LAKE & RESERVOIR ASSESSMENTS – YADKIN-PEE DEE RIVER BASIN

Roberdel Lake

Intensive Survey Unit
Environmental Sciences Section
Division of Water Quality
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GLOSSARY

Algae	Small aquatic plants that occur as single cells, colonies, or filaments. May also be referred to as phytoplankton, although phytoplankton are a subset of algae.
Algal biovolume	The volume of all living algae in a unit area at a given point in time. To determine biovolume, individual cells in a known amount of sample are counted. Cells are measured to obtain their cell volume, which is used in calculating biovolume
Algal density	The density of algae based on the number of units (single cells, filaments and/or colonies) present in a milliliter of water. The severity of an algae bloom many be determined by the algal density as follows: Mild bloom = 20,000 to 30,000 units/ml Severe bloom = 30,000 to 100,000 units/ml Extreme bloom = Greater than 100,000 units/ml
Algal Growth Potential Test (AGPT)	A test to determine the nutrient that is the most limiting to the growth of algae in a body of water. The sample water is split such that one sub-sample is given additional nitrogen, another is given phosphorus, a third may be given a combination of nitrogen and phosphorus, and one sub-sample is not treated and acts as the control. A specific species of algae is added to each sub-sample and is allowed to grow for a given period of time. The dry weights of algae in each sub-sample and the control are then measured to determine the rate of productivity in each treatment. The treatment (nitrogen or phosphorus) with the greatest algal productivity is said to be the limiting nutrient of the sample source. If the control sample has an algal dry weight greater than 5 mg/L, the source water is considered to be unlimited for either nitrogen or phosphorus.
Centric diatom	Diatoms photosynthetic algae that have a siliceous skeleton (frustule) and are found in almost every aquatic environment including fresh and marine waters, soils, in fact almost anywhere moist. Centric diatoms are circular in shape and are often found in the water column.
Chlorophyll *a*	Chlorophyll *a* is an algal pigment that is used as an approximate measure of algal biomass. The concentration of chlorophyll-a is used in the calculation of the NCTSI, and the value listed is a lake-wide average from all sampling locations.
Clinograde	In productive lakes where oxygen levels drop to zero in the lower waters near the bottom, the graphed changes in oxygen from the surface to the lake bottom produces a curve known as clinograde curve.
Coccoid	Round or spherical shaped cell
Conductivity	This is a measure of the ability of water to conduct an electrical current. This measure increases as water becomes more mineralized. The concentrations listed are the range of values observed in surface readings from the sampling locations.
Dissolved oxygen	The range of surface concentrations found at the sampling locations.
Dissolved oxygen saturation	The capacity of water to absorb oxygen gas. Often expressed as a percentage, the amount of oxygen that can dissolved into water will change depending on a number of parameters, the most important being temperature. Dissolved oxygen saturation is inversely proportion to temperature, that is, as temperature increases, water's capacity for oxygen will decrease, and vice versa.
Eutrophic	Describes a lake with high plant productivity and low water transparency.

Eutrophication	The process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a lake.
Limiting nutrient	The plant nutrient present in lowest concentration relative to need limits growth such that addition of the limiting nutrient will stimulate additional growth. In north temperate lakes, phosphorus (P) is commonly the limiting nutrient for algal growth
Manganese	A naturally occurring metal commonly found in soils and organic matter. As a trace nutrient, manganese is essential to all forms of biological life. Manganese in lakes is released from bottom sediments and enters the water column when the oxygen concentration in the water near the lake bottom is extremely low or absent. Manganese in lake water may cause taste and odor problems in drinking water and require additional treatment of the raw water at water treatment facilities to alleviate this problem.
Mesotrophic	Describes a lake with moderate plant productivity and water transparency
NCTSI	North Carolina Trophic State Index was specifically developed for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). It takes the nutrients present along with chlorophyll *a* and Secchi depth to calculate a lake's biological productivity.
Oligotrophic	Describes a lake with low plant productivity and high water transparency.
pH	The range of surface pH readings found at the sampling locations. This value is used to express the relative acidity or alkalinity of water
Photic zone	The portion of the water column in which there is sufficient light for algal growth. DWQ considers 2 times the Secchi depth as depicting the photic zone.
Secchi depth	This is a measure of water transparency expressed in meters. This parameter is used in the calculation of the NCTSI value for the lake. The depth listed is an average value from all sampling locations in the lake.
Temperature	The range of surface temperatures found at the sampling locations.
Total Kjeldahl nitrogen (TKN)	The sum of organic nitrogen and ammonia in a water body. High measurements of TKN typically results from sewage and manure discharges in water bodies.
Total organic Nitrogen (TON)	Total Organic Nitrogen (TON) can represent a major reservoir of nitrogen in aquatic systems during summer months. Similar to phosphorus, this concentration can be related to lake productivity and is used in the calculation of the NCTSI. The concentration listed is a lake-wide average from all sampling stations and is calculated by subtracting Ammonia concentrations from TKN concentrations.
Total phosphorus (TP)	Total phosphorus (TP) includes all forms of phosphorus that occur in water. This nutrient is essential for the growth of aquatic plants and is often the nutrient that limits the growth of phytoplankton. It is used to calculate the NCTSI. The concentration listed is a lake-wide average from all sampling stations.
Trophic state	This is a relative description of the biological productivity of a lake based on the calculated NCTSI value. Trophic states may range from extremely productive (Hypereutrophic) to very low productivity (Oligotrophic)
Turbidity	A measure of the ability of light to pass through a volume of water. Turbidity may be influenced by suspended sediment and/or algae in the water.
Watershed	A drainage area in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Overview

The Yadkin-Pee Dee River Basin covers 7,213 square miles within 21 counties in North Carolina in the mountain and piedmont regions. It is the second largest basin in the state. The river basin originates on the eastern slope of the Blue Ridge Mountains in Caldwell and Wilkes counties. The Yadkin River flows northeast for approximately 100 miles before turning southeast and joining with the Uwharrie River to form the Pee Dee River. The Pee Dee River continues flowing southeast across the North Carolina-South Carolina state line into South Carolina and to Winyah Bay.

Prior sampling in the Yadkin basin resulted in High Rock Lake, the upper portion of Tuckertown Lake and Rockingham City Lake being listed as impaired. The upper portion of High Rock Lake below normal operating level was impaired in 2004 for violations of the state water quality standards for turbidity, chlorophyll *a*, and dissolved oxygen. The lower portion of High Rock Lake to the dam) is also listed as impaired for turbidity. Data collected in 2005 and 2006 supported impairment of High Rock Lake based on elevated turbidity and chlorophyll *a* values. The upper portion of Tuckertown Lake to the mouth of Cabin Creek was placed on the 303(d) List in 2004 as impaired for low dissolved oxygen. The upper most DWQ ambient sampling site is downstream of Cabin Creek, and dissolved oxygen values in this portion of the reservoir in 2006 were adequate. Rockingham City Lake was impaired in 1998 for aquatic weeds. A survey of the lake in the early summer of 2006 determined that the lake is still impaired for aquatic plants.

Twenty-three reservoirs were sampled in the Yadkin-Pee Dee River Basin between 1 January 2002 and 30 September 2006. In 2006, DWQ staff discovered Chinese Mystery Snails (*Cipangopaludina chinensis*) in Tuckertown Reservoir. These snails are a nonnative species commonly found in aquarium and pet stores. Where they have become established in other parts of the United States, they have out competed native snails for food and habitat. Also found in Tuckertown Reservoir and Badin Lake were mats of the fibrous blue green alga, *Lyngbya wollei.* Lyngbya can form huge mats that impede swimming and boating and can greatly reduce the aesthetic values of a lake where it has become established. The mats generally form on the lake bottom but often come to the surface of the water where they may decay and produce a strong, offensive odor. One lake, Lake Howell (Coddle Creek Reservoir), a water supply for Concord, was sampled for the first time by DWQ in 2006.

Lakes Lee, Monroe and Twitty were identified in the 2006 Report to the Environmental Review Commission on the Status of Water Quality in Water Supply Reservoirs Sampled by the Division of Water Quality as needing additional sampling to better determine if these lakes should be listed as impaired. The 2006 sampling resulted in all three lakes are being listed as impaired based on exceedances of the chlorophyll a standard.

The remaining 18 lakes sampled during 2006 were not rated due to insufficient sampling. However, six lakes were identified as having potential problems and additional sampling on those lakes will be conducted as resources become available. Those lakes are Salem, Fisher, Concord, Back Creek, Bunch and Badin.

Following the description of the assessment methodology used for the Yadkin-Pee Dee River Basin, there are individual summaries for each of the lakes and Appendix A, a matrix that distills the information used to make the lakes use support assessments. For further background information on a particular lake (including sampling data), please go to http://www.esb.enr.state.nc.us/.

Assessment Methodology

For this report, data from January 1, 2002 through September 30, 2006 were reviewed. All lakes except High Rock Lake were sampled only during the summer of 2006 from May through September. High Rock Lake was sampled April 2005 through August of 2006. The extended sampling period was due to a special study being conducted to better document current conditions in the reservoir and support development of a nutrient model for the watershed. Data were assessed for excursions of the state's class C water quality standards for chlorophyll-a, pH, dissolved oxygen, turbidity, and surface metals. The water supply standards sampled and evaluated were total suspended solids (TSS), nickel, manganese, chlorides and total hardness.

Other parameters discussed in this report include Secchi depth and percent dissolved oxygen saturation. Secchi depth provides a measure of water clarity and is used in calculating the trophic or nutrient enriched status of a lake. Percent dissolved oxygen saturation gives information on the amount of dissolved oxygen in the water column and may be increased by photosynthesis.

On lakes without obvious segmentation or differences in hydrology and morphology between stations, all samples taken on a particular sampling date regardless of station are treated as replicates and the average concentration is used to determine if the standards are being met. Readings of pH are the only exception as it is inappropriate to average pH values. For a lake such as High Rock Lake, which has very definite differences between portions of the lake and has been given different assessment units based on hydrology and morphology, results are averaged within the assessment unit. See the matrix in Appendix A for how the stations are grouped.

A water quality standard is exceeded (denoted by CE in matrix) if data values are do not meet the state's water quality standard for more than 10% of the samples where the sample size consists of ten or more observations for the basinwide assessment period. Ideally, ten observations are needed to provide enough data to reasonably interpret water quality conditions within the lake or reservoir. Fewer observations increase the possibility of misinterpreting random unusual conditions as representative of ongoing water quality trends. If the water quality standard is exceeded, either in less than 10% of the data collected during the assessment period or if the sample observation size is less than ten for the basinwide assessment period, then the water quality standard for that parameter is designated exceeded (E in the matrix).

Additional data considered as part of the use support assessment includes historic DWQ water quality data, documented algal blooms and/or fish kills, problematic aquatic macrophytes, or listing on the EPA's 303(d) List of Impaired Waters.

Lakes receive an overall rating of Supporting or Impaired when ten or more samples per water quality criteria are collected for evaluation within the basinwide assessment period. Otherwise, the lake is considered as Not Rated. The exception is for a lake listed on the 303(d) List of Impaired Waters or where additional data indicates water quality problems not captured during sampling. These lakes are listed as Impaired along with the reason for the impairment.

A more complete discussion of lake ecology and assessment can be found at http://www.esb.enr.state.nc.us/. The 1990 North Carolina Lake Assessment Report (downloadable from this website) contains a detailed chapter on ecological concepts that clarifies how the parameters discussed in this review related to water quality and reservoir health.

Assessments by Subbasin

Subbasin 030701

W. Kerr Scott Reservoir

Construction of W. Kerr Scott Reservoir took place between 1960 and 1962. The project was open for public use in 1963. Located in the foothills of the Blue Ridge Mountains, this reservoir is within the Mountain ecoregion of the state.

W. Kerr Scott Reservoir was sampled by DWQ monthly from May through September, 2006 and in June, July and August, 2005. Dissolved oxygen and water temperature in 2006 were similar to those values observed from 1981 through 2005. Surface pH values were also similar. Secchi depths ranged from 1.7 to 2.2 meters in 2006. This range was similar to Secchi depths measured at this reservoir since 1981. Conductivity measurements in 2006 were consistent with those previously measured by DWQ for this reservoir, suggesting that the physical parameters of this system have remained fairly stable since 1981.

Nutrient concentrations in 2006 were similar to those observed since 1981. Total phosphorus values were low and within range of concentrations to be expected in lakes located in the Mountain ecoregion. Total organic nitrogen and total Kjeldahl nitrogen ranged from low to moderate while ammonia and nitrite + nitrate values were generally low, with the exception of values measured in May, 2006. Nitrite + nitrate concentrations at all three lake sampling sites on May 23, 2006 were very elevated. This was more likely due to the availability of nitrogen in the system in the spring prior to an increase in the phytoplankton community as suggested by the low chlorophyll *a* concentrations in May as compared with increasing concentrations in July through September. In response to the available nutrients, lake-wide chlorophyll *a* values were greater than the state water quality standard of 15 μg/L for Trout Waters at YAD007A in August and at all three lake sampling sites in September (Appendix B).

W. Kerr Scott Reservoir was consistently mesotrophic (moderate biological productivity) in 2006 based on the calculated NCTSI scores. Historically, this reservoir has ranged between mesotrophic and oligotrophic (very low biological productivity) since 1981. Because this lake was sampled eight times during this evaluation period (less than 10 trips for evaluation of rating status), W. Kerr Scott Reservoir was designated as Not Rated.

Repair work on the swimming beach began in mid-December 2006 with the lowering of the lake water level to near elevation 1026 ft mean sea level (msl). Repair work was completed in January 2007 and the return to normal pool level (1030 ft msl) was expected to occur within four to six weeks. There were no complaints received by the Army Corps of Engineers regarding the drawdown of the reservoir, and some permit holders used the opportunity to repair their docks.

Additional sampling may be performed in this reservoir during the High Rock Lake TMDL special sampling beginning in 2007.

Subbasin 030704

Salem Lake

Salem Lake is located in the municipality of Winston-Salem. Created in 1919, this small reservoir serves as the water supply source for the city. Salem Lake provides water to eastern and southeastern Winston-Salem as well as serving as a reserve water basin for the Yadkin River (http://www.cityofws.org/Assets/CityOfWS//Documents/departments/utilities/pdf_files/Water%20Division%20Operations2.pdf). DWQ monitored Salem Lake five times in 2006 (May through September).

Secchi depths were generally less than a meter. Surface dissolved oxygen, while not less than the state's instantaneous reading of 4.0 mg/L, was low at site YAD077C in July (4.5 mg/L) and August (4.3 mg/L). This sampling site is located in the lower end of the reservoir near the dam. Manganese concentrations at this site were also greater than the state water quality standard of 200 μg/L in 2006 (Appendix A). Very low dissolved oxygen concentrations near the bottom of the lake at this site (range = 3.0 to 0.1 mg/L) may have contributed to the release of naturally occurring manganese from the bottom sediments into the water column. Raw water with elevated manganese levels requires additional treatment by water treatment facilities to reduce potential taste and odor problems in drinking water. All other sampled metals in Salem Lake were within the state's water quality standards for lakes designated as water supply sources.

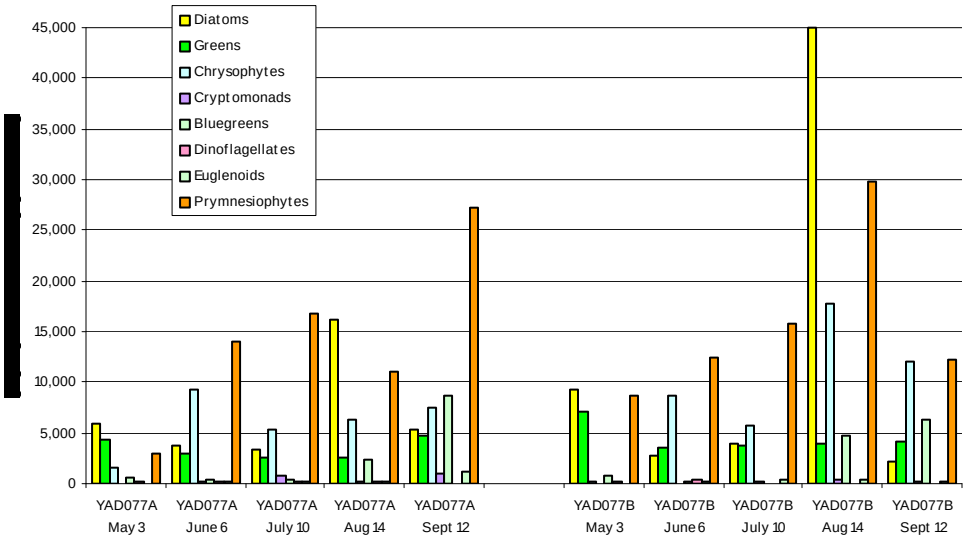

Figure 1. Phytoplankton Groups of Salem Lake, Summer 2006

Total phosphorus and total organic nitrogen generally ranged from moderate to elevated throughout the reservoir. Chlorophyll *a* values in Salem Lake ranged from moderate to elevated in 2006 with values in the Lowery Creek Arm (YAD077B) and Kerners Mill Creek Arm (YAD077A) greater than the state water quality standard of 40 µg/L in July and August. Algal blooms were observed from June through September in the arms of Salem Lake. In May and August, the pinnate diatom, *Nitzschia*, was common. The prymnesiophyte *Chrysochromulina* was the most common genus throughout the summer and the filamentous blue green alga *Cylindrospermopsis* was common in September (Figure 1)

Based on the calculated NCTSI scores, Salem Lake was determined to be eutrophic in 2006. Trophic scores were similar to those previously calculated by DWQ for this small reservoir since 1981. The elevated chlorophyll a values and depressed dissolved oxygen concentrations indicate that there may be problems at this lake. Additional sampling is warranted as resources become available.

Winston Lake

Winston Lake is a small reservoir located in the City of Winston-Salem. The lake was built in 1919 as a water supply source but is no longer used for that purpose. The lake is currently used for non-contact recreation such as fishing.

One station was sampled in Winston Lake by DWQ five times from May through September of 2006. Dissolved oxygen and pH measurements were within state water quality standards during the sampling period. One of five (20%) of the dissolved oxygen saturation values was above 120% saturation. The dissolved oxygen saturation found was 125% saturation on August 10, 2006. This indicates that significant algal activity (production of dissolved oxygen by algae) was occurring in the lake.

Nutrient concentrations were generally moderate to elevated in Winston Lake in 2006. The highest nutrient values were generally found for total organic nitrogen, nitrite + nitrate, and total Kjeldahl nitrogen (Appendix B). Total phosphorus was generally found in more moderate amounts. No chlorophyll *a* values were above the state water quality standard of 40 µg/L. Trophic state analyses indicated that Winston Lake is a biologically productive lake with a 2006 average NCTSI score placing the lake in the eutrophic category.

Surface metals in Winston Lake were within applicable state water quality standards with the exception of iron. Iron was found to be greater than the state water quality action level of 1000 µg/L in 60% of the samples collected. Iron values ranged from 660 µg/L to 1600 µg/L in 2006. Iron is present in naturally occurring high amounts in local soils. Field notes indicated that Winston Lake was very shallow and frequently had high turbidity levels, especially after a rain. These high iron values may be due to re-suspension of bottom sediments due to wind mixing along with nonpoint source runoff from iron rich soils upstream in the watershed.

Winston Lake appears to be supporting its aquatic life designated uses at this time.

High Rock Lake

High Rock Lake, built in 1927, is in the Yadkin River chain of lakes located between W. Kerr Scott and Tuckertown Reservoirs. The lake's primary uses are hydroelectric power generation, water supply and public recreation. The surrounding watershed is agriculture, forested, and urban areas. The lake receives drainage waters from nearby major urban areas including: Winston Salem, Salisbury, Lexington, and High Point. The immediate lakeside perimeter is highly developed with new homes being built. Lake levels are highly variable in response to a nearly constant release rate needed for energy production and an inconsistent inflow. The soils in the watershed are described as reddish and brown in color, highly erodable, and have contributed to high sedimentation, which has filled in the upper section of the lake to the degree that some areas are no longer navigable by boat.

High Rock Lake is separated into four assessment units. Sampling stations are established in each of these units (Appendix A). The lake was sampled from August 2004 through September 2006. Three of the four assessment units were sampled 22 times and the remaining assessment unit was sampled 19 times during the sampling period (Appendix A).

At two locations (one the middle of the main stem of the lake and the other near the dam), thermisters (programmed temperature recorders) documented temperature profiles. These devices were deployed at three lake sampling sites (YAD169F, YAD152A, and in the Abbots Creek Arm from March through November 2005. These thermisters were programmed to record water temperatures every two hours. At YAD152A where water depth is shallow, data showed little stratification. However, at the dam location (YAD169F) where water depths are much deeper, stratification layers are particularly evident in the warmer months and less so during cooler months.

Surface water temperature was greater than the state water quality standard of 32 °C (89.6 °F) in the main body of High Rock Lake and the Second Creek arm on July 19, August 16, 2005 and August 1, 2006 (August 2, 2006 for the Second Creek arm sampling site). Air temperatures on the days preceding sampling and on these sampling dates were in the low to mid 90's (32 to 35 °C). These high ambient air temperatures may have assisted in the warming of the lake water and producing the surface water temperature excursions observed. Sampling was conducted between 11 AM and 2 PM, times of day when temperatures are the highest and the air is usually the calmest. Water temperatures dropped below the standard of 32 °C at a depth of one meter from the surface. As there remained sufficient cooler water (temperatures measured at 1 meter and deeper were all below the temperature maximum) to support fish populations, these elevated temperatures are not considered sufficient to result in impairment of aquatic life.

Surface dissolved oxygen levels did not exceed state water quality standards during the sampling period; however, surface dissolved oxygen values were elevated during the warm months. These high values were consistent with previous data. Surface pH values in three of the four assessment units did exceed the state water quality standard of 9.0 s.u. (Appendix A & B). Again, pH was consistent with previous sampling events data. A predictable warm weather relationship between elevated dissolved oxygen, pH values, and algal growth was observed. Warmer temperatures during summer speed up the rates of photosynthesis. During photosynthesis carbon dioxide is taken up, increasing the pH values. Oxygen is produced and released into the water, increasing dissolved oxygen levels.

Turbidity in three of the four assessment units exceeded the state water quality standard of 25 NTU for lakes. The elevated turbidity values corresponded with low Secchi depths (which ranged from 0.1 to 1.4 meters),

and observations of extremely orange to brown water color. Secchi depths were similar to those observed in the past.

Nutrient levels in High Rock Lake varied greatly and tended to be elevated. Chlorophyll *a* values ranged from low to elevated. Chlorophyll *a* values did exceed the state water quality standard of 40 μg/L during more than 10% of sampling events, in all four assessment units (Appendix A). Mean chlorophyll a values from May through September 2006 were greater than 40 μg/L at eight of the 11 lake sampling sites (Figure 2)

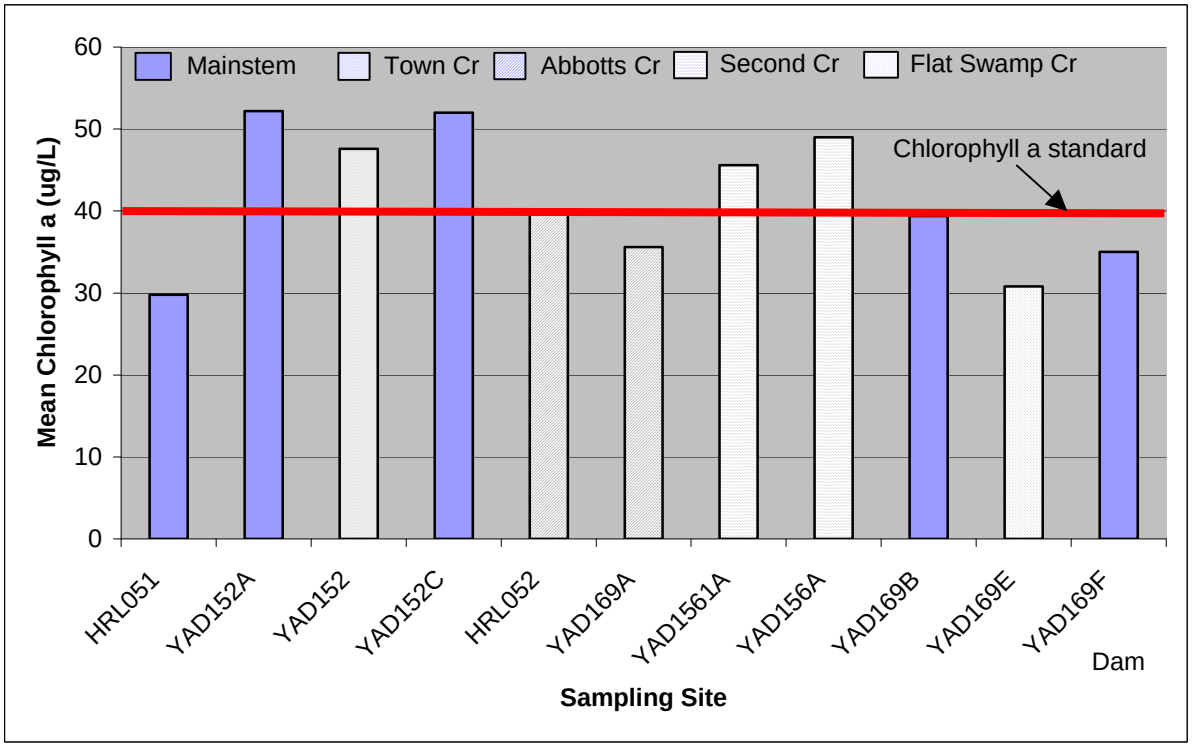

Figure 2. Mean chlorophyll *a* values by sampling station for May through September, 2006

With the assistance of EPA's Athens Laboratory, Algal Growth Potential Tests (AGPT) were conducted at six stations on the lake. Algal growth potential tests are used to determine the potential of the water body to grow algae and the nutrient that is controlling algal growth. Tests indicated nitrogen was the predominate limiting nutrient controlling algal growth in High Rock Lake for samples taken June 15, 2005 and July 19, 2006. (Figures 3a and 3b).

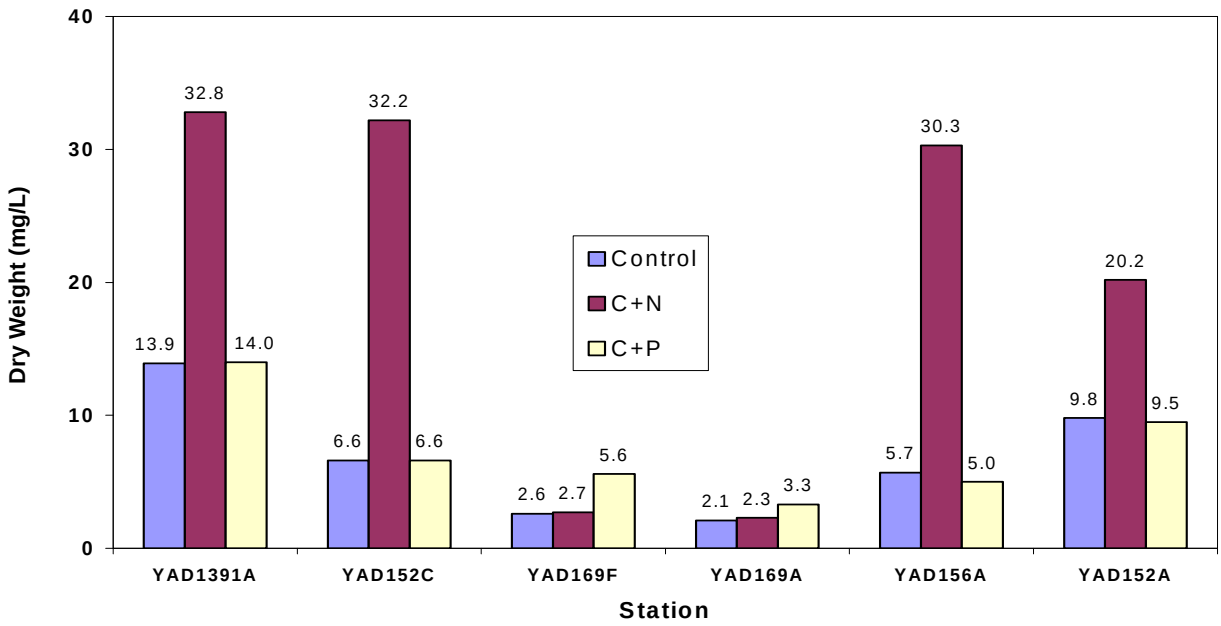

Figure 3a. Results of the Algal Growth Potential Test, June 15, 2005

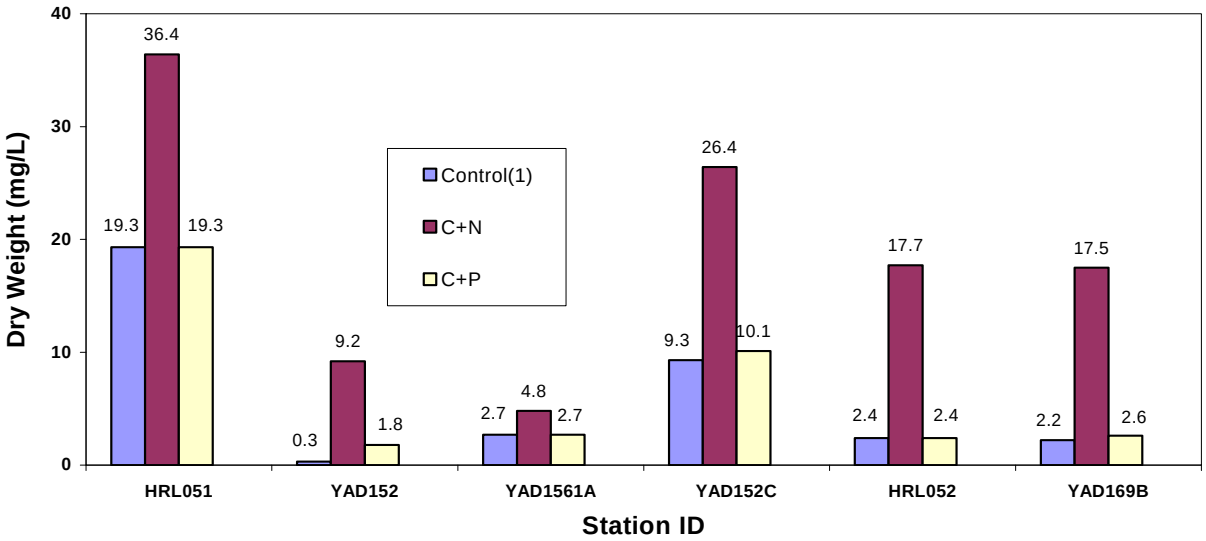

Figure 3b. Results of the Algal Growth Potential Test, July 19, 2006

In 2004, algae samples were collected for the basinwide assessment program. In 2005 and 2006, algae samples were collected as part of a scoping study for the Modeling Unit in DWQ's Planning Section. Phytoplankton assemblages were characterized at four stations for three consecutive months in 2004 and at five stations every other month for a total of six times in 2005 and 2006 (Table 1).

Table 1. Locations of Algal Samples Including Station Description and Years Characterized.

Station Code	Station Description	Year Characterized
YAD1391A	HIGH ROCK LAKE UPSTREAM S POTTS CK NR LINWOOD, NC	2005
YAD152A	HIGH ROCK LAKE AT MOUTH OF TOWN CK	2006
YAD152C	HIGH ROCK LAKE NEAR ROCKWELL, NC	2004, 2005 & 2006
HRL052	ABBOTTS CREEK ABOVE HOLLYWAY CHURCH RD BRIDGE	2005, 2006
YAD169A	ABBOTTS CREEK AT NC HWY 8 NEAR COTTON GROVE, NC	2004
YAD1561A	SECOND CREEK AT SR 1002 NEAR LIBERTY, NC	2006
YAD156A	SECOND CREEK AT MOUTH NEAR GRANITE QUARRY, NC	2004
YAD169B	HIGH ROCK LAKE UPSTREAM OF PANTHER CREEK	2004
YAD169E	HIGH ROCK LAKE AT MOUTH OF FLAT SWAMP CREEK	2004, 2006
YAD169F	HIGH ROCK LAKE NEAR HIGH ROCK, NC	2004, 2005 & 2006

Algal densities and assemblage structure in High Rock Lake fluctuated over time with highest densities occurring during the summer growing season of May through September. Densities in most sections of the lake were comparable with severe to extreme blooms occurring at all stations during this time (Figure 4). Severe algae blooms range between 30,000 to 1000,000 units/ml. Extreme blooms are those that are greater than 100,000 units/ml. The most upper station, YAD1391A, where samples contained a lot of sediment and reflected a riparian environment was the only location that did not experience blooms (Figure 5). Blue greens overwhelmingly dominated the algal assemblages in 88% of the samples collected during the May through September period (Appendix C). The majority (31%) of the blooms were dominated by the blue green alga, *Pseudanabaena* sp*.,* which comprised up to 63% of the assemblage.

Blue green blooms may discolor water, cause taste and odor problems in processed drinking water, and are common indicators of eutrophication. *Pseudanabaena* is arguably the most common alga found in large North Carolina reservoirs. It is relatively small (cells < 2x5μm), often forms extreme blooms that, unlike other blue greens, inhabit the complete photic zone as opposed to collecting at the surface. *Pseudanabaena* can fix atmospheric nitrogen (N_2) into a biologically usable form (nitrate/nitrite or NO_x). Other filamentous blue greens found in the lake, such as *Cylindrospermopsis,* are documented in other locations as producing toxins. There have been no reported health problems associated with blue greens in North Carolina.

On August 23, 2006, a surface bloom of *Euglena* sp. was observed in the main channel of High Rock Lake between Crane Creek and Swearing Creek. Analysis of samples collected at this site confirmed the presence of the bloom. *Euglena* sp. can vary in color and, in this particular case, a dark red euglenoid was dominant. *Euglena* sp. commonly ball up and form cysts when under stress making them difficult to identify (Figures 6a and 6b). Euglena blooms are often found on the surface of still waters that have a high organic nutrient content. These blooms may give the water a characteristic red or green surface sheen and a fishy odor.

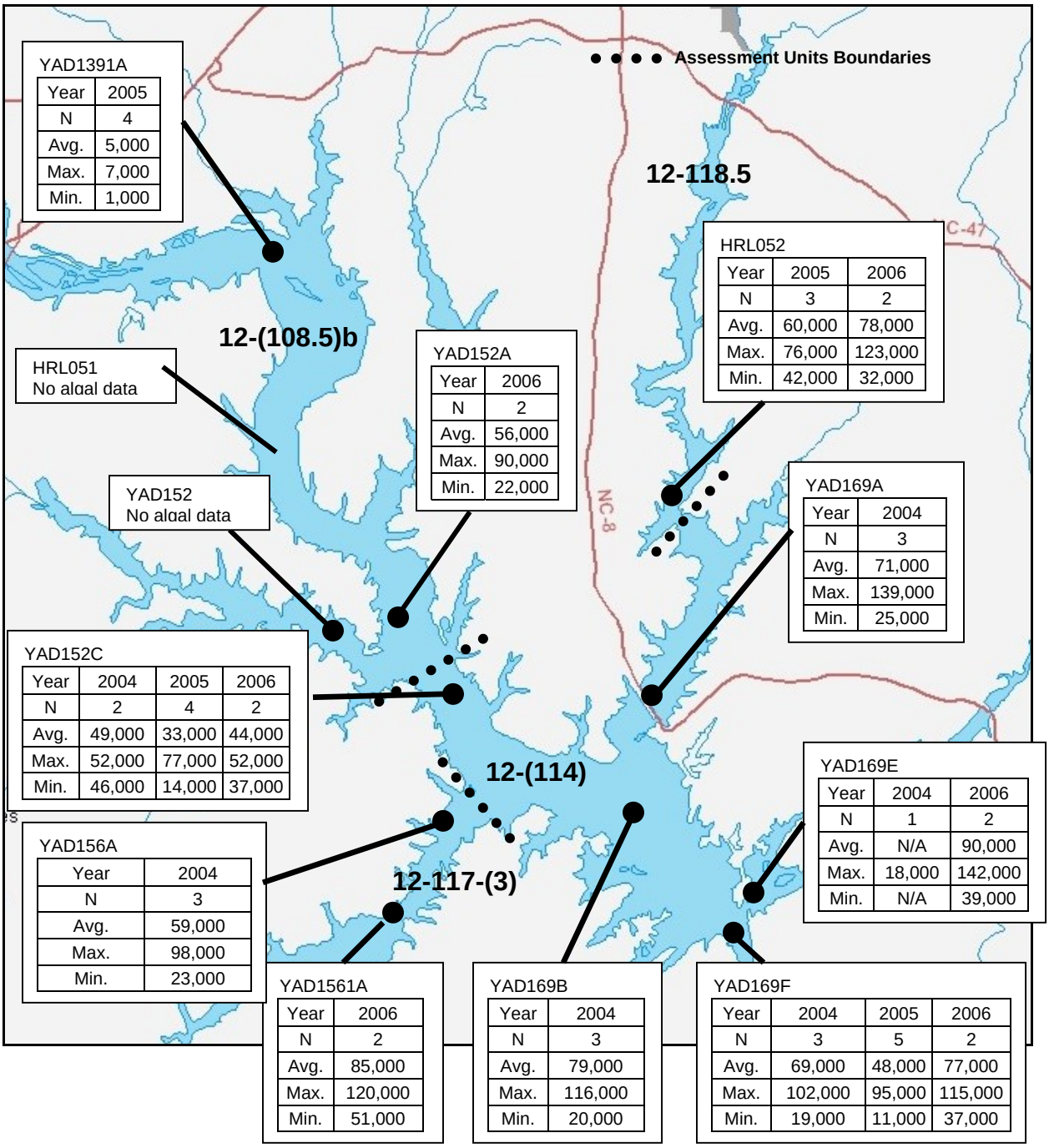

Figure 4. Average Densities of Algae in High Rock Lake from May to September 2006

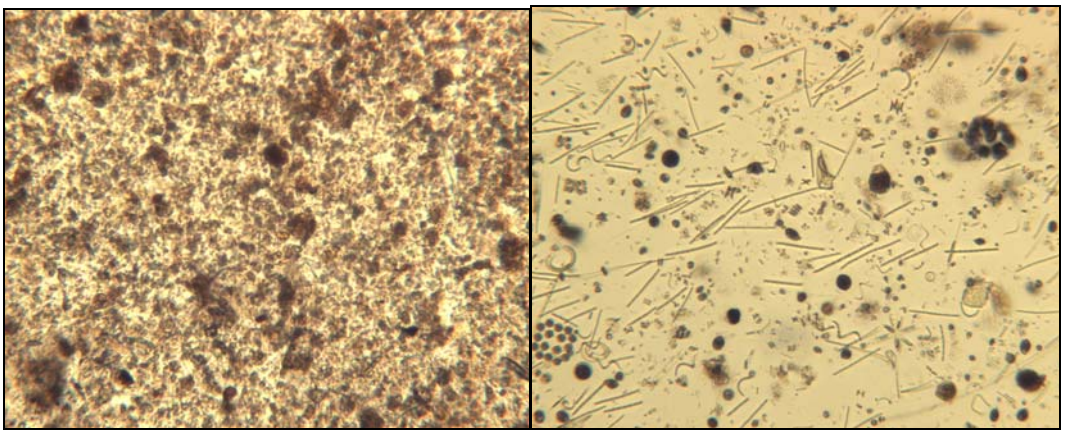

Figure 5. Digital images of samples collected on 9/21/05 (200X magnification).
On the left is the sample collected from station YAD1391A. Note that it is full of sediment in comparison to the relatively clear sample collected from station YAD169F on the right.

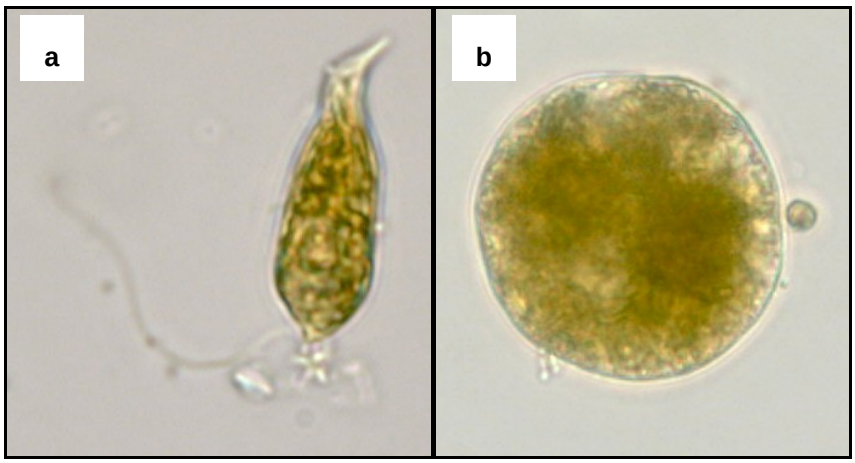

Figure 6. Magnified Image of Euglena sp. (a) and Euglena sp. forming a cyst (b).

High Rock Lake was consistently eutrophic (very high biological productivity) during the sampling period, based on the NCTSI calculations. This is consistent with monitoring that has taken place since 1981. The uses of High Rock Lake were determined to be impaired due to elevated chlorophyll *a*, turbidity and pH (Appendix A).

Subbasin 030707

Lake Thom-A-Lex

Lake Thom-A-Lex is located near the Cities of Lexington and Thomasville. The lake was built in 1957 as a drinking water supply for these two cities. The watershed draining to the lake is primarily composed of commercial and urban areas.

Lake Thom-A-Lex was sampled by DWQ from May through September in 2006 for a total of five sampling trips. There are two sampling sites located on this lake. Physical lake parameters in 2006 were similar to those observed in previous sampling years. Dissolved oxygen and pH measurements were within state water quality standards during the sampling period. The average lake-wide Secchi readings for the summer of 2006 ranged from 0.5 to 0.7 meters. These readings were fairly low, indicating limited water clarity.

Nutrient concentrations generally ranged from moderate to elevated with the exceptions of ammonia and nitrite + nitrate, which were generally below DWQ laboratory detection levels. The greatest lake wide average concentrations of total phosphorus, total Kjeldahl nitrogen and total organic nitrogen were observed in July and August.

The lake-wide average chlorophyll *a* values for the summer of 2006 ranged from 21 μg/L to 50 μg/L. The state chlorophyll *a* standard (40 *u*g/L) was exceeded during August and September and chlorophyll levels were elevated (> 20 *u*g/L) during May and July. Forty percent of lake-wide average chlorophyll *a* values were greater than the state water quality standard of 40 μg/L, indicating elevated biological productivity by algae (Appendix A). Severe blooms were observed from May through July. Extreme blooms occurred during August and September (50 μg/L). Staff field notes indicated that the lake water had a brown coloration in 2006 that impacted the aesthetics of the lake. Surface mats, scums or flecks were not observed in the lake at the time of the algal blooms.

Algal densities at the sampling site near the dam (YAD1611A) ranged from 40,000 to 214,000 units/ ml (Table 2). Blooms were comprised of the prymnesiophyte *Chrysochromulina* and the filamentous blue green *Cylindrospermopsis* during early summer (Figure 7). Blooms during July-September were comprised of *Cylindrospermopsis*. *Chrysochromulina* is sometimes associated with elevated chlorophyll concentrations and taste and odor problems in processed drinking water. Filamentous blue greens frequently bloom in local freshwaters during mid to late summer and are often associated with eutrophication. They are also associated with taste and odor problems in processed drinking water. *Cylindrospermopsis* is known to be toxic elsewhere in the world, but there have been no reported health problems associated with this alga in North Carolina

Surface metals in Lake Thom-A-Lex were within applicable state water quality standards.

Trophic state analyses confirmed that Lake Thom-A-Lex is a biologically productive lake with a 2006 average NCTSI score placing the lake in the eutrophic category. Lake Thom-A-Lex appears to be supporting its designated use as a secondary water supply at this time although insufficient data is available to rate it. The eutrophic conditions found in the lake also warrant cause for future concern and monitoring.

Table 2. Chlorophyll a, Phytoplankton Densities and Common Algae at the Lake Thom-a-Lex DWQ Sampling Site Near the Dam, 2006

YAD1611A	Chl *a* (*ug*/ L)	Unit Density (units/ml)	Common Phytoplankton Groups	Common Algae
4-May-06	25	51,000	Blue green, Prymnesiophyte	*Cylindrospermopsis, Chrysochromulina*
20-Jun-06	18	40,000	Blue green, Prymnesiophyte	*Cylindrospermopsis, Chrysochromulina*
12-Jul-06	32	68,000	Blue green	*Cylindrospermopsis*
10-Aug-06	52	179,000	Blue green	*Cylindrospermopsis*
12-Sep-06	45	214,000	Blue green	*Cylindrospermopsis*

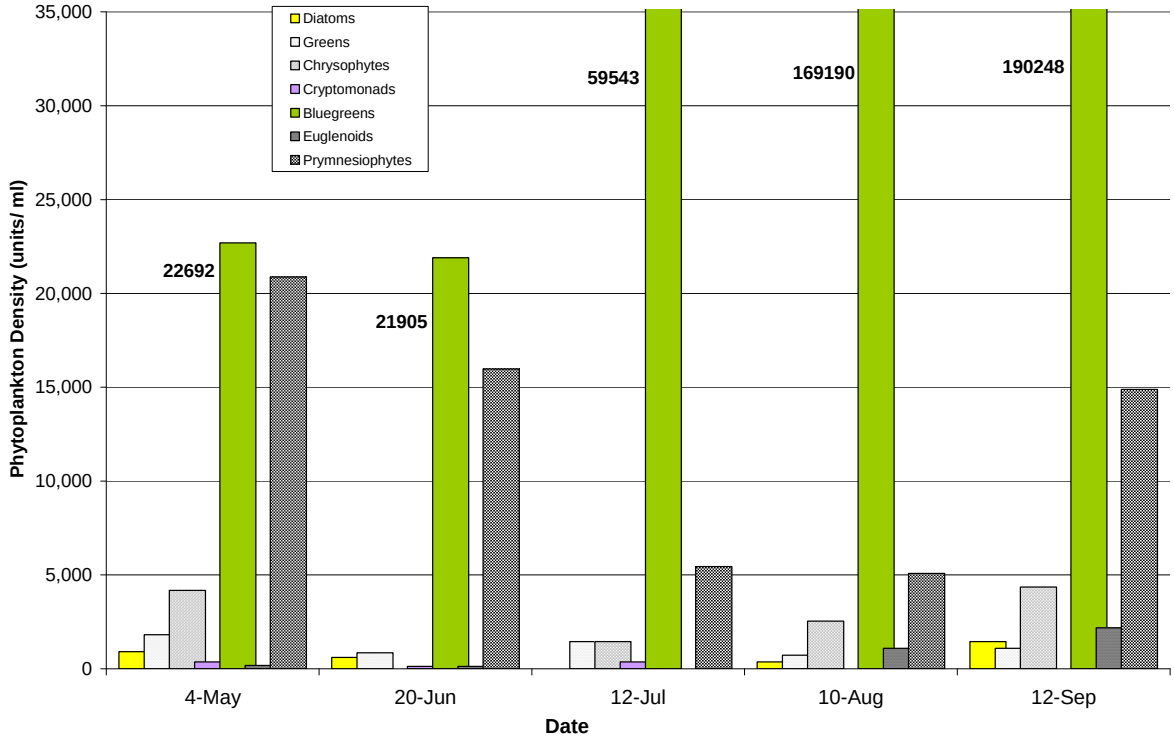

Figure 7. Lake Thom-A-Lex Algae Groups at YAD1611A in 2006. Densities are labeled for blue green algae.

Subbasin 030708

Tuckertown Reservoir

Tuckertown Reservoir is a run-of-the-river reservoir located between High Rock Lake and Badin Lake on the Yadkin River and its primary uses are hydroelectric power generation and public recreation. The watershed surrounding this lake is composed of forested, agricultural and urban areas.

DWQ staff sampled Tuckertown Reservoir five times in 2006 (monthly from May through September).

Surface dissolved oxygen was consistently greatest at the sampling site near the dam (YAD1780A). The highest concentration was observed on July 12th (13.6 mg/L). In contrast, dissolved oxygen concentrations at the upstream sampling site (YAD172C) were generally lower. On August 9th, the surface dissolved concentration at YAD172C was 2.4 mg/L, which was less than the state water quality instantaneous reading of 4.0 mg/L. These lower dissolved oxygen values in the upper end of the lake were due to the release of hypolimnetic water from High Rock Lake, located upstream of Tuckertown Reservoir. Lake-wide mean dissolved oxygen concentrations were above the water quality standard of 4.0 mg/L as an instantaneous reading in 2006. Lake-wide surface pH values did not exceed state water quality standards. Percent dissolved oxygen saturation concentrations for Tuckertown Reservoir were 137.3% in June and 123.6% in July, suggesting increased algae productivity in this reservoir.

Total phosphorus, total Kjeldahl nitrogen and total organic nitrogen concentrations were generally elevated in 2006. As suggested by the elevated dissolved oxygen saturation, algae productivity was stimulated by the availability of nutrients in Tuckertown Reservoir. Lake-wide mean chlorophyll *a* values, an indicator of this productivity, were greater than the state water quality standard of 40 µg/L in June (46.5 *µg*/L) and August (41.5 *µ*g/L). Staff field notes for May 2nd indicated that the water of Tuckertown Reservoir had a green coloration and that potential aesthetic enjoyment of the reservoir may have decreased due to elevated alga populations.

Elevated dissolved oxygen and percent dissolved oxygen saturation suggested increased algal photosynthetic activity on the days the reservoir was sampled. Staff and public reports regarding the discovery of mats of the filamentous blue green alga, *Lyngbya wollei*, in Tuckertown Reservoir were received in the summer of 2006. *L. wolle*i is common in the Southeast and thrives in slightly alkaline, warm nutrient-rich water. It is known for forming dense, musty-smelling mats of entangled filaments that are tough, fibrous and have a cotton-like feel. *L. wollei* mats are found on the lake sediment and can float to the surface. In low light, the mats have a blue-black color that shifts to yellow-green or yellow in intense sunlight. These mats can jeopardize the uses of a lake or reservoir by clogging water intakes, fouling boat propellers, destroying fish spawning areas and habitats, and by producing an offensive odor and unsightly appearance that reduces swimming enjoyment and lake aesthetics. In 2006, *L. wollei* was observed in coves and small tributaries of Tuckertown Reservoir.

DWQ staff also discovered large Chinese mystery snails (*Cipangopaludina chinensis*) in Tuckertown Reservoir in 2006 (Figure 8). Also commonly known as Chinese apple or rice snails, these snails are commonly found in the aquaria trade where they are sold as aquarium scavengers and for algae control. The

shell is strong and smooth with six to seven whorls. These whorls are strongly convex and the whorl sutures are very indented. The shell color can range from light to very dark olive-green and there is no color banding. The shell can be up to two inches in length. Chinese mystery snail can serve as vectors for the transmission of parasites and disease, some of which can infect humans. The snail shells will clog the screens of water intakes and the snail, itself, competes with native snails for food and space. The means by which these nonnative snails were introduced to Tuckertown Reservoir is unknown, but snail harvesting in High Rock Lake by fishermen for food has been observed by NC Wildlife Resources officers (http://www.cofc.edu/~fwgna/archive/6Oct05.html).

Figure 8. Chinese Mystery Snail Collected From Tuckertown Reservoir

Based on the calculated NCTSI scores for 2006, Tuckertown Reservoir was determined to be very biologically productive (eutrophic). This reservoir has been eutrophic since 1982 when if was first monitored by DWQ. .

Badin Lake

Badin Lake was sampled six times by DWQ staff during the current water quality evaluation period. Constructed in 1917, this reservoir is located on the Yadkin River immediately downstream of Tuckertown Reservoir.

Lake-wide mean dissolved oxygen and pH values were less than state water quality standards during the sampling period in 2006 or on October 10, 2002. A single dissolved oxygen value below the instantaneous standard of 4 mg/L was observed at YAD178B (3.6 mg/L), located in the southern arm of the lake, on October 10, 2002.

The highest dissolved oxygen value was observed at this site on July 12, 2006 (12.5 mg/L) and percent dissolved oxygen saturation was 162.0%. Secchi depths at the lake sampling sites during this evaluation period ranged from 1.1 to 2.8 meters, indicating good water clarity.

Generally, nutrient concentrations in Badin Lake were at moderate levels, with increases occurring in October 2002 as well as in May and September 2006. This is consistent with the algae biological productivity, as suggested by lake-wide chlorophyll a concentrations, which begins to increase in June and decreases in September. Lake-wide average chlorophyll *a* values peaked in June and July 2006, but were not greater than the state water quality standard of 40 μg/L. Individual sampling site chlorophyll *a* values were also less than the state water quality standard. Surface metals were not greater than the applicable state water quality standards.

Staff and public reports regarding the discovery of mats of the filamentous blue green alga, *Lyngbya wollei*, in Badin Lake were received in the summer of 2002 and 2006. *L. wollei* is common in the Southeast and is known for forming dense, musty-smelling mats of entangled filaments. These mats are tough, fibrous and have a cotton-like feel. *L. wollei* mats are found on the sediment and can float to the surface. In low light, the mats have a blue-black color that shifts to yellow-green or yellow in intense sunlight. These mats can jeopardize the uses of a lake or reservoir by clogging water intakes, fouling boat propellers, destroying fish spawning areas and habitats, and by producing an offensive odor and unsightly appearance that reduces swimming enjoyment and lake aesthetics. In 2006, *L. wollei* was observed on the east side of the lake adjacent to the Uwharrie National Forest and adjacent to the residential community at Uwharrie Point. *L. wollei* was also observed in a canal on the western side of the lake in 2002.

A study of the water quality of Badin Lake was conducted from August through October 2002 by DWQ in response to fish kills that occurred in 2000 and 2001. Results of that study determined that the potential cause of the kill was stress due to low oxygen water related to poor food availability (due to a loss of threadfin shad), elevated water temperatures and dissolved oxygen concentrations. The latter may have been due to blue green algae blooms. This stress left the fish vulnerable to red sore disease; a common infection that often attacks weakened fish. Researchers at NCSU are also investigating these kills.

Based on calculated NCTSI scores, Badin Lake was determined to be predominantly eutrophic in 2006 as well as on October 10, 2002. Because this reservoir was sampled six times during this evaluation period (less than 10 trips for evaluation of rating status), it was designated as Not Rated (Appendix A).

Lake Tillery

Lake Tillery was constructed in 1928 and is currently used for hydroelectric power and recreational purposes. It is one of the lower lakes within the Yadkin River chain, located between Falls Lake and Blewett Falls Lake. The surrounding watershed is comprised of rolling hills with a combination of mostly forest and agriculture.

Lake Tillery was sampled by DWQ once monthly May and July through September, 2006 for a total of four sampling events. During the 2006 sampling season, water levels of Lake Tillery fluctuated due to environmental and river flow studies conducted by Progress Energy from July 22 to August 13. These studies were in support of relicensing through the U.S. Federal Energy Regulatory Commission (FERC) for Lake Tillery and Blewett Falls Lake hydroelectric plants.

More information about these studies can be found on Progress Energy's website: http://www.progress-energy.com/aboutus/news/article.asp?id=14502.

Surface water temperatures and surface pH values were similar to those observed in previous DWQ sampling efforts since 1981. Low surface dissolved oxygen concentrations were observed at the most upstream sampling site (YAD185A) on August 17, 2006 (4.6 mg/L). Historically, this site has exhibited periodic low dissolved oxygen values that have been attributed to hypolimnetic water release from Falls Lake, upstream of Lake Tillery. Surface pH values did not exceed state water quality standards during the sampling period in 2006. Secchi depths were consistent with previous measurements, ranging from 1.1 to 1.9 meters in 2006, indicating good water clarity.

Nutrient concentrations for 2006 appear similar to 1999, ranging low to moderate. Total phosphorus values were moderate. Total organic nitrogen and total Kjeldahl nitrogen both were generally moderate with the exception of the September 26, 2006 sampling event in which both were extremely elevated. Nitrite + nitrate values were ranged widely from low to extremely elevated. The lake-wide average chlorophyll *a* concentrations ranged from low to moderate (Appendix B) and individual lake sampling site chlorophyll *a* values were not greater than the state water quality standard of 40 μg/L. Surface metals were also within applicable state water quality standards.

According to NCTSI scores, Lake Tillery was mesotrophic (moderate biological productivity) in May and eutrophic (high biological productivity) for the sampling visits in July, August and September 2006. Historically, NCTSI scores for Lake Tillery have been predominantly mesotrophic.

Subbasin 030709

Lake Reese

In 1983, the City of Asheboro impounded the Uwharrie River to form Lake Reese, a water supply that is also used for recreation. The lake is only used for drinking water after the primary water supply (Back Creek Lake) has a three-foot drop in level. DWQ staff sampled this lake monthly from May through September. Lake Reese was also sampled three times (monthly from June through August) in 2005.

Lake-wide average water temperature, pH, and dissolved oxygen values did not exceed state water quality standards in 2005 and 2006. Lake-wide average nutrient concentrations generally ranged from moderate to elevated, with the exceptions of ammonia and nitrite + nitrate, which were low.

Chlorophyll *a* concentrations in 2005 were similar to those observed in 2006, and lake-wide average values were not greater than the state water quality standard of 40 µg/L (Appendix A and B). A water sample collected on August 10, 2004 from Lake Reese was submitted to DWQ for phytoplankton analysis by the Asheboro Water Treatment Facility. Analysis confirmed the existence of an algal bloom dominated by the filamentous blue green alga *Cylindrospermopsis*. Another filamentous blue green alga, *Planktolyngbya*, was also found in the sample. Both of these blue green algae are indicators of eutrophication. *Cylindrospermopsis* is also known to produce taste and odor problems in processed drinking water.

Surface metal samples collected at the dam in 2005 and 2006 did not exceed applicable state water quality standards with the exception of manganese. On September 21, 2006, a manganese concentration of 590 µg/L was observed. This value was greater than the state water quality standard of 200 µg/L for a lake designated as a water supply. Manganese will dissolve into the water column from bottom sediments when the water over the sediment is very low in oxygen. On September 21st, very low dissolved oxygen concentrations near the dam were observed at a depth of three meters from the surface down to the lake bottom (seven meters). Manganese contributes to taste and odor problems in drinking water. These problems can be reduced or eliminated by additional treatment of the raw water at the water treatment facility.

Based on the calculated NCTSI scores, Lake Reese was determined to be eutrophic in 2005 and 2006.

Back Creek Lake (Lake Lucas)

Back Creek Lake (also called Lake Lucas) is the primary water supply for the City of Asheboro. The reservoir is part of a public park where fishing, boating, and swimming are permitted. Back Creek Lake was sampled five times in 2006 (monthly from May through September), and three times in 2005 (monthly from June through August).

Lake-wide average surface water temperature and pH did not exceed state water quality standards. Average lake-wide dissolved oxygen did not exceed state water quality standards, although the value for September 21, 2006 (4.0 mg/L) was at the instantaneous dissolved oxygen standard. At the mid-lake sampling site (YAD181K), the dissolved oxygen value at 11:00 AM (3.4 mg/L) was lower than the state water quality standard (Appendix B). Secchi depths were generally less than one meter, indicating that the clarity of the water was poor. Turbidity values were not greater than the state water quality standard of 25 mg/L, however.

Nutrient concentrations for 2006 and 2005 were elevated for total phosphorus, total Kjeldahl nitrogen, and total organic nitrogen. Lake-wide average total phosphorus concentrations ranged from 0.05 mg/L to 0.80 mg/L, total Kjeldahl nitrogen from 0.58 mg/L to 0.84 mg/L, and total organic nitrogen from 0.57 mg/L to 0.83 mg/L. In response to the elevated nutrient concentrations, lake-wide average chlorophyll *a* values were greater than the state water quality standard of 40 μg/L from June through September 2006 (Appendix A and B). Eighty percent of the average chlorophyll *a* values in 2006 were greater than the water quality standard. All phytoplankton observed were common to North Carolina, and are sometimes associated with elevated chlorophyll *a*.

A water sample was collected on August 10, 2004 from Back Creek Lake and submitted to DWQ for phytoplankton analysis by the Asheboro Water Treatment Facility. Analysis confirmed the existence of an algal bloom dominated by the filamentous blue green alga *Cylindrospermopsis*. Another filamentous blue green alga, *Planktolyngbya*, was also found in the sample. Both of these blue green algae are indicators of eutrophication. *Cylindrospermopsis* is also known to produce taste and odor problems in processed drinking water. An Algal Growth Potential Test (AGPT) was performed on a sample of water collected at the mid-lake sampling site (YAD181K) on August 17, 2006. The results of this test indicated that nitrogen was the nutrient limiting algal growth in the lake on this date.

Surface metals in 2005 and 2006 were within applicable state water quality standards with the exception of manganese. On September 21, 2006 the concentration of manganese observed was 450 µg/L, which was greater than the state water quality standard of 200 µg/L for lakes designated as water supplies (Appendix A and B). Manganese is a naturally occurring element found in soil and organic matter. In lakes, manganese may be released from the bottom sediment of a lake when dissolved oxygen concentrations in the water near the sediment are very low or absent. In Back Creek Lake, the concentration of dissolved oxygen at the dam sampling site was very low from May through August 2006 at a depth of approximately five meters (depth to bottom was approximately 10 meters). Surface manganese concentrations gradually increased from May through August. In September, a turnover event (movement of the surface water to the bottom of the lake in response to cooling from the air temperature) occurred as suggested by the drop in surface dissolved oxygen concentrations. When the surface water sank toward the bottom of the lake, it moved the bottom waters up to the surface. Elevated manganese concentrations in these bottom waters are then near the surface, and this is the water that was tested for metals in September. The result was the elevated manganese concentration observed. Manganese may contribute to taste and odor problems in drinking water. These problems can be reduced or eliminated by additional treatment of the raw water at the water treatment facility.

Based on the calculated NCTSI scores, Back Creek Reservoir was determined to the very biologically productive (eutrophic). On August 17, 2006 the NCTSI score for this lake indicated that the biological productivity was extreme (hypereutrophic). This lake was sampled eight times during this evaluation period, which is less than the ten sampling events needed to rate its uses. Conditions in the reservoir, both observed and measured, indicate that the level of productivity may periodically produce conditions (i.e., algal blooms, low dissolved oxygen, discolored lake water) that could jeopardize the intended uses of this lake.

Historically, Back Creek Lake has been determined to be eutrophic since 1989 when it was first sampled by DWQ staff. The elevated level of productivity observed in 2006 along with the presence of problematic blue green algae warrants further monitoring of this lake by DWQ to evaluate if the designated uses are being supported.

Lake Bunch

Lake Bunch was built by the City of Asheboro for use as a water supply reservoir in 1932. The lake is located on the west side of Asheboro on an unnamed tributary to Cedar Fork, upstream of Back Creek Lake.

Surface pH and dissolved oxygen concentrations were not greater than the state water quality standards. Secchi depths ranged from 3.0 to 3.7 meters in 2005 and from 1.6 to 3.7 in 2006. These measurements are indicative of good water clarity for a Piedmont lake.

Nutrient concentrations in 2006 and 2005 were generally low to moderate for total phosphorus and moderate to very high for total Kjeldahl nitrogen, and total organic nitrogen (Appendix B). Nutrient concentrations found in Lake Bunch indicate the potential for biological productivity. From May through July, 2006 and in June, 2005, a spike in the dissolved oxygen concentration was observed in Lake Bunch at a depth of three to four meters from the surface. In 2006, this increase ranged from 11.8 to 15.9 mg/L and on June 28, 2005, the subsurface dissolved oxygen value at three meters was 18.3 mg/L. The presence of a subsurface increase in dissolved oxygen is often indicative of the presence of an algae bloom at that depth.

Chlorophyll *a* levels exceeded the state standard of 40 μg/L from May to July (Appendix A and B). An analysis of water samples indicated that the phytoplankton densities remained acceptable throughout most of the summer, barely reaching the 10,000 units/ml to be considered a mild bloom (Table 3). Conversely, biovolume measures, estimates of biomass, peaked in July at 21,000 mm^3/m^3 (Table 4). This level was four times the 5,000 mm^3/m^3 that is an alternate bloom determination measure. Based on density, algae assemblages were dominated by diatoms in May, were diverse in June and July (no dominance), then shifted to blue green algae in August and September. Based on biovolume, the algae assemblage shifted between four major groups of algae starting with diatoms, then to Raphidophytes, followed by blue green algae and finally shifting to green algae. Blue green blooms may discolor water and cause taste and odor problems. They are common indicators of eutrophication.

Table 3. Phytoplankton densities and % dominance in Lake Bunch during 2006

Date	Unit Density (units/ml)	Dominant Algal Group	% Density	Dominant Genus	**% Density**
5/25/06	8,000	Diatom	42%	Centrics	42%
6/13/06	2,000	Blue green	46%	No dominant	0%
7/31/06	5,000	Blue green	73%	No dominant	0%
8/22/06	7,000	Blue green	66%	*Aphanizomenon*	64%
9/27/06	10,000	Blue green	78%	*Aphanocapsa*	77%

Table 4. Phytoplankton Biovolumes (BV) and Percent Dominance (%) in Lake Bunch during 2006

Date	BV (mm^3/m^3)	Dominant Algal Group	% BV	Dominant Genus	% BV
5/25/06	17,000	Diatom	46%	Centrics	46%
6/13/06	15,000	Raphidophyte	84%	*Gonyostomum*	84%
7/31/06	21,000	Blue green	95%	*Anabaena & Aphanizomenon*	56% & 32%
8/22/06	18,000	Blue green	98%	*Aphanizomenon*	95%
9/27/06	12,000	Green	92%	*Tetraedron*	92%

During the months that had elevated chlorophyll *a* levels (> 40μg/L) *Gonyostomum* (Figure 9) a large, chlorophyll *a*-packed alga, was present. Its presence, even at low densities (100 to 400 units/ml), had a dramatic effect on chlorophyll *a* concentrations as demonstrated by the dramatic drop in chlorophyll *a* from July to August when *Gonyostomum* was no longer present. Therefore, it was the type of algae present, not necessarily their densities, which was responsible for the elevated concentrations of chlorophyll *a* in Lake Bunch. *Gonyostomum* are known to form blooms during summer and are general indicators of dystrophic and eutrophic waters. There are no known adverse environmental or human health effects associated with *Gonyostomum*.

Based on the calculated NCTSI scores, Lake Bunch was determined to be very biologically productive (eutrophic) in 2005 and 2006.

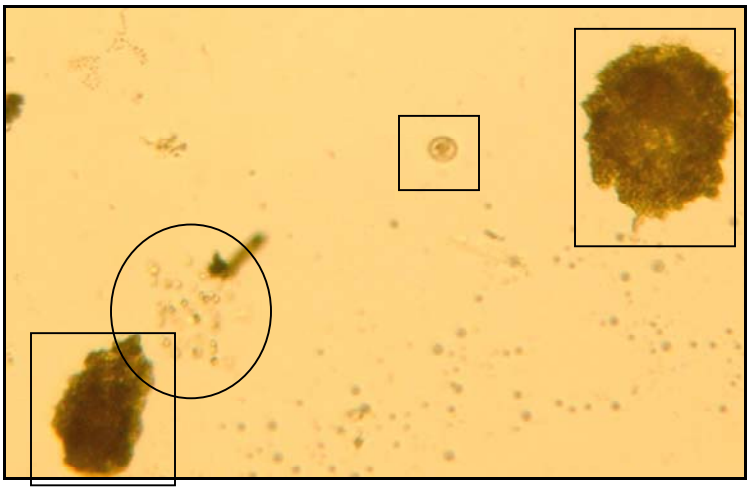

Figure 9. Image of the algae in Lake Bunch that shows the size variation (200X magnification): A colony of *Aphanocapsa* (cells < 2 μm, biovolume = 0.05 μm^3) is in the circle. A centric diatom (cell = 8μm, biovolume = 270μm^3) is in the square. *Gonyostomum* (cell > 50 μm, biovolume > 1000μm^3) are in the rectangles.

McCrary Lake

McCrary Lake is primarily used to regulate flow upstream of Lake Bunch. The lake is located on the west side of Asheboro and a landfill is on the west side of this lake. DWQ staff sampled McCrary Lake monthly from May through September 2006 and from June through May 2005.

Secchi depths in 2006 ranged from 2.2 to 3.6 meters and in 2005, ranged from 2.4 to 3.1 meters. These Secchi depths were indicative of good water clarity for a Piedmont Lake. Surface dissolved oxygen and pH were not greater than state water quality standards in both sampling years.

Nutrient concentrations were in the low to moderate range for total phosphorus (range of 0.02 mg/L to 0.04 mg/L), total Kjeldahl nitrogen (range of 0.46 mg/L to 0.55 mg/L), and total organic nitrogen (range of 0.45 mg/L to 0.54 mg/L) indicating a low to moderate potential for biological productivity. Chlorophyll *a* values ranged from 3 to 32 *μ*g/L.

Aquatic weeds were collected from along the bank of the lake. These plants covered the majority of the shoreline and extended out four to five meters. Two submersed aquatic vegetative species were collected. The majority of the sample was southern Naiad (*Najas guadalupensis*), which is common in many North Carolina lakes and ponds. Southern naiad has thin stems and leaves, and grows in dense clumps. More information on southern naiad can be found at http://plants.ifas.ulf.edu/nagupic.html. Also in the sample was brittle naiad (*Najas minor*), which is non-native and considered noxious when found in dense growths as it can choke out other aquatic plants. This aquatic plant is dark green and has clumps of highly serrated

leaves. Information on brittle naiad can be found at http://www.weedscience.ncsu.edu/aquaticweeds/facts/apfs006-99.pdf.

McCrary Lake was determined to be predominantly mesotrophic based on the calculated NCTSI scores for 2005 and 2006.

Subbasin 030710

Blewett Falls Lake

Blewett Falls Lake is a run-of-the-river reservoir located on the Yadkin River. It is the lowermost reservoir of the Yadkin-Pee Dee Chain of Lakes, a series of reservoirs constructed on the Yadkin River.

DWQ staff sampled Blewett Falls Lake in May, August and September 2006. Water levels in the reservoir fluctuated in response to changes in the water levels of Lake Tillery, upstream. The level of Lake Tillery was changed for the purpose of studies conducted by Progress Energy from July 22 to August 13, 2006 in support of the relicensing project through the U.S. Federal Energy Regulatory Commission (FERC) for the Lake Tillery and Blewett Falls Lake hydroelectric plants. Extensive environmental studies and modeling of water temperature, dissolved oxygen concentrations, and river flow patterns in the Pee Dee River downstream of the Tillery hydroelectric plant are part of these studies (www.progress-energy.com/aboutus/news/article.asp?id=14502).

Secchi depths at the single lake sampling site near the dam in Blewett Falls Lake (YAD260B) were consistently less than one meter. Staff field notes indicated that the water color of the reservoir appeared green, however, turbidity values were not greater than the state water quality standard of 25 NTU. Strong thermal stratification was not observed in Blewett Falls Lake on each of the sampling trips. A strong decrease in dissolved oxygen with depth was also not observed. Two factors may have contributed to these observations: the shallowness of the sampling site (approximately five meters) and the fluctuations in the level of the reservoir. Together, these factors may have allowed the water column to be better mixed and decreased the potential for strong stratification during the summer.

Total phosphorus concentrations were elevated while total organic nitrogen values ranged from moderate to elevated. Chlorophyll *a* values were moderate to elevated, but did not exceed the state water quality standard of 40 μg/L. Concentrations of surface metals were within applicable state water quality standards. Based on the calculated NCTSI scores, Blewett Falls was determined to be very biologically productive (eutrophic) on the days it was sampled in 2006.

Subbasin 030711

Lake Howell (Coddle Creek Reservoir)

This reservoir, constructed in 1993 as a water supply source for the Cities of Concord and Kannapolis, does not have public access. Lake Howell is owned, operated and maintained by the Water and Sewer Authority of Cabarrus County. DWQ sampled Lake Howell for the first time in 2006. Lake-wide mean Secchi depths ranged from 1.5 to 2.7 meters, indicating good water clarity. Surface dissolved oxygen, pH and water temperatures did not exceed state water quality standards.

Total phosphorus and total Kjeldahl nitrogen concentrations ranged from low to moderate while total organic nitrogen ranged from moderate to elevated. Both ammonia and nitrite + nitrate concentrations were low. In response to the moderate levels of nutrients in this reservoir, lake-wide mean chlorophyll *a* values were moderate (range = 10 to 19 μg/L). The concentration of surface metals measured near the dam did not exceed applicable state water quality standards for reservoirs designated as water supply sources.

Hydrilla (*Hydrilla verticillata*), an invasive aquatic plant, was observed near the upper end of Lake Howell near the boat ramp. On August 16th, pieces of hydrilla were observed by DWQ staff floating throughout the reservoir. According to Rob Emens, Division of Water Resources Aquatic Weed Program, grass carp were placed in Lake Howell in the spring of 2006 to control the hydrilla. The Division of Water Resources is also working with the City of Concord on a 50/50 cost share program for additional grass carp stocking.

Based on the calculated NCTSI scores for Lake Howell, the trophic state of this reservoir from May through September 2006 ranged from moderate to elevated biological productivity (mesotrophic to eutrophic).

Subbasin 030712

Kannapolis Lake

Kannapolis Lake is the water supply source for the City of Kannapolis and access to the lake is not available to the public.

Kannapolis Lake was sampled monthly from May through September by DWQ staff. Secchi depths ranged from 0.7 to 1.6 meters with lower readings occurring at the sampling site located at the upper end of the reservoir (YAD207A). Low dissolved oxygen (hypoxic conditions) were consistently observed at a depth of approximately four to five meters from the surface at the sampling site near the dam (YAD207C) on each of the five sampling trips. Depth to the bottom of the lake at this site was approximately ten meters. The depth of the thermocline coincided with the depth of hypoxia at YAD207C indicating that the lake was consistently stratified from May through September and that biological productivity was most likely to occur within the top two to three meters near the dam. Surface dissolved oxygen and pH values did not exceed state water quality standards in 2006.

Total phosphorus concentrations in Kannapolis Lake were consistently elevated on each sampling trip. Total organic nitrogen and total Kjeldahl nitrogen were also elevated while nitrite + nitrate and ammonia concentrations were low based on staff observations using the ambient lakes database. This variation in nutrient concentrations is commonly observed in biologically productive lakes in the piedmont region of the state. Lake-wide mean chlorophyll *a* values were elevated, but did not exceed the state water quality standard of 40 μg/L. The greatest chlorophyll *a* concentration observed at a single sampling site (40 μg/L) occurred on August 16, 2006 at YAD207A. Field notes taken on each of the sampling trips in 2006 noted that the lake water had a greenish color associated with algae in the water column. No algal mats, scums or flecks in the lake water were observed, however. Surface metals near the dam did not exceed state water quality standards.

Kannapolis Lake was determined to be very biologically productive (eutrophic) on each of the five DWQ sampling trips in 2006. In 1989 and 1995 when this reservoir was previously sampled by DWQ, the trophic state was also determined to be eutrophic.

Lake Fisher

Located north of Concord, Lake Fisher is the primary water supply source for the city. In addition to a water supply, the lake is part of a city park that is open to the public for fishing and boating. Park regulations require boats to use electric trolling motors or gas motors no larger than 10 hsp (www.ci.concord.nc.us/downloads/parksrec/Lake.Fisher.2006.pdf).

Staff sampled this reservoir monthly from May through September 2006. Secchi depths were predominantly less than a meter at each of the three sampling sites, suggesting elevated turbidity and decreased water clarity. Lake-wide mean turbidity values greater than the state water quality standard of 25 NTU were observed during 20% of the sampling trips in 2006 (Appendix A). The majority of the elevated turbidity observations occurred at the upper end of the lake (YAD215R). Staff field notes indicate that this region of the lake appeared muddy and the water had a brown coloration.

Total phosphorus concentrations were elevated in 2006 as were total Kjeldahl nitrogen and total organic nitrogen. In response to the presence of these nutrient levels, lake-wide mean chlorophyll *a* concentrations were greater than the state water quality standard of 40 μg/L in 20% of the 2006 sampling trips. The greatest chlorophyll *a* value (57 μg/L) was observed on July 20th at YAD215R. Lake-wide pH values were less than the standard of 9.0 s.u. Percent dissolved oxygen concentrations at the mid-lake (YAD215T) and near dam (YAD216A) sampling sites on July 20th were greater than 120%, suggesting an increase in photosynthetic activity at these sites. This agreed with the elevated chlorophyll *a* values observed on this date.

Surface metals at YAD216A were not greater than the applicable state water quality standards in 2006 with the exception of manganese on September 14th (420 μg/L). This value was greater than the state water quality standard of 200 μg/L for surface waters designated as water supply sources. Recent rainfall of approximately 1 to 3 inches may have contributed to the input of naturally occurring manganese-rich local soils and decaying vegetation from nonpoint source runoff in the lake's watershed. Manganese may contribute to taste and odor problems in drinking water. These problems can be reduced or eliminated by additional treatment of the raw water at the water treatment facility. No problems were reported for this location.

Based on the calculated NCTSI scores, Lake Fisher was determined to be very productive (eutrophic) on each of the five sampling trips conducted in 2006. This finding is consistent with previous NCTSI scores measured since 1989.

Lake Concord

Lake Concord is a secondary water supply reservoir for the City of Concord. The lake was constructed in the 1930s and public access is prohibited. The drainage area surrounding this lake consists of the urban area associated with the City of Concord. There are also many houses on the immediate shoreline.

Lake Concord was sampled by DWQ from May through September in 2006 for a total of five sampling trips. There are three sampling sites located on this lake. Dissolved oxygen and pH measurements were within state water quality standards during the sampling period. Twenty percent of the average lake-wide dissolved oxygen saturation values were above 120% saturation (Appendix A). The elevated saturation values suggest that significant algal activity (production of dissolved oxygen by algae) was occurring in the lake. Secchi depths were all less than one meter indicating somewhat limited water clarity.

Nutrient concentrations were elevated for several parameters. Total phosphorus values ranged from 0.05 mg/L to 0.08 mg/L and total Kjeldahl nitrogen ranged from 0.53 mg/L to 1.10 mg/L. Total organic nitrogen values were elevated as well with values ranging from 0.52 mg/L to 1.09 mg/L. Sixty percent of lake-wide average chlorophyll *a* values were greater than the state water quality standard of 40 µg/L (Appendix A). The individual sampling site chlorophyll *a* values ranged from 29 µg/L to 57 µg/L.

Algal densities were high throughout the summer and peaked during July through August. The prymnesiophyte *Chrysochromulina* was most common during May but was succeeded by the filamentous blue green *Cylindrospermopsis* in July and September (Table 5). *Chrysochromulina* is sometimes associated with elevated chlorophyll concentrations and taste and odor problems in processed drinking water. Filamentous blue greens frequently bloom in local freshwaters during mid to late summer and are often associated with eutrophication. *Cylindrospermopsis* is known to be toxic elsewhere in the world, but there have been no reported health problems associated with this alga in North Carolina.

Table 5. Chlorophyll *a* and dominant phytoplankton at Station YAD216G on Lake Concord

Date	Chl a (ug/L)	Dominant Group	Dominant Genus
5/17/2006	33	Prymnesiophyte	Chrysochromulina
7/20/2006	56	Blue green	Cylindrospermopsis
8/28/2006	51	Blue green	Cylindrospermopsis
9/14/2006	34	Blue green	Cylindrospermopsis
9/26/2006	52	Blue green	Cylindrospermopsis

Surface metals in Lake Concord were within applicable state water quality standards with the exception of manganese. Manganese was found to be greater than the state water quality standard of 200 mg/L for lakes designated as water supplies on September 14, 2006 (400 mg/L) at station YAD216G. Field notes for this day indicated that Lake Concord was muddy in appearance with a recent rain of approximately 1 to 3 inches. Since manganese is present in naturally high amounts in plants and local soils, the high levels found were probably associated with sediment in runoff and erosion caused by the recent rainfall.

The average calculated NCTSI confirmed that Lake Concord was very biologically productive (eutrophic) in 2006. The trophic status of this lake has not changed since it was first monitored by DWQ staff in 1989.

Subbasin 030714

Lake Lee

Lake Lee is a small reservoir located within the municipality of Monroe. Constructed in 1927, this lake serves as an emergency or back-up water supply source for Monroe. Water from Lake Monroe flows into Lake Lee, and water from Lake Lee is pumped into a tributary of Lake Twitty (Lake Stewart) during periods of low flow.

Based on historical water quality sampling by DWQ, Lake Lee has exhibited elevated nutrients and chlorophyll *a* values, which may impact the designated uses of the lake as a water supply. In 2006, water quality monitoring by DWQ staff sampled Lake Lee twice a month from May through September for a total of ten sampling trips. The purpose of this intense monitoring effort was to evaluate the current water quality conditions and to determine if the lake is supporting its designated uses.

Total phosphorus and nitrogen concentrations were extremely elevated, and the availability of these nutrients contributed to chlorophyll *a* values greater than the state water quality standard of 40 μg/L at each of the three sampling sites on each sampling trip (Appendices A and B). Secchi depths were consistently less than a meter throughout the lake, suggesting a decrease in water clarity and light penetration into the water column. Lake-wide mean turbidity values did not exceed state water quality standards, however. This indicates that the dominant source of decreased water clarity may have been due algae rather than sediment.

Algal blooms were documented in Lake Lee at each of the three sampling sites throughout the entire sampling period of 2006 (Figure 10). The majority of these blooms were severe and dominated by blue green algae (Tables 6 and 7). *Anabaena* was the most prevalent bloom former, accounting for 97% of the biomass on May 31st at the dam. The algal densities in 2006 were much lower than the extreme blooms documented in August 2000, however (Figure 11).

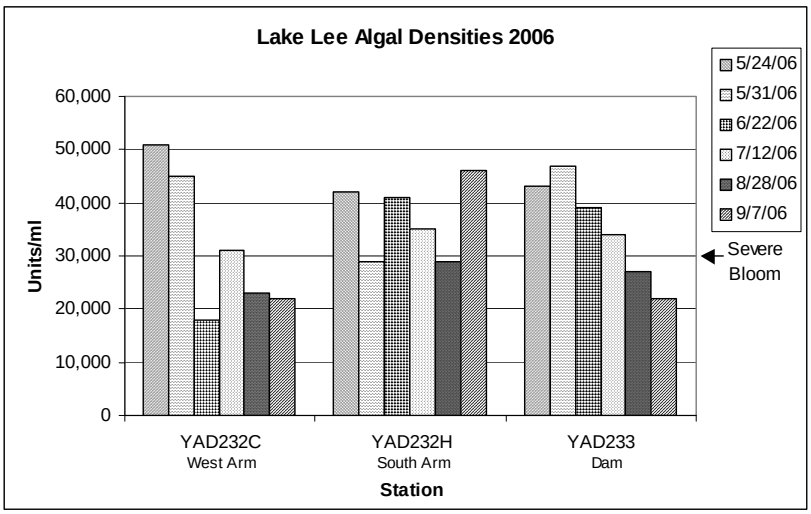

Figure 10. Algal Densities (units/ml) in Lake Lee, May – September, 2006

Table 6. Algal Densities (units/ml) in Lake Lee, May – September 2006

Station	Date	Density	Dominant Group	% Density	Dominant Genus	% Density
YAD232C	5/24/06	51,000	Green	40%	No dominant	-
YAD232H	5/24/06	42,000	Blue green	40%	No dominant	-
YAD233	5/24/06	43,000	Green	45%	No dominant	-
YAD232C	5/31/06	45,000	Blue green	55%	No dominant	-
YAD232H	5/31/06	29,000	Blue green & green	52% & 40%	Chroococcus	32%
YAD233	5/31/06	47,000	Blue green	74%	Anabaena	55%
YAD233	6/8/06	34,000	Blue green	82%	*Anabaena*	73%
YAD232C	6/22/06	18,000	No dominant	-	No dominant	-
YAD232H	6/22/06	41,000	Blue green	44%	No dominant	-
YAD233	6/22/06	39,000	No dominant	-	No dominant	-
YAD232C	7/12/06	31,000	Blue green & green	47% & 40%	No dominant	-
YAD232H	7/12/06	35,000	Blue green	52%	No dominant	-
YAD233	7/12/06	34,000	Green	48%	No dominant	-
YAD232C	8/28/06	23,000	Blue green	42%	No dominant	-
YAD232H	8/28/06	29,000	Blue green	56%	No dominant	-
YAD233	8/28/06	27,000	Blue green	55%	No dominant	-
YAD232C	9/7/06	22,000	Green	43%	No dominant	-
YAD232H	9/7/06	46,000	No dominant	-	No dominant	-
YAD233	9/7/06	22,000	No dominant	-	No dominant	-

Table 7. Algal Biovolume (mm3/m3) in Lake Lee, May – September 2006

Station	Date	Biovolume	Dominant Group	% BV	Dominant Genus	% BV
YAD232C	5/24/06	59,000	Blue green	70%	Anabaena	69%
YAD232H	5/24/06	47,000	Blue green	76%	*Anabaena*	74%
YAD233	5/24/06	28,000	No dominant	-	*Anabaena*	33%
YAD232C	5/31/06	207,000	Blue green	95%	*Anabaena*	94%
YAD232H	5/31/06	59,000	Blue green	90%	*Anabaena*	89%
YAD233	5/31/06	223,000	Blue green	97%	*Anabaena*	97%
YAD233	6/8/06	164,000	Blue green	93%	*Anabaena*	92%
YAD232C	6/22/06	15,000	Blue green	52%	*Anabaena*	48%
YAD232H	6/22/06	88,000	Blue green	81%	*Anabaena*	77%
YAD233	6/22/06	64,000	Blue green	75%	*Anabaena*	71%
YAD232C	7/12/06	46,000	Blue green	69%	*Anabaena*	67%
YAD232H	7/12/06	34,000	Blue green	64%	*Anabaena*	55%
YAD233	7/12/06	51,000	Green & blue green	49% & 44%	*Carteria & Anabaena*	43% & 43%
YAD232C	8/28/06	12,000	Blue green	46%	*Coelosphaerium*	39%
YAD232H	8/28/06	24,000	Blue green	74%	*Coelosphaerium*	53%
YAD233	8/28/06	11,000	No dominant	-	No dominant	-
YAD232C	9/7/06	13,000	No dominant	-	No dominant	-
YAD232H	9/7/06	27,000	No dominant	-	No dominant	-
YAD233	9/7/06	11,000	No dominant	-	No dominant	-

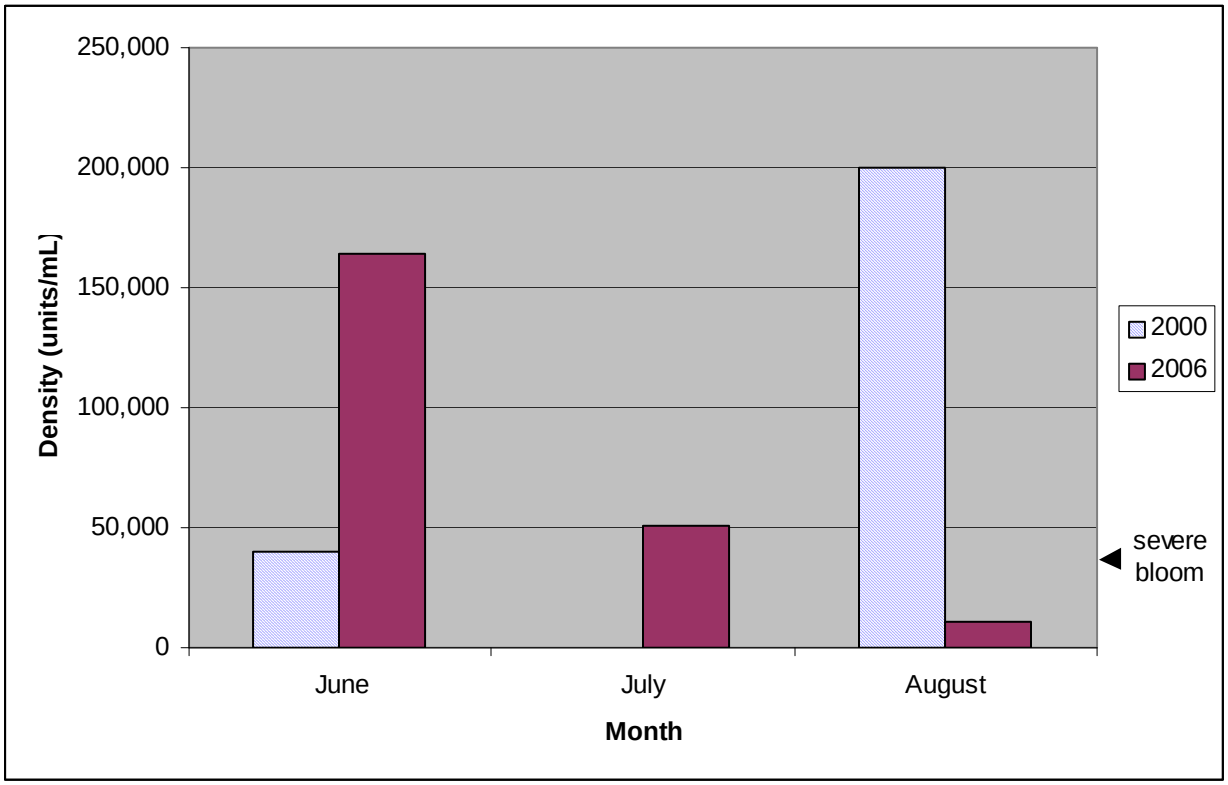

Figure 11. A Comparison of Algal Densities at the Dam (YAD233) on Lake Lee for 2000 and 2006.

Algal densities in the lake arms during 2006 did fluctuate more frequently than at the dam, where densities decreased over the summer. The average densities ranged between 32,000 (YAD232C) and 37,000 (YAD232H) where the average biovolume ranged between 47,000 (YAD232H) to 65,000 (YAD233). These relatively high biovolumes can be attributed to the long chains (> 25 cells) and large cells (>4 μm) of *Anabaena* (Figure 12).

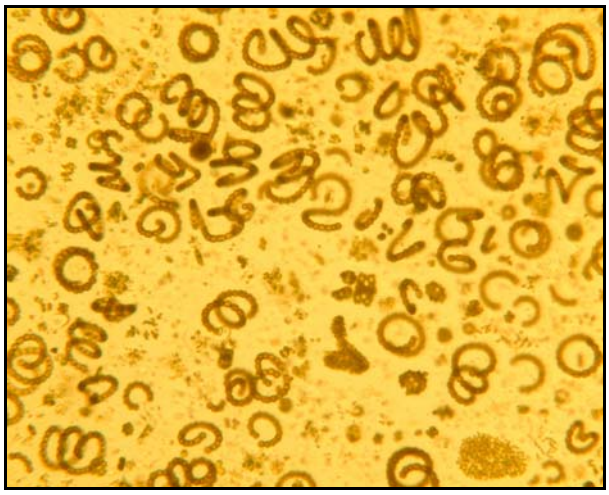

Figure 12. *Anabaena*, the dominant alga in Lake Lee on June 8, 2006 (magnification 200X).

Despite the dominance of blue greens, the algal assemblage was quite diverse. There were up to 50 genera representative of 9 major algal groups (Table 8). The diversity is exemplified at station YAD232H in September where even though densities were high (46,000 units/ml) there were no dominant taxa by density or biovolume.

Table 8. Number of Genera by Major Algal Groups

Algal Groups	5/24/06	5/31/06	6/22/06	7/12/06	8/28/06	9/7/06
Diatoms	5	6	4	4	5	5
Greens	20	21	26	20	18	23
Chrysomonads	4	2	3	2	3	4
Cryptomonads	2	2	2	2	2	2
Blue greens	9	11	11	12	10	9
Euglenoids	3	2	2	3	2	3
Prymnesiophytes	1	1	1	0	1	1
Dinoflagellates	0	0	2	1	2	2
Raphidophytes	0	0	0	1	1	1
Total Genera	44	45	41	45	44	50

Algal blooms are common indicators of nutrient enrichment. Algal blooms are also known to discolor water, alter pH and cause drastic swings in dissolved oxygen over 24 hour periods. Many types of algae are known to form blooms with blue greens being the most problematic. Some blue greens, such as *Anabaena*, may produce toxins. There have been no known reports of adverse human health effects associated with blue green toxins in North Carolina.

Staff observed large amounts of duckweed (*Lemna* spp.) and water meal (*Wolffia* spp.) on the surface of the lake beginning in June. These tiny floating plants are known to thrive in calm water bodies with high amounts of nitrogen.

In response to the presence of photosynthetic algal blooms, surface dissolved oxygen values were as high as 14.9 mg/L and percent dissolved oxygen reached 188%. Increases in pH values were not as dramatic. The highest pH concentration was observed at YAD232H was 9.3 s.u. on May 31st. A very sharp break (clinograde) from a zone of oxygenated to hypoxic water was observed at the sampling site near the dam (YAD233) at a depth of approximately one meter from the surface. A similar shift was observed at the sampling sites in each arm of lake, but due to the shallowness of these sites (approximately one meter) mixing occurred more often and strong stratification was less frequent than at the near dam sampling site.

Surface metals were within the states water quality standards with the exception of manganese. On five of the ten sampling trips, manganese levels near the dam were greater than the state water quality standard of 200 μg/L for reservoirs designated as water supply sources (Appendix B). There are no known point sources of manganese in this waterbody. Manganese is naturally occurring in soils and plant materials, and in small amounts it supports plant growth and health. In eutrophic conditions, such as those found in this lake, changes in water chemistry result in the release of manganese from plant material and sediments into the water column. The concentrations of manganese found in Lake Lee can be removed during the processing of the raw water by the water treatment facility and therefore are not impairing the use of this lake as a water supply source. Actions taken to address the violation of the chlorophyll *a* standard will, in turn, reduce manganese concentrations.

Based on the calculated NCTSI scores, Lake Lee was determined to be hypereutrophic or extremely biologically productive. Lake Lee was also determined to be hypereutrophic in 1989 and eutrophic in 1995 based on the calculated NCTSI scores.

Lake Lee is rated as impaired for aquatic life based on chlorophyll *a* concentrations (Appendix A). As noted, the manganese concentrations are expected to decrease as a result of addressing the chlorophyll *a* issues and there have been no reported problems with treatment of the water from Lake Lee for drinking purposes; therefore, we are not listing Lake Lee for manganese at this time. Follow-up monitoring as nutrient management strategies are implemented will track manganese concentrations and will assist with determining if additional controls are necessary.

Lake Monroe

Lake Monroe is a secondary water supply reservoir built in 1955 for the City of Monroe and is also used for recreation. The drainage area surrounding this lake consists of a mixture of urban and residential areas, with many houses and a cow pasture located on the immediate shoreline.

Lake Monroe was sampled by DWQ from May through September in 2006 for a total of five sampling trips. There are two sampling sites located on this lake. Dissolved oxygen measurements were within state water quality standards during the sampling period, however, 60% of the lake-wide average dissolved oxygen saturation values were greater than 120% (Appendix A). The lake-wide average dissolved oxygen saturation values ranged from 104.1% to 138.8% for the summer of 2006. These high values indicated a large amount of oxygen production by algae present in the lake. One pH value of 9.2 s.u., greater than the state water quality standard of 9.0 s.u., was found at station YAD232D on May 24, 2006. Limited water clarity was present in the lake with all Secchi depths less than one meter. Lake-wide average Secchi measurements ranged from 0.4 to 0.6 meters throughout the summer of 2006. Surface metals in Lake Monroe were within applicable state water quality standards.

Nutrient concentrations were elevated for several parameters. All total phosphorus values ranged from 0.08 mg/L to 0.24 mg/L and total Kjeldahl nitrogen (TKN) values and ranged from 1.4 mg/L to 2.0 mg/L. Total organic nitrogen values were very elevated, ranging from 1.38 mg/L to 1.99 mg/L. All chlorophyll *a* values were greater than the state water quality standard of 40 μg/L, indicating elevated biological productivity by algae. The individual site chlorophyll *a* values ranged from 56 μg/L to 97 μg/L.

Analysis of phytoplankton collected during 2006 indicated that severe algal blooms were observed throughout the study. The largest blooms occurred during July. Algal densities ranged approximately from 63,000 to 143,000 units/ml. Algal diversity ranged from approximately 20 to 25 taxa/sample and included six major algal groups. *Pseudanabaena*, *Cylindrospermopsis* and other blue green algae consistently dominated samples. Blue green algae are notorious bloom formers. Blooms can cause unsightly water discoloration, surface films, flecks, mats, taste and odor problems and some are even known to produce toxins. However, there have been no documented cases of health problems caused by blue greens in North Carolina.

Trophic state analyses confirmed that Lake Monroe is an extremely biologically productive lake with a 2006 average NCTSI score placing the lake in the hypereutrophic category. The hypereutrophic conditions and high biological productivity found at this lake warrant cause for concern and additional monitoring. Although, Lake Monroe was only sampled five times, chlorophyll a and pH concentrations indicate impairment. Since this lake feeds into Lake Lee, its nutrient concentrations need to be addressed and; therefore, this lake is rated as impaired for aquatic life based on chlorophyll *a* concentrations.

Lake Twitty
(Lake Stewart)

Owned by the City of Monroe, this reservoir is a water supply source for Monroe and open to the public for recreation. A hypolimnetic aeration system is in operation at the lower end near the dam. Based on previous monitoring by DWQ staff, conditions in this reservoir (elevated nutrients, dissolved oxygen and pH values) along with NCTSI scores indicate elevated algae productivity. Lake Twitty was sampled ten times from May through September 2006 by DWQ staff to determine if its designated use as a water supply source is being fully supported or if additional management strategies are needed to protect that use.

Secchi depths at all three lake sampling sites were consistently less than one meter. The lake water appeared green in color, suggestive of a algal growth. Total phosphorus, total organic nitrogen, and total Kjeldahl nitrogen were elevated in 2006. Surface metals were within state water quality standards with the exception of manganese and copper. Concentrations of manganese were found to be greater than the state water quality standard of 200 μg/L on July 12th and August 9th. There are no known point sources of manganese in this waterbody. Manganese is naturally occurring in soils and plant materials, and in small amounts it is necessary to support plant growth and health. In eutrophic conditions, such as those found in this lake, changes in water chemistry result in the release of manganese from plant material and sediments into the water column. The concentrations of manganese found in Lake Twitty can be removed during the processing of the raw water by the water treatment facility and therefore are not impairing the use of this lake as a water supply source.

Copper was greater than the state's water quality action level of 7.0 μg/L on June 8th and July 12th. According to Mr. Allan Killough, Water Treatment Facility Supervisor for the City of Monroe, Lake Twitty was treated twice during the summer of 2006 with copper based algaecide. The product used remains in suspension, which may have produced the elevated copper values observed. These algaecide treatments are performed using appropriate application rates and a product approved for use in water supplies; therefore, the elevated copper concentrations are not considered violations of the surface water quality standards.

Lake-wide mean chlorophyll *a* values were greater than the state water quality standard of 40 μg/L from June through September. The highest chlorophyll *a* concentrations were observed at the sampling sites in the arms of the lake (Stewarts Creek and Chinkapin Creek). Surface dissolved oxygen was higher at the tributary sampling sites as compared with the lower end of the reservoir near the dam. This may have been due to the hypolimnetic aeration system near the dam, which continuously mixed the water column and brought lower oxygenated water from the lower levels of the reservoir to the surface. Surface percent dissolved oxygen was greater than 120% lake-wide on June 22nd, July 12th and July 31st. The greater levels of percent dissolved oxygen were frequently observed at the sampling sites in the two arms of the reservoir.

Algal blooms were documented in Lake Twitty throughout the summer sampling period (May through September 2006). Approximately 73% of these blooms were at severe levels (Figure 13) and of theses severe blooms, 82% were dominated by blue green algae (Table 9). Algal biovolumes, densities and assemblage structure were similar in both arms of the lake. Small blue green coccoid taxa, *Chroococcus* and *Aphanocapsa* dominated in the earlier months of the summer, then shifted to another relatively small blue green taxon, *Pseudanabaena sp*, in July and August.

Table 9. Algal Densities (units/ml) and Dominance in Lake Twitty, May – September 2006.

Station	Date	Density	Dominant Group	% Density	Dominant Genus	% Density
YAD235D	5/24/06	28,000	No dominant	-	No dominant	-
YAD235F	5/24/06	38,000	Blue green	42%	*Aphanocapsa*	35%
YAD235D	5/31/06	39,000	Blue green	54%	*Chroococcus*	35%
YAD235F	5/31/06	36,000	Blue green	73%	*Chroococcus*	57%
YAD235D	6/22/06	38,000	Blue green	47%	No dominant	-
YAD235D	7/12/06	67,000	Blue green	81%	*Pseudanabaena*	50%
YAD235F	7/12/06	68,000	Blue green	73%	*Pseudanabaena*	44%
YAD235D	8/28/06	51,000	Blue green	67%	*Pseudanabaena*	45%
YAD235F	8/28/06	39,000	Blue green	70%	*Pseudanabaena*	48%
YAD235D	9/7/06	27,000	Blue green	51%	No dominant	-
YAD235F	9/7/06	16,000	No dominant	-	No dominant	-

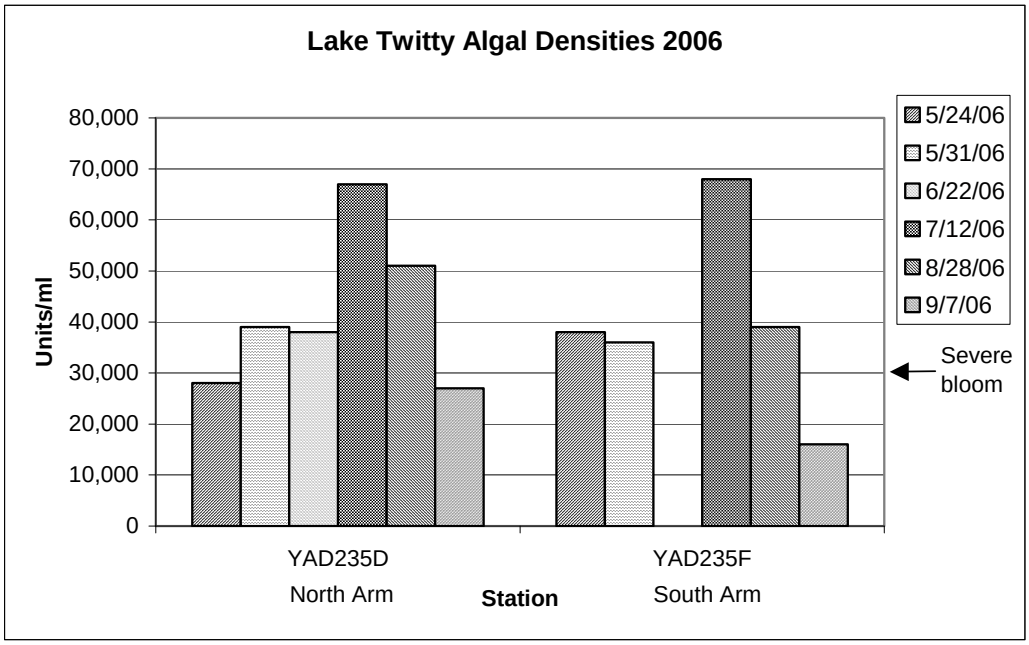

Figure 13. Algal Densities in Lake Twitty, May – September, 2006

There was a spike in biovolume at YAD235F (south arm) in July that was attributed to a bloom of the filamentous blue green *Anabaena* (Table 10). Despite the dominance of blue greens, the algal assemblage was quite diverse. There were up to 39 genera representative of 8 major algal groups (Table 11). The densities and assemblages in 2006 were similar to those documented in 2000 (Figure 14).

Table 10. Algal Biovolumes (mm^3/m^3) and Dominance in Lake Twitty, May – September, 2006

Station	Date	Biovolume	Dominant Group	% Biovolume	Dominant Genus	% Biovolume
YAD235D	5/24/06	7,000	Green	48%	No dominant	-
YAD235F	5/24/06	15,000	Blue green	47%	*Anabaena*	42%
YAD235D	5/31/06	13,000	No dominant	-	No dominant	-
YAD235F	5/31/06	10,000	No dominant	-	No dominant	-
YAD235D	6/22/06	11,000	No dominant	-	No dominant	-
YAD235D	7/12/06	27,000	Blue green	71%	*Anabaena*	52%
YAD235F	7/12/06	56,000	Blue green	78%	*Anabaena*	68%
YAD235D	8/28/06	14,000	No dominant	-	No dominant	-
YAD235F	8/28/06	9,000	No dominant	-	*Peridinium*	37%
YAD235D	9/7/06	10,000	No dominant	-	No dominant	-
YAD235F	9/7/06	11,000	No dominant	-	No dominant	-

Table 11. Number of Genera by Major Algal Groups

Algal Group	5/24/06	5/31/06	6/22/06	7/12/06	8/28/06	9/7/06
Diatoms	3	3	4	4	4	4
Greens	21	21	15	19	17	18
Chrysomonads	2	1	2	1	1	1
Cryptomonads	2	2	2	2	2	2
Blue greens	8	9	8	10	8	9
Euglenoids	1	1	0	0	2	3
Prymnesiophytes	1	1	1	0	0	3
Dinoflagellates	1	2	2	1	1	1
Total Genera	39	39	34	37	35	39

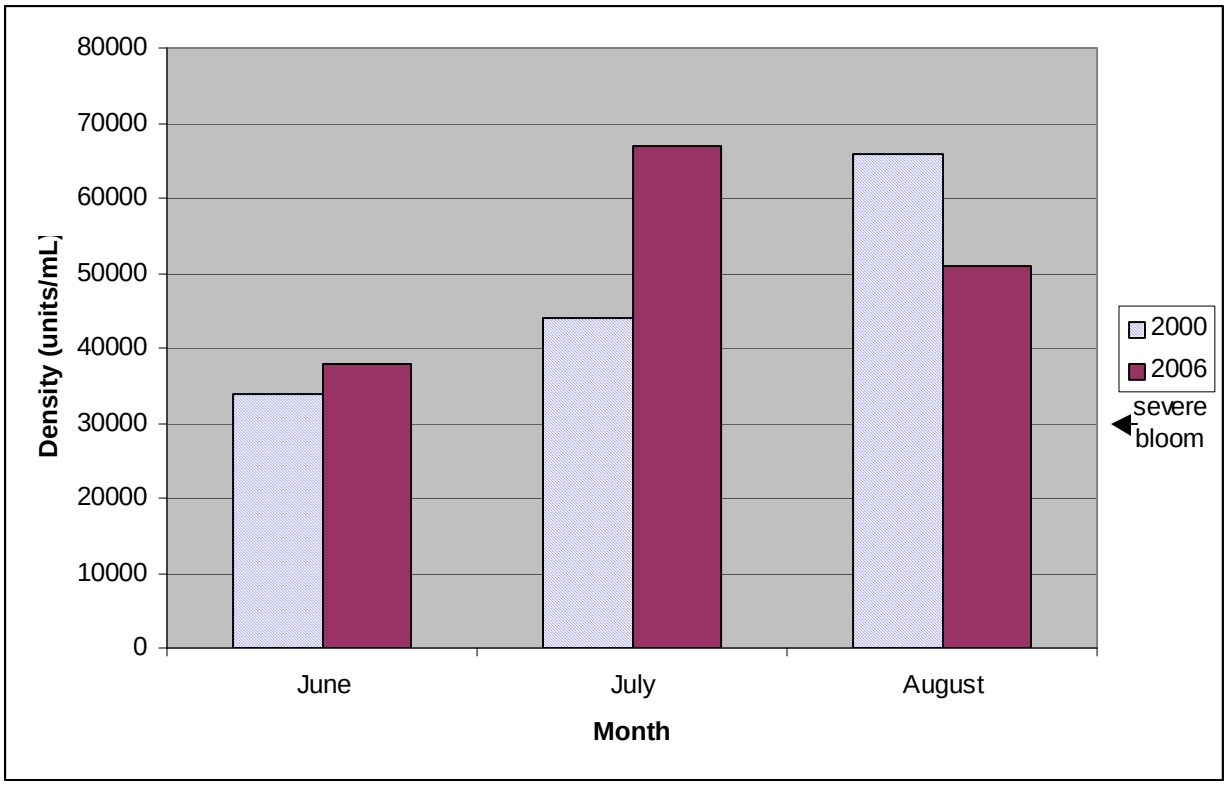

Figure 14. Algal Densities (units/ml) in Lake Twitty, 2000

Algal blooms are common indicators of nutrient enrichment. Blooms are known to discolor water, alter pH and concentrations of dissolved oxygen. Many types of algae are known to form blooms with blue greens being the most problematic. The dominant alga in Lake Twitty, *Pseudanabaena*, is one of the most common algae in Piedmont reservoirs. *Pseudanabaena* blooms throughout the water column as opposed to the algae that collect at the surface (surface blooms). Some blue greens, such as *Anabaena,* may produce toxins. There have been no known reports of adverse human health effects associated with blue green toxins in North Carolina.

Based on the calculated NCTSI scores, Lake Twitty ranged from very eutrophic to hypereutrophic. Elevated nutrients and elevated chlorophyll *a* values indicated that the biological productivity in this reservoir is very high.

Lake Twitty was rated as Impaired based on chlorophyll *a* exceedances (Appendix A).

Subbasin 030716

Roberdel Lake

Roberdel Lake, located near the City of Rockingham, is a water supply reservoir originally built as a millpond in the 1930s. Hitchcock Creek is the main tributary to this lake. The watershed has a mixture of forested and urban areas, which includes houses along the shore.

Roberdel Lake was monitored monthly from May through September 2006 for a total of five sampling events. Lake-wide mean Secchi depths ranged from 0.7 to 1.1 meters. Field notes indicated that the water in Roberdel Lake was tannin-stained (tea colored). Values for pH ranged from 5.1 to 6.1 s.u., and were similar to previous observations made by DWQ in this lake since 1989. These pH values, while often less than the state water quality standard of 6.0 s.u., are due to naturally occurring conditions often associated with tannic lake waters. Turbidity values in 2006 were low (Appendix B). Dissolved oxygen, surface water temperature, Secchi depth and conductivity did not vary much since 1989, suggesting that the system have remained stable.

Total phosphorus and total Kjeldahl nitrogen concentrations were moderate while total organic nitrogen ranged from moderate to elevated. Lake-wide average chlorophyll *a* values ranged from low in May and moderate throughout the remaining sampling months of 2006. Surface metals did not exceed applicable state water quality standards.

An NCTSI score could not be assigned due to the highly colored water typical of a dystrophic lake.

Water Lake

Water Lake is the main water supply reservoir for the City of Hamlet with Marks Creek as its primary tributary. There is no public access to the lake and its watershed is undisturbed and forested. Water Lake was monitored monthly during the months of May through September, totaling to five sampling events for 2006. The aquatic macrophyte Water Bulrush (*Scirpus subterminalis*) was observed by DWQ staff throughout the upper end of the lake along with fragrant water lily (*Nuphar odorata*).

Water Lake had good visibility with Secchi depths that ranged between 1.0 to 1.8 meters. The Secchi depth at the upstream sampling station

(YAD280C) was to the lake bottom. Dissolved oxygen during 2006 was within state water quality standards. Surface pH values were below (5.9 s.u) the state water quality standard of a target range of 6.0 to 9.0 s.u on all sampling dates. This lake is located within the Sandhills region of the state. Sandhills lakes frequently have lower pH values than typical Piedmont lakes due to sandy soils and tannin producing vegetation such as pines and oaks. These tannins readily leach through the soil and into the water, reducing the pH and producing a light, tea-like coloration of the water, which was noted in field notes by DWQ staff in 2006. Unlike dystrophic lakes, the pH values in Sandhills lakes rarely drop below 5.0 s.u. and the lake water does not take on the darker coloration commonly found in dystrophic lakes. This is due to Sandhills soils which have a high mineral content as opposed to the high organic matter (peat) content soils which contribute higher levels of tannins associated with dystrophic lakes in the state.

Nutrient concentrations in 2006 generally ranged from low to moderate. Chlorophyll *a* exceeded the state water quality standard at the northern site (YAD280C) on July 17, 2006 with a concentration of 45 μg/L, but the average lake concentration remained below water quality standards. The single elevated chlorophyll a value may have been due to epiphytic algae that dislodged from the Water Bulrush during sample collection as opposed to elevated water column phytoplankton. The lower end of Water Lake is treated monthly with approximately 550 lbs of copper sulfate to reduce algal blooms according to Mr. Robert Brown, Supervisor of Hamlet City Water Treatment Facility. Copper concentrations consistently exceeded state water quality action levels (range = 43 to 120 μg/L, Appendix B) as a result of this treatment. As noted in the discussion of Lake Twitty's copper application, these elevated concentrations are not considered a violation as the copper was being applied per the label. Other surface metals were within applicable state water quality standards.

Based on the calculated NCTSI scores, Water Lake was mesotrophic (moderate biological productivity) from May through June and eutrophic from July through September.

Subbasin 030717

Wadesboro City Pond

Wadesboro City Pond, built in 1938, is used as a water supply source and recreation for the City of Wadesboro. The watershed consists of a mixture of forested and agricultural areas. Wadesboro City Pond was monitored monthly between May and September, totaling to five sampling events in 2006.

Lake-wide average Secchi depths ranged from 0.9 to 1.2 meters during 2006. Dissolved oxygen, and pH values did not exceed state water quality standards in 2006.

Nutrient concentrations ranged from moderate to elevated in 2006 with the exceptions of ammonia and nitrite + nitrate, which were consistently below DWQ laboratory detection levels. This suggests a potential uptake of available nitrogen by algae in the lake. Lake-wide mean chlorophyll *a* concentrations exceeded the state water quality standard of 40 *µg/L* 60% of the time (3 out of 5 sampling events) with the highest value (120 *µg/L)* observed at the upstream sampling site (YAD275H) on August 15th.

Algae blooms were observed throughout much of the summer sampling period at Wadesboro City Pond. Moderate blooms were observed during August at YAD275H and during July at YAD275J (Table 12). Algal densities ranged approximately from 21,000 to 105,000 units/ml. Algal diversity ranged from approximately 8 to 22 taxa/sample and included eight major algal groups (Figure 14).

Table 12. Chlorophyll *a*, Phytoplankton Densities and Common Genera in Wadesboro City Pond

YAD275H	Chl-*a* (*ug*/ L)	Unit Density (units/ml)	Common Phytoplankton Group	Common Genus
25-May-06	15	45,000	Chrysophyte	nondescript flagellates
17-Jul-06	58	36,000	Blue green	*Cylindrospermopsis*
15-Aug-06	30	21,000	Blue green	*Cylindrospermopsis*
28-Sep-06	51	80,000	Blue green	*Cylindrospermopsis*

YAD275J	Chl-*a* (*ug*/ L)	Unit Density (units/ml)	Common Phytoplankton Group	Dominant Genus
25-May-06	20	50,000	Chrysophyte	nondescript flagellates
17-Jul-06	26	22,000	Blue green	*Cylindrospermopsis*
15-Aug-06	120	32,000	Blue green	*Cylindrospermopsis*
28-Sep-06	51	105,000	Blue green	*Cylindrospermopsis*

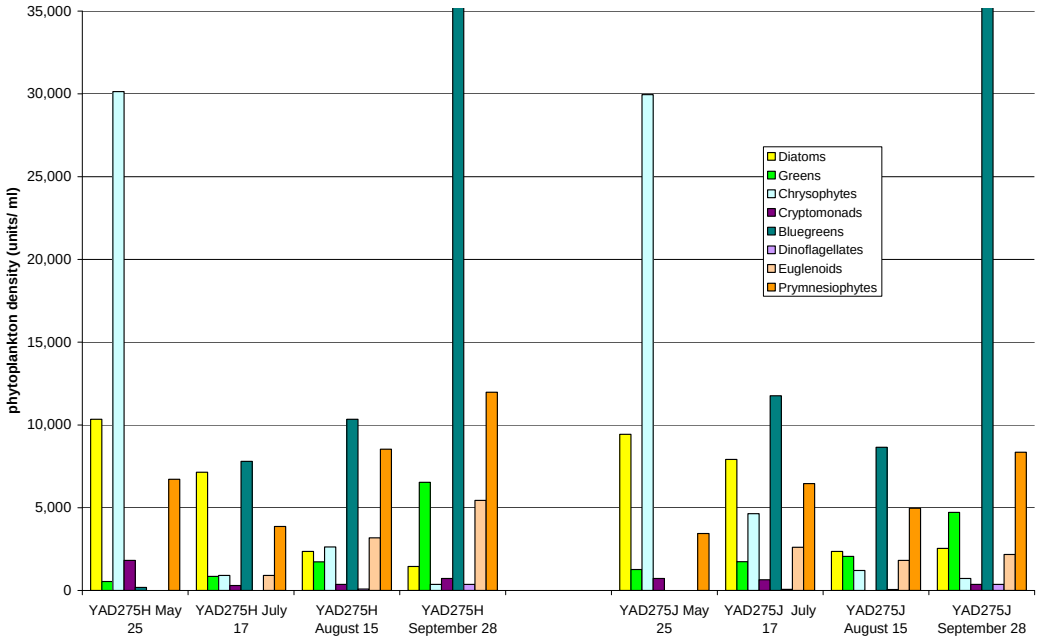

Figure 15. Phytoplankton Groups at the Two Sampling Sites in Wadesboro City Pond, Summer 2006

Chlorophyll *a* concentrations were elevated (≥20 *µg/L)* during much of the study, and the state chlorophyll *a* standard (40 *µg/L)* was exceeded at both sites during July at YAD275H and during August at YAD275J. Small, nondescript chrysophyte flagellates were common in May, but the filamentous blue green *Cylindrospermopsis* became the most common genus afterwards. This is not surprising since local freshwater algal assemblages tend to shift towards blue greens during mid to late summer. Filamentous blue greens are often associated with eutrophication and may cause taste and odor problems in drinking water. *Cylindrospermopsis* is known to be toxic elsewhere in the world, but there have been no reported health problems associated with this alga in North Carolina. While not the most common genus in the samples, the prymnesiophyte *Chrysochromulina* was prevalent throughout the summer. This genus has been associated with high chlorophyll levels elsewhere in the state's freshwaters and may have contributed to the high chlorophyll *a* levels encountered in the pond.

Surface metals in Wadesboro City Pond were within applicable state water quality standards with the exceptions of manganese and copper. Manganese was found to be greater than the state water quality standard of 200 mg/L for lakes designated as water supplies on September 28, 2006 (220 mg/L). Copper was found to be greater than the Action Level of 7.0 µg/L, on May 25, 2006 (28.0 µg/L). Elevated copper has been observed several times previously at the northern station. According to Mr. Hugh James, Water Treatment Plant Supervisor for the Town of Wadesboro, Wadesboro City Pond is treated with copper sulfate every year in the spring for algal blooms. This treatment is likely the sources of elevated copper found on May 25, 2006. As the copper sulfate is being applied per the label, the elevated concentrations are not considered violations of the water quality standard.

Based on the calculated NCTSI scores, Wadesboro City Pond was eutrophic (high biological productivity) for the entire sampling period in 2006. This lake has been eutrophic (high biological productivity) since DWQ started sampling in 1989.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030701***	***030704***	***030704***
	Lakes Ambient Program Name	W. Kerr Scott Reservoir	Salem Lake	Winston Lake
	Trophic Status (NC TSI)	Mesotrophic	Eutrophic	Eutrophic
	Mean Depth (meters)	12.0	5.5	2.5
	Volume ($10^6 m^3$)	189.0	0.8	0.03
	Watershed Area (mi^2)	347.5	25.5	6.6
	Assessment Unit Name	**Yadkin River (W. Kerr Scott Reservoir below Elevation 1030)**	**Salem Creek(Middle Fork Muddy Creek, Salem Lake)**	**Frazier Creek (Winston Lake)**
	Classification	WS-IVB Tr	WS-III	C
	Assessment Unit	12-(27.5)	12-94-12-(1)	12-94-12-6-1
	Stations in Assessment Unit	YAD007A, YAD008, YAD008A	YAD077A, YAD077B, YAD077C	YAD077D
	Number of Sampling Trips	8	5	5
Water Quality Standards				
Chlorophyll *a*	>40 ug/L	E (20%)	E (40%)	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE
Turbidity	>25 NTU	NCE	NCE	NCE
Temperature	>29°C Mountains and Upper Piedmont >32°C Piedmont	E (13%) +	NCE	NCE
Metals	15A NCAC 2B .0211	ND	E (Mn - 100%)*	NCE
Other Data				
% Saturation DO	>120%	N	N	Y (20%)
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	N	N
Fish	Kills related to eutrophication	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	N	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	N	N	N
303(d)	Listed on 303(d) [year listed]	N	N	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR	NR	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N	N	N
	Rating:	**NR**	**NR**	**NR**

E = Criteria exceeded but N<10 (full key on last page of this appendix)
NR = Not rated. Not Rated is used where there are <10 samples & Other Data indicate potential problems.

+ W. Kerr Scott Reservoir is located in the Mountains Region of the state therefore the >29°C is applicable. All other Yadkin lakes are in Piedmont.
* Mn (Manganese) concentrations are probably related to the high organic carbon present due to the algal blooms and is not considered to be distinct from the chlorophyll-a violation. Addressing algal blooms should result in decreased Mn concentrations. There are no point sources of Mn in the watershed.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030704***			
	Lakes Ambient Program Name	**High Rock Lake**			
	Trophic Status (NC TSI)	Eutrophic			
	Mean Depth (meters)	5.0			
	Volume ($10^6 m^3$)	314.0			
	Watershed Area (mi^2)	2929.0			
	Assessment Unit Name	**Yadkin River (including upper portion of High Rock Lake below normal operating level)**	**Yadkin River (including lower portion of High Rock Lake)**	**Abbots Creek Arm of High Rock Lake**	**Second Creek Arm of High Rock Lake**
	Classification	WS-V	WS-IV B	WS-V B	WS-IV B
	Assessment Unit	12-(108.5)b	12-(114)	12-118.5	12-117-(3)
	Stations in Assessment Unit	YAD1391A, HRL051, YAD152A	YAD152C, YAD169A, YAD169B, YAD169E, YAD169F	HRL052	YAD1561A, YAD156A
	Number of Sampling Trips	22	22	19	22
Water Quality Standards					
Chlorophyll *a*	>40 ug/L	CE (24%)	CE (24%)	CE (36%)	CE (41%)
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	CE (23%)	CE (33%)	CE (11%)	CE (41%)
Turbidity	>25 NTU	CE (27%)	E (9%)	CE (17%)	CE (10%)
Temperature	>32°C Piedmont	NCE	CE (12%)+	NCE	CE (18%)+
Metals	15A NCAC 2B .0211	ND	ND	ND	ND
Other Data					
% Saturation DO	>120%	Y (23%)	Y (42%)	Y (32%)	Y (52%)
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	Y	Y	Y	Y
Fish	Kills related to eutrophication	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N	N
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	N	N	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	Y	Y	Y	Y
303(d)	Listed on 303(d) [year listed]	2004 - Turbidity, Chla	2004 - Turbidity	2004 - Turbidity	N
AGPT	gal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	Y (2006-HRL051=19.3 mg/L; 2005 - YAD1391A=13.9 mg/L, YAD152A= 9.8 mg/L)	Y (2006-YAD152C=9.3 mg/L; 2005-YAD152C=6.6 mg/L)	NR	Y (2005-YAD156A=5.7 mg/L)
Macrophytes	miting access to public ramps, docks, mming areas; reducing access by fish and other aquatic life to habitat	N	N	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N	N
Sediments	clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	Y	Y	Y	Y
	Rating:	**I - Chla, pH, and Turbidity**	**I - Chla, pH +**	**I - Chla, pH, Turbidity**	**I - Chla, pH, Turbidity +**

E = Criteria exceeded but N<10 (full key on last page of this appendix)
CE = Criteria exceeded – parameter is problematic, highly productive or exceeds the standard in >10% of the samples.
I = Impaired

+ These two segments are not listed for temperature as there is no point source and these locations are in open water areas of the lake that would not be shaded by improved riparian buffers. Temperatures in the water column below the surface at these sites were all below the temperature standard and therefore aquatic life had sufficient habitat. Other factors contributing to the no impairment decision include that the samples were taken on hot days (air temperature ranged from 32 to 35 C).

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030707***	***030708***		
	Lakes Ambient Program Name	**Lake Thom-A-Lex**	**Tuckertown Reservoir**	**Badin Lake**	**Lake Tillery**
	Trophic Status (NC TSI)	Eutrophic	Eutrophic	Eutrophic	Eutrophic
	Mean Depth (meters)	8.0	10.0	14.0	7.2
	Volume ($10^6 m^3$)	7.8	297.5	344.0	166.0
	Watershed Area (mi^2)	39.4	4120.0	4116.0	4834.0
	Assessment Unit Name	**Abbots Creek (including Lexington-Thomasville Water Supply Reservoir at normal reservoir elevation, Lake Thom-A-Lex)**	**Yadkin River (including lower portion of Tuckertown Lake)**	**Yadkin River (including Badin Lake)**	**Pee Dee River (including Lake Tillery below normal operating levels)**
	Classification	WS-II CA	WS-IV B CA	WS-IV B CA	WS-IV B CA
	Assessment Unit	12-119-(4.5)	12-(124.5)c	12-(124.5)d	13-(1)
	Stations in Assessment Unit	YAD160B, YAD1611A	YAD172C, YAD1780A	YAD178B, YAD178E, YAD178F, YAD178F1	YAD185A, YAD189, YAD189B, YAD189C
	Number of Sampling Trips	8	5	6	4
Water Quality Standards					
Chlorophyll *a*	>40 ug/L	E (40%)	E (40%)	NCE	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE	NCE
Turbidity	>25 NTU	NCE	NCE	NCE	NCE
Temperature	>32°C Piedmont	NCE	NCE	NCE	NCE
Metals	15A NCAC 2B .0211	NCE	NCE	NCE	NCE
Other Data					
% Saturation DO	>120%	N	Y (40%)	N	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	Y (*Lyngbia woolei* mats reported by staff)	Y (*Lyngbia woolei* mats reported by staff)	N
Fish	Kills related to eutrophication	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N	N
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	Y (*Lyngbia woolei* mats reported by public)	Y (*Lyngbia woolei* mats reported by public)	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	N	N	N	N
303(d)	Listed on 303(d) [year listed]	N	N	N	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR	NR	NR	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	Y	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N	N	N	N
	Rating:	**NR**	**NR**	**NR**	**NR**

E = Criteria exceeded but N<10 (full key on last page of this appendix)
NR = Not rated. Not Rated is used where there are <10 samples & Other Data indicate potential problems.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030709***			
	Lakes Ambient Program Name	**Lake Reese**	**Back Creek Lake**	**Lake Bunch**	**McCrary Lake**
	Trophic Status (NC TSI)	Eutrophic	Eutrophic	Eutrophic	Eutrophic
	Mean Depth (meters)	5.0	4.0	3.0	3.0
	Volume ($10^6 m^3$)	0.9	5.0	0.04	0.85
	Watershed Area (mi^2)	100.0	15.8	2.3	0.8
	Assessment Unit Name	**Uwharrie River**	**Back Creek (Back Creek Lake)**	**Unnamed tributary to Cedar Fork Creek (Lake Bunch)**	**Unnamed tributary to Cedar Fork Creek**
	Classification	WS-III CA	WS-II HQW CA	WS-II HQW CA	WS-II HQW CA
	Assessment Unit	13-2-(1.3)	13-2-3-3-(0.7)	13-2-3-3-2-2-(2)	13-2-3-3-2-2-(1)
	Stations in Assessment Unit	YAD179B, YAD179D, YAD179F	YAD181J, YAD181K, YAD181L	YAD181G	YAD181E
	Number of Sampling Trips	8	8	8	8
Water Quality Standards					
Chlorophyll *a*	>40 ug/L	NCE	E (80%)	E (60%)	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE	NCE
Turbidity	>25 NTU	NCE	NCE	NCE	NCE
Temperature	>32°C Piedmont	NCE	NCE	NCE	NCE
Metals	15A NCAC 2B .0211	E (Mn - 13%)*	E (Mn - 13%)*	NCE	NCE
Other Data					
% Saturation DO	>120%	N	N	N	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	N	N	N
Fish	Kills related to eutrophication	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	N	N
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	N	N	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	N	Y	N	N
303(d)	Listed on 303(d) [year listed]	N	N	N	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR	NR	NR	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	N	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N	N	N	N
	Rating:	**NR**	**NR**	**NR**	**NR**

E = Criteria exceeded but N<10 (full key on last page of this appendix)

* Mn (Manganese) concentrations are probably related to the high organic carbon present due to the algal blooms and is not considered to be distinct from the chlorophyll-a violation. Addressing algal blooms should result in decreased Mn concentrations. There are no point sources of Mn in the watershed.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	*030710*	*030711*	*030712*		
	Lakes Ambient Program Name	**Blewett Falls Lake**	**Lake Howell (Coddle Creek Reservoir)**	**Kannapolis Lake**	**Lake Fisher**	**Lake Concord**
	Trophic Status (NC TSI)	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic
	Mean Depth (meters)	3.3		5.0	4.7	3.7
	Volume ($10^6 m^3$)	38.0	18.9	5.2	3.2	1.3
	Watershed Area (mi^2)	6784.0	47.0	10.8	78.4	3.9
	Assessment Unit Name	**Pee Dee River (including Blewett Falls Lake below normal operating levels)**	**East Fork Coddle Creek (including water supply reservoir for Concord)**	**Irish Buffalo Creek [Kannapolis Lake (Cannon Lake)]**	**Cold Water Creek (Lake Fisher)**	**Cold Water Creek (Lake Concord)**
	Classification	WS-IV B	WS-II HQW	WS-III CA	WS-IV CA	WS-IV CA
	Assessment Unit	13-(15.5)	13-17-6-(1.5)	13-17-9-(1)	13-17-9-4-(1)	13-17-9-4-2-(2)
	Stations in Assessment Unit	YAD260B	CCR01, CCR02, CCR03	YAD207A, YAD207C	YAD215R, YAD215T, YAD216A	YAD216C, YAD216E, YAD216G
	Number of Sampling Trips	3	5	5	5	5
Water Quality Standards						
Chlorophyll *a*	>40 ug/L	NCE	NCE	NCE	E (20%)	E (60%)
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	NCE	NCE	NCE	NCE
Turbidity	>25 NTU	NCE	NCE	NCE	E (20%)	NCE
Temperature	>32°C Piedmont	E (33%)	NCE	NCE	NCE	NCE
Metals	15A NCAC 2B .0211	NCE	NCE	NCE	E (Mn-20%)	E (Mn-20%)
Other Data						
% Saturation DO	>120%	N	N	N	N	Y (20%)
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N	N	N	N	N
Fish	Kills related to eutrophication	N	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	Grass Carp	N	N	N
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	N	N	N	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	N	N	N	N	N
303(d)	Listed on 303(d) [year listed]	N	N	N	N	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR	NR	NR	NR	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	Y (Hydrilla at boat ramp observed by staff)	N	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N	N	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N	N	N	N	N
	Rating:	**NR**	**NR**	**NR**	**NR**	**NR**

E = Criteria exceeded but N<10 (full key on last page of this appendix)

Mn concentrations are probably related to the high organic carbon present due to the algal blooms and are not considered to be distinct from the chlorophyll-a violation. Addressing algal blooms should result in decreased Mn concentrations. There are no point sources of Mn in the watershed.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030714***		***030714***	***030716***	
	Lakes Ambient Program Name	**Lake Lee**	**Lake Monroe**	**Lake Twitty**	**Roberdel Lake**	**Water Lake**
	Trophic Status (NC TSI)	Hypereutrophic	Hypereutrophic	Hypereutrophic	Dystrophic	Eutrophic
	Mean Depth (meters)	1.5	5.5	10.0	2.5	3.0
	Volume ($10^6 m^3$)	9.5	1.8	7.6	10.0	0.06
	Watershed Area (mi^2)	51.4	140.8	35.5	140.2	3.1
	Assessment Unit Name	**Richardson Creek (Lake Lee)**	**Little Richardson Creek (Lake Monroe)**	**Stewarts Creek [Lake Twitty (Lake Stewart)]**	**Hitchcock Creek (Roberdel Lake)**	**Marks Creek (Water Lake)**
	Classification	WS-IV CA	WS-IV	WS-III CA	WS-III CA	WS-II HQW CA
	Assessment Unit	13-17-36-(3.5)	13-17-36-4-(0.5)	13-17-36-9-(4.5)	13-39-(8.5)	13-45-(1)
	Stations in Assessment Unit	YAD232C, YAD232H, YAD233	YAD232D, YAD232F	YAD235F, YAD235D, YAD236	YAD262E, YAD263	YAD280C, YAD280E
	Number of Sampling Trips	10	5	10	5	5
Water Quality Standards						
Chlorophyll *a*	>40 ug/L	CE (100%)	E (100%)	CE (80%)	NCE	NCE
Dissolved Oxygen	<4.0 mg/L	NCE	NCE	NCE	NCE	NCE
pH	<6 s.u. or > 9 s.u.	NCE	CE (10%)	E (3%)	NCE	NCE
Turbidity	>25 NTU	NCE	NCE	NCE	NCE	NCE
Temperature	>32°C Piedmont	NCE	NCE	NCE	NCE	NCE
Metals	15A NCAC 2B .0211	CE (Mn-50%)	NCE	CE (Cu-20%, Mn-20%)*	NCE	E (Cu-100%)*
Other Data						
% Saturation DO	>120%	Y (50%)	Y (60%)	Y (30%)	N	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	Y	N	N	N	N
Fish	Kills related to eutrophication	N	N	N	N	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	N	N	Copper sulfate	N	Copper sulfate
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N	N	N	N	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N	N	N	N	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	Y	N	Y	N	N
303(d)	Listed on 303(d) [year listed]	N	N	N	N	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR	NR	NR	NR	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N	N	N	N	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N	N	N	N	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N	N	N	N	N
	Rating:	**I - Chla***	**I - Chla**	**I - Chla**	**NR**	**NR**

E = Criteria exceeded but N<10 (full key on last page of this appendix)
CE = Criteria exceeded – parameter is problematic, highly productive or exceeds the standard in >10% of the samples.
I = Impaired

* Cu (Copper) concentrations were elevated due to application of copper sulfate per label and therefore are not considered violations of the Cu standard. Mn concentrations are probably related to the high organic carbon present due to the algal blooms and are not considered to be distinct from the chlorophyll-a violation. Addressing algal blooms should result in decreased Mn concentrations. There are no point sources of Mn in the watershed.

APPENDIX A. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT MATRIX

	Subbasin:	***030717***
	Lakes Ambient Program Name	**Wadesboro City Pond**
	Trophic Status (NC TSI)	Eutrophic
	Mean Depth (meters)	2.5
	Volume ($10^6 m^3$)	0.1
	Watershed Area (mi^2)	
	Assessment Unit Name	**North Fork Jones Creek (City Pond)**
	Classification	WS-II HQW CA
	Assessment Unit	13-42-1-(0.3)
	Stations in Assessment Unit	YAD275H, YAD275J
	Number of Sampling Trips	5
Water Quality Standards		
Chlorophyll *a*	>40 ug/L	E (60%)
Dissolved Oxygen	<4.0 mg/L	NCE
pH	<6 s.u. or > 9 s.u.	NCE
Turbidity	>25 NTU	NCE
Temperature	>32°C Piedmont	E (20%)
Metals	15A NCAC 2B .0211	E (Cu-20%, Mn-20%)*
Other Data		
% Saturation DO	>120%	N
Algae	Documented blooms during 2 or more sampling events in 1 year with historic blooms	N
Fish	Kills related to eutrophication	N
Chemically/Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.	Copper sulfate
Aesthetics complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state	N
TSI	Increase of 2 trophic levels from one 5-yr period to next	N
Historic DWQ Data	Conclusions from other reports (link to other reports)	N
303(d)	Listed on 303(d) [year listed]	N
AGPT	Algal Growth Potential Test 5-9 mg/L = concern 10 mg/L or more = problematic	NR
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat	N
Taste and Odor	Public complaints or taste and odor causing algal species are dominant	N
Sediments	Clogging intakes – dredging program necessary; Frequent public/agency complaints - visual observation	N
	Rating:	**NR**

* Cu concentrations were elevated due to application of copper sulfate per label and therefore are not considered violations of the Cu standard. Mn concentrations are probably related to the high organic carbon present due to the algal blooms and is not considered to be distinct from the chlorophyll-a violation. Addressing algal blooms should result in decreased Mn concentrations. There are no point sources of Mn in the watershed.

RATING KEY:
S = Supporting
I = Impaired
NR = Not Rated. Not Rated is used where there are <10 samples & Other Data indicate potential problems.

KEY:
E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
CE = Criteria Exceeded - parameter is problematic, highly productive or exceeds the standard in >10% of samples
NCE = No Criteria Exceeded
- = Standard not applicable based on Classification
ND = No Data - sample not taken for this parameter
Y = In Other Data portion, indicates that the parameter has exceeded target or has occurred
N = In Other Data portion, indicates that the parameter is within target or has not occurred per available informationSTa

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Criteria Used for Determining Ratings

	DO mg/L	Water Temp °C	pH s.u.	Percent SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	**Total Hardness Calculated** mg/L
C & B Criteria - Mountains	**<4.0**	**>29**	**<6 or >9**	**120%**	**40**	**-**	**25**	**0.012**	**50**	**25**	**88**	**7**	**50**	**2**	**50**	**-**	**1000**	**-**	**-**
C & B Criteria – Piedmont If different than Mountains		**>32**																	
Tr Criteria [t]	**<6.0**				**15**	**10**	**10**												
WS-II though WS-V [t]						**500**					**25**					**200**		**250**	**100**

[t]-For Trout & Water Supply Classifications, all C criteria according to region apply. Those criteria listed in the table represent criteria that are specific to Tr and WS classifications.

Data Used for Determining Ratings By Lake and Assessment Unit (AU)

Region	**Lake**	**AU**	**Classification**	**Comments**
Mountain	**KERR SCOTT RESERVOIR**	**12-(2.57)**	**WS-IV B Tr**	**No metals taken**

Date m/d/yr	**Sampling Station**	**DO mg/L**	**Water Temp °C**	**pH s.u.**	**Percent DO SAT**	**Chla µg/L**	**TSS mg/L**	**Turbidity NTU**
7-Sep-06	YAD007A	6.6	26.0	7.2	81.4%	16	2.5	3.0
7-Sep-06	YAD008	6.4	26.1	7.0	79.0%	21	<2.5	3.0
7-Sep-06	YAD008A	6.2	26.3	7.0	76.9%	28	2.8	2.8
		6.4	**26.1**		**79.1%**	**21.7**	**2.6**	**2.9**
16-Aug-06	YAD007A	6.9	27.8	7.7	87.9%	16	3.2	3.0
16-Aug-06	YAD008	7.6	27.9	7.9	97.0%	13	<2.5	3.2
16-Aug-06	YAD008A	7.3	28.2	7.6	93.6%	11	2.5	2.5
		7.3	**28.0**		**92.8%**	**13.3**	**2.7**	**2.9**
11-Jul-06	YAD007A	8.9	27.3	8.3	112.3%	12	3.5	3.3
11-Jul-06	YAD008	8.6	27.7	8.6	109.3%	12	3.5	3.1
11-Jul-06	YAD008A	8.3	27.8	8.7	105.7%	10	<2.5	2.7
		8.6	**27.6**		**109.1%**	**11.3**	**3.2**	**3.0**
19-Jun-06	YAD007A	8.3	26.3	8.3	102.9%	8	3.0	2.1
19-Jun-06	YAD008	8.2	26.5	8.4	102.0%	7	2.8	2.0
19-Jun-06	YAD008A	8.0	26.9	8.3	100.2%	6	2.8	1.3
		8.2	**26.6**		**101.7%**	**7.0**	**2.9**	**1.8**
23-May-06	YAD007A	9.1	20.2	8.4	100.5%	7	4.0	2.2
23-May-06	YAD008	8.9	20.8	8.4	99.5%	9	2.8	2.1
23-May-06	YAD008A	9.5	21.1	8.4	106.8%	8	<2.5	1.7
		9.2	**20.7**		**102.3%**	**8.0**	**3.1**	**2.0**
17-Aug-05	YAD007A	8.8	29.2	9.1	114.9%		5.0	3.5
17-Aug-05	YAD008	8.1	29.8	9.0	106.8%		3.8	3.6
17-Aug-05	YAD008A	7.6	30.6	8.8	101.6%		5.2	3.3
		8.2	**29.9**		**107.8%**		**4.7**	**3.5**
20-Jul-05	YAD007A	8.8	28.3	8.9	113.1%		3.2	5.4
20-Jul-05	YAD008	8.4	28.5	9.0	108.3%		2.8	3.9
20-Jul-05	YAD008A	7.8	29.3	8.8	102.0%		<5.0	3.5
		8.3	**28.7**		**107.8%**		**3.7**	**4.3**

KEY: E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
CE = Criteria Exceeded - parameter is problematic, highly productive or exceeds the standard in >10% of samples
NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
Mountain	KERR SCOTT RESERVOIR	12-(2.57)	WS-IV B Tr	No metals taken

Date m/d/yr	Sampling Station	DO mg/L	Water Temp °C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
21-Jun-05	YAD007A	8.7	25.1	8.7	105.5%		4.0	4.7
21-Jun-05	YAD008	9.7	25.4	8.8	118.3%		3.2	3.8
21-Jun-05	YAD008A	8.6	25.2	8.9	104.5%		2.8	3.1
		9.0	**25.2**		**109.4%**		**3.3**	**3.9**
	N=	8	8	24	8	5	8	8
	% EXCEED =	*NCE*	*E (13%)*	*NCE*	*NCE*	*E (20%)*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	SALEM LAKE	12-94-12(4)	WS-III	No Mercury or Arsenic samples

Date M/d/yr	Sampling Station	DO mg/L	Water Temp °C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardnes Calculated mg/L
September 12, 2006	YAD077A	7.6	24.5	7.4	91.2%	42	9.2	9.6											
September 12, 2006	YAD077B	8.2	24.5	7.4	98.4%	27	8.2	8.7											
September 12, 2006	YAD077C	5.0	25.0	7.4	60.5%	22	4.8	7.4	<10	<10	<10	<2.0	<25	<2.0		350	230	<5.0	26.9
		6.9	**24.7**		**83.4%**	**30.3**	**7.4**	**8.6**											
August 14, 2006	YAD077A	7.0	28.0	7.2	89.5%	56	6.8	7.5											
August 14, 2006	YAD077B	7.0	27.6	7.4	88.8%	49	8.2	7.3											
August 14, 2006	YAD077C	4.3	28.1	7.1	55.0%	38	4.5	4.8	<10	<10	<10	<2.0	<25	<2.0		380	230	<5.0	51.4
		6.1	**27.9**		**77.8%**	**47.7**	**6.5**	**6.5**											
July 10, 2006	YAD077A	8.1	26.1	7.5	100.0%	60	12.0	15.0											
July 10, 2006	YAD077B	6.6	25.9	7.4	81.2%	42	9.8	11.0											
July 10, 2006	YAD077C	4.5	26.1	7.4	55.6%	27	14.0	15.0	<10	<10	<10	<2.0	<25	<2.0		250	730	5.7	25.2
		6.4	**26.0**		**78.9%**	**43.0**	**11.9**	**13.7**											
June 6, 2006	YAD077A	7.9	24.9	7.5	95.5%	30	6.2	6.5											
June 6, 2006	YAD077B	7.3	25.1	7.5	88.5%	28	6.8	6.9											
June 6, 2006	YAD077C	7.2	24.6	7.5	86.5%	31	4.8	5.3	<10	<10	<10	<2.0	<25	<2.0		240	230	7.5	31.8
		7.5	**24.9**		**90.2%**	**29.7**	**5.9**	**6.2**											
May 3, 2006	YAD077A	9.0	19.8	7.7	98.6%	24	6.8	6.0											
May 3, 2006	YAD077B	9.1	19.9	7.7	99.9%	26	4.8	4.6											
May 3, 2006	YAD077C	8.6	19.4	7.6	93.5%	26	8.0	6.7	<10	<10	<10	<2.0	<25	<2.0		220	220	8.0	29.5
		8.9	**19.7**		**97.3%**	**25.3**	**6.5**	**5.8**											
	N=	5	5	15	5	5	5	5	5	*5*	*5*	*5*	*5*	*5*		*5*	*5*	*5*	*5*
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*E (40%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*ND*	*E (100%)*	*NCE*	*NCE*	*NCE*

KEY: E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
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NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	WINSTON LAKE	12-94-12-6-1	C	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardnes Calculated mg/L
September 12, 2006	YAD077D	7.4	23.4	7.1	86.9%	34	7.8	11.0	<10	10	<10	<2.0	<25	<2.0	58	880	<5.0	33.0
August 10, 2006	YAD077D	9.4	30.3	8.6	125.0%	30	5.2	11.0	<10	10	<10	<2.0	<25	<2.0	62	660	7.9	30.9
July 10, 2006	YAD077D	6.7	25.1	7.1	81.3%	12	8.5	10.0	<10	10	<10	<2.0	<25	<2.0	110	1200	5.2	32.0
June 6, 2006	YAD077D	7.2	23.4	7.3	84.6%	10	8.2	12.0	<10	<10	<10	<2.0	<25	<2.0	190	1600	6.5	38.5
May 31, 2006	YAD077D	8.2	26.5	7.9	102.0%	4	7.0	8.8	<10	<10	<10	<2.0	<25	<2.0	90	1100	6.4	54.5
	N=	5	5		5	5	5	5	5	5	5	5	5	5	5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*Y (20%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (60%)*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE THOM-A-LEX	12-119-(4.5)	WS-II CA	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardnes Calculated mg/L
September 12, 2006	YAD160B	8.0	25.5	7.9	97.7%	55	12.0	13.0										
September 12, 2006	YAD1611A	8.1	25.8	8.1	99.5%	45	8.5	6.8	<10	<10	<10	<2.0	<25	<2.0	140	150	<5.0	34.4
		8.1	**25.7**		**98.6%**	**50.0**	**10.3**	**9.9**										
August 10, 2006	YAD160B	7.0	29.5	8.4	91.8%	48	8.2	10.0										
August 10, 2006	YAD1611A	7.8	29.7	8.7	102.7%	52	7.2	6.8	<10	<10	<10	<2.0	<25	<2.0	84	150	6.7	28.7
		7.4	**29.6**		**97.3%**	**50.0**	**7.7**	**8.4**										
July 12, 2006	YAD160B	7.7	27.8	7.4	98.1%	31	10.0	20.0										
July 12, 2006	YAD1611A	7.1	27.5	7.5	89.9%	32	12.0	19.0	<10	<10	<10	<2.0	<25	<2.0	70	670	<5.0	29.8
		7.4	**27.7**		**94.0%**	**31.5**	**11.0**	**19.5**										
June 20, 2006	YAD160B	7.8	28.3	8.2	100.2%	24	16.0	17.0										
June 20, 2006	YAD1611A	7.5	28.2	8.0	96.2%	18	7.8	6.1	<10	<10	<10	3.0	<25	<2.0	100	210	<5	45.2
		7.7	**28.3**		**98.2%**	**21.0**	**11.9**	**11.6**										
May 4, 2006	YAD160B	9.5	20.8	8.2	106.2%	38	10.0	13.0										
May 4, 2006	YAD1611A	9.0	21.4	8.1	101.8%	25	6.2	7.7	<10	<10	<10	<2.0	<25	<2.0	110	180	<5	44.4
		9.3	**21.1**		**104.0%**	**31.5**	**8.1**	**10.4**										
August 10, 2005	YAD160B	8.5	28.9	8.6	110.4%		9.0	8.8										
August 10, 2005	YAD1611A	8.6	29.0	8.7	111.9%		7.8	5.6	<10	<10	<10	2.8	<25	<2.0	79	160	<5	44.4
		8.6	**29.0**		**111.2%**		**8.4**	**7.2**										
July 11, 2005	YAD160B	8.9	29.4	8.8	116.6%		7.2	7.4										
July 11, 2005	YAD1611A	7.8	29.1	8.6	101.6%		5.8	5.8	<10	<10	<10	2.8	<25	<2.0	61	140	<5 **J8**	44.8
		8.4	**29.3**		**109.1%**		**6.5**	**6.6**										
June 16, 2005	YAD160B	8.8	28.9	8.6	114.3%		11.0	16.0										
June 16, 2005	YAD1611A	8.2	28.3	8.4	105.3%		6.0	6.9	<10	<10	<10	2.8	<25	<2.0	52	250	<5	44.4
		8.5	**28.6**		**109.8%**		**8.5**	**11.5**										
	N=	8	8	16	8	5	8	8	8	8	8	8	8	8	8	8	8	8
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*E (40%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

KEY: E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
CE = Criteria Exceeded - parameter is problematic, highly productive or exceeds the standard in >10% of samples
NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	HIGH ROCK LAKE	12-(108.5)b	WS-V	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
September 12, 2006	HRL051	6.3	23.7	7.3	74.4%	12	27.0	40.0
September 12, 2006	YAD152	6.1	25.8	7.5	74.9%	56	16.0	17.0
September 12, 2006	YAD152A	9.4	25.2	7.9	114.2%	50	14.0	20.0
		7.3	**24.9**		**87.8%**	**39.3**	**19.0**	**25.7**
August 1, 2006	HRL051	8.0	30.9	7.9	107.5%	31	16.0	22.0
August 1, 2006	YAD152	11.6	31.4	**9.9**	157.2%	55	12.0	7.3
August 1, 2006	YAD152A	12.9	31.4	**10.0**	174.9%	59	13.0	10.0
August 1, 2006	YAD152Aa	12.8	31.1	**10.0**	172.6%			
August 1, 2006	YAD152Ab	12.8	31.1	**10.0**	172.6%			
		11.6	**31.2**		**157.0%**	**48.3**	**13.7**	**13.1**
July 19, 2006	HRL051	7.5	31.5	7.0	101.8%	34	20.0	32.0
July 19, 2006	YAD152	10.1	32.2	**9.3**	138.8%	48	8.5	11.0
July 19, 2006	YAD152A	12.5	31.9	**9.3**	170.9%	68	9.2	12.0
July 19, 2006	YAD152Aa	11.3	32.6	**9.3**	156.3%			
July 19, 2006	YAD152Ab	13.0	32.1	**9.4**	178.3%			
		10.9	**32.1**		**149.2%**	**50.0**	**12.6**	**18.3**
June 21, 2006	HRL051	11.4	31.0	8.7	153.5%	46	24.0	15.0
June 21, 2006	YAD152	11.1	31.1	**9.3**	149.7%	52	10.0	6.7
June 21, 2006	YAD152A	11.9	30.3	**9.4**	158.3%	39	12.0	8.7
June 21, 2006	YAD152Aa	13.0	29.7	**9.5**	171.2%			
June 21, 2006	YAD152Ab	12.4	30.2	**9.4**	164.7%			
		12.0	**30.5**		**159.5%**	**45.7**	**15.3**	**10.1**
May 2, 2006	HRL051	8.7	18.2	7.3	92.3%	26	19	26
May 2, 2006	YAD152	9.3	20.2	8.2	102.7%	27	8.5	7.9
May 2, 2006	YAD152A	10.4	10.2	7.9	92.6%	45	11	14
May 2, 2006	YAD152Aa	10.3	19.0	7.9	111.1%			
May 2, 2006	YAD152Ab	9.7	19.6	7.9	105.9%			
		9.7	**17.4**		**100.9%**	**32.7**	**12.8**	**16.0**
April 19, 2006	HRL051	7.0	21.3	7.1	79.0%	26	20.0	20.0
April 19, 2006	YAD152	10.2	20.7	8.8	113.8%	37	6.5	5.8
April 19, 2006	YAD152A	9.2	20.7	6.8	102.6%	34	8.2	7.5
April 19, 2006	YAD152Aa	9.2	20.6	7.9	102.4%			
April 19, 2006	YAD152Ab	8.7	20.7	7.5	97.0%			
		8.9	**20.8**		**99.0%**	**32.3**	**11.6**	**11.1**
March 8, 2006	HRL051	9.9	13.4	6.8	94.8%	12	39.0	50.0
March 8, 2006	YAD152	10.8	12.4	7.5	101.2%	46	18.0	20.0
March 8, 2006	YAD152A	10.6	12.0	7.1	98.4%	18	15.0	20.0
March 8, 2006	YAD152C	10.3	11.7	6.9	95.0%	10	17.0	22.0
		10.1	**14.1**		**97.7%**	**21.5**	**22.3**	**28.0**
February 8, 2006	HRL051	9.9	7.7	7.4	83.0%	4	30.0	30.0
February 8, 2006	YAD152	10.9	9.2	7.9	94.8%	45	15.0	13.0
February 8, 2006	YAD152A	10.1	9.0	7.7	87.4%	24	20.0	22.0
		10.3	**8.6**		**88.4%**	**24.3**	**21.7**	**21.7**

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	HIGH ROCK LAKE	12-(108.5)b	WS-V	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
January 19, 2006	HRL051	11.2	7.7	6.6	93.9%	6	26.0	50.0
January 19, 2006	YAD1391A	11.4	7.8	6.7	95.8%	6	18.0	35.0
January 19, 2006	YAD152A	11.2	8.3	6.6	95.3%	9	38.0	90.0
		11.3	**7.9**		**95.0%**	**7.0**	**27.3**	**58.3**
December 13, 2005	HRL051	11.6	5.6	6.5	92.3%	4	9.0	18.0
December 13, 2005	YAD1391A	11.8	5.0	6.6	92.4%	6	5.5	12.0
December 13, 2005	YAD152A	11.7	6.8	6.5	95.9%	7	11.0	21.0
		11.7	**5.8**		**93.5%**	**5.7**	**8.5**	**17.0**
November 30, 2005	HRL051	10.3	9.9	7.4	91.1%	3	38.0	29.0
November 30, 2005	YAD1391A	10.5	9.8	7.5	92.6%	7	103.0	70.0
November 30, 2005	YAD152A	10.4	10.6	7.4	93.5%	5	25.0	28.0
		10.4	**10.1**		**92.4%**	**5.0**	**55.3**	**42.3**
October 20, 2005	HRL051	7.8	19.8	7.5	85.5%	13	24.0	20.0
October 20, 2005	YAD1391A	9.8	20.3	7.7	108.5%	21	18.0	15.0
October 20, 2005	YAD152A	12.7	22.7	8.5	147.3%	64	13.0	17.0
		10.1	**20.9**		**113.8%**	**32.7**	**18.3**	**17.3**
September 21, 2005	HRL051	6.5	29.1	7.0	84.7%		48.0	37.0
September 21, 2005	YAD1391A	5.5	28.7	6.8	71.2%		119.0	90.0
September 21, 2005	YAD152A	11.2	29.1	8.6	145.9%		16.0	17.0
		7.7	**29.0**		**100.6%**		**61.0**	**48.0**
August 16, 2005	HRL051	8.4	30.9	7.1	112.9%		18.0	24.0
August 16, 2005	YAD1391A	5.7	29.8	6.8	75.2%		18.0	21.0
August 16, 2005	YAD152A	12.4	32.2	**9.3**	170.4%		13.0	14.0
		8.8	**31.0**		**119.5%**		**16.3**	**19.7**
July 19, 2005	HRL051	7.1	30.0	7.1	94.0%		17.0	33.0
July 19, 2005	YAD1391A	8.0	30.5	7.8	106.8%		23.0	28.0
July 19, 2005	YAD152A	11.6	31.7	**9.4**	158.0%		18.0	9.5
		8.9	**30.7**		**119.6%**		**19.3**	**23.5**
June 15, 2005	HRL051	8.7	30.0	7.6	115.1%		19.0	31.0
June 15, 2005	YAD1391A	11.5	30.8	8.9	154.3%		15.0	24.0
June 15, 2005	YAD152A	13.2	30.5	**9.4**	176.2%		9.0	11.0
		11.1	**30.4**		**148.5%**		**14.3**	**22.0**
May 10, 2005	HRL051	9.8	21.4	7.4	110.8%		14.0	10.0
May 10, 2005	YAD1391A	11.3	21.5	8.7	128.0%		12.0	10.0
May 10, 2005	YAD152A	15.4	21.9	**9.1**	175.8%		10.0	7.9
		12.2	**21.6**		**138.2%**		**12.0**	**9.3**
April 11, 2005	HRL051	8.9	21.2	7.2	100.3%	23	17.0	19.0
April 11, 2005	YAD1391A	11.0	21.2	7.4	123.9%	31	17.0	16.0
April 11, 2005	YAD152A	10.4	21.8	7.3	118.5%	25	8.0	9.4
		10.1	**21.4**		**114.2%**	**26.3**	**14.0**	**14.8**
March 29, 2005	HRL051	9.0	12.1	6.6	83.7%	12	40.0	290.0
March 29, 2005	YAD1391A	9.2	12.7	6.6	86.8%	17	33.0	210.0

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	HIGH ROCK LAKE	12-(108.5)b	WS-V	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
March 29, 2005	YAD152A	9.3	11.9	6.7	86.1%	9	32.0	230.0
		9.2	**12.2**		**85.5%**	**12.7**	**35.0**	**243.3**
August 26, 2004	YAD152A	8.0	28.1	8.1	102.4%	40	14.0	14.0
August 18, 2004	YAD152A	9.6	26.2	8.8	118.8%			
		8.8	**27.2**		**110.6%**	**40**	**14.0**	**14.0**
July 21, 2004	YAD1391A	6.1	30.5	7.2	81.4%	42	12.0	17.0
July 21, 2004	YAD152A	11.2	30.3	**9.3**	149.0%	41	4.0	8.2
		8.7	**30.4**		**115.2%**	**41.5**	**8.0**	**12.6**
June 16, 2004	YAD1391A	6.8	29.3	7.4	88.9%	3	20.0	20.0
June 16, 2004	YAD152A	7.7	27.1	8.7	96.8%	39	10.0	11.0
		7.3	**28.2**		**92.9%**	**21.0**	**15.0**	**15.5**
	N=	22	22	74	22	17	22	22
	% EXCEED =	*NCE*	*NCE*	*CE (23%)*	*Y (23%)*	*CE (24%)*	*NCE*	*CE (27%)*

Region	Lake	AU	Classfication	Comments
PIEDMONT	HIGH ROCK LAKE	12-(114)	WS-IV & B	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
September 14, 2006	YAD169B	6.3	24.9	8.2	76.1%	37	10.0	14.0
September 14, 2006	YAD169E	4.5	25.3	7.3	54.8%	28	7.2	8.3
September 14, 2006	YAD169F	4.4	25.3	7.6	53.6%	27	5.8	7.6
September 12, 2006	YAD152C	9.8	26.2	8.2	121.3%	59	10.0	11.0
September 12, 2006	YAD169A	4.1	26.2	7.9	50.7%	35	6.8	7.8
		5.8	**25.6**		**71.3%**	**37.2**	**8.0**	**9.7**
August 2, 2006	YAD169B	11.2	33.3	**9.7**	156.8%	56	8.5	5.6
August 2, 2006	YAD169E	10.8	32.7	**9.7**	149.6%	34	8.5	6.1
August 2, 2006	YAD169F	10.9	32.0	**9.6**	149.3%	39	8.0	5.4
August 1, 2006	YAD152C	12.0	31.9	**9.8**	164.0%	63	12.0	13.0
August 1, 2006	YAD169A	9.9	30.7	**9.9**	132.6%	41	9.0	4.7
		11.0	**32.1**		**150.5%**	**46.6**	**9.2**	**7.0**
July 19, 2006	YAD152C	12.7	31.9	**9.2**	173.6%	65	8.5	10.0
July 19, 2006	YAD169A	9.5	30.5	**9.3**	126.8%	46	7.0	5.4
July 19, 2006	YAD169B	10.3	30.8	**9.5**	138.2%	43	7.0	4.4
July 19, 2006	YAD169E	8.9	30.7	**9.2**	119.2%	37	8.8	6.8
July 19, 2006	YAD169F	9.9	31.6	**9.4**	134.7%	40	6.2	6.2
		10.3	**31.1**		**138.5%**	**46.2**	**7.5**	**6.6**
June 21, 2006	YAD152C	12.0	31.0	**9.5**	161.6%	44	9.0	5.2
June 21, 2006	YAD169A	11.1	29.5	**9.3**	145.6%	42	6.0	5.2
June 21, 2006	YAD169B	11.9	31.9	**9.6**	162.7%	33	7.5	5.8
June 21, 2006	YAD169E	11.3	30.0	**9.4**	149.5%	32	7.0	4.0
June 21, 2006	YAD169F	10.8	29.9	**9.3**	142.7%	39	7.2	4.4
		11.4	**30.5**		**152.4%**	**38.0**	**7.3**	**4.9**

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classfication	Comments
PIEDMONT	HIGH ROCK LAKE	12-(114)	WS-IV & B	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
May 2, 2006	YAD152C	11.6	20.5	8.9	128.9%	71	10.0	10.0
May 2, 2006	YAD169A	7.8	20.5	7.6	86.7%	14	6.5	6.1
May 2, 2006	YAD169B	9.2	20.9	8.0	103.0%	28	6.8	5.9
May 2, 2006	YAD169E	8.8	20.9	7.7	98.6%	23	8.5	7.0
May 2, 2006	YAD169F	9.1	21.3	8.0	102.7%	30	6.2	6.0
		9.3	**20.8**		**104.0%**	**33.2**	**7.6**	**7.0**
April 19, 2006	YAD152C	9.1	20.4	7.9	100.9%	37	6.2	6.9
April 19, 2006	YAD169A	10.4	20.0	**9.0**	114.4%	38	6.2	4.4
April 19, 2006	YAD169B	10.3	20.1	8.9	113.5%	47	6.2	4.5
April 19, 2006	YAD169E	11.7	20.5	**9.4**	130.0%	41	6.8	4.6
April 19, 2006	YAD169F	11.3	20.1	**9.3**	124.6%	40	5.8	3.6
		10.6	**20.2**		**116.7%**	**40.6**	**6.2**	**4.8**
March 8, 2006	YAD169A	12.2	10.9	7.7	110.4%	42	13.0	11.0
March 8, 2006	YAD169B	11.2	11.3	7.3	102.3%	24		10.0
March 8, 2006	YAD169E	12.4	11.6	7.6	114.1%	33	7.8	8.1
March 8, 2006	YAD169F	11.7	11.3	7.8	106.9%	33	8.2	7.9
		11.6	**13.1**		**110.1%**	**34.5**	**9.7**	**8.4**
February 9, 2006	YAD169E	10.4	8.2	7.5	88.3%	27	10.0	13.0
February 9, 2006	YAD169F	9.5	8.1	7.6	80.4%	14	10.0	16.0
February 8, 2006	YAD152C	10.0	8.8	7.7	86.1%	12	18.0	26.0
February 8, 2006	YAD169A	10.0	8.8	7.7	86.1%	46	15.0	17.0
February 8, 2006	YAD169B	10.0	8.8	7.8	86.1%	21	13.0	16.0
		10.0	**8.5**		**85.4%**	**24.0**	**13.2**	**17.6**
January 19, 2006	YAD152C	11.2	8.6	6.8	96.0%	5	38.0	95.0
January 19, 2006	YAD169A	11.2	8.7	7.1	96.2%	23	10.0	18.0
January 19, 2006	YAD169B	10.2	9.5	6.7	89.3%	17	36.0	110.0
January 19, 2006	YAD169E	10.5	9.2	7.0	91.3%	19	23.0	60.0
January 19, 2006	YAD169F	9.8	9.2	6.6	85.2%	10	44.0	120.0
		10.6	**9.0**		**91.6%**	**14.8**	**30.2**	**80.6**
December 13, 2005	YAD152C	11.7	6.5	6.7	95.2%	4	12.0	19.0
December 13, 2005	YAD169A	8.4	8.3	7.0	71.5%	14	9.5	14.0
December 13, 2005	YAD169B	9.5	8.0	6.8	80.2%	10	9.5	16.0
December 13, 2005	YAD169E	9.4	8.7	6.8	80.8%	9	4.0	9.6
December 13, 2005	YAD169F	9.6	7.9	6.7	80.9%	8	9.5	18.0
		9.7	**7.9**		**81.7%**	**9.0**	**8.9**	**15.3**
November 30, 2005	YAD152C	10.4	10.8	7.4	93.5%	9	20.0	12.0
November 30, 2005	YAD169A	9.0	11.5	7.7	82.6%	16	10.0	9.5
November 30, 2005	YAD169B	10.2	11.5	7.3	93.6%	15	7.5	9.3
November 30, 2005	YAD169E	9.6	12.6	7.3	90.3%	13	7.0	7.0
November 30, 2005	YAD169F	10.1	11.5	7.3	92.7%	13	8.0	7.8
		9.9	**11.6**		**90.5%**	**13.2**	**10.5**	**9.1**
October 20, 2005	YAD152C	12.3	22.3	8.5	141.5%	60	10.0	11.0
October 20, 2005	YAD169A	7.6	21.4	8.2	85.9%	28	10.0	7.5

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classfication	Comments
PIEDMONT	HIGH ROCK LAKE	12-(114)	WS-IV & B	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
October 20, 2005	YAD169B	12.2	22.3	8.5	140.4%	59	9.8	12.0
October 20, 2005	YAD169E	10.5	23.4	7.8	123.4%	24	9.0	8.7
October 20, 2005	YAD169F	10.2	23.4	7.9	119.8%	20	8.5	9.8
		10.6	**22.6**		**122.2%**	**38.2**	**9.5**	**9.8**
September 21, 2005	YAD152C	10.4	28.9	8.4	135.0%		12.0	12.0
September 21, 2005	YAD169A	8.2	27.1	8.2	103.1%		7.2	6.0
September 21, 2005	YAD169B	11.6	28.4	8.9	149.3%		7.0	5.0
September 21, 2005	YAD169E	10.6	28.9	9.0	137.6%		7.5	4.3
September 21, 2005	YAD169F	10.7	29.2	8.9	139.7%		7.2	5.5
		10.3	**28.5**		**132.9%**		**8.2**	**6.6**
August 16, 2005	YAD152C	10.9	31.6	9.0	148.3%		10.0	11.0
August 16, 2005	YAD169A	8.5	31.6	8.9	115.6%		4.8	5.7
August 16, 2005	YAD169B	11.0	33.6	**9.3**	154.7%		8.0	8.9
August 16, 2005	YAD169E	9.3	32.1	**9.2**	127.6%		6.8	5.4
August 16, 2005	YAD169F	9.8	33.0	**9.1**	136.5%		7.0	5.4
		9.9	**32.4**		**136.5%**		**7.3**	**7.3**
July 19, 2005	YAD152C	11.0	31.9	**9.4**	150.4%		8.5	6.9
July 19, 2005	YAD169A	9.8	33.0	**9.3**	136.5%		5.2	5.9
July 19, 2005	YAD169B	11.0	32.2	**9.3**	151.1%		7.2	6.2
July 19, 2005	YAD169E	9.4	31.8	9.0	128.3%		6.2	5.7
July 19, 2005	YAD169F	10.6	31.7	**9.2**	144.4%		6.8	6.0
		10.4	**32.1**		**142.1%**		**6.8**	**6.1**
June 21, 2006	Cross Section a	11.2	31.9	**9.5**	153.1%			
June 21, 2006	Cross Section b	11.3	31.9	**9.6**	154.5%			
June 21, 2006	Cross Section Mid	12.1	31.3	**9.6**	163.7%			
		11.1	**31.8**		**151.6%**		**6.8**	**6.1**
June 15, 2005	YAD152C	12.4	29.9	**9.2**	163.8%		9.2	10.0
June 15, 2005	YAD169A	10.3	30.0	**9.3**	136.3%		31.0	4.5
June 15, 2005	YAD169B	11.2	29.6	**9.4**	147.2%		6.5	5.5
June 15, 2005	YAD169E	10.2	29.8	**9.2**	134.5%		6.0	5.3
June 15, 2005	YAD169F	11.2	30.2	**9.4**	148.7%		7.2	4.4
		11.1	**29.9**		**146.1%**		**12.0**	**5.9**
May 10, 2005	YAD152C	14.6	21.8	**9.2**	166.4%		10.0	7.2
May 10, 2005	YAD169A	12.6	21.2	8.9	141.9%		8.0	6.2
May 10, 2005	YAD169B	12.6	19.4	9.0	137.0%		6.0	5.6
May 10, 2005	YAD169E	12.1	21.7	8.9	137.3%		8.0	6.0
May 10, 2005	YAD169F	11.6	20.5	8.7	128.9%		6.0	4.6
		12.7	**20.9**		**142.3%**		**7.6**	**5.9**
April 11, 2005	YAD152C	10.1	20.0	7.5	111.1%	36	8.0	10.0
April 11, 2005	YAD169A	11.8	18.7	7.6	126.5%	71	12.0	11.0
April 11, 2005	YAD169B	10.8	20.4	7.6	119.8%	40	9.0	11.0
April 11, 2005	YAD169E	11.5	18.9	7.6	123.8%	57	10.0	9.3
April 11, 2005	YAD169F	10.7	18.7	7.5	114.7%	42	10.0	11.0

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classfication	Comments
PIEDMONT	HIGH ROCK LAKE	12-(114)	WS-IV & B	No metals

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
		11.0	**19.3**		**119.2%**	**49.2**	**9.8**	**10.5**
March 29, 2005	YAD152C	9.3	12.2	6.7	86.7%	9	24.0	180.0
March 29, 2005	YAD169A	10.8	12.4	7.2	101.2%	30	10.0	8.8
March 29, 2005	YAD169B	9.5	12.9	7.0	90.0%	7	34.0	85.0
March 29, 2005	YAD169E	9.9	12.9	7.1	93.8%	13	11.0	21.0
March 29, 2005	YAD169F	9.9	12.8	7.1	93.6%	12	12.0	28.0
		9.9	**12.6**		**93.1%**	**14.2**	**18.2**	**64.6**
August 26, 2004	YAD152C	10.0	28.2	9.0	128.2%	47	8.0	11.0
August 26, 2004	YAD169A	9.2	28.3	9.0	118.2%	30	7.0	6.6
August 26, 2004	YAD169B	9.1	27.4	9.0	115.1%	40	7.0	6.1
August 26, 2004	YAD169E	8.3	27.5	8.8	105.1%	26	5.0	6.1
August 26, 2004	YAD169F	8.3	27.2	8.8	104.6%	30	6.0	3.9
		9.0	**27.7**		**114.2%**	**34.6**	**6.6**	**6.7**
August 18, 2004	YAD169A	8.5	27.4	8.8	107.5%			
August 18, 2004	YAD169F	5.1	25.5	7.4	62.3%			
		6.8	**26.5**		**84.9%**			
July 21, 2004	YAD152C	11.4	29.6	**9.3**	149.8%	49	6.0	10.0
July 21, 2004	YAD169A	7.6	29.6	8.8	99.9%	26	6.0	6.0
July 21, 2004	YAD169B	8.4	29.1	**9.1**	109.4%	40	6.0	7.6
July 21, 2004	YAD169E	9.1	29.9	**9.2**	120.2%	30	4.0	6.3
July 21, 2004	YAD169F	9.2	30.3	**9.3**	122.4%	33	3.0	5.0
		9.1	**29.7**		**120.3%**	**35.6**	**5.0**	**7.0**
June 16, 2004	YAD152C	8.1	27.1	8.7	101.9%	50	12.0	11.0
June 16, 2004	YAD169A	7.8	27.2	8.8	98.3%	35	4.0	6.9
June 16, 2004	YAD169B	7.6	26.8	8.6	95.1%	23	5.0	5.2
June 16, 2004	YAD169E	7.4	26.6	8.5	92.2%	24	7.0	4.8
June 16, 2004	YAD169F	6.8	26.3	8.1	84.3%	23	6.0	4.3
		7.5	**26.8**		**94.4%**	**31.0**	**6.8**	**6.4**
	N=	24	24	114	24	17	22	22
	% EXCEED =	*NCE*	*CE (4%)*	*CE (33%)*	*Y (42%)*	*CE (24%)*	*NCE*	*E (9%)*

Region	Lake	AU	Classification	Comments
PIEDMONT	HIGH ROCK LAKE	12-118.5	WS-V & B	No metals taken

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
September 14, 2006	HRL052	5.8	24.3	7.9	69.3%	49	6.2	16.0
August 1, 2006	HRL052	8.2	31.0	**9.5**	110.4%	37	9.0	7.0
July 19, 2006	HRL052	8.7	30.6	8.8	116.3%	42	8.0	7.2
June 21, 2006	HRL052	10.2	29.0	8.9	132.7%	34	8.2	6.0
May 2, 2006	HRL052	9.2	20.4	7.8	102.0%	37	10	10
April 19, 2006	HRL052	9.1	20.4	8.5	100.9%	20	5.5	5.4
March 8, 2006	HRL052	13.0	11.3	7.8	118.8%	52	14.0	15.0
February 8, 2006	HRL052	10.8	8.9	7.9	93.2%	39	14.0	1.0

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	**HIGH ROCK LAKE**	**12-118.5**	**WS-V & B**	**No metals taken**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
January 19, 2006	HRL052	10.2	8.7	7.2	87.6%	40	16.0	27.0
December 13, 2005	HRL052	9.8	6.9	6.8	80.6%	10	17.0	37.0
November 30, 2005	HRL052	9.8	11.8	7.7	90.6%	44	14.0	12.0
October 20, 2005	HRL052	11.0	22.0	8.4	125.8%	38	7.8	6.6
September 21, 2005	HRL052	8.5	27.4	8.4	107.5%		11.0	6.0
August 16, 2005	HRL052	9.4	31.2	9.0	127.0%		7.0	6.5
July 19, 2005	HRL052	8.4	30.8	8.9	112.7%		7.2	5.6
June 15, 2005	HRL052	13.2	30.5	**9.4**	176.2%		7.5	5.7
May 10, 2005	HRL052	11.9	23.9	8.6	141.1%		9.0	
April 11, 2005	HRL052	13.3	22.4	8.0	153.3%	53	14.0	8.8
March 29, 2005	HRL052	9.4	13.7	7.0	90.6%	14	29.0	75.0
	N=	19	19	19	19	14	19	18
	% EXCEED =	*NCE*	*NCE*	*CE (11%)*	*Y (32%)*	*CE (36%)*	*NCE*	*CE (17%)*

Region	Lake	AU	Classification	Comments
PIEDMONT	**HIGH ROCK LAKE**	**12-117-(3)**	**WS-IV & B**	**No metals taken**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
September 14, 2006	YAD156A		25.3	7.3		40	7.0	12.0
September 14, 2006	YAD1561A		25.0	7.4		40	4.5	12.0
			25.2			**40.0**	**5.8**	**12.0**
August 2, 2006	YAD156A	12.7	33.9	**9.8**	179.5%	49	12.0	6.9
August 2, 2006	YAD1561A	11.1	32.2	**9.5**	152.5%	61	8.8	6.4
		11.9	**33.1**		**166.0%**	**55.0**	**10.4**	**6.7**
July 19, 2006	YAD156A	12.9	31.7	**9.7**	175.8%	61	7.8	8.4
July 19, 2006	YAD1561A	12.0	32.4	**9.8**	165.4%	52	8.8	6.1
		12.5	**32.1**		**170.6%**	**56.5**	**8.3**	**7.3**
June 21, 2006	YAD156A	11.7	31.3	**9.5**	158.3%	62	8.8	6.2
June 21, 2006	YAD1561A	12.6	30.0	**9.2**	166.7%	50	9.8	4.9
		12.2	**30.7**		**162.5%**	**56.0**	**9.3**	**5.6**
May 2, 2006	YAD156A	9.8	21.1	8.3	110.2%	33	6.2	5.8
May 2, 2006	YAD1561A	8.9	21.2	7.9	100.3%	25	6.5	4.8
		9.4	**21.2**		**105.3%**	**29.0**	**6.4**	**5.3**
April 19, 2006	YAD156A	11.0	20.3	9.0	121.7%	52	6.2	4.8
April 19, 2006	YAD1561A	11.1	20.2	**9.1**	122.6%	48	6.8	4.9
		11.1	**20.3**		**122.2%**	**50.0**	**6.5**	**4.9**
March 8, 2006	YAD156A	10.7	11.4	7.3	98.0%	26	9.2	10.0
March 8, 2006	YAD1561A	10.4	11.4	7.1	95.2%	30	12.0	13.0
		10.6	**11.4**		**96.6%**	**28.0**	**10.6**	**11.5**
February 9, 2006	YAD1561A	10.4	8.1	8.1	88.1%	28		
January 19, 2006	YAD156A	10.2	9.0	6.8	88.3%	11	46.0	120.0
December 13, 2005	YAD156A	12.5	7.3	6.7	103.8%	7	11.0	21.0

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	HIGH ROCK LAKE	12-117-(3)	WS-IV & B	No metals taken

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU
November 30, 2005	YAD156A	10.0	10.6	7.3	89.9%	14	10.0	10.0
October 20, 2005	YAD156A	10.0	21.7	7.9	113.7%	46	9.5	9.8
September 21, 2005	YAD156A	10.0	29.6	8.5	131.4%		9.0	8.5
August 16, 2005	YAD156A	10.8	33.0	**9.3**	150.4%		8.0	8.8
July 19, 2005	YAD156A	10.9	32.3	**9.3**	150.0%		9.0	8.8
June 15, 2005	YAD156A	11.5	29.7	**9.2**	151.4%		6.7	6.5
May 10, 2005	YAD156A	13.8	21.8	**9.2**	157.3%		10.0	7.0
April 11, 2005	YAD156A	11.3	19.6	7.8	123.3%	36	9.0	7.8
March 29, 2005	YAD156A	9.6	13.5	6.9	92.2%	10	21.0	55.0
August 26, 2004	YAD156A	9.4	27.5	9.0	119.1%	53	7.0	5.4
July 21, 2004	YAD156A	10.7	29.8	**9.3**	141.1%	44	5.0	4.3
June 16, 2004	YAD156A	7.3	26.8	8.3	91.3%	23	8.0	7.2
	N=	21	22	29	21	17	21	21
	% EXCEED =	*NCE*	*CE (5%)*	*CE (41%)*	*Y (52%)*	*CE (41%)*	*NCE*	*CE (10%)*

Region	Lake	AU	Classification	Comments
PIEDMONT	TUCKERTOWN RESERVOIR	12-(124.5)c	WS-IV CA & B	No Mercury or Arsenic taken

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 25, 2006	YAD172C	7.2	24.5	7.2	86.4%	27	6.8	9.3										
September 25, 2006	YAD1780A	8.5	24.5	7.4	102.0%	38	5.5	4.6	<10	<10	<10	<2.0	<25	<2.0	31	150	8.9	24.7
		7.9	**24.5**		**94.2%**	**32.5**	**6.2**	**7.0**										
August 9, 2006	YAD172C	2.4	29.3	7.6	31.4%	28	4.8	5.2										
August 9, 2006	YAD1780A	8.6	30.7	8.2	115.2%	55	4.8	5.2	<10 **J6**	<10 **J6**	<10 **J6**	<2.0 **J6**	<25 **J6**	<2.0 **J6**	72 **J6**	130 **J6**		
		5.5	**30.0**		**73.3%**	**41.5**	**4.8**	**5.2**										
July 12, 2006	YAD172C	5.6	27.2	7.5	70.6%	19	7.0	10.0										
July 12, 2006	YAD1780A	13.6	28.9	8.4	176.6%	49	7.0	5.7	<10	<10	<10	<2.0	<25	<2.0	52	180	6.7	25.3
		9.6	**28.1**		**123.6%**	**34.0**	**7.0**	**7.9**										
June 20, 2006	YAD172C	10.7	29.2	8.6	139.7%	49	8.2	6.2										
June 20, 2006	YAD1780A	10.7	27.2	8.5	134.8%	44	7.8	3.1	<10	<10	<10	<2.0	<25	<2.0	44	110	7.0	29.2
		10.7	**28.2**		**137.3%**	**46.5**	**8.0**	**4.7**										
May 2, 2006	YAD172C	6.2	19.8	7.0	67.9%	7	9.5	13.0										
May 2, 2006	YAD1780A	9.0	20.0	7.2	99.0%	15	6.2	6.7	<10	<10	<10	<2.0	<25	<2.0	77	260	7.5	30.2
		7.6	**19.9**		**83.5%**	**11.0**	**7.9**	**9.9**										
	N=	5	5	10	5	5	5	5	5	5	5	5	5	5	5	5	4	4
	% EXCEED =	*NCE*	*NCE*	*NCE*	*Y (40%)*	*E (40%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	BADIN LAKE	12-(136.3)	WS-IV CA & B	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 25, 2006	YAD178B	6.1	25.3	7.1	74.3%	11	3.5	3.9												
September 25, 2006	YAD178E	6.0	25.5	7.6	73.3%	8	<2.5	2.3												
September 25, 2006	YAD178F	5.3	25.1	7.1	64.3%	6	<2.5	1.8												
September 25, 2006	YAD178F1	4.8	25.0	7.3	58.1%	5	<2.5	2.3	<2.0	<10	<10	<10	2.8	<25	<2.0	<5.0	38	73	8.4	26.2
		5.6	**25.2**		**67.5%**	**7.5**	**3.5**	**2.6**	**<2.0**	**<10**	**<10**	**<10**	**2.8**	**<25**	**<2.0**	**<5.0**	**38**	**73**	**8.4**	**26.2**
August 9, 2006	YAD178B	5.7	30.0	7.4	75.4%	26	4.2	4.1		<10	<10	<10	2.8	<25	<2.0		48	130	12.0	26.8
August 9, 2006	YAD178E	7.6	30.2	8.0	100.9%	16	3.0	2.1		<10	<10	<10	<2.0	<25	<2.0		14	<50	11.0	24.1
August 9, 2006	YAD178F	7.7	30.4	7.9	102.6%	24	3.5	2.8		<10	<10	<10	<2.0	<25	<2.0		21	59	10.0	26.1
August 9, 2006	YAD178F1	7.6	30.5	7.7	101.4%	23	2.5	2.7		<10	<10	<10	<2.0	<25	<2.0		21	<50	9.9	26.1
		7.2	**30.3**		**95.1%**	**22.3**	**3.3**	**2.9**		**<10**	**<10**	**<10**	**<2.0**	**<25**	**<2.0**		**26**	**59.8**	**10.7**	**25.8**
July 12, 2006	YAD178B	12.5	28.8	8.0	162.0%	30	4.0	3.7												
July 12, 2006	YAD178E	8.8	28.6	8.1	113.7%	23	3.5	2.3												
July 12, 2006	YAD178F	8.3	27.1	7.8	104.4%	18	3.2	3.1												
July 12, 2006	YAD178F1	6.3	27.5	7.2	79.8%	19	4.0	2.9	<2.0	<10	<10	<10	<2.0	<25	<2.0	<5.0	35	97	7.2	26.1
		9.0	**28.0**		**115.0%**	**22.5**	**3.7**	**3.0**	**<2.0**	**<10**	**<10**	**<10**	**<2.0**	**<25**	**<2.0**	**<5.0**	**35**	**97**	**7.2**	**26.1**
June 7, 2006	YAD178B	8.4	25.6	7.6	102.8%	15	5.5	7.3		<10	<10	<10	<2.0	<25	<2.0		39	170	7.5	23.3
June 7, 2006	YAD178E	8.3	25.5	8.2	101.4%	12	2.8	3.8		<10	<10	<10	2.0	<25	<2.0		19	<50	7.5	21.7
June 7, 2006	YAD178F	8.9	25.7	7.7	109.1%	17	4.0	3.3		<10	<10	<10	<2.0	<25	<2.0		17	<50	8.0	23.4
June 7, 2006	YAD178F1	8.9	26.2	7.8	110.1%	18	3.8	3.7		<10	<10	<10	<2.0	<25	<2.0		23	68	6.5	24.3
		8.6	**25.8**		**105.9%**	**15.5**	**4.0**	**4.5**		**<10**	**<10**	**<10**	**<2.0**	**<25**	**<2.0**		**24.5**	**72**	**7.4**	**23.2**
May 3, 2006	YAD178B	7.1	20.1	7.4	78.3%	9	3.5	4.8		<10	<10	<10	<2.0	<25	<2.0		42	170	7.5	26.6
May 3, 2006	YAD178E	8.9	19.8	7.8	97.5%	9	2.5	3.4											**Z**	
May 3, 2006	YAD178F	9.7	20.0	7.5	106.7%	22	4.5	5.5		<10	<10	<10	<2.0	<25	<2.0		21	120	5.5	25.4
May 3, 2006	YAD178F1	9.2	19.8	7.4	100.8%	9	3.8	4.0		<10	<10	<10	<2.0	<25	<2.0		27	130	7.5	105.1
		8.7	**19.9**		**95.8%**	**12.3**	**3.6**	**4.4**		**<10**	**<10**	**<10**	**<2.0**	**<25**	**<2.0**		**30**	**140**	**6.8**	**52.4**
October 10, 2002	BL10	8.3	22.8	6.5	96.4%	30		2.1												
October 10, 2002	BL7	4.7	23.6	6.6	55.4%	12		3.6												
October 10, 2002	BL8	6.0	23.7	6.7	70.9%	12		1.8												
October 10, 2002	BL9	6.7	23.6	6.6	79.0%	19		2.6												
October 10, 2002	YAD178B	3.6	23.7	6.7	42.5%	15		3.2												
October 10, 2002	YAD178F	6.8	23.8	6.7	80.5%	12		1.6					2.0			<10			14.0	23.8
October 10, 2002	YAD178F1	7.7	23.7	6.9	91.0%	16		1.8		<10	<10	<10	2.2	<25	<2.0	<10	41	62	14.0	23.8
		6.3	**23.6**		**73.7%**	**16.6**		**2.4**		**<10**	**<10**	**<10**	**2.1**	**<25**	**<2.0**	**<10**	**41**	**62**	**14.0**	**23.8**
	N=	6	6	27	6	6	5	6	2	6	6	6	6	6	6	3	6	6	6	6
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

KEY: E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
CE = Criteria Exceeded - parameter is problematic, highly productive or exceeds the standard in >10% of samples
NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE TILLERY	13-(1)	WS-IV CA & B	No Mercury or Arsenic taken

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 26, 2006	YAD185A	6.7	25.8	7.2	82.3%	7	54.0	2.9										
September 26, 2006	YAD189	8.0	26.0	7.3	98.6%	11	4.5	3.5										
September 26, 2006	YAD189B	7.4	26.1	7.4	91.4%	9	3.5	2.7										
September 26, 2006	YAD189C	6.7	26.0	7.5	82.6%	11	3.5	2.9	<10	<10	<10	<2.0	<25	<2.0	40	72	6.9	26.4
		7.2	**26.0**		**88.7%**	**9.5**	**16.4**	**3.0**										
August 17, 2006	YAD185A	4.6	27.5	7.3	58.3%	11		3.5										
August 17, 2006	YAD189	6.6	28.4	7.4	84.9%	20		3.1										
August 17, 2006	YAD189B	6.5	28.6	7.3	83.9%	15		5.3										
August 17, 2006	YAD189C	6.6	28.6	7.2	85.2%	15		3.2	<10	<10	<10	<2.0	<25	<2.0	44	67	6.4	27.7
		6.1	**28.3**		**78.1%**	**15.3**		**3.8**										
July 25, 2006	YAD185A	9.3	29.9	8.0	122.9%	28	5.2	3.2										
July 25, 2006	YAD189	8.7	29.9	7.8	114.9%	26	4.2	3.2										
July 25, 2006	YAD189B	8.9	30.2	7.9	118.2%	30	6.2	2.5										
July 25, 2006	YAD189C	9.0	30.0	7.9	119.1%	25	5.0	2.2	<10	<10	<10	<2.0	<25	<2.0	19	<50	6.4	25.0
		9.0	**30.0**		**118.8%**	**27.3**	**5.2**	**2.8**										
May 3, 2006	YAD185A	9.2	18.5	7.6	98.2%	2	4.0	4.1										
May 3, 2006	YAD189	9.9	20.3	7.6	109.6%	15	5.0	8.2										
May 3, 2006	YAD189B	9.4	20.1	7.9	103.6%	6	<2.5	4.0										
May 3, 2006	YAD189C	9.0	19.9	7.6	98.8%	5	4.0	5.1	<10	<10	<10	<2.0	<25	<2.0	15	170	5.5	25.2
		9.4	**19.7**		**102.6%**	**7.0**	**3.9**	**5.4**										
	N=	4	4	16	4	4	3	4	4	4	4	4	4	4	4	4	4	4
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE REESE	13-2-(1.3)	WS-III CA	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 21, 2006	YAD179B	5.7	22.0	7.1	65.2%	25	7.2	13.0												
September 21, 2006	YAD179D	7.0	22.8	7.2	81.3%	25	5.8	9.5												
September 21, 2006	YAD179F	6.0	23.8	7.2	71.0%	27	9.0	8.8	<0.2	<10	<10	<10	<2.0	<25	<2.0	<5.0	590	270	<5.0	37.5
		6.2	**22.9**		**72.5%**	**25.7**	**7.3**	**10.4**												
August 17, 2006	YAD179B	5.0	28.0	7.8	63.9%	25	11.0	12.0												
August 17, 2006	YAD179D	6.2	28.0	7.2	79.2%	26	9.8	11.0												
August 17, 2006	YAD179F	6.9	28.0	7.3	88.2%	23	7.8	5.3		<10	<10	<10	<2.0	<25	<2.0		92	160	<5.0	39.6
		6.0	**28.0**		**77.1%**	**24.7**	**9.5**	**9.4**												
July 13, 2006	YAD179B	8.2	29.6	8.2	107.8%	33	7.2	6.3												
July 13, 2006	YAD179D	7.6	29.2	8.1	99.2%	33	6.0	4.7												
July 13, 2006	YAD179F	8.1	28.3	8.3	104.1%	20	<5.0	4.7		<10	<10	<10	<2.0	<25	<2.0	<50	30	180	<5.0	33.6
		8.0	**29.0**		**103.7%**	**28.7**	**6.6**	**5.2**												
June 15, 2006	YAD179B	5.7	24.8	7.9	66.7%	23	8.5	11.0												

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NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE REESE	13-2-(1.3)	WS-III CA	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
June 15, 2006	YAD179D	7.1	25.3	7.9	86.4%	21	5.8	4.7												
June 15, 2006	YAD179F	7.6	25.6	8.2	93.0%	21	5.8	4.0		<10	<10	<10	<2.0	<25	<2.0		30	110	<5.0	44.3
		6.8	**25.2**		**82.0%**	**21.7**	**6.7**	**6.6**												
May 25, 2006	YAD179B	8.5	24.6	8.0	102.1%	16	3.5	4.6												
May 25, 2006	YAD179D	8.6	24.7	8.1	103.5%	10	4.8	3.6												
May 25, 2006	YAD179F	8.3	23.8	8.2	98.3%	11	4.0	4.0		<10	<10	<10	<2.0	<25	<2.0		37	170	<5.0	43.8
		8.5	**24.4**		**101.3%**	**12.3**	**4.1**	**4.1**												
August 15, 2005	YAD179B	7.6	30.0	8.3	100.6%		8.5	9.4												
August 15, 2005	YAD179D	8.2	29.7	8.4	108.0%		5.8	5.9												
August 15, 2005	YAD179F	7.4	29.1	7.8	96.4%		3.8	4.3		<10	<10	<10	<2.0	<25	<2.0		37	130	<5.0	42.9
		7.7	**29.6**		**101.7%**		**6.0**	**6.5**												
July 18, 2005	YAD179B	7.9	31.4	8.7	107.1%		6.8	7.1												
July 18, 2005	YAD179D	7.8	30.8	8.7	104.7%		4.5	5.0												
July 18, 2005	YAD179F	7.7	30.7	8.6	103.1%		5.0	4.8		<10	<10	<10	<2.0	<25	<2.0		26	120	<5.0 **J8**	
		7.8	**31.0**		**105.0%**		**5.4**	**5.6**												
June 23, 2005	YAD179B	7.4	27.2	7.8	93.2%		7.2	8.2												
June 23, 2005	YAD179D	7.9	27.3	8.5	99.7%		4.5	6.3												
June 23, 2005	YAD179F	7.6	27.7	8.3	96.6%		4.5	4.8		<10	<10	<10	<2.0	<25	<2.0		32	160	<5.0	46.2
		7.6	**27.4**		**96.5%**		**5.4**	**6.4**												
	N=	8	8	24	8	5	8	8	1	8	8	8	8	8	8	2	8	8	8	6
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (13%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	BACK CREEK LAKE	13-2-3-3-(0.7)	WS-II CA HQW	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 21, 2006	YAD181L	4.0	24.0	7.2	47.5%	37	3.8	7.3	<10	<10	<10	<2.0	<25	<2.0	<5.0	450	260	<5.0	37.0
September 21, 2006	YAD181K	3.4	24.2	7.3	40.6%	30	5.2	6.7											
September 21, 2006	YAD181J	4.7	24.1	7.4	56.0%	59	7.0	11.0											
		4.0	**24.1**		**48.0%**	**42.0**	**5.3**	**8.3**											
August 17, 2006	YAD181L	6.2	27.8	7.5	79.0%	60	7.0	8.1	<10	<10	<10	<2.0	<25	<2.0		190	460	<5.0	33.6
August 17, 2006	YAD181K	6.7	28.2	7.6	85.9%	60	9.5	6.8											
August 17, 2006	YAD181J	4.1	27.9	7.5	52.3%	57	5.5	9.3											
		5.7	**28.0**		**72.4%**	**59.0**	**7.3**	**8.1**											
July 13, 2006	YAD181L	8.5	29.3	8.5	111.1%	97	7.2	9.7	<10	<10	<10	<2.0	<25	<2.0		170	590	5.0	31.8
July 13, 2006	YAD181K	8.8	29.9	8.6	116.3%	46	4.2	6.8											
July 13, 2006	YAD181J	8.2	29.6	8.5	107.8%	40	6.8	7.2											
		8.5	**29.6**		**111.7%**	**61.0**	**6.1**	**7.9**											
June 15, 2006	YAD181L	6.9	25.1	7.9	83.7%	24	4.8	6.3	<10	<10	<10	<2.0	<25	<2.0		120	500	<5.0	36.0

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NCE = No Criteria Exceeded

Y = Criteria are exceeded but are not included in 15 NCAC 2B .0200

APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	**BACK CREEK LAKE**	**13-2-3-3-(0.7)**	**WS-II CA HQW**	**-**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
June 15, 2006	YAD181K	7.5	25.2	8.1	91.1%	56	7.2	5.6											
June 15, 2006	YAD181J	7.8	25.4	8.2	95.1%	65	8.2	9.5											
		7.4	**25.2**		**90.0%**	**48.3**	**6.7**	**7.1**											
May 25, 2006	YAD181L	8.6	23.6	7.9	101.4%	17	<5.0	5.5	<10	<10	<10	<2.0	<25	<2.0		89	200	<5.0	46.3
May 25, 2006	YAD181K	9.2	24.1	8.2	109.5%	21	3.2	4.7											
May 25, 2006	YAD181J	9.6	24.1	8.2	114.3%	30	5.5	6.0											
		9.1	**23.9**		**108.4%**	**22.7**	**4.4**	**5.4**											
August 15, 2005	YAD181L	7.2	29.3	8.0	94.1%		7.5	8.8	<10	<10	<10	<2.0	<25	<2.0		150	520		
August 15, 2005	YAD181K	7.5	30.3	8.2	99.8%		9.0	8.1											
August 15, 2005	YAD181J	8.5	30.1	8.5	112.7%		9.5	9.9											
		7.7	**29.9**		**102.2%**		**8.7**	**8.9**											
July 18, 2005	YAD181L	8.7	31.0	8.9	117.1%		8.0	7.2	<10	<10	<10	<2.0	<25	<2.0		110		6.5 **J8**	37.3
July 18, 2005	YAD181K	8.4	31.7	8.8	114.4%		7.0	7.4											
July 18, 2005	YAD181J	9.0	31.4	8.8	122.0%		9.6	9.9											
		8.7	**31.4**		**117.8%**		**8.2**	**8.2**											
June 23, 2005	YAD181L	8.0	26.4	8.5	99.4%		6.3	9.3	<10	<10	<10	<2.0	<25	<2.0		91	340	<5.0	37.0
June 23, 2005	YAD181K	8.0	27.3	8.6	101.0%		5.9	5.6											
June 23, 2005	YAD181J	8.1	27.2	8.5	102.0%		9.6	11.0											
		8.0	**27.0**		**100.8%**		**7.3**	**8.6**											
	N=	8	8	24	8	5	8	8	8	8	8	8	8	8	1	8	7	7	7
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*E (80%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (Mn-13%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	**Classification**	**Comments**
PIEDMONT	BUNCH LAKE	13-2-3-3-2-2-(2)	**WS-II CA HQW**	**-**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 27, 2006	YAD181G	8.4	23.9	7.8	99.6%	16	<2.5	4.5		<10	<10	<10	<2.0	<25	<2.0		14	68	<5.0	31.2
August 22, 2006	YAD181G	7.8	28.9	8.4	101.3%	14	<2.5	3.0	<2.0	<10	<10	<10	3.9	<25	<2.0	<5.0	12	97	<5.0	32.1
July 31, 2006	YAD181G	7.4	31.0	8.2	99.6%	42	3.5	7.3		<10	<10	<10	<2.0	<25	<2.0		13	150	6.4	30.7
June 13, 2006	YAD181G	7.6	26.7	7.4	94.9%	52	5.2	3.6		<10	<10	<10	<2.0	<25	<2.0		12	100	<5.0	32.3
May 24, 2006	YAD181G	8.5	23.1	8.3	99.3%	50	4.5	3.1		<10	<10	<10	<2.0	<25	<2.0		15	150	<5.0	41.9
August 23, 2005	YAD181G	7.3	29.9	8.3	96.4%		3.5	2.6		<10	<10	<10	3.7	<25	<2.0		<10	120	<5.0	32.1
July 21, 2005	YAD181G	7.4	31.2	8.5	100.0%		3.5	4.1		<10	<10	<10	<2.0	<25	<2.0		12	130	<5 **J8**	31.8
June 28, 2005	YAD181G	7.5	28.1	8.3	96.0%		170.0	3.6		15	<10	<10	<2.0	<25	<2.0		16	110	<5.0	30.7
	N=	8	8	8	8	5	8	8	1	8	8	8	8	8	8	1	8	8	8	8
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*E (60%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

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NCE = No Criteria Exceeded

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	MCCRARY LAKE	13-2-3-3-2-2-(2)	WS-II CA HQW	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 27, 2006	YAD181E	6.9	23.1	7.7	80.6%	3	2.5	2.2		<10	<10	<10	<2.0	<25	<2.0		140	100	<5.0	54.3
August 22, 2006	YAD181E	7.6	28.6	8.3	98.2%	14	<5.0	2.4	<2.0	<10	<10	<10	<2.0	<25	<2.0	<5.0	17	120	<5.0	53.9
July 31, 2006	YAD181E	7.2	30.4	8.1	95.9%	31	4.5	4.8		<10	<10	<10	<2.0	<25	<2.0		18	130	<5.0	51.0
June 13, 2006	YAD181E	7.2	26.2	7.4	89.1%	13	4.5	3.0		<10	<10	<10	<2.0	<25	<2.0		31	210	5.0	50.6
May 24, 2006	YAD181E	8.7	22.3	8.0	100.1%	15	4.2	2.8		<10	<10	<10	<2.0	<25	<2.0		45	260	<5.0	39.9
August 23, 2005	YAD181E	7.0	29.5	7.9	91.8%		5.2	5.1		<10	<10	<10	<2.0	<25	<2.0		22	150	<5.0	53.9
July 21, 2005	YAD181E	7.5	31.4	8.6	101.7%		5.0	5.4		<10	<10	<10	<2.0	<25	<2.0		40	130	5.5 **J8**	51.4
June 28, 2005	YAD181E	7.3	27.7	8.7	92.8%		3.2	3.1		15	<10	<10	<2.0	<25	<2.0		40	140	<5.0	51.4
	N=	8	8	8	8	5	8	8	1	8	8	8	8	8	8	1	8	8	8	8
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	BLEWETT FALLS	13-(15.5)	WS-IV & B	No Mercury samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 26, 2006	YAD260B	6.4	25.3	7.6	77.9%	13	13.0	16.0	<10	<10	<10	<2.0	<25	<2.0		110	560	7.9	30.3
August 3, 2006	YAD260B	8.1	32.5	7.8	111.9%	28	8.5	7.2	<10	<10	<10	<2.0	<25	<2.0	<5.0	100	270	8.4	28.6
May 3, 2006	YAD260B	8.8	19.1	8.1	95.1%	11	9.0	14	<10	<10	<10	<2.0	<25	<2.0		79	540	5.5	28.7
	N=	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3
	% EXCEED =	*NCE*	*E (33%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE HOWELL (CODDLE CREEK RESERVOIR)	13-17-6-(1.5)	WS-II HQW	No Mercury or Arsenic Samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 27, 2006	CCR01	8.1	24.3	7.9	96.8%				<10	<10	<10	<2.0	<25	<2.0	35	61	<5.0	37.8
September 27, 2006	CCR02	7.5	24.0	7.7	89.1%	14	4.0	4.4										
September 27, 2006	CCR03	6.4	23.9	7.3	75.9%	11	6.8	10.0										
		7.3	**24.1**		**87.3%**	**12.5**	**5.4**	**7.2**										
August 16, 2006	CCR01	8.2	28.0	8.3	104.8%	17		4.1	<10	<10	<10	<2.0	<25	<2.0	16	<50	<5.0	39.0
August 16, 2006	CCR02	7.9	28.4	8.5	101.7%	18		3.5										
August 16, 2006	CCR03	7.3	28.7	8.4	94.4%	22		6.2										
		7.8	**28.4**		**100.3%**	**19.0**		**4.6**										
July 19, 2006	CCR01	7.9	30.4	7.7	105.3%	4	<2.5	2.4	15	<10	<10	<2.0	<25	<2.0	34	<50	5.2	38.3
July 19, 2006	CCR02	8.5	29.9	8.1	112.3%	9	<5	2.0										
July 19, 2006	CCR03	8.9	30.1	8.5	118.0%	16	3.5	3.4										

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	**LAKE HOWELL (CODDLE CREEK RESERVOIR)**	**13-17-6-(1.5)**	**WS-II HQW**	**No Mercury or Arsenic Samples**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
		8.4	**30.1**		**111.9%**	**9.7**	**3.7**	**2.6**										
June 7, 2006	CCR01	8.5	25.3	8.8	103.5%	12	<5	4.0	<10	<10	<10	2.5	<25	<2.0	52	69	<5	36.9
June 7, 2006	CCR02	8.5	25.3	8.8	103.5%	17	2.5	4.9										
June 7, 2006	CCR03	8.6	24.8	8.6	103.7%	17	3.0	5.9										
		8.5	**25.1**		**103.6%**	**15.3**	**2.8**	**4.9**										
May 18, 2006	CCR01	10.3	21.4	8.2	116.5%	19	5.2	4.1	<10	<10	<10	<2.0	<25	<2.0	83	64	<5	38.3
May 18, 2006	CCR02	10.1	20.9	8.4	113.1%	17	5.2	3.9										
May 18, 2006	CCR03	9.6	21.2	7.9	108.1%	16	8.0	8.1										
		10.0	**21.2**		**112.6%**	**17.3**	**6.1**	**5.4**										
	N=	5	5	15	5	5	4	5	5	5	5	5	5	5	5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	KANNAPOLIS LAKE	13-17-9-(1)	**WS-III**	**-**

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 27, 2006	YAD207A	7.5	24.1	7.0	89.3%	32	5.2	7.8	<10	<10	<10	<2.0	<25	<2.0		59	180	<5.0	27.0
September 27, 2006	YAD207C	7.7	24.0	7.1	91.5%	32	3.8	6.3											
		7.6	**24.1**		**90.4%**	**32.0**	**4.5**	**7.1**											
August 16, 2006	YAD207A	7.8	28.1	7.5	99.9%	40		10.0	<10	<10	<10	<2.0	<25	<2.0		47	120	<5.0	
August 16, 2006	YAD207C	7.4	28.0	6.8	94.6%	29		6.8											
		7.6	**28.1**		**97.3%**	**34.5**		**8.4**											
July 19, 2006	YAD207A	7.8	31.1	7.9	105.2%	20	2.8	4.2	<10	<10	<10	2.3	<25	<2.0		25	75	5.7	29.2
July 19, 2006	YAD207C	8.0	31.0	7.7	107.7%	15	3.2	2.9											
		7.9	**31.1**		**106.5%**	**17.5**	**3.0**	**3.6**											
June 7, 2006	YAD207A	8.0	25.1	7.5	97.0%	16	4.5	6.2	<10	<10	<10	2.3	<25	<2.0		50	200	5.5	28.7
June 7, 2006	YAD207C	8.5	25.2	7.9	103.3%	15	5.0	4.8											
		8.3	**25.2**		**100.2%**	**15.5**	**4.8**	**5.5**											
May 18, 2006	YAD207A	9.4	21.2	8.1	105.9%	32	4.2	7.0	<10	<10	<10	2.5	<25	<2.0		44	210	<5.0	27.3
May 18, 2006	YAD207C	10.3	21.3	8.0	116.3%	28	10.0	4.8											
		9.9	**21.3**		**111.1%**	**30.0**	**7.1**	**5.9**											
	N=	5	5	10	5	5	4	5	5	5	5	5	5	5		5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*ND*	*NCE*	*NCE*	*NCE*	*NCE*

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE FISHER	13-17-9-4-(1)	WS-IV CA	-

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 26, 2006	YAD215R	7.7	23.2	7.1	90.1%	35	9.5	12.0											
September 26, 2006	YAD215T	7.8	23.7	7.4	92.2%	46	9.8	6.6											
September 26, 2006	YAD216A	8.0	23.5	7.5	94.2%	38	9.5	6.4	<10	<10	<10	4.0	<25	<2.0		100	170	6.4	44.8
		7.8	**23.5**		**92.2%**	**39.7**	**9.6**	**8.3**											
September 14, 2006	YAD215R	6.5	20.4	6.7	72.1%	6	36.0	85.0											
September 14, 2006	YAD215T	5.4	24.1	6.8	64.3%	32	6.2	12.0											
September 14, 2006	YAD216A	4.2	24.3	7.3	50.2%	26	5.2	9.3	<10	<10	<10	<2.0	<25	<2.0		420	130	5.7	49.3
		5.4	**22.9**		**62.2%**	**21.3**	**15.8**	**35.4**											
August 28, 2006	YAD215R	7.6	30.0	7.5	100.6%	38		29.0											
August 28, 2006	YAD215T	8.2	29.2	8.6	107.0%	37		6.2											
August 28, 2006	YAD216A	9.1	29.4	8.7	119.2%	43		5.2	<10	<10	<10	<2.0	<25	<2.0		51	87	7.1	53.9
		8.3	**29.5**		**108.9%**	**39.3**		**13.5**											
July 20, 2006	YAD215R	7.9	30.4	8.0	105.3%	57	2.8	23.0											
July 20, 2006	YAD215T	9.2	30.6	8.6	123.0%	34	23.0	8.1											
July 20, 2006	YAD216A	9.2	30.8	8.6	123.4%	32	12.0	12.0	<10	<10	<10	<2.0	<25	<2.0		97	110	8.8	58.0
		8.8	**30.6**		**117.2%**	**41.0**	**12.6**	**14.4**											
May 17, 2006	YAD215R	8.6	21.5	7.5	97.4%	28	22.0	21.0											
May 17, 2006	YAD215T	9.1	21.7	8.1	103.5%	21	6.8	6.1											
May 17, 2006	YAD216A	8.8	21.0	8.0	98.7%	19	5.8	4.6	<10	<10	<10	<2.0	<25	<2.0		75	100	8.4	54.3
		8.8	**21.4**		**99.9%**	**22.7**	**11.5**	**10.6**											
	N=	5	5	15	5	5	4	5	5	5	5	5	5	5		5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*E (20%)*	*NCE*	*E (20%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*ND*	*E (20%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE CONCORD	13-17-9-4(2)	WS-IV CA	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 26, 2006	YAD216C	8.8	24.3	7.3	105.2%	46	7.5	12.0										
September 26, 2006	YAD216E	10.0	24.0	7.9	118.8%	47	18.0	16.0										
September 26, 2006	YAD216G	9.3	23.9	7.6	110.3%	52	9.5	10.0	<10	<10	<10	<2.0	<25	<2.0	74	280	<5.0	26.9
		9.4	**24.1**		**111.4%**	**48.3**	**11.7**	**12.7**										
September 14, 2006	YAD216C	7.2	21.9	6.7	82.2%	29	16.0	29.0										
September 14, 2006	YAD216E	8.4	23.3	6.7	98.5%	35	19.0	24.0										
September 14, 2006	YAD216G	6.6	22.0	7.6	75.5%	34	15.0	23.0	10	<10	<10	3.1	<25	<2.0	400	900	<5.0	28.7
		7.4	**22.4**		**85.4%**	**32.7**	**16.7**	**25.3**										
August 28, 2006	YAD216C	8.6	29.0	8.5	111.9%	50		12.0										
August 28, 2006	YAD216E	7.9	29.1	7.6	102.9%	57		25.0										
August 28, 2006	YAD216G	9.3	28.6	8.6	120.1%	51		17.0	<10	<10	<10	<2.0	<25	<2.0	89	430	<5.0	29.8
		8.6	**28.9**		**111.6%**	**52.7**		**18.0**										

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE CONCORD	13-17-9-4(2)	WS-IV CA	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
July 20, 2006	YAD216C	9.2	31.6	8.1	125.1%	56	7.5	14.0										
July 20, 2006	YAD216E	9.0	31.7	8.2	122.6%	53	6.2	18.0										
July 20, 2006	YAD216G	9.6	31.4	8.4	130.1%	52	5.5	13.0	<10	<10	<10	5.6	<25	<2.0	97	280	6.7	34.5
		9.3	**31.6**		**125.9%**	**53.7**	**6.4**	**15.0**										
May 17, 2006	YAD216C	9.3	23.0	8.2	108.5%	31	9.8	9.2										
May 17, 2006	YAD216E	9.6	23.8	8.1	113.7%	32	22.0	16.0										
May 17, 2006	YAD216G	9.8	22.2	8.2	112.6%	33	8.8	7.0	<10	<10	<10	<2.0	<25	<2.0	65	250	5.9	36.5
		9.6	**23.0**		**111.6%**	**32.0**	**13.5**	**10.7**										
	N=	5	5	15	5	5	4	5	5	5	5	5	5	5	5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*E (20%)*	*E (60%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (20%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE LEE	13-17-36-(3.5)	WS-IV CA	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 25, 2006	YAD232C	4.6	25.1	6.5	55.8%	46	14.0	17.0										
September 25, 2006	YAD232H	5.6	24.8	6.6	67.5%	68	14.0	19.0										
September 25, 2006	YAD233	5.5	25.1	7.0	66.7%	140	9.8	16.0	<10	<10	<10	<2.0	<25	<2.0	200	790	6.9	32.7
		5.2	**25.0**		**63.3%**	**84.7**	**12.6**	**17.3**										
September 7, 2006	YAD232C	9.3	27.2	7.0	117.2%	120		15.0										
September 7, 2006	YAD232H	9.9	27.3	8.5	124.9%	150		14.0										
September 7, 2006	YAD233	8.2	26.0	6.9	101.1%	120		9.1	<10	<10	<10	<2.0	<25	<2.0	130	520	<5.0	30.2
		9.1	**26.8**		**114.4%**	**130.0**		**12.7**										
August 28, 2006	YAD232C	10.1	31.4	7.7	136.9%	81		23.0										
August 28, 2006	YAD232H	10.0	29.4	8.0	131.0%	59		16.0										
August 28, 2006	YAD233	10.4	30.4	8.2	138.6%	59		10.0	<10	<10	<10	2.6	<25	<2.0	220	590	7.1	43.1
		10.2	**30.4**		**135.5%**	**66.3**		**16.3**										
August 9, 2006	YAD232C	6.0	30.6	6.7	80.2%	73	13.0	14.0										
August 9, 2006	YAD232H	6.6	30.2	6.7	87.6%	143	9.0	13.0										
August 9, 2006	YAD233	3.6	30.3	7.2	47.9%	55	9.0	13.0	<10	<10	<10	<2.0	<25	<2.0	430	640	12.0	46.8
		5.4	**30.4**		**71.9%**	**90.3**	**10.3**	**13.3**										
July 31, 2006	YAD232C	6.1	29.6	6.9	80.2%	90	11.0	14.0										
July 31, 2006	YAD232H	7.0	30.0	6.9	92.6%	110	32.0	39.0										
July 31, 2006	YAD233	8.3	30.7	7.7	111.2%	100	8.8	10.0	<10	<10	<10	<2.0	<25	<2.0	190	470	10.0	46.4
		7.1	**30.1**		**94.7%**	**100.0**	**17.3**	**21.0**										
July 12, 2006	YAD232C	8.5	28.0	7.1	108.6%	87	12.0	17.0										
July 12, 2006	YAD232H	9.5	28.6	7.9	122.7%	120	24.0	17.0										
July 12, 2006	YAD233	10.1	28.6	8.5	130.4%	150	8.5	18.0	<10	<10	<10	<2.0	<25	<2.0	210	720	8.8	38.4
		9.4	**28.4**		**120.6%**	**119.0**	**14.8**	**17.3**										

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE LEE	13-17-36-(3.5)	WS-IV CA	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
June 22, 2006	YAD232C	7.8	30.1	6.9	103.4%	48	16.0	16.0										
June 22, 2006	YAD232H	10.8	29.1	8.5	140.7%	89	12.0	13.0										
June 22, 2006	YAD233	11.3	32.3	9.0	155.5%	94	11.0	9.5	<10	<10	<10	5.9	<25	<2.0	110	380	8.4	39.3
		10.0	**30.5**		**133.2%**	**77.0**	**13.0**	**12.8**										
June 8, 2006	YAD232C	7.5	26.9	7.3	94.0%	84	21.0	16.0										
June 8, 2006	YAD232H	9.3	27.1	8.0	117.0%	98	16.0	25.0										
June 8, 2006	YAD233	14.9	27.2	**9.2**	187.7%	380	16.0	28.0	<10	<10	<10	<2.0	<25	<2.0	340	750	18.0	53.0
		10.6	**27.1**		**132.9%**	**187.3**	**17.7**	**23.0**										
May 31, 2006	YAD232C	8.8	27.1	7.9	110.7%	130	20.0	29.0										
May 31, 2006	YAD232H	9.8	27.1	8.6	123.2%	110	18.0	23.0										
May 31, 2006	YAD233	13.7	26.9	**9.3**	171.7%	210	14.0	21.0	<10	<10	<10	<2.0	<25	<2.0	200	470	17.0	90.7
		10.8	**27.0**		**135.2%**	**150.0**	**17.3**	**24.3**										
May 24, 2006	YAD232C	10.0	23.7	7.8	118.2%	100	24.0	20.0										
May 24, 2006	YAD232H	10.0	24.3	8.0	119.5%	73	18.0	16.0										
May 24, 2006	YAD233	8.6	23.1	7.4	100.5%	88	18.0	16.0	<10	<10	<10	<2.0	<25	<2.0	300	820	17.0	54.3
		9.5	**23.7**		**112.7%**	**87.0**	**20.0**	**17.3**										
	N=	10	10	30	10	10	8	10	10	10	10	10	10	10	10	10	10	10
	% EXCEED =	*NCE*	*NCE*	*E(7%)*	*Y (50%)*	*CE (100%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (50%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE MONROE	13-17-36-4-(0.5)	WS-IV	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 7, 2006	YAD232D	10.0	27.8	8.6	127.3%	97		11.0										
September 7, 2006	YAD232F	9.4	27.4	8.2	118.9%	87		7.5	<10	<10	<10	<2.0	<25	<2.0	88	200	6.4	32.6
		9.7	**27.6**		**123.1%**	**92.0**		**9.3**										
August 9, 2006	YAD232D	8.4	31.6	7.7	114.3%	75	7.2	8.1										
August 9, 2006	YAD232F	7.0	30.8	7.6	93.9%	66	6.5	9.0	<10	<10	<10	2.4	<25	<2.0	110	150	12.0	33.6
		7.7	**31.2**		**104.1%**	**70.5**	**6.9**	**8.6**										
July 12, 2006	YAD232D	10.1	29.3	8.6	132.1%	67	9.0	11.0										
July 12, 2006	YAD232F	10.9	30.5	8.9	145.5%	84	7.0	12.0	<10	<10	<10	4.1	<25	<2.0	56	260	8.8	32.2
		10.5	**29.9**		**138.8%**	**75.5**	**8.0**	**11.5**										
June 8, 2006	YAD232D	8.1	26.2	8.3	100.2%	56	7.8	14.0										
June 8, 2006	YAD232F	9.3	27.1	8.8	117.0%	60	7.2	9.6	<10	<10	<10	2.2	<25	<2.0	160	250	15.0	43.8
		8.7	**26.7**		**108.6%**	**58.0**	**7.5**	**11.8**										
May 24, 2006	YAD232D	11.3	25.8	9.2	138.8%	75	14.0	13.0										
May 24, 2006	YAD232F	11.5	24.7	8.9	138.4%	70	12.0	12.0	<10	<10	<10	2.9	<25	<2.0	93	240	14.0	42.4
		11.4	**25.3**		**138.6%**	**72.5**	**13.0**	**12.5**										
	N=	5	5	10	5	5	4	5	5	5	5	5	5	5	5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*E (10%)*	*Y (60%)*	*E (100%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

KEY: E = Criteria is exceeded in less than 10% of the measurements or criteria exceeded but n<10
CE = Criteria Exceeded - parameter is problematic, highly productive or exceeds the standard in >10% of samples
NCE = No Criteria Exceeded

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE TWITTY	13-17-36-9-(4.5)	WS-III CA	No Mercury samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 25, 2006	YAD235D	7.2	25.2	7.3	87.5%	77	6.0	8.1											
September 25, 2006	YAD235F	6.1	25.1	7.0	74.0%	45	5.5	8.7											
September 25, 2006	YAD236	6.1	25.3	7.1	74.3%	42	9.0	7.4	<10	<10	<10	3.8	<25	<2.0		100	260	11.0	48.1
		6.5	**25.2**		**78.6%**	**54.7**	**6.8**	**8.1**											
September 7, 2006	YAD235D	5.0	27.9	7.0	63.8%	43	10.0	10.0											
September 7, 2006	YAD235F	7.9	28.0	7.9	101.0%	85	12.0	12.0											
September 7, 2006	YAD236	3.4	27.1	7.0	42.8%	31	11.0	7.0	<10	<10	<10	3.4	<25	<2.0		160	280	9.7	48.5
		5.4	**27.7**		**69.2%**	**53.0**	**11.0**	**9.7**											
August 28, 2006	YAD235D	10.8	30.4	8.4	143.9%	65	9.8	6.9											
August 28, 2006	YAD235F	9.4	29.5	8.2	123.3%	47	8.8	9.6											
August 28, 2006	YAD236	6.8	20.3	7.7	75.3%	50	8.2	7.4	<10	<10	<10	3.6	<25	<2.0		130	210	11.0	49.3
		9.0	**26.7**		**114.2%**	**54.0**	**8.9**	**8.0**											
August 9, 2006	YAD235D	6.6	30.8	7.0	88.6%	68	10.0	8.2											
August 9, 2006	YAD235F	7.1	30.9	7.3	95.4%	72	8.5	9.2											
August 9, 2006	YAD236	3.9	30.5	7.0	71.6%	44	8.8	10.0	<10	<10	<10	3.6	<25	<2.0		300	570	15.0	52.6
		5.9	**30.7**		**85.2%**	**61.3**	**9.1**	**9.1**											
July 31, 2006	YAD235D	9.3	31.2	7.9	125.6%	50	7.2	7.7											
July 31, 2006	YAD235F	10.0	32.0	8.4	136.9%	50	9.0	6.8											
July 31, 2006	YAD236	8.2	31.4	7.6	111.2%	62	8.2	9.3	<10	<10	<10	4.2	<25	<2.0		120	310	13.0	48.9
		9.2	**31.5**		**124.6%**	**54.0**	**8.1**	**7.9**											
July 12, 2006	YAD235D	11.0	31.1	**9.2**	148.3%	65	8.0	11.0											
July 12, 2006	YAD235F	11.2	29.7	9.0	147.5%	61	9.5	11.0											
July 12, 2006	YAD236	8.2	28.7	7.8	106.1%	56	9.5	12.0	<10	<10	<10	8.5	<25	<2.0		260	550	12.0	48.5
		10.1	**29.8**		**134.0%**	**60.7**	**9.0**	**11.3**											
June 22, 2006	YAD235D	9.9	30.1	8.8	131.2%	76	8.0	7.0											
June 22, 2006	YAD235F	10.5	30.0	9.0	139.0%	52	6.8	6.3											
June 22, 2006	YAD236	9.4	28.9	8.7	122.0%	39	7.5	9.4	<10	<10	<10	5.2	<25	<2.0		61	170	12.0	48.9
		9.9	**29.7**		**130.7%**	**55.7**	**7.4**	**7.6**											
June 8, 2006	YAD235D	8.1	26.4	7.5	100.6%	64		7.1											
June 8, 2006	YAD235F	7.5	26.0	7.3	92.5%	42		6.2											
June 8, 2006	YAD236	7.0	25.8	7.3	86.0%	39		7.1	<10	<10	<10	8.4	<25	<2.0		78	280	13.0	49.3
		7.5	**26.1**		**93.0%**	**48.3**		**6.8**											
May 31, 2006	YAD235D	10.2	25.8	7.9	125.3%	46		6.1											
May 31, 2006	YAD235F	10.1	27.4	8.7	127.7%	49		7.1											
May 31, 2006	YAD236	7.4	25.5	7.6	90.4%	21		9.8	<10	<10	<10	5	<25	<2.0		55	150	13.0	55.8
		9.2	**26.2**		**114.5%**	**38.7**		**7.7**											
May 24, 2006	YAD235D	9.1	22.8	7.8	105.7%	34		7.3											
May 24, 2006	YAD235F	10.0	23.3	8.6	117.3%	42		5.6											
May 24, 2006	YAD236	8.4	22.3	7.3	96.7%	30		7.9		<10	<10	<10	5.7	<25	<2.0	94	240	15.0	49.8

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
PIEDMONT	LAKE TWITTY	13-17-36-9-(4.5)	WS-III CA	No Mercury samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
		9.2	**22.8**		**106.6%**	**35.3**		**6.9**											
	N=	10	10	30	10	10	7	10	10	10	10	10	10	10		10	10	10	10
	% EXCEED =	*NCE*	*NCE*	*E(3%)*	*Y (30%)*	*CE (80%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*CE (20%)*	*NCE*	*NCE*	*NCE*	*CE (20%)*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
DYSTROPHIC	ROBERDEL LAKE	13-39-(8.5)	WS-III CA	No Mercury or Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 28, 2006	YAD262E	6.4	23.2	5.1	74.9%	15	5.5	4.8										
September 28, 2006	YAD263	5.6	23.6	6.1	66.0%	14	3.8	3.9	<10	<10	<10	<2.0	<25	<2.0	33	900	<5.0	5.5
		6.0	**23.4**		**70.5%**	**14.5**	**4.7**	**4.4**										
August 15, 2006	YAD262E	7.7	29.7	5.3	101.4%	24	13.0	6.8										
August 15, 2006	YAD263	7.4	28.2	5.3	94.9%	30	6.5	14.0	<10	<10	<10	<2.0	<25	<2.0	28	870	<5.0	6.3
		7.6	**29.0**		**98.2%**	**27.0**	**9.8**	**10.4**										
July 17, 2006	YAD262E	5.9	30.6	5.4	78.9%	13	5.2	3.6										
July 17, 2006	YAD263	6.2	30.0	5.8	82.1%	20	4.2	3.3	13	<10	<10	<2.0	<25	<2.0	48	960	<5.0	6.4
		6.1	**30.3**		**80.5%**	**16.5**	**4.7**	**3.5**										
June 21, 2006	YAD262E	6.3	28.4	5.4	81.1%	19	6.8	5.2										
June 21, 2006	YAD263	7.1	28.2	5.6	91.1%	7	7.2	4.6	<10	<10	<10	<2.0	<25	<2.0	71	690	<5.0	7.1
		6.7	**28.3**		**86.1%**	**13.0**	**7.0**	**4.9**										
May 10, 2006	YAD262E	8.0	19.5	5.4	87.1%	4	8.8	8.1										
May 10, 2006	YAD263	8.2	19.1	5.7	88.6%	5	<5.0	3.3	<10	<10	<10	<2.0	<25	<2.0	25	610	<5.0	6.6
		8.1	**19.3**		**87.9%**	**4.5**	**8.8**	**5.7**										
	N=	5	5	10	5	5	5	5										
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
SANDHILLS	WATER LAKE	13-45-(1)	WS-II CA HQW	No Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 28, 2006	YAD280C	7.9	22.8	5.7	91.8%	14	<5.0	1.9											
September 28, 2006	YAD280E	7.5	23.9	6.0	89.0%	17	<2.5	2.2	<0.2	<10	<10	<10	85.0	<25	<2.0	10	250	5.7	5.1
		7.7	**23.4**		**90.4%**	**15.5**	**3.8**	**2.1**											
August 15, 2006	YAD280C	7.9	28.3	5.7	101.5%	20	3.5	2.3											
August 15, 2006	YAD280E	7.8	28.2	6.1	100.0%	22	<2.5	2.5		<10	<10	<10	65.0	<25	<2.0	20	370	5.6	5.1
		7.9	**28.3**		**100.8%**	**21.0**	**3.0**	**2.4**											

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APPENDIX B. YADKIN-PEE DEE RIVER BASIN LAKES USE ASSESSMENT DATA

Region	Lake	AU	Classification	Comments
SANDHILLS	WATER LAKE	13-45-(1)	WS-II CA HQW	No Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Hg µg/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
July 17, 2006	YAD280C	7.5	29.9	5.8	99.1%	45	9.5	4.2											
July 17, 2006	YAD280E	7.8	30.6	6.4	104.3%	17	<2.5	2.2		15	<10	<10	43.0	<25	<2.0	12	240	8.2	5.0
		7.7	**30.3**		**101.7%**	**31.0**	**6.0**	**3.2**											
June 21, 2006	YAD280C	7.9	28.5	5.9	101.9%	8	3.8	1.5											
June 21, 2006	YAD280E	7.8	28.9	6.2	101.3%	9	<2.5	1.2		<10	<10	<10	96.0	<25	<2.0	15	160	5.5	5.4
		7.9	**28.7**		**101.6%**	**8.5**	**3.2**	**1.4**											
May 10, 2006	YAD280C	7.8	20.6	5.7	86.8%	15	6.0	4.8											
May 10, 2006	YAD280E	8.1	21.2	6.4	91.2%	2	<2.5	3.0		22	<10	<10	120.0	<25	<2.0	13	130	6.4	5.7
		8.0	**20.9**		**89.0%**	**8.5**	**4.3**	**3.9**											
	N=	5	5	10	5	5	5	5		5	5	5	5	5	5	5	5	5	5
	% EXCEED =	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (100%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*

Region	Lake	AU	Classification	Comments
PIEDMONT	CITY POND (WADESBORO)	13-42-1-(0.3)	WS-II CA HQW	No Arsenic samples

Date m/d/yr	Sampling Station	DO mg/L	Water Temp C	pH s.u.	Percent DO SAT	Chla µg/L	TSS mg/L	Turbidity NTU	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	Mn µg/L	Fe µg/L	Chloride mg/L	Total Hardness Calculated mg/L
September 28, 2006	YAD275H	7.1	23.9	6.3	84.2%	51	5.5	9.9										
September 28, 2006	YAD275J	7.3	25.8	6.9	89.7%	51	3.2	7.9	<10	<10	<10	2.6	<25	<2.0	220	670	<5.0	18.2
		7.2	**24.9**		**87.0%**	**51.0**	**3.2**	**8.9**										
August 15. 2006	YAD275H	8.3	30.7	7.8	111.2%	120	9.0	7.3										
August 15. 2006	YAD275J	8.3	30.7	7.8	111.2%	30	<5.0	3.9	<10	<10	<10	2.4	<25	<2.0	79	340	<5.0	16.8
		8.3	**30.7**		**111.2%**	**75.0**	**3.2**	**5.6**										
July 17, 2006	YAD275H	8.5	31.8	7.6	116.0%	26	5.5	5.3										
July 17, 2006	YAD275J	8.2	32.5	8.2	113.2%	58	4.5	6.6	<10	<10	<10	3.8	<25	<2.0	67	630	<5.0	15.9
		8.4	**32.2**		**114.6%**	**42.0**	**3.2**	**6.0**										
June 21, 2006	YAD275H	7.7	30.5	6.5	102.8%	20	7.2	8.1										
June 21, 2006	YAD275J	8.7	31.8	6.8	118.7%	34	7.8	6.7	<10	<10	<10	4.0	<25	<2.0	62	570	<5.0	14.3
		8.2	**31.2**		**110.8%**	**27.0**	**3.2**	**7.4**										
May 25, 2006	YAD275H	8.9	25.0	6.9	107.7%	20	8.2	6.9										
May 25, 2006	YAD275J	8.9	26.7	8.1	111.1%	15	6.0	5.1	<10	<10	<10	28.0	<25	<2.0	80	300	<5.0	46.1
		8.9	**25.9**		**109.4%**	**17.5**	**3.2**	**6.0**										
	N=	5	5	10	5	5	5	5										
	% EXCEED =	*NCE*	*E (20%)*	*NCE*	*NCE*	*E (60%)*	*NCE*	*NCE*	*NCE*	*NCE*	*NCE*	*E (20%)*	*NCE*	*NCE*	*E (20%)*	*NCE*	*NCE*	*NCE*

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APPENDIX C. HIGH ROCK LAKE ALGAL DENSITIES AND BIOVOLUMES 2004-2006

Table C1. Phytoplankton Densities and % Dominance in High Rock Lake

Station	Date Collected	Unit Density (U/ml)	Dominant Division	% Density	Dominant Genus	% Density
YAD156A	6/16/04	23,000	Blue greens	76%	***Chroococcus***	46%
YAD169A	6/16/04	25,000	Blue greens	71%	No dominant	-
YAD169B	6/16/04	20,000	Blue greens	72%	***Chroococcus***	46%
YAD169E	6/16/04	18,000	Blue greens	66%	*Chroococcus*	40%
YAD169F	6/16/04	19,000	Blue greens	73%	*Chroococcus*	39%
YAD152C	7/21/04	46,000	Blue greens	72%	*Pseudanabaena*	30%
YAD156A	7/21/04	98,000	Blue greens	89%	*Pseudanabaena*	51%
YAD169A	7/21/04	49,000	Blue greens	92%	*Cylindrospermopsis & Aphanizomenon*	50% & 33%
YAD169B	7/21/04	116,000	Blue greens	94%	*Pseudanabaena & Cylindrospermopsis*	46% & 39%
YAD169F	7/21/04	102,000	Blue greens	92%	*Pseudanabaena*	48%
YAD152C	8/26/04	52,000	Blue greens	84%	*Pseudanabaena*	55%
YAD156A	8/26/04	57,000	Blue greens	91%	*Pseudanabaena*	56%
YAD169A	8/26/04	139,000	Blue greens	91%	*Dactylococcopsis & Pseudanabaena*	37% & 30%
YAD169B	8/26/04	100,000	Blue greens	90%	*Pseudanabaena & Cylindrospermopsis*	50% & 33%
YAD169F	8/26/04	86,000	Blue greens	93%	*Pseudanabaena & Cylindrospermopsis*	38% & 34%
HRL052	3/29/05	1,000	No dominant	-	No dominant	-
YAD1391A	3/29/05	1,000	Diatoms	71%	***Aulacoseira***	35%
YAD152C	3/29/05	1,000	Diatoms	95%	*Synedra*	68%
YAD169F	3/29/05	1,000	Diatoms & Greens	40% & 41%	No dominant	-
HRL052	5/10/05	17,000	Greens	41%	No dominant	-
YAD1391A	5/10/05	7,000	Greens	43%	No dominant	-
YAD152C	5/10/05	14,000	Greens	43%	No dominant	-
YAD169F	5/10/05	11,000	Greens	46%	***Ankistrodesmus***	33%
HRL052	6/15/05	42,000	Blue greens	64%	*Pseudanabaena*	33%
YAD1391A	6/15/05	7,000	Blue greens	46%	No dominant	-
YAD152C	6/15/05	17,000	Blue greens	40%	No dominant	-
YAD169F	6/15/05	25,000	Blue greens	55%	No dominant	-
HRL052	7/19/05	76,000	Blue greens	80%	No dominant	-
YAD1391A	7/19/05	6,000	Blue greens	70%	No dominant	-
YAD152C	7/19/05	77,000	Blue greens	90%	*Cylindrospermopsis & Pseudanabaena*	39% & 32%
YAD169F	7/19/05	95,000	Blue greens	92%	*Cylindrospermopsis*	42%
HRL052	9/21/05	61,000	Blue greens	78%	*Pseudanabaena & Cylindrospermopsis*	37% & 33%
YAD1391A	9/21/05	1,000	No dominant	-	No dominant	-
YAD152C	9/21/05	24,000	Blue greens	59%	***Pseudanabaena***	30%
YAD169F	9/21/05	61,000	Blue greens	74%	*Pseudanabaena*	43%
HRL052	11/30/05	19,000	No dominant	-	No dominant	-

APPENDIX C. HIGH ROCK LAKE ALGAL DENSITIES AND BIOVOLUMES 2004-2006

Station	Date Collected	Unit Density (U/ml)	Dominant Division	% Density	Dominant Genus	% Density
YAD1391A	11/30/05	1,000	Diatoms	87%	***Eunotia***	33%
YAD152C	11/30/05	4,000	No dominant	-	No dominant	-
YAD169F	11/30/05	7,000	Cryptomonads	46%	***Rhodomonas***	32%
YAD152A	1/19/06	1,000	Diatoms	44%	*Rhodomonas*	42%
HRL052	2/8/06	17,000	Cryptomonads	49%	No dominant	-
YAD152A	2/8/06	1,000	Diatoms	41%	No dominant	-
YAD152C	2/8/06	2,000	Cryptomonads	66%	***Rhodomonas***	62%
YAD1561A	2/9/06	10,000	Greens	62%	*Ankistrodesmus*	47%
YAD169E	2/9/06	14,000	Diatoms	45%	No dominant	-
YAD169F	2/9/06	5,000	Cryptomonads	41%	***Rhodomonas***	36%
HRL052	4/19/06	41,000	Prymnesiophytes	82%	*Chrysochromulina*	82%
YAD152A	4/19/06	34,000	Prymnesiophytes	58%	*Chrysochromulina*	58%
YAD152C	4/19/06	37,000	Prymnesiophytes	59%	*Chrysochromulina*	59%
YAD1561A	4/19/06	37,000	Prymnesiophytes	60%	*Chrysochromulina*	60%
YAD169E	4/19/06	33,000	Prymnesiophytes	74%	*Chrysochromulina*	74%
YAD169F	4/19/06	36,000	Prymnesiophytes	62%	*Chrysochromulina*	62%
HRL052	6/21/06	32,000	Blue greens	66%	No dominant	-
YAD152A	6/21/06	22,000	Blue greens	69%	No dominant	-
YAD152C	6/21/06	37,000	Blue greens	80%	No dominant	-
YAD1561A	6/21/06	51,000	Blue greens	68%	No dominant	-
YAD169E	6/21/06	39,000	Blue greens	64%	No dominant	-
YAD169F	6/21/06	37,000	Blue greens	82%	No dominant	-
HRL052	8/1/06	123,000	Blue greens	95%	***Pseudanabaena***	59%
YAD152A	8/1/06	90,000	Blue greens	87%	*Pseudanabaena*	63%
YAD152C	8/1/06	52,000	Blue greens	85%	*Pseudanabaena*	56%
YAD1561A	8/2/06	120,000	Blue greens	88%	*Pseudanabaena*	63%
YAD169E	8/2/06	142,000	Blue greens	95%	*Pseudanabaena & Cylindrospermopsis*	59% & 31%
YAD169F	8/2/06	115,000	Blue greens	93%	*Pseudanabaena & Cylindrospermopsis*	55% & 33%

Table C2. Phytoplankton Biovolumes (BV) and % Dominance in High Rock Lake

Station	Date Collected	Biovolume mm^3/m^3	Dominant Division	% BV	Dominant Genus	% BV
YAD156A	6/16/04	6,300	Blue greens	58%	***Chroococcus***	33%
YAD169A	6/16/04	8,100	Blue greens	61%	No dominant	-
YAD169B	6/16/04	8,400	Blue greens	59%	***Chroococcus***	40%
YAD169E	6/16/04	5,500	Blue greens	56%	No dominant	-
YAD169F	6/16/04	6,700	Blue greens	62%	***Chroococcus***	33%
YAD152C	7/21/04	7,900	Blue greens	45%	No dominant	-
YAD156A	7/21/04	13,000	Blue greens	75%	***Pseudanabaena***	45%
YAD169A	7/21/04	31,200	Blue greens	95%	*Aphanizomenon*	84%
YAD169B	7/21/04	14,400	Blue greens	78%	*Pseudanabaena & Cylindrospermopsis*	39% & 33%
YAD169F	7/21/04	13,800	Blue greens	67%	*Pseudanabaena*	32%
YAD152C	8/26/04	8,500	Blue greens	44%	*Pseudanabaena*	30%
YAD156A	8/26/04	6,400	Blue greens	75%	*Pseudanabaena*	46%
YAD169A	8/26/04	18,200	Blue greens	69%	*Anabaena*	35%
YAD169B	8/26/04	11,200	Blue greens	73%	*Cylindrospermopsis*	32%
YAD169F	8/26/04	15,900	Blue greens	89%	*Pseudanabaena*	64%
HRL052	3/29/05	900	No Dominant	-	*Gloeocystis*	30%
YAD1391A	3/29/05	600	Diatoms	59%	No dominant	-
YAD152C	3/29/05	300	Diatoms	99%	***Synedra***	86%
YAD169F	3/29/05	600	Diatoms	45%	*Aulacoseira*	33%
HRL052	5/10/05	4,600	Diatoms	48%	*Aulacoseira*	48%
YAD1391A	5/10/05	1,400	Diatoms	46%	No dominant	-
YAD152C	5/10/05	4,500	Greens	52%	***Chlamydomonas***	33%
YAD169F	5/10/05	1,900	Diatoms	52%	*Aulacoseira*	38%
HRL052	6/15/05	17,300	Blue greens	71%	*Aphanizomenon*	46%
YAD1391A	6/15/05	2,300	No Dominant	-	No dominant	-
YAD152C	6/15/05	5,100	Greens	43%	No dominant	-
YAD169F	6/15/05	11,800	Dinoflagellates	41%	***Ceratium***	32%
HRL052	7/19/05	20,300	Blue greens	58%	No dominant	-
YAD1391A	7/19/05	1,500	No Dominant	-	No dominant	-
YAD152C	7/19/05	12,300	Blue greens	74%	No dominant	-
YAD169F	7/19/05	10,200	Blue greens	73%	***Cylindrospermopsis***	41%
HRL052	9/21/05	11,400	No Dominant	-	No dominant	-
YAD1391A	9/21/05	600	Eugenoids	70%	***Phacus***	63%
YAD152C	9/21/05	7,500	No Dominant	-	No dominant	-
YAD169F	9/21/05	20,300	Blue greens	42%	No dominant	-
HRL052	11/30/05	6,500	No Dominant	-	No dominant	-
YAD1391A	11/30/05	2,400	Diatoms	73%	***Melosira***	42%
YAD152C	11/30/05	800	No Dominant	-	No dominant	-
YAD169F	11/30/05	2,100	Cryptomonads	48%	***Cryptomonas***	33%
YAD152A	1/19/06	400	Diatoms	65%	*Aulacoseira*	39%
HRL052	2/8/06	6,800	Diatoms	48%	*Centrics & Pseudanabaena*	40% & 37%
YAD152A	2/8/06	500	Diatoms	60%	No dominant	-

APPENDIX C. HIGH ROCK LAKE ALGAL DENSITIES AND BIOVOLUMES 2004-2006

Station	Date Collected	Biovolume mm^3/m^3	Dominant Division	% BV	Dominant Genus	% BV
YAD152C	2/8/06	700	No Dominant	-	***Aulacoseira***	33%
YAD1561A	2/9/06	3,100	Greens	41%	No dominant	-
YAD169E	2/9/06	6,800	Diatoms	65%	***Aulacoseira***	59%
YAD169F	2/9/06	2,600	Diatoms	57%	*Aulacoseira*	55%
HRL052	4/19/06	14,900	Prymnesiophytes	86%	*Chrysochromulina*	86%
YAD152A	4/19/06	15,900	Prymnesiophytes	49%	*Chrysochromulina*	49%
YAD152C	4/19/06	14,800	Prymnesiophytes	55%	*Chrysochromulina*	55%
YAD1561A	4/19/06	15,100	Prymnesiophytes	56%	*Chrysochromulina*	56%
YAD169E	4/19/06	11,900	Prymnesiophytes	79%	*Chrysochromulina*	79%
YAD169F	4/19/06	11,700	Prymnesiophytes	73%	*Chrysochromulina*	73%
HRL052	6/21/06	11,100	Blue greens	44%	No dominant	-
YAD152A	6/21/06	4,300	Blue greens	48%	No dominant	-
YAD152C	6/21/06	11,500	Blue greens	51%	No dominant	-
YAD1561A	6/21/06	25,100	Chromophytes	57%	***Gonyostomum***	57%
YAD169E	6/21/06	21,000	Blue greens	47%	No dominant	-
YAD169F	6/21/06	16,400	Blue greens	80%	***Aphanizomenon***	44%
HRL052	8/1/06	17,800	Blue greens	89%	*Anabaena*	30%
YAD152A	8/1/06	14,100	Blue greens	65%	*Pseudanabaena*	36%
YAD152C	8/1/06	10,000	Blue greens	68%	*Anabaena*	31%
YAD1561A	8/2/06	15,600	Blue greens	62%	***Pseudanabaena***	44%
YAD169E	8/2/06	24,100	Blue greens	73%	No dominant	-
YAD169F	8/2/06	15,100	Blue greens	61%	***Pseudanabaena***	33%