# 2016-2017 White Pond Monitoring Report

Concord, Massachusetts

**PREPARED FOR**

Town of Concord
Division of Natural Resources
141 Keyes Road
Concord, Massachusetts 01742

**PREPARED BY**


ESS Group, Inc.
100 Fifth Avenue, 5th Floor
Waltham, Massachusetts 02451


Project No. C617-001
Revised August 25, 2017

www.essgroup.com

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## INTRODUCTION

ESS Group, Inc. (ESS) was contracted by the Town of Concord (Town) to complete a monitoring program at White Pond. The goal of the monitoring program was to further investigate in-pond and shoreline conditions that may contribute to the formation of algae blooms in the pond. This report provides details of the study approach and results, as well as a discussion of management options recommended based on study findings.

### Acknowledgments

Funding for this study was provided through the Concord Community Preservation Act.

## APPROACH

An overview of the study approach is presented in Table A.

**Table A. Summary of 2016-2017 Monitoring Program Approach**

| Element | Description | # Locations | Date(s) |
|---|---|---|---|
| Sediment Sampling | Collect sediment samples representative of entire pond to map potential phosphorus "hotspots" | 12 | August 16, 2016 |
| Wet Weather Runoff | Collect shoreline runoff during a high-intensity rainfall event | 6 | May 25-26, 2017 |
| In-Pond Sampling Event | Document temperature, dissolved oxygen, nutrients, turbidity, key metals, and biology (phytoplankton and zooplankton) through the water column over the course of the day. | 1 vertical profile (multiple measurements from surface to bottom) | August 18, 2016 |

Additional details on each element are presented in the following sections.

### Sediment Sampling

The intent of the sediment sampling event was to develop a more complete understanding of the sources of internal phosphorus recycling at White Pond. Internal recycling was not originally identified as a major contributor of phosphorus in the 2015 *White Pond Watershed Management Plan* (ESS 2015a). This was based on the analysis of total phosphorus in one composite sediment sample. However, subsequent algae blooms in late spring and summer of 2015 generated interest in potential sediment sources of phosphorus. In response, a more robust sediment sampling program was developed for the current study. This program included sample collection from 12 locations to map the distribution of phosphorus in the sediments of White Pond. It also incorporated a phosphorus fractionation analytical approach to measure levels of the forms of phosphorus that are most available for uptake when released into the water column.

Using a Lexan core liner to extract a core from the Ekman dredge

Sediment sampling locations were distributed throughout the pond and selected to represent sandy and mucky shallow areas near the pond's periphery, as well as each of the three deep basins where anoxic (no oxygen) bottom-water conditions are known to develop in summer and persist into autumn.

Samples were collected from the pond bottom using a six-inch by six-inch Ekman grab sampler. Prior to retrieval of sample material, the grab was inspected to ensure the recovered sediments were adequate for analysis (i.e., at least two inches retained with no evidence of washout). A two-inch diameter Lexan core liner was used to extract representative sub-sample from the least-disturbed (generally central) portion of the recovered grab sampler and extruded directly into labware.

Collected samples were sent to the laboratory for analysis of total phosphorus, as well as the two primary phosphorus fractions most likely to be released and become "available" to algae: loosely sorbed phosphorus and iron-bound phosphorus. Sediment phosphorus was analyzed by Phoenix Environmental Laboratories of Manchester, Connecticut.

## Wet Weather Runoff Sampling

Wet weather runoff sampling was delayed until 2017 due to very dry conditions in summer and fall of 2016. Stormwater sampling methodology followed the approach outlined in the *White Pond Watershed Management Plan* (2015a) for the 2013 stormwater sampling. The 2017 sampling focused on Town land at six eroded bank areas along the western and southwestern shoreline of the pond. All six sampling areas were also sampled in 2013. GKY, Inc. first-flush unattended samplers were installed the afternoon of May 25, 2017 and collected the next morning immediately following a rain event. The total rainfall received during the event was 1.12 inches, with rainfall intensity reaching approximately 0.25" per hour at times (as measured at Hanscom Field in Bedford, Massachusetts). Samplers were installed with collection ports flush with the ground surface and the sampling receptacle just below grade. At the time of 2017 sampling, erosion control measures were present in all but two of the sampling areas (1 and 9). These erosion control measures were not present during the 2013 sampling.

**Vertical profiles were collected using a YSI Pro2030 multiparameter water quality meter**

## In-Pond Sampling

The intent of this sampling event was to identify potential changes in the water column over short time periods that may indicate movement of algae and transfer of nutrients from deeper hypolimnetic waters into shallow epilimnetic waters, which could be a mechanism for the development of algae blooms.

To accomplish this, ESS sampled a single vertical profile of the pond over an eight-hour period on August 18, 2016. Sampling was initiated shortly after sunrise at 6:30 and sampling continued through the final profile at 14:30. Weather on the day of sampling began with overcast conditions, calm conditions, and seasonable air temperatures (16°C [61°F]). By 9:30, conditions were mostly sunny with light southwesterly winds. The air temperature increased to approximately 31°C (87°F) by the time of the final profile.

*Field-measured Parameters –Every 30 minutes:*

- Secchi disk depth (transparency) from the surface
- Temperature at one-meter increments over the full profile
- Dissolved oxygen at one-meter increments over the full profile

*Field-measured Parameters – Twice over the course of the day (morning and afternoon):*

- Turbidity – surface, thermocline, and bottom

*Lab Analytes – Twice over the course of the day (morning and afternoon):*

- Algae – surface and thermocline (in the algal lens)
    - Analyzed by GreenWater Labs of Palatka, Florida
- Zooplankton – integrated depth sample from thermocline to surface using a 50-cm (diameter) by 200 cm (length) plankton net with 64-micron mesh
    - Analyzed in-house by ESS
- Total and dissolved phosphorus – surface, thermocline, and bottom
    - Analyzed by Phoenix Environmental Laboratories of Manchester, Connecticut
- Total nitrogen – surface, thermocline, and bottom
    - Analyzed by Phoenix Environmental Laboratories of Manchester, Connecticut
- Metals (iron, aluminum, magnesium, and calcium) – surface, thermocline, and bottom
    - Analyzed by Phoenix Environmental Laboratories of Manchester, Connecticut

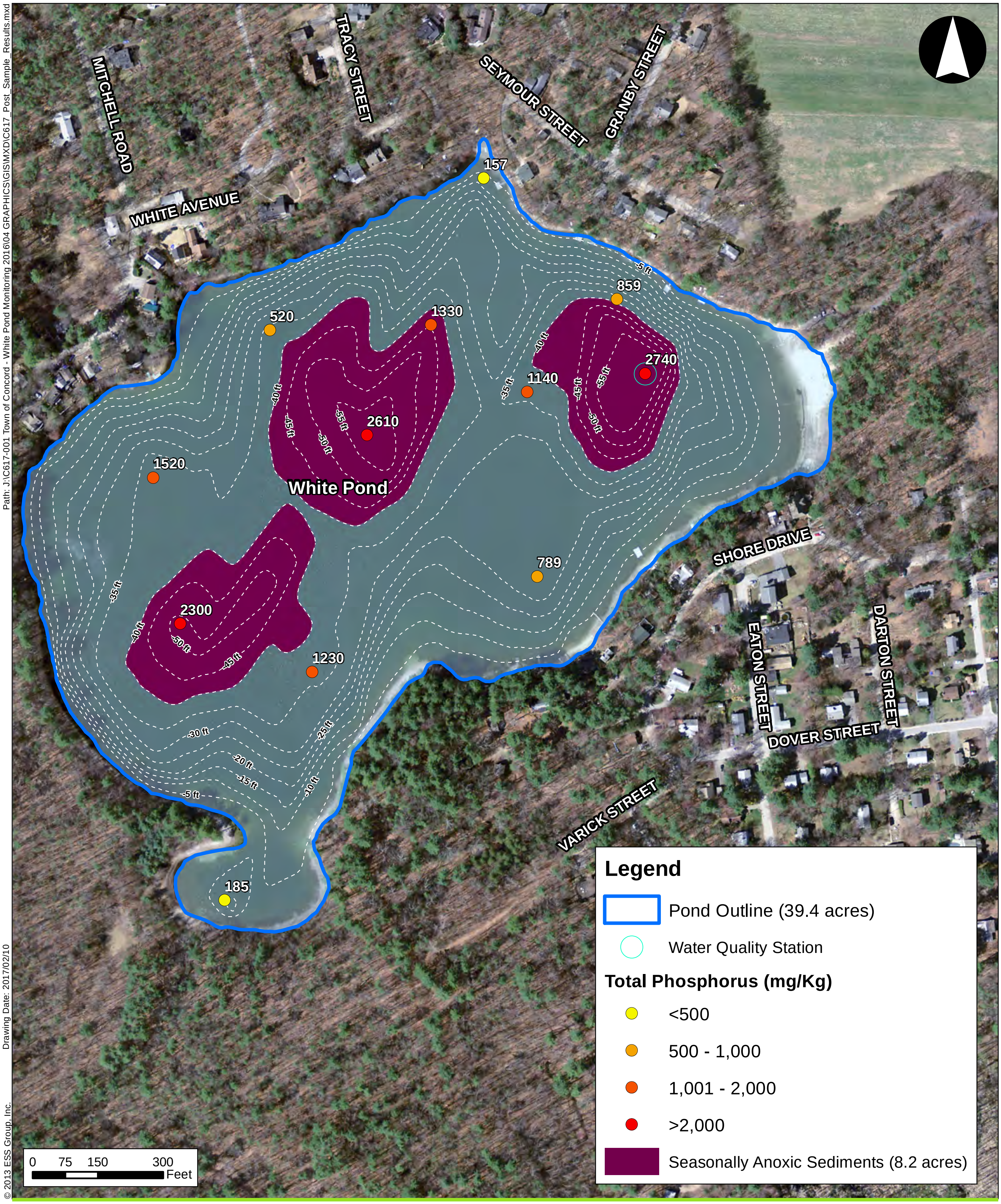
# RESULTS

## Sediment Sampling

Total phosphorus concentrations in White Pond sediments were highly variable, ranging from 157 mg/Kg to 2,740 mg/Kg (Table B and Figure 1). These values are higher, and in some cases orders of magnitude higher, than the total phosphorus concentration observed from a single sediment sample (96 mg/Kg) collected in 2013 (ESS 2015a). The lowest phosphorus concentrations were generally observed in the sediments of shallow waters, while the highest were observed in the deepest parts of the pond. Among the three deepest samples, the highest total phosphorus concentration was observed in the eastern basin, with the lowest in the western basin.


**Sediment core collected in southwestern portion of White Pond.**

This pattern is typical in ponds like White Pond, where there are no perennial tributaries and the side slopes are steep and coarse-grained. In such ponds, plankton growth and death cycles tend to be a primary source of nutrient-rich fine sediment accretion. This results in deposition where deep waters provide the greatest habitat volume. Conversely, in ponds with perennial tributaries, the streams may be the primary source of nutrient-rich fine sediment to the pond and deposition would likely be associated with the inlet. Furthermore, gravity and currents combine to preferentially quickly transport nutrient-rich fine sediments downslope in a steep-sided pond, leaving the cleaner (and coarser) sediments behind near the shoreline.




ESS group environmental consulting & engineering services

**White Pond - 2016 Monitoring Program**
Concord, Middlesex County, Massachusetts

**Total Sediment Phosphorus**

1 inch = 300 feet

Source: 1) USGS, Aerial Imagery 0.3m, 2013
2) ESS Bathymetry, 10/1/2013
3) ESS, Field Data, 2016

**Figure 1**

Loosely sorbed phosphorus, also known as labile or exchangeable phosphorus, is the most readily available phosphorus fraction. Iron-bound phosphorus may also become available under extended periods of anoxia, as ferric iron (which is good at binding phosphorus) is reduced to ferrous iron (which is not good at binding phosphorus). Together, these fractions of phosphorus are the most mobile and readily available forms for biological activity, such as uptake by algae or cyanobacteria (blue-green algae).

Overall, available sediment phosphorus demonstrates similar patterns in distribution to total phosphorus (Table B and Figure 2) and the two were positively associated (Figure 3). However, unlike total phosphorus, available phosphorus was highest in the western basin and lowest in the western basin.

In White Pond, most of the available phosphorus is present in the iron-bound form (Table B), which accounted for up to 49% of total phosphorus. Loosely sorbed phosphorus accounted for less than 3% of total phosphorus in all samples.

Full laboratory results are presented in Appendix A.

**Table B. Summary of Sediment Results at White Pond**

| Station | Phosphorus (mg/Kg dry) | | | |
|---|---|---|---|---|
| | Total | Iron-Bound | Loosely Sorbed | Available as Iron-Bound + Loosely Sorbed |
| S1 | 2,740 | 319 | 15.3 | 334.3 |
| S2 | 859 | 104 | 1.9 | 105.9 |
| S3 | 157 | 77 | 1.3 | 78.3 |
| S4 | 1,330 | 176 | 6.6 | 182.6 |
| S5 | 1,140 | 174 | 3.6 | 177.6 |
| S6 | 789 | 108 | 22.6 | 130.6 |
| S7 | 2,610 | 428 | 10.9 | 438.9 |
| S8 | 520 | 194 | 5.7 | 199.7 |
| S9 | 1,520 | 269 | 11.9 | 280.9 |
| S10 | 2,300 | 544 | 11.9 | 555.9 |
| S11 | 1,230 | 266 | 13.5 | 279.5 |
| S12 | 185 | 58 | 0.8 | 59.1 |

## Wet Weather Runoff Sampling

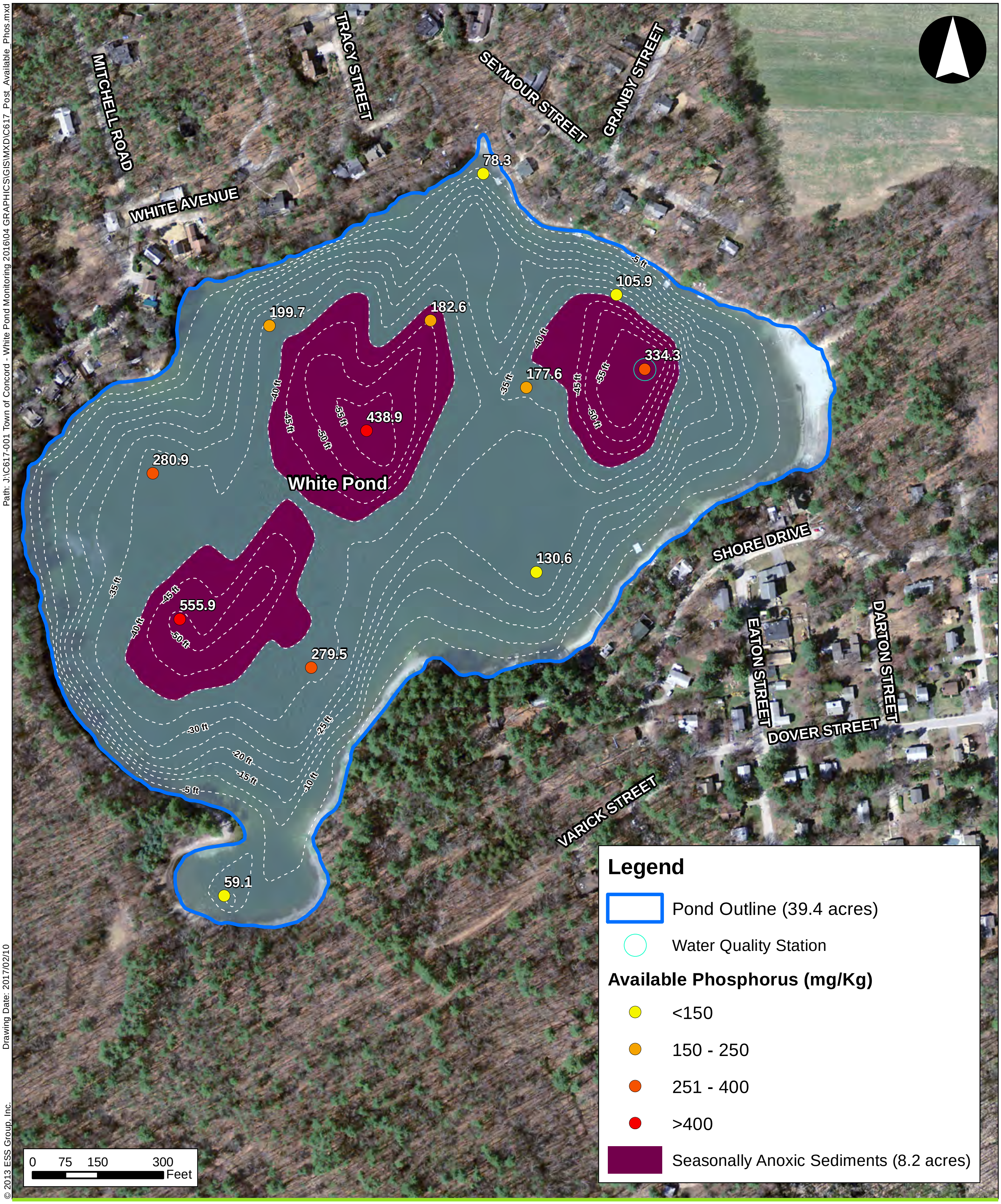
Stormwater collected as sheet or rill flow from eroded shoreline areas on Town land in the spring of 2017 contained increased concentrations of TSS compared to the 2013 sampling (Table C). Excessive concentrations of TSS may elevate lake turbidity, thereby reducing the penetration of light at depth in the water column. However, all other measured parameters were lower in 2017 than 2013. Specific conductance was greatly reduced compared to the 2013 sampling. Concentrations of total nitrogen decreased by more than half of the amount present in 2013, whereas the concentration of total phosphorus decreased by more than one third of the amount present in 2013.

**Table C. Stormwater Sampling Results: Fall 2013 and Spring 2017**

| Area | TSS (mg/L) | | Specific Conductance (µS/cm) | | TKN (mg/L) | | Nitrate-N (mg/L) | | Total N | | Total Phosphorus (mg/L) | | Dissolved Phosphorus (mg/L) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2017 | 2013 | 2017 | 2013 | 2017 | 2013 | 2017 | 2013 | 2017 | 2013 | 2017 | 2013 | 2017 |
| **1** | 180 | 250 | 54 | 9.9 | 2.9 | 1.68 | 0.64 | 0.08 | 3.54 | 1.76 | 0.68 | 0.233 | NS | 0.012 |
| **3** | 92 | 100 | 63 | 10.5 | 2.7 | 0.99 | 0.35 | 0.08 | 3.05 | 1.07 | 0.66 | 0.085 | NS | 0.011 |
| **5** | 310 | 660 | 57 | 11.5 | 5.8 | 3.02 | 0.075 | 0.12 | 5.875 | 3.14 | 0.73 | 0.385 | NS | 0.019 |
| **6** | 290 | InS | 51 | InS | 4.8 | 1.44 | 0.06 | 0.08* | 4.86 | 1.52 | 1.4 | 0.211 | NS | InS |
| **7** | 420 | 28 | 37 | 4.5 | 3.7 | 0.96 | 0.093 | 0.09 | 3.793 | 1.05 | 1.6 | 0.099 | NS | 0.013 |
| **9** | 100 | InS | 99 | InS | 10 | 3.6 | 1.1 | 0.13 | 11.1 | 3.73 | 0.79 | 0.803 | NS | InS |
| **Average** | **232** | **260** | **60** | **9.1** | **4.98** | **1.95** | **0.39** | **0.09** | **5.37** | **2.05** | **0.98** | **0.303** | **NS** | **0.014** |

***NS = Not sampled as part of the study. The scope of water quality sampling was limited to six representative eroded areas***
***InS = Insufficient sample to measure parameter***
****Due to insufficient sample volume, laboratory methods could only provide results as nitrite-nitrate-N. However, nitrite-N is expected to represent a minimal portion of the total reported value.***


**Installation of the stormwater sampler on May 25, 2017, prior to an overnight storm which dropped 1.12 inches of rain. Note coir log in foreground of photograph at left. Installed sampler depicted at right.**

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Drawing Date: 2017/02/10



ess group environmental consulting & engineering services

**White Pond - 2016 Monitoring Program**
Concord, Middlesex County, Massachusetts

**Available Sediment Phosphorus**

1 inch = 300 feet

Source: 1) USGS, Aerial Imagery 0.3m, 2013
2) ESS Bathymetry, 10/1/2013
3) ESS, Field Data, 2016

**Figure 2**

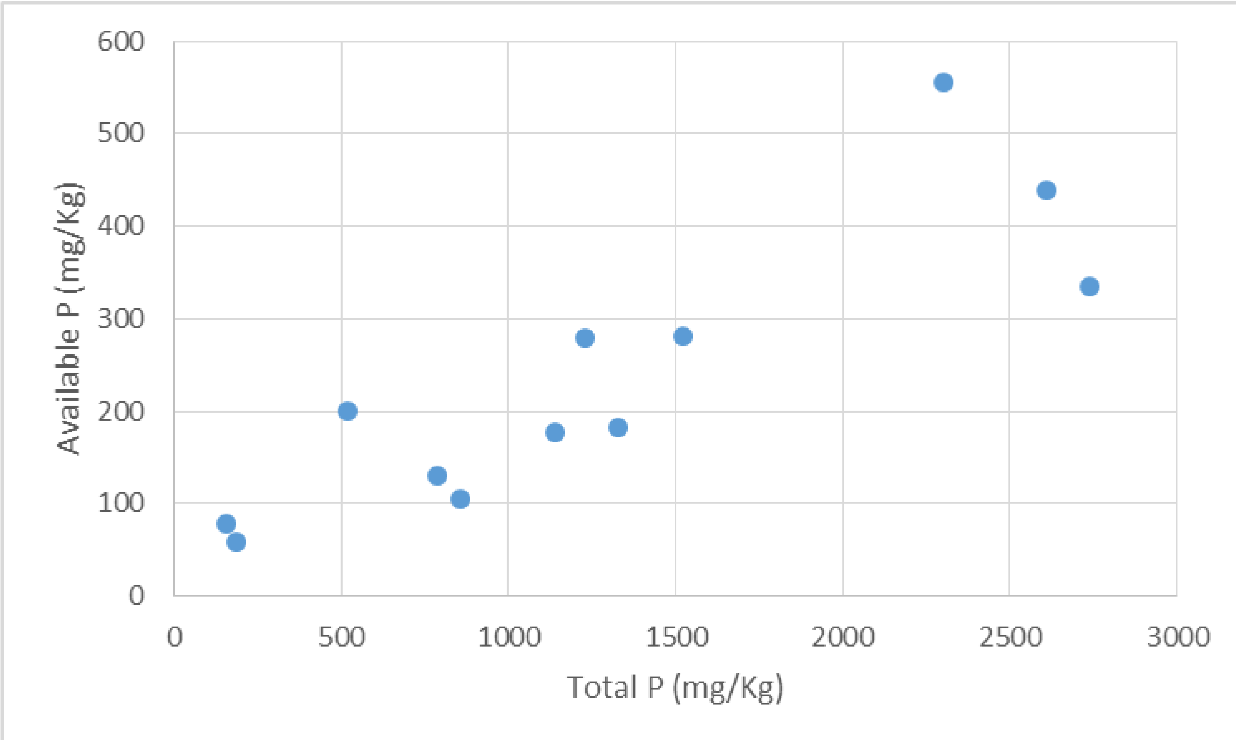


**Figure 3. Scatterplot of Available and Total Sediment Phosphorus**

## In-Pond Sampling

### Water Quality

Key highlights of the water quality results are as follows:

#### Temperature

A clear thermocline was evident in White Pond during the in-pond sampling event, extending from approximately 6 m to 12 m deep (Figure 4), which is consistent with observations in previous years (ESS 2015a, 2015b, and 2015c). The difference in temperatures from the top of the thermocline to the bottom was more than 15°C (27°F).

Over the course of the day, the epilimnion (surface waters) of the pond gradually warmed, as would be anticipated with increasing air temperature and more direct insolation. Temperatures were fairly steady for most of the day in the thermocline and bottom water, although occasional vertical shifts in temperature were noted, especially at the margins of the thermocline.

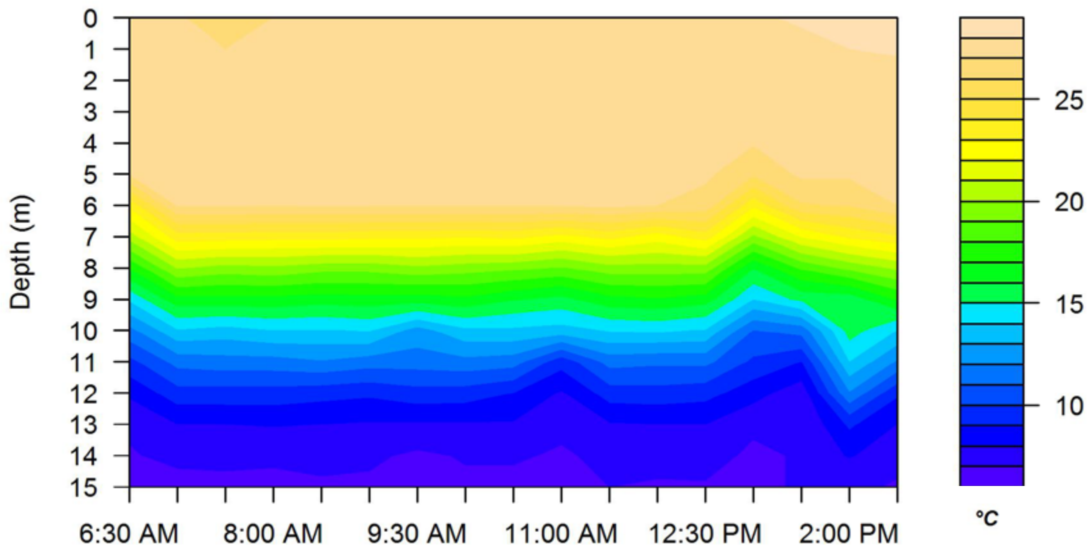


**Figure 4. Thermal Profile**

### Dissolved Oxygen

Consistent with previous observations of White Pond during summer thermal stratification (ESS 2015a, 2015b, and 2015c), a metalimnetic maximum in dissolved oxygen concentrations was observed during the 2016 in-pond sampling event (Figure 5). This layer was evident in waters between approximately 5 m and 9 m deep.

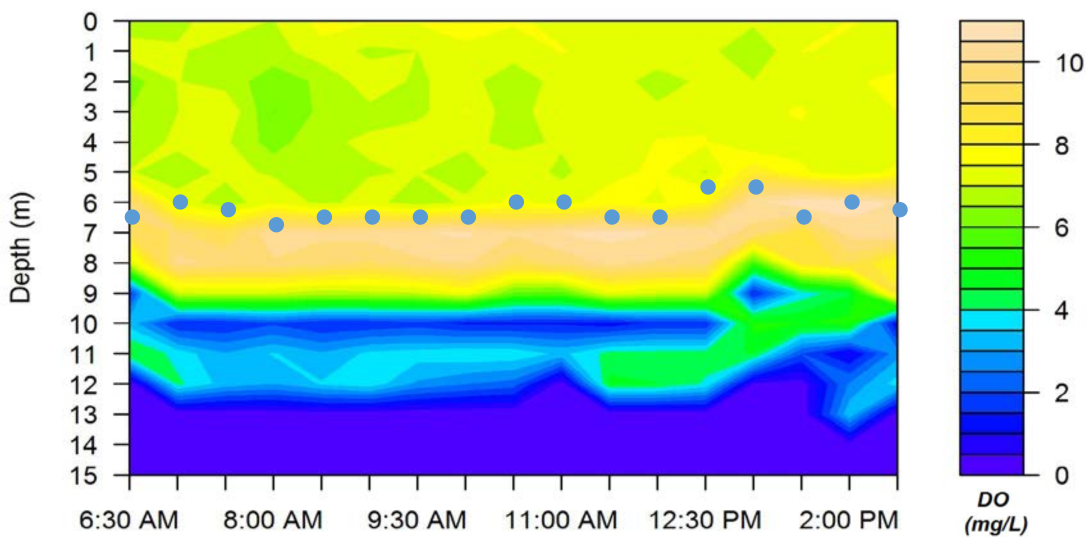


**Figure 5. Dissolved Oxygen Concentration Profile**
*Note: Blue points indicate Secchi transparency*

Above this layer, epilimnetic dissolved oxygen levels were somewhat lower but still more than adequate to support aquatic life (i.e., above 6.0 mg/L at all times). Below the metalimnetic maximum, dissolved oxygen concentrations generally declined sharply to severely hypoxic (< 2 mg/L) levels at approximately 9 to 10 m deep. However, this hypoxic layer was observed to be relatively thin (typically just 1 m thick) and underlain by a 1 m to 2 m layer of moderately oxygenated (3 mg/L to 5 mg/L) water. Anoxic waters were generally limited to the bottom 2 m to 3 m of the pond.

As with temperature, dissolved oxygen concentrations steadily increased in the epilimnion over the course of the day (Figure 5). Likewise, occasional vertical shifts in dissolved oxygen concentrations were noted. However, shifts in dissolved oxygen were more apparent than thermal shifts, especially between 12:30 and 14:30 (2:30 pm), when the layer of severe hypoxia became constricted or disappeared altogether, while the metalimnetic dissolved oxygen maximum first shifted upward and then broadened over time.

**Secchi Transparency**

Secchi transparency ranged from 5.5 m (18 ft) to 6.75 m (22 ft), illustrating the substantial differences that may be observed over the course of a single day (Figure 5). The greatest transparency was observed at 8:00 am while the lowest was observed in early afternoon, at 12:30 pm and 1:00 pm. These observations are similar to those observed during previous studies of the pond (ESS 2015a, 2015b, and 2015c) and within a meter of the long-term summer median for the 1987 to 2014 period (Walker 2015).

**Other Water Quality Parameters**

Turbidity results reflected modest levels of color and colloidal material in the waters of White Pond (Table D). This is similar to measurements made in prior years (ESS 2015a, 2015b, and 2015c) and indicates that water clarity was not substantially lower than previously observed.

However, the total phosphorus results observed during this study (Table D) were the highest observed at White Pond, particularly at the surface, where total phosphorus concentrations were more than twice as high as observed in 2013, 2014, or 2015 (ESS 2015a, 2015b, and 2015c). Soluble phosphorus results were not as extreme but were still amongst the highest observed at White Pond. Given the limited amount of in-pond phosphorus data for White Pond, it would be premature to conclude that this represents an increasing trend in water column phosphorus concentrations. Additionally, the phosphorus concentrations observed at White Pond are still well within the range of those observed at nearby Walden Pond over the last three decades (Köster et al. 2005). However, in combination with prior observations from 2013, 2014, and 2015, the 2016 results confirm that water column phosphorus levels in White Pond exceed those typical of an oligotrophic (nutrient-poor) pond, at least occasionally.

In contrast, nitrogen levels were modest (Table D) and total Kjeldahl nitrogen (TKN) results in surface and thermocline waters were among the lowest observed in recent years (ESS 2015a, 2015b, and 2015c). The concentration of TKN in bottom waters was almost identical to what was observed in August 2015 (ESS 2015c). As with phosphorus, the difference in surface and thermocline TKN results from those observed previously does not necessarily indicate a trend. TKN can be influenced by both natural sources (e.g., plankton or dust) and anthropogenic ones (e.g., ammonia from septic systems).

Most of the metals analyzed demonstrated an even distribution through the water column (Table D). Iron was the primary exception, being concentrated primarily in the bottom waters of the pond. The concentration of iron in the bottom waters is typical of stratified ponds that develop an anoxic layer below the thermocline while maintaining high concentrations of dissolved oxygen above. This condition develops because iron quickly complexes with phosphorus and precipitates out of solution in the presence of oxygen. This process causes iron to settle back into the bottom waters, where it becomes concentrated relative to the surface. In many ways, this is an important process because it helps to counter phosphorus release from the sediments.

Surface waters were characterized by a doubling in turbidity and a substantial decrease in total phosphorus between morning and afternoon (Table D). However, every other water chemistry analyte measured held steady or decreased modestly over the same time period. The reason for this observation is uncertain. If vertical plankton migrations were a direct cause, the expectation would be for changes in total phosphorus and turbidity to be positively correlated.

The thermocline experienced a doubling of total phosphorus concurrent with a substantial increase in iron and a modest increase in TKN between morning and afternoon (Table D). All other analytes remained steady over the period. This may indicate increased vertical flux of iron and phosphorus from bottom waters into the thermocline in the afternoon. It is possible that this was associated with the same event driving the changes observed in temperature and dissolved oxygen profiles at this time (Figures 4 and 5).

Bottom waters witnessed a modest increase in turbidity, total phosphorus, soluble phosphorus, and TKN between morning and afternoon (Table D). Other analytes held steady or decreased modestly from morning to afternoon.

Full laboratory results are included in Appendix B.

**Table D. Summary of In-Pond Water Quality Results**

| Analyte | Surface | | Thermocline | | Bottom | |
|---|---|---|---|---|---|---|
| | AM | PM | AM | PM | AM | PM |
| **Turbidity (NTU)** | 0.52 | 1.04 | 0.63 | 0.62 | 2.39 | 2.74 |
| **Total Phosphorus (mg/L)** | 0.027 | 0.018 | 0.013 | 0.028 | 0.052 | 0.062 |
| **Soluble Phosphorus (mg/L)** | 0.010 | 0.010 | 0.013 | 0.012 | 0.022 | 0.028 |
| **Nitrite – Nitrogen (mg/L)** | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 | < 0.010 |
| **Nitrate – Nitrogen (mg/L)** | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| **TKN (mg/L)** | 0.31 | 0.29 | 0.33 | 0.38 | 1.20 | 1.25 |
| **Aluminum (mg/L)** | 0.020 | 0.020 | 0.022 | 0.011 | 0.019 | 0.017 |
| **Calcium (mg/L)** | 3.21 | 2.99 | 3.16 | 3.22 | 3.61 | 3.39 |
| **Iron (mg/L)** | 0.018 | 0.015 | 0.018 | 0.071 | 2.04 | 2.04 |
| **Magnesium (mg/L)** | 0.738 | 0.691 | 0.722 | 0.712 | 0.753 | 0.711 |

## Biology

### Zooplankton

The zooplankton community in White Pond was characterized by a diversity of small-, medium-, and large-bodied grazing taxa, including multiple cladocerans (water fleas), copepods, and a rotifer (Table E). The only predaceous zooplankter observed was a hydrozoan (*Hydra* sp.).

The overall abundance of zooplankton in White Pond was higher in the afternoon than in the morning (Table E), which may reflect movement of zooplankton away from shallow, predator-rich shoreline areas to deeper open waters of the deep hole during the day. Additionally, species composition shifted from one dominated by small-bodied copepod nauplii in the morning to dominance by a more diverse group of organisms, including medium- to large-bodied *Daphnia retrocurva*, and larger copepods (such as *Epischura nordenskioldi* and diaptomids).

Most of the zooplankters observed in White Pond have a widespread distribution and are found in many kinds of lakes and ponds. However, *Daphnia retrocurva* is a species typical of late summer in oligotrophic ponds (Sterner 1998). All *D. retrocurva* individuals observed had developed a pointed "helmet," which forms during warm weather and is thought to be a defense against predation by other invertebrates.

**Table E. Summary of Zooplankton Results**

| Group | Taxon | Morning | | Afternoon | |
|---|---|---|---|---|---|
| | | Relative Abundance | Size | Relative Abundance | Size |
| Cladocerans (water fleas) | *Daphnia retrocurva* | Occasional | Medium to Large | Abundant | Medium to Large |
| | *Diaphanosoma birgei* | Absent | - | Occasional | Medium |
| | *Eubosmina longispina* | Occasional | Small | Rare | Small |
| | *Holopedium gibberum* | Rare | Medium | Absent | |
| Copepods | Copepod nauplii (larvae) | Abundant | Small | Rare | Small |
| | Calanoida | Occasional | Small | Abundant | Small |
| | Diaptomidae | Occasional | Large | Rare | Large |
| | *Epischura nordenskioldi* | Common | Large | Abundant | Large |
| Hydrozoans | *Hydra sp.* | Rare | - | Rare | - |
| Rotifers | *Kellicotia longispina* | Occasional | Small | Common | Small |

### Phytoplankton

A diverse phytoplankton community was observed in each of the samples collected from the surface and thermocline of White Pond (Table F). The structure of the phytoplankton community was remarkably similar between the surface versus thermocline and morning versus afternoon samples. However, a few modest differences were observed: 1) total cell counts were higher in surface waters than in the thermocline; 2) total cell counts were higher in the morning than the afternoon.

Cyanobacteria were the dominant phytoplankton group in all samples (Table F). However, the observed cell counts were well below the state health advisory threshold of 70,000 cells/mL. Additionally, the most numerous species was *Aphanothece clathrata*, which is not considered a toxigenic species (Appendix C). Potentially toxigenic taxa, including *Radiocystis geminata*, *Microcystis* sp., and

*Dolichospermum* sp. were also present but at lower densities. These results are very similar to those obtained in August 2015 (ESS 2015c).

Although not sampled as part of this study, a cyanobacteria bloom consisting primarily of *Anabaena* (=*Dolichospermum*), *Coelosphaerium*, and *Nostoc* was later observed on October 18, 2016 (Delia Kaye, pers. comm. October 19, 2016).

Some kettle ponds in Massachusetts appear to be characterized by recurring cyanobacteria blooms while others are not. For example, several kettle ponds on Cape Cod, including Long Pond (Barnstable), Cliff Pond (Brewster), Great Pond (Eastham), Hamblin Pond (Barnstable), and Hinckley's Pond (Harwich) have experienced recent cyanobacteria blooms. However, the 20 named kettle ponds at Cape Cod National Seashore apparently do not host cyanobacteria at levels that would impair water clarity or pond uses (National Park Service 2017). This variability in condition can be observed over relatively short distances and human disturbance is not always associated with cyanobacteria dominance. In fact, there is emerging evidence that phosphorus levels and associated cyanobacteria blooms are increasing continent-wide, even in lakes and ponds with little or no human disturbance (Stoddard et al. 2015, WRS 2014).

**Table F. Summary of Phytoplankton Results**

| Group | Common Name | Surface Cell Counts (cells/mL) | | Thermocline Cell Counts (cells/mL) | |
|---|---|---|---|---|---|
| | | Morning | Afternoon | Morning | Afternoon |
| Bacillariophyceae | Diatoms | 35 | 51 | 16 | 12 |
| Charophyta | Desmids | 4 | 32 | 1 | 1 |
| Chlorophyta | Green Algae | 2,603 | 2,046 | 2,923 | 1,409 |
| Chrysophyceae | Golden-brown Algae | 47 | 20 | 31 | 0 |
| Cryptophyta | Cryptophytes | 20 | 51 | 94 | 122 |
| Cyanobacteria | Blue-green Algae | 22,079 | 14,892 | 14,211 | 9,142 |
| Dinophyta | Dinoflagellates | 4 | 24 | 20 | 5 |
| Others | Miscellaneous Flagellates and Unicells | 173 | 204 | 188 | 330 |
| Synurophyceae | Golden-brown Algae | 0 | 0 | 0 | 79 |
| Xanthophyceae | Yellow-green Algae | 16 | 16 | 0 | 0 |
| **Total** | | **24,981** | **17,336** | **17,485** | **11,098** |

## CONCLUSIONS

### Sediment

One notable result obtained is that the concentrations of phosphorus in White Pond's sediments were significantly higher than anticipated, given previous sediment sampling results. However, the majority of total phosphorus in the sediments appears to be present in unavailable forms. Of the potentially available forms, iron-bound phosphorus is the most abundant fraction. In shallow, well-oxygenation waters, iron-bound phosphorus is likely to remain locked in the sediments. However, in the three deep basins of the pond, seasonal anoxia creates conditions that favor the release of iron-bound phosphorus into the hypolimnion. Under certain circumstances (such as those described in the preceding paragraphs), this phosphorus may be able to escape the hypolimnion and mobilize into the metalimnion or epilimnion, where it can spur algal growth.

**Shoreline Runoff**

With few exceptions, concentrations of most measured pollutants detected in shoreline runoff samples were lower in the May 2017 event than the event sampled in November 2013. In particular, nitrogen and phosphorus were substantially reduced in May 2017. Soluble phosphorus, which represents the fraction most immediately available for uptake by algae, was not measured in the November 2013 event. However, the results obtained from May 2017 indicate that the concentrations were comparable to those collected in surface waters of the pond on prior occasions (including the in-pond water quality sampling event conducted as part of this study on August 18, 2016).

The shoreline runoff dataset is limited to two storms and should therefore be interpreted with caution. The precipitation totals for the two storms were different, with the November 2013 storm being somewhat wetter (1.74 inches). Therefore, the November 2013 storm might be expected to result in more intense runoff.

However, maximum rainfall intensity was similar for each storm event (0.24 inches per hour for the November 2013 storm compared to 0.23 inches per hour for the May 2017 storm). Furthermore, evidence of active channelized flow was observed at each location during both storms. Therefore, the two storm events appear to be reasonably analogous in terms of potential to generate shoreline runoff.

That said, the November 2013 and May 2017 storms do represent samples collected from different seasons of different years. Therefore, seasonal variability in the concentration of pollutants might reasonably be anticipated in the shoreline runoff samples. Measurements by Colman and Friesz (2001) at nearby Walden Pond imply that tree pollen could be a major component of the atmospheric deposition of phosphorus in the area. Given the dominant vegetation type near White Pond (mixed forest and residential), tree pollen (primarily pine, oak, and maple) would be anticipated to reach a seasonal maximum during the spring. Therefore, phosphorus levels in shoreline runoff might be expected to be elevated in the spring compared to autumn.

**Sampler following the May 25-26, 2017 storm event. Note the small oak catkins (male flowers) deposited on the sampler and surrounding soil.**

However, contrary to this expectation, total phosphorus concentrations were actually lower in most of the May 2017 samples than the November 2013 samples. The only exception was at Area 9, where total phosphorus was marginally higher in May 2017.

The overall apparent improvement in runoff water quality in May 2017 may be, at least in part, associated with the temporary erosion control measures installed at select locations near the shoreline of the pond. Observations by field staff during a period of active rainfall on the morning of May 26 suggest evidence of minor ponding and sediment deposition directly upslope of the erosion control measures (i.e., attenuation of runoff and erosion), where installed.

Shoreline erosion was identified as a major source of nutrient loading to White Pond in the *White Pond Watershed Management Plan* (ESS 2015a). The results of the May 2017 shoreline runoff sampling effort do not necessarily contradict this finding. However, they suggest that shoreline runoff has not become measurably worse and may even have improved in the intervening time period.

**In-pond Water Quality and Biology**

Another notable result of the in-pond portion of this study is the documentation of diel shifts in dissolved oxygen, particularly within the metalimnion (thermocline). Additionally, coincident shifts in iron and phosphorus concentrations appeared to occur during this study. While this study alone is not sufficient to establish definite connections between these observations, they are worth considering further, as they may provide insight into the development or suppression of algae blooms at White Pond and, in turn, appropriate management approaches.

One possible explanation for the observed changes is displacement of the thermocline induced by propagation of internal waves (also known as seiches). These waves are well documented in large lakes (such as the Laurentian Great Lakes) but have also been demonstrated in ponds closer in size and morphometry to White Pond (e.g., Pannard et al. 2011). Although it is uncertain whether internal waves are generated on a regular basis (or at all) in White Pond, they could be a mechanism by which thermal and biological activity profiles are disrupted, thereby enhancing the transfer of nutrients between the otherwise stratified layers of the pond.

A second potential source of the observed changes could be biological in nature. Biologically driven shifts in dissolved oxygen and nutrients may occur when autotrophs (phytoplankton) adjust their vertical position to take advantage of light or nutrients, or when zooplankton become concentrated at a certain depth that provides better forage or refuge from predators. The phytoplankton and zooplankton communities observed in White Pond include taxa known to make diel horizontal or vertical migrations. The zooplankton, in particular, demonstrated a substantial shift in abundance over the course of the day, becoming more numerous in the afternoon, presumably as they concentrated in the refuge provided by the deep water near the center of the pond.

Even if nutrients are not being directly transferred by internal waves or biological movements, a small amount may mobilize via passive diffusion across the thermocline. Furthermore, cooling temperatures in the autumn will eventually erode the thermocline and allow the pond to turn over, which may physically entrain hypolimnetic phosphorus into surface waters. However, as long as dissolved oxygen is present and iron levels remain sufficient (currently in excess of a 16:1 ratio in bottom waters), phosphorus will quickly be bound up and precipitated out of solution, rather than generating a problematic autumnal algae bloom.

## MANAGEMENT RECOMMENDATIONS

### Control Watershed Nutrient Loading

Based on the results of this study, ESS continues to emphasize the importance of implementing the watershed pollutant loading controls previously recommended in the *White Pond Watershed Management Plan* (ESS 2015a), including stormwater best management practices and shoreline slope stabilization and erosion control measures. Many of these controls have already been or are in the process of being implemented and, at this time, appear to be achieving some success in reducing direct runoff volumes and associated nutrients and sediments from the watershed. Implementation of structural controls includes proper maintenance, which is critical to their continued function. Furthermore, the Town should continue periodic (at least annual) monitoring to detect new or worsening areas of shoreline erosion is also important so that these potential sources can be adequately addressed before becoming more substantial problems.

**In-pond Nutrient and Algae Management**

Given the occasional recurrence of nuisance algae blooms since June 2015, the Town may wish to further consider in-pond management actions. The in-pond management options recommended for consideration provide a means to supplement the previously recommended watershed controls. Options discussed in further detail below include hypolimnetic aeration or oxygenation, sediment nutrient inactivation, and water column nutrient inactivation.

**Hypolimnetic Aeration or Oxygenation**

Hypolimnetic aeration and oxygenation differ primarily in that aeration relies on atmospheric oxygen while oxygenation requires a supplied oxygen source on site. Otherwise, both approaches attempt to counteract the release of iron-bound phosphorus by seasonally delivering oxygen to the hypolimnion. If properly designed, either approach could also directly benefit trout by adding dissolved oxygen to the cold, deep waters they occupy in White Pond during the summer months.


In White Pond, these management techniques would need to be carefully designed to maximize oxygen transfer within the relatively thin hypolimnion while avoiding disruption of the thermocline, which could inadvertently release phosphorus into surface waters or disturb coldwater fish (i.e., holdover trout). Another consideration with aeration is operational noise. If a compressor or pump is required, the noise may also be noticeable to visitors and residents.

The cost of aeration or oxygenation varies significantly depending on the system design and power requirements. However, it is unlikely that an aeration system of sufficient capacity for White Pond could be obtained for much less than $25,000 (not including design costs) and multiple units might be required. Furthermore, maintenance and operation costs may be significant over the life of the aeration system (thousands of dollars per year). Aeration usually relies on a motorized pump to deliver air to the pond bottom. Although some models are solar-powered, most require some sort of power supply. Over time, the cost of power to operate the aeration system tends to be the most significant expense.

**Sediment Nutrient Inactivation**

This approach, which has been generally described in prior reports (ESS 2015a and 2015b), would target long-term (multiple season) binding of phosphorus in the sediments by adding one or more doses of alum (aluminum sulfate) or another nutrient inactivation agent. Unlike iron, aluminum is an effective binding agent in the absence of oxygen. Therefore, increasing the availability of aluminum on the pond bottom may effectively prevent release of sediment phosphorus for a substantial period of time. Given that White Pond is a kettle pond with a low flushing rate, sediment nutrient inactivation would be likely to last for five to ten years or more.

Although other nutrient inactivation agents are available, alum and sodium aluminate are the two most commonly used. These have a long track record of successful use and are generally more economical to apply than other materials. However, alum is acidic and, if applied at high doses without sufficient buffering, can result in a temporary but significant drop in pH that may negatively impact aquatic life. Sodium aluminate is basic and can be mixed with alum to prevent pH falls during treatment, while also adding further capacity for inactivation of phosphorus. Therefore, in most cases, alum and sodium aluminate are used together to deliver a pH-balanced treatment and avoid negative impacts to aquatic life.

Alum may be applied directly to the surface of the pond or injected at depth. The former approach typically results in a faster application and more phosphorus being removed from the water column. However, the latter approach allows for a more precise application to the targeted sediments and further reduces the potential for sudden pH shifts in surface waters. Due to the slower speeds required to keep the injection nozzles at the correct depth, the latter approach also requires a substantially longer period of time to complete the application, which results in a higher treatment cost.

Sediment nutrient inactivation programs are commonly implemented in kettle ponds and other deep lakes where sediment phosphorus release is a substantial component of the total phosphorus load. Many of the Massachusetts water bodies with a history of major alum treatments are located in the southeast portion of the state, including Cape Cod, where kettle ponds abound.

An alum treatment targeted at White Pond sediments would require a significant dose (i.e., thousands of gallons of inactivation agent) to be effective over the long term. Such a program would be an ambitious undertaking and require thoughtful logistical planning to allow for delivery and storage of materials as well as access for the treatment vessel, which may be of substantial size. Furthermore, additional study would be needed to properly design the treatment for maximum longevity and minimum impact to aquatic life.

Although design of a nutrient inactivation program is beyond the scope of the current study, the available phosphorus concentrations measured in pond sediments suggest that at least $150,000 should be anticipated to cover program design, mobilization of equipment, material costs, application, and necessary monitoring, which may be extensive to ensure protection of aquatic life. Emerging research (e.g., Huser 2012) suggests that sediment nutrient inactivation is more effective in deep ponds when treatments are split over time. This means that two or more mobilizations may be desirable to achieve best results, which would increase treatment costs by one half or more.

**Water Column (Low-dose) Nutrient Inactivation**

This approach is similar to sediment nutrient inactivation but involves much smaller applications that are primarily targeted at stripping phosphorus and particulates (including algae and suspended sediments) from the water column. Unlike a copper algaecide treatment, low-dose alum application addresses the proximal cause of nuisance algal blooms, which is the excess availability of nutrients. Therefore, in ponds with low flushing rates, it is generally considered to be superior to algaecides.

As the primary objective of low-dose nutrient inactivation is to remove nuisance algae and biologically available phosphorus from surface waters, application is almost always surficial. Low-dose nutrient inactivation programs are generally implemented in one of two ways.

The first type of low-dose treatment program is proactive in nature. It involves scheduled low-dose treatments on a periodic basis, typically once a year in spring or early summer prior to the development of an anticipated bloom or an important recreational period (e.g., beginning of school vacation). Although water quality monitoring is usually incorporated into this kind of program, it is primarily used to track results rather than as a basis for timing of treatment. This type of program is most appropriate where algae blooms recur on a fairly predictable basis or recreational needs require predictability in water quality conditions. It may also be suitable where incremental control of phosphorus release from the sediments is desired to spread costs over multiple years. Low-dose nutrient inactivation is used on a regular basis in Massachusetts. Dug Pond in Natick is one example of a proactive low-dose alum treatment program that has been successfully implemented for many years.

The second type of low-dose treatment program is responsive. This type of management program will usually rely on monitoring of water quality or biological conditions to identify the need for a treatment. Typical triggers for treatment include a sustained spike in phosphorus concentrations, a sudden drop in Secchi transparency, and/or a shift in algal community composition toward dominance by cyanobacteria. Frequent or even continuous monitoring of conditions is best, as algae blooms can develop rapidly and mobilization for treatment may take several days to a week or more, depending on contractor availability and material supplies. This type of program is most appropriate where algae blooms are infrequent, treatment timing is flexible, and/or a strong monitoring program is in place. Indian Lake in Worcester is an example of a responsive low-dose alum treatment program that has had success when monitoring and treatment efforts were well-coordinated.

Although a certain level of planning, design, and monitoring is required to ensure a successful low-dose nutrient inactivation, application is relatively straightforward and presents fewer logistical challenges than sediment nutrient inactivation. A low-dose treatment could potentially be applied from a smaller vessel in a fraction of the time required for an alum treatment targeting inactivation of sediment phosphorus. Additionally, alum treatments targeting the water column pose minimal risk to aquatic life because dosage rates are much lower than those used for sediment nutrient inactivation. Therefore, even under poorly buffered conditions, problematic swings in pH are unlikely to occur.

The costs to implement a low-dose nutrient inactivation program vary with commodity prices and volume of water to be treated. However, costs of approximately $800 to $1,200/acre of treatment (not necessarily total acreage of the pond) can be anticipated.

## Summary of In-pond Management Options

The essential information about each of the in-pond options described in the previous section is summarized in Table G.

Note that the implementation of any of these options will also require program design, permitting, and monitoring. This is likely to add $10,000 to $25,000 in initial costs. Additional monitoring or mitigation required under permit conditions may also add to annual project costs. At a minimum, an Order of Conditions must be obtained from the Concord Natural Resources Commission. These management options may also be subject to project review by the Massachusetts Natural Heritage and Endangered Species Program, as White Pond is located within a Priority Habitat of Rare Species. Aeration and oxygenation may also require a Chapter 91 Waterways permit for placement of equipment in a Great Pond.

**Table G. White Pond In-pond Management Summary**

| Management Option | Benefits/Mode of Action | Advantages | Limitations | Approximate Costs |
|---|---|---|---|---|
| Hypolimnetic Aeration/ Oxygenation | Prevents release of iron-bound phosphorus (approximately half of sediment phosphorus, on average)<br><br>Provides dissolved oxygen source for trout during summer stratification | Relies on natural aerobic processes to rehabilitate pond<br><br>If well-designed and operated, can be highly beneficial to aquatic life, particularly trout | Difficult to achieve results over large areas<br><br>Careful design required to avoid negative impacts to pond biology<br><br>May require substantial amount of power for operation<br><br>Some compressor-driven units are noisy<br><br>Bulkier units may alter aesthetic of the pond<br><br>Periodic unit maintenance required | At least $25,000 for implementation, possibly much higher – equipment and operation costs vary substantially by unit type |

| Management Option | Benefits/Mode of Action | Advantages | Limitations | Approximate Costs |
|---|---|---|---|---|
| Sediment Nutrient Inactivation | Prevents release of phosphorus from sediments and, thereby, likelihood of nuisance algae blooms | The most reliable method for reducing internal loading of phosphorus<br><br>Treatment likely to last many years, possibly more than a decade | Requires careful design, implementation, and monitoring to avoid pH shifts and adverse impacts to aquatic life<br><br>Logistically difficult to implement – may require access improvements to be feasible<br><br>Requires multiple days to complete application | At least $150,000 for implementation, possibly much higher – depends on application approach, commodity costs, and monitoring requirements |
| Water Column (Low-dose) Nutrient Inactivation | Strips phosphorus, algae, and suspended sediments from water column – flocculent quickly settles to bottom of pond | Easier to design and implement than a sediment nutrient inactivation program<br><br>Reduced dose means less risk of pH shifts<br><br>Some long-term benefit may be achieved over time<br><br>Minimal disruption to in-pond recreation | May need to be repeated annually or more often, depending on recurrence of blooms | Generally $800 to $1,200/acre for implementation.<br><br>Likely $15,000 to $25,000 overall at White Pond. |

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[WRS] Water Resource Services, Inc. 2014. Investigation of Algal Blooms and Possible Controls for Cliff Pond, Nickerson State Park, Brewster, Massachusetts..

# Appendix A

## Sediment Phosphorus Lab Report

Tuesday, November 22, 2016

Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Project ID: C617-001
Sample ID#s: BN94511 - BN94522

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.

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

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

If you have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.

Sincerely yours,

Phyllis Shiller

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #MA-CT-007
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

PHOENIX

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 9:20 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94511

Project ID: C617-001
Client ID: S1

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 10.5 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 2740 | 24 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 319 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 15.3 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

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Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

# Environmental Laboratories, Inc.

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Tel. (860) 645-1102 Fax (860) 645-0823

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 9:40 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94512

Project ID: C617-001
Client ID: S2

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 18.9 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 859 | 13 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 104 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 1.9 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

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**November 22, 2016**
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Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 10:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94513

Project ID: C617-001
Client ID: S3

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 35.9 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 157 | 7.0 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 77 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 1.3 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

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ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 10:15 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94514

Project ID: C617-001
Client ID: S6

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 9.27 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 1330 | 27 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 176 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 6.6 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

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ESS Group Inc.
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Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 10:30 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94515

Project ID: C617-001
Client ID: S4

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 11.1 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 1140 | 23 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 174 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 3.6 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

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10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 10:45 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94516

Project ID: C617-001
Client ID: S5

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 12.9 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 789 | 19 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 108 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 22.6 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

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| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 11:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94517

Project ID: C617-001
Client ID: S7

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 8.96 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 2610 | 28 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 428 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 10.9 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 11:15 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94518

Project ID: C617-001
Client ID: S8

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 13.6 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 520 | 18 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 194 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 5.7 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

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

**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 11:30 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94519

Project ID: C617-001
Client ID: S10

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 8.18 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 1520 | 31 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 269 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 11.9 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 11:50 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94520

Project ID: C617-001
Client ID: S11

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 10.5 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 2300 | 24 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 544 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 11.9 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
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**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 12:05 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94521

Project ID: C617-001
Client ID: S9

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 9.82 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 1230 | 25 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 266 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 13.5 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

## Environmental Laboratories, Inc.

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

# Analysis Report

November 22, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SEDIMENT | Collected by: | | 08/16/16 | 12:15 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94511
Phoenix ID: BN94522

Project ID: C617-001
Client ID: S12

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Total Solids @ 104C | 36.5 | 0.1 | % | 1 | 08/22/16 | AS/KH | SM2540B-97 |
| Phosphorus, Total | 185 | 6.8 | mg/Kg | 5 | 08/22/16 | MA | SM4500PE-99 |
| Iron Bound Phosphorous | 58.3 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |
| Loosely-sorbed Phosphorous | 0.78 | 1.0 | ppm | | 11/18/16 | * | SM4500PE-99 |

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

**Comments:**

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
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**Phyllis Shiller, Laboratory Director**
**November 22, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# QA/QC Report

November 22, 2016

## QA/QC Data

SDG I.D.: GBN94511

| 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 356395 (mg/Kg), QC Sample No: BN92757 (BN94511, BN94512, BN94513, BN94514, BN94515, BN94516, BN94517, BN94518, BN94519, BN94520, BN94521, BN94522) | | | | | | | | | | | | | |
| Phosphorus, Total as P | BRL | 0.50 | 9850 | 8500 | 14.7 | 89.6 | | | | | | 85 - 115 | 30 |
| Comment: | | | | | | | | | | | | | |
| Additional: LCS acceptance range is 85-115% MS acceptance range 75-125%. | | | | | | | | | | | | | |
| QA/QC Batch 356219 (), QC Sample No: BN94474 (BN94511, BN94512, BN94513, BN94514, BN94515, BN94516, BN94517, BN94518, BN94519, BN94520, BN94521, BN94522) | | | | | | | | | | | | | |
| Total Solids | BRL | 0.1 | 25.9 | 25.9 | 0 | 100 | | | | | | 85 - 115 | 30 |
| Comment: | | | | | | | | | | | | | |
| Additional: LCS acceptance range is 85-115% MS acceptance range 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

Phyllis Shiller, Laboratory Director
November 22, 2016

Tuesday, November 22, 2016

Criteria: None

State: MA

# Sample Criteria Exceedances Report

## GBN94511 - ESSGRPRI

| 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 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.

Cooler: Yes ☒ No ☐
Coolant: IPK ☐ ICE ☒ No ☐

Temp 1 °C Pg of

# CHAIN OF CUSTODY RECORD

**PHOENIX** Environmental Laboratories, Inc.

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
**Client Services (860) 645-8726**

**Data Delivery:**
☐ Fax #:
☒ Email: mladewig@essgrap.com

Customer: ESS Group Inc
Address: 10 Hemingway Drive
2nd Floor
East Providence, RI 02915

Project: C617-001
Report to: Matt Ladewig
Invoice to: Barbara Cabral
Phone #: 401-330-1204
Fax #:

Project P.O:

This section MUST be completed with Bottle Quantities.

**Client Sample - Information - Identification**

Sampler's Signature: Jacquel Mackay Date: 8/18

**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

Analysis Request

| PHOENIX USE ONLY SAMPLE # | Customer Sample Identification | Sample Matrix | Date Sampled | Time Sampled | Total Phosphorus | Loosely sorbed phosphorus | Iron bound phosphorus | Soil VOA Vials [ ] methanol [ ] H2O | GL Soil container ( 4 ) oz | 40 ml VOA Vial [ ] As is [ ] HCl | GL Amber 1000ml [ ] As is [ ] H2SO4 | PL As is [ ]250ml [ ]500ml [ ]1000ml | PL H2SO4 [ ]250ml [ ]500ml | PL HNO3 250ml | PL NaOH 250ml | Bacteria (as is) | Bacteria (w/thio) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94511 | S1 | SE | 8/16/16 | 0920 | X | X | X | | 2 | | | | | | | | |
| 94512 | S2 | ↓ | ↓ | 0940 | ↓ | ↓ | ↓ | | 2 | | | | | | | | |
| 94513 | S3 | | | 1000 | | | | | 2 | | | | | | | | |
| 94514 | S6 | | | 1015 | | | | | 2 | | | | | | | | |
| 94515 | S4 | | | 1030 | | | | | 2 | | | | | | | | |
| 94516 | S5 | | | 1045 | | | | | 2 | | | | | | | | |
| 94517 | S7 | | | 1100 | | | | | 2 | | | | | | | | |
| 94518 | S8 | | | 1115 | | | | | 2 | | | | | | | | |
| 94519 | S10 | | | 1130 | | | | | 2 | | | | | | | | |
| 94520 | S11 | | | 1150 | | | | | 2 | | | | | | | | |
| 94521 | S9 | | | 1205 | | | | | 2 | | | | | | | | |
| 94522 | S12 | | | 1215 | | | | | 2 | | | | | | | | |

| Relinquished by: | Accepted by: | Date: | Time: |
|---|---|---|---|
| Jacquel Mackay | [signature] | 8/18/16 | 13:00 |
| [signature] | Claudine | 8/18/16 | 1602 |

Comments, Special Requirements or Regulations: *Phosphorus low detect
*Loosely sorbed phosphorus and Iron bound phosphorus to be analyzed by Northeast Labs (sediment samples)
Phoenix Quote: 6/17/16 White Pond Concord, MA

**Turnaround:**
☐ 1 Day*
☐ 2 Days*
☐ 3 Days*
☐ Standard
☐ Other
* SURCHARGE APPLIES

**RI**
☐ Direct Exposure (Residential)
☐ GW
☐ Other

**CT**
☐ RCP Cert
☐ GW Protection
☐ SW Protection
☐ GA Mobility
☐ GB Mobility
☐ Residential DEC
☐ I/C DEC
☐ Other

**MA**
☐ MCP Certification
☐ GW-1
☐ GW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ MWRA eSMART
☐ Other

State where samples were collected: MA

**Data Format**
☒ Excel
☒ PDF
☐ GIS/Key
☐ EQuIS
☐ Other

**Data Package**
☐ Tier II Checklist
☐ Full Data Package*
☒ Phoenix Std Report
☐ Other
* SURCHARGE APPLIES

# Appendix B

# Water Chemistry Lab Reports

Wednesday, August 24, 2016

Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

Project ID: C617-001
Sample ID#s: BN94505 - BN94510

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.

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

If you have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.

Sincerely yours,

Phyllis Shiller

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #MA-CT-007
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

# Analysis Report

August 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 7:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94505

Project ID: C617-001
Client ID: SURFACE-WHITE

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.020 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 3.21 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 0.018 | 0.010 | mg/L | 1 | 08/20/16 | LK | E200.7 |
| Magnesium | 0.738 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Phosphorus, Dissolved as P Low Level | 0.010 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:19 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:19 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.31 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 0.31 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.027 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
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**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

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 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 7:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94506

Project ID: C617-001
Client ID: THERMOCLINE-WP

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.022 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 3.16 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 0.018 | 0.010 | mg/L | 1 | 08/20/16 | LK | E200.7 |
| Magnesium | 0.722 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Phosphorus, Dissolved as P Low Level | 0.013 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:20 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:20 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.33 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 0.33 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.013 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

# PHOENIX

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 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 7:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94507

Project ID: C617-001
Client ID: BOTTOM-WP

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.019 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 3.61 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 2.04 | 0.010 | mg/L | 1 | 08/19/16 | LK | E200.7 |
| Magnesium | 0.753 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Phosphorus, Dissolved as P Low Level | 0.022 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:21 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:21 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 1.20 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 1.20 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.052 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 12:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94508

Project ID: C617-001
Client ID: SURFACE-WP

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.020 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 2.99 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 0.015 | 0.010 | mg/L | 1 | 08/20/16 | LK | E200.7 |
| Magnesium | 0.691 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| **Phosphorus, Dissolved as P Low Level** | 0.010 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:26 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:26 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.29 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 0.29 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.018 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

**Comments:**

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Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

# PHOENIX

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 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 12:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94509

Project ID: C617-001
Client ID: THERMODINE-WP

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.011 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 3.22 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 0.071 | 0.010 | mg/L | 1 | 08/20/16 | LK | E200.7 |
| Magnesium | 0.712 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| **Phosphorus, Dissolved as P Low Level** | 0.012 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:27 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:27 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.38 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 0.38 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.028 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

## Comments:

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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

**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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 24, 2016

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | JM | 08/18/16 | 12:00 |
| Location Code: | ESSGRPRI | Received by: | SW | 08/18/16 | 16:02 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBN94505
Phoenix ID: BN94510

Project ID: C617-001
Client ID: BOTTOM-WP

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Aluminum | 0.017 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Calcium | 3.39 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| Iron | 2.04 | 0.010 | mg/L | 1 | 08/19/16 | LK | E200.7 |
| Magnesium | 0.711 | 0.010 | mg/L | 1 | 08/19/16 | LK | SW6010C |
| **Phosphorus, Dissolved as P Low Level** | 0.028 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 08/18/16 21:28 | KD | E353.2 |
| Nitrate-N | < 0.02 | 0.02 | mg/L | 1 | 08/18/16 21:28 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 1.25 | 0.10 | mg/L | 1 | 08/23/16 | WHM | E351.1 |
| Total Nitrogen | 1.25 | 0.10 | mg/L | 1 | 08/23/16 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.062 | 0.003 | mg/L | 0.5 | 08/23/16 | MA | SM4500PE-99 |
| Total Metals Digestion | Completed | | | | 08/18/16 | AG | |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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

**Phyllis Shiller, Laboratory Director**
**August 24, 2016**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

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

# QA/QC Report

August 24, 2016

## QA/QC Data

SDG I.D.: GBN94505

| 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 356168 (mg/L), QC Sample No: BN94417 (BN94505, BN94506, BN94507, BN94508, BN94509, BN94510) | | | | | | | | | | | | | |
| **ICP Metals - Aqueous** | | | | | | | | | | | | | |
| Aluminum | BRL | 0.010 | <0.010 | <0.010 | NC | 95.2 | | | 96.2 | | | 75 - 125 | 20 |
| Calcium | BRL | 0.010 | 18.6 | 18.6 | 0 | 102 | | | NC | | | 75 - 125 | 20 |
| Iron | BRL | 0.010 | 0.331 | 0.328 | 0.90 | 100 | | | 99.9 | | | 75 - 125 | 20 |
| Magnesium | BRL | 0.010 | 5.08 | 5.08 | 0 | 104 | | | NC | | | 75 - 125 | 20 |

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Tel. (860) 645-1102 Fax (860) 645-0823

# QA/QC Report

August 24, 2016

## QA/QC Data

SDG I.D.: GBN94505

| 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 356555 (mg/L), QC Sample No: BN94167 (BN94505, BN94506, BN94507, BN94508, BN94509, BN94510) | | | | | | | | | | | | | |
| Phosphorus, as P | BRL | 0.01 | 5.18 | 5.39 | 4.00 | 106 | | | 108 | | | 85 - 115 | 20 |
| QA/QC Batch 356181 (mg/L), QC Sample No: BN94395 (BN94505, BN94506, BN94507, BN94508, BN94509, BN94510) | | | | | | | | | | | | | |
| Nitrate-N | BRL | 0.02 | <0.02 | <0.02 | NC | 106 | | | 95.7 | | | 85 - 115 | 20 |
| Nitrite-N | BRL | 0.01 | 0.052 | 0.05 | 3.90 | 92.4 | | | 96.4 | | | 85 - 115 | 20 |
| QA/QC Batch 356464 (mg/L), QC Sample No: BN94396 (BN94505, BN94506, BN94507, BN94508, BN94509, BN94510) | | | | | | | | | | | | | |
| Nitrogen Tot Kjeldahl | BRL | 0.10 | 0.87 | 1 | 13.9 | 98.4 | | | 99.5 | | | 85 - 115 | 20 |

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 24, 2016

Wednesday, August 24, 2016

Criteria: None

State: CT

# Sample Criteria Exceedences Report

**GBN94505 - ESSGRPRI**



| 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 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.

**PHOENIX** *Environmental Laboratories, Inc.*

# CHAIN OF CUSTODY RECORD

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
**Client Services (860) 645-8726**

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

**Data Delivery:**
☐ Fax #:
☐ Email: mladewig@essgroup.com

Customer: ESS Group, Inc.
Address: 10 Hemingway Dr. 2nd Floor
East Providence, RI 02915

Project: C617-001
Report to: Matt Ladewig
Invoice to: Barbara Cabral
Phone #: 401-330-1204
Fax #:

Project P.O:

This section MUST be completed with Bottle Quantities.

**Client Sample - Information - Identification**

Sampler's Signature: Jacquel Mackay Date: 8/18

**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

Analysis Request

| PHOENIX USE ONLY SAMPLE # | Customer Sample Identification | Sample Matrix | Date Sampled | Time Sampled | total P | dissolved P | total nitrogen | ~~iron~~ | ~~Aluminum~~ | metals | Soil VOA Vials [ ] methanol [ ] H2O | GL Soil container ( ) oz ( ) oz | 40 ml VOA Vial [ ] As is [ ] HCl | GL Amber 1000ml [ ] As is [ ] H2SO4 | PL As is [ ]250ml [ ]500ml [ ]1000ml | PL H2SO4 [ ]250ml [ ]500ml | PL HNO3 250ml | PL NaOH 250ml | Bacteria (as is) | Bacteria (w/thio) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94505 | surface-white | SW | 8/18 | 7:00 | X | X | X | | | X | | | | | 1 | 2 | 1 | | | | low detect P |
| 94506 | thermocline-wP | SW | 8/18 | 7:00 | ↓ | ↓ | ↓ | | | ↓ | | | | | 1 | 2 | 1 | | | | |
| 94507 | bottom-wP | SW | 8/18 | 7:00 | ↓ | ↓ | ↓ | | | ↓ | | | | | 1 | 2 | 1 | | | | |
| 94508 | surface-wP | SW | 8/18 | 12:00 | X | X | X | | | X | | | | | 1 | 2 | 1 | | | | |
| 94509 | thermocline-wP | SW | 8/18 | 12:00 | ↓ | ↓ | ↓ | | | ↓ | | | | | 1 | 2 | 1 | | | | |
| 94510 | bottom-wP | SW | 8/18 | 12:00 | ↓ | ↓ | ↓ | | | ↓ | | | | | 1 | 2 | 1 | | | | |

| Relinquished by: | Accepted by: | Date: | Time: |
|---|---|---|---|
| Jacquel Mackay | [signature] | 8/18/16 | 1300 |
| [signature] | CParadine | 8/18/16 | 1602 |

**Comments, Special Requirements or Regulations:**
wP = white pond in Sample ID
Phosphorus - please use low detect
Metals - Fe, Ca, Aluminum, Mg

**Turnaround:**
☐ 1 Day*
☐ 2 Days*
☐ 3 Days*
☑ Standard
☐ Other
* SURCHARGE APPLIES

**RI**
☐ Direct Exposure (Residential)
☐ GW
☐ Other

**CT**
☐ RCP Cert
☐ GW Protection
☐ SW Protection
☐ GA Mobility
☐ GB Mobility
☐ Residential DEC
☐ I/C DEC
☐ Other

**MA**
☐ MCP Certification
☐ GW-1
☐ GW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ MWRA eSMART
☐ Other

State where samples were collected: ______

**Data Format**
☒ Excel
☒ PDF
☐ GIS/Key
☐ EQuIS
☐ Other

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

* SURCHARGE APPLIES

**Friday, June 02, 2017**

**Attn: Mr Matt Ladewig**
**ESS Group Inc.**
**10 Hemingway Drive 2nd Floor**
**Riverside, RI 02915-2224**

**Project ID: WHITE POND CONCORD**
**Sample ID#s: BY30076 - BY30081**

**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 have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext. 200.**

**Sincerely yours,**

Phyllis Shiller

**Phyllis Shiller**
**Laboratory Director**

**NELAC - #NY11301**
**CT Lab Registration #PH-0618**
**MA Lab Registration #MA-CT-007**
**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**

**587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040**
**Telephone (860) 645-1102 Fax (860) 645-0823**

PHOENIX

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 9:15 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30076

Project ID: WHITE POND CONCORD
Client ID: AREA 1

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Phosphorus, Dissolved as P Low Level | 0.012 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 05/26/17 18:04 | KD | E353.2 |
| Nitrate-N | 0.08 | 0.02 | mg/L | 1 | 05/26/17 18:04 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 1.68 | 0.10 | mg/L | 1 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 1.76 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.233 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Total Suspended Solids | 250 | 6.7 | mg/L | 1.3 | 05/30/17 | SD/KH | SM2540D-97,-11 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

Environmental Laboratories, Inc.

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 9:35 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30077

Project ID: WHITE POND CONCORD
Client ID: AREA 3

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Phosphorus, Dissolved as P Low Level | 0.011 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 05/26/17 18:05 | KD | E353.2 |
| Nitrate-N | 0.08 | 0.02 | mg/L | 1 | 05/26/17 18:05 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.99 | 0.10 | mg/L | 1 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 1.07 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.085 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Total Suspended Solids | 100 | 5.0 | mg/L | 1 | 05/30/17 | SD/KH | SM2540D-97,-11 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 10:05 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30078

Project ID: WHITE POND CONCORD
Client ID: AREA 5

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Phosphorus, Dissolved as P Low Level | 0.019 | 0.005 | mg/L | 1 | 05/30/17 | JR | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 05/26/17 18:06 | KD | E353.2 |
| Nitrate-N | 0.12 | 0.02 | mg/L | 1 | 05/26/17 18:06 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 3.02 | 0.10 | mg/L | 1 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 3.14 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.385 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Total Suspended Solids | 660 | 14 | mg/L | 2.9 | 05/30/17 | SD/KH | SM2540D-97,-11 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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

**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

**Ver 1**

PHOENIX

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 8:45 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30079

Project ID: WHITE POND CONCORD
Client ID: AREA 6

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Nitrate-Nitrite (N) | 0.08 | 0.02 | mg/L | 1 | 05/30/17 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 1.44 | 0.10 | mg/L | 1 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 1.52 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.211 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 8:30 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30080

Project ID: WHITE POND CONCORD
Client ID: AREA 7

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Phosphorus, Dissolved as P Low Level | 0.013 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Nitrite-N | < 0.010 | 0.010 | mg/L | 1 | 05/26/17 18:07 | KD | E353.2 |
| Nitrate-N | 0.09 | 0.02 | mg/L | 1 | 05/26/17 18:07 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 0.96 | 0.10 | mg/L | 1 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 1.05 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.099 | 0.003 | mg/L | 0.5 | 05/30/17 | JR | SM4500PE-99 |
| Total Suspended Solids | 28 | 5.0 | mg/L | 1 | 05/30/17 | SD/KH | SM2540D-97,-11 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

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

**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# Analysis Report

June 02, 2017

FOR: Attn: Mr Matt Ladewig
ESS Group Inc.
10 Hemingway Drive 2nd Floor
Riverside, RI 02915-2224

| Sample Information | | Custody Information | | Date | Time |
|---|---|---|---|---|---|
| Matrix: | SURFACE WATER | Collected by: | | 05/26/17 | 9:54 |
| Location Code: | ESSGRPRI | Received by: | SW | 05/26/17 | 15:20 |
| Rush Request: | Standard | Analyzed by: | see "By" below | | |
| P.O.#: | | | | | |

## Laboratory Data

SDG ID: GBY30076
Phoenix ID: BY30081

Project ID: WHITE POND CONCORD
Client ID: AREA 4

| Parameter | Result | RL/ PQL | Units | Dilution | Date/Time | By | Reference |
|---|---|---|---|---|---|---|---|
| Nitrate-Nitrite (N) | 0.13 | 0.02 | mg/L | 1 | 05/30/17 | KD | E353.2 |
| Nitrogen Tot Kjeldahl | 3.60 | 0.20 | mg/L | 2 | 06/01/17 | WHM | E351.1 |
| Total Nitrogen | 3.73 | 0.10 | mg/L | 1 | 06/01/17 | WHM | SM4500NH3/E300.0-97 |
| Phosphorus, as P | 0.803 | 0.013 | mg/L | 2.5 | 05/30/17 | JR | SM4500PE-99 |

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

**Comments:**

Dissolved-Phosphate was not field filtered within 15 minutes of collection.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.
This report must not be reproduced except in full as defined by the attached chain of custody.

Phyllis Shiller

**Phyllis Shiller, Laboratory Director**
**June 02, 2017**
**Reviewed and Released by: Bobbi Aloisa, Vice President**

PHOENIX

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

# QA/QC Report

June 02, 2017

## QA/QC Data

SDG I.D.: GBY30076

| 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 388118 (mg/L), QC Sample No: BY29845 (BY30076, BY30077, BY30078, BY30080) | | | | | | | | | | | | | | |
| Nitrate-N | BRL | 0.02 | 0.11 | 0.11 | 0 | 101 | | | 106 | | | 90 - 110 | 20 | |
| Nitrite-N | BRL | 0.01 | 0.068 | 0.07 | 2.90 | 108 | | | 112 | | | 90 - 110 | 20 | m |
| QA/QC Batch 388191 (mg/L), QC Sample No: BY29998 (BY30076, BY30077, BY30078, BY30080) | | | | | | | | | | | | | | |
| Total Suspended Solids | BRL | 5.0 | 47 | 48 | 2.10 | 97.0 | | | | | | 85 - 115 | | |
| QA/QC Batch 388383 (mg/L), QC Sample No: BY30067 (BY30076, BY30077, BY30078, BY30079, BY30080, BY30081) | | | | | | | | | | | | | | |
| Nitrogen Tot Kjeldahl | BRL | 0.10 | 0.61 | 0.62 | 1.60 | 102 | | | 99.2 | | | 85 - 115 | 20 | |
| QA/QC Batch 388178 (mg/L), QC Sample No: BY30240 (BY30076, BY30077, BY30078, BY30079, BY30080, BY30081) | | | | | | | | | | | | | | |
| Phosphorus, as P | BRL | 0.01 | 0.032 | 0.02 | NC | 101 | | | 90.8 | | | 85 - 115 | 20 | |
| Comment: | | | | | | | | | | | | | | |
| Additional: LCS acceptance range is 85-115% MS acceptance range 75-125%. | | | | | | | | | | | | | | |
| QA/QC Batch 388291 (mg/L), QC Sample No: BY30672 (BY30079, BY30081) | | | | | | | | | | | | | | |
| Nitrate-N | BRL | 0.02 | 0.60 | 0.60 | 0 | 94.8 | | | 96.8 | | | 90 - 110 | 20 | |

m = This parameter is outside laboratory MS/MSD specified recovery limits.

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
June 02, 2017

# Sample Criteria Exceedances Report

## GBY30076 - ESSGRPRI

Criteria: None

State: MA

| 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 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.
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NY # 11301

# Analysis Comments

June 02, 2017 SDG I.D.: GBY30076

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

Coolant: IPK ☑ ICE ☐ No ☐

Temp 4.3°C Pg of

**PHOENIX**
*Environmental Laboratories, Inc.*

# CHAIN OF CUSTODY RECORD

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
**Client Services (860) 645-8726**

**Data Delivery:**
☐ Fax #:
☑ Email: mladewig@essgroup.com

Customer: ESS Group Inc.
Address: 10 Hemingway drive, 2nd floor
East Providence, RI 02915

Project: White Pond, Concord
Report to: Matt Ladewig
Invoice to: Barbara Cabral
Phone #: 401-330-1204
Fax #:

Project P.O:

This section MUST be completed with Bottle Quantities.

**Client Sample - Information - Identification**

Sampler's Signature: [signature] Date: 5/26/17

**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

Analysis Request

| PHOENIX USE ONLY SAMPLE # | Customer Sample Identification | Sample Matrix | Date Sampled | Time Sampled | TSS | Total Phos | Dissolved Phos | Total Nitrogen | Specific Conductivity | Soil VOA Vials [ ] methanol [ ] H2O | GL Soil container ( ) oz ( ) oz | 40 ml VOA Vial [ ] As is [ ] HCl | GL Amber 1000ml [ ] As is [ ] H2SO4 | PL As is [ ]250ml [ ]500ml [ ]1000ml | PL H2SO4 [✓]250ml [ ]500ml | PL HNO3 250ml | PL NaOH 250ml | Bacteria (as is) | Bacteria (w/thio) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30076 | Area 1 | SW | 5/26/17 | 0915 | ✓ | ✓ | ✓ | ✓ | | | | | | X | X | | | | |
| 30077 | Area 3 | SW | ↓ | 0935 | ↓ | ↓ | ↓ | ↓ | | | | | | X | X | | | | |
| 30078 | Area 5 | SW | ↓ | 1005 | ↓ | ↓ | ↓ | ↓ | | | | | | X | X | | | | |
| 30079 | Area 6 | SW | ↓ | 0845 | ↓ | ↓ | ↓ | ↓ | X | | | | | | X | | | | |
| 30080 | Area 7 | SW | ↓ | 0830 | ↓ | ↓ | ↓ | ↓ | | | | | | X | X | | | | |
| 30081 | Area ~~#~~ 4 | SW | ↓ | 0954 | ↓ | ↓ | ↓ | ↓ | X | | | | | | X | | | | |

| Relinquished by: | Accepted by: | Date: | Time: |
|---|---|---|---|
| Mike Mahoney | [signature] | 5/26/17 | 11:35 |
| [signature] | [signature] | 5/26/17 | 15:20 |

**Comments, Special Requirements or Regulations:**
Note: low detect on phosphorus (0.01 mg/L or better)
Reference 6/17/16 Quote for White Pond

**Turnaround:**
☐ 1 Day*
☐ 2 Days*
☐ 3 Days*
☑ Standard
☐ Other
* SURCHARGE APPLIES

**RI**
☐ Direct Exposure (Residential)
☐ GW
☐ Other

**CT**
☐ RCP Cert
☐ GW Protection
☐ SW Protection
☐ GA Mobility
☐ GB Mobility
☐ Residential DEC
☐ I/C DEC
☐ Other

**MA**
☐ MCP Certification
☐ GW-1
☐ GW-2
☐ GW-3
☐ S-1
☐ S-2
☐ S-3
☐ MWRA eSMART
☐ Other

**State where samples were collected:** MA

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

**Data Package**
☐ Tier II Checklist
☐ Full Data Package*
☐ Phoenix Std Report
☐ Other
* SURCHARGE APPLIES

## Bobbi Aloisa

| | |
|---|---|
| **From:** | Bobbi Aloisa |
| **Sent:** | Tuesday, May 30, 2017 11:48 AM |
| **To:** | mladewig@essgroup.com; Bobbi Aloisa |
| **Subject:** | White Pond Concord sample issue |
| **Attachments:** | GBY30076-ChainofCustody-1.pdf |

HI Matt
On the attached chain, for samples Area 6 and Area 4 you only submitted a preserved $H_2SO_4$ sample and no "as is" sample. We can't analyze the following : TSS, dissolved phosphorus and specific conductivity. If you have any questions or concerns please do not hesitate to contact me directly.

Thank you -
Bobbi

Bobbi Aloisa
Vice President
Director of Client Services
Phoenix Environmental Laboratories
587 East Middle Turnpike
Manchester, CT 06040
Ph: 860-645-8728

## Appendix C

## Phytoplankton Lab Report

# ESS Group Algal ID and Enumeration Report

Prepared: September 9, 2016
Prepared By: GreenWater Laboratories

Samples: 4 (Collected on 6/2/16)

1. White Pond AM Surface
2. White Pond AM Thermocline

## Sample 1: White Pond AM Surface

Total cell numbers in the White Pond AM Surface sample collected on 8/18/16 were 24,981 cells/mL. Blue-green algae (Cyanobacteria; 22,079 cells/mL) were the most abundant algal group in the sample accounting for 88.4% of total cell numbers. Other algal groups in the sample were diatoms (Bacillariophyceae; 35 cells/mL), desmids (Charophyta; 4 cells/mL), green algae (Chlorophyta; 2,603 cells/mL), chrysophyceaen golden-brown algae (Chrysophyceae; 47 cells/mL), cryptophytes (Cryptophyta; 20 cells/mL), dinoflagellates (Dinophyta; 4 cells/mL), unknown flagellates and unicells (Miscellaneous; 173 cells/mL) and yellow-green algae (Xanthophyceae; 16 cells/mL). The most abundant species was the colonial cyanophyte *Aphanothece clathrata* (10,477 cells/mL; Fig. 1). A total of 54 species were observed in the sample with green algae the most diverse algal group with 21 taxa observed.

Total cell numbers of potentially toxigenic cyanobacteria (PTOX Cyano) in the sample were 3,770 cells/mL (15.1% of total cell numbers). PTOX Cyano species observed in the sample included *Radiocystis geminata* (3,770 cells/mL; Fig. 2).

## Sample 2: White Pond AM Thermocline

Total cell numbers in the White Pond AM Thermocline sample collected on 8/18/16 were 17,336 cells/mL. Blue-green algae (Cyanobacteria; 14,892 cells/mL) were the most abundant algal group in the sample accounting for 85.9% of total cell numbers. Other algal groups in the sample were diatoms (Bacillariophyceae; 51 cells/mL), desmids (Charophyta; 32 cells/mL), green algae (Chlorophyta; 2,046 cells/mL), chrysophyceaen golden-brown algae (Chrysophyceae; 20 cells/mL), cryptophytes (Cryptophyta; 51 cells/mL), dinoflagellates (Dinophyta; 24 cells/mL), unknown flagellates and unicells (Miscellaneous; 204 cells/mL) and yellow-green algae (Xanthophyceae; 16 cells/mL). The most abundant species was the colonial cyanophyte *Aphanothece clathrata* (8,671 cells/mL). A total of 53 species were observed in the sample with green algae the most diverse algal group with 20 taxa observed.

Total cell numbers of potentially toxigenic cyanobacteria (PTOX Cyano) in the sample were 2,016 cells/mL (11.6% of total cell numbers). PTOX Cyano species observed in the sample included *Radiocystis geminata* (1,508 cells/mL), *Microcystis* sp. (507 cells/mL; Fig. 3) and *Dolichospermum* sp. (1 cell/mL; Fig. 4).



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info@greenwaterlab.com • greenwaterlab.com cyanolab.com

## Sample 3: White Pond PM Surface

Total cell numbers in the White Pond PM Surface sample collected on 8/18/16 were 17,485 cells/mL. Blue-green algae (Cyanobacteria; 14,211 cells/mL) were the most abundant algal group in the sample accounting for 81.3% of total cell numbers. Other algal groups in the sample were diatoms (Bacillariophyceae; 16 cells/mL), desmids (Charophyta; 1 cells/mL), green algae (Chlorophyta; 2,923 cells/mL), chrysophyceaen golden-brown algae (Chrysophyceae; 31 cells/mL), cryptophytes (Cryptophyta; 94 cells/mL), dinoflagellates (Dinophyta; 20 cells/mL) and unknown flagellates and unicells (Miscellaneous; 188 cells/mL). The most abundant species was the colonial cyanophyte *Aphanothece clathrata* (7,948 cells/mL). A total of 50 species were observed in the sample with green algae the most diverse algal group with 17 taxa observed.

Total cell numbers of potentially toxigenic cyanobacteria (PTOX Cyano) in the sample were 1,618 cells/mL (9.3% of total cell numbers). PTOX Cyano species observed in the sample included *Radiocystis geminata* (1,508 cells/mL), *Microcystis* sp. (65 cells/mL), *Dolichospermum* sp. (39 cells/mL) and nostocalean filament sp. (6 cells/mL).

## Sample 4: White Pond PM Thermocline

Total cell numbers in the White Pond PM Thermocline sample collected on 8/18/16 were 11,098 cells/mL. Blue-green algae (Cyanobacteria; 9,142 cells/mL) were the most abundant algal group in the sample accounting for 82.4% of total cell numbers. Other algal groups in the sample were diatoms (Bacillariophyceae; 12 cells/mL), desmids (Charophyta; 1 cell/mL), green algae (Chlorophyta; 1,409 cells/mL), cryptophytes (Cryptophyta; 243 cells/mL), dinoflagellates (Dinophyta; 5 cells/mL), unknown flagellates and unicells (Miscellaneous; 330 cells/mL) and synurophyceaen golden-brown algae (Synurophyceae; 79 cells/mL). The most abundant species was the colonial cyanophyte *Aphanothece clathrata* (5,419 cells/mL). A total of 62 species were observed in the sample with green algae the most diverse algal group with 26 taxa observed.

Total cell numbers of potentially toxigenic cyanobacteria (PTOX Cyano) in the sample were 885 cells/mL (8.0% of total cell numbers). PTOX Cyano species observed in the sample included *Radiocystis geminata* (754 cells/mL), *Dolichospermum* sp. (79 cells/mL) and *Microcystis* sp. (52 cells/mL).

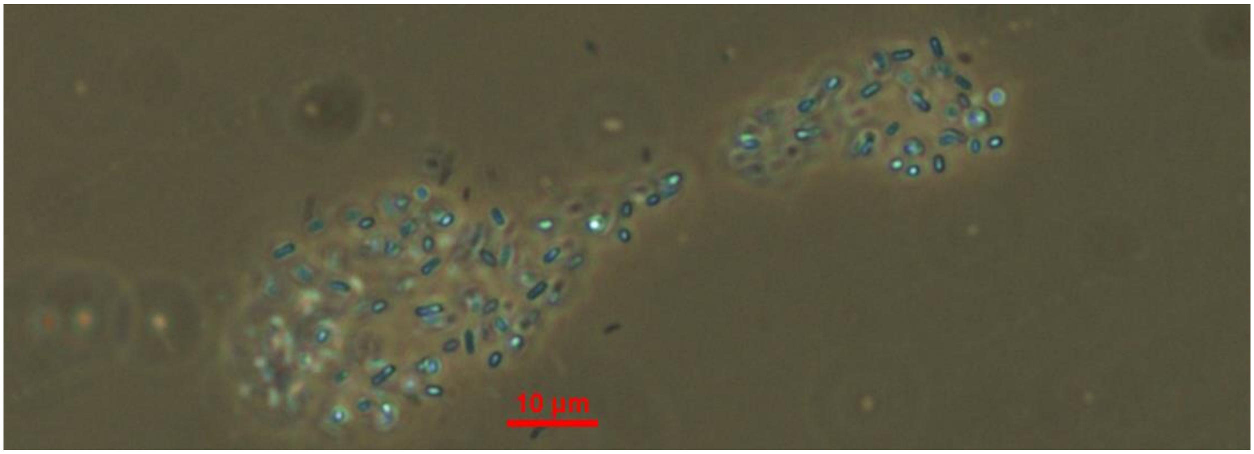


Fig. 1 *Aphanothece clathrata* 400X (scale bar = 10µm)

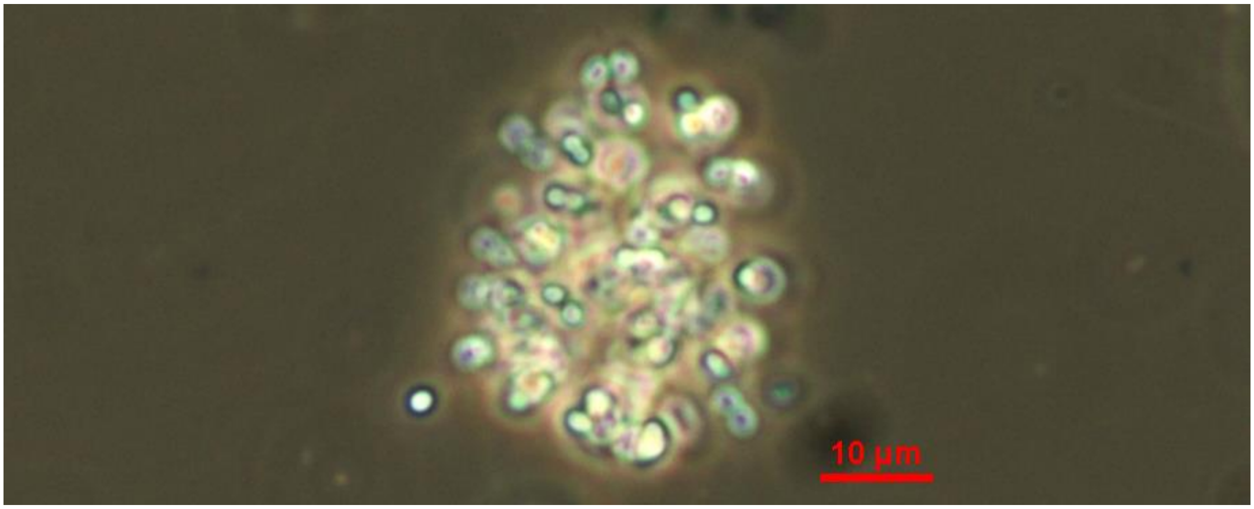


Fig. 2 *Radiocystis geminata* 400X (scale bar = 10µm)

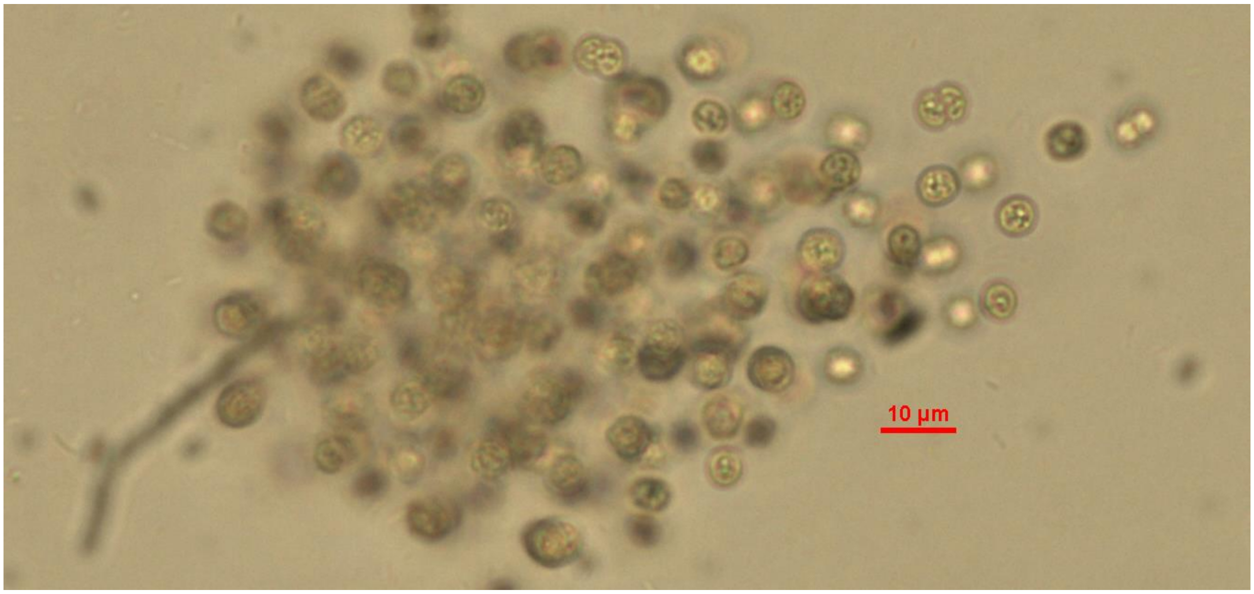


Fig. 3 *Microcystis* sp. 400X (scale bar = 10µm)

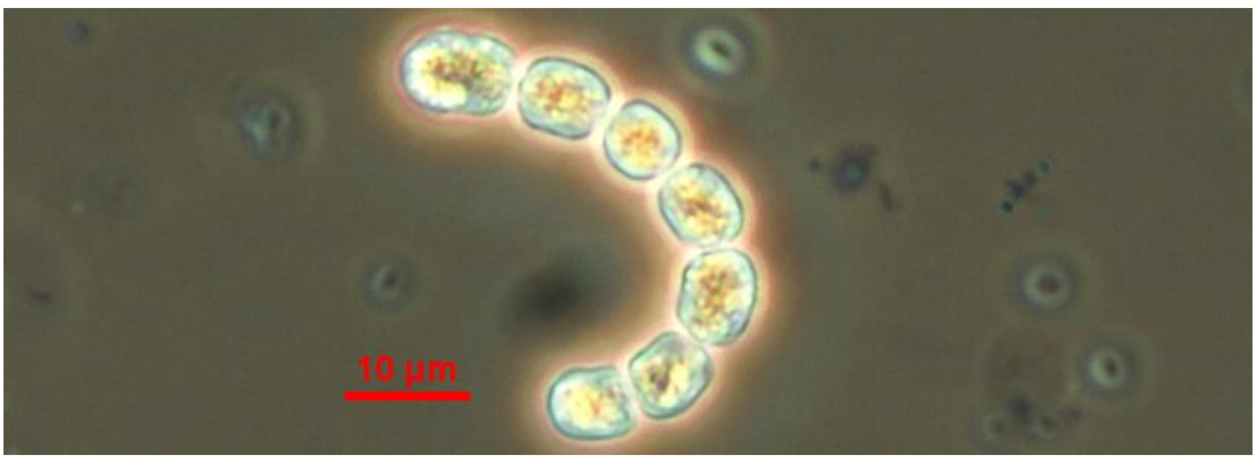


Fig. 4 *Dolichospermum* sp. 400X (scale bar = 10µm)