2023 Annual Report

Lake Massapoag
Sharon, Massachusetts

February 2024

Lake Massapoag

Prepared For:

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TABLE OF CONTENTS

TABLES

FIGURES IN REPORT

FIGURES APPENDED AT END

ATTACHMENTS

1.0 Setting

Lake Massapoag on September 19, 2023.

Lake Massapoag is an approximately 389-acre lake located entirely in the Town of Sharon. The Lake consists of three coves; Horton's Cove (located between Beach Street and Beach Road), Fletcher's Cover (located east of Sturges Road), and the South Cove (located in the southern portion of the lake to the west of Community Center Drive). The lake also has the Lagoon located to the east of the South Cove. The lake receives inflows from the Lagoon and several small tributaries, including a Canoe River tributary into the southern portion of the lake, and Sucker Brook into the southeast portion of the lake. The lake outflow is through Massapoag Brook to the north which eventually flows into the Neponset River. The lake's shoreline includes residential homes, public beaches, and summer camps. The lake is listed on the 2022 MassDEP Integrated List of Waters for the presence of invasive aquatic weeds and high mercury content in fish (MassDEP, 2023).

The lake supports wildlife habitat, as well as outdoor recreation by residents on the lake, the public visiting the lake, and the large summer camps that operate on the lake. However, the lake has faced ongoing issues of high *E. coli* levels at beaches, causing beach closures. Also, repeated cyanobacteria blooms on the lake have impacted recreation. To face these environmental challenges, and the ongoing problem of invasive species in the lake, the Lake Massapoag Advisory Committee (LMAC) is currently working with Massachusetts Executive Office of Energy and Environmental Affairs through the Municipal Vulnerability Preparedness (MVP) program and MassDEP through the 604(b) Water Quality Management Planning program to develop a climate resiliency watershed-based plan for Lake Massapoag for 2025-2050.

TRC prepared the following report to summarize monitoring activities performed at Lake Massapoag for the calendar year 2024. Results from this report include results from TRC's investigations, as well as additional analysis of data collected by LMAC and the Neponset River Watershed Association (NepRWA). TRC also performed grab sediment sampling in March 2023, a separate alum monitoring report on a low-dose alum treatment in the South Cove on July 26, 2023, and Deep Hole core sediment sampling in November. The March sediment results are described in the "2023 Sediment and Water Quality Results" letter report dated June 8, 2023 and included in Attachment B.

2.0 Management Actions Implemented in 2023

The management actions undertaken in 2023 include the following:

1. **Hand-Pulling and Diver Assisted Suction Harvesting (DASH).** This action was focused within Fletcher's Cove, the Lagoon, and the South Cove. The Town contracted Sterling Aquatic LLC to conduct work within Fletcher's Cove and the Lagoon. A total of 20 days of hand-pulling were performed in June and July 2023 in Fletcher's Cove and the Lagoon, and a total of approximately 23,730 lbs. (approximately 14 cubic yards) of plant material

was pulled. Sterling Aquatic also performed one day of weed raking in part of the Veterans Memorial Beach swim area to help clear curly leaf pondweed impeding safe swimmer use. The Town contracted New England Aquatic Services to conduct additional DASH efforts in the South Cove from September 25 to September 29, 2023 where 5,265 gallons (approximately 26 cubic yards) of plant material was removed.

2. **Alum Treatment and EutroSORB Socks.** A low-dose alum treatment was conducted in the South Cove on July 26, 2023 by Water and Wetland (W&W). A summary of the alum treatment can be found in TRC's "Low Dose Alum Treatment Monitoring Report", revision date November 7, 2023, included in Attachment G. Additionally, six EutroSORB socks were placed by W&W at the Lagoon entrance into the lake to adsorb phosphorus and reduce inputs into the lake on July 14, and two EutroSORB socks were placed at the Canoe River entrance on by LMAC on August 17; all removed in late October.

3.0 Approach

TRC completed field visits to Lake Massapoag on May 17, July 17 and September 19, 2023. During these visits, TRC conducted a field assessment of physical, biological, and water quality conditions in the lake. The approach used for the 2023 monitoring program is discussed in the following sections.

3.1 Water Quality

Water quality sampling visits were conducted on May 17, July 17 and September 19, 2023. In May and July, water quality was assessed through in-situ measurements, as well as the collection of samples for laboratory analysis at the deep hole location of the lake. During the field visit in September, an additional water quality sample was collected from the South Cove. Field measurements included the following:

- Water transparency (Secchi disk depth)
- Water temperature
- Dissolved oxygen (concentration and percent saturation)
- Specific conductance
- pH
- Turbidity

Water transparency was measured using a Secchi disk at the surface of the lake. Water temperature, dissolved oxygen, and specific conductance were measured at one-meter intervals along a vertical profile in the water column. Turbidity and pH were measured in surface, mid-depth, and bottom waters.

Grab samples for laboratory analysis were collected from surface and bottom depths at the deep hole and at the surface of the South Cove. Samples were stored in laboratory-approved bottles and transported under chain-of-custody to the appropriate laboratory. Samples were sent to Phoenix Environmental Laboratories of Manchester, Connecticut for analysis of total and dissolved phosphorus and total nitrogen (total Kjeldahl nitrogen (TKN), nitrite, and nitrate). Chlorophyll a samples were also collected at the surface of the deep hole and at the South Cove.

Chlorophyll a samples were sent to Alpha Analytical Laboratory (Alpha) of Westborough, Massachusetts for analysis.

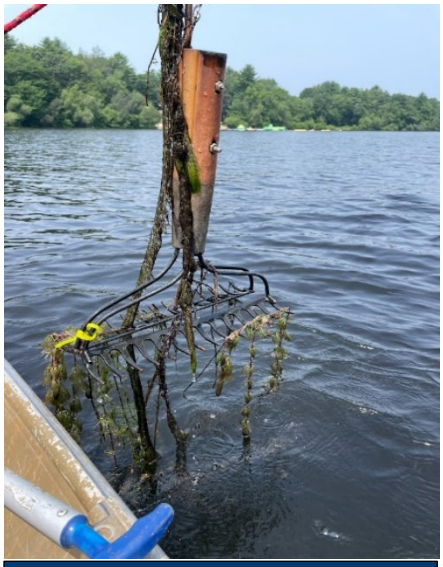
3.2 Aquatic Vegetation

On July 17, 2023, TRC conducted mapping of aquatic plants, with a focus on identification of the extent and density of exotic and nuisance species.

TRC used plant rakes and direct observation to map the aquatic vegetative community composition, as well as cover and biovolume at 133 locations in Lake Massapoag. All vascular aquatic plants were identified to genus or species level in the field by qualified staff. Percent cover and biovolume were visually ranked using the following scale:

- 0 = 0% (no cover)
- 1 = 1-24%
- 2 = 25-49%
- 3 = 50-74%
- 4 = 75% or more.

All observed species, percent cover, and biovolume were recorded at each point and positions were collected with a GPS receiver.



Plant rake method used at the Lake Massapoag plant survey conducted on July 17, 2023.

4.0 Results

4.1 Water Quality

Water quality results for Lake Massapoag from the three sampling events are discussed by parameter in the following sections. Surface water quality parameters are compared to Class B Surface Water Standards (310 CMR 4.05(3)(b)), where applicable. However, it should be noted that the water quality presented in this report represents a limited snapshot of water quality in the lake and a select group of parameters. Each of these parameters should be expected to vary on a daily, seasonal, and interannual basis. In-lake water quality sampling locations are located in Figure 1. Field measurement profiles for each sampling date are included in Attachment A.

4.1.1 Dissolved Oxygen

As in terrestrial ecosystems, oxygen is required to support respiration in most life associated with aquatic ecosystems, including plants, algae, fish, invertebrates, and many other life forms. Oxygen dissolves in water at a rate inversely related to temperature; solubility increases with decreasing water temperature.

Additionally, the concentration of dissolved oxygen impacts chemical processes in water. Metals, such as iron and manganese, may become more soluble in their reduced forms, which dominate

under anoxic conditions. Similarly, nutrients like phosphorus may be released at a higher rate from bottom sediments when dissolved oxygen is low. In Massachusetts, the state instantaneous dissolved oxygen standard for support of warmwater fisheries in Class B waters is 5.0 mg/L (or as naturally occurs).

At the Lake Massapoag deep hole, dissolved oxygen values were within the standard at the surface during all sampling events (Figure A, Table 1). The May monitoring event showed dissolved oxygen concentrations greater than 5.0 mg/L down to the bottom of the lake; however, dissolved oxygen did not meet the standard at the bottom of the water column in the July and September monitoring events (Figure A, Table 1). This suggests dissolved oxygen conditions remain insufficient to support aquatic life at depth during the summer months.

Dissolved oxygen concentrations at the South Cove (9.75 mg/L) met the standard during the September sampling round (Table 1). Measurement of dissolved oxygen greater than 100% is indicative of the surface of the South Cove being supersaturated with dissolved oxygen. A likely cause of this could be the presence of algae in the water that is generating oxygen faster than it can leave the water through diffusion.

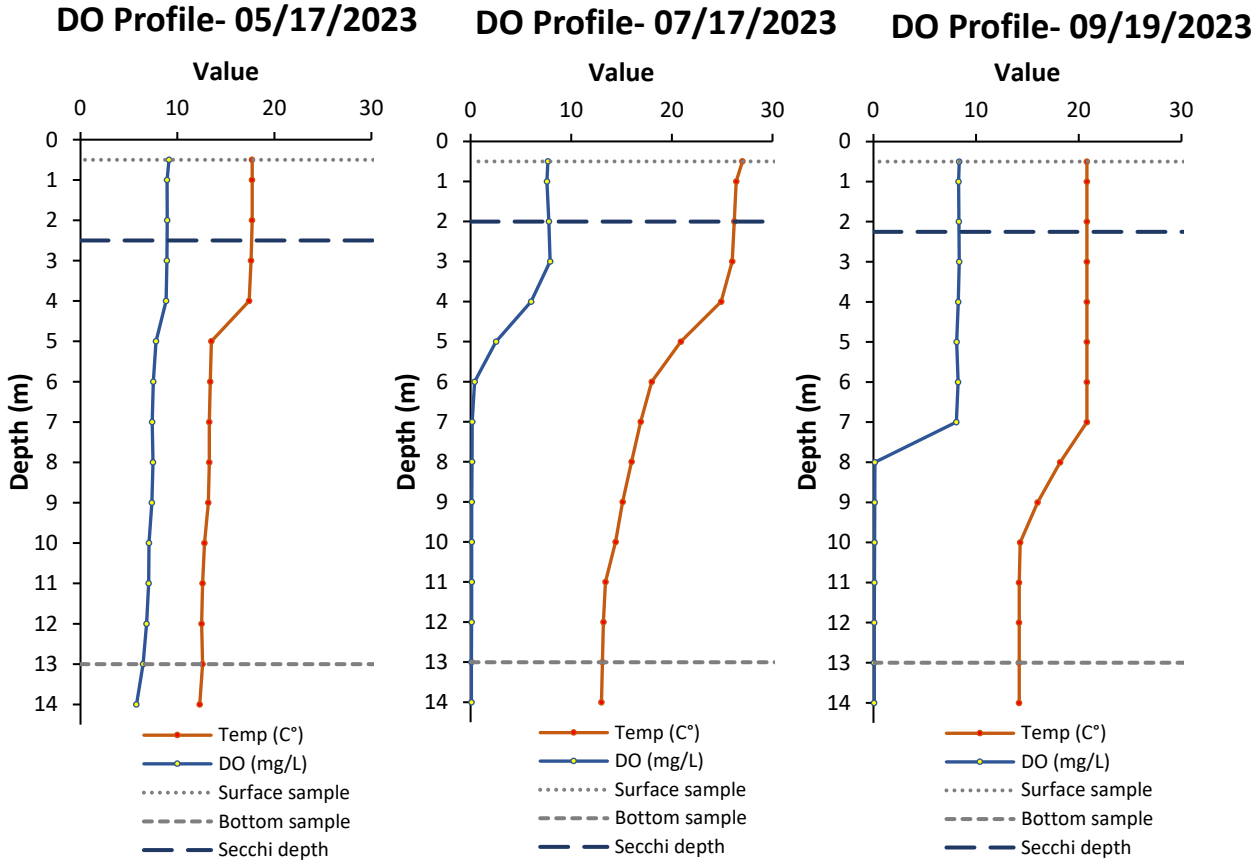


Figure A. Dissolved oxygen and temperature profiles from the three site visits collected at the deep hole spot in 2023.

4.1.2 Specific Conductance

Conductivity is a measure of dissolved ions (salts) in the water. Because temperature can strongly affect conductivity in water, specific conductivity is a standard method of correcting conductivity measurements to 25 degrees Celsius. Although there are no state numerical standards for conductivity, measurements above 100 µS/cm appear to be associated with human impact in eastern Massachusetts, except near the immediate coast or limestone outcrops. Pavement deicing is one of the most obvious sources of human-derived conductivity, although landscape practices (such as liming and fertilization), septic systems, and treated wastewater discharges, among other contributions may also serve as sources.

Measurements of specific conductance throughout the lake were generally high (greater than 100 µS/cm) indicating human activity, such as dissolved ionic pollutants (i.e. salts), has an impact on water quality in the lake (Table 1).

4.1.3 pH

The pH of water indicates whether it is acidic (< 7 SU), circumneutral (~7 SU), or basic (> 7 SU). As with dissolved oxygen, pH may vary substantially over distances and over time (even a single day). Therefore, a single snapshot of pH (as collected in this study) should be interpreted with caution.

In Massachusetts, the state standard in Class B waters is 6.5 SU to 8.3 SU and not more than 0.5 SU outside of the natural background range.

The deep hole and South Cove had pH values within the state standard for Class B waters (Table 1).

4.1.4 Turbidity

Turbidity is a measure of light scattering by matter in the water column. Some waterbodies are naturally turbid.

There is no numerical standard for turbidity in Massachusetts Class B waters, although the narrative standard indicates that they shall be free of turbidity in concentrations that are aesthetically objectionable or would impair any use assigned to this class.

Generally, turbidity values greater than 1 NTU above background are considered excessive. Turbidity values in July were at measured at 2.07 and 2.06 NTUs in the mid and bottom of the deep hole, respectively (Table 1). However, no extreme turbidity values were recorded in 2023.

4.1.5 Transparency

Water transparency is often expressed as the depth at which a Secchi disk just becomes visible. Low transparency measurements indicate poor transmission of light through the water column, although this may be due to a variety of causes including, but not limited to, natural staining, suspended sediments, algal growth, and manmade pollutants. Some waterbodies are naturally less transparent than others and low transparency does not necessarily indicate poor water quality. Higher transparencies are generally considered to be more aesthetically pleasing but also allow aquatic plants to grow at greater depths.

Transparency at Lake Massapoag ranged from 2 to 2.5 meters (6.6 to 8.2 feet) in the deep hole and at 1.5 meters (4.9 feet) in the South Cove (Table 1). Secchi disk readings were highest in May and lowest in July.

Table 1. Field Measured water Quality Parameters

Sample	Visit Date	Sample Depth (m)	Temp (°C)	Dissolved Oxygen (mg/L / % saturation)	Specific Conductance (µS/cm)	pH (SU)	Turbidity (NTU)	Secchi Disk (m)
Deep hole, Surface	**5/17**	0.5	17.7	9.13/ 97.4	174.7	7.51	0.08	2.5
	7/17	0.5	27.0	7.69/ 97.6	172.6	7.64	0.15	2.0
	9/19	0.5	20.8	8.36/ 95.3	167.2	7.78	0.28	2.25
Deep hole, Mid	**5/17**	7	13.3	7.41/ 72.0	173.4	7.12	0.09	N/A
	7/17	6	18.0	0.4/ 4.3	185.2	7.55	2.07	N/A
	9/19	7	20.8	0.16/ 1.6	168	7.32	0.42	N/A
Deep hole, Bottom	**5/17**	13	12.3	6.47/ 60.7	173.7	7.20	0.17	N/A
	7/17	13	13.1	0.09/ 0.9	193.0	7.37	2.06	N/A
	9/19	13	14.2	0.08/ 0.8	241.8	7.13	0.07	N/A
South Cove	**9/19**	0.5	20.3	9.75/ 110.3	159.1	7.15	0.19	1.5

4.1.6 Nutrients

High levels of nutrients (e.g., nitrogen and phosphorus) in the water column can lead to undesirable biological consequences. For example, floating plants like duckweed and water meal may grow to excessive levels when soluble inorganic nitrogen (e.g., nitrate, ammonia) and phosphorus are present at high concentrations. Likewise, high levels of these nutrients may also trigger excessive algal growth, leading to bloom conditions and, under certain conditions, dominance by harmful species of cyanobacteria. Phosphorus tends to be the limiting nutrient in freshwater lakes while nitrogen is more likely to be limiting in brackish or salt waters, although this can vary between water bodies and over time at the same water body. Co-limitation by phosphorus and nitrogen can also occur.

Phosphorus is an essential nutrient for aquatic life but high levels of phosphorus can result in rapid growth of algae and lead to eutrophication, particularly in freshwater waterbodies. Excessive phosphorus may also encourage cyanobacteria blooms to develop, which can result in odor issues or production of cyanotoxins, such as microcystin. Total phosphorus values include dissolved phosphorus in addition to the phosphorus found in or bound to sediment and organic compounds. Dissolved phosphorus is readily available for uptake by aquatic organisms and elevated dissolved phosphorus values may be indications of leaching of fertilizer, human or animal waste, or internal loading from sediments.

Although there is no statewide phosphorus standard for Class B waters, lower concentrations are preferable and concentrations in excess of 0.025 mg/L are typically considered excessive.

Total phosphorus levels in May were borderline excessive (>0.025 mg/L), with the surface sample being slightly greater than 0.025 mg/L and the bottom sample at 0.025 mg/L. The total phosphorus concentrations observed in July and September exceeded 0.025 mg/L at the bottom of the deep hole, but not at the surface of the deep hole (Table 2). A particularly high total phosphorus

concentration was observed at the bottom of the deep hole in September (0.129 mg/L). Total phosphorus at the South Cove was observed to be borderline excessive, with a concentration of 0.023 mg/L.

Dissolved phosphorus, which represents the portion of total phosphorus that is most likely to be available for biological uptake, exceeded 0.025 mg/L at the bottom deep hole sample collected in September (Table 2). Due to a lab error, dissolved phosphorus samples were not processed for the May sampling event. As a replacement and per LMAC's request, TRC collected an additional dissolved phosphorus sample at Fletcher's Cove during the September site visit, which had a concentration of 0.019 mg/L.

The nitrogen cycle is somewhat more complex than that of phosphorus. As with phosphorus, nitrogen compounds can be added to a lake via atmospheric deposition, inputs of plant matter from shoreline vegetation, and transport of nitrogen into a lake through runoff, other surface flows, or groundwater movement. However, unlike phosphorus, otherwise stable elemental nitrogen can be converted into more available forms of nitrogen and added to the lake system when it is "fixed" by cyanobacteria. Likewise, nitrogen can be removed from the lake system through the process of denitrification, in which microbes convert nitrate back to inert gaseous nitrogen. A measurement of total nitrogen is the sum of nitrate-nitrogen, nitrite-nitrogen, and total Kjeldahl nitrogen (TKN).

Although there is no statewide nitrogen standard for Class B waters, lower concentrations are generally preferable and total nitrogen concentrations in excess of 1.0 mg/L are often indicative of excessive anthropogenic sources.

Total nitrogen concentrations were not observed to be greater than 1.0 mg/L in the deep hole or South Cove (Table 2). In Lake Massapoag, the total nitrogen values were mainly comprised of TKN, which includes organic and ammonia nitrogen. Ammonia nitrogen can be released from sediments through biologically mediated anaerobic processes. Therefore, the higher TKN in bottom waters could possibly be due to ammonia release during periods of anoxia. Except for the May sampling event, nitrate-nitrogen and nitrite-nitrogen values were found to be below the laboratory reporting limit at all locations.

4.1.7 Chlorophyll A

Algal density can be inferred by measuring chlorophyll a, the primary photosynthetic pigment found in most algal cells. Although there is no statewide chlorophyll a standard for Class B waters, high chlorophyll a levels are generally considered undesirable because they are associated with elevated algal production and eutrophic conditions.

The chlorophyll a concentrations in Lake Massapoag ranged from 2.93 and 7.07 mg/m3 over the three sampling events (Table 2). While not extreme, these values continue to reflect algal growth within the lake. The chlorophyll a concentration at the surface of the deep hole in September was higher than the chlorophyll a concentration in May or July, indicating increased algal production in the later summer time period.

Table 2. Lab-Analyzed Water Quality Parameters

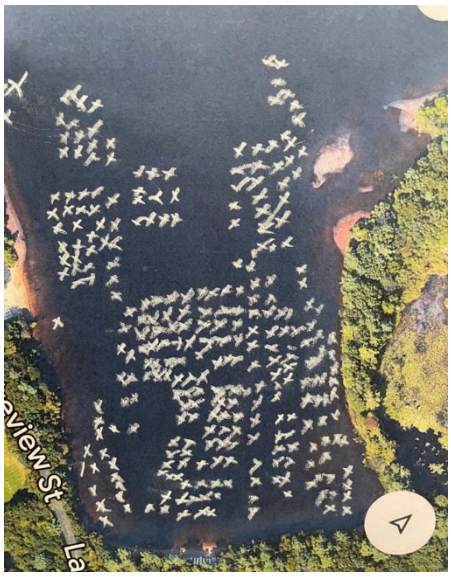
Sample	Visit Date	Nitrite-N (mg/L)	Nitrate-N (mg/L)	TKN (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Chlorophyll a (mg/m^3)
Deep Hole, Surface	**5/17**	<0.010	0.15	0.39	0.54	0.029	NT	5.28
	7/17	<0.010	<0.02	0.4	0.4	0.016	0.008	2.93
	9/19	<0.010	<0.02	0.33	0.33	0.024	0.013	7.07
Deep Hole, Bottom	**5/17**	<0.010	0.18	0.27	0.46	0.025	NT	--
	7/17	<0.010	<0.02	0.52	0.52	0.03	0.022	--
	9/19	<0.010	<0.02	0.89	0.89	0.129	0.107	--
South Cove	**9/19**	<0.010	<0.02	0.32	0.32	0.023	0.012	5.49
Fletcher's Cove	**9/19**	--	--	--	--	--	0.019	--

NT = not tested

4.2 Aquatic Vegetation

Aquatic plant cover was mainly observed along the margins of Lake Massapoag and covered approximately 58 acres (Figure 2). The majority of the aquatic plant growth observed was sparse (i.e. between 1% and 25% plant cover). Dense plant growth (i.e. greater than 50% plant cover) encompassed approximately 11.7 acres and was observed in Fletcher's Cove, South Cove, and the Lagoon just east of South Cove.

Aquatic plant biovolume was generally low for the majority of the observed plant beds (Figure 3). Biovolume in the South Cove and Fletchers Cove were categorized as moderate to high with density values ranging from 26% to 75% (i.e. between 26% to 75% of the water column occupied). At the time of the survey, no areas of the lake were observed to have biovolume greater than 75%, with the exception of the Lagoon which hosted approximately 3.7 acres of very high biovolume plant beds (i.e. greater than 75% of the water column occupied). TRC notes that since the plant survey in July, residents of Lake Massapoag mapped dense fanwort beds occupying the entirety of the South Cove water column in October, which postdated DASH efforts in the South Cove in September (see image to the right).



Fanwort mapped by lake residents on October 26, 2023. "X" symbols indicate locations of fanwort observed from boat.

The aquatic plant community observed at Lake Massapoag consisted of 16 species, three of which are invasive exotic species (Table 3). Two of the three invasives, fanwort (*Cabomba caroliniana*) and variable-leaf milfoil (*Myriophyllum heterophyllum*), are often associated with the formation of high-biovolume, nuisance-level beds. In contrast, the third invasive species, mudmat (*Glossostigma cleistanthum*), while capable of forming extensive beds, is diminutive in size. Each of the aquatic invasive species are further profiled in subsections below. All three species were also identified in the 2022 plant survey conducted by TRC (TRC, 2022).

The most frequently observed native aquatic plant species included waterweed (*Elodea nutallii*), stonewort (*Nitella* sp. – a type of macroalgae), watershield (*Brasenia schreberi*), and yelllow water lily (*Nuphar variegata*). The floating leaved lilies and watershields were almost exclusively observed in Fletcher's Cover and the eastern part of South Cove, as well as in the Lagoon. State-listed species are known to occur in the lake and include toothcup (*Rotala ramosior*) and resupinate bladderwort (*Utricularia resupinata*). Both species are protected under the Massachusetts Endangered Species Act and are classified as Endangered and Threatened, respectively; however, mapping the presence of these species was beyond the scope of TRC's surveys for 2023. A botanist survey was conducted for LMAC by Pondweed Pursuits LLC in August and September with the report submitted to NHESP and LMAC later in September.

Table 3. Aquatic Plant Species Observed at Lake Massapoag, July 2023

Scientific Name	Common Name	Growth Form	Status
Brasenia schreberi	Watershield	Floating leaved- attached	Native
Cabomba caroliniana	**Fanwort**	**Submerged- attached**	**Invasive**
Eleocharis sp.	Spikerush	Submerged- attached	Native
Elatine sp.	Waterwort	Submerged- attached	Native
Elodea nuttallii	Free-flowered waterweed	Submerged- attached	Native
Glossostigma cleistanthum	**Mudmat**	**Emergent**	**Invasive**
Myriophyllum heterophyllum	**Variable-leaf milfoil**	**Submerged- attached**	**Invasive**
Najas gracillima	Slender waternymph	Submerged- attached	Native
Nuphar variegata	Yellow water-lily	Floating leaved- attached	Native
Nymphaea odorata	White water-lily	Floating leaved- attached	Native
Nitella sp.	Stonewort	Submerged- attached	Native macroalga
Potamogeton epihydrus	Ribbon-leaved pondweed	Submerged-attached	Native
Potamogeton perfoliatus	Clasping-leaved pondweed	Submerged- attached	Native

Scientific Name	Common Name	Growth Form	Status
Utricularia radiata	Floating bladderwort	Floating- unattached	Native
Utricularia minor	Lesser bladderwort	Submerged- unattached	Native
Vallisneria americana	Tape grass	Submerged- attached	Native

4.2.1 Fanwort

Fanwort (Cabomba caroliniana) is a submerged invasive aquatic plant that can form dense mats at the water's surface. The green underwater leaves are fanlike and arranged oppositely along the stem. Fanwort is a hardy and persistent species that can become established in a range of aquatic habitats but prefers slow moving waters including lakes and ponds. It often displaces native species and reduces biodiversity. Fanwort was observed in Fletcher's and South Cove, covering approximately 3% of the lake (11.6 acres) in sparse to moderate patches (Figure 4). TRC notes that the plant survey was conducted following DASH efforts in Fletcher's Cove and the Lagoon, but prior to management of the South Cove. Following the plant survey in July, dense beds were observed by residents in the South Cove in September and again in October, about a month after DASH efforts occurred in the cove.

Fanwort (*Cabomba caroliniana*) observed at Lake Massapoag on July 17, 2023

4.2.2 Mudmat

Mudmat (*Glossostigma cleistanthum*) is an invasive species that forms dense mats in the littoral zone. Although diminutive in height, it readily spreads horizontally with tiny pairs of leaves arising from stems. Mudmat was mainly observed in sparse patches along the lake margin. Mudmat was observed to be moderately dense in three patches located by Memorial Beach, along the eastern margin, and in the South Cove (Figure 5). Given the minute size of this plant the impact of this species on lake water quality and ecology is unlikely to be significant.

4.2.3 Variable-Leaf Milfoil

Variable-leaf milfoil (*Myriophyllum heterophyllum*) is also a submerged invasive aquatic plant with densely packed, feather-like leaves whorled around a main stem. Variable leaf milfoil can form dense mats and grow in up to 10 feet of water or more where water levels vary or clarity is high. Variable-leaf milfoil is a hardy species and can become established in a range of aquatic habitats but prefers slow moving waters. Once established, variable-leaf milfoil can outcompete native species producing dense, high-biovolume mats and reducing overall biodiversity. Similar to fanwort, the variable leaf milfoil was observed in Fletcher's Cove and South Cove, covering approximately 2% of the lake (8 acres) in sparse to moderate patches (Figure 6). TRC notes that DASH contractors were also instructed to remove any variable leaf milfoil observed, in addition to

the fanwort.

5.0 Additional Data Collection

TRC also conducted an analysis of the other Lake Massapoag data collected during the 2023 season. Data was provided to TRC by LMAC.

5.1 Inflow Sampling

Samples were collected at several inflow locations during rain events from June through October, 2023. Each rain event exceeded 0.25 inches. Samples were collected by LMAC and submitted to G&L Laboratories of Quincy, Massachusetts for analysis of phosphorus and *E. coli*. Sample locations and a summary of the laboratory results from 2023 and 2022 for comparison are included in Attachment C. The following sections provide an analysis of the phosphorus and *E. coli* results.

5.1.1 Phosphorus Sampling

Phosphorus levels were sampled at 16 locations, although not every location was sampled during each sampling day. Sampling events were performed monthly from July to October, with three events occurring during the month of June. Six of the sixteen locations sampled reported phosphorus levels exceeding 0.05 mg/L and include the Lagoon, 140 East Foxboro Street, Opp 123 Beach St., Wetland/SHS, Opp 3 Capen Hill, and 240 Massapoag. These values show excessive phosphorus inflows into the lake.

When compared to the results from 2022, some locations show continued phosphorus inputs into the lake (140 East Foxboro Street, Opp 123 Beach St, Wetland/SHS), while other locations sampled (Lagoon Inflow, Canoe River, Sucker Brook, and Long Meadow) showed exceedances in 2022 but not in 2023. It is important to note that sampling results between the two years are different as sampling conducted in 2023 targeted inflows following rain events; while sampling in 2022 did not specifically target rain events. TRC acknowledges that due to town staffing constraints, inflow locations were not sampled consistently throughout the season, and a full set of August samples was lost due to incorrect pickup by a lab collecting DPW water samples.

5.1.2 E. coli Sampling

Fecal coliform bacteria, including *E. coli*, occur in the intestines of humans and other warm-blooded animals. Although these bacteria may not directly cause illness, they serve as indicators of fecal contamination and possible pathogens. Possible sources of *E. coli* in surface water include sewage or animal waste contamination. Results were compared to the Massachusetts Department of Public Health (MDPH) standard for *E. coli* in freshwater beaches, which is 235 cfu/ 100 mL.

E. coli was sampled at 11 dedicated inflow locations monthly from June to September. Eight of the 11 sample locations showed high *E. coli* results (single measurements exceeding 235 cfu/100 mL) and include the Lagoon, 140 East Foxboro Street, Opp 123 Beach St, Wetlands/SHS, Sucker Brook, Long Meadow, Landfill Drain S, and Landfill Drain N. High *E. coli* concentrations indicate a potential fecal contamination issue flowing into Lake Massapoag.

When compared to *E. coli* results from 2022, all inflow locations showed continued *E. coli* inputs; except for Canoe River which was sampled once this season and did not have a detection of *E. coli*. *E. coli* levels in Sucker Brook were lower in 2023 compared to 2022. As with the phosphorus results, it should be considered that the 2023 inflow sampling targeted wet weather events, while 2022 did not. TRC acknowledges that because of LMAC staffing constraints, inflow locations were not sampled consistently throughout the season. Additionally, a full set of August samples was lost due to incorrect pickup by a lab which tests the Town of Sharon Department of Public Works (DPW) water samples.

5.2 Additional *E. coli* Sampling at Town Beaches

E. coli was sampled weekly at the public beaches (Memorial Beach Swim Docks, Memorial Beach Center, and Community Center Beach) and at other non-public swimming areas (Camp Wonderland, Camp Everwood/ Gannett, Camp Everwood, and the Massapoag Lake Yacht Club). *E. coli* exceedances (greater than 235 colonial/100mL or a geometric mean of 5 sample results below 125 cfu) were observed at the Community Center Beach in 2023, but not as frequently, or to as high levels as in 2022. It should be noted that the beach was closed to swimming for the entire 2023 season due to frequent *E. coli* exceedances in 2022. It is possible the reduction in *E. coli* exceedances in the 2023 season is associated with the reduction in swimmer use of the beach. Additional *E. coli* exceedances were observed at Camp Everwood/Gannett and at Camp Everwood, also causing beach closures. *E. coli* sampling locations and results are included in Attachment D.

5.3 Additional Sucker Brook Sampling

NepRWA's Community Water Monitoring Network (CWMN) program includes Sucker Brook as one of their sampling sites. The sample location is directly upstream of Massapoag Avenue. As part of the CWMN, sampling at Sucker Brook was performed monthly from May to October 2023. Samples were analyzed for *E. coli*, total phosphorus, chlorophyll a, pH, and water temperature. A duplicate sample was collected on May 11 and analyzed for additional parameters including total nitrogen, orthophosphate (PO4-P) and ammoniacal nitrogen (NH3-N).

Results show that *E. coli* was detected in the stream, but at concentrations below the MDPH standard of 235 cfu/100 mL with the exception of the sample collected in September (2,480 MPN/100mL). NepRWA notes that the September sampling event occurred following a 2-inch rain event that occurred 24 hours before sample collection. The average of the NepRWA sample *E. coli* levels in Sucker Brook were lower in 2023 when compared to the average of the LMAC sample *E. coli* levels in Sucker Brook in 2022. Total phosphorus concentrations on all sampling dates were below 0.05 mg/L; however, concentrations in July and August were elevated (0.0483 and 0.0484 mg/L respectively) compared to the May and June results. This indicates that water inflowing from Sucker Brook contributes to the input of phosphorus into Lake Massapoag. Chlorophyll a levels ranged from 0.232 to 1.9 ug/L, suggesting evidence of photosynthetic periphyton on the stream bottom. The total nitrogen value recorded in May was not considered excessive (less than 1.0 mg/L). Orthophosphate is the simplest form of phosphate. Since it is both soluble and chemically reactive, it is the form most readily available to algae and cyanobacteria. The orthophosphate value for Sucker Brook in May indicates that readily available phosphorus made up about a third of the total phosphorus in the water. Ammonia nitrogen measures the amount of ammonia within the water. The ammonia nitrogen value in May indicates that only about 5% of the total nitrogen value is comprised of ammonia nitrogen. Ammonia can have toxic effects on aquatic life and can be exacerbated by elevated pH and temperature conditions in the

water. According to 310 CMR 4.00 Massachusetts Surface Water Quality Standards, the criterion continuous concentration[1] for ammonia at a pH of 7.0 and temperature of 20^{oC} is calculated to be 1.9 mg/L. The ammoniacal nitrogen value of 0.0452 mg/L is orders of magnitude below the standard for causing chronic toxicity exposure.

Table 4. NepRWA CWMN Sucker Brook Testing – May through October 2023

Visit Date	*E. coli* (MPN/100mL)	Total Phosphorus (mg/L)	PO4-P (mg/L)	Total Nitrogen (mg/L)	NH3-N (mg/L)	Chlorophyll A (ug/L)	pH	Water Temp. (oC)
5/11/2023	148	0.0282	NT	NT	NT	0.681	6.87	10
5/11/2023 (Duplicate)	52	0.0264	0.00889	0.814	0.0452	1.04	6.92	NT
6/8/2023	122	0.0233	NT	NT	NT	1.9	6.91	11
7/13/2023	169	0.0483	NT	NT	NT	0.2	7.11	17
8/10/2023	109	0.0484	NT	NT	NT	0.338	7.1	15
9/14/2023	2,480	N/A	NT	NT	NT	0.232	6.51	19
10/12/2023	187	N/A	NT	NT	NT	0.57	7.83	NT

NT= Not Tested, N/A= Not Available, and holding time exceeded.

5.4 Testing *E. coli* Sampling Media

LMAC conducted an experiment on *E. coli* sampling methods by sampling water, sand, and the bottom algae layer for *E. coli* at Community Center Beach and Sucker Brook. Results of the sampling are included in Attachment E. Samples were collected on September 11, 18, and 25, 2023. These samples show that *E. coli* concentrations were greatest in the bottom algae layer compared to the sand. *E. coli* concentrations were lowest in the water compared to the sand and algae layer sampled.

5.5 Additional Phycocyanin Sampling

Phycocyanin is a blue pigment found in cyanobacteria and can be used as an indicator for harmful algal blooms. An increase in phycocyanin levels and total chlorophyll concentration are strongly correlated with the presence of microcystin toxins (Brient et al., 2008; Francy et al., 2016); therefore, phycocyanin concentrations are a good proxy indicator to predict the oncoming of harmful algal blooms and presence of toxins in a water body. Concentrations of phycocyanin at 30 ug/L is equivalent to the World Health Organization's (WHO) Alert Level 1 or 20,000 cyanobacteria cells/ml (Brient et al., 2008). Alert Level 1 triggers weekly water monitoring to assess the risk of a bloom. Concentrations of phycocyanin at 90 ug/L is equivalent to WHO's Alert Level 2, or 100,000 cells/mL of cyanobacteria (Brient et al., 2008). Alert Level 2 triggers a water use restriction due to the high potential risk of cyanotoxin.

[1] An EPA established aquatic life criteria. Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in ambient water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable adverse effect. This is the chronic criterion.

Phycocyanin levels were measured in the South Cove, Fletchers Cove, and Main Basin. Samples were collected by LMAC weekly from June to October. Phycocyanin results are included in Attachment F. Results showed fluctuating phycocyanin levels across all sample areas from June to October. Levels appeared to peak in Fletchers Cover (August 16) and VMB2 (September 4 and October 12) but were below 30 ug/L. VMB 1 (September 4) and South Cove 1 and 2 (September 29) show phycocyanin results exceeding 30 ug/L but below 90 ug/L. The exceedance of phycocyanin at the South Cove in September indicates cyanobacteria was present at high densities, suggesting a potential risk for toxicity in the Cove.

6.0 Next Steps

TRC proposes continued plant and water quality monitoring of the lake. Monitoring enables early detection of new management issues and subsequent rapid response actions. Monitoring also provides needed feedback for evaluating the success of any management actions and making adjustments to the management program.

It is imperative that any vegetation management action program (i.e., DASH) include the monitoring of aquatic vegetation by mapping aquatic plant species distribution, cover, and biovolume with focus on the distribution and density of exotic plant species (except for mudmat which is not considered problematic at this time). Monitoring provides data for the purpose of detecting new infestations, as well as tracking the effectiveness of any management practices that may be implemented. Monitoring is essential if management efforts are to be cost-effective since early detection and control of any future infestation can save management costs.

Monitoring aquatic plants in the lake is recommended biannually when an active management program is in effect. This allows for the capture of both pre- and post-management conditions. Pre-management mapping should be performed in late spring or early summer to assess re-growth of fanwort, variable-leaf milfoil, and any other new, potentially threatening exotic species. Additional mapping should be performed toward the end of the growing season in late August or September, approximately a week after DASH efforts are completed, to evaluate the impacts of the management efforts and to provide guidance to the Town. It is preferred if the mapping is performed by the same entity and follows the same procedures from one visit to the next in order to ensure reliable and comparable data collection methods.

In addition to vegetation monitoring, TRC recommends continuing the current water quality monitoring program for the purpose of detecting changes in lake or watershed conditions that might encourage algae blooms, as well as tracking the effectiveness of any future management practices that may be implemented.

Recommendations provided here are based on the current results. TRC recommends focusing on the following to help maintain the health of Lake Massapoag; 1) reduce and/or contain the fragmentation of fanwort and milfoil to help stop the spread of the invasive species to other areas of the lake, and 2) reduce external sources of pollutant loading into the lake to help minimize the occurrences of excessive *E. coli* and cyanobacteria in the lake. TRC notes that additional upcoming investigations are planned for Lake Massapoag in 2024. In early 2024 TRC will have the results of core sampling conducted in November 2023, and a proposed alum dosing plan. By the end of the fiscal year, an internal phosphorus loading assessment, groundwater seepage survey, shoreline and storm drain wet weather surveys, and Lagoon hot spot analysis are planned, as well as continued monitoring of the lake inflows, Sucker Brook, and the lake's deep

hole and South Cove. Results of these tasks and recommendations will be incorporated into the Lake Massapoag Watershed-Based Plan.

7.0 References

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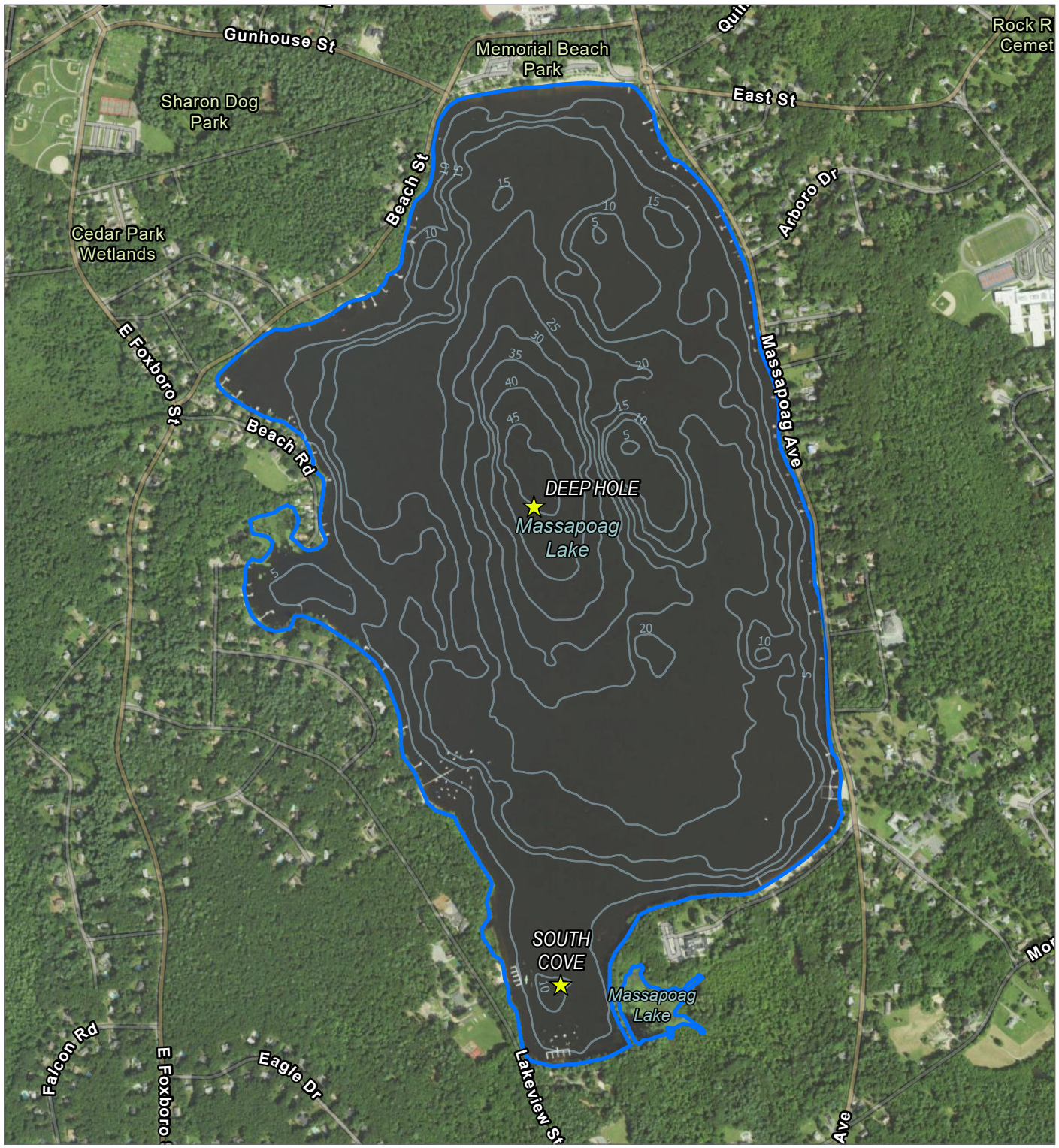
Francy D. S., Brady A. M. G., Ecker C. D., Graham J. L., Stelzer E. A., Struffolino P. & Loftin K. A. 2016 Estimating microcystin levels at recreational sites in western Lake Erie and Ohio. Harmful Algae 58, 23–34.

MassDEP. 2023. Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle. CN 568.1, Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA.

TRC. 2022. Lake Massapoag Water Quality Assessment and Aquatic Plant Mapping. Revised January 12, 2023.

FIGURES



★ WATER QUALITY SAMPLE LOCATIONS

SHORELINE

BATHYMETRY CONTOURS (FEET)

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 2022
MASSGIS, INLAND WATER BATHYMETRY, 2019

0 500 1,000 FEET

1:12,000 1" = 1,000'

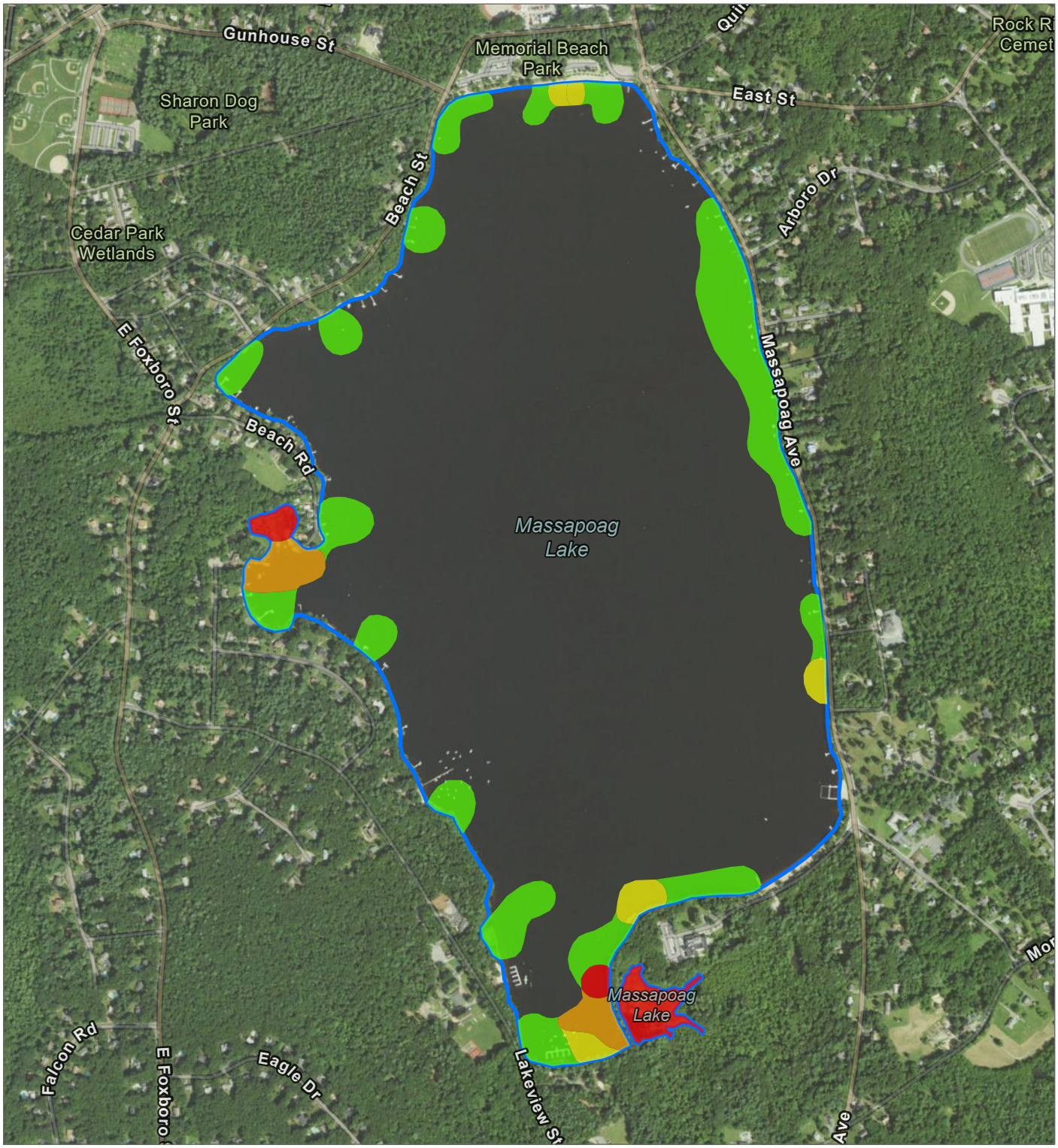
PROJECT: **2023 ANNUAL REPORT**
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE:
WATER QUALITY SAMPLING LOCATIONS

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	S. DEHAINAUT		
APPROVED BY:	M. O'BRIEN		**FIGURE 1**
DATE:	DECEMBER 2023		

TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236

FILE: 547193_LAKEMASSAPOAG_2023FIGURES



PLANT COVER

- 1% - 25% (42.1 ACRES)
- 26% - 50% (4.6 ACRES)
- 51% - 75% (5.8 ACRES)
- 76% - 100% (5.9 ACRES)

SHORELINE

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023

N

0 500 1,000
FEET
1:12,000 1" = 1,000'

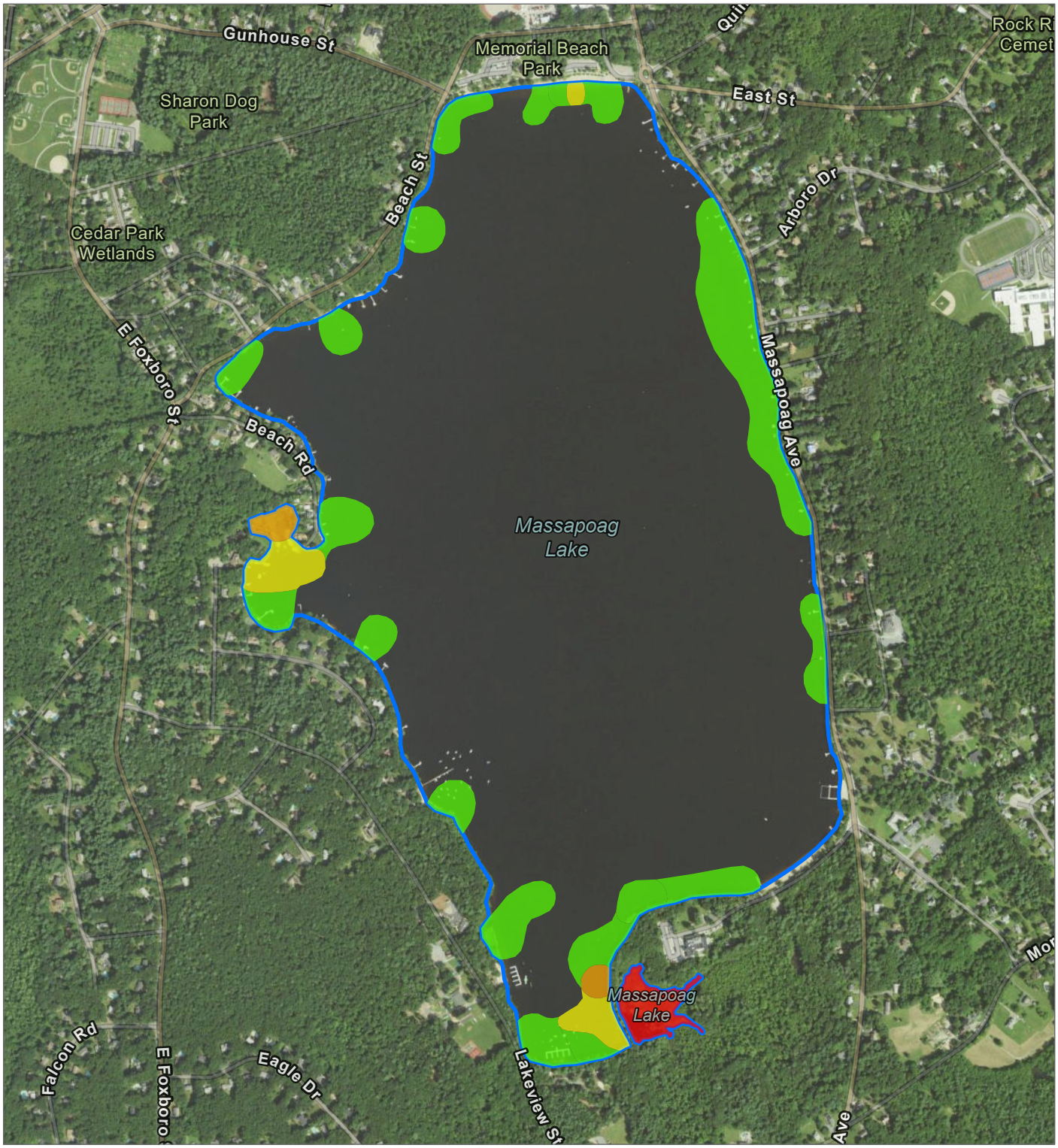
PROJECT: 2023 ANNUAL REPORT
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE: PLANT COVERAGE

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	K. BACHAND		
APPROVED BY:	M. O'BRIEN		FIGURE 2
DATE:	DECEMBER 2023		

TRC
404 WYMAN STREET
SUITE 375
WALTHAM, MA 02451
PHONE: 781.419.7696

FILE: 547193_LAKEMASSAPOAG_2023FIGURES



PLANT BIOVOLUME

- 1% - 25% (46.4 ACRES)
- 26% - 50% (6.2 ACRES)
- 51% - 75% (2.2 ACRES)
- 76% - 100% (3.7 ACRES)

SHORELINE

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023

N

0 500 1,000
FEET
1:12,000 1" = 1,000'

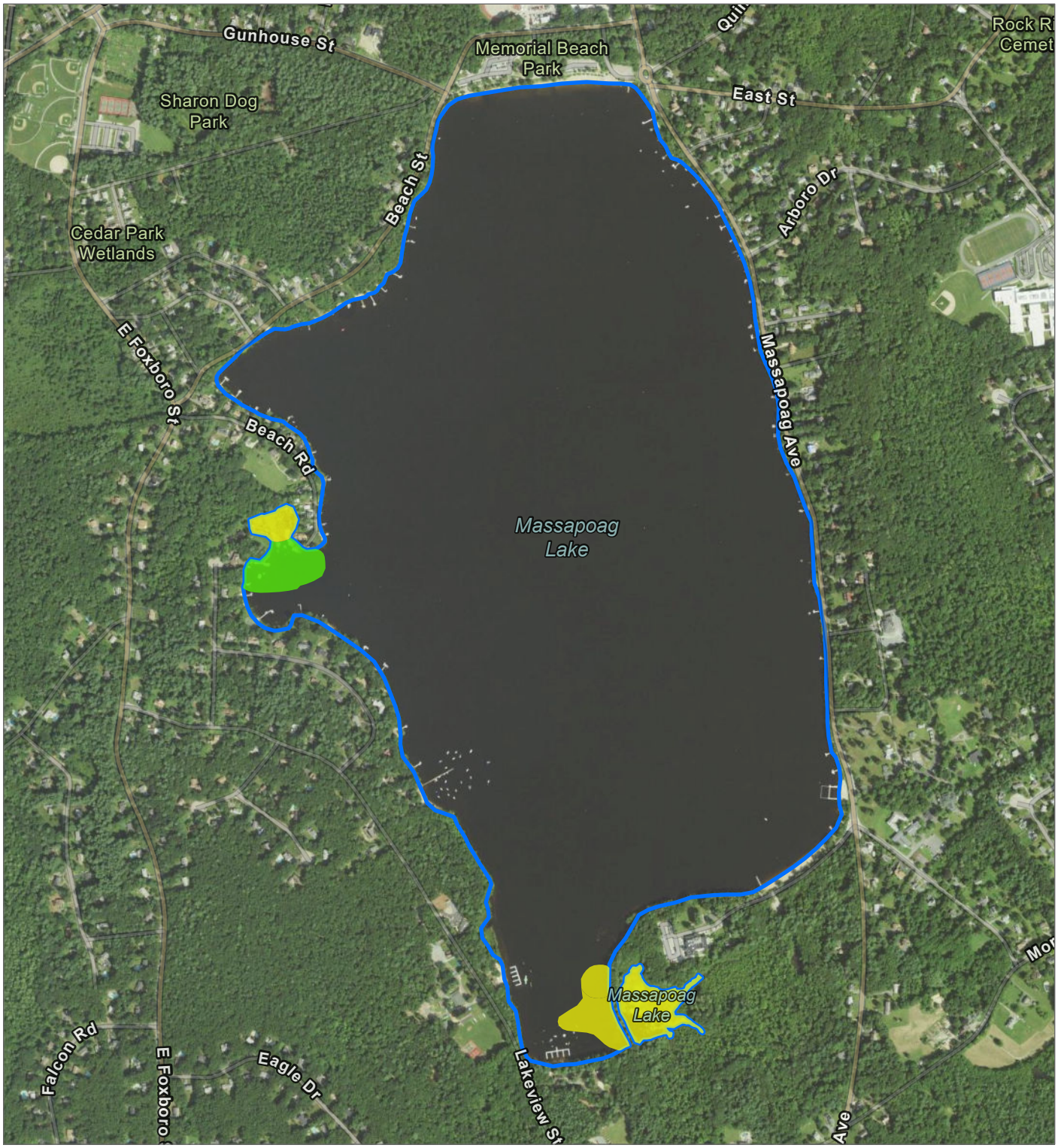
PROJECT: **2023 ANNUAL REPORT**
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE: **PLANT BIOVOLUME**

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	K. BACHAND		
APPROVED BY:	M. O'BRIEN		**FIGURE 3**
DATE:	DECEMBER 2023		

TRC
404 WYMAN STREET
SUITE 375
WALTHAM, MA 02451
PHONE: 781.419.7696

FILE: 547193_LAKEMASSAPOAG_2023FIGURES



FANWORT COVERAGE

- 1% - 25% (3.4 ACRES)
- 26% - 50% (8.2 ACRES)
- 51% - 75% (0.0 ACRES)
- 76% - 100% (0.0 ACRES)

SHORELINE

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023

N

0 500 1,000
FEET
1:12,000 1" = 1,000'

PROJECT: **2023 ANNUAL REPORT**
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE: **FANWORT COVERAGE**

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	K. BACHAND		
APPROVED BY:	M. O'BRIEN		**FIGURE 4**
DATE:	DECEMBER 2023		

TRC
404 WYMAN STREET
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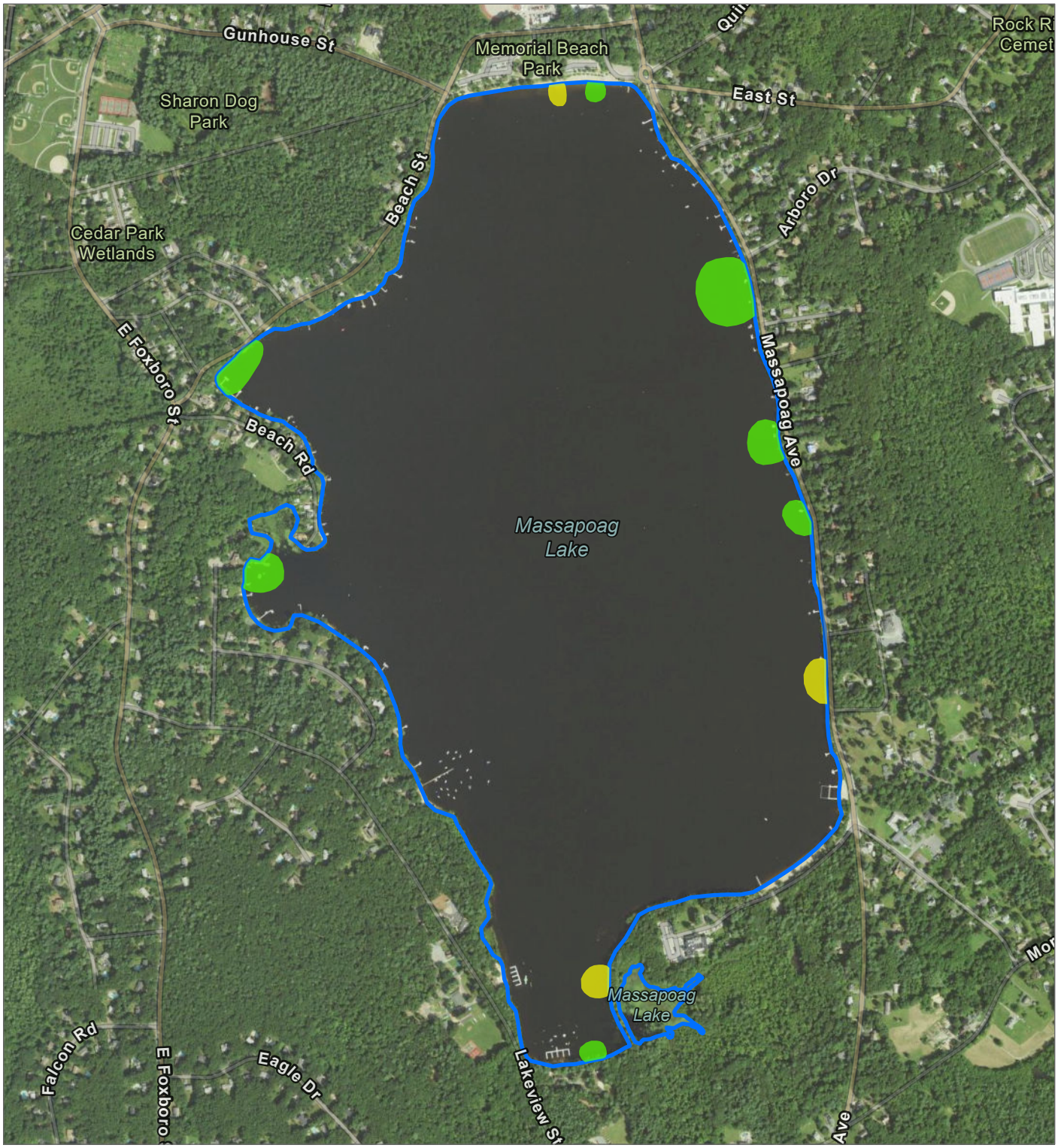
FILE: 547193_LAKEMASSAPOAG_2023FIGURES



MUDMAT COVERAGE

- 1% - 25% (9.6 ACRES)
- 26% - 50% (2.2 ACRES)
- 51% - 75% (0.0 ACRES)
- 76% - 100% (0.0 ACRES)

SHORELINE

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023

N

0 500 1,000
FEET
1:12,000 1" = 1,000'

PROJECT: 2023 ANNUAL REPORT
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE: MUDMAT COVERAGE

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	K. BACHAND		
APPROVED BY:	M. O'BRIEN		FIGURE 5
DATE:	DECEMBER 2023		

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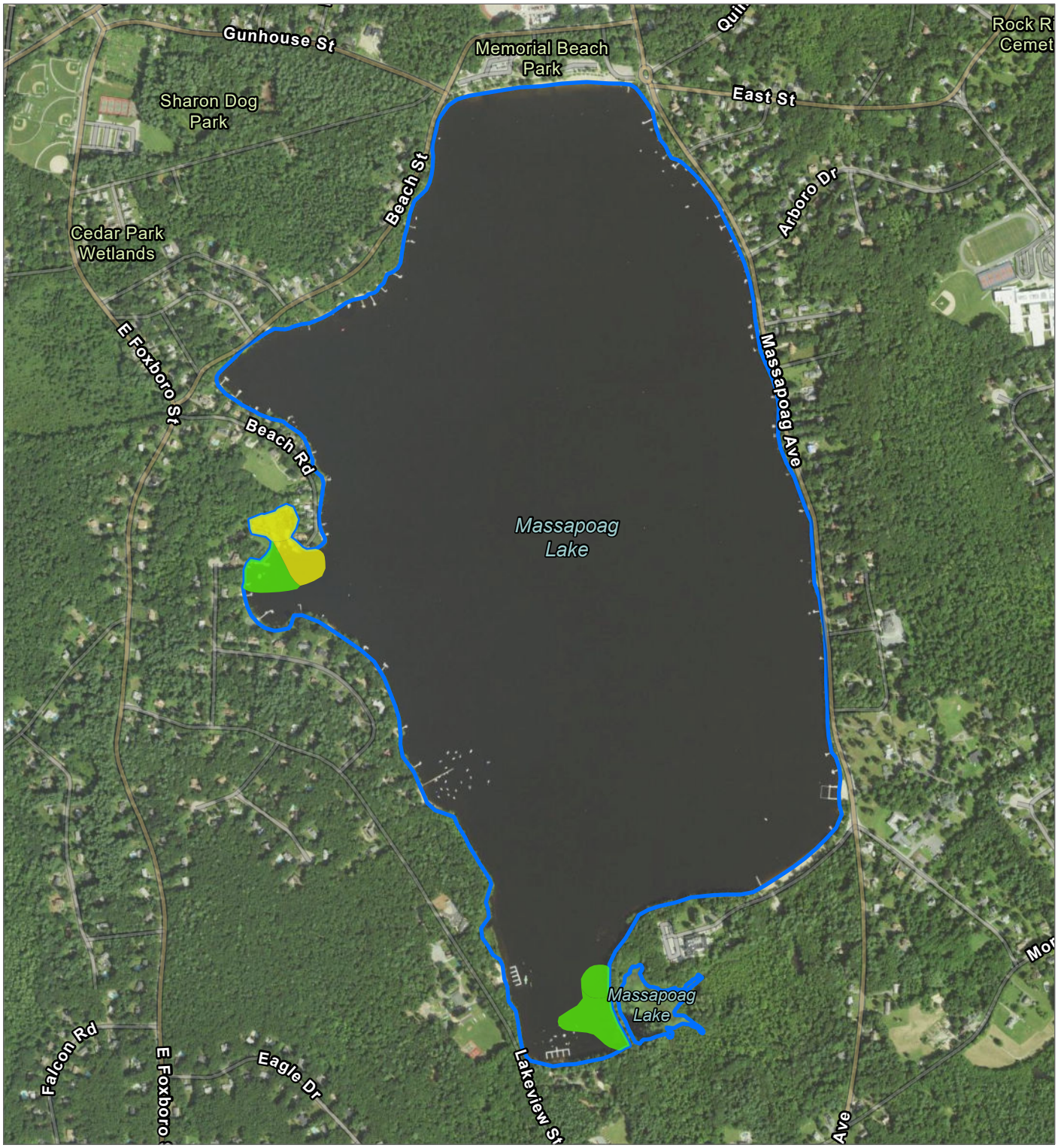
FILE: 547193_LAKEMASSAPOAG_2023FIGURES



VARIABLE-LEAF MILFOIL COVERAGE

- 1% - 25% (5.1 ACRES)
- 26% - 50% (2.9 ACRES)
- 51% - 75% (0.0 ACRES)
- 76% - 100% (0.0 ACRES)

SHORELINE

BASE MAP: ESRI, NAIP IMAGERY, 2018
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023

N

0 500 1,000
FEET
1:12,000 1" = 1,000'

PROJECT: 2023 ANNUAL REPORT
LAKE MASSAPOAG
TOWN OF SHARON, MA

TITLE: VARIABLE-LEAF MILFOIL COVERAGE

DRAWN BY:	T. LATHAM	PROJ. NO.:	547193.0000.0000
CHECKED BY:	K. BACHAND		
APPROVED BY:	M. O'BRIEN		FIGURE 6
DATE:	DECEMBER 2023		

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FILE: 547193_LAKEMASSAPOAG_2023FIGURES

Attachment A: Water Quality Profiles

Water Quality Profiles

Table 1. 2023 Field-Measured Water Quality Data at Deep Hole

Depth (m)	May 17, 2023							July 17, 2023							September 19, 2023						
	DO (mg/L)	DO (%)	SC. (µS/ cm)	Temp (C)	pH (SU)	Turb (NTU)	Secchi (m)	DO (mg/L)	DO (%)	SC (µS/ cm)	Temp (°C)	pH (SU)	Turb (NTU)	Secchi (m)	DO (mg/L)	DO (%)	SC (µS/ cm)	Temp (°C)	pH (SU)	Turb (NTU)	Secchi (m)
0.5	9.13	*97.4*	174.7	17.7	7.51	0.08	2.5	7.69	97.6	172.6	27.0	7.64	0.15	2.0	8.36	95.3	167.2	20.8	7.78	0.28	2.25
1	8.94	*96.3*	175.1	17.7	-	-		7.59	95.2	173.1	26.4	-	-		8.31	94.3	167.2	20.8	--	--	
2	8.95	*95.3*	175.1	17.7	-	-		7.78	98.1	173.5	26.2	-	-		8.34	94.4	167.3	20.8	--	--	
3	8.93	*95.5*	174.9	17.6	-	-		7.90	99.5	173.9	26.0	-	-		8.36	94.8	167.3	20.8	--	--	
4	8.84	*93.6*	175.0	17.4	-	-		6.02	73.5	176.7	24.9	-	-		8.27	93.6	167.4	20.8	--	--	
5	7.80	*76.3*	173.1	13.5	-	-		2.53	28.6	181.5	20.9	-	-		8.11	91.9	167.5	20.8	--	--	
6	7.52	*73.1*	173.1	13.4	-	-		0.40	4.3	185.2	18.0	7.55*	2.07*		8.26	93.5	167.9	20.8	--	--	
7	7.41	*72.0*	173.4	13.3	7.12	0.09		0.16	1.6	187.5	16.9	-	-		8.09	91.6	168.0	20.8	7.32	0.42	
8	7.49	*71.7*	173.3	13.3	-	-		0.14	1.4	183.7	16.0	-	-		0.15	1.8	199.8	18.2	--	--	
9	7.38	*71.2*	173.5	13.2	-	-		0.12	1.2	184.2	15.1	-	-		0.13	1.3	207.6	16.0	--	--	
10	7.08	*67.9*	173.3	12.8	-	-		0.11	1.1	184.6	14.4	-	-		0.12	1.2	210.9	14.3	--	--	
11	7.05	*67.3*	173.4	12.6	-	-		0.11	1.0	189.5	13.4	-	-		0.10	1.0	220.1	14.2	--	--	
12	6.83	*65.2*	173.6	12.5	-	-		0.10	1.0	191.3	13.2	-	-		0.09	0.9	239.3	14.2	--	--	
13	6.47	*60.7*	173.7	12.6	7.20	0.17		0.09	0.9	193.0	13.1	7.37	2.06		0.08	0.8	241.8	14.2	7.13	0.07	
14	5.78	*54.4*	173.9	12.3	-	-		0.08	0.8	202.5	13.0	-	-		0.08	0.8	242.8	14.2	--	--	

Table 2. September 2023 Field-Measured Water Quality Data at South Cove

Depth (m)	September 19, 2023						
	DO (mg/L)	DO (%)	SC (µS/cm)	Temp (°C)	pH (SU)	Turb (NTU)	Secchi (m)
0.5	9.75	110.3	159.1	20.3	7.15	0.19	1.5
1	10.13	112.5	160.7	19.9	--	--	
2	4.51	48.9	122.5	18.8	--	--	
3	0.47	4.90	91.0	17.9	--	--	

Attachment B: “2023 Sediment and Water Quality Results” TRC 2023

404 Wyman Street, Suite 375
Waltham, Massachusetts 02451
p 781.419.7696
www.trccompanies.com

MEMORANDUM

TO:	Town of Sharon- Lake Massapoag Advisory Committee	DATE:	June 8, 2023
FROM:	Margaret O'Brien	TRC PROJECT NO.:	538513.0000.0000
SUBJECT:	2023 Sediment and Water Quality results		
COPY TO:			

Dear Committee,

Below please find a summary of the 2023 sediment and water quality results to date.

Sediment Sampling

TRC collected four sediment samples (labeled SED-1 through SED-4) below the 30-foot contour within the central portion of Lake Massapoag on March 28, 2023. The samples were collected using a 6-inch x 6-inch x 6-inch Ekman grab sampler. Sediment samples were sent to Phoenix Laboratories and processed for the following analyses: total phosphorus, percent moisture, iron-bound phosphorus, and loosely sorbed phosphorus.

The phosphorus fractions were analyzed to assess the potential for internal phosphorus loading from sediments of Lake Massapoag, as represented by the iron-bound and loosely sorbed phosphorus fraction. The laboratory results showed that iron and loosely sorbed phosphorus values ranged from 54.49 mg/kg to 100.10 mg/kg. The samples with the highest iron and loosely-sorbed phosphorus values were collected closest to the deep hole sampling location below the 40-foot contour (SED-2 and SED-3). Total phosphorus ranged from 1,000 mg/kg to 1,580 mg/kg (Table 1). The highest samples, SED-4, was located around the 35-foot contour south of the deep hole sampling spot.

Iron-bound and loosely sorbed phosphorus, collectively referred to as a mobile phosphorus, readily release into the water column during low dissolved oxygen conditions. When these fractions circulate toward the surface of the lake, they can contribute to development of algal blooms. Based on the laboratory results received from Phoenix, iron-bound and loosely sorbed phosphorus represented a smaller fraction of total phosphorus analyzed in the samples, as compared to the deep hole sediment sample collected in 2022 (Table 1). Although the mobile phosphorus values are not considered excessive, the values collected within the deeper portions of the lake indicate that mobile phosphorus could be a potential source for internal phosphorus loading within the lake.

Table 1. Phosphorus Fractionation from Sediment Samples

Sediment Sample ID	% Moisture	% Solids	Iron and Loosely Sorbed P (mg/kg dry weight)	Total P (mg/kg dry weight)	Calculated Iron and Loosely Sorbed Fractionation Percentage (%)
SED-1	84%	16%	54.49	1,000	5%
SED-2	85%	15%	96.68	1,140	8%
SED-3	84%	16%	100.10	1,160	9%
SED-4	87%	13%	68.28	1,580	4%
Deep Hole*	84%	18%	260	991	26%

*Sample collected in November 2022

Water Quality Monitoring

TRC completed one round of water quality monitoring at Lake Massapoag on May 17, 2023. A surface and bottom sample was collected from the deep hole location of the lake. Water quality was assessed through direct measurement, as well as the collection of samples for laboratory analysis. Field measurements included the following:

- Water transparency (Secchi disk depth)
- Water temperature
- Dissolved oxygen (concentration and percent saturation)
- Specific conductance
- pH
- Turbidity

Secchi disk was collected from the surface of the lake. Water temperature, dissolved oxygen, and specific conductance were measured at one-meter intervals for a vertical profile of the water column. Turbidity and pH were collected near the surface, middle, and bottom of the water column.

Grab samples were collected in laboratory-approved bottle ware and transported under chain-of-custody to the appropriate laboratory. Samples were sent to Phoenix Laboratories for analysis of total phosphorus and total nitrogen (total Kjeldahl nitrogen (TKN), nitrite, and nitrate). A sample was sent to Alpha Analytical to analyze for chlorophyll a.

At Lake Massapoag, the observed dissolved oxygen concentrations met the state standard for warmwater fisheries (>5 mg/L) through the water column in May (Table 2). A difference in temperature from top to bottom indicates the beginning of thermal stratification, which would be typical for a lake in the later spring time, as warm water begins to overlay cold water and inhibit vertical mixing. Such conditions were documented at the lake in June and July 2022. Specific conductance measurements exceeded 100 µS/cm, indicating impact from human activity. Water column pH values indicate circumneutral waters within the lake and turbidity levels were not considered excessive. Secchi disk transparency at the lake was measured to be 2.5 meters, and may reflect some reduction due to water color, particulates, and/or algal growth.

Table 2. May 2023 Field-Measured Water Quality Data at Deep Hole

Depth (m)	May 17, 2023					
	DO (mg/L)	DO (%)	SC. (µS/cm)	Temp (C)	pH (SU)	Turb (NTU)
0.5	9.13	*97.4*	174.7	17.7	7.51	0.08
1	8.94	*96.3*	175.1	17.7	-	-
2	8.95	*95.3*	175.1	17.7	-	-
3	8.93	*95.5*	174.9	17.6	-	-
4	8.84	*93.6*	175.0	17.4	-	-
5	7.80	*76.3*	173.1	13.5	-	-
6	7.52	*73.1*	173.1	13.4	-	-
7	7.41	*72.0*	173.4	13.3	7.12	0.09
8	7.49	*71.7*	173.3	13.3	-	-
9	7.38	*71.2*	173.5	13.2	-	-
10	7.08	*67.9*	173.3	12.8	-	-
11	7.05	*67.3*	173.4	12.6	-	-
12	6.83	*65.2*	173.6	12.5	-	-
13	6.47	*60.7*	173.7	12.6	7.20	0.17
14	5.78	*54.4*	173.9	12.3	-	-

Total phosphorus levels were borderline excessive (>0.025 mg/L), with the surface sample being slightly greater than 0.025 mg/L. Total nitrogen concentrations were not considered excessive (>1.0 mg/L) and were predominantly composed of TKN. Chlorophyll a concentrations of 5.28 mg/m^3 are indicative of moderate algae growth (Table 3).

Table 3. May 2023 Water Quality Analytical Data

Location	Depth (m)	Total P (mg/L)	Total N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Chlorophyll a (mg/m^3)
Deep Hole -Surface	0.5	0.029	0.54	0.15	<0.01	0.39	5.28
Deep Hole – Bottom	13	0.025	0.46	0.18	<0.01	0.27	-

The water quality results from May 2023 are generally consistent with what was observed in the summer of 2022. These results, combined with the results from the additional sampling planned for July and September of this year, will help to build the baseline condition dataset at Lake Massapoag and inform recommendations for management actions in the future.

Attachment C: Inflow Sampling Locations and Results

INFLOWS TO LAKE MASSAPOAG 2022: Phosphorus, E. Coli, Nutrients

				rain event	post 2-day rain			Phosp
Phosphorus (mg/L)	5/23/2022	6/27/2022	7/25/2022	8/22/2022	9/7/2022	9/26/2022	10/31/2022	% high
Lagoon Inflow	0.350	0.024	0.038	1.150	0.229	0.019	0.021	43%
Canoe River	0.049	0.110	0.400		0.050	0.040	0.024	50%
Fletcher's Cove	0.022	0.010	0.019	0.010	0.027	0.015	0.010	0%
140 East Foxboro	0.133	0.132		0.607	0.131	0.123	0.044	83%
Opp 123 Beach St	0.726	0.157			0.049	0.026	0.035	40%
Wetland/SHS	0.545				0.066	0.069	0.061	100%
Sucker Brook	0.019	0.021	0.032	0.141	0.030	0.012	0.015	14%
Longmeadow	0.032			0.689			0.016	33%
Landfill Drain S	0.021	0.019	0.035		0.032	0.043	0.038	0%
Landfill Drain N	0.021				0.016	0.035	0.010	0%
308 Massapoag					0.041	0.089		50%

High Phosphorus > .05 mg/l. (inflows):

Source: Town of Sharon Lake Committee, G&L Labs, sampling by Conservation Department

8/22 rain event sample inside lagoon, no flow, sample murky

						See Hot Spot tab		
				rain event	post 2-day rair	SuckerBr only	**Total Nitrogen**	**E coli**
E. coli (cfu/100 ml)		6/27/2022	7/25/2022	8/22/2022	9/7/2022	10/6/2022	10/31/2022	% high
Lagoon Inflow		10	40	1700	4100		0.65	50%
Canoe River		710	28		2300		1.62	67%
Fletcher's Cove		45	12	90	20			0%
140 East Foxboro		<10		2800	760		1.75	67%
Opp 123 Beach St		<10			360			50%
Wetland/SHS					1900		2.18	100%
Sucker Brook		410	260	>8000	6100	1733	0.81	100%
Longmeadow				340				100%
Landfill Drain S		<10	<5		640			33%
Landfill Drain N					280			100%
308 Massapoag					760			100%

Source: Town of Sharon Board of Health, G&L Labs, sampling by Conservation Dept.

8/22 rain event sample inside lagoon, no flow, sample murky

INFLOWS TO LAKE MASSAPOAG 2023: Phosphorus, E. Coli, Nutrients

RAIN EVENT SAMPLING (except 6/25 testing after hand pulling fanwort)

Phosp

Phosphorus (mg/L)	6/13/2023	6/20/2023*	6/27/2023	7/17/2023	8/31/2023	9/26/2023	10/23/2023	Average	% high
Lagoon	0.085	0.028	0.015	0.024				0.038	25%
Lagoon Inflow						0.027		0.027	
Everwood Dock	0.016	<.010						0.016	
Canoe River			0.030			0.022		0.026	
Fletcher's Cove		0.028*	0.015					0.015	
140 East Foxboro		0.015	0.057	0.049	0.039	0.052		0.042	40%
Opp 123 Beach St			0.085	0.021	0.100	0.107		0.078	75%
Wetland/SHS		0.067	0.152	0.045	0.097	0.094		0.091	80%
Sucker Brook			0.031	0.033	0.022	0.028		0.029	
Longmeadow			0.030			0.025	0.022	0.026	
Landfill Drain S			0.039		0.013		0.025	0.026	
Landfill Drain N			0.027				0.015	0.021	
Opp 3 Capen Hill			0.048		0.052	0.191	0.046	0.084	50%
240 Massapoag			0.076		0.025	0.124	0.051	0.069	75%
308 Massapoag						0.048	0.022	0.035	
Massapoag/Morse			0.037		0.016		0.045	0.033	
Rain past 48 hours (inches)	0.3	2.4	.5	3.0	.8	1.0	1.0		

Source: Town of Sharon Lake Committee, G&L Labs. High Phosphorus > .05 mg/l. (inflows):

Notes: Hand-pulling in lagoon 6/12-6/15, Fletchers Cove July various dates through 7/19. *P measured in Fletchers Cove on 6/25.

Rain: Approx. figures from Wunderground Norwood Airport, Blue Hill Observatory Milton, and/or Sharon reported.

RAIN EVENT SAMPLING

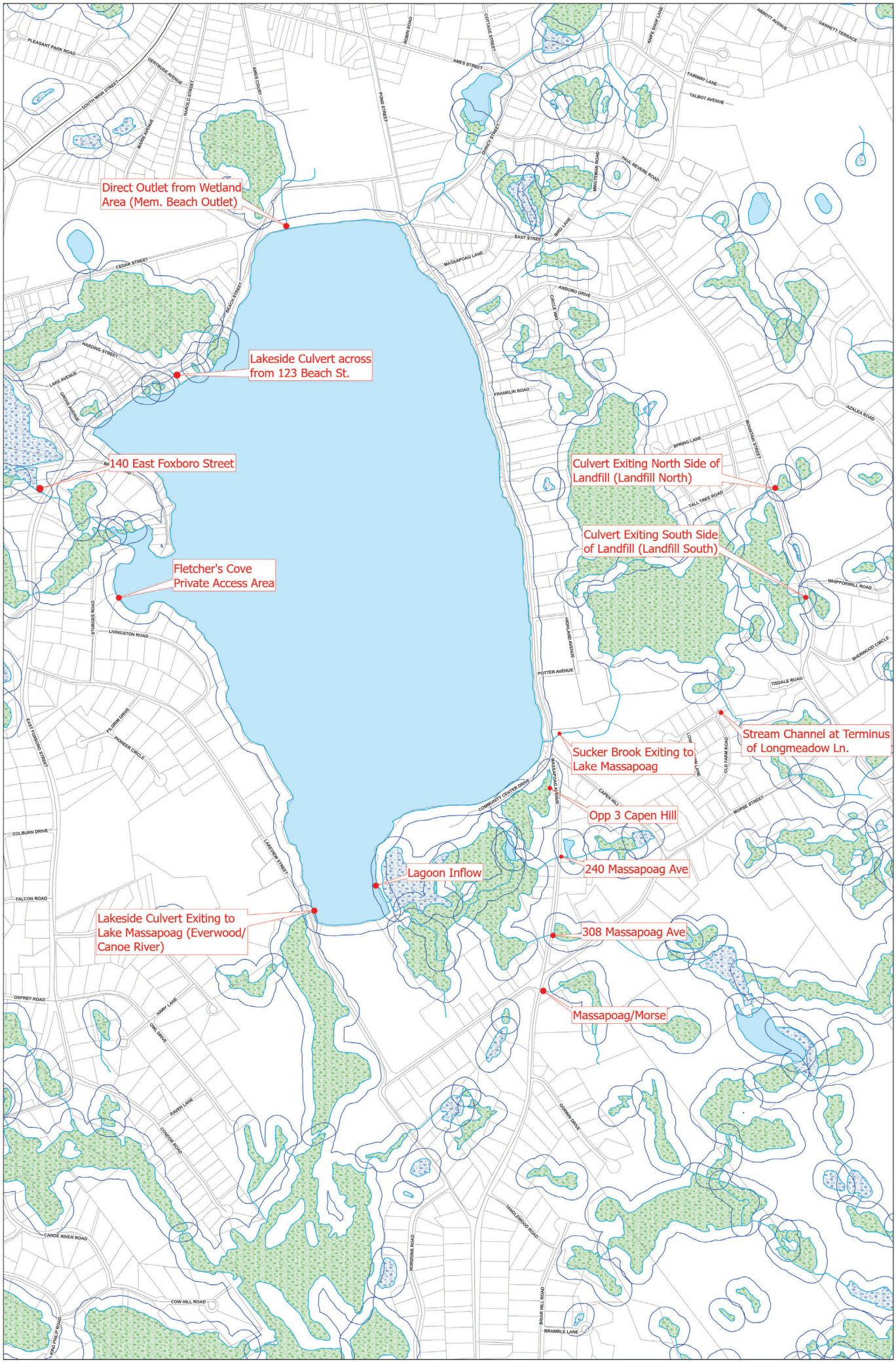
E coli

E. coli (cfu/100 ml)			6/27/2023	7/17/2023	8/31/2023	9/25/2023		Average	% high
Lagoon			<10*	1400				700	50%
Lagoon Inflow									
Everwood Dock									
Canoe River			<10*					<10*	
Fletcher's Cove			55					55	
140 East Foxboro			50	500				275	50%
Opp 123 Beach St			310	100				205	50%
Wetland/SHS			180	1100				640	50%
Sucker Brook			2600	1800	260	330		1248	100%
Longmeadow			3100		60			1580	50%
Landfill Drain S			460					460	100%
Landfill Drain N			470					470	100%
Opp 3 Capen Hill					10			10	
Rain past 48 hours (inches)	0.3	2.4	.5	3.0	.8	1.0			

Source: Town of Sharon Lake Committee, G&L Labs. High E. coli > 235 cfu/100 ml. (beaches):

Rain: Approx. figures from Wunderground Norwood Airport, Blue Hill Observatory Milton, and/or Sharon reported.

* 6/29/2023


Direct Outlet from Wetland Area (Mem. Beach Outlet)
Lakeside Culvert across from 123 Beach St.
140 East Foxboro Street
Fletcher's Cove Private Access Area
Culvert Exiting North Side of Landfill (Landfill North)
Culvert Exiting South Side of Landfill (Landfill South)
Stream Channel at Terminus of Longmeadow Ln.
Sucker Brook Exiting to Lake Massapoag
Opp 3 Capen Hill
240 Massapoag Ave
Lagoon Inflow
Lakeside Culvert Exiting to Lake Massapoag (Everwood/ Canoe River)
308 Massapoag Ave
Massapoag/Morse
PLEASANT PARK ROAD
SOUTH MAIN STREET
GERTRUDE AVENUE
HAROLD STREET
MAPLE AVENUE
AMES COURT
POND STREET
ROBIN ROAD
COTTAGE STREET
AMES STREET
KNIFE SHOP LANE
ABBOTT AVENUE
GANNETT TERRACE
FAIRWAY LANE
TALBOT AVENUE
CHURCH STREET
MINUTEMAN ROAD
PAUL REVERE ROAD
EAST STREET
BIRD LANE
MASSAPOAG LANE
CEDAR STREET
BEACON STREET
HARDING STREET
LAKE AVENUE
GROVE AVENUE
CIRCLE WAY
ARBORO DRIVE
FRANKLIN ROAD
AZALEA ROAD
MOUNTAIN STREET
SPRING LANE
TALL TREE ROAD
WHIPPORWILL ROAD
BIRCHWOOD CIRCLE
TISDALE ROAD
HIGHLAND AVENUE
POTTER AVENUE
LIVINGSTON ROAD
OLD FARM ROAD
LOW
MORSE STREET
CAPEN HILL
MASSAPOAG AVENUE
COMMUNITY CENTER DRIVE
LAKEVIEW STREET
COLBURN DRIVE
FALCON ROAD
EAST FOXBORO STREET
PILGRIM DRIVE
PIONEER CIRCLE
OSPREY ROAD
HAWK LANE
OWL DRIVE
RAVEN LANE
CONDOR ROAD
CANOE RIVER ROAD
COW HILL ROAD
KING PHILIP ROAD
HORIZONS ROAD
GORHAM DRIVE
TANGLEWOOD ROAD
BRIAR HILL ROAD
BRAMBLE LANE

Attachment D: *E. coli* Beach Locations and Results

Town Public Swimming Area Beaches							Other Swimming Areas (non-public beaches)							
Date (weekly & retests)	Memorial Beach Swim Docks	Geo-mean	Memorial Beach Center	Geo-mean	Community Center Beach	Geo-mean	Camp Wonderland	Geo-mean	Camp Everwood/ Gannett	Geo-mean	Camp Everwood	Geo-mean	Massapoag Yacht Club	Geo-mean
6/6/2022									20		<5			
6/13/2022	20		5										<5	
6/20/2022	<5		5		68		<5 (6/23)		15		10		64	
6/27/2022	16		32		260*!		5		<5		20		<5	
6/28/2022					160									
7/5/2022							10		10		5		<5	
7/6/2022	10		152		1340*!									
7/8/2022					<5	103								
7/11/2022	<5	8	5	14	15	76	<5		20		25		<5	
7/18/2022	5	9	15	18	16	40	5		60		20		<5	
7/25/2022	5	9	15	18	16	40	5		60		20		<5	
8/1/2022	5	7	76	21	116	24			48		8		<5	
8/8/2022	24	19	20	14	800*!	74	176		25		10		<5	
8/10/2022					12	78								
8/14/2022				closed for season										
8/15/2022	<5	7	5	14	20	51	closed		52		20		10	
8/21/2022	closed for season													
8/22/2022	< 5	7	24	19	1380	133	closed		16		5		5	
8/29/2022	< 5	6	16	20	296	238	closed		closed		closed		10	
9/6/2022	<5	4	<5	10	108	234	closed		closed		closed		10	
9/12/2022	5	3	52	12	600	221	closed		closed		closed			
9/19/2022	10	4	8	14	96	303	closed		closed		closed			
9/26/2022														
% high E. coli, 2022 season					53%									
Historical:														
% high E. coli, early 80s			22%		5%		5%		8%		5%			
% high total coliform, early 80s			16%		8%		20%		6%		12%			
Beach Site #	1		2		3		4		5		6		7	

NOTES:

Insert new rows to enter retest dates and results after a high E. coli reading, change date as needed for holiday.

Limit for Swimming Areas <235 colonies/100 ml. Geomean is a 5 test average. Must be <126.

Geomean: Geometric mean of 5 sample results (126 cfu violation) **Geomean Calculator:** http://www.graftacs.com/geomean.php

KEY: **Star * =** * In violation of regulations-retested **Exclamation ! =** Beach closed **NT =** No sample taken/tested

COLOR KEY **E. coli closure:** **Algae closure:**

SOURCE 2022: Sharon Board of Health, https://www.townofsharon.net/health-department/pages/swimming-beach-and-lake-testing

SOURCE 1980s: IEP Inc., https://www.townofsharon.net/lake-management-study-committee/files/diagnosticfeasibility-study-lake-massapoag-iep-1984

Town Public Swimming Area Beaches							Other Swimming Areas (non-public beaches)							
Date	**Memorial Beach Swim Docks**	**Geo-mean**	**Memorial Beach Center**	**Geo-mean**	**Community Center Beach!**	**Geo-mean**	**Camp Wonderland**	**Geo-mean**	**Camp Everwood/ Gannett**	**Geo-mean**	**Camp Everwood**	**Geo-mean**	**Massapoag Yacht Club**	**Geo-mean**
5.30.23	<5		5		20								<5	
6.5.23	<5		124		15								10	
6.12.23	8		16		116				**980		**184		<5	
6.16.23									5		5			
6.19.23	<5		56		188		48		20		5		5	
6.26.23	<5	4	<5	18	708	87	<5		<5		25		<5	
7.6.23	32	6	28	25	40	100	5		5		5		10	
7.10.23	10	7	24	18	24	110	20		8		100		5	
7.17.23	16	9	72	24	308	134	20		200		500		28	
7.18.23									120		68			
7.24.23	16	12	148	29	52	104	5		24		5		<5	
7.31.23	5	13	40	49	100	69	No test		10		24		5	
8.3.23							<5							
8.7.23	<5	8	16	44	800	125	10		35		5		5	
8.14.23	5	7	<5	29	40	139	<5		32		12		<5	
8.21.23	32	8	15	21	15	76	No test		32		28		40	
8.28.23	5	7	10	12	<5	43	No test		No test		No test		15	
9.5.23	20	9	10	9	760	64	No test		No test		No test		No test	
9.11.23	32	14	184	15	172	47	No test		No test		No test		No test	
9.18.23	5	14	24	23	15	39	No test		No test		No test		No test	
9.25.23	5	10	5	19	25	43	No test		No test		No test		No test	
Percent High					22%				8%		8%			
Beach Site #	1		2		3		4		5		6		7	

NOTES:

Insert new rows to enter retest dates and results after a high E. coli reading, change date as needed for holiday.

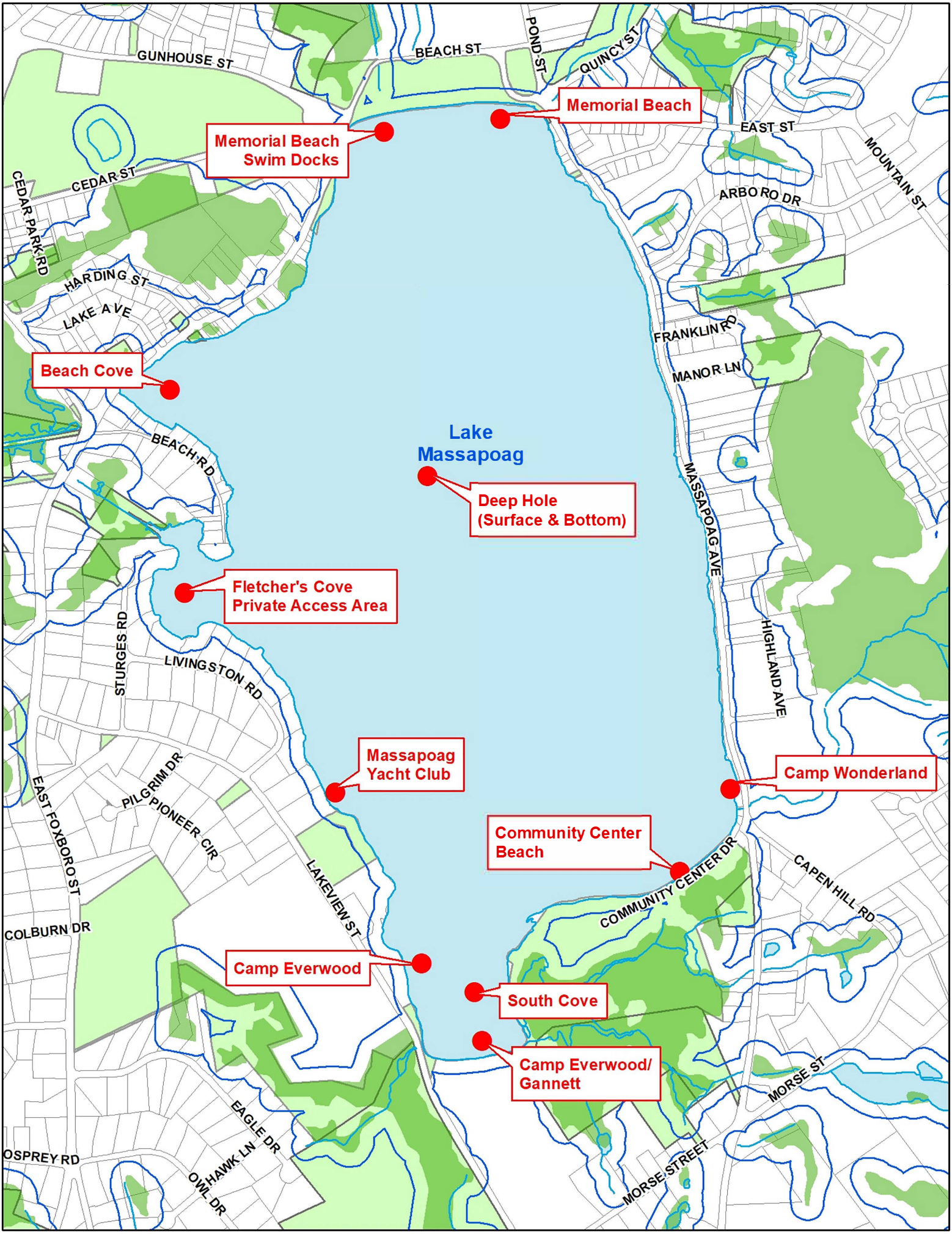
Limit for Swimming Areas <235 colonies/100 ml. Geomean is a 5 test average. Must be <126.

Geomean: Geometric mean of 5 sample results (126 cfu violation) **Geomean Calculator:** http://www.graftacs.com/geomean.php

KEY: **Star * =** * In violation of regulations-retested **Exclamation ! =** Beach closed **NT =** No sample taken/tested

COLOR KEY **E. coli closure:** **Algae closure:** **Note**: Community Center Beach closed to swimming all season.

SOURCE: https://www.townofsharon.net/health-department/pages/swimming-beach-and-lake-testing


Lake Massapoag
Memorial Beach
Memorial Beach Swim Docks
Beach Cove
Deep Hole (Surface & Bottom)
Fletcher's Cove Private Access Area
Massapoag Yacht Club
Community Center Beach
Camp Wonderland
Camp Everwood
South Cove
Camp Everwood/ Gannett
GUNHOUSE ST
BEACH ST
POND ST
QUINCY ST
EAST ST
MOUNTAIN ST
ARBORO DR
CEDAR ST
CEDAR PARK RD
HARDING ST
LAKE AVE
FRANKLIN RD
MANOR LN
BEACH RD
MASSAPOAG AVE
HIGHLAND AVE
STURGES RD
LIVINGSTON RD
PILGRIM DR
PIONEER CIR
EAST FOXBORO ST
LAKEVIEW ST
COMMUNITY CENTER DR
CAPEN HILL RD
COLBURN DR
MORSE ST
MORSE STREET
EAGLE DR
OSPREY RD
HAWK LN
OWL DR

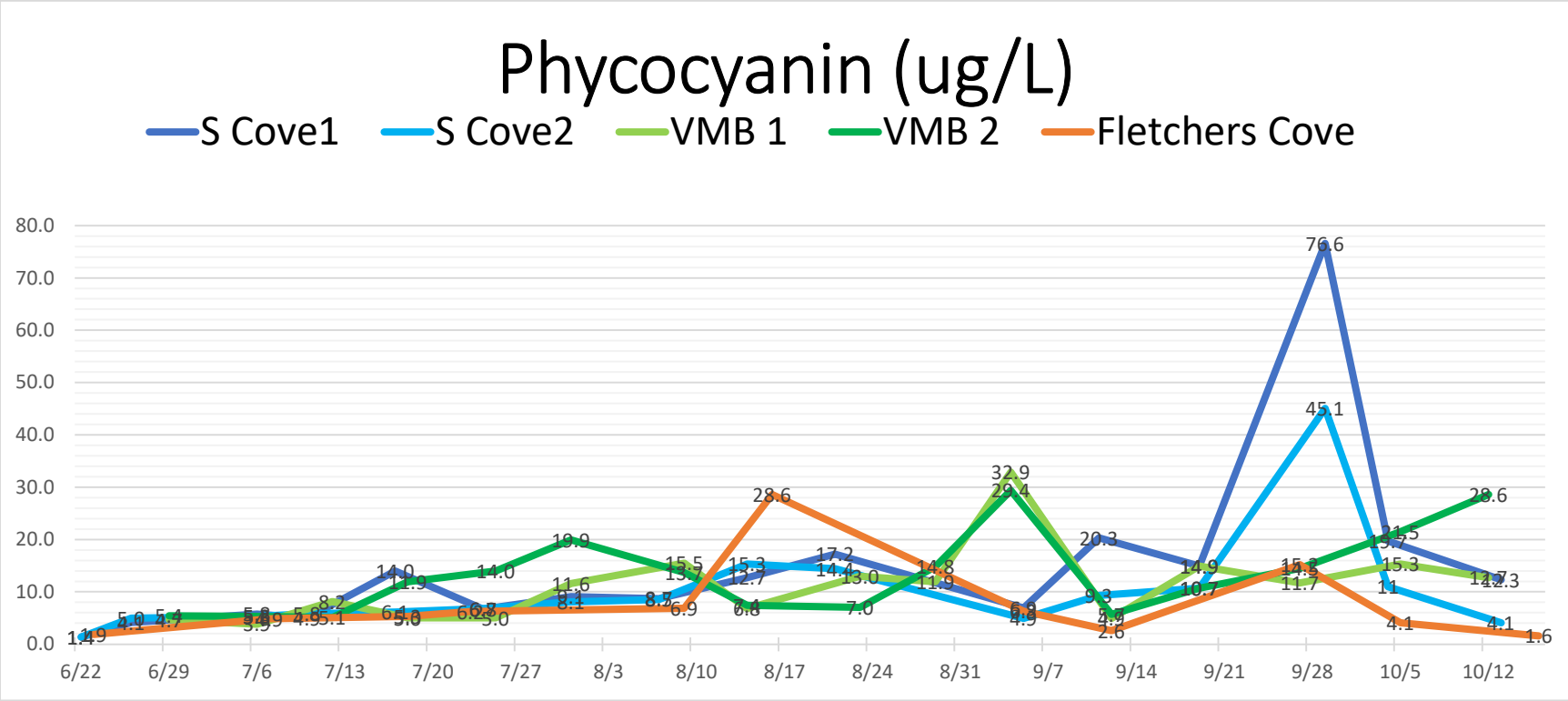
Attachment E: *E. coli* Sediment and Algae Layer Sampling

2023 Community Center Beach and Sucker Brook sediment testing
E. coli in water vs sand vs bottom algae layer

Community Center Beach (CFU/100 ml)	**11-Sep**	**18-Sep**	**25-Sep**	
Water	40	20	<10	
Community Center Beach (CFU/g)				
Water	0.4	0.2	<0.1	CFU/g
Sand	157	158	13	CFU/gdw
Algae		8,222	4,286	CFU/gdw
Sucker Brook (CFU/100 ml)				
Water	2700		330	
Sucker Brook (CFU/g)				
Water	27		3.3	CFU/g
Sand	159			CFU/gdw

Attachment F: Phycocyanin Results

2023 Lake Massapoag Phycocyanin Levels Weekly Monitoring – Grab Samples



Phycocyanin (PC) is a photosynthetic protein found only in cyanobacteria, so the levels correlate with the level of cyanobacteria.

WHO alert levels (Brient *et al.* 2008)

Level 1: PC > 30 µg/L (equivalent to 20,000 cells/ml) Requires weekly water monitoring to assess the risk of bloom.

Level 2: PC > 90 µg/L (equivalent to 100,000 cells/ml). Restrict water use due to the high potential risk of cyanotoxin.

Source: Debbie Tatro, LMAC

Attachment G: Low-Dose Alum Report

10 Hemingway Drive, 2nd Fl.
East Providence, RI 02915

T 401.434.5560
TRCcompanies.com

August 25, 2023

Revised: September 26, 2023
November 7, 2023

Laura Russell
Lake Massapoag Advisory Committee
90 South Main Street
Sharon, Massachusetts 02067

Re: ***Low Dose Alum Treatment Monitoring Report***
South Cove of Lake Massapoag
Sharon, Massachusetts
TRC Project No. 556559.0000.0000

Dear Ms. Russell,

TRC Environmental Corporation (TRC), provides the Lake Massapoag Advisory Committee ("LMAC", the Client) with this summary report of the 2023 alum treatment program at Lake Massapoag in Sharon, Massachusetts. The purpose of the alum treatment was to reduce the availability of phosphorus in the lake and to prevent blooms of potentially toxigenic cyanobacteria in the South Cove and areas adjacent to the Everwood Day Campgrounds.

TRC was contracted to provide monitoring of water quality in accordance with Special Condition No. 11 of the Amended Order of Conditions (DEP File No. SE-280-0425) and the Massachusetts Natural Heritage and Endangered Species Program (NHESP) Determination Letter, dated June 23, 2023. This report is intended to serve as documentation of the key monitoring provided by TRC immediately prior to and during implementation of the July 26, 2023 alum application at Lake Massapoag. Additionally, this report includes the initial post-treatment monitoring results collected by TRC.

Permits Obtained

Prior to the start of the alum treatment at Lake Massapoag, the project received the following permits, licenses, or approvals:

- Amended Order of Conditions (File #SE-280-0425) issued in June 2023.
- MESA Determination Letter (NHESP Tracking No. 02-10499) issued on June 23, 2023.
- License to Apply Chemicals (License No. WM04-0001307) from the Massachusetts Department of Environmental Protection for the application of alum and sodium aluminate to Lake Massapoag.

TRC conducting pre-treatment water quality sampling prior to the start of alum treatment on July 26, 2023.

Project Implementation

Water & Wetland LLC (Water & Wetland) served as the chemical applicator under direct contract with the Client. Following initial project staging on Everwood Day Campgrounds adjacent to the lake, aluminum sulfate (alum) and sodium aluminate were applied to the lake from separate boat-mounted tanks over a period of approximately four hours, with a two hour pause in the middle. Water & Wetland reported that the final volume of treatment over

the course of the program was approximately 1,500 gallons of aluminum sulfate and 750 gallons of sodium aluminate which was consistent with the South Cove low dose treatment plan (Table 1). The areal aluminum dose rate is 8.8 grams Al/m^2.

Table 1. Alum and Sodium Aluminate Applied to Lake Massapoag on July 26, 2023

Units	Aluminum Sulfate	Sodium Aluminate
Gallons	1,500	750
Lbs per Gallon	11.09	12.6
Lbs	16,635	9,450
% Aluminum (Al)	4.4	10
Pounds of Aluminum	732	945

Water Quality Monitoring

Methods

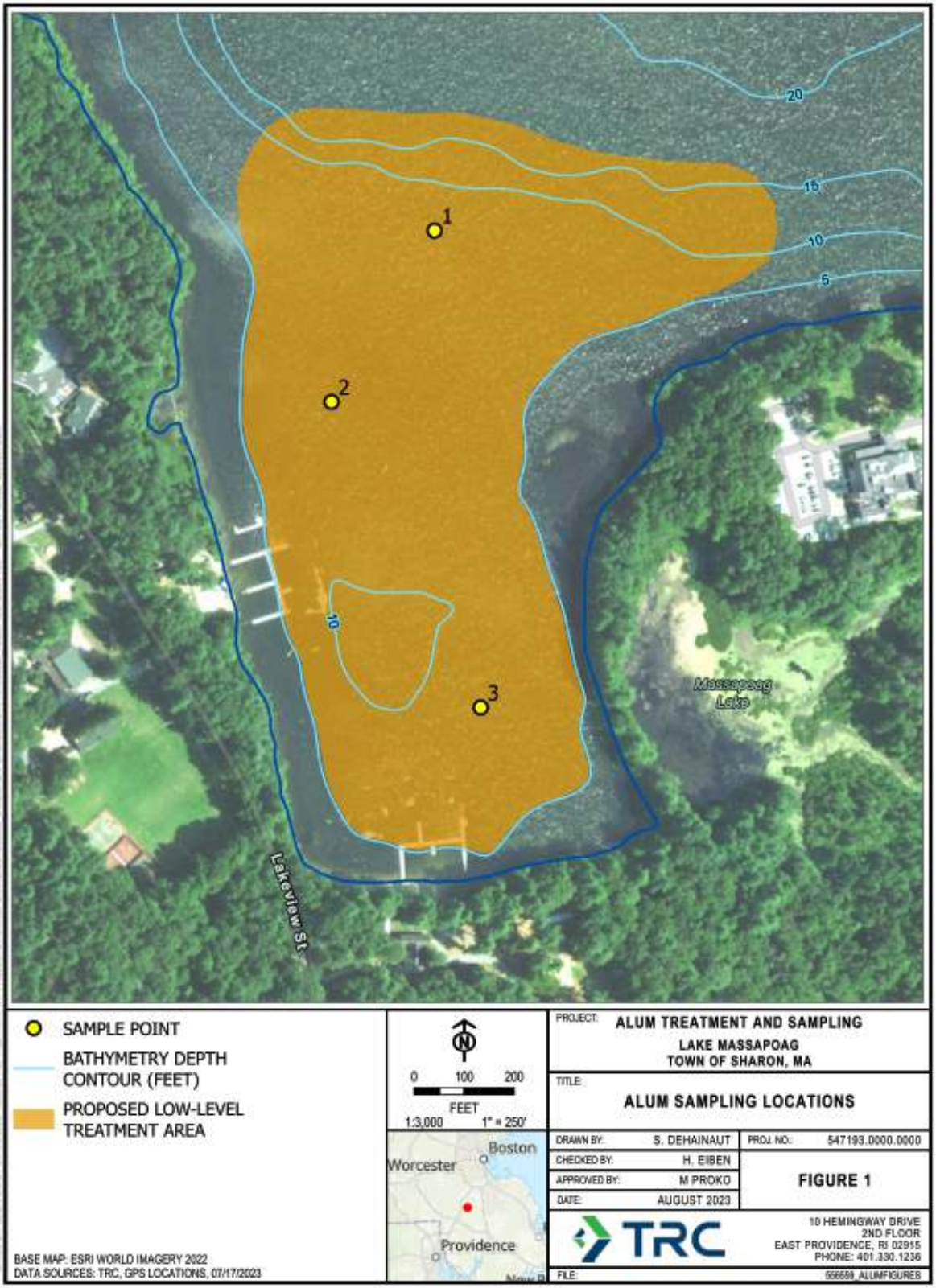
One June 26, 2023, TRC completed comprehensive monitoring events prior to the commencement of alum treatment. One round of pre-treatment water quality monitoring was completed in Lake Massapoag at three sampling locations 1, 2, and 3 (Figure 1).

During the treatment, TRC recorded pH levels at various locations and depths in the lake, and areas inside the active treatment zone. These pH measurements were collected during the entirety of active treatment.

TRC also completed a comprehensive post-treatment water quality monitoring event following the conclusion of the alum treatment, at the same locations, the next morning on June 27, 2023.

Flocculant is evident as whitish cloud below the surface during the alum treatment.

During the pre- and post-treatment water quality monitoring event, TRC measured the following water quality parameters in the field: water temperature, dissolved oxygen, specific conductance, pH, and Secchi disk depth. TRC also collected pre- and post-treatment water samples at the three locations for laboratory analysis of the following parameters: alkalinity, total phosphorus, chlorophyll A, and phytoplankton.


20
15
10
5
1
2
3
10
Massapoag Lake
Lakeview St
SAMPLE POINT
BATHYMETRY DEPTH CONTOUR (FEET)
PROPOSED LOW-LEVEL TREATMENT AREA
BASE MAP: ESRI WORLD IMAGERY 2022
DATA SOURCES: TRC, GPS LOCATIONS, 07/17/2023
0 100 200
FEET
1:3,000 1" = 250'
Boston
Worcester
Providence
PROJECT: ALUM TREATMENT AND SAMPLING
LAKE MASSAPOAG
TOWN OF SHARON, MA
TITLE: ALUM SAMPLING LOCATIONS
DRAWN BY: S. DEHAINAUT
CHECKED BY: H. EIBEN
APPROVED BY: M PROKO
DATE: AUGUST 2023
PROJ. NO.: 547193.0000.0000
FIGURE 1
TRC
10 HEMINGWAY DRIVE
2ND FLOOR
EAST PROVIDENCE, RI 02915
PHONE: 401.330.1236
FILE: 556559_ALUMFIGURES

Results

During Treatment Monitoring

Water & Wetland applying the treatment on July 26, 2023.

The first pass of the treatment was located near the beach to the south of the cove where the treatment vessel traversed orientated West to East multiple times. After this first pass, TRC staff noticed pH levels drastically dropping as low as 4.64 in some areas, well below the permitted operating range for pH (i.e., 6.5 SU to 7.7 SU). TRC's understanding from communication with Water & Wetland in the field is that they adjusted their dosages (i.e. increasing sodium aluminate ratio to alum) after the first pass. TRC observed Water & Wetland move to a deeper part of the treatment area, closer to the lake center, for a second pass of treatment. After one more pass by Water & Wetland, pH levels were as low as 4.8-5.6 SU in some of the profiles collected by TRC. At this point, TRC observed biological stress in the center of the cove, as multiple small fish (later identified as yellow perch) started coming to the surface. About an hour after the treatment had started, Water & Wetland paused active treatment at approximately 4:30 pm while TRC contacted the client to relay observations and confer on preferred course of action.

During discussions with the client, TRC continued to monitor pH and biological activity in the treatment area. TRC continued to note signs of biological stress and pH readings below the threshold. The pH values began rising around 6:00 pm and, in consultation with TRC and Water & Wetland, the client allowed the treatment to continue at a lower ratio of alum to sodium aluminate, with the intent of raising pH levels back into the permitted range. Water & Wetland began treating again at 6:30 pm and continued until the treatment was complete at around 7:30 pm. The pH values during this time stayed within the permitted pH operating range. Towards the end of the treatment, about 7:15 pm, pH readings were about 7.2 SU in the southern part of the cove near the beach. Refer to Table 2 for a summary of the measured pH values, inclusive of all depths. Field notes that document the pH measurements during the treatment, including locations, times, and depths, are included in Attachment A.

Table 2. Maximum, Minimum and Median pH Observed during Alum Treatment

Maximum pH (SU)	Minimum pH (SU)	Median pH (SU)
7.75	4.12	6.96

Pre and Post-Treatment Monitoring

Overall, the post-treatment field measurements were consistent with the values recorded during the pre-treatment field measurements. The Secchi depth appeared to slightly decrease between the pre-treatment field measurements and the post-treatment field measurements at locations 1. The decrease in water clarity at location 1 may have been caused by strong winds at the time of the post-treatment measurements. However, this was expected to be temporary with improvement anticipated going forward. Secchi depth at locations 2 and 3 were either the same or increased from the pre- to post-treatment measurements (Table 3).

The post-treatment pH levels remained low in the lake (as seen in Tables 4 through 6), at around 5.99 SU between the three sampling locations. The other field-measured parameters (dissolved oxygen and specific conductance)

were relatively similar between the pre- and post-treatment results (Tables 3 through 6), suggesting no meaningful impact of the treatment on those parameters.

On the morning of July 27, TRC staff observed several dead fish, all young-of-year yellow perch, that washed up on the shoreline of Everwood Day Campgrounds during post-treatment sampling.

Table 3. Pre- and Post-treatment Comprehensive Monitoring Field Results

Parameter	Units	Pre-treatment Location 1	Pre-treatment Location 2	Pre-treatment Location 3	Post-treatment Location 1	Post-treatment Location 2	Post-treatment Location 3
Temperature*	°C	28.3	28.4	28.7	26.5	26.6	26.5
DO*	mg/L	7.10	7.41	6.83	7.31	6.96	6.69
	%	91.45	95.8	88.7	90.6	86.8	83.3
Specific conductance*	(µS/cm)	174.0	172.1	170.3	172.7	172.4	182.2
pH*	(SU)	7.19	6.88	6.75	6.86	6.22	6.19
Secchi disk depth	m	2.5	1.5	1.0	2.0	1.5	1.5
Total depth	m	3.25	1.8	1.5	3	1.8	1.5

*Measured 0.5 m below water surface

Table 4. Pre- and Post-treatment Temperature and Dissolved Oxygen Profiles at Location 1

Depth (m)	Pre-treatment					Post-treatment				
	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH (SU)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH
0.5	28.3	7.10	91.4	174.0	7.19	26.5	7.31	90.6	172.7	6.06
1.0	27.9	7.04	90.1	173.8	7.14	26.5	7.22	89.8	172.7	6.34
1.5	27.7	7.17	91.2	173.7	7.05	26.5	7.14	88.8	173.2	6.05
2.0	27.2	7.03	89.3	173.5	7.04	26.5	7.24	89.1	173.6	5.95
2.5	26.6	7.00	87.5	172.1	6.68	26.5	7.04	87.9	174.4	5.93
3.0	26.5	6.83	84.8	167.2	6.67					

Table 5. Pre- and Post-treatment Temperature and Dissolved Oxygen Profiles at Location 2

Depth (m)	Pre-treatment					Post-treatment				
	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH (SU)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH (SU)
0.5	28.4	7.41	95.8	172.1	6.88	26.6	6.96	86.8	172.4	6.22
1.0	27.5	7.01	88.5	168.3	6.62	26.6	6.78	84.5	174.4	6.09
1.5	26.5	6.67	83.1	165.7	6.49	26.5	7.14	88.4	177.4	6.04

Table 6. Pre- and Post-treatment Temperature and Dissolved Oxygen Profiles at Location 3

Depth (m)	Pre-treatment					Post-treatment				
	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH (SU)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Spec Cond (µS/cm)	pH (SU)
0.5	28.7	6.83	88.7	170.3	6.75	26.5	6.69	83.3	182.2	6.19
1.0	27.5	6.55	82.5	167.5	6.42	26.1	6.33	78.3	177.8	6.04

Laboratory results at the three monitoring locations were relatively consistent between the pre- and post-treatment water samples (Table 7). Alkalinity slightly decreased from the pre- to the post-treatment samples except at location 3, which increased. Overall, alkalinity values generally stayed consistent from pre- to post-treatment (ranging from 9.9 to 11.6 mg/L), indicating that alkalinity in the lake rebounded quickly and did not experience a significant or prolonged decline as a result of the alum treatment. Similar to alkalinity, total phosphorus slightly decreased from the pre- to the post-treatment samples except alkalinity at location 3, which increased. However, it is likely that total phosphorus will continue to decrease with time, as more of the flocculent settled out of the water column, taking the bound phosphorus with it. Chlorophyll A was not extreme anywhere. However, it was higher post-treatment at locations 1 and 2. Chlorophyll A test methodology does not distinguish between active pigment and pheophytin (a breakdown product), so some portion of this could be “inactive” pigment. This could mean that portions of the Chlorophyll A concentrations could include pigment from dead algae. Laboratory reports are included in Attachment B.

Table 7. Pre- and Post-treatment Comprehensive Monitoring Lab Results

Analyte	Units	Pre-treatment Location 1	Pre-treatment Location 2	Pre-treatment Location 3	Post treatment Location 1	Post treatment Location 2	Post treatment Location 3
Alkalinity	mg/L	10.2	11.1	10.6	10.1	9.9	11.6
Total Phosphorus	mg/L	0.016	0.014	0.019	0.013	0.011	0.013
Chlorophyll-A	mg/m3	2.78	3.31	3.51	4.84	4.13	3.41

Phytoplankton samples were also taken during pre- and post- treatment monitoring at all three sampling locations. Sub-bloom levels of cyanobacteria were present in both the pre- and post-treatment phytoplankton samples. Some of the species observed are potential toxin producers (e.g., *Microcystis aeruginosa, Dolichospermum (Anabaena)* spp). They were present at several hundred to a few thousand cells per mL, which is well below the state recreational advisory guidance (70,000 cells/mL). The phytoplankton laboratory data are included in Attachment C.

After post-treatment measurements were conducted in the treatment area, TRC took pH readings outside of the treatment area, closer to the center of Lake Massapoag, to compare pH values (Table 8). pH readings at depth towards the center of the lake ranged from 5.92 SU to 6.26 SU, indicating lower pH levels outside the treatment area on the morning of July 27th.

Table 8. Post-treatment Monitoring in a Non-Treatment Area

Depth (m)	pH (SU)
0.5	6.18
1.0	6.20
1.5	6.26
2.0	6.25
2.5	6.24
3.0	5.92
3.5	5.92

Recommendations for Future Treatments

Should the client wish to pursue future low dose alum applications to the lake, TRC recommends performing the treatment earlier in the summer when the water temperature in the lake is cooler. The client has indicated that in previous summers, the fish community at Lake Massapoag tends to show temperature-related signs of stress. It is likely that warmer water temperatures may have already been placing a stress on the aquatic community prior to the alum treatment. Applications planned for late June may reduce the impacts to the biological community. Results from a June treatment paired with observations of the lakes condition and summer weather patterns can be used to inform whether another treatment in late July or early August would be appropriate.

TRC also recommends applying alum to a small-scale area as a “test run” prior to future treatments, preferably the day of the treatment when water conditions are most similar. This would allow the contractor to adjust the ratio of alum and sodium aluminate accordingly before proceeding with the full treatment. Extensive pH monitoring should continue to occur prior to, during, and post-treatment to identify areas where the pH may be out of range.

Finally, TRC recommends a more thorough bathymetric survey of the treatment area to ensure that dosage volumes are calculated accurately and that treatment areas are not occurring in areas shallower than five feet, in order to remain in compliance with the MESA Determination Letter.

Sincerely,

TRC Environmental Corporation

Morgan Proko

Morgan Proko
Staff Scientist

Attachment A: During Treatment Field Notes

404 Wyman Street, Ste. 375
Waltham, MA 02451
T 781.419.7696
TRCcompanies.com

In-Treatment pH Monitoring:

Timeline

1300: Morgan Proko and Sophia Mottola (TRC) arrive on Site for pre-treatment sampling.

1445: Colin and Grace (Water & Wetland, W&W) arrive on Site.

1520: Alum treatment of South Cove begins with first pass of treatment. W&W targets area closer to southern end of cove by beaches.

1605: Initial readings are low (see below). Morgan notifies TRC and communicates with W&W of the low readings. Colin states he will make adjustments. W&W returns to fill up boat and perform a second pass of treatment. Morgan continues to monitor pH during the second pass.

1630: Numbers still low after W&W adjustment. Five small fish observed in center of the lake, floating near the surface. Treatment Stops.

1630-1830: Treatment on pause while discussions with W&W and the client occur. TRC continues to monitor pH.

1730: TRC field staff observe additional small fish in the center of the cove.

1800: TRC meets with Laura and Josh. Client decides to pursue treatment. W&W adjusts ratios again.

1830: Treatment resumes. Monitoring within range for remainder of treatment (see below).

1930: Treatment ends.

pH Readings

Sample Time: 1535	**Location: Near the beaches, first pass**
Depth (m)	**pH**
0.5	7.05
1	5.66
1.5	5.74
2	5.95
2.5	5.54
Total Depth= 2.6	

Sample Time: 1610	**Location: Near the beaches, second pass.**
Depth (m)	**pH**
0.5	6.42
1	4.64
1.5	5.5
Total Depth= 1.5	

Sample Time: 1615	Location: Close to center of cove, second pass
Depth (m)	**pH**
0.5	4.12
1	4.23
Total Depth= 1.5	

Sample Time: 1630	Location: Close to center of cove, second pass
Depth (m)	**pH**
0.5	5.65
1	4.8
1.5	5.6
Total Depth= 1.5	

Sample Time: 1710	Location: Close to center of cove, while treatment stopped.		
Depth (m)	**pH**	**DO (mg/L)**	**DO (%)**
0.5	7.05	7.24	92.3
1	6.75	7.21	91.7
Total Depth= 1.5			

Sample Time: 1715	Location: Center of cove, while treatment stopped.		
Depth (m)	**pH**	**DO (mg/L)**	**DO (%)**
0.5	6.6	6.72	75.5
1	7.0	6.04	75.6
Total Depth= 1.2			

Sample Time: 1830	Location: Center of cove, treatment resumes.
Depth (m)	**pH**
0.5	7.75
1	7.18
Total Depth= 1.5	

Sample Time: 1835	Location: Center of cove
Depth (m)	**pH**
0.5	7.18
1	7.44
Total Depth= 1.5	

Sample Time: 1845	Location: Center of cove
Depth (m)	**pH**
0.5	6.92
1	6.92
Total Depth= 1.2	

Sample Time: 1855	Location: Closer to Location 3
Depth (m)	**pH**
0.5	7.56
1	7.20
Total Depth= 1.5	

Sample Time: 1913	Location: Closer to Location 3
Depth (m)	**pH**
0.5	7.7
1	7.65
Total Depth= 1.5	

Sample Time: 1925	Location: Closer to Location 3
Depth (m)	**pH**
0.5	7.01
Total Depth= 1.5	

Attachment B: Laboratory Reports

PHOENIX
Environmental Laboratories, Inc.

Thursday, August 03, 2023

Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Project ID: LAKE MASSAPOAG
SDG ID: GCO61701
Sample ID#s: CO61701 - CO61706

This laboratory is in compliance with the NELAC requirements of procedures used except where indicated.

This report contains results for the parameters tested, under the sampling conditions described on the Chain Of Custody, as received by the laboratory. This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included.

A scanned version of the COC form accompanies the analytical report and is an exact duplicate of the original.

If you are the client above and have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext.200. The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.

Sincerely yours,

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #M-CT007
ME Lab Registration #CT-007
NH Lab Registration #213693-A,B
NJ Lab Registration #CT-003
NY Lab Registration #11301
PA Lab Registration #68-03530
RI Lab Registration #63
VT Lab Registration #VT11301

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Sample Id Cross Reference

August 03, 2023

SDG I.D.: GCO61701

Project ID: LAKE MASSAPOAG

Client Id	Lab Id	Matrix
MASS-1-PRE	CO61701	SURFACE WATER
MASS-2-PRE	CO61702	SURFACE WATER
MASS-3-PRE	CO61703	SURFACE WATER
MASS-1-POST	CO61704	SURFACE WATER
MASS-2-POST	CO61705	SURFACE WATER
MASS-3-POST	CO61706	SURFACE WATER

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/26/23	13:50
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61701

Project ID: LAKE MASSAPOAG
Client ID: MASS-1-PRE

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	10.2	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.016	0.003	mg/L	0.5	08/02/23	JR	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

If you are the client above and have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext.200.
The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.

Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/26/23	14:10
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61702

Project ID: LAKE MASSAPOAG
Client ID: MASS-2-PRE

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	11.1	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.014	0.003	mg/L	0.5	08/02/23	JR	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

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Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/26/23	14:20
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61703

Project ID: LAKE MASSAPOAG
Client ID: MASS-3-PRE

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	10.6	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.019	0.003	mg/L	0.5	08/02/23	JR	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

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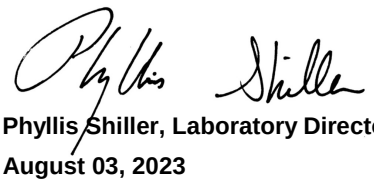

Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/27/23	10:00
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61704

Project ID: LAKE MASSAPOAG
Client ID: MASS-1-POST

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	10.1	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.013	0.003	mg/L	0.5	08/02/23	LG	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

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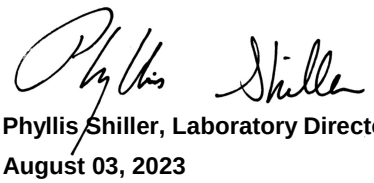
The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.



Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/27/23	10:15
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61705

Project ID: LAKE MASSAPOAG
Client ID: MASS-2-POST

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	9.9	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.011	0.003	mg/L	0.5	08/02/23	LG	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

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The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.

Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

Analysis Report

August 03, 2023

FOR: Attn: Margaret O'Brien
ESS Group Inc. A TRC Company
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Sample Information		Custody Information		Date	Time
Matrix:	SURFACE WATER	Collected by:		07/27/23	10:25
Location Code:	TRC-RI	Received by:	CP	07/28/23	17:51
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCO61701
Phoenix ID: CO61706

Project ID: LAKE MASSAPOAG
Client ID: MASS-3-POST

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Alkalinity-CaCO3	11.6	5.00	mg/L	1	07/29/23	MW/KDB	SM2320B-11
Phosphorus, as P	0.013	0.003	mg/L	0.5	08/02/23	LG	SM4500PE-11

RL/PQL=Reporting/Practical Quantitation Level ND=Not Detected BRL=Below Reporting Level

Comments:

If you are the client above and have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext.200.
The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.

Phyllis Shiller, Laboratory Director
August 03, 2023
Reviewed and Released by: Anil Makol, Project Manager

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102

QA/QC Report

August 03, 2023

QA/QC Data

SDG I.D.: GCO61701

Parameter	Blank	Blk RL	Sample Result	Dup Result	Dup RPD	LCS %	LCSD %	LCS RPD	MS %	MSD %	MS RPD	% Rec Limits	% RPD Limits
QA/QC Batch 689915 (mg/L), QC Sample No: CO61174 (CO61701, CO61702, CO61703)													
Phosphorus, as P	BRL	0.01	0.097	0.100	3.00	98.1			106			85 - 115	20
Comment:													
Additional criteria matrix spike acceptance range is 75-125%.													
QA/QC Batch 689295 (mg/L), QC Sample No: CO61410 (CO61701, CO61702, CO61703, CO61704, CO61705, CO61706)													
Alkalinity-CaCO3	BRL	5.00	407	396	2.70	92.7						85 - 115	20
QA/QC Batch 689955 (mg/L), QC Sample No: CO62062 (CO61704, CO61705, CO61706)													
Phosphorus, as P	BRL	0.01	2.01	1.89	6.20	96.3			115			85 - 115	20
Comment:													
Additional criteria matrix spike acceptance range is 75-125%.													

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.

RPD - Relative Percent Difference
LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS - Matrix Spike
MS Dup - Matrix Spike Duplicate
NC - No Criteria
Intf - Interference

Phyllis Shiller, Laboratory Director
August 03, 2023

Thursday, August 03, 2023

Criteria: None

State: CT

Sample Criteria Exceedances Report

GCO61701 - TRC-RI

SampNo	Acode	Phoenix Analyte	Criteria	Result	RL	Criteria	RL Criteria	Analysis Units

*** No Data to Display ***

Phoenix Laboratories does not assume responsibility for the data contained in this exceedance report. It is provided as an additional tool to identify requested criteria exceedences. All efforts are made to ensure the accuracy of the data (obtained from appropriate agencies). A lack of exceedence information does not necessarily suggest conformance to the criteria. It is ultimately the site professional's responsibility to determine appropriate compliance.

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Comments

August 03, 2023 SDG I.D.: GCO61701

The following analysis comments are made regarding exceptions to criteria not already noted in the Analysis Report or QA/QC Report: None.

Cooler: Yes ☐ No ☐
Coolant: IPK ☐ ICE ☐ No ☐
Temp 2.0 °C Pg of

PHOENIX
Environmental Laboratories, Inc.

CT/MA/RI CHAIN OF CUSTODY RECORD

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: makrina@phoenixlabs.com Fax (860) 645-0823
Client Services (860) 645-1102

Data Delivery/Contact Options:
☐ Fax:
☐ Phone:
☑ Email: mobrien@trccompanies.com

Customer: TRC
Address: 10 Hemenway Dr
E. Providence, RI

Project: Lake Massapoag
Report to: Margaret OBrien
Invoice to:
Quote #

Project P.O:

This section MUST be completed with Bottle Quantities.

Sampler's Signature
Client Sample - Information - Identification
Date: 7/27/23

Matrix Code:
DW=Drinking Water **GW**=Ground Water **SW**=Surface Water **WW**=Waste Water
RW=Raw Water **SE**=Sediment **SL**=Sludge **S**=Soil **SD**=Solid **W**=Wipe **OIL**=Oil
B=Bulk **L**=Liquid **X** = _____(Other)

PHOENIX USE ONLY SAMPLE #	Customer Sample Identification	Sample Matrix	Date Sampled	Time Sampled	*MS/MSD (May be billable at analysis unit rate)	Total Phos	alkalinity
61701	Mass-1-Pre	SW	7/26	1350	✓	✓	✓
61702	Mass-2-Pre	SW	7/26	1410	✓	✓	✓
61703	Mass-3-Pre	SW	7/26	1420	✓	✓	✓
61704	Mass-1-Post	SW	7/27	1000	✓	✓	✓
61705	Mass-2-Post	SW	7/27	1015	✓	✓	✓
61706	Mass-3-Post	SW	7/27	1025	✓	✓	✓

GL Amber 8 oz. [ ] w/H_3PO_4 [ ] $NAHSO_4$	Soil VOA Vials [ ] methanol [ ] H_2O	GL Soil container ( ) oz	GL Soil container ( ) oz	40 ml VOA Vial [ ] As is [ ] HCl	GL Amber 1000ml [ ] As is [ ] H_2SO_4	PL As is	PL H_2SO_4	PL HNO_3 250ml	PL NaOH 250ml	Bacteria Bottle w/thio	Bacteria Bottle as is
						1	1				
						1	1				
						1	1				
						1	1				
						1	1				
						1	1				

Relinquished by:	Accepted by:	Date:	Time:
		7-28-23	930
		7/28/23	17:51

Comments, Special Requirements or Regulations:
* low detect OA phos
-0.01 mg/L or better

Turnaround Time:
☐ 1 Day* ☐ 2 Days* ☐ 3 Days* ☐ 4 Days* ☐ 5 Days*
☑ Standard ☐ Other _____

RI
☐ RES DEC
☐ I/C DEC
☐ GA Leachability
☐ GB Leachability
☐ GA -GW Objectives
☐ GB -GW Objectives
☐ Other

CT
☐ RCP Cert
☐ GWPC
☐ SWPC
☐ GA PMC
☐ GB PMC
☐ SWPC
☐ RES DEC
☐ I/C DEC

MA
☐ MCP Certification
☐ GW-1 ☐ RCS-1 / RCGW-1
☐ GW-2 ☐ RCS-2 / RCGW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ SW Protection
☐ _____

Data Format
☑ Excel
☑ PDF
☐ GIS/Key
☐ EQuIS
☐ Other

Data Package
☐ Tier II Checklist*
☐ Full Data Package*
☐ Phoenix Std
☐ Other

***MS/MSD are considered site samples and will be billed as such in accordance with the prices quoted.**

*** SURCHARGES MAY APPLY**

State where samples were collected: MA

*** SURCHARGE APPLIES**

Form PEL126 Rev. 1/23

ANALYTICAL REPORT

Lab Number:	L2343267
Client:	TRC Companies, Inc. 404 Wyman St. Suite 375 Waltham, MA 02451
ATTN:	Margaret O'Brien
Phone:	(781) 419-7704
Project Name:	LAKE MASSAPOAG ALUM
Project Number:	556559.0000.0000
Report Date:	08/10/23

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0826), IL (200077), IN (C-MA-03), KY (KY98045), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), OH (CL108), OR (MA-1316), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #525-23-122-91930).

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

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343267
Report Date: 08/10/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2343267-01	MASS-1-POST	WATER	SHARON, MA	07/27/23 10:00	07/27/23
L2343267-02	MASS-2-POST	WATER	SHARON, MA	07/27/23 10:15	07/27/23
L2343267-03	MASS-3-POST	WATER	SHARON, MA	07/27/23 10:25	07/27/23

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343267
Project Number:	556559.0000.0000	**Report Date:**	08/10/23

Case Narrative

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

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

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

Please contact Project Management at 800-624-9220 with any questions.

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

Authorized Signature:  Ashaley Moynihan

Title: Technical Director/Representative Date: 08/10/23

INORGANICS
&
MISCELLANEOUS

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343267
Report Date: 08/10/23

SAMPLE RESULTS

Lab ID: L2343267-01
Client ID: MASS-1-POST
Sample Location: SHARON, MA

Date Collected: 07/27/23 10:00
Date Received: 07/27/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	4.84		mg/m3	2.00	NA	1	07/28/23 06:45	07/31/23 13:45	121,10200H	LOF

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343267
Report Date: 08/10/23

SAMPLE RESULTS

Lab ID: L2343267-02
Client ID: MASS-2-POST
Sample Location: SHARON, MA

Date Collected: 07/27/23 10:15
Date Received: 07/27/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	4.13		mg/m3	2.00	NA	1	07/28/23 06:45	07/31/23 13:45	121,10200H	LOF

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343267
Report Date: 08/10/23

SAMPLE RESULTS

Lab ID: L2343267-03
Client ID: MASS-3-POST
Sample Location: SHARON, MA

Date Collected: 07/27/23 10:25
Date Received: 07/27/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	3.41		mg/m3	2.00	NA	1	07/28/23 06:45	07/31/23 13:45	121,10200H	LOF

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000
Lab Number: L2343267
Report Date: 08/10/23

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-03 Batch: WG1808866-1										
Chlorophyll A	ND		mg/m3	2.00	NA	1	07/28/23 06:45	07/31/23 13:45	121,10200H	LOF

Lab Duplicate Analysis

Batch Quality Control

Project Name: LAKE MASSAPOAG ALUM

Project Number: 556559.0000.0000

Lab Number: L2343267

Report Date: 08/10/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1808866-2 QC Sample: L2343347-05 Client ID: DUP Sample						
Chlorophyll A	ND	2.01	mg/m3	NC		35

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343267
Report Date: 08/10/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2343267-01A	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)
L2343267-01B	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)
L2343267-02A	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)
L2343267-02B	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)
L2343267-03A	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)
L2343267-03B	Brown Plastic 1000ml unpreserved	A	NA		3.4	Y	Absent		CHLORO-A(1)

*Values in parentheses indicate holding time in days

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343267
Project Number:	556559.0000.0000	**Report Date:**	08/10/23

GLOSSARY

Acronyms

DL - Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EMPC - Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LOD - Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

LOQ - Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NDPA/DPA - N-Nitrosodiphenylamine/Diphenylamine.

NI - Not Ignitable.

NP - Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.

NR - No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

STLP - Semi-dynamic Tank Leaching Procedure per EPA Method 1315.

TEF - Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.

TEQ - Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.

TIC - Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343267
Project Number:	556559.0000.0000	**Report Date:**	08/10/23

Footnotes

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

Terms

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

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

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

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343267
Project Number:	556559.0000.0000	**Report Date:**	08/10/23

Data Qualifiers

ND - Not detected at the reporting limit (RL) for the sample.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343267
Project Number:	556559.0000.0000	**Report Date:**	08/10/23

REFERENCES

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

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

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

Certification Information

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

Westborough Facility
EPA 624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625.1: alpha-Terpineol
EPA 8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 524.2: THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables).
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb**,** As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

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

CHAIN OF CUSTODY

PAGE _____ OF _____

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 7/27/23

ALPHA Job #: L2343267

Client Information

Client: TRC
Address: 404 Wyman St Suite 375 Waltham, MA 02451
Phone: 781 419 7707
Fax:
Email: mobrien@trcompanies.com
☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Lake Massapoag Alum
Project Location: Sharon, MA
Project #: 556559.0000.0000
Project Manager: Margaret O'brien
ALPHA Quote #:

Turn-Around Time

☑ Standard ☐ RUSH (only confirmed if pre-approved)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☑ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Is Matrix Spike (MS) Required on this SDG? (If yes see note in Comments)
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

If MS is required, indicate in Sample Specific Comments which samples and what tests MS to be performed.
(Note: All *CAM* methods for inorganic analyses require MS every 20 soil samples)

ANALYSIS: CAM-A

SAMPLE HANDLING
Filtration
☐ Done ☐ Not needed ☐ Lab to do
Preservation
☐ Lab to do (Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	CAM-A	Sample Specific Comments	TOTAL # BOTTLES
43267-01	Mass-1-Post	7/27	1000	SW	MP	x		2
-02	Mass-2-Post	7/27	1015	SW	MP	x		2
-03	Mass-3-Post	7/27	1025	SW	MP	x		2

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

	Container Type															
	Preservative															

Relinquished By:	Date/Time	Received By:	Date/Time
	7/27 1210		7/27/23 1210
	7/27/23	AAL	7/27/23 1600

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 18-Jan-2010)

ANALYTICAL REPORT

Lab Number:	L2343158
Client:	TRC Companies, Inc. 404 Wyman St. Suite 375 Waltham, MA 02451
ATTN:	Margaret O'Brien
Phone:	(781) 419-7704
Project Name:	LAKE MASSAPOAG ALUM
Project Number:	556559.0000.0000
Report Date:	08/04/23

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0826), IL (200077), IN (C-MA-03), KY (KY98045), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), OH (CL108), OR (MA-1316), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #525-23-122-91930).

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

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343158
Report Date: 08/04/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2343158-01	MASS-1-PRE	WATER	SHARON, MA	07/26/23 13:50	07/26/23
L2343158-02	MASS-2-PRE	WATER	SHARON, MA	07/26/23 14:10	07/26/23
L2343158-03	MASS-3-PRE	WATER	SHARON, MA	07/26/23 14:20	07/26/23

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343158
Project Number:	556559.0000.0000	**Report Date:**	08/04/23

Case Narrative

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

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

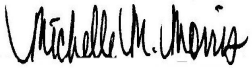
When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

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

Please contact Project Management at 800-624-9220 with any questions.

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

Authorized Signature:  Michelle M. Morris

Title: Technical Director/Representative Date: 08/04/23

INORGANICS
&
MISCELLANEOUS

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343158
Report Date: 08/04/23

SAMPLE RESULTS

Lab ID: L2343158-01
Client ID: MASS-1-PRE
Sample Location: SHARON, MA

Date Collected: 07/26/23 13:50
Date Received: 07/26/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	2.78		mg/m3	2.00	NA	1	07/27/23 07:10	07/28/23 08:30	121,10200H	MKT

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343158
Report Date: 08/04/23

SAMPLE RESULTS

Lab ID: L2343158-02
Client ID: MASS-2-PRE
Sample Location: SHARON, MA

Date Collected: 07/26/23 14:10
Date Received: 07/26/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	3.31		mg/m3	2.00	NA	1	07/27/23 07:10	07/28/23 08:30	121,10200H	MKT

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343158
Report Date: 08/04/23

SAMPLE RESULTS

Lab ID: L2343158-03
Client ID: MASS-3-PRE
Sample Location: SHARON, MA

Date Collected: 07/26/23 14:20
Date Received: 07/26/23
Field Prep: Not Specified

Sample Depth:
Matrix: Water

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Chlorophyll A	3.51		mg/m3	2.00	NA	1	07/27/23 07:10	07/28/23 08:30	121,10200H	MKT

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000
Lab Number: L2343158
Report Date: 08/04/23

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-03 Batch: WG1808331-1										
Chlorophyll A	ND		mg/m3	2.00	NA	1	07/27/23 07:10	07/28/23 08:30	121,10200H	MKT

Lab Duplicate Analysis

Batch Quality Control

Project Name: LAKE MASSAPOAG ALUM

Project Number: 556559.0000.0000

Lab Number: L2343158

Report Date: 08/04/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1808331-2 QC Sample: L2343158-03 Client ID: MASS-3-PRE						
Chlorophyll A	3.51	2.96	mg/m3	17		35

Project Name: LAKE MASSAPOAG ALUM
Project Number: 556559.0000.0000

Lab Number: L2343158
Report Date: 08/04/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2343158-01A	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)
L2343158-01B	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)
L2343158-02A	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)
L2343158-02B	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)
L2343158-03A	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)
L2343158-03B	Brown Plastic 1000ml unpreserved	A	NA		4.6	Y	Absent		CHLORO-A(1)

*Values in parentheses indicate holding time in days

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343158
Project Number:	556559.0000.0000	**Report Date:**	08/04/23

GLOSSARY

Acronyms

DL - Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EMPC - Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LOD - Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

LOQ - Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NDPA/DPA - N-Nitrosodiphenylamine/Diphenylamine.

NI - Not Ignitable.

NP - Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.

NR - No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

STLP - Semi-dynamic Tank Leaching Procedure per EPA Method 1315.

TEF - Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.

TEQ - Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.

TIC - Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343158
Project Number:	556559.0000.0000	**Report Date:**	08/04/23

Footnotes

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

Terms

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

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

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

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343158
Project Number:	556559.0000.0000	**Report Date:**	08/04/23

Data Qualifiers

ND - Not detected at the reporting limit (RL) for the sample.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Report Format: Data Usability Report

Project Name:	LAKE MASSAPOAG ALUM	**Lab Number:**	L2343158
Project Number:	556559.0000.0000	**Report Date:**	08/04/23

REFERENCES

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

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

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

Certification Information

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

Westborough Facility
EPA 624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625.1: alpha-Terpineol
EPA 8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 524.2: THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables).
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb**,** As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

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

CHAIN OF CUSTODY

PAGE _____ OF _____

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 07/26/23

ALPHA Job #: L2343158

Client Information

Client: TRC
Address: 404 Wyman St Suite 375
Waltham, MA 02451
Phone: 781 419 7707
Fax:
Email: mobren@trcompanies.com
☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Lake Massapoag Alum
Project Location: Sharon, MA
Project #: 356559.0000.0000
Project Manager: Margaret OBrien
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTO

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Is Matrix Spike (MS) Required on this SDG? (If yes see note in Comments)
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

If MS is required , indicate in Sample Specific Comments which samples and what tests MS to be performed.
(Note: All *CAM* methods for inorganic analyses require MS every 20 soil samples)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS Cadmium	SAMPLE HANDLING	TOTAL # BOTTLES
43580	Mass-1-Pre	7/26/23	1350	SW	MP	x		
-02	Mass-2-Pre	7/26/23	1410	SW	MP	x		
-03	Mass-3-Pre	7/26/23	1420	SW	MP	x		

SAMPLE HANDLING: Filtration ☐ Done ☐ Not needed ☐ Lab to do; Preservation ☐ Lab to do (Please specify below); Sample Specific Comments

Container Type																		
Preservative																		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
	4:27 7/26/23		16:27
Shawn Thompson	16:27 7/26/23	AAL	7/26/23 2050

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 16-Jan-2010)

Attachment C: Phytoplankton Results

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-1-pre
Sample Depth:
Sample Date: 26-Jul-23

Total Density (#/mL): 565
Total Biovolume (um^3/mL): 160,913
Trophic State Index: 36.7

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Rhodomonas minuta	277	49.0	5,539	3.4
2	Cryptomonas erosa	102	18.0	52,899	32.9
3	Sphaerocystis schroeteri	45	8.0	12,660	7.9
4	Gomphosphaeria wichurae	28	5.0	42,726	26.6
5	Aphanothece sp.	23	4.0	5,426	3.4
6	Ankistrodesmus falcatus	23	4.0	1,017	0.6
7	Chroococcus minimus	17	3.0	1,424	0.9
8	Crucigenia quadrata	11	2.0	1,441	0.9
9	Microcystis aeruginosa	6	1.0	11,303	7.0
10	Anabaena flos-aquae	6	1.0	11,360	7.1
11	Cyclotella stelligera	6	1.0	311	0.2
12	Melosira distans alpigena	6	1.0	1,978	1.2
13	Tabellaria flocculosa	6	1.0	3,334	2.1
14	Anabaena planctonica	6	1.0	8,274	5.1
15	Oocystis pusilla	6	1.0	1,221	0.8

Microcystis aeruginosa cells/mL = 1,413

Anabaena flos-aquae cells/mL = 170

Anabaena planctonica cells/mL = 45

Aquatic Analysts

Sample ID: ZM76

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-1-post
Sample Depth:
Sample Date: 27-Jul-23

Total Density (#/mL): 343
Total Biovolume (um^3/mL): 169,847
Trophic State Index: 37.1

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Cryptomonas erosa	143	41.7	74,451	43.8
2	Rhodomonas minuta	63	18.3	1,253	0.7
3	Trachelomonas volvocina	33	9.6	61,848	36.4
4	Sphaerocystis schroeteri	27	7.8	9,396	5.5
5	Gomphosphaeria wichurae	18	5.2	10,148	6.0
6	Aphanothece sp.	15	4.3	2,416	1.4
7	Microcystis aeruginosa	12	3.5	6,204	3.7
8	Kephyrion spirale	9	2.6	564	0.3
9	Kephyrion littorale	6	1.7	567	0.3
10	Chrysococcus rufescens	3	0.9	254	0.1
11	Crucigenia quadrata	3	0.9	254	0.1
12	Gomphonema gracile	3	0.9	731	0.4
13	Oocystis pusilla	3	0.9	644	0.4
14	Oocystis lacustris	3	0.9	931	0.5
15	Kephyrion sp.	3	0.9	188	0.1

Microcystis aeruginosa cells/mL = 776

Aquatic Analysts

Sample ID: ZM79

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-2-pre
Sample Depth:
Sample Date: 26-Jul-23

Total Density (#/mL): 350
Total Biovolume (um^3/mL): 136,492
Trophic State Index: 35.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Cryptomonas erosa	120	34.2	62,320	45.7
2	Rhodomonas minuta	57	16.2	1,135	0.8
3	Sphaerocystis schroeteri	44	12.6	18,545	13.6
4	Aphanothece sp.	28	8.1	4,087	3.0
5	Epithemia sorex	13	3.6	17,258	12.6
6	Scenedesmus quadricauda	9	2.7	2,460	1.8
7	Gomphosphaeria wichurae	9	2.7	6,358	4.7
8	Microcystis aeruginosa	9	2.7	6,282	4.6
9	Kephyrion spirale	6	1.8	397	0.3
10	Ankistrodesmus falcatus	6	1.8	158	0.1
11	Asterionella formosa	6	1.8	1,388	1.0
12	Oocystis pusilla	6	1.8	2,725	2.0
13	Cyclotella stelligera	6	1.8	520	0.4
14	Cyclotella comta	3	0.9	7,159	5.2
15	Navicula cryptocephala	3	0.9	583	0.4
16	Synedra rumpens	3	0.9	442	0.3
17	Anabaena flos-aquae	3	0.9	1,690	1.2
18	Chlamydomonas sp.	3	0.9	1,025	0.8
19	Nitzschia frustulum	3	0.9	378	0.3
20	Navicula pupula	3	0.9	852	0.6
21	Chroococcus minimus	3	0.9	177	0.1
22	Melosira distans alpigena	3	0.9	552	0.4

Anabaena flos-aquae cells/mL = 25

Microcystis aeruginosa cells/mL = 785

Aquatic Analysts

Sample ID: ZM77

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-2-post
Sample Depth:
Sample Date: 27-Jul-23

Total Density (#/mL): 475
Total Biovolume (um^3/mL): 206,777
Trophic State Index: 38.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Cryptomonas erosa	154	32.5	80,142	38.8
2	Rhodomonas minuta	81	17.1	1,622	0.8
3	Gomphosphaeria wichurae	49	10.3	32,706	15.8
4	Microcystis aeruginosa	28	6.0	11,356	5.5
5	Trachelomonas volvocina	24	5.1	45,871	22.2
6	Aphanothece sp.	24	5.1	4,745	2.3
7	Sphaerocystis schroeteri	20	4.3	9,227	4.5
8	Kephyrion spirale	20	4.3	1,278	0.6
9	Chroococcus minimus	12	2.6	562	0.3
10	Oocystis lacustris	8	1.7	1,898	0.9
11	Chlamydomonas sp.	8	1.7	2,636	1.3
12	Crucigenia quadrata	8	1.7	2,758	1.3
13	Quadrigula closterioides	8	1.7	1,557	0.8
14	Staurastrum dejectum	4	0.9	1,622	0.8
15	Melosira distans alpigena	4	0.9	1,420	0.7
16	Oocystis pusilla	4	0.9	876	0.4
17	Kephyrion littorale	4	0.9	385	0.2
18	Glenodinium sp.	4	0.9	2,839	1.4
19	Ulothrix sp.	4	0.9	2,596	1.3
20	Elakatothrix gelatinosa	4	0.9	681	0.3

Microcystis aeruginosa cells/mL = 1,420

Aquatic Analysts

Sample ID: ZM80

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-3-pre
Sample Depth:
Sample Date: 26-Jul-23

Total Density (#/mL): 371
Total Biovolume (um^3/mL): 131,691
Trophic State Index: 35.3

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Cryptomonas erosa	75	20.2	39,087	29.7
2	Gomphosphaeria wichurae	35	9.5	16,342	12.4
3	Kephyrion spirale	27	7.1	1,671	1.3
4	Eunotia pectinalis	18	4.8	15,281	11.6
5	Sphaerocystis schroeteri	18	4.8	8,666	6.6
6	Rhodomonas minuta	18	4.8	354	0.3
7	Aphanothece sp.	18	4.8	2,653	2.0
8	Kephyrion littorale	18	4.8	1,680	1.3
9	Chlamydomonas sp.	13	3.6	4,311	3.3
10	Chrysococcus rufescens	9	2.4	752	0.6
11	Tabellaria flocculosa	9	2.4	5,217	4.0
12	Fragilaria construens venter	9	2.4	671	0.5
13	Navicula cryptocephala	9	2.4	1,636	1.2
14	Cyclotella stelligera	9	2.4	486	0.4
15	Cymbella minuta	9	2.4	3,272	2.5
16	Synedra rumpens	9	2.4	1,238	0.9
17	Synedra radians	9	2.4	3,184	2.4
18	Oocystis lacustris	9	2.4	2,759	2.1
19	Coelastrum microporum	4	1.2	4,245	3.2
20	Pediastrum duplex	4	1.2	2,405	1.8
21	Microcystis aeruginosa	4	1.2	1,415	1.1
22	Scenedesmus denticulatus	4	1.2	796	0.6
23	Achnanthes recurvata	4	1.2	354	0.3
24	Achnanthes hauckiana	4	1.2	212	0.2
25	Crucigenia quadrata	4	1.2	376	0.3
26	Fragilaria construens	4	1.2	495	0.4
27	Elakatothrix gelatinosa	4	1.2	743	0.6
28	Oocystis pusilla	4	1.2	955	0.7
29	Trachelomonas hispida	4	1.2	9,285	7.1
30	Scenedesmus quadricauda	4	1.2	1,150	0.9

Phytoplankton Sample Analysis

Sample: Massapoag L
Sample Site: Mass-3-post
Sample Depth:
Sample Date: 27-Jul-23

Total Density (#/mL): 306
Total Biovolume (um^3/mL): 95,414
Trophic State Index: 33.0

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Cryptomonas erosa	73	23.9	37,920	39.7
2	Kephyrion spirale	50	16.5	3,181	3.3
3	Kephyrion littorale	48	15.6	4,530	4.7
4	Chlamydomonas sp.	25	8.3	8,204	8.6
5	Rhodomonas minuta	20	6.4	393	0.4
6	Achnanthes minutissima	11	3.7	561	0.6
7	Sphaerocystis schroeteri	11	3.7	3,927	4.1
8	Gomphosphaeria wichurae	6	1.8	1,414	1.5
9	Cyclotella stelligera	6	1.8	309	0.3
10	Kephyrion sp.	6	1.8	353	0.4
11	Oocystis pusilla	6	1.8	1,212	1.3
12	Microcystis aeruginosa	6	1.8	3,814	4.0
13	Anabaena flos-aquae	6	1.8	7,141	7.5
14	Trachelomonas volvocina	6	1.8	10,574	11.1
15	Ulothrix sp.	6	1.8	4,488	4.7
16	Ankistrodesmus falcatus	6	1.8	351	0.4
17	Glenodinium sp.	3	0.9	1,963	2.1
18	Nitzschia palea	3	0.9	505	0.5
19	Aphanothece sp.	3	0.9	337	0.4
20	Coscinodiscus sp.	3	0.9	2,104	2.2
21	Elakatothrix gelatinosa	3	0.9	118	0.1
22	Eunotia pectinalis	3	0.9	2,019	2.1

Microcystis aeruginosa cells/mL = 477

Anabaena flos-aquae cells/mL = 107

Aquatic Analysts

Sample ID: ZM81