PHOSPHORUS INACTIVATION OF SURFICIAL SEDIMENT IN HINCKLEY'S POND, HARWICH, MASSACHUSETTS

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INTRODUCTION AND BACKGROUND

Hinckley's Pond is designated as a Great Pond and is situated in northwest Harwich (Figure 1), covering 174 acres to an average depth of 13 ft with a maximum depth of 28 ft. Pond volume is about 2,270 acre-feet, just under 100 million cubic feet or 2.8 million cubic meters. Detention time averages about 157 days, equating to replacement of the water in the pond about 2.3 times per year, a more rapid flushing rate than for many Cape Cod ponds.

Hinckley's Pond receives most of its water from Long Pond to the east via overflow that constitutes the start of the Herring River. Long Pond was treated with aluminum in 2008 and has exhibited desirable conditions ever since that time. Additional overland flow comes from Seymour Pond to the north, through a canal dug to connect the lakes and provide water for cranberry farming in the 1850s. There are two bogs adjacent to Hinckley's Pond, and these bogs have used water from the pond, particularly for fall harvest flooding, after which the water is returned to Hinckley's Pond. One of those bogs, the larger one on the east side of the pond, was taken out of service after the 2020 harvest and has been purchased as conservation land. The other bog, at the west end of the pond, is leased by a private landowner for cranberry farming but is part of a larger parcel, some of which has been donated as conservation land.

Most of the rest of the watershed is either low density residential land or water (Long and Seymour Ponds), although a portion of Cape Cod Regional Technical High School drains runoff to the pond through the Jenkins cranberry bog on the eastern side. Stormwater collection and treatment systems are minimal in this watershed, and a lot of runoff percolates into soil before reaching the pond, but evidence of stormwater inputs has been observed near the pond. Residential land is served by on-site Title 5 wastewater disposal systems.

The entire watershed covers about 2,422 acres, including 740-acre Long Pond and 182-acre Seymour Pond. The direct drainage area to Hinckley's Pond is about 190 acres. Groundwater inflowing to Hinckley's Pond has two main sources: the runoff that infiltrates into the land between the ponds (the 190-acre groundwater contribution zone for Hinckley's Pond alone) and subsurface flow that discharges from Long Pond and enters Hinckley's Pond. Groundwater flowing in the upper portion of the aquifer along the predominant northeast-southwest flow path will likely be captured by the much deeper Long Pond upgradient of Hinckley's Pond. Surface water overflow from Long Pond appears to be much greater than groundwater outseepage, but detailed quantification is lacking. It appears that surface water inflows are more important at Hinckley's Pond than most other kettlehole ponds on Cape Cod.

Hinckley's Pond has suffered impairment of uses including swimming and fish and wildlife habitat for about two decades as a consequence of algal blooms, many dominated by cyanobacteria. Phosphorus concentrations were excessive and the ratio of nitrogen to phosphorus is variable, with values in deeper water low enough to favor cyanobacteria during summer. Examination of available data and investigations to fill knowledge gaps revealed a high potential for internal phosphorus loading, which is recycling of previous phosphorus inputs from the watershed under low oxygen conditions. This is a common problem for Cape Cod ponds, which have been subject to agricultural and residential inputs for many decades. The inputs from any one year are not overwhelming, but a portion of each phosphorus input is incorporated into the sediment under the pond, mostly bound to iron or organic matter. The iron releases some of that phosphorus back into

Figure 1. Hinckley's Pond and immediate area in Harwich and Brewster, Massachusetts

overlying waters under low oxygen conditions, which are brought on by periodic thermal stratification resulting in inadequate mixing and elevated oxygen demand by the organic matter in the sediment. With enough release of iron-bound phosphorus, algal blooms are supported, and the normally low ratio of nitrogen to phosphorus associated with that release favors cyanobacteria.

Actions to improve the condition of Hinckley's Pond specifically seek to reduce the phosphorus concentration in the pond and raise the nitrogen to phosphorus ratio to discourage cyanobacteria blooms. A comparison of pond management alternatives was performed using the available data. From a technical perspective, examination of pond management alternatives suggested that the phosphorus concentration in Hinckley's Pond should be reduced by at least a third (from 30 µg/L to no more than 20 µg/L) to sufficiently lower the probability of nuisance algal blooms and achieve desirable water clarity. A reduction to 10 µg/L was preferred but may not be practical in light of current land uses and incoming water quality. Calculations indicate that a 90% reduction in the internal load would achieve more than the minimum reduction (reducing phosphorus by at least a third), and such a reduction could be obtained through treatment with aluminum, which binds phosphorus more permanently than iron. Reducing the internal load of phosphorus also helps raise the nitrogen to phosphorus ratio and discourage cyanobacteria blooms.

As a result of the analysis of the causes of water quality impairment in Hinckley's Pond an aluminum treatment was planned and supported by the Town of Harwich. Based on sediment features and laboratory assays, the prescribed dose was 108 g/m^2 over an area of 90 acres (36 hectares), the area of Hinckley's Pond deeper than 12 feet (3.6 meters, Figure 2). While a lesser dose may be adequate in shallower water, it was acknowledged that focusing of treated sediments into deeper water is likely, so the dose was set at 108 g/m^2 throughout the target treatment area.

The inactivation of internal phosphorus reserves will provide benefits for as long as it takes to replace those reserves and more aggressive watershed management could extent the benefits of the project. Other treatments of stratified ponds have provided benefits for an average of over 20 years, while shallower ponds have experienced improved conditions for more than a decade without additional management actions. Hinckley's Pond is likely to fall in between these two pond types, having weak to intermittent stratification, and the continued inputs from cranberry bogs appeared to represent the largest threat to water quality, at least prior to the cessation of cranberry farming on the eastern (Jenkins) bog. This report, however, focuses on the actual phosphorus inactivation treatment and follow up monitoring. An interim report was issued in February of 2020 based on monitoring through October 2019 and another was issued in late 2020 to include monitoring since 2019. This report updates and finalizes contracted monitoring through October 2021.

Figure 2. Hinckley's Pond target treatment area

ALUMINUM APPLICATION

SOLitude Lake Management conducted the aluminum sulfate/sodium aluminate application utilizing a custom-built barge with a subsurface injection system that allows for controlled application and proper mixing of liquid aluminum sulfate and sodium aluminate at variable boat speeds. The barge position was managed by a global positioning system that allows the operator to know where the vessel is and direct application within the target area in a precise manner. The treatment vessel was loaded with aluminum compounds at the end of James Road on the southeast side of the pond. Two large storage tanks for aluminum sulfate and aluminum sulfate were placed at the end of the road and filled from tanker trucks that arrived daily during treatment operations. The barge was loaded via flexible piping from those tanks in shallow water off the end of James Road. The treatment area was broken into 4 sections of 22.5 acres each (Figure 3) and the barge travelled on parallel paths along the short axis of each treatment section when applying the two aluminum compounds simultaneously (Figure 4).

SOLitude applied the aluminum sulfate and sodium aluminate at a ratio that maintained the pH between 6 and 8 (Appendix). There were some metering problems with the onboard pumps that resulted in more aluminum sulfate and less sodium aluminate being applied in many runs, and the ratio of the two compounds varied from the targeted 2:1 (alum to aluminate by volume) only nominally (area averages from 1.99 to 2.06 and grand average of 2.02, Table 1). Chemicals were simultaneously distributed by means of a dual manifold injection system at 2-3 m below the water surface to facilitate an active mixing zone, which was assessed visually with an underwater camera to be up to 20 feet, depending on water depth. Mixing was therefore almost complete over the water column in the treatment area.

The total dose of 108 g/m^2 was applied over the target area during 12 days over the period of September 10 through 25, 2019. Delivery and use of aluminum compounds over the treatment period and difficulty determining exactly how much chemical remained in each tank resulted in an excess of aluminum sulfate at the end of the 10th day of treatment on September 23rd. Consequently, more sodium aluminate was delivered on the 24th and 25th and the remaining chemical was applied on those dates, maintaining a ratio close to that desired. This last aluminum dose was applied in long runs parallel to the long axis of the treatment area, evening distribution among the delineated areas. The total volume of chemical applied was 77,643 gallons of aluminum sulfate and 38,488 gallons of sodium aluminate (Table 1), equating to a total aluminum load of 39,174 kg and an areal dose in the target zone of 108 g/m^2, exactly as specified.

DEMOBILIZATION AND SITE RESTORATION

The contractor removed all equipment related to the aluminum treatment within a week of the end of the treatment process. All disturbed upland areas were restored to their former conditions. The independent monitor inspected the property during the late October sampling and determined that SOLitude had properly vacated and restored that area. The staging and access area were in acceptable condition in spring and summer of 2020.

Figure 3. Hinckley's Pond treatment area division and monitoring stations

Figure 4. Hinckley's Pond treatment pattern

Table 1. Aluminum application to Hinckley's Pond, September 2019

Area	Acres	Required Quantity		Pass#	Applied Quantity		Ratio
		Alum	Soal		Alum	Soal	
A	22.5	19416	9708	1	4855	2410	2.01
				2	4862	2363	2.06
				3	4856	2377	2.04
				4	3857	1901	2.03
B	22.5	19416	9708	1	4856	2423	2.00
				2	4856	2418	2.01
				3	4856	2413	2.01
				4	4055	2021	2.01
C	22.5	19416	9708	1	4821	2395	2.01
				2	4870	2430	2.00
				3	4849	2394	2.03
				4	3856	1913	2.02
D	22.5	19416	9708	1	4809	2411	1.99
				2	4794	2380	2.01
				3	4844	2406	2.01
				4	3874	1936	2.00
EXTRA					3873	1897	2.04
Totals	90	77664	38832		77643	38488	**2.02**
Total Dose 108 g/m2				Four Passes of 27 g/m2			

MONITORING DURING TREATMENT

Monitoring was conducted by WRS as a separate contractor reporting to the Town of Harwich but contracted through SOLitude as part of the project contract process. This third-party monitor communicated with SOLitude and the Town as the project proceeded, aiding in rectifying any problems as determined from monitoring. High or low pH readings were reported to SOLitude for immediate adjustment, but such action was rarely necessary. There were some mechanical barge problems that resulted in downtime, but the treatment, when underway, went very smoothly almost all of the time.

WRS monitored pH, temperature, oxygen, conductivity, turbidity and chlorophyll-a at near surface, middle, and near bottom depths with field instruments at four locations (A, B, C and D in Figure 3) at least three times per day during treatment. Alkalinity samples were collected and assessed with a titration kit on shore after each monitoring run. Secchi transparency was assessed occasionally to track treatment progress with regard to water clarity. Data for the monitoring program during treatment are provided in tabular form in the Appendix but are summarized in Figures 5-12.

Additional observations were made in the treatment plume during the actual application of aluminum compounds. The main focus was on floc formation and pH during actual treatment. The application lead to excellent floc formation with uniform distribution of aluminum floc on the bottom in the target area with minimal drift outside the target area. Visual assessment with an underwater camera indicated that significant floc was found no farther than 100 feet outside the targeted zone and usually <50 feet, a remarkable achievement under what were often windy conditions. Desirable mixing and rapid settling of the floc are the primary factors in reduced drift.

The target pH was between 6 and 8 standard units, but the preferred range is between 6.5 and 7.5 to maximize treatment efficiency and minimize any water quality issues. Out of 161 discrete pH measurements recorded from the treatment plume, five were <6.0 (5.3, 3 at 5.8 and 5.9 on 9/16/19) and one was >8.0 (8.1 on 9/23/19). A total of 27 values (17%) were outside the range of 6.5-7.5 preferred during treatment but only 6 values were in a range of concern (<6 or >8) and only for a brief time. All values outside the 6.5-7.5 range were in the treatment plume, usually near the point of discharge, where mixing is not yet complete. In all cases with values outside the range of 6.5-7.5, the pH returned to within that range within a few minutes. The reason for pH deviation is almost always either incomplete mixing at the time of measurement or a shift in the ratio of the two aluminum chemicals induced by pump issues. The observed pH deviations represent no significant threat to the health of Hinckley's Pond.

Mixing during the treatment was substantial; there was no stratification prior to or during treatment. Considering available historic data from the PALS program from 2005 through 2018, it is common for Hinckley's Pond to destratify by early September. The pond is not deep enough to have strong thermal stratification and cooling temperatures combined with wind in late August of most years leads to mixing if stratification is present. Consequently, while measurements were collected from surface to bottom, there was very little vertical variation in any water quality feature and values for Figures 5-12 are reported as water column averages. Discrete values are reported in tabular form in the Appendix for those interested in that level of detail.

The average pH (Figure 5, vertical lines delineate treatment period) varied from 6.3 to 7.2 standard units during treatment, while the pH the day before treatment started, two days after treatment ended, and one month after treatment ended was 6.7 in each case. That variation induced by treatment is evident in Figure 5 but is minor from any ecological perspective. No stress on aquatic organisms would be expected and daily visual monitoring detected no unusual accumulations of stressed or dead organisms. A total of <10 dead fish were observed during the treatment process and there was no evidence that those fish were killed by the treatment. Most dead fish were large white suckers and similar specimens were found dead in the two weeks before treatment. There were many shells from dead mussels observed in shallow water prior to treatment and video transects were shot before and after treatment in five locations, with no evidence of any mortality from treatment. There was one area of viviparid snail shell accumulation noted after treatment that was not recorded prior to treatment, but the underwater video indicated no significant loss of viviparid snails in the pond after treatment.

Alkalinity was just over 4 mg/L prior to treatment and during the two monitoring events just after and a month after treatment ended (Figure 6). Alkalinity during treatment ranged from 3.8 to 6.0 mg/L, suggesting no significant change in alkalinity during treatment and no lasting effects. Given low alkalinity and the potential for change during treatment, the results are impressive.

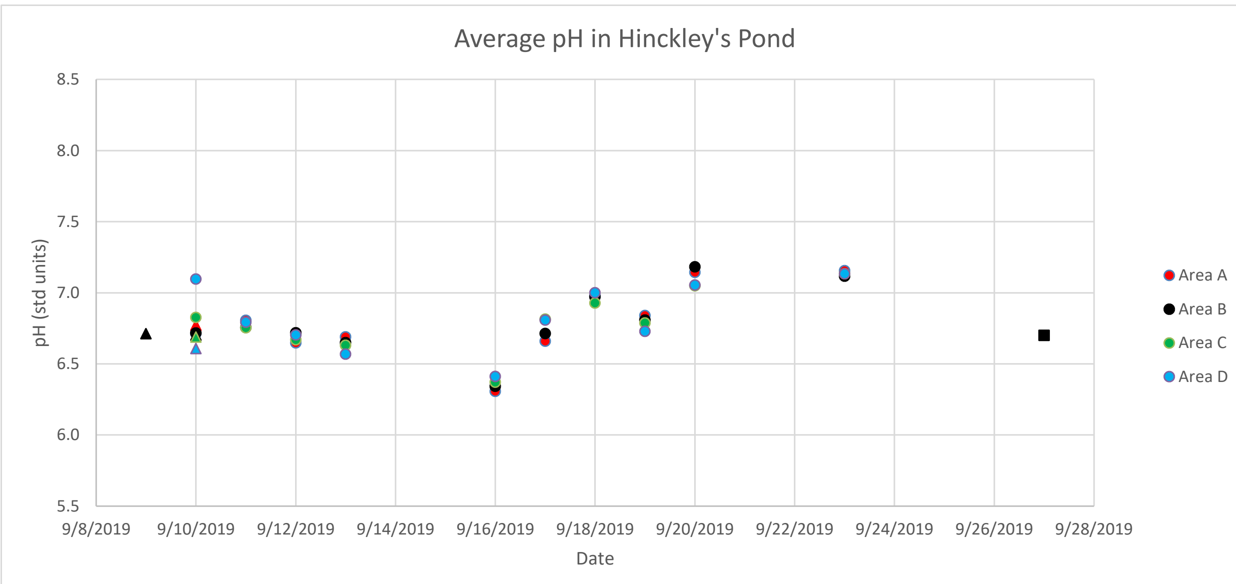

Figure 5. Average pH in Hinckley's Pond during treatment

The triangle-shaped markers represent one day or less before treatment while the square marker indicates the value two days after treatment was complete. This convention applies to Figures 5-12.

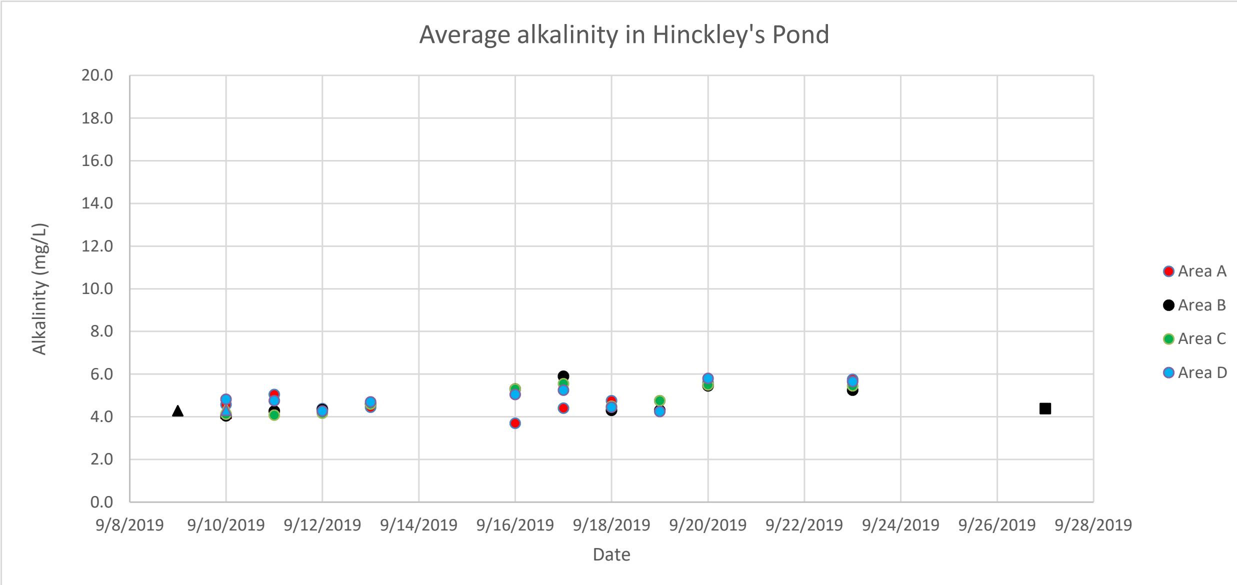

Figure 6. Average alkalinity in Hinckley's Pond during treatment

The average temperature was about 21 ^{o}C prior to treatment with very little vertical variation and declined slightly during treatment with the onset of cooler weather (Figure 7). The average temperature two days after treatment concluded was just under 20 ^{o}C and the average temperature a month later was about 14 ^{o}C. Dissolved oxygen was never low from the day before treatment through treatment and beyond (Figure 8). Hinckley's Pond is subject to low oxygen near the bottom for much of July and August, but it is common for it to be mixed and well oxygenated in September. No oxygen issues were noted as a result of treatment, with average values ranging from about 7.8 to 9.5 mg/L and none lower than the aquatic life support standard of 5 mg/L.

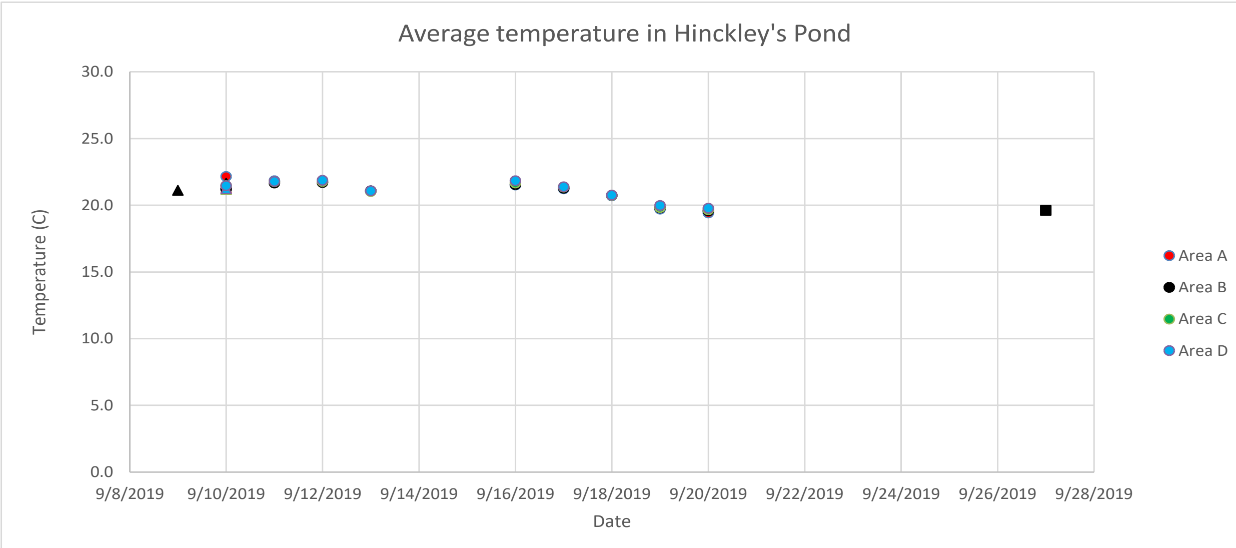

Figure 7. Average temperature in Hinckley's Pond during treatment

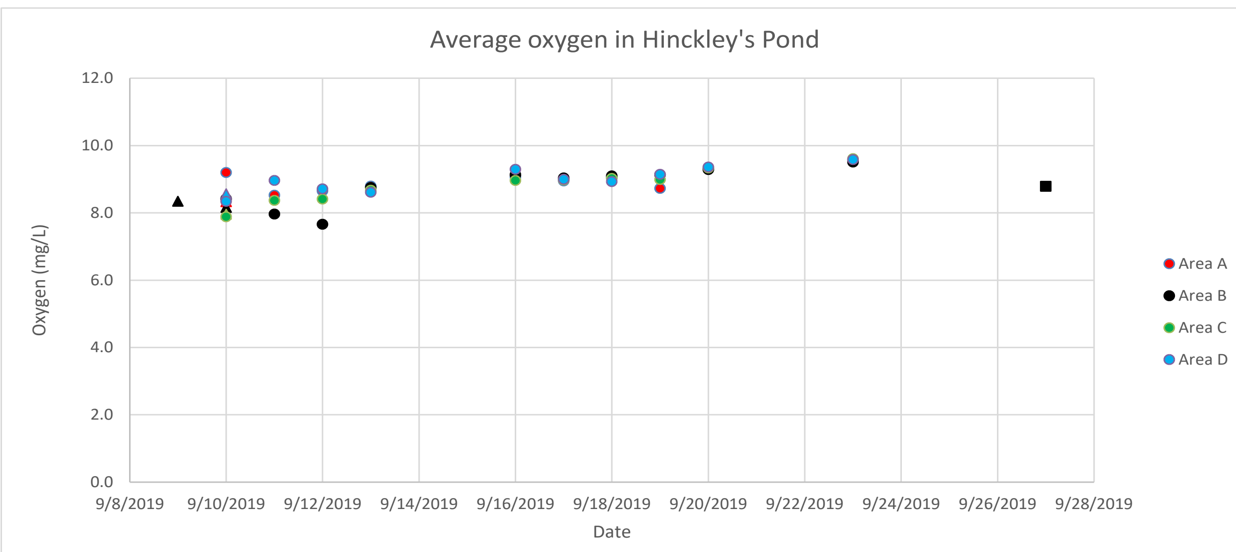

Figure 8. Average oxygen in Hinckley's Pond during treatment

Treatment adds aluminum that reacts and settles fairly quickly but also adds sulfate and sodium that remain in solution for a potentially long time, raising dissolved solids content. Conductivity, a measure of dissolved solids, rises during treatment and was expected to gradually decline as flushing reduced it to background levels. Typical of Cape Cod kettle ponds, Hinckley's Pond had an average conductivity of about 90 µS prior to treatment with minimal vertical or horizontal variation (Figure 9). That value rose steadily during treatment to about 150 µS with more variation as treatment occurred. The average value was about 147 µS two days after treatment and about 126 µS a month after treatment. Natural flushing of this pond returned conductivity to its normal level by spring 2020 and is discussed later in this report.

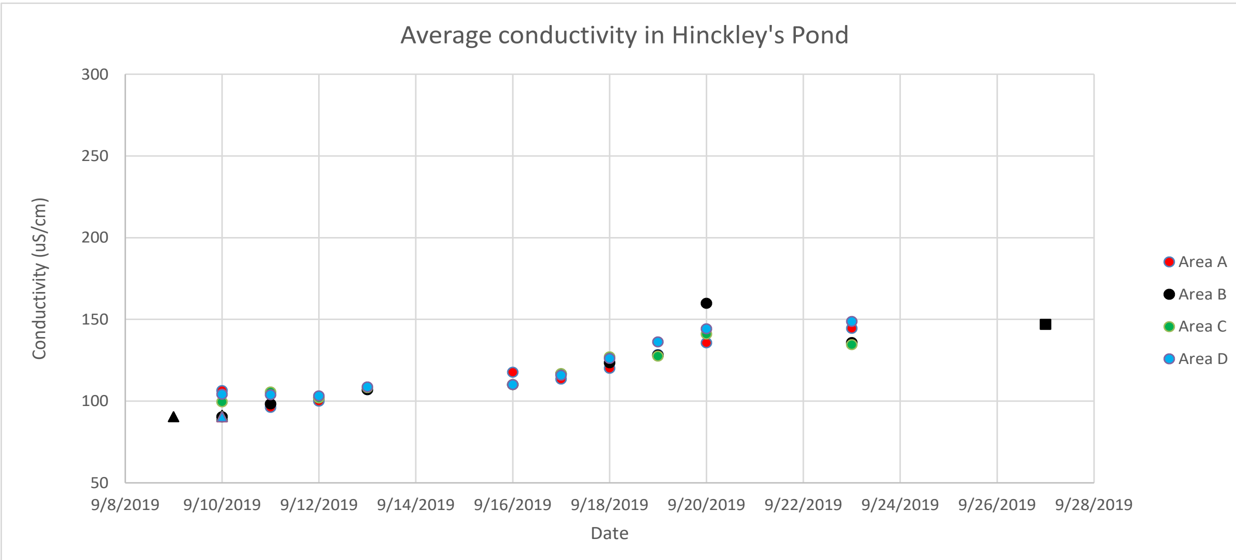

Figure 9. Average conductivity in Hinckley's Pond during treatment

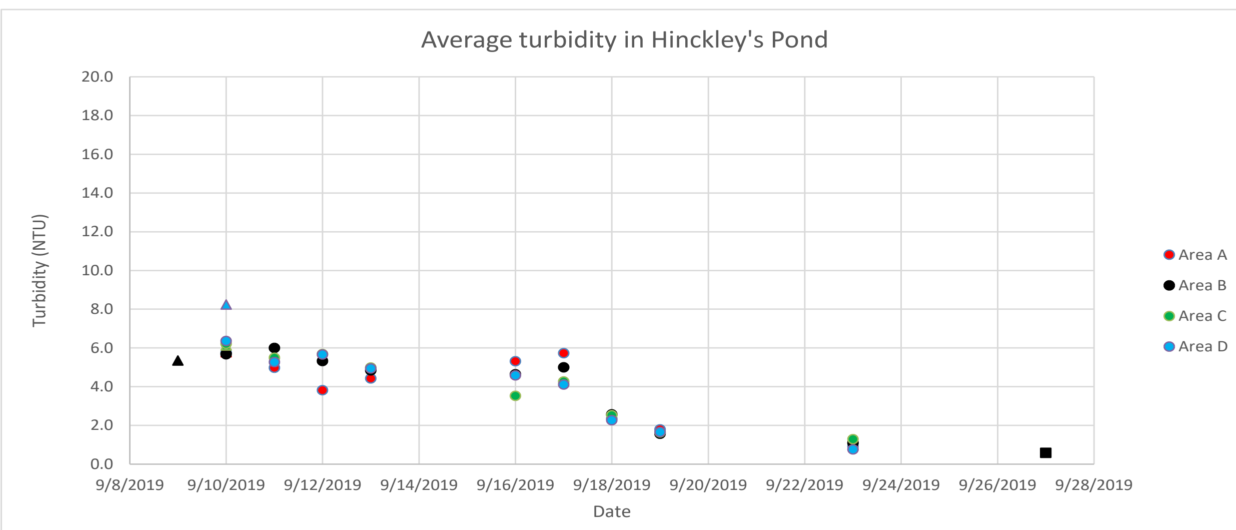

Figure 10. Average turbidity in Hinckley's Pond during treatment

Turbidity and chlorophyll-a, both controlled by algae in the water column, declined markedly over the treatment period (Figures 10 and 11) as the aluminum coagulated and settled out particles from the water column. The primary intent of the treatment is to inactivate phosphorus in the surficial sediment, but the application mode also strips phosphorus from the water column, including both particulate forms like algae and some of the dissolved phosphorus that may be in the water column after a summer of internal loading. The result was very clear water at the end of the treatment program (Figure 12), with Secchi transparency increasing from 2.5 to 6.4 m (from 8 to 21 feet).

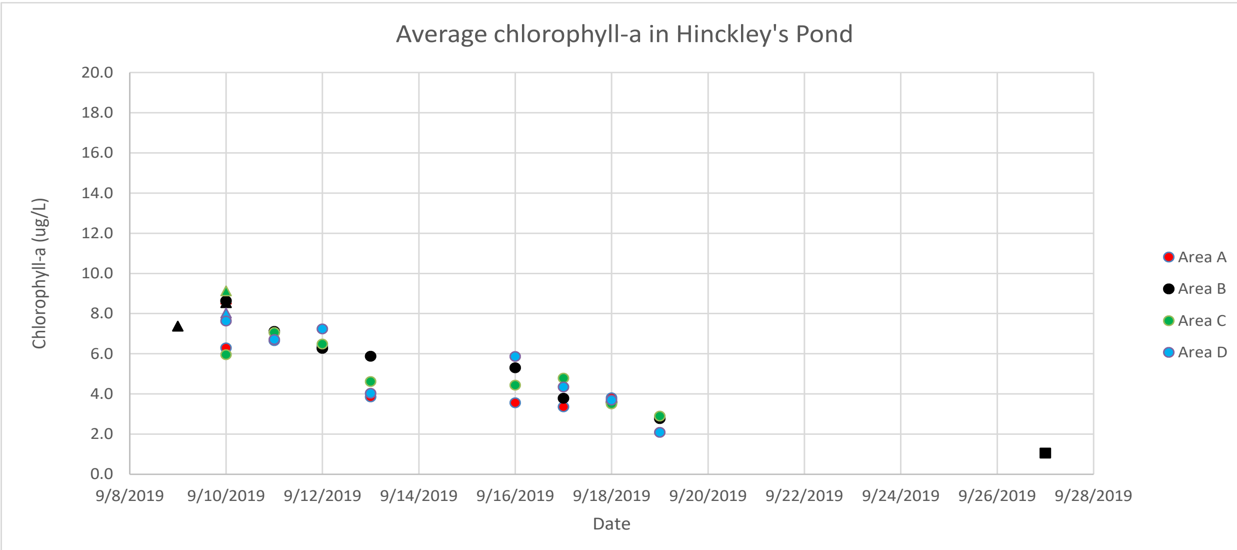

Figure 11. Average chlorophyll-a in Hinckley's Pond during treatment

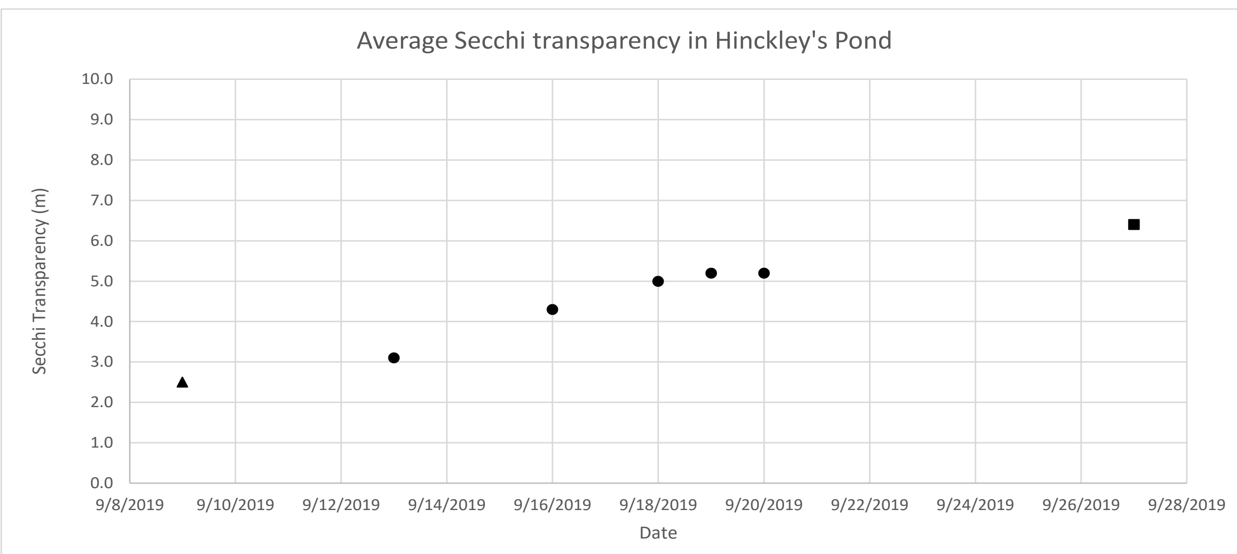

Figure 12. Average Secchi transparency in Hinckley's Pond during treatment

Aluminum ranged from 10 to 20 µg/L on September 9th, the day before treatment started. Values two days after treatment concluded were 25 to 78 µg/L, lower that usually observed for such treatments. By the late October sampling, just over a month after treatment ended, aluminum had declined to 10 to 13 µg/L, essentially at background levels (Appendix). No further aluminum sampling was conducted.

MONITORING BEFORE AND AFTER TREATMENT

Alkalinity in Hinckley's Pond is low (<10 mg/L), did not change much during treatment, and was not appreciably different through two years of monitoring post-treatment (Appendix). With low alkalinity the pH can fluctuate substantially in response to multiple influences, most notably elevated algae which remove carbon dioxide from the water during photosynthesis and cause the pH to rise. Inputs of water from upstream lakes (Long Pond and Seymour Pond) can also have an influence. The pH remained between 6.5 and 8.0 standard units, with the highest values obtained near the surface, indicative of algal influence. The pH appeared to become more stable over time and was close to neutral (7.0) much of 2021. No problems for aquatic health are indicated.

Conductivity was increased by treatment but returned to its background level by the May 2020 sampling as a consequence of natural flushing of the pond. Conductivity throughout the water column increased over the two summers of post-treatment monitoring, peaking at about 110 µS in surface waters in August, up from around 92 µS in May (Appendix) for all but the deepest location. Higher values were detected near the sediment-water interface with peak values of 145-199 µS in July of both 2020 and 2021. This suggests ongoing release of dissolved substances from the sediment, especially when oxygen is low. The aluminum treatment was intended to reduce the release of phosphorus but has little effect on many other compounds subject to release, such as iron or ammonium.

The thermal profile for Hinckley's Pond is variable among summers, as the pond is too shallow to strongly stratify and the weather pattern will dictate how much thermal gradient develops. No significant thermal gradient was detected except during the July samplings with top to bottom differentials of 4.6 C^o in 2020 and 7.2 C^o in 2021. That gradient corresponded to a complete loss of oxygen at the bottom, however, and may have allowed some release of phosphorus despite the treatment. Oxygen in July 2020 was <1 mg/L at depths >6 m but was 7.8 mg/L at 5 m of water depth. Oxygen in July 2021 was <1 mg/L at depths >7 m but was 4.3 mg/L at 6 m. Oxygen was also near 0 mg/L at >7 m in August of each year but considerably higher just a meter or two above the bottom. With relatively little thermal resistance to mixing this suggests a very strong oxygen demand by organic matter on the bottom in deeper water. The reactions that release iron-bound phosphorus when oxygen is low will be supported. The treatment was intended to transfer as much iron-bound phosphorus to aluminum as possible, with aluminum not dissociating under low oxygen, but some iron-bound phosphorus undoubtedly remains and is subject to release under these conditions. Oxygen during all other samplings was above the 2 mg/L threshold for water that is often associated with phosphorus release from the sediment below.

Phosphorus concentrations are best understood within the context of historical monitoring, which includes a town program with one to five monthly samplings per year, one of which is performed as part of the PALS program. Total phosphorus is assessed at multiple depths in the deepest part of the lake as with the WRS monitoring program. Values for the upper 4 m of the water column, 5-6 m depth increment, and water deeper than 6 m (Figure 13) indicate that total phosphorus concentrations have been elevated since at least 2005. The upper waters have averaged 28 µg/L, the mid-depth average was 50 µg/L, and the deep zone has averaged 72 µg/L for the 15 years prior to treatment, all elevated values capable of supporting algal blooms.

Monitoring of phosphorus was conducted at four depths (1, 3, 5 and 7 m) at a central station in Hinckley's Pond prior to treatment, just after treatment, one month after treatment in 2019, and monthly in May through October in 2020 and 2021. After treatment, total phosphorus for the first two post-treatment years averaged 17 µg/L in the upper 4 m of water column, 19 µg/L at 5 m and 25 µg/L at 7 m, representing declines of 39, 62 and 65% from respective pre-treatment conditions. Treatment stripped the water column of most phosphorus and is limiting release from sediments exposed to low oxygen. The concentration of phosphorus in Hinckley's Pond for the foreseeable future should be a function of the concentration in incoming water and any remaining internal loading. That should not be overly high for the inflow from Seymour Pond and Long Pond but can be quite high from the two cranberry bogs that discharged to Hinckley's Pond in the fall through 2020. Cessation of operations at the larger, eastern bog after 2020 should reduce loading to the pond.

The post-treatment pattern of phosphorus concentration does exhibit smaller spikes in phosphorus in deep water during summer (Figure 13, Appendix). There have also been substantial oscillations in phosphorus concentration at shallower depths. Aside from internal loading, it is also possible that there is some relationship to the alewife population, which brings nutrients to the pond in May and should remove some in the fall. In between, juveniles may be foraging in the sediment after depleting zooplankton resources, resulting in some movement of phosphorus into the overlying water. Some amount of lab error cannot be ruled out; the quality assurance samples were generally acceptable but there was some variation and even a slight error at low concentrations can make a difference.

There was another substantial increase in phosphorus reflected in the October samples. The bogs had been harvested and drained not long before the October sampling of 2020 and this is a distinctly likely source of additional phosphorus based on past study of this lake and these bogs. However, there was no major increase in 2019 between the treatment and the end of October, with bog harvest and discharge to Hinckley's Pond in between. Very little evidence of the harvest was apparent in late October 2019, while substantial numbers of cranberries and related leaves were observed along the shore of the pond in mid-October 2020. It is unclear if there had been any change in practice, but the impact was visually apparent in 2020. The larger, eastern bog was no active in 2021 and should not be the cause of the observed phosphorus increase that October.

Dissolved phosphorus was also measured by WRS (Appendix) in 2019 and 2020 and was generally low. Even before treatment, algal uptake of phosphorus converted most available phosphorus to particulate forms that would be measured as total phosphorus but not dissolved phosphorus. The Harwich/PALS program did not assess dissolved phosphorus, so we have little with which to compare recent values. Yet dissolved phosphorus just prior to treatment ranged from 9-19 µg/L while for the entire year after treatment dissolved phosphorus ranged from 5-7 µg/L, so the benefit from treatment is apparent.

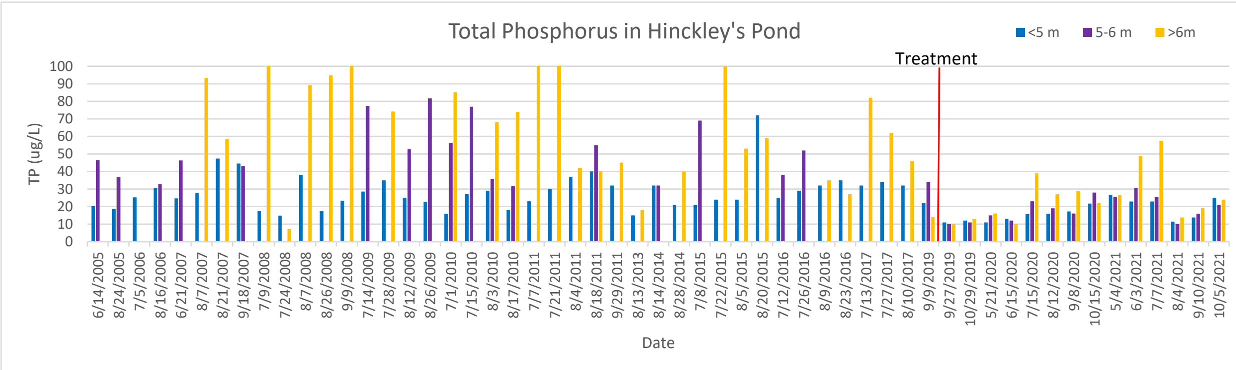

Figure 13. Total phosphorus in Hinckley's Pond, 2005-2021

Table 2. Mass of phosphorus in Hinckleys Pond

Date	P Mass (kg)	Vol Wtd TP (ug/L)
9/9/2019	63490	23.0
9/27/2019	28520	10.3
10/29/2019	33100	12.0
5/21/2020	32370	11.7
6/15/2020	35240	12.8
7/15/2020	50540	18.3
8/12/2020	48730	17.7
9/8/2020	49710	18.0
10/15/2020	64460	23.4
5/4/2021	72081	26.1
6/3/2021	70016	25.4
7/7/2021	68639	24.9
8/4/2021	30632	11.1
9/10/2021	39711	14.4
10/5/2021	68320	24.8

A useful exercise involves calculating the mass of phosphorus in Hinckley's Pond for each date for which we have a phosphorus profile. That profile only involves 4 depths, but we can multiply the phosphorus concentration for each defined depth stratum by the volume of that stratum and sum up the resulting mass estimates to get an idea of how phosphorus mass is changing over time. We can also divide that mass by the total pond volume to get a volume weighted phosphorus concentration that is more accurate than the simple average of the 4 measurements from each sampling date (Table 2).

The resulting estimates, while rough, suggest that the pre-treatment mass of phosphorus was 63,490 kg, equating to an average concentration of 23 µg/L. The treatment reduced the mass to 28,520 kg and an average concentration of 10.3 µg/L, a very desirable state. There was an increase to 33,100 kg by late October, raising the concentration to 12 µg/L, most likely related to inputs from the cranberry bogs. The October sampling was very late in the month, long after the bogs were drained, and the 16% increase is likely to represent a net increase from those discharges.

The mass was just slightly less in May 2020 and increased just a little in June 2020, but increased markedly to 50,540 kg in July, yielding an average concentration of 18.3 µg/L. This represents a 43% increase. The timing coincides with low oxygen in water >6 m deep, so internal loading is a possible source, but it also coincides with the time in which hungry juvenile alewife would be foraging in the sediment. The phosphorus mass remained similar in August and September 2020 but increased in October, potentially related to cranberry bog inputs. The volume-weighted phosphorus concentration in October was 23 µg/L, about what it was at the start of treatment in 2019.

The calculated phosphorus mass in May of 2021 was higher than in October 2020 and suggested a volume-weighted average phosphorus concentration of 26 µg/L. Phosphorus remained similar into July but was distinctly lower in August 2021, a more than 50% decrease. There was a slight increase in September, but the volume-weighted phosphorus concentrations were acceptably low at 11 and 14 µg/L in August and September, respectively. There was a major increase in early October 2021, back to May-July levels, but only one cranberry bog was discharging in 2021. The reasons for the large fluctuations in phosphorus, either as total mass or volume-weighted concentration, and not clear. However, much of the total phosphorus may be in forms unavailable to algae, so it is really the algal biomass that determines project success from the perspective of lake users.

Algal biomass was not extreme in 2020 or 2021 and did not include significant amounts of cyanobacteria. While the phosphorus mass balance progression illustrated here is disturbing, the results in terms of the algae community have as desired. Chlorophyll-a has been assessed by the Harwich/PALS program and WRS and offers a comparison for pre- and post-treatment data (Figure 14). From 2005 until treatment in September 2019, chlorophyll-a averaged 14 µg/L in the upper 4 m, 18 µg/L at 5-6 m, and 33 µg/L deeper than 6 m, all high values. The tendency for values to increase with depth suggests that most algae are being produced in deeper water where nutrient concentrations are higher, but light still penetrates enough to support growth. Although the average is lower, very high values are detected at the surface when those deep algae blooms, usually cyanobacteria, develop gas pockets in their cells and rise to the surface.

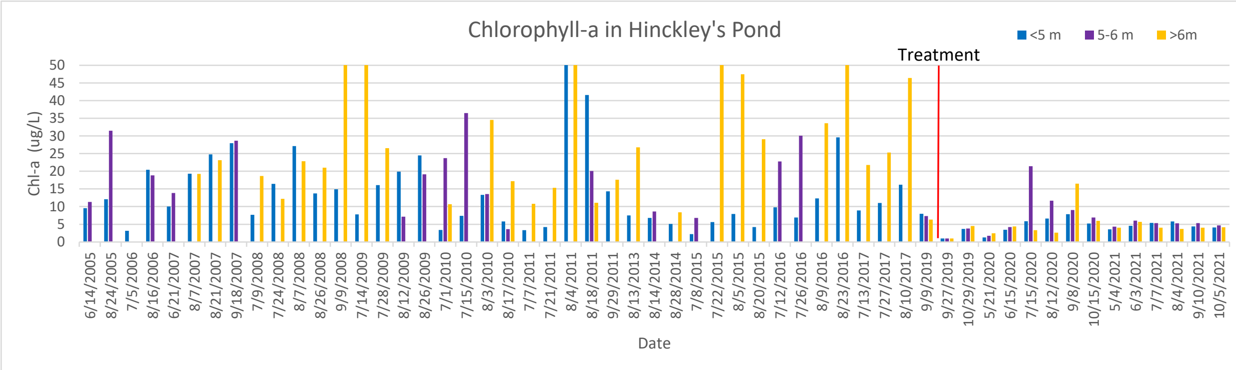

Figure 14. Chlorophyll-a in Hinckley's Pond, 2005-2021

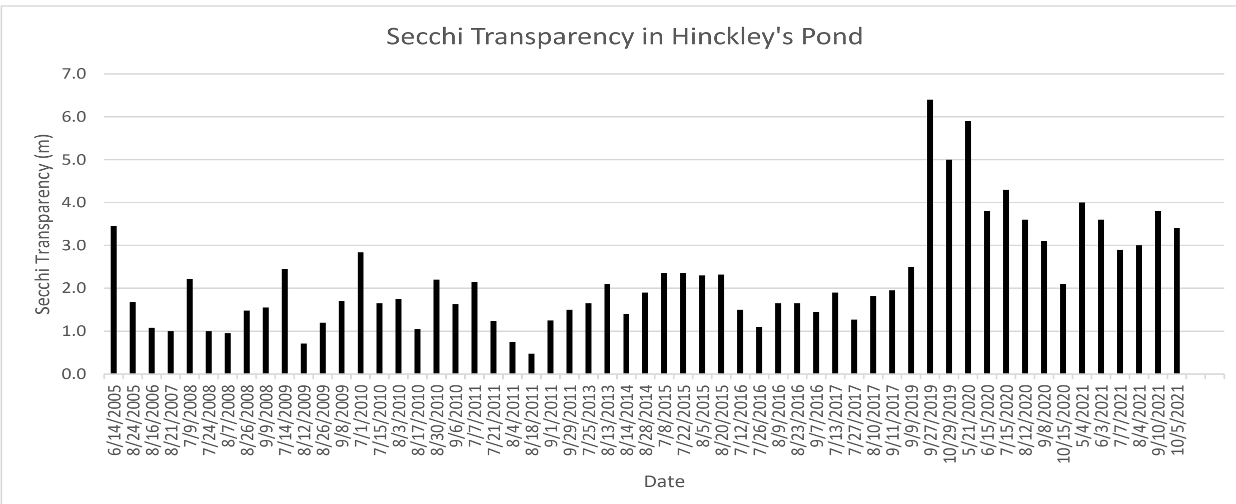

Figure 15. Secchi transparency in Hinckley's Pond, 2005-2021

The treatment was expected to prevent algae blooms from forming, particularly cyanobacteria. Chlorophyll-a was close to 1 µg/L at the end of treatment and increased to between 3.7 and 4.5 µg/L a month later. Monitoring in 2020 and 2021 revealed some increase in chlorophyll-a over the summer, but values remained much lower than pre-treatment (Figure 14). The average post-treatment concentration was 4.5 µg/L in the upper 4 m, 6.5 µg/L at 5 m and 4.7 µg/L at 7 m. Those are very favorable values compared to pre-treatment chlorophyll-a levels, suggesting a decrease of 64-86% and a move from clearly eutrophic to lower level mesotrophic status. There was a mid-depth peak in chlorophyll-a in July and to a lesser extent in August 2020, plus a deep zone peak in September 2020, suggesting the build-up of algae in an area usually indicative of either cyanobacteria or golden algae, both of which are known to employ non-surface growth strategies. Those peaks turned out to be golden algae, not cyanobacteria, and no such peak occurred in 2021.

Secchi transparency has been measured by the PALS and WRS monitoring programs and provides a useful comparison (Figure 15). From 2005 until the recent aluminum treatment, Secchi transparency averaged 1.6 m (5.3 feet), a low value that impairs recreation and aquatic habitat. The low clarity is almost entirely due to algae in the water column, often cyanobacteria during summer. Immediately before treatment the clarity was 2.5 m, one of the higher values noted in recent years, but clarity rose to 6.4 m at the end of treatment, with a steady increase as treatment proceeded and removed algae and other solids from the water column (Figure 12). However, a month later, after the cranberry bogs had released their harvest waters back into the pond, the clarity had declined to 5 m. This is still high clarity and the decline since treatment cannot be definitively attributed to the return water from the bogs, but the commensurate increase in chlorophyll is consistent with high nutrient inputs known to come from the bogs from previous study.

In May 2020 the clarity was 5.9 m, consistent with immediate post-treatment clarity. Zooplankton were abundant and phosphorus was low, leading to lower algae productivity and rapid consumption by zooplankton. By June the year's alewife population had hatched and zooplankton were greatly depressed in biomass and size. Phosphorus had not yet risen, but with no zooplankton to eat algae, biomass began to accumulate, and water clarity declined to 3.8 m. In July clarity increased slightly to 4.3 m, but the extra phosphorus and mid-depth algal accumulation was a concern. Clarity then decreased in successive August, September and October samplings, reaching 2.1 m in mid-October.

In 2021 the clarity was 4.0 m in early May with plenty of zooplankton but elevated phosphorus. Clarity declined into summer, reaching a low of 2.9 m in July and being only slightly higher at 3.0 m in August. Clarity increased to 3.8 m in September and was 3.4 m in October (Appendix, Figure 15). While still better than the pre-treatment average, the treatment was intended to maintain higher clarity than has been achieved routinely in Hinckley's Pond.

It should be noted that other lakes with alewife have been observed to experience a decline in clarity over the summer as there is just no grazing pressure on the algae and there is always some phosphorus available. Comparison between aluminum-treated lakes with and without alewife indicates that average post-treatment clarity in the non-alewife lakes is about 5 m while that of the alewife lakes is about 3.5 m. The average post-treatment clarity in Hinckley's Pond is 3.9 m to date, but for 2021 after time for the pond to reach a new equilibrium, the average clarity was 3.5 m, a match for the alewife lake average.

The most important aspect of treatment, however, is reduction in cyanobacteria, and all Cape Cod treatments have experienced decreases in cyanobacteria. In most cases cyanobacteria blooms have been absent after treatment, but even where cyanobacteria are still sometimes abundant, they are much less abundant than before treatment. Algae in the water column (phytoplankton) in Hinckley's Pond have undergone a dramatic shift in composition while zooplankton have remained scarce during summer.

Sporadic past assessment of phytoplankton has been conducted, enough to know that cyanobacteria often dominate during summer, but detailed assessment has not been consistently made. Zooplankton have rarely been assessed in the past but are an important component of the aquatic ecosystem and likely to be limited in Hinckley's Pond due to the summer presence of alewife young-of-the-year. Hinckley's Pond and upstream Long Pond are valued alewife nurseries, with adults arriving in late April and early May to lay eggs and the young living in the ponds until late summer or early fall. However, the filtering feeding mode of alewife limits zooplankton abundance in ponds that support these runs, limiting food for other small fish. Ecological tradeoffs are recognized.

Hinckley's Pond did indeed have few zooplankton in all but one sample (Figure 16, Appendix). Biomass values <50 µg/L are considered low and values <10 µg/L are minimal; the two pre-treatment samples had biomasses <10 µg/L. Just a few taxa were observed, including rotifers, copepods and cladocerans, but none were abundant. Average body size for all zooplankton was <0.33 mm and for crustacean zooplankton (the main fish food forms and most important grazers on algae) body length averaged <0.5 mm. This means that there is very limited zooplankton to support small fish and those present are tiny. It also means that there will be minimal grazing on algae in the water column. This is a typical consequence of having a juvenile alewife population in a pond.

The seasonal progression in such lakes often involves more and larger zooplankton over the winter and into the spring when alewife are absent from a pond, and that appears to be the case in Hinckley's Pond. Large bodied cladocerans, including *Daphnia* which are efficient filter feeders and desired food for small fish, were abundant and biomass was high (Figure 16, Appendix). Mean size was much higher as well (Figure 17, Appendix). Mean size was somewhat variable in 2020 and 2021 after treatment but is less relevant because biomass was so low after May when young alewife decimated the zooplankton community.

Treatment with aluminum can temporarily depress zooplankton populations, as zooplankters in the treatment zone may be caught in the floc and settled out of the water column. The biomass of zooplankton was extremely low two days after treatment, but the starting values were already so low that this does not represent an ecologically significant change. It is likely that the aluminum dose and associated floc would have removed zooplankton in the treatment zone, which covers about half the pond, but biomass had already begun to rebound a month later and copepods and cladocerans increased greatly by spring 2020 as is expected normally in this lake. The same pattern of elevated zooplankton biomass and mean size in early spring followed by great depression of biomass and variation in average length was again observed in 2021. Zooplankton community features in Hinckley's Pond are largely a function of alewife presence or absence.

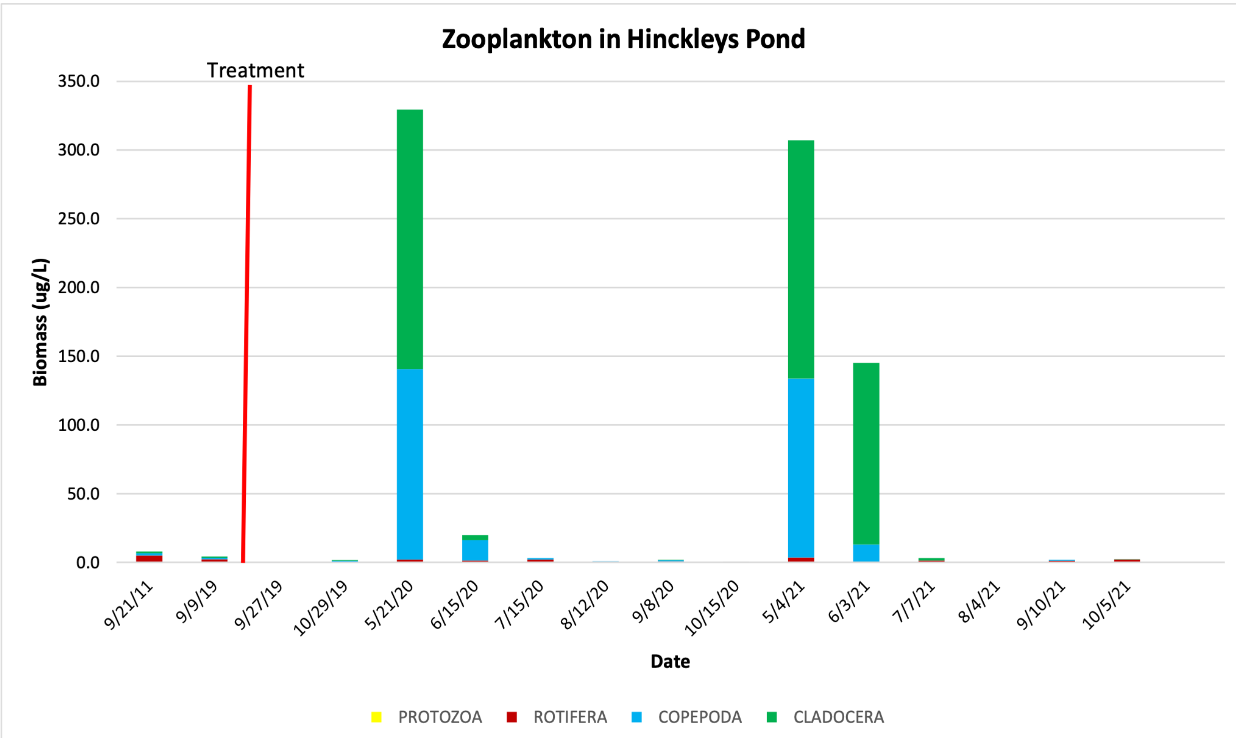

Figure 16. Zooplankton biomass in Hinckley's Pond

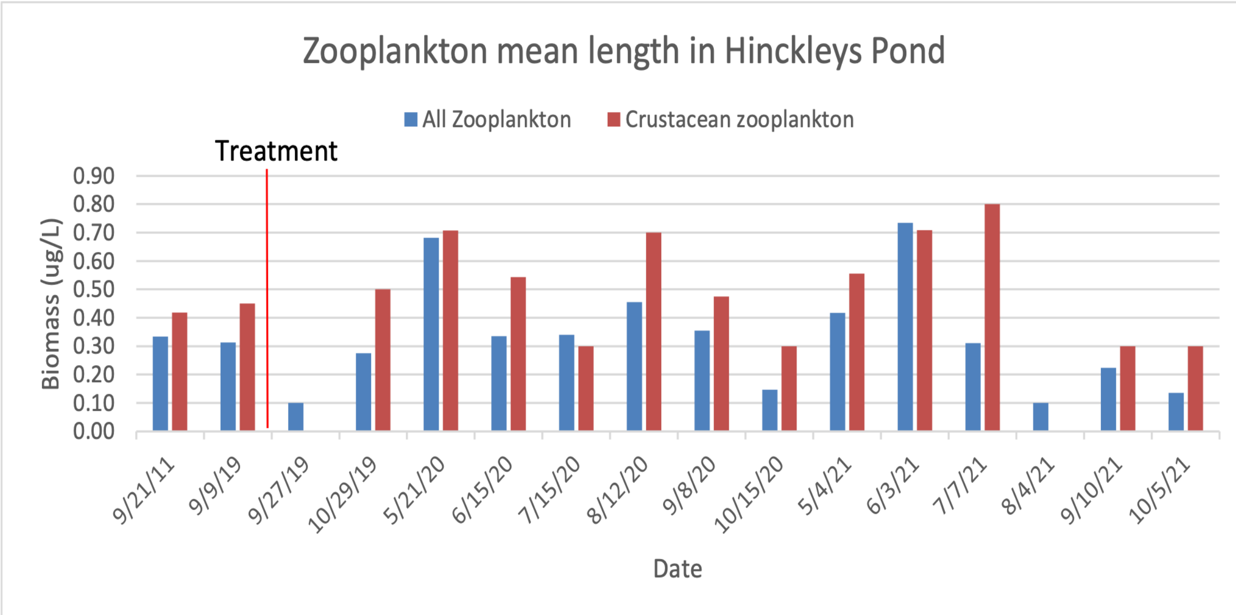

Figure 17. Zooplankton mean length in Hinckley's Pond

Hinckley's Pond suffered from summer cyanobacteria blooms for many years based on reliable observations, but relatively few phytoplankton samples have been analyzed. Three samples from 2011 (Figure 18, Appendix) illustrate what is believed to be the typical summer scenario for Hinckley's Pond, with cyanobacteria dominance grading into other algae later on. Dominant cyanobacteria included *Dolichospermum* (formerly *Anabaena*), *Aphanizomenon, Planktolyngbya* and *Pseudanabaena*, all possible toxin producers although no toxin testing results are known for this pond. Additionally, *Microcystis* and *Planktothrix*, also possible toxin producers, are known from Hinckley's Pond but were not found in 2011. Green algae that are sometimes abundant included mostly members of the orders Chlorellales and Sphaeropleales, all microscopic forms that discolor the water green. Diatoms, dinoflagellates and golden algae have all been abundant, usually in spring or late summer/fall. All three 2011 samples had elevated biomass; the biomass over which algae become objectionably abundant is about 3000 µg/L while values <1000 µg/L are considered low. Observations by WRS staff while on Cape Cod for other projects between 2012 and 2019 confirmed the frequency and severity of blooms in Hinckley's Pond, with blooms starting as early as June and continuing through the summer.

In 2019 a cyanobacteria bloom was reported in June, but conditions in August were much better than usual; the commonly problematic forms were present but not abundant (Appendix). The dinoflagellate *Peridinium* was abundant; this genus often achieves dominance after cyanobacteria blooms subside and organic content is high in the water column. Biomass in

August was <1000 µg/L but had risen to about 6500 µg/L in September just before the start of treatment.

Aluminum treatment usually clears the treatment zone of most phytoplankton and the treatment of Hinckley's Pond in September of 2019 resulted in very low phytoplankton abundance (Figure 17, Appendix). Biomass was <1000 µg/L in both post-treatment samples collected in 2019, with dinoflagellates and golden algae most abundant. Note that chlorophyll-a increased between the immediate post-treatment sample and one month later, while measured phytoplankton biomass declined; this is a minor discrepancy at the encountered levels of chlorophyll-a and algae biomass and may represent either measurement error or non-algal organic matter fluorescing like algae and giving a false positive for chlorophyll-a. With the discharge of organic matter-laden cranberry bog water in October 2019, the latter is a logical explanation, but all values were considered low.

Diatoms, golden algae and dinoflagellates were the most abundant groups in 2020 and 2021. Very small amounts of *Dolichospermum, Planktolyngbya* and *Pseudanabaena* were detected whereas these and other cyanobacteria were dominant in many pre-treatment summers. With regard to algal composition, the 2019 treatment of Hinckley's Pond was a major success, at least through 2021. Biomasses from samples do not always match up well with water clarity. Some of the discrepancy relates to clarity being a function of particle size and not just particle abundance, and the range of algal particle size is large. Also, there are other sources of turbidity and reduced clarity, particularly after the bogs discharged to the lake in October 2020.

Clarity has increased post-treatment and cyanobacteria have been minimized, such that Hinckley's Pond now supplies conditions that meet its intended uses. Recreational use of the pond has increased and users report much greater satisfaction for swimming, boating and fishing.

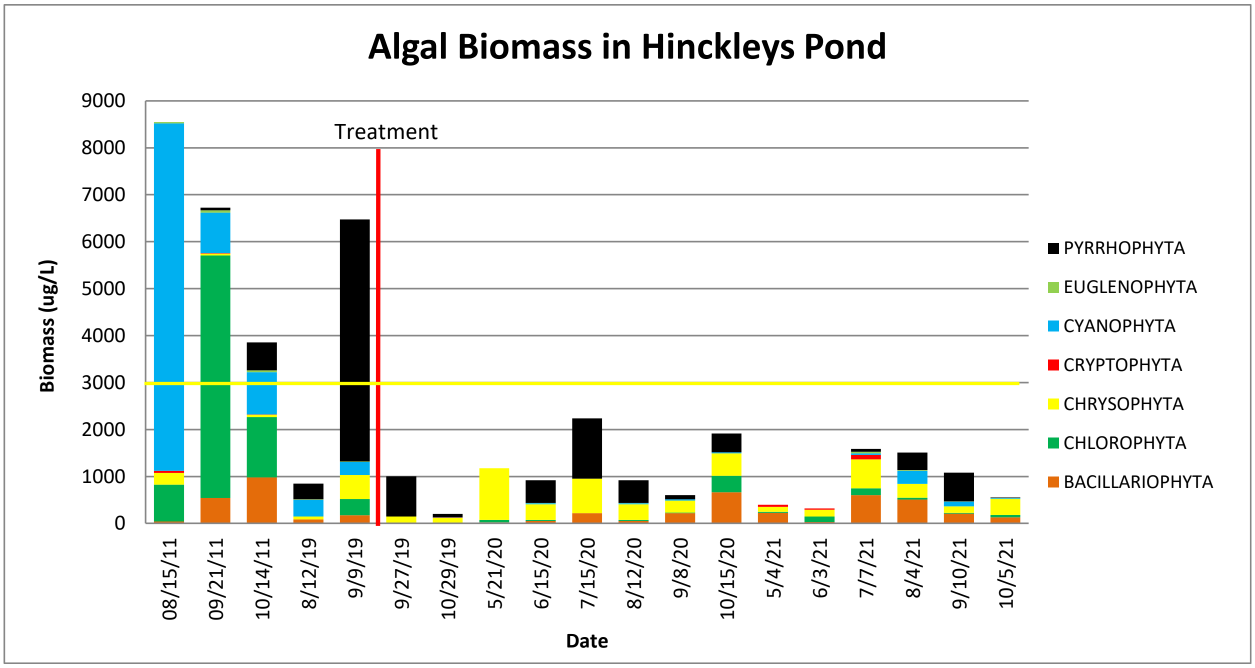

Figure 18. Phytoplankton biomass in Hinckley's Pond

ADDITIONAL ISSUES

The potential impact of the cranberry bogs has been discussed in this report and is not a new issue. The 2011 report quantified the impact and found that while the input of nutrients and organic matter was not overwhelming in any one year, the annual loading was a potent long-term factor in low oxygen and internal phosphorus loading. Management practices for cranberry bogs have changed drastically over the past 3-4 decades, but we have no knowledge of the management details relating to the two bogs that withdraw and discharge water to Hinckley's Pond. Given their collective area relative to the lake, the influence is expected to be substantial over a period of years, and the longevity of treatment results may depend to a large degree on implementation of best management practices for the bogs.

The primary hint that there was an unduly high level of current impact was the presence of many cranberries and associated leaf and stem debris along shore after harvest in 2020. Proper filtration of discharge water from the bogs would not result in so much large organic matter. A thorough review of practices at the bogs, possibly involving the Cranberry Experiment Station, was advised in interim reports. However, the larger, eastern (Jenkins) bog has been taken out of service and is being purchased as conservation land as of 2021. This is a major development that should benefit Hinckley's Pond, depending on what the land is used for in the future. Restoration to a more natural wetland system is under consideration and would be highly desirable from a pond management perspective.

Disposition of the western bog deserves some community discussion. The owners are conservation minded and have taken steps to preserve the natural state of much of their land in this area. The bog itself is leased to a grower but its ongoing viability as a cranberry production bog is uncertain. Reducing its discharge to Hinckley's Pond would also be desirable.

While this project focused on water quality and related conditions within Hinckley's Pond, observations are routinely made during field trips of any condition of interest around the pond as well. One observation involves invasive species. Purple loosestrife (Lythrum salicaria) is proliferating along the shore, mostly between Panorama Point Road and the closest point of the pond to Rt 124, but with a few scattered locations elsewhere along the shore. It is not yet very dense and could be hand-pulled if action is taken soon. A control program for this species is recommended.

SUMMARY AND CONCLUSIONS

Hinckley's Pond has suffered from blooms of cyanobacteria and other algae for many years with internal release of phosphorus from organic sediment determined to be a major factor in supporting those blooms. As a result, an aluminum treatment was conducted over the 90 acres of the pond under which organic sediment rich in available phosphorus was detected. The dose was 108 g/m^2 with simultaneous application of aluminum sulfate and sodium aluminate at approximately a 2:1 ratio by volume in four installments of 27 g/m^2 each between September 10th and 25th of 2019. Hinckley's Pond was not thermally stratified over the period of treatment, clarity at the start was moderate at 2.5 m, and cyanobacteria were not dominant. No die-off of fish or shellfish was observed during treatment and no distressed organisms were detected.

Water clarity increased to 6.4 m by the end of treatment with commensurate decreases in phytoplankton, chlorophyll-a and turbidity. No decrease in oxygen was measured. While the pH fluctuated slightly during treatment, it remained between 6 and 8 and returned to the pre-treatment value of 6.7 standard units within two days after treatment. After treatment, the pH was within the range accepted in Massachusetts for fish and wildlife protection and propagation for the two years of monitoring covered in this report. Conductivity increased from about 90 to 150 µS as a result of residual sulfate and sodium in the water column following treatment and declined to 90 µS again by May 2020 as a result of normal flushing of the pond. Conductivity near the bottom in water >7 m deep is elevated during summer and most of the water column reaches conductivity of about 110 µS by October, a likely indication of ongoing movement of substances from sediment into water under low oxygen conditions that continue to occur in July and August. Aluminum was minimally elevated in the water column at the end of treatment and returned to barely detectable concentrations one month after treatment.

Phosphorus in the water column decreased from a range of 14 to 34 µg/L just prior to treatment to 10 to 13 µg/L through one month post-treatment. Phosphorus concentrations remained low in May and June 2020 but increased in July, coincident with low oxygen in water >6 m deep and an increase in conductivity near the bottom, signaling sediment-water interactions and possible phosphorus release. However, this is also the timeframe over which young alewife deplete zooplankton resources and often switch to foraging in the sediment, a process that can result in increased phosphorus concentrations in the water column. On a mass balance basis, phosphorus increased by 43%, although the confidence intervals on this estimate are large. No major increase in phosphorus mass or concentration was detected after July until October, very shortly after the cranberry bogs were drained to the pond, when a 30% increase in mass and concentration was observed, putting both close to the measured values immediately before treatment.

Phosphorus was elevated in May 2021 at 26 µg/L and decreased slowly into July then dramatically in August, declining to 11 µg/L. Concentrations then increased in September and October 2021, reaching almost 25 µg/L. The pattern of fluctuation is substantial and not readily explainable by any one factor. We do not have adequate data for a more detailed analysis, but the shift in algae composition and water clarity has been desirable, despite variation in phosphorus concentrations. Overall, phosphorus concentrations averaged 28, 50, and 72 µg/L for shallow, mid-depth, and deep water layers, respectively, for the 15 years prior to treatment and 17, 19, and 25 µg/L for those same layers for two years after treatment, decreases of 39-65%.

Water clarity was substantially increased by aluminum application in September 2019, remained high in May 2020, then declined during summer as non-cyanobacterial algae accumulated in the water column. Clarity further declined in fall after cranberry bog harvest with subsequent discharges to the pond. Clarity in May 2021 was improved over late 2020 but was not as high as just after treatment or May 2020. Clarity declined during summer 2021 and increased somewhat going into fall, with only the smaller of two cranberry bogs active in 2021. Overall, the post-treatment average Secchi transparency was 3.9 m, compared to the pre-treatment average of 1.6 m. While post-treatment clarity is not as high in Hinckley's Pond as some other treated ponds on Cape Cod, it is consistent with clarity achieved in ponds that serve as alewife nurseries. Alewife decimate the zooplankton community when present in a pond, leading to the highest possible phytoplankton biomass attainable for the level of fertility (mainly related to phosphorus concentration) in the pond.

Chlorophyll-a, an algal pigment indicative of the amount of algae present, averaged 14 to 33 µg/L in shallow, mid-depth, and deep water layers over 15 years prior to treatment but was reduced to 4.5 to 6.5 µg/L for the two years following treatment, a decrease of 64-86%. No significant amounts of cyanobacteria were observed in any sample since treatment. The disconnect between indicators of algae abundance, water clarity, and phosphorus suggests that other sources of turbidity may be important (e.g., resuspended sediment or bog inputs) and that much of the phosphorus in the water column is not readily available for use by algae. Additionally, the shift in types of algae represents a shift in particle size distribution that affects clarity independently of any change in abundance.

As a consequence of alewife being in Hinckley's Pond for the summer the zooplankton community declines in biomass and mean size to minimal levels from June through September and provides no significant grazing pressure on algae. Summer loss of clarity is therefore related mainly to an accumulation of generally desirable algae types that are not hazardous to people but are not being processed efficiently in the food web. Water clarity has increased and cyanobacteria no longer dominate in Hinckley's Pond, so conditions are much improved from the perspective of human lake users, with increased enjoyment expressed by swimmers, boaters and fishermen.

Ongoing assessment of water quality in Hinckley's Pond is strongly recommended and continuation of volunteer monitoring efforts in Harwich is perceived as largely sufficient for tracking conditions and further evaluating the results of the phosphorus inactivation project.

APPENDIX

Appendix Table A1. Raw field data for monitoring immediately before, during and after treatment, exclusive of spot checks, in Hinckley's Pond.

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
Central	9/9/2019	11:15:29	N	21.5	0.1	90	7.0	4.2	4.8	106.3	9.3		2.5
Central	9/9/2019	11:16:13		21.5	1.0	90	7.0	7.0	5.0	106.2	9.3	4.4	
Central	9/9/2019	11:16:53		21.2	2.0	90	7.0	10.0	5.2	104.9	9.2		
Central	9/9/2019	11:17:14		21.1	3.0	90	7.0	11.2	5.3	102.8	9.0	4.2	
Central	9/9/2019	11:17:46		21.1	4.0	90	7.0	7.8	5.4	98.1	8.6		
Central	9/9/2019	11:18:23		21.0	5.0	91	7.0	8.1	5.5	91.5	8.1	4.2	
Central	9/9/2019	11:18:44		20.9	6.0	90	7.0	6.4	5.5	89.4	7.9		
Central	9/9/2019	11:19:11		20.9	7.1	91	7.0	6.2	5.5	83.1	7.3	4.3	
Central	9/9/2019	11:20:55		20.9	7.5	92	6.8	5.6	5.9	73.9	6.5		
A	9/10/2019	7:48:40	N	21.5	1.0	90	6.8	8.7	5.0	107.5	9.4	4.3	
A	9/10/2019	7:49:13		21.3	3.0	90	6.8	10.0	5.0	104.1	9.1		
A	9/10/2019	7:53:24		21.0	4.8	91	6.7	7.5	7.3	74.0	6.5	4.0	
A	9/10/2019	12:48:59	N	22.0	1.0	90	6.6	3.4	5.9	114.2	9.9	5.1	
A	9/10/2019	12:50:29		21.8	3.0	90	6.7	7.7	4.7	110.9	9.6		
A	9/10/2019	12:50:58		21.8	4.9	90	6.7	7.7	5.5	110.0	9.6	3.8	
A	9/10/2019	17:33:42	Y	22.6	1.0	94	6.7	7.4	5.5	102.9	8.8	5.0	
A	9/10/2019	17:34:27		22.4	3.0	135	6.8	5.1	4.9	101.7	8.7		
A	9/10/2019	17:35:02		22.4	4.1	140	6.9	6.5	8.1	102.0	8.7	4.4	
A	9/11/2019	6:33:59	N	21.6	1.0	95	6.8	7.6	5.8	101.1	8.8	5.4	
A	9/11/2019	6:34:27		21.6	3.0	95	6.8	7.9	4.5	100.6	8.7		
A	9/11/2019	6:35:31		21.5	4.3	96	6.7	8.3	5.8	92.6	8.1	4.4	
A	9/11/2019	17:24:46	Y	22.1	0.9	97	6.9	4.7	4.5	103.4	8.89	5.7	
A	9/11/2019	17:25:03		22.1	3.0	97	6.9	6.7	4.0	102.7	8.8		
A	9/11/2019	17:25:32		22.1	4.2	97	6.8	4.7	5.3	90.9	7.8	4.7	
A	9/12/2019	8:23:43	N	21.9	1.1	98	6.7	5.4	3.8	100.1	8.7	4.0	
A	9/12/2019	8:24:08		21.9	3.0	99	6.7	6.2	1.5	99.9	8.6		
A	9/12/2019	8:24:25		21.8	4.9	99	6.7	5.6	2.6	99.0	8.6	3.8	
A	9/12/2019	11:17:13	N	21.8	0.9	99	6.7	6.3	3.6	99.9	8.7	4.5	
A	9/12/2019	11:17:32		21.8	3.0	99	6.7	6.4	4.6	99.4	8.6		
A	9/12/2019	11:19:33		21.8	3.9	99	6.6	6.6	5.5	96.7	8.4	4.3	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
A	9/12/2019	16:23:50	N	21.6	1.1	102	6.5	6.6	4.2	101.4	8.8	4.3	
A	9/12/2019	16:24:27		21.6	3.0	102	6.5	7.3	4.3	101.6	8.8		
A	9/12/2019	16:25:04		21.6	4.5	103	6.6	7.1	4.3	101.3	8.8	5.4	
A	9/13/2019	8:31:18	N	21.0	1.1	104	6.7	4.6	3.7	96.5	8.5	4.6	
A	9/13/2019	8:31:52		20.9	3.0	104	6.7	5.5	4.0	95.8	8.4		
A	9/13/2019	8:33:17		20.7	4.0	104	6.7	22.3	4.7	93.4	8.3	4.3	
A	9/13/2019	12:24:33	Y	21.2	1.0	105	6.7	0.9	4.6	101.2	8.9		
A	9/13/2019	12:25:12		21.1	3.2	105	6.7	4.9	4.3	100.7	8.8		
A	9/13/2019	12:27:40		21.0	4.0	105	6.5	37.2	5.0	99.9	8.8		
A	9/13/2019	16:01:02	Y	21.3	1.0	106	6.7	2.7	5.4	105.3	9.2		
A	9/13/2019	16:01:28		21.3	3.0	106	6.7	4.7	4.3	105.2	9.2		
A	9/13/2019	16:01:48		21.3	4.5	124	6.7	3.8	3.8	104.1	9.1		
A	9/16/2019	14:30:04	Y	21.7	1.0	111	6.3	3.0	6.2	106.0	9.2		
A	9/16/2019	14:31:00		21.6	3.1	110	6.3	4.9	5.2	105.7	9.2		
A	9/16/2019	14:31:38		21.3	4.5	111	6.3	7.0	7.6	101.5	8.9		
A	9/16/2019	16:42:24	Y	21.7	1.0	110	6.4	5.0	4.0	107.2	9.3	4.0	
A	9/16/2019	16:43:20		21.4	3.1	118	6.4	3.4	4.5	102.8	9.0		
A	9/16/2019	16:44:02		21.4	4.5	146	6.4	1.5	4.4	102.2	8.9	3.4	
A	9/17/2019	8:52:47	Y	21.1	1.1	111	6.4	3.2	3.2	102.8	9.0		
A	9/17/2019	8:53:29		21.1	3.1	113	6.4	3.9	2.8	101.6	8.9		
A	9/17/2019	8:54:10		21.0	4.6	115	6.4	3.1	2.6	97.4	8.6		
A	9/17/2019	12:58:22	N	21.4	1.1	113	6.8	0.3	4.1	104.3	9.1		
A	9/17/2019	12:58:53		21.2	3.1	114	6.8	2.4	4.2	103.8	9.1		
A	9/17/2019	12:59:33		21.1	4.5	115	6.7	4.0	25.0	96.6	8.5		
A	9/17/2019	16:20:00	N	21.4	1.1	114	6.8	4.0	3.0	105.7	9.2	4.5	
A	9/17/2019	16:21:05		21.4	3.0	113	6.8	4.4	3.4	105.2	9.2		
A	9/17/2019	16:22:13		21.2	4.5	114	6.8	4.9	3.4	103.5	9.1	4.3	
A	9/18/2019	8:09:34	N	21.0	1.0	117	6.9	4.0	4.0	101.5	8.9		
A	9/18/2019	8:09:54		20.9	3.1	117	6.9	3.8	3.0	101.6	8.9		
A	9/18/2019	8:10:23		21.0	4.4	117	6.9	4.3	2.6	93.6	8.2		
A	9/18/2019	12:34:23	N	20.7	1.0	121	7.4	2.1	1.8	103.0	9.1		
A	9/18/2019	12:34:58		20.7	3.0	121	7.4	3.8	1.8	102.3	9.1		
A	9/18/2019	12:36:19		20.7	3.8	121	7.2	3.7	2.6	101.4	9.0		

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
A	9/18/2019	17:08:37	N	20.5	1.0	122	6.8	4.0	1.8	108.5	9.6	5.0	
A	9/18/2019	17:09:03		20.5	3.0	123	6.7	4.2	1.8	104.3	9.3		
A	9/18/2019	17:09:20		20.5	4.3	122	6.7	4.4	1.8	104.6	9.3	4.5	
A	9/19/2019	7:53:59	N	19.5	1.0	128	7.0	2.4	1.9	99.7	9.0		
A	9/19/2019	7:54:34		19.5	3.0	128	7.0	3.9	1.8	98.9	9.0		
A	9/19/2019	7:55:52		19.4	4.2	128	6.9	3.4	0.9	98.1	8.9		
A	9/19/2019	12:05:33	Y	19.8	1.0	129	6.8	1.8	1.4	102.0	9.2		
A	9/19/2019	12:05:52		19.8	3.0	128	6.8	2.3	1.4	101.0	9.1		
A	9/19/2019	12:06:05		19.6	4.6	128	6.8	2.3	1.4	101.0	9.1		
A	9/19/2019	16:49:43	Y	20.1	1.0	128	6.8	2.7	1.7	103.7	9.3	5.1	
A	9/19/2019	16:50:07		20.1	3.1	128	6.8	3.1	1.4	104.0	9.3		
A	9/19/2019	16:50:43		19.8	5.1	132	6.7	3.6	4.3	62.9	5.7	4.4	
A	9/20/2019	8:15:05	N	19.4	1.0	137	7.3				9.2		
A	9/20/2019	8:15:15		19.3	3.0	136	7.3				9.2		
A	9/20/2019	8:15:30		19.3	5.0	136	7.2				9.2		
A	9/20/2019	12:25:10	N	19.7	1.0	134	7.1				9.4		
A	9/20/2019	12:25:17		19.5	3.0	137	7.1				9.4		
A	9/20/2019	12:25:40		19.4	5.0	134	7.1				9.4		
A	9/20/2019	15:30:12	Y		1.0		7.0					5.6	
A	9/20/2019	15:30:18			3.0		7.0						
A	9/20/2019	15:30:29			5.0		7.2					5.6	
A	9/23/2019	8:05:07	N		1.0		7.1		1.0		9.6		
A	9/23/2019	8:05:15			3.0		7.1		1.3		9.6		
A	9/23/2019	8:05:28			5.0		7.1		1.6		9.5		
A	9/23/2019	12:20:30	Y		1.0	145	7.2		0.8		9.6		
A	9/23/2019	12:20:40			3.0	149	7.2		0.9		9.5		
A	9/23/2019	12:20:50			5.0	150	7.1		0.9		9.5		
A	9/23/2019	16:50:10	Y		1.0	140	7.2		0.6		9.6	5.9	
A	9/23/2019	16:50:23			3.0	142	7.2		0.6		9.6		
A	9/23/2019	16:50:38			5.0	141	7.2		0.6		9.6	5.6	

Appendix Table A1. Raw field data (continued)

Hinckleys Station	Date DD/MM/YY	Time HH:MM:SS	Treated on this date by time of sampling	Temp °C	Depth m	SpCond µS/cm	pH Units	CHL µg/l	Turbidity NTU	DO % Sat	DO mg/l	Alk mg/L	Secchi m
B	9/10/2019	8:07:23	N	21.4	1.0	90	6.7	8.8	5.5	107.6	9.4	4.1	
B	9/10/2019	8:08:01		21.4	3.0	90	6.7	9.9	5.5	105.9	9.2		
B	9/10/2019	8:08:45		21.1	5.1	91	6.7	7.9	5.8	85.2	7.5		
B	9/10/2019	8:09:14		21.0	6.1	91	6.7	7.9	5.9	86.2	7.6	4.0	
B	9/10/2019	12:40:16	N	21.9	1.1	90	6.9	3.1	5.8	113.5	9.8	4.6	
B	9/10/2019	12:40:56		21.7	3.1	90	6.9	6.9	5.7	113.4	9.8		
B	9/10/2019	12:45:56		21.5	5.0	90	6.6	9.9	7.9	97.4	8.5		
B	9/10/2019	12:46:03		21.1	5.8	91	6.8	13.2	6.7	73.5	6.5	3.4	
B	9/10/2019	17:08:18	N	22.2	0.9	91	6.6	6.9	5.3	102.7	8.8	4.4	
B	9/10/2019	17:08:38		22.2	3.1	93	6.6	7.2	4.6	103.3	8.9		
B	9/10/2019	17:09:23		21.5	5.0	94	6.7	9.2	5.5	83.6	7.3		
B	9/10/2019	17:13:12		21.1	5.7	91	6.6	12.0	6.2	64.9	5.7	4.3	
B	9/11/2019	6:44:05	N	21.6	1.0	97	6.8	7.1	5.5	100.7	8.8	3.5	
B	9/11/2019	6:44:41		21.6	3.0	96	6.8	6.9	5.3	94.5	8.2		
B	9/11/2019	6:45:04		21.2	5.1	99	6.8	8.7	5.8	79.5	7.0		
B	9/11/2019	6:47:14		21.1	7.0	101	6.7	8.5	7.5	67.0	5.9	4.3	
B	9/11/2019	17:41:31	N	22.3	1.0	99	6.8	7.1	6.4	104.9	9.0	4.9	
B	9/11/2019	17:41:46		22.2	3.0	97	6.8	7.2	5.0	104.7	9.0		
B	9/11/2019	17:43:14		22.2	4.1	97	6.8	6.4	6.0	103.8	8.9		
B	9/11/2019	17:44:55		21.3	6.5	100	6.7	5.1	6.5	80.3	7.0	4.4	
B	9/12/2019	8:01:45	N	21.9	1.1	99	6.8	6.6	3.7	99.7	8.6	4.8	
B	9/12/2019	8:02:27		21.9	3.0	98	6.8	6.7	4.1	99.2	8.6		
B	9/12/2019	8:02:50		21.8	5.0	98	6.8	7.0	4.0	95.5	8.3		
B	9/12/2019	8:03:45		21.3	6.5	101	6.7	6.0	5.6	63.4	5.6	4.4	
B	9/12/2019	11:24:59	Y	21.9	1.0	130	6.6	6.3	7.8	98.6	8.5	4.1	
B	9/12/2019	11:25:26		21.8	3.0	100	6.7	6.3	8.1	97.5	8.4		
B	9/12/2019	11:26:05		21.9	4.9	99	6.6	6.2	6.6	97.9	8.5		
B	9/12/2019	11:26:37		21.1	6.9	103	6.6	4.1	6.6	51.4	4.5	4.2	
B	9/12/2019	8:01:45	Y	21.9	1.1	99	6.8	6.6	3.7	99.7	8.6	4.2	
B	9/12/2019	8:02:27		21.9	3.0	98	6.8	6.7	4.1	99.2	8.6		
B	9/12/2019	8:02:50		21.8	5.0	98	6.8	7.0	4.0	95.5	8.3		
B	9/12/2019	8:03:45		21.3	6.5	101	6.7	6.0	5.6	63.4	5.6	4.3	
B	9/13/2019	8:40:45	N	21.0	1.0	106	6.7	4.3	4.4	97.4	8.6	4.8	3.1
B	9/13/2019	8:41:34		20.9	2.9	106	6.7	5.6	4.3	96.7	8.5		
B	9/13/2019	8:42:20		20.9	4.9	104	6.7	6.8	5.2	95.1	8.4		
B	9/13/2019	8:43:02		20.8	5.5	103	6.7	16.5	8.7	92.0	8.1	4.4	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
B	9/13/2019	13:00:59	N	21.2	1.2	106	6.5	2.4	4.5	101.4	8.9		
B	9/13/2019	13:01:31		21.1	3.1	108	6.5	4.2	4.1	101.0	8.9		
B	9/13/2019	13:02:01		21.1	5.1	111	6.5	4.8	3.9	100.4	8.8		
B	9/13/2019	13:03:18		21.0	6.8	110	6.5	4.4	3.5	99.8	8.8		
B	9/13/2019	16:05:34	N	21.3	1.1	108	6.7	3.8	4.6	104.1	9.1		
B	9/13/2019	16:06:10		21.3	3.0	108	6.7	5.6	4.5	103.6	9.1		
B	9/13/2019	16:06:48		21.3	5.0	108	6.7	6.1	4.8	102.9	9.0		
B	9/13/2019	16:07:50		21.3	7.0	107	6.7	6.1	5.6	102.4	9.0		
B	9/16/2019	14:36:53	N	21.6	1.1	110	6.3	2.4	5.2	106.1	9.2		4.3
B	9/16/2019	14:37:34		21.6	3.2	111	6.3	4.9	4.8	105.8	9.2		
B	9/16/2019	14:38:30		21.5	5.1	110	6.3	5.0	4.5	105.1	9.2		
B	9/16/2019	14:39:48		21.4	6.7	110	6.3	5.9	6.4	102.1	8.9		
B	9/16/2019	16:48:08	N	21.8	1.0	110	6.3	4.2	4.0	106.7	9.2	5.7	
B	9/16/2019	16:49:15		21.7	3.0	110	6.4	5.4	3.6	106.0	9.2		
B	9/16/2019	16:50:35		21.5	5.0	110	6.4	7.0	4.1	104.2	9.1		
B	9/16/2019	16:51:59		21.4	6.7	110	6.3	7.7	4.6	103.8	9.1	4.9	
B	9/17/2019	8:57:19	N	21.2	1.0	113	6.5	3.0	12.6	103.1	9.0		
B	9/17/2019	8:57:57		21.2	3.1	113	6.5	4.3	9.3	103.0	9.0		
B	9/17/2019	8:58:28		21.2	5.0	113	6.5	4.2	7.7	102.2	9.0		
B	9/17/2019	8:59:43		21.1	6.4	113	6.5	4.4	1.8	101.3	8.9		
B	9/17/2019	12:45:21	Y	21.4	1.0	112	6.9	2.0	3.6	105.0	9.2		
B	9/17/2019	12:46:05		21.3	3.0	112	6.9	4.0	3.6	104.6	9.1		
B	9/17/2019	12:46:48		21.2	5.0	112	6.9	4.1	3.6	103.0	9.0		
B	9/17/2019	12:47:53		21.2	6.4	112	6.9	4.3	5.3	101.1	8.9		
B	9/17/2019	16:11:31	Y	21.5	1.0	119	6.7	4.0	3.4	105.2	9.2	5.3	
B	9/17/2019	16:12:43		21.5	3.0	121	6.8	4.1	2.8	104.9	9.1		
B	9/17/2019	16:13:48		21.4	5.0	132	6.8	3.5	3.0	104.0	9.1		
B	9/17/2019	16:14:31		21.3	6.4	128	6.8	3.4	3.0	103.6	9.1	6.5	
B	9/18/2019	7:46:40	N	20.9	1.0	121	7.0	2.8	4.2	101.9	9.0		5.0
B	9/18/2019	7:47:06		20.8	3.0	120	7.0	3.5	4.2	100.6	8.9		
B	9/18/2019	7:48:00		20.8	5.0	118	7.0	3.3	4.3	99.3	8.8		
B	9/18/2019	7:48:41		20.8	6.7	116	7.0	3.1	4.4	98.6	8.7		
B	9/18/2019	12:40:14	N	20.8	1.0	123	7.1	3.0	1.7	104.3	9.2		
B	9/18/2019	12:40:38		20.8	2.9	123	7.1	3.5	1.8	103.5	9.1		
B	9/18/2019	12:41:16		20.8	4.9	123	7.1	3.6	1.7	103.4	9.1		
B	9/18/2019	12:41:41		20.7	6.4	124	7.1	3.2	1.7	102.7	9.1		

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
B	9/18/2019	17:01:32	N	20.7	1.1	127	6.8	4.1	1.8	106.1	9.4	4.4	
B	9/18/2019	17:01:55		20.7	2.9	128	6.8	4.4	1.8	105.8	9.4		
B	9/18/2019	17:02:20		20.7	5.0	129	6.8	4.5	1.6	104.8	9.3		
B	9/18/2019	17:02:32		20.6	6.1	130	6.8	4.0	1.6	104.7	9.3	4.2	
B	9/19/2019	8:29:44	N	19.7	1.0	128	6.9	1.8	1.6	100.3	9.0		
B	9/19/2019	8:30:25		19.7	3.0	128	7.0	3.7	1.5	99.7	9.0		
B	9/19/2019	8:30:58		19.7	5.0	127	6.9	3.8	1.4	99.2	9.0		
B	9/19/2019	8:32:04		19.6	7.0	127	6.9	2.9	1.5	97.4	8.8		
B	9/19/2019	12:18:00	N	19.9	1.0	128	6.8	1.5	1.2	103.9	9.3		5.2
B	9/19/2019	12:18:27		19.8	3.1	127	6.7	2.4	1.3	102.3	9.2		
B	9/19/2019	12:18:51		19.8	5.0	127	6.7	3.1	1.4	101.5	9.1		
B	9/19/2019	12:19:14		19.7	6.8	127	6.8	3.0	1.4	101.2	9.1		
B	9/19/2019	16:45:42	Y	20.1	1.0	128	6.8	1.9	3.2	104.7	9.4	4.2	
B	9/19/2019	16:45:55		20.1	3.0	128	6.7	3.0	1.8	104.1	9.3		
B	9/19/2019	16:46:23		19.7	5.0	128	6.7	3.4	1.2	102.0	9.2		
B	9/19/2019	16:46:45		19.7	6.9	134	6.7	2.9	1.3	101.5	9.2	4.4	
B	9/20/2019	8:35:05	N	19.6	1.0	144	7.4				9.2		
B	9/20/2019	8:35:15		19.5	3.0	148	7.4				9.2		
B	9/20/2019	8:35:30		19.5	5.0	159	7.4				9.2		
B	9/20/2019	8:35:45		19.5	7.0	173	7.5				9.2		
B	9/20/2019	12:31:10	Y	19.9	1.0	151	7.0				9.4		
B	9/20/2019	12:31:17		19.6	3.0	152	7.0				9.5		
B	9/20/2019	12:31:40		19.6	5.0	174	7.4				9.4		
B	9/20/2019	12:31:55		19.5	7.0	178	7.3				9.4		
B	9/20/2019	15:40:12	Y		1.0		6.8					5.3	5.2
B	9/20/2019	15:40:18			3.0		7.0						
B	9/20/2019	15:40:29			5.0		7.0						
B	9/20/2019	15:40:38			7.0		7.0					5.6	
B	9/23/2019	8:15:07	N		1.0		7.0						5.6
B	9/23/2019	8:15:15			3.0		7.0						
B	9/23/2019	8:15:28			5.0		7.0						
B	9/23/2019	8:15:45			7.0		6.9						
B	9/23/2019	12:30:30	N		1.0	137	7.2		1.0		9.5		
B	9/23/2019	12:30:40			3.0	137	7.2		1.0		9.5		
B	9/23/2019	12:30:50			5.0	138	7.2		1.0		9.5		
B	9/23/2019	12:30:59			7.0	140	7.1		2.0		9.5		
B	9/23/2019	17:10:10	N		1.0	133	7.2		0.7		9.5	5.2	
B	9/23/2019	17:10:23			3.0	134	7.2		0.8		9.5		
B	9/23/2019	17:10:38			5.0	134	7.2		0.8		9.5		
B	9/23/2019	17:10:49			7.0	134	7.2		1.5		9.6	5.3	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
C	9/10/2019	8:15:27	N	21.4	1.1	90	6.7	9.8	6.2	106.0	9.3	4.1	
C	9/10/2019	8:15:50		21.4	3.0	90	6.7	11.6	6.1	105.0	9.2		
C	9/10/2019	8:16:50		21.0	5.0	91	6.7	8.3	6.1	77.8	6.8		
C	9/10/2019	8:17:17		21.0	5.7	91	6.7	6.8	6.1	74.5	6.6	4.7	
C	9/10/2019	12:35:13	Y	21.8	1.0	93	7.0	4.4	7.0	111.3	9.6	4.2	
C	9/10/2019	12:35:45		21.6	3.0	106	7.0	6.0	6.8	106.2	9.2		
C	9/10/2019	12:36:21		21.0	4.8	97	7.0	7.4	6.6	81.7	7.2		
C	9/10/2019	12:36:56		21.0	5.5	94	6.9	5.3	6.6	75.9	6.7	4.2	
C	9/10/2019	16:59:12	Y	22.1	1.0	97	6.7	7.0	5.7	101.9	8.8	4.2	
C	9/10/2019	16:59:45		22.0	3.1	107	6.7	8.4	5.8	100.7	8.7		
C	9/10/2019	17:00:31		21.2	5.1	102	6.7	4.6	5.8	76.1	6.7		
C	9/10/2019	17:01:04		21.1	5.6	101	6.7	4.6	5.4	71.0	6.2	3.9	
C	9/11/2019	6:57:10	N	21.6	1.0	97	6.7	8.3	5.2	101.1	8.8	5.0	
C	9/11/2019	6:57:29		21.6	3.1	97	6.7	7.9	5.2	101.1	8.8		
C	9/11/2019	6:57:53		21.2	5.0	101	6.7	6.6	5.2	77.1	6.8		
C	9/11/2019	6:58:13		21.2	5.6	101	6.7	7.4	5.3	71.9	6.3	4.4	
C	9/11/2019	17:56:03	N	22.3	1.0	97	6.8	8.0	5.7	106.3	9.1	3.8	
C	9/11/2019	17:56:38		22.2	3.1	101	6.9	7.8	5.5	106.4	9.1		
C	9/11/2019	17:56:54		22.2	5.0	127	6.9	6.8	5.2	106.0	9.1		
C	9/11/2019	17:59:05		21.9	5.7	124	6.7	3.7	6.7	103.7	9.0	3.1	
C	9/12/2019	7:46:03	N	22.0	1.0	104	6.9	5.7	4.3	103.9	9.0	4.4	
C	9/12/2019	7:46:40		22.0	3.0	104	6.9	5.7	4.5	103.1	8.9		
C	9/12/2019	7:47:09		21.8	5.0	99	6.9	7.2	5.5	97.5	8.5		
C	9/12/2019	7:48:30		21.8	5.6	100	6.8	7.6	5.4	90.6	7.9	4.2	
C	9/12/2019	11:41:04	N	21.9	1.1	101	6.6	6.7	4.8	100.3	8.7	4.2	
C	9/12/2019	11:41:24		21.9	3.0	101	6.6	6.7	5.2	100.4	8.7		
C	9/12/2019	11:42:09		21.8	5.0	103	6.6	5.6	4.9	97.0	8.4		
C	9/12/2019	11:42:51		21.5	6.0	101	6.5	3.7	6.0	75.3	6.6	4.2	
C	9/12/2019	16:33:50	N	21.76	1.04	103	6.52	7.35	7.6	101.5	8.8	3.7	
C	9/12/2019	16:34:32		21.75	3.05	103	6.55	7.61	7.2	101.1	8.76		
C	9/12/2019	16:35:08		21.73	5.16	103	6.56	7.41	7	100.9	8.75		
C	9/12/2019	16:39:36		21.67	5.79	102	6.58	6.72	5.8	94.9	8.23	4.3	
C	9/13/2019	7:48:24	N	20.9	0.7	106	6.7	5.4	4.8	93.4	8.2	4.3	
C	9/13/2019	7:48:47		20.9	0.9	106	6.7	5.3	4.5	94.8	8.4		
C	9/13/2019	7:49:31		20.9	3.1	106	6.7	6.4	4.4	94.2	8.3		
C	9/13/2019	7:51:57		20.8	5.1	105	6.7	6.2	4.5	95.2	8.4	4.9	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
C	9/13/2019	12:31:46	Y	21.2	1.0	106	6.6	2.9	4.5	100.4	8.8		
C	9/13/2019	12:32:19		21.0	3.0	105	6.6	4.3	4.7	100.2	8.8		
C	9/13/2019	12:32:45		21.0	5.1	106	6.6	4.8	4.2	100.0	8.8		
C	9/13/2019	12:33:30		20.9	6.6	106	6.6	4.3	4.6	99.1	8.7		
C	9/13/2019	12:38:16	Y	21.3	1.1	116	6.6	2.1	6.1	99.4	8.7		
C	9/13/2019	12:38:59		21.1	3.1	112	6.6	3.9	6.4	99.3	8.7		
C	9/13/2019	12:39:48		21.1	5.0	111	6.6	4.5	5.8	98.7	8.7		
C	9/13/2019	12:43:30		20.8	6.3	117	6.5	4.0	4.3	99.6	8.8		
C	9/13/2019	16:11:24	Y	21.4	1.1	106	6.7	3.7	5.8	104.8	9.2		
C	9/13/2019	16:11:52		21.3	3.1	107	6.7	4.7	5.3	103.6	9.1		
C	9/13/2019	16:12:14		21.1	5.0	107	6.7	5.3	5.0	102.5	9.0		
C	9/13/2019	16:13:40		21.0	6.0	110	6.5	6.4	5.0	95.4	8.4		
C	9/16/2019	14:45:58	N	21.8	1.0	110	6.4	3.3	4.0	105.2	9.1		
C	9/16/2019	14:46:39		21.7	3.0	110	6.4	5.2	4.2	105.8	9.2		
C	9/16/2019	14:47:20		21.6	5.0	110	6.4	5.5	4.0	103.4	9.0		
C	9/16/2019	14:48:42		21.5	6.1	110	6.3	3.3	2.9	102.2	8.9		
C	9/16/2019	16:57:45	N	21.9	1.0	110	6.4	4.3	3.5	107.2	9.3	5.1	
C	9/16/2019	16:58:59		21.8	3.0	111	6.4	5.3	3.8	106.2	9.2		
C	9/16/2019	17:00:19		21.7	5.0	110	6.4	4.7	3.9	105.0	9.1		
C	9/16/2019	17:01:38		21.5	6.3	110	6.4	4.0	1.9	91.5	8.0	5.5	
C	9/17/2019	8:18:48	N	21.2	1.1	112	6.9	3.6	3.3	102.1	8.9		
C	9/17/2019	8:19:29		21.2	3.1	112	6.9	5.3	3.4	101.8	8.9		
C	9/17/2019	8:20:10		21.2	5.0	111	6.9	5.8	4.0	101.5	8.9		
C	9/17/2019	8:22:26		21.2	5.9	112	6.6	6.3	5.6	99.6	8.7		
C	9/17/2019	13:05:41	N	21.4	1.1	117	6.7	2.0	3.5	103.4	9.0		
C	9/17/2019	13:06:15		21.4	3.0	117	6.7	3.4	3.6	103.2	9.0		
C	9/17/2019	13:06:49		21.4	5.1	117	6.8	4.1	3.9	102.7	9.0		
C	9/17/2019	13:08:19		21.2	6.3	127	6.7	3.3	2.7	100.9	8.8		
C	9/17/2019	16:37:41	N	21.6	1.1	118	7.0	3.2	4.1	105.2	9.2	4.8	
C	9/17/2019	16:38:41		21.6	3.0	118	7.0	4.7	4.2	105.7	9.2		
C	9/17/2019	16:39:21		21.5	5.0	116	6.9	4.3	4.1	105.3	9.2		
C	9/17/2019	16:41:50		21.4	5.8	125	6.8	11.6	8.8	103.3	9.0	6.3	
C	9/18/2019	7:35:39	N	20.8	1.1	116	7.0	3.9	3.7	100.1	8.8		
C	9/18/2019	7:36:52		20.8	3.0	116	7.0	4.1	3.9	100.4	8.9		
C	9/18/2019	7:37:46		20.8	5.1	116	7.0	4.1	3.6	100.3	8.9		
C	9/18/2019	7:38:45		20.8	5.7	116	7.0	4.0	5.6	95.5	8.4		
C	9/18/2019	12:48:45	Y	20.8	1.0	127	7.0	3.2	1.7	103.4	9.1		
C	9/18/2019	12:49:23		20.7	3.0	135	7.0	3.4	1.7	103.0	9.1		
C	9/18/2019	12:49:51		20.7	4.9	136	7.0	2.9	1.6	102.5	9.1		
C	9/18/2019	12:50:12		20.8	6.0	145	7.0	2.7	1.6	101.9	9.0		

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
C	9/18/2019	16:53:40	Y	20.7	1.0	129	6.8	2.9	1.7	106.2	9.4	4.6	
C	9/18/2019	16:54:23		20.7	5.0	129	6.8	3.7	1.8	104.1	9.2		
C	9/18/2019	16:54:30		20.7	5.0	130	6.8	3.6	1.7	104.3	9.2		
C	9/18/2019	16:54:58		20.7	6.0	130	6.8	3.6	1.7	104.1	9.2	4.4	
C	9/19/2019	8:41:36	N	19.7	1.0	128	6.9	2.4	1.8	100.9	9.1		
C	9/19/2019	8:42:16		19.8	3.0	129	6.9	3.3	1.8	100.7	9.1		
C	9/19/2019	8:42:53		19.7	5.0	127	6.9	3.4	1.8	99.6	9.0		
C	9/19/2019	8:43:24		19.6	5.9	127	6.9	3.3	1.8	98.1	8.9		
C	9/19/2019	12:22:44	N	19.9	0.9	128	6.7	1.6	1.6	101.8	9.1		
C	9/19/2019	12:23:09		19.9	3.0	129	6.7	2.3	0.5	101.8	9.1		
C	9/19/2019	12:23:35		19.6	5.0	128	6.7	2.7	1.2	100.6	9.1		
C	9/19/2019	12:24:08		19.6	6.5	127	6.7	4.3	2.0	84.7	7.7		
C	9/19/2019	16:41:00	N	20.2	1.0	127	6.8	1.8	1.7	105.1	9.4	4.7	
C	9/19/2019	16:41:27		20.2	3.0	127	6.8	2.8	1.7	104.1	9.3		
C	9/19/2019	16:41:47		19.9	5.0	127	6.8	3.0	1.7	103.8	9.3		
C	9/19/2019	16:42:18		19.8	6.3	127	6.8	4.0	2.1	98.1	8.8	4.8	
C	9/20/2019	8:55:05	N	19.6	1.0	142	7.3				9.3		
C	9/20/2019	8:55:15		19.6	3.0	142	7.3				9.3		
C	9/20/2019	8:55:30		19.6	5.0	141	7.2				9.2		
C	9/20/2019	8:55:45		19.5	6.5	140	7.2				9.2		
C	9/20/2019	12:39:10	Y	20.0	1.0	141	7.0				9.4		
C	9/20/2019	12:39:17		19.7	3.0	141	7.0				9.5		
C	9/20/2019	12:39:40		19.7	5.0	140	7.0				9.4		
C	9/20/2019	12:39:55		19.6	6.5	141	7.0				9.4		
C	9/20/2019	15:50:12	Y		1.0		6.8					5.8	
C	9/20/2019	15:50:18			3.0		6.8						
C	9/20/2019	15:50:29			5.0		7.0						
C	9/20/2019	15:50:38			6.5		7.0					5.2	
C	9/23/2019	8:25:07	N		1.0		7.0		1.2				
C	9/23/2019	8:25:15			3.0		7.0		1.2				
C	9/23/2019	8:25:28			5.0		7.0		1.4				
C	9/23/2019	8:25:45			6.5		7.0		1.2				
C	9/23/2019	12:50:30	N		1.0	139	7.3		3.2		9.5		
C	9/23/2019	12:50:40			3.0	139	7.3		2.1		9.6		
C	9/23/2019	12:50:50			5.0	139	7.3		1.6		9.6		
C	9/23/2019	12:50:59			6.5	140	7.2		1.4		9.6		
C	9/23/2019	17:25:10	N		1.0	131	7.1		0.4		9.6	5.4	
C	9/23/2019	17:25:23			3.0	130	7.1		0.5		9.7		
C	9/23/2019	17:25:38			5.0	130	7.1		0.6		9.6		
C	9/23/2019	17:25:49			6.5	129	7.2		0.7		9.7	5.5	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
D	9/10/2019	8:26:27	N	21.3	1.0	90	6.6	8.5	6.5	107.1	9.4	4.2	
D	9/10/2019	8:27:26		21.3	3.0	90	6.7	8.3	5.7	105.8	9.3		
D	9/10/2019	8:30:11		21.0	4.4	91	6.5	7.3	12.5	80.6	7.1	4.4	
D	9/10/2019	12:26:46	N	21.7	1.0	91	7.1	4.4	7.3	111.9	9.7	4.3	
D	9/10/2019	12:27:23		21.3	3.0	97	7.2	14.2	7.2	102.9	9.0		
D	9/10/2019	12:27:48		21.1	4.7	102	7.1	5.1	7.1	84.5	7.4	5.3	
D	9/10/2019	16:46:23	N	22.2	1.0	93	7.2	5.7	5.4	102.6	8.8	5.1	
D	9/10/2019	16:47:04		21.3	3.1	120	7.2	8.3	5.6	86.8	7.6		
D	9/10/2019	16:47:44		21.3	4.8	122	6.8	8.2	5.6	85.0	7.5	4.6	
D	9/11/2019	7:07:12	N	21.3	1.0	97	6.7	7.1	6.0	100.3	8.8	4.8	
D	9/11/2019	7:07:35		21.3	3.0	96	6.7	7.6	5.8	100.1	8.8		
D	9/11/2019	7:08:00		21.3	4.3	97	6.7	7.3	5.7	100.0	8.7	4.3	
D	9/11/2019	17:13:54	Y	22.4	1.0	103	6.9	5.8	4.1	107.9	9.2	5.4	
D	9/11/2019	17:14:17		22.2	3.0	115	6.9	6.4	5.0	107.1	9.2		
D	9/11/2019	17:14:27		22.2	4.3	116	6.9	6.1	5.0	105.8	9.1	4.5	
D	9/12/2019	7:20:00	N	22.0	1.1	105	7.0	5.6	4.9	103.5	8.9	4.3	
D	9/12/2019	7:22:37		22.0	3.0	104	6.9	7.6	6.6	96.8	8.3		
D	9/12/2019	7:23:04		22.0	4.8	105	6.9	8.2	6.5	101.7	8.8	4.3	
D	9/12/2019	11:58:48	N	21.9	1.0	103	6.6	6.9	5.4	101.7	8.8	4.7	
D	9/12/2019	11:59:17		21.9	3.0	103	6.6	7.3	5.1	101.3	8.8		
D	9/12/2019	11:59:48		21.9	4.5	103	6.6	7.3	6.3	98.1	8.5	4.2	
D	9/12/2019	16:50:51	N	21.8	1.1	102	6.6	7.5	5.5	101.8	8.8	4.2	
D	9/12/2019	16:51:37		21.8	3.0	102	6.6	7.7	5.4	101.4	8.8		
D	9/12/2019	16:52:13		21.8	4.5	102	6.6	7.2	5.3	101.0	8.8	3.9	
D	9/13/2019	8:56:02	N	21.0	1.0	106	6.7	3.0	4.7	96.6	8.5	4.7	
D	9/13/2019	8:56:47		20.9	3.0	106	6.7	4.8	4.8	95.7	8.4		
D	9/13/2019	9:00:09		20.9	3.8	107	6.6	5.3	4.7	91.8	8.1	4.7	
D	9/13/2019	12:47:47	N	21.2	1.0	106	6.5	3.2	5.1	100.0	8.8		
D	9/13/2019	12:48:15		21.2	3.1	105	6.5	5.0	5.1	99.7	8.7		
D	9/13/2019	12:48:51		21.1	4.4	108	6.5	3.8	5.2	97.9	8.6		
D	9/13/2019	16:17:45	N	21.3	1.0	111	6.6	3.2	5.4	103.1	9.0		
D	9/13/2019	16:18:18		21.1	3.1	115	6.6	4.5	4.8	100.6	8.8		
D	9/13/2019	16:18:50		21.0	4.5	115	6.6	3.6	4.7	97.9	8.6		
D	9/16/2019	14:58:46	N	21.8	1.1	111	6.4	3.7	4.7	108.0	9.3		
D	9/16/2019	14:59:22		21.8	3.0	110	6.4	5.9	4.8	107.6	9.3		
D	9/16/2019	15:00:04		21.8	4.4	110	6.4	5.1	2.2	104.1	9.0		
D	9/16/2019	17:07:13	N	22.0	1.0	110	6.4	5.9	6.2	109.3	9.4	5.0	
D	9/16/2019	17:08:24		21.9	3.0	110	6.4	5.3	5.0	107.8	9.3		
D	9/16/2019	17:09:07		21.8	4.5	110	6.4	9.2	4.6	108.1	9.4	5.1	

Appendix Table A1. Raw field data (continued)

Hinckleys	Date	Time	Treated on this date by time of sampling	Temp	Depth	SpCond	pH	CHL	Turbidity	DO	DO	Alk	Secchi
Station	DD/MM/YY	HH:MM:SS		°C	m	µS/cm	Units	µg/l	NTU	% Sat	mg/l	mg/L	m
D	9/17/2019	8:12:55	N	21.3	1.1	113	6.9	4.6	4.0	101.4	8.9		
D	9/17/2019	8:13:43		21.2	3.0	111	6.9	5.8	4.0	101.6	8.9		
D	9/17/2019	8:14:22		20.8	4.5	111	6.9	3.0	4.0	93.9	8.3		
D	9/17/2019	13:13:39	Y	21.5	1.0	120	6.7	2.5	4.5	104.8	9.1		
D	9/17/2019	13:14:18		21.5	3.0	119	6.7	3.5	3.9	104.6	9.1		
D	9/17/2019	13:15:00		21.5	4.5	115	6.7	3.3	3.9	104.6	9.1		
D	9/17/2019	16:46:58	Y	21.6	1.0	118	6.8	5.2	4.7	106.6	9.3	4.9	
D	9/17/2019	16:47:51		21.6	3.0	118	6.8	5.9	4.1	106.4	9.2		
D	9/17/2019	16:48:56		21.4	4.4	118	6.8	5.3	3.7	104.7	9.1	5.6	
D	9/18/2019	7:58:24	N	20.8	1.0	124	7.0	2.4	3.6	101.6	9.0		
D	9/18/2019	7:58:42		20.8	3.0	123	7.0	3.2	3.7	101.2	8.9		
D	9/18/2019	8:01:33		20.8	4.3	122	6.9	3.9	4.0	87.4	7.7		
D	9/18/2019	12:54:28	N	20.8	1.0	126	7.0	4.0	1.7	103.8	9.2		
D	9/18/2019	12:54:49		20.8	3.0	126	7.0	4.5	1.7	103.1	9.1		
D	9/18/2019	12:55:17		20.8	4.7	129	7.0	3.8	1.6	102.5	9.1		
D	9/18/2019	16:41:42	N	20.7	1.0	128	7.1	2.0	1.2	103.9	9.2	4.4	
D	9/18/2019	16:42:33		20.7	3.0	129	7.0	4.6	1.5	103.7	9.2		
D	9/18/2019	16:43:09		20.7	4.7	128	7.0	4.8	1.4	103.3	9.1	4.5	
D	9/19/2019	8:51:42	N	19.8	1.0	128	6.7	1.9	1.6	102.2	9.2		
D	9/19/2019	8:52:09		19.8	3.0	128	6.7	3.5	1.5	101.4	9.1		
D	9/19/2019	8:52:33		19.8	4.5	128	6.7	3.5	1.5	100.6	9.1		
D	9/19/2019	12:29:52	Y	20.1	1.0	132	6.7	1.4	1.6	102.0	9.1		
D	9/19/2019	12:30:20		19.9	3.1	136	6.7	1.6	1.6	101.2	9.1		
D	9/19/2019	12:30:51		19.8	4.8	141	6.8	1.5	1.7	100.7	9.1		
D	9/19/2019	16:35:54	Y	20.3	1.0	136	6.8	1.6	2.0	103.9	9.3	4.2	
D	9/19/2019	16:36:14		20.1	3.0	142	6.7	2.0	1.5	103.2	9.2		
D	9/19/2019	16:36:36		20.0	4.7	155	6.8	1.8	2.0	102.5	9.2	4.3	
D	9/20/2019	9:15:05	N	19.8	1.0	148	7.2				9.3		
D	9/20/2019	9:15:15		19.6	3.0	142	7.2				9.3		
D	9/20/2019	9:15:30		19.6	5.0	139	7.2				9.2		
D	9/20/2019	12:45:10	N	20.2	1.0	145	7.1				9.5		
D	9/20/2019	12:45:17		19.8	3.0	147	7.1				9.4		
D	9/20/2019	12:45:40		19.7	5.0	145	7.1				9.5		

Appendix Table A1. Raw field data (continued)

Hinckleys Station	Date DD/MM/YY	Time HH:MM:SS	Treated on this date by time of sampling	Temp °C	Depth m	SpCond µS/cm	pH Units	CHL µg/l	Turbidity NTU	DO % Sat	DO mg/l	Alk mg/L	Secchi m
D	9/20/2019	16:10:12	N		1.0		7.0					6.5	
D	9/20/2019	16:10:18			3.0		6.8						
D	9/20/2019	16:10:29			5.0		6.8					5.1	
D	9/23/2019	8:45:07	N		1.0		7.1		0.9				
D	9/23/2019	8:45:15			3.0		7.1		0.9				
D	9/23/2019	8:45:28			5.0		7.0		0.8				
D	9/23/2019	13:10:40	Y		1.0	149	7.2		0.3		9.5		
D	9/23/2019	13:10:50			3.0	149	7.2		0.6		9.5		
D	9/23/2019	13:10:59			5.0	149	7.2		0.7		9.6		
D	9/23/2019	17:35:10	Y		1.0	147	7.2		0.8		9.6	5.4	
D	9/23/2019	17:35:23			3.0	149	7.1		0.9		9.6		
D	9/23/2019	17:35:38			5.0	150	7.1		1.0		9.7	5.9	
Central	9/27/2019	13:09:49	N	23.6	0.1	148	6.8	0.7	0.2	104.2	8.7		6.4
Central	9/27/2019	13:20:51		21.3	1.0	147	6.7	1.3	0.8	102.1	8.9	4.5	
Central	9/27/2019	13:13:31		21.7	2.0	147	6.8	1.2	0.6	102.6	8.9		
Central	9/27/2019	13:57:10		23.2	3.0	148	6.7	1.2	0.4	103.0	8.7	4.4	
Central	9/27/2019	13:16:08		21.6	4.0	147	6.7	1.0	0.8	103.0	9.0		
Central	9/27/2019	14:02:00		22.9	5.0	145	6.6	0.8	0.5	102.1	8.7	4.3	
Central	9/27/2019	13:18:22		22.0	6.0	147	6.7	1.1	0.8	103.0	8.9		
Central	9/27/2019	14:08:31		22.7	7.0	146	6.6	1.1	0.5	101.1	8.6	4.3	

Appendix Table A2. Central station water quality data for Hinckley's Pond.

Location	Date	Depth	pH	Alk	Temp	DO	DO	SpCond	Turbidity	CHL	Secchi			Total P	Diss. P	Diss. Al
Hinckleys	DD/MM/Y	meters	Units	mg/L	°C	mg/l	% Sat	µS/cm	NTU	µg/l	m			µg/l	µg/l	µg/l
Central	9/9/2019	0.1	7.0		21.5	9.3	106.3	90	4.8	4.2	2.5					
Central	9/9/2019	1.0	7.0	4.4	21.5	9.3	106.2	90	5.0	7.0				19	18	10
Central	9/9/2019	2.0	7.0		21.2	9.2	104.9	90	5.2	10.0						
Central	9/9/2019	3.0	7.0	4.2	21.1	9.0	102.8	90	5.3	11.2				24	16	10
QA/QC	9/9/2019	3.0												29	5	10
Central	9/9/2019	4.0	7.0		21.1	8.6	98.1	90	5.4	7.8						
Central	9/9/2019	5.0	7.0	4.2	21.0	8.1	91.5	91	5.5	8.1				34	9	20
Central	9/9/2019	6.0	7.0		20.9	7.9	89.4	90	5.5	6.4						
Central	9/9/2019	7.1	7.0	4.3	20.9	7.3	83.1	91	5.5	6.2				14	13	11
Central	9/9/2019	7.5	6.8		20.9	6.5	73.9	92	5.9	5.6						
Central	9/27/2019	0.1	6.8		19.6	8.7	104.2	148	0.2	0.7	6.4					
Central	9/27/2019	1.0	6.7	4.5	19.3	8.9	102.1	147	0.8	1.3				10	6	78
QA/QC	9/27/2019	1.0												11	8	35
Central	9/27/2019	2.0	6.8		19.7	8.9	102.6	147	0.6	1.2						
Central	9/27/2019	3.0	6.7	4.4	19.2	8.7	103.0	148	0.4	1.2				11	7	69
Central	9/27/2019	4.0	6.7		19.6	9.0	103.0	147	0.8	1.0						
Central	9/27/2019	5.0	6.6	4.3	19.9	8.7	102.1	145	0.5	0.8				10	7	27
Central	9/27/2019	6.0	6.7		20.0	8.9	103.0	147	0.8	1.1						
Central	9/27/2019	7.0	6.6	4.3	19.7	8.6	101.1	146	0.5	1.1				10	6	25
Central	10/29/2019	0.3	6.8		13.8	10.2	99.6	125	0.8	3.4	5.0					
Central	10/29/2019	1.0	6.7	4.2	13.8	10.1	99.3	126	0.8	3.6				13	5	10
QA/QC	10/29/2019	1.0												17	5	10
Central	10/29/2019	2.0	6.7		13.8	10.1	99.1	125	0.7	3.8						
Central	10/29/2019	3.0	6.7	4.0	13.8	10.2	99.3	125	0.8	3.9				11	5	10
Central	10/29/2019	4.0	6.7		13.7	10.1	98.8	126	0.8	3.9						
Central	10/29/2019	5.0	6.7	4.0	13.7	10.1	98.8	126	0.8	3.9				11	5	13
Central	10/29/2019	6.0	6.7		13.7	10.1	98.6	126	0.8	3.9						
Central	10/29/2019	7.0	6.6	4.1	13.7	10.1	98.4	126	0.9	4.1				13	5	10
Central	10/29/2019	7.5	6.6		13.7	10.0	97.9	126	1.0	4.8						
Central	10/29/2019	7.9	6.6		13.7	10.0	97.3	127	1.4	4.5						
Central	5/21/2020	0.2	8.0		16.0	10.2	104.7	90	1.9	0.9	5.9					
Central	5/21/2020	1.0	7.9	6.0	16.0	10.2	104.6	90	1.9	1.1				11	5	
Central	5/21/2020	2.0	7.9		15.9	10.2	104.2	90	2.1	1.7						
Central	5/21/2020	3.0	7.8	6.0	15.8	10.1	103.1	90	2.1	1.2				11	5	
Central	5/21/2020	4.1	7.8		15.7	10.1	102.5	90	2.2	1.5						
Central	5/21/2020	5.0	7.7	6.0	15.6	10.0	102.2	90	2.2	1.8				14	5	
QA/QC	5/21/2020	5.0												16	5	
Central	5/21/2020	6.0	7.6		15.6	10.0	101.3	91	2.3	1.7						
Central	5/21/2020	7.0	7.6	6.0	15.6	9.9	100.9	90	2.3	2.2				16	5	
Central	5/21/2020	7.5	7.3		15.6	9.9	100.3	90	2.4	2.7						

Appendix Table A2. Central station water quality data for Hinckley's Pond (continued).

Location	Date	Depth	pH	Alk	Temp	DO	DO	SpCond	Turbidity	CHL	Secchi			Total P	Diss. P	Diss. Al
Hinckleys	DD/MM/Y	meters	Units	mg/L	°C	mg/l	% Sat	µS/cm	NTU	µg/l	m			µg/l	µg/l	µg/l
Central	6/15/2020	0.3	7.3		21.4	8.8	100.8	93	8.1	2.7	3.8					
Central	6/15/2020	1.0	7.2	6.3	21.5	8.8	100.4	93	7.0	3.3				15	5	
Central	6/15/2020	2.0	7.2		21.5	8.8	100.4	93	6.2	3.5						
Central	6/15/2020	3.0	7.2	5.4	21.5	8.8	100.7	93	5.4	3.8				11	5	
Central	6/15/2020	4.0	7.2		21.5	8.8	100.9	93	4.7	4.1						
Central	6/15/2020	5.0	7.2	6.0	21.4	8.8	100.5	93	4.5	4.1				11	5	
QA/QC	6/15/2020	5.0												13	5	
Central	6/15/2020	6.0	7.2		21.4	8.8	100.8	93	4.3	4.3						
Central	6/15/2020	7.0	7.1	5.8	21.4	8.8	101.2	93	4.2	4.4				10	5	
Central	6/15/2020	8.0	7.1		21.4	8.8	101.2	93	4.1	4.4						
Central	7/15/2020	0.1	6.9		25.5	8.0	98.6	95	5.2	5.3	4.3					
Central	7/15/2020	1.0	6.9	4.8	25.5	8.0	99.2	95	5.5	5.7				17	5	
Central	7/15/2020	2.0	6.8		25.5	8.0	98.9	95	5.8	5.9						
Central	7/15/2020	3.0	6.8	5.0	25.5	8.0	98.8	95	6.1	6.4				15	5	
QA/QC	7/15/2020	3.0												15	5	
Central	7/15/2020	4.0	6.7		25.5	8.0	98.6	94	6.6	5.9						
Central	7/15/2020	5.0	6.6	5.1	25.5	7.8	96.0	94	7.2	6.8				23	5	
Central	7/15/2020	6.0	6.7		24.1	0.7	8.3	96	7.5	36.2						
Central	7/15/2020	7.0	6.7	13.2	22.5	0.1	0.6	114	7.2	2.4				39	5	
Central	7/15/2020	7.6	6.7		20.9	0.0	0.0	145	10.0	4.2						
Central	8/12/2020	0.3	7.5		27.4	8.4	107.1	109	3.8	6.3	3.6					
Central	8/12/2020	1.0	7.5	4.5	27.4	8.3	107.0	109	3.9	6.7				16	5	
QA/QC-MB	8/12/2020	1.0												13.8		
Central	8/12/2020	2.0	7.5		27.4	8.3	106.9	109	3.8	7.0						
Central	8/12/2020	3.0	7.4	4.5	27.4	8.3	105.9	109	3.9	7.0				18	5	
Central	8/12/2020	4.0	7.4		27.4	8.1	104.0	109	4.0	6.1						
Central	8/12/2020	5.0	7.2	4.7	26.7	6.1	77.7	109	4.3	14.2				19	5	
Central	8/12/2020	6.0	6.9		26.1	1.6	19.5	110	4.9	9.1						
Central	8/12/2020	7.0	6.5	5.9	25.2	0.0	0.0	115	6.0	2.6				27	5	
QA/QC	8/12/2020	7.0												27	5	
QA/QC-MB	8/12/2020	7.0												26.6		
Central	9/8/2020	0.3	7.8		23.5	8.7	103.2	107	4.4	6.3	3.1					
Central	9/8/2020	1.0	7.7	4.0	23.5	8.6	103.0	107	4.5	7.2				19	8	
QA/QC	9/8/2020	1.0												20	5	
QA/QC - MB	9/8/2020	1.0												13.8		
Central	9/8/2020	2.0	7.7		23.5	8.6	102.5	107	4.5	8.0						
Central	9/8/2020	3.0	7.6	3.8	23.4	8.5	101.7	108	4.7	9.0				16	5	
Central	9/8/2020	4.0	7.6		23.4	8.5	101.1	108	4.9	8.7						
Central	9/8/2020	5.0	7.5	3.8	23.4	8.4	100.0	108	4.9	7.9				16	5	
Central	9/8/2020	6.0	7.4		23.4	7.9	93.9	108	5.1	10.2						
Central	9/8/2020	7.0	7.2	3.7	23.3	5.4	64.2	109	5.7	17.1				31	6	
QA/QC - MB	9/8/2020	7.0												26.6		
Central	9/8/2020	7.4	6.9		23.2	4.6	54.8	112	15.1	15.9						
Central	10/15/2020	1.0	6.7	3.0	16.3	9.9	102.1	108	4.5	3.5	2.1			22	6	
QA/QC - MB	10/15/2020	1.0												20.2		
Central	10/15/2020	3.0	6.7	3.3	16.2	9.8	101.5	107	4.7	6.9				23	6	
Central	10/15/2020	5.0	6.7	3.1	16.2	9.8	101.3	107	4.6	6.9				28	5	
Central	10/15/2020	6.4	6.7		16.2	9.1	93.7	107	4.9	6.1						
Central	10/15/2020	7.0	6.4	3.3	16.0	9.4	96.9	108	5.2	5.8				22	6	

Appendix Table A2. Central station water quality data for Hinckley's Pond (continued).

Location	Date	Depth	pH	Alk	Temp	DO	DO	SpCond	Turbidity	CHL	Secchi			Total P	Diss. P	Diss. Al
Hinckleys	DD/MM/YY	meters	Units	mg/L	°C	mg/l	% Sat	µS/cm	NTU	µg/l	m			µg/l	µg/l	µg/l
Central	5/4/2021	0.1	7.3		14.3	10.0	99.0	93	1.8	3.1	4.0					
Central	5/4/2021	1.0	7.3	3.2	14.3	10.0	99.2	93	1.7	3.3				24.4		
Central	5/4/2021	2.0	7.3		14.3	10.0	99.0	93	1.8	3.6						
Central	5/4/2021	3.0	7.2	3.7	14.3	10.0	98.9	92	1.9	4.0				28.7		
Central	5/4/2021	4.0	7.2		14.3	10.0	99.0	92	2.0	3.7						
Central	5/4/2021	5.0	7.2	3.3	14.3	10.0	98.9	92	2.0	4.0				25.5		
Central	5/4/2021	6.0	7.2		14.3	10.0	98.9	92	2.0	4.6						
Central	5/4/2021	7.0	7.2	3.5	14.3	10.0	98.9	92	2.1	3.7				26.6		
Central	5/4/2021	7.6	7.1		14.2	9.4	93.3	92	2.7	4.4						
Central	6/3/2021	0.3	7.2		18.6	9.1	98.2	109	1.9	3.9	3.6					
Central	6/3/2021	1.0	7.1	4.9	18.6	9.1	98.5	110	1.7	3.9				23.4		
Central	6/3/2021	2.0	7.1		18.5	9.1	98.7	109	1.9	4.2						
Central	6/3/2021	3.0	7.1	4.7	18.2	9.1	97.3	109	1.9	4.6				22.3		
Central	6/3/2021	4.0	7.1		17.3	7.8	82.3	109	1.9	6.0						
Central	6/3/2021	5.0	7.0	4.4	17.1	6.2	65.1	109	2.0	6.6				30.6		
Central	6/3/2021	6.0	6.9		17.0	5.9	62.2	109	2.0	5.4						
Central	6/3/2021	7.0	6.9	5.8	17.0	4.9	51.8	109	2.5	5.7				48.9		
Central	7/7/2021	0.1	7.6		24.3	8.6	104.5	111	1.3	3.8	2.9					
Central	7/7/2021	1.0	7.5	4.2	24.0	8.9	106.7	111	1.2	4.7				23.4		
Central	7/7/2021	2.0	7.5		23.8	8.7	104.1	111	1.1	6.0						
Central	7/7/2021	3.0	7.4	4.1	23.7	8.7	103.7	110	1.2	6.1				22.3		
Central	7/7/2021	4.0	7.4		23.5	7.8	93.0	111	1.4	6.6						
Central	7/7/2021	5.0	7.2	5.7	23.2	6.4	75.5	111	1.5	6.0				25.5		
Central	7/7/2021	6.0	7.0		22.4	4.3	50.3	112	1.7	4.7						
Central	7/7/2021	7.0	6.5	37.4	19.0	0.2	2.1	151	2.1	3.6				57.4		
Central	7/7/2021	7.5	6.5		17.1	0.0	0.0	199	2.9	4.4						
Central	8/4/2021	0.2	7.4		24.6	8.7	106.3	111	1.2	1.8	3.0					
Central	8/4/2021	1.0	7.4	4.8	24.6	8.8	106.5	111	1.1	6.4				10		
Central	8/4/2021	2.0	7.4		24.6	8.7	105.9	111	1.1	6.7						
Central	8/4/2021	3.0	7.3	5.2	24.5	8.5	102.9	111	1.1	6.8				12.8		
Central	8/4/2021	4.0	7.3		24.4	8.4	101.6	111	1.1	7.4						
Central	8/4/2021	5.0	6.8	4.7	24.2	5.3	63.9	112	1.7	7.1				10		
Central	8/4/2021	6.0	6.6		24.0	3.2	38.9	112	2.0	3.4						
Central	8/4/2021	7.0	6.4	6.2	23.3	0.0	0.0	114	2.7	3.7				13.8		
Central	9/10/2021	0.3	7.1		23.7	8.4	101.1	106	1.2	2.5	3.8					
Central	9/10/2021	1.0	7.1	4.8	23.7	8.5	101.4	108	1.2	3.0				13.8		
Central	9/10/2021	2.0	7.0		23.6	8.5	101.2	106	1.3	5.0						
Central	9/10/2021	3.0	7.0	4.0	23.6	8.5	101.4	107	1.3	5.5				13.8		
Central	9/10/2021	4.0	7.0		23.6	8.5	101.9	107	1.3	6.1						
Central	9/10/2021	5.0	6.9	4.2	23.5	8.5	101.7	107	1.3	6.1				15.9		
Central	9/10/2021	6.0	6.9		23.5	8.5	101.2	107	1.3	4.5						
Central	9/10/2021	7.0	6.8	3.8	23.5	8.2	97.3	107	1.1	4.0				19.1		
Central	10/5/2021	0.2	7.0		19.4	8.6	94.5	105	1.2	3.8	3.4					
Central	10/5/2021	1.0	7.0	4.0	19.4	8.6	94.2	105	1.3	3.9				29		
Central	10/5/2021	2.0	6.9		19.4	8.6	94.2	104	1.3	4.0						
Central	10/5/2021	3.0	6.9	4.2	19.4	8.5	93.7	104	1.3	4.5				21		
Central	10/5/2021	4.0	6.9		19.4	8.5	93.7	104	1.2	4.4						
Central	10/5/2021	5.0	6.8	3.6	19.4	8.5	93.5	104	1.2	5.6				21		
Central	10/5/2021	5.9	6.8		19.4	8.5	93.2	104	1.3	3.8						
Central	10/5/2021	7.0	6.7	3.8	19.4	8.4	92.3	104	2.1	3.9				24		
Central	10/5/2021	7.2	6.7		19.4	8.4	92.5	104	1.8	4.4						

Appendix Table A3. Zooplankton in Hinckley's Pond.

	ZOOPLANKTON BIOMASS (UG/L)															
TAXON	**9/21/11**	**9/9/19**	**9/27/19**	**10/29/19**	**5/21/20**	**6/15/20**	**7/15/20**	**8/12/20**	**9/8/20**	**10/15/20**	**5/4/21**	**6/3/21**	**7/7/21**	**8/4/21**	**9/10/21**	**10/5/21**
PROTOZOA																
Ciliophora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mastigophora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sarcodina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROTIFERA																
Asplanchna	4.8	2.2	0.0	0.2	2.0	1.0	2.0	0.5	0.8	0.3	1.1	0.7	1.3	0.0	1.0	1.6
Conochilus	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.3
Filinia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Keratella	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1
Ploesoma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polyarthra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Trichocerca	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COPEPODA																
Copepoda-Cyclopoida																
Cyclops	0.5	0.5	0.0	0.4	66.8	6.3	0.0	0.0	0.3	0.0	53.8	8.1	0.0	0.0	0.0	0.0
Mesocyclops	0.0	0.0	0.0	0.0	39.8	0.7	0.0	0.0	0.0	0.0	34.1	0.8	0.0	0.0	0.0	0.0
Copepoda-Calanoida	0.0	0.0	0.0	0.0												
Diaptomus	0.0	0.0	0.0	0.0	5.8	1.6	0.0	0.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Other Copepoda-Nauplii	1.3	0.6	0.0	0.5	26.2	6.2	1.1	0.0	0.3	0.0	41.7	3.5	0.0	0.0	0.8	0.0
CLADOCERA																
Alona	0.0	0.7	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bosmina	0.3	0.2	0.0	0.0	18.9	1.0	0.0	0.0	0.1	0.1	34.3	9.8	0.0	0.0	0.0	0.3
Ceriodaphnia	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Daphnia ambigua	0.0	0.0	0.0	0.0	156.6	1.7	0.0	0.0	0.2	0.0	121.5	9.2	0.0	0.0	0.0	0.0
Holopedium	0.8	0.0	0.0	0.0	13.3	0.0	0.0	0.0	0.0	0.0	17.5	113.0	1.8	0.0	0.0	0.0
OTHER ZOOPLANKTON																
Hydracarina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	627.0	0.0	0.0	0.0	0.0
SUMMARY STATISTICS																
BIOMASS	**9/21/11**	**9/9/19**	**9/27/19**	**10/29/19**	**5/21/20**	**6/15/20**	**7/15/20**	**8/12/20**	**9/8/20**	**10/15/20**	**5/4/21**	**6/3/21**	**7/7/21**	**8/4/21**	**9/10/21**	**10/5/21**
PROTOZOA	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROTIFERA	4.9	2.3	0.02	0.2	2.1	1.4	2.1	0.5	0.8	0.4	3.6	0.7	1.3	0.2	1.1	2.0
COPEPODA	1.8	1.1	0.00	0.9	138.6	14.8	1.1	0.1	0.7	0.0	130.2	12.4	0.0	0.0	0.8	0.0
CLADOCERA	1.1	0.9	0.00	0.5	188.8	3.6	0.0	0.0	0.3	0.1	173.3	132.0	1.8	0.0	0.0	0.3
OTHER ZOOPLANKTON	0.0	0.0	0.00	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	627.0	0.0	0.0	0.0	0.0
TOTAL ZOOPLANKTON	7.8	4.3	0.02	1.7	329.5	19.8	3.1	3.1	1.8	0.5	307.1	772.0	3.1	0.2	1.9	2.3
MEAN LENGTH (mm): ALL FORMS	0.33	0.31	0.10	0.28	0.68	0.34	0.34	0.46	0.35	0.15	0.42	0.73	0.31	0.10	0.22	0.14
MEAN LENGTH: CRUSTACEANS	0.42	0.45	0.00	0.50	0.71	0.54	0.30	0.70	0.48	0.30	0.56	0.71	0.80	0.00	0.30	0.30

Appendix Table A4. Phytoplankton in Hinckley's Pond from 2011.

	PHYTOPLANKTON DENSITY					
	(CELLS/ML)			(UG/L)		
	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys
TAXON	**08/15/11**	**09/21/11**	**10/14/11**	**08/15/11**	**09/21/11**	**10/14/11**
BACILLARIOPHYTA						
Centric Diatoms						
Aulacoseira	0	650	890	0.0	195.0	267.0
Cyclotella	0	130	20	0.0	13.0	2.0
Araphid Pennate Diatoms						
Synedra	25	364	550	20.0	291.2	584.0
Tabellaria	0	52	0	0.0	41.6	0.0
Monoraphid Pennate Diatoms						
Biraphid Pennate Diatoms						
Nitzschia	25	0	0	20.0	0.0	0.0
CHLOROPHYTA						
Flagellated Chlorophytes						
Coccoid/Colonial Chlorophytes						
Ankistrodesmus	0	780	230	0.0	78.0	23.0
Coelastrum	0	416	200	0.0	83.2	40.0
Golenkinia	0	624	120	0.0	124.8	24.0
Micractinium	200	1300	60	600.0	3900.0	180.0
Pediastrum	0	208	400	0.0	41.6	80.0
Scenedesmus	600	416	640	60.0	41.6	64.0
Schroederia	50	260	80	125.0	650.0	200.0
Filamentous Chlorophytes						
Desmids						
Staurastrum	0	312	840	0.0	249.6	672.0
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Mallomonas	25	78	30	12.5	39.0	50.0
Synura	300	0	0	240.0	0.0	0.0
Non-Motile Classic Chrysophytes						
Haptophytes						
Tribophytes/Eustigmatophytes						
Raphidophytes						
CRYPTOPHYTA						
Cryptomonas	200	52	40	40.0	10.4	8.0
CYANOPHYTA						
Unicellular and Colonial Forms						
Aphanocapsa	0	0	2400	0.0	0.0	24.0
Filamentous Nitrogen Fixers						
Anabaena	27750	0	0	5550.0	0.0	0.0
Aphanizomenon	10500	4680	5200	1365.0	608.4	676.0
Filamentous Non-Nitrogen Fixers						
Planktolyngbya	47500	23400	11250	475.0	234.0	112.5
Pseudanabaena	1500	1560	8500	15.0	15.6	85.0
EUGLENOPHYTA						
Trachelomonas	25	52	40	25.0	52.0	40.0
PYRRHOPHYTA						
Peridinium	0	26	80	0.0	54.6	597.0

	(CELLS/ML)			(UG/L)		
	Hinckley	Hinckley	Hinckley	Hinckley	Hinckley	Hinckley
Phytoplankton Group	**08/15/11**	**09/21/11**	**10/14/11**	**08/15/11**	**09/21/11**	**10/14/11**
BACILLARIOPHYTA	**50**	**1196**	**1510**	**40.0**	**540.8**	**981.0**
Centric Diatoms	0	780	930	0.0	208.0	282.0
Araphid Pennate Diatoms	25	416	550	20.0	332.8	584.0
Monoraphid Pennate Diatoms	0	0	0	0.0	0.0	0.0
Biraphid Pennate Diatoms	25	0	30	20.0	0.0	115.0
CHLOROPHYTA	**850**	**4316**	**2570**	**785.0**	**5168.8**	**1283.0**
Flagellated Chlorophytes	0	0	0	0.0	0.0	0.0
Coccoid/Colonial Chlorophytes	850	4004	1730	785.0	4919.2	611.0
Filamentous Chlorophytes	0	0	0	0.0	0.0	0.0
Desmids	0	312	840	0.0	249.6	672.0
CHRYSOPHYTA	**325**	**78**	**30**	**252.5**	**39.0**	**50.0**
Flagellated Classic Chrysophytes	325	78	30	252.5	39.0	50.0
Non-Motile Classic Chrysophytes	0	0	0	0.0	0.0	0.0
Haptophytes	0	0	0	0.0	0.0	0.0
Tribophytes/Eustigmatophytes	0	0	0	0.0	0.0	0.0
Raphidophytes	0	0	0	0.0	0.0	0.0
CRYPTOPHYTA	**200**	**52**	**40**	**40.0**	**10.4**	**8.0**
CYANOPHYTA	**87250**	**29640**	**27350**	**7405.0**	**858.0**	**897.5**
Unicellular and Colonial Forms	0	0	2400	0.0	0.0	24.0
Filamentous Nitrogen Fixers	38250	4680	5200	6915.0	608.4	676.0
Filamentous Non-Nitrogen Fixers	49000	24960	19750	490.0	249.6	197.5
EUGLENOPHYTA	**25**	**52**	**40**	**25.0**	**52.0**	**40.0**
PYRRHOPHYTA	**0**	**26**	**80**	**0.0**	**54.6**	**597.0**
TOTAL	**88700**	**35360**	**31620**	**8547.5**	**6723.6**	**3856.5**
CELL DIVERSITY	**0.48**	**0.59**	**0.78**	**0.52**	**0.72**	**1.04**
CELL EVENNESS	**0.43**	**0.46**	**0.56**	**0.47**	**0.56**	**0.76**

Appendix Table A5. Phytoplankton in Hinckley's Pond from 2019.

	PHYTOPLANKTON DENSITY (CELLS/ML)					PHYTOPLANKTON BIOMASS (UG/L)			
TAXON	**08/12/19**	**09/09/19**	**09/27/19**	**10/29/19**	**TAXON**	**08/12/19**	**09/09/19**	**09/27/19**	**10/29/19**
BACILLARIOPHYTA					**BACILLARIOPHYTA**				
Centric Diatoms					**Centric Diatoms**				
Acanthoceras	0	30	0	0	*Acanthoceras*	0.0	35.5	0.0	0.0
Aulacoseira	14	74	15	14	*Aulacoseira*	4.2	22.2	4.4	4.3
Urosolenia	28	22	0	0	*Urosolenia*	33.6	26.6	0.0	0.0
Araphid Pennate Diatoms					**Araphid Pennate Diatoms**				
Asterionella	0	0	0	28	*Asterionella*	0.0	0.0	0.0	5.7
Fragilaria/related taxa	0	185	0	0	*Fragilaria/related taxa*	0.0	55.5	0.0	0.0
Synedra	14	7	0	0	*Synedra*	11.2	5.9	0.0	0.0
Tabellaria	28	0	0	7	*Tabellaria*	22.4	0.0	0.0	5.7
Biraphid Pennate Diatoms					**Biraphid Pennate Diatoms**				
Eunotia	0	7	0	0	*Eunotia*	0.0	7.4	0.0	0.0
Nitzschia	21	30	0	0	*Nitzschia*	16.8	23.7	0.0	0.0
Coccoid/Colonial Chlorophytes					**Coccoid/Colonial Chlorophytes**				
Closteriopsis	0	30	7	0	*Closteriopsis*	0.0	14.8	3.7	0.0
Coelastrum	0	89	0	0	*Coelastrum*	0.0	17.8	0.0	0.0
Golenkinia	0	7	7	0	*Golenkinia*	0.0	1.5	1.5	0.0
Micractinium	0	89	0	0	*Micractinium*	0.0	266.4	0.0	0.0
Paulschulzia	0	30	0	0	*Paulschulzia*	0.0	11.8	0.0	0.0
Pediastrum	0	104	30	0	*Pediastrum*	0.0	20.7	5.9	0.0
Scenedesmus	0	118	0	57	*Scenedesmus*	0.0	11.8	0.0	5.7
CHRYSOPHYTA					**CHRYSOPHYTA**				
Flagellated Classic Chrysophytes					**Flagellated Classic Chrysophytes**				
Dinobryon	14	170	44	28	*Dinobryon*	42.0	510.6	133.2	85.2
Mallomonas	35	0	0	21	*Mallomonas*	17.5	0.0	0.0	10.7
CRYPTOPHYTA					**CRYPTOPHYTA**				
Cryptomonas	0	0	0	28	*Cryptomonas*	0.0	0.0	0.0	5.7
CYANOPHYTA					**CYANOPHYTA**				
Unicellular and Colonial Forms					**Unicellular and Colonial Forms**				
Microcystis	0	1480	0	0	*Microcystis*	0.0	14.8	0.0	0.0
Filamentous Nitrogen Fixers					**Filamentous Nitrogen Fixers**				
Aphanizomenon	1540	296	0	0	*Aphanizomenon*	200.2	38.5	0.0	0.0
Dolichospermum	210	222	0	0	*Dolichospermum*	42.0	44.4	0.0	0.0
Filamentous Non-Nitrogen Fixers					**Filamentous Non-Nitrogen Fixers**				
Planktolyngbya	11200	18130	0	0	*Planktolyngbya*	112.0	181.3	0.0	0.0
Planktothrix	0	0	0	284	*Planktothrix*	0.0	0.0	0.0	2.8
Pseudanabaena	0	0	0	284	*Pseudanabaena*	0.0	0.0	0.0	2.8
EUGLENOPHYTA					**EUGLENOPHYTA**				
Euglena	0	7	0	0	*Euglena*	0.0	3.7	0.0	0.0
Trachelomonas	14	7	0	0	*Trachelomonas*	14.0	7.4	0.0	0.0
PYRRHOPHYTA					**PYRRHOPHYTA**				
Peridinium	14	185	104	36	*Peridinium*	329.7	5150.4	852.5	74.6
DENSITY (CELLS/ML) SUMMARY					**DENSITY (UG/ML) SUMMARY**				
BACILLARIOPHYTA	**105**	**355.2**	**14.8**	**49.7**	**BACILLARIOPHYTA**	**88.2**	**176.9**	**4.4**	**15.6**
Centric Diatoms	42	125.8	14.8	14.2	Centric Diatoms	37.8	84.4	4.4	4.3
Araphid Pennate Diatoms	42	192.4	0	35.5	Araphid Pennate Diatoms	33.6	61.4	0.0	11.4
Monoraphid Pennate Diatoms	0	0	0	0	Monoraphid Pennate Diatoms	0.0	0.0	0.0	0.0
Biraphid Pennate Diatoms	21	37	0	0	Biraphid Pennate Diatoms	16.8	31.1	0.0	0.0
CHLOROPHYTA	**0**	**466.2**	**44.4**	**56.8**	**CHLOROPHYTA**	**0.0**	**344.8**	**11.1**	**5.7**
Flagellated Chlorophytes	0	0	0	0	Flagellated Chlorophytes	0.0	0.0	0.0	0.0
Coccoid/Colonial Chlorophytes	0	466.2	44.4	56.8	Coccoid/Colonial Chlorophytes	0.0	344.8	11.1	5.7
Filamentous Chlorophytes	0	0	0	0	Filamentous Chlorophytes	0.0	0.0	0.0	0.0
Desmids	0	0	0	0	Desmids	0.0	0.0	0.0	0.0
CHRYSOPHYTA	**49**	**170.2**	**44.4**	**49.7**	**CHRYSOPHYTA**	**59.5**	**510.6**	**133.2**	**95.9**
Flagellated Classic Chrysophyt	49	170.2	44.4	49.7	Flagellated Classic Chrysophy	59.5	510.6	133.2	95.9
Non-Motile Classic Chrysophyte	0	0	0	0	Non-Motile Classic Chrysophyt	0.0	0.0	0.0	0.0
Haptophytes	0	0	0	0	Haptophytes	0.0	0.0	0.0	0.0
Tribophytes/Eustigmatophytes	0	0	0	0	Tribophytes/Eustigmatophytes	0.0	0.0	0.0	0.0
Raphidophytes	0	0	0	0	Raphidophytes	0.0	0.0	0.0	0.0
CRYPTOPHYTA	**0**	**0**	**0**	**28.4**	**CRYPTOPHYTA**	**0.0**	**0.0**	**0.0**	**5.7**
CYANOPHYTA	**12950**	**20128**	**0**	**568**	**CYANOPHYTA**	**354.2**	**279.0**	**0.0**	**5.7**
Unicellular and Colonial Forms	0	1480	0	0	Unicellular and Colonial Forms	0.0	14.8	0.0	0.0
Filamentous Nitrogen Fixers	1750	518	0	0	Filamentous Nitrogen Fixers	242.2	82.9	0.0	0.0
Filamentous Non-Nitrogen Fixer	11200	18130	0	568	Filamentous Non-Nitrogen Fixe	112.0	181.3	0.0	5.7
EUGLENOPHYTA	**14**	**14.8**	**0**	**0**	**EUGLENOPHYTA**	**14.0**	**11.1**	**0.0**	**0.0**
PYRRHOPHYTA	**14**	**185**	**103.6**	**35.5**	**PYRRHOPHYTA**	**329.7**	**5150.4**	**852.5**	**74.6**
TOTAL	**13132**	**21319.4**	**207.2**	**788.1**	**TOTAL**	**845.6**	**6472.8**	**1001.2**	**203.1**
CELL DIVERSITY	**0.24**	**0.32**	**0.60**	**0.71**	**BIOMASS DIVERSITY**	**0.79**	**0.40**	**0.21**	**0.65**
CELL EVENNESS	**0.22**	**0.24**	**0.77**	**0.71**	**BIOMASS EVENNESS**	**0.73**	**0.30**	**0.27**	**0.65**

Appendix Table A6. Phytoplankton in Hinckley's Pond from 2020.

TAXON	PHYTOPLANKTON DENSITY (CELLS/ML) 05/21/20	06/15/20	07/15/20	08/12/20	09/08/20	10/15/20
BACILLARIOPHYTA						
Centric Diatoms						
Acanthoceras	0	0	0	0	8	16
Aulacoseira	0	29	20	29	249	122
Urosolenia	0	19	68	19	0	16
Araphid Pennate Diatoms						
Asterionella	27	0	0	0	66	454
Fragilaria/related taxa	0	0	136	0	0	0
Synedra	14	0	27	0	50	316
Tabellaria	14	29	88	29	100	203
Biraphid Pennate Diatoms						
Eunotia	0	0	0	0	0	0
Nitzschia	0	0	0	0	0	0
CHLOROPHYTA						
Flagellated Chlorophytes						
Pandorina	0	115	0	115	66	0
Coccoid/Colonial Chlorophytes						
Elakatothrix	27	0	0	0	0	0
Golenkinia	0	19	0	19	8	16
Pediastrum	0	0	0	0	0	97
Scenedesmus	54	38	0	38	33	65
Schroederia	7	0	0	0	0	0
Filamentous Chlorophytes						
Ulothrix	27	0	0	0	0	0
Desmids						
Cosmarium	14	0	0	0	0	0
Spirogyra	0	0	0	0	0	16
Staurastrum	7	0	0	0	0	0
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Chrysosphaerella	0	0	0	0	0	259
Dinobryon	367	106	245	106	83	113
Mallomonas	0	0	0	0	0	65
Uroglena	0	192	0	192	83	0
CYANOPHYTA						
Unicellular and Colonial Forms						
Dolichospermum	0	96	0	96	0	0
Filamentous Non-Nitrogen Fixers						
Planktolyngbya	0	0	0	0	2905	2268
Pseudanabaena	0	0	0	0	0	243
EUGLENOPHYTA						
Euglena	0	10	0	10	0	0
PYRRHOPHYTA						
Peridinium	0	230	54	230	42	24
DENSITY (CELLS/ML) SUMMARY						
BACILLARIOPHYTA	**54.4**	**76.8**	**340**	**76.8**	**473.1**	**1134**
Centric Diatoms	0	48	88.4	48	257.3	153.9
Araphid Pennate Diatoms	54.4	28.8	251.6	28.8	215.8	972
Monoraphid Pennate Diatoms	0	0	0	0	0	0
Biraphid Pennate Diatoms	0	0	0	0	0	8.1
CHLOROPHYTA	**136**	**172.8**	**0**	**172.8**	**107.9**	**194.4**
Flagellated Chlorophytes	0	115.2	0	115.2	66.4	0
Coccoid/Colonial Chlorophytes	88.4	57.6	0	57.6	41.5	178.2
Filamentous Chlorophytes	27.2	0	0	0	0	0
Desmids	20.4	0	0	0	0	16.2
CHRYSOPHYTA	**367.2**	**297.6**	**244.8**	**297.6**	**166**	**437.4**
Flagellated Classic Chrysophytes	367.2	297.6	244.8	297.6	166	437.4
Non-Motile Classic Chrysophytes	0	0	0	0	0	0
Haptophytes	0	0	0	0	0	0
Tribophytes/Eustigmatophytes	0	0	0	0	0	0
Raphidophytes	0	0	0	0	0	0
CRYPTOPHYTA	**0**	**0**	**0**	**0**	**0**	**0**
CYANOPHYTA	**0**	**96**	**0**	**96**	**2905**	**2511**
Unicellular and Colonial Forms	0	0	0	0	0	0
Filamentous Nitrogen Fixers	0	96	0	96	0	0
Filamentous Non-Nitrogen Fixers	0	0	0	0	2905	2511
EUGLENOPHYTA	**0**	**9.6**	**0**	**9.6**	**0**	**0**
PYRRHOPHYTA	**0**	**230.4**	**54.4**	**230.4**	**41.5**	**24.3**
TOTAL	**557.6**	**883.2**	**639.2**	**883.2**	**3693.5**	**4301.1**
CELL DIVERSITY	**0.57**	**0.88**	**0.72**	**0.88**	**0.42**	**0.77**
CELL EVENNESS	**0.57**	**0.84**	**0.85**	**0.84**	**0.39**	**0.63**

TAXON	PHYTOPLANKTON BIOMASS (UG/L) 05/21/20	06/15/20	07/15/20	08/12/20	09/08/20	10/15/20
BACILLARIOPHYTA						
Centric Diatoms						
Acanthoceras	0.0	0.0	0.0	0.0	10.0	19.4
Aulacoseira	0.0	8.6	6.1	8.6	74.7	36.5
Urosolenia	0.0	23.0	81.6	23.0	0.0	19.4
Araphid Pennate Diatoms						
Asterionella	5.4	0.0	0.0	0.0	13.3	90.7
Fragilaria/related taxa	0.0	0.0	40.8	0.0	0.0	0.0
Synedra	10.9	0.0	21.8	0.0	39.8	252.7
Tabellaria	10.9	23.0	70.7	23.0	79.7	162.0
Biraphid Pennate Diatoms						
Eunotia	0.0	0.0	0.0	0.0	0.0	0.0
Nitzschia	0.0	0.0	0.0	0.0	0.0	0.0
CHLOROPHYTA						
Flagellated Chlorophytes						
Pandorina	0.0	11.5	0.0	11.5	6.6	0.0
Coccoid/Colonial Chlorophytes						
Elakatothrix	2.7	0.0	0.0	0.0	0.0	0.0
Golenkinia	0.0	3.8	0.0	3.8	1.7	3.2
Pediastrum	0.0	0.0	0.0	0.0	0.0	19.4
Scenedesmus	5.4	3.8	0.0	3.8	3.3	6.5
Schroederia	17.0	0.0	0.0	0.0	0.0	0.0
Filamentous Chlorophytes						
Ulothrix	5.4	0.0	0.0	0.0	0.0	0.0
Desmids						
Cosmarium	10.9	0.0	0.0	0.0	0.0	0.0
Spirogyra	0.0	0.0	0.0	0.0	0.0	324.0
Staurastrum	5.4	0.0	0.0	0.0	0.0	0.0
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Chrysosphaerella	0.0	0.0	0.0	0.0	0.0	103.7
Dinobryon	1101.6	316.8	734.4	316.8	249.0	340.2
Mallomonas	0.0	0.0	0.0	0.0	0.0	32.4
Uroglena	0.0	19.2	0.0	19.2	8.3	0.0
CYANOPHYTA						
Unicellular and Colonial Forms						
Dolichospermum	0.0	19.2	0.0	19.2	0.0	0.0
Filamentous Non-Nitrogen Fixers						
Planktolyngbya	0.0	0.0	0.0	0.0	29.1	22.7
Pseudanabaena	0.0	0.0	0.0	0.0	0.0	2.4
EUGLENOPHYTA						
Euglena	0.0	4.8	0.0	4.8	0.0	0.0
PYRRHOPHYTA						
Peridinium	0.0	483.8	1281.1	483.8	87.2	398.5
DENSITY (UG/ML) SUMMARY						
BACILLARIOPHYTA	**27.2**	**54.7**	**221.0**	**54.7**	**217.5**	**661.8**
Centric Diatoms	0.0	31.7	87.7	31.7	84.7	75.3
Araphid Pennate Diatoms	27.2	23.0	133.3	23.0	132.8	505.4
Monoraphid Pennate Diatoms	0.0	0.0	0.0	0.0	0.0	0.0
Biraphid Pennate Diatoms	0.0	0.0	0.0	0.0	0.0	81.0
CHLOROPHYTA	**46.9**	**19.2**	**0.0**	**19.2**	**11.6**	**353.2**
Flagellated Chlorophytes	0.0	11.5	0.0	11.5	6.6	0.0
Coccoid/Colonial Chlorophytes	25.2	7.7	0.0	7.7	5.0	29.2
Filamentous Chlorophytes	5.4	0.0	0.0	0.0	0.0	0.0
Desmids	16.3	0.0	0.0	0.0	0.0	324.0
CHRYSOPHYTA	**1101.6**	**336.0**	**734.4**	**336.0**	**257.3**	**476.3**
Flagellated Classic Chrysophytes	1101.6	336.0	734.4	336.0	257.3	476.3
Non-Motile Classic Chrysophytes	0.0	0.0	0.0	0.0	0.0	0.0
Haptophytes	0.0	0.0	0.0	0.0	0.0	0.0
Tribophytes/Eustigmatophytes	0.0	0.0	0.0	0.0	0.0	0.0
Raphidophytes	0.0	0.0	0.0	0.0	0.0	0.0
CRYPTOPHYTA	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
CYANOPHYTA	**0.0**	**19.2**	**0.0**	**19.2**	**29.1**	**25.1**
Unicellular and Colonial Forms	0.0	0.0	0.0	0.0	0.0	0.0
Filamentous Nitrogen Fixers	0.0	19.2	0.0	19.2	0.0	0.0
Filamentous Non-Nitrogen Fixers	0.0	0.0	0.0	0.0	29.1	25.1
EUGLENOPHYTA	**0.0**	**4.8**	**0.0**	**4.8**	**0.0**	**0.0**
PYRRHOPHYTA	**0.0**	**483.8**	**1281.1**	**483.8**	**87.2**	**398.5**
TOTAL	**1175.7**	**917.8**	**2236.5**	**917.8**	**602.6**	**1914.8**
BIOMASS DIVERSITY	**0.16**	**0.53**	**0.46**	**0.53**	**0.78**	**0.96**
BIOMASS EVENNESS	**0.16**	**0.51**	**0.54**	**0.51**	**0.73**	**0.78**

Appendix Table A7. Phytoplankton in Hinckley's Pond from 2021.

PHYTOPLANKTON DENSITY (CELLS/ML)						
	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys
TAXON	**05/04/21**	**06/03/21**	**07/07/21**	**08/04/21**	**09/10/21**	**10/05/21**
BACILLARIOPHYTA						
Centric Diatoms						
Acanthoceras	0	0	29	0	26	6
Aulacoseira	0	0	173	56	60	19
Cyclotella	0	0	230	0	0	0
Urosolenia	0	0	72	14	13	6
Araphid Pennate Diatoms						
Asterionella	230	99	29	14	9	50
Fragilaria/related taxa	0	0	0	0	0	25
Synedra	29	12	230	70	30	56
Tabellaria	192	0	58	392	151	62
Monoraphid Pennate Diatoms						
Biraphid Pennate Diatoms						
Nitzschia	0	0	216	0	0	0
CHLOROPHYTA						
Flagellated Chlorophytes						
Chlamydomonas	0	50	0	0	0	0
Pandorina	0	0	0	84	0	0
Coccoid/Colonial Chlorophytes						
Actinastrum	0	0	58	0	0	0
Crucigenia	0	50	115	0	0	149
Dictyosphaerium	0	0	230	0	0	0
Elakatothrix	0	0	115	0	0	0
Oocystis	0	50	58	0	0	0
Pediastrum	0	0	0	84	0	0
Scenedesmus	77	347	691	28	17	50
Schroederia	0	12	0	0	0	0
Sphaerocystis	0	99	0	0	0	0
Filamentous Chlorophytes						
Desmids						
Staurastrum	19	0	0	14	17	37
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Dinobryon	29	50	202	98	43	112
Mallomonas	38	0	0	0	9	6
Non-Motile Classic Chrysophytes						
Haptophytes						
Tribophytes/Eustigmatophytes						
Centritractus	0	0	86	7	17	0
Raphidophytes						
CRYPTOPHYTA						
Cryptomonas	230	136	475	0	0	0
CYANOPHYTA						
Unicellular and Colonial Forms						
Filamentous Nitrogen Fixers						
Filamentous Non-Nitrogen Fixers						
Planktolyngbya	0	0	2880	27720	9933	1860
Pseudanabaena	0	0	0	210	215	0
EUGLENOPHYTA						
Euglena	0	0	14	21	9	6
Trachelomonas	0	0	29	7	4	0
PYRRHOPHYTA						
Peridinium	0	0	29	35	26	6
DENSITY (CELLS/ML) SUMMARY						
BACILLARIOPHYTA	**451.2**	**111.6**	**1036.8**	**546**	**288.1**	**223.2**
Centric Diatoms	0	0	504	70	98.9	31
Araphid Pennate Diatoms	451.2	111.6	316.8	476	189.2	192.2
Monoraphid Pennate Diatoms	0	0	0	0	0	0
Biraphid Pennate Diatoms	0	0	216	0	0	0
CHLOROPHYTA	**96**	**607.6**	**1267.2**	**210**	**34.4**	**235.6**
Flagellated Chlorophytes	0	49.6	0	84	0	0
Coccoid/Colonial Chlorophytes	76.8	558	1267.2	112	17.2	198.4
Filamentous Chlorophytes	0	0	0	0	0	0
Desmids	19.2	0	0	14	17.2	37.2
CHRYSOPHYTA	**67.2**	**49.6**	**288**	**105**	**68.8**	**117.8**
Flagellated Classic Chrysophytes	67.2	49.6	201.6	98	51.6	117.8
Non-Motile Classic Chrysophytes	0	0	0	0	0	0
Haptophytes	0	0	0	0	0	0
Tribophytes/Eustigmatophytes	0	0	86.4	7	17.2	0
Raphidophytes	0	0	0	0	0	0
CRYPTOPHYTA	**230.4**	**136.4**	**475.2**	**0**	**0**	**0**
CYANOPHYTA	**0**	**0**	**2880**	**27930**	**10148**	**1860**
Unicellular and Colonial Forms	0	0	0	0	0	0
Filamentous Nitrogen Fixers	0	0	0	0	0	0
Filamentous Non-Nitrogen Fixers	0	0	2880	27930	10148	1860
EUGLENOPHYTA	**0**	**0**	**43.2**	**28**	**12.9**	**6.2**
PYRRHOPHYTA	**0**	**0**	**28.8**	**35**	**25.8**	**6.2**
TOTAL	**844.8**	**905.2**	**6019.2**	**28854**	**10578**	**2449**
CELL DIVERSITY	**0.75**	**0.82**	**0.88**	**0.11**	**0.15**	**0.47**
CELL EVENNESS	**0.83**	**0.82**	**0.67**	**0.09**	**0.13**	**0.40**

PHYTOPLANKTON BIOMASS (UG/L)						
	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys	Hinckleys
TAXON	**05/04/21**	**06/03/21**	**07/07/21**	**08/04/21**	**09/10/21**	**10/05/21**
BACILLARIOPHYTA						
Centric Diatoms						
Acanthoceras	0.0	0.0	34.6	0.0	31.0	7.4
Aulacoseira	0.0	0.0	51.8	16.8	18.1	5.6
Cyclotella	0.0	0.0	23.0	0.0	0.0	0.0
Urosolenia	0.0	0.0	86.4	16.8	15.5	7.4
Araphid Pennate Diatoms						
Asterionella	46.1	19.8	5.8	2.8	1.7	9.9
Fragilaria/related taxa	0.0	0.0	0.0	0.0	0.0	7.4
Synedra	23.0	9.9	184.3	156.8	24.1	44.6
Tabellaria	153.6	0.0	46.1	313.6	120.4	49.6
Monoraphid Pennate Diatoms						
Biraphid Pennate Diatoms						
Nitzschia	0.0	0.0	172.8	0.0	0.0	0.0
CHLOROPHYTA						
Flagellated Chlorophytes						
Chlamydomonas	0.0	5.0	0.0	0.0	0.0	0.0
Pandorina	0.0	0.0	0.0	8.4	0.0	0.0
Coccoid/Colonial Chlorophytes						
Actinastrum	0.0	0.0	5.8	0.0	0.0	0.0
Crucigenia	0.0	5.0	11.5	0.0	0.0	14.9
Dictyosphaerium	0.0	0.0	23.0	0.0	0.0	0.0
Elakatothrix	0.0	0.0	11.5	0.0	0.0	0.0
Oocystis	0.0	19.8	23.0	0.0	0.0	0.0
Pediastrum	0.0	0.0	0.0	16.8	0.0	0.0
Scenedesmus	7.7	34.7	69.1	2.8	1.7	5.0
Schroederia	0.0	31.0	0.0	0.0	0.0	0.0
Sphaerocystis	0.0	19.8	0.0	0.0	0.0	0.0
Filamentous Chlorophytes						
Desmids						
Staurastrum	15.4	0.0	0.0	11.2	13.8	29.8
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Dinobryon	86.4	148.8	604.8	294.0	129.0	334.8
Mallomonas	19.2	0.0	0.0	0.0	4.3	3.1
Non-Motile Classic Chrysophytes						
Haptophytes						
Tribophytes/Eustigmatophytes						
Centritractus	0.0	0.0	13.0	1.1	2.6	0.0
Raphidophytes						
CRYPTOPHYTA						
Cryptomonas	46.1	27.3	95.0	0.0	0.0	0.0
CYANOPHYTA						
Unicellular and Colonial Forms						
Filamentous Nitrogen Fixers						
Filamentous Non-Nitrogen Fixers						
Planktolyngbya	0.0	0.0	28.8	277.2	99.3	18.6
Pseudanabaena	0.0	0.0	0.0	2.1	2.2	0.0
EUGLENOPHYTA						
Euglena	0.0	0.0	7.2	10.5	4.3	3.1
Trachelomonas	0.0	0.0	28.8	7.0	4.3	0.0
PYRRHOPHYTA						
Peridinium	0.0	0.0	60.5	373.8	607.6	13.0
DENSITY (UG/ML) SUMMARY						
BACILLARIOPHYTA	**222.7**	**29.8**	**604.8**	**506.8**	**210.7**	**132.1**
Centric Diatoms	0.0	0.0	195.8	33.6	64.5	20.5
Araphid Pennate Diatoms	222.7	29.8	236.2	473.2	146.2	111.6
Monoraphid Pennate Diatoms	0.0	0.0	0.0	0.0	0.0	0.0
Biraphid Pennate Diatoms	0.0	0.0	172.8	0.0	0.0	0.0
CHLOROPHYTA	**23.0**	**115.3**	**144.0**	**39.2**	**15.5**	**49.6**
Flagellated Chlorophytes	0.0	5.0	0.0	8.4	0.0	0.0
Coccoid/Colonial Chlorophytes	7.7	110.4	144.0	19.6	1.7	19.8
Filamentous Chlorophytes	0.0	0.0	0.0	0.0	0.0	0.0
Desmids	15.4	0.0	0.0	11.2	13.8	29.8
CHRYSOPHYTA	**105.6**	**148.8**	**617.8**	**295.1**	**135.9**	**337.9**
Flagellated Classic Chrysophytes	105.6	148.8	604.8	294.0	133.3	337.9
Non-Motile Classic Chrysophytes	0.0	0.0	0.0	0.0	0.0	0.0
Haptophytes	0.0	0.0	0.0	0.0	0.0	0.0
Tribophytes/Eustigmatophytes	0.0	0.0	13.0	1.1	2.6	0.0
Raphidophytes	0.0	0.0	0.0	0.0	0.0	0.0
CRYPTOPHYTA	**46.1**	**27.3**	**95.0**	**0.0**	**0.0**	**0.0**
CYANOPHYTA	**0.0**	**0.0**	**28.8**	**279.3**	**101.5**	**18.6**
Unicellular and Colonial Forms	0.0	0.0	0.0	0.0	0.0	0.0
Filamentous Nitrogen Fixers	0.0	0.0	0.0	0.0	0.0	0.0
Filamentous Non-Nitrogen Fixers	0.0	0.0	28.8	279.3	101.5	18.6
EUGLENOPHYTA	**0.0**	**0.0**	**36.0**	**17.5**	**8.6**	**3.1**
PYRRHOPHYTA	**0.0**	**0.0**	**60.5**	**373.8**	**607.6**	**13.0**
TOTAL	**397.4**	**321.2**	**1586.9**	**1511.7**	**1079.7**	**554.3**
BIOMASS DIVERSITY	**0.74**	**0.77**	**0.98**	**0.80**	**0.66**	**0.68**
BIOMASS EVENNESS	**0.82**	**0.77**	**0.74**	**0.67**	**0.55**	**0.58**