Mount Kemble Lake

2015 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.
Morristown, NJ

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YEAR END SUMMARY
2015 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

Introduction

The following report is the 2015 Year-End Summary of the Water Quality Monitoring and Lake Management Program for Mount Kemble Lake located in Morristown, Morris County, New Jersey. This report includes details of lake surveys, the water quality monitoring program, phytoplankton surveys, and observations logged during site visits in 2015. Recommendations for Mount Kemble Lake management efforts for the 2016 season are also included. The Appendix of this report includes graphs and tables of the 2015 field data, reference guides, along with supporting documents for this report.

The 2015 Lake Management Program for Mount Kemble Lake focused on control of nuisance and invasive aquatic plant growth, most specifically curly-leaf pondweed (*Potamogeton crispus)*, leafy pondweed (*Potamogeton foliosus*), and southern naiad (*Najas guadalupensis*). Through the season a total of five (5) different aquatic macrophytes were observed during surveys of the lake (Table 1), with invasive species highlighted in red. One (1) of these species duckweed (*Lemna minor*) is a floating aquatic plant.

Scientific Name	Common Name
Potamogeton foliosus	Leafy Pondweed
Potamogeton crispus	Curly-leaf Pondweed
Lemna minor	Small Duckweed
Najas guadalupensis	Southern Naiad
Potamogeton diversifolius	Variable Pondweed

Table 1. 2015 Observed Aquatic Macrophytes.

Weather Discussion

The 2015 year was one of interesting weather as both temperature and rainfall were very unpredictable. In terms of temperature, the beginning of the year was one of the coldest in years as February was the 3rd coldest since records were kept in 1895. The rest of the year saw the temperatures were generally slightly above average for the summer months with the exception of May, which was also the 3rd warmest. Temperatures remained mild in the fall as September was the 3rd warmest and November was the 5th warmest on record. As for precipitation, the beginning of the year was relatively close to average either going slightly over or below average for a given month. May was the 3rd driest on record, but was followed by the 4th wettest June. The rest of the year was mostly below average with the exception of October which was slightly above the average. (Figure 2.)

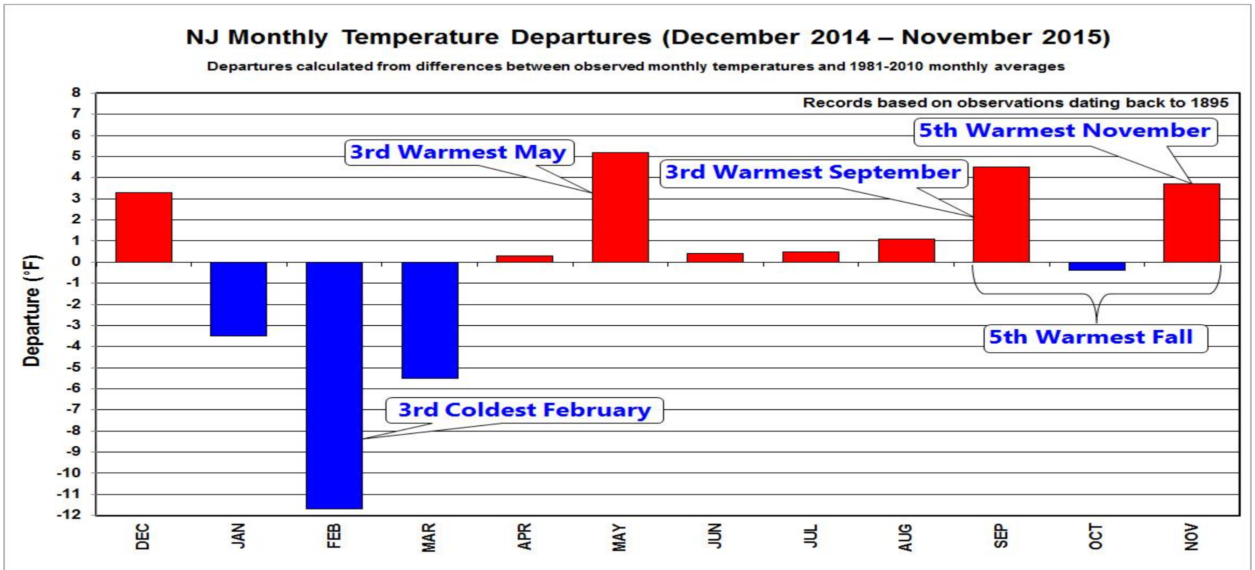


Figure 1: Temperature Departures.

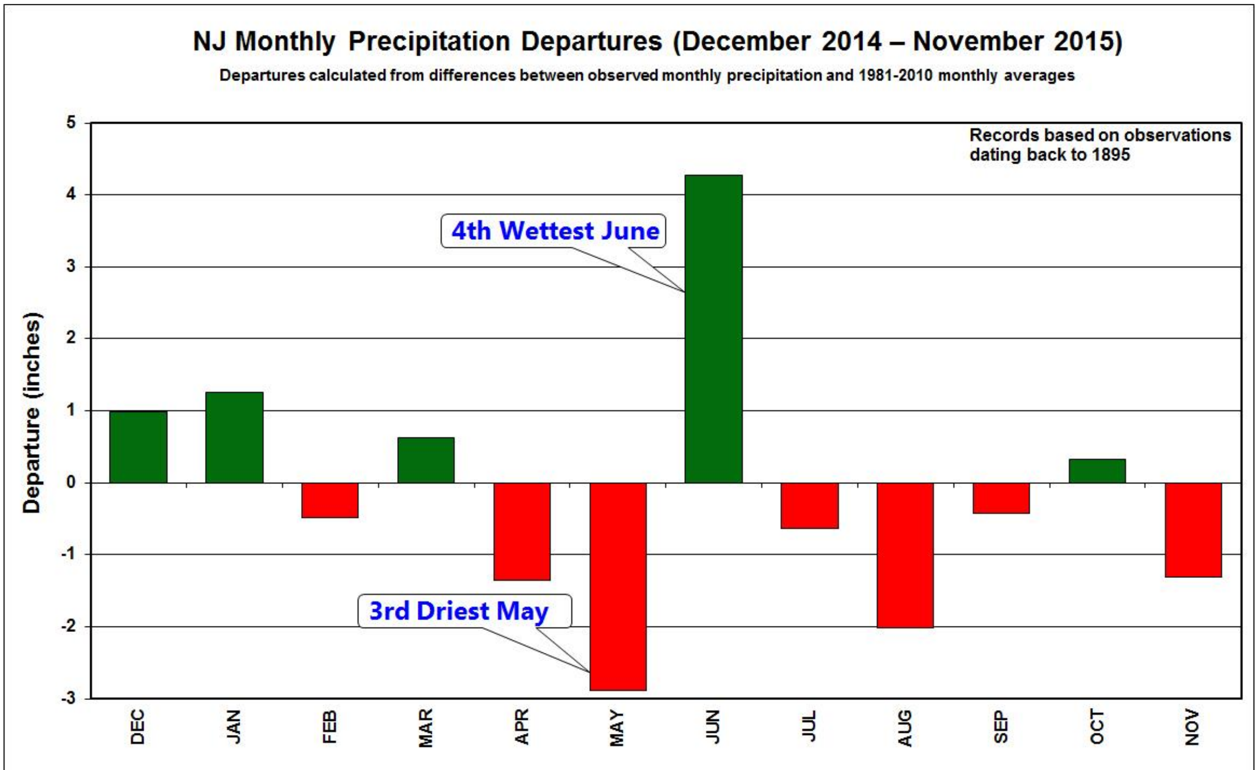


Figure 2: Precipitation Departures.

Lake Management

Aquatic biologists were at Mount Kemble Lake on nine (9) dates from April through August to conduct on-water assessments of aquatic vegetation and algae growth, and to perform *in situ* water quality analysis. On three (3) dates, comprehensive water quality analysis was conducted including, sampling for planktonic algae and zooplankton, lab sample collection and lake profile analysis for temperature and dissolved oxygen. Following each survey, biologists would review lake conditions to determine if management activity was required. In 2015, on three (3) dates SŌLitude Lake Management field staff conducted herbicide and algaecide applications for control of nuisance and invasive aquatic vegetation growth. The table below provides a reference to indicate dates of applications, what aquatic pesticides were applied, and the target acreage and aquatic plant species for each date (Table 2).

Date	Service Performed	Acres Treated	Target Species
5/26/2015	Copper Sulfate	6.7	Unicellular Algae
7/8/2015	Reward	2	*N. guadalupensis*
	Copper Sulfate	2.25	Filamentous Algae
7/23/2015	Reward	2	*N. guadalupensis*
	Copper Sulfate	2	Filamentous Algae

Table 2: Mount Kemble Lake 2015 Treatment Log

The early season survey conducted at Mount Kemble Lake during April was highlighted by only a single rooted stem of curly-leaf pondweed (*P. crispus*), which was pulled by hand. Weed anchors were also thrown to look for plants not visible from the surface, but yielded no plant matter. Water clarity was six feet and the lake as a whole looked good. On May 26th, the second survey of the season was conducted and at this time aquatic plant life was minimal as only a few stems of curly-leaf pondweed and leafy pondweed (*P. foliosus*) were observed along the western shoreline. Since the previous visit there was a build up of unicellular algae that caused the water clarity to drop approximately one foot to five feet. In an effort to increase water clarity **Copper Sulfate** was employed. A lake survey was conducted in early June, which reported trace amounts of individual stems of curly-leaf pondweed along the eastern and northern areas of the shoreline. The western shoreline saw in an increase in the amount of curly-leaf pondweed as trace to sparse clusters were observed. Recent rains had reduced the clarity to two and a half feet as the water was turbid, but unicellular algae was not present in high quantities in the water column.

On June 22nd the lake was visited again and the survey indicated trace to sparse patches of curly-leaf pondweed along the western shoreline and a few small patches located near the beach area. The eastern shoreline was mostly free from submersed aquatic vegetation as only trace amounts of curly-leaf pondweed were observed. Leafy pondweed was observed floating on the surface of the lake, but few rooted stems were discovered. At this time, the north end of the lake, by the inlet supported sparse densities of southern naiad (*N. guadalupensis*), that were at least three feet from the surface and did not impede lake activities. Water clarity naturally improved to five feet, which is closer to the acceptable range for freshwater lake systems. The lake was surveyed again in early July and was highlighted by more aquatic plant growth. Near the lake inlet southern naiad was found in trace to sparse densities, while variable leaf pondweed (*P. diversifolius*) was found in moderate densities. It was observed along the majority of the western shoreline and near some of the docks along the eastern shoreline. Benthic filamentous algae was observed sporadically along many areas of the shoreline with the highest densities occurring near the inlet. Floating filamentous algae was observed in trace densities along the western shoreline and was also found in sparse densities near the inlet. These areas of the lake required treatment, in which the herbicide **Reward** was used to suppress the aquatic plant growth, while **Copper Sulfate** was applied to gain control of the benthic and floating filamentous algae.

In mid July the lake was surveyed and reported dense amounts of southern naiad along the western shoreline intermixed with sparse densities of leafy pondweed. There were also many patches of the above mentioned combination that were observed near several of the docks on the eastern shoreline. The north end of the lake was supporting dense amounts of southern naiad and leafy pondweed. Water clarity had improved naturally to over seven feet, which for that late in the season would be considered excellent. The southern naiad from the previous treatment appeared to have impacted the plants, but a supplemental application was needed. **Reward** was employed to achieve control of the previously treated, but still alive southern naiad, and **Copper Sulfate** was used for the algae that was growing on the plants.

On August 12th, the lake survey was highlighted by sparse patches of leafy pondweed that were observed mostly along the western shoreline, stopping right before the beach area. A very small portion of the northern cove contained moderate to heavy southern naiad, but the tops appeared brown and the plants were at least two feet below the surface and did not impede any lake activities. At this time water clarity had improved to eight feet, which was the highest it had been the entire summer. The last survey of the 2015 lake management season occurred on August 26th and at this time the pondweed along the western shoreline was observed in amounts less dense than the previous survey. The northern cove looked similar to the visit two weeks prior. At this point in the season the lake looked great as there was minimal plant growth, no visible algae growth on the surface, and a water clarity of eight feet.

Water Quality Monitoring Program

In 2015, the water quality monitoring program included *in-situ* field measured limnological analysis including temperature/dissolved oxygen profiles, pH, transparency, alkalinity, and total hardness. In addition, surface water chemistry samples were collected at the north inlet and lake station, as well as from the lake bottom at the lake station site, and transported to Aqua Pro-Tech Laboratories (Fairfield, New Jersey) for analysis of the following parameters: ammonia, conductivity, nitrate, total phosphorus, and total suspended solids. On April 27th, samples for total phosphorous were also collected at the inlet and outlet in accordance with the New Jersey Total Maximum Daily Load (TMDL) threshold. Collection for phytoplankton and zooplankton identification and enumeration was also performed on three dates. Provided in the Appendix is a short description of each water quality parameter, and laboratory data results. Below is the water quality data tabulated to provide a seasonal reference.

Water Quality Data Tables

Mount Kemble Lake Water Quality Results – Inlet Station			
Parameter	**Units**	**4/27/2015**	**Limits**
Total Phosphorus	mg/L	0.09	0.03

Table 3. 2015 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mount Kemble Lake Water Quality Results- North Station					
Parameter	**Units**	**4/27/2015**	**6/5/2015**	**7/31/2015**	**Limits**
Temperature	°C	13.6	19.1	27.5	NA
Dissolved Oxygen	mg/L	12.87	10.13	8.19	<4.0
ph	SU	8.50	7.50	8.50	9
Alkalinity	mg/L	48.0	72.0	80.0	NA
Total Hardness	mg/L	120.0	100.0	120.0	NA
Secchi	feet	4.0	2.0	4'est	<4'
Ammonia	mg/l	<0.2	<0.2	<0.2	0.3
Nitrate	mg/L	0.8	0.6	<0.2	0.3
Total Phosphorus	mg/L	0.05	0.08	0.04	0.03
Total Suspended Solids	mg/L	3.0	4.0	<3.0	25
Conductivity	Umhos/cm	348	301	355	1500

Table 4. 2015 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mount Kemble Lake Water Quality Results- Lake Station Surface					
Parameter	**Units**	**4/27/2015**	**6/5/2015**	**7/31/2015**	**Limits**
Temperature	°C	13.3	19.5	27	NA
Dissolved Oxygen	mg/L	13.35	10.29	8.26	<4.0
ph	SU	8.50	8.00	8.50	9
Alkalinity	feet	48.0	76.0	80.0	NA
Total Hardness	mg/L	120.0	100.0	120.0	NA
Secchi	mg/L	4.5'	2.5'	5.0	<4'
Ammonia	mg/l	<0.2	<0.2	<0.2	0.3
Nitrate	mg/L	0.8	0.7	<0.2	0.3
Total Phosphorus	mg/L	0.04	0.15	0.03	0.03
Total Suspended Solids	mg/L	5.0	4.0	<3.0	25
Conductivity	Umhos/cm	341	333	359	1500

Table 5. 2015 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Lake Station-Bottom					
Parameter	**Units**	**4/27/2015**	**6/5/2015**	**7/31/2015**	**Limits**
Dissolved Oxygen	mg/L	0.55	0.14	2.66	<4.0
Ammonia	mg/L	0.3	0.79	<0.2	0.3
Nitrate	mg/L	0.7	0.6	<0.2	0.3
Total Phosphorus	mg/L	0.22	0.21	0.04	0.03
Total Suspended Solids	mg/L	6.0	5.0	<3.0	25
Conductivity	umhos/cm	451	376	371	1500

Table 6. 2015 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Mount Kemble Lake Water Quality Results – Outlet Station			
Parameter	**Units**	**4/28/2015**	**Limits**
Total Phosphorus	mg/L	0.05	0.03

Table 7. 2015 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that are outside the acceptable lake management limit.

Water Quality Results Summary

During 2015, the surface water temperature was 13.3° C in April, and increased to 19.5°C, and 27.0°C in June and July, respectively. The pH values collected from the inlet and lake station sites throughout the year ranged from 7.5 to 8.5, which falls within the typical range for freshwater lake systems, and is within historical readings of the past several years for Mt. Kemble Lake. For the majority of the 2015 season pH values were 8.0, but were occasionally observed at 7.5 or 8.5. The hardness levels were stable, ranging from 100 mg/L to 120 mg/L at either location throughout the season. The typical range characteristics to freshwater lakes are those falling between 4 and 200mg/L. The chemical composition of Mount Kemble Lake's surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 48 to 80 mg/L, and within a comparable level compared to similar NJ freshwater lakes' chemical composition and nearly identical to the values observed in 2014. Conductivity was consistent throughout the season with values ranging from 301 to 451 µmhos/cm., with the highest observed value obtained in the April lake bottom sample.

Ammonia and nitrates are nutrients based on the chemical composition of nitrogen. These naturally occurring compounds when influenced by human activity can cause excessive plant and algae growth. All of the lake surface samples showed results that were within the acceptable range for ammonia; however, the June 5th sample was the exception as values were nearly four times the accepted value When dissolved oxygen is exceptionally low, ammonia cannot be oxidized into nitrate, which is why this sample had such a high value for ammonia.

Nitrates were found elevated in the April and June surface samples, but decreased to values that were within acceptable limits for freshwater lake systems. In April, nitrate levels were 0.8 mg/L in both surface sites, and were 0.7 mg/L in the bottom sample. During the June sampling nitrate levels were 0.7 mg/L and 0.6 mg/L at the lake station and inlet stations respectively, with the bottom sample providing a reading of 0.6 mg/L as well. These numbers are slightly elevated and higher values of nitrates would suggest more nutrients available for plant and algae growth.

Total phosphorus is usually present in freshwater lakes at low concentrations. Total phosphorus concentrations in a freshwater lake system should be less than 0.03 mg/L to prevent higher productivity. In the 2015 season nearly every sample showed that the lake was supporting values above the acceptable threshold. The lake bottom station had extremely high values in the April and June samples at 0.22 and 0.21 mg/L respectively. The surface samples were generally slightly above the acceptable value for phosphorus and by the seasons end both sampling locations were either at or marginally above the typical values expected in a eutrophic lake system. Although phosphorus levels were high throughout the season, there were no instances of excessive plant or algae growth.

Oligotrophic <0.012mg/L Very Good	Mesotrophic 0.012 - 0.024mg/L Good	Eutrophic 0.025 - 0.096mg/L Fair	Hypereutrophic >0.096mg/L Impoundments

Table 8: Trophic Status Based on Phosphorus Values

Transparency (water clarity) displayed moderate variability in 2015, with observed secchi readings between 2.5 and 8.0 feet. The highest secchi measurement was recorded on both surveys in August, while the lowest observed clarity reading was on June 5th, likely affected by turbidity from recent rainfall. Overall, water clarity was considered fair to good throughout the season, and was not observed to be negatively affected by blooms of planktonic algae.

Lake Profile Description

In 2015, temperature and dissolved oxygen profiles were collected from the lake station sampling site utilizing a temperature / dissolved oxygen meter. The April profile revealed a well mixed water column, with favorable dissolved oxygen to a depth of twenty-one feet. During June, the lake profile revealed what is called a positive heterograde curve, which simply means that the water quality conditions of the lake depleted dissolved oxygen below a depth of approximately twelve feet, and likely supported an algae

	4/27/2015		6/5/2015		7/31/2015	
Depth (m)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	13.3	13.35	19.5	10.29	27.0	8.26
1	13.2	13.33	19.2	10.27	26.8	8.40
2	13.1	13.33	19.2	10.30	26.7	8.25
3	11.9	14.20	18.2	4.85	26.6	7.35
4	9.3	13.41	13.2	4.48	24.9	4.08
5	6.9	7.70	9.5	0.87	23.7	4.65
6	5.9	3.57	7.4	0.23	23.6	3.33
7	5.2	2.04	6.1	0.17	23.2	3.08
8	4.9	1.17	5.7	0.15	22.8	2.07
9	4.7	0.55	5.5	0.14	22.1	2.66

Table 9. Mount Kemble Lake Dissolved Oxygen Profiles.

bloom at about five feet, which corresponds with the observed water clarity of five feet. The algae bloom at this depth is indicated by the spike in dissolved oxygen at this depth alone. This type of water quality condition is observed most frequently in lakes where the surface area is small relative to the maximum depth and protected from intense wind action by surrounding topography and vegetation, which is descriptive of Mt. Kemble Lake. The July 31st lake profile displayed a more typical mid-summer stratification, where dissolved oxygen is consistent to a particular depth, in this case approximately nine feet, and then declines to anoxia at an approximate depth of eighteen feet. Complete profile graphs are provided in the Appendix of this report.

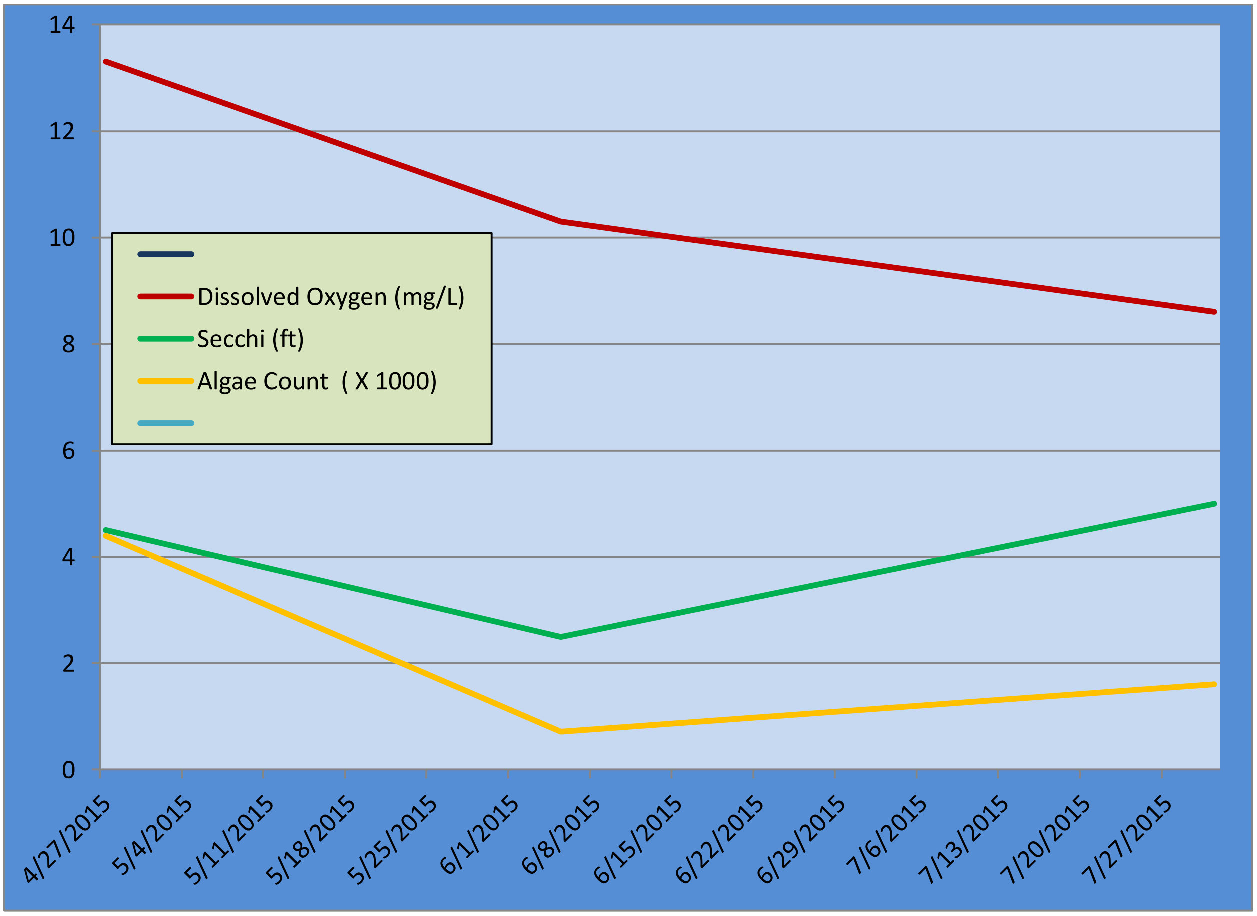


Figure 3. Mount Kemble Lake Seasonal Profile

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2015, surface phytoplankton samples were collected at two established water quality monitoring sites in April, June, and July. Samples were collected in dedicated, pre-rinsed one liter plastic bottles and placed in a cooler with ice for transport. The samples were identified and enumerated under a compound microscope immediately upon return to SŌLitude Lake Managements's laboratory. The 2015 microscopic examination data sheets and graphs are provided in the Appendix. In 2015, a single vertical zooplankton tow was conducted at the lake station on each date. The collected sample was preserved in the field, and returned to SŌLitude's lab for analysis.

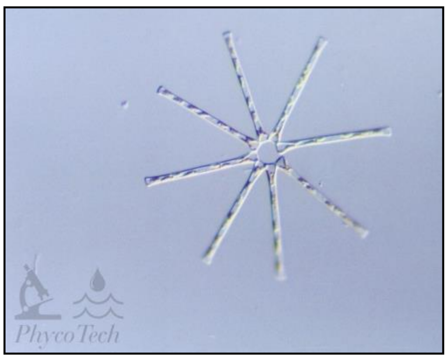
A Phytoplankton Primer

Lakes typically contain three broad categories of phytoplankton (also sometimes referred to as algae). These include filamentous phytoplankton, macroscopic multi-branched phytoplankton (which appear similar to submersed plants), and unicellular phytoplankton. Each category shall be discussed in turn, although the results of the 2015 sampling will focus on the unicellular phytoplankton population.

Filamentous phytoplankton are typically macroscopic (that is, visible with the naked eye), composed of long chains of cells that are attached to a substrate, typically the lake bottom, submersed or emergent vegetation, or rocks. This is called benthic filamentous algae (BFA), and rampant growth can become visible at the surface. As pieces of benthic filamentous algae break apart, it often floats on the surface as dense unsightly mats called floating filamentous algae (FFA). Typically, genera of green algae or blue-green algae develop into nuisance filamentous mats. Abundant nuisance growth of filamentous phytoplankton creates numerous negative impacts to a lake. These can include a decrease in aesthetics, a decrease in recreational uses, increased fishing frustration, and water quality degradation.

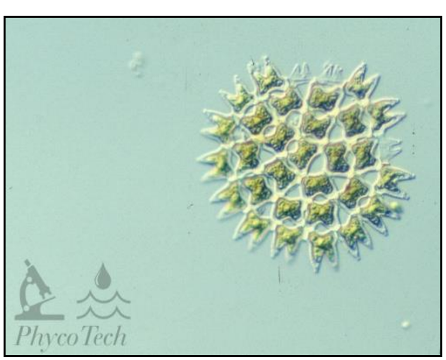
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, under ideal conditions, this type of phytoplankton can reach lengths of several feet, and create a dense carpet on the bottom of a lake. Therefore, it typically does not reach nuisance levels in a lake, save for high use areas such as beaches and other popular swim areas. Since this phytoplankton occupies a similar ecological niche as submersed plants, it's often included in detailed and visual aquatic plant surveys. It provides numerous benefits to a lake system, including sediment stabilization, acting as a nutrient sink, providing invertebrate and fish shelter and habitat, and is one of the first to re-colonize a disturbed area. In the Northeast, muskgrass (*Chara* sp.) and stonewort (*Nitella* sp.) are two of the most common macroscopic multi-branched phytoplankton.

Unicellular phytoplankton are typically microscopic, and consist of individual cells or colonies of cells suspended in the water column. At high enough densities (often called a bloom), they can impart a green or brown (and sometimes, even red) tint to the water column. Unicellular phytoplankton belongs to several taxonomic groups with density and diversity of these groups often varying due to seasonality. When unicellular phytoplankton density becomes elevated it can reduce water clarity (giving the water a “pea soup” appearance), and impart undesirable odors. Usually blue-green algae are responsible for these odors, but other groups or extremely elevated densities can impart them as well. In addition to decreased aesthetics, unicellular phytoplankton blooms can cause degradation of water quality, increase the water temperature (turbid water warms faster than clear water), and can possibly produce a variety of toxins (in the case of blue-green algae), depending on the type of genera present and environmental conditions. Numerous groups of unicellular phytoplankton are common in the Northeast, including diatoms, golden algae, green algae, blue-green algae, euglenoids and dinoflagellates. Each group shall be discussed in turn.



Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population characteristics of diatoms. Some are round and cylindrical (centric) in shape, while others are long and wing-shaped (pennales). They are usually brown in color, and reach maximum abundance in colder or acidic water. Therefore, they tend to dominate in winter and early spring. Common diatoms in the Northeast include *Fragilaria*, *Cyclotella*, *Navicula*, and *Asterionella* (pictured).

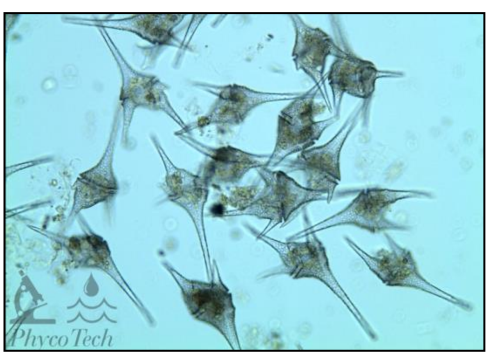
Golden Algae are typically yellow or light brown in color. Cell size is usually small oval shaped with a partially empty area, but several genera create colonies of smaller cells. Most have two flagella, and some type of scales or a rigid coating that grants it a fuzzy appearance. However, a few filamentous forms are possible as well. They typically prefer cooler water, so they dominate in the late fall, winter, or early spring. They also tend to bloom at deeper (cooler) depths. They are common in low nutrient water, and numerous forms produce taste and odor compounds. Common golden algae in the Northeast include *Dinobryon* (pictured), *Mallomonas*, and *Synura*.



Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically with distinct cell shapes light green in color. Some prefer acidic waters, and others highly eutrophic (sewage) conditions. A green algae bloom usually occurs in water with high nitrogen levels. Green algae typically dominate in mid to late summer in the Northeast. Common genera include *Chlorella*, *Scenedesmus*, *Spirogyra* and *Pediastrum* (pictured).

Blue-green algae are actually photosynthetic bacteria. Therefore, they tend to be small, simple in structure and lacking interior cell details. Blue-green algae are typically encased in a mucilaginous outer layer. Some genera are adorned with heterocysts, swollen structures capable of fixing nitrogen, a competitive advantage. These types tend to bloom in nitrogen-poor or eutrophic systems. Yet, blue-green algae are tolerant of a wide variety of water chemistries, and boast many oligotrophic forms as well. Blue-green algae often have gas vesicles which provide increased buoyancy another competitive advantage over other groups of phytoplankton, due to their propensity to shade out others by blooming at the surface. Numerous blue-green algae are documented taste and odor (T&O) producers, and under certain environmental conditions and high enough densities, can produce toxins dangerous to fish, livestock, and possibly humans. Blue-green algae typically dominate a lake system in late summer to early fall. Common blue-green algae that occur in the Northeast include *Anabaena* (pictured), *Aphanizomenon, Microcystis* and *Coelosphaerium.*

Euglenoids are typically motile with 0 to 3 (typically 2) flagella, one of which is longer. Euglenoids has plasticity of shape, and usually are grass green in color (although sometime they are clear or even red). Most forms have a distinct red "eyespot. They are often associated with high organic content water, and eutrophic conditions. Common euglenoids that occur in the Northeast include *Euglena* (pictured), *Phacus,* and *Trachelomonas*.



Dinoflagellates are very common in marine environments, in which they often cause toxic blooms. However, toxin production in freshwater genera is very rare. Dinoflagellates are typically single ovoid to spherical cells, but large compared to phytoplankton from other groups. They usually possess two flagella (one wrapped around the middle of the cell) which grant them rotation while they move through the water column.

Cellulose plates (armored dinoflagellates) are more common, but genera without cellulose plates (naked dinoflagellates) also occur. They generally prefer organic-rich or acidic waters, and can impart a coffee-like brown tint to the water at high enough densities. Common dinoflagellates in the Northeast include *Ceratium* (pictured) and *Peridinium*.

PHYTOPLANKTON RESULTS

In April, the phytoplankton density was considered very high, with almost exclusively diatoms, a small amount of golden algae, with traces of green algae and euglenoids at the inlet station. Diversity was high at the inlet station with ten (10) genera, and moderate to high at the lake station with eight (8) total genera. Both stations were dominated by the diatom *Nitzschia* at 3960 and 4060 (orgs/mL) accounting for at least 90% of all organisms found at each location respectively. Despite the high algal composition the water clarity was considered fair at this time.

Algal Group	**Inlet Station**		
% Abundance	**4/27/2015**	**6/5/2015**	**7/31/2015**
Diatoms	**95.3%**	18.3%	**78.1%**
Golden Algae	3.6%	7.1%	1.3%
Protozoa			
Green Algae	0.2%	**73.2%**	
Blue-green Algae			
Dinoflagellates		1.4%	20.6%
Euglenoids	0.9%		
Total Orgs / mL	**4400**	**710**	**1600**

Table 10. Inlet Station

By June, the phytoplankton density decreased significantly at both sites while diversity remained similar. The abundance of diatoms decreased while the abundance of green algae increased and became the dominant form of algae present in the sample. *Sphaerocystis* was the green algae that was the dominant genera at both sites. At each site green algae accounted for at least 70% of the total sample.

Algal Group			
% Abundance	**4/27/2015**	**6/5/2015**	**7/31/2015**
Diatoms	**93.0%**	24.5%	**91.1%**
Golden Algae	6.2%	1.8%	0.9%
Protozoa			
Green Algae	0.2%	**70.2%**	0.5%
Blue-green Algae			
Dinoflagellates		3.5%	7.5%
Euglenoids	0.6%		
Total Orgs. / mL	**4510**	**570**	**2150**

Table 11. Lake Station

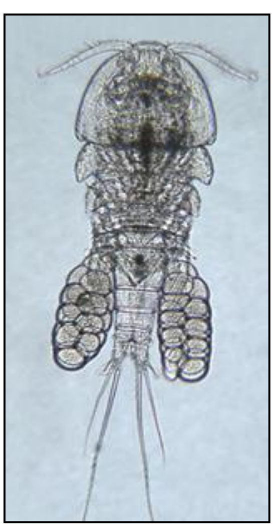
On the final sampling date on July 31th, the algal community at each sampling site saw large increases in density as the inlet site had 1600 (orgs/mL) and the lake station had 2150 (orgs/mL). At this time the diversity had dropped to the lowest it has been all summer as only three (3) genera were present in the inlet station and six (6) genera were present in the lake station. Both of the sampling locations were dominated by the diatom *Synedra*, which accounted for 78% of the inlet site and over 90% of the lake station sampling location.

A Zooplankton Primer

Zooplankton provides an important link in a typical lake's food web between phytoplankton and developing/juvenile stages of fish. In general, zooplankton feed on phytoplankton, while fish in turn feed on zooplankton. The rate of phytoplankton feeding efficiency is primarily based on body size, but zooplankton group, and to some effect specific genera, also plays an important role. There are three main groups of zooplankton found in freshwater systems: rotifers, cladocera, and copepods.

Rotifers are a diverse group of zooplankton, very common in lakes and marine environments alike. Rotifers are generally the smallest zooplankton of the three groups, and thus typically the least efficient phytoplankton grazers. Feeding preferences are determined primarily by mouth structures, and include generalist feeders (omnivores), which eat any small organic detritus encountered, and predators, which eat other smaller rotifers and small phytoplankton. Generalist feeders include *Filinia, Keratella, Lecane, Euchlanis,* and *Brachionus*. Predator genera include *Polyarthra* (larger species), *Asplanchna, Synchaeta*, and *Trichocerca*.

Cladocera are less diverse, but also very common in freshwater lakes. They are sometimes called "water fleas". They spend most of their lifecycle reproducing via parthenogenesis (asexual reproduction with an all female population) only switching to less efficient sexual reproduction when environmental conditions decline. Some genera (such as *Daphnia*) can be quite large (up to 5.0 mm long, visible without magnification), and thus can be classified as highly efficient phytoplankton grazers. Most cladocera are phytoplankton grazers, although their diet includes most organic matter ingested, including bacteria and protozoa. Body size (and thus mouth size) determines feeding efficiency, but ironically the larger-bodied genera are easier to see by predaceous fish, and thus typically have reduced numbers in populations of zooplanktivorous fish. *Daphnia* are the most efficient phytoplankton feeders, while *Ceriodaphnia, Bosmina* and *Eubosmina* are less efficient. There are a few predator genera as well, including *Polyphemus* and *Leptodora*.



Copepods are almost excusive to freshwater lake systems (not streams or rivers) and estuarine and marine systems. Of the six suborders native to the United States, three are parasitic, and three are free living. One of the free living, *Harpacticoida* are exclusively benthic and thus often not collected in traditional plankton tows (unless the bottom sediments are disturbed). The remaining two suborders, the Calanoida and the Cyclopoida are of primary concern during lake studies. All copepods have several naupilar stages, followed by several immature stages, before reaching an adult stage. Both suborder adults are considered large bodied zooplankton, but have distinct feeding preferences. Calanoids are almost exclusively phytoplankton feeders and have even demonstrated selective feeding strategies. Cyclopoids have mouth parts suitable for biting and seizing prey. Their diet is primarily other crustacean zooplankton (including cannibalism on younger life stages), as well as phytoplankton and organic detritus ingestion, but less efficiently.

Zooplankton samples were collected with an 80 um Nitex plankton net. At the Lake Station, a single vertical tow was performed to a depth of 18 feet. Using as little site water as possible, the sides of the net were rinsed of any trapped zooplankton, concentrating the organisms into the net bottom. This concentrate was then emptied into a clean 1000 mL HDPE sample bottle. Immediately after collection, the sample was preserved with an equal amount of 10% sucrose formalin, to achieve a 5% solution. Sucrose was added to the preservative to help maintain carapace integrity. The samples were then placed in a cooler stocked with blue ice. On arrival at SŌLitude's laboratory, the samples were stored in a dark refrigerator until the samples were identified and enumerated.

In the laboratory, each sample was manually mixed for about one minute, before a one mL subsample was removed using a calibrated syringe. The subsample was placed on a Sedgewick-Rafter counting cell, and examined under a compound microscope at 100X magnification. By using calibrated guides on the microscope stage, the entire one mL sample was examined, and any zooplankton were identified and enumerated to the lowest practical taxa using regionally appropriate taxonomic keys. This procedure was repeated two more times to generate three replicate counts. The counts were then averaged, and back-calculated to achieve an organism per liter density. The zooplankton count data sheets in the Appendix describe the step by step procedures for all three replicates, and the final averaged densities. Also included in the Appendix are pie charts depicting the sample date zooplankton group distribution.

2015 Zooplankton Results

Zooplankton Group	4/27/2015	6/5/2015	7/31/2015
Rotifers	**68.5%**	19.6%	**55.9%**
Cladocera	6.3%	**68.9%**	8.8%
Copepoda	25.2%	11.5%	35.3%
Total Zooplankton (Orgs. / mL)	693	3735	165

Table 12. Mount Kemble Lake 2015 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 693 organisms per liter, which is considered low to moderate. Sample diversity was moderate with eight different genera observed. At this time Rotifers accounted for 68.5 percent of the total zooplankton community with *Keratella* being the most abundant genera. Additionally, a single genus of Cladoceran (*Daphnia*) and Copepod (*Cyclopoid nauplii*) were also represented in the zooplankton community, with *Daphnia* individually only accounting for 6.3 percent of the community and *Cyclopoid nauplii* respresenting 25.2 percent of the total sample.

The June sampling revealed a much higher density of zooplankton as there were 3735 organisms per liter. At this time the Cladocerans were the most commonly found as *Bosmina* accounted for 68.9 percent of the total. At this time zooplankton diversity is considered low as only a total of four (4) different genera were found in the sample. The most commonly found rotifer was *Polyarthra* as it accounted for more than half of all of the rotifers found at the sampling location. Only one genera of *Copepoda* (*Cyclopoid nauplii*) was found and it accounted for a total of 11.5 percent of the zooplankton observed.

On the final sampling date of July 3^{1st}, the zooplankton composition was still considered moderate as six (6) different genera were found at that time; however, density had decreased as only 165 organisms per milliliter were found. Rotifers made of 55.9 percent of the zooplankton composition with *Keratella* being the most abundant in the sample. *Cyclopoid nauplii* made up 35.3 percent of the sample and the Cladoceran *Bosmina* made up only 8.8 percent of the sample.

Discussion

The 2016 management program of Mount Kemble Lake will continue to focus on the control of nuisance densities of plant and algae growth. The target aquatic macrophyte species observed at Mount Kemble Lake in 2015 were southern naiad (*N. guadalupensis*) and leafy pondweed (*P. foliosus*). It is recommended that localized applications of the contact aquatic herbicide **Reward** continue to be utilized through the season for its ability to selectively control nuisance submerged vegetation by rapid absorption into the target plant. Throughout the 2015 lake management season, the appearance of curly-leaf pondweed was minimal, as only individual stems were seen occasionally during some of the lake surveys. In addition, it is beneficial to allow certain amounts of plants to persist in the lake to provide dissolved oxygen, habitat and compete for nutrients required for nuisance plant and algae development. The growth of leafy pondweed and southern naiad should be encouraged in areas of the lake, such as the northern inlet, where they are not interrupting recreational activities or reducing the aesthetic appeal of the lake.

Copper sulfate will continue to provide the most effective and cost efficient management method for controlling nuisance density filamentous and planktonic algae growth. It should be reminded that **Copper Sulfate** has acknowledged negative impacts on zooplankton populations, with localized targeted applications recommended for only nuisance growth of filamentous algae, and limited use on planktonic algae blooms only at times when water clarity is significantly impaired. Numerous other copper and non-copper based algaecides are available and at the request of the Association, SŌLitude Lake Management would be happy to discuss these alternatives.

Efforts in the restoration of Mount Kemble Lake should focus on a nutrient inactivation treatment to bind phosphorus and other suspended particles in the water column to provide a nutrient barrier over lake sediments which will reduce sediment release of phosphorus. In 2015, areas of the lake sampled for water quality testing showed increased amounts of phosphorus, which is used for growth by aquatic plants and algae. Based on 2015 testing results it is recommended that an alum treatment be conducted in the 2016 lake management season. An Alum treatment in previous years had displayed a dramatic improvement in water clarity, which typically lasts until the next significant water exchange period.

The current Mount Kemble Lake Water Quality Monitoring Program is well-designed, and provides suitable water quality data allowing for proactive management of the lakes' environment and reduces the opportunity for the development of problematic situations. It is important to continue water quality monitoring on a regular yearly basis over the long-term to build a baseline data record which will assist biologists in developing more quantitative analysis for greatest possible management procedures.

The entire staff at SŌLitude Lake Management appreciates the opportunity to be of service to the Mount Kemble Lake Association and looks forward to assisting the Association on the stewardship of Kemble Lake in the 2016 lake management season.

Sincerely,

Carl Cummins

Carl Cummins
Environmental Scientist

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LAKE MANAGEMENT
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www.solitudelakemanagement.com

APPENDIX

APPENDIX A: WATER QUALITY PARAMETER DESCRIPTION
APPENDIX B: AQUATIC MACROPHYTE GUIDE
APPENDIX C: WATER QUALITY SAMPLING MAP
APPENDIX D: PHYTOPLANKTON ENUMERATION CHARTS
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS
APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES
APPENDIX G: LAB DATA REPORTS

Appendix A: Water Quality Parameter Descriptions

Temperature

Temperature is measured in degrees Celsius, and is very important to aquatic biota. Several factors affect temperature in a lake system, including air temperature, season, wind, water flow through the system, and shade trees. Turbidity can also increase water temperature as suspended particles absorb sun rays more efficiently. Water depth also affects temperature. In general, deeper water remains cooler during the summer months.

Temperature preferences vary among aquatic biota. Since water temperature typically varies between 5 ºC and 30 ºC during the season, most aquatic biota can flourish under this wide range of temperatures. Of more concern is thermal shock, which occurs when temperature rapidly changes in a short amount of time. Some aquatic biota can become stressed when temperature changes as little as 1-2 ºC in a 24 hour period.

Dissolved Oxygen

Dissolved Oxygen is the measurement of the amount of oxygen freely available to aquatic biota in water. Several factors play a role in affecting the amount of dissolved oxygen in the water. These factors include temperature (warmer water holds less dissolved oxygen), low atmospheric pressure (such as higher altitude) decreases the solubility of oxygen, mineral content of the water can reduce the water's dissolved oxygen capacity, and water mixing (via wind, flow over rocks, or thermal upwelling) increases dissolved oxygen in the water. In addition, an over abundance of organic matter, such as dead algae or plants causes rapid aerobic bacteria growth. During this growth, bacteria consume oxygen during respiration, which can cause the water's dissolved oxygen to decrease.

Dissolved oxygen has a wide range, from 0 mg/L to 20 mg/L. To support diverse aquatic biota, 5-6 mg/L is minimally required, but 9-10 mg/L is an indicator of better overall water quality. Dissolved oxygen reading of below 4 mg/L is stressful to most aquatic organisms, especially fish.

Water Clarity

Transparency (or visibility) is measured with a Secchi disc, and can provide an experienced biologist with a quick determination of a lake's water quality. In short, higher visibility indicates a cleaner (and healthier) aquatic system. Cloudy conditions could indicate nutrient rich sediments entering the lake or excessive algal blooms due to nutrient availability, leading to a degradation of water quality.
Clear conditions allow greater light penetration and the establishment of a deeper photic zone. The photic zone is the depth of active photosynthesis carried out by plants and algae. A byproduct of photosynthesis is dissolved oxygen, required for use by higher aquatic organisms, such as zooplankton and fish.

Total Hardness

Hardness is a measure of dissolved salts in the water, usually calcium, but also magnesium and iron. Hardness is usually influenced by the rock and soil types of the watershed, and the amount of runoff over these surfaces. Hardness can be measured for only calcium content (Hardness (Ca)), or for all three salts, called Total Hardness. Water with Hardness (Ca) less than 10 mg/L can only support sparse aquatic biota. Freshwater typically has a Hardness (Ca) level from 4 to 100 mg/L. In general, the degree of total hardness can be classified according to the table to the right.

Alkalinity

Alkalinity is the measure of the water's capacity to neutralize acids. A higher alkalinity can buffer the water against rapid pH changes, which in turn prevents undue stress on aquatic biota due to fluctuating pH levels. The alkalinity of a lake is primarily a function of the watersheds soil and rock composition. Limestone, dolomite and calcite are all a source of alkalinity. High levels of precipitation in a short amount of time can decrease the waters alkalinity. A typical freshwater lake has an alkalinity of 20-200 mg/L. A lake with a low alkalinity typically also has a low pH, which can limit the diversity of aquatic biota.

pH

The measurement of acidity or alkalinity of the water is called pH (the "potential for hydrogen"). Several factors can impact the pH of a lake, including precipitation in a short amount of time, rock and soil composition of the watershed, algal blooms (increase the pH), and aquatic plant decomposition (decreases the pH). A pH level of 6.5 to 7.5 is considered excellent, but most lake systems fall in the range of 6.0 to 8.5. Aquatic biota can become stressed if the pH drops below 6.0, or increases above 8.5 for an extended amount of time.

Most aquatic biota are adapted to specific pH ranges. When the pH fluctuates rapidly, it can cause changes in aquatic biota diversity. Immature stages of aquatic insects and juvenile fish are more sensitive to low pH values than their adult counterparts. Therefore, a low pH can actually inhibit the hatch rate and early development of these organisms.

Conductivity

Conductivity is the measure of water's ability to conduct an electrical current, and is measured in umhos/cm, the higher the number of charged particles(ions) in the water, the easier for electricity to pass through it. Conductivity is useful in lake management by estimating the dissolved ionic matter in the water, the lower the conductivity, the higher the quality of water (oligotrophic). A higher conductivity usually indicates an abundance of plant nutrients (total phosphorous and nitrate), or eutrophic conditions. Industrial discharge, road salt runoff, and septic tank leaching can increase conductivity. Distilled water has a conductivity of 0.5 to 2.0 umhos/cm, while drinking water conductivity typically ranges from 50to 1,500 umhos/cm. Conductivity below 500 umhos/cm is considered ideal in a lake system.

Nitrate

Nitrates are chemical compounds derived from nitrogen and oxygen. Nitrogen is needed by all plants and animals to make proteins needed for growth and reproduction. Nitrates are generated during plant and animal decomposition, from man-made sources, and from livestock and waterfowl sources. Man-made sources of nitrates include septic system leaching, fertilizer runoff, and improperly treated wastewater. Freshwater lake systems can potentially receive large nitrate inputs from waterfowl, specifically large flocks of Canada geese. An increase in nitrate levels can in turn cause an increase in total phosphorous levels. A nitrate level greater than 0.3 mg/L can promote excessive growth of aquatic plants and algae.

Total Phosphorous

Total phosphorous is a chemical compound derived from phosphorous and oxygen. Total phosphorous is usually present in freshwater in low concentrations, and is often the limiting nutrient to aquatic plant growth. However, man-made sources of phosphorous include septic system leaching, fertilizer runoff, and improperly treated wastewater. These phosphorous inputs usually enter a freshwater lake system during rain events, and bank erosion.

A total phosphorous level greater than 0.03 mg/L can promote excessive aquatic plant growth and decomposition, either in the form of algal blooms, or nuisance quantities of aquatic plants. This process is called eutrophication, and when induced or sped up by man-made nutrient inputs, it is called cultural eutrophication. As a result of this excessive growth, recreational activities, such as swimming, boating, and fishing in the lake can be negatively impacted. In addition, aerobic bacteria will thrive under these conditions, causing a decrease in dissolved oxygen levels which can negatively impact aquatic biota such as fish.

Total Suspended Solids

Total suspended solids refer to all of the particulate matter suspended in the water column. When these solids settle to the bottom of a water body (a process called siltation), they become sediments. There are two components that make up total suspended solids: inorganic and organic. The inorganic portion is usually considerably higher than the organic portion and includes silts, clays, and soils. Organic solids include algae, zooplankton, bacteria and organic debris. All these solids create turbid (or "muddy") conditions. The geology and vegetation of a watershed affect the amount of suspended solids that enter a lake system. Most suspended solids originate from accelerated soil erosion from agricultural operations, logging activities, and construction activities. Another source is the disturbance of bottom sediments from dredging activities, grazing of bottom feeding fish, and recreational activities such as boating.

Ammonia

Ammonia is a type of nitrogen compound used by plants and algae to support growth. Ammonia content in a body of water is influenced by decaying plants and animals, animal waste, industrial waste effluent, agricultural runoff, and atmospheric nitrogen gas transfer. A concentration exceeding 0.30 mg/L can promote excessive plant and algae growth. Elevated ammonia levels can increase nitrification, which in turn depletes the oxygen content of water. Extremely high ammonia levels can be toxic to aquatic biota (such as fish).

Appendix B: Aquatic Macrophyte Guide

Small Duckweed (*Lemna minor*. Common Names: Small duckweed, water lentil, lesser duckweed. **Native.**). Small duckweed is a free floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces via budding at at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It over winters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It's also consumed by muskrat, beaver and fish, and dense mats of duckweed can actually inhibit mosquito breeding.

Curly-leaf Pondweed (*Potamogeton crispus*. Common Name: curly-leaf pondweed. **Invasive.**): Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong, and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, Curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.

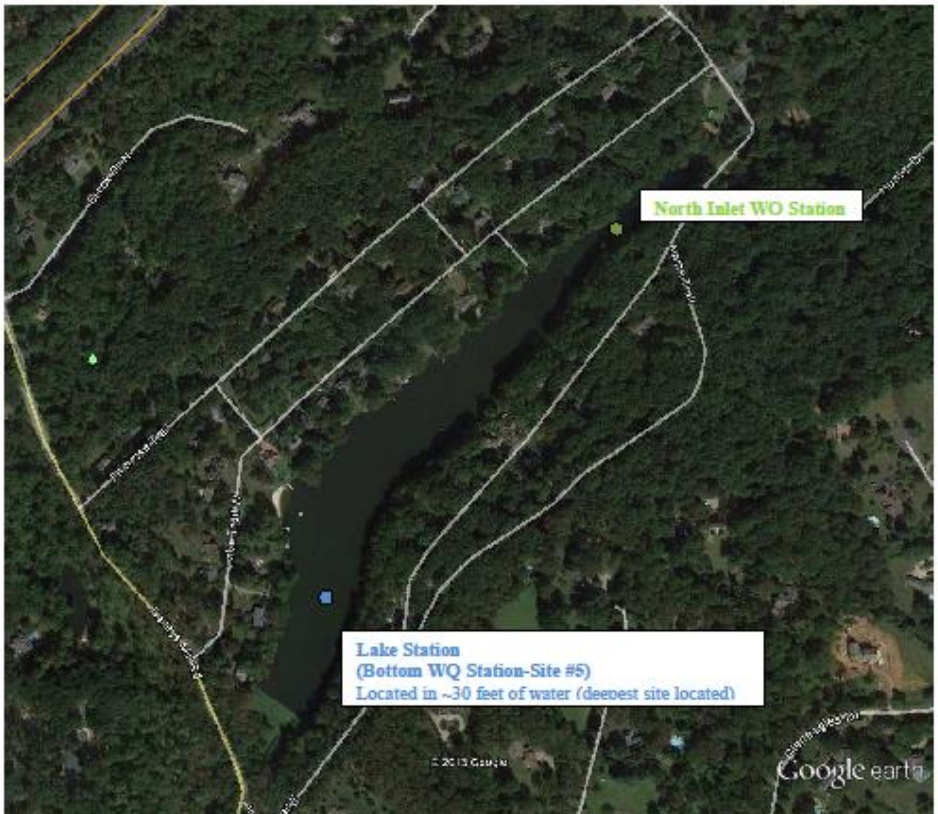
Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native**.): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly more narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.

Southern Naiad (*Najas guadalupensis*. Common Names: Southern water nymph, bushy pondweed. **Native**.): Southern naiad is an annual aquatic plant that can form dense stands of rooted vegetation. Its ribbon-like leaves are dark-green to greenish-purple, and are wider and less pointed than slender naiad. Flowers occur at the base of the leaves, but are so small, they usually require magnification to detect. Southern naiad is widely distributed, but is less common than slender naiad in northern zones. Southern naiad reproduces by seeds and fragmentation.

Variable-leaf Pondweed (*Potamogeton diversifolius*. Common Names: Water-thread pondweed, variable-leaf pondweed, snailseed pondweed. **Native**.): Variable-leaf pondweed have freely-branched stems emerging from slender rhizomes. The submersed leaves are narrow and linear with one obvious midvein bordered by a row of hollow cells. The floating leaves are shaped like an ellipse, but are usually less than 4 cm long, Variable-leaf pondweed fruit spikes are produced in two distinct forms. It occurs in lakes, ponds, rivers and streams and prefers soft sediment and water less than 2 meters deep. Waterfowl graze on the fruit, and local fauna often graze on the stems and leaves.

APPENDIX C: WATER QUALITY SAMPLING MAP

Mount Kemble Lake 2015 Water Quality Monitoring Sites



Mount Kemble Lake
Morris County, New Jersey

2014 Water Quality Sampling Sites Map

● = North Inlet WQ Site
● = Lake Station WQ Site

Allied Biological

580 Rockport Road
Hackettstown, NJ 07840
(908) 850-0303
FAX 850-4994

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 4/27/15	Examination Date: 4/27/15	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella	30	20	
Cyclotella	130	100	
Cymbella			
Diatoma			
Fragilaria	30		
Melosira			
Navicula	10		
Nitzschia	3960	4060	
Pinnularia			
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra	30	10	
Tabellaria			
Cocconeis			

CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**
Dinobryon	130	120	
Mallomonas	30	160	
Synura			
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	**A**	**B**	**C**
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum			
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus		10	
Spirogyra			
Staurastrum			
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium	10		
Cosmerium			

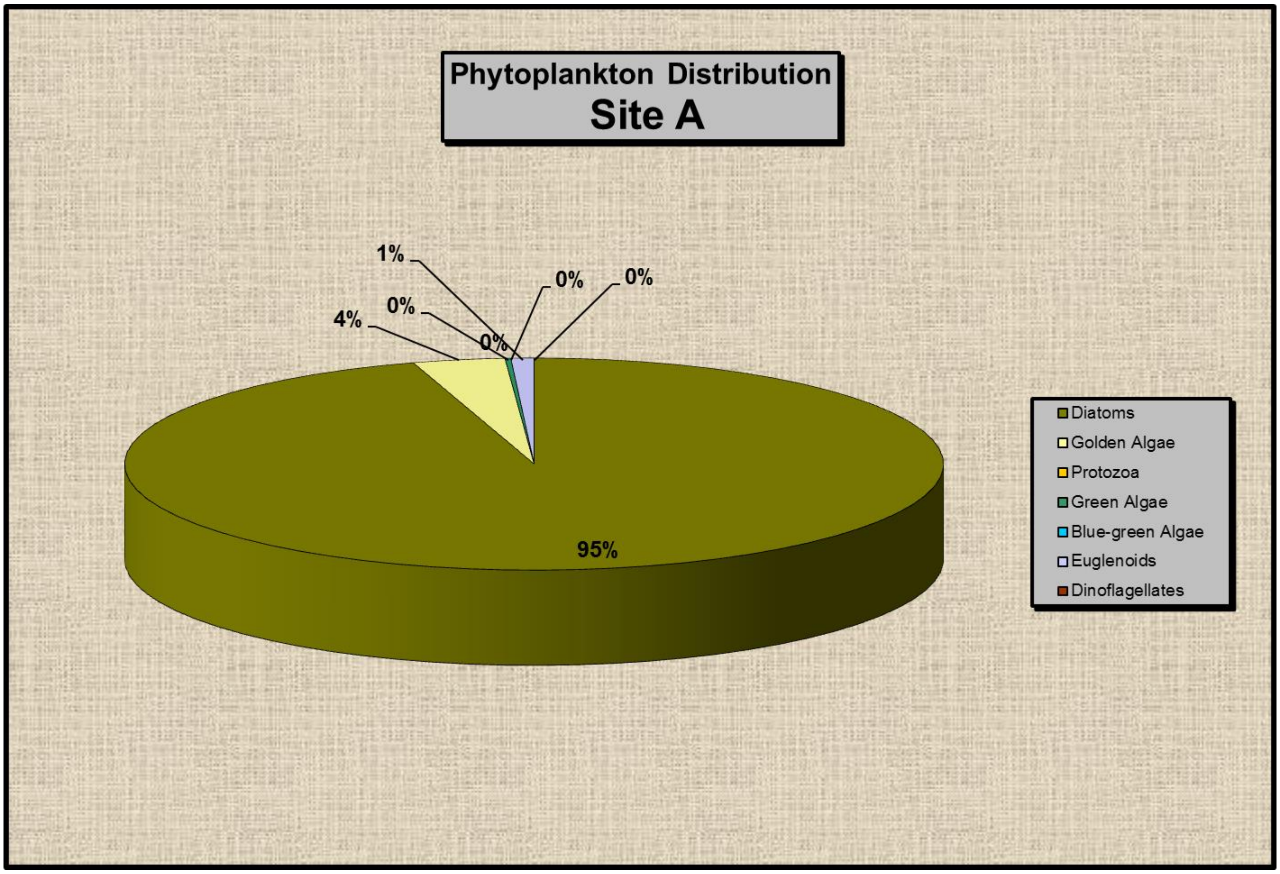
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			

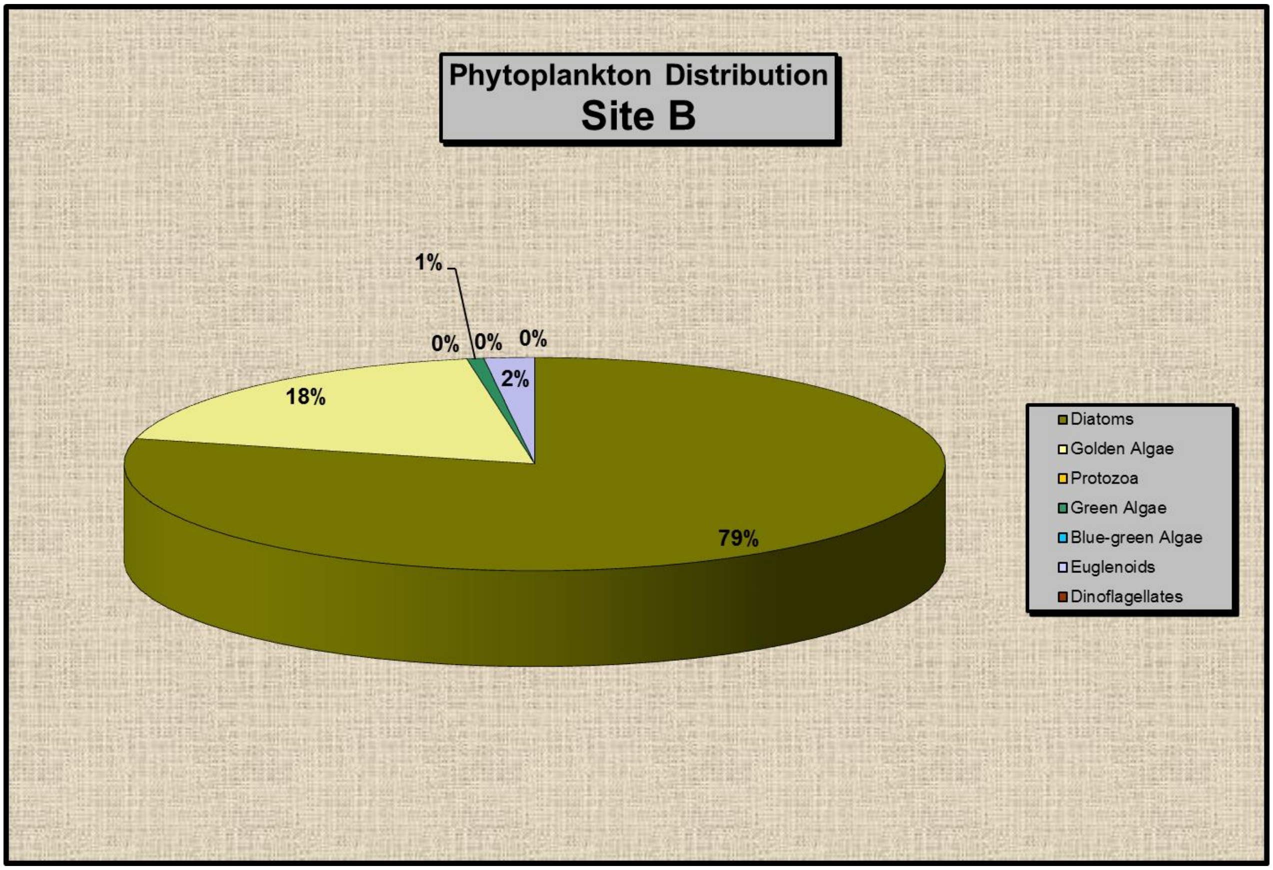
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas	40	30	

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium			
Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	10	8	
TRANSPARENCY:	4.0	4.5	
ORGANISMS PER MILLILITER:	**4400**	**4510**	

NOTES: This was the first sampling event at this site in 2015. The algal density is high with moderate diversity. The assemblage at each site is dominated by a bloom of the diatom *Nitzschia*. Diatom blooms are typical in early spring, and typically not the target of control. Trace amounts of golden algae, green algae and euglenoids were also observed at both sites. The water clarity at each site was fair.


Phytoplankton Distribution
Site A
1%
0%
0%
4%
0%
0%
95%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates


Phytoplankton Distribution
Site B
1%
0%
0%
0%
2%
18%
79%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 6/5/15	Examination Date: 6/5/15	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella		30	
Cyclotella			
Cymbella			
Diatoma			
Fragilaria	110	110	
Melosira			
Navicula	10		
Nitzschia			
Pinnularia			
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra			
Tabellaria	10		
Cocconeis			

CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**
Dinobryon	50		
Mallomonas		10	
Synura			
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	**A**	**B**	**C**
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium	20	10	
Coelastrum	80	50	
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus	20	10	
Spirogyra			
Staurastrum	90	90	
Sphaerocystis	310	240	
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium			
Cosmerium			

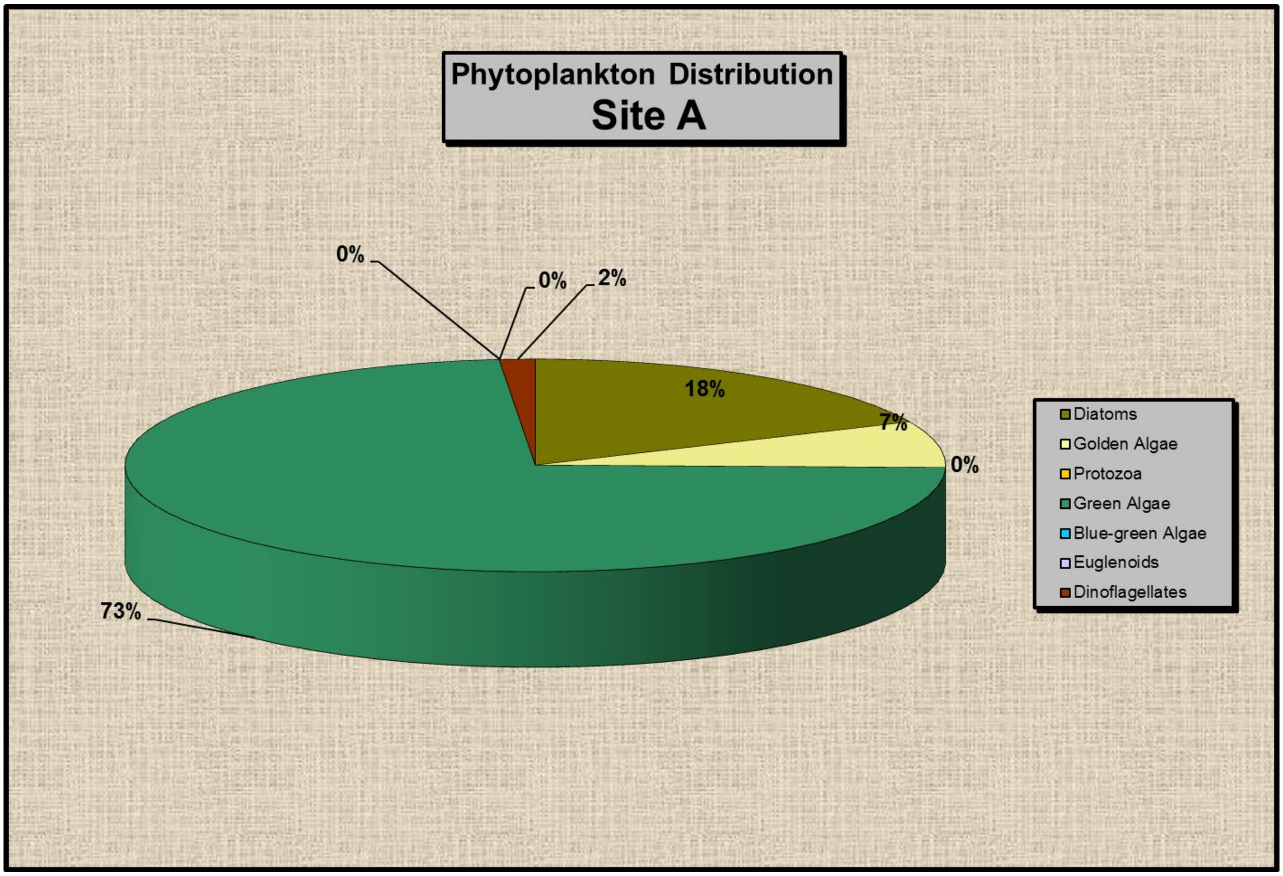
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			

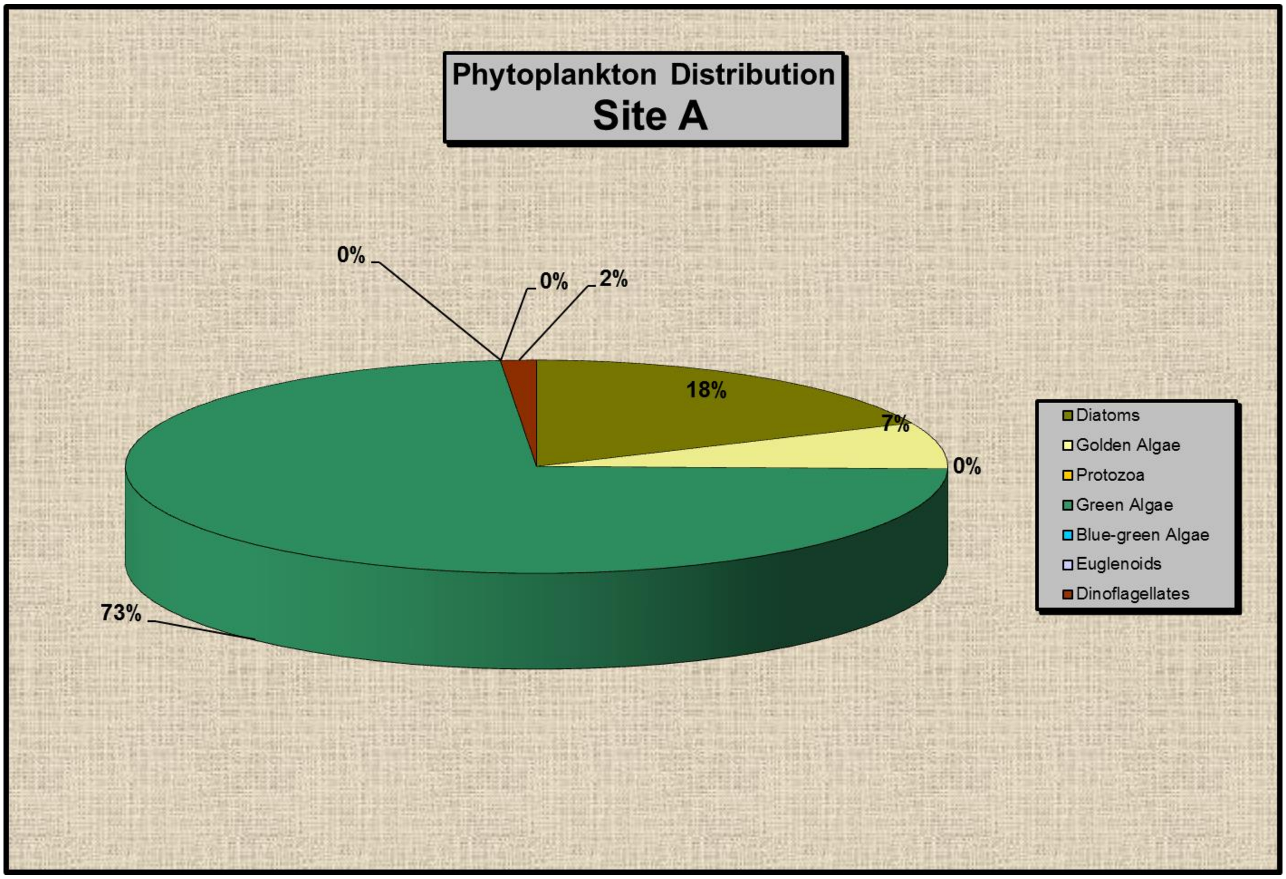
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium			
Peridinium	10	20	

SITE	**A**	**B**	**C**
TOTAL GENERA:	10	9	
TRANSPARENCY:	2’	2.5’	
ORGANISMS PER MILLILITER:	**710**	**570**	

NOTES: Algal density decreased significantly since the last sampling event. Algal density is now considered moderate at both sites. Algal diversity continues to be moderate at each site. The assemblage is dominated by the green algae *Sphaerocystis*. Diatoms and golden algae were observed. Traces of dinoflagellates were also observed at both sites. Water clarity decreased at both sites since the last sampling event and is


Phytoplankton Distribution
Site A
0%
0%
2%
18%
7%
0%
73%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates


Phytoplankton Distribution
Site A
0%
0%
2%
18%
7%
0%
73%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 7/31/15	Examination Date: 7/31/15	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Navicula		10	
Nitzschia			
Pinnularia			
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra	1250	1950	
Tabellaria			
Cocconeis			

CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**
Dinobryon			
Mallomonas	20	20	
Synura			
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	**A**	**B**	**C**
Ankistrodesmus		10	
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum			
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus			
Spirogyra			
Staurastrum			
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium			
Cosmerium			

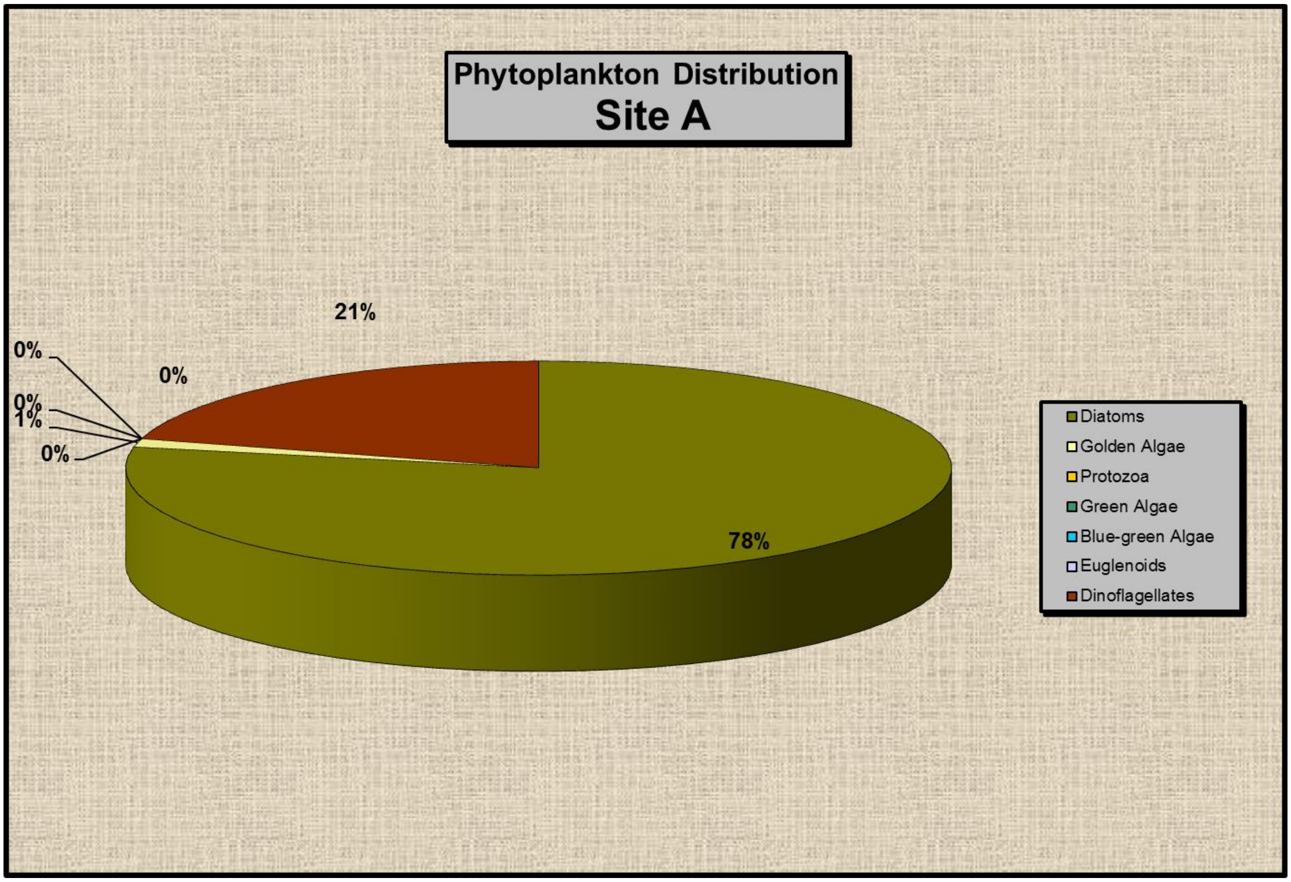
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			

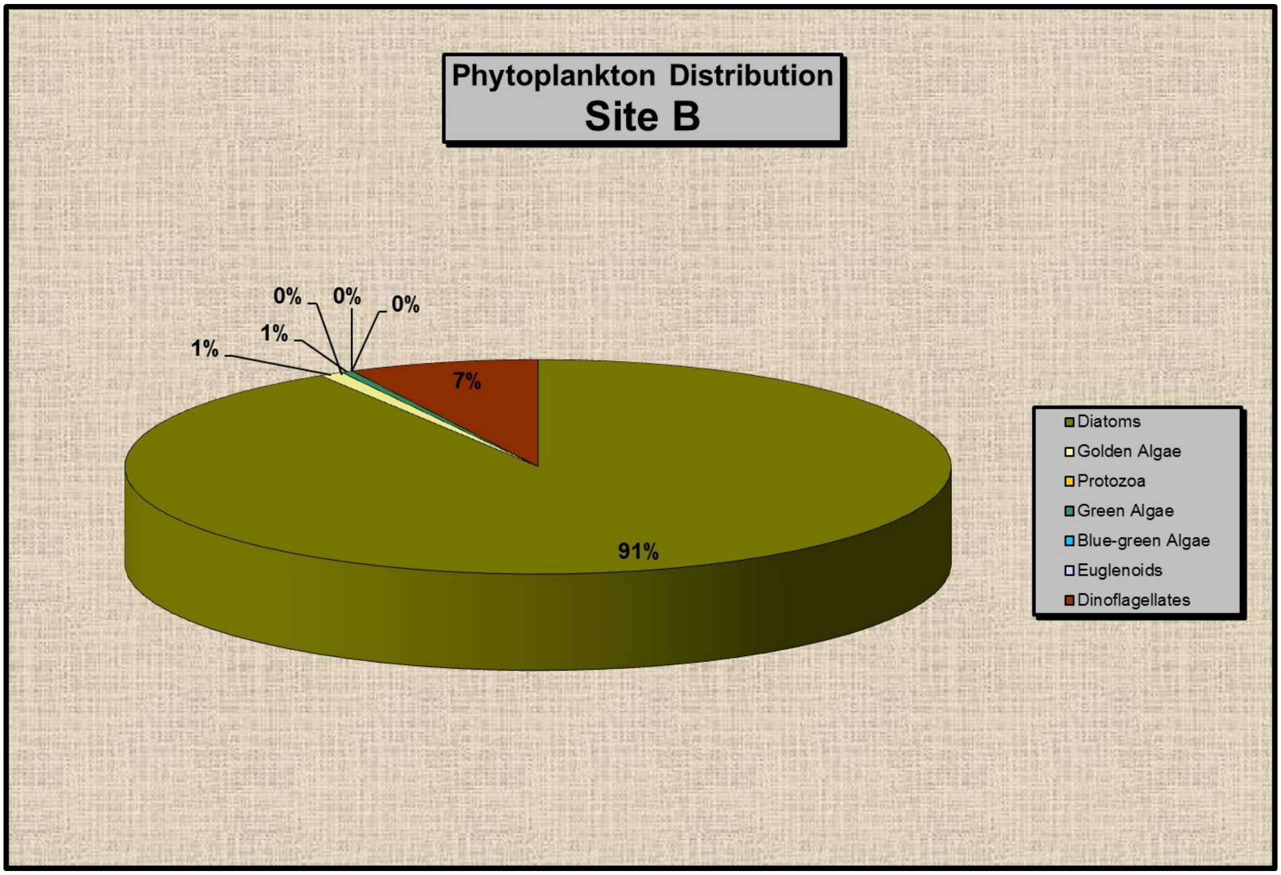
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium			
Peridinium	330	160	

SITE	**A**	**B**	**C**
TOTAL GENERA:	3	6	
TRANSPARENCY:	4'est	5'	
ORGANISMS PER MILLILITER:	**1,600**	**2,160**	

NOTES: Algal density increased at both sites and is now considered to be high. Algal diversity decreased at each site since the last sampling event. The algal diversity is now considered to be low at site A whereas site B is moderate. The assemblage is dominated by the diatom *Synedra*. Dinoflagellates and golden algae were also observed this week. Trace amounts of green algae were observed at site B only. Water clarity increased


Phytoplankton Distribution
Site A
21%
0%
0%
0%
1%
0%
78%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates


Phytoplankton Distribution
Site B
0%
0%
0%
1%
1%
7%
91%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

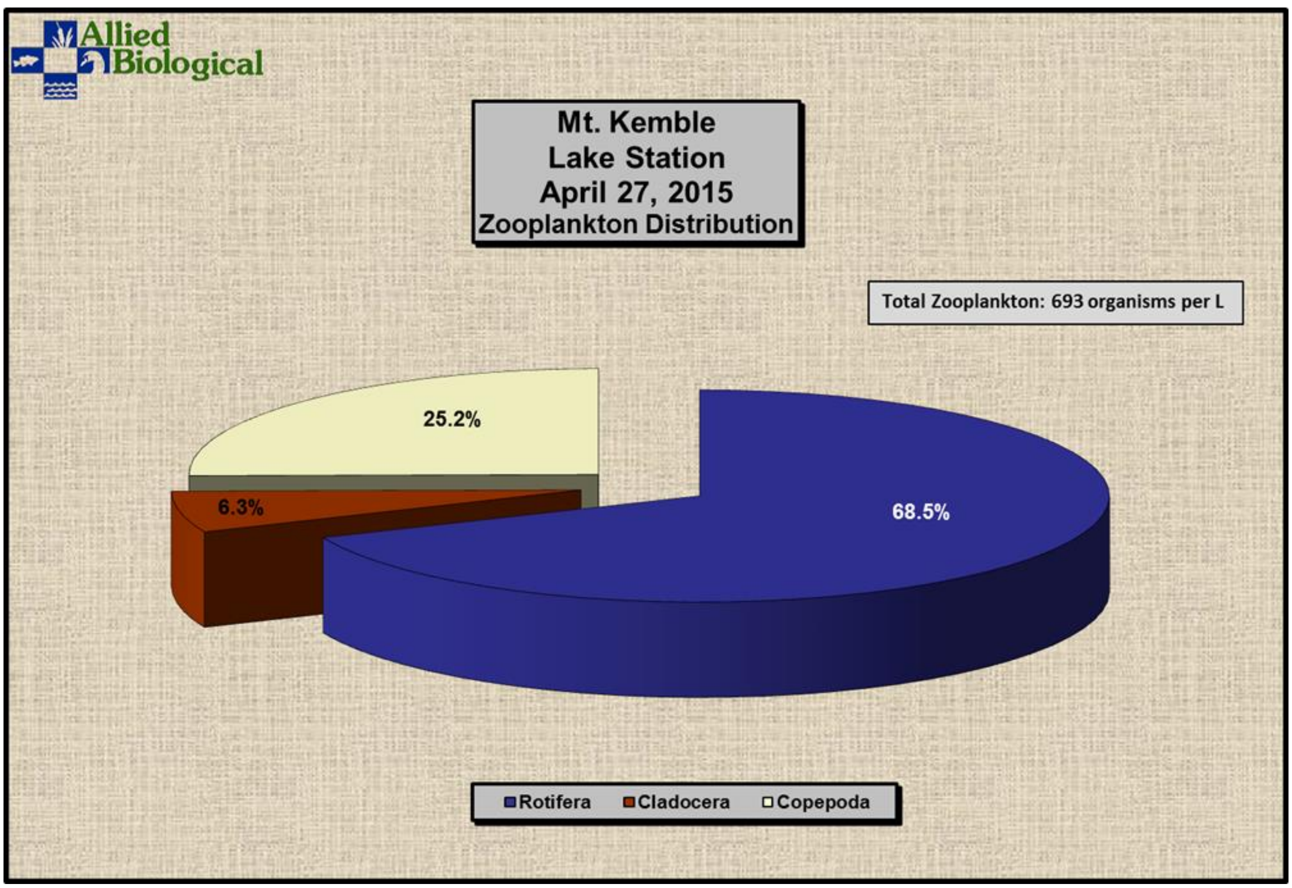
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

Zooplankton Count Results

Site: Mt. Kemble **Date: 4/27/15**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Keratella*	14	24	15	17.67	17667	68.8	257
			Kellicotta		3	1	1.33	1333	68.8	19
			Brachionus	6	6	7	6.33	6333	68.8	92
		Synchaetidae	*Polyarthra*	7	7	2	5.33	5333	68.8	78
		Asplanchnidae	*Asplanchna*		1	2	1.00	1000	68.8	15
		Testudinellidae	Filinia	1	1	1	1.00	1000	68.8	15
									Total:	**475**
Cladocera	**Cladocera**	Daphniidae	Bosmina		2	1	3.00	3000	68.8	44
									Total:	**44**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	7	11	12	10.00	10000	68.8	145
			Cyclopoidae	2			2.00	2000	68.8	29
									Total:	**174**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
693	475	68.5%	44	6.3%	174	25.2%

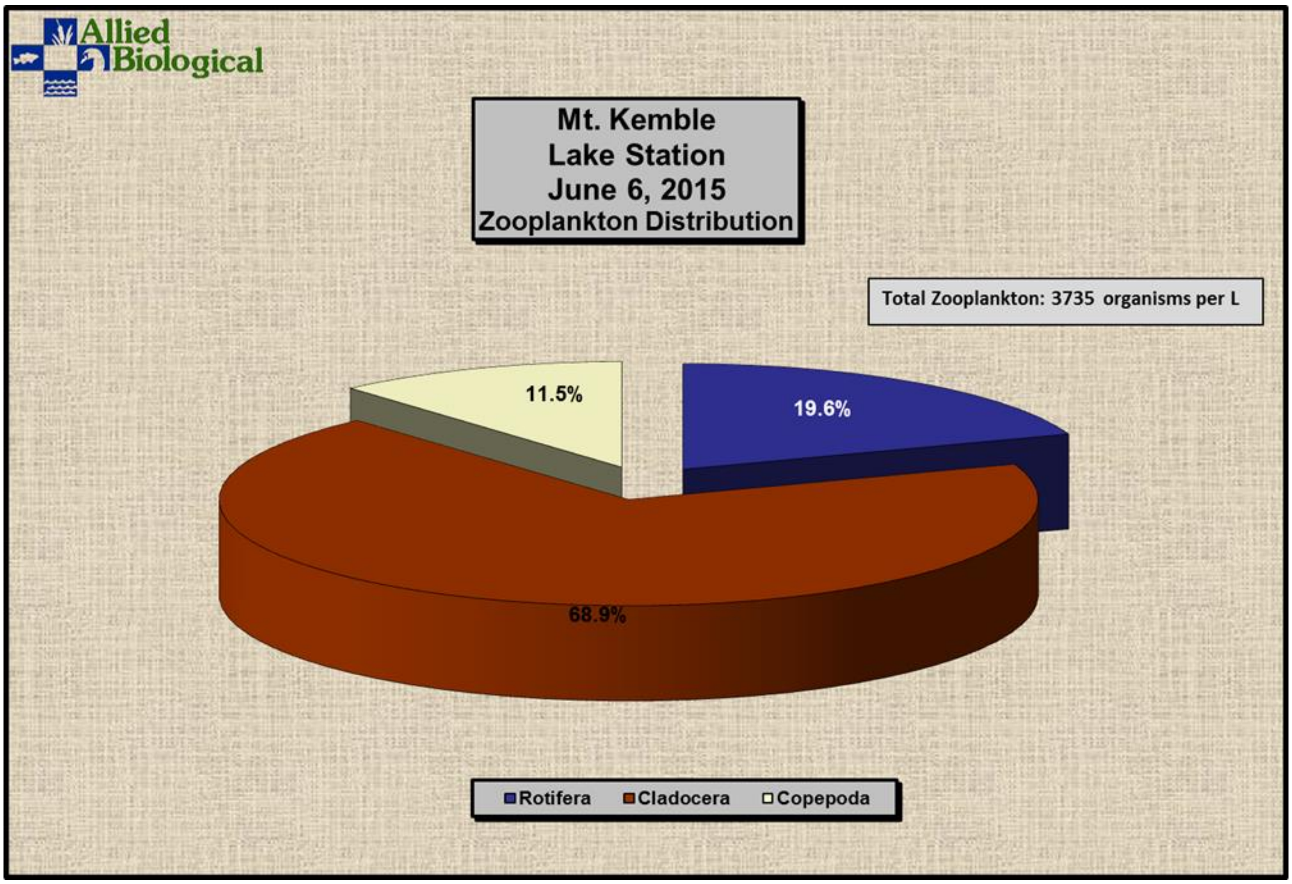


Zooplankton Count Results

Site: Mt. Kemble **Date: 6/5/15**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Keratella*	23	11	7	13.67	13667	68.8	199
			Kellicotta				0.00	0	68.8	0
			Brachionus				0.00	0	68.8	0
		Synchaetidae	*Polyarthra*	48	36	23	35.67	35667	68.8	518
		Asplanchnidae	*Asplanchna*				1.00	1000	68.8	15
		Testudinellidae	Filinia				0.00	0	68.8	0
									Total:	**732**
Cladocera	**Cladocera**	Daphniidae	Bosmina	64	68	45	177.00	177000	68.8	2573
									Total:	**2573**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	44	30	15	29.67	29667	68.8	431
			Cyclopoidae				0.00	0	68.8	0
									Total:	**431**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
3735	732	19.6%	2573	68.9%	431	11.5%

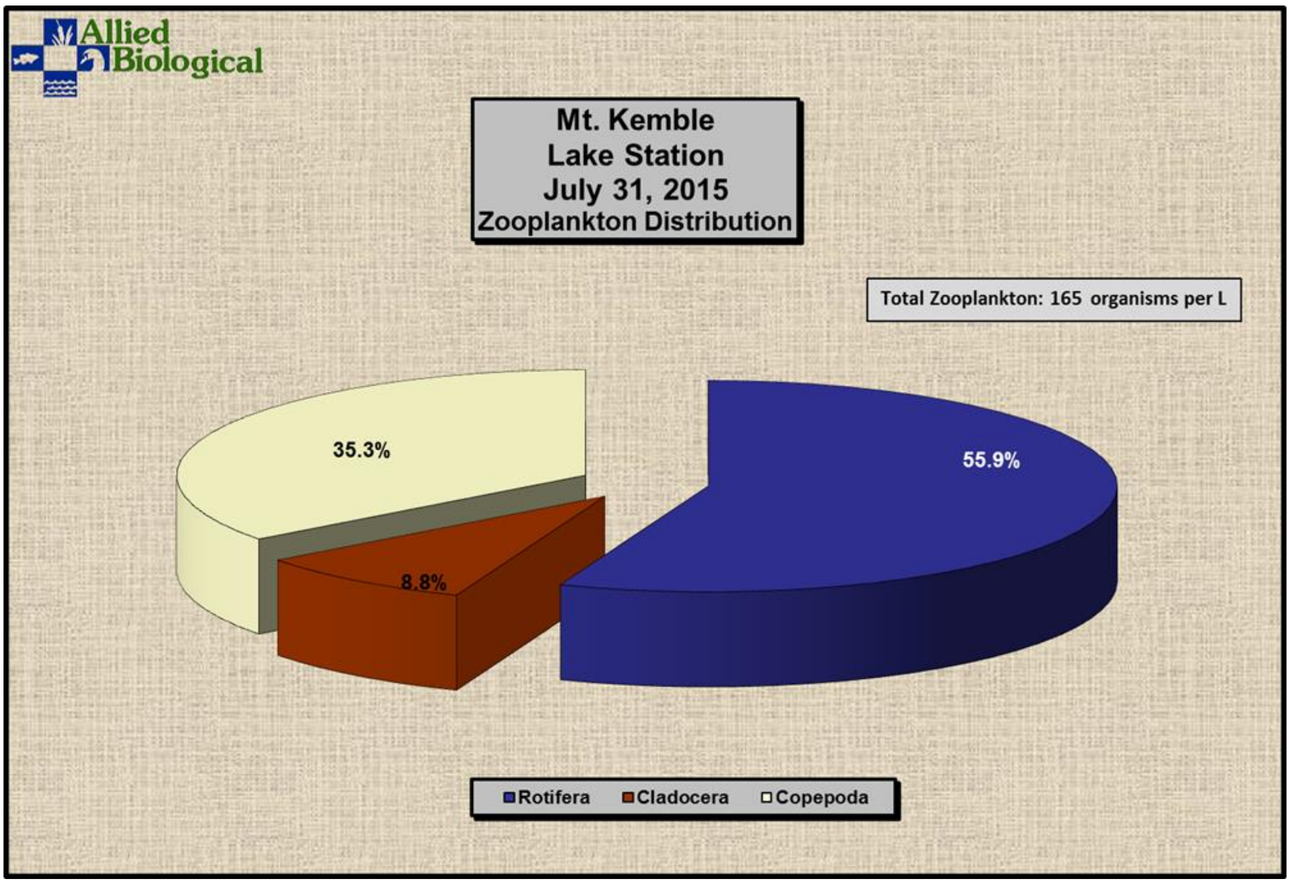


Zooplankton Count Results

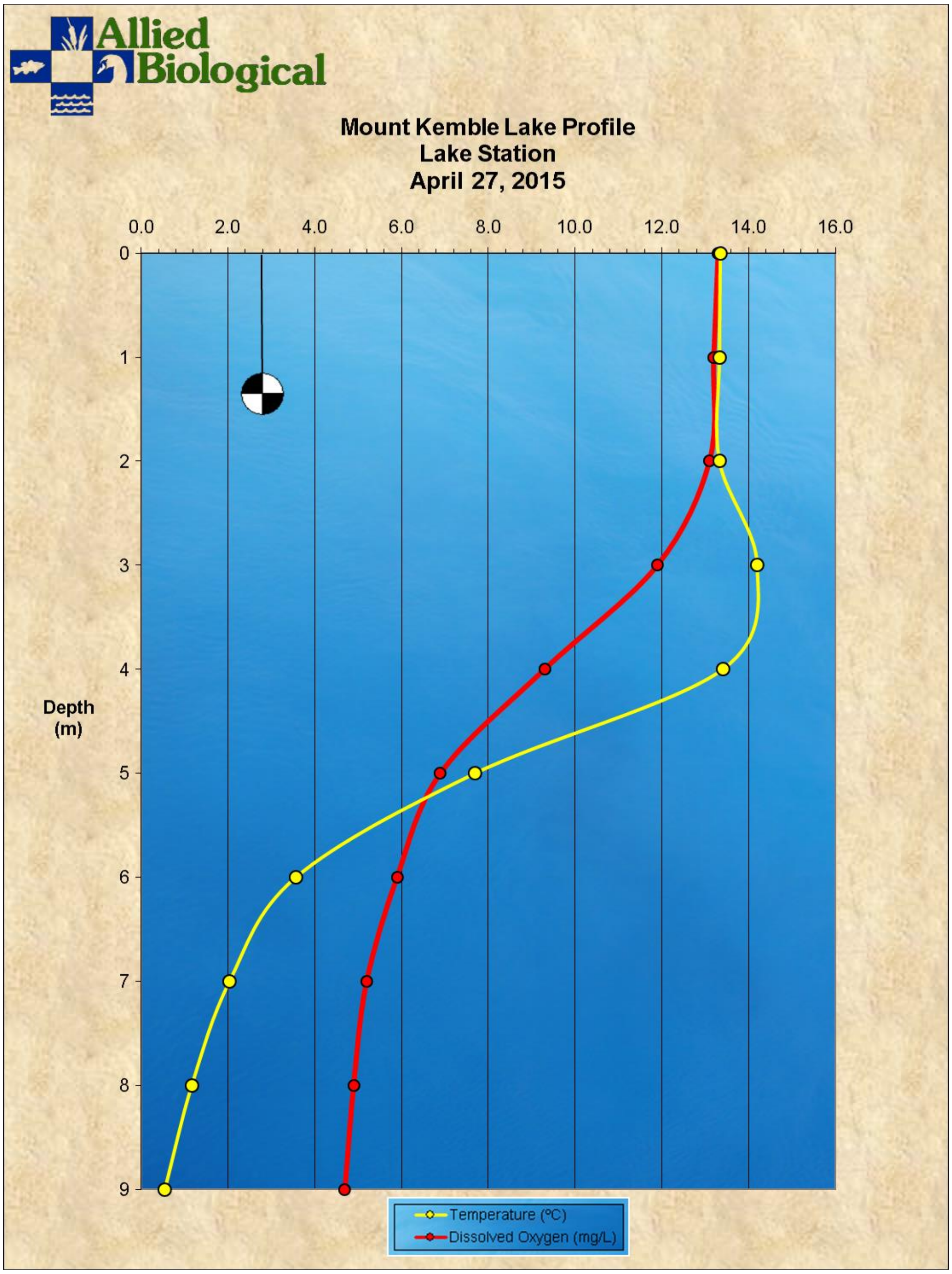
Site: Mt. Kemble **Date: 7/31/15**

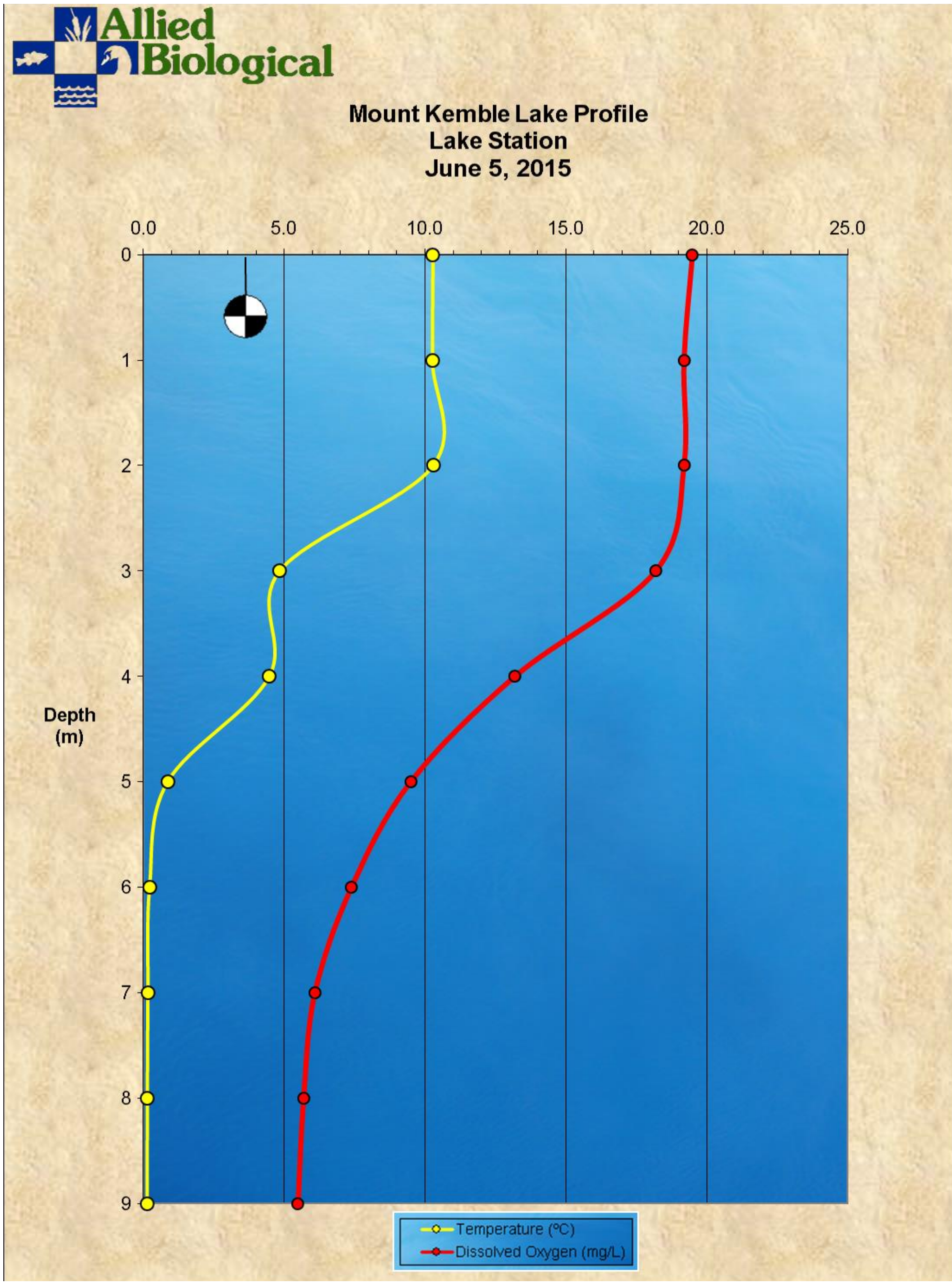
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Keratella*	4	2	2	2.67	2667	68.8	39
			Kellicotta				0.00	0	68.8	0
			Brachionus			5	1.67	1667	68.8	24
		Synchaetidae	*Polyarthra*	1	1	1	1.00	1000	68.8	15
		Asplanchnidae	*Asplanchna*				0.00	0	68.8	0
		Trichoceridae	Trichocerca	1			0.33	333	68.8	5
		Testudinellidae	Filinia	1	1		0.67	667	68.8	10
									Total:	**92**
Cladocera	**Cladocera**	Daphniidae	Bosmina		1		1.00	1000	68.8	15
									Total:	**15**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	3	3	6	4.00	4000	68.8	58
			Cyclopoidae				0.00	0	68.8	0
									Total:	**58**

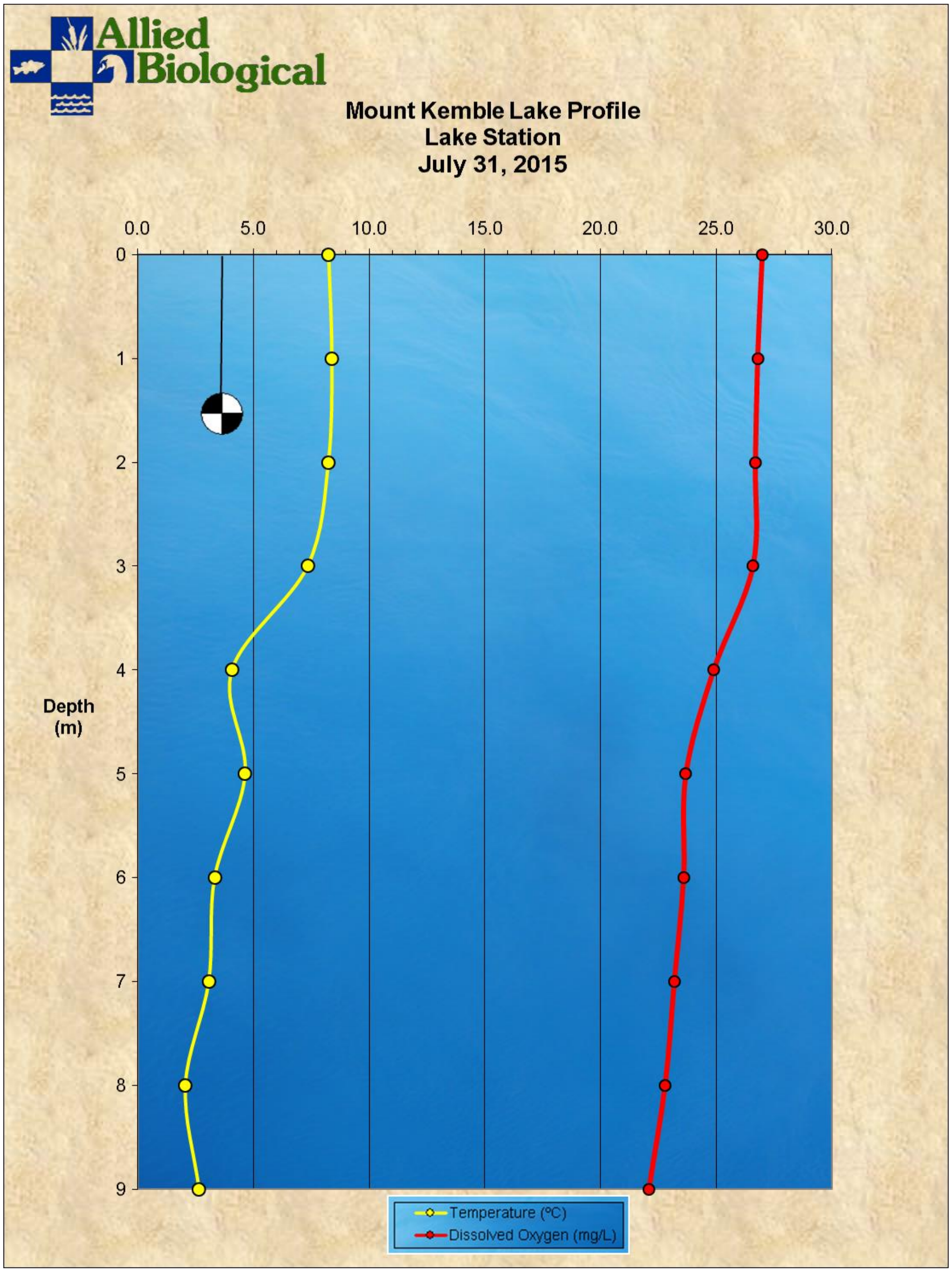
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
165	92	55.9%	15	8.8%	58	35.3%



APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES




Allied Biological
Mount Kemble Lake Profile
Lake Station
June 5, 2015
0.0
5.0
10.0
15.0
20.0
25.0
0
1
2
3
4
5
6
7
8
9
Depth (m)
Temperature (ºC)
Dissolved Oxygen (mg/L)


Allied Biological
Mount Kemble Lake Profile
Lake Station
July 31, 2015
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0
1
2
3
4
5
6
7
8
9
Depth (m)
Temperature (ºC)
Dissolved Oxygen (mg/L)

APPENDIX G: LAB DATA REPORTS

Order Information	
Allied Biological	
APL **Order ID :**	**5040712**
Site Name :	**Mt. Kemble Lake**
Date to Lab :	**04/27/2015 15:24**

Samples List

Field ID	Lab ID	Matrix
SOUTH STATION SURFACE	5040712-01	Lake
SOUTH STATION BOTTOM	5040712-02	Lake
NORTH STATION	5040712-03	Lake
OUTLET STATION	5040712-04	Lake
INLET STATION	5040712-05	Lake

Printing Options

Page Breaks Off

Turning **Page Breaks** on prints each sample on a new page.
Turning **Page Breaks** off prints the report on the minimum number of pages.

SOUTH STATION SURFACE	5040712-01	04/27/2015, 11:15	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	04/30/2015 17:39	1.00	341	umhos/cm	
Nitrate	EPA 300.0	04/28/2015 18:00	0.200	0.800	mg/L	10
Phosphorus Total	4500PE	05/06/2015 09:30	0.0100	0.0400	mg/L	
TSS	SM 2540D	05/01/2015 14:10	3.00	5.00	mg/L	

SOUTH STATION BOTTOM	5040712-02	04/27/2015, 11:25	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Ammonia	SM 4500 NH3 D	05/08/2015 12:00	0.200	0.300	mg/L	3
Conductivity	SM 2510B	04/30/2015 17:39	1.00	451	umhos/cm	
Nitrate	EPA 300.0	04/28/2015 18:00	0.200	0.700	mg/L	10
Phosphorus Total	4500PE	05/06/2015 09:30	0.0100	0.220	mg/L	
TSS	SM 2540D	05/01/2015 14:10	3.00	6.00	mg/L	

NORTH STATION	5040712-03	04/27/2015, 11:00	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit

Conductivity	SM 2510B	04/30/2015 17:39	1.00	348	umhos/cm	
Nitrate	EPA 300.0	04/28/2015 18:00	0.200	0.800	mg/L	10
Phosphorus Total	4500PE	05/06/2015 09:30	0.0100	0.0500	mg/L	
TSS	SM 2540D	05/01/2015 14:10	3.00	3.00	mg/L	

OUTLET STATION	5040712-04	04/27/2015, 12:15	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Phosphorus Total	4500PE	05/06/2015 09:30	0.0100	0.0500	mg/L	

INLET STATION	5040712-05	04/27/2015, 12:00	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Phosphorus Total	4500PE	05/06/2015 09:30	0.0100	0.0900	mg/L	

Order Information	
Allied Biological	
***APL* Order ID :**	**5060188**
Site Name :	**Mt. Kemble**
Date to Lab :	**06/05/2015 13:31**

Samples List

Field ID	Lab ID	Matrix
North Station	5060188-01	Lake
Lake Station	5060188-02	Lake
Bottom Sample	5060188-03	Lake

Printing Options

Page Breaks Off	Turning **Page Breaks** on prints each sample on a new page. Turning **Page Breaks** off prints the report on the minimum number of pages.

North Station	5060188-01	06/05/2015, 10:50	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	06/17/2015 16:00	1.00	301	umhos/cm	
Nitrate	EPA 300.0	06/05/2015 15:56	0.200	0.600	mg/L	10
Phosphorus Total	4500PE	06/22/2015 15:00	0.0100	0.0800	mg/L	
TSS	SM 2540D	06/12/2015 11:07	3.00	4.00	mg/L	

Lake Station	5060188-02	06/05/2015, 11:20	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	06/17/2015 16:00	1.00	333	umhos/cm	
Nitrate	EPA 300.0	06/05/2015 15:56	0.200	0.700	mg/L	10
Phosphorus Total	4500PE	06/22/2015 15:00	0.0100	0.150	mg/L	
TSS	SM 2540D	06/12/2015 11:07	3.00	4.00	mg/L	

Bottom Sample	5060188-03	06/05/2015, 11:25	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Ammonia	SM 4500 NH3 D	06/11/2015 10:00	0.200	0.790	mg/L	3
Conductivity	SM 2510B	06/17/2015 16:00	1.00	376	umhos/cm	
Nitrate	EPA 300.0	06/05/2015 15:56	0.200	0.600	mg/L	10
Phosphorus Total	4500PE	06/22/2015 15:00	0.0100	0.210	mg/L	
TSS	SM 2540D	06/12/2015 11:07	3.00	5.00	mg/L	

Order Information

Allied Biological

APL Order ID :	**5070990**
Site Name :	**MT KEMBLE**
Date to Lab :	**07/31/2015 11:50**

Samples List

Field ID	Lab ID	Matrix
NORTH STATION	5070990-01	Lake
SOUTH STATION SURFACE	5070990-02	Lake
SOUTH STATION BOTTOM	5070990-03	Lake

Printing Options

Page Breaks Off

Turning **Page Breaks** on prints each sample on a new page.
Turning **Page Breaks** off prints the report on the minimum number of pages.

NORTH STATION	5070990-01	07/31/2015, 10:55	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	08/14/2015 15:16	1.00	355	umhos/cm	
Phosphorus Total	4500PE	08/07/2015 09:30	0.0100	0.0400	mg/L	

SOUTH STATION SURFACE	5070990-02	07/31/2015, 09:57	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	08/14/2015 15:16	1.00	359	umhos/cm	
Phosphorus Total	4500PE	08/07/2015 09:30	0.0100	0.0300	mg/L	

SOUTH STATION BOTTOM	5070990-03	07/31/2015, 10:10	Lake

Click here to request additional or contingent analyses for this Sample ID.

Test	Method	Date Posted	MDL	Result	Units	Limit
Conductivity	SM 2510B	08/14/2015 15:16	1.00	371	umhos/cm	
Phosphorus Total	4500PE	08/07/2015 09:30	0.0100	0.0400	mg/L	