	5.7	Increase



Hydrilla PIS locations Jun - Aug 2022 Cayuga Lake at Aurora, NY



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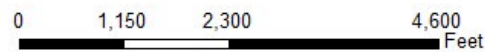
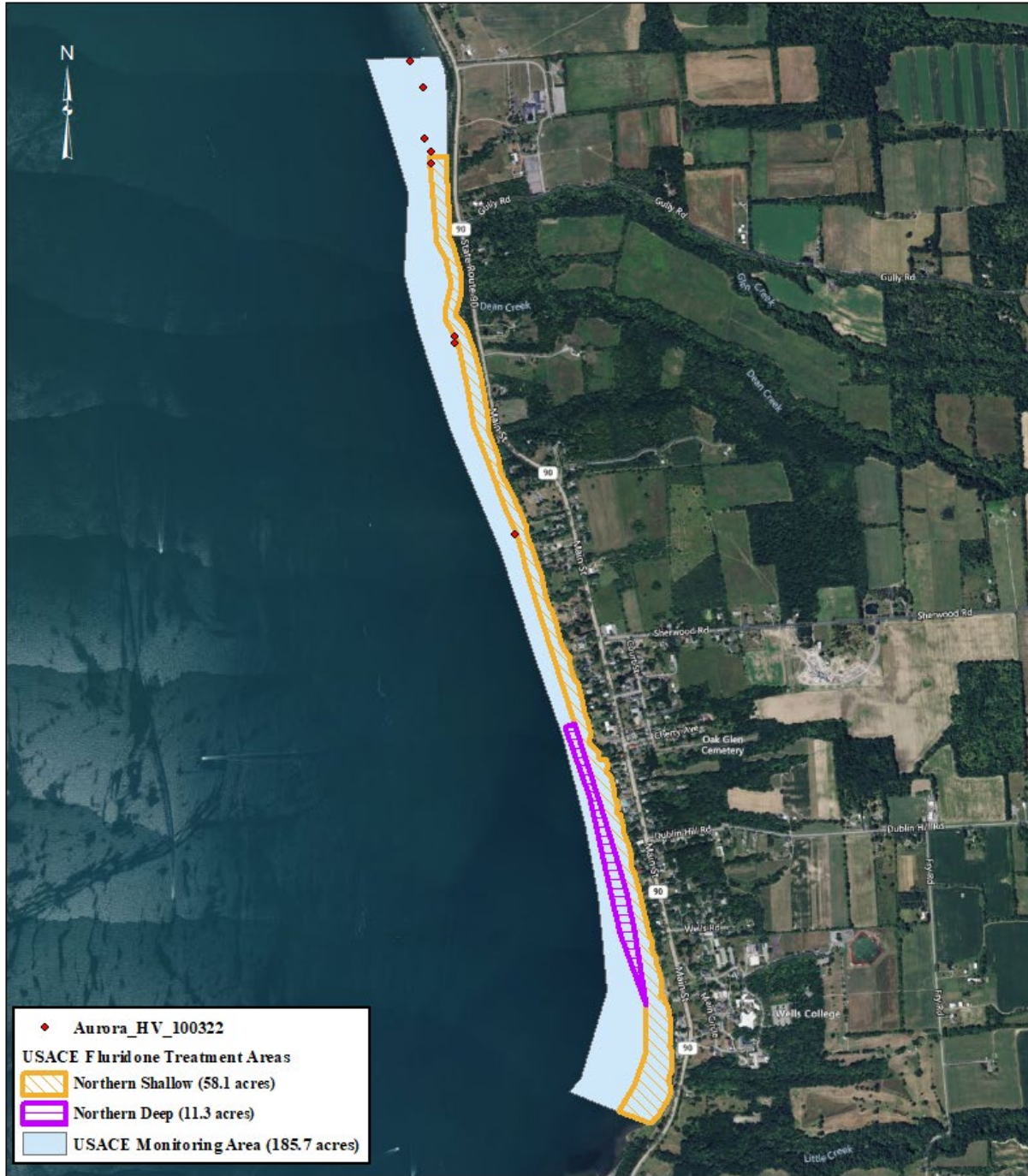


Figure 2-2 Hydrilla Locations from Point Intercept Surveys, June through August 2022



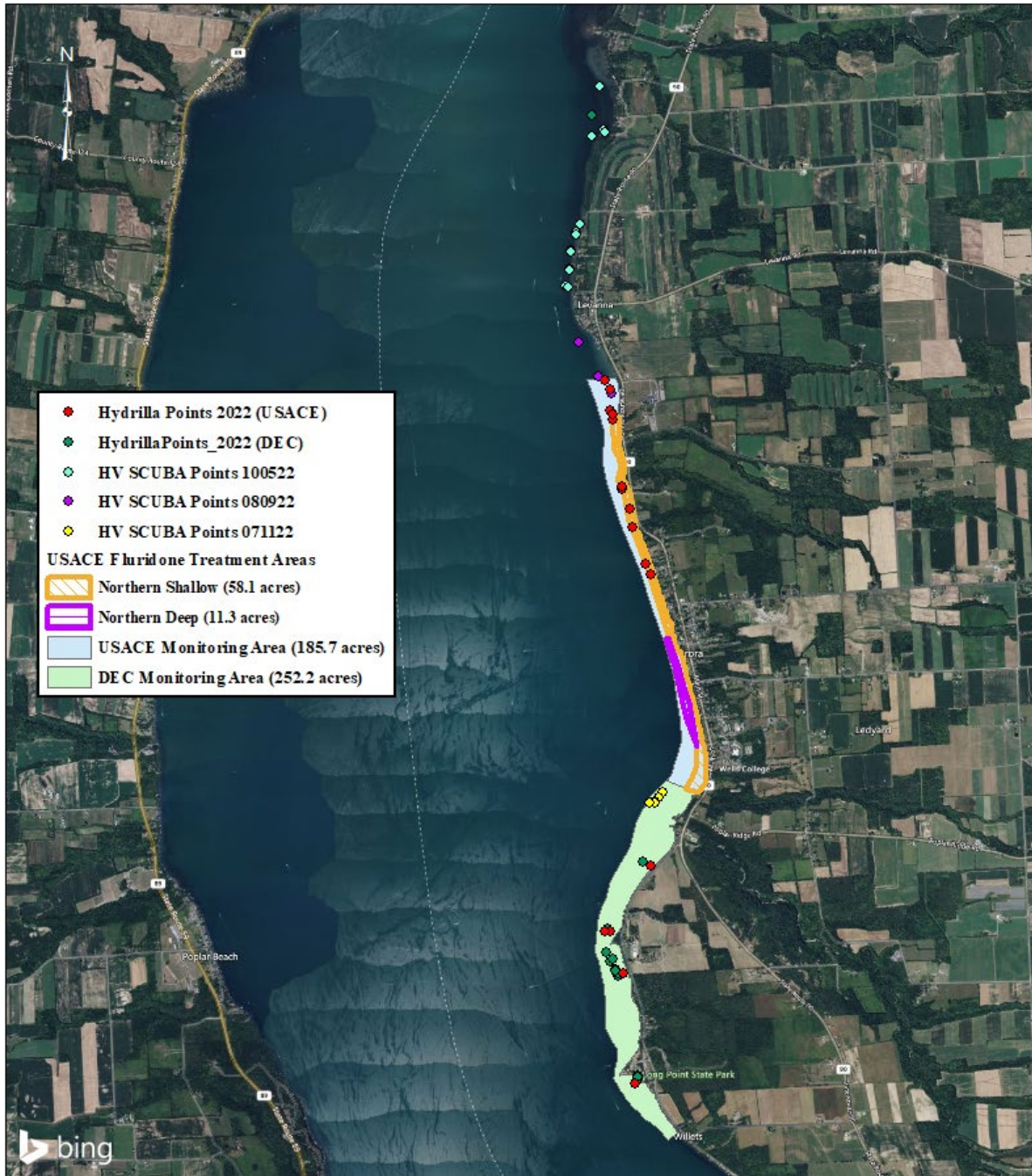
Hydrilla PIS locations Oct 2022
Cayuga Lake at Aurora, NY



US Army Corps of Engineers
Buffalo District
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0 1,150 2,300 4,600 Feet

Figure 2-3 Hydrilla Locations from Point Intercept Surveys, October 2022



2022 Hydrilla Locations Cayuga Lake at Aurora, NY



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Figure 2-4 2022 Hydrilla Locations from All Point Intercept Surveys

3 STUDY IMPROVEMENTS

The study improvements summarized in this section are based on lessons learned from the fifth year (2021) of the herbicide application effort, coordination with the study partners on work plan development, and activities conducted during the 2022 herbicide application.

3.1 Herbicide Application and Analysis

3.1.1 Herbicide Application

Transfer of the herbicide from the shore-based areas to the skiff and airboat, and application of the herbicide in 2022 was smooth and efficient. In high wind conditions, which occur regularly on Cayuga Lake's east shoreline, the skiff is a safer and more stable work boat than the airboat. For 2022, the 20-foot skiff was permanently stationed at the Cortland office and used for the Aurora treatments. The staging areas in Aurora adequately supported operations. Although inclement weather can significantly affect the application and subsequent in-lake sampling schedule, unsafe lake conditions delayed application by several days for only one event. The Project team needs to continue to look at long-range weather forecasts when planning future applications/sampling and build in schedule flexibility for each event.

3.1.2 Analysis

SePRO's proprietary HPLC method was used for analysis of fluridone in the in-lake samples taken by the JV. USACE samples were analyzed by the Community Science Institute in Ithaca, New York, using the RaPID assay (enzyme-linked immunosorbent assay) method (RaPID Assay Fluridone Test Kit), which allowed for a comparison of fluridone testing results.

3.2 2022 Lessons Learned

3.2.1 Communication

Twenty-four-hour email notification prior to herbicide treatments, including changes in treatment schedule, was effective, and no issues were raised by the Cayuga County Health Department or other stakeholders. This type of communication needs to continue in future treatment programs. There were several instances where a change in treatment date and/or delay in start time was necessary, and these were communicated with and approved by the Wells College water treatment plant.

3.2.2 In-Lake Sampling

Frequency of In-Lake Sampling and Logistics. In-lake samples should continue to be collected between day four and day seven after each fluridone application so that results can be obtained before the next treatment (assuming a 48-hour turnaround time). That way, the results can be used to ensure that target concentrations are achieved and not exceeded.

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4 REFERENCES

USACE (United States Army Corps of Engineers). 2022. *Architect-Engineer Scope of Work Aquatic Plant Control ERDC Demonstration Project Stewart Park, Cayuga Lake, Ithaca, NY*. April 2022.

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APPENDIX A. NYSDEC SUMMARY REPORT

Cayuga Lake (Aurora) NY Hydrilla Control Project

Contract #011991 - New York State Department of Environmental Conservation

and

SOLitude Lake Management

Post-treatment Report, December 19, 2022

Pre-treatment/Permitting

SOLitude Lake Management applied for Article 15 permits from New York State Department of Environmental Conservation (NYSDEC) for the use of two herbicides, Sonar H4C (active ingredient fluridone; EPA Reg. No. 67690-61) and Harpoon Granular (active ingredient copper ethylenediamine complex; EPA Reg. No. 67690-100). Areas and quantities were pre-determined in the proposal process (See Figure 3 and Table 1). Permits were sent to Region 7 offices on April 20, 2022. During this process, letters of notification were sent to homeowners abutting the modeled dilution zone (See Figure 4). On August 8, a discrepancy in the mailing list was brought to the attention of SOLitude Lake Management. Some parcels (3 properties total) were not listed on the Town Clerk website and additional notifications were sent to these property owners on August 11. These letters described the nature of the work to be performed, tentative treatment dates and water use restrictions. Between April 27-May 2, Sonar H4C quantities were changed slightly to agree with the concentration formula found on the product label (see Table 1). The discrepancy was brought to our attention and ultimately changed by Region 7 Pesticide Specialist Jerry Kimmel. Article 15 permits were received from the NYSDEC on June 8, 2022 and allowed the use of up to 12,353.52 lbs. of Sonar H4C (AV-7-22-39) over the course of ten-weeks and 123.8 acres, and up to 8,000 lbs. of Harpoon Granular across 11.764 acres (AV-7-22-38).

Treatment

Sonar H4C herbicide treatments were conducted via licensed applicators within SOLitude Lake Management and were done through the use of a bow-mounted spreader. Treatments were scheduled to be performed weekly, on Wednesdays, starting on June 29, 2022 and continuing for a 10-week period. The only deviation from this plan was during the tenth and final treatment of the year. Adverse weather conditions did not allow for the safe application of herbicide during the pre-scheduled date of August 31 and the treatment was rescheduled and performed on September 7. Treatment zones were mapped on an EZ-Guide navigation system and treatment paths were marked. For treatment areas, rates and applied product amounts, see Table 2.

Following the third treatment but prior to the fourth treatment, hydrilla was located by SePRO outside of the permitted treatment plots. An area was delineated to encompass the newly found plants (see Figure 1) and a new application area was added for the remainder of the treatments starting during treatment 4 (3.3 acres, ~18-foot average depth). In order to not change the overall amount of herbicide being applied throughout the year, the United States Army Corp of Engineers (USACE) cut some shallow water, near shore, treatment areas along the Southern Shallow Zone (see Figures 1 and 2).

This new deep 3.3 acre zone (Southern Deep Add) was the target of a Harpoon treatment conducted on the same day as the final Sonar H4C treatment (September 7). Application rate for Harpoon was 1 mg/L (79.7 lbs. per foot of plant growth). The treatment area was 3.3 acres and the height of the target plants was ~1 ft. This correlated to 263.01 lbs. of Harpoon Granular being applied across 3.3 surface acres.

Sampling/Analysis

Sonar H4C samples were collected within 48 hours of the application. Sample locations were pre-determined during the proposal and permitting process. Samples were collected by SOLitude Lake Management

Staff using GPS systems to pinpoint sampling locations. Six samples were collected during each sampling event (See Figure 3). Samples were collected and stored on ice until they were overnight shipped to the lab for analysis. Week 1 samples were sent to SePRO SRTC Laboratory, while weeks 2-10 were sent to Community Science Institute. Two sampling events occurred after the completion of the final treatment to ensure concentrations were below water use restriction thresholds. Community Science Institute used Eurofins Abraxis, Fluridone, Magnetic Particle ELISA, 100-test (PN 500511) kits in order to determine fluridone concentrations. (SOLitude Lake Management purchased these kits prior to the start of the treatment and had them shipped to the lab.) Community Science Institute had between a 10–20-day turnaround time on samples. For sample results, see Table 3.

Week 6 samples, collected on August 5, returned unusually high concentrations. Samples during this event were collected near the benthos. This was done with a 10' long section of pvc pipe with a ball valve on the end. This allowed the sampler to collect benthic samples. This change in sampling methods may have accounted for the erroneous sample results. Beginning in week 7, collected on 8/12, samples were collected via a van Dorn water sampler and results returned to within normal limits.

Harpoon granular samples were collected 7-14 days following the application. Three samples were collected and shipped overnight to the SePRO SRTC. Sampling locations were one sample within the treatment zone, one sample within the dilution zone but outside the treatment zone and one sample outside the dilution zone. All three samples returned concentrations below detection limit for the analysis employed by SePRO.

Post-treatment/Summary

Applications in Aurora were done as scheduled except for a one-week delay for the final (week 10) treatment. Work was completed without any adverse setbacks or issues as all equipment was functioning properly.

Pre-treatment surveys conducted in 2023 will determine the efficacy of treatments conducted in 2022 but surveys conducted in 2022 showed that control efforts were having an effect on hydrilla in the treatment zones.

Discussion/Recommendations

Plans for permits and treatment in 2023 are underway. It is recommended that all areas treated in 2022 continue treatment for 2023. Treatments should consist of an 8–10-week treatment with Sonar H4C followed by a spot treatment with Harpoon Granular as necessary. With new instances of Hydrilla being discovered near current treatment zones it is evident that there may be slight shifts of treatment zones in 2023. Through consultation with the US Army Corp of Engineers, the zones and rates should be finalized by Spring 2023.

Table 2: Application quantities, target concentrations and application dates

Week Number	Product Name	Southern Shallow 1	Southern Shallow 2	Little Creek Wetland	Southern Deep	Southern Deep Add	Weekly Totals (lbs.)	Rate	Application Date
1	Sonar H4C	1139.2	51.3	0.4	478.5	0	1683.05	20 ppb	6/29
2	Sonar H4C	1139.2	51.3	0.4	478.5	0	1683.05	20 ppb	7/6
3	Sonar H4C	768.96	34.63	0.27	322.98	0	1157.11	13.5 ppb	7/13
4	Sonar H4C	749.99	34.63	0.27	322.98	60.5 (20 ppb)	1117.21	13.5 ppb	7/20
5	Sonar H4C	749.99	34.63	0.27	322.98	52.94 (17.5 ppb)	1117.21	13.5 ppb	7/27

Week Number	Product Name	Southern Shallow 1	Southern Shallow 2	Little Creek Wetland	Southern Deep	Southern Deep Add	Weekly Totals (lbs.)	Rate	Application Date
6	Sonar H4C	749.99	34.63	0.27	322.98	52.94 (17.5 ppb)	1117.21	13.5 ppb	8/3
7	Sonar H4C	749.99	34.63	0.27	322.98	52.94 (17.5 ppb)	1117.21	13.5 ppb	8/10
8	Sonar H4C	749.99	34.63	0.27	322.98	52.94 (17.5 ppb)	1117.21	13.5 ppb	8/17
9	Sonar H4C	749.99	34.63	0.27	322.98	-	1117.21	13.5 ppb	8/24
10	Sonar H4C	749.99	34.63	0.27	322.98	-	1117.21	13.5 ppb	9/7
Total		89 acres (569.6 acft)	2.7 acres (25.65 acft)	0.2 acres (0.2 acft)	31.9 acres (239.25-acft)	3.3 acres (60.06-acft)	12343.68		

Table 3: Sample results (all results in ppb)

	Sites					
Date	LPD1	SD1	SS1	SS2	SS3	SS4
7/1	1.5	<1	<1	<1	3.1	1.7
7/8	1.1	1.9	8.1	11.1	3.2	<0.5
7/15	<0.5	4.7	2.2	2.7	1.1	4.4
7/22	<0.5	1.6	2.8	2.7	1.5	6
7/29	<0.5	1.2	1.5	1.6	1.9	2.9
8/5	13.8	40.2	30.8	13.6	28.6	34.8
8/12	<0.5	1.2	5.8	4.1	2.6	3.7
8/19	1.2	2.3	2.5	4.8	3.7	2
8/26	2.8	<0.5	1.9	3.7	2.3	3.1
9/9	<0.5	1.1	0.7	0.8	0.5	2
9/19	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
9/26	<0.5	0.7	<0.5	<0.5	<0.5	<0.5

Figure 1: Map denoting Southern Deep Add zone that was added to treatments week 4.

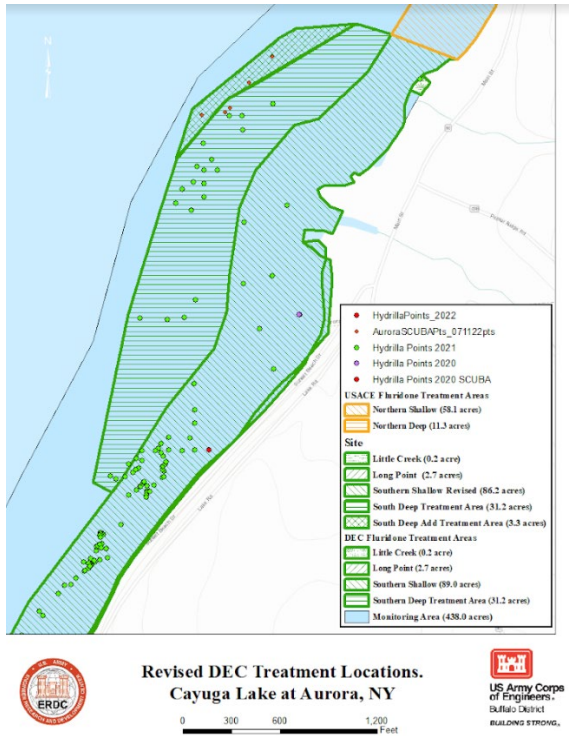


Figure 2: Map denoting reduced application area near shore and southern section of Southern Shallow zone to accommodate product being applied to Southern Deep Add.

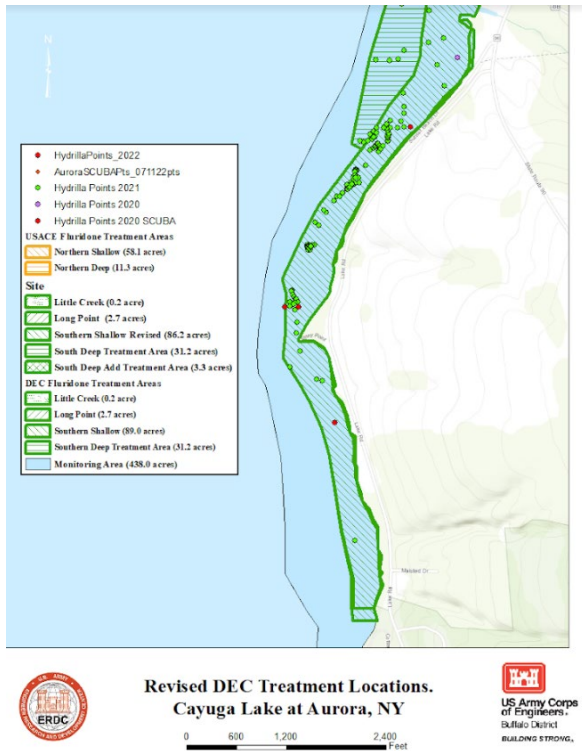


Figure 3: Water sample collection locations and treatment zones for Sonar H4C. 3 harpoon samples were collected following the treatment. One sample within the treatment zone, one sample within the dilution zone but outside the treatment zone and one sample outside the dilution zone.



Figure 4: Mapped area of the modeled dilution zone.

