LAKE HOPATCONG
WATER QUALITY MONITORING
ANNUAL REPORT 2010

PREPARED FOR:

The Lake Hopatcong Commission
P.O. Box 8515
Landing, New Jersey 07850

PREPARED BY:

Princeton Hydro, LLC
1108 Old York Road, Suite 1
P.O. Box 720
Ringoes, New Jersey 08551
(P) 908.237.5660 • (F) 908.237.5666

120 East Uwchlan Avenue
Suite 204
Exton, Pennsylvania 19341
(P) 610.524.4220 • (F) 610.524.9434

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1.0 INTRODUCTION

Princeton Hydro, LLC conducted general water quality monitoring of Lake Hopatcong during the 2010 growing season (May through September). This monitoring program represents a continuation of the long-term monitoring program of Lake Hopatcong. However, it should be noted that the 2010, 2011 and 2012 water quality monitoring programs are being funded through the NJDEP, SFY10, Non-Point Source (319(h) of the Clean Water Act) grant program (Project Grant RP10-087)

The current water quality monitoring program is a modified version of the program that was originally initiated in the Phase I Diagnostic / Feasibility Study of Lake Hopatcong (PAS, 1983) and continued through the Phase II Implementation Project. Both the Phase I and Phase II projects were funded by the US EPA Clean Lakes (314) Program. The modified monitoring program also continued through the development, revision and approval of the TMDL-based Restoration Plan, as well as through the installation of a series of watershed project funded through a NJDEP 319 grants and a US EPA Targeted Watershed grant.

The current water quality monitoring program is valuable in terms of continuing to assess the overall "health" of the lake on a year to year basis, identifying long-term trends or changes in water quality, and quantifying and objectively assessing the success and potential impacts of restoration efforts. In addition, the in-lake water quality monitoring program will be an important component of evaluating the long-term success of the implementation of the phosphorus TMDL-based Restoration Plan, which was approved by NJDEP in April of 2006.

2.0 MATERIALS AND METHODS

In-lake water quality monitoring was conducted at the following eleven (11) locations in Lake Hopatcong (represented as red circles in Figure 1, Appendix A) during the study period:

Station Number	Location
1	Woodport Bay
2	Mid-Lake
3	Crescent Cove/River Styx
4	Point Pleasant/King Cove
5	Outlet
6	Henderson Cove
7	Inlet from Lake Shawnee
8*	Great Cove
9*	Byram Cove
10	Northern Woodport Bay
11	Jefferson Canals

* *In-situ* monitoring only

The 2010 sampling dates were 25 May, 28 June, 28 July, 25 August and 22 September. A Eureka Amphibian PDA with Manta multi-probe unit was used to monitor the *in-situ* parameters dissolved oxygen (DO), temperature, pH, and conductivity during each sampling event. Data were recorded at 1.0 m increments starting at 0.5 m below the water's surface and continued to within 0.5 m of the lake sediments at each station during each sampling date. In addition, water clarity was measured at each sampling station with a Secchi disk.

Discrete water quality samples were collected with a Van Dorn sampling device at 0.5 m below the lake surface and 0.5 m above the sediments at the mid-lake sampling site (Station #2). Discrete samples were collected from a mid-depth position at the remaining six (6) original sampling stations (Stations #1, 3, 4, 5, 6 and 7) and additionally at the Northern Woodport Bay and Jefferson Canals sites (Stations #10 and #11, respectively) on each date. Discrete water samples were appropriately preserved, stored on ice, and transported to a State-certified laboratory for the analysis of the following parameters:

- total suspended solids
- total phosphorous-P
- nitrate-N
- ammonia-N
- chlorophyll *a*

All laboratory analyses were performed in accordance with *Standard Methods for the Examination of Water and Wastewater, 18th Edition* (American Public Health Association, 1992). Monitoring at the Great Cove (Station #8) and Byram Cove (Station #9) sampling stations consisted of collecting *in-situ* and Secchi disk data; no discrete water samples were collected from these two stations for laboratory analyses. It should be noted that prior to 2005, Station #10 had been monitored for *in-situ* observations only. However, due to observations made at Station #10 by the Lake Hopatcong Commission operations staff, it was decided that this sampling station should be added to the discrete sampling list.

During each sampling event, vertical plankton tows were also conducted at the deep sampling station (Station #2). A 50-µm mesh plankton net was used to sample the phytoplankton, while a 150-µm mesh plankton net was used to sample the zooplankton. The vertical tows were deployed starting immediately above the anoxic zone (DO concentrations < 1 mg/L) and conducted through the water column to the surface.

Additional Water Quality Data Collected in 2010

In addition to the standard, long-term, in-lake monitoring program, supplemental in-lake data were collected during the 2010 monitoring program. From 2006 to 2008 three, near shore, in-lake sampling sites were established and monitored. These additional in-lake sampling sites were located immediately adjacent to drainage areas that were receiving a structural BMP as part of an existing 319(h) grant (SFY05; Grant RP05-080). The three near-shore, in-lake sampling stations include:

1. The southern end of Crescent Cove in the Borough of Hopatcong (NPS-1).
2. Ingram Cove, located in the Borough of Hopatcong (removed from monitoring program).
3. Along the eastern shoreline of the lake, in the Township of Jefferson, just south of Brady's Bridge (NPS-2).

Through the course of implementing the SFY05 319(h) grant, it was determined that no BMP would be installed in the Ingram Cove drainage basin; the Ingram Cove project was dropped from the grant due to site specific limitations associated with existing utilities. Subsequently, the proposed Ingram Cove project was moved to the Crescent Cove drainage area. However, monitoring of the Ingram Cove sampling station continued through 2008 but was discontinued during the 2009 and 2010 monitoring programs.

For the remaining two supplemental in-lake sampling stations, monitoring occurred during the May through September 2010 in-lake monitoring events. Monitoring included collecting *in-situ* data at 0.5 – 1.0 meters from surface to bottom for temperature, dissolved oxygen, pH and conductivity. Water clarity was also measured at each station with a Secchi disk. Discrete mid-depth water samples were collected and analyzed for TP and TSS. The Crescent Cove station is NPS-1, while the Township of Jefferson station is NPS-2; both are shown in Figure 1 as yellow circles with an "X" inside (Appendix A).

As part of the SFY10 319 grant, some additional watershed-based restoration projects will be implemented to reduce the NPS pollutant load entering Lake Hopatcong, with an emphasis on TP and TSS. Similar to the SFY05 grant, three near-shore sampling sites were located immediately adjacent to drainage areas that were receiving a structural BMP or MTD as part of the SFY10 319(h) grant (Grant RP10-087). These three near-shore, in-lake sampling stations include:

1. In Ashley Cove in the Township of Jefferson (NPS-3).
2. In King Cove in the Township of Roxbury (NPS-4).
3. Southern end of the public beach at the Hopatcong State Park (NPS-5).

Similar to the SFY05 near-shore sampling program (NPS-1 and NPS-2), *in-situ* monitoring and discrete samples were collected for TP and TSS at three SFY10 earn-shore sampling stations during each of the five 2010 monitoring events. However, one addition to the SFY10 sampling program was the collection of an additional set of discrete samples for the analysis of chlorophyll *a*, a photosynthetic pigment all alga possess.

3.0 RESULTS AND DISCUSSION

Thermal Stratification

Thermal stratification is a condition where the warmer surface waters (called the epilimnion) are separated from the cooler bottom waters (called the hypolimnion) through differences in density, and hence, temperature. Thermal stratification separates the bottom waters from the surface waters with a layer of water that displays a sharp decline in temperature with depth (called the metalimnion or thermocline). In turn, this separation of the water layers can have a substantial impact on the ecological processes of a lake (for details see below). Thermal stratification tends to be most pronounced in the deeper portions of a lake. Thus, for convenience, the discussion on thermal stratification in Lake Hopatcong focuses primarily on the deep, mid-lake (Station #2) sampling station.

In-situ measurements during the 2010-growing season were generally consistent with values recorded in previous years' monitoring programs. By late May 2010, the lake was very weakly stratified between 3 and 5 meters. From surface to bottom (14 meters), the temperature decreased from 20.44°C at the surface to 11.75°C at the bottom (Appendix B).

During the remaining four monitoring events the lake was strongly stratified at Station #2 with the thermocline migrating through the water column over the growing season. In June the thermocline was between 5 and 9 meters and by September it was between 9 and 12 meters (Appendix B).

Other than Station #2, the only other long-term monitoring stations that exhibited some degree of thermal stratification were Stations #8 (Great Cove) and #9 (Byram Cove). These coves were weakly stratified from May through July; in late August 2010 Station #8 was well mixed while Station #9 will exhibited weak stratification. By late September 2010 both coves were well mixed (Appendix B). Approximately 2" of rain fell in the region immediately prior to the 25 August 2010 sampling event, which resulted in the substantially cooler water temperatures in August relative to July.

Four of the five near-shore 319 sampling stations were actually thermally stratified in late May 2010, in spite of being relatively shallow. The exception to this was NPS-4, which was well mixed from surface to bottom (Appendix B). By June 2010 all the 319 sampling stations were well mixed except for NPS-3. During the July and August 2010 monitoring events, all five 319 sampling stations were well mixed; however, by September 2010 NPS-1 and NPS-3 were thermally stratified (Appendix B).

Thermal stratification can effectively "seal off" the bottom waters from the surface waters and overlying atmosphere, which can result in a depletion of dissolved oxygen (DO) in the bottom waters. With the exception of a few groups of bacteria, all aquatic organisms require measurable amounts of DO (> 1 mg/L) to exist. Thus, once the bottom waters of a lake are depleted of DO, a condition termed anoxia, that portion of the lake is no longer available as viable habitat.

Dissolved Oxygen

Atmospheric oxygen enters water by diffusion from the atmosphere, facilitated by wind and wave action and as a by-product of photosynthesis. Adequate dissolved oxygen (DO) is necessary for acceptable water quality. Oxygen is a necessary element for most forms of life. As dissolved oxygen concentrations fall below 5.0 mg/L, aquatic life is put under stress. DO concentrations that remain below 1.0 – 2.0 mg/L for a few hours can result in large fish kills and loss of other aquatic life. Although some aquatic organisms require a minimum of 1.0 mg/L of DO to survive, the NJDEP State criteria for DO concentrations in surface waters is 5.0 mg/L or greater, for a healthy and diverse aquatic ecosystem.

In addition to a temporary loss of bottom habitat, anoxic conditions (DO < 1 mg/L) can produce chemical reactions that result in a release of phosphorus from the sediments and into the overlying waters. In turn, a storm event can transport this phosphorus to the upper waters and stimulate additional algal growth. This process is called internal loading. Given the temporary loss of bottom water habitat and the increase in the internal phosphorus load, anoxic conditions are generally considered undesirable in a lake.

During the 25 May 2010 sampling event, DO concentrations were above the 5.0 mg/L threshold throughout the eleven standard, in-lake monitoring stations at Lake Hopatcong. While the surface waters of the lake still had DO concentrations well above the 5.0 mg/L threshold during the June 2010 event, concentrations at depths equal to or greater than 6 to 7 meters were below this desirable threshold (Appendix B). The general distribution of DO concentrations throughout Lake Hopatcong during the July 2010 event, were essentially the same as those of the June 2010 event.

By late August 2010 well oxygenated conditions were observed from the surface to 8 meters at Station #2, while DO concentrations in deeper waters varying between 2.04 and 2.21 mg/L. DO concentrations were above the 5.0 mg/L threshold from surface to bottom at all of the remaining in-lake stations except for Station #9; DO concentrations were less than 5.0 mg/L at Station #9 at depths of 7.0 and 7.5 meters.

DO concentrations at Station #2 during the September 2010 event were above the 5.0 mg/L threshold from the surface down to a depth of 9 meters. Below 9 meters the DO concentrations varied between 1.68 and 3.06 mg/L. With the exception of the bottom waters at Station #8, the rest of Lake Hopatcong was well oxygenated (> 5.0 mg/L) from surface to bottom (Appendix B).

It should be noted that no deep water anoxic (DO concentrations less than 1 mg/L) conditions were found in Lake Hopatcong during the August 2010 event. In fact none of the 2010 sampling events had deep water DO concentration fall below 1 mg/L. While the later part of the growing season was relatively dry, when storm event did occur they were particularly severe, which may have provided enough energy to mix at least sections of the lake to prevent the complete depletion of DO in the bottom waters. For example, at least 2” of rain fell immediately prior to the 25 August 2010 monitoring event, which my have contributing toward transferring DO to the deeper waters.

All five 319 sampling stations were well oxygenated from surface to bottom during all five 2010 monitoring events. DO concentrations varied from 6.23 to 24.84 mg/L (Appendix B).

pH

The optimal range of pH for most freshwater organisms is between 6.0 and 9.0. For the most part, the pH throughout the water column of Lake Hopatcong was within this optimal range. The exception to this was during the 25 May 2010 monitoring event when the pH of the surface waters at Stations #3 (River Styx / Crescent Cove) exceed 9.0. Such elevated pH values at Station #3 were also measured during the May 2009 monitoring event. Such temporarily elevated pH values in the surface waters can be attributed to high rates of algal and/or aquatic plant photosynthesis. As algae and plants photosynthesize, they produce DO as a by-product, as well as increase the pH of their immediate environment. However, by June and for the rest of the 2010 growing season the pH at Station #3 was below 9.0 (Appendix B).

In spite of these temporarily elevated pH values at Station #3 in May 2010, the pH of Lake Hopatcong through most of the 2010 growing season was within the optimal range for most aquatic organisms. Similar results were observed in 2007 through 2009.

It should also be noted that the pH values at all five near-shore 319 sampling stations were below 9.0 during all five monitoring events except for NPS-1 (southern end of Crescent Cove) during the 25 May 2010 monitoring event.

Water Clarity (as measured with a Secchi disk)

Water clarity or transparency, as measured with a Secchi disk, was generally acceptable at all of the sampling stations during the 2009 sampling season. Based on Princeton Hydro's in-house long-term database of lakes in northern New Jersey, water clarity is considered acceptable for recreational activities when the Secchi depth is equal to or greater than 1.0 m (3.3 ft). Secchi depth measurements throughout most of Lake Hopatcong were greater than 1.0 meter in 2008. For example, at the mid-lake sampling station (Station #2), the Secchi depth varied from 1.2 to 2.5 meters (6.2 to 8.25 ft) through the course of the 2009 sampling season.

All Secchi depth values in May and June 2010 were equal to or greater than the 1 meter (3.3 ft) established threshold for acceptable "recreational" water quality in Lake Hopatcong. In July 2010 all in-lake sampling stations were equal to or greater than 1 meter except for Station #3 and Station #5 (the Outlet). In August and September 2010 Station #3 was the only in-lake sampling station that had a Secchi depth less than 1 meter (Appendix B). While the Secchi depth was less than 1 meter at Station #11 during the August and September events, this was due to the low water depth; during both events Secchi depth was to the bottom at Station #11.

NPS-3 (Ashley Cove) was the only 319 sampling station that had a Secchi depth less than 1 meter during the May 2010 monitoring event. In contrast, NPS-1 was the only 319 sampling station that had a Secchi depth less than 1 meter during the June 2010 monitoring event. In July 2010 NPS-1, NPS-2 (eastern shoreline of the lake) and NPS-3 had Secchi depths less than 1 meter. In August and September 2010 all 319 sampling stations each one had Secchi depths either greater than 1 meter or to the bottom. The exception was NPS-1 where the Secchi depth was less than 1 meter during the August and September 2010 monitoring events (Appendix B).

Ammonia-Nitrogen (NH_4-N)

Surface water NH_4-N concentrations above 0.05 mg/L tend to stimulate elevated rates of algal growth. During the May 2010 sampling event Station #11 (Jefferson Canals) was the only location where the surface water NH_4-N concentration was above the 0.05 mg/L, being 0.06 mg/L (Appendix C). The rest of the May 2010 surface water NH_4-N concentrations, as well as all of those measured at all in-lake stations from June through September 2010, varied from < 0.01 to 0.03 mg/L. Thus, NH_4-N concentrations were generally low in Lake Hopatcong during the 2010 growing season.

Bottom water NH_4-N concentrations were monitored seasonally at the mid-lake sampling site (Station #2). Bottom water NH_4-N concentrations varied between 0.35 and 0.91 mg/L through the 2010 growing season (Appendix C). Bottom water NH_4-N concentrations are typically elevated during the summer season, as a result of lower concentrations of DO. Under such conditions, bacterial decomposition of organic matter results in an accumulation of NH_4-N. The severe limitation of light in the bottom waters exacerbates these conditions through the negligible uptake of NH_4-N by algae. Thus, this seasonal accumulation of NH_4-N is common occurrence in Lake Hopatcong.

Nitrate-Nitrogen (NO_3-N)

Surface water NO_3-N concentrations throughout the 2010 sampling season of Lake Hopatcong varied between <0.02 mg/L and 0.15 mg/L. While there was a considerable amount of variation both among the sampling stations and between sampling events, NO_3-N concentrations in the northern end of the lake (Stations #7, #10 and #11) were generally higher in May, June and August 2010, relative to the other sampling stations. As has been identified in past monitoring events these elevated NO_3-N concentrations in the northern end of the lake were primarily due to the nearshore, on-site wastewater treatment systems (septic systems) in the Township of Jefferson. In particular, elevated NO_3-N concentrations have been measured at Station #11 during previous monitoring years and these historically high concentrations have been attributed to the horizontal movement of leachate from near-shore septic system leachfields.

Total Phosphorous (TP)

Phosphorus has been identified as the primary limiting nutrient for algae and aquatic plants in Lake Hopatcong. Essentially, a small increase in the phosphorus load will result in a substantial increase in algal and aquatic plant growth. For example, one pound of phosphorus can generate as much as 1,100 lbs of wet algae biomass. This fact emphasizes the continued need to reduce the annual phosphorus load entering Lake Hopatcong, as detailed in the lake's revised TMDL and associated Restoration Plan.

Studies have shown that TP concentrations as low as 0.03 mg/L can stimulate high rates of algal growth resulting in eutrophic or highly productive conditions. Based on Princeton Hydro's in-house database on northern New Jersey lakes, TP concentrations equal to or greater than 0.06 mg/L will typically result in the development of algal blooms / mats that are perceived as a nuisance by the layperson.

The State's Surface Water Quality Standard (SWQS, N.J.A.C. 7:9B – 1.14(c) 5) for TP in the surface waters of a freshwater lake or impoundment is 0.05 mg/L. This established TP concentration is for any freshwater lake or impoundment in New Jersey that does not have an established TMDL. Lake Hopatcong has established a phosphorus TMDL, which was revised and approved by NJDEP in June 2006. Based on its refined phosphorus TMDL, the long-term management goal is to maintain an average, growing season TP concentration of 0.03 mg/L within the surface waters of Lake Hopatcong.

During the 25 May 2010 sampling event, TP concentrations throughout the lake generally varied between 0.01 mg/L and 0.04 mg/L and had a lake-wide mean value of 0.03 mg/L. The Canals (Station #11) had the highest TP concentration of 0.04 mg/L at this time.

During the 28 June 2010 sampling event, TP concentrations throughout Lake Hopatcong varied between <0.01 mg/L and 0.03 mg/L with a lake-wide mean value of 0.02 mg/L. In contrast, TP concentrations during the 28 July 2010 event varied between 0.02 and 0.05 mg/L with a lake-wide mean value of 0.03 mg/L.

During the 25 August 2010 sampling event, TP concentrations in the surface waters varied between 0.02 mg/L and 0.06 mg/L with a lake-wide mean value of 0.03 mg/L. Finally, during the 22 September 2010 sampling event, surface water TP concentrations again varied between 0.01 mg/L and 0.04 mg/L with a lake-wide mean value of 0.02 mg/L.

It has been well documented in past reports that Station #3 (River Styx / Crescent Cove) consistently has the highest TP concentrations among the standard eleven monitoring stations in Lake Hopatcong. Since the long-term monitoring of Lake Hoaptcong was initiated in the 1980's, elevated TP concentrations In the River Styx / Crescent Cove section of the lake is a re-occurring condition. For example, the mean TP concentration at Station #2 (Mid-lake) was 0.011 mg/L, while the Station #3 mean was 0.038 mg/L; the lake-wide mean TP concentration in 2010 was 0.024 mg/L. Thus, Station #3 continues to experience the highest TP concentrations in Lake Hopatcong. However, the 2009 mean TP concentration at Station #3 was 0.042 mg/L, while the 2010 mean was 0.038 mg/L. Thus, this decline in TP concentrations from 2009 to 2010 at Station #3 may indicate that long-term reductions may be underway in this part of the lake.

Bottom water TP concentrations at the mid-lake sampling station (Station #2) varied between 0.01 and 0.24 mg/L from May through September of 2010. The elevated TP concentrations in the deep waters were attributed to the depressed DO concentrations and the lack of mixing with the atmosphere during the summer season.

TP concentrations in four of the five 319 in-lake sampling stations (NPS-2 – NPS-5) were generally low, varying between < 0.01 and 0.03 mg/L throughout the 2010 growing season. The exception was NPS-3 (Ashley Cove), where the TP concentration was 0.04 mg/L during the July and August 2010 sampling events. However, for the most part, in-lake TP concentrations were not excessive at these four 319 stations.

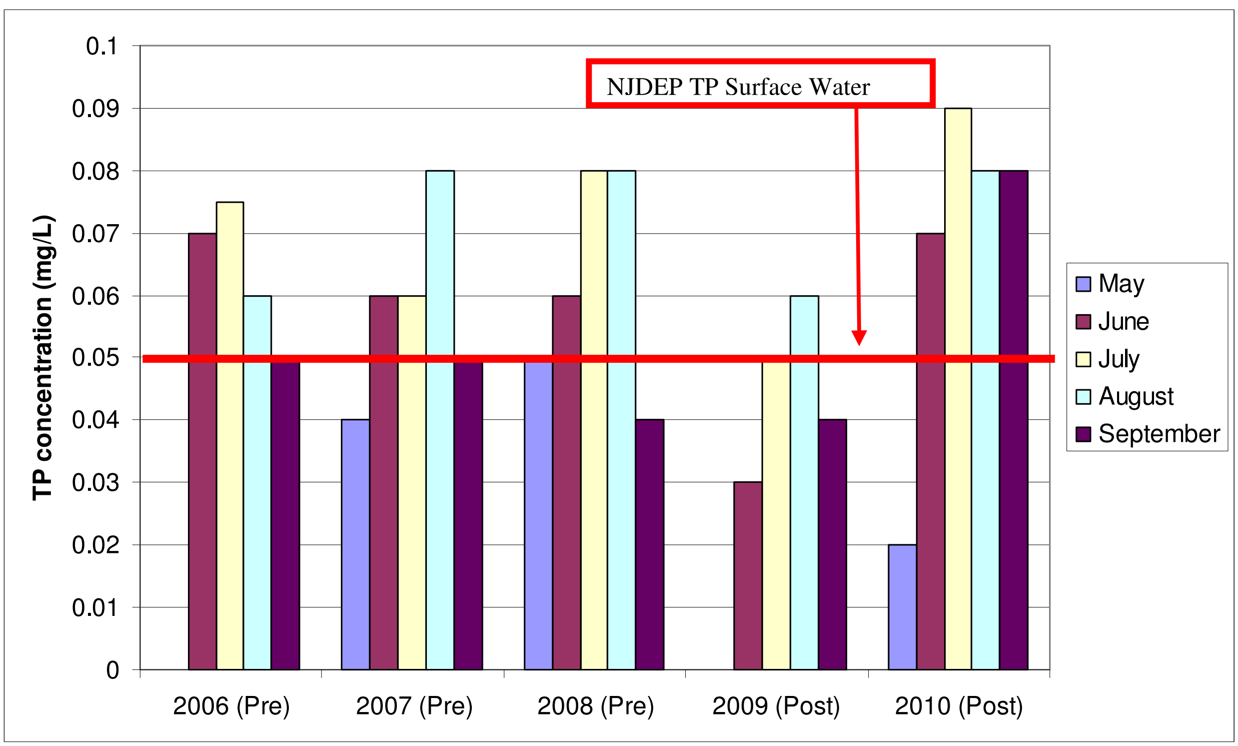
In contrast to the 319 in-lake sampling stations NPS-2 through NPS-5, NPS-1 (southern end of Crescent Cove) had elevated TP concentrations from June through September 2010, varying between 0.07 and 0.09 mg/L. This is in sharp contrast to the lower TP concentrations observed in 2009 (see Table 1).

As part of the existing SFY05 319 grant, a large Aqua-Filter Manufactured Treatment Device (MTD) was installed in the southern end of the Crescent Cove drainage basin to reduce a large portion of the TP and TSS loads that enter the lake from this section of the watershed. This MTD was installed in November of 2008 and the 2009 growing season was the first post-installation year of monitoring. In-lake TP concentrations, and to a lesser extent TSS concentrations, were lower in at NPS-1 in 2009 relative to the pre-installation years of 2006-08 (Table 1 and Figure 1). Based on these data the installed Aqua-Filter reduced in a reduction in the in-lake pollutant concentrations, in spite of 2009 being a relatively wet year.

Table 1
The Mean and Range of TP and TSS Concentrations for Crescent Cove From June through September of Each Monitored Year

Monitoring Year	TP mean and range	TSS mean and range
2006 (pre-installation)	0.064 mg/L (0.05 – 0.09 mg/L)	12 mg/L (6 – 15 mg/L)
2007 (pre-installation)	0.063 mg/L (0.05 – 0.08 mg/L)	7 mg/L (3 – 11 mg/L)
2008 (pre-installation)	0.065 mg/L (0.04 – 0.08 mg/L)	18 mg/L (1.5 – 48 mg/L)
2009 (post-installation)	0.045 mg/L (0.03 – 0.06 mg/L)	7 mg/L (1.5 – 8 mg/L)
2010 (post-installation)	0.068 mg/L (0.02 – 0.08 mg/L)	8 mg/L (1 -15 mg/L)

Figure 1 – TP Concentrations at Crescent Cove



As shown in Table 1, before the Aqua-Filter was installed the mean TP concentration in Crescent Cove varied between 0.063 to 0.065 mg/L; these mean values are greater than both the State's Surface Water Quality Standard of 0.05 mg/L for standing waterbodies as well as the targeted TMDL concentration of 0.03 mg/L. However, after the Aqua-Filter was installed in late 2008, the mean TP concentration declined to 0.045 mg/L (Table 1; 2009 monitoring year). While this value was still greater than the targeted TMDL concentration of 0.03 mg/L, it was below the State's Surface Water Quality Standard of 0.05 mg/L.

In addition to a reduction in the mean TP concentration, the frequency of the Crescent Cove station violating the State Standard declined in 2009, after the Aqua-Filter was installed. Prior to the installation of the Aqua-Filter (2006-2008) the TP concentration at the Crescent Cove station was above the State Standard three out of four to five sampling events. In contrast, after the Aqua-Filter was installed (2009) the TP concentration at the Crescent Cove station was above the State Standard in only one of four sampling events (Figure 1).

However, in sharp contrast to the 2009 results, during the 2010 growing season, only one of the five sampling events were below the Sate Standard at NPS-1. The mean TP concentration at NPS-1 in 2010 was similar to the mean values measured prior to the installation of the Aqua-Filter (2006-08). These conditions were in spite of the fact that 2010 had a relatively dry growing season.

There are two possible explanations to the observed 2010 conditions at NPS-1. First, since the 2010 growing season was relatively dry, it is possible that the bottom waters of Crescent Cove became depleted of DO (< 1 mg/L) and release phosphorus into the water column. Based on the in-situ data collected this year (Appendix C), this does not appear to be the case. DO concentrations in the southern end of Crescent Cove were well oxygenated from surface to bottom throughout the 2010 growing season. Thus, the alternative explanation is that the Aqua-Filter may need to be cleaned out. The removal of accumulated solids from the Aqua-Swirl portion of the structure and/or the replacement of the filter "pillows" from the main structure of the Aqua-Filter may be required in order to maximize the pollutant removal capacity of this MTD. At a minimum, the Aqua-Swirl should be inspected quarterly and will probably need to be vacuumed out 1-2 times per year. The filter pillows are expected to have a life of at least a year so some maintenance and clean-out activities may be due. Thus, the Commission should contact the Borough of Hopatcong and find out what has been done to date to maintain the installed Aqua-Filter.

Chlorophyll a

Chlorophyll *a* is a pigment possessed by all algal groups, used in the process of photosynthesis. Its measurement is an excellent means of quantifying algal biomass. In general, an algal bloom is typically perceived as a problem by the layperson when chlorophyll *a* concentrations are equal to or greater than 30.0 mg/m^3. Based on the findings of the refined TMDL, the existing average seasonal chlorophyll *a* concentration under current conditions is 15 mg/m^3, while the maximum seasonal value is 26 mg/m^3. In contrast, the targeted average and maximum chlorophyll *a* concentrations, once Lake Hopatcong is in complete compliance with the TMDL, are predicted to be 8 and 14 mg/m^3, respectively.

Two of the five 2010 lake-wide chlorophyll *a* mean values (May and June) were less than targeted mean of 8 mg/m^3. In contrast, only one of the five 2009 lake-wide chlorophyll *a* mean values were less than targeted mean of 8 mg/m^3.

Similar to 2009, none of the May or June 2010 chlorophyll *a* concentrations exceeded the targeted seasonal maximum of 14 mg/m^3. In July and August 2010, 55% of the chlorophyll *a* concentrations were below the maximum of 14 mg/m^3 for each monitoring event. In September 2010, 78% of the chlorophyll *a* concentrations were below the maximum of 14 mg/m^3. This is in sharp contrast to the 2009 summer results when only 22% of the chlorophyll *a* concentrations were below the maximum of 14 mg/m^3; for September 2009 only 33% of the chlorophyll *a* concentrations were below the maximum of 14 mg/m^3. Thus, chlorophyll *a* concentrations were generally lower in 2010 relative to 2009.

It should be noted that as is typically observed at Lake Hopatcong, Station #3 had the highest single (43.5 mg/m^3 measured on 25 August 2010) chlorophyll *a* concentration of the nine discrete sampling stations monitored in 2010. However, it should also be noted that this single Station #3 chlorophyll *a* maximum value was the lowest measured when compared to the 2005 – 2009 database.

Phytoplankton

Phytoplankton are algae that are freely floating in the open waters of a lake or pond. These algae are vital to supporting a healthy ecosystem, since they are the base of the aquatic food web. However, high densities of phytoplankton can produce nuisance conditions. The majority of nuisance algal blooms in freshwater ecosystems is the result of cyanobacteria, also known as blue-green algae. Some of the more common water quality problems created by blue-green algae include bright green surface scums, taste and odor problems and the generation of cyanotoxins.

Table 1 lists the dominant phytoplankton identified in Lake Hopatcong during each water quality monitoring event in 2010. Algal abundance was high on 29 May 2009 with the dominant algae being the diatom *Tabellaria*, the chrysophyte *Chromulin*a, and the blue-green alga *Coelosphaerium*. A wide variety of green algae and several other blue-green algae were identified as well, including *Oscillatoria* and *Anabaena* (Table 1).

Algal diversity and abundance was relatively high during the 28 June 2010 sampling event. The blue-green *Coelosphaerium* and the green alga *Pediastrum* were the dominant genera. Several diatoms and green algae, as well as the blue-green *Anabaena* were also fairly common.

Algal diversity was high and abundance was moderate during the 28 July 2010 sampling event, with the dominant algae being the blue-green *Anabaena*, the diatom *Melosira* and the green alga *Pediastrum* (Table 1). Other blue-green algae, *Aphanocapsa* and *Coelosphaerium*, the diatom Fragilaria and the green alga Sphaeriocystis were also fairly common.

Algal abundance and diversity were high during the 25 August 2010 sampling event with the dominant algae being the blue-green *Anabaena*, the diatom *Melosira* and the chrysophyte *Dinobryon*. Other identified algae included the blue-green algae *Oscillatoria* and *Lyngbya*, several diatoms and a variety of green algae (Table 1).

Algal abundance and diversity was relatively high in Lake Hopatcong during the 22 September 2010 sampling event, with the dominant alga being the diatom *Melosira*. Three blue-green algae, three diatoms and the dinoflagellate *Ceratium* were relatively common with a wide variety of green algae (Table 1).

While algal abundance was moderate to high, algal diversity was high as well. Blue-green algae, some of the genera known to produce nuisance surface scums, were common, as well as several other algal groups including green algae, diatoms and chrysophytes. It should be noted that blue-green algae did not appear to dominant the phytoplankton community in 2010 as has been observed in past monitoring events.

Zooplankton

Zooplankton are the micro-animals that live in the open waters of a lake or pond. Some large-bodied zooplankton are a source of food for forage and/or young gamefish. In addition, many of these large-bodied zooplankton are also herbivorous (i.e. algae eating) and can function as a natural means of controlling excessive algal biomass. Given the important role zooplankton serve in the aquatic food web of lakes and ponds, samples for these organisms were collected at Station #2 during each monitoring event. The results of these samples are provided in Table 2.

During the 25 May 2010 sampling event, small-bodied zooplankton that feed primarily on bacteria and detritus were the dominant forms. In contrast, the herbivorous (algae-eating) cladoceran *Ceriodaphnia* was the dominant zooplankter during the 28 June 2010 sampling event (Table 2).

By 28 July 2010 zooplankton abundance was moderate while diversity was high with the dominant genus being the rotifer *Keratella*; however, the herbivorous cladoceran *Ceriodaphnia* was still present. By 25 August 2010 *Ceriodaphnia* was once again one of the dominant genera in the zooplankton community of Lake Hopatcong, along with the small-bodied cladoceran *Bosmina* and juvenile copepods (called nauplii). By 22 September 2010 the dominant zooplankter was the predaceous copepod *Cyclops*, however, the herbivore *Ceriodaphnia* was still present (Table 2).

Table 1
Phytoplankton in Lake Hopatcong during the 2010 Growing Season

Sampling Date	Phytoplankton
25 May 2010	Algal abundance was high. The dominant algae were the diatom *Tabellaria*, the chrysophyte *Chromulina* and the blue-green alga *Coelosphaerium*. A wide variety of green algae were present as well as the dinoflagellate *Peridinium*, the diatom *Fragilaria* and two additional blue-greens (*Oscillatoria* and *Anabaena*).
28 June 2010	Large diversity of algae was identified; total abundance was moderate. The dominant genera were the blue-green alga *Coelosphaerium* and the green alga *Pediastrum*. Several genera of diatoms and the blue-green alga *Anabaena* were fairly common. A wide variety of green algae were also present.
28 July 2010	Diversity was high and abundance was moderate. The dominant algae were the blue-green alga *Anabaena*, the diatom *Melosira* and the green alga *Pediastrum*. Two blue-green algae (*Coelosphaerium* and *Aphanocapsa*), a diatom (*Fragilaria*) and a green alga (*Sphaeriocystis*) were fairly common. A large diversity of blue-green algae was also identified along with a few dinoflagellates and diatoms.
25 August 2010	Abundance and diversity was high with the dominant algae being the blue-green alga *Anabaena*, the diatom *Melosira*, and the chrysophyte *Dinobryon*. Other identified algae included the blue-green *Anabaena*, several diatoms (*Fragilaria* and *Asterionella*) and a variety of green algae.
22 September 2010	Abundance and diversity was high; the dominant alga was the filamentous diatom *Melosira*. Three blue-green were identified (*Oscillatoria*, *Anabaena*, *Lyngbya*), as well as three genera of diatoms (*Fragilaria*, *Tabellaria*, *Cyclotella*), the dinoflagellate *Ceratium* and a wide variety of green algae.

Table 2
Zooplankton in Lake Hopatcong during the 2010 Growing Season

Sampling Date	Zooplankton
25 May 2010	Zooplankton numbers were moderate and the dominant genus was the small-bodied cladoceran *Bosmina*. Another small-bodied cladoceran (*Cydorus*) and juvenile copepods (known as nauplii) were also found in the sample. In addition, several rotifers (*Keratella*, *Conochilus*, *Asplanchna*, *Polyarthra*) were identified.
28 June 2010	Zooplankton numbers were high with the dominant genus being the herbivorous (algae-eating) cladoceran *Ceriodaphnia*. The small-bodied cladoceran *Bosmina* was fairly common. Two copepods (*Cyclops* and the herbivore *Diaptomus*) were present along with nauplii as well as several rotifers (*Conochilus*, *Asplanchna*).
28 July 2010	Zooplankton abundance was moderate and diversity was high with dominant genus being the rotifer *Keratella*. Small-bodied *Bosmina* and nauplii were fairly common. Two herbivores were identified (*Diaptomus* and *Ceriodaphnia*) as well as a few more rotifers *Conochilus* and *Asplanchna*.
25 August 2010	Zooplankton abundance was moderate with the most common genera being the cladocerans *Bosmina* and *Ceriodaphnia* and nauplii The predaceous copepod *Cyclops* was present along with a number rotifers (*Conochilus*, *Asplanchna* and *Keratella*).
22 September 2010	Zooplankton abundance was moderate with the most common genus being the predaceous *Cyclops*. One herbivore (*Ceriodaphnia*) was identified along with two small-bodied cladocerans (*Bosmina* and *Chydorus*), several rotifers (*Asplanchna* and *Keratella*) and nauplii

Recreational Fishery and Potential Brown Trout Habitat

Of the recreational gamefish that reside or are stocked in Lake Hopatcong, trout are the most sensitive in terms of water quality. For their sustained management, all species of trout require DO concentrations of at least 4 mg/L or greater. However, the State's designated water quality criterion to sustain a healthy, aquatic ecosystem is a DO concentration of at least 5 mg/L.

While all trout are designated as coldwater fish, trout species display varying levels of thermal tolerance. Brown trout (*Salmo trutta*) have an <u>optimal</u> summer water temperature range of 18 to 24^{o}C (65 to 75^{o}F) (USEPA, 1994). However, these fish can survive in waters as warm as 26^{o}C (79^{o}F) (Scott and Crossman, 1973), defined here as acceptable habitat. The 2010 temperature and DO data for Lake Hopatcong were examined to identify the presence of optimal and acceptable brown trout habitat. As with previous monitoring reports, this analysis focused primarily on *in-situ* data collected at the mid-lake sampling station (Station #2).

For the sake of this analysis, sections of the lake that had DO concentrations equal to or greater than 5 mg/L and water temperatures less than 24^{o}C were considered optimal habitat for brown trout. In contrast, sections of the lake that had DO concentrations equal to or greater than 5 mg/L and water temperatures between 24 and 26^{o}C were considered carry over habitat for brown trout.

On 25 May 2010 optimal brown trout habitat was identified throughout the entire water column in Lake Hopatcong (Appendix B). By 28 June 2010, the optimal brown trout habitat was found at a depth of 6.0 meters (approximately 20 feet), while carry over habitat was found from the surface to a depth of 5 meters.

By 28 July 2010, optimal / carry over brown trout habitat was limited to depths between 5.0 and 6.0 meters (16 and 20 feet). However, it should be noted that carry over brown trout habitat was also identified at depths between 5.0 and 6.0 meters at both Station #8 (Great Cove) and Station #9 (Byram Cove).

In sharp contrast to July, optimal brown trout habitat was re-established by 25 August 2010 from the surface to 8 meters (26.4 ft). Similar results were found on 22 September 2010 when optimal brown trout habitat remained from the surface to 8 meters. Similar to past monitoring years, the *in-situ* data revealed that varying levels of acceptable brown trout habitat persisted through the entire 2010 growing season in Lake Hopatcong.

Mechanical Weed Harvesting Program

Many of the more shallow sections of Lake Hopatcong are susceptible to the proliferation of nuisance densities of rooted aquatic plants. Given the size of Lake Hopatcong, the composition of its aquatic plant community, and its heavy and diverse recreational use, mechanical weed harvesting is the most cost effective and ecologically sound method of controlling nuisance weed densities. Thus, the weed harvesting program has been in operation at Lake Hopatcong since the mid-1980's with varying levels of success. However, one consistent advantage mechanical weed harvesting has over other management techniques, such as the application of aquatic herbicides, is that phosphorus is removed from the lake along with the weed biomass. In fact, based on a plant biomass study conducted at Lake Hopatcong in 2006 and the plant harvesting records from 2006 to 2008, approximately 6-8% of the total phosphorus load targeted for reduction under the established TMDL is removed through the mechanical weed harvesting program.

In sharp contrast to the 2006 – 2008 harvesting years, only 1.2% of the phosphorus load targeted for reduction under the TMDL was removed through mechanical weed harvesting during the 2009 growing season. This substantial reduction in the amount of plant biomass and phosphorus removed in 2009 was due to severe budgetary cuts that resulted in laying off the Commission's full time Operation Staff and late start up date. In turn, this resulted in only 1.2% of the plant biomass harvested in 2009.

However, the 2010 harvesting season resulted in the estimated removal of approximately 6% of the phosphorus load targeted for reduction under the TMDL, similar to the percentages removed in 2006 – 2008. Using the results of the 2006 plant biomass / phosphorus study, it was estimated that the 2010 mechanical weed harvesting program removed 433 lbs (196 kg) of total phosphorus from the lake. If this removed phosphorus was utilized by filamentous and planktonic algae, it would have the potential to generate approximately 476,000 lbs of wet algae biomass.

Inter-annual Analysis of Water Quality Data

Annual mean values of Secchi depth, chlorophyll *a* and total phosphorus concentrations were calculated for the years 1991 through 2010. The annual mean values for Station #2 were graphed, along with the long-term, "running mean" for the lake.

The 2010 mean Secchi depth was 2.5 meters and was the highest value since the 2002 mean value and was the second highest mean Secchi depth since 1991 (Figure 2 in Appendix A). Since 2005 the mean Secchi depth at Station #2 has exhibited a trend of increasing water clarity, with the exception of 2009 which was an unusually wet and cool year. In addition, the long-term Secchi depth mean remains above 2 meters.

The 2010 mean chlorophyll *a* concentration at Station #2 was the lowest value out of the entire 1991 – 2010 database (Figure 3 in Appendix A). In addition, with the exception of 2009, mean chlorophyll *a* has exhibited a decreasing trend in concentration since 2004. These results correlate well with the Secchi depth values; as algal biomass (measured as chlorophyll *a*) declines, water clarity will increase. The long-term mean chlorophyll *a* was slightly less than 10 mg/m^3, which was greater than the targeted mean endpoint of 8 mg/m^3 as per the TMDL, but below the targeted maximum endpoint of 14 mg/m^3.

Based on the Secchi depth and chlorophyll *a* concentration data, algal productivity was generally lower in Lake Hopatcong during the 2010 growing season, relative to previous monitoring years. Based on these results, TP concentrations were expected to be lower and this was certainly the case. The mean TP concentration at Station #2 was 0.011 mg/L, which was the lower mean value out of the entire 1991 – 2010 database (Figure 4 in Appendix A). While from 2004 to 2007 there was a slight increase in the mean TP concentration at Station #2, from 2007 to 2010 this mean value has been on the decline (Figure 4 in Appendix A). Thus, the long-term inter-annual trend among the three water quality parameters is in general agreement. As watershed-based and weed harvesting management measures continue at Lake Hoaptcong, TP concentrations within the lake should decline. In turn, a decline in the amount of available phosphorus in the water column limits algal growth and biomass (measured as chlorophyll *a*), resulting in an increase in water quality (measured with a Secchi disk).

Water Quality Impairments and Established TMDL Criteria

As identified in N.J.A.C. 7:9B-1.5(g)2 "Except as due to natural condition, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation or otherwise render the waters unsuitable for the designated uses." For Lake Hopatcong, these objectionable conditions specifically include both algal blooms and nuisance densities of aquatic vegetation.

Given the undesirable water quality conditions experienced in select portions of Lake Hopatcong, NJDEP conducted a Total Maximum Daily Load (TMDL) analysis for total phosphorus, the primary nutrient limiting algal and plant growth in the lake. This TMDL was revised by Princeton Hydro, who also developed a Restoration Plan for the lake and watershed. The revised TMDL and associated Restoration Plan were approved by NJDEP in 2006 and have been used to obtain grant funding through both NJDEP and US EPA to implement various watershed-based projects to reduce the existing phosphorus loads. Some of these projects were completed in 2008-10 and implementation will continue into 2011. Thus, continuing the long-term monitoring program and augmenting it with near-shore, in-lake and stormwater sampling will provide a means of quantifying the water quality improvements associated with the implementation of these projects.

As described in detail in the TMDL Restoration Plan, a targeted mean TP concentration, as well as mean and maximum chlorophyll *a* ecological endpoints, was established to identify compliance with the TMDL. These criteria are located immediately below Table 3 and of the three criteria the one that is critical in the long-term evaluation of progress made toward compliance with the TMDL, is the mean TP concentration. The chlorophyll *a* ecological endpoints provide the guidance and framework needed to translate the TP concentration into a layperson's perspective on how the lake is responding to the Restoration Plan (i.e. algal blooms).

It should be noted that in addition to the TMDL criteria listed below Table 3, each municipality within the watershed has an existing and targeted annual phosphorus load as per the TMDL. Thus, each municipality is responsible for contributing on a proportional basis toward attaining the overall targeted TP load for the Lake Hopatcong watershed. However, the water quality criteria below Table 3 serve as short-term, year-specific indicators on the progress made toward attaining the overall targeted TP load for the TMDL.

Based on the mean TP concentrations, the Crescent Cove / River Styx section of the lake (Station #3) was out of compliance with the TMDL, where concentrations exceeded the 0.03 mg/L criteria. However, it should be noted that the 2010 Crescent Cove mean TP concentration of 0.04 mg/L is below the State's surface water standard. This decline in the Crescent Cove mean

TP concentration in both 2009 and 2010 is at least partially attributed to the Aqua-Filter that was installed in that drainage area as well as all of the other watershed management activities (i.e. use of non-phosphorus fertilizers, sewering some of the homes in that portion of the watershed). The results of the 2010 mean TP concentration is similar to those observed in 2009; Station #3 was the only one that was out of compliance with the TMDL.

The targeted mean chlorophyll *a* endpoint for Lake Hoaptcong is 8 mg/m^3, while the targeted maximum chlorophyll *a* endpoint is 14 mg/m^3. In 2010, three of the nine stations were below the targeted mean chlorophyll *a* endpoint, with two additional stations being slightly above (less than 1 mg/m^3) the endpoint (Table 3). This is in sharp contrast to 2009 when only one station was below the targeted mean endpoint and another was slightly above the endpoint.

In 2010, four of the nine stations have maximum chlorophyll *a* values below the targeted maximum chlorophyll *a* endpoint (Table 3). In addition, only one sampling station, Station #3, had a maximum chlorophyll *a* concentration greater than the 30 mg/m^3 threshold in 2010. In contrast, only two of the nine stations in 2009 had maximum chlorophyll *a* values below the targeted maximum chlorophyll *a* endpoint and four stations had maximum values that were greater than the 30 mg/m^3 threshold.

Finally, it should be cited that the mean and maximum chlorophyll *a* concentrations for 2010 were 21.5 and 43.5 mg/m^3, respectively, while the mean and maximum values for 2009 were 26.6 and 73.6 mg/m^3, respectively. Based on these comparisons, water quality conditions in the open waters of Lake Hopatcong were generally better in 2010 relative to conditions observed in 2009.

Table 3
Summary of 2010 water quality data for select sampling stations at Lake Hopatcong

Station	Mean TP	Mean chl. *a*	Maximum chl. *a*
Station #1	0.03	**15.7**	**25.3**
Station #2	0.011	6.1	8.3
Station #3	**0.04**	**21.5**	**43.5***
Station #4	0.02	**8.5**	11.7
Station #5	0.02	**11.5**	**16.3**
Station #6	0.02	5.3	7.1
Station #7	0.02	5.7	10.3
Station #10	0.03	**15.9**	**25.8**
Station #11	0.03	**8.6**	**19.8**

Please note, any parameter in red indicates the value is above (in violation) the threshold identified under the targeted conditions as described in the TMDL. It should be noted that none of the mean TP concentrations exceeded the State's established Surface Water Quality Standard for TP, which is 0.05 mg/L (N.J.A.C. 7:9B – 1.14 (c) 5.). In addition, the * for the maximum chlorophyll *a* concentrations identifies a concentration greater than 30 mg/m^3, which is the threshold when most laypeople perceive the water can being unsuitable or too "scummy" for recreational use.

TMDL Criteria for Lake Hopatcong

Targeted mean TP concentration	0.03 mg/L
Targeted mean chlorophyll *a* concentration endpoint	8 mg/m^3
Targeted maximum chlorophyll *a* concentration endpoint	14 mg/m^3

4.0 SUMMARY

This report documents the findings of the 2010 Lake Hopatcong water quality monitoring program. This section provides a summary of the 2010 water quality conditions, as well as recommendations on how to preserve the highly valued aquatic resources of Lake Hopatcong.

1. Based on the 2010 water quality database, and similar to past monitoring years, the water quality conditions of Lake Hopatcong were generally consistent with those of a meso- to slightly eutrophic ecosystem.

2. Overall, the surface waters (to approximately 5 meters) of Lake Hopatcong remained well oxygenated (dissolved oxygen concentrations > 5 mg/L) throughout the monitoring season. In contrast to past monitoring years except for 2009, an anoxic zone (< 1 mg/L) did not develop in Lake Hopatcong over the 2010 growing season. This was in spite of the fact that 2010 was drier and hotter relative to 2009.

3. It has been well documented that phosphorus is the primary limiting nutrient in Lake Hopatcong. That is, a slight increase in phosphorus will result in a substantial increase in the amount of algal and/or aquatic plant biomass. TP concentrations in the surface waters of Lake Hopatcong typically varied between <0.01 mg/L and 0.06 mg/L. Similar to past monitoring years Station #3 (River Styx/Crescent Cove) and the 319 Crescent Cove station displayed the highest TP concentrations.

4. An Aqua-Filter, a large Manufactured Treatment Device, was installed in the Crescent Cove drainage basin in November / December 2008. While there was a substantial reduction in the amount of TP at the 319 Crescent Cove station in 2009, TP concentrations at this station in 2010 were similar to those experienced prior to the installation of the Aqua-Filter (2006-2008). Based on these observations, it is more than likely that the Aqua-Filter needs to be cleaned out and the filter pillows may need to be replaced.

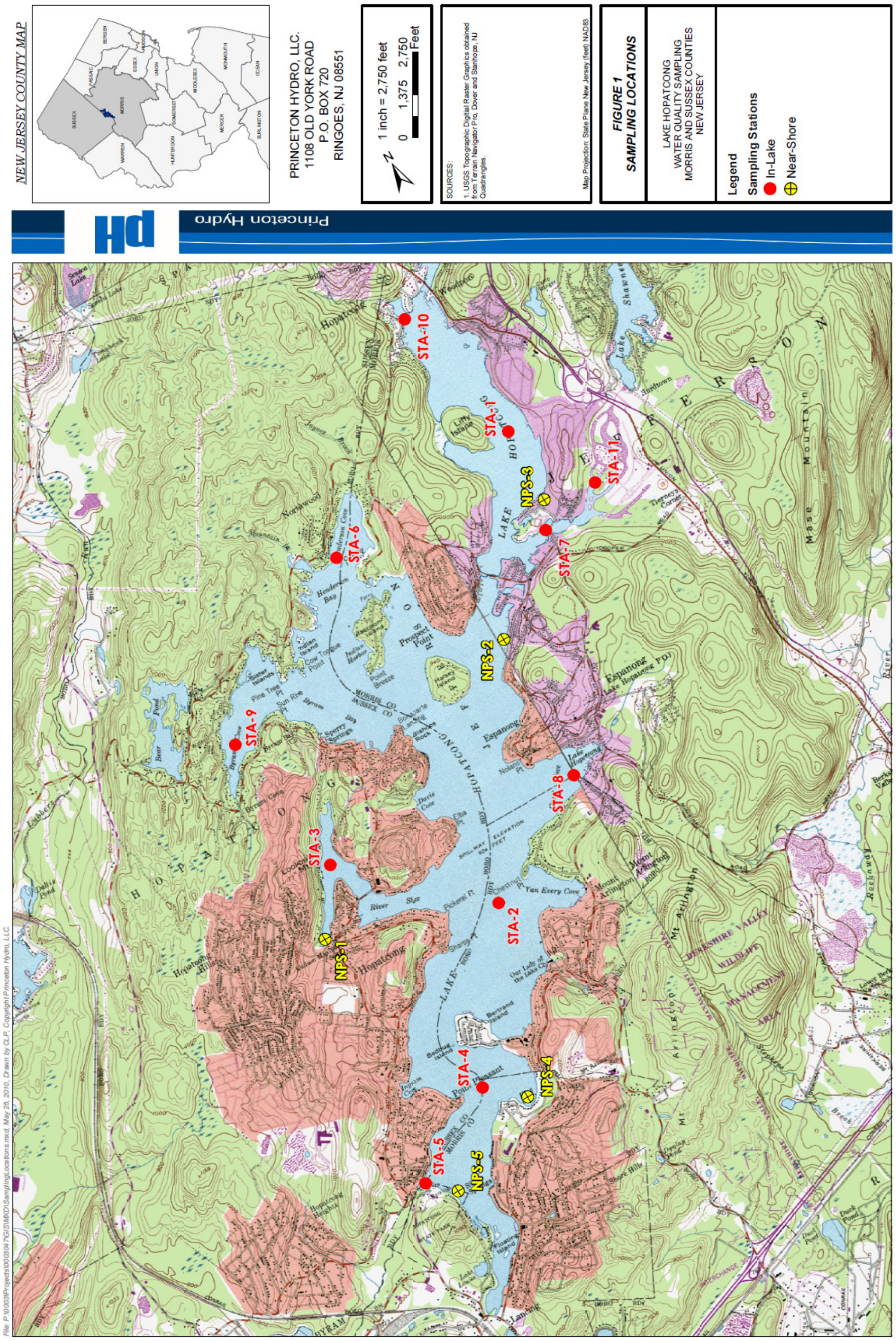
5. Based on the *in-situ* conditions, carry over <u>brown trout</u> habitat was available throughout the entire 2010 growing season. Such results are consistent with those measured in previous monitoring years at Lake Hopatcong.

6. Approximately 1,213 tons of aquatic plant biomass was removed in 2010 through the mechanical weed harvesting program; this accounted for approximately 6% of the TP load targeted for removal under the TMDL. This estimated amount of TP removed was similar to those removed during the 2006-2008 growing seasons.

7. With the results of the 2010 monitoring program, an inter-annual trend of lowered TP and chlorophyll *a* concentrations, with a resulting increased water clarity, was evident in the mid-lake sampling station of Lake Hopatcong. The mean TP concentration at the mid-lake sampling station was one of the lowest measured since continuous monitoring began in 1991. In addition, the mean and maximum chlorophyll *a* concentrations at Station #3 were lower in 2010 relative to 2009. All of these data indicate that water quality conditions have been improving in Lake Hopatcong, particularly in the open waters.

APPENDIX A

FIGURES


NEW JERSEY COUNTY MAP
PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551
1 inch = 2,750 feet
0 1,375 2,750
Feet
SOURCES:
1. USGS Topographic Digital Raster Graphics obtained from Terrain Navigator Pro, Dover and Stanhope, NJ Quadrangles.
Map Projection: State Plane New Jersey (feet) NAD83
FIGURE 1
SAMPLING LOCATIONS
LAKE HOPATCONG
WATER QUALITY SAMPLING
MORRIS AND SUSSEX COUNTIES
NEW JERSEY
Legend
Sampling Stations
In-Lake
Near-Shore
Princeton Hydro
STA-1
STA-2
STA-3
STA-4
STA-5
STA-6
STA-7
STA-8
STA-9
STA-10
STA-11
NPS-1
NPS-2
NPS-3
NPS-4
NPS-5

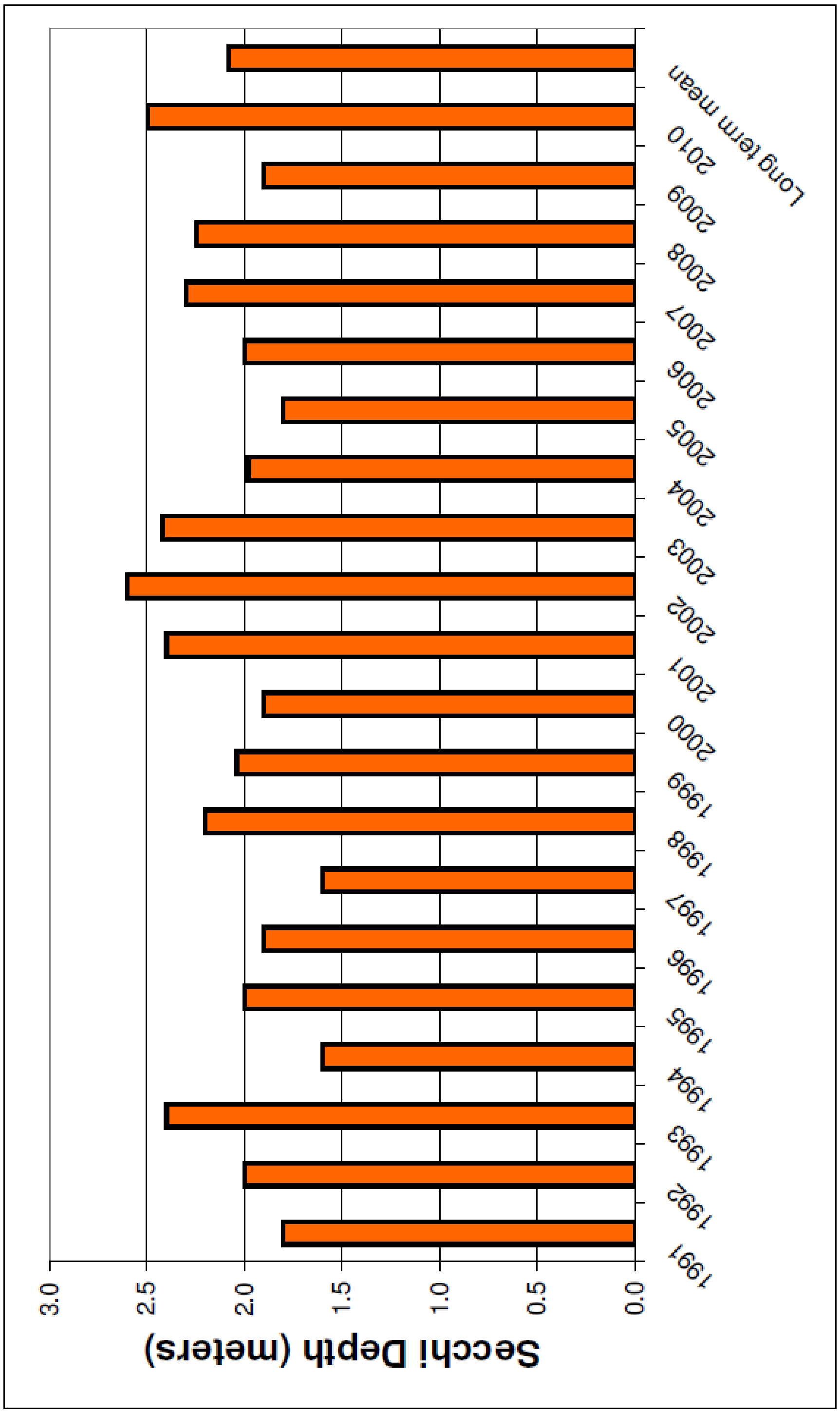


Figure 2 - Lake Hopatcong Long-Term Secchi Depth (meters)

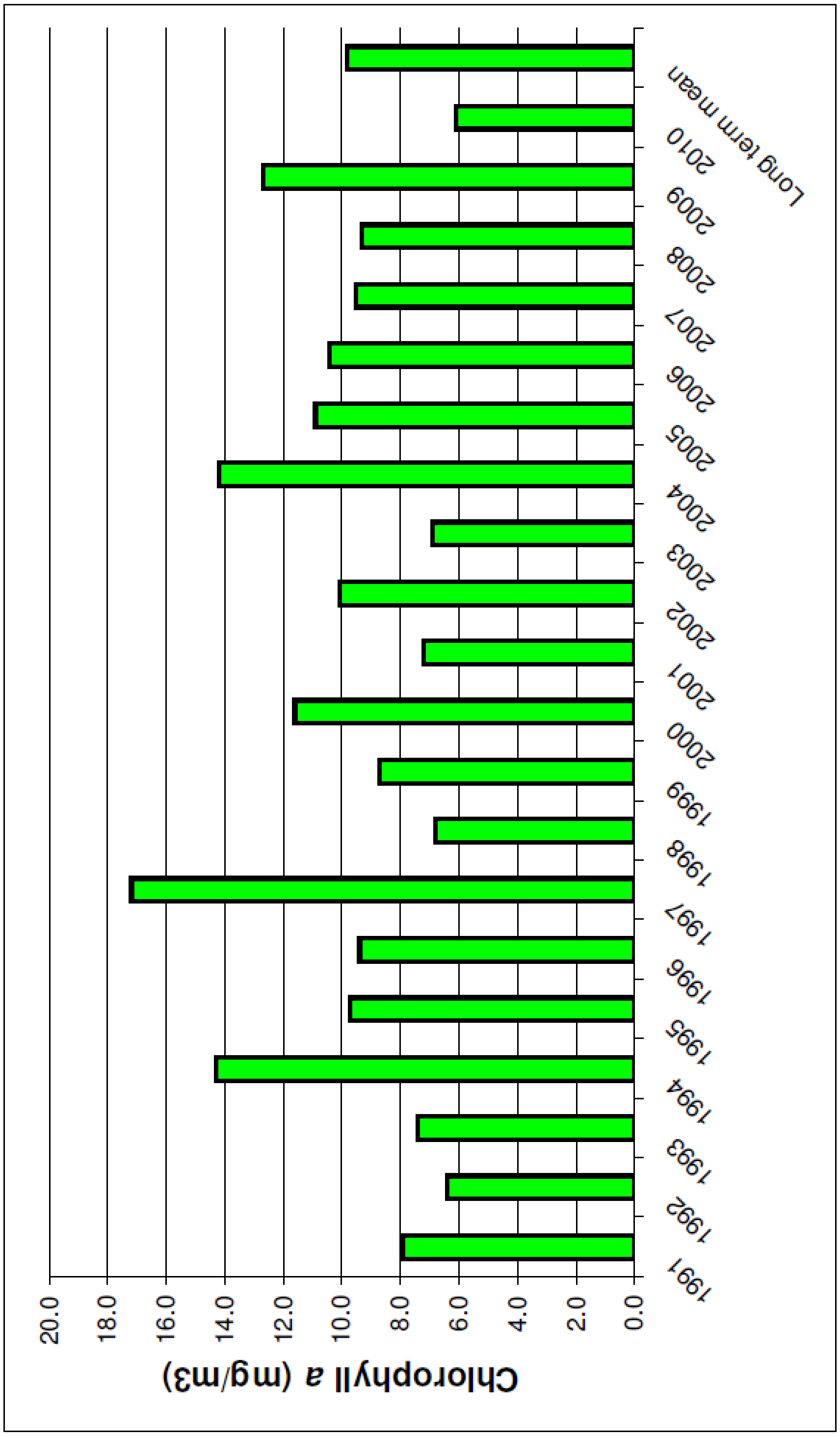


Figure 3 - Lake Hopatcong Long-Term Chlorophyll a Concentrations (mg/m3)

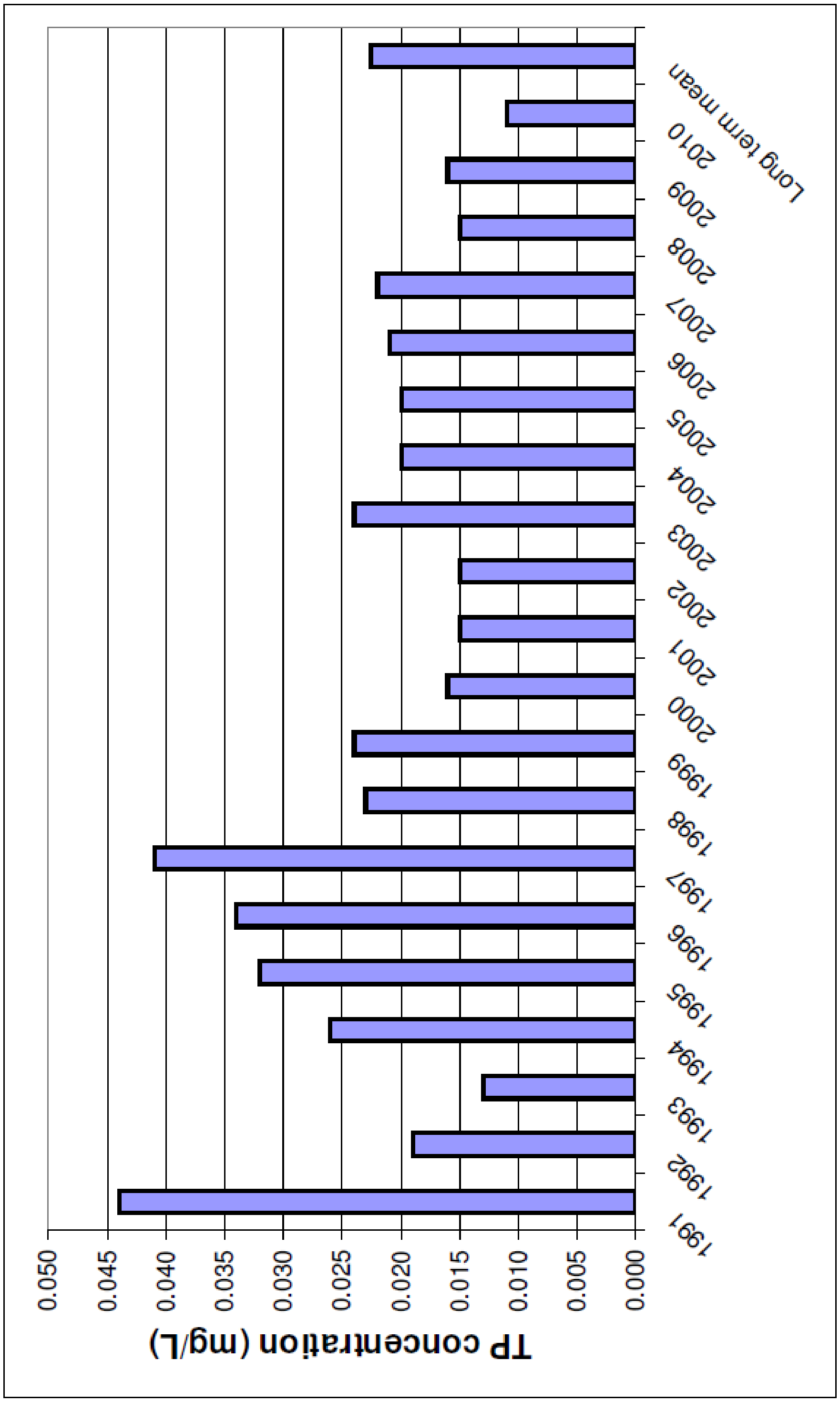


Figure 4 - Lake Hopatcong Long-Term Total Phosphorus Concentrations (mg/L)

APPENDIX B

IN-SITU DATA

In-Situ **Monitoring for Lake Hopatcong 5/25/10**								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity**	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
ST-1	**1.9**	**1.5**	**Surface**	23.73	0.285	14.6	7.9	172.97
			1.0	20.78	0.278	15.35	7.87	171.89
			1.5	20.2	0.289	12.56	7.38	139.09
ST-2	**14.1**	**2.5**	**Surface**	20.44	0.317	13.22	8.17	147.03
			1.0	19.27	0.313	13.27	8.28	144.26
			2.0	19	0.313	13.14	8.3	142.07
			3.0	18.31	0.315	13.28	8.3	141.54
			4.0	17.35	0.317	13.87	8.15	144.89
			5.0	15.98	0.319	14.08	7.95	142.95
			6.0	15.06	0.321	14.53	7.76	144.7
			7.0	14.48	0.342	13.4	7.54	131.74
			8.0	14.19	0.345	12.65	7.39	123.59
			9.0	13.6	0.347	11.9	7.25	114.79
			10.0	13.34	0.349	11.5	7.17	110.27
			11.0	13.03	0.349	11.23	7.12	106.95
			12.0	12.75	0.35	10.57	7.05	100.11
			13.0	12.4	0.354	8.78	6.95	82.51
			14.0	11.75	0.36	7.15	7.1	66.2
ST-3	**2.3**	**2.3**	**Surface**	23.2	0.492	16.92	9.48	198.64
			1.0	20.82	0.567	18.48	9.55	207.2
			2.0	18.82	0.666	15.29	8.74	164.87
			2.3	18.78	0.646	13.97	8.36	150.49
ST-4	**3.1**	**2.1**	**Surface**	20.58	0.336	10.05	8.03	112.07
			1.0	20.29	0.335	10.28	8.05	114.04
			2.0	18.99	0.337	9.73	7.72	105.15
			3.0	17.26	0.34	6.91	7.2	72.16
ST-5	**3.5**	**2**	**Surface**	20.42	0.337	10.54	7.7	117.2
			1.0	19.92	0.336	10.32	7.79	113.69
			2.0	18.94	0.336	9.41	7.57	101.67
			3.0	18.46	0.34	6.88	7.21	73.56
			3.5	18.17	0.345	5.44	7.07	57.85
ST-6	**2.5**	**2.5**	**Surface**	22.68	0.343	15.47	8.39	179.7
			1.0	20.25	0.34	16.41	8.56	181.9
			2.0	18.02	0.342	14.96	7.65	158.49
			3.0	17.81	0.343	15.08	7.61	159.14
ST-7	**1.6**	**1.6**	**Surface**	22.17	0.184	14.49	7.17	166.68
			1.0	21	0.189	13.27	7	149.13
			1.5	20.67	0.196	12.84	6.97	143.45
ST-8	**7.6**	**2.2**	**Surface**	19.09	0.324	15.85	8.31	171.57
			1.0	18.82	0.32	15.3	8.32	164.76
			2.0	18.46	0.325	15.03	8.28	160.7
			3.0	18.34	0.326	14.82	8.3	158.11
			4.0	17.77	0.327	14.34	8.05	151.2
			5.0	14.92	0.337	13.9	7.65	137.99
			6.0	14.51	0.338	13.04	7.49	128.28
			7.0	13.56	0.341	11.18	7.25	107.81
			7.5	13.42	0.345	9.51	7.08	91.41
ST-9	**8**	**2.2**	**Surface**	22.69	0.35	14.34	8.52	166.64
			1.0	21.26	0.351	14.9	8.54	168.44
			2.0	18.38	0.343	15.21	8.36	162.38
			3.0	16.73	0.344	14.96	8.2	154.32
			4.0	15.51	0.345	14.63	8.02	147.13
			5.0	15.27	0.347	13.75	7.84	137.59
			6.0	14.85	0.348	12.66	7.64	125.48
			7.0	14.55	0.348	11.96	7.5	117.84
			8.0	14.07	0.354	8.87	7.27	86.44
ST-10	**1.7**	**1.7**	**Surface**	23.44	0.306	14.7	7.92	173.29
			1.0	21.11	0.298	15.46	7.98	174.17
			1.5	20.63	0.305	13.46	7.49	150.27
ST-11	**1.1**	**1.1**	**Surface**	21.9	0.132	15.51	7.03	177.37
			1.0	21.11	0.138	14.09	6.91	158.7

***In-Situ* Monitoring for Lake Hopatcong 6/28/10**								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity**	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
ST-1	**2**	**1.1**	**Surface**	27.53	0.279	8.58	7.54	110.48
			1.0	27.48	0.278	8.42	7.46	108.28
			2.0	27.05	0.281	7.82	7.35	99.87
ST-2	**14.75**	**2.75**	**Surface**	25.73	0.318	8.56	7.98	106.68
			1.0	25.73	0.318	8.38	7.96	104.42
			2.0	25.68	0.318	8.27	7.95	103.02
			3.0	25.62	0.318	8.2	7.92	101.98
			4.0	25.32	0.321	7.84	7.76	97.01
			5.0	21.59	0.316	7.05	7.5	81.32
			6.0	19.65	0.332	4.41	7.06	48.95
			7.0	17.08	0.339	2.85	6.96	30.08
			8.0	14.96	0.341	2.71	6.93	27.35
			9.0	13.55	0.345	3.74	6.91	36.57
			10.0	13.24	0.347	3.98	6.9	38.67
			11.0	13.01	0.352	4.14	6.89	39.96
			12.0	12.83	0.354	4.17	6.91	40.09
			13.0	12.59	0.361	4.32	6.91	41.33
			14.0	12.12	0.37	4.55	6.94	43.03
			14.5	11.93	0.384	5.16	7.13	48.66
ST-3	**2.1**	**1.9**	**Surface**	27.94	0.473	10.74	8.21	139.4
			1.0	27.28	0.489	10.71	8.4	137.39
			2.0	25.75	0.522	8.26	7.88	103.07
ST-4	**2.5**	**2.25**	**Surface**	26.17	0.328	7.55	7.4	94.85
			1.0	26.14	0.327	7.43	7.5	93.32
			2.0	26.17	0.325	7.51	7.51	94.35
			3.0	26.19	0.324	7.21	7.45	90.69
ST-5	**3.25**	**1**	**Surface**	26.6	0.331	7.3	7.38	92.45
			1.0	26.53	0.33	7.17	7.39	90.65
			2.0	26.37	0.33	7.04	7.38	88.75
			3.0	25.24	0.333	3.16	7.05	39.14
			3.3	24.63	0.338	2.2	6.96	26.9
ST-6	**2.4**	**1.6**	**Surface**	26.86	0.324	11.08	7.64	140.96
			1.0	26.82	0.326	10.69	7.61	135.97
			2.0	26.55	0.327	10.51	7.67	133.03
			3.0	26.44	0.328	10.36	7.53	130.81
ST-7	**2**	**2**	**Surface**	27.31	0.292	11.79	7.95	151.24
			1.0	27.29	0.292	10.94	7.94	140.31
			2.0	27.19	0.296	10.9	8.03	139.47
ST-8	**7.5**	**2.7**	**Surface**	26.02	0.322	8.83	7.92	110.71
			1.0	26.02	0.322	8.74	7.91	109.58
			2.0	26.04	0.322	8.63	7.91	108.15
			3.0	26.04	0.322	8.56	7.89	107.34
			4.0	26.03	0.321	8.46	7.9	106.04
			5.0	26.01	0.321	8.47	7.88	106.19
			6.0	24.07	0.323	8.31	7.69	100.48
			7.0	23.02	0.325	8.22	7.55	98.2
ST-9	**8**	**2.3**	**Surface**	26.32	0.322	10.1	8.43	127.26
			1.0	26.29	0.322	10	8.43	125.95
			2.0	26.15	0.324	9.88	8.4	124.06
			3.0	25.66	0.325	9.45	8.12	117.6
			4.0	24.68	0.325	9.36	7.96	114.52
			5.0	22.69	0.325	8.76	7.7	103.21
			6.0	19.94	0.328	7.15	7.45	79.89
			7.0	17.68	0.334	4.86	7.23	51.85
			8.0	15.78	0.359	3.97	7.14	40.7
ST-10	**1.5**	**1**	**Surface**	27.7	0.293	10.44	7.74	134.89
			1.0	27.24	0.288	9.81	7.58	125.69
			1.5	27.1	0.291	8.91	7.46	113.79
ST-11	**1.1**	**1.1**	**Surface**	27.31	0.27	8.3	7.41	106.47
			1.0	26.28	0.269	8.35	7.36	105.1

***In-Situ* Monitoring for Lake Hopatcong 7/28/10**								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity***	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
ST-1	**2**	**1**	**Surface**	26.75	0.3515	9.6	8.01	120.35
			1.0	26.74	0.352	9.36	8	117.36
			2.0	26.68	0.3605	9.03	7.91	113.11
ST-2	**13.7**	**2.2**	**Surface**	26.43	0.426	7.62	7.99	95.03
			1.0	26.44	0.4245	7.64	7.97	95.38
			2.0	26.42	0.4245	7.65	7.96	95.46
			3.0	26.41	0.4245	7.64	7.94	95.21
			4.0	26.4	0.424	7.57	7.92	94.31
			5.0	26.22	0.4235	7.32	7.84	90.99
			6.0	23.84	0.4165	4.69	7.45	55.86
			7.0	19.51	0.407	2.54	7.2	27.84
			8.0	16.27	0.4115	2.46	7.14	25.18
			9.0	14.15	0.403	2.99	7.16	29.26
			10.0	13.56	0.415	3.72	7.16	35.96
			11.0	13.12	0.4185	4.04	7.16	38.67
			12.0	12.65	0.4175	4.17	7.19	39.5
			13.0	12.21	0.4325	4.27	7.29	40.02
			13.5	12.02	0.535	4.28	7.36	40.01
ST-3	**2**	**0.8**	**Surface**	27.02	0.557	10.1	8.49	127.37
			1.0	26.92	0.54	9.77	8.48	123.03
			2.0	26.27	0.5665	6.04	7.66	75.21
ST-4	**3**	**1.2**	**Surface**	26.44	0.4265	7.57	7.85	94.51
			1.0	26.42	0.4255	7.61	7.91	94.87
			2.0	26.4	0.4255	7.58	7.92	94.47
			3.0	26.41	0.4255	7.57	7.92	94.35
ST-5	**3.2**	**0.8**	**Surface**	26.34	0.4265	7.49	7.81	93.22
			1.0	26.35	0.4285	7.64	8.02	95.19
			2.0	26.28	0.423	7.49	8.01	93.12
			3.0	25.92	0.4255	3.19	7.39	39.5
ST-6	**2.2**	**1.4**	**Surface**	26.46	0.42	9.79	8.11	122.23
			1.0	26.45	0.419	9.69	8.1	120.88
			2.0	26.44	0.4195	9.45	8.07	117.93
ST-7	**1.4**	**1.4**	**Surface**	26.35	0.398	10.17	8.12	126.67
			1.0	26.34	0.398	10.02	8.15	124.73
			1.5	26	0.402	9.82	8.05	121.47
ST-8	**7.5**	**2.3**	**Surface**	26.7	0.4065	10.35	7.92	129.69
			1.0	26.69	0.405	10.21	7.96	127.97
			2.0	26.67	0.406	10.09	7.97	126.37
			3.0	26.66	0.4075	10.01	7.98	125.33
			4.0	26.63	0.4085	9.94	8	124.4
			5.0	26.26	0.415	9.76	8.04	121.38
			6.0	25.26	0.4135	8.89	7.85	108.56
			7.0	19.46	0.3935	4.69	7.31	51.29
ST-9	**8.2**	**2**	**Surface**	26.14	0.4075	9.42	8.05	116.81
			1.0	26.16	0.418	9.32	8.04	115.72
			2.0	26.16	0.4175	9.14	8.01	113.48
			3.0	26.14	0.417	9.03	7.98	112.09
			4.0	26.05	0.4145	9.03	8.01	111.83
			5.0	25.99	0.414	8.61	7.92	106.54
			6.0	25.5	0.411	7.03	7.62	86.22
			7.0	19.13	0.3975	4.25	7.26	46.21
			8.0	15.74	0.449	3.8	7.33	38.5
ST-10	**1.3**	**1**	**Surface**	26.86	0.3525	10.21	8.29	128.27
			1.0	26.85	0.3525	10.08	8.3	126.55
ST-11	**1**	**1**	**Surface**	25.64	0.325	8.76	7.46	107.63
			1.0	25.09	0.328	7.98	7.35	97.08

* = 28 July Conductivity concentrations are approximate due to possible meter malfunction

In-Situ **Monitoring for Lake Hopatcong 8/25/10**								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity**	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
ST-1	**1.7**	**1**	**Surface**	21.63	0.335	8.58	7.46	100.89
			1.0	21.65	0.335	8.59	7.51	100.94
			2.0	21.44	0.335	8.59	7.52	100.59
ST-2	**13.5**	**2.8**	**Surface**	22.8	0.376	7.4	6.97	88.98
			1.0	22.81	0.376	7.35	7.05	88.37
			2.0	22.8	0.376	7.4	7.18	88.97
			3.0	22.8	0.376	7.47	7.23	89.8
			4.0	22.8	0.376	7.5	7.25	90.16
			5.0	22.8	0.376	7.49	7.3	89.99
			6.0	22.8	0.376	7.48	7.3	89.87
			7.0	22.79	0.376	7.41	7.31	89.05
			8.0	22.76	0.376	7.37	7.3	88.59
			9.0	15.33	0.373	2.2	6.87	22.83
			10.0	13.9	0.374	2.19	6.79	21.98
			11.0	13.16	0.38	2.04	6.77	20.19
			12.0	12.7	0.381	2	6.8	19.57
			13.0	12.13	0.393	2.09	6.81	20.17
			13.5	11.94	0.406	2.21	6.84	21.21
ST-3	**1.9**	**0.7**	**Surface**	21.55	0.477	9.44	8.13	110.79
			1.0	21.4	0.478	9.11	8.01	106.61
			2.0	21.25	0.483	4.18	7.16	48.87
ST-4	**2.5**	**1.5**	**Surface**	21.5	0.379	8.15	7.11	95.51
			1.0	21.5	0.379	8.19	7.2	96
			2.0	21.49	0.379	8.18	7.28	95.89
			3.0	21.5	0.379	7.52	7.2	88.22
ST-5	**3.2**	**1.6**	**Surface**	21.28	0.377	8.34	6.84	97.36
			1.0	21.25	0.377	8.19	6.97	95.51
			2.0	21.2	0.376	8.08	7.06	94.18
			3.0	21.16	0.373	7.77	7.13	90.52
ST-6	**2.2**	**2.2**	**Surface**	21.87	0.373	9.21	7.88	108.76
			1.0	21.82	0.373	9.2	7.87	108.53
			2.0	21.49	0.375	9.17	7.87	107.47
ST-7	**1.5**	**1.5+**	**Surface**	21.19	0.415	8.46	7	98.57
			1.0	20.72	0.424	8.36	7.03	96.59
			1.5	20.68	0.425	8.41	7.08	97.11
ST-8	**7.1**	**2.8**	**Surface**	22.84	0.376	7.86	6.99	94.51
			1.0	22.84	0.376	7.86	7.06	94.54
			2.0	22.83	0.376	7.65	7.12	92.05
			3.0	22.82	0.376	7.49	7.15	90.03
			4.0	22.77	0.376	7.57	7.18	90.98
			5.0	22.74	0.376	7.66	7.2	92
			6.0	22.72	0.376	7.62	7.2	91.5
			7.0	22.67	0.373	7.54	7.21	90.37
ST-9	**7.8**		**Surface**	23.11	0.376	8.01	7.45	96.89
			1.0	23.1	0.376	8.34	7.48	100.88
			2.0	23.06	0.376	8.4	7.49	101.53
			3.0	23.01	0.376	8.56	7.5	103.34
			4.0	22.97	0.376	8.72	7.47	105.15
			5.0	22.9	0.376	8.51	7.45	102.45
			6.0	21.85	0.375	5.86	7.17	69.18
			7.0	20.69	0.367	2.82	6.82	32.59
			7.5	19.57	0.38	2.3	6.68	25.98
ST-10	**1.5**	**1.4**	**Surface**	20.9	0.341	9.82	7.42	113.79
			1.0	20.62	0.345	9.66	7.71	111.29
			1.5	20.58	0.347	9.66	7.88	111.26
ST-11	**0.9**	**0.9+**	**Surface**	20.22	0.351	9.25	6.9	105.72
			1.0	20.19	0.351	8.42	6.89	96.25

***In-Situ* Monitoring for Lake Hopatcong 9/22/10**								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity**	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
ST-1	**1.7**	**1**	**Surface**	19.89	0.35	9.41	7.74	105.01
			1.0	19.65	0.35	9.49	7.7	105.34
			1.5	18.9	0.35	9.4	7.67	102.77
ST-2	**13.7**	**2.2**	**Surface**	19.78	0.375	9.08	7.7	101.08
			1.0	19.74	0.375	8.75	7.62	97.38
			2.0	19.58	0.375	8.68	7.56	96.22
			3.0	19.53	0.375	8.63	7.52	95.55
			4.0	19.44	0.375	8.59	7.49	94.95
			5.0	19.39	0.375	8.54	7.45	94.32
			6.0	19.36	0.374	8.46	7.41	93.45
			7.0	19.32	0.375	8.41	7.4	92.74
			8.0	19.3	0.374	8.12	7.38	89.54
			9.0	19.19	0.374	7.17	7.3	78.91
			10.0	16.84	0.376	3.06	7.03	32.13
			11.0	13.67	0.385	2.54	6.96	24.86
			12.0	12.36	0.394	1.87	7	17.81
			13.0	11.99	0.404	1.77	7.01	16.75
			13.5	11.93	0.412	1.68	7.01	15.89
ST-3	**1.9**	**0.6**	**Surface**	21.75	0.474	10.02	8.55	116
			1.0	19.73	0.473	10.42	8.52	115.88
			2.0	19.1	0.472	9.48	8.3	104.17
ST-4	**2.5**	**2.1**	**Surface**	19.32	0.381	9.83	8.2	108.45
			1.0	19.25	0.382	9.62	8.22	105.95
			2.0	19.13	0.382	9.69	8.3	106.53
			2.5	19.21	0.381	9.69	8.31	106.66
ST-5	**2**	**1.5**	**Surface**	19.48	0.383	8.76	8.08	96.97
			1.0	19.38	0.384	9.15	8.1	101.09
			2.0	18.93	0.383	9.25	8.09	101.26
ST-6	**2**	**2**	**Surface**	20.59	0.378	10.28	8.24	116.32
			1.0	20.38	0.376	10.26	8.35	115.55
			2.0	19.48	0.377	10.66	8.42	117.92
ST-7	**1.5**	**1.5**	**Surface**	20.18	0.427	10.09	8.17	113.21
			1.0	19.88	0.434	9.98	8.17	111.3
			1.5	19.01	0.456	9.88	8.16	108.35
ST-8	**7**	**2.5**	**Surface**	20.24	0.375	9.1	7.52	102.18
			1.0	20.05	0.375	8.93	7.54	99.9
			2.0	19.84	0.375	8.81	7.55	98.19
			3.0	19.85	0.375	8.7	7.54	96.99
			4.0	19.82	0.375	8.62	7.53	96.02
			5.0	19.81	0.375	8.61	7.52	95.93
			6.0	19.79	0.375	8.48	7.51	94.45
			7.0	19.76	0.372	4.31	7.06	47.99
ST-9	**7.8**	**2.5**	**Surface**	20.3	0.375	9.46	7.67	106.39
			1.0	19.89	0.375	9.23	7.64	102.98
			2.0	19.65	0.375	9.06	7.62	100.63
			3.0	19.36	0.375	8.72	7.57	96.22
			4.0	19.32	0.375	8.11	7.46	89.43
			5.0	19.29	0.375	7.81	7.41	86.12
			6.0	19.27	0.375	7.65	7.37	84.27
			7.0	19.2	0.375	7.64	7.35	84.03
			7.5	19.06	0.436	6.1	7.19	66.96
ST-10	**1.2**	**1.2**	**Surface**	20.84	0.357	10.38	8.16	118.01
			1.0	20.44	0.356	10.25	8.21	115.6
			1.2	20.13	0.358	10.35	8.45	116.01
ST-11	**0.75**	**0.75**	**Surface**	18.89	0.416	8.92	7.58	97.55
			0.8	18.43	0.416	8.78	7.51	95.19

In-Situ Monitoring for Hopatcong 319 Stations 5/25/10								
Station	DEPTH (meters)			Temperature	Conductivity	Dissolved Oxygen	pH	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(mmhos/cm)	(mg/L)	(units)	(%)
NPS 1	1.5	1.5	Surface	24.96	0.652	17.69	9.34	214.72
			1.00	20.66	0.787	19.53	9.34	218.45
			1.50	20.43	0.881	24.84	9.66	276.65
NPS 2	1.2	1.2	Surface	21.53	0.322	14.62	7.98	166.13
			1.00	20.58	0.314	14.25	8.12	158.93
NPS 3	0.75	0.75	Surface	23	0.279	14.85	7.62	173.52
			0.80	21.59	0.275	14.61	7.61	166.19
NPS 4	1.4	1.4	Surface	20.64	0.34	10.43	8.03	116.5
			1.00	20.49	0.34	10.48	8.03	116.72
			1.25	20.45	0.34	10.43	8.05	116.03
NPS 5	2.5	2	Surface	21.22	0.338	9.91	7.96	111.93
			1.00	20.28	0.337	9.92	7.94	109.99
			2.00	19.58	0.338	9.17	7.7	100.32
			2.50	18.81	0.339	6.23	7.19	67.08

In-Situ Monitoring for Hopatcong 319 Stations 6/28/10								
Station	DEPTH (meters)			Temperature	Conductivity	Dissolved Oxygen	pH	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(mmhos/cm)	(mg/L)	(units)	(%)
NPS 1	1.2	0.9	Surface	27.27	0.591	10.21	7.94	130.93
			1.00	27.23	0.592	10.08	7.96	129.19
NPS 2	1.2	1.2	Surface	26.59	0.319	8.71	8.62	110.26
			1.00	26.56	0.317	9.01	8.77	114.09
NPS 3	1.1	1.1	Surface	28.04	0.276	9.89	8.06	128.55
			0.80	26.95	0.278	10.31	8.3	131.42
NPS 4	1.2	1.2	Surface	28.37	0.349	12.72	7.93	166.31
			1.00	27.66	0.348	13.37	8.34	172.58
NPS 5	2.2	1.1	Surface	26.83	0.331	7.55	7.56	96.04
			1.00	26.64	0.331	7.61	7.52	96.41
			2.00	26.45	0.331	7.05	7.41	89.12

In-Situ Monitoring for Hopatcong 319 Stations 7/28/10								
Station	DEPTH (meters)			Temperature	Conductivity*	Dissolved Oxygen	pH	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(mmhos/cm)	(mg/L)	(units)	(%)
NPS 1	1.2	0.4	Surface	26.17	0.619	9.7	8.36	120.59
			1.00	26.18	0.6175	9.43	8.34	117.22
NPS 2	1	0.8	Surface	26.37	0.3935	10.26	8.66	127.78
			1.00	26.22	0.3945	8.95	8.34	111.22
NPS 3	0.5	0.5	Surface	26.22	0.355	10.64	8.74	132.1
			0.50	26.24	0.354	10.49	8.76	130.34
NPS 4	1.2	1	Surface	26.9	0.403	9.78	8.31	123
			1.00	26.78	0.4015	9.99	8.65	125.35
NPS 5	1.7	1	Surface	26.47	0.4235	7.33	7.76	91.52
			1.00	26.4	0.42	7.3	7.88	91.03
			1.50	26.36	0.419	7.04	7.84	87.75

* = 28 July Conductivity values are approximate due to possible meter malfunction

In-Situ Monitoring for Hopatcong 319 Stations 8/25/10								
Station	DEPTH (meters)			Temperature	Conductivity	Dissolved Oxygen	pH	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(mmhos/cm)	(mg/L)	(units)	(%)
NPS 1	1.3	0.5	Surface	21.14	0.451	9.41	8.02	109.52
			1.00	20.73	0.439	9.22	7.95	106.46
NPS 2	1	1.0+	Surface	20.85	0.36	8.88	7.2	102.73
			1.00	20.68	0.359	8.5	7.26	98.02
NPS 3	0.8	0.8+	Surface	20.04	0.329	10.31	7.3	117.39
			0.50	19.85	0.328	10.31	7.41	116.95
NPS 4	1.1	1.1+	Surface	20.49	0.377	8.03	7.06	92.31
			1.00	20.47	0.377	7.96	7.15	91.43
NPS 5	1.7	1.5	Surface	21.1	0.376	8.25	7.06	95.96
			1.00	21.08	0.376	8.31	7.19	96.62
			1.50	20.77	0.371	8.42	7.28	97.32

In-Situ Monitoring for Hopatcong 319 Stations 9/22/10								
Station	DEPTH (meters)			Temperature	Conductivity	Dissolved Oxygen	pH	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(mmhos/cm)	(mg/L)	(units)	(%)
NPS 1	1.1	0.6	Surface	20.93	0.481	9.95	8.08	113.3
			1.00	19.59	0.474	9.54	8.14	105.79
NPS 2	0.8	0.8	Surface	19.94	0.375	9.28	7.94	103.63
			1.00	19.94	0.375	9.1	7.96	101.68
NPS 3	0.75	0.75	Surface	21	0.352	10.22	8.34	116.52
			0.50	19.77	0.351	11.55	8.86	128.55
NPS 4	1.5	1.5	Surface	19.35	0.387	9.9	8.34	109.25
			1.00	19.34	0.386	9.98	8.44	110.16
NPS 5	2	1.2	Surface	20.07	0.384	9.58	8.19	107.28
			1.00	19.31	0.383	9.92	8.42	109.35
			2.00	19.1	0.383	9.28	8.24	101.92

APPENDIX C

WATER QUALITY DATA

HOPATCONG
25-May-2010

STATION	Chlorophyll (mg/m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	6.9	0.03	0.04	0.02	ND <2
ST-2	7.6	0.01	0.08	0.01	ND <2
ST-3	2.1	0.02	0.05	0.02	ND <2
ST-4	7.5	0.02	0.02	0.02	ND <2
ST-5	9.6	ND <0.01	0.04	0.02	2
ST-6	7.1	ND <0.01	0.03	0.02	ND <2
ST-7	7.9	0.04	0.11	0.02	ND <2
ST-10	7.7	0.02	0.15	0.03	ND <2
ST-11	7.5	0.06	0.13	0.04	2
ST-2 DEEP		0.35	0.09	0.07	3
MEAN	**7.1**	**0.03**	**0.07**	**0.02**	**2.0**

HOPATCONG
28-Jun-10

STATION	Chlorophyll (mg/m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	11	0.02	0.04	0.03	6
ST-2	2.8	ND <0.01	0.03	ND <0.01	ND <2
ST-3	2.7	ND <0.01	0.04	0.03	3
ST-4	8.2	ND <0.01	0.04	0.02	ND <2
ST-5	11.9	0.01	ND	0.02	ND <2
ST-6	2.1	ND <0.01	0.03	0.02	ND <2
ST-7	1.4	0.01	0.05	0.01	ND <2
ST-10	13	ND <0.01	0.07	0.03	4
ST-11	2.3	0.02	0.08	0.02	ND <2
ST-2 DEEP		0.63	0.12	0.01	8
MEAN	**6.2**	**0.02**	**0.05**	**0.02**	**4.3**

HOPATCONG
28-Jul-10

STATION	Chlorophyll (mg/m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	25.3	ND <0.01	0.07	0.04	9
ST-2	4.3	ND <0.01	0.02	0.01	5
ST-3	30.1	ND <0.01	0.05	0.05	9
ST-4	8	ND <0.01	0.03	0.03	6
ST-5	16.3	ND <0.01	ND <0.02	0.04	9
ST-6	6.2	ND <0.01	ND <0.02	0.02	4
ST-7	3	ND <0.01	0.02	0.02	ND <2
ST-10	25.8	ND <0.01	0.02	0.03	5
ST-11	6	ND <0.01	0.02	0.02	ND <2
ST-2 DEEP		0.88	0.06	0.24	9
MEAN	**13.9**	**< 0.01**	**0.03**	**0.03**	**6.7**

HOPATCONG
25-Aug-10

STATION	Chlorophyll (mg/m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	19.7	0.03	0.05	0.03	7
ST-2	7.6	0.03	ND <0.02	0.02	ND <2
ST-3	43.5	0.02	0.06	0.06	9
ST-4	11.7	0.02	ND <0.02	0.02	4
ST-5	11.6	0.03	0.03	0.02	3
ST-6	5.9	0.03	ND <0.02	0.02	ND <2
ST-7	6	0.02	0.04	0.02	ND <2
ST-10	19.2	0.02	0.04	0.03	5
ST-11	19.8	0.02	0.12	0.04	15
ST-2 DEEP		0.91	0.10	0.23	11
MEAN	**16.1**	**0.02**	**0.06**	**0.03**	**7.2**

HOPATCONG
22-Sep-10

STATION	Chlorophyll (mg/m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	15.8	0.01	0.05	0.03	6
ST-2	8.3	0.02	0.03	0.01	ND <2
ST-3	28.9	0.02	0.03	0.03	6
ST-4	7.2	0.02	0.03	0.02	ND <2
ST-5	8.1	0.01	0.03	0.02	3
ST-6	5	0.02	0.03	0.01	2
ST-7	10.3	0.02	0.04	0.02	3
ST-10	13.8	0.03	0.03	0.04	2
ST-11	7.6	0.02	0.04	0.02	ND <2
ST-2 DEEP		0.87	0.03	0.17	8
MEAN	**11.7**	**0.02**	**0.03**	**0.02**	**3.7**

319 Sampling for Lake Hopatcong 2010

5/25/2010

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.02	ND <2	NS
NPS 2	0.01	ND <2	
NPS 3	0.02	ND <2	8.7
NPS 4	0.01	ND <2	8.7
NPS 5	0.01	ND <2	7

6/28/2010

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.07	4	
NPS 2	0.03	ND <2	
NPS 3	0.02	2	4.8
NPS 4	0.03	5	3.1
NPS 5	0.03	5	13.1

7/28/2010

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.09	15	
NPS 2	0.02	29	
NPS 3	0.04	12	14.1
NPS 4	0.02	ND <2	5.1
NPS 5	0.03	6	11.3

8/25/2010

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.08	12	
NPS 2	0.02	ND <2	
NPS 3	0.04	9	20.4
NPS 4	0.02	ND <2	6.6
NPS 5	0.02	2	7.9

9/22/2010

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.08	10	
NPS 2	ND <0.01	ND <2	
NPS 3	0.03	4	9.2
NPS 4	0.02	ND <2	6.7
NPS 5	ND <0.01	2	6.5