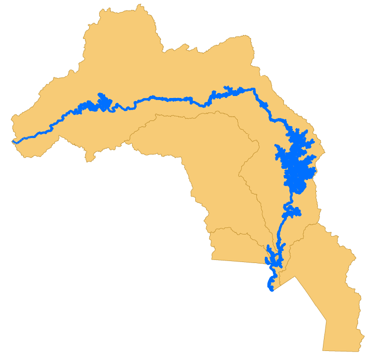
CHAPTER FOUR

Catawba River Chain of Lakes



Includes: Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake & Lake Wylie

The Catawba Chain of Lakes

One of the most prominent hydrologic features of the Catawba River basin is the series of hydropower impoundments along the river's length that are widely referred to as the Catawba Chain of Lakes (Figure 4-1). This chain-like configuration presents a unique challenge to water quality management. The outflows from upstream reservoirs, as well as inputs from the surrounding watershed and direct discharges to the lakes themselves, influence the water quality in each impoundment. Therefore, water quality issues in a particular impoundment cannot be addressed without first considering the influence of watershed conditions, upstream water quality, and releases from upstream reservoirs. Downstream impacts must also be evaluated before any management decisions are implemented.

Impacts to water quality are magnified by the presence of a reservoir. Dams significantly slow the flow of water and create conditions not present in riverine systems. These conditions increase nutrient availability and give algae more time to grow. A reservoir may suffer the symptoms of excessive nutrient and sediment inputs, while a river receiving the same level of pollutants may not. In this case, the river may be moving pollutants quickly downstream, thus, preventing localized water quality problems. Similarly, two reservoirs receiving the same pollutant load may not exhibit the same symptoms. For example, one reservoir may have many small, isolated coves with little flow that allow algae to grow for extended periods of time, while another reservoir may simply act like a wide portion of a river with a continuous exchange of water and little algal growth.

All seven of the Catawba River Chain Lakes (Catawba-Wateree Project) are owned by Duke Energy Company and were created to generate electricity. The chain lakes were completed between 1904 and 1928 with the exception of Lake Norman, which was completed in 1963. These hydro projects provided much of the electrical power base needed to drive the industrial expansion (furniture, textile, etc.) seen in the first half of the 20th century. In some ways, the prosperity enjoyed by this area of North Carolina can be linked to the presence of these dams. In addition to renewable power generation, the lakes are popular recreational areas visited millions of times per year and provide drinking water to the local population. The lakes are also contributing to a recent economic expansion as new residents seek lakefront housing and commercial developments relocate near reliable water supplies. For statistics on the lakes, see Table 4-1.

Table 4-1: Statistics on Major Lakes in the Catawba River Basin (Upstream to downstream order)

Lake	Surface Area (ac)[1]	Mean Depth (ft)[1]	Max. Depth (ft)[1]	Shore Length (mi)[1]	Retent. Time (Days)[1]	Trophic Level[2]	Elev. MSL (ft)[1]	Cumulative Watershed Area (Sq. Mi.)[1]	Local Watershed Area (Sq. Mi.)[3]
Lake James	6,510	46	118	145	208	Oligo	1194	380	380
Lake Rhodhiss	3,515	20	52	90	21	Eutro	995	1,090	710
Lake Hickory	4,100	33	85	105	33	Meso	931	1,310	220
Lookout Shoals	1,270	30	69	39	7	Eutro	835	1,449	140
Lake Norman	32,510	33	118	520	239	Oligo	760	1,790	340
Mt. Island Lake	3,234	16	52	61	12	Oligo	648	1,859	70
Lake Wylie	12,450	23	69	327	39	Eutro	569	3,020	1160

1: Data from *1995 Catawba River Basinwide Water Quality Management Plan*; 2: Data from *2008 Lake and Reservoir Assessments Catawba River Basin*
3: Local Watershed Area: watershed area from the upstream dam to the dowmstream dam of that lake.

Figure 4-1: NC Portion of the Catawba Chain of Lake

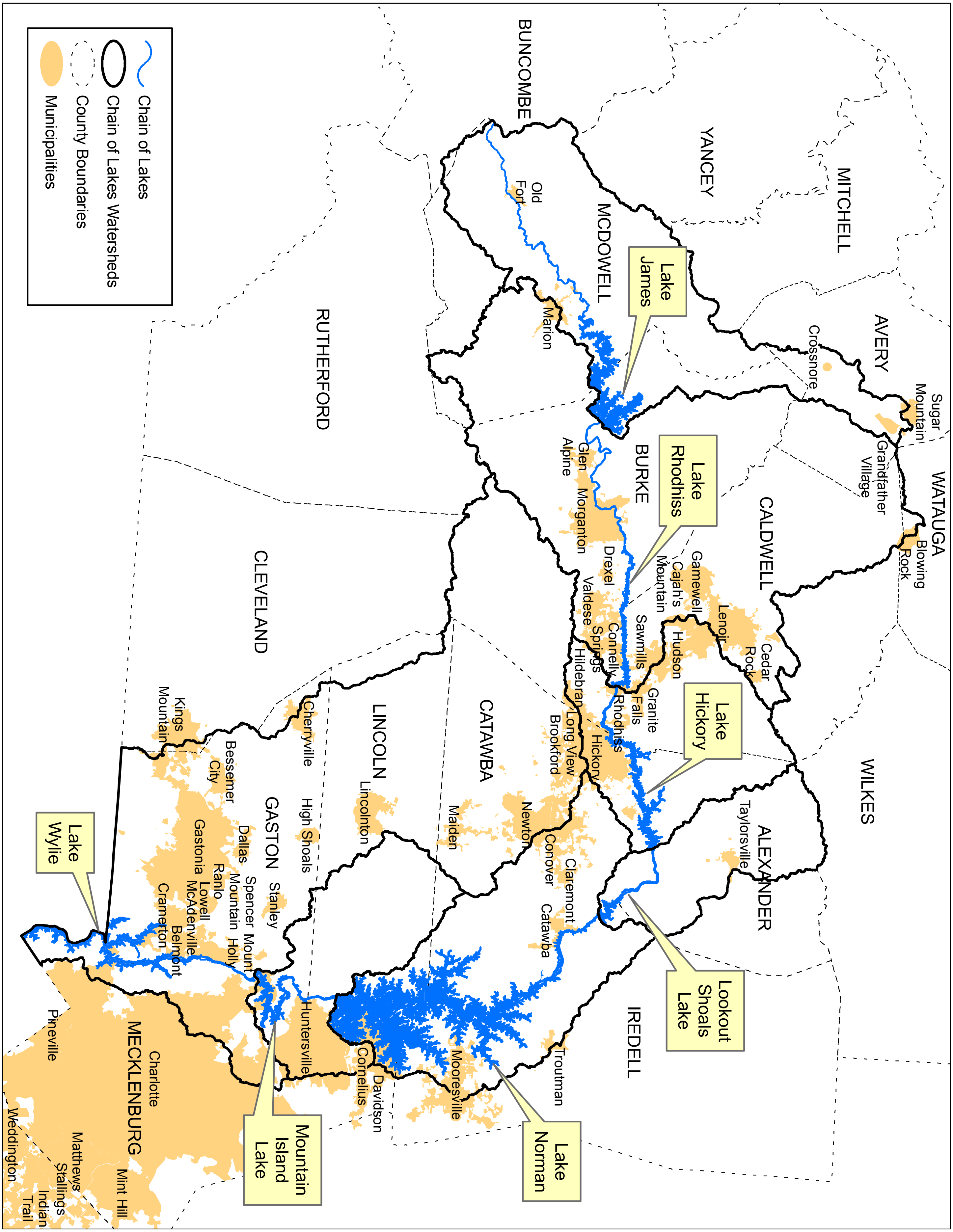


Figure 4-2: Entire Catawba Chain of Lakes

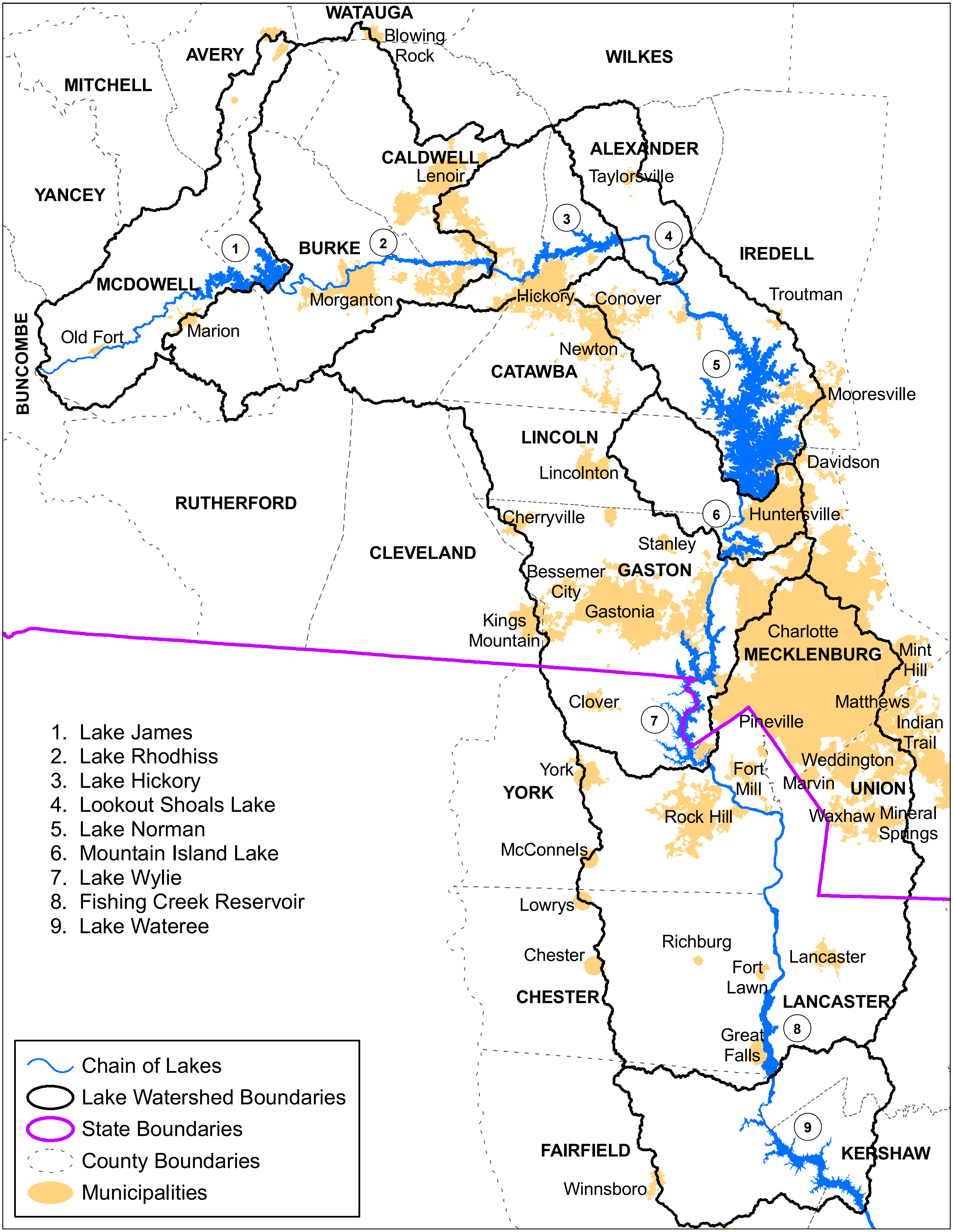


Table 4-2: Other Major Lakes Within the Catawba River Basin (Not on Catawba River)

Lake	Surface Area (Acres)	Trophic Level	Watershed Area (Sq. Mi.)	Major Uses
Lake Tahoma	161	Oligo	--	Rec (was Hydro)
Little River Dam	162	Eutro	25	Rec (was Hydro)
Bessemer City	15	Meso	0.4	WS
Newton City Lake	17	Oligo	--	WS

Off the mainstem of the Catawba River, there are four other lakes (greater than 14 acres) that have been sampled by DWQ in the past (Table 4-2) which include Little River Dam Lake, Lake Tahoma, Maiden Lake, Bessemer City Lake and Newton City Lake. Little River Dam is no longer used for hydropower purposes but has become a local fishing spot. It is located on a tributary to Lake Hickory. Lake Tahoma, located on Buck Creek, a tributary to the Catawba River upstream from Lake James, was originally created in the 1920s for hydropower purposes. It is now a recreational lake owned by Lake Tahoma Inc., a corporation of property owners living around the lake. The last three lakes are small water supply reservoirs that serve the municipalities of Maiden, Bessemer City and Newton.

General Information & Water Quality by Lake

Five lakes (James, Rhodhiss, Hickory, Norman and Wylie) were sampled by DWQ-ESS in 2007 as per the regular five year lake sampling cycle. The entire chain is located within the 03050101 Catawba River Headwater 8-digit HUC watershed. Each of the lakes hold a water supply designation of WS-IV and/or WS-V and have a secondary classification of B (primary recreation). Table 4-3 summarizes the data collected between April - September of 2007. The following section discusses each lake's water quality. Data were reported by DWQ-ESS in the *Catawba Lake and Reservoir Assessment* document.

Table 4-3: Chain of Lakes Description & Parameters of Concern from 2007 Data Summarized by Lake

Lake	AU#	Description	Classification	Parameters of Concern[1]
Lake James	11-(23)	From North Fork Catawba River to Bridgewater Dam	WS-V, B	None
Lake Rhodhiss	11-(37)	From Johns River to Rhodhiss Dam	WS-IV, B; CA	Chlorophyll *a*, **High pH**, TP, TN
Lake Hickory	11-(53)	From U.S. Highway 321 Bridge to N.C. Hwy. 127	WS-IV, B; CA	High Temperature
	11-(59.9)	From N.C. Hwy. 127 to Oxford Dam	WS-V, B	Chlorophyll *a*
Lake Norman	11-(75)	From Lyle Creek to Cowan's Ford Dam	WS-IV, B; CA	None
Lake Wylie	11-(117)	From Mountain Island Dam to Interstate Highway 85 Bridge at Belmont	WS-IV; CA	**Low pH**, Low DO
	11-(122)	From I-85 bridge to the upstream side of Paw Creek Arm of Lake Wylie, Catawba River	WS-IV, B; CA	Copper, Turbidity
	11-(123.5)a	From the upstream side of Paw Creek Arm of Lake Wylie to North Carolina-South Carolina State Line	WS-V, B	pH, Turbidity, Chlorophyll *a*
	11-(123.5)b	South Fork Catawba River Arm of Lake Wylie	WS-V, B	**Copper**, Turbidity, **High Temperature**

[1] Parameters of Concern: Physical or chemical data collected at lake monitoring sites which have elevated values. Parameters in **bold** indicate an impairment.

Understanding This Section

Use Support & Monitoring Box:

Figure 4-3: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (1,849 ac)	
AU #	11-(37)
2010 IR Cat.	5
Lake Stations*	2007
(CTB034A)	High pH - 11% Chlorophyll a - 11%
*Stations in **bold** were sampled less than ten times.	

To reduce confusion and provide a quick reference, each lake discussed below has a corresponding Use Support and Monitoring Box (Figure 4-3). The top row indicates the Draft 2010 Use Support and the area of that lake. The second row displays the assessment number(s), as described below, to the corresponding data listed in that table, and the third row indicate the Integrated Report category which further defines the Draft 2010 Use Support. These first three rows are consistent for all boxes in this Chapter. The rows following are based on what type of monitoring stations are found on that lake and mostly include lake station monitoring data. The first of these rows indicated the type of data whether it's a lake or ambient monitoring station and the year the data was collected. The rows below list the station ID in parenthesis (e.g., CTB034A) and the station's data to the right. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter. Stations listed in **bold** were sampled less than ten times during this sampling cycle and were not used for use support assessment.

Assessment Unit Numbers [AU#]:

Each waterbody throughout the state is given one or more assessment unit (AU) number(s). These identification numbers are assigned to a particular waterbody or portion of a waterbody for many reasons. One of those reasons is to reduce confusion when different waters have the same name. For example, there are five different streams in different parts of the Catawba River Basin named Big Branch. Another reason is to identify a particular segment of a stream or lake. A longer stream or lake may be split into multiple segments to provide more accurate assessments, classifications and reporting of a particular portion of that waterbody.

These AU numbers are indicated in the second row of each *Use Support and Monitoring Box* and are often displayed in [brackets]. If multiple segments of a lake are included in the box, each AU# will be listed. To reduce space, some AU numbers may be abbreviated. For example, the North Fork Catawba River is split into four segments, 11-24-(1), 11-24-(2.5)a, 11-24-(2.5)b, and 11-24-(13). This is then abbreviated to 11-24-(1), (2.5)a, (2.5)b & (13) where the common numbers are removed from the first part of the AU.

DWQ Lake Sampling & Assessment:

DWQ's Intensive Survey Unit samples lakes in each basin ever five years. Regular sampling events include physical (temperature, pH, dissolved oxygen, conductivity and secchi depth) and chemical (total phosphorus, total nitrogen, TKN, chlorophyll *a* and turbidity) parameters. Ten sampling events are needed at each station in a lake for use support assessment. In the case ten events are not collected, the data will not be used for use support purposes but can provide insight on current conditions within the lake. Stations listed in the *Use Support and Monitoring Box* in **bold** indicate those sampled less than ten times during this sampling cycle.

The methodology and procedures used by the Intensive Survey Unit to monitor lakes is explained in the *Standard Operating Procedures*.

Lake James

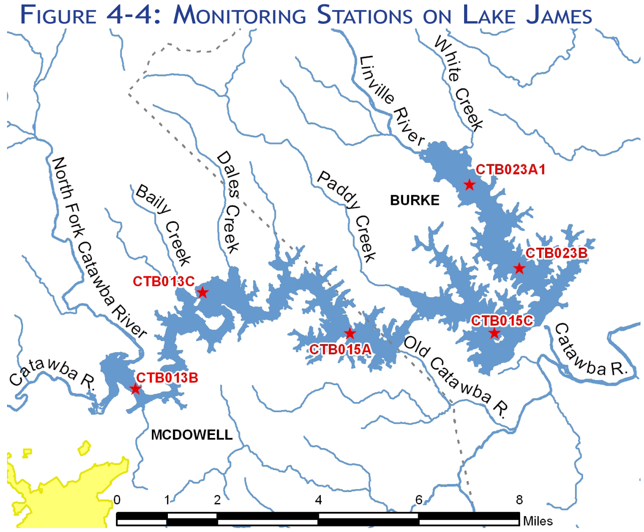
Formed by the impoundment of the Catawba River and the Linville River create Lake James, which is the most upstream reservoir in the Catawba Chain of Lakes and is operated by Duke Energy. The Catawba, the North Fork of the Catawba, and the Linville Rivers are the lake's major tributaries. The lake is used to generate electricity at the Bridgewater Hydroelectric Plant; public recreation is a secondary use.

Use Support: Supporting (5,810 ac)	
AU #	11-(23)
2010 IR Cat.	2
Lake Stations	2007
(CTB013B)	High Temp - 27%
(CTB013C)	No Exceedances
(CTB015A)	High Temp - 17%
(CTB015C)	High Temp - 11%
(CTB023A1)	High Temp - 18%
(CTB023B)	High Temp - 10%

Water Quality Assessment

The Catawba and Linville River portions of Lake James are joined by a small canal located at the Highway 126 Bridge. Water from the Catawba River portion of the lake flows through this canal into the Linville River portion. Due to the shallowness of the channel, warm, oxygenated surface water from the Catawba River portion flows into the Linville River section during the summer months, and the colder, less oxygenated water becomes trapped in the Catawba River side.

Figure 4-4: Monitoring Stations on Lake James



Lake James has undergone rapid shoreline development since last evaluated in 2002. In 1997, the shoreline was mostly forested but ten years later in 2007, the shoreline was 50% to 75% developed for residential use and is still being developed.

The water clarity during the 2007 sampling period was clearest right before the water left the lake near the reservoir dam. Decreased water clarity was noted at the first sampling station (CTB013B) of the Catawba arm (Figure 4-4). This is similar to what has been sampled in past cycles. Turbidity levels were well under the State's standard of 50 NTU. Low turbidity and high water clarity suggests the lake is acting as a catchment basin by slowing the flow enough to allow sediment and other materials to settle out of the water column before exiting the lake over the dam.

Temperature values were elevated due to high air temperatures during the summer months and severe drought. Even though all but one station exceeded the temperature standard, the lake will not be impaired for high temperature due to the severe drought in 2007 and result values were less than two degrees over the standard. The high water temperatures; therefore, extremely likely due to natural conditions.

On the Catawba River side of the lake, TKN (total Kjeldahl nitrogen) and TP (total phosphorus) levels were elevated as compared to previous years. TP levels measured were high for a mountain region lake. Nitrite and nitrate levels ranged from elevated to extremely elevated from April to June then decreased to normal levels by late July. In general, nutrient concentrations were greater in the Catawba River portion of the reservoir as compared to the Linville River portion. The lake was determined to be oligotrophic (low biological productivity) in 2007.

Even though excellent water clarity and elevated nutrients levels are favorable for algal growth, Lake James did not have nutrient levels sufficient to potentially produce nuisance algal blooms (Algal Growth Potential Test, 2007). However, a slight increase in algal growth did contribute to slightly higher chlorophyll *a* values. The State's standard for chlorophyll *a* is not to exceed 40 µg/L. Most stations recorded levels below 10 µg/L except for the most upstream station of the Catawba River arm (CTB013B) which consistently measured between 15 and 20 µg/L. Two other stations measured above 10 µg/L during the April sample (CTB013C & CTB015A). The Catawba River side of the lake may show more algal activity due to nutrient loading and reduced flow.

An Algal Growth Potential Test was conducted on samples from Lake James. This test is used to identify which, if any, nutrient might be limiting algal growth. The limiting nutrient (phosphorus or nitrogen) is the one that is used up first in the system decreasing continued growth of algae. The results of this test indicated that the lower portion of the Catawba River side was phosphorus limited and the lower portion of the Linville River side was nitrogen limited. However, the upper portion of the Linville River side was co-limited for nitrogen and phosphorus. Therefore, if a nutrient management strategy were developed for Lake James, some combination of nitrogen and phosphorus would probably be considered.

Point & Nonpoint Source Loading

Nonpoint Source Loading

Land use north of Lake James watershed consist mostly of forested land (Pisgah National Forest); however, south of Lake James the land use also includes agricultural and developed areas. Nutrients and sediment from these land uses have the most potential to cause water quality issues to Lake James. Nutrient loading from agricultural practices originate from the amount and timing of fertilizer application, livestock access to streams and general stormwater runoff from the land. Sediment from nonpoint sources in the Lake James watershed include agricultural practices, land development and other land disturbing activities. Implementation of agricultural and land development best management practices (BMPs) could help prevent large portions of these nutrients and sediment from reaching the streams and the lake. Runoff from lake front properties could also be impacting the water quality. It is suggested that local governments educate property owners and ensure implementation of the 50 foot buffers around the lake. Additional buffer information can be found in the *Buffers Chapter*.

Point Source Loading

There are 13 NPDES Discharger Permits within the Lake James watershed (Table 4-4). The City of Marion's Catawba River WWTP (NC0071200) is located about three and a half miles upstream of Lake James, discharges directly into the Catawba River, and has had difficulty meeting its permit requirements during 2004 through 2008. The monitoring station downstream of this facility, on average, had the highest measured levels of turbidity, suggesting that the Marion WWTP may contribute to the turbidity in the upper Catawba River arm of Lake James. The facility was granted a Special Order of Consent (SOC) to allow the city time to make necessary upgrades that would bring the facility back into compliance. However, after an extension of the SOC, the City came to the conclusion to shut the facility down and divert influent flow to the City's Corpening Creek WWTP (NC0031879) which was also recently under SOC. The City of Marion will be requesting Rescission of NPDES Permit NC0071200 in May 2010. For more information on these facility, see *Chapter 1 -* North Muddy Creek (030501010601).

Table 4-4: NPDES Discharger Permits within Lake James Watersheds

Facility	Permit #	Major/Minor; Permitted Flow (MGD)	12-Digit HUC #	Receiving Stream
Coats American-Sevier Plant	NC0004243	Major; 2.0	030501010202	North Fork Catawba River
Old Fort WWTP	NC0021229	Major; 1.2	030501010101	Curtis Creek
Linville Land Harbor WWTP	NC0022756	Minor; 0.225	030501010301	Linville River
GGCC Utility WWTP	NC0023124	Minor; 0.07	030501010301	Linville River
Crossnore WWTP	NC0026654	Minor; 0.07	030501010301	Mill Timber Creek
Linville Resorts WWTP	NC0039446	Minor; 0.15	030501010301	Linville River
Corpening Forestry Training Center	NC0040339	Minor; 0.018	030501010301	Linville River
Jonas Ridge Adult Care Facility	NC0060224	Minor; 0.0075	030501010301	Camp Creek
Linville Ridge Country Club WWTP	NC0062413	Minor; 0.015	030501010301	Trib. to W. Fk Linville River
The Switzerland Inn	NC0030996	Minor; 0.01	030501010201	Buchanan Creek
City of Marion Catawba R WWTP	NC0071200	Minor; 0.25	030501010106	Catawba River
Blue Ridge Country Club WWTP	NC0080098	Minor; 0.202	030501010202	North Fork Catawba River

Figure 4-5: Exposed lake bed at upper end of Lake James

*Picture from Catawba RiverKeeper

Drought

Lake James was greatly impacted by the drought in 2007. By early October 2007, many areas of the lake were exposed as the water levels dropped by nine feet from normal full pool levels (Figure 4-5. Despite the drought that occurred during the monitoring period, the biological productivity, as indicated by algal density, had not significantly changed since the last cycle. However, the combination of low water levels and high air temperature caused water temperature exceedances in late summer at four out of the six lake monitoring stations as mentioned earlier. The lake will not be on the Impaired Waters list for these exceedances as the high temperatures and drought are considered natural causes. For more information on how high water temperatures can effect aquatic life, see Chapter 3, Section 3.3.6 of the *Supplemental Guide to North Carolina's Basinwide Planning.*

Aquatic Weed Infestation

Duke Energy discovered the nuisance aquatic plant, Hydrilla, in the Catawba River arm in 1999. This plant has the potential of spreading rapidly throughout the lake, reducing available boating and swimming areas, and decreasing the lake's aesthetic appearance. In 2002, 21,500 sterile grass carp were stocked by the NC Wildlife Resources Commission to control the spread of Hydrilla. During this sampling cycle, there were no observations of Hydrilla in the lake. However, the lack of reported observations should not be interpreted as an indication that this aquatic weed has been eradicated from the lake.

Recommendations for Lake James

Buffers

Due to the recent development pressures seen around the lake, local governments should work together to educate and ensure implementation of the Catawba River mainstem 50-foot riparian buffer rules adopted by the EMC in August of 2004. DWQ will also work with the Western Piedmont Council of Government (WPCOG) to find educational opportunities to assist in this effort. For more information about the Catawba River Buffer rules, see the *Buffers Chapter*.

Monitoring

During the next sampling cycle DWQ's Intensive Survey Unit will try to sample the six lake stations, at minimum, five times (monthly May - September). As resources become available, the six lake stations should be sampled and include all regularly sampled parameters ten or more times. This would assist in having a range of data to better assess for nutrients and other parameters that could impact aquatic health within Lake James.

Local Initiatives

The Lake James Environmental Association joined the efforts of the Environmental Quality Institute/University of North Carolina at Asheville to begin monitoring the lake in 2001. Through this Volunteer Water Information Network (VWIN), 13 sites in and around Lake James were sampled for pH, alkalinity, turbidity, TSS, conductivity, copper, lead, zinc, ortho P, ammonia-N and nitrate-N. For more information about the VWIN program, visit the *VWIN website*.

Lake Rhodhiss, Hickory & Lookout Shoals

Lakes Rhodhiss, Hickory and Lookout Shoals are perhaps the most closely linked in the lake chain and exhibit some of the most significant water quality trends in the basin. These are the first impoundments below the forested Blue Ridge and are heavily influenced by the urbanized corridor along Interstate 40. Although these lakes are relatively small in volume, compared to Lake James (upstream) and Lake Norman (downstream), the land area draining to them is large. In effect, most of the pollution generated by the urban centers (Morganton, Hickory, Lenoir, etc.) and agricultural operations makes its way to these reservoirs. The current result of this runoff is elevated inputs of nutrients and sediment. Each impoundment's response to this load is different and is discussed individually below.

DWQ advocates a broad scale locally-driven management strategy be developed for these lakes collectively. At a minimum, this strategy should build upon the local efforts recently developed for Lake Rhodhiss discussed below and facilitate regional cooperation among local stakeholders.

Lake Rhodhiss

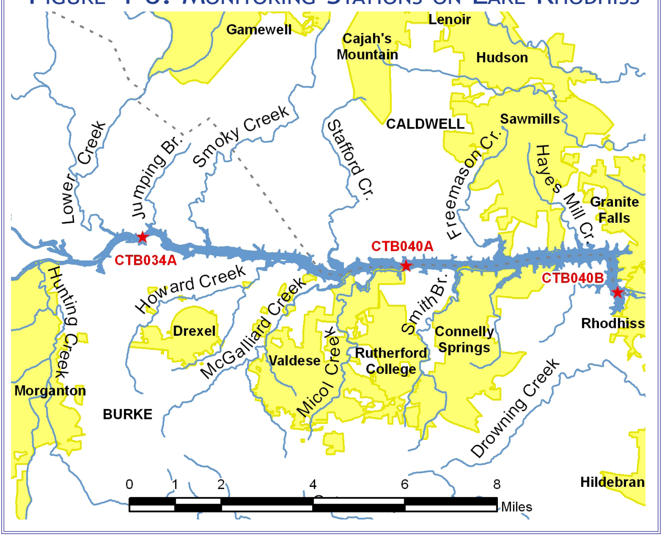
Use Support: Impaired (1,849 ac)	
AU #	11-(37)
2010 IR Cat.	5
Lake Stations*	2007
(CTB034A)	High pH - 11% Chlorophyll a - 11%
(CTB040A)	High pH - 11%
(CTB040B)	High pH - 22%

*Stations in **bold** were sampled less than ten times during this sampling cycle.

Lake Rhodhiss is a run-of-the-river reservoir located on the Catawba River downstream of Lake James and upstream of Lake Hickory and has the largest drainage area (710 square miles) of all seven lakes. The 10-digit watersheds (HUCs 0305010104, 0305010105, 0305010106, 0305010107 and most of 0305010108) which drain to the lake are mostly forested in the upper headwaters and transition to urban and agricultural lands closer to the lake. Three major roads (US-321, US-70 and US-64) encompass the lake and drive much of the development in this area. There are 14 municipalities surrounding the lake along these corridors including Morganton, Lenoir, Gamewell, Sawmills, Drexel, Rhodhiss and Valdese. Along with the impacts from these land uses, there are also 11 minor and four major NPDES dischargers within these watersheds. Two of the major facilities (City of Morganton's WWTP and the Town of Valdese Lake Rhodhiss WWTP) discharge directly into the lake. These factors as well as the close relationship to downstream lakes make the health of Lake Rhodhiss significant to the health and water quality of the Chain of Lakes. By protecting the headwater lakes, such as Lake Rhodhiss, the accumulative impacts downstream can be minimized.

As seen in Figure 4-6, there are seven major streams which flow into the headwaters of the lake and include Lower Creek, Johns Creek, Warrior Fork, Canoe Creek, Catawba River, Silver Creek and Hunting Creek. Of these seven waterbodies, two appear on the 2008 Impaired Waters list (Lower & Hunting Creeks) along with seven other smaller streams within the lake's watersheds. Most of these impairments are due to poor biological integrity; however, some impairments are due to low pH and turbidity standard exceedances. Three Ambient Monitoring System (AMS) stations are located in the watershed on Wilson Creek, Lower Creek and the Catawba River. For more details about these sites, see *Chapter 1 - Catawba River Headwaters Subbasin*.

Figure 4-6: Monitoring Stations on Lake Rhodhiss



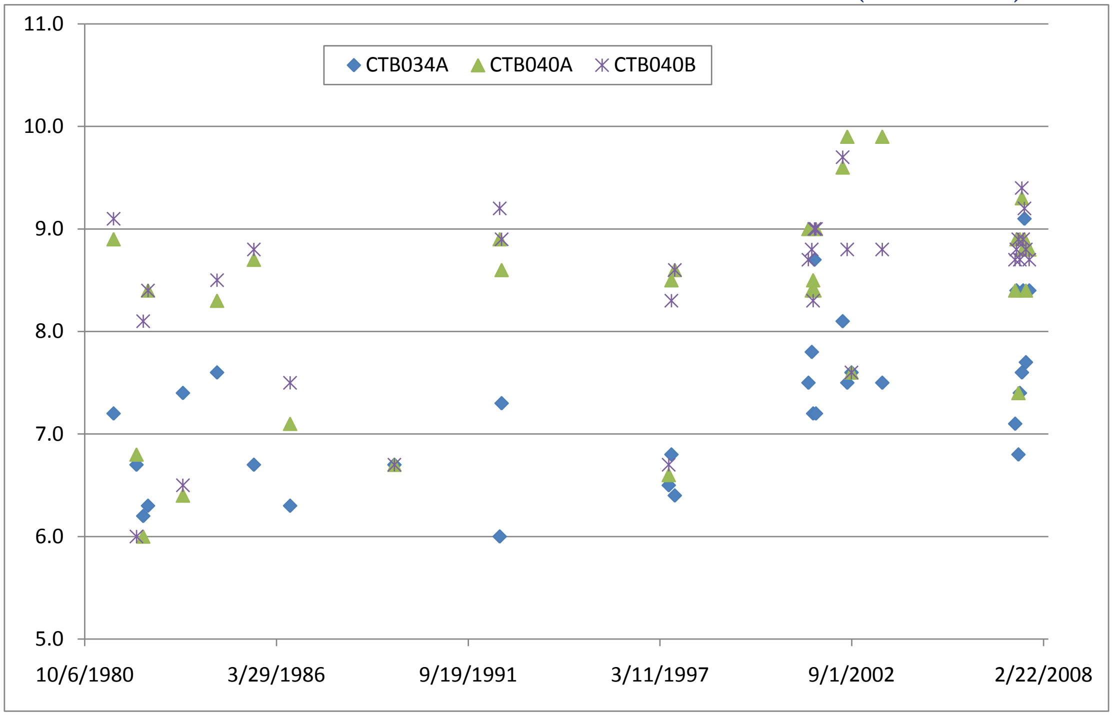
Water Quality Assessment

Lake Rhodhiss was first placed on the Impaired Waters list in 2006 for high pH based on data collected in 2002. During the 2007 monitoring cycle, the Intensive Survey Unit, within the Environmental Science Section (ESS) of DWQ, sampled the three ambient station in Lake Rhodhiss (CTB034A, CTB040A & CTB40B) (See Figure 4-6) nine times. Data from 2007 continue to support impairment due to exceedances of the pH standard and will remain on the 2010 Impaired Waters Report.

During this cycle, all three sites had elevated pH levels in more than 10% of the nine samples and one site (CTB034A) showed elevated chlorophyll *a* levels in September (70 µg/l). Conclusions which are consistent with previous monitoring cycles as well as current data collected from agencies or watershed groups outside of DWQ indicated that the lake was eutrophic (exhibited elevated biological productivity) during the summer sampling months of 2007.

In 2007, four out of the 27 total surface samples had pH values greater than the state standard of 9.0 su. Another ten surface samples were elevated above 8.7 su but did not exceed the state standard. This is not unlike what was observed during the 2002 sampling. Ambient stations located within the Lake Rhodhiss watershed and upstream of the lake stations, measured pH levels around 6.7 to 6.9 su; however, conditions in streams are not the same as those found in a lake due to water flow rates, water temperature, algal activity and loading rates. Figure 4-7 displays all pH samples for each of the three lake stations between 1981 and 2007. In the early 1980's, Lake Rhodhiss had a median pH of 7.0 su, which has increased over time. The median pH of samples taken in 2007 was 8.7 su.

Figure 4-7: pH History of the Three Lake Stations in Lake Rhodhiss (1982-2007)



Chlorophyll *a*, an indicator of algal productivity, was the only other parameter sampled that exceeded the state standard of 40 µg/l. A sample taken in September of 2007 (CTB34A) resulted in a value of 70 µg/l which was associated with a blue green algae bloom. Even though the state standard for chlorophyll *a* is set at 40 µg/l statewide, levels over 25 µg/l are considered elevated for mountain and upper piedmont regions lakes like Lake Rhodhiss. Twelve out of the 27 total samples were at or near 25 µg/l, indicating algal productivity. Algal blooms were observed during the sampling cycle at the upper end of the reservoir as well as near the dam.

During the previous sampling cycle in 2001 and 2002, reports of taste and odor problems in drinking water processed from the lake resulted in an in-depth special study at that time to investigate the extent and nature of the algal blooms which were causing the problems. Results of that special study found the existence of 15 well-established algae clusters or communities.

Analysis of data collected from lake monitoring efforts during the 2007 assessment indicated that excess nutrients and slow retention times contributed to blue-green algae blooms that occurred near the dam from mid-June through September. Based on an Algal Growth Potential Test conducted in 2007, Lake Rhodhiss was determined to be co-limited for nitrogen and phosphorus (i.e., neither nutrient, by itself, limited the growth of algae). *Cylindrospermopsis sp*, a blue-green alga associated with nutrient-rich water, was the dominate alga in the 2007 summer blooms. As seen in 2002, drought conditions in 2007 increased the retention time (amount of time that water traveled through the reservoir) allowing additional time for the nutrients from point and nonpoint source runoff to be utilized by the algae. As long as these conditions continue to reoccur, algae will remain an issue for Lake Rhodhiss.

Taste and odor problems in drinking water processed from the lake were being reported again in May 2010 to the public utility companies. The source of the taste and odor problems from these reports are not known at this time.

Point & Nonpoint Source Nutrient Loading

In July 2009, the Western Piedmont Council of Governments (WPCOG), published the results of a *Phosphorus and Nitrogen Loading and Export* study of Lake Rhodhiss (conducted by Carolina Land & Lakes RC&D, Inc.) to help better understand the origin of the nutrients within the watershed. This study was one of the first steps toward the development of a *Lake Rhodhiss Watershed Management Plan*, further discussed below. The study estimated nutrient and sediment loads from point and nonpoint sources for the Lake Rhodhiss watersheds. Please note that this study was conducted during a time of drought; therefore, nonpoint source estimates may typically be higher than the study shows.

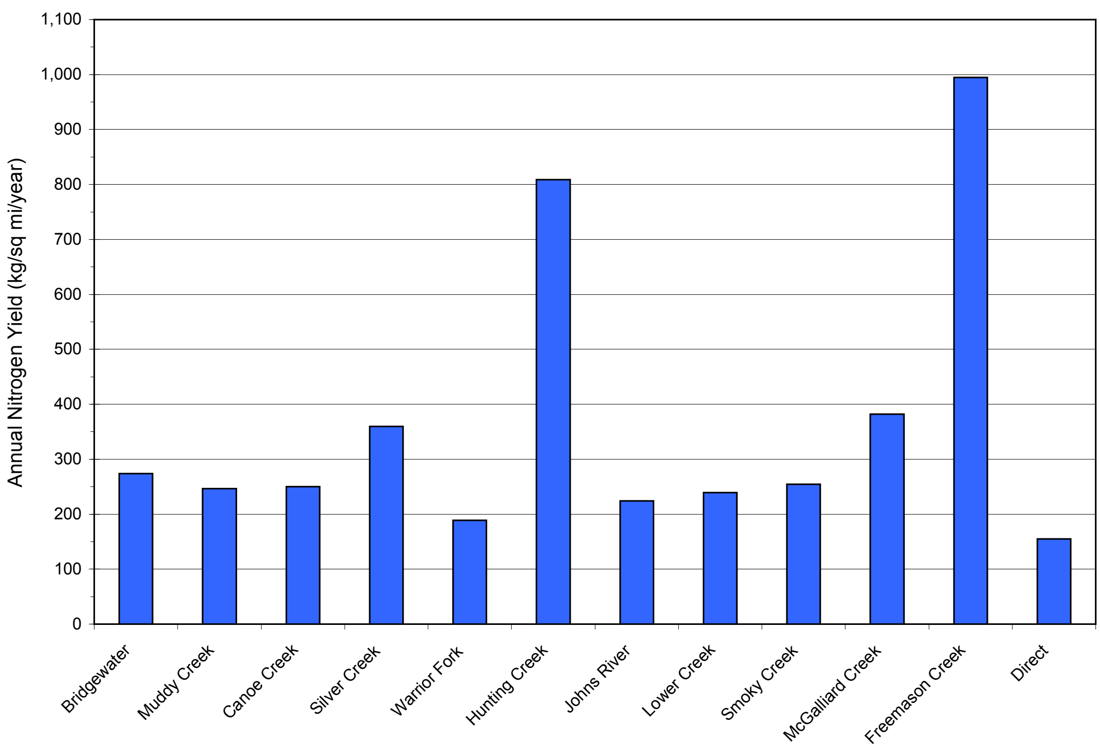
Nonpoint Source Loading

Figure 4-8 and Figure 4-9 show the nitrogen and phosphorus loadings from nonpoint sources for each watershed. These figures are based on information collected by Carolina Land & Lakes RC&D, Inc. between April 2007 and May 2008. Nutrient loads from point sources are not included in these graphs. The annual nitrogen and phosphorus yields are calculated by kilogram per square mile per year which eliminates the watershed size variable and provides a more accurate comparison of the watersheds.

As seen in Figure 4-8, the Hunting Creek and Freemason Creek watersheds produced the highest levels of nitrogen. The Hunting Creek watershed runs through the City of Morganton and is roughly 50 to 60% developed. Freemason Creek watershed; however, is mostly agricultural. In Figure 4-9, four watersheds appear to produce a higher phosphorus yield than other watersheds (Silver, Hunting, Lower Creeks and Johns River watersheds). Silver Creek watershed is mixed land use of developed and agricultural land with little forested area compared to the other three watersheds. The majority of Johns River watershed drains large tracks of forested land; however, about 12 miles upstream of the lake some agricultural lands line the river. The headwaters in the Lower Creek watershed flow through the City of Lenoir and the Town of Gamewell then flow through large agricultural lands further downstream. Construction and fertilizing activities which are likely sources of excess nutrient loading, are prominent in all five of these watershed. On these graphs, Bridgewater (the first bar) is referring to the last dam on Lake James.

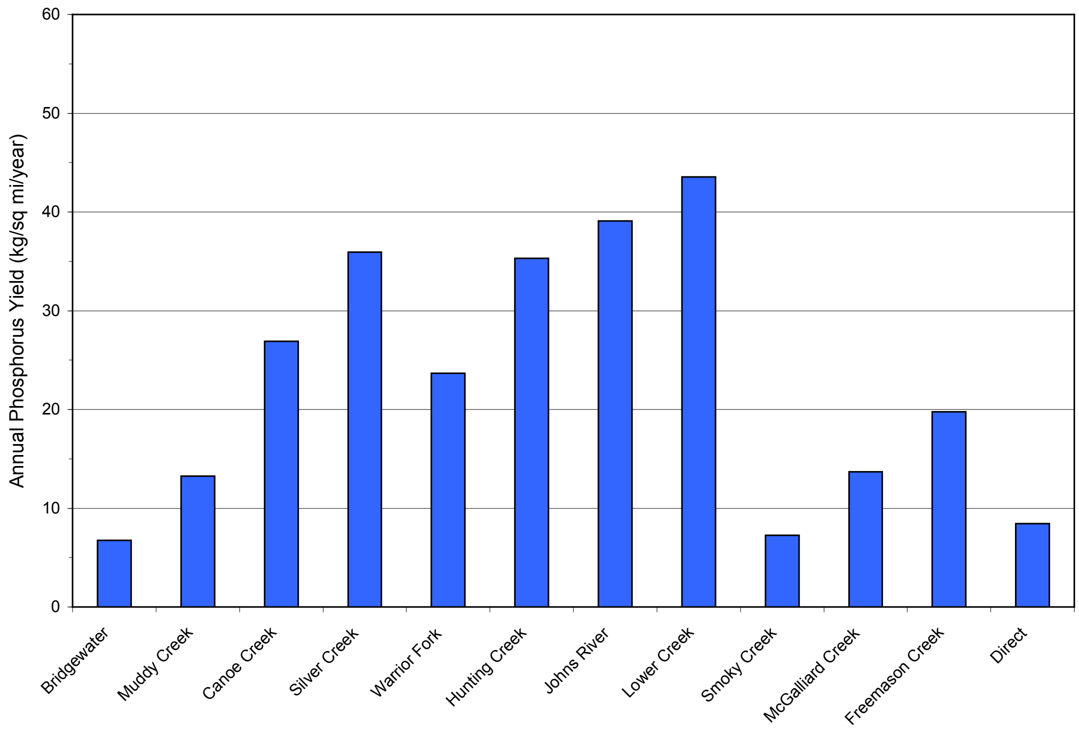
It was determined that total loading could not be linked to generalized land use patterns; however, activities such as construction and fertilizing agricultural and residential lands play a significant role. The study showed that the majority of phosphorus entering the streams is attached to suspended sediment that is being washed off the land.

Figure 4-8: Annual Nonpoint Source Nitrogen Yield by Watershed*



***Source**: Carolina Land & Lakes RC&D, Inc., *Phosphorus and Nitrogen Loading and Export From Rhodhiss Lake, North Carolina*

Figure 4-9: Annual Nonpoint Source Phosphorus Yield by Watershed*



Source: Carolina Land & Lakes RC&D, Inc., *Phosphorus and Nitrogen Loading and Export From Rhodhiss Lake, North Carolina*

Point Source Loading

There are four major NPDES Dischargers releasing effluent within these watersheds. The locations of these facilities are shown on the Permits map in *Chapter 11*. The City of Marion's WWTP (NC0031879) is the most upstream facility and is permitted to releases 3 MGD to Youngs Fork (Corpening Creek). The City of Lenoir's WWTP (NC0023981) is permitted to release 6 MGD of effluent to Lower Creek. The City of Morganton WWTP (NC0026573) and the Town of Valdese's WWTP (NC0041696) release directly into Lake Rhodhiss and are permitted for 13 MGD and 10.5 MGD, respectively.

Table 4-5: Annual Point Source Loading from WWTPs in Lake Rhodhiss*

Facility	TN (metric tons/yr)	TP (metric tons/yr)
Morganton WWTP	142.21	20.03
Valdese WWTP	23.23	10.27
Lenoir WWTP	18.76	4.08
Marion WWTP	7.39	1.65
Total	**191.59**	**36.04**

Source: Carolina Land & Lakes RC&D, Inc., *Phosphorus and Nitrogen Loading and Export From Rhodhiss Lake, North Carolina*

Nutrient loads within the effluent of both Marion and Lenoir's WWTPs are greatly reduced due to organic uptake, settling of sediment and the distance of the dischargers from the lake. Table 4-5 shows the nutrient loads within the effluent being released from each facility. It is clear that Morganton and Valdese have the largest input of both phosphorus and nitrogen in to the lake. The reduction of nutrients for these two facilities is especially critical to the overall loading because both facilities discharge directly into the lake. For additional information on how the loads for each facility was calculated, see the Carolina Land & Lakes RC&D, Inc., *Phosphorus and Nitrogen Loading and Export* document on the WPCOG website.

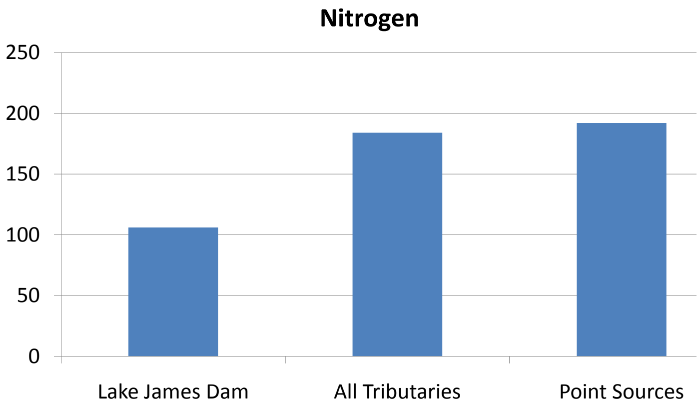
Table 4-6: NPDES Discharger Permits within Lake Rhodhiss' Watersheds

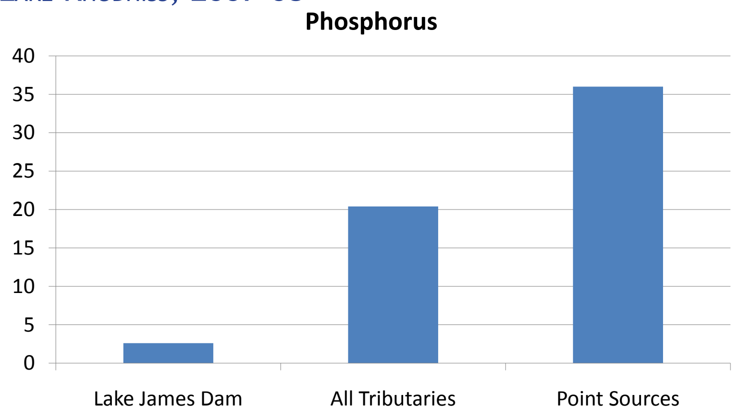
Facility	Permit #	Major/Minor; Permitted Flow (MGD)	12-Digit HUC #	Receiving Stream
Lenoir Lower Creek WWTP	NC0023981	Major; 6.0	030501010702	Lower Creek
Morganton Catawba R. Pollution Control Facility	NC0026573	Major; 13.0	030501010608	Catawba River
Valdese Lake Rhodhiss WWTP	NC0041696	Major; 10.5	030501010801	Lake Rhodhiss
Marion Corpening Creek WWTP	NC0031879	Major; 3.0	030501010607	Corpening Creek
Collettsville Elementary School	NC0050075	Minor; 0.01	030501010505	Johns River
Sugar Hill Truck Stop	NC0029831	Minor; 0.005	030501010601	North Fork Muddy Creek
Ceadarbrook Residential Center	NC0035157	Minor; 0.003	030501010602	Long Branch
Days Inn - Marion	NC0040291	Minor; 0.02	030501010601	Hicks Branch
Jonas Ridge Adult Care Facility	NC0060224	Minor; 0.0075	030501010401	Cranberry Creek
Nebo Elementary School WWTP	NC0067148	Minor; 0.0075	030501010607	Shadrick Creek
McDowell Assisted Living WWTP	NC0075353	Minor; 0.01	030501010601	North Fork Muddy Creek
Harmony Estates WWTP	NC0079481	Minor; 0.04	030501010603	North Fork Muddy Creek
Baton Elementary School	NC0030783	Minor; 0.015	030501010801	Stafford Creek
NC Outward Bound School	NC0040754	Minor; 0.0075	030501010402	Roses Creek
Cedar Rock Country Clud	NC0043231	Minor; 0.009	030501010701	Tributary to Lower Cr.

Point vs. Nonpoint Source Loading

As seen in Figure 4-8, nitrogen loading from upstream (Bridgewater/Lake James Dam) accounts for about 20% of total nitrogen loading. Point and nonpoint sources about equally account for the remainder of the total nitrogen load. Phosphorus loading was dominated by the WWTP facilities within the watershed, accounting for 61% in which 85% was released from Morganton and Valdese. The remaining 39% of phosphorus was coming from nonpoint sources within the lake's watersheds, mainly Lower Creek. Conclusions from the study noted that majority of nonpoint source phosphorus was being carried by sediment washed off the land during rainstorm events. Of the nutrient and sediment loads entering the lake, 12% of sediment, 35% of nitrogen and 38% of phosphorus was retained by the lake. Most of the nutrients retained by the lake were likely utilized by algae or other biological organic matter or attached to sediment particles and settled before reaching the dam (Knight, 2009).

Figure 4-10: Nutrient Budget in Metric Ton/Year for Lake Rhodhiss, 2007-08*





*** Source**: Carolina Land & Lakes RC&D, Inc., *Phosphorus and Nitrogen Loading and Export From Rhodhiss Lake, North Carolina*

* Data used for these graphs and data analysis for the Lake Rhodhiss Point & Nonpoint Source Nutrient Loading Section are summaries of information found in the Phosphorus and Nitrogen Loading and Export study conducted by Carolina Land & Lakes RC&D, Inc. DWQ's current and historical data as well as other watershed studies are congruent with much of the findings presented in this study.

Drought

The 2007 drought may have had an impact on Lake Rhodhiss; however, not to the magnitude of other lakes within the chain. The drought would have had the most impact on the lake through slowed retention time. Even though less nutrients and sediment were washed off the land via rainfall, the nutrients that did make it to the lake were present for a longer period of time, providing a greater chance of being utilized by algae. The lake was last monitored in 2002 which was also a drought year. The elevated nutrient levels during this monitoring cycle could be due to an increased intensity and duration of the drought but could also be due to increased loading. Further study is needed before that conclusion could be determined.

Lake Rhodhiss Nutrient Management Action Plan

Due to the high pH impairment of the lake, a Lake Rhodhiss Nutrient Management Action Plan was developed. Excessive nutrients within the lake have been shown to be originating from both point and nonpoint sources. The action plan below discusses how both sources will be addressed during the coming five year period.

Point Source Action Plan

Beginning in November 2008, an optimization study was conducted with three out of the four major NPDES dischargers into Lake Rhodhiss (Marion, Morganton and Valdese). The Lenoir facility was not included in this study because construction was completed to reduce phosphorus. The Asheville Regional Office is working closely with the other three facilities to ensure pilot studies and resulting implementation efforts are completed by end of summer 2011. These facilities are participating voluntarily with the goal of reducing effluent total phosphorus concentrations to 2 mg/L.

All four facilities (Marion, Morganton, Lenoir and Valdese WWTPs) will be required through their NPDES permit to monitor their effluent weekly for nitrogen and phosphorus. Permits will also include the requirement to conduct upstream/downstream monitoring for nutrients monthly during the period of the study for these facilities. This monitoring will provide clear nutrient contribution data from each facility by determining what the levels are in-stream above and below each facility's discharge pipe. Valdese discharges directly into Lake Rhodhiss and therefore upstream and downstream monitoring of nutrients is not required.

During the upcoming cycle, DWQ will evaluate monitoring results from the dischargers as well as DWQ lake monitoring data to determine if a TMDL will need to be developed. Due to the fact the lake is co-limited for nutrients, the TMDL would specify total nitrogen and total phosphorus reductions from point and nonpoint sources. Limits consistent with the TMDL will be incorporated into the permit renewals for the affected facilities.

Nonpoint Source Action Plan

A Watershed Management Plan was developed by the Western Piedmont Council of Government (WPCOG) in 2009 to address point and nonpoint source nutrient loading for the entire Lake Rhodhiss watershed. This document includes recommendations that identify areas for implementing best management practices (BMPs) to reduce nutrient loading from both agricultural and non-agricultural nonpoint sources. DWQ will work with the WPCOG and other active watershed partners to ensure practices are implemented where they will be most effective during the upcoming planning cycle. Monitoring in these areas will be continued to evaluate the water quality benefits from these efforts. Continued monitoring will also assist in determining if nonpoint source BMPs need to be focused in additional locations.

Recommendations for Lake Rhodhiss

Buffers

Due to the recent development pressures seen around the lake, local governments should continue to work together to educate and ensure implementation of the Catawba River mainstem 50-foot riparian buffer rules adopted by the EMC in August of 2004. DWQ will also work with the WPCOG to find educational opportunities to assist in this effort. For more information about the Catawba River Buffer rules, see the *Buffers Chapter*.

Monitoring

During the next sampling cycle DWQ's Intensive Survey Unit will try to sample the three lake stations, at minimum, five times (monthly May - September). As resources become available, the three lake stations should be sampled and include all regularly sampled parameters ten or more times. This would assist in having a range of data to better assess for nutrients and other parameters that could impact aquatic health within Rhodhiss.

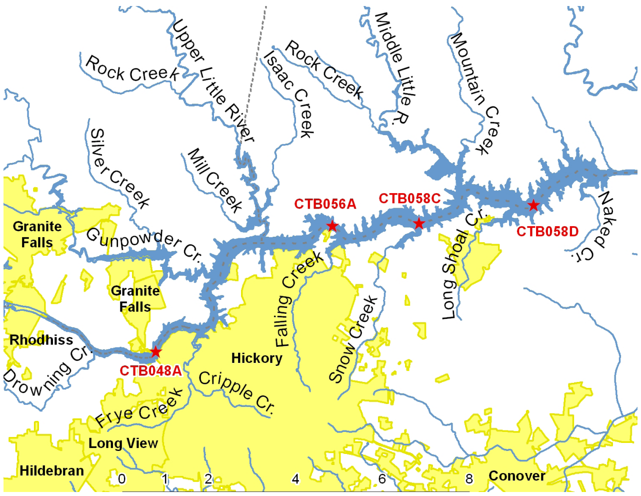
Lake Hickory

Use Support: Supporting (3,326 ac)	
AU #	11-(53) & (59.9)
2010 IR Cat.	2
Lake Stations*	2007
(CTB048A)	No Exceedances
(CTB056A)	No Exceedances
(CTB058C)	No Exceedances
(CTB058D)	No Exceedances

*Stations in **bold** were sampled less than ten times during this sampling cycle.

Lake Hickory is a run-of-the-river reservoir located between Lake Rhodhiss and Lookout Shoals Lake on the Catawba River. The lake was filled in 1928 and is operated by Duke Energy. It has the smallest drainage area of any other major lake in the chain. The 10-digit watersheds (HUCs 0305010109 and part of 0305010108 and 0305010110) which drain to the lake, are mostly forested in the upper headwaters, agricultural lands north of the lake, and urban areas south of the lake. The waters of the lake are used to generate hydroelectric power, for public water supply and for recreational purposes. Lake Hickory is classified from the Rhodhiss Dam to the US Highway 321 bridge on the Catawba River as WS-IV, B, CA, and from the US Highway 321 bridge to Oxford Dam as WS-V, B.

Figure 4-11: Monitoring Stations on Lake Hickory



As seen in Figure 4-11, there are five major streams draining into Lake Hickory as well as flow draining directly into the lake from Lake Rhodhiss. These two lakes have very similar water quality issues due to proximity as well as similar land use activities. For more information on water quality within Lake Rhodhiss, see the section above. The five streams include Gunpowder Creek, Drowning Creek, and Upper, Middle, and Lower Little Rivers. The upper segment of Lower Little River is the only one of these streams which appears on the 2008 Impaired Waters list (low pH). Gunpowder Creek, Lower Little River and Muddy Fork (a tributary to the Lower Little River) are expected to be on the 2010 Impaired Waters list for biological integrity and low pH. For further analysis of these streams impairments, see *Chapter 1 - Catawba River Headwaters Subbasin*.

Water Quality Assessment

In 2007, the Intensive Survey Unit sampled at each of the four lake stations, seen in Figure 4-11, approximately nine times. None of the lake stations showed any standard violations. However, there was one sample with elevated chlorophyll *a* and two with low DO values which occurred during September and may have been caused by cool weather mitigated turnover of the lake.

Chlorophyll *a* is an indicator of algal productivity. Even though the state standard for chlorophyll *a* is set at 40 µg/l statewide, levels over 25 µg/l are considered elevated for mountain and upper piedmont regions lakes like Lake Hickory. Nine out of the 32 total samples were near 25 µg/l, indicating early signs possible algal productivity. Overall, nutrient levels ranged from low to moderate. The consistent decline in dissolved oxygen levels, and increase in chlorophyll *a* and pH levels throughout the summer are similar to what was observed in Lake Rhodhiss.

An Algal Growth Potential Test was conducted on samples from Lake Hickory. This test is used to identify which, if any, nutrient might be limiting algal growth. The limiting nutrient (phosphorus or nitrogen) is the one that is used up first in the system decreasing continued growth of algae. The results of the Algal Growth Potential Test revealed nitrogen as the limiting nutrient for algal growth within the lake (Algal Growth Potential Test, 2007). The results were similar to values seen in 2002.

Algal blooms (*Euglenoid*) were seen at the lower end of the reservoir from late July through late September of 2007 which indicates elevated nutrient and organic loading. This suggests the excess nutrients are not solely from Lake Rhodhiss and, Lake Hickory is likely receiving nutrients from its own watersheds. Increased residence time due to the drought may have also contributed to the growth of the bloom. Taste and odor problems in drinking water processed from the lake were reported to the public utility companies in May of 2010.

Point & Nonpoint Source Nutrient Loading

Nonpoint Source Loading

On the north side of the lake, agricultural activities dominate the land use with exception of the very northern part of the drainage area which is mostly forested. Excess nutrient loads from agricultural practices can originate from the amount and/or timing of fertilization, the ability of cattle to have access to streams and general stormwater runoff from the land. Implementation of agricultural best management practices (BMPs) could help reduce nutrient delivery to these streams.

The City of Hickory is located just south of Lake Hickory and a majority of the city drains into the tributaries and lake. Urban stormwater runoff from the city can be toxic to aquatic life if not properly controlled or treated before reaching a waterbody. The City of Hickory began Phase II Stormwater implementation in July 2007 to reduce the impacts from urban runoff. Water quality improvements from these efforts will likely be evident during the next sampling cycle.

Point Source Loading

There are four major and eight minor NPDES Dischargers permitted in the lake's watersheds. Table 4-7 lists these facilities and respective receiving streams. Gunpowder Creek WWTP (NC0023736) received some major violations for elevated fecal coliform bacteria (FCB) and ammonia nitrogen values found within the plants effluent between 2004 and 2006. However, by the end of 2006, the issue had been corrected and the facility has not received violations for those two parameters since. None of these facilities are considered to be greatly affecting the water quality in the lake; however, during a drought year like 2007, the accumulative impacts can negatively affect aquatic life health.

Table 4-7: NPDES Discharger Permits within Lake Hickory's Watersheds

Facility	Permit #	Major/Minor; Permitted Flow (MGD)	12-Digit HUC #	Receiving Stream
Rhodhiss WWTP	NC0025917	Minor; <0.01	030501010804	Lake Hickory
Huffman Fishing	NC0025135	Major; 0.25	030501010804	Trib. to Lake Hickory
Gunpowder Cr. WWTP	NC0023736	Major; 2.0	030501010803	Gunpowder Cr.
Granite Falls WWTP	NC0021890	Minor; 0.9	030501010803	Gunpowder Cr.
Oak Hill Elementary School	NC0041220	Minor; 0.003	030501010901	Mountain Run
Shuford Yarns LLC-Dudley Shoals Plant	NC0035211	Minor; 0.0054	030501010901	Upper Little River
Gateway Alternate School	NC0041157	Minor; 0.004	030501010901	Upper Little River
Northeast WWTP	NC0020401	Major; 6.0	030501010904	Lake Hickory
Schneider Mills WWTP	NC0034860	Major; 0.78	030501011003	Muddy Fork
Carolina Glove Company	NC0034967	Minor; 0.015	030501011003	Lower Little River
Taylorsville WWTP	NC0026271	Minor; 0.83	030501011003	Lower Little River

Point vs. Nonpoint Source Loading

Due to the amount of urban and agricultural land in these watersheds, nonpoint sources are likely having a greater impact on the lakes water quality than point sources during regular rainfall conditions. The local Soil & Water Conservation Districts (SWCD's) have recognized this fact and between 2003 and 2008, installed over 130 agricultural BMPs to reduce the effects of agricultural practices on aquatic life.

Drought

Lake Hickory was greatly impacted by the 2007 drought that caused water levels to drop to extreme lows. Figure 4-12 shows exposed structures normally several feet under water. These types of drought conditions can significantly reduce the amount and impacts of agricultural and urban nonpoint source runoff received by the lake; however, drought also increases the impacts of point sources. When there is less stream/lake volume, the percent of effluent within the receiving stream/lake is increased. Therefore, the normal effluent flow during an extended drought can have a greater impact on water quality than during normal rainfall.

Figure 4-12: Exposed bridge pilings

*Picture from Catawba RiverKeeper

Aquatic Weed Infestation

Approximately two to three acres of the invasive aquatic macrophyte, parrotfeather (*Myriophyllum aquaticum*) was discovered by Duke Energy aquatic plant biologists during the fall of 2001. By June 2002, this plant was found to infest 74 acres of the lake. In February 2004, the Aquatic Weed Control Council approved a work-plan for the State of NC's Weed Control Program that allocated $20,000 for the control of parrotfeather for Lake Hickory. These efforts along with high water flooding in 2004, homeowners action and herbicide treatment in 2006 and 2007 helped to eliminated the majority of the problem.

Recommendations for Lake Hickory

Restoration Efforts

A local watershed management plan, similar to the Lake Rhodhiss plan completed by the WPCOG, should be created and implemented for Lake Hickory. Due to the natural similarities between these two lakes and direct flow from Lake Rhodhiss, the nutrient issues currently identified within Rhodhiss are expected to occur within Hickory if action is not taken on a local scale. DWQ will work with local agencies as needed to begin development of such plan.

Buffers

Due to the recent development pressures seen around the lake, local governments should continue to work together to educate and ensure implementation the Catawba River mainstem 50-foot riparian buffer rules adopted by the EMC in August of 2004. For more information about the Catawba River Buffer rules, see the *Buffers Chapter*.

Monitoring

During the next sampling cycle DWQ's Intensive Survey Unit will try to sample the four lake stations, at minimum, five times (monthly May - September). As resources become available, the four lake stations should be sampled and include all regularly sampled parameters ten or more times. This would assist in having a range of data to better assess for nutrients and other parameters that could impact aquatic health within Lake Hickory.

Lake Norman

Use Support: Supporting (31,332 ac)	
AU #	11-(75)
2010 IR Cat.	2
Lake Stations*	2007
(CTB079A)	No Exceedances
(CTB082A)	No Exceedances
(CTB082AA)	No Exceedances
(CTB082B)	No Exceedances
(CTB082BB)	No Exceedances
(CTB082M)	No Exceedances
(CTB082Q)	No Exceedances
(CTB082R)	No Exceedances

*Stations in **bold** were sampled less than ten times during this sampling cycle.

Lake Norman is the largest man-made lake in NC and is located between Lookout Shoals Lake and Mountain Island Lake on the Catawba River. This lake is an important recreational lake for citizens of the State, providing opportunities for swimming, fishing and boating year round. It is owned and operated by Duke Energy for hydroelectric power generation. The lake has the third largest local watershed area (Table 4-1) compared to others within this river basin. The drainage basin of Lake Norman contains two 10-digit HUCs (0305010111 and 0305010112). In the upper HUC (0305010111), the land use consists of almost equal parts agricultural and forested lands; however, the lower HUC (0305010112) is dominated by dense residential neighborhoods and retail complexes. The lake is split into two segments [AU: 11-(74) & 11-(75)] which are both classified as WS-IV and critical area (CA) and the lower segment has an additional secondary B classification.

As seen in Figure 4-13, there are nine major streams draining into Lake Norman and include Catawba River (Lookout Shoals Lake), Lyle Creek, McLin Creek, Balls Creek, Mountain Creek, Reeds Creek, Norwood Creek, Reeder Creek and Buffalo Shoals Creek. None of these streams appeared on the 2008 Impaired Waters list; however, McLin Creek has been placed on the DRAFT 2010 Impaired Waters list for biological integrity. For more information about this creek and others within these watersheds, see *Chapter 1 - Catawba River Headwaters Subbasin*.

Water Quality Assessment

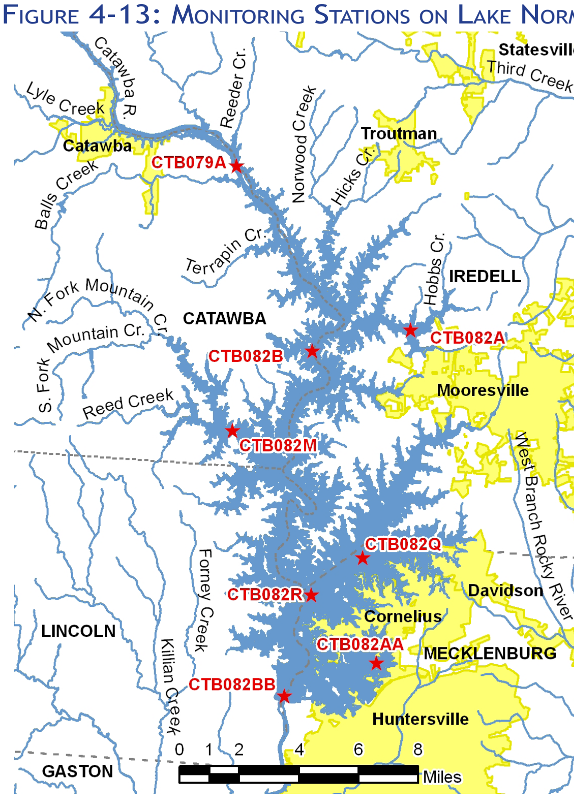
In 2007, the Intensive Survey Unit took nine samples at the eight stations within the lake. None of the eight monitoring stations within the lake violated any standards during 2007 sampling.

Overall, Lake Norman has some of the best water quality of the five lakes sampled within the chain. Nutrient monitoring at the eight stations determined the lake had low biological productivity (oligotrophic). Organic nitrogen was low; however, inorganic nitrogen was elevated which could be a result of impacts from severe drought conditions. Total phosphorous levels were generally below the DWQ laboratory detection level and all other lake station parameters were normal.

An ambient monitoring station was located on the upper reaches of the lake (same location as CTB079A). Samples collected between February 2004 and January 2007 indicate a decline in pH levels from past cycles. This is a common trend in streams across the basin.

Duke Energy routinely monitors the water quality of the lake as a requirement of the NPDES permit for the McGuire Nuclear Station. Monitoring in 2005 for water quality and fish communities showed similar results to the 2004 data. No obvious short-term or long-term impacts of the nuclear station operations were observed.

Figure 4-13: Monitoring Stations on Lake Norman



Point & Nonpoint Source Nutrient Loading

Nonpoint Source Loading

Dense residential neighborhoods dominate most of the shoreline surrounding Lake Norman with agricultural land seen more in the headwaters of the lake. Stormwater runoff from these residential areas have more of an impact on the lake than seen in other watersheds due to the compact nature of the neighborhoods, large amounts of impervious surfaces and the close vicinity of the houses to the lake. Agricultural properties are more spread out in this area as compared to residential properties and are located mostly in the headwaters of the watershed. This allows runoff longer time and travel before reaching the lake, so that nutrients can be utilized by aquatic organisms and adsorbed by sediments within the streams. Storm water runoff from impervious surfaces associated with lake-side residential development, along with runoff from lawns and landscapes treated improperly with fertilizers and pesticides, enter the lake with little to no biological and sediment uptake.

Point Source Loading

There are 22 minor and two major NPDES Dischargers located within Lake Norman's watersheds. Table 4-9 lists these facilities and the receiving streams of the permitted discharge. None of these facilities received any major violations nor are any considered to be impacting water quality within the lake.

Table 4-9: NPDES Discharger Permits within Lake Norman's watersheds

Facility	Permit #	Major/Minor; Permitted Flow (MGD)	HUC	Receiving Stream
Marshall Steam Station	NC0004987	Major; 0	030501011202	Lake Norman
Cross Country Campground	NC0022497	Minor; 0.065	030501011201	Reed Creek
Conover Northeast WWTP	NC0024252	Major; 1.5	030501011102	Lyle Creek
Conover Southeast WWTP	NC0024279	Minor; 0.3	030501011101	McLin Creek
Claremont North WWTP	NC0032662	Minor; 0.1	030501011102	Mull Creek
Commscope WWTP	NC0034754	Minor; 0.02	030501011105	Trib to Terrapin Creek
Bunker Hill High School	NC0044059	Minor; 0.015	030501011102	Trib to Lyle Creek
Camp Dogwood	NC0044253	Minor; 0.01	030501011201	Lake Norman
Sherrills Ford Elem. School	NC0045438	Minor; 0.007	030501011201	Trib to Lake Norman
Bandys High School	NC0051608	Minor; 0.015	030501011201	Battle Run
Bridgeport WWTP	NC0056154	Minor; 0.1	030501011203	Lake Norman
Country Valley WWTP	NC0058742	Minor; 0.1	030501011101	Hagan Fork
Spinnaker Bay WWTP	NC0060593	Minor; 0.125	030501011201	Lake Norman
City of Hickory's Catawba WWTP	NC0025542	Minor; 0.225	030501011102	Lake Norman
Mill Creek Middle School	NC0086304	Minor; 0.065	030501011104	Balls Creek
Mallard Head WWTP	NC0062481	Minor; 0.02	030501011203	Lake Norman
Killians Crossroads WWTP	NC0063355	Minor; 0.075	030501011201	Lake Norman
Lake Norman Motel	NC0064599	Minor; 0.075	030501011201	Lake Norman
Murray's Mill Historical Site	NC0069345	Minor; 0.0125	030501011104	Balls Creek
Lake Norman Woods WWTP	NC0071528	Minor; 0.025	030501011105	Lake Norman
Diamond Head WWTP	NC0074772	Minor; 0.1	030501011203	Lake Norman
Alexander Island WWTP	NC0075205	Minor; 0.015	030501011203	Lake Norman
Windemere WWTP	NC0080691	Minor; 0.09	030501011105	Lake Norman
Claremont McLin Cr WWTP	NC0081370	Minor; 0.3	030501011104	McLin Creek
Carolina Water Service Inc WTP 3 facilities	NC0084565	Minor; 0		Lake Norman
Lincoln County WTP	NC0084573	Minor; 0		Lake Norman

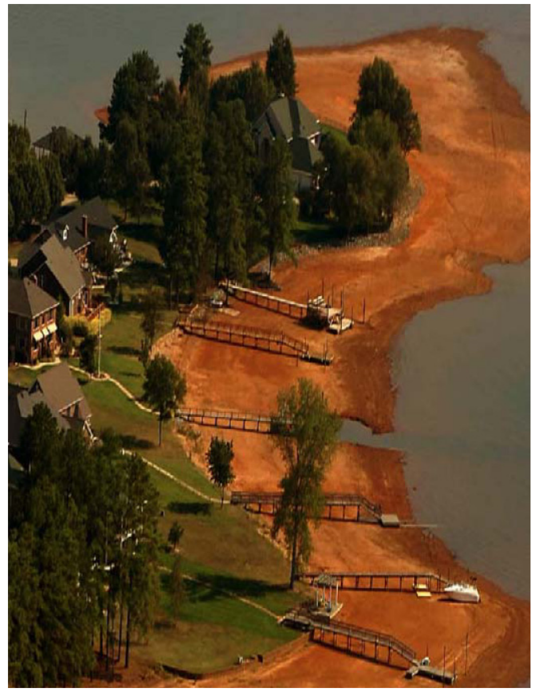
Point vs. Nonpoint Source Loading

Due to the high development density around Lake Norman, nonpoint source pollution is more likely to have a greater impact than the point sources. This increases the need for greater protection of riparian buffers and proper treatment of stormwater.

Aquatic Weed Infestation

The invasive aquatic plant, Hydrilla, has become established in Lake Norman. Control efforts currently underway are through the stocking of sterile grass carp. In 2006 and 2007, the lake was restocked with 400 grass carp through a joint effort of the Lake Norman Marine Commission, Duke Energy, and the NC Division of Water Resources. Another 1,200 grass carp are to be stocked in 2010.

FIGURE 4-14: EXPOSED SHORELINE OF NORMAN



*Picture from Charlotte Observer

Drought

Like most lakes within the chain, Lake Norman was also effected by the 2007 drought (Figure 4-14). Extreme low water levels which were a result of the drought caused several boat ramps to close in August of 2007 which greatly reduced public recreation use of the lake. No impacts were reported on the nuclear power station which uses the reservoir as a source of cooling water.

Recommendations for Lake Norman

Buffers

Due to the development pressures seen around the lake, local governments should continue to work together to educate and ensure implementation the Catawba River mainstem 50-foot riparian buffer rules adopted by the EMC in August of 2004. It is recommended that lake front property owners exempt from these buffer rules allow a 50-foot riparian zone to grow with minimal maintenance on a voluntarily basis. Trees, low growing shrubs or other ground cover plants will not only assist in filtering pollutants and excess nutrients from stormwater runoff, but also secure bank stability to prevent erosion which will inevitably reduce the size of the property. For more information about the Catawba River Buffer rules, see the *Buffers section* below.

Monitoring

During the next sampling cycle DWQ's Intensive Survey Unit will try to sample the eight lake stations, at minimum, five times (monthly May - September). As resources become available, the eight lake stations should be sampled and include all regularly sampled parameters ten or more times. This would assist in having a range of data to better assess for nutrients and other parameters that could impact aquatic health within Lake Norman.

MOUNTAIN ISLAND LAKE

USE SUPPORT: IMPAIRED (1,937 AC)	
AU #	11-(114)
2010 IR Cat.	5
AMS (C3699000)	Low pH - 12%

Mountain Island Lake is directly below Lake Norman, between the Cowan's Ford Dam and the Mountain Island Dam near the Town of Mount Holly water supply intake. The lake serves as the primary water supply for Charlotte-Mecklenburg, Gaston County and Mount Holly.

Lake monitoring was not conducted on Mountain Island Lake [AU: 11-(114)] during this sampling cycle; however, ambient monitoring station samples were collected during this cycle between February 2004 and January 2007. During that time, 12% of pH samples were below 6 su. The state standard for pH is between 6 and 9 su. Exceedances only occurred in the first three years during the months of March and April. The lake will appear on the Draft 2010 Impaired Waters list for the first time due to pH standard exceedances. The source of low pH is unknown at this time, but has been seen basinwide.

Aquatic Weed Infestation

The invasive aquatic plant, Hydrilla, was first noted in the lake in 2000. In 2002, it was observed in the upper portion of the lake and by 2004 it covered more than 625 acres. As soon as the nuisances aquatic plant was spotted in 2000, efforts began to rid the lake of the plant by stocking grass carp as a biological control. An additional 20,000 grass carp were restocked in the lake in 2002 and another 400 will be stocked in 2010.

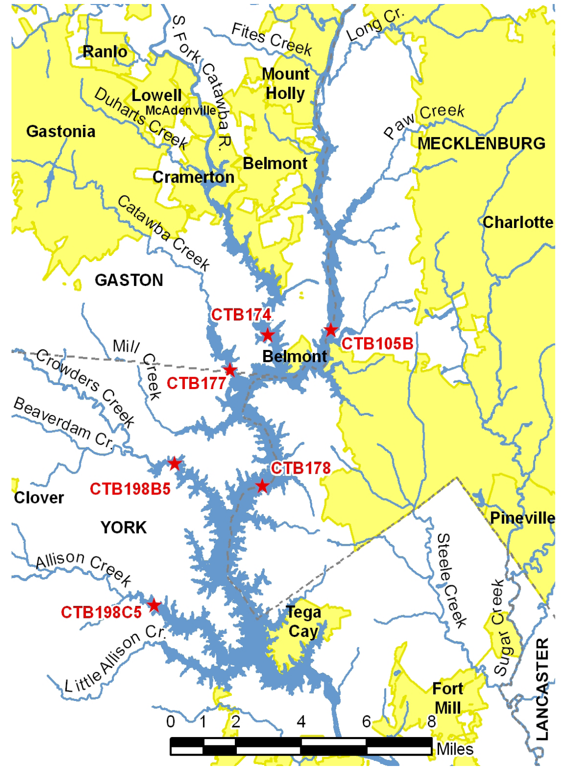
Recommendations for Mountain Island Lake

DWQ is currently in the planning stages of a special study to collect additional data that will assist in determining the severity of the low pH impairment. The lake's Use Support rating will be reassessed at the completion of that study.

Lake Wylie

Lake Wylie is a large reservoir on the Catawba River which is split between the North Carolina and South Carolina state border. The lake serves as a recreational area for boating, fishing and swimming as well as a water supply. All streams within subbasins 03050101 & 03050102 flow down into Lake Wylie. The lake itself is contained within 0305010114, 0305010115 and 0305010206. The land use surrounding the lake is mostly urban and forested with some agricultural lands. Lake Wylie is split into four separate segments [AUs: 11-(117), 11-(122), 11-(123.5)a and 11-(123.5)b] and is classified as WS-IV, CA; WS-IV, B, CA; and WS-V, B respectively. There are 21 minor and seven major NPDES Dischargers permitted on Lake Wylie or within its tributaries.

Figure 4-15: Monitoring Stations on Lake Wylie



As seen in Figure 4-15, there are eight major streams draining into Lake Wylie and include Paw Creek, Long Creek, Catawba River (Mountain Island Lake), Dutchmans Creek, Fites Creek, South Fork Catawba River, Duharts Creek and Catawba Creek. Crowders Creek feeds into the lake on the South Carolina side of the state line. Of these streams, South Fork Catawba River, Catawba Creek and Crowders Creek appeared on the 2008 303(d) Impaired Waters list due to ecological and biological integrity as well as low pH standard violations. Two segments of the lake were also on the 2008 list for low pH and elevated turbidity (discussed below). The three streams mentioned above are on the DRAFT 2010 Impaired Waters list and are likely to be joined by Dutchmans Creek and Long Creek. For more information about these creeks and others within these watersheds, see *Chapter 1* & *Chapter 2*.

Water Quality Assessment

Use Support: Impaired (375 ac)	
2008 IR Cat.	5
2010 IR Cat.	5
AMS (C3900000)	Low pH - 17%

Lake Wylie [AU: 11-(117)]: The upper most segment [AU: 11-(117)] mainstem of the lake flows from the Mountain Island Dam to the Interstate 85 bridge at Belmont. This segment was placed on the 2008 Impaired Waters list for low pH standard violations in 2006 and may remain listed in 2010. The percent of samples with this violation has increased from none in 2002, 14% in 2006 and 17% in 2008. The source of low pH is unknown; however, Mountain Island Lake was also listed for low pH in 2010 with 12% of samples below the pH standards. There are no lake monitoring stations within this segment of the lake due to the hydrologic characteristics. Nutrient samples taken at the AMS station (located at NC-27) indicated slightly elevated inorganic nitrogen levels. These values were higher than those taken in Mountain Island Lake and Dutchmans Creek, which flows into Lake Wylie just upstream of the AMS. The land use along this segment is dominated by residential neighborhoods with a few industrial facilities.

Use Support: Supporting (601 ac)	
2008 IR Cat.	2t
2010 IR Cat.	2t
AMS (C4220000)	No Exceedance

Lake Wylie [AU: 11-(122)]: This segment of Lake Wylie flows from the I-85 bridge to the upstream side of the Paw Creek's Arm of Lake Wylie. Currently, the segment is supporting its water supply, secondary recreation and critical area designated uses. There are no lake monitoring sites within this segment; however, an AMS site is located upstream of the Paw Creek confluence. Monitoring results showed no standard exceedances; however, copper (8.3%) and turbidity (8.6%) levels were elevated. The excess turbidity was running off a nearby construction site which corrected the problem through DWQ enforcement actions. Levels are expected to decrease in the near future. Excess copper is likely due to stormwater runoff from dense urban area lining either side of the segment.

Lake Wylie [AU: 11-(123.5)a]: The third segment of Lake Wylie encompasses the mainstem of the lake and includes Paw Creek cove and the Catawba Creek arm down to SC. In 2007, the Intensive Survey Unit sampled each parameter at least nine times at CTB105B and CTB177 lake stations. Some parameters for these stations were sampled ten times. Ten samples were taken for all parameters at CTB178. Three other lake stations were monitored on this segment in South Carolina (SC).

Use Support: Supporting (4,294 ac)	
2008 IR Cat.	2t
2010 IR Cat.	3a
AMS (C7400000) (C7500000)	 No Exceedance No Exceedance
Lake Stations*	2007
(CTB105B)	No Exceedances
(CTB177)	Low pH - 11%
(CTB178)	No Exceedances
(CTB198B5)	Chlor. *a* - 30%
(CTB198C5)	No Exceedances
(CTB198D)	No Exceedances
*Stations in **bold** were sampled less than ten times during this sampling cycle.	

A comparison of the 2007 data collected on this segment at all three NC lake stations to data collected at these stations between 1997 to 2002 show an increase across the board in chlorophyll *a*, total nitrogen and pH levels. Total phosphorous decreased slightly at CTB105B and CTB177, but increased slightly at CTB178. Specific conductivity levels decreased at all three stations. The total phosphorous increase at CTB178 is likely originating from the South Fork Catawba River arm of the lake.

One of the three lake stations that DWQ monitors in SC is located about two miles south of the state line on the mainstem of the lake. The other two stations are located on the Crowders Creek arm and the Allison Creek arm of the lake. The Allison Creek watershed is completely in SC and does not receive flow from NC. Station CTB198B5 (Crowders Creek arm) experienced a significant decline in conductivity and nutrient levels and a slight decline in the average pH value between 1997 and 2007. Even though this station has a 30% standard exceedance for chlorophyll *a*, the average value of samples taken has dropped. This increase in water quality is likely the result of the closure of facilities that discharged to the NC portion of Crowders Creek and efforts to control nonpoint source pollutants through implementation of BMPs. Chlorophyll *a* values are also expected to further decline as benefits from these efforts are just beginning to be seen. For more information about Crowders Creek and the efforts made to improve water quality, see *Chapter 1 - Lake Wylie (0305010115)*.

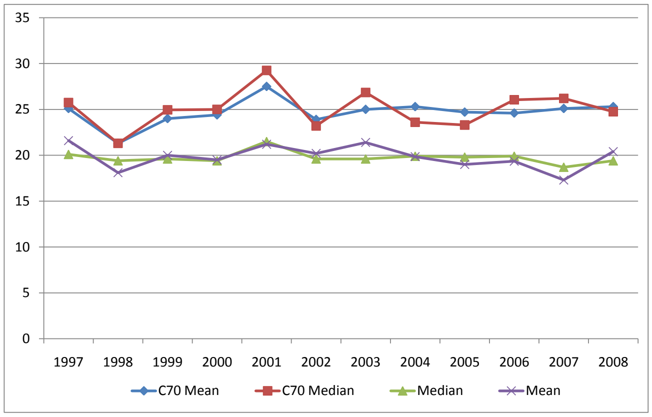
The Allison Creek arm (CTB198C5) station exhibited an increase in all nutrient parameters and pH with a decrease in conductivity levels. The most southern mainstem station (CTB198D) increased in pH, total nitrogen and chlorophyll *a* values, but experienced a decline in conductivity and total phosphorous levels. This site is downstream of the Allison Creek confluence which may be contributing partly to the increase in pH, total nitrogen and chlorophyll *a* values. Increases in pH and chlorophyll *a* levels are more likely due to severe algal blooms in August of 2007 and moderate blooms in September.

Lake Wylie [AU: 11-(123.5)b]: The South Fork Catawba River segment of the lake begins at the line between the Town of Cramerton and the City of Belmont and flows to its confluence with the mainstem of the lake. In 2007, the Intensive Survey Unit sampled the physical parameters (temperature, dissolved oxygen (DO), pH, conductivity, and secchi depth) nine times at CTB174 during the summer months. The chemical parameters (phosphorus, nitrogen, chlorophyll *a* and turbidity) for these stations were sampled ten times. The segment also includes an AMS station co-located with the lake station at the NC-273 bridge.

Use Support: Impaired (1,291 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
AMS (C7000000)	Copper - 69% Temperature - 27%
Lake Stations*	2007
(CTB174)	No Exceedances
*Stations in **bold** were sampled less than ten times during this sampling cycle.	

Data collected at the lake station in 2007 indicated an increase in nutrients and pH levels with a slight decline in specific conductivity values as compared to data collected between 1997 and 2002. The elevated nutrient levels are of concern due to the fact that this segment is included in a chlorophyll *a* TMDL. Further discussion about this topic can be found in the *Action Plan* section below.

Figure 4-16: Summarized Temperature (cfs) Values for AMS C7000000 as Compared to the Average of the Other AMS Sites in this HUC



Out of the nine surface temperature samples taken at the lake station during 2007, six exceeded the state temperature standard. The high temperatures were also recorded at the AMS station C7000000 in 27% of samples. These co-located monitoring sites are about two and a half miles downstream of the Duke Energy's Allen Steam Station discharge channel. Figure 4-16 shows the temperature mean and median of the AMS station C7000000 (blue and red lines, respectively) and the mean and median of five other AMS sites that are located on Lake Wylie (purple and green lines, respectively). As seen on the graph, the AMS stations average water temperature is roughly 5°C higher than the other Wylie AMS station averages. Duke Energy conducted a water quality assessment study to evaluate whether the discharge is having a negative effect on aquatic life, which is required by the state every five years. DWQ reviewed the results of the study and confirmed that the facilities thermal discharge, even though periodically above the state standard, is not negatively impacting aquatic life. Therefore, this segment will not be Impaired for high temperature.

Copper levels in the South Fork arm are also elevated. Even though this will be the first time this segment of the lake will be placed on the Impaired Waters list for copper, this exceedance is not new. In fact, the percent of samples exceeding the standard has dropped from 81% (data years: 1997-2002) to the current 69% (data years: 2004-2008). The source of the excess copper is likely stormwater runoff from surrounding urban areas.

The Algal Growth Potential Test was completed on all segments of the lake and indicated the nutrient limiting algal growth was nitrogen (Algal Growth Potential Test, 2007). Chlorophyll *a* values in Lake Wylie were higher than any other lake in the chain with a lake-wide average for 2007 of 21.4 µg/L. In early June, a value of 41 µg/L (exceeding the state standard of 40 µg/L) was collected at CTB198B5 in SC. Of all samples collected in Lake Wylie for the 2007 cycle, 31% of chlorophyll *a* samples were above 25 µg/L indicating an emerging nutrient problem.

The algal blooms in the lower portion of the lake support the evidence of excess nutrients. Moderate to severe blooms were reported between June and August at three different stations (CTB198B5, CTB178 & CTB198D). The most severe bloom was located in Crowders Creek in August of 2007. No one alga dominated these blooms, but rather multiple taxa were present.

Point & Nonpoint Source Nutrient Loading

This topic is discussed in detail in the Action Plan section below. Table 4-10 lists seven major and 21 minor NPDES discharge facilities within the Lake Wylie watersheds and lists the respected receiving streams.

Table 4-10: NPDES Discharger Permits within Lake Wylie's watersheds

Facility	Permit #	Major/Minor; Permitted Flow (MGD)	HUC	Receiving Stream
Pharr Yarns Industrial WWTP	NC0004812	Major; 1.0	030501020605	SFCR
Gastonia Long Creek WWTP	NC0020184	Major; 16.0	030501020603	Long Creek
Cramerton Eagle Road WWTP	NC0006033	Major; 4.0	030501020605	SFCR
Allen Steam Station	NC0004979	Major; 10.0	030501020605	SFCR
Mount Holly WWTP	NC0021156	Major; 4.0	030501011405	Main Stem Wylie
Clariant Mount Holly East WWTP	NC0004375	Major; 3.9	030501011405	Main Stem Wylie
Belmont WWTP	NC0021181	Major; 5.0	030501011405	Main Stem Wylie
Lola Street WWTP	NC0020036	Minor; 0.5	030501020601	Mauney Creek
Dallas WWTP	NC0068888	Minor; 0.6	030501020603	Dallas Branch
Spencer Mountain WWTP	NC0020966	Minor; 0.050	030501020605	SFCR
Gastonia WTP	NC0040070	Minor; 1.2	030501020603	Tributary to Long Cr.
Lowell WWTP	NC0025861	Minor; 0.6	030501020605	SFCR

Facility	Permit #	Major/Minor; Permitted Flow (MGD)	HUC	Receiving Stream
College Park WWTP	NC0033421	Minor; 0.022	030501020603	Little Long Creek
McAdenville WWTP	NC0020052	Minor; 0.13	030501020605	SFCR
Kings Grant WWTP	NC0032760	Minor; 0.07	030501020605	SFCR
Mount Holly WTP	NC0084689	Minor; 0.1	030501011402	Main Stem Wylie
Charlotte Terminal 2	NC0004839	Minor; 0.057	030501011403	Paw Creek
Charlotte II Terminal	NC0005185	Minor; 0.259	030501011403	Paw Creek
Refuel Terminal Operations	NC0046531	Minor; 0.0432	030501011403	Paw Creek
Belmont Textile Machinery WWTP	NC0023540	Minor; 0.005	030501011405	Fites Creek
Gough Econ WWTP	NC0058084	Minor; 0.0012	030501011405	Trib to Main Stem Wylie
Berryhill Elem. Sch. WWTP	NC0028711	Minor; 0.006	030501011404	Main Stem Wylie
Emerald Point WWTP	NC0059579	Minor; 0.06	030501011406	Main Stem Wylie
Queen Harbor WWTP	NC0062383	Minor; 0.1	030501011505	Main Stem Wylie
Harbor Estates WWTP	NC0063860	Minor; 0.075	030501011505	Main Stem Wylie
Riverpointe WWTP	NC0071242	Minor; 0.1	030501011505	Main Stem Wylie
The Hideaways WWTP	NC0057401	Minor; 0.2	030501011505	Main Stem Wylie
Mariners Watch WWTP	NC0068705	Minor; 0.0025	030501011505	Main Stem Wylie

Drought

Lake Wylie was effected by the 2007 drought as were all of the lakes in the Catawba chain. The lake hit a record low level of 92.9 feet in October, which beat the 2002 record of 93.8 feet (Figure 4-17). Prolonged drought conditions can significantly reduce impacts of agricultural and urban nonpoint source runoff received by the lakes; however, drought increases the impacts of point sources. When there is less stream/lake volume, the concentration of effluent within the receiving waterbody is increased. Therefore, the normal effluent flow during an extended drought can have a greater impact on water quality than during normal rainfall.

Figure 4-17: Lake Wylie shoreline during 2007 drought

*Picture from Pat Holman

Aquatic Weed Infestation

The invasive aquatic plants, Hydrilla and Alligatorweed, have been seen spotted in a few different locations throughout the lake. One patch of Hydrilla has been reported to be 90 acres in size. A long term plan has been developed by the Lake Wylie Marine Commission, Duke Energy, DENR, NC-WRC, and the SC Department of Natural Resources. In 2010, 500 grass carp will be stocked in the lake to help reduce the aquatic weeds. For more information about the long term plan, visit the *Lake Wylie Marine Commission* website.

Lake Wylie TMDL Evaluation & Action Plan

Eutrophic conditions in Lake Wylie and several of its major tributaries have been evident for many years. To address eutrophication in Lake Wylie, DWQ and South Carolina DHEC developed a nutrient control strategy for the Lake Wylie watershed. In 1996, EPA approved the Lake Wylie TMDL, including the point source allocation included in the Lake Wylie Nutrient Management Plan. The Lake Wylie Nutrient Management Area (Figure 4-18) is considered to be Lake Wylie and its tributaries including the Catawba River and its tributaries below Mountain Island Dam and the South Fork Catawba River below its confluence with Long Creek.

Current Conditions

Data from the most recent lake assessment period indicate that nutrient enrichment continues to be a major concern in (both) the North and South Carolina portions of the lake. Samples showed that total phosphorus levels were highest at the lake station on the South Fork arm. And, all four stations monitored within North Carolina had moderate nitrogen levels and elevated chlorophyll-a levels. Even though there were no chlorophyll *a* exceedances, except for Crowders Creek (SC), all arms of the lake had chlorophyll *a* concentrations greater than 25 µg/l in at least 40% of the samples (Table 4-11). This indicates that, although there are currently no exceedances of the chlorophyll *a* standard, there may be emerging localized eutrophication issues in the arms of the lake. The mainstem arm of the lake had lower nutrient levels comparatively, with no chlorophyll *a* concentrations greater than 25 µg/L. The Crowders Creek sample site (SC-CTB198B5) is located five miles downstream of the NC/SC state line, at which two chlorophyll *a* samples were over the North Carolina standard of 40 µg/l. Multiple samples at this site were over SC standards for chlorophyll *a* (40 ug/l), total phosphorus (0.06 mg/l) and total nitrogen (1.5 mg/l) as well.

Table 4-11: Chlorophyll *a* levels for 2007

Stream	% Over 25
South Fork	40%
Catawba Cr.	50%
Crowders Cr.	90%
Allison Cr.	40%

Chlorophyll a TMDL Evaluation

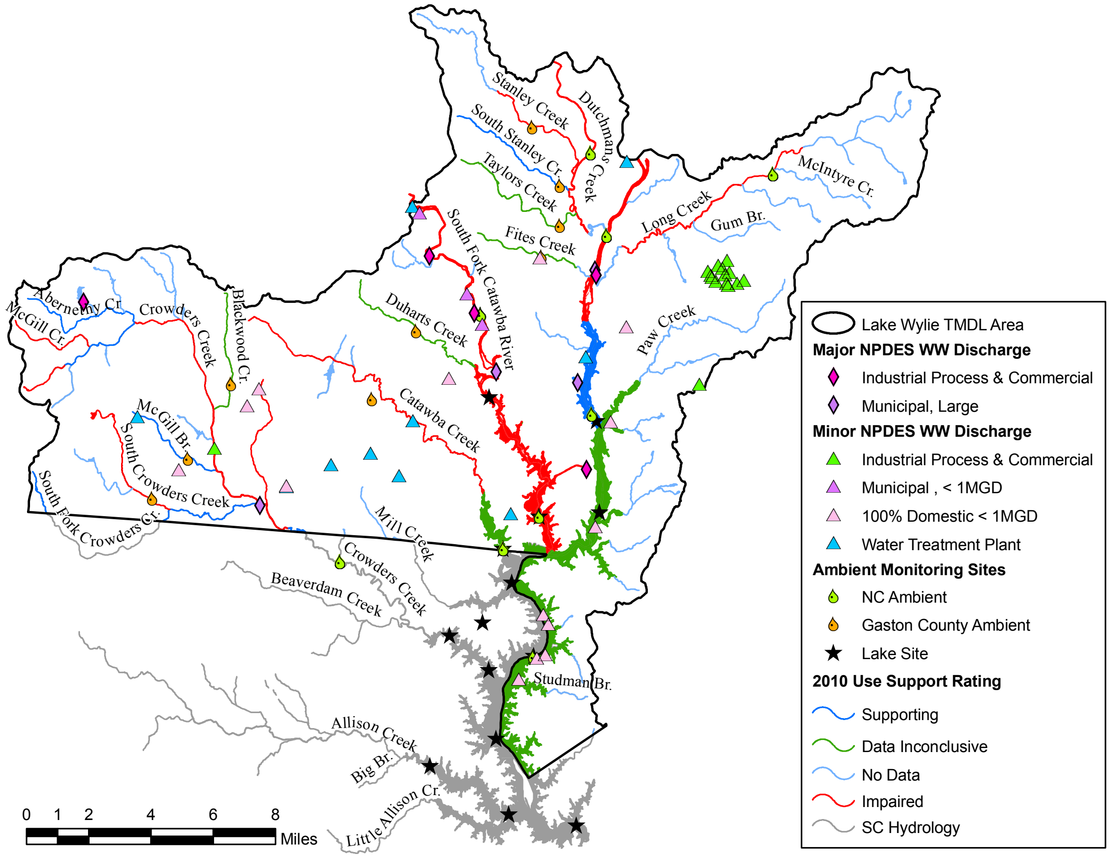
The Lake Wylie chlorophyll *a* TMDL was recently evaluated to determine if dischargers listed within the TMDL were in compliance with the individually assigned waste load allocations (see Table 4-12). According to the limited data collected during this planning cycle, facilities that have permitted nutrient limits are meeting given allocations. Those facilities include Gastonia's Long Creek WWTP and the Crowders Creek WWTP. Three other facilities in the original TMDL have closed. Mount Holly and Belmont WWTP's will both receive limits as per the TMDL during this permit cycle.

Table 4-12: TMDL Point Source Waste Load Allocations (Updated from Original)

Tributary	Discharger	Flow (MGD)	TN, mg/L (lb/day)	TP, mg/L (lb/day)	Notes
South Fork	Gastonia's Long Creek WWTP (NC0020184)	16.0	*6.0 (801)	1.0 (133)	
	JPS (NCG500169)	4.0	8.8 (293)	2.7 (90)	Inactive, Cramerton (NC0006033) took over the JPS allocations and limits went into effect in 2009.
Catawba River (mainstem)	Mt. Holly WWTP (NC0021156)	4.0	*9.0 (300)	1.5 (50)	These limits will be given during the 2010 permitting cycle.
	Belmont WWTP (NC0021181)	5.0	*8.4 (350)	1.4 (58)	These limits will be given during the 2010 permitting cycle.
Crowders Cr.	Gastonia Crowders Creek WWTP (NC0074268)	6.0	*6.0 (300)	1.0 (50)	
* April - October TN Limit					

The original 1996 TMDL and the 1995 nutrient management strategy are included in the Chain of Lakes *Appendix 4-B*.

FIGURE 4-18: LAKE WYLIE CHLOROPHYLL *a* TMDL MANAGEMENT AREA



2010 Action Plan

DWQ will appropriately place Lake Wylie in categories 1(t) and 3(t) of the Integrated Report for chlorophyll *a* to the EPA in order to reflect no criteria exceeded or not enough data for chlorophyll *a* and the presence of an approved TMDL. It is important to note that just because the lake is no longer impaired for chlorophyll *a*, the TMDL is still in effect. It appears that the existing strategy is currently sufficient to address nutrient loading into the lake as long as nutrient loading does not exceed the TMDL allocations. However, continued eutrophication concerns within the arms of Lake Wylie suggest that the nutrient management strategy may not be sufficient in the future to maintain the TMDL load allocations. For example, in the original strategy, discharges above Long Creek (a South Fork Catawba River tributary) were not given individual allocations.

Given the evidence of potential nutrient enrichment problems in the arms of the lake, DWQ is currently working on a monitoring plan to collect nutrient samples across the management area. This additional monitoring will assist in reevaluating nutrient loads during the upcoming planning cycle. It is also recommended that all Major NPDES Dischargers monitor their effluent weekly for total phosphorus and total nitrogen. And, all Minor NPDES Dischargers should monitor their effluent monthly (if not already required to monitor more frequently) for total phosphorus and total nitrogen. Due to the historic eutrophication issues in the lake and elevated chlorophyll *a* concentrations in the arms of the lake, this data is needed to ensure that the TMDL allocated loads are not exceeded. This will help prevent the lake from becoming impaired for chlorophyll *a* again in the future.

Over the next basinwide cycle, DWQ will consider the need to expand the management area to include Long Creek, which flows into the South Fork Catawba River. DWQ will also determine whether all other existing permits within the management area should be explicitly included in the nutrient management strategy as mentioned above. In the meantime, DWQ supports and encourages the continued efforts of municipalities and county governments to identify and implement local nonpoint source reduction plans and wastewater treatment plant upgrades.

Recommendations/Additional Information for the Chain of Lakes

Chain of Lakes Buffer Rules

On July 7, 2003, the Environmental Management Commission completed a stakeholder process to protect mainstem riparian habitat on the Catawba River by finalizing the "Catawba River Basin Buffer Rules" (§15A NCAC 02B.0243). The temporary rule became permanent in August 2004.

The Catawba River basin buffer rules require a 50-foot wide riparian buffer directly adjacent to surface waters along the Catawba River mainstem below Lake James and along mainstem lakes in the Catawba River basin. The rules create a two-zone protection area that allows for all existing uses that were in place on June 30, 2001. As long as the current land use was in place on that date, the Catawba River basin buffer rules do not apply. Otherwise, zone one is the 30-foot wide strip closest to the waterline that must remain generally undisturbed. Zone two constitutes the remaining 20 feet of buffers and allows for grading and revegetating as long as the health of zone one is not impacted. There are many exemptions and activities that are allowable with mitigation inside the buffer zone. Those include, but are not limited to, access roads, view corridors and timber harvesting. For a complete copy of the rule and the list of all exemptions, please refer to *§15A NCAC 02B.0243*. For more discussion on the process used to develop the rule, visit this *webpage*.

In addition to the rules discussed above, several other programs are implemented in the basin to protect riparian habitat. Protective zoning ordinances are in effect in all or part of Burke, McDowell and Mecklenburg counties. In addition, special protection is given to riparian habitat in water supply watersheds, high quality waters, outstanding resource waters, and trout waters throughout the basin. For additional information on all types of buffers within the Catawba River Basin, see the *Buffers Chapter*.

Adoption of a Catawba River Coalition

The Discharge Monitoring Coalition Program was developed by DWQ and permit-holders, to create an effective and efficient way to assess water quality within a watershed context. Participating permit holders voluntarily develop a monitoring program with the DWQ that is designed to evaluate coalition interests and watershed specific issues. In order to better utilize the resources spent by permittees, the monitoring locations are coordinated with the State's existing ambient and biological monitoring networks. This integrated management of monitoring resources reduces duplication and provides a more complete picture of watershed conditions. Coalition coordinators within DWQ are able to facilitate the collection of water quality data at 270 monitoring locations on a monthly basis. The Coalition Program substantially increases the data resources available to coalition members and the State for making basin-wide water quality management decisions.

During the last planning cycle DWQ has been actively promoting the formation of a Catawba River Basin Coalition for a number of reasons. There are many benefits to be gained by permitted facilities within the Catawba basin that take advantage of an organization such as a monitoring coalition, including potential cost savings, increased industry networking, more consistent and coordinated data, monitoring flexibility, reduction of in-stream permit requirements and an overall increase in environmental stewardship.

- Collaboration & Networking: Coalitions give members an outlet to discuss and address member-specific problems, watershed specific issues and potential watershed-based projects. It also provides the members with a collective voice to address issues in their river basin. The group gives smaller facilities the opportunity to hear about some of the larger concerns and all facilities the opportunity to discuss those concerns without the presence and influence of regulators or other stakeholders. In addition, it increases the opportunity for collaboration with DWQ through member's increased involvement in watershed management and increased exposure to DWQ staff and programs.

- Consistent, Reliable Data: Coalitions are able to evaluate and determine station locations throughout the basin with input from DWQ, which allows for a more evenly distributed pool of data to assess short and long term trends throughout the basin. The data is collected consistently from station to station giving the Coalition a more reliable and comparable dataset. This dataset is also more beneficial to DWQ when assessing a watershed for stressor sources.

- Monitoring Flexibility: One of the major benefits to forming a Coalition is that there are no set parameters to monitor or set number of stations which are required. These are negotiable factors as the members proceed through the coalition formation process. Members work with DWQ to come up with an agreed upon list of parameters that meets the needs of all parties involved. The number and placement of monitoring stations are also cooperatively developed by the members and DWQ. These decisions are then approved by both parties before an agreement between the Division and the Coalitions is signed.

💧 Permit Benefits: Members of a coalition enjoy the benefit of having in-stream monitoring requirements of their individual permits waived as long as they remain members of the Coalition Program. This frees up staff time and resources to be used elsewhere.

💧 Environmental Stewardship: Participation in the Coalition Program is voluntary. This type of monitoring is not only economical and efficient, but it is also a proactive way to provide critical data that gives members a better handle on what's happening with the water quality in their basin. This knowledge allows the Coalition to better manage decision-making processes about water quality issues.

💧 Potential Cost Savings: Monitoring stations are strategically placed to minimize overlap of sampling efforts between facilities and DWQ. As seen in other coalitions throughout the state, this may reduce the number of sample sites and in turn reduce overall cost to coalition members. Additionally, individual facilities may realize cost savings in the increased efficiency of staff no longer required to collect and analyze their own in-stream samples.

Coalitions empower members to make collectively well-informed decisions on how to handle water quality issues. The broad scale sampling and basin networking provides big picture knowledge to members about what's in the water, how it may or may not be effecting those downstream and what impacts to the basin are being caused by other sources. A Coalition is recommended in the Catawba River Basin to gather reliable and representative data that would aid in the decision making process as the basin faces increasing challenges from development and deteriorating conditions. Visit the following web link for more information about the *Discharge Monitoring Coalition Program*.

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