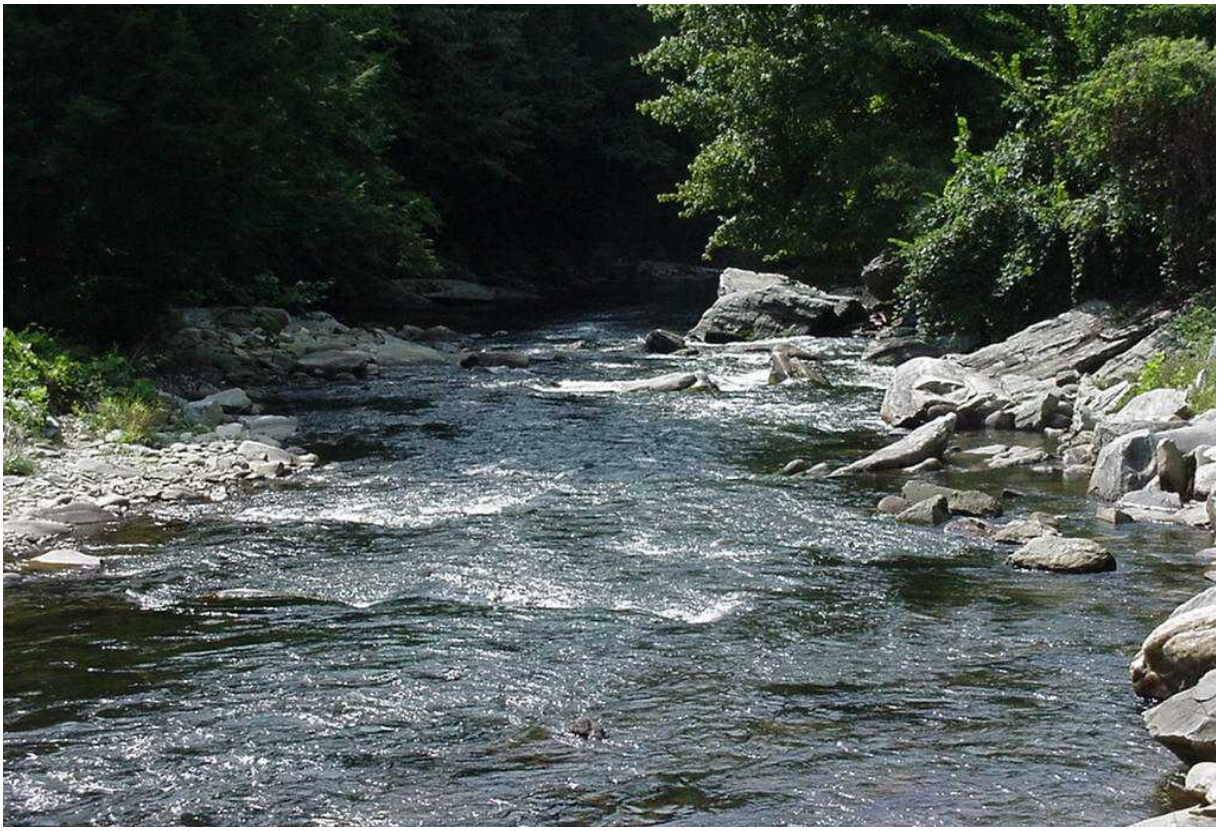
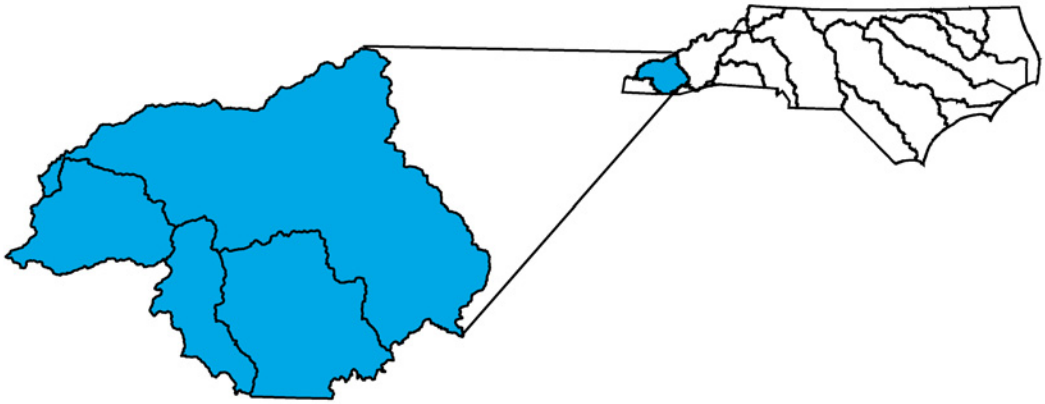


Little Tennessee River Basinwide Water Quality Plan

March 2007



North Carolina Department of
Environment and Natural Resources

Division of Water Quality
Basinwide Planning Unit

LITTLE TENNESSEE RIVER BASIN
WATER QUALITY PLAN

March 2007

NC Department of Environment & Natural Resources
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This document was approved and endorsed by the NC Environmental Management Commission on March 8, 2007 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Little Tennessee River basin. This plan is the third five-year update to the Little Tennessee River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in May 1997.

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Executive Summary

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the North Carolina Division of Water Quality (DWQ) for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholders throughout the state.

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters while allowing for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.
- Assure equitable distribution of waste assimilative capacity.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

This document is the third five-year update of the *Little Tennessee River Basinwide Water Quality Plan*. The first basinwide plan for the Little Tennessee River basin was completed in 1997 and the second in 2002. The format of this plan was revised in response to comments received during the first and second planning cycles. DWQ replaced much of the general information in the first two plans with more detailed information specific to the Little Tennessee River basin. For this plan, a greater emphasis was placed on identifying water quality concerns on the watershed level in order to facilitate protection and restoration efforts.

DWQ considered comments from the Western North Carolina Basinwide Planning Conference held in the region and subsequent discussions with local resource agency staff and citizens during draft plan development. This input will help guide continuing water quality management activities throughout the river basin over the next five years.

Basin Overview

The Little Tennessee River basin is located within the Blue Ridge Province of the Appalachian Mountains of western North Carolina (Figure *iii* & *iv*). It encompasses about 1,800 mi^2 in Swain, Macon, Clay, Graham, Cherokee, and Jackson counties. Much of the land within the basin is federally owned (49 percent) and in the U.S. Forest Service's Nantahala National Forest (including the Joyce Kilmer/Slick Rock Wilderness Area) or the Great Smoky Mountains National Park (GSMNP). The basin also includes the Cherokee Indian Reservation. Subbasins

within the Little Tennessee River basin are described by a six-digit code (040401, 040402, 040403, 040404).

The North Carolina section of the Little Tennessee River is typical of many other mountain rivers. The gradient is relatively steep in most reaches of the river and the substrate is dominated by riffle habitats. The headwater reaches of the Little Tennessee River are located in Georgia. Most tributaries are high gradient streams capable of supporting trout populations in the upper reaches. Most of the basin is forested. However, lower reaches of many tributary catchments are farmed or developed resulting in the increased potential for nonpoint source problems.

The Little Tennessee River is one of three major tributaries of Fontana Lake. The other two are the Nantahala River and the Tuckasegee River. The Cheoah River, the fourth major tributary of the Little Tennessee River in North Carolina, has its confluence with the river below Fontana Lake.

The Little Tennessee River basin has one of the most outstanding and diverse aquatic communities within the entire state. It is home to a variety of rare species, including crayfish, mussels, fish, aquatic insects, and amphibians. The stretch of Little Tennessee River between Franklin and Fontana Lake (25 miles) has a faunal diversity that rivals any in the state and perhaps in the nation. Forestland continues to comprise a large majority of this basin, owing to its relatively pristine condition. Although habitat fragmentation due to dam construction has occurred throughout this system in North Carolina and Tennessee, it continues to support an incredibly rich and diverse ecosystem.

Information presented in this basinwide water quality plan is based on data collected from September 1999 to August 2004. Maps of each subbasin are included in each of the subbasin chapters. Each subbasin has its own characteristics and water quality concerns. These are discussed in Chapters 1 - 4.

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on the predominant land use in a watershed. In the Little Tennessee River basin, sediment, habitat degradation, and fecal coliform bacteria contamination were the most commonly identified possible stressors. Water quality decline can often be attributed to a combination of many stressors that lead to habitat and water quality degradation. In some way, every person, industry, landowner, and municipality in the basin impacts water quality. Therefore, every resident of the basin must play a role in management strategies designed to protect and restore the streams, lakes, and rivers of the basin.

Subbasin 04-04-01

The Little Tennessee River originates in Rabun County, Georgia and flows north into Macon County, North Carolina. Subbasin 04-04-01 contains approximately 35 miles of the Little Tennessee River from the state line to the Macon-Swain county line below Tellico Creek. The river upstream of Lake Emory (Porters Bend Dam) has a very gradual gradient as it flows through a broad valley. Below the lake, the gradient steepens and the flow quickens as it flows through the Needmore Tract towards Fontana Reservoir. Major tributaries to the Little Tennessee River in this subbasin include the Cullasaja River and Cartoogechaye Creek; smaller tributaries include Middle, Coweeta, Cowee, Tessentee, Tellico, and Burningtown Creeks.

Headwaters of many tributaries are protected within the Nantahala National Forest. Most tributaries are high gradient streams capable of supporting trout populations in their upper reaches. In the lower reaches, many of the watersheds are farmed or developed and the tributaries are affected by erosion, scour, and sediment deposition. The Town of Franklin and a portion of the Town of Highlands are the large population centers in this subbasin. Strip development is focused along US 23/441 south from Franklin towards Dillard, Rabun Gap, and Mountain City, GA. Low-density residential development is increasing throughout the watershed. Despite the development, almost 90 percent of the subbasin is forested

There are 12 NPDES permitted dischargers in this subbasin. The largest is the Town of Franklin WWTP, which discharges 1.65 MGD into the Little Tennessee River (Lake Emory). This facility is required to monitor whole effluent toxicity.

Most sites monitored for benthic macroinvertebrates or fish were rated Good or Excellent; no sites were rated Poor. Two sites rated Fair, including the Little Tennessee River near the NC-GA state line and the upper reaches of the Cullasaja River near the Town of Highlands. The Little Tennessee River has at times experienced elevated conductivity due to permitted dischargers in Georgia, and the instream and riparian habitats continue to suffer from poor land use and watershed practices. The upper Cullasaja River continues to be impaired by land use practices in the Town of Highlands area. Streams that have consistently been rated Excellent were Coweeta, Turtle Pond, Burningtown, and Tellico Creeks

The primary problem in this basin continues to be nonpoint source pollution, including inputs of sediment and (or) nutrients. Although much of this subbasin is forested, development is often located along the stream corridor. Farmland and new residential areas are typically found adjacent to streams. The riparian zones at many of the sites in the subbasin are narrow, sparsely vegetated with mature trees and mowed lawns, or in pasture. Many of the streams sampled were more turbid than expected for mountain streams. Habitat degradation is attributable to the combination of steep gradients, chronic erosion, and nonpoint source sedimentation. Many of the sites would benefit from bank stabilization and stream restoration techniques.

Subbasin 04-04-02

This subbasin drains 1,021 square miles. The majority of the subbasin lies in Jackson and Swain counties, but small portions of Graham and Macon counties are also included.

Fontana Lake is the largest impoundment in this region and the body of water to which all streams in this subbasin flow. Fontana Lake/Reservoir, operated by the Tennessee Valley Authority, is the result of damming the Little Tennessee River in the 1940's near Fontana Village on the Graham/Swain County line. Flood control and hydroelectric power generation are the primary purposes for Fontana Lake, though recreational use is growing steadily.

The principle tributaries to the Little Tennessee River are the Oconaluftee River and the Tuckasegee River. This subbasin contains over 1,390 miles of streams and rivers and 12,456 acres of lakes and ponds.

Much of the catchment to the north of the Little Tennessee River is within either the Great Smoky Mountains National Park or the Cherokee Indian Qualla Boundary. Most streams on the north side of the lake are in a roadless area and can only be reached by hiking trails or boat

across Fontana Lake. Much of the remainder of this subbasin is included in the Nantahala National Forest, although this does not preclude other land uses.

The largest towns in the subbasin are Bryson City, Cherokee, Cullowhee, and Sylva. The area also contains some of the most pristine and some of the highest quality waters in the State. It also contains some of the most famous trout streams in North Carolina, including Hazel Creek, Forney Creek, Deep Creek and Noland Creek. Portions of Alarka Creek, the Tuckasegee River, Caney Fork, and most of the Oconaluftee River catchments are classified as High Quality Waters (HQW). Small streams, formally classified for water supply, have also been reclassified as HQW: Whiterock, Wolf, Clingman's, and Twentymile Creeks and Long, Jenkins, Dednan, and Moore Spring Branches. The Tuckasegee River upstream of Tanassee Creek is classified as Outstanding Resource Waters.

There are 25 NPDES permitted dischargers in this subbasin, but only three have permitted flows greater than 0.5 MGD: the Tuckasegee Water & Sewer Authority (0.5 MGD to Scott Creek); the Tuckasegee Water & Sewer Authority (1.5 MGD to the Tuckasegee River), and the Town of Bryson City's WWTP (0.6 MGD to the Tuckasegee River). Only the latter two facilities are required to monitor whole effluent toxicity. See Section 2.3.1 for more information. For the listing of NPDES permit holders, refer to Appendix V.

The primary problem in this basin continues to be nonpoint source pollution, including inputs of sediment and (or) nutrients. Although much of this subbasin is forested, development is often located along the stream corridor. Farmland and new residential areas are typically found adjacent to streams, often with inadequate riparian buffer zones. Many of the sampled sites have roads that run parallel to the stream leading to narrow riparian zones with frequent breaks. Water quality was not a problem throughout most of this area, but there was evidence of habitat problems. These included few pools, relatively uniform riffles and runs, and an embedded substrate. These changes have been shown to have less effect on the benthic macroinvertebrates than fish fauna.

Whereas actual water quality is the most important parameter for macroinvertebrates in mountain streams, fishes are affected to a higher degree by habitat alterations (in addition to water quality), especially; the lack of riparian shading of the stream, increased nutrient loads, lack of bank stability, and silt accumulation of plunge pools and riffles. The lack of stream shading raises water temperatures, excluding sensitive cold-water fishes such as trout. An increase in nutrient loads causes a shift in species composition towards dominance by the central stoneroller and the river chub. Silt accumulation, caused by unstable banks and overland runoff limits habitats in riffles, resulting in a low number or complete lack of darters and sculpin.

Subbasin 04-04-03

This subbasin contains most of the Nantahala River catchment. Headwaters of the Nantahala River are entirely within the Nantahala National Forest. The river, from its source to the confluence with Roaring Fork, is classified ORW. Much of the land adjacent to this reach is privately owned. The river and most tributaries are high gradient systems capable of supporting wild trout populations.

The Nantahala River was impounded in 1942, creating Nantahala Lake. Additional flow is diverted into the project from Whiteoak and Dicks Creek. Duke Energy acquired the development in 1988. Flow is diverted to downstream generators at Beechertown, bypassing a

seven-mile reach of the river prior to discharging back into the original channel above the Nantahala Gorge. The regulated reach of the river below the powerhouse is very popular for rafting and canoeing. Development has increased along the gorge corridor as it relates to the recreational industry. Ninety six percent of the subbasin is forested.

There are two NPDES permitted dischargers in this subbasin: Macon County Schools-Nantahala WWTP and the Nantahala Outdoor Center. No significant compliance problems were noted during the most recent review period.

Subbasin 04-04-04

This subbasin contains the Cheoah River and all of its tributaries. Significant sections of most tributary catchments are within the Nantahala National Forest and are minimally impacted. These tributaries are typically high-gradient streams capable of supporting trout populations. However, lower reaches of some tributaries and corridors along Tulula Creek, Sweetwater Creek, Little Snowbird Creek, Yellow Creek, and the Cheoah River are not in the national forest. Thus, they are more likely to be impacted by land disturbing activities. Tulula Creek flows through the Town of Robbinsville, where the stream becomes the Cheoah River at its confluence with Sweetwater Creek. Ninety four percent of the subbasin is forested.

Robbinsville is the only urban area in this subbasin. There are only three NPDES permitted dischargers in this subbasin. The Robbinsville Wastewater Treatment Plant (WWTP), a minor municipal discharger releases 0.63 MGD into Long Creek, a tributary of the Cheoah River. The town's water treatment plant discharges 0.1 MGD to Rock Creek, a headwater tributary to Long Creek. Wide Creek Trout Sales has an unlimited discharge to Snowbird Creek, a tributary to Lake Santeetlah. None of these facilities is required to monitor whole effluent toxicity.

The Cheoah River is dammed below Robbinsville to form Santeetlah Lake. Tapoco, Inc. manages the flow in the river and in the impoundment to provide hydroelectric power for the Aluminum Company of America. The de-watered tailwater reach is approximately nine river miles in length prior to its confluence with the Little Tennessee River below Cheoah Dam.

The upper half of the Snowbird Creek watershed, along with several tributaries to Long Creek, is classified High Quality Waters (HQW). Other portions of the Long Creek watershed (Town of Robbinsville's water supply) are classified WS-I, which are HQW by definition. Several other streams would likely meet the criteria for reclassification to HQW or Outstanding Resource Waters. Refer to Chapter 5 for further information. Additionally, the Cheoah River floodplain is considered a significant natural heritage area by the state because of the rare and endangered species it contains.

Use Support Summary

Use support assessments based on surface water classifications form the foundation of this basinwide plan. Surface waters are classified according to their best-intended use. Determining how well a waterbody supports its use (*use support* rating) is an important method of interpreting water quality data and assessing water quality.

Biological, chemical, and physical monitoring data collected between September 1999 and August 2004 were used to assign use support ratings in the Little Tennessee River basin. A total of 39.9 miles (5.4 percent) and 170.6 acres (1.4 percent) of stream are Impaired in the Little

Tennessee River basin. The impairments are associated with toxic impacts and impoundment. Table *i* and Table *ii* present a summary of the Impaired waters and the associated stressors. Figures *i* and *ii* present a summary of stressors and sources identified for all waters in the Little Tennessee River Basin. Current status and recommendations for restoration of water quality for each Impaired water are discussed in the subbasin chapters (Chapters 1 - 4). Maps showing the current use support rating are also presented in each subbasin chapter.

Table *i* Summary of Use Support Ratings by Category and Subbasin in the Little Tennessee River Basin

	Subbasin 04-04-01		**Subbasin 04-04-02**		**Subbasin 04-04-03**		**Subbasin 04-04-04**	
Use Support Rating	**Aquatic Life**	**Recreation**	**Aquatic Life**	**Recreation**	**Aquatic Life**	**Recreation**	**Aquatic Life**	**Recreation**
Monitored Waters								
Supporting	133.2 mi	35.9 mi	150.6 mi	26.5 mi	32.0 mi	3.5 mi	29.0 mi	1.4 mi
Impaired*	3.7 mi (2.7%)	0.0	0.0 0.0	30.7 mi (54%) 170.6 ac (100%)	0.0	0.0	3.4 mi (1%)	0.0
Not Rated	2.1 mi 42.1 ac	0.0 0.0	5.3 mi 10,947.9 ac	0.0 0.0	1,380.2 ac	0.0	281.9 mi	0.0
Total	**139.0 mi 42.1 ac**	**35.9 mi**	**155.9 mi 10,947.9 ac**	**57.2 mi 170.6 ac**	**32.0 mi 1,380.2 ac**	**3.5 mi 0.0 ac**	**314.3 mi**	**1.4 mi**
Unmonitored Waters								
Not Rated	0.0	0.0	9.5 mi	9.5 mi	0.0	0.0	0.0	0.0
No Data	368.9 mi 11.6 ac	472.0 mi 53.7 ac	1,225.0 mi 1,508.8 ac	1,323.7 mi 12,286.1 ac	214.8 mi 0.0 ac	243.3 mi 1,380.2 ac	306.9 mi	619.7 mi
Total	**368.9 mi 11.6 ac**	**472.0 mi 53.7 ac**	**1,234.5 mi 1,508.8 ac**	**1,333.2 mi 12,286.1 ac**	**214.8 mi 0.0 ac**	**243.3 mi 1,380.2 ac**	**306.9 mi**	**619.7 mi**
Totals								
All Waters**	**507.9 mi 53.7 ac**	**507.9 mi 53.7 ac**	**1,390.4 mi 12,456.7 ac**	**1,390.4 mi 12,456.7 ac**	**246.8 mi 1,380.2 ac**	**246.8 mi 1,380.2 ac**	**621.2 mi**	**621.1 mi**

* The noted percent Impaired is the percent of monitored miles/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

Use support methodology has changed significantly since the 2002 revision of the *Little Tennessee River Basinwide Water Quality Plan*. In the previous plan, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). FS was used to identify waters that were meeting their designated use. Impaired waters were rated PS and NS, depending on the degree of degradation. NR was used to identify waters with no data or those that had inconclusive data.

The *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina no longer subdivides the Impaired category and rates waters as Supporting (S), Impaired (I), Not Rated (NR), or No Data (ND). These ratings refer to whether the classified uses of the water (such as water supply, aquatic life, primary/secondary recreation) are being met. Detailed information on use support methodology is provided in Appendix VIII.

Table *ii* Summary of Impaired Waters in the Little Tennessee River Basin

Stream/ River Name*	Assessment Unit Number (AU#)	Subbasin	Class	Miles/ Acres	Category	Water Quality Stressor/Source
Cullasaja River (Ravenel Lake)	2-21-(0.5)a	04-04-01	WS-III Tr	3.7 mi	Aquatic Life	Toxic impacts and habitat degradation associated with impoundment
Savannah Creek	2-79-36	04-04-02	C Tr	13.4 mi	Recreation	Fecal coliform bacteria, Turbidity and habitat degradation associated with agriculture
Scott Creek	2-79-39	04-04-02	C Tr	15.3 mi	Recreation	Fecal coliform bacteria associated with failing septic systems, MS4 NPDES and WWTP NPDES, turbidity and habitat degradation associated with impervious surfaces and construction
Tuckasegee River	2-79-(35.5)a, 2-79-(38)	04-04-02	C Tr	2.1 mi	Recreation	Fecal coliform bacteria
Tuckasegee River Arm of Fontana Lake	2-(78)a	04-04-02	C	170.6 ac	Recreation	Fecal coliform bacteria and sediment
Cheoah River	2-190-(22)a	04-04-04	C Tr	3.4 mi	Aquatic Life	Habitat degradation associated with impoundment

Use Support Category	Units	Total Impaired Length/Acres	Percent of Impaired Monitored Waters
Aquatic Life	Freshwater miles	9.2 mi	1.4
Recreation	Freshwater miles/acres	30.7 mi/170.6 ac	31.3/100
Fish Consumption	Freshwater miles	0.0	0.0
Water Supply	Freshwater miles	0.0	0.0

Use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: aquatic life, fish consumption, recreation, shellfish harvesting, and water supply. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams, and lakes. A full description of the classifications is available in the DWQ document titled *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*. This document is available on-line at http://h2o.enr.state.nc.us/csu/.

Challenges Related to Achieving Water Quality Protection

Several streams in the Little Tennessee River basin appear on the 303(d) list of impaired waters and as urbanization continues the risk of impairment increases. Balancing economic growth and water quality protection will be a tremendous challenge. Point source impacts on surface waters can be measured and addressed through the basinwide planning process and do not represent the greatest threat to water quality in the basin.

> ***Cumulative Effects***
>
> While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

The cumulative effects of nonpoint source pollution are the primary threat to water quality and aquatic habitat in the Little Tennessee River basin. Nonpoint source pollution issues can be identified through the basinwide plan, but actions to address these impacts must be taken at the local government level. Such actions should include:

- Develop and enforce local erosion control ordinances
- Require stormwater best management practices for existing and new development
- Develop and enforce buffer ordinances
- Conduct comprehensive land use planning that assesses and reduces the impact of development on natural resources.

This basinwide plan presents many water quality initiatives and accomplishments that are underway within the basin. These actions provide a foundation on which future initiatives can be built. Individual homeowners can participate in resource protection by doing the following on their own properties.

- To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns.
- Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose.
- Instead of disposing of yard waste, use the materials to start a compost pile.
- Learn to use Integrated Pest Management (IPM) in the garden and on the lawn to reduce dependence on harmful pesticides.
- Pick up after pets.
- Use, store, and dispose of chemicals properly.
- Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed.
- Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff.
- Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.
- Support local government watershed planning efforts and ordinance development.

Impacts from Steep Slope Disturbance

Dramatic elevation changes and steep slopes define mountain topography. Building sites perched along mountainsides provide access to unparalleled vistas and are a major incentive for development. However, construction on steep slopes presents a variety of risks to the environment and human safety.

Poorly controlled erosion and sediment from steep slope disturbance negatively impact water quality, hydrology, aquatic habitat, and can threaten human safety and welfare. Soil types, geology, weather patterns, natural slope, surrounding uses, historic uses, and other factors all contribute to unstable slopes. Improper grading practices disrupt natural stormwater runoff patterns and result in poor drainage, high runoff velocities, and increased peak flows during storm events. There is an inherent element of instability in all slopes and those who choose to undertake grading and/or construction activities should be responsible for adequate site assessment, planning, designing, and construction of reasonably safe and stable artificial slopes.

Local communities also have a role in reducing impacts from steep slope development. These impacts can also be addressed through the implementation of city and/or county land use and sediment and erosion control plans. Land use plans are a non-regulatory approach to protect water quality, natural resources and sensitive areas. In the planning process, a community gathers data and public input to guide future development by establishing long-range goals for the local community over a ten- to twenty-year period. They can also help control the rate of development, growth patterns and conserve open space throughout the community. Land use plans examine the relationship between land uses and other areas of interest including quality-of-life, transportation, recreation, infrastructure and natural resource protection (Jolley, 2003).

Population Growth and Changes in Land Use

Little Tennessee River ***Basin Statistics***
(North Carolina Portion)

Total Area: 1,797 sq. miles
Freshwater Stream Miles: 2,565 mi
No. of Counties: 6
No. of Municipalities: 9
No. of Subbasins: 4
Population (2000): 116,966*
Pop. Density (2000): 44 persons/sq. mile*

Water Quality Statistics

Aquatic Life
Percent Monitored Streams: 23.2% mi, 89.1% ac
Percent Supporting: 53.5% mi
Percent Impaired: 1.4% mi

Recreation
Percent Monitored Streams: 3.5% mi, 1.2% ac
Percent Supporting: 68.7% mi
Percent Impaired: 31.3% mi, 100% ac

* Estimated based on % of county land area that is partially or entirely within the basin, not the entire county population.

The Little Tennessee River basin encompasses all or portions of six counties and nine municipalities. In 2000, the overall population in the basin (based on the percent of the county land area in the basin) was 79,493. The most populated areas are located in and around Webster, Highlands, Sylva, Dillsboro and Santeetlah.

Between 1990 and 2000, county populations increased by over 20,000 people. The fastest growing county was Macon (21.2 percent increase), followed by Jackson (19.0 percent increase). County populations are expected to grow by another 34,000 people (22.5 percent) by 2020. This would result in a total population of over 150,000 people in the six counties partially or entirely contained within the Little Tennessee River basin. Population growth trends and the accompanying impacts to water quality are discussed in Chapters 6 and 7.

Expanding populations are typically characterized by a loss of natural areas and an increase in impervious surface. Based on the current land cover information provided by the National Resources Inventory (USDA-NRCS, 2001), there was a 77.5 percent decrease (10,700 acres) in cultivated cropland in the Little Tennessee River basin from 1982 to 1997. Uncultivated cropland increased by nearly 89.6 percent (6,900 acres). Pasture land decreased by 31.2 percent (11,500 acres). Urban and built-up areas also increased by nearly 141 percent (30,200 acres). Land use cover tables and statistics are included in Appendix III.

Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. The impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

Impacts from Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (e.g., buildings, roads, parking lots, etc.) instead of absorbing into the soil. In some cases, stormwater runoff drains directly into streams, rivers, lakes, and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. The impact of stormwater runoff is particularly severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches or curb and gutter systems into nearby streams. For more information on stormwater as it relates to growth and development, refer to Chapter 7.

There are several different stormwater programs administered by DWQ. One or more of these programs may affect communities in the Little Tennessee River basin. The goal of DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollution. For more information on statewide stormwater programs, refer to Chapter 8.

Septic Systems and Straight Pipes

In the Little Tennessee River basin, wastewater from many households is not treated at a wastewater treatment plant (WWTP). Instead, it is treated on-site through the use of permitted septic systems. However, wastewater from some homes illegally discharges directly into streams through what is known as a "straight pipe". In some cases, wastewater can also enter streams through failing septic systems. In highly susceptible areas, wastewater from failing septic systems or straight pipes can contaminate a drinking water supply or recreational waters with nutrients, disease pathogens (such as fecal coliform bacteria), and endocrine disturbing chemicals.

In order to protect human health and maintain water quality, straight pipes must be eliminated and failing septic systems should be repaired. The NC Wastewater Discharge Elimination (WaDE) Program is actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of North Carolina. This program uses door-to-door surveys to locate straight pipes and failing septic systems, and offers deferred loans or grants to

homeowners who have to eliminate the straight pipes by installing a septic system. Refer to Chapter 8 for more information on septic systems and straight pipes.

Water Quality Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Certain stressors are associated with specific use support categories. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts. For example, in the recreation category, violations of the fecal coliform bacteria standard are the reason for impairment; therefore, fecal coliform bacteria is the stressor for Impaired waters in this category. A discussion of the two most significant stressors in the Little Tennessee is presented below and a summary of all stressors and their sources is presented in Figures *i* & *ii*.

Figure *i* Stressors Identified for Streams in the Little Tennessee River Basin

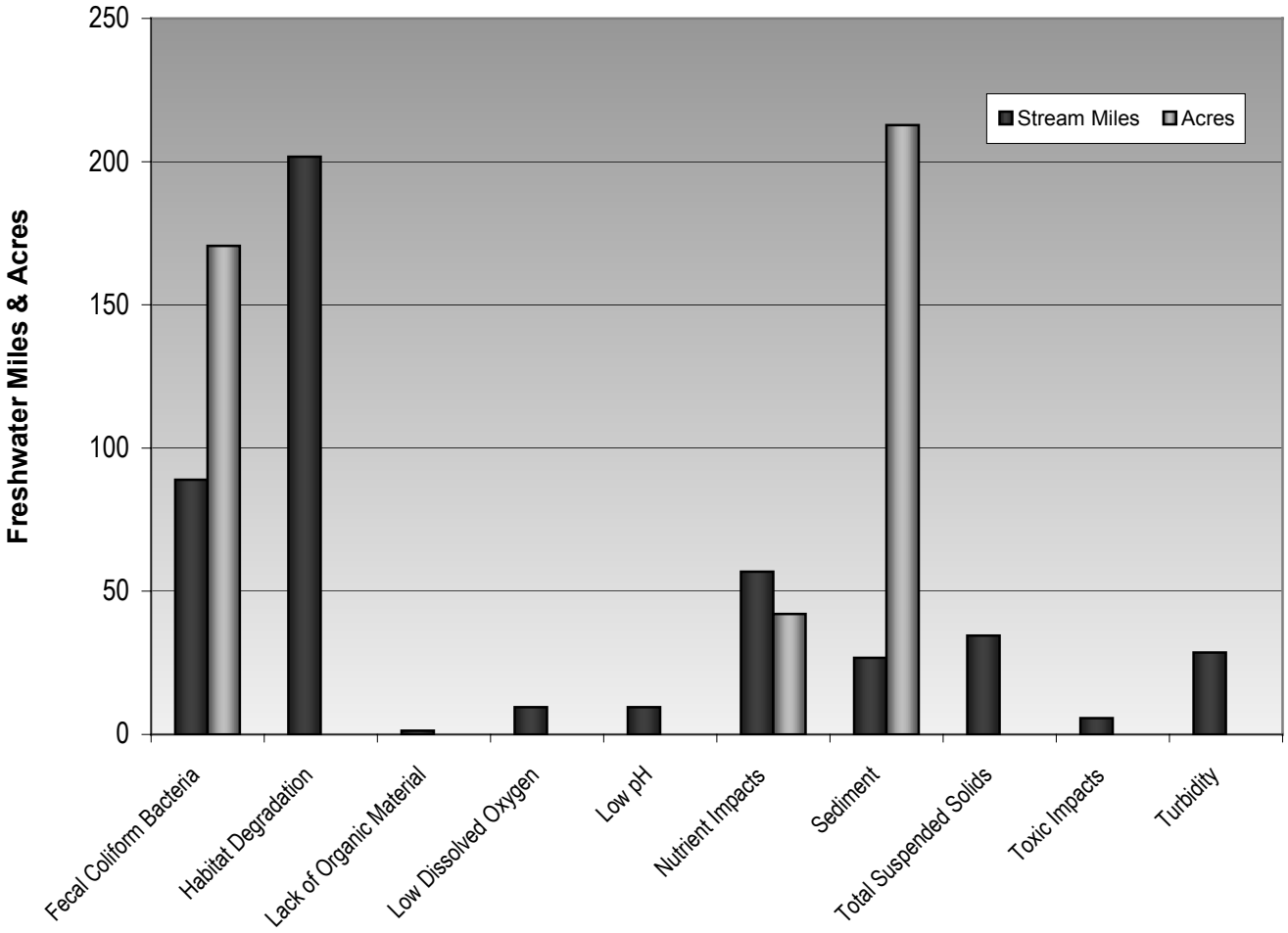
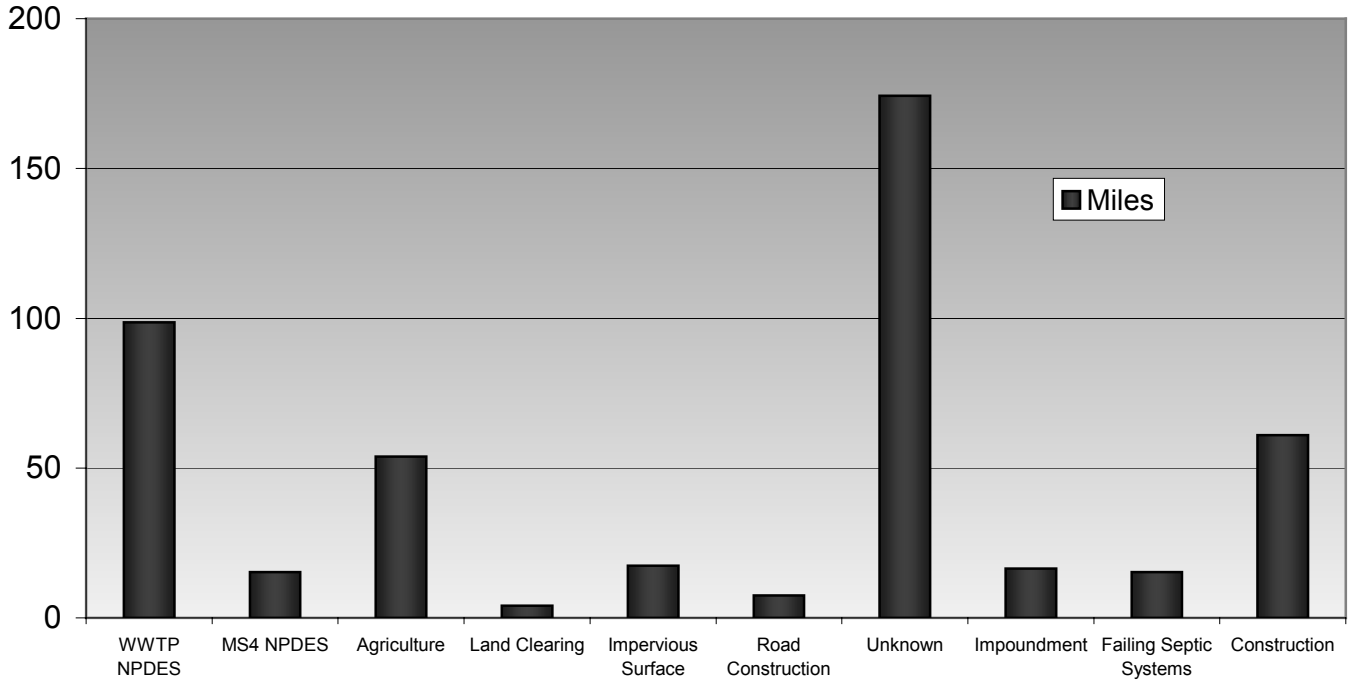


Figure *ii* Sources of Stressors Identified in the Little Tennessee River Basin



Fecal Coliform Bacteria

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a direct danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health. Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters. Most new stream impairments that were identified in the Little Tennessee during this assessment period were due to fecal coliform bacteria contamination. Over 30 miles of stream are now impaired for recreation in this basin. These streams are discussed in Chapter 2.

Habitat Degradation

In the Little Tennessee River basin, nearly 200 stream miles are suffering from at least one form of habitat degradation. Quantifying the amount of habitat degradation is very difficult in most cases. The most common stressors associated with physical habitat degradation are sediment, lack of organic material and stream channelization.

Sediment fills in pools and embeds or covers riffle habitat areas. Sediment may come from disturbed land in the watershed via runoff through storm sewers, ditches and roads or may be from stream banks that are eroded during high flow events. In many disturbed and developed

watersheds, increased surface runoff becomes more common as impervious surfaces prevent infiltration of rain into the ground. In addition to the loss of instream habitat as noted above, sediment also can alter fish feeding and damage gills. During high flow events, suspended sediment can scour habitats as well as fish and insects.

Organic materials (wood and leaf) in streams are important as habitat and as a food source. A lack of organic habitat can reduce the diversity of benthic and fish species. A lack of organic habitat may also result from reduced riparian area quality associated with unstable stream banks and a lack of stream shading. Organic material in streams can form temporary dams that slow waters during high flows, reducing stream bank erosion and providing increased habitat.

Channelized streams are characterized by having little habitat diversity. Straightened stream channels increase water velocity during rain events and prevent the formation of pools and riffles seen in naturally sinuous streams. Streams can become channelized due to watershed development, where streams are moved and straightened to allow for roads and structures to be built. This type of channelization is most common in highly urbanized areas where the streams are usually a stormwater conveyance. Ditching to drain land for forestry, agriculture and development also channelizes streams. These streams are often maintained as ditches and are not allowed to recover to a more natural state. Channelization can also occur by the force of large amounts of water running off the land. These high flows overrun natural bends and the sediment from eroded stream banks is deposited in the stream, resulting in low diversity aquatic habitats. These streams are most closely associated with urbanized and urbanizing areas.

To assess instream habitat degradation requires extensive technical and monetary resources. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impacted by activities that caused habitat degradation. As point-source discharges become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

DWQ recommends the use of careful planning to maintain riparian buffers and the use of good land use management practices during all land disturbing activities to prevent habitat degradation. In addition, watersheds that are being developed need to maintain management practices for long periods to prevent excessive runoff that is the ultimate source of the habitat degradation noted above. Streams with noted habitat degradation are discussed in the subbasin chapters (Chapters 1-4).

Other chemical and biological factors can also impact water quality. These include excess algal growth, low dissolved oxygen, nitrogen and phosphorus levels, pH, and fecal coliform bacteria. Chapter 6 provides definitions and recommendations for reducing impacts associated with physical, chemical, and biological factors.

Local Involvement

Local organizations and agencies are able to combine professional expertise and local knowledge not present at the state and federal level. This allows groups to holistically understand the challenges and opportunities of local water quality concerns. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests and encourages others to become involved and invested in these projects. Working in cooperation across jurisdictional boundaries and agency lines opens the door to additional funding opportunities and

eases the difficulty of generating matching or leveraged funds. This could potentially allow local entities to do more work and be involved in more activities because funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of local efforts is key to water quality improvements, and DWQ applauds the foresight and proactive response by locally based organizations and agencies to protect water quality. There are many excellent examples of local agencies and groups using these cooperative strategies throughout the state. Several local watershed projects are highlighted throughout the subbasin chapters (Chapters 1-4). Chapter 13 also examines the local and federal initiatives underway in the Little Tennessee River basin.

Water Quality Standards and Classifications

Throughout the Little Tennessee River basin, water quality is generally good and even excellent. Chapter 5 discusses water quality standards and classifications and includes maps showing the designated Water Supply (WS) watersheds, High Quality Waters (HQW), and Outstanding Resource Waters (ORW).

In the Little Tennessee River basin, several municipalities and smaller outlying communities are being pressured to expand. This often involves construction and/or development in areas of pristine waters along several tributaries of the Little Tennessee, Tuckasegee, and the Cullasaja Rivers. HQW and ORW are supplemental classifications to the primary freshwater classification placed on a waterbody. Special management strategies are often associated with the supplemental HQW and ORW classification and are intended to prevent degradation of water quality below present levels from point and nonpoint sources of pollution.

Agriculture and Water Quality

Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. Chapter 9 provides information related to agricultural activities in the Little Tennessee River basin and also identifies funding opportunities for best management practices (BMP). During this assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMP projects totaling $199,407 (Table *iii*). BMPs included planned systems for reducing soil erosion and nutrient runoff, planned systems for protecting streams and streambanks, and the installation of planned systems to manage liquid and solid waste to prevent or minimize degradation of soil and water resources.

In several streams throughout the basin, DWQ noted evidence and observed several areas where livestock had direct, easy access to the streams. Fencing, or livestock exclusion, prevents livestock from entering a stream and provides an area of vegetative cover, which can secure streambanks, lower stream velocities, trap suspended sediments, and decrease downgradient erosion. Livestock exclusion is also effective in reducing nutrient, bacteria, and sediment loads in a stream (Line and Jennings, 2002). For more information on either of these agricultural funding opportunities, see Chapter 9.

Table *iii* Summary of NCACSP projects in the Little Tennessee River Basin

Purpose of BMP									
	Erosion Reduction[1]		Sediment Reduction[2]		Stream Protection[3]		Animal Waste[4]		Total Cost ($)
	Total	Cost ($)	Total	Cost ($)	Total	Cost ($)	Total	Cost ($)	
Subbasin 04-04-01	32.2 acres	4,203	5.51 acres	11,805	20 units 5,485 ft.	21,068 5,580	3 units	35,133	65,984
Subbasin 04-04-02	14.1 acres 230 ft.	1,878 392	1 unit	1,089	630 units 5,321 ft.	61,950 6,417	6 units	37,446	109,172
Subbasin 04-04-03	10 acres	2,250							2,250
Subbasin 04-04-04					15 units 814 ft.	20,806 1,195			22,001

[1] Erosion Reduction/Nutrient Loss Reduction in Field
[2] Sediment/Nutrient Delivery Reduction from Field
[3] Stream Protection from Animals
[4] Proper Animal Waste Management

Total Benefits					
Subbasin	Soil Saved (tons)	(N)itrogen Saved (lb.)	(P)hosph-orous Saved (lb.)	Waste-N Saved (lb.)	Waste-P Saved (lb.)
03-02-01	3,158	2,606	142	1,683	332
03-02-02	4,174.34	2,681.32	326.30	5,307.70	3,226.60
03-02-03	70	38	5		
03-02-04	20.60	90	8		

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the NCDENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus, and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

Forestry and Water Quality

Based on land cover information provided by the North Carolina Corporate Geographic Database (CGIA) and the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), 93 percent (358,300 acres) of land in the Little Tennessee River basin consists of forestland. There was about 4 stream miles (AU# 2-23) that were noted or identified by stressors associated with land clearing or forestry activities. Where forest harvesting is identified as a source of water quality impact, DWQ will notify the Division of Forest Resources to investigate for potential violations and the enforcement of management strategies. Chapter 10 presents more information related to the impacts of forestry on water quality.

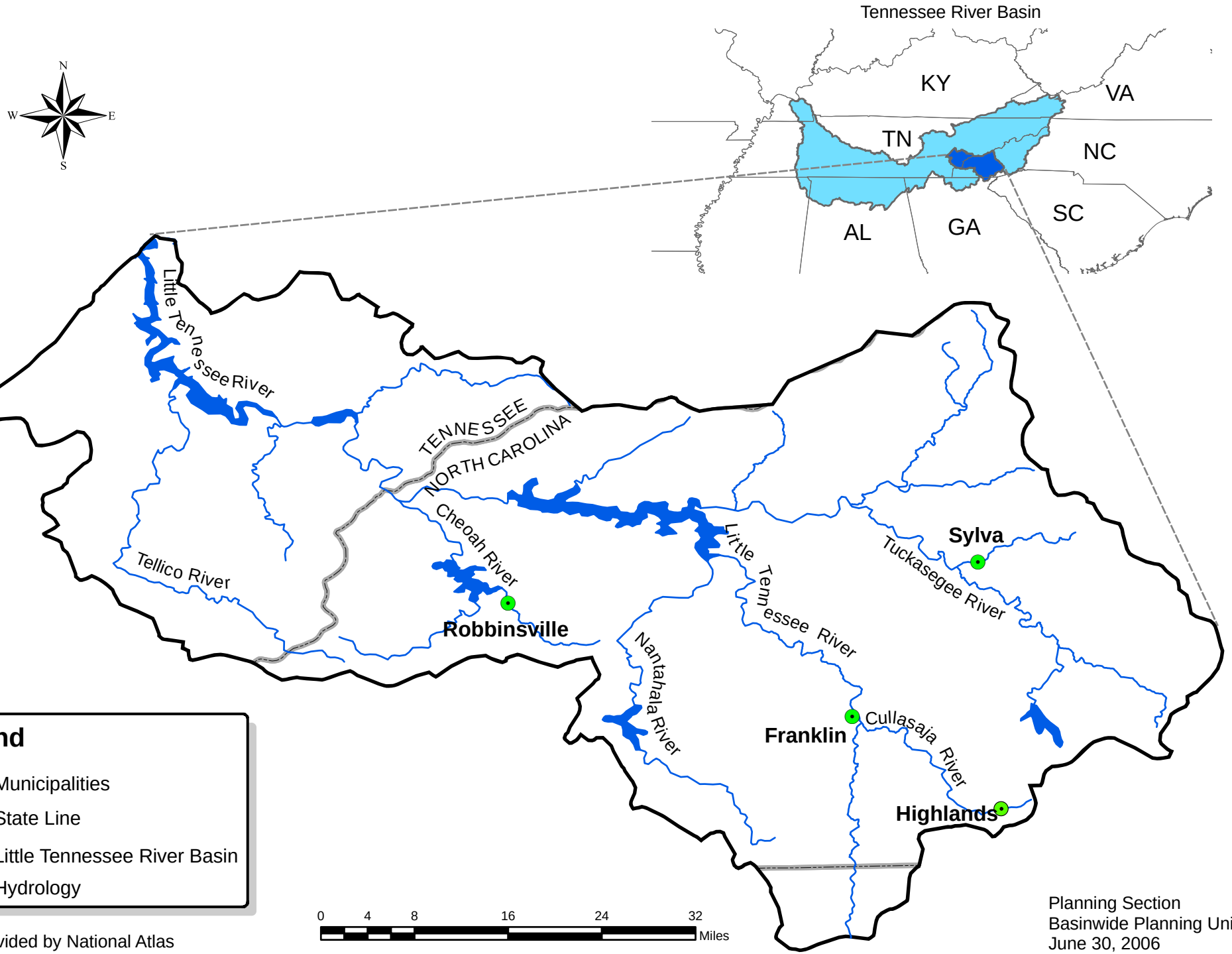
Water Resources

Chapter 11 presents information related to minimum streamflow requirements, interbasin transfers, and the impact to water quality during drought conditions. The chapter also includes the federal cataloging units, or hydrologic units, as they relate to the state subbasin boundaries.

Natural Resources

The Little Tennessee River basin has one of the most outstanding and diverse aquatic communities within the entire state. It is home to a variety of rare species, including crayfish, mussels, fish, aquatic insects, and amphibians. The stretch of Little Tennessee River between Franklin and Fontana Lake (25 miles) has a faunal diversity that rivals any in the state and perhaps in the nation. Forestland continues to comprise a large majority of this basin, owing to its relatively pristine condition. Although habitat fragmentation due to dam construction has occurred throughout this system in North Carolina and Tennessee, it continues to support an incredibly rich and diverse ecosystem. Chapter 12 presents information related to the ecological significance of the basin and identifies endangered and threatened species, significant natural areas and aquatic habitats, and public lands that are locally significant.

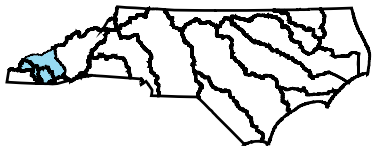
Figure iii General Map of the Entire Little Tennessee River Basin

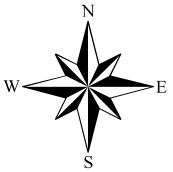


*Data provided by National Atlas

Planning Section
Basinwide Planning Unit
June 30, 2006

Figure iv General Map of the Little Tennessee River Basin in North Carolina





SWAIN
GRAHAM
MACON
JACKSON
CHEROKEE
CLAY

Forney Creek
Noland Creek
Little Tennessee River
Cheoah River
Fontana Lake
Bryson City
Tuckasegee River
Scott Creek
Sylva
Dillsboro
Webster
Caney Fork
Forest Hills
Santeetlah
Santeetlah Lake
Robbinsville
Snowbirds Creek
Nantahala River
Little Tennessee River
Nantahala Lake
Franklin
Cartoogechaye Creek
Tuckasegee River
Thorpe Lake
Cullasaja River
Nantahala River
Highlands

Planning Section
Basinwide Planning Unit
May 15, 2006

6 3 0 6 12
Miles

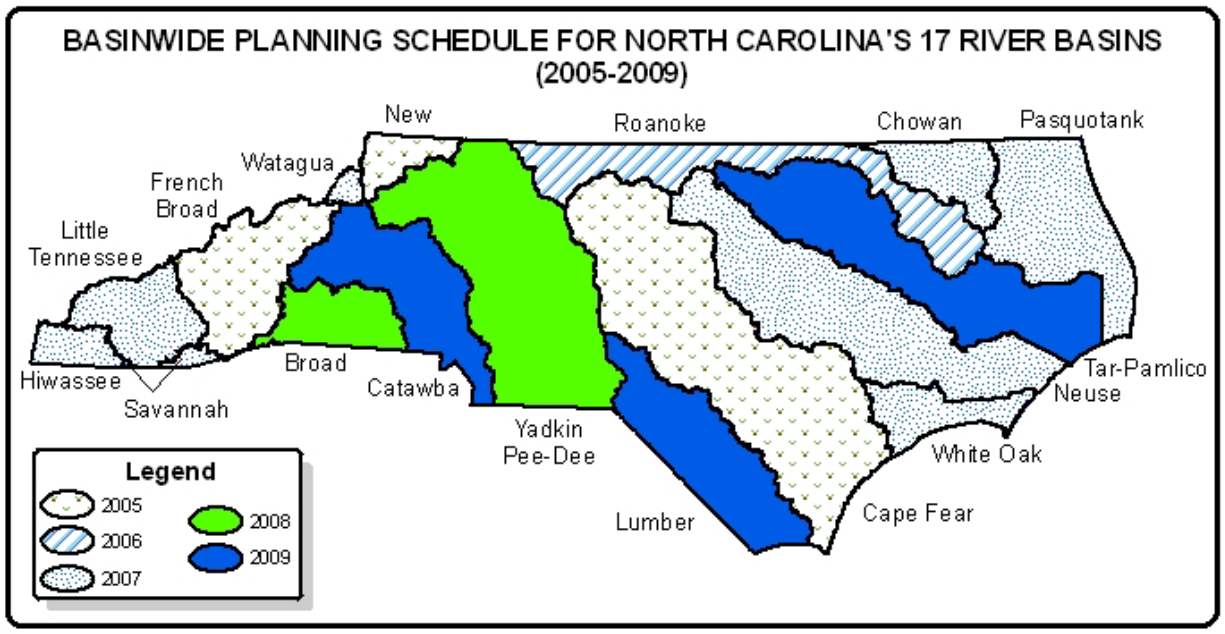
Introduction

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2).

While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 Basinwide Planning Schedule (2005 to 2009)



Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.
- Assure equitable distribution of waste assimilative capacity.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

- Focusing resources on one river basin at a time.
- Using sound ecological planning and fostering comprehensive NPDES permitting by working on a watershed scale.
- Ensuring better consistency and equitability by clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- Fostering public participation to increase involvement and awareness about water quality.
- Integrating and coordinating programs and agencies to improve implementation of point and nonpoint source pollution reduction strategies.

How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

Division of Water Quality Functions and Locations

For more information on the basinwide planning process, DWQ activities, or contacts, visit http://h2o.enr.state.nc.us/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 Basinwide Planning Schedule (2004 to 2011)

Basin	DWQ Biological Data Collection	Draft Out For Public Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2005	7/2007	9/2007	11/2007
Pasquotank	Summer 2005	7/2007	9/2007	12/2007
Neuse	Summer 2005	9/2007	11/2007	1/2008
Broad	Summer 2005	1/2008	3/2008	7/2008
Yadkin-Pee Dee	Summer 2006	3/2008	5/2008	9/2008
Lumber	Summer 2006	1/2009	3/2009	7/2009
Tar-Pamlico	Summer 2007	5/2009	7/2009	9/2009
Catawba	Summer 2007	7/2009	9/2009	12/2009
French Broad	Summer 2007	3/2010	4/2010	7/2010
New	Summer 2008	8/2010	11/2010	1/2011
Cape Fear	Summer 2008	9/2010	11/2010	2/2011
Roanoke	Summer 2004	7/2006	9/2006	1/2007
White Oak	Summer 2004	3/2007	5/2007	6/2007
Savannah	Summer 2004	1/2007	3/2007	8/2007
Watauga	Summer 2004	11/2006	1/2007	9/2007
Hiwassee	Summer 2004	1/2007	3/2007	8/2007
Little Tennessee	Summer 2004	1/2007	3/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

Table 2 Five-Year Planning Process for Development of an Individual Basinwide Plan

Years 1 – 2 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Conduct biological monitoring activities • Conduct special studies and other water quality sampling activities • Coordinate with local stakeholders and other agencies to continue to implement goals within current basinwide plan
Years 2 – 3 **Data Analysis and Collect Information from State and Local Agencies**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Work with state and local agencies to establish goals and objectives • Identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other state/local agencies
Years 3 – 5 **Preparation of Draft Basinwide Plan, Public Review, Approval of Plan, Issue NPDES Permits, and Begin Implementation of Plan**	• Develop draft basinwide plan based on water quality data, use support ratings, and recommended pollution control strategies • Circulate draft basinwide plan for review and present draft plan for public review • Revise plan (when appropriate) to reflect public comments • Submit plan to Environmental Management Commission for approval • Issue NPDES permits • Coordinate with other agencies and local interest groups to prioritize implementation actions • Conduct special studies and other water quality sampling activities

Some Other Reference Materials

There are several reference documents and websites that provide additional information about basinwide planning and the basin's water quality. These include:

- *Supplemental Guide To North Carolina's Basinwide Planning* (January 2007) This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. Visit the website at http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm to download this document.
- *Little Tennessee River Basinwide Assessment Report* (April 2005). This technical report presents physical, chemical, and biological data collected in the Little Tennessee River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website at http://www.esb.enr.state.nc.us/.
- *Little Tennessee River Basinwide Water Quality Management Plan* (May 1997; April 2002). These first basinwide plans for the Little Tennessee basin present water quality data, information, and recommended management strategies for the first two five-year cycles.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager, C.S. and J.P. Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

How to Read the Basinwide Plan

Chapters 1 - 4: Subbasin and Watershed Information

- **Summarizes information and data by subbasin, including:**
  - **Recommendations from the previous basin plan.**
  - **Achievements, current priority issues and concerns.**
  - **Impaired waters and water with notable impacts.**
  - **Goals and recommendations for the next five years by subbasin.**

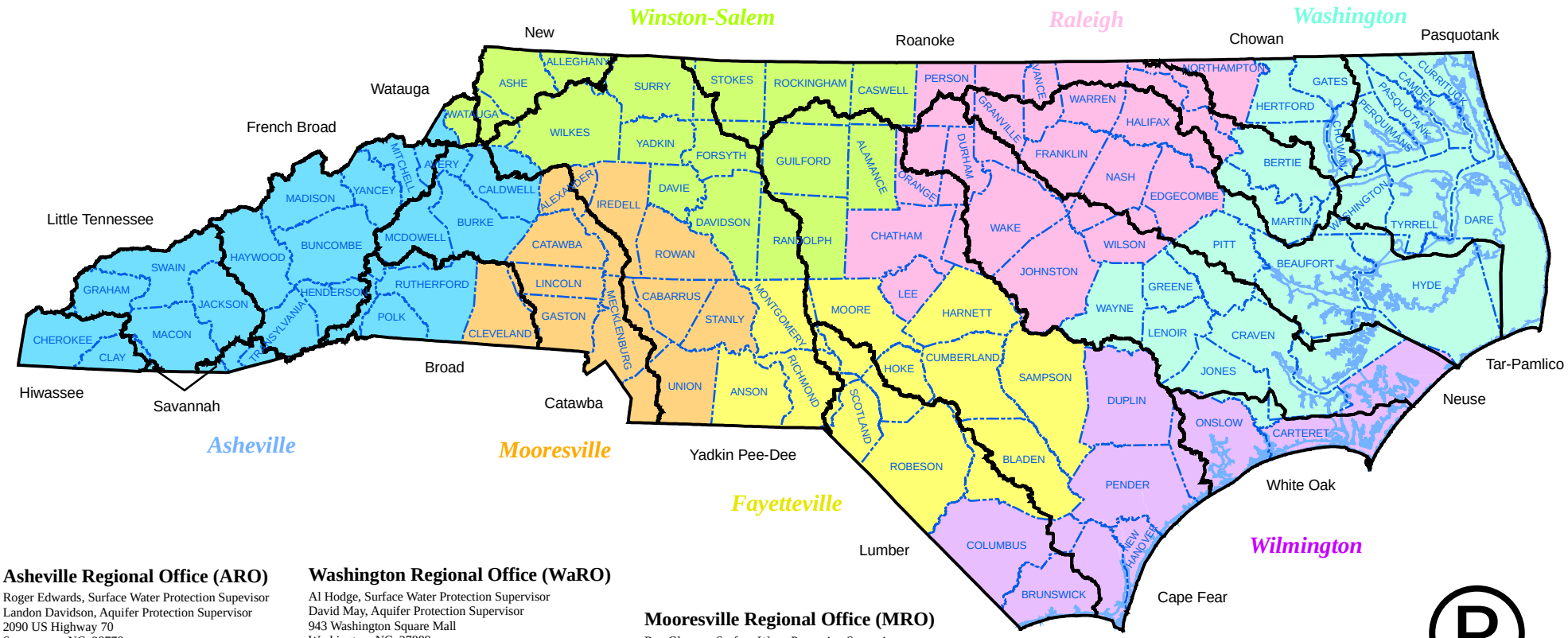
Chapters 5 – 13

- **Presents information on various topics of interest to the protection and restoration of water quality in the basin, including:**
  - **Stream classifications.**
  - **Population and land cover changes.**
  - **Water Quality stressors.**
  - **Agricultural, forestry and permitting activities in the basin.**
  - **Water and natural resources.**
  - **Local initiatives.**

Appendices

- **Population and land use changes over time and local governments in the basin.**
- **Water quality data collected by DWQ, use support methodology and 303(d) listing.**
- **NPDES dischargers and general stormwater permits.**
- **Points of contact, and a glossary of terms and acronyms.**

Figure 2 North Carolina Department of Environment and Natural Resources
Division of Water Quality Regional Offices



Asheville Regional Office (ARO)

Roger Edwards, Surface Water Protection Supevisor
Landon Davidson, Aquifer Protection Supervisor
2090 US Highway 70
Swannanoa, NC 28778
COURIER 12-59-01
Phone: (828) 296-4500
Fax: (828) 299-7043

Avery	Haywood	Polk
Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

Fayetteville Regional Office (FRO)

Belinda Hinson, Surface Water Protection Supervisor
Art Barnhardt, Aquifer Protection Supervisor
225 Green Street
Systel Building Suite 714
Fayetteville, NC 28301-5043
COURIER 14-56-25
Phone: (910) 433-3300
Fax: (910) 486-0707

Anson	Moore
Bladen	Richmond
Cumberland	Robeson
Harnett	Sampson
Hoke	Scotland
Montgomery	

Washington Regional Office (WaRO)

Al Hodge, Surface Water Protection Supervisor
David May, Aquifer Protection Supervisor
943 Washington Square Mall
Washington, NC 27889
COURIER 16-04-01
Phone: (252) 946-6481
Fax: (252) 946-9215
Fax: (252) 975-3716

Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

Raleigh Regional Office (RRO)

Chuck Wakild, Surface Water Protection Supervisor
Jay Zimmerman, Aquifer Protection Supervisor
3800 Barrett Drive
Raleigh, NC 27609
COURIER 52-01-00
Phone: (919) 791-4200
Fax: (919) 571-4718

Chatham	Johnston	Vance
Durham	Lee	Wake
Edgecombe	Nash	Warren
Franklin	Northampton	Wilson
Granville	Orange	
Halifax	Person	

Mooresville Regional Office (MRO)

Rex Gleason, Surface Water Protection Supervisor
Andrew Pitner, Aquifer Protection Supevisor
610 East Center Avenue / Suite 301
Mooresville, NC 28115
COURIER 09-08-06
Phone: (704) 663-1699
Fax: (704) 663-6040

Alexander	Lincoln
Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

Wilmington Regional Office (WiRO)

Ed Beck, Surface Water Protection Supervisor
Charlie Stehman, Aquifer Protection Supervisor
127 Cardinal Drive Extension
Wilmington, NC 28405-2845
COURIER 04-16-33
Phone: (910) 796-7215
Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

Winston-Salem Regional Office (WSRO)

Steve Tedder, Surface Water Protection Supervisor
Sherri Knight, Aquifer Protection Supervisor
585 Waughtown Street
Winston-Salem, NC 27107
COURIER 13-15-01
Phone: (336) 771-5000
Fax: (336) 771-4631

Alamance	Forsyth	Watauga
Alleghany	Guilford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
Davie	Surry	

Central Office

DENR
DIVISION OF WATER QUALITY
1617 MAIL SERVICE CENTER
RALEIGH NC 27699-1617
COURIER 52-01-00
Phone: (919) 733-7015
Fax: (919) 733-2496

NCDENR

Planning Section
Basinwide Planning Unit
July 12, 2006

Chapter 1
Little Tennessee River Subbasin 04-04-01

Including the: Little Tennessee River, Cullasaja River, and Cartoogechaye Creek Watersheds

1.1 Subbasin Overview

Subbasin 04-04-01 at a Glance

Land and Water Area

Total area:	370 mi²
Land area:	369 mi²
Water area:	1 mi²

Population (County)

2000 Est. Pop.: 22,358 people
Pop. Density: 12 persons/mi²

Land Cover (percent)

Forest/Wetland:	89.1%
Water:	0.3%
Urban:	0.9%
Cultivated Crop:	0.9%
Pasture/ Managed Herbaceous:	8.8%

Counties

Macon

Municipalities

Franklin and Highlands

Monitored Stream Statistics

Aquatic Life

Total Streams:	139.0 mi/42.1 ac
Total Supporting:	133.2 mi
Total Impaired:	3.7 mi
Total Not Rated:	2.1 mi/42.1 ac

Recreation

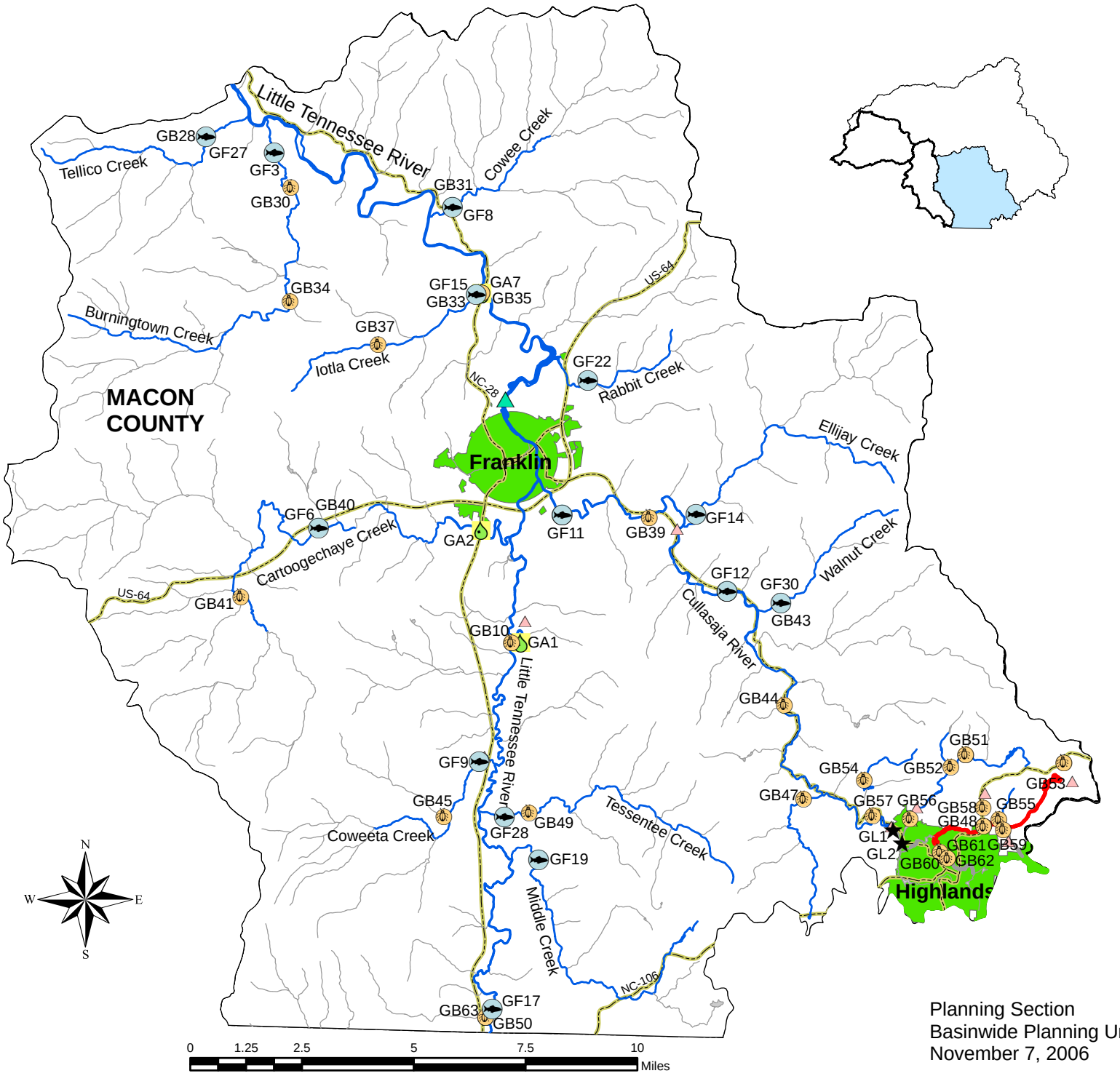
Total Streams:	35.9 mi
Total Supporting:	35.9 mi

The Little Tennessee River originates in Rabun County, Georgia and flows north into Macon County, North Carolina. Subbasin 04-04-01 contains approximately 35 miles of the Little Tennessee River from the state line to the Macon-Swain county line below Tellico Creek. The river upstream of Lake Emory (Porters Bend Dam) has a very gradual gradient as it flows through a broad valley. Below the lake, the gradient steepens and the flow quickens as it flows through the Needmore Tract towards Fontana Reservoir. Major tributaries to the Little Tennessee River in this subbasin include the Cullasaja River and Cartoogechaye Creek; smaller tributaries include Middle, Coweeta, Cowee, Tessentee, Tellico, and Burningtown Creeks.

Headwaters of many tributaries are protected within the Nantahala National Forest. Most tributaries are high gradient streams capable of supporting trout populations in their upper reaches. In the lower reaches, many of the watersheds are farmed or developed and the tributaries are affected by erosion, scour, and sediment deposition. The Town of Franklin and a portion of the Town of Highlands are the large population centers in this subbasin. Strip development is focused along US 23/441 south from Franklin towards Dillard, Rabun Gap, and Mountain City, GA. Low-density residential development is increasing throughout the watershed. Despite the development, almost 90 percent of the subbasin is forested

There are 12 NPDES permitted dischargers in this subbasin. The largest is the Town of Franklin WWTP, which discharges 1.65 MGD into the Little Tennessee River (Lake Emory). This facility is required to monitor whole effluent toxicity. Refer to Appendix V for the listing of NPDES permit holders.

Figure 3 Little Tennessee Subbasin 04-04-01



Legend

Monitoring Stations
- Ambient Monitoring Station
- Benthic Community
- Fish Community
- Lake Monitoring Station
- Recreation Locations

NPDES Discharges
- Major
- Minor

Aquatic Life Use Support Rating
- Impaired
- No Data
- Not Rated
- Supporting

Recreation Use Support Rating
- Impaired
- Primary Roads
- County Boundary
- Municipality
- Subbasin Boundary

Planning Section
Basinwide Planning Unit
November 7, 2006

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Ammons Branch													
2-21-2	WS-III	0.8 FW Miles	From source to Cullasaja River	S	GB55	NI	2001		ND				
Big Creek (Randall Lake)													
2-21-5-1-(0.5)	WS-II;Tr,HQW	3.4 FW Miles	From source to a point 0.7 mile upstream of mouth	S	GB51	G	2001		ND			Sediment	Unknown
					GB51	E	2000						
Big Creek Arm of Lake Sequoyah													
2-21-5-1-(4)	WS-II;Tr,HQW,C	0.6 FW Miles	From a point 0.7 mile upstream of mouth to Lake Sequoyah, Cullasaja River	S	GB56	G	2000		ND				
Burningtown Creek													
2-38	B;Tr	11.7 FW Miles	From source to Little Tennessee River	S	GF3	E	2004		ND			Sediment	Unknown
					GB34	G	2004						
					GB30	E	2004						
Cartoogechaye Creek													
2-19-(1)	WS-III;Tr	7.7 FW Miles	From source to a point 0.5 mile downstream of Lenior Branch	S	GF6	G	2004		ND			Sediment	Unknown
												Habitat Degradation	Unknown
					GB41	E	2004						
					GB40	G	2004						
2-19-(10.5)	B;Tr	2.7 FW Miles	From Town of Franklin water supply intake to Little Tennessee River	S	GA2	NCE			S	GA2	NCE		

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Cowee Creek													
2-29	C;Tr	4.0 FW Miles		**S**					ND			Sediment	Unknown
	From source to Little Tennessee River				GF8	G	2004						
					GB31	E	2004						
Coweeta Creek													
2-10	B;Tr	4.6 FW Miles		**S**					ND				
	From source to Little Tennessee River				GF9	G	2004						
					GB45	E	2004						
Cullasaja River													
2-21-(5.5)	B;Tr	10.6 FW Miles		**S**					ND			Habitat Degradation	Unknown
	From dam at Lake Sequoyah to Little Tennessee River				GB44	G	2004						
					GB39	G	2004						
					GB57	GF	2000						
					GF12	G	1999						
					GF12	G	1999						
					GF11	GF	1999						
					GF11	GF	1999						
Cullasaja River (Lake Sequoyah)													
2-21-(3.5)b	WS-III;Tr,CA	42.1 FW Acres		**NR**	GL1	ID			ND			Nutrient Impacts	Unknown
					GL2	ID						Sediment	Unknown
	From backwaters of Lake Sequoyah to dam at Lake												

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Cullasaja River(Ravenel Lake)													
2-21-(0.5)a	WS-III;Tr	3.7 FW Miles	Source to 0.6 miles downstream of US64 (head of Mirror lake)	I					ND			Toxic Impacts	Unknown
					GB48	F	2004					Habitat Degradation	Impoundment
					GB48	F	2001						
					GB53	NR	2001						
					GB48	F	2000						
					GB53	NI	2000						
2-21-(0.5)b	WS-III;Tr	0.7 FW Miles	From 0.6 miles downstream of US64 (head of Mirror lake) to Mirror lake	ND					ND			Habitat Degradation	Impoundment
												Habitat Degradation	Unknown
												Toxic Impacts	Unknown
Ellijay Creek													
2-21-23	C;Tr	7.2 FW Miles	From source to Cullasaja River	S					ND				
					GF14	G	2004						
Houston Branch													
2-21-5-1-3-(2)	WS-II;HQW	0.9 FW Miles	From Dam at Highlands Reservoir to Big Creek	S					ND				
					GB52	NI	2000						
Iotla Creek													
2-27	C	5.5 FW Miles	From source to Little Tennessee River	S					ND			Nutrient Impacts	Agriculture
					GF15	GF	2004					Habitat Degradation	Construction
					GB37	G	2004					Habitat Degradation	Agriculture
					GB33	G	2004						

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
LITTLE TENNESSEE RIVER													
2-(1)a	C	2.1 FW Miles	From North Carolina-Georgia State line to the confluence of Mulberry Creek	I	GF17	F	2004		ND			Habitat Degradation	Impervious Surface
												Habitat Degradation	Agriculture
					GB50	GF	2004					Habitat Degradation	WWTP NPDES
					GB50	F	2000						
2-(1)b	C	15.9 FW Miles	From the confluence of Mulberry Creek to the confluence of Cartoogechaye Creek	S	GA1	NCE			S	GA1	NCE	Habitat Degradation	Unknown
					GB10	G	2004						
					GB10	GF	1999						
LITTLE TENNESSEE RIVER (Including backwaters of Lake Emory)													
2-(1)c	C	7.3 FW Miles	From the confluence of Cartoogechaye Cr. to a point 0.4 mile upstream of N.C. Hwy. 28 (located 0.42 mile upstream of mouth of Iotla Creek)	S	GA7	NCE			S	GA7	NCE	Total Suspended Solids	WWTP NPDES
					GB35	GF	2004						
LITTLE TENNESSEE RIVER (Including the backwaters of Fontana Lake at normal pool elevation 1708 fee													
2-(26.5)a	B	10.0 FW Miles	From to a point 0.4 mile upstream of N.C. Hwy. 28 (located 0.42 mile upstream of mouth of Iotla Creek) to subbasin 01/02 border	S	GA7	NCE			S	GA7	NCE		
					GB35	GF	2004						
Middle Creek													
2-8	C;Tr	8.8 FW Miles	From source to Little Tennessee River	S	GF19	G	2004		ND				
					GB49	E	2004						

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Mill Creek													
2-21-3	WS-III;Tr	1.3 FW Miles		**NR**					ND			Lack of Organic Material	Unknown
	From source to Mirror Lake, Cullasaja River				GB62	NR	2000					Toxic Impacts	Unknown
					GB61	NR	2000					Habitat Degradation	Impoundment
					GB60	NR	2000					Habitat Degradation	Construction
Rabbitt Creek													
2-23	C;Tr	4.0 FW Miles		**S**					ND			Habitat Degradation	Impoundment
	From source to Lake Emory, Little Tennessee River				GF22	GF	2004					Habitat Degradation	Construction
												Habitat Degradation	Land Clearing
Saltrock Branch													
2-21-1	WS-III	0.8 FW Miles		**NR**					ND			Habitat Degradation	Unknown
	From source to Cullasaja River				GB59	NR	2001						
Skitty Creek (Cliffside Lake)													
2-21-6-(1)	B;Tr	1.9 FW Miles		**S**					ND				
	From source to Dam at Cliffside Lake				GB54	NI	2000						
Tellico Creek													
2-40	C;Tr	5.9 FW Miles		**S**					ND				
	From source to Little Tennessee River				GF27	G	2004						
					GB28	E	2004						
Tessentee Creek													
2-9	C;Tr	8.1 FW Miles		**S**					ND				
	From source to Little Tennessee River				GF28	G	2004						
					GB46	E	2004						

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Turtle Pond Creek													
2-21-8	C;Tr	4.0	FW Miles	**S**					ND				
From source to Cullasaja River					GB47	E	2004						
UT to Cullasaja River(Ravenel Lake)													
2-21-(0.5)aUT2	WS-III;Tr	1.1	FW Miles	**S**					ND				
Source to Cullasaja River					GB58	NI	2001						
Walnut Creek													
2-21-17	C;Tr	4.5	FW Miles	**S**					ND			Habitat Degradation	Construction
From source to Cullasaja River					GF30	NR	2004					Habitat Degradation	Agriculture
					GB43	E	2004						

Table 3 Little Tennessee Subbasin 04-04-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
GF - Fish Community Survey
GB - Benthic Community Survey
GA - Ambient Monitoring Site
GL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2006:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	131.1	FW Miles
NR	m	2.1	FW Miles
I	m	5.8	FW Miles
NR	m	42.1	FW Acres
ND		368.9	FW Miles
ND		11.6	FW Acres

Recreation Rating Summary

S	m	35.9	FW Miles
ND		472.0	FW Miles
ND		53.7	FW Acres

Fish Consumption Rating Summary

I	e	503.1	FW Miles
I	e	53.7	FW Acres
I		4.8	FW Miles

During this assessment period, benthic macroinvertebrate samples were collected at 31 sites. Fish community samples were collected at 14 locations, and ambient water chemistry was monitored at three sites. None of the water quality variables analyzed as part of the ambient chemistry program had statistically significant exceedances over the five-year monitoring period (1999 – 2004) for the Little Tennessee River at Prentiss, for the Little Tennessee River at Iotla, and for Cartoogechaye Creek near Franklin.

Most sites monitored for benthic macroinvertebrates or fish were rated Good or Excellent; no sites were rated Poor. Two sites rated Fair, including the Little Tennessee River near the NC-GA state line and the upper reaches of the Cullasaja River near the Town of Highlands. The Little Tennessee River has at times experienced elevated conductivity due to permitted dischargers in Georgia, and the instream and riparian habitats continue to suffer from poor land use and watershed practices. The upper Cullasaja River continues to be impaired by land use practices in the area in and around the Town of Highlands. More than half of the impaired section (4.8 miles) of the upper Cullasaja River lies upstream of the Town of Highlands. Streams that have consistently been rated Excellent were Coweeta, Turtle Pond, Burningtown, and Tellico Creeks. Refer to the *2005 Little Tennessee River Basinwide Assessment Report* at http://h2o.enr.state.nc.us/esb/Basinwide/LTN2005.pdf and Appendix IV for more information on monitoring.

The riparian zones at many of the sites in the subbasin are narrow, sparsely vegetated with mature trees and mowed lawns, or in pasture. Many of the streams sampled were more turbid than expected for mountain streams. Habitat degradation is attributable to the combination of steep gradients, chronic erosion, and nonpoint source sedimentation. Many of the sites would benefit from bank stabilization and stream restoration techniques.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 3. Table 3 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to Appendix VIII for more information about use support methodology.

Waters in the following sections and in Table 3 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

1.2 Use Support Assessment Summary

Table 4 Summary of Use Support Ratings by Category in Subbasin 04-04-01

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	133.2 mi	35.9 mi
Impaired*	3.7 mi (2.7%)	0.0
Not Rated	2.1 mi 42.1 ac	0.0 0.0
Total	**139.0 mi** **42.1 ac**	**35.9 mi**
Unmonitored Waters		
No Data	368.9 mi 11.6 ac	472.0 mi 53.7 ac
Total	**368.9 mi** **11.6 ac**	**472.0 mi** **53.7 ac**
Totals		
All Waters**	**507.9 mi** **53.7 ac**	**507.9 mi** **53.7 ac**

* The noted percent Impaired is the percent of monitored miles/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification is assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and VIII, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

In subbasin 04-04-01, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Refer to Table 4 for a summary of use support for waters in subbasin 04-04-01.

1.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Appendix VI.

1.3.1 Little Tennessee River [AU# 2-(1)a]

2002 Recommendations
DWQ recommended further communication with GA EPD and stressed the need for BMP installation throughout the watershed in both North Carolina and Georgia.

Current Status
DWQ sampled the fish and benthic communities at sites GF17 and GB50, respectively. Extremely high conductivity levels (highest of any fish site in the basin) continue to show

impacts from point source dischargers. However, the benthic population improved from Fair in 1999 to Good-Fair in 2004. The Little Tennessee River from the state line to the confluence of Mulberry Creek (2.1miles) remains Impaired in the Aquatic Life category because of a Fair bioclassification at site GF17.

The Little Tennessee River watershed above sites GF17 and GB50 is approximately 56 square miles, mostly in Georgia. There are four NPDES permitted facilities within the river's watershed in Georgia. The largest is commonly referred to as Rabun Mills. The Little Tennessee Watershed Association (LTWA) compared their fish community data to discharge operations at Rabun Mills between years 1990 and 2002. Fluctuations in their data correlated well with plant operations upstream. For example, the fish community improved from 1992 to 1993 while the plant was not operating. The plant resumed operation under a more restrictive permit in 1994 and fish populations improved gradually through 1997. This trend reversed in the period 1998 – 2002 and coincided with anecdotal and visual observations of impacts from the discharge. At the time of publication, the plant is again idle. However, problems related to Dillard and Sky City WWTP's, agriculture, road construction, small industries, urbanization, residential development, and failing septic systems remain a concern. Beginning downstream of the NC/GA state line, Little Tennessee River is Designated Critical Habitat for the Appalachia elktoe mussel, further raising the importance of clean water in the river.

2007 Recommendations

Because the Little Tennessee is affected by both point and nonpoint sources of pollution, reversing impairment in this reach will require corrective action on both fronts. DWQ will continue conversations with GA EPD to find opportunities to improve NPDES discharger performance. Protective measures should be written into the NPDES permit for any new operation at the old Rabun Mills plant. These measures should be prepared and made available to potential new owners before assuming operation of the plant.

Ultimately, DWQ is required to develop a TMDL for this river segment and will seek cooperation from Georgia. Georgia will be required to implement the terms of the TMDL once EPA approves it. Local action is also needed to address nonpoint source pollution through installation of BMPs and riparian zone protection/restoration.

1.3.2 Upper Cullasaja River Watershed Including Cullasaja River (Ravenel Lake) [AU# 2-21-(0.5)] and Mill Creek [AU# 2-21-3]

The upper Cullasaja River Watershed is located in southeastern Macon County and contains most of the Town of Highlands and surrounding lands (Figure 4). The 14.4 square mile watershed lies on the Highlands Plateau, a high elevation area noted for exceptionally high rainfall (80 - over 100 inches per year). The watershed was historically logged and many of the streams dammed and/or channelized. Estimates provided by the Upper Cullasaja Watershed Association (UCWA) indicate land use in the watershed was approximately 50 percent residential-commercial-industrial (high level of impervious cover), and 50 percent forested as of 2004. Streams begin demonstrating negative impacts as imperviousness exceeds 10 percent of a watershed (Chapter 6).

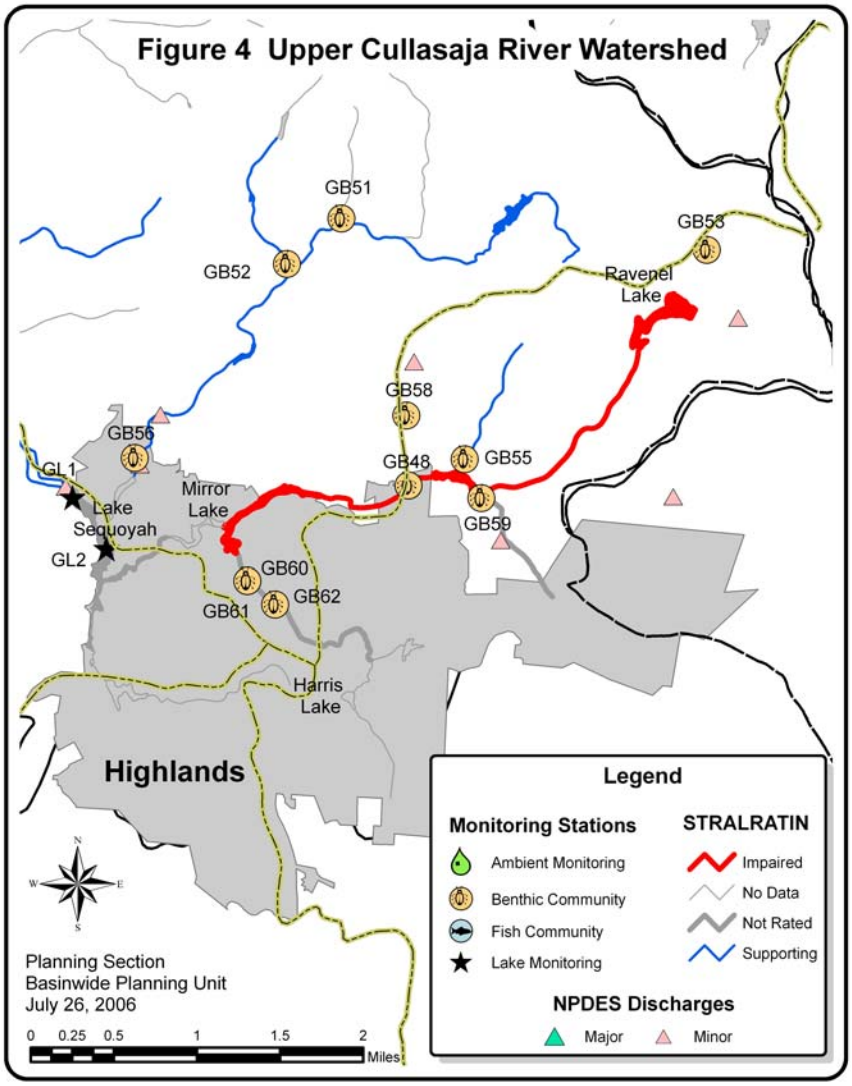
The watershed includes *all* streams draining to the Cullasaja River from its headwaters to Big Creek. Within this watershed, the Cullasaja River from its source to Macon County SR-1545 (2.2 miles) and Mill Creek from its source to Mirror Lake (1.3 miles) are listed as Impaired on

North Carolina's 303(d) list. Other significant drainages include the *Cullasaja River from SR-1545 to Big Creek, Big Creek itself, and Monger Creek.* These streams are not impaired, but are discussed here because of their direct connection to the impaired segments.

2002 Recommendations

The Cullasaja River upstream of Lake Sequoyah (4.8 miles) and Mill Creek (1.4 miles) were impaired for aquatic life based on benthic macroinvertebrate collections in the 1990's. DWQ recommended a variety of strategies that together could improve habitat and water quality in the Upper Cullasaja River Watershed. These recommendations included; developing a plan to address the impact of dams on movement of benthic macroinvertebrates, protection and restoration of vegetated riparian zones, nutrient and pesticide management, and extensive erosion control.

Figure 4 Upper Cullasaja River Watershed



Current Status of the Upper Cullasaja River

DWQ conducted extensive sampling in the upper Cullasaja River Watershed as part of a Watershed Assessment and Restoration Project (WARP) and its Basinwide Assessment program. A wide range of data was collected to evaluate potential causes and sources of impairment. Data collection activities included: benthic macroinvertebrate sampling; assessment of stream habitat, morphology, and riparian zone condition; water quality sampling to evaluate stream chemistry and toxicity; analysis of stream bed sediment for chemistry and toxicity; and characterization of watershed land use, conditions and pollution sources. A total of 17 benthic samples were collected, ranging from Fair on the Cullasaja River (site GB48) to Excellent in Big Creek (site GB51).

The WARP study determined that sedimentation is a significant problem in many of the impoundments, but the primary causes of biological impairment in the Cullasaja River are dam-related issues including the prevention of fish and benthic macroinvertebrate colonization and migration, lower water levels, increased temperature, and shifts in food availability. The lack of

organic microhabitat (sticks and leaf packs), pesticides, elevated cadmium, and low dissolved oxygen levels also contribute to impairment.

Current Status of Mill Creek

Revised assessment methods prevent updating the use support rating for Mill Creek because of its small size. It is, therefore, Not Rated at sites GB60, GB61, GB62. A number of stressors likely act together to impact the biological community in Mill Creek and it will remain on the 303(d) List of Impaired Waters until a documented improvement in the benthic community occurs. Multiple stressors cumulatively cause impairment to the stream, but current information does not identify any single stressor as a primary cause of impairment. The following stressors are believed to cumulatively cause impairment:

1) Scour of benthic macroinvertebrates and organic microhabitats from urban storm flows for areas downstream of Highlands' town center.
2) The lack of upstream colonization sources for the benthic community after storms and other impacts due to toxicants and in-stream impoundments in tributaries.
3) The lack of organic microhabitat (leafpacks, sticks) aquatic species in Mill Creek above the town center. Toxicants are a potential stressor in the Mill Creek mainstem.

According to LTWA data, water quality in Mill Creek has improved slightly, first when the WWTP discharge was moved and second when leaks at the old WWTP were repaired.

Current Status of Other Tributaries

Several other streams were also evaluated during the WARP study. Big Creek, Houston Branch, and Ammons Branch watersheds are mostly forested with minimal disturbance and considered Supporting for aquatic life. Saltrock Branch, however, is heavily impacted by a golf community and would benefit greatly from habitat restoration efforts. Because of its small size, it is Not Rated for aquatic life.

Current Status of Lake Sequoyah

DWQ's Lakes Assessment Unit evaluated Lake Sequoyah in summer 2004. The lake, classified as Trout Waters (Tr), had last been sampled by DWQ in 1999. In 2004, notable problems included elevated temperatures, turbidity, and low dissolved oxygen. Each of these negatively affects trout populations. Frequent rainfall events in the watershed during 2004 may have contributed to the increase in nonpoint source runoff, decreased water clarity, and increased total phosphorus in comparison with levels observed in 1999, a drier year. Aquatic life in Lake Sequoyah is Not Rated because of an insufficient number of samples.

The Upper Cullasaja Watershed Association (UCWA) has noted Lake Sequoyah, along with most impoundments in the watershed, has shown significant impacts from sediment deposition. Much of this sedimentation occurred prior to the enacting of local sediment and erosion control measures but continues as development on steep slopes progresses (Chapter 6). Reducing current sediment loads and removing existing sediment deposits are high priorities for many local watershed residents.

In 2005, Hurricane Ivan aggravated flooding and erosion problems in the watershed leaving large sediment deposits near critical drinking water intakes. The Town of Highlands, Upper Cullasaja Watershed Association, and the Mirror Lake Improvement Association are working together to secure funds to remove built-up sediment in the lakes and pave eroding gravel roads.

Water Quality Initiatives

The Upper Cullasaja Watershed Association and the Town of Highlands have taken many significant steps towards addressing water quality issues over the last assessment period. Since its inception, UCWA's primary focus has evolved from rainfall measurement and erosion control to understanding and implementing effective stormwater management in the watershed.

UCWA received a Regional Geographic Initiative grant from the U.S. Environmental Protection Agency to determine stakeholder concerns and issues within the watershed and define possible solutions. In 2004, UCWA compiled their findings in the Upper Cullasaja River Watershed Strategy and Action Plan. The action plan divides the watershed into four subbasins including: Upper Cullasaja River, Mill Creek, Monger Creek, and Big Creek. General recommendations are given for the entire watershed and specific tasks are outlined for each watershed. In cooperation with agents from North Carolina State University, UCWA proceeded to publish an addendum to the 2004 Action Plan that included a detailed assessment of both Mill and Monger Creeks and an assessment of stream restoration opportunities in those watersheds. Several of the key recommendations supported by DWQ are outlined below under "2007 Recommendations."

Concurrent with the efforts described above, UCWA has been collecting monthly rainfall data throughout the Highlands Plateau since 2000 and joined the Volunteer Water Information Network (Chapter 13) program in 2005. With the help of this data and future data, UCWA plans to work with the Town of Highlands to develop and implement the town's comprehensive stormwater management plan.

The Town of Highlands has received a $40,000 Clean Water Management Trust Fund grant to develop a new stormwater management plan. The plan will include an inventory of existing stormwater infrastructure, mapping of the stormwater system, stormwater modeling, preparation of a Master Plan document, development of a stormwater-related capital improvement plan, financial analysis, and an ordinance and policy review. Data provided by UCWA will be instrumental in preparation of this plan. UCWA will also continue to seek opportunities to partner with the Town of Highlands in managing urban stormwater runoff through specific retrofit, conservation, and BMP-based projects.

The Town of Highlands receives drinking water from the Cullasaja and Big Creek watersheds. In 2005, the Town extended its extraterritorial jurisdiction (ETJ) into areas outside the Town limits, encompassing a large portion of the watershed. One objective for extending the ETJ was to better manage the Cullasaja and Big Creek watersheds, which are classified WS-III and WS-II respectively. Over the next five years, UCWA plans to work with the Town of Highlands in a project that would identify and map perennial streams in these watersheds, both inside and outside the Town limits, which are not currently identified on USGS maps. This will make better protection of water resources possible through enforcement of the natural vegetative buffer requirements in the Town's existing watershed regulations. UCWA also intends to provide documentation of soil erosion and sources of sediment loading in these streams.

2007 Recommendations

Substantial planning and assessment exercises were successfully completed during the last assessment cycle. Two documents, the Upper Cullasaja Watershed Strategy and Action Plan (UCWA, 2004) and the WARP study report (DENR, 2002) provide extensive recommendations and justification for improved management and restoration activities in the watershed. During the next assessment cycle, efforts should be focused on implementing those recommendations.

Of the many recommendations outlined in these documents, DWQ feels the following recommendations are the highest priority. They are listed in no particular order.

- Evaluate and implement the following at each of the impoundments in the upper Cullasaja River watershed; minimum and/or bypass flows, sediment transport devices, and fish passages. Doing so will allow passage of aquatic organisms and help address sediment build up, elevated temperatures, and low dissolved oxygen levels. If the problems associated with dams are not addressed, then the recovery potential for the Cullasaja River is limited and other strategies listed below will have limited effect.
- Complete restoration projects at all sites identified in the Upper Cullasaja Watershed Strategy and Action Plan. Successful completion will improve habitat conditions and stormwater management in the watershed.
- Pesticide and nutrient management programs should be evaluated and improved to further decrease the use of these materials and their potential to enter lakes and streams. Homeowners and landscapers should also be educated about the responsible use of pesticides, fertilizers, and hydroseed mix.
- Woody vegetation should be planted along cleared streams, and large woody debris and rock clusters should be placed in the stream channel where wooded buffers are not planted. This action will stabilize eroding streambanks, provide shade, and produce leaf packs and other organic instream habitat.

1.4 Status and Recommendations for Waters with Noted Impacts

Based on DWQ's most recent use support methodologies, the surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Refer to Section 1.1 for more information about AU#. Nonpoint source program agency contacts are listed in Appendix VII.

1.4.1 Burningtown Creek [AU# 2-38]

Current Status

Burningtown Creek is the largest tributary to the Little Tennessee River downstream of Franklin. Compared with much of the county, its watershed is largely undeveloped excepting light residential and agricultural activities. The stream provides habitat for several sensitive species including the spotfin chub, hellbender salamander, smoky dace, and the sicklefin redhorse. DWQ sampled the fish and benthic communities at sites GF3 and GB30, respectively. Both sites received Excellent bioclassifications, but some minor impacts from sedimentation were noted. DWQ also sampled the upstream benthic community at site GB34. The site rated Good, slightly lower than the downstream site.

LTWA monitors Burningtown Creek and two of its tributaries, Younce Creek and Left Prong Burningtown Creek. Their data shows a healthy fish population in Burningtown Creek and the Left Prong. Younce Creek is degraded, but by unknown causes. They report impacts from cattle near the mouth of Burningtown Creek.

2007 Recommendations
Further investigation is needed into the causes of degradation in Younce Creek. Once identified, an appropriate solution can be determined. Cattle owners should consult with the Macon County Soil and Water Conservation District to find ways to reduce impacts from their livestock.

1.4.2 Cartoogechaye Creek Watershed Including Cartoogechaye Creek [AU# 2-19-(1) and 2-19-(10.5)], Allison Creek [AU# 2-19-3], Blaine Branch [AU# 2-19-13], Jones Creek [AU# 2-19-2], Mill Creek [AU# 2-19-9], Wayah Creek [AU# 2-19-8-(8)]

Current Status
Cartoogechaye Creek is the second largest tributary to the Little Tennessee River in this subbasin. It enters the river near the backwaters of Lake Emory. The creek's watershed drains west-central Macon County, and provides drinking water to the Town of Franklin. The benthic community at site GB40 rated Good in 2004, down from Excellent in 1999. The habitat was good, indicating the decline is likely due to a change in water quality. Site GB41, in the headwaters, rated Excellent. The fish community at site GF6 rated Good. The watershed becomes more urbanized and stresses stream health as it approaches Franklin.

Special Studies
The Little Tennessee Watershed Association (LTWA) also monitored fish communities in the Cartoogechaye watershed at 14 locations. Their monitoring results indicate a high incidence of the parasitic infection called blackspot. Blackspot is often associated with organic enrichment, but can be found in healthy streams. LTWA reports blackspot was in decline in 2006. Further monitoring will determine if the trend will continue.

LTWA also evaluated several tributaries to Cartoogechaye Creek. Blaine Branch and Mill Creek (not to be confused with Mill Creek in Highlands) suffer from channelization, bank erosion, development, and riparian zone disturbance. LTWA suspects Wayah Creek may have been impacted by the LBJ Job Corps waste water treatment plant, but this plant recently connected to the Town of Franklin sewer system. LTWA expects conditions in the creek to improve after this connection. Allison Creek is under increased pressure from development.

In 1998, LTWA monitoring noted a dramatic decline in the fish community at a site near the Macon County Recreation Park. Further investigation into the decline led to the identification of an undocumented point source pollution problem. The problem was corrected and the fish community improved immediately. This successful resolution indicates the practical value of volunteer monitoring programs. Local volunteer programs provide monitoring resolution DWQ does not have the resources to provide. In this case, local actions were able to correct a water quality problem in a timely manner.

2007 Recommendations
Nutrient and erosion control measures are necessary on both agricultural and residential areas. Residential landowners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality

in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Macon County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

The Cartoogechaye Creek watershed also presents many opportunities for stream restoration and stabilization projects. The detailed watershed information provided by LTWA should be used to direct resources toward the most significant problems in the watershed.

1.4.3 Cowee Creek [AU# 2-29]

Current Status
Cowee Creek drains the northeast corner of Macon County, an area with historical ruby mining operations and scattered residential and pasture areas. DWQ sampled the fish community at site GF8 and the benthic community at site GB31 in 2004. The fish community was rated Good and the benthic community rated Excellent, improving steadily from Good-Fair in 1994. Biologists noted turbid water and slight sedimentation, but also collected the most pollution intolerant fish species than at any other site in the subbasin.

LTWA collected fish samples on Cowee Creek and three of its larger tributaries: Caler Fork, Matlock Creek, and Beasley Creek. Their results compare well with the DWQ samples and indicate the fish community in the downstream reach is in good health. However, they note significant impacts in and above Caler Fork, where sediment has a more significant impact. LTWA measured the single largest drop in stream health at their site on Caler Fork. They report turbidity problems on this stream even during dry spells. LTWA noted Matlock Creek is also deteriorating, perhaps due to an increase in organic loading from development. Beasley is in good condition and supports a healthy population of rainbow trout.

2007 Recommendations
Further investigation is needed to determine the cause of deterioration observed in Matlock and Caler Creeks. If residential activities are identified as a primary stressor, residents should implement BMPs to reduce runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. Residents are also encouraged to report sediment problems to the DENR Regional Office in Asheville.

1.4.4 Iotla Creek [AU# 2-27]

Current Status
The Iotla Creek watershed contains large amounts of agriculture and the Macon County Regional Airport. Impacts from these land use practices are evident in both DWQ and LTWA sample results. DWQ sampled this stream in two locations in 2004. The fish and benthic communities were evaluated downstream of the airport at sites GB33 and GF15. At this location, the benthic community rated Good and the fish community rated Good-Fair. Biologists noted sediment problems, nutrient enrichment, and trash. The fish habitat rated lowest of any in the subbasin.

The benthic community was sampled upstream at site GB37 and received a Good bioclassification. The habitat at this site is similar to the downstream benthic site. An agricultural ditch enters the creek just upstream of the sample location and adds to the sediment problems observed.

Samples collected by LTWA confirm the instream habitat in Iotla Creek is some of the poorest in the basin and much of the lower reach has been channelized. Despite these problems, LTWA notes the spotfin chub has been collected near the confluence with the Little Tennessee River.

2007Recommendations
The nutrient and sediment impacts from agricultural activities should be reduced. These impacts can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Macon County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

1.4.5 Little Tennessee River and Lake Emory [AU# 2-(1)b and 2-(1)c]

Current Status
The Little Tennessee River from the GA-NC state line to Mulberry Creek is considered Impaired and is discussed in section 1.3.1. The Little Tennessee River from Mulberry Creek to Lake Emory is not impaired and is discussed here. The Little Tennessee River gains volume rapidly as it flows into North Carolina, becoming a major river. Land use in the watershed south of Franklin is a mix of light commercial, agriculture, scattered residences and broken tracts of forest. DWQ sampled the benthic community at GB10 and maintains ambient sampling stations at site GA1 and GA7. Habitat problems include very poor riparian vegetation, lack of pools, and infrequent riffles. DWQ performed a seasonally and flow adjusted trend analysis on the ambient chemistry and determined significant upward trends in both total phosphorus and water temperature over the period 1994 – 2004.

The Lake Emory segment is a run-of-river impoundment created in the 1920's by construction of Porter Bend Dam at Franklin. DWQ considered it shallow and eutrophic based on samples collected in 1988. In 1994, DWQ Lake Assessment Unit ceased sampling this reservoir because sediment accumulation prevented boat access. Sediment deposition had become so pronounced that vegetation had become established on sediment bars and the upstream areas resembled a braided stream rather than a lake. DWQ determined Lake Emory was no longer functioning as a reservoir and TVA gave it an ecological health rating of Very Poor.

The USGS conducted an analysis of sediment loads to Lake Emory from 2000-2001. The study compared sediment loads from the Cullasaja River, Cartoogechaye Creek, and the mainstem Little Tennessee River. This study noted that riparian agricultural activities and increasing urbanization in the upper portion of the watershed in the towns of Highlands and Franklin have increased the river's sediment load. The study also notes the dam has trapped many of those sediments, protecting the downstream habitat in the Needmore area.

Downstream of Lake Emory, water quality and habitat improves significantly. TVA has been monitoring this reach since 1998, rating it Good or Excellent each time. This section of river is one of the healthiest major rivers in the southeast and supports a complete biological community.

In 2004, a major conservation purchase was completed in the Needmore area, protecting the flood plain along 26 miles of the river (See section 1.5.1). While this purchase was a significant move forward towards permanent protection for the river, recent data from NCWRC, USFWS, and citizen observations indicate the river remains threatened by upstream pollution. Unpublished data from NCWRC indicate the Appalachian elktoe population below Lake Emory is in decline. Excess sediment is being deposited in the reach as development continues upstream and outside the Needmore Tract without sufficient erosion control. Historically, many wetland areas both in and around the Needmore tract we damaged and now need restoring.

2007 Recommendations
The heavy sediment in Lake Emory and increasing loads in the downstream reach demonstrates the need for strong sediment and erosion control, wetland restoration, and streambank stabilization throughout the entire watershed. Macon County has adopted a Soil Erosion & Sedimentation Control Ordinance that helps reduce erosion problems originating from certain new land disturbing activities. This ordinance must be vigorously enforced. Erosion from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Macon County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding. Wetland restoration opportunities should be pursued as they arise.

1.4.6 Rabbit Creek [AU# 2-23]

Current Status
The Rabbit Creek watershed lies northeast of Franklin and drains the Holly Springs community. DWQ evaluated the fish community at site GF22 in 2004, when it received a Good-Fair bioclassification. The riparian zone was significantly degraded and needs restoration. The riparian zone included manicured lawns, pastures, unstable banks, and invasive weeds. The stream was more turbid than most streams in the subbasin.

LTWA has been sampling Rabbit Creek for many years. From 1990 to 2000, the fish community rating steadily improved. Recovery from disturbance during golf course construction and removal of cattle access may be responsible for the improvement. Unfortunately, LTWA data began showing a decline in 2001 and 2002. The negative changes appear to be related to increasing sedimentation originating from poor land use practices in Cat Creek, a tributary to Rabbit Creek.

Cat Creek suffers from severe habitat degradation due to land clearing activities, channelization, livestock access, and several small impoundments. In 2000, a half-mile reach of Cat Creek was re-channelized and the riparian zone was cleared. This action resulted in a significant increase in streambank erosion and sediment delivery to Rabbit Creek.

2007 Recommendations
Restoration in Cat Creek will likely improve conditions in Rabbit Creek. Restoration options should be evaluated and if deemed feasible, a restoration plan for Cat Creek should be developed and executed. In the meantime, residential landowners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free

of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Macon County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

1.4.7 Walnut Creek [AU# 2-21-17]

Current Status
Walnut Creek is a tributary to the middle reaches of the Cullasaja River and is adjacent to the Ellijay Creek watershed. It is a high gradient Southern Appalachian-type trout stream with plunge pools and riffles. DWQ sampled the fish and benthic communities in 2004 (sites GF30 and GB43). The benthic site was sampled in response to complaints of dead fish, soapy water, and development. There are no NPDES discharges in the watershed, but conductivity was elevated for a mountain stream. The results from the benthic sample suggest instream habitat appears to be declining. Increased residential development along the stream banks and agricultural activities in the watershed are affecting the riparian and in-stream habitats by increasing the sediment load. The stream is significantly embedded with sand at site GB43. The fish site technically qualified as a regional reference site based on land use calculations and despite noted sediment problems. The fish community was typical of many un-impacted trout streams (low species diversity, a reproducing population of naturalized rainbow trout, and mottled sculpin being the numerically dominant species).

2007 Recommendations
Residential landowners can use a variety of techniques to reduce sediment runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Macon County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

1.5 Additional Water Quality Issues within Subbasin 04-04-01

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

This section also discusses ideas, rules and practices in place to preserve and maintain the pristine waters of the Little Tennessee River basin. This is particularly important because many of the waters are designated as high quality or outstanding resource waters (HQW and ORW, respectively). Those surface waters given an Excellent bioclassification may be eligible for reclassification to a High Quality Water (HQW) or Outstanding Resource Water (ORW). These streams are shown in Table 3. Special management strategies, or rules, are in place to better

manage the cumulative impact of pollutant discharges, and several landowners have voluntarily participated in land conservation, stabilization, and/or restoration projects.

1.5.1 The Land Trust for the Little Tennessee River Corridor Protection Project: Protecting Water Quality Through Land Conservation

The LTLT is a locally-led 501(c)3 non-profit organization based in Macon County with a mission to conserve the waters, forests, farms, and heritage of the Upper Little Tennessee and Hiwassee River Valleys. Since 1997, the LTLT has been a driving force for water quality protection in the Little Tennessee basin. Through a multitude of partnerships, LTLT has channeled resources into three programs: rural land conservation, land stewardship and restoration, and outreach and education—each of which is having direct and positive impacts on water quality in the basin.

Principal among these, LTLT's rural land conservation program helps to protect water quality by protecting private lands, such as headwater forest areas or bottomland floodplains, from inappropriate development. This is accomplished by working with private landowners to place conservation easements on their property, by accepting gifts of land, and by purchasing at-risk properties.

Since January 2002, a strategic goal of LTLT has been the protection, through easement or purchase, of 75 percent of the land fronting the main stem of the Little Tennessee River between Franklin and Fontana Reservoir. The 25 miles of free-flowing Little Tennessee River downstream of the town of Franklin is considered by many to be the "Noah's Ark" of Blue Ridge rivers due to its rich biological diversity, being home to half the native, freshwater fish species in North Carolina and the greatest diversity of freshwater mussels in the State. The river corridor also encompasses the most intact archeological landscape remaining of the 18th century Cherokee and is a key link in a forested corridor connecting the Nantahala and Cowee Mountain Ranges.

A keystone to this river corridor conservation project was achieved in January 2004, when the 4500-acre Needmore Tract was purchased by the State of North Carolina. The Tract encompasses 26 miles of Little Tennessee River frontage-- over half of this reach of river--along with 37 miles of tributary streams. LTLT helped unite efforts by rural residents, local governments, sportsmen and environmentalists to conserve this extraordinary landscape. The $19 million dollar purchase was made possible by $7.5 million from the Ecological Enhancement Program, $6.6 million from the Clean Water Management Trust Fund, $1.5 million from the Natural Heritage Trust Fund, $2 million from the US Fish and Wildlife Service and $2 million from private foundations and individual donations, including from LTLT and its supporters. The Tract is now managed by the NC Wildlife Resources Commission.

LTLT has continued to expand this work to conserve this entire river corridor, both upstream and downstream of Franklin. By December 2006, LTLT expects to have protected 16 additional parcels along this lower reach of the Little Tennessee River, totaling 663 acres and 5.44 miles, bringing the total river frontage protected to 63 percent. In addition, LTLT continues to protect key nodes along the Little Tennessee River upstream of Franklin, with 6 parcels containing over 180 acres and almost 3 miles of river frontage protected so far.

1.5.2 Management Strategies for Water Quality Protection

Municipalities and smaller outlying communities are being pressured to expand and this involves construction and/or development in areas of pristine waters along the Little Tennessee River and its tributaries. High Quality Water (HQW) and Outstanding Resource Water (ORW) are supplemental classifications to the primary freshwater classification(s) placed on a waterbody. Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody. Below is a brief summary of these strategies and the administrative code under which the strategies are found. More detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/. Definitions of the primary and supplemental classifications can be found in Chapter 5.

HQW is intended to protect waters with water quality higher than the state's water quality standards. In the Little Tennessee River basin, waters classified as Water Supply I and II (WS-I and WS-II), ORW, and waters designated by the NC Wildlife Resources Commission (WRC) as native (wild) trout waters are subject to HQW rules. Streams that petitioned for WS-I or WS-II or are considered Excellent based on biological and physical/chemical parameters may qualify for the HQW supplemental designation.

New discharges and expansions of existing discharges may, in general, be permitted in waters classified as HQW provided that the effluent limits are met for dissolved oxygen (DO), ammonia/nitrogen levels (NH_3-N), and the biochemical oxygen demand (BOD_5). More stringent limitations may be necessary to ensure that the cumulative effects from more than one discharge of oxygen-consuming wastes will not cause the dissolved oxygen concentration in the receiving water to drop more than 0.5 milligrams per liter (mg/l) below background levels. Discharges from single-family residential structures into surface waters are prohibited. When a discharge from an existing single-family home fails, a septic tank, dual or recirculation sand filters, disinfection, and step aeration should be installed (Administrative Code 15A NCAC 2B .0224)

In addition to the above, development activities which require an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). Under these rules, stormwater management strategies must be implemented if development activities are within one mile of and draining to waters designated as HQW. The low-density option requires a 30-foot wide vegetative buffer between development activities and the stream. This option can be used when the built upon area is less than 12 percent of the total land area or the proposed development is for a single-family residential home on one acre or greater. Vegetated areas may be used to transport stormwater in the low-density option, but it must not lead to a discrete stormwater collection system (e.g., constructed). The high-density option is for all land disturbing activities on greater than one acre. For high-density projects, structural stormwater controls must be constructed (e.g., wet detention ponds, stormwater infiltration systems, innovative systems) and must be designed to control runoff from all surfaces affected by one inch or more of rainfall. More stringent stormwater management measures may be required on a case-by-case basis where it is determined additional measures are needed to protect and maintain existing and anticipated uses of the water (Administrative Code 15A NCAC 2H .1006).

ORWs are unique and special surface waters that have some outstanding resource value (e.g., outstanding fish habitat and fisheries, unusually high levels of water-based recreation, special ecological or scientific significance). No new discharge or expansions on existing discharges are permitted. Rules related to the development activities are similar to those for HQW, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). In addition, site-specific stormwater management strategies may be developed to protect the resource values of these waters.

Many of the streams in this subbasin are also classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Those streams noted as having Excellent bioclassifications in Table 3 may qualify for HQW or ORW classification. There may also be many more streams in the basin that qualify for such designation that DWQ has not monitored. DWQ relies on citizen requests to initiate the stream reclassification process (See Section 5.1.4) and encourages requests for reclassification to HQW or ORW when it is warranted. Appropriate stream classification will help to protect water quality in the long-term.

Native Southern Appalachian Brook Trout occupy many high elevation streams in the Little Tennessee River Basin. They are the only trout native to the southern Appalachian Mountains and require clear, cold streams to survive. They are very sensitive to excess sediment. Efforts to restore and expand their populations across the basin will benefit from designation as HQW or ORW. Those streams that can support Native Appalachian Brook Trout should be identified and evaluated for qualification as HQW or ORW.

1.5.3 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the Little Tennessee River basin. Hundreds of permit applications for onsite septic systems are approved every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in both Georgia and North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the

warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

1.5.4 Floodplain Protection

The riverside land that gets periodically inundated by a river's floodwaters is called the floodplain. Floodplains serve important purposes. They:

- temporarily store floodwaters,
- improve water quality,
- provide important habitat for river wildlife, and
- create opportunities for recreation.

Natural floodplains help reduce the heights of floods. During periods of high water, floodplains serve as natural sponges, storing and slowly releasing floodwaters. The floodplain provides additional "storage," reducing the velocity of the river and increasing the capacity of the river channel to move floodwaters downstream.

When the river is cut off from its floodplain by levees and dikes, flood heights are often increased. The construction of levees along the Lower Missouri River, for example, has increased flood heights by as much as twelve feet. By contrast, protected floodplain wetlands along the Charles River in Massachusetts store and slowly release floodwaters -- providing as much "storage" as a medium-sized reservoir.

Natural floodplains also help improve water quality. As water courses through the floodplain, plants serve as natural filters, trapping sediments and capturing pollutants. Nitrogen and phosphorous (found in fertilizers) that wash off farm fields, suburban backyards and city streets ignite a chemical chain reaction which reduces the amount of oxygen in the water, suffocating fish and other aquatic organisms.

Many floodplain plants will use nitrogen and phosphorous before they can reach the river, improving water quality. Many cities have built artificial wetlands to reduce water treatment costs. Studies of heavily polluted waters flowing through Tinicum Marsh in Pennsylvania, for example, have shown significant reductions in phosphorous and nitrogen. The water treatment value of Georgia's 2,300-acre Alcovy River Swamp is more than $1 million a year. Floodplains also play an important role in the recharging of groundwater supplies (American Rivers, 2006).

County governments are strongly encouraged to adopt and implement comprehensive floodplain protection. Doing so will help protect its aquatic resources over the long-term. Guidance on floodplain ordinance adoption is provided by the Association of State Flood Plain Managers a www.floods.org.

1.5.5 Special Management Strategies for Threatened and Endangered Species

Several streams in Little Tennessee River subbasin 04-04-01 are home to Federally listed Threatened and Endangered Species. The Little Tennessee River hosts the Appalachian Elktoe, Littlewing Pearlymussel, and the Spotfin Chub. The Spotfin Chub is also found in 11 tributaries to the Little Tennessee River downstream of Lake Emory including Cowee Creek. Recent studies indicate the Spotfin may also be present in Licklog Creek, pushing the total colonized

tributaries to 12. The entire river from the GA/NC state line to Fontana Lake is designated as critical habitat. Section .0100 of the Administrative Code states the following:

> Certain waters provide habitat for federally-listed aquatic animal species that are listed as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act, 16 U.S.C. 1531-1544 and subsequent modifications. Maintenance and recovery of the water quality conditions required to sustain and recover federally-listed threatened and endangered aquatic animal species contributes to the support and maintenance of a balanced and indigenous community of aquatic organisms and thereby protects the biological integrity of the waters. The Division shall develop site-specific management strategies under the provisions of 15A NCAC 2B .0225 or 15A NCAC 2B .0227 for those waters. These plans shall be developed within the basinwide planning schedule with all plans completed at the end of each watershed's first complete five year cycle following adoption of this Rule. Nothing in this Rule shall prevent the Division from taking other actions within its authority to maintain and restore the quality of these waters.

An interagency team from the USFWS, the NC Wildlife Resources Commission and the NC Natural Heritage Program was asked to develop technical reports to support NCDWQ's development of site-specific management strategies to restore water quality in the Little Tennessee River Basin. It is intended to provide a framework for getting additional stakeholder input prior to formulating the water quality management strategy which will be completed through rule-making by NCDWQ (with the requisite public involvement and Environmental Management Commission oversight).

Chapter 2
Little Tennessee River Subbasin 04-04-02
Including: The Tuckasegee River Watershed and Fontana Lake

2.1 Subbasin Overview

Subbasin 04-04-02 at a Glance

Land and Water Area

Total area:	1,021 mi²
Land area:	998 mi²
Water area:	23 mi²

Population Statistics

2000 Est. Pop.:	42,815 people
Pop. Density:	24 persons/mi²

Land Cover (percent)

Forest/Wetland:	93.5%
Surface Water:	2.3%
Urban:	0.6%
Cultivated Crop:	0.3%
Pasture/ Managed Herbaceous:	3.3%

Counties

Jackson, Swain and Graham

Municipalities

Dillsboro, Sylva, Webster, Forest Hills and Bryson City

Monitored Streams Statistics

Aquatic Life

Total Streams:	155.9 mi/10,947.9 ac
Total Supporting:	150.6 mi
Total Not Rated:	5.3 mi/10,947.9 ac

Recreation

Total Streams:	57.2 mi/170.6 ac
Total Supporting:	26.5 mi
Total Impaired:	30.7 mi/170.6 ac

This subbasin drains 1,021 square miles. The majority of the subbasin lies in Jackson and Swain counties, but small portions of Graham and Macon counties are also included.

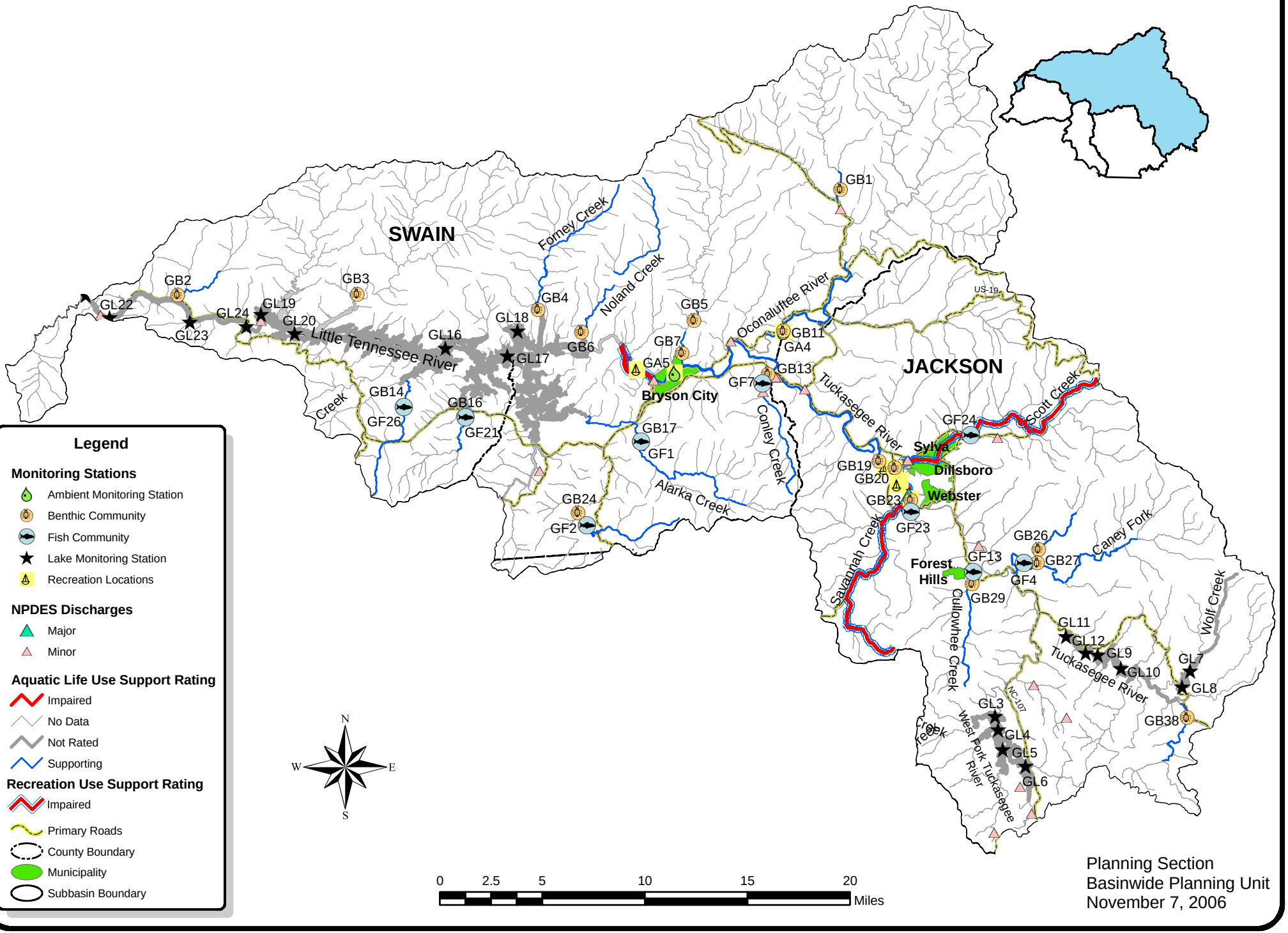
Fontana Lake is the largest impoundment in this region and the body of water to which all streams in this subbasin flow. Fontana Lake/Reservoir, operated by the Tennessee Valley Authority, is the result of damming the Little Tennessee River in the 1940's near Fontana Village on the Graham/Swain County line. Flood control and hydroelectric power generation are the primary purposes for Fontana Lake, though recreational use is growing steadily.

The principle tributaries to the Little Tennessee River are the Oconaluftee River and the Tuckasegee River. This subbasin contains over 1,390 miles of streams and rivers and 12,456 acres of lakes and ponds.

Much of the catchment to the north of the Little Tennessee River is within either the Great Smoky Mountains National Park or the Cherokee Indian Qualla Boundary. Most streams on the north side of the lake are in a roadless area and can only be reached by hiking trails or boat across Fontana Lake. Much of the remainder of this subbasin is included in the Nantahala National Forest, although this does not preclude other land uses.

The largest towns in the subbasin are Bryson City, Cherokee, Cullowhee, and Sylva. The area also contains some of the most pristine and some of the highest quality waters in the State. It also contains some of the most famous trout streams in North Carolina, including Hazel Creek, Forney Creek, Deep Creek and Noland Creek. Portions of Alarka Creek, the Tuckasegee River, Caney Fork, and most of the Oconaluftee River catchments are classified as High Quality Waters (HQW). Small streams, formally classified for water supply, have also been reclassified as HQW: Whiterock, Wolf, Clingman's, and Twentymile Creeks and Long, Jenkins, Dednan, and Moore Spring Branches. The Tuckasegee River upstream of Tanassee Creek is classified as Outstanding Resource Waters.

Figure 5 Little Tennessee Subbasin 04-04-02



Planning Section
Basinwide Planning Unit
November 7, 2006

Table 5 Little Tennessee Subbasin 04-04-02

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Alarka Creek													
2-69-(2.5)	C;Tr	13.1	FW Miles	S					ND			Nutrient Impacts	Unknown
From Upper Long Creek to Fontana Lake, Little Tennessee R.					GF1	GF	2004					Habitat Degradation	Agriculture
					GB17	E	2004					Habitat Degradation	Construction
Bradley Fork													
2-79-55-12-(11)	B;Tr,HQW	2.1	FW Miles	S					ND				
From Chasteen Creek to Oconaluftee River					GB1	E	2004						
Brush Creek													
2-46	C	6.3	FW Miles	S					ND				
From source to Little Tennessee River					GF2	G	2004						
Caney Fork													
2-79-28-(2.5)	WS-III;Tr	1.3	FW Miles	S					ND				
From Mull Creek to Tuckaseegee River					GF4	G	2004						
					GB27	E	2004						
Conley Creek (Connelly Creek)													
2-79-52	C;Tr	7.4	FW Miles	S					ND				
From source to Tuckasegee River					GF7	NR	2004						
					GB13	G	2004						
Cullowhee Creek													
2-79-31a	C;Tr	8.7	FW Miles	S					ND			Habitat Degradation	Unknown
From source to first crossing of NC 107 near Cullowhee					GF13	GF	2004						
					GB29	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Deep Creek													
2-79-63-(16)	WS-II,B;Tr,HQW	0.8 FW Miles	From Indian Creek to Juney Whank Branch	**S**	GB5	E	2004		ND				
2-79-63-(21)	B;Tr	1.8 FW Miles	From Town of Bryson City water supply intake (located just below Great Smoky Mountains National Park Boundary) to Tuckasegee River	**S**	GB7	E	2004		ND				
Forney Creek													
2-97	C;Tr	9.5 FW Miles	From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River	**S**	GB4	E	2004		ND				
Hazel Creek													
2-146-(19)	WS-IV;Tr,CA	0.9 FW Miles	From a point 0.7 mile upstream of mouth to Hazel Creek Arm of Fontana Lake, Little Tennessee River	**S**	GB3	E	2004		ND				
LITTLE TENNESSEE RIVER (Calderwood Lake)													
2-(167)b	C;Tr	107.5 FW Acres	From Fontana Dam to North Carolina-Tennessee State Line Calderwood Lake Portion	**NR**	GL21	ID			ND				
LITTLE TENNESSEE RIVER (Cheoah Lake)													
2-(167)a	C;Tr	592.9 FW Acres	From Fontana Dam to North Carolina-Tennessee State Line Cheoah Lake Portion	**NR**	GL24 GL23 GL22	ID ID ID			ND				

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
LITTLE TENNESSEE RIVER (Fontana Lake below elev. 1708)													
2-(140.5)	WS-IV,B;CA	1,696.7	FW Acres	**NR**	GL19	ID			ND				
					GL20	ID							
From the upstream side of Shoal Branch to Fontana Dam													
LITTLE TENNESSEE RIVER (Fontana Lake below elevation 1708 MSL)													
2-(66)	B	5,568.1	FW Acres	**NR**	GL16	ID			ND				
					GL17	ID							
From Nantahala River Arm of Fontana Lake to the upstream side of mouth of Shoal Branch													
LITTLE TENNESSEE RIVER (Including the backwaters of Fontana Lake at normal pool elevation 1708 fee													
2-(26.5)b	B	11.9	FW Miles	**S**					ND				
From Subbasin 01/02 boundary to Nantahala River Arm of Fontana Lake					GB24	G	2004						
Moses Creek													
2-79-28-8	WS-III;Tr	4.1	FW Miles	**S**					ND				
From source to Caney Fork					GB26	E	2004						
Noland Creek													
2-90	C;Tr	10.8	FW Miles	**S**					ND				
From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River					GB6	G	2004						
Oconaluftee River													
2-79-55-(16.5)	C;Tr	8.3	FW Miles	**S**	GA4	NCE			**S**	GA4	NCE		
From Raven Fork to Cherokee Indian Reservation boundary (approximately 0.4 miles downstream of Goose Creek)					GB11	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Panther Creek													
2-115	C;Tr	2.4	FW Miles	S					ND			Nutrient Impacts	Construction
From source to Fontana Lake, Little Tennessee River					GF21	NR	2004					Nutrient Impacts	Unknown
					GB16	G	2004					Nutrient Impacts	Agriculture
Savannah Creek													
2-79-36	C;Tr	13.4	FW Miles	S					I	GA8	CE	Fecal Coliform Bacteria	Unknown
From source to Tuckasegee River					GF23	G	2004					Turbidity	Unknown
					GB23	G	2004					Habitat Degradation	Agriculture
Scott Creek													
2-79-39	C;Tr	15.3	FW Miles	S					I	GA11	CE	Fecal Coliform Bacteria	Failing Septic Syst
From source to Tuckasegee River					GF24	NR	2004					Fecal Coliform Bacteria	MS4 NPDES
					GB20	G	2004					Fecal Coliform Bacteria	WWTP NPDES
												Turbidity	Unknown
												Habitat Degradation	Impervious Surface
												Habitat Degradation	Construction
Stecoah Creek													
2-130	C;Tr	7.4	FW Miles	S					ND			Nutrient Impacts	Unknown
From source to Fontana Lake, Little Tennessee River					GF26	NR	2004					Nutrient Impacts	Agriculture
					GB14	G	2004					Habitat Degradation	Road Construction
												Habitat Degradation	Construction
												Habitat Degradation	Construction

Table 5 Little Tennessee Subbasin 04-04-02

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Tuckaseegee River (Bear Creek Lake)													
2-79-(5.5)b	WS-III,B;Tr	443.8	FW Acres	**NR**	GL10	ID			ND				
					GL9	ID							
From Tennessee Creek to West Fork Tuckaseegee River													
Tuckaseegee River (Cedar Cliff Lake)													
2-79-(5.5)c	WS-III,B;Tr	131.4	FW Acres	**NR**	GL11	ID			ND				
					GL12	ID							
From Tennessee Creek to West Fork Tuckaseegee River													
Tuckasegee River													
2-79-(35.5)a	C;Tr	1.4	FW Miles	ND					**I**	GA9	CE	Fecal Coliform Bacteria	Unknown
From Savannah Creek to UT 0.3 miles upstream of Yellow Bird Creek													
2-79-(35.5)b	C;Tr	0.5	FW Miles	ND					**S**	GA10	NCE	Fecal Coliform Bacteria	WWTP NPDES
From UT 0.3 miles upstream of yellow Bird Creek to Dillsboro Dam													
2-79-(38)	C	0.7	FW Miles	ND					**I**	GA12	CE	Fecal Coliform Bacteria	Unknown
From Dillsboro Dam to Mack Town Branch													
2-79-(40.5)	B	17.7	FW Miles	**S**	GA5	NCE			**S**	GA5	NCE	Fecal Coliform Bacteria	WWTP NPDES
From Mack Town Branch to Cochran Branch					GB19	E	2004					Total Suspended Solids	WWTP NPDES
Tuckasegee River (East Fork Lake)													
2-79-(0.5)	WS-III,B;Tr,OR	4.4	FW Miles	**S**					ND				
From source to Tennessee Creek					GB38	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1708 MSL													
2-(78)a	C	170.6	FW Acres	ND					**I**	GA13	CE	Fecal Coliform Bacteria	Unknown
From Lemmons Creek to Peachtree Creek												Sediment	Unknown
2-(89)	B	1,019.0	FW Acres	**NR**	GL18	ID			ND				
That portion of Tuckasegee River Arm of Fontana Lake below the upstream side of the mouth of Noland Creek													
Twentymile Creek													
2-178-(4)	C;Tr,HQW	3.0	FW Miles	**S**					ND				
From Proctor Branch to Lake Cheoah, Little Tennessee River					GB2	G	2004						
West Fork Tuckasegee River (Thorpe Lake below elevation 3492 MSL)													
2-79-23-(1)	WS-III,B;HQW	1,388.5	FW Acres	**NR**	GL3	ID			ND				
					GL5	ID							
					GL6	ID							
					GL4	ID							
From source in Thorpe Lake Backwater at Elevation 3492 MSL to Thorpe Dam													
Wolf Creek (Wolf Creek Lake)													
2-79-9-(1)	WS-III,B;Tr,HQ	5.3	FW Miles	**NR**	GL8	ID			ND				
					GL7	ID							
From source to Wolf Creek Dam													

Table 5 Little Tennessee Subbasin 04-04-02

AU Number	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
Description			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
GF - Fish Community Survey
GB - Benthic Community Survey
GA - Ambient Monitoring Site
GL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2006:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	150.6	FW Miles
NR	m	5.3	FW Miles
NR	m	10,947.9	FW Acres
NR	e	9.5	FW Miles
ND		1,225.0	FW Miles
ND		1,508.8	FW Acres

Recreation Rating Summary

S	m	26.5	FW Miles
I	m	30.7	FW Miles
I	m	170.6	FW Acres
NR	e	9.5	FW Miles
ND		1,323.7	FW Miles
ND		12,286.1	FW Acres

Fish Consumption Rating Summary

I	e	1,377.2	FW Miles
I	e	12,456.7	FW Acres
I		13.3	FW Miles

There are 25 NPDES permitted dischargers in this subbasin, but only three have permitted flows greater than 0.5 MGD: the Tuckasegee Water & Sewer Authority (0.5 MGD to Scott Creek); the Tuckasegee Water & Sewer Authority (1.5 MGD to the Tuckasegee River), and the Town of Bryson City's WWTP (0.6 MGD to the Tuckasegee River). Only the latter two facilities are required to monitor whole effluent toxicity. See Section 2.3.1 for more information. For the listing of NPDES permit holders, refer to Appendix V.

Additional information regarding population and land use changes throughout the entire basin can be found in Appendices I and III, respectively.

The primary problem in this basin continues to be nonpoint source pollution, including inputs of sediment and (or) nutrients. Although much of this subbasin is forested, development is often located along the stream corridor. Farmland and new residential areas are typically found adjacent to streams, often with inadequate riparian buffer zones. Many of the sampled sites have roads that run parallel to the stream leading to narrow riparian zones with frequent breaks. Water quality was not a problem throughout most of this area, but there was evidence of habitat problems. These included few pools, relatively uniform riffles and runs, and an embedded substrate. These changes have been shown to have less effect on the benthic macroinvertebrates than fish fauna.

Whereas actual water quality is the most important parameter for macroinvertebrates in mountain streams, fishes are affected to a higher degree by habitat alterations (in addition to water quality), especially; the lack of riparian shading of the stream, increased nutrient loads, lack of bank stability, and silt accumulation of plunge pools and riffles. The lack of stream shading raises water temperatures, excluding sensitive cold-water fishes such as trout. An increase in nutrient loads causes a shift in species composition towards dominance by the central stoneroller and the river chub. Silt accumulation, caused by unstable banks and overland runoff limits habitats in riffles, resulting in a low number or complete lack of darters and sculpin.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 5. Table 5 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to Appendix VIII for more information about use support ratings.

There were 20 benthic macroinvertebrate community and 9 fish community samples collected during this assessment period. Data were also collected from two ambient monitoring stations. Refer to the *2005 Little Tennessee Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/Basinwide/LTN2005.pdf and Appendix IV for more information on monitoring.

Waters in the following sections and in Table 5 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

2.2 Use Support Assessment Summary

Table 6 Summary of Use Support Ratings by Category in Subbasin 04-04-02

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	150.6 mi	26.5 mi
Impaired*	0.0 0.0	30.7 mi (54%) 170.6 ac (100%)
Not Rated	5.3 mi 10,947.9 ac	0.0 0.0
Total	**155.9 mi** **10,947.9 ac**	**57.2 mi** **170.6 ac**
Unmonitored Waters		
Not Rated	9.5 mi	9.5 mi
No Data	1,225.0 mi 1,508.8 ac	1,323.7 mi 12,286.1 ac
Total	**1,234.5 mi** **1,508.8 ac**	**1,333.2 mi** **12,286.1 ac**
Totals		
All Waters**	**1,390.4 mi** **12,456.7 ac**	**1,390.4 mi** **12,456.7 ac**

* The noted percent Impaired is the percent of monitored miles/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification is assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and VIII, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

In subbasin 04-04-02, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Refer to Table 6 for a summary of use support for waters in subbasin 04-04-02.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Appendix VI.

2.3.1 Beech Flats Prong [AU# 2-79-55-2a]

Current Status

Beech Flats Prong (2.3 miles), located in the GSMNP, is Impaired due to acidic conditions resulting from exposure of Anakeesta rock formations in the vicinity of Newfound Gap as a result of US Highway 441 construction. This conclusion is based on a Fair benthic bioclassification assigned in 1995. Anakeesta rock contains elements that, when exposed to water, produce low pH levels and high concentrations of heavy metals in adjacent streams. It is

fairly common throughout the southwestern Appalachian Mountains for road cuts or landslides, mining activities or the use of fill material containing this rock to cause water quality impacts.

2007 Recommendations
No scientifically and economically defensible way to minimize the Anakeesta exposure has been found. DWQ strongly discourages all construction projects that disturb Anakeesta rock formations. DWQ does not plan to conduct further sampling on Beech Flats Prong.

2.3.2 Savannah Creek [AU# 2-79-36]

Current Status
The Savannah Creek watershed drains the west-central portion of Jackson County. Savannah Creek itself flows alongside US 441 and NC 116 for much of its length before joining the Tuckasegee River near Webster. Traditionally, land use in the watershed was agricultural with light residential and commercial activity along the transportation corridors. Residential development is increasing substantially and elevating sediment and erosion concerns.

DWQ sampled fecal coliform bacteria concentrations in Savannah Creek as part of a Class B (Recreation) use-attainability study for the Tuckasegee River initiated in 2003 (See Section 2.3.4). The samples exceeded state standards and indicate Savannah Creek, from its source to the Tuckasegee River (13.4 miles), is Impaired in the recreation category. The sources of fecal coliform contamination are unknown, but may include failing septic systems and/or agricultural runoff. For a description of Recreation Use Support assessment methodologies, refer to Appendix VIII.

DWQ also sampled the fish and benthic communities at sites GF23 and GB23. The benthic population declined from Excellent in 1994 to Good in 2004. The fish community received a Good bioclassification. These results indicate Savannah Creek is Supporting aquatic life. However, these data do not reflect the habitat threats posed by development in the watershed. Many stream reaches have been channelized and riparian vegetation removed. Streambanks have been stabilized with concrete slabs and riprap.

The Watershed Association for the Tuckasegee River (WATR) coordinates sampling in the Savannah Creek Watershed as part of a larger the Volunteer Water Information Network (Chapter 13) project. Data collected on tributaries and in the mainstem between July 2003 and June 2005 indicated turbidity and suspended solid readings were well above the regional average, despite 80 percent of these samples being collected during dry weather or after light precipitation, when erosion due to rainfall is low. This condition usually occurs when there is heavy sediment build-up in the streambed, when there is extensive streambank erosion, or in high energy, fast flowing streams in headwater areas where watersheds have been cleared of most trees. Suspended solid readings were highest in Greens Creek [AU# 2-79-36-11], suggesting it may be a major source of sediment delivered to Savannah Creek. WATR plans to sample other tributaries to Savannah Creek to assess the spatial pattern of erosion and sediment transport.

WATR also evaluated fecal coliform concentrations in the Savannah Creek watershed. Their results support DWQ's findings and suggest contamination exists both upstream of and within Greens Creek.

Water Quality Initiatives

After monitoring results noted Greens Creek was a significant contributor of both sediment and fecal coliform bacteria, WATR embarked on an effort to develop a Watershed Action Plan. In 2004, WATR requested and received technical assistance from the U.S. Environmental Protection Agency (EPA).

WATR volunteers embarked on a sampling project consisting of daily turbidity readings at 10 sites in the Greens Creek watershed and daily rainfall, throughout April 2005. The purposes of the study were (1) to determine spatial and temporal patterns in turbidity, and (2) to evaluate the turbidity values with respect to the DWQ limit of 10 NTU for trout-habitat waters. Greens Creek drains a 9.4 sq. mile watershed within the 47 sq. miles of Savannah Creek watershed. This nested watershed configuration will allow WATR and its partners to focus efforts first on Greens Creek in order to gain early success via measurable criterion. Meanwhile actions on the larger and more complex Savannah Creek Watershed can grow as funding and public awareness expand. By focusing on the Savannah Creek Watershed, WATR is dedicated to making a reduction in the pollution loading to the middle reach of the Tuckasegee River where the public recreation is concentrated.

Sites were selected above the mouth of each main tributary, and also upstream of the tributary confluence along the main stem of Greens Creek. These site pairs were used to determine the relative sediment input for each tributary. The Unnamed Tributary (Site 9) is a special case. It drains a small area that was heavily impacted by a developer who was cited and fined for violating the Jackson County sediment control ordinance about the time of this project. Therefore, the Unnamed Tributary was a known turbidity source from the onset of the project. WATR's turbidity data are summarized in Table 7.

Table 7 Summary of turbidity along Greens Creek and in its tributaries collected daily during April 2006 – Source: Watershed Association of the Tuckasegee River

Site	Site Name	Min	Median	Max	Average	Freq greater than 10 NTU
1	Greens Crk at Confluence	5.4	10.2	77.0	13.5	53%
2	Brooks Branch	13.9	23.3	154.0	28.9	100%
3	Greens Crk abv Brooks	5.7	9.9	69.2	12.7	47%
4	Brushy Fork	5.1	9.4	35.3	10.5	30%
5	Greens Crk abv Brushy Fork	5.6	8.7	53.9	10.9	37%
6	Peewee Branch	14.0	19.2	77.4	21.7	100%
7	Sugar Fork	4.0	8.0	20.4	8.5	10%
8	Greens Crk abv Sugar Fork	4.7	7.9	55.8	10.1	17%
9	Unnamed Trib	19.6	28.1	751.0	62.5	100%
10	Upper Greens Creek	3.3	5.4	13.1	5.6	3%

These data suggest that the Unnamed Tributary, Peewee, and Brooks Branch should be the focus of further assessment and, in time, the focus of restoration activities. These data, with other corroborating measurements, will help in planning restoration activities for Greens Creek watershed and, in turn, help improve conditions in Savannah Creek.

2007 Recommendations

Fecal coliform contamination sources in the Savannah Creek watershed should be identified and corrected. Additionally, sediment and erosion control problems should be addressed to prevent further habitat degradation. A key challenge to stream restoration is gaining voluntary participation and improvements from local landowners. In mountainous terrain, stream density is significantly larger than in other parts of the state, and there are many stream-side landowners. Upslope landowners also contribute sediment through gullies and across down-slope land parcels. Consequently, public education and involvement is critical to load reductions. Sediment reduction from excavation and construction activities will depend heavily on education of excavators and contractors through Clear Water Contractor Courses and follow-up educational opportunities. Achieving load reductions will also require dilligent enforcement of the county erosion ordinance. Despite all the tools and BMPs available, innovation and extensive public communication are still needed to address the challenges of erosion in mountainous watersheds. With respect to fecal coliform loads, proposed reductions can utilize the WaDE program extensively. The Greens Creek Watershed Action Plan is scheduled for completion in 2007. It will provide site-specific strategies to reduce sediment and erosion impacts to Savannah Creek. Funding should be directed towards implementing these strategies.

2.3.3 Scotts Creek [AU# 2-79-39]

Current Status

Scott Creek is a large, swift tributary to the Tuckasegee River. Draining northeastern Jackson County, US 19/23 and Old US 19/23 parallel the creek is for most of its length. The stream passes through many residential areas before entering the urban environment in Sylva and Dillsboro.

DWQ sampled fecal coliform bacteria concentrations in Scotts Creek as part of a Class B (Recreation) use-attainability study for the Tuckasegee River initiated in 2003. (See Section 2.3.4) The samples exceeded state standards and indicate Scotts Creek, from its source to the Tuckasegee River (15.3 miles), is Impaired in the recreation category. The sources of fecal coliform contamination are unknown, but may include failing septic systems and/or nonpoint source runoff. For a description of Recreation Use Support assessment methodologies, refer to Appendix VIII.

In 2004, DWQ evaluated the fish and benthic macroinvertebrate communities at sites GF24 and GB20, respectively. GB20 is downstream of the Sylva WWTP and a few other small dischargers and adjacent to the parking lot of the Great Smoky Mountains Railroad in downtown Dillsboro. The stream channel is highly modified and the bank is armored by riprap. The site received a low habitat score because of the poor riparian zone in Dillsboro, plus a relatively uniform riffle/run habitat. The stream was very turbid after storms during the sample period and water levels rose and fell quickly, reflecting the high amount of impervious surface in the watershed. The fish community upstream of US19/23 was not rated in 2004 because it had characteristics of a trout stream (low total species diversity, low diversities of darters and cyprinids, a low percentage of omnivores + herbivores, and a high percentage of insectivores) and criteria have yet to be developed for this type of fish community. Wild, young-of-year and stocked adult brown trout were collected along with wild, young-of-year, juvenile, and adult rainbow trout. Species collected at this site but not typically found in trout streams included redbreast sunfish, bluegill, and largemouth bass. Although not rated, the community appeared to be supporting its designated uses as trout (Tr) waters.

Water Quality Initiatives

The Watershed Association for the Tuckasegee River (WATR) coordinates sampling in Scotts Creek as part of a larger the Volunteer Water Information Network (Mass, 2006). WATR's VWIN annual sampling program runs from July through June. As of October 2006, WATR had collected 38 months of VWIN data at 15 sites (16 sites during the first 2 years) throughout the watershed. WATR has also collected fecal coliform data for the last 3 years, particularly during 2004, which can be compared to DWQ coliform sampling in 2005.

Table 8 Mean TSS Concentrations
Source: Watershed Association of the Tuckasegee River

	Mean TSS
	mg/L
Kirkland Crk	19.4
Greens Crk	16.2
Savannah Crk	19.1
Barkers Crk	14.3
Scotts Crk	34.7
Tuck. abv Barkers Crk	19.9
Tuck. blw Bryson City	16.9
Cullowhee Crk WCU	10.4
Tuck. abv Scotts Crk	11.4
Conley Crk	10.9

WATR's data supports DWQ's findings of elevated fecal coliform concentrations and also shows relatively higher average concentration of suspended sediment compared to other streams in Subbasin 04-04-02. See Table 8.

In 2006, WATR received funds to develop and install a public turbidity meter. The novel project will raise public awareness of turbidity concentrations by displaying real-time turbidity values on a billboard near the creek. WATR with the help of faculty from Western Carolina University will develop and install the real-time turbidity meter on Scotts Creek in Sylva. People who drive or walk by will know the turbidity level and can see the conditions in the creek at the same time. This meter coupled with public education efforts including a public survey before and after the meter is activated and articles in the local paper will help inform the citizens of Scotts Creek and beyond. The data will be electronically logged and used for assessment in future planning and restoration projects.

In the fall of 2004, WATR put together the Coliform Action Group, a group of advisors and stakeholders who work cooperatively to identify coliform sources and develop solutions to reduce contamination sources. In particular, WATR worked with the Tuckasegee Sewer and Water Authority (TWSA) to sample along Scotts Creek above and within Sylva, with the objective of defining source areas. Additionally, TWSA has made significant investments in sewer line repair and replacement. Their efforts have identified and repaired or replaced many old and leaking sewer pipes.

2007 Recommendations

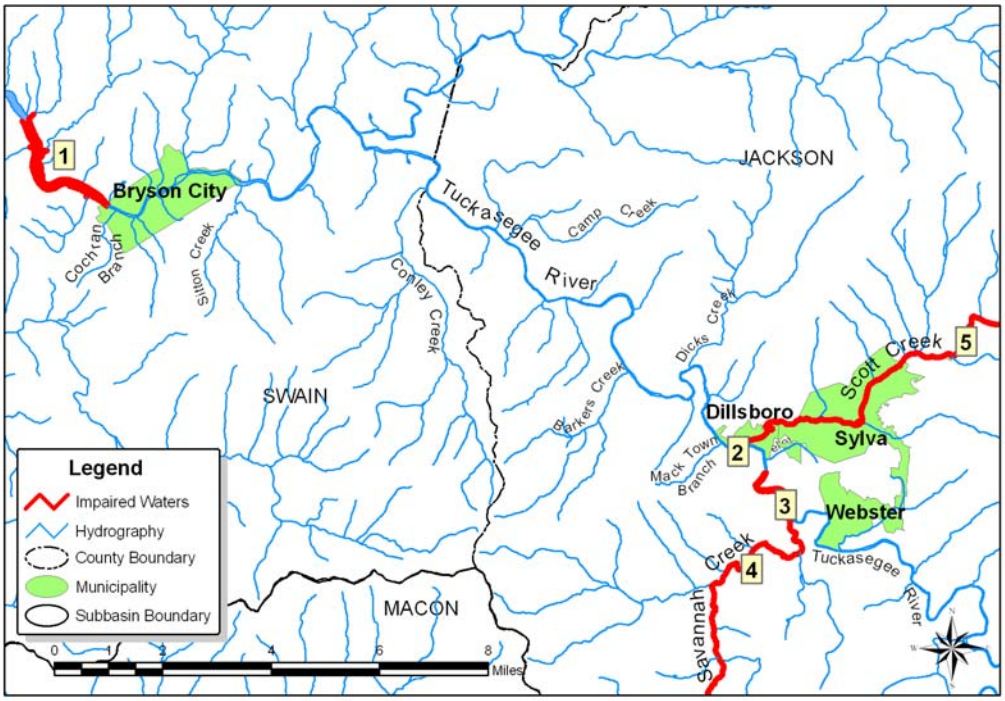
Efforts to identify and repair or replace leaking sewer lines should continue. Additional efforts to identify other sources of fecal coliform contamination are necessary. Monitoring to track fecal coliform bacteria concentrations should continue. TWSA needs support for camera inspections and other standard methods to detect fecal sources to Scotts Creek, followed by corrective actions. To address sediment and turbidity concerns, a plan to reduce erosion in the watershed should be developed. The plan should be implemented. Jackson County and the Towns of Sylva and Dillsboro should implement stormwater control measures equivalent to or stronger than Phase II stormwater requirements (See Section 8.2.2). Sediment and erosion control ordinances must be strictly enforced.

2.3.4 Tuckasegee River [AU# 2-79-(35.5)a, 2-79-(38), and 2-(78)a]

Current Status

In 2001, DWQ received a request to reclassify two Tuckasegee River reaches to Class B - Recreation. The requested reaches included the river from Savannah Creek to Mack Town Branch and Cochran Branch to the Tuckasegee River Arm of Fontana Lake. A study to determine if fecal coliform bacteria levels met Class B standards was initiated in 2003. Initial sampling revealed extremely elevated fecal coliform concentrations. The study was rescheduled for 2005 to allow time for sewer and wastewater treatment upgrades to be completed. The study was completed in 2005 and included sampling on major tributaries with suspected fecal coliform contamination. With the exception of one sample location between Leatherwood and the Dillsboro Dam, all sites evaluated in this study exceeded fecal coliform bacteria standards. Therefore, the Tuckasegee River is Impaired in the Recreation category in these reaches (See Figure 6). At the Dillsboro Dam, the watershed drainage area is approximately 347 mi^2.

Figure 6 Recreation Impairment in the Tuckasegee River-Watershed



	AU#	River Name	Segment	Mileage/Acers
1	2-(78)a	Tuckasegee	Lemmons Creek to Peachtree Creek	170.6 ac
2	2-79-(38)	Tuckasegee	Dillsboro Dam to Macktown Branch	0.7 mi
3	2-79-(35.5)a	Tuckasegee	Savannah Creek to Upper Tuckasegee Upstream of Yeallow Bird Creek	1.4 mi
4	2-79-36	Savannah	Source to Tuckasegee River	13.4 mi
5	2-79-39	Scotts Creek	Source to Tuckasegee River	15.3 mi

The Tuckasegee Water and Sewer Authority (TWSA) operates two wastewater treatment plants that discharge to the upstream reach. WWTP #1 discharges directly into the Tuckasegee River and WWTP #2 discharges to Scotts Creek. Each of these is required to monitor effluent bacteria concentrations. Concentrations at WWTP #2 were consistently low. Concentrations were

elevated at WWTP #1, but did not coincide with DWQ measurements within the river. Additionally, concentrations in Savannah Creek and Scotts Creek above WWTP #2 were the highest in the study, suggesting sources other than the treatment plants are contributing to impairment. These sources are unknown, but could include failing septic systems, illicit discharges, and residential/agricultural runoff.

In December 2006, TWSA entered into a Special Order of Consent (SOC) with DWQ because of chronic difficulties meeting discharge limits for Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Fecal Coliform in their NPDES permit. During the time in which this SOC is effective, TWSA will operate under relaxed permit limits and follow a specific schedule for improvements that will assure their compliance with the original permit limits by 2010. The schedule is as follows:

1. Completion of preliminary Engineering Report – June 1, 2006
2. Submit NPDES Renewal with flow increase – April 1, 2007
3. Submit Plans and Specs for Upgrade after issuance of Permit – May 1, 2008
4. Notice to Proceed for Construction – March 1, 2009
5. Complete Construction and submit engineering certification – August 1, 2010
6. Compliance with NPDES Permit Final Limits – December 1, 2010
7. Quarterly progress repots should be submitted to the Asheville Regional Office until the completion of the project.

TWSA will be subject to a $1000 fine for each violation of this SOC and a $5,000 fine if the final compliance deadline is not met.

The Bryson City Wastewater Treatment Facility discharges to the Tuckasegee River just upstream of the lower study reach. This facility is also required to disinfect and monitor its effluent concentration. The facility was fully compliant during the study, but fecal coliform levels remained elevated in the river, suggesting again that other sources are contributing to impairment in this reach. A dramatic spike in fecal coliform concentrations following a one-inch rainfall points towards nonpoint sources of contamination. The plant has also suffered from grease problems and has begun implementation of a grease elimination program that includes flushing lines and an education component. The Bryson City also has a grease ordinance that prohibits disposal of grease into the sewer system.

In addition to bacteria issues, sediment and turbidity are concerns in the Tuckasegee River. The entire Tuckasegee River watershed drains to Fontana Lake, carrying a tremendous load of sediment, trash, and woody debris. The swift and powerful currents slow as they enter the backwaters of the lake downstream of Bryson City, depositing their load. Several feet of sediment is deposited yearly and trash and woody debris block recreational access. These deposits are heaviest following heavy rainfall events. WATR estimates 55,000 tons of sediment were transported past Bryson City during the hurricanes of September 2004.

The Fontana Lake Users Association in cooperation with Swain County conducts an ongoing trash and debris cleanup program. This program collects trash and floating woody debris deposited in the Fontana headwaters after periods of heavy rain. Large floating trees are bundled and anchored to the lakebed to replace fish habitat destroyed by excess sediment deposits.

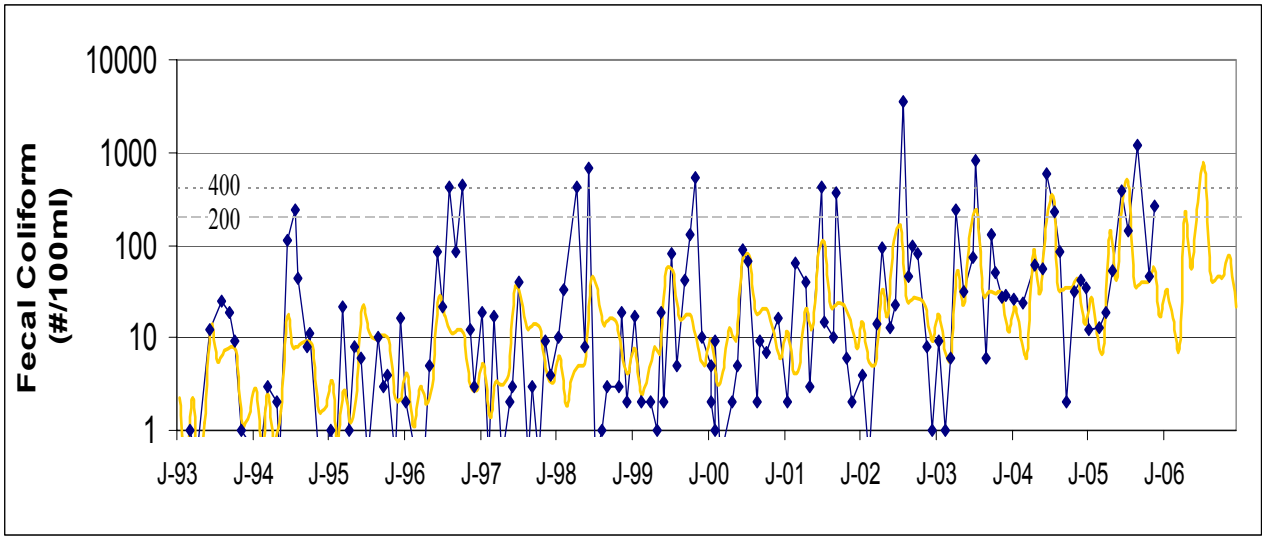
2007 Recommendations

The Watershed Association of the Tuckasegee River analyzed fecal coliform bacteria collected at site GA5 and determined a seasonal trend in concentration may mask an upward trend in bacteria

concentrations. In the use-attainability study of the lower Tuckasegee River in Bryson City, fecal coliform levels above the recreation-use limit were observed at the monitoring point at the inflow of Cochran Branch, in the vicinity of the outflow of the Bryson City WWTP. It was estimated that impairment did not extend up river because of measurements made at the ambient station located in the center of Bryson City. Monthly measurements, when averaged together, were below the regulatory limit indicating acceptable conditions (no impairment). A closer look at the data suggests that this conclusion could be revisited.

The monthly data are shown in Figure 7. Looking only at the data points for the summer months (June, July, and August) it appears that most years have at least one value over the retulatory limit of 200 col/100 mL, and in the past 2 years the 3-month average value has exceeded the limit (225 and 403 col/100mL for 2004 and 2005, respectively). Because it is the summer months when recreational exposure usually occurs, a seasonal evaluation of bacteria concentrations is needed.

Figure 7 Monthly Fecal Coliform Concentrations Measured by DWQ at the Tuckasegee River - Bryson City station. The 200 and 400 unit standards appear as straight dashed and dotted lines, respectively.



DWQ will complete a trend analysis that compensates for seasonality and flow to determine if fecal coliform concentrations are rising at this site. Fecal coliform bacteria sources must be identified. Once identified, a plan to reduce or eliminate those sources should be developed and implemented.

To effectively reduce sediment deposits in Fontana Lake, erosion problems must be addressed across the entire 1,571mile² watershed. Reductions at this scale require comprehensive programs implemented by citizen groups, local governments, and service providers best suited to implement such a plan. At a minimum, property owners should implement recommendations included in Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more

affordable to farm owners. Chapter 9 describes many of these programs. The Swain County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding. Local, State, and Federal governments should adopt and/or enforce programs that require erosion control and low-impact development techniques.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix VII.

2.4.1 Alarka Creek [AU# 2-69-(2.5)]

Current Status

Alarka Creek is a medium-size tributary to the Little Tennessee River Arm of Fontana Reservoir. The creek's watershed (25 mi^2) drains southern Swain County. The headwaters are classified as High Quality Waters, but land uses in the lower portion of the catchment are residential and pasture. The benthic community sample at site GB17 indicates the water quality is Excellent. However, the fish community at site GF1 reflects significant habitat problems, receiving only a Good-Fair bioclassification. Also, an exceptionally large number of fish were collected, indicating the stream may be nutrient enriched. Likely sources for excess nutrients include nonpoint source runoff from lawns and/or failing septic systems. In many locations, the riparian zone was narrow or nonexistent and manicured lawns reached to the stream bank.

The Swain County Soil and Water Conservation District identified concentrated livestock, row cropping, Christmas tree farming, and new development projects as possible pollution sources in the watershed. Swain SWCD is focusing efforts on this watershed.

2007 Recommendations

Where damaged or missing, a vegetated riparian zone should be reestablished. Sources of nutrient enrichment should be identified and corrected. Property owners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf.

The impacts from agricultural operations can be reduced through use of agricultural best management practices including streambank stabilization, livestock exclusion, off stream watering systems, and critical area seeding. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Swain County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.2 Camp Creek [AU# 2-79-49]

Current Status
DWQ received a request to reclassify Camp Creek to trout waters in 2004. In 2005, the fish community was sampled at several sites in the Camp Creek watershed to determine if the reclassification was appropriate. This survey was conducted outside the data window for this assessment, so the data will not be used to assign a use support rating at this time. However, the survey did indicate significant habitat problems in the watershed. The primary habitat problems were unstable, eroding stream banks, and narrow or non-existent riparian vegetation.

2007 Recommendations
Stream bank stabilization and riparian zone restoration projects are needed in this watershed. The Swain County Soil and Water District and local NRCS staff can assist landowners with choosing appropriate BMPs and identifying funding

2.4.3 Cullowhee Creek [AU# 2-79-31a & b]

Current Status
Cullowhee Creek flows north through Jackson County in the southwestern portion of North Carolina. The majority of the headwaters are forested and of good water quality. The lower portion of the watershed includes Western Carolina University, light commercial, and residential development. The stream through this section was historically moved and channelized resulting in poor habitat and flood protection. In 2004, DWQ sampled Cullowhee Creek at two locations upstream of the university. The benthic community at site GB29 rated Excellent, but the fish community at GF13 only received a Good-Fair bioclassification. These results suggest water quality is good, but habitat problems are negatively affecting fish populations.

In 2004, a leaking sewer pipe was found in an unnamed tributary to Cullowhee Creek, but ownership was questionable. TWSA assumed responsibility and replaced the leaking line. This along with other sewer improvements around the Cullowhee community and an expanding university population will likely bring increased demand for housing development.

Water Quality Initiatives
In June 2005, a major stream restoration project was initiated on approximately 5,000 feet of Cullowhee Creek flowing through WCU. Discovery Land Company is funding the project as mitigation for stream impacts caused during a development project in the Cashiers area. The project will restore many of the stream's functions lost during recent decades of substantial development within the watershed. Such functions in the stream channel include improving bank stability, sediment transport, and storm flow regulation. More information on this project can be found at http://www3.wcu.edu/%7Emlord/CCRestoreWeb/CCRestorationHome.html

2007 Recommendations
DWQ should sample Cullowhee Creek downstream of the urbanized university area to track the water quality impacts resulting from development in this expanding community. Best management practices designed to control stormwater flow should be installed where possible and new development projects should incorporate low impact development (LID) techniques. Refer to Chapter 6 for information on LID.

2.4.4 Panther Creek [AU# 2-115]

Current Status
Panther Creek, in northeastern Graham County, is a high gradient tributary to the Panther Creek Arm of Fontana Reservoir. Habitat and water quality are good, but the benthic community has declined from Excellent to Good at site GB16. Both the benthic sample and a fish community sample at site GF21 indicate nutrient enrichment. New residential development and small agricultural operations are possible sources for nutrients.

2007 Recommendations
Monitoring should continue to determine if stream quality continues to decline. Residential property owners can use a variety of techniques to reduce pollution caused by runoff from their yards. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Graham County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.5 Stecoah Creek [AU# 2-130]

Current Status
Stecoah Creek, in northeastern Graham County, is a small tributary to Fontana Reservoir. The recent NC 28 widening project occurred in the middle part of its watershed. This stream is located in a more densely developed residential drainage than other streams in the subbasin. Some channelization has occurred, and a significant amount of substrate (large rocks) has been removed from the streambed for retaining walls around adjacent livestock areas or stream bank protection. Areas along the bank near the residential and agricultural areas are actively eroding. Riparian vegetation consists of mostly grasses and a few trees. The fish community at site GF26 indicated nutrient enrichment, possibly from straight piping and/or nonpoint source runoff.

2007 Recommendations
Restoration will likely improve conditions in Stecoah Creek. Restoration options should be evaluated and if deemed feasible, a restoration plan for Stecoah Creek should be developed and executed. In the meantime, residential landowners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Graham County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.5 Additional Water Quality Issues within Subbasin 04-04-02

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

This section also discusses ideas, rules, and practices in place to preserve and maintain the pristine waters of the Little Tennessee River basin. This is particularly important because many of the waters are designated high quality or outstanding resource waters (HQW and ORW, respectively). Those surface waters given an Excellent bioclassification may be eligible for reclassification to a High Quality Water (HQW) or Outstanding Resource Water (ORW). These streams are shown in Table 5. Special management strategies, or rules, are in place to better manage the cumulative impact of pollutant discharges, and several landowners have voluntarily participated in land conservation, stabilization, and/or restoration projects.

2.5.1 Fontana Lake Waste Recovery

Fontana Lake is a popular recreation site, and over many years has developed a large and permanent population of houseboats in several of its coves. In the late 1990's, local citizens became concerned that untreated sewage produced on these boats was discharging directly into the lake. High fecal coliform bacteria concentrations supported these concerns, and during winter lake level drawdowns, when houseboats rest on dry land, straight pipes connected directly to toilets were identified under many of the boats.

After confirming raw sewage was discharging into the lake, local citizens formed a partnership to eliminate the discharges and create a sewage pumping and collection program called Fontana Lake Waste Recovery (FLWR). The partnership includes houseboat owners, marina operator, the Fontana Lake Users Association, and the Partnership for the Future of Bryson City/Swain County. The program is supported by ordinances in Graham and Swain Counties that require every houseboat owner to install a permanent toilet and sewage holding tank on their boat. Marina and boat dock owners maintain pump-out stations and recovery boats to serve houseboats within their harbor. Houseboat owners pay a yearly fee to fund the pump-out system. The ordinances also specified that boats not in compliance could be removed from the lake.

The program became fully operational in 2005, and fecal coliform concentrations dropped dramatically. The success of this program is largely due to the cooperation between a variety of organizations and individuals. TVA and CWMTF provided substantial funding to build the pump stations, retrofit the houseboats, and acquire pump boats. Swain and Graham counties administer the program with marina and houseboat owner participation.

In 2006, WATR was asked to design and coordinate a monitoring program to determine the fecal coliform levels in the lake and to determine if the required wastewater holding tanks were effective.

Forty-one (41) sampling sites were identified in the vicinity of five marinas: Alarka, Greasy Branch, Crisp, Prince, and Fontana. Each site was sampled at least twice; and the sites near Alarka and Greasy were sampled a third time. The sites were chosen in order to have one site upstream of all the houseboats (in the inundated portion of the feeder tributary) and subsequent

sites located roughly equidistant toward the main body of the lake. In addition, several tributaries were also sampled farther upstream where the creeks were flowing and not inundated. Data showed that Fontana Lake was very clean except for two particular sites, where measured fecal coliform exceeded the NC health standard for organized recreational use, which is 200 col/100mL. One site located on Panther Creek upstream of all actively used houseboats is downstream of a popular campground. The exceedence is judged to be caused by contamination from the tributary and not from the houseboats. In the second case, two samples exceeding the health standard were collected in the vicinity of a houseboat that was known to be out of compliance with the ordinance. Soon thereafter, the offending houseboat was moved and access was denied until it was brought into compliance.

In this study, the tributaries generally had more contamination than the water around the marinas. The average fecal coliform concentration in the tributaries was 98 col/100mL, whereas the average for samples collected near the marinas (excluding the samples collected upstream in the inundated portion of the creeks) was 12 col/100mL, statistically different at the 0.01 level. While none of the tributary samples exceeded the health standard, the sampling itself was limited; and it appears likely that some of the tributaries are capable of exceeding that limit. More assessment of the tributary fecal levels needs to be done in both Swain and Graham counties.

The study concludes that tributaries feeding Fontana Lake are the most significant source of fecal coliform contamination in the lake, and that wastewater from in-compliance houseboats no longer poses unacceptable health risks. In short, this study shows the lake to be very clean with only minor bacterial levels – well below levels of concern (McMillan and others, 2006).

DWQ applauds the initiative and creativity demonstrated during the creation of this program. It is a model for interagency, government, and citizen cooperation.

2.5.2 Management Strategies for Water Quality Protection

Municipalities and smaller outlying communities are being pressured to expand and this involves construction and/or developing in areas along tributaries of the Tuckasegee River and the river itself. HQW and ORW are supplemental classifications to the primary freshwater classification(s) placed on a waterbody (Chapter 5). Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody.

Waters in the Little Tennessee River Basin under special management strategies are designated with a "@" or "#" symbol in the stream classifications schedule. The "@" identifies waters that are subject to the specific actions specified in 15A NCAC 2B .0224, the High Quality Waters (HQW) rule, in order to protect downstream waters designated as HQW. Point source discharges are prohibited to segments classified HQW with a "#" symbol according to the provisions of 15A NCAC 2B .0201 in order to protect the existing and anticipated usage of those waters.

A summary of the special management strategies for HQW and ORW waters can be found in Chapter 5. Detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/codes_statutes.htm.

Many of the streams in this subbasin are also classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Those streams noted as having Excellent bioclassifications in Table 5 may qualify for HQW or ORW classification. There may also be many more streams in the basin that qualify for such designation that DWQ has not monitored. DWQ relies on citizen requests to initiate the stream reclassification process (See Section 5.1.4) and encourages requests for reclassification to HQW or ORW when it is warranted. Appropriate stream classification will help to protect water quality in the long-term.

Native Southern Appalachian Brook Trout occupy many high elevation streams in the Little Tennessee River Basin. They are the only trout native to the southern Appalachian Mountains and require clear, cold streams to survive. They are very sensitive to excess sediment. Efforts to restore and expand their populations across the basin will benefit from designation as HQW or ORW. Those streams that can support Native Appalachian Brook Trout should be identified and evaluated for qualification as HQW or ORW.

2.5.3 North Shore Fontana Lake Stream Reclassification

In June 2005, the North Carolina General Assembly passed Session Law 2005-97, directing the Environmental Management Commission to initiate a rule-making process to adopt rules to reclassify the entire watershed of all creeks that drain to the north shore of Fontana Lake between and including Eagle and Forney Creeks.

In August 2005, DWQ biologists conducted a benthic community survey to evaluate the appropriateness of ORW status for the streams identified by the NC General Assembly. While it was not practicable to sample all 35 named streams, it was appropriate, given the protected and pristine nature of the watershed, to select representative streams of varying drainage areas and extrapolate the results of the assessed streams to the unassessed streams with similar drainage areas. Therefore, seven sites were sampled, with drainage areas ranging from 0.5 to 44.8 square miles.

Each site sampled received an Excellent bioclassification. Additionally, at least one rare species was collected at every site. In Eagle Creek, biologists collected an extremely rare species that has been collected only seven other times out of 5,800 benthic collections performed by DWQ. Based on these results, DWQ believes all streams identified in Session Law 2005-97 deserve

ORW classification. At the time of this writing, the request for reclassification was moving successfully through the approval process.

2.5.4 Federal Energy Regulatory Commission Hydropower Relicensing

The Federal Energy Regulatory Commission (FERC), under the authority of the Federal Power Act, issues licenses for the construction, operation, and maintenance of non-federal hydroelectric developments. Duke Energy operates several hydroelectric projects in subbasin 04-04-02 including the East Fork, West Fork, Bryson, and Dillsboro Projects. The operation of these hydropower projects has provided an affordable and dependable supply of electrical power to a growing population in western North Carolina since 1929. These projects were built and began operations 50 – 80 years ago, well before modern regulatory requirements were in place. While providing much needed power to a growing customer base, these same facilities have also resulted in reduced flows and fluctuating flows in river reaches downstream from dams and fluctuating reservoir levels. This has resulted in a variety of impacts to water related natural resources. The licenses for these projects expired in 2005 and 2006. The process to relicense these projects began in 1999.

The relicensing of these facilities will have a significant impact on the future health of these important freshwater ecosystems as well as on the lives of the people and communities who utilize and live adjacent to the resources. In late 2000, in an effort to identify issues and stakeholder interests in the projects, Duke Energy assembled the Tuckasegee Cooperative Stakeholder Team (TCST), consisting of stakeholders who represented various interests and uses of the waters and related natural resources of the Tuckasegee River Basin upstream of Bryson City. The TCST included state and federal resource agencies, local governments, adjacent landowners, resource users, water dependent businesses, conservation organizations, Duke Power and others. The TCST worked to develop a comprehensive set of recommendations for the new license that addresses resource protection, enhancement, and mitigation measures commensurate with project impacts. The documented result of this effort is called the Consensus Agreement.

The Consensus Agreement is comprehensive in scope and includes numerous provisions for resource management, protection, and enhancement opportunities including: new recreation facilities and access areas, improvements in recreation and rule curve information, changes in lake levels and rule curves, minimum flows and bypass flows, angling and boating recreation flows, resource enhancement initiatives, shoreline management, sediment management, and cultural resource protection. The complete consensus agreement can be found in the Bryson (FERC #2601), Dillsboro (FERC #2602), East Fork Tuckasegee River (FERC #2698), or West Fork Tuckasegee River (FERC #2686), Nantahala (FERC #2692) Final License Applications filed to FERC. These and other associated documents can be obtained at: http://www.ferc.gov.

2.5.5 Kirkland Creek [AU# 2-79-61-(2)] and Other Tuckasegee River Tributaries

Current Status

DWQ did not sample Kirkland Creek during this assessment cycle, but reconnaissance by WATR revealed fecal coliform contamination and elevated turbidity levels on par with Scotts Creek and Savannah Creek. Those two streams are significantly degraded and will appear on the 2008 303(d) list of impaired waters (See Sections 2.3.2-4).

In lower reach of the Tuckasegee River as it flows through Swain County, other creeks also have problems but WATR's monitoring data is more sparse. At Conleys Creek, for example, the geometric mean concentration for fecal coliform was >484 col/100mL.

With volunteer help and generous assistance from the Jackson County Public Health Department, who performed the laboratory evaluations, WATR sampled creeks in Swain County for bacteria. These results are shown in Table 9.

Table 9 WATR Monitoring: Bacteria Concentrations in Tuckasegee River Tributaries
Source: Watershed Association of the Tuckasegee River

Location	**e. coli** (MPN/100 mL)				**Fecal coliform** (col/100ml)	
	7/5/06	7/17/06	8/1/06	8/8/06	8/1/06	8/8/06
Tuck Abv Connelly	**1460**	52	**143.9**		107	
Connelly Creek	**200**	**246**	101.4		77	
Oconaluftee at Two Rivers Motel	**2430**	**158**	**235.9**		163	
Coopers Creek	**200**	NA	73.8		90	
Johnson Branch		**683**	**686.7**	**13775**	**200**	**547**
Kirkland Creek	**740**	**341**	74.9		61	
Jenkins Branch	**7060**	**6131**	**2420**	**48392**	**200**	**7375**
Toot Hollow	**740**	**481**	**2420**	**1112**	**200**	**560**
Bryson Branch	**630**	**146**	**2420**	**910**	**200**	193
Tuck Below Bryson City	**850**	52	72.3		62	
Lower Alarka Creek	**520**		122.3		81	

EPA recommends the maximum e.coli level for organized recreation is 126 MPN/100mL

2007 Recommendations

Further assessment work is necessary to identify and rank the relative health of tributaries to the Tuckasegee River. Biological community data is needed in addition to an intensive fecal coliform investigation and turbidity/suspended solids analysis. The results of those surveys should be used to secure funding for planning and to restoration of water quality. DWQ will conduct monitoring as resources allow, and encourages WATR to continue its monitoring efforts.

2.5.6 General Support for Volunteer Watershed Associations

WATR identified the following needs that must be met to assure their ongoing success and effectiveness:

- Open and regular communication with state regulators, state agency representatives, watershed experts, and city/county government workers is critical. The Little Tennessee Non Point Source Team facilitated this communication during the last basinwide cycle. The Team should continue to meet and adjust to changing watershed needs. In late 2005, the Non Point Source Team initiated a web site for the dissemination of the information to the public www.littleTbasin.org about water quality issues.

- Technical assistance is needed from EPA and NC State Extension.
- Continued collaboration with the Eastern Band of Cherokee Indians and the support of Cherokee Preservation Foundation. WATR worked with the Cherokee Office of Environment and Natural Resources to organize a regional workshop *Partners for Water Quality in the Little Tennessee River Basin* and Clear Water Contractor courses designed to train construction professionals on techniques used to avoid water quality impacts during construction. Similar activities should be pursued in the next basinwide cycle.
- Form an Oconaluftee Watershed Group on the Reservation.
- Funding from a wide variety of sources is needed. Funds to pay for operational expenses are particularly important.
- Watershed associations need training on data collection methods and Quality Assurance Project Plan (QAPP) production. This will assure volunteer data is available for official decision-making at appropriate scales.
- New citizen-based training programs, such as the Stream Monitoring Information Exchange (SMIE), should be implemented. This system is being tested in WNC, but more training is needed.
- Better communication is needed with the NC Ecosystem Enhancement Program (EEP). In late 2005, EEP issued a request for proposals for restoration projects on 15000 ft of streams in the Tuckasegee River watershed. There was no consultation with local watershed organizations prior to the request. Therefore, projects proposed by outside engineering firms may conflict with ongoing efforts by local watershed organizations. Citizen cooperation for such an endeavor is paramount.
- Flexible conservation easements are needed. In mountainous areas, streams are often property divides with two landowners owning opposite stream banks, making agreement and cooperation difficult. Flexibility and innovation in conservation easements used for stream restorations is important to protecting aquatic and riparian habitat.
- Support is needed for watershed-wide data acquisition and assessment. Although WATR has collected VWIN data on 11 tributaries to the Tuckasegee River, there are many more streams that are suspected of contributing high loads of turbidity, sediment and fecal coliform contamination. More that 80 percent of the watershed remains unmonitored by DWQ. There are few grant programs in DWQ or EPA that focus primarily on monitoring.
- Better enforcement of trout stream buffers and buffer education for landowners is critical. Currently, county inspectors poorly enforce the requirement for 25-ft natural buffers along classified trout streams. Landowners with streamside properties need both education and incentives for restoring the functionality of buffers, i.e., stream bank stabilization, sediment trapping, and stream shading for temperature control.
- Long-term support for Clear Water Contractors Courses is needed. Erosion occurring during excavation and development at building sites is a major source of turbidity and sediment to the streams. In 2006, WATR facilitated the first Clear Water Contractor courses in the watershed. The project was sponsored by the Cherokee Preservation Foundation, the Cherokee Office of Environment and Natural Resources, and the Southwestern NC Resource, Conservation, and Development Council. These courses are critical to engendering environmental stewardship within the development community. These classes should be held annually. A shorter refresher course should be developed for graduates of past courses. The program should be expanded to include Macon and Graham Counties.
- A comprehensive data review and summary is needed. There are no programs to bring together historic and current data to assess potentially unknown water quality problems, such as residual contamination from past mining and agricultural operations. In Haywood County,

pesticide use led to groundwater contamination, and WATR knows of no systematic assessment as to whether or not similar conditions exist in the Tuckasegee river watershed.
- Ecological and water quality data, such as those collected by the NC Wildlife Resources Commission and by university professors, need to be combined to get a better idea of conditions.
- Groundwater quality in the watershed should be systematically assessed.
- Effects of Christmas tree growing on water quality need to be documented for the special conditions found in mountainous terrain.
- An economic cost benefit analysis to determine the value of trout and other sport fisheries; stream and river access; clean and clear water; and undisturbed habitat to the Jackson and Swain County economies needs to be completed.
- WATR needs to assist in citizen conservation efforts upstream from the Duke Energy impoundments.

2.5.7 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the Little Tennessee River basin. Hundreds of permit applications for onsite septic systems are approved every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

2.5.8 Floodplain Protection

The riverside land that gets periodically inundated by a river's floodwaters is called the floodplain. Floodplains serve important purposes. They:

- temporarily store floodwaters,
- improve water quality,
- provide important habitat for river wildlife, and
- create opportunities for recreation.

Natural floodplains help reduce the heights of floods. During periods of high water, floodplains serve as natural sponges, storing and slowly releasing floodwaters. The floodplain provides additional "storage," reducing the velocity of the river and increasing the capacity of the river channel to move floodwaters downstream.

When the river is cut off from its floodplain by levees and dikes, flood heights are often increased. The construction of levees along the Lower Missouri River, for example, has increased flood heights by as much as twelve feet. By contrast, protected floodplain wetlands along the Charles River in Massachusetts store and slowly release floodwaters -- providing as much "storage" as a medium-sized reservoir.

Natural floodplains also help improve water quality. As water courses through the floodplain, plants serve as natural filters, trapping sediments and capturing pollutants. Nitrogen and phosphorous (found in fertilizers) that wash off farm fields, suburban backyards and city streets ignite a chemical chain reaction which reduces the amount of oxygen in the water, suffocating fish and other aquatic organisms.

Many floodplain plants will use nitrogen and phosphorous before they can reach the river, improving water quality. Many cities have built artificial wetlands to reduce water treatment costs. Studies of heavily polluted waters flowing through Tinicum Marsh in Pennsylvania, for example, have shown significant reductions in phosphorous and nitrogen. The water treatment

value of Georgia's 2,300-acre Alcovy River Swamp is more than $1 million a year. Floodplains also play an important role in the recharging of groundwater supplies (American Rivers, 2006).

County governments are strongly encouraged to adopt and implement comprehensive floodplain protection. Doing so will help protect its aquatic resources over the long-term. Guidance on floodplain ordinance adoption is provided by the Association of State Flood Plain Managers at www.floods.org.

2.5.9 Special Management Strategies for Threatened and Endangered Species

Several streams in Little Tennessee River subbasin 04-04-02 are home to federally listed Threatened and Endangered Species. The Tuckasegee River hosts the Appalachian elktoe and the Spotfin Chub. Section .0100 of the Administrative Code states the following:

> Certain waters provide habitat for federally-listed aquatic animal species that are listed as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act, 16 U.S.C. 1531-1544 and subsequent modifications. Maintenance and recovery of the water quality conditions required to sustain and recover federally-listed threatened and endangered aquatic animal species contributes to the support and maintenance of a balanced and indigenous community of aquatic organisms and thereby protects the biological integrity of the waters. The Division shall develop site-specific management strategies under the provisions of 15A NCAC 2B .0225 or 15A NCAC 2B .0227 for those waters. These plans shall be developed within the basinwide planning schedule with all plans completed at the end of each watershed's first complete five year cycle following adoption of this Rule. Nothing in this Rule shall prevent the Division from taking other actions within its authority to maintain and restore the quality of these waters.

An interagency team from the USFWS, the NC Wildlife Resources Commission and the NC Natural Heritage Program was asked to develop technical reports to support NCDWQ's development of site-specific management strategies to restore water quality in the Little Tennessee River Basin. It is intended to provide a framework for getting additional stakeholder input prior to formulating the water quality management strategy which will be completed through rule-making by NCDWQ (with the requisite public involvement and Environmental Management Commission oversight).

Chapter 3
Little Tennessee River Subbasin 04-04-03
Including the: Nantahala River Watershed

3.1 Subbasin Overview

Subbasin 04-04-03 at a Glance

Land and Water Area

Total area:	155 mi²
Land area:	152 mi²
Water area:	3 mi²

Population Statistics

2000 Est. Pop.:	8,750 people
Pop. Density:	5 persons/mi²

Land Cover (percent)

Forest/Wetland:	96.2%
Surface Water:	1.7%
Urban:	0.2%
Cultivated Crop:	0.1%
Pasture/ Managed Herbaceous:	1.8%

Counties

Cherokee, Clay, Macon and Swain

Monitored Streams Statistics

Aquatic Life

Total Streams:	32.0 mi/1,380.2 ac
Total Supporting:	32.0 mi
Total Not Rated:	1,380.2 ac

Recreation

Total Streams:	3.5 mi
Total Supporting:	3.5 mi

This subbasin contains most of the Nantahala River catchment. Headwaters of the Nantahala River are entirely within the Nantahala National Forest. The river, from its source to the confluence with Roaring Fork, is classified ORW. Much of the land adjacent to this reach is privately owned. The river and most tributaries are high gradient systems capable of supporting wild trout populations.

The Nantahala River was impounded in 1942, creating Nantahala Lake. Additional flow is diverted into the project from Whiteoak and Dicks Creek. Duke Energy acquired the development in 1988. Flow is diverted to downstream generators at Beechertown, bypassing a seven-mile reach of the river prior to discharging back into the original channel above the Nantahala Gorge. The regulated reach of the river below the powerhouse is very popular for rafting and canoeing. Development has increased along the gorge corridor as it relates to the recreational industry. Ninety six percent of the subbasin is forested.

There are two NPDES permitted dischargers in this subbasin: Macon County Schools-Nantahala WWTP and the Nantahala Outdoor Center. No significant compliance problems were noted during the most recent review period.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 8. Table 10 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support for waters in the subbasin. Refer to Appendix VIII for more information about use support methodology.

There were 5 benthic macroinvertebrate community samples collected during this assessment period. Data were also collected from one ambient monitoring station. Data collected from the ambient station has historically indicated good water quality. However, there were occasional periods when turbidity exceeded the state standard for Trout waters during this assessment cycle. These exceedences occurred in only four percent of the measurements, and therefore do not indicate impairment. Refer to the *2005 Little Tennessee River Basinwide Assessment Report* at http://h2o.enr.state.nc.us/esb/Basinwide/LTN2005.pdf and Appendix IV for more information on monitoring.

Figure 8 Little Tennessee Subbasin 04-04-03

Planning Section
Basinwide Planning Unit
May 22, 2006

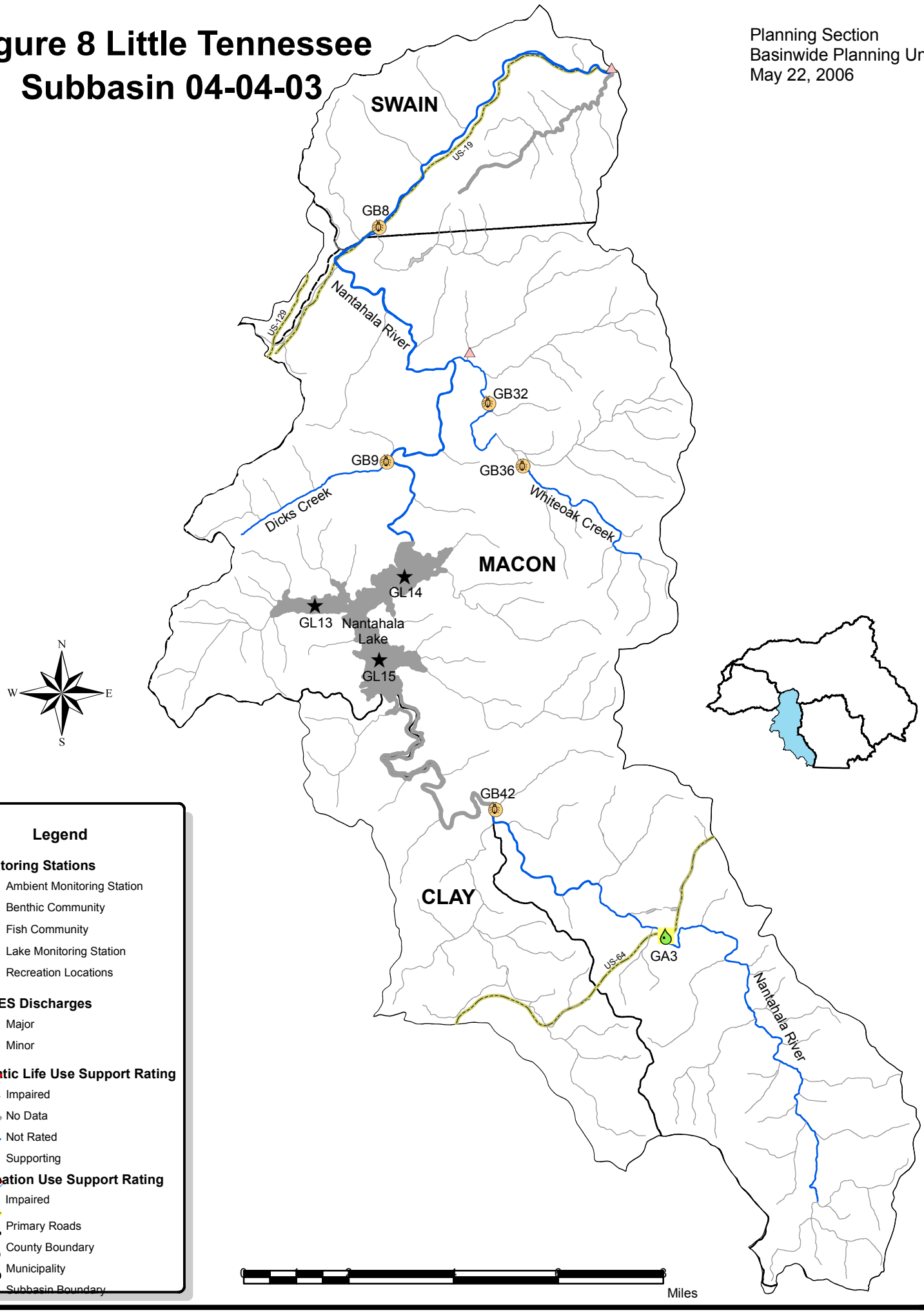


Table 10 Little Tennessee Subbasin 04-04-03

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Dicks Creek													
2-57-42	C;Tr	3.3	FW Miles	**S**					ND			Habitat Degradation	Impoundment
From source to Nantahala River					GB9	GF	2004						
Nantahala River													
2-57-(0.5)	B;Tr,ORW	3.5	FW Miles	**S**	GA3	NCE			**S**	GA3	NCE		
From source to Roaring Fork					GB42	E	2004						
2-57-(22.5)b	B;Tr	18.2	FW Miles	**S**					ND				
From Nanthahala Lake Dam to Nantahala River Arm of Fontana Lake, Little Tennessee R.					GB8	G	2004						
Nantahala River [Nantahala Lake (Aquone Lake)]													
2-57-(22.5)a	B;Tr	1,380.2	FW Acres	**NR**	GL14	ID			ND				
					GL15	ID							
					GL13	ID							
From Roaring Fork to Nantahala Lake Dam													
Silvermine Creek													
2-57-55	C	4.8	FW Miles	ND					ND				
From source to Nantahala River													
Whiteoak Creek													
2-57-45a	C;Tr	3.5	FW Miles	**S**					ND			Nutrient Impacts	Unknown
From source to SR 1397					GB36	GF	2004						
2-57-45c	C;Tr	3.6	FW Miles	**S**					ND				
From SR 1423 to Nantahala River					GB32	E	2004						

Table 10 Little Tennessee Subbasin 04-04-03

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
GF - Fish Community Survey
GB - Benthic Community Survey
GA - Ambient Monitoring Site
GL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2006:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	32.0	FW Miles
NR	m	1,380.2	FW Acres
ND		214.8	FW Miles

Recreation Rating Summary

S	m	3.5	FW Miles
ND		243.3	FW Miles
ND		1,380.2	FW Acres

Fish Consumption Rating Summary

I	e	246.8	FW Miles
I	e	1,380.2	FW Acres

Waters in the following sections and in Table 10 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

3.2 Use Support Assessment Summary

Table 11 Summary of Use Support Ratings by Category in Subbasin 04-04-03

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	32.0 mi	3.5 mi
Impaired*	0.0	0.0
Not Rated	1,380.2 ac	0.0
Total	**32.0 mi 1,380.2 ac**	**3.5 mi 0.0 ac**
Unmonitored Waters		
No Data	214.8 mi 0.0 ac	243.3 mi 1,380.2 ac
Total	**214.8 mi 0.0 ac**	**243.3 mi 1,380.2 ac**
Totals		
All Waters**	**246.8 mi 1,380.2 ac**	**246.8 mi 1,380.2 ac**

* The noted percent Impaired is the percent of monitored miles/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification are assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and VIII, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

In subbasin 04-04-03, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Refer to Table 11 for a summary of use support for waters in subbasin 04-04-03.

3.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Appendix VI.

3.3.1 White Oak Creek [AU# 2-57-45a]

Current Status
White Oak Creek from SR1397 to SR1423 (1.0 miles) was Impaired in 1996 due to nutrient enrichment and a Fair benthic community below a trout farm. DWQ sampled the benthic community in two locations (GB32 and GB36) in 2004. At site GB36, just below the trout farm, the bioclassification improved to Good-Fair indicating water quality is improving. However, a large population of snails indicates nutrient inputs from the trout farm are still impacting the stream. A 3.6 mile segment downstream is rated Excellent (GB32), indicating a full recovery from the upstream impacts.

2007 Recommendations
Because of the improvement to Good-Fair at site GB36, DWQ recommends White Oak Creek be removed from the 303(d) list of Impaired waters. The trout farm should continue to improve nutrient management at its facility.

3.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix VII.

3.4.1 Dicks Creek [AU# 2-57-42]

Current Status
Water in Dicks Creek was historically impounded at Dicks Creek Pond and diverted into Duke Energy's Nantahala Hydroelectric Project. As part of the1999 agreement between Duke Energy, NCDENR, USDA, and USFWS, this diversion ceased and flows in Dicks Creek were allowed to pass through Dicks Creek dam, into the Nantahala River. In 2003, Duke Energy agreed to restore additional flow in Dicks Creek as part of its mitigation for impacts caused by the Nantahala Hydroelectric Project. More information on this agreement can be found in Section 2.5.4.

DWQ sampled the benthic community in Dicks Creek at site GB9 to determine the condition of the stream prior to the introduction of new, stable flows. This site received a Good-Fair bioclassification in 2004.

2007 Recommendations
DWQ will sample Dicks Creek to evaluate the stream response to restored flows.

3.5 Additional Water Quality Issues within Subbasin 04-04-03

The following section discusses general issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

Those surface waters given an Excellent bioclassification may be eligible for reclassification to a High Quality Water (HQW) and/or Outstanding Resource Water (ORW). These streams are shown in Table 10. For more information about water quality standards and reclassification, see Chapter 5.

3.5.1 Management Strategies for Water Quality Protection

Municipalities and smaller outlying communities are being pressured to expand and this involves construction and/or development in areas of pristine waters along the Little Tennessee River and its tributaries. High Quality Water (HQW) and Outstanding Resource Water (ORW) are supplemental classifications to the primary freshwater classification(s) placed on a waterbody. Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody. Below is a brief summary of these strategies and the administrative code under which the strategies are found. More detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/. Definitions of the primary and supplemental classifications can be found in Chapter 5.

HQW is intended to protect waters with water quality higher than the state's water quality standards. In the Little Tennessee River basin, waters classified as ORW and waters designated by the NC Wildlife Resources Commission (WRC) as native (wild) trout waters are subject to HQW rules.

New discharges and expansions of existing discharges may, in general, be permitted in waters classified as HQW provided that the effluent limits are met for dissolved oxygen (DO), ammonia/nitrogen levels (NH_3-N), and the biochemical oxygen demand (BOD_5). More stringent limitations may be necessary to ensure that the cumulative effects from more than one discharge of oxygen-consuming wastes will not cause the dissolved oxygen concentration in the receiving water to drop more than 0.5 milligrams per liter (mg/l) below background levels. Discharges from single-family residential structures into surface waters are prohibited. When a discharge from an existing single-family home fails, a septic tank, dual or recirculation sand filters, disinfection, and step aeration should be installed (Administrative Code 15A NCAC 2B .0224)

In addition to the above, development activities which require an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). Under these rules, stormwater management strategies must be implemented if development activities are within one mile of and draining to waters designated as HQW. The low-density option requires a 30-foot wide vegetative buffer between development activities and the stream. This option can be used when the built upon area is less than 12 percent of the total land area or the proposed development is for a single-family residential home on one acre or greater. Vegetated areas may

be used to transport stormwater in the low-density option, but it must not lead to a discrete stormwater collection system (e.g., constructed). The high-density option is for all land disturbing activities on greater than one acre. For high-density projects, structural stormwater controls must be constructed (e.g., wet detention ponds, stormwater infiltration systems, innovative systems) and must be designed to control runoff from all surfaces affected by one inch or more of rainfall. More stringent stormwater management measures may be required on a case-by-case basis where it is determined additional measures are needed to protect and maintain existing and anticipated uses of the water (Administrative Code 15A NCAC 2H .1006).

ORWs are unique and special surface waters that have some outstanding resource value (e.g., outstanding fish habitat and fisheries, unusually high levels of water-based recreation, special ecological or scientific significance). No new discharge or expansions on existing discharges are permitted. Rules related to the development activities are similar to those for HQW, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). In addition, site-specific stormwater management strategies may be developed to protect the resource values of these waters.

Many of the streams in this subbasin are also classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Those streams noted as having Excellent bioclassifications in Table 10 may qualify for HQW or ORW classification. There may also be many more streams in the basin that qualify for such designation that DWQ has not monitored. DWQ relies on citizen requests to initiate the stream reclassification process (See Section 5.1.4) and encourages requests for reclassification to HQW or ORW when it is warranted. Appropriate stream classification will help to protect water quality in the long-term.

Native Southern Appalachian Brook Trout occupy many high elevation streams in the Little Tennessee River Basin. They are the only trout native to the southern Appalachian Mountains and require clear, cold streams to survive. They are very sensitive to excess sediment. Efforts to restore and expand their populations across the basin will benefit from designation as HQW or ORW. Those streams that can support Native Appalachian Brook Trout should be identified and evaluated for qualification as HQW or ORW.

3.5.2 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the Little Tennessee River basin. Hundreds of permit applications for onsite septic systems are approved every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the

warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

Chapter 4
Little Tennessee River Subbasin 04-04-04
Including the: Cheoah River Watershed and Santeetlah lake

4.1 Subbasin Overview

Subbasin 04-04-04 at a Glance

Land and Water Area

Total area:	221 mi²
Land area:	220 mi²
Water area:	<1 mi²

Population Statistics

2000 Est. Pop.:	5,995 people
Pop. Density:	27 persons/mi²

Land Cover (percent)

Forest/Wetland:	94.0%
Surface Water:	2.1%
Urban:	0.5%
Cultivated Crop:	0.2%
Pasture/ Managed Herbaceous:	3.2%

Counties

Cherokee and Graham

Municipalities

Santeetlah and Robbinsville

Monitored Streams Statistics

Aquatic Life

Total Streams:	314.3 mi
Total Supporting:	29.0 mi
Total Impaired:	3.4 mi
Total Not Rated:	281.9 mi

Recreation

Total Streams:	1.4 mi
Total Supporting:	1.4 mi

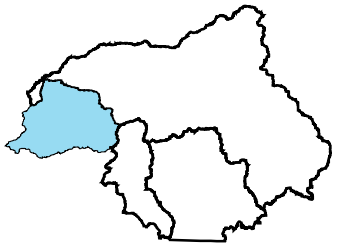
This subbasin contains the Cheoah River and all of its tributaries. Significant sections of most tributary catchments are within the Nantahala National Forest and are minimally impacted. These tributaries are typically high-gradient streams capable of supporting trout populations. However, lower reaches of some tributaries and corridors along Tulula Creek, Sweetwater Creek, Little Snowbird Creek, Yellow Creek, and the Cheoah River are not in the national forest. Thus, they are more likely to be impacted by land disturbing activities. Tulula Creek flows through the Town of Robbinsville, where the stream becomes the Cheoah River at its confluence with Sweetwater Creek. Ninety four percent of the subbasin is forested.

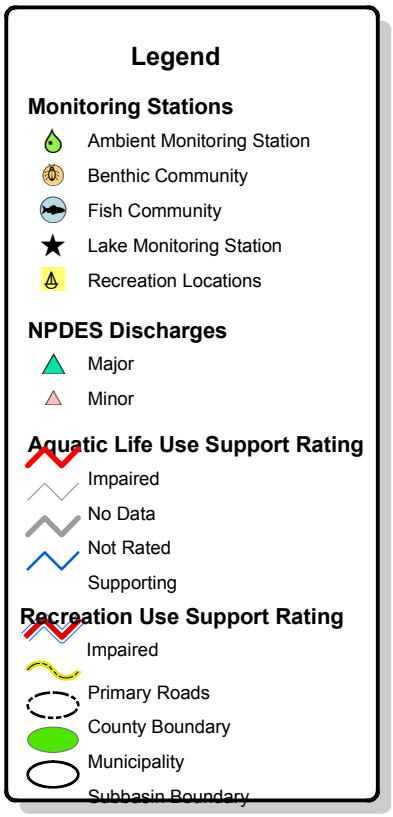
Robbinsville is the only urban area in this subbasin. There are only three NPDES permitted dischargers in this subbasin. The Robbinsville Wastewater Treatment Plant (WWTP), a minor municipal discharger releases 0.63 MGD into Long Creek, a tributary of the Cheoah River. The town's water treatment plant discharges 0.1 MGD to Rock Creek, a headwater tributary to Long Creek. Wide Creek Trout Sales has an unlimited discharge to Snowbird Creek, a tributary to Lake Santeetlah. None of these facilities is required to monitor whole effluent toxicity.

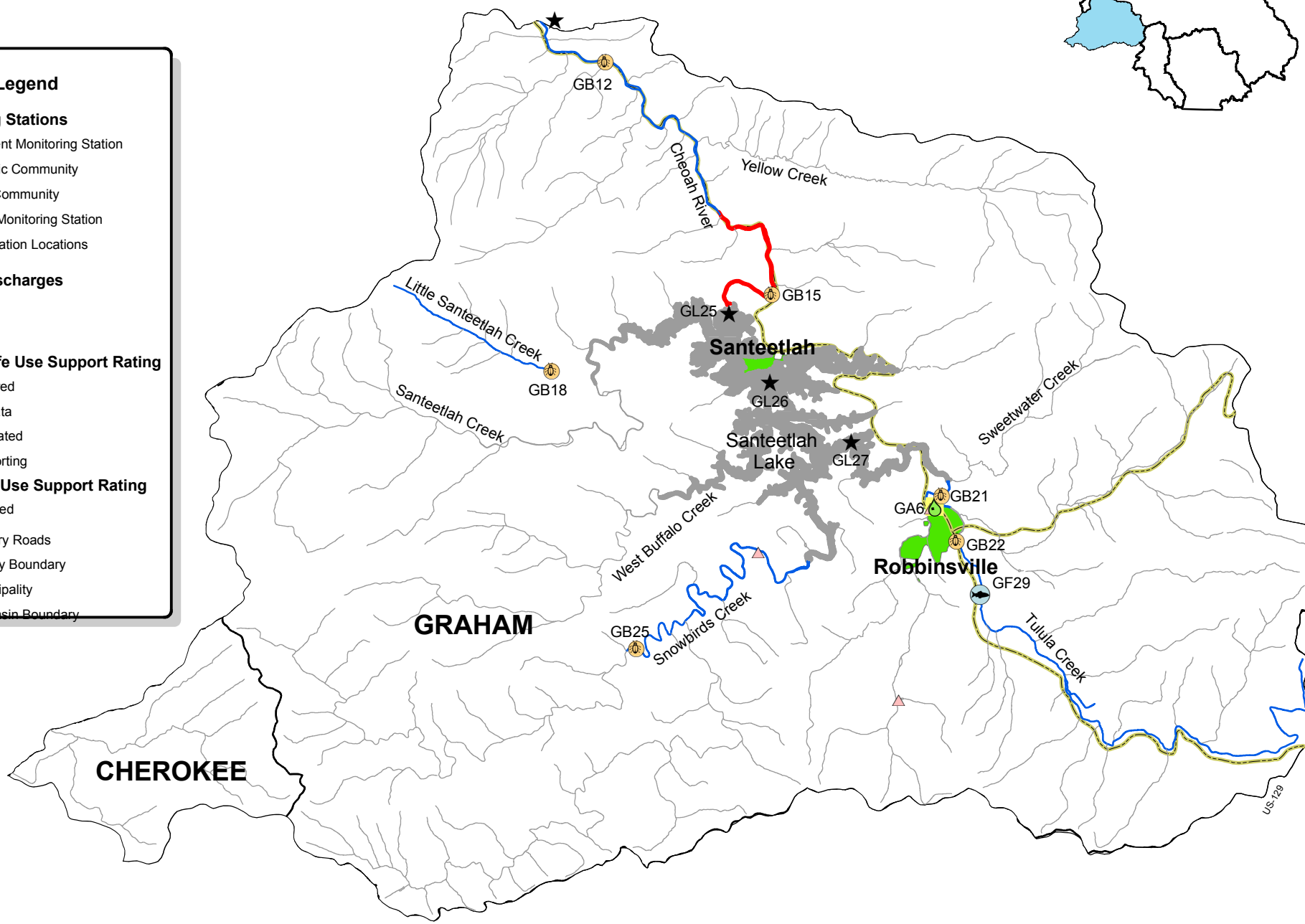
A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 9. Table 12 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support for waters in the subbasin. Refer to Appendix VIII for more information about use support methodology.

The Cheoah River is dammed below Robbinsville to form Santeetlah Lake. Tapoco, Inc. manages the flow in the river and in the impoundment to provide hydroelectric power for the Aluminum Company of America. The de-watered tailwater reach is approximately nine river miles in length prior to its confluence with the Little Tennessee River below Cheoah Dam.

Figure 9 Little Tennessee Subbasin 04-04-04







Miles

Planning Section
Basinwide Planning Unit
May 22, 2006

Table 12 Little Tennessee Subbasin 04-04-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Cheoah River													
2-190-(22)a	C;Tr	3.4 FW Miles		I					ND			Habitat Degradation	Impoundment
	From Santeetlah Dam to Rock Creek				GB15	F	2004						
2-190-(22)b	C;Tr	5.9 FW Miles		S					ND				
	From Rock Creek to Calderwood Lake, Little Tennessee River				GB12	E	2004						
2-190-(3.5)	C;Tr	1.4 FW Miles		S	GA6	NCE			S	GA6	NCE		
	From the Town of Robbinsville's proposed water supply intake, to Mountain Creek				GB21	G	2004						
Cheoah River, Santeetlah Lake below elevation 1940 MSL													
2-190-(5)	B;Tr	1.9 FW Miles		NR	GL25	ID			ND				
					GL27	ID							
					GL26	ID							
	From Mountain Creek to Santeetlah Dam												
Little Santeetlah Creek													
2-190-19-7	C;Tr	3.3 FW Miles		S					ND				
	From source to Santeetlah Creek				GB18	G	2004						
Snowbird Creek													
2-190-9-(15.5)	C;Tr	5.6 FW Miles		S					ND				
	From Polecat Branch to Santeetlah Lake, Cheoah River				GB25	E	2004						
Tulula Creek													
2-190-2-(0.5)	WS-III;Tr	12.8 FW Miles		S					ND			Habitat Degradation	Unknown
	From source to a point 0.5 mile upstream of mouth				GF29	GF	2004					Nutrient Impacts	Unknown
					GB22	G	2004						

Table 12 Little Tennessee Subbasin 04-04-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
West Buffalo Creek Arm of Santeetlah Lake													
2-190-12b	B;Tr	280.0 FW Miles	From SR 1148 to Santeetlah Lake, Cheoah River	**NR**					ND				

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
GF - Fish Community Survey
GB - Benthic Community Survey
GA - Ambient Monitoring Site
GL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2006:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	29.0	FW Miles
NR	m	281.9	FW Miles
I	m	3.4	FW Miles
ND		306.9	FW Miles

Recreation Rating Summary

S	m	1.4	FW Miles
ND		619.7	FW Miles

Fish Consumption Rating Summary

I	e	615.3	FW Miles
I		5.9	FW Miles

The upper half of the Snowbird Creek watershed, along with several tributaries to Long Creek, is classified High Quality Waters (HQW). Other portions of the Long Creek watershed (Town of Robbinsville's water supply) are classified WS-I, which are HQW by definition. Several other streams would likely meet the criteria for reclassification to HQW or Outstanding Resource Waters. Refer to Chapter 5 for further information. Additionally, the Cheoah River floodplain is considered a significant natural heritage area by the state because of the rare and endangered species it contains.

There were six benthic macroinvertebrate community and one fish community samples collected during this assessment period. Data were also collected from one ambient monitoring station. Data collected from the ambient station has historically indicated good water quality. However, there were occasional periods when turbidity exceeded the state standard for Trout waters during this assessment cycle. These exceedances occurred in only four percent of the measurements, and therefore do not indicate impairment. Refer to the *2005 Little Tennessee River Basinwide Assessment Report* at http://h2o.enr.state.nc.us/esb/Basinwide/LTN2005.pdf and Appendix IV for more information on monitoring.

Waters in the following sections and in Table 12 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

4.2 Use Support Assessment Summary

Table 13 Summary of Use Support Ratings by Category in Subbasin 04-04-04

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	29.0 mi	1.4 mi
Impaired*	3.4 mi (1%)	0.0
Not Rated	281.9 mi	0.0
Total	**314.3 mi**	**1.4 mi**
Unmonitored Waters		
No Data	306.9 mi	619.7 mi
Total	**306.9 mi**	**619.7 mi**
Totals		
All Waters**	**621.2 mi**	**621.1 mi**

* The noted percent Impaired is the percent of monitored miles/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification are assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and IX, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

In subbasin 04-04-04, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an

evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants.

Refer to Table 13 for a summary of use support for waters in subbasin 04-04-04.

4.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Appendix VI.

4.3.1 Cheoah River [AU# 2-190-(22)a]

Current Status
Santeetlah Dam is located on the Cheoah River in Graham County. The Santeetlah Development was completed in 1928, and consists of a dam, pipeline/tunnel, and powerhouse. Santeetlah Dam creates Santeetlah Reservoir, which has a normal full pool area of approximately 2,881 acres and a drainage area of 176 square miles. The normal full pool elevation of Santeetlah Reservoir is 1,940.9 feet (USGS).

The Santeetlah powerhouse is located on the left bank of the Little Tennessee River (Cheoah Reservoir) about five miles upstream of Cheoah Dam. Water is withdrawn from Santeetlah Reservoir through an intake in the Santeetlah Dam and is passed through a 5-mile tunnel and pipeline to the powerhouse located on the Little Tennessee River.

The Santeetlah Development is operated as a storage impoundment in accordance with an annual operating curve, which establishes target seasonal reservoir levels. The current operating curve was adopted in 2004 as part of the Tapoco Project Relicensing Settlement Agreement. Under the current operating guide, Santeetlah Reservoir is operated to maintain high recreational elevations during the summer months, followed by fall drawdown to allow for collection of rainfall and runoff during the late fall, winter, and early spring. The current operating curve was developed to also provide protection and enhancement for a variety of other resources and uses, including aquatic species and habitat, water quality, reservoir wetlands, archaeological sites, and scenic appearance throughout the year. During the period April 1 to November 1, the maximum drawdown at Santeetlah Reservoir is 4-5 feet. The reservoir is filled during the month of March at such a rate that by April 1 the maximum drawdown is 5 feet. During the period December 1 to March 1, the maximum drawdown is 10 feet. During the month of November, the reservoir is drawn down at such a rate that by December 1 the maximum drawdown is 10 feet.

Prior to the Relicensing Settlement Agreement, there were no regular flow releases from Santeetlah Dam into the Cheoah River. Water from Santeetlah Reservoir was diverted to the powerhouse located on the Little Tennessee River upstream of Cheoah Dam. The drainage area for the Cheoah River below Santeetlah Dam was made up of leakage from the dam, tributary inflow and occasional spills from the dam. The lack of flow severely impacted the benthic

community (GB15) in this reach and resulted in Impairment in the aquatic life category from Santeetlah Dam to Rock Creek (3.4 miles). Beginning September 1, 2005 as part of the Relicensing Settlement Agreement, Tapoco began releasing minimum flows designed to enhance and protect the biologic community in the Cheoah River below the dam.

As an additional enhancement, Tapoco established a fund intended to improve resource management in the river. The fund provides monetary support to the North Carolina Wildlife Resources Commission, North Carolina Department of Environment and Natural Resources, U. S. Forest Service, Eastern Band of Cherokee Indians, and U. S. Fish and Wildlife Service. These agencies may use the fund to monitor biology and habitat in the river, add large woody debris (habitat), manage gravel and vegetation (bank stabilization), and other natural resource stewardship activities including threatened and endangered species recovery efforts, exotic species control, and environmental outreach and education directly related to segments of the Cheoah River and Little Tennessee River affected by dam operation.

The complete consensus agreement can be found in the Tapoco (FERC #2169), Final License Application filed with FERC. These and other associated documents can be obtained at: http://www.ferc.gov

2007 Recommendations
DWQ will resample site GB15 to evaluate improvements expected in the benthic population after minimum flows take effect. Additionally, local efforts are needed to reduce the impact of increased recreational use on water quality, especially around stream accesses and parking areas.

4.3.2 West Buffalo Creek Arm of Santeetlah Lake [AU# 2-190-12b]

Current Status
The West Buffalo Creek arm of Santeetlah Lake is on the 303(d) list (289 acres) for impairment due to nutrient enrichment (chlorophyll *a*) based on special studies conducted by the Division of Water Quality in 1993 and 1999. Nutrient concentrations were especially high immediately downstream of trout farms on West Buffalo Creek. The Clean Water Management Trust Fund awarded $1.25 million dollars to support the buyout of the four trout farms on the West Buffalo Creek arm responsible for the largest contributions of nutrients to the creek. The four farms were fully decommissioned by the end of March 2004.

During the spring, summer, and fall of 2005, the Division of Water Quality conducted a special study of West Buffalo Creek and the West Buffalo Creek arm of Santeetlah Lake. This study was conducted to document changes or improvements to the water quality of Buffalo Creek following the de-population and dismantling of the trout farms. This study examined both physical, chemical and biological water quality parameters on West Buffalo Creek and Santeetlah Lake to determine the degree of nutrient reduction obtained from the trout farm removal.

Results from that study indicate that the nutrient reduction strategy was effective. Nutrient loading into the West Buffalo Creek arm of the lake was reduced up to 92 percent and algal blooms were diminished. Phytoplankton species shifts also occurred. *Anabaena spiroides, a* filamentous blue-green alga responsible for blooms and complaints in 1993 and 1999, was not present in samples analyzed in 2005. While problematic species were still present, densities were more than 50 percent lower in 2005 than in previous years.

Additionally, feedback from local citizens was very positive regarding the appearance of the West Buffalo Creek arm of Santeetlah Lake. Citizens commented that 2005 was the first year in recent memory that they did not see the "pea soup" appearance they had witnessed in years past. However, an insufficient number of samples (<10) were available to assign a use support rating to this segment.

2007 Recommendations
It is clear that management efforts and nutrient reductions have restored this body of water to fully supporting its designated uses. DWQ recommends the West Buffalo Creek arm of Santeetlah Lake be removed from the Impaired Waters List. The Graham County Soil and Water Conservation District has current plans with other agricultural produces along this stream to fence out cattle from West Buffalo Creek to further enhance the conservation efforts on this creek. DWQ supports Graham County SWCD in this effort.

4.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix VII.

4.4.1 Sweetwater Creek

Current Status
The Sweetwater Creek watershed is almost entirely in private ownership, and much of the land is used for growing hay. The Graham County Soil and Water Conservation District is aware of streambank stability problems and has assisted landowners along the creek with planning and installing BMPs. The District plans to continue to devote conservation resources to this watershed but will require landowner participation. The North Carolina Department of Transportation has plans to widen NC 143 near the stream.

2007 Recommendations
DWQ supports Graham County SWCD's efforts in the watershed and encourages local landowners to participate in their efforts.

4.4.2 Tulula Creek [AU# 2-190-2-(0.5)]

Current Status
The Tulula Creek watershed lies within the southeastern corner of Graham County. For much of its length, US 129 and a railroad parallel the creek as it courses down the valley before flowing through the urban areas in and around Robbinsville. Land use in the headwater portions are generally forested, but the mainstem valley is mostly agriculture and residential. In 2004, DWQ sampled the fish and benthic communities at sites GF29 and GB22. While not impaired, both samples indicated degradation. The benthic community declined from Excellent in 1999 to

Good in 2004 and the fish community rated only Good-Fair. Habitat degradation and nutrient enrichment are stressors likely causing the declines.

2007 Recommendations
Sources of nutrient enrichment should be identified and corrected. Property owners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Graham County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

4.5 Additional Water Quality Issues within Subbasin 04-04-04

The following section discusses general issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

Those surface waters given an Excellent bioclassification may be eligible for reclassification to a High Quality Water (HQW) or Outstanding Resource Water (ORW). These streams are shown in Table 12. For more information about water quality standards and reclassification, see Chapter 5.

4.5.1 Management Strategies for Water Quality Protection

Municipalities and smaller outlying communities are being pressured to expand and this involves construction and/or development in areas of pristine waters along the Little Tennessee River and its tributaries. High Quality Water (HQW) and Outstanding Resource Water (ORW) are supplemental classifications to the primary freshwater classification(s) placed on a waterbody. Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody. Below is a brief summary of these strategies and the administrative code under which the strategies are found. More detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/. Definitions of the primary and supplemental classifications can be found in Chapter 5.

HQW is intended to protect waters with water quality higher than the state's water quality standards. In the Little Tennessee River basin, waters classified as ORW and waters designated by the NC Wildlife Resources Commission (WRC) as native (wild) trout waters are subject to HQW rules.

New discharges and expansions of existing discharges may, in general, be permitted in waters classified as HQW provided that the effluent limits are met for dissolved oxygen (DO), ammonia/nitrogen levels (NH_3-N), and the biochemical oxygen demand (BOD_5). More stringent limitations may be necessary to ensure that the cumulative effects from more than one discharge

of oxygen-consuming wastes will not cause the dissolved oxygen concentration in the receiving water to drop more than 0.5 milligrams per liter (mg/l) below background levels. Discharges from single-family residential structures into surface waters are prohibited. When a discharge from an existing single-family home fails, a septic tank, dual or recirculation sand filters, disinfection, and step aeration should be installed (Administrative Code 15A NCAC 2B .0224).

In addition to the above, development activities which require an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). Under these rules, stormwater management strategies must be implemented if development activities are within one mile of and draining to waters designated as HQW. The low-density option requires a 30-foot wide vegetative buffer between development activities and the stream. This option can be used when the built upon area is less than 12 percent of the total land area or the proposed development is for a single-family residential home on one acre or greater. Vegetated areas may be used to transport stormwater in the low-density option, but it must not lead to a discrete stormwater collection system (e.g., constructed). The high-density option is for all land disturbing activities on greater than one acre. For high-density projects, structural stormwater controls must be constructed (e.g., wet detention ponds, stormwater infiltration systems, innovative systems) and must be designed to control runoff from all surfaces affected by one inch or more of rainfall. More stringent stormwater management measures may be required on a case-by-case basis where it is determined additional measures are needed to protect and maintain existing and anticipated uses of the water (Administrative Code 15A NCAC 2H .1006).

ORWs are unique and special surface waters that have some outstanding resource value (e.g., outstanding fish habitat and fisheries, unusually high levels of water-based recreation, special ecological or scientific significance). No new discharge or expansions on existing discharges are permitted. Rules related to the development activities are similar to those for HQW, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). In addition, site-specific stormwater management strategies may be developed to protect the resource values of these waters.

Many of the streams in this subbasin are also classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information

regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Those streams noted as having Excellent bioclassifications in Table 12 may qualify for HQW or ORW classification. There may also be many more streams in the basin that qualify for such designation that DWQ has not monitored. DWQ relies on citizen requests to initiate the stream reclassification process (See Section 5.1.4) and encourages requests for reclassification to HQW or ORW when it is warranted. Appropriate stream classification will help to protect water quality in the long-term.

Native Southern Appalachian Brook Trout occupy many high elevation streams in the Little Tennessee River Basin. They are the only trout native to the southern Appalachian Mountains and require clear, cold streams to survive. They are very sensitive to excess sediment. Efforts to restore and expand their populations across the basin will benefit from designation as HQW or ORW. Those streams that can support Native Appalachian Brook Trout should be identified and evaluated for qualification as HQW or ORW.

4.5.2 Special Management Strategies for Threatened and Endangered Species

Several streams in Little Tennessee River subbasin 04-04-04 are home to Federally listed Threatened and Endangered Species. The Cheoah River and Talula Creek host the Appalachian elktoe. Section .0100 of the Administrative Code states the following:

> Certain waters provide habitat for federally-listed aquatic animal species that are listed as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act, 16 U.S.C. 1531-1544 and subsequent modifications. Maintenance and recovery of the water quality conditions required to sustain and recover federally-listed threatened and endangered aquatic animal species contributes to the support and maintenance of a balanced and indigenous community of aquatic organisms and thereby protects the biological integrity of the waters. The Division shall develop site-specific management strategies under the provisions of 15A NCAC 2B .0225 or 15A NCAC 2B .0227 for those waters. These plans shall be developed within the basinwide planning schedule with all plans completed at the end of each watershed's first complete five year cycle following adoption of this Rule. Nothing in this Rule shall prevent the Division from taking other actions within its authority to maintain and restore the quality of these waters.

An interagency team from the USFWS, the NC Wildlife Resources Commission and the NC Natural Heritage Program was asked to develop technical reports to support NCDWQ's development of site-specific management strategies to restore water quality in the Little Tennessee River Basin. It is intended to provide a framework for getting additional stakeholder input prior to formulating the water quality management strategy which will be completed through rule-making by NCDWQ (with the requisite public involvement and Environmental Management Commission oversight).

4.5.3 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the Little Tennessee River basin. Hundreds of permit applications for onsite septic systems are approved

every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

Chapter 5
North Carolina Water Quality Classifications and Standards

5.1 Description of Surface Water Classifications and Standards

North Carolina's Water Quality Standards Program adopted classifications and water quality standards for all the state's river basins by 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters, and the protection of unique and special pristine waters with outstanding resource values.

5.1.1 Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 14 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*. Information on this subject is also available at DWQ's website: http://h2o.enr.state.nc.us/wqhome.html.

5.1.2 Statewide Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all state surface waters. The other primary and supplemental classifications have more stringent standards than for C and SC, and therefore, require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare and endangered aquatic species.

High Quality Waters (Class HQW)
There are 362.1 stream miles and 1,388.5 acres of HQW waters in the Little Tennessee River basin (Figure 10). Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities, which expand beyond their currently permitted loadings, address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Table 14 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS	
Class*	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C and SC uses.
SA	Suitable for commercial shellfish harvesting and SB and SC uses.
WS	*Water Supply (WS)*: Assigned to watersheds based on land use characteristics. The WS classifications have management strategies to protect the surface water supply. For WS-I through WS-IV, these include limits on point source discharges and local programs to control nonpoint source and stormwater runoff. A WS Critical Area (CA) has more stringent protection measures and is designated within one-half mile from a WS intake or WS reservoir. All WS classifications are suitable for Class C uses.
WS-I	Generally located in natural and undeveloped watersheds.
WS-II	Generally located in predominantly undeveloped watersheds.
WS-III	Generally located in low to moderately developed watersheds.
WS-IV	Generally located in moderately to highly developed watersheds.
WS-V	Generally upstream of and draining to Class WS-IV waters. No categorical restrictions on watershed development or treated wastewater discharges.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Waters that have low velocities and other natural characteristics that are different from adjacent streams (i.e., lower pH, lower levels of dissolved oxygen).
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
HQW	*High Quality Waters*: Waters that have excellent water quality, primary nursery areas and other functional nursery areas, WS-I and WS-II or SA waters.
ORW	*Outstanding Resource Waters*: Unique and special waters of exceptional state or national recreational or ecological significance which require special protection.
NSW	*Nutrient Sensitive Waters*: Waters subject to excessive plant growth and requiring limitations on nutrient inputs.

* Primary classifications beginning with "S" are assigned to saltwaters.

Criteria for HQW Classification

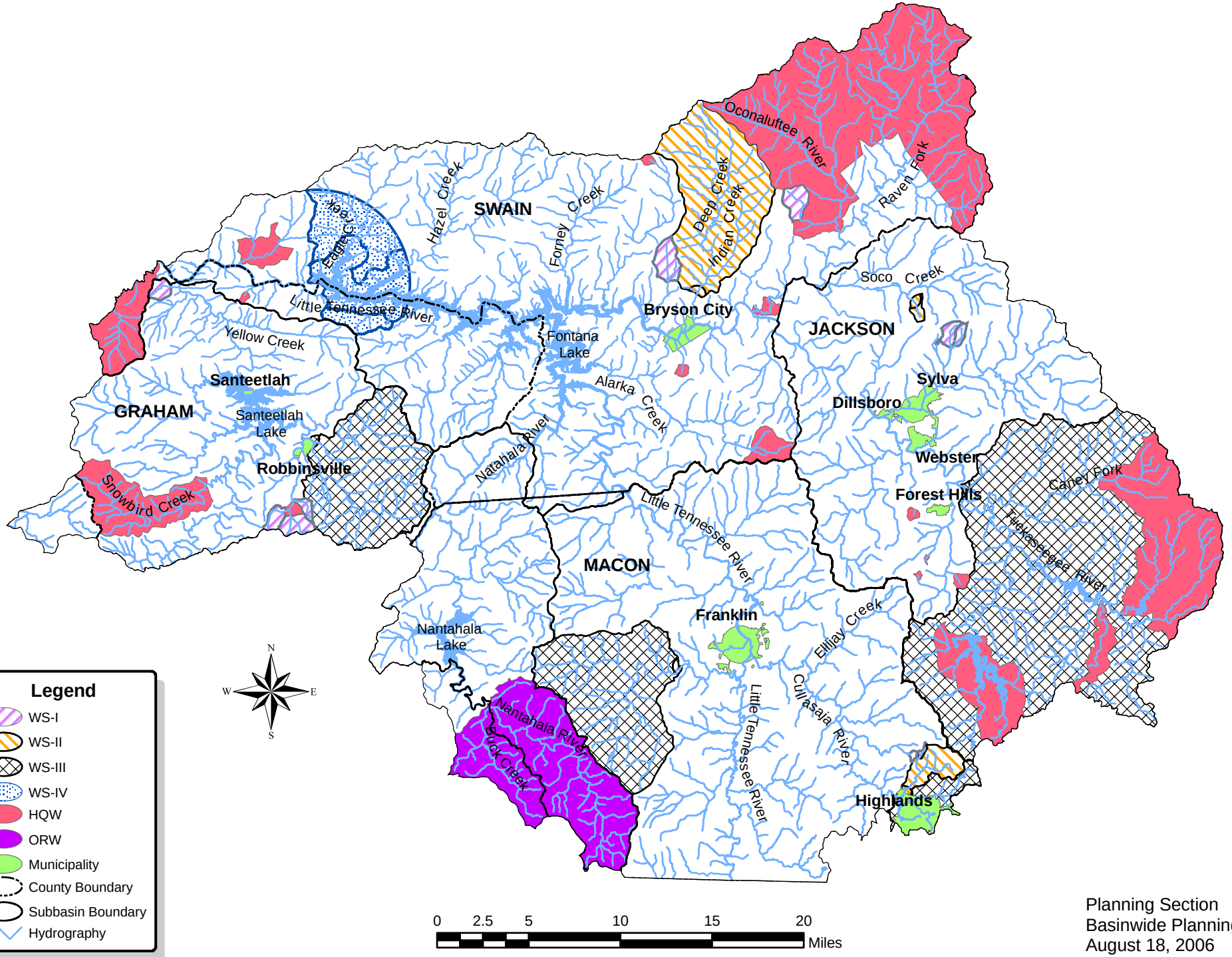
- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission (WRC).
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
- Waters classified by DWQ as WS-I, WS-II or SA.

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs, are required to control runoff from the development using either a low density or high density option. The low-density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high-density option requires structural stormwater controls. In addition, the Division of Land Resources (DLR) requires more stringent erosion controls for land-disturbing projects within one mile of and draining to HQWs.

Outstanding Resource Waters (Class ORW)

There are 94.5 stream miles of ORW waters in the Little Tennessee River basin (Figure 10). These waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

Figure 10 ORWs, HQWs and Water Supply Watersheds in the Little Tennessee River Basin



Planning Section
Basinwide Planning Unit
August 18, 2006

The ORW rule defines outstanding resource values as including one or more of the following:

- an outstanding fisheries resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- within a state or national park or forest; or
- a special ecological or scientific significance.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

Primary Recreation (Class B)

There are 465.9 stream miles and 11,971.0 acres classified for primary recreation in the Little Tennessee River basin. Waters classified as Class B are protected for primary recreation, include frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters much be treated to avoid potential impacts to the existing water quality.

Trout Waters (Class Tr)

There are 1,596.2 stream miles and 3,808.8 acres classified as trout (Tr) waters in the Little Tennessee River basin. Different water quality standards for some parameters, such as dissolved oxygen, temperature and turbidity, have been developed to protect freshwaters for natural trout propagation and survival of stocked trout. These water quality standards result in more restrictive limits for wastewater discharges to trout waters.

There are no watershed development restrictions associated with the Tr classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect Tr streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as Tr waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along Tr waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected Tr water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

A state fishery management classification, Designated Public Mountain Tr Waters, is administered by the NC WRC. It provides for public access to streams for fishing and regulates fishing activities (seasons, size limits, creel limits, and bait and lure restrictions). Although many of these waters are also classified Tr by DWQ, this is not the same classification.

Water Supply Watersheds (Class WS)

There are 515.23 stream miles and 4,506.9 acres currently classified for water supply in the Little Tennessee River basin (Figure 10). The purpose of the Water Supply Watershed Protection

Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution to water supplies.

There are five water supply classifications (WS-I to WS-V) that are defined according to the land use characteristics of the watershed. The WS-I classification carries the greatest protection for water supplies. No development is allowed in these watersheds. Generally, WS-I lands are publicly owned. WS-V watersheds have the least amount of protection and do not require development restrictions. These are either former water supply sources or sources used by industry. WS-I and WS-II classifications are also HQW by definition because requirements for these levels of water supply protection are at least as stringent as those for HQWs. Those watersheds classified as WS-II through WS-IV require local governments having jurisdiction within the watersheds to adopt and implement land use ordinances for development that are at least as stringent as the state's minimum requirements. A 30-foot vegetated setback is required on perennial streams in these watersheds. The Little Tennessee River basin currently contains WS-I, WS-II, WS-III and WS-IV water supply watersheds.

5.1.3 Special Management Strategies

There are 33.3 stream miles subject to special management strategies. Waters under special management strategies are designated with a "+" or "@" symbol in the stream classifications schedule. Under these strategies, stormwater controls are required on land within one mile of and draining to the designated ORW areas. Discharge limitations also apply to the "+" designated waters. These limitations were developed using most of the HQW management strategies as a framework. A summary of the special management strategies for HQW and ORW waters can be found in Section 2.5.2. Detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/.

5.1.4 Reclassification of Surface Waters

The classification of a surface water may be changed after a request is submitted to the Classifications and Standards Unit. DWQ reviews each request for reclassification and conducts an assessment of the surface water to determine if the reclassification is appropriate. If it is determined that a reclassification is justified, the request must proceed through the state rule-making process. To initiate a reclassification, the "Application to Request Reclassification of NC Surface Waters" must be completed and submitted to DWQ's Classifications and Standards Unit. For more information on requests for reclassification and contact information, visit http://h2o.enr.state.nc.us/csu/.

Chapter 6
Water Quality Stressors

6.1 Stressor and Source Identification

6.1.1 Introduction – Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired as well as Supporting waters with noted impacts. Identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations as well as information from other agencies and the public to identify potential water quality stressors. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address water quality problems.

Most stressors to the biological community are complex groupings of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely impact aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor or group of stressors may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered watershed hydrology.

> ***Cumulative Effects***
>
> While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

Stressors to recreational uses include pathogenic indicators such as fecal coliform bacteria, escheria coli and enterrococci. Stressors to fish consumption are mercury and any other substance that causes the issuance of a fish consumption advisory by the NC Division of Health and Human Services (NCDHHS).

6.1.2 Overview of Stressors Identified in the Little Tennessee River Basin

The stressors noted below are summarized for all waters and for all use support categories. Figure 11 identifies stressors noted for streams in the Little Tennessee River Basin during the most recent assessment period. The stressors noted in the figure may not be the sole reason for the impairment. For specific discussion of stressors to impairments or noted impacts, refer to the subbasin chapters (Chapters 1 – 4). Stressor definitions and potential impacts are discussed in the remainder of this chapter.

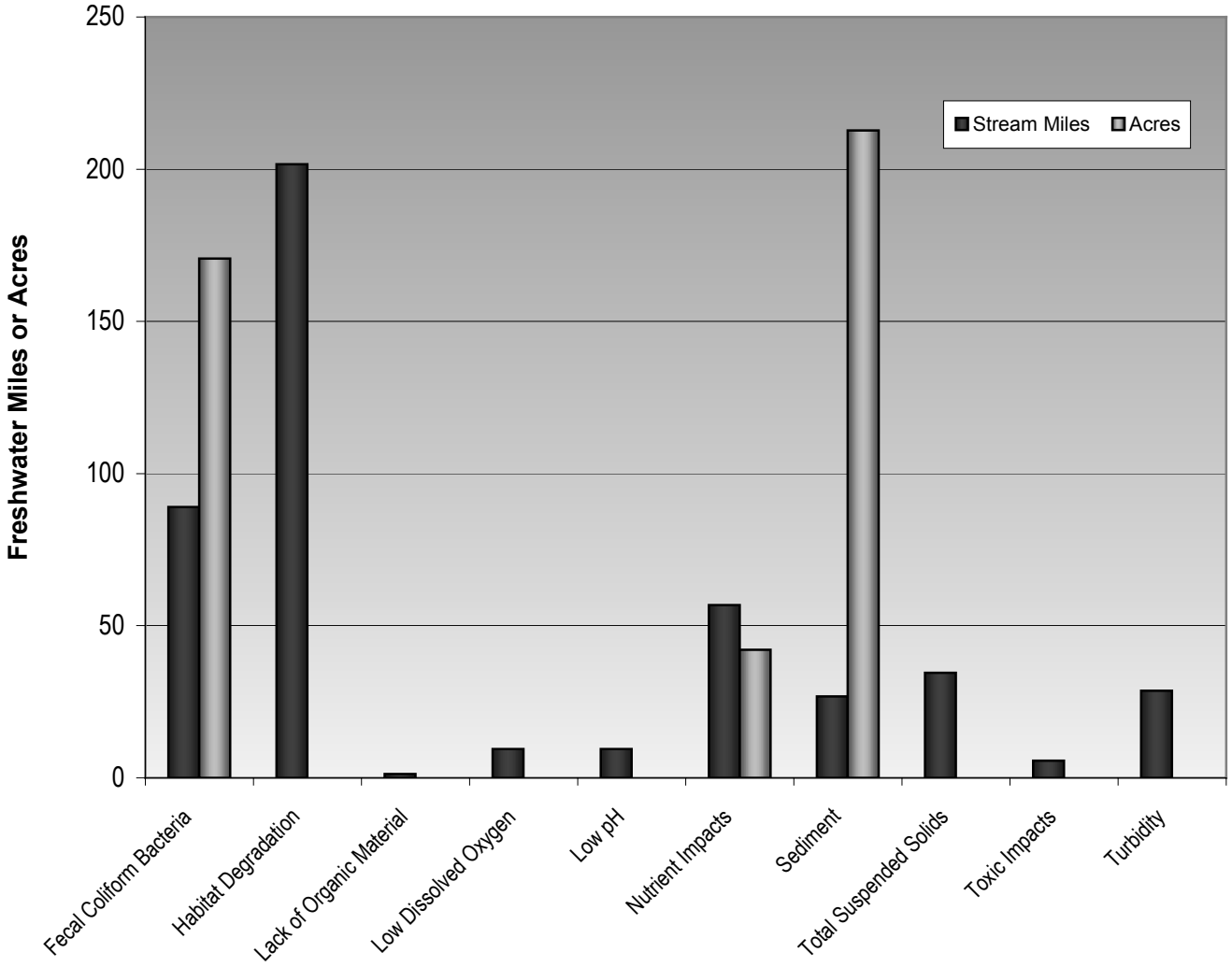


Figure 11 Stressors Identified for Streams in the Little Tennessee River Basin

6.1.3 Introduction – Sources of Stressors

Pollutants that enter waters fall into two general categories: *point sources* and *nonpoint sources*. Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state.

Point Sources

Piped discharges from:

- Municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to waters by rainfall, runoff, and snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given these characteristics, it is difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed.

Nonpoint Sources

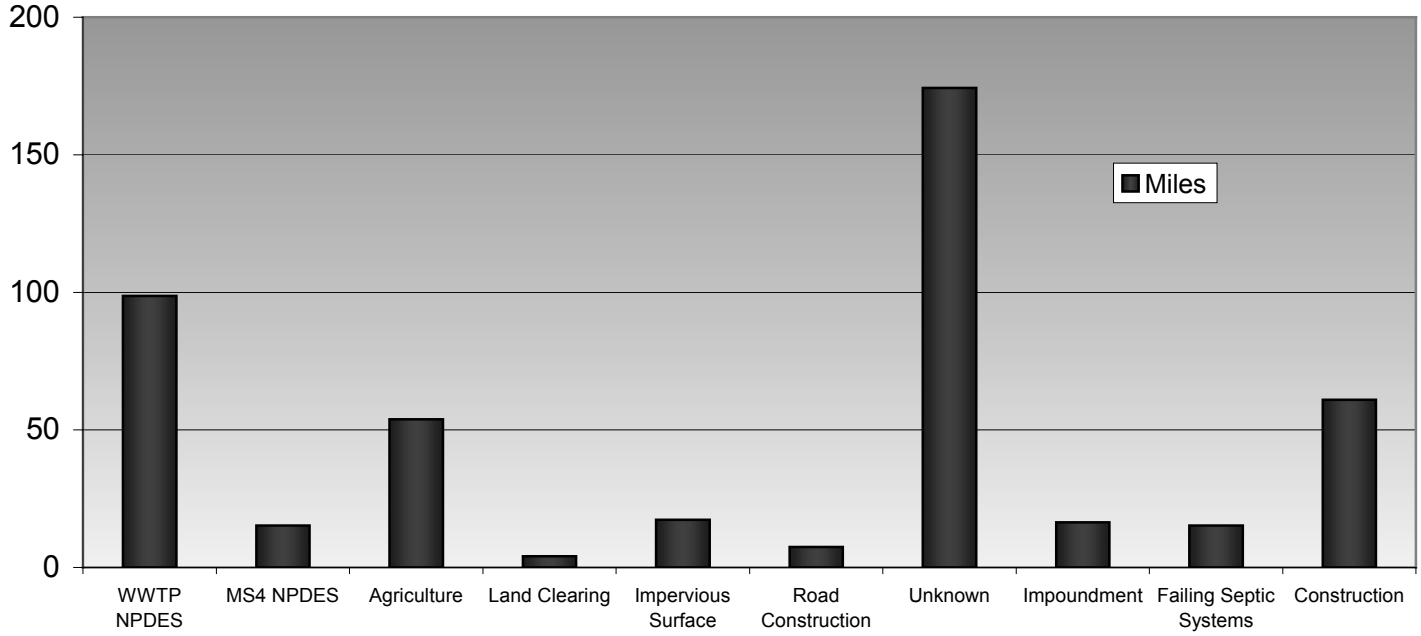
- Construction activities
- Roads, parking lots and rooftops
- Agriculture
- Failing septic systems and straight pipes
- Timber harvesting
- Hydrologic modifications

DWQ identifies the source of a stressor, point or nonpoint, as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Sources of stressors identified in the Little Tennessee River basin during the most recent assessment period include urban or impervious surface runoff, land clearing, and road building. Point source discharges are also considered a water quality stressor source. In addition to these sources, many impacts originate from unknown sources.

6.1.4 Overview of Stressor Sources Identified in the Little Tennessee River Basin

The sources noted below are summarized for all waters and for all use support categories. Figure 12 identifies sources of stressors noted for waters in the Little Tennessee River Basin during the most recent assessment period. Refer to the subbasin chapters (Chapters 1 – 4) for a complete listing and discussion of sources by stream.

Figure 12 Sources of Stressors Identified in the Little Tennessee River Basin



WWTP NPDES (wastewater treatment plants) were noted as a potential source to several stream miles in the Little Tennessee River basin. WWTPs are just one of many sources that can contribute excess nutrients that may increase the potential for algal blooms and cause exceedances in the chlorophyll *a* standard. WWTPs were noted as a potential source of water quality problems in 98.6 stream miles. Better treatment technology and upgrades to facilities in the Little Tennessee River basin are likely to decrease the number of stream miles impacted by WWTPs. MS4 NPDESs were noted as a potential source of water quality problems in 15.3 stream miles.

Field observations indicate that agricultural activities may be impacting water quality in several watersheds of the Little Tennessee River basin. In several areas where pasture was noted as the predominant land use, cattle had direct, easy access to the stream. Agriculture was noted as a potential stressor source for 53.8 stream miles. For more information related to agricultural water quality initiatives, refer to Chapter 9.

Impervious surface as a stressor source accounted for noted impacts to 17.4 stream miles and road construction activities accounted for noted impacts to 7.4 stream miles. Impervious surface cover and road construction activities are often associated with increased development. Refer to Chapter 7 for more information related to population growth and land cover changes and their potential impacts on water quality.

Stressor sources could not be identified for 599.7 stream miles in the Little Tennessee River basin. These stream segments may be in areas where sources could not be identified during field observations, but the streams had noted impacts (i.e., habitat degradation). DWQ and the local agencies will work to identify potential sources for these stream segments during the next basinwide cycle.

6.2 Aquatic Life Stressors – Habitat Degradation

6.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, streambank erosion, channelization, lack of riparian vegetation, loss of pools and/or riffles, loss of organic (woody and leaf) habitat, and streambed scour. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater. In the Little Tennessee River basin, 9.2 stream miles are Impaired where at least one form of habitat degradation has been identified as the stressor. There are an additional 201.6 stream miles that are not Impaired but where habitat degradation is a noted impact to water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. Altered hydrology increases both sources of stressors and delivery of the stressors to the receiving waters. Refer to the subbasin chapters (Chapters 1 – 4) for more information on the types of habitat degradation noted in a particular stream segment.

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (i.e., construction, mining, timber harvest, agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization (straightening) has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Some Best Management Practices to Improve Habitat Degradation

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

Quantifying the amount of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and then even more resources to restore them. Although DWQ and other agencies (i.e., SWCD, NRCS, town and county governments) are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been Impaired by activities that cause habitat degradation. As point source dischargers become less common sources of water quality impairment, nonpoint sources that pollute water and cause habitat degradation must be addressed to further improve water quality in North Carolina's streams and rivers.

6.2.2 Sedimentation

Sedimentation is a natural process that is important to the maintenance of diverse aquatic habitats. It is the process by which soil particles that washed off the landscape and stream banks are deposited within the stream. Streams naturally tend toward a state of equilibrium between erosion and deposition of sediments. As streams meander through their floodplains, the outside of the stream cuts into the bank eroding it away, while the inside of the stream deposits sediments to create sand bars further downstream. The natural process of erosion and deposition can be disrupted by human activities such as dams, dredging, agriculture, development, or logging. Construction projects or logging in the upper reaches of a watershed may worsen erosion or sediment deposition on someone else's property further downstream. If people straighten, narrow, or move stream channels without taking into consideration their natural energy, erosion and sediment deposition rates can increase, resulting in the loss of valuable agricultural land, damage to roads or structures, destruction of productive wetlands, and addition of sediments and nutrients to waterways that can degrade surface water quality and biodiversity.

Overloading of sediment in the form of sand, silt and clay particles fills pools and covers or embeds riffles that are vital aquatic insect and fish habitats. Suspended sediment can decrease primary productivity (i.e., photosynthesis) by shading sunlight from aquatic plants, thereby affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency which leads to reduced growth by some species, respiratory impairment, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers

and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment also increases the cost of treating municipal drinking water.

Streambank erosion and land-disturbing activities are sources of sedimentation. Streambank erosion is often caused by high stormwater flows immediately following rainfall events or snowmelts. Watersheds with large amounts of impervious surface transport water to streams more rapidly and at higher volumes than in watersheds with more vegetative cover. In many urban areas, stormwater is delivered directly to the stream by a stormwater sewer system. This high volume and concentrated flow of water after rain events undercuts streambanks often causing streambanks to collapse. This leads to large amounts of sediment being deposited into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks. Minimizing impervious surface area and reducing the amount of stormwater outlets releasing stormwater directly to the stream can often prevent substantial amounts of erosion.

Land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing, and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water. In most land-disturbing activities, sedimentation can be controlled through the use of appropriate best management practices (BMPs). BMPs that minimize the amount of acreage and length of time that the soil is exposed during land-disturbing activities can greatly reduce the amount of soil erosion. For more information on sedimentation as it relates to changes in land use, refer to Chapter 7.

Livestock grazing with unlimited access to the stream channel and banks can also cause severe streambank erosion resulting in sedimentation and degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and entrenchment by the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (EPA, 1999). For more information on the livestock exclusion, refer to Chapter 5.

6.2.3 Loss of Riparian Vegetation

During the 2002 basinwide sampling, DWQ biologists reported degradation of aquatic communities at several sites throughout the Little Tennessee River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas (NCDENR-DWQ, 2003). The loss of riparian vegetation and subsequent reduction of organic aquatic habitats (Section 5.2.4) is most commonly associated with land clearing for development, agriculture, pastureland, and forestry. Instream organic habitat loss has also been caused by stream channelization or debris removal activities.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a streambank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees,

shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the streambanks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, 2004). To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

6.2.4 Loss of Instream Organic Microhabitats

Organic microhabitat (i.e., leafpacks, sticks and large wood) and edge habitat (i.e., root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of aquatic insects, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Little Tennessee River basin is directly related to the absence of riparian vegetation. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed. For more information related to headwater streams, refer to Chapter 7.

6.2.5 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Typical modifications are described in the text box. Although increased flooding, streambank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996). Direct or immediate biological effects of channelization include injury and mortality of aquatic insects, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in the aquatic insect, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically in parts of the Little Tennessee River basin and continues to occur in some watersheds, especially in small headwater streams.

Typical Channel Modifications

- Removal of any obstructions, natural or artificial, that inhibit a stream's capacity to convey water (clearing and snagging).
- Widening, deepening or straightening of the channel to maximize conveyance of water.
- Lining the bed or banks with rock or other resistant materials.

6.2.6 Recommendations for Reducing Habitat Degradation

In March 2002, Environmental Management Commission (EMC) sent a letter to the Sedimentation Control Commission (SCC) expressing seven recommendations for improving erosion and sedimentation control, based on a comprehensive performance review of the turbidity standard conducted in 2001 by DWQ staff. Specifically, the recommendations are that the EMC and SCC:

(1) Evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect.

(2) Prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site.

(3) Jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by the NC Division of Land Resources (DLR). This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins.

(4) Evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool.

(5) Support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques.

(6) Jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard.

(7) Hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

DWQ will continue to work cooperatively with DLR and local programs that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Little Tennessee River basin. Additionally, more public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available through numerous federal and state programs for landowners to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Chapters 9 and 13). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VII.

6.2.7 Small Dams, Impoundments, and Water Features

The consensus among river ecologists is that dams are the single greatest cause of the decline of river ecosystems (World Commission on Dams, 2000). This report was focused on large dams, but by design, all dams, including small impoundments, alter the natural flow regime, and with it virtually every aspect of a river ecosystem, including water quality, sediment transport and deposition, fish migrations and reproduction, and riparian and floodplain habitat and the organisms that rely on this habitat (Raphals, 2001). Dams also require ongoing maintenance. For example, reservoirs in sediment-laden streams lose storage capacity as silt accumulates in the reservoir.

Dams cause significant adverse impacts to the ecology of rivers and streams by blocking migration of fish to upriver spawning habitat; warming water temperatures in impoundments well above downstream conditions and accumulating sediment, which degrades water quality and often buries high quality fisheries habitat.

The damming and/or diverting of streams can lead to the loss of habitat resulting from the inundation of wetlands, riparian areas, and farmland in upstream areas of the impounded waterway, or erosion of these resources in downstream areas. As dams trap sediment and other pollutants, changes in water quality especially in tailwaters and downstream areas occur. They include: reduced sediment transport, decreased dissolved oxygen, altered temperature regimes, and increased levels of some pollutants, such as hydrogen sulfide, nutrients, and manganese.

Once streams are impounded, water demand dictates the artificial regulation and control of streamflow. The new flow rates and volume often do not reproduce natural conditions preceding the impoundment. Releases of impounded water with decreased levels of dissolved oxygen, high turbidity, or altered temperature can reduce downstream populations of fish and other organisms. Not only can reservoir water temperatures and oxygen content differ significantly from expected

seasonal temperatures in the formerly free-flowing stream or river, but critical minimum flows needed for riparian areas are often not maintained as well. (EPA, 1995).

These effects are seen in both large and small impoundments. In 2003, the Tennessee Department of Environment and Conservation, Division of Water Pollution Control was awarded a grant to perform a probabilistic monitoring study of 75 streams below small impoundments. Many of these are similar to those found in western North Carolina. The study measured effects of the impoundments on aquatic life, nutrients, dissolved oxygen, pH, iron, manganese, habitat, flow and periphyton density in the downstream stream reaches.

Macroinvertebrate communities were adversely affected in most of the streams sampled. Of the 75 sites below impoundments, only four passed biological criteria guidelines or were comparable to unimpounded streams in both seasons sampled. A shift in the type of dominant organisms toward more tolerant taxa was also observed.

Lack of adequate flow was one of the biggest problems downstream of impoundments. Approximately one third of the perennial streams that were randomly selected for reconnaissance were dry. Of those with flow during the summer reconnaissance, one fourth had dry channels by the fall sampling period. Thirty-nine percent of the dams with year-round discharge provided insufficient flow to supply adequate habitat for aquatic life during at least one season.

Disruption of habitat was a major concern below most of the impoundments. Sediment deposition was the most significant habitat problem in impounded streams with 80% failing to meet regional expectations. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many aquatic organisms. Other frequently documented habitat problems included embedded substrate, instability of banks, loss of stream sinuosity and disruption of bank vegetation.

The most frequently encountered chemical water quality problems below impoundments were elevated iron, manganese and nutrients as well as low dissolved oxygen concentrations. Elevated manganese was the number one problem. Ammonia was the most frequently elevated nutrient.

Dissolved oxygen in lakes and streams is critical to support fish and aquatic life. Low levels of dissolved oxygen may be caused by decay of organic material, respiration of algae, inflow of substantial amounts of ground water, or reduced stream flow. Dissolved oxygen was below criteria in at least one season at 21 of the impounded test sites. Many sites that passed dissolved oxygen criteria during daylight hours did not maintain saturation comparable to reference levels. Streams with dissolved oxygen saturation below this level may not be providing adequate oxygen to support benthic communities appropriate for the ecoregion.

Water temperature is an important component of the aquatic environment. Almost all facets of life history and distribution of aquatic macroinvertebrates are influenced by temperature. Eight of the impounded streams violated the temperature criterion at the time of sampling. Most of the test sites fell outside the temperature ranges found in regional reference streams.

Approximately half of the impounded test sites had elevated suspended solids (TSS) compared to regional reference streams. Total suspended solids (TSS) can include a wide variety of material, such as silt and decaying organic matter. High TSS can block light from reaching submerged vegetation. Particles can clog gills, reduce growth rates, decrease resistance to disease and

prevent egg and larval development of benthic fauna. Suspended particles absorb heat from sunlight, which can result in higher water temperatures. Pollutants such as bacteria, nutrients, pesticides and metals may attach to sediment particles and be transported to the water where they are released or carried further downstream. (Arnwine, 2006)

These results clearly demonstrate the negative impact small dams and impoundments can have on stream habitat and water quality. DWQ strongly encourages developers and homeowners to carefully consider these impacts before choosing to install a water feature. In many cases, the harm caused will outweigh the benefits. Additionally, many existing small dams and impoundments may have outlived their usefulness. These old dams negatively influence biological communities and may have become maintenance problems. Removal options should be explored for these dams.

6.3 Aquatic Life Stressors – Water Quality Standards

6.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As with habitat degradation, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following are water quality standards that were identified for waters with noted impacts. Refer to the subbasin chapters (Chapter 1 – 4) for more information on the affected waters.

6.3.2 pH

The pH water quality standard for Class C waters is between 6.0 and 9.0. In the Little Tennessee River basin during the most recent assessment period, pH was identified as a potential stressor for 9.5 stream miles for waters with noted impacts.

6.3.3 Toxic Impacts

Toxic impacts are noted as a stressor during biological monitoring. Waters are not impaired due to toxic impacts, but toxic impacts can be noted as a potential stressor on the system. In the Little Tennessee River basin during the most recent assessment period, toxic impacts were noted on 5.7 stream miles. Refer to Chapter 1 for more information.

6.3.4 Fish Consumption Advisories and Advice Related to Mercury

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water, and eventually, to biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway for mercury in the environment is through the atmosphere. Mercury emitted from industrial and municipal stacks into the ambient air can circulate around the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also

commonly found in wastewater; however, mercury in wastewater is typically not at levels that could be solely responsible for elevated fish levels

Fish is part of a healthy diet and an excellent source of protein and other essential nutrients. However, nearly all fish and shellfish contain trace levels of mercury. The risks from mercury in fish depend on the amount of fish eaten and the levels of mercury in the fish. In March 2003, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued a joint consumer advisory for mercury in fish and shellfish. The advice is for women who might become pregnant, women who are pregnant, nursing mothers, and young children. Aside from being issued jointly by two federal agencies, this advisory is important because it emphasizes positive benefits of eating fish and gives examples of commonly eaten fish that are low in mercury. In the past, the FDA issued an advisory on consumption of commercially caught fish, while the EPA issued advice on recreationally caught fish.

By following these three recommendations for selecting and eating fish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury. These recommendations are:

- **Do not eat shark, swordfish, king mackerel, or tilefish**. They contain high levels of mercury.

- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna, has more mercury than canned light tuna. So, when choosing your two meals of fish, you may eat up to 6 ounces (one average meal) of albacore per week.

- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters. Don't consume any other fish during that week.

For more detailed information, visit EPA's website at http://www.epa.gov/waterscience/fish/ or visit the FDA at http://www.cfsan.fda.gov/seafood1.html. The FDA's food information toll-free phone number is 1-888-SAFEFOOD.

The NC Department of Health and Human Services (NCDHHS) also issues fish consumption advisories and advice for those fish species and areas at risk for contaminants. NCDHHS notifies people to either limit consumption or avoid eating certain kinds of fish. While most freshwater fish in North Carolina contain very low levels of mercury and are safe to eat, several species have been found to have higher levels. More information regarding use support assessment methodology related to fish consumption advisories and advice can be found in Appendix VIII.

Due to high levels of mercury in seventeen saltwater and five freshwater fish species, the NCDHHS offers the following health advice (updated March 31, 2006).

> Women of childbearing age (15 to 44 years), pregnant women, nursing women, and children under 15:

- **Do not eat** the following ocean fish: almaco jack, banded rudderfish, canned white tuna (albacore tuna), cobia, crevalle jack, greater amberjack, south Atlantic grouper (gag, scamp, red, and snowy), king mackerel, ladyfish, little tunny, marlin, orange roughy, shark, Spanish mackerel, swordfish, tilefish, or tuna (fresh or frozen).
- **Do not eat** the following freshwater fish: bowfin (blackfish), catfish (caught wild), chain pickerel (jack fish), or warmouth caught in North Carolina waters south and east of Interstate 85.
- **Do not eat** largemouth bass caught in North Carolina waters (statewide).
- Eat up to two meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

All other people:

- Eat no more than one meal (6 ounces) per week of ocean and/or freshwater fish listed above. These fish are often high in mercury.
- Eat up to four meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

For more information and detailed listing of site-specific advisories, visit the NCDHHS website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

6.4 Recreation Stressor – Fecal Coliform Bacteria

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 colonies/100ml in more than 20 percent of the samples. These additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is the greatest. Several streams in the Little Tennessee River basin are Impaired for fecal coliform bacteria. Those include Scotts Creek, Savannah Creek, and segments of the Tuckasegee River (See Chapter 2).

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a direct danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health. Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes that could make water unsafe for human contact (swimming). Fecal coliform bacteria and other

potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters.

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals and domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period of time (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

There are a number of factors beyond the control of any state regulatory agency that contribute to elevated levels of disease-causing bacteria. Therefore, the state does not encourage swimming in surface waters. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming and shellfish harvesting for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

Chapter 7
Population Growth, Land Cover Changes, and Water Quality in Western North Carolina

Once one of the most remote and sparsely populated regions of the state, western North Carolina is now penetrated by modern interstates and highways that provide speedy access to the deepest folds of the rugged terrain. This improved access coupled with an abundance of recreational opportunities, cultural activities, and countless other amenities sets the stage for rapid population increases. With this growth comes increased pressure on the natural environment. Every person living in or visiting a watershed contributes to impacts on water quality. If water pollution is to be eliminated, each individual should be aware of these contributions and take actions to reduce them. The following section describes the most common impacts of human activity and offers suggestions to lessen those impacts.

7.1 Impacts of Population Growth and Land Cover Changes

7.1.1 Rapid Urbanization

Population growth results in dramatic impacts on the natural landscape. The most obvious impact is the expansion of urban and suburban areas. New stores, roads, and subdivisions are products of growing populations. What is not so obvious is the astonishing rate at which rural landscapes are converted to developed land. Between 1982 and 1997, the United States population increased by 15 percent. Over the same period, developed land increased by 34 percent – more than double the rate of population growth (NRI, 2001; U.S. Census Bureau, 2000). Locally, the trend can be even more pronounced. For example, the urban area of Charleston, SC expanded 250 percent between 1973 and 1994 while its population grew by 40 percent (Allen and Lu, 2000).

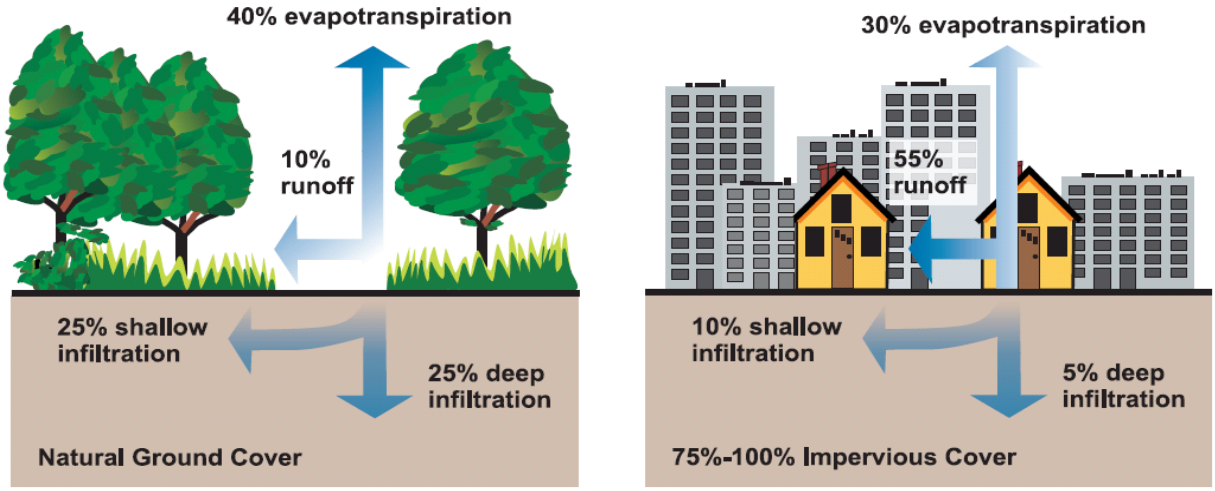
County populations in the Little Tennessee River basin are expected to grow by over 20 percent between 2000 and 2020. Jackson and Macon may see growth exceeding 30 percent (See Appendix I). If development patterns follow the trends described above, there could be a 40 percent increase in developed land in the Little Tennessee River basin by 2020. Such an increase in developed land poses a significant threat to water quality and stream health because it will be accompanied by a similar increase in impervious surfaces.

Impervious surfaces are materials that prevent infiltration of water into the soil and include roads, rooftops, and parking lots (Figure 13). Impervious surfaces alter the natural hydrology, prevent the infiltration of water into the ground, and concentrate the flow of stormwater over the landscape. In undeveloped watersheds, stormwater filters down through the soil, replenishing groundwater quantity with water of good quality.

Vegetation stabilizes the soil, slows the flow of stormwater over land, and filters out some pollutants, by both slowing the flow of the water and trapping some pollutants in the root system. As the imperviousness of a watershed increases, the greater volume of stormwater increases the possibility of flooding and reduces the potential for pollutants to settle out, meaning that more pollution is delivered to drinking water streams and aquifers. Too much paving and hardening of

a watershed can reduce infiltration and groundwater levels which in turn can decrease the availability of aquifers, streams and rivers for drinking water supplies (Kauffman and Brant, 2000). It is well established that stream degradation begins to occur when 10 percent or more of a watershed is covered with impervious surfaces (Schueler, 1995).

Figure 13 Impervious Cover and Surface Runoff (EPA, 2003)



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

7.1.2 Population Growth and Urbanization Impacts on Aquatic Resources

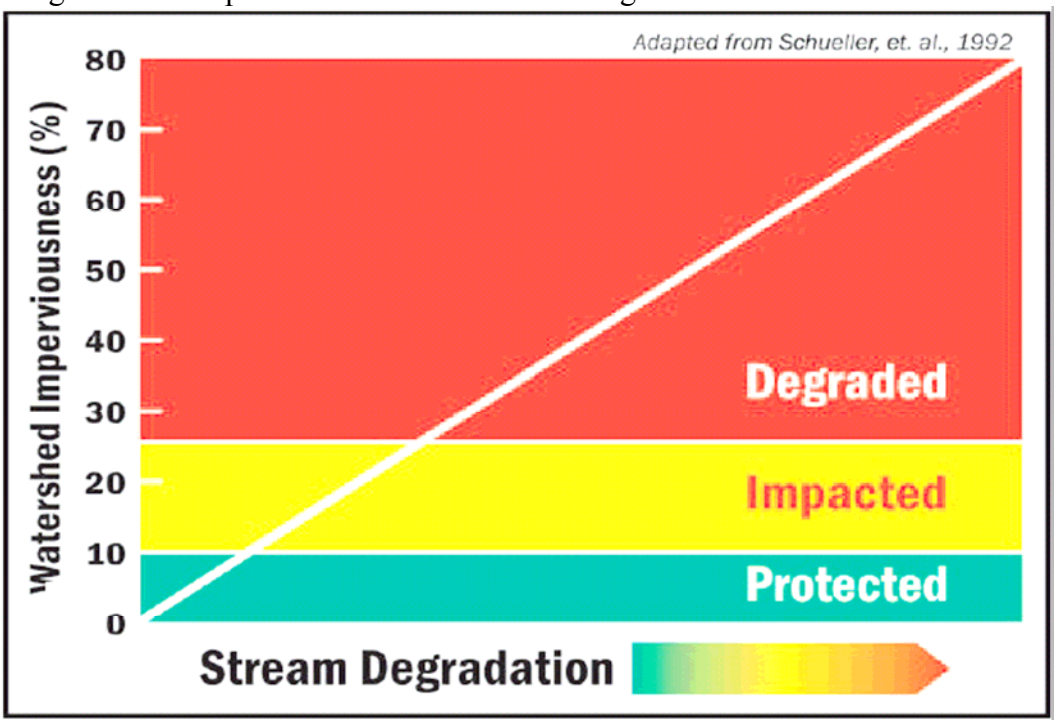
Urbanization poses one of the greatest threats to aquatic resources. The small towns and communities in western North Carolina are usually not considered urban centers, but even small concentrations of urbanizing areas have significant impacts on local waterways. For example, a one-acre parking lot produces 16 times more runoff than a one-acre meadow (Schueler and Holland, 2000). A wide variety of studies over the past decade converge on a central point: when more than 10 percent of the acreage in a watershed is covered in roads, parking lots, rooftops, and other impervious surfaces, the rivers and streams within the watershed become seriously degraded. Brown trout populations have been shown to decline sharply at 10 to 15 percent imperviousness. If urbanized area covers more than 25 percent of a watershed, these studies point to an irreversible decline in ecosystem health (Beach, 2002 and Galli, 1991).

Greater numbers of homes, stores, and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams, rivers, lakes and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

As development in surrounding metropolitan areas consumes neighboring forests and fields, the impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled (Orr and Stuart, 2000). As watershed vegetation is replaced with impervious surfaces, the ability of the landscape to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency also increases. These effects are compounded

when small streams are channelized (straightened) or piped, and storm sewer systems are installed to increase transport of stormwater downstream. Bank scour from these frequent high flow events tends to enlarge streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999). See Figure 14.

Figure 14 Impervious Cover and Stream Degradation



7.2 Key Elements of a Comprehensive Watershed Protection Strategy

Extensive research on the impacts of development and alarming population growth projections make it clear that comprehensive land use planning is necessary to protect aquatic resources. In order for land use planning to effectively protect watersheds in the long-term, tools and strategies must be applied at several scales. Effective implementation will require commitment ranging from the individual citizen to the state government. A comprehensive watershed protection plan should act on the following elements:

Basin Scale (Implemented by Town, County, and State Governments)

1. Characterize the watersheds within a basin as developed or undeveloped, identifying the watersheds that are currently less than 10 percent impervious and those that are more than ten percent impervious.
2. Focus new construction projects to the already developed watersheds first. Then assign any construction that cannot be accommodated in developed watersheds to a limited number of undeveloped watersheds. The watersheds to be developed should be determined by their ecological importance and by other regional growth considerations, such as the value of terrestrial ecosystems, the economic development potential as determined by proximity to roads and rail lines, and the disposition of landowners in the area toward land preservation and development.
3. Adopt policies that maintain impervious surfaces in undeveloped watersheds at less than ten percent. These can include private conservation easements, purchase of development

rights, infrastructure planning, urban service boundaries, rural zoning (20-200 acres per unit, depending on the area), and urban growth boundaries.
4. Ensure that local governments develop land use plans to provide adequate land for future development within developed or developing watersheds.

Neighborhood Scale (Implemented by Town and County Governments)

1. Allow residential densities that support transit, reduce vehicle trips per household and minimize land consumption. The minimum density for new development should be seven to ten net units per acre.
2. Require block densities that support walking and reduce the length of vehicle trips. Cities that support walking and transit often have more than 100 blocks per square mile.
3. Connect the street network by requiring subdivision road systems to link to adjacent subdivisions.
4. Integrate houses with stores, civic buildings, neighborhood recreational facilities, and other daily or weekly destinations.
5. Incorporate pedestrian and bike facilities (greenways) into new development and ensure these systems provide for inter-neighborhood travel.
6. Encourage and require other design features and public facilities that accommodate and support walking by creating neighborhoods with a pleasing scale and appearance. (e.g., short front-yard setbacks, neighborhood parks, alleys, and architectural and material quality)

Site Scale (Implemented by Individual Property Owners, Developers, and Town and County Governments)

1. Require application of the most effective structural stormwater practices, especially focusing on hot spots such as high-volume streets, gas stations, and parking lots.
2. Establish buffers and setbacks that are appropriate for the area to be developed – more extensive in undeveloped watersheds than in developed watersheds. In developed watersheds, buffers and setbacks should be reconciled to other urban design needs such as density and a connected street network.
3. Educate homeowners about their responsibility in watershed management, such as buffer and yard maintenance, proper disposal of oil and other toxic materials, and the impacts of excessive automobile use (Beach, 2002).

7.3 Focus Areas for Managing the Impacts of Population Growth

The elements of watershed protection listed in Section 5.2 above are intended to guide land use planning and population density decision-making. This section discusses specific concepts necessary to reduce the impacts of population growth.

7.3.1 Control Stormwater Runoff and Pollution

Introduction to Stormwater

Stormwater runoff is rainfall or snowmelt that runs off the ground and impervious surfaces (e.g., buildings, roads, parking lots, etc.). Because urbanization usually involves creation of new impervious surfaces, stormwater can quickly become a major concern in growing communities.

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious

(nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Common Pollutants in Stormwater

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and power as it travels through the pipes. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and destroying aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, rooftops, and parking lots, which are harmful to the health and reproduction of aquatic life. The steep slopes and large elevation changes in western North Carolina intensify this effect as water rushes downhill.

Storm sewers should not be confused with sanitary sewers, which transport human and industrial wastewaters to a treatment plant before discharging into surface waters. There is no pre-treatment of stormwater in North Carolina.

Uncontrolled stormwater runoff has many impacts on both humans and the environment. Cumulative effects include flooding, undercut and eroding streambanks, widened stream channels, threats to public health and safety, impaired recreational use, and increased costs for drinking and wastewater treatment. For more information on stormwater runoff, visit the DWQ Stormwater Permitting Unit at http://h2o.enr.state.nc.us/su/stormwater.html or the NC Stormwater information page at http://www.ncstormwater.org/. Additional fact sheets and information can also be found at http://www.stormwatercenter.net/intro_factsheets.htm and www.bae.ncsu.edu/stormwater/index.html.

Common Stormwater Pollutants

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

Controlling Stormwater Runoff and Pollution

Many daily activities have the potential to cause stormwater pollution. Any situation where activities can contribute more pollutants to stormwater runoff is an area that should be considered for efforts to minimize stormwater impacts. A major component in reducing stormwater impacts involves planning up front in the design process. New construction designs should include plans to prevent or minimize the amount of runoff leaving the site. Wide streets, large cul-de-sacs, long driveways, and sidewalks lining both sides of the street are all features of urbanizing areas that create excess impervious cover and consume natural areas. In many instances, the presence of intact riparian buffers and/or wetlands in urban areas can reduce the impacts of urban development. Establishment and protection of buffers should be considered where feasible, and the amount of impervious cover should be limited as much as possible.

"Good housekeeping" to reduce the volume of stormwater leaving a site and reducing the amount of pollutants used in our own backyards can also minimize the impact of stormwater runoff.

DWQ has published a pamphlet entitled *Improving Water Quality in Your Own Backyard: Stormwater Management Starts at Home*. The pamphlet provides information on how homeowners and businesses can reduce the amount of runoff leaving their property and how to reduce the amount and types of pollutants in that runoff. This document is available on-line at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf or by calling (919) 733-5083 ext. 558.

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. In particular, forested buffers provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, 2004). For more information or to obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

7.3.2 Protect Headwater Streams

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles (Figure 15). This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. These streams account for approximately 80 percent of the stream network and provide many valuable services for quality and quantity of water delivered downstream (Meyer et al., 2003). However, degradation of headwater streams can (and does) impact the larger stream or river.

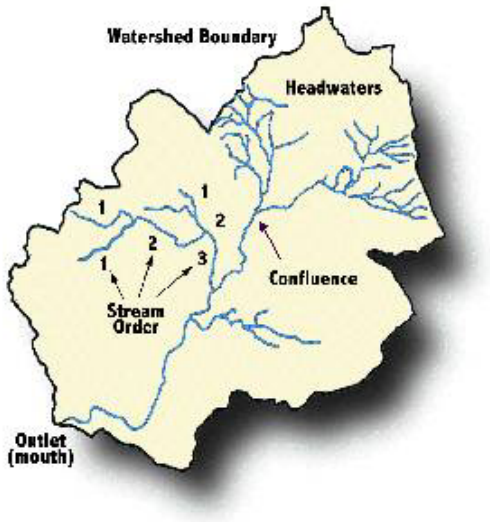


Figure 15 Diagram of Headwater Streams within a Watershed Boundary

There are three types of headwater streams: 1) perennial (flow year-round); 2) intermittent (flow during wet seasons); and 3) ephemeral (flow only after precipitation events). All types of headwater streams provide benefits to larger streams and rivers. Headwater streams control flooding, recharges groundwater, maintain water quality, reduce downstream sedimentation, recycle nutrients, and create habitat for plants and animals (Meyer et al., 2003).

In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community. However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, as occurs during land use changes, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwater streams also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community. In addition to macroinvertebrates, these streams support diverse populations of plants and animals that face similar problems if streams are disturbed. Headwater streams are able to provide these important ecosystem services due to their unique locations, distinctive flow patterns, and small drainage areas.

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed. For a more detailed description of watershed hydrology and watershed management, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

7.3.3 Reduce Impacts from Steep Slope Disturbance

Dramatic elevation changes and steep slopes define mountain topography. Building sites perched along mountainsides provide access to unparalleled vistas and are a major incentive for development. However, construction on steep slopes presents a variety of risks to the environment and human safety.

Poorly controlled erosion and sediment from steep slope disturbance negatively impacts water quality, hydrology, aquatic habitat, and can threaten human safety and welfare. Soil types, geology, weather patterns, natural slope, surrounding uses, historic uses, and other factors all contribute to unstable slopes. Steep slope disturbance usually involves some form of grading. Grading is the mechanical excavation and filling of natural slopes to produce a level working surface. Improper grading practices disrupt natural stormwater runoff patterns and result in poor drainage, high runoff velocities, and increased peak flows during storm events. There is an inherent element of instability in all slopes and those who choose to undertake grading and/or

construction activities should be responsible for adequate site assessment, planning, designing, and construction of reasonably safe and stable artificial slopes.

In cases where construction activities occur on steep slopes, slope stabilization should be mandated through a Site Grading Plan and/or Site Fingerprinting. Site Grading Plans identify areas intended for grading and address impacts to existing drainage patterns. They identify practices to stabilize, maintain and protect slopes from runoff and include a schedule for grading disturbance as well as methods for disposal of borrow and fill materials. Site Fingerprinting is a low-impact development (LID) best management practice (BMP) that minimizes land disturbances. Fingerprinting involves clearing and grading only those onsite areas necessary for access and construction activities. Extensive clearing and grading accelerates sediment and pollutant transport off-site. Fingerprinting and maintenance of vegetated buffers during grading operations provide sediment control that reduces runoff and off-site sedimentation (Yaggi and Wegner, 2002).

Local communities also have a role in reducing impacts from steep slope development. These impacts can also be addressed through the implementation of city and/or county land use and sediment and erosion control plans. Land use plans are a non-regulatory approach to protect water quality, natural resources and sensitive areas. In the planning process, a community gathers data and public input to guide future development by establishing long-range goals for the local community over a ten- to twenty-year period. They can also help control the rate of development, growth patterns and conserve open space throughout the community. Land use plans examine the relationship between land uses and other areas of interest including quality-of-life, transportation, recreation, infrastructure and natural resource protection (Jolley, 2003).

Sediment and Erosion Control Plans are a regulatory approach to reducing the impacts of steep slope development and ensure that land disturbing activities do not result in water quality degradation, soil erosion, flooding, or harm to human health (i.e., landslides). The Division of Land Resources (DLR) Land Quality Section (LQS) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced during construction activities. Under the Sedimentation Pollution Control Act, cities and counties are given the option to adopt local ordinances that meet or exceed the minimum requirements established by the State. Local programs must be reviewed and approved by the NC Sedimentation Control Commission. Once approved, local staff performs plan reviews and enforces compliance. If for some reason the local program is not being enforced, the NC Sedimentation Control Commission can assume administrative control of the local program until the local government assures the State that it can administer and enforce sediment and erosion control rules. The Sedimentation and Pollution Control Act as well as an example of a local ordinance can be found on the DLR website (http://www.dlr.enr.state.nc.us/pages/sedimentation.html).

The requirements outlined in the Sedimentation Pollution Control Act were designed to be implementable statewide and may not fully capture the needs of mountain communities. For example, only projects disturbing more than one-acre of land are required to produce a sediment and erosion control plan. Many small construction projects fall below this threshold. In steep mountainous terrain, even these small disturbances can produce an astounding volume of sediment runoff. DWQ strongly encourages local governments to adopt Sediment and Erosion Control ordinances that exceed the State's minimum requirements.

7.3.4 Implement Effective Education Programs

North Carolina's natural resources are under stress and could be lost in the absence of a widespread awareness of their existence, their significance and their value. Government officials, business leaders and private citizens must better understand the complexity of the natural ecosystems that support our quality of life and make this state an appealing place to live, work and visit.

These natural resources are not isolated from each other or from the people; each element is part of the ecosystem, interrelated and interconnected. When one part of the system is affected, other parts feel the impact. Sound development decisions require an understanding of these interconnections as well as of the life-support roles played by natural resources.

The cause and effect relationship between human behavior and the environment and the economics of that relationship must be well understood by decision makers - including individuals, business, industry, government, and elected officials - to instill a conservation ethic and a sense of stewardship into the choices facing the state. Such stewardship of land, water, air and biological resources is required to continue to enjoy the existing quality of life and to ensure future improvements.

Environmental policy is often viewed as regulatory in nature. The coercive powers of the state are limited, and no regulatory initiative that presses these limits can long survive. Environmental quality ultimately depends upon the understanding and support of individual and corporate citizens who come to embrace standards and practices that discourage pollution while they prize high quality air, water and soil. This relationship between knowledge of the environment and support for its protection form a basis of public policy development. While the need for education to improve our understanding of ecology and environment is accepted as important, the practice of environment education may take many forms. DWQ encourages implementation of educational programs tailored to specific audiences that invoke the following principles:

1. **Respect and care for the community of life.**
   All things are connected. When something affects one part of the environment, other parts feel the impact. The more we understand and respect our own community, the better we will understand this interconnectedness and our responsibilities to the global community of life.

2. **Improve the quality of human life.**
   The aim of development is to improve the overall quality of human life. Development must enable all people to realize their potential and lead lives of dignity and fulfillment. This kind of development requires a healthy and robust supporting ecosystem.

3. **Conserve North Carolina's vitality and diversity.**
   Renewable natural resources are the base of all economies. Soil, water, air, timber, medicines, plants, fish, wildlife and domesticated species -- all come from natural systems and can be maintained through conservation.
   Life support systems are the ecological processes that shape climate, cleanse air and water, regulate water flow, recycle essential elements, create and regenerate soil and keep our environment fit for life. We must prevent pollution and degradation of these ecosystems as well as the natural plant and wildlife habitats they provide.

Biological diversity includes the total array of species, genetic varieties, habitats and ecosystems on Earth. It contributes to our quality of life, including a healthy economy. It is a foundation of the Earth's biosphere, buffering us from the inevitable changes in the environment.

4. **Change personal understanding and practice.**
   Society must promote values that build and support its ability to continuously improve the quality of living for its citizens. This requires maintaining the quality and integrity of our natural environment. Knowledge, awareness and decision-making skills must be taught through formal and non-formal education to promote problem solving and constructive action to nurture the life-giving qualities of our ecosystem.

5. **Enable communities to care for their own environment.**
   Living within the limits set by the environment depends on the beliefs and commitment of individuals, but it is through communities that people share concerns and promote practices that can nourish rather than cripple their natural life-support systems.

6. **Provide a state and local knowledge base for integrating development and conservation.**
   Economic policy can be an effective instrument for sustaining ecosystems and natural resources. Every economy depends on the environment as a source of life support and raw materials. The knowledge base for each city, county and the state must be strengthened, and information on environmental matters made more accessible. The State's adult and student populations must understand certain ecological and civics concepts, and North Carolina's place within those concepts.

7.4 The Role of Local Governments

7.4.1 Reducing Impacts from Existing Urbanization

Below is a summary of management actions recommended for local authorities, followed by discussions on large watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated (NCDENR-DWQ, 2003).

Actions one through five are important to restoring and sustaining aquatic communities in watersheds, with the first three recommendations being the most important.

(1) **Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development** (e.g., increased stormwater volumes and increased frequency and duration of erosive and scouring flows). This should be viewed as a long-term process. Although there are many uncertainties, costs in the range of $1 million per square mile can probably be anticipated.

   (a) Over the short term, currently feasible retrofit projects should be identified and implemented.
   (b) In the long term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
   (c) Grant funds for these retrofit projects may be available from EPA initiatives, such as EPA Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

(2) **A watershed scale strategy to address toxic inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods.** As an initial framework for planning toxicity reduction efforts, the following general approach is proposed:

   (a) Implementation of available BMP opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove toxics from stormwater.
   (b) Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
   (c) Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
   (d) Development and implementation of a broad set of source reduction activities focused on: reducing non-storm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.

(3) **Stream channel restoration activities should be implemented in target areas, in conjunction with stormwater retrofit BMPs, in order to improve aquatic habitat.** Before beginning stream channel restoration, a geomorphologic survey should be conducted to determine the best areas for stream channel restoration. Additionally, it would be advantageous to implement retrofit BMPs before embarking on stream channel restoration, as restoration is best designed for flows driven by reduced stormwater runoff. Costs of approximately $200 per foot of channel should be anticipated (Haupt, et al., 2002 and Weinkam, 2001). Grant funds for these retrofit projects may be available from federal sources, such as EPA Section 319 funds, or state sources including North Carolina Clean Water Management Trust Fund.

(4) Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic loading, and to some extent, its impacts. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use; street sweeping; catch basin clean-out practices; and the installation of additional BMPs targeting biological oxygen demand (BOD) and nutrient removal at appropriate sites.

(5) Prevention of further channel erosion and habitat degradation will require effective post-construction stormwater management for all new development in the study area.

(6) Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may also be beneficial.

(7) Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:

   (a) Redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;
   (b) Protecting existing woody riparian areas on all streams;
   (c) Replanting native riparian vegetation on stream channels where such vegetation is absent; and
   (d) Reducing and properly managing pesticide and fertilizer use.

7.4.2 Reducing Impacts of Future Urbanization

Proactive planning efforts at the local level are needed to assure that urbanization is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management, and economic growth. Managing population growth requires planning for the needs of increased population, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin. Public education is also needed in the Little Tennessee River basin so that citizens can learn and understand the value of urban planning and stormwater management.

Streams in areas adjacent to high growth areas of the basin are at a high risk of loosing healthy aquatic communities. These biological communities are important to maintaining the ecological integrity in the Little Tennessee River basin. Unimpacted streams are important sources of benthic macroinvertebrates and fish for reestablishment of biological communities in nearby streams that are recovering from past impacts or are being restored.

To prevent further impairment to aquatic life in streams in urbanizing watersheds local governments should:

(1) Identify waters that are threatened by construction activities.
(2) Protect existing riparian habitat along streams.
(3) Implement stormwater BMPs during and after construction.
(4) Develop land use plans that minimize disturbance in sensitive areas of watersheds.
(5) Minimize impervious surfaces including roads and parking lots.
(6) Develop public outreach programs to educate citizens about stormwater runoff.
(7) Enact a Stormwater Control Ordinance. EPA offers a model ordinance at: http://www.epa.gov/nps/ordinance/stormwater.htm

For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. For an example of local community planning effort to reduce stormwater runoff, visit http://www.charmeck.org/Home.htm. For more information on stormwater programs across the state, refer to Chapter 6.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize the use of curb and gutter

7.5 The Role of Homeowners and Landowners

7.5.1 Ten Simple Steps to Reduce Runoff and Pollution from Individual Homes

1. To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns.
2. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose.
3. Instead of disposing of yard waste, use the materials to start a compost pile.
4. Learn to use Integrated Pest Management (IPM) in the garden and on the lawn to reduce dependence on harmful pesticides.
5. Pick up after pets.
6. Use, store, and dispose of chemicals properly.
7. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed.
8. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff.
9. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.
10. Support local government watershed planning efforts and ordinance development.

Chapter 8
Stormwater and Wastewater Programs

8.1 NPDES Wastewater Discharge Permit Summary

The primary pollutants associated with point source discharges are:

* oxygen-consuming wastes,
* nutrients,
* color, and
* toxic substances including chlorine, ammonia and metals.

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities that serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

Types of Wastewater Discharges

Major Facilities: Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities: Facilities not defined as Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (from toilets, sinks, washers).

Municipal Facilities: Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal Facilities: Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

Currently, there are 35 permitted wastewater discharges in the Little Tennessee River basin. Table 15 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter. For a complete listing of permitted facilities in the basin, refer to Appendix V.

Roughly sixty percent of NPDES permitted wastewater flow in the Little Tennessee River basin is from major municipal wastewater treatment plants (WWTP). Nonmunicipal discharges also contribute substantial wastewater flow into the Little Tennessee River basin. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter.

Table 15 Summary of NPDES Dischargers and Permitted Flows for the Little Tennessee River Basin

	Little Tennessee River Subbasins				
Facility Categories	**01**	**02**	**03**	**04**	**Total**
Total Facilities	11	20	1	3	35
Total Permitted Flow (MGD)	3.39	3.39	0.002	0.64	7.422
Facilities Grouped by Size					
Major Discharges	1	1	0	0	2
Total Permitted Flow (MGD)	1.65	1.50	0	0	3.15
Minor Discharges	10	19	1	3	33
Total Permitted Flow (MGD)	1.74	1.89	0.002	0.64	4.27
Facilities Grouped by Type					
100% Domestic Waste	8	13	1	0	22
Total Permitted Flow (MGD)	0.24	0.048	0.002	0	0.29
Municipal Facilities	3	3	0	2	8
Total Permitted Flow (MGD)	3.15	2.6	0	0.64	6.39
Nonmunicipal Facilities	0	4	0	1	5
Total Permitted Flow (MGD)	0	3.08	0	--	3.08

8.2 DWQ Stormwater Programs

There are several different stormwater programs administered by DWQ and local jurisdictions. One or more of these programs affects many communities in the Little Tennessee River basin. The goal of the DWQ stormwater discharge programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table 17.

8.2.1 NPDES Phase I

Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more. There are no NPDES Phase I stormwater permits issued to communities in the basin.

Phase I also had requirements for eleven categories of industrial sources to be covered under stormwater permits. Industrial activities which require permitting are defined in ten categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Construction sites disturbing greater than five acres were also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program. Excluding construction stormwater general permits, there are 106 general stormwater permits and 6 individual stormwater permits. Refer to the subbasin chapters for more information on stormwater programs and permits and a complete listing of individual permits in Appendix V.

8.2.2 NPDES Phase II

The Phase II stormwater program is an extension of the Phase I program that expands permit coverage to include smaller municipalities below 100,000 populations. The local governments permitted under Phase II are required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1. Public education and outreach on stormwater impacts;
2. public involvement/participation;
3. illicit discharge detection and elimination;
4. construction site stormwater runoff control;
5. post-construction stormwater management for new development and redevelopment; and
6. pollution prevention/good housekeeping for municipal operations.

Construction sites greater than one acre will also be required to obtain an NPDES stormwater permit under Phase II of the EPA stormwater program in addition to erosion and sedimentation control approvals.

Those municipalities and counties required to obtain a NPDES stormwater permit under the Phase II rules are identified using 1990 US Census Designated Urban Areas and the results of the 2000 US Census. Based on federal census data, EPA identified 123 cities, including, and 33 counties in North Carolina that would be required to obtain permits for stormwater management.

The EPA delegated Phase II implementation to each state and then in 1999 the Division of Water Quality and the Environmental Management Commission (EMC) initiated a rulemaking process.

Stormwater Management Rule Update:

In 2002, the EMC adopted temporary stormwater rules and by 2003 had adopted permanent rules that were to become effective August 1, 2004. In early 2004, the Rules Review Commission (RRC) objected to the rules for failure to comply with the Administrative Procedures Act and lack of statutory authority. The EMC challenged the decision of the RRC in court (EMC v. RRC 04 CVS 3157). A Wake County Superior Court ruled in the EMC's favor and the RRC subsequently approved the EMC's rules. However, while the case was pending the legislature enacted a separate set of requirements in 2004 that were designed to replace the EMC rules.

These rules include NPDES stormwater rules covering owners and operators of storm sewer systems and State stormwater rules covering activities in urbanizing areas. The EMC amended the rules at their November 10, 2005 meeting to address objections raised by the RRC at their October 2005 meeting. The inconsistency between the legislative requirements and the EMC rules necessitated consideration of Senate Bill 1566 in the 2006 short session. The legislature approved Session Law 2006-246, Senate Bill 1566 in 2006.

Senate bill 1566 provides that development projects in Phase II municipalities and counties that cumulatively disturb one acre or more of land must comply with the post-construction stormwater standards set out in the bill. The bill sets out criteria whereby unincorporated areas of counties will be subject to Phase II requirements. Under these criteria 25 counties are fully covered, while 8 counties have portions that are subject to the stormwater requirements. The bill

also provides a designation and petition process by which additional local governments and other entities may be required to obtain a stormwater management permit.

The bill sets out stormwater controls that are based on a project's level of density and its proximity to Shellfish Resource Waters. Shellfish Resource Waters are waters classified by the EMC as Class SA waters (shellfish growing waters) that contain an average concentration of 500 parts per million of natural chloride ion (saltwater).

The Water Quality Committee (WQC) met in November 2006 and directed DWQ Staff to return to the January 2007 WQC meeting with proposed amendments to the State Stormwater Rules. These rules will extend the coastal post-construction stormwater controls in Session Law 2006-246 to all 20 Coastal Counties (Table 16).

Low Density Projects

Development projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered low density if they contain no more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a low density project if it contains no more than 24 percent built-upon area or no more than two dwelling units per acre. Low density projects must use vegetated conveyances to the maximum extent practicable to transport stormwater runoff from the project.

High Density Projects

Projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered high density if they contain more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a high density project if it contains more than 24 percent built-upon area or more than two dwelling units per acre. High density projects must use structural stormwater management systems that will control and treat runoff from the first one inch of rain unless the project is in a coastal county, in which case the project must use structural stormwater management systems that will control and treat runoff from the first one and one-half inches of rain. In addition, projects that are located within one-half mile and draining to Shellfish Resource Waters must control and treat the difference in the stormwater runoff from the pre-development and post-development conditions for the one-year twenty-four hour storm as well as meet certain design standards.

Implementation

The bill provides an implementation schedule that requires regulated entities to apply for an NPDES stormwater management permit within 18 months of being notified that it is a regulated entity subject to the requirements of this act. A regulated entity must implement its post-construction program no later than 24 months from the date the permit is issued and fully implement its permitted program within five years of permit issuance. City of Jacksonville and Onslow County have both submitted applications for Phase II.

The bill authorizes the EMC to adopt Phase II stormwater management rules. If the EMC does adopt rules, the rules must be substantially identical to the provisions of this act and will be automatically subject to review by the General Assembly and not subject to review by the RRC. The bill became effective retroactively to July 1, 2006.

Table 16 Major Post-Construction Stormwater Controls in SL 2006-246

	Shellfish Resource Waters* (SA Waters w/ > 500 ppm chlorides)	SA Designated Waters – Not Shellfish Resource Waters*	Coastal County – Not SA Designated Waters	Non – Coastal County
Low Density Threshold	12%	24%	24%	24%
Storm Design for High Density	Difference in pre and post-development for 1-yr, 24-hour storm**	Runoff from first 1.5 inches of rain	Runoff from first 1.5 inches of rain	Runoff from first 1 inch of rain
Setback	30 feet	30 feet	30 feet	30 feet
Other Controls	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm		

*These controls apply within ½ mile and draining to these waters.
**Amount of Runoff that would need to be controlled in inches for the difference in pre- and post-development conditions for the 1-year, 24-hour storm.

For additional information on stormwater programs please go to http://h2o.enr.state.nc.us/su/

2007 Recommendations

DWQ recommends that the local governments develop programs that can go beyond the Phase II six minimum measures. Implementation of Phase II, as well as the other stormwater programs, should help to reduce future impacts to streams in the basin. Local governments, to the extent possible, should identify sites for preservation or restoration. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government stormwater programs.

8.2.3 State Stormwater Program

The State Stormwater Management Program was established in the late 1980s under the authority of the North Carolina Environmental Management Commission (EMC) and North Carolina General Statute 143-214.7. This program, codified in 15A NCAC 2H .1000, affects development activities that require either an Erosion and Sediment Control Plan (for disturbances of one or more acres) or a CAMA major permit within one of the 20 coastal counties and/or development draining to Outstanding Resource Waters (ORW) or High Quality Waters (HQW).

The State Stormwater Management Program requires new developments to protect these sensitive waters by maintaining a low density of impervious surfaces, maintaining vegetative setbacks, and transporting runoff through vegetative conveyances. Low density development thresholds vary from 12-30 percent built-upon area (impervious surface) depending on the classification of the receiving stream. If low density design criteria cannot be met, then high density development requires the installation of structural best management practices (BMPs) to collect and treat stormwater runoff from the project. High density BMPs must control the runoff

from the 1 or 1.5-inch storm event (depending on the receiving stream classification) and remove 85 percent or 90 percent of the total suspended solids.

Current Status
Table 17 shows the 5 counties in the Little Tennessee River basin where permits may be required under the state stormwater management program.

2007 Recommendations
DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

8.3 Water Supply Watershed Stormwater Rules

Current Status
The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution. The program attempts to minimize the impacts of stormwater runoff by utilizing low-density development or stormwater treatment in high-density areas.

All communities in the Little Tennessee River basin in water supply watersheds have EMC approved water supply watershed protection ordinances.

2007 Recommendations
DWQ recommends continued implementation of local water supply protection ordinances to ensure safe and economical treatment of drinking water. Communities should also integrate water supply protection ordinances with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for both drinking water and aquatic life.

Table 17 Communities in the Little Tennessee River Basin Subject to Stormwater Requirements

Local Government	NPDES Phase I and Phase II	State Stormwater Program	Water Supply Watershed Stormwater Requirements
Municipalities			
Bryson City			
Dillsboro			
Forest Hill			
Franklin			
Highlands			**X**
Robbinsville			**X**
Santeetlah			
Sylva			
Webster			
Counties			
Cherokee			**X**
Clay		**X**	**X**
Graham		**X**	**X**
Jackson		**X**	**X**
Macon		**X**	**X**
Swain		**X**	**X**

8.3.1 Septic Systems and Straight Piping

In the Little Tennessee River basin, wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated on-site through the use of permitted septic systems. Wastewater from some of these homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the State.

With on-site septic systems, the septic tank unit treats some wastes, and the drainfield associated with the septic tank provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground's surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed, or the systems are not maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tanks must be properly installed and maintained to ensure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the

environmental health sections of the local county health departments. See Appendix VII for contact information.

The discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemical nutrients, disease pathogens and endocrine disrupting chemicals. Although DWQ ambient monitoring of the waters in the Little Tennessee basin show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation, volunteer monitoring in smaller streams shows a higher concentration of bacteria and other pollutants. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents. Reducing bacterial contamination is crucial for supporting a tourist economy.

In order to protect human health and maintain water quality, straight pipes must be eliminated and failing septic systems should be repaired. The NC Wastewater Discharge Elimination (WaDE) Program is actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of North Carolina. This program uses door-to-door surveys to locate straight pipes and failing septic systems, and offers deferred loans or grants to homeowners who have to eliminate the straight pipes by installing a septic system.

2007 Recommendations

The WaDE Program in collaboration with the Local Health Departments should request additional funding from the CWMTF and Section 319 Program to continue the straight pipe elimination program for the Little Tennessee basin. Additional monitoring of fecal coliform throughout tributary watersheds where straight pipes and failing septic systems are a potential problem should be conducted in order to narrow the focus of the surveys. For more information on the WaDE Program, contact the DENR On-Site Wastewater Section (OSWW), NC Division of Environmental Health, toll free at 1-866-223-5718 or visit their website at http://www.deh.enr.state.nc.us/oww/Wade/wade.htm.

Additionally, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and that an adequate repair area is also available. Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. DWQ has developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. The publication includes a discussion about septic system maintenance and offers other sources of information. To obtain a free copy, call (919) 733-5083. The following website also offers good information in three easy to follow steps: http://www.wsg.washington.edu/outreach/mas/water_quality/septicsense/septicmain.html.

Chapter 9
Agriculture and Water Quality

9.1 Animal Operations

In 1992, the Environmental Management Commission (EMC) adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system.

Key Animal Operation Legislation (1995-2003)

1995 Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.

1996 Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

1997 House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. NCDENR was required to develop and adopt economically feasible odor control standards by March 1, 1999.

1998 House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.

1999 House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required NCDENR to develop an inventory of inactive lagoons. The Bill requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

2000 Attorney General Easley reached a landmark agreement with Smithfield Foods, Inc. to phase out hog lagoons and implement new technologies that will substantially reduce pollutants from hog farms. The agreement commits Smith field to phase out all anaerobic lagoon systems on 276 company-owned farms. Legislation will be required to phase out the remaining systems statewide within a 5-year period (State of Environment Report 2000).

2001 House Bill 1216 extended (again) the moratorium on new construction or expansion of swine farms.

There are no registered animal operations in the Little Tennessee.

9.2 Impacted Streams in Agricultural Areas

In the Little Tennessee River basin, the majority of agricultural land is uncultivated cropland. There are also a few specialty crop farms in this river basin such as Christmas tree farms. Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination, and sedimentation.

Based on the most recent information from the USDA Natural Resources Conservation Service (NRCS) National Resources Inventory (NRI), agricultural land use in the Little Tennessee River basin has decreased from the year 1982 to 1997. Cultivated cropland and pasture use have decreased by 77.5 percent (10,700 acres) and 31.2 percent (11,500 acres), respectively. Uncultivated cropland increased by 89.5 percent (6,900 acres). This same data also shows that urban and built-up areas increased by 140.5 percent (30,200 acres) (USDA-NRCS, 2001). Refer to Appendix III for more information related to land use changes in the Little Tennessee River basin.

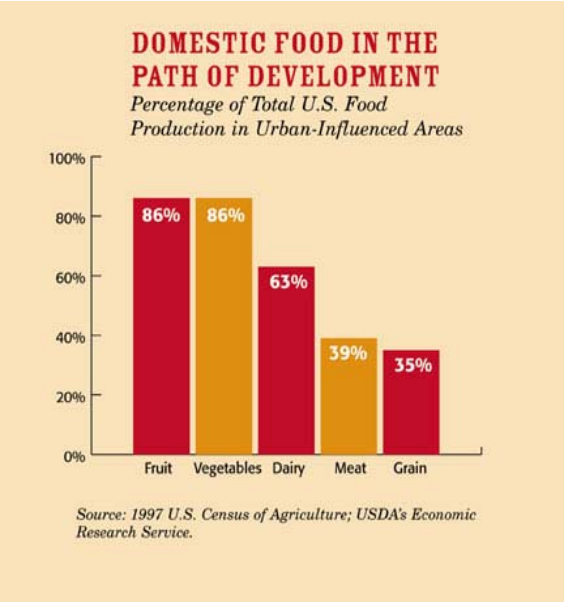
2007 Recommendations

DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. Local Soil and Water Conservation District (SWCD) and NRCS staff should investigate these streams to assess agricultural impacts and recommend best management practices (BMPs) to reduce the impacts. DWQ recommends that funding and technical support for agricultural BMPs continue and increase. Refer to Appendix VII for agricultural nonpoint source agency contact information.

9.3 Working Land Conservation Benefits

Working Lands are those used for agriculture, forestry or other natural resource industries. Well-managed working lands provide important non-market goods and services. For example, farms, ranches, and forestlands provide food and cover for wildlife, help control flooding, protect wetlands and watersheds, and maintain air quality. They can absorb and filter wastewater, runoff, and provide groundwater recharge.

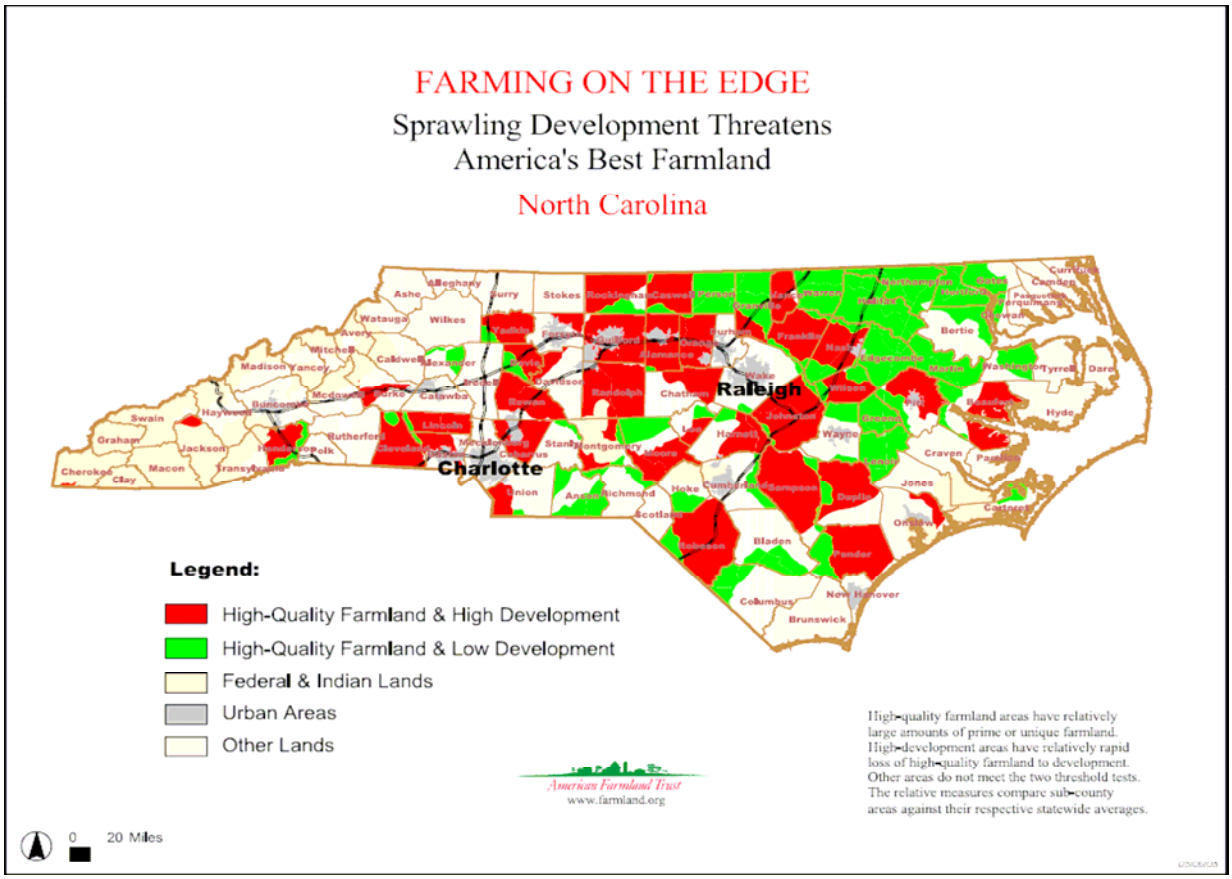
Rapid urbanization is forcing the conversion of working land to developed land at an astonishing rate in North Carolina. From1992-1997, over 170,000 acres of agricultural land was converted to developed land. That was the 12th highest rate in the nation. The figures for Prime Farmland, the best land for growing crops, are even more disturbing. North Carolina is losing prime farmland at the fourth fastest rate in the nation (USDA, 2001). The 1997 U.S. Census of Agriculture shows that a large percentage of cropland is in urban-influenced areas, making them prime targets for development. It is well established that developed land negatively impacts water quality (See Section 7.1).



Therefore, preserving North Carolina's working lands should be a priority.

The value of specific working lands can be calculated for any watershed by performing a Cost of Community Services (COCS) study. COCS studies are a case study approach used to determine a community's public service costs versus revenues based on current land use. Their particular niche is to evaluate the overall contribution of agricultural and other open lands on equal ground with residential, commercial and industrial development.

As of January 2002, 83 COCS studies conducted in 19 states found that tax and other revenues collected from farm, ranch and forest landowners more than covered the public service costs these lands incur. COCS studies show that on average, residential development generates significant tax revenue but requires costly public services that typically are subsidized by revenues from commercial and industrial land uses. The special contribution of COCS studies is that they show that farm, ranch, and forestlands are important commercial land uses that help balance community budgets. Working lands are not just vacant land waiting to be developed (Freedgood and others, 2002)



A recent analysis of the fiscal impact of different land uses in Macon County, NC demonstrates the cost-saving benefits to the county of maintaining farmland and open space. Using county budget data and tax data from fiscal year 2000, the study indicates that typical residential and commercial properties cost the county budget by demanding more in tax-supported services than they contribute in property tax revenues. Such services include schools, roads, water and sewer lines, fire and police protection, and social and administrative services. On the other hand, the typical farmland/open-space parcel contributed more property tax to the county budget than it demanded in expenditures for county services. Analyzing a scenario of a 30-acre parcel of

farmland/open-space, the study estimated that the county budget would gain $290 if the land remained as farmland, but would lose a net $532 if converted to ten 3-acre lots with houses on them (Jones and Kask, 2001).

The opportunities for private landowners to protect working lands are growing. North Carolina cities and counties have now begun to use the new set of farmland protection tools authorized by the General Assembly in 2005 through Session Law 2005-390. Along with an expanded definition of agriculture and a revamped Agricultural Development and Farmland Preservation Trust Fund, this legislation authorized a new category for localities to promote the stability of their agricultural sectors. Counties and municipalities now have the authority to create an Enhanced Voluntary Agricultural District (EVAD) option, which offers an increased set of incentives for landowners to restrict development over a ten-year period. Polk County in the mountains and Wentworth in the Piedmont are amongst the first jurisdictions in the state to utilize this new tool, with the recent adoption of local EVAD ordinances. Landowners interested in working land protection should contact their local land trust; NRCS field representative, or Soil and Water Conservation District. The Farmland Information Center is also an excellent online resource: http://www.farmlandinfo.org/. Local government officials interested in the value of working land conservation should visit the Land Trust Alliance's Economic Benefits of Open Space Protection web page at: http://www.lta.org/resources/economic_benefits.htm.

9.4 Agricultural Best Management Practices and Funding Opportunities

9.4.1 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. Through EQIP, the Natural Resources Conservation Service (NRCS) provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals, optimize environmental benefits, and help farmers and ranchers meet Federal, State, Tribal, and local environmental requirements. The 2002 Farm Bill reauthorized national EQIP funding at $6.16 billion over the six-year period of FY 2002 through FY 2007. Program priorities are as follows:

- Reduction of nonpoint source pollution including nutrients, sediment, pesticides, and excess salinity in impaired watersheds consistent with TMDLs where available; reduction of groundwater contamination; reduction of point source pollution including contamination from confined animal feeding operations
- Conservation of ground and surface water resources
- Reduction of emissions including particulate matter, nitrogen oxides (NOx), volatile organic compounds, and ozone precursors and depleters that contribute to air quality impairment violations of National Ambient Air Quality Standards
- Reduction in soil erosion and sedimentation from unacceptable levels on agricultural land
- Promotion of at-risk species habitat conservation.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

North Carolina EQIP Funding 2000-2005

2000:	$1.1 Million
2001:	$3.5 Million
2002:	$7.1 Million
2003:	$10.0 Million
2004:	$13.2 Million
2005:	$14.3 Million

For the years 2001-2006, $139,645 has been allocated Jackson County covering 322 acres. In Swain County, $195,392. was been allocated covering 831 acres. Typical conservation practices installed in both counties included access road, animal trails, critical area planting, fencing, heavy use area protection, nutrient management, pest management, pasture planting, prescribed grazing, spring developments, underground outlets, lined outlets, pipeline, livestock watering tanks, and upland wildlife habitat management.

EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

NRCS district contacts for the Little Tennessee River basin are provided in Appendix VII, and EQIP signup information can be found on NRCS website at http://www.nc.nrcs.usda.gov/programs/EQIP/index.html.

9.4.2 USDA - NRCS Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP, USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

WHIP has proven to be a highly effective and widely accepted program across the state. Currently, there are several active wildlife contracts underway within the Little Tennessee River Watershed. The Farm Security and Rural Investment Act of 2002 reauthorized WHIP as a voluntary approach to improve wildlife habitat in our Nation. Program administration of WHIP

is provided under the Natural Resources Conservation Service. Contact your local Natural Resources Conservation Service office for further information about this program.

9.4.3 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best management practices. These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divides the approved BMPs into five main purposes or categories.

- *Erosion Reduction/Nutrient Loss Reduction in Fields*
  Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams to improve water quality. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, stripcropping, terraces, and Christmas tree conservation cover.

- *Sediment/Nutrient Delivery Reduction from Fields*
  Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.

- *Stream Protection from Animals*
  Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination, and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (i.e., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.

- *Proper Animal Waste Management*
  A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.

- *Agricultural Chemical (agrichemical) Pollution Prevention*
  Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned BMP is completed, inspected and certified to be installed according to NCACSP standards. The annual statewide budget for BMP cost sharing is approximately $6.9 million. From 2003 to 2006, $199,407 was provided for projects in the Little Tennessee River basin. Table 18 summaries the cost and total BMPs implemented (i.e., acres, units, and linear feet) throughout the Little Tennessee River basin.

County Soil and Water Conservation District (SWCD) contacts for the Little Tennessee River basin are included in Appendix VII. BMP definitions and DSWC contact information can be found online at www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html.

Table 18 Summary of NCACSP projects in the Little Tennessee River Basin

	Purpose of BMP								
	Erosion Reduction[1]		Sediment Reduction[2]		Stream Protection[3]		Animal Waste[4]		Total Cost ($)
	Total	Cost ($)	Total	Cost ($)	Total	Cost ($)	Total	Cost ($)	
Subbasin 04-04-01	32.2 acres	4,203	5.51 acres	11,805	20 units 5,485 ft.	21,068 5,580	3 unit	35,133	65,984
Subbasin 04-04-02	14.1 acres 230 ft.	1,878 392	1 unit	1,089	630 units 5,321 ft.	61,950 6,417	6 units	37,446	109,172
Subbasin 04-04-03	10 acres	2,250							2,250
Subbasin 04-04-04					15 units 814 ft.	20,806 1,195			22,001

[1] Erosion Reduction/Nutrient Loss Reduction in Field
[2] Sediment/Nutrient Delivery Reduction from Field
[3] Stream Protection from Animals
[4] Proper Animal Waste Management

Total Benefits					
Subbasin	Soil Saved (tons)	(N)itrogen Saved (lb.)	(P)hosph-orous Saved (lb.)	Waste-N Saved (lb.)	Waste-P Saved (lb.)
03-02-01	3,158	2,606	142	1,683	332
03-02-02	4,174.34	2,681.32	326.30	5,307.70	3,226.60
03-02-03	70	38	5		
03-02-04	20.60	90	8		

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the NCDENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus, and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

Chapter 10
Forestry in the Little Tennessee River Basin

10.1 Forestland Ownership and Resources

Approximately 52 percent of forestland in the Little Tennessee basin is privately owned. The majority of the balance is comprised of publicly owned land in the Nantahala National Forest and Great Smoky Mountains National Park. This ownership estimate comes from the most recent data published by the USDA-Forest Service *Forest Statistics for North Carolina, 2002.* (Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

10.1.1 Forest Management

At least 800 acres of land were established or regenerated with forest trees across the basin from September 1, 1999 through August 31, 2004. During this same time period the Division of Forest Resources provided nearly 600 individual forest plans for landowners that encompassed almost 25,000 acres in the basin.

10.1.2 Forest Legacy Program

In 2002, the USDA Forest Service provided initial match funding through its Forest Legacy Program to be used for the acquisition of a conservation easement encompassing nearly 1,100 acres. This funding supplemented private and state grants that were used to conserve a significant portion of forestland within the viewshed of the Blue Ridge Parkway, near Balsam Mountain in Jackson and Haywood counties. This Forest Legacy project is located in subbasin 04-04-02 of the Little Tennessee basin.

The Forest Legacy Program partners with participating states to support efforts that protect environmentally sensitive forestlands. The program is specifically designed to encourage the protection of privately owned forestlands and is entirely voluntary. It encourages and supports acquisition of conservation easements that most often are used to place restrictions on development, while requiring sustainable forestry practices, and protecting other values. The program's Web site has more information: www.fs.fed.us/spf/coop/programs/loa/flp.shtml.

10.1.3 Christmas Tree Production

The Division of Forest Resources does not oversee regulations related to land clearing activities for Christmas tree production or the associated BMPs for tree farming operations. These activities are deemed to be an agricultural/horticultural activity and are under the oversight of the NC Department of Agriculture & Consumer Services (NCA&CS) and their recommended agricultural BMPs. The NC Cooperative Extension Service through NC State University has developed extensive guidelines and recommendations for Christmas tree operations. This material is available on-line at www.ces.ncsu.edu/fletcher/programs/xmas/.

10.2 Forestry Water Quality Regulations in North Carolina

10.2.1 Forest Practice Guidelines (FPG) for Water Quality

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Ch.113A Art.4 referred to as "SPCA"). However, forestry operations may be exempted from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101 - .0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S.77-13 & G.S.77-14).

The North Carolina Division of Forest Resources (DFR) is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the DFR works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the DFR are referred to the appropriate State agency for enforcement action.

During the period September 1, 1999 through August 31, 2004 the Division of Forest Resources conducted 349 FPG inspections of forestry-related activities in the basin; 87 percent of the sites inspected were in compliance.

10.2.2 Other Forestry Related Water Quality Regulations

In addition to the State regulations noted above, DFR monitors the implementation of the following Federal rules relating to water quality and forestry operations:

- The Section 404 silviculture exemption under the Clean Water Act
- The federally-mandated 15 Best Management Practices (BMPs) related to road construction in wetlands
- The federally-mandated BMPs for mechanical site preparation activities for the establishment of pine plantations in wetlands of the southeastern U.S.

10.2.3 Water Quality Foresters

While the DFR currently has a Water Quality Forester located in ten of the DFR's thirteen Districts across the State, there are none assigned within the Little Tennessee River basin. However, the forester staff based in the DFR's Sylva District Office and Asheville Regional Office address water quality issues related to forestry as time permits, while also handling wildfire suppression and forest management duties.

10.2.4 Forestry Best Management Practices (BMPs)

Implementing Forestry Best Management Practices is strongly encouraged by the Division of Forest Resources in order to efficiently and effectively protect the water resources of North Carolina. During this reporting period, the DFR recorded over 500 instances across 28,000 acres in which BMPs were either noted in use or had been recommended. The Forestry Best Management Practices Manual describes recommended techniques that should be used to help comply with the State's forestry laws and help protect water quality. This manual is currently undergoing its first revision since adoption in 1989. This revision, led by the DENR-appointed Technical Advisory Committee (TAC) has undertaken four years of effort.

To further assess BMPs, the DFR conducted a detailed, statewide BMP Implementation Survey from March 2000 through March 2003 to evaluate Forestry BMPs on *active* harvest operations. This survey evaluated 26 harvest sites in the basin, with a resulting BMP implementation rate of 73 percent. The problems most often cited in this survey relate to stream crossings, skid trails, and site rehabilitation. This survey, and additional surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

10.2.5 Watersheds and BMP Research

In 1933 the USDA-Forest Service set aside 3,900 acres (later increased to 5,750 acres) of the Nantahala National Forest located between the communities of Franklin and Otto (Subbasin 04-04-01) to create the Coweeta Experimental Forest for an expanded program in watershed research. An intensive program of weir construction began in 1934 along with a network of 56 standard rain gages, numerous groundwater wells, and meteorological stations.

Since then, scientists have conducted a variety of watershed experiments at Coweeta. Early studies documented the harmful effects on soil and water resources by unrestricted land-use practices that included farming, grazing, and logging. The knowledge gained in these early experiments was the basis for a pilot test of intensive multi-resource management of Southern Appalachian forests and has provided guidelines for watershed management and Best Management Practices on public and private lands alike.

More recent experiments have demonstrated improved methods for managing steep mountain lands to minimize damage to soil and water. The centerpiece of today's efforts is the Long-Term Ecological Research (LTER) Program with the University of Georgia, begun in 1980 and funded through the National Science Foundation. More information about Coweeta LTER is available at: http://coweeta.ecology.uga.edu/.

10.2.6 Bridgemats

The DFR has been providing bridgemats on loan out to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream crossings, instead of culverts or hard-surfaced 'ford' crossings. Wooden timber bridgemats have been available for use in the basin for nearly seven years, and are available upon request from the Sylva District Office. In 2005, six new 25-foot wooden bridgemats were assigned to the Sylva District; these mats were acquired with USEPA 319-Grant funds, allowing DFR to continue this successful program. More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFR's Web site www.dfr.state.nc.us.

10.2.7 Forest Products Industry

There are five forest products-related manufacturers or processors located within the basin. These manufacturers pay an assessment to the state, which is then combined with annual legislative appropriations, to fund the "Forest Development Program" (FDP), which provides cost-shared reforestation assistance for forest landowners.

10.2.8 Protection from Wildfires

The "Firewise Communities" program is a national, multi-agency effort designed to reach homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildfires, before a fire starts. The Firewise Communities program offers a series of practical steps that individuals and communities can take to minimize wildfire risks. The Firewise approach emphasizes community responsibility for planning in the design of a safe community as well as effective emergency response, and individual responsibility for safer home construction and design, landscaping, and maintenance. In North Carolina, the most susceptible areas for wildfires in which homes and woodlands co-exist are in the mountains and areas of the coast.

Some examples of Firewise practices include:

- Maintaining a 'defensible perimeter' around homes and structures by controlling vegetation growth
- Removing so-called 'ladder fuels' from around structures, that may allow a small fire on the ground to move upwards, and into the structure
- Constructing access roads and driveways in a way that will allow access by fire trucks and other heavy emergency response vehicles.

More information is available on the North Carolina Firewise Web site http://www.ncfirewise.org/ and the national Web site http://www.firewise.org./

10.2.9 Forestry Accomplishments

Since the previous basinwide plan was produced, the DFR accomplished the following tasks in an ongoing effort to improve compliance with forest regulations and, in turn, minimize nonpoint source (NPS) pollution from forestry activities:

- Replaced worn-out wood timber bridgemats in the Sylva District with new mats available for use throughout the basin.
- Established a Forestry NPS Unit that develops and oversees projects throughout the state that involves protection, restoration and education on forestry NPS issues.
- Revised and produced 10,000 copies of a pocket field guide outlining the requirements of the FPGs and suggested BMPs to implement.
- Created and published 15,000 copies of a new brochure "Call Before You Cut" for landowners promoting pre-harvest planning to insure water quality issues are addressed prior to undertaking timber harvesting.
- Continued to assist with workshops in cooperation with the N.C. Forestry Association's "ProLogger" logger training program.
- DFR continues its efforts to protect water quality through various protection, restoration, and education projects. This includes research projects, on-site demonstrations, and integration of NPS topics through the DFR's network of Educational State Forests and State Forests. Progress reports and summaries are posted in the 'Water Quality' section of the DFR's Web site http://www.dfr.state.nc.us./ as they are completed.

Chapter 11
Water Resources

11.1 River Basin Hydrologic Units

Under the federal system, the Little Tennessee River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). Cataloging units are further divided into smaller watershed units (14-digit hydrologic units or local watersheds) that are used for smaller scale planning like that done by NCEEP (Chapter 13). There are 3 local watershed units in the basin, all of which are listed in Table 19.

Table 19 Hydrologic Subdivisions in the Little Tennessee River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-Digit Codes	USGS 8-Digit Hydrologic Units	USGS 14-Digit Hydrologic Units Local Watersheds*
Upper Little Tennessee River Cullasaja River, Lake Sequoyah Catoojechaye Creek Nantahala River, Nanatahala Lake	04-04-01 and 04-04-03	06010202	020010, 020020, 020030, 030010, 030020, 030030, 040010, 040020, 040030, 040040, 050010, 050020, 050030
Tuckasegee River Lake Glenville, Wolf Creek Reservoir Oconoluftee River, Deep Creek	04-04-02	06010203	050040, 050050, 060010, 060020, 060030, 060040, 060050, 060060, 060070, 070010, 070020, 080010, 080020, 080030, 080040, 010010, 010020, 010030, 010040, 010050, 010060, 010070, 020010, 020020, 020030, 020040, 030010, 030020, 030030, 030040, 030050, 030060, 030070, 030080, 040010, 040020, 040030, 040040, 040050, 040060, 040070
Lower Little Tennessee River Santeetlah Lake, Snowbird Creek Tulula Creek, Cheoah River	04-04-04	06010204	010010, 010020, 010030, 020010, 020020, 020030, 020040, 020050, 030010

* Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

11.2 Minimum Streamflow

Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. The Division of Water Resources (DWR), in conjunction with the Wildlife Resources Commission (WRC), recommends conditions related to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources (DLR) issues the permits.

Under the authority of the Federal Power Act, the Federal Energy Regulatory Commission (FERC) licenses all non-federal dams located on the navigable waters in the United States that

produce hydropower for the purposes of interstate commerce. The license may include requirements for flows from the project for designated in-stream or off-stream uses.

The studies to support the license application of Duke Power for the bypass projects: Nantahala Project (FERC Project No. 2692), West Fork Project (FERC Project No. 2686), East Fork Project (FERC Project No. 2698); and the run-of-river projects: Dillsboro (FERC Project No. 2602), Franklin (FERC Project No. 2603), and Bryson City (FERC Project No. 2601) have been completed. The license application has been submitted and the Federal Energy Regulatory Commission is now proceeding through the National Environmental Policy Act (NEPA) process. To review the studies, go to: http://www.nantahalapower.com/lakes/relicensing/. The results of these projects are discussed in more detail in the Subbasin Chapters (1-4).

The licenses for Dillsboro, Franklin and Bryson City expired on 7/31/2005; the licenses for West Fork and East Fork expired on 1/31/2006; and the license for Nantahala expired on 2-28-2006. The projects will continue to operate until the new licenses are issued with annual licenses issued by the FERC, containing terms and conditions from the expired licenses.
Under the authority of Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers issues permits for the discharge of fill material into navigable waters. The permit may include requirements for flows for designated in-stream or off-stream uses. A 404 permit will not only apply to dams under state and federal regulatory authorities mentioned above, but will also cover structures that are not under their authority, such as weirs, diversions, and small dams. Table 20 presents minimum streamflow projects in the Little Tennessee River basin.

Table 20 Minimum Streamflow Projects in the Little Tennessee Basin

Name	Subbasin	Waterbody	Drainage Area (sq. mi.)	Min. Streamflow (cubic feet/sec)
East Fork Project				
Tanasee Dam	04-04-02	Tanasee Creek	25	0
Wolf Creek Dam	04-04-02	Wolf Creek	15	0
Bear Creek Dam	04-04-02	Tuckasegee River	75.3	0
Cedar Cliff Dam	04-04-02	Tuckasegee River	80.7	10[1]
West Fork Project				
Thorpe Dam	04-04-02	West Fork Tuckasegee River	36.7	0
Little Glenville Dam	04-04-02	West Fork Tuckasegee River	54.7	20
Tapoco (Tallassee) Project				
Cheoah Dam	04-04-02	Little Tennessee River	1608	Run-of-river[2]
Calderwood Dam	Tennessee	Little Tennessee River	1856	Run-of-river[2]
Chilhowee Dam	Tennessee	Little Tennessee River	1977	Run-of-river[2]
Santeetlah Dam	04-04-04	Cheoah River	176	0
Nantahala Project				
Diamond Valley Dam	04-04-03	UT to Dicks Creek	0.4	Run-of-river[2]
Dicks Creek Dam	04-04-03	Dicks Creek	3.5	Run-of-river[2]
Whiteoak Dam	04-04-03	Whiteoak Creek	13.8	8[4]
Nantahala Dam	04-04-03	Nantahala River	91	606[1]
Queens Creek Project				
Queens Creek Dam	04-04-03	Queens Creek	3.6	2.0 or 1.0[3]
Other Projects				
Franklin (Lake Emory	04-04-01	Little Tennessee River	310	Run-of-river[2]
Dillsboro Dam	04-04-02	Tuckasegee River	290	Run-of-river[2]
Bryson City	04-04-02	Oconaluftee River	188	Run-of-river[2]
Pyle Dam	04-04-01	Potts Branch	0.5	0.2
Westgate Plaza Dam	04-04-01	UT to Cartoogechaye Creek	0.47	0.3

[1] Release made at the powerhouse.

[2] The project generates or dam spills in a run-of-river mode, i.e., inflow equals outflow. Dams with more storage capacity can have a greater effect on streamflow.

[3] Minimum flow of 2.0 cfs from December 1 through May 31 and 1.0 cfs from June 1 through November 30, or inflow, whichever is less.

[4] The release is from July 1 to November 15; and the release is actually from the Whiteoak pipeline(penstock) into Dicks Creek which flows into the Nantahala River upstream of the Whiteoak Creek confluence. There currently is no flow requirement below the Whiteoak Creek dam.

11.3 Interbasin Transfers (IBT)

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. Also, persons wishing to transfer more than the minimum transfer quantity allowed by the IBT law (usually 2 MGD) must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State, and included as part G.S. 143-215.22G of the law. These boundaries differ slightly from the 17 major river basins delineated by DWQ.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer must outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as support documentation for a transfer petition. Currently, there are no certified interbasin transfers in the Little Tennessee River basin. However, the Town of Highlands straddles the Little Tennessee and Savannah River basin divide, resulting in a minor transfer estimated to be less than 0.1 MGD. For more information on interbasin transfers, visit the website at http://www.ncwater.org/or call DWR at (919) 733-4064.

11.3.1 Local Water Supply Planning

The North Carolina General Assembly mandated a local and state water supply planning process in 1989 to assure that communities have an adequate supply of potable water for future needs. Under this statute, all units of local government that provide, or plan to provide, public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs.

Table 21 shows the water use and the service population for water systems that use water from the Little Tennessee River Basin and submit a Local Water Supply Plan to the Division of Water Resources. Except where noted, the data is from the systems' 2002 LWSP.

Table 21 Local Water Supply Planning in the Little Tennessee River Basin

Population and Water Use for LWSP systems using water from the Little Tennessee River Basin					
County	System	Average Daily Demand (mgd)		Population Served	
		2002	2020	2002	2020
Graham	Robbinsville	0.53	0.546	2800	2844
Graham	Santeetlah	0.025	0.03	60	70
Macon	Franklin (1997 Data)	1.044	2.06	7125	10000
Macon	Highlands	0.485	1.176	1173	1614
	Totals	**2.084**	**3.812**	**11158**	**14528**

11.3.2 Registered Water Withdrawals

Large water users are required to register their withdrawals with the Division of Water Resources. General Statute 143-215.22H requires non-agricultural users that withdraw 100,000 gallons per day or more and agricultural users that withdraw 1,000,000 gallons per day or more to report their withdrawals. Details of this program can be found on the Division's website at: www.ncwater.org. Table 22 lists the registered water withdrawers in the Little Tennessee River Basin.

Table 22 Registered Water Withdraws in the Little Tennessee River Basin

2004 Registered Water Withdrawals in the Little Tennessee River Basin			
County	Registered Facility	Source of Withdrawal	Average for Days Used (mgd)
Graham	Alcoa Power Generating Inc.-Tapoco Division -- Santeetlah Powerhouse	Cheoah River	379
Graham	Alcoa Power Generating Inc. - Tapoco Division -- Cheoah Powerhouse	Cheoah River	3074
Jackson	Duke Energy - Bear Creek Hydro-electric Facility	East Fork Tuckasegee River	151
Jackson	Duke Energy - Cedar Cliff Hydro-electric Facility	East Fork Tuckasegee River	151.60
Macon	Duke Enregy - Nantahala Hydro-electric Facility	Nantahala River	259.70
Macon	Duke Energy - Queens Creek Hydro-electric Facility	Queens Creek	4.60
Jackson	Duke Energy - Tanasee Creek Hydro-electric Facility	East Fork Tuckasegee River	87.20
Jackson	Duke Energy - Thorpe Hydro-electric Facility	West Fork Tuckasegee River	73.90
Jackson	Duke Energy - Tuckasegee Hydro-electric Facility	Tuckasegee River	71
Cherokee	Nantahala Talc & Limestone Co Inc - Hewitt Quarry	Nantahala River	0.39
Graham	Fontana Village Resort	Fontana Lake	0.26
Jackson	Forest Hills - Carolina Water Service (1999 Data)	Ground Water	0.04
Macon	Otter Creek Trout Farm (1999 Data)	Otter Creek	1.44
Swain	Cooper Creek Trout Farm	Cooper Creek	1.69
Swain	Tumbling Waters Campground & Trout Pond	Panther Creek	0.20

11.4 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts these wastewater discharges

make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.
As streamflows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount dissolved oxygen in the water, but at night algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause problems for recreation and difficulty in water treatment resulting in taste and odor problems in finished drinking water.

11.5 Source Water Assessment of Public Water Supplies

11.5.1 Introduction

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This new focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments require that states develop and implement a SWAP to:

- Delineate source water assessment areas;
- Inventory potential contaminants in these areas; and
- Determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the SWAP is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled *North Carolina's Source Water Assessment Program Plan*, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://www.deh.enr.state.nc.us/pws/index.htm.

11.5.2 Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program

North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1986, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at http://www.deh.enr.state.nc.us/pws/swap.

Water Supply Watershed Protection (WSWP) Program

DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at http://h2o.enr.state.nc.us/wswp/index.html.

11.5.3 Susceptibility Determination – North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating

The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible", a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating

Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (i.e., turbidity and total coliform) and watershed

characteristics (i.e., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating
The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)
In order to inventory PCSs, the SWAP conducted a review of relevant, available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that were attainable and contained usable geographic information related to PCSs.

11.5.4 Source Water Protection

The PWS Section believes that the information from the source water assessments will become the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage identified sources of contamination and to reduce or eliminate the potential threat to drinking water supplies through locally implemented programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP as well as materials such as:

- Fact sheets outlining sources of funding and other resources for local SWP efforts.
- Success stories describing local SWP efforts in North Carolina.
- Guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://www.deh.enr.state.nc.us/pws/swap.

11.5.5 Public Water Supply Susceptibility Determinations in the Little Tennessee River Basin

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. A second round of assessments were completed in April 2005. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the PWS web page (http://www.deh.enr.state.nc.us/pws/swap). To view a report, select the PWS System of interest by clicking on the "SWAP Reports" icon.

In the Little Tennessee River Basin, 354 public water supply sources were identified. Eleven are surface water sources, 3 are groundwater source that are under the influence of surface water (like springs) and 340 are groundwater sources. All of 340 groundwater sources have a Higher susceptibility rating. Table 23 identifies the eleven surface water sources, 3 groundwater sources under the influence of surface water and the overall susceptibility ratings for all of these sources. It is important to note that a susceptibility rating of Higher does not imply poor water quality.

Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

Table 23 SWAP Results for Surface Water Sources in the Little Tennessee River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS Name
0138010	H	L	M	Cheoah River	Robbinsville Water Treatment Plant
0138010	M	L	M	Rock Creek	Robbinsville Water Treatment Plant
0138010	M	L	M	Burgin Creek	Robbinsville Water Treatment Plant
0138010	M	L	M	Long Creek	Robbinsville Water Treatment Plant
0138101	H	L	M	Fontana Lake	Fontana Village Resort Water Treatment Plant
0150035	H	L	M	Tuckasegee River	Tuckasegee Water & Sewer Authority
0150116	H	L	M	Tuckasegee River	Western Carolina University Water Treatment Plant
0157010	H	L	M	Cartoogechaye River	Town of Franklin
0157015	H	L	M	Big Creek	Highlands Water Treatment Plant
0157015	M	L	M	Lake Sequoia	Highlands Water Treatment Plant
0187010	H	L	M	Deep Creek	Bryson City
0150190*	H	L	M	Well #1	Moonshine Creek Campground
0157117*	H	L	M	Spring #1	King Mountain Club Water
0157117*	H	L	M	Spring #2	King Mountain Club Water

* Groundwater sources under the influence of surface water

Chapter 12
Natural Resources

12.1 Ecological Significance of the Little Tennessee Basin

The Little Tennessee River basin has one of the most outstanding and diverse aquatic communities within the entire state. It is home to a variety of rare species, including crayfish, mussels, fish, aquatic insects, and amphibians. The stretch of Little Tennessee River between Franklin and Fontana Lake (25 miles) has a faunal diversity that rivals any in the state and perhaps in the nation. Forestland continues to comprise a large majority of this basin, owing to its relatively pristine condition. Although habitat fragmentation due to dam construction has occurred throughout this system in North Carolina and Tennessee, it continues to support an incredibly rich and diverse ecosystem.

12.2 Rare Aquatic and Wetland-Dwelling Animal Species

Table 24 lists the rare fish, mollusks, insects, amphibians, and reptiles found throughout the Little Tennessee River basin. For information on any of the species listed in Table 24, visit the NC Natural Heritage Program (NHP) website at www.ncnhp.org.

Considerable work is in progress regarding the life history of **sicklefin redhorse**, including movement and spawning habitat studies, which will soon lead to a formal species description. The Little Tennessee basin contains six species of redhorse, an amazing diversity of these bottom-dwelling fish. In 2005, specimens of **littlewing pearlymussel** were collected in the Little Tennessee River, after an absence of collection for nine years. This is a particularly encouraging find considering the species is presumed extirpated from the Hiwassee basin and the Little Tennessee is its only known remaining habitat within North Carolina. Efforts are under way to study populations of **Appalachian elktoe** and **spotfin chub** to inform U.S. Fish and Wildlife Service of current status of these species.

There are several rare freshwater mussels in the Little Tennessee River basin. In general, freshwater mussels are declining throughout the Southeast, which is the area of greatest freshwater mussel diversity in the world. Mussels have a unique life cycle that depends on the availability of a proper fish host. Female mussels are fertilized and produce larval mussels, called glochidia, which are often packaged as a 'lure' to attract fish. The fish 'consumes' the lure and glochidia attach to its fins and gills. The glochidia remain attached to the fish for a maturation period, then drop into the substrate to begin growth to adulthood. The continued survival of freshwater mussels depends on water quality but also on the availability of appropriate habitat and host fish.

Table 24 List of Rare Animals Associated with Aquatic and Wetland Habitats in the Little Tennessee River Basin (August 2006)

Scientific Name	Common Name	Major Group	State Status	Federal Status
Skistodiaptomus carolinensis	Carolina Skistodiaptomus (a copepod)	Crustacean	SR	
Cambarus georgiae	Little Tennessee River crayfish	Crustacean	SC	
Cambarus reburrus	French Broad River crayfish	Crustacean	SR	FSC
Cambarus tuckasegee	Tuckasegee stream crayfish	Crustacean	SR	
Orconectes sp. 3	No common name	Crustacean	SR	
Amblyscirtes reversa	Reversed roadside-skipper (butterfly)	Invertebrate	SR	
Autochton cellus	Golden banded-skipper (butterfly)	Invertebrate	SR	
Ladona julia	Chalk-fronted corporal (dragonfly)	Invertebrate	SR	
Barbaetis benfieldi	Benfield's bearded small minnow mayfly	Invertebrate	SR	
Isoperla frisoni	A stonefly	Invertebrate	SR	
Megaleuctra williamsae	Williams' rare winter stonefly	Invertebrate	SR	
Zapada chila	A stonefly	Invertebrate	SR	
Matrioptila jeanae	A caddisfly	Invertebrate	SR	
Micrasema burksi	A caddisfly	Invertebrate	SR	
Rhyacophila amicis	A caddisfly	Invertebrate	SR	
Rhyacophila mainensis	A caddisfly	Invertebrate	SR	
Rhyacophila vibox	A Rhyacophilan caddisfly	Invertebrate	SR	
Alasmidonta raveneliana	Appalachian elktoe	Mollusk	E	FE
Alasmidonta viridis	Slippershell mussel	Mollusk	E	
Elliptio dilatata	Spike	Mollusk	SC	
Fusconaia barnesiana	Tennessee pigtoe	Mollusk	E	
Lampsilis fasciola	Wavy-rayed lampmussel	Mollusk	SC	
Pegias fabula	Littlewing pearlymussel	Mollusk	E	FE
Villosa iris	Rainbow	Mollusk	SC	
Ambystoma talpoideum	Mole salamander	Amphibian	SC	
Cryptobranchus alleganiensis	Hellbender	Amphibian	SC	FSC
Desmognathus aeneus	Seepage salamander	Amphibian	SR	FSC
Desmognathus santeetlah	Santeetlah dusky salamander	Amphibian	SR	
Eurycea junaluska	Junaluska salamander	Amphibian	T	FSC
Eurycea longicauda	Longtail salamander	Amphibian	SC	
Hemidactylium scutatum	Four-toed salamander	Amphibian	SC	
Moxostoma sp. 2	Sicklefin redhorse	Fish	SR	
Clinostomus funduloides ssp. 1	Little Tennessee River rosyside dace	Fish	SC	FSC
Erimonax monachus	Spotfin chub	Fish	T	FT
Luxilus chrysocephalus	Striped shiner	Fish	T	
Notropis lutipinnis	Yellowfin shiner	Fish	SC	
Noturus flavus	Stonecat	Fish	E	
Etheostoma vulneratum	Wounded darter	Fish	SC	FSC
Percina squamata	Olive darter	Fish	SC	FSC
Sorex palustris punctulatus	Southern water shrew	Mammal	SC	FSC
Glyptemys muhlenbergii	Bog turtle	Reptile	T	FT (S/A)

Listing Abbreviations: E = Endangered; T = Threatened; SC = Special Concern; SR = Significantly Rare; FE = Federal Endangered; FT = Federal Threatened; FT (S/A) = Federal Threatened due to Similar Appearance; FSC = Federal Species of Concern

12.3 Significant Natural Heritage Areas in the Little Tennessee River Basin

The NC Natural Heritage Program (NHP) compiles a list of Significant Natural Heritage Areas as required by the Nature Preserves Act. The list is based on the program's inventory of natural diversity in the state. Natural areas are evaluated based on the number and quality occurrences of rare plant and animal species, rare or high-quality natural communities, and special animal habitats. The global and statewide rarity of these elements and their quality at a site is compared with other occurrences to determine a site's significance. Sites included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access to the site exists.

The Significant Natural Heritage Areas found in the Little Tennessee River basin are shown in Figure 16. The NC NHP compiles a list of Significant Natural Heritage Areas as required by the Nature Preserves Act. The list is based on the program's inventory of natural diversity in the state. The terrestrial and aquatic natural heritage areas included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access to the site exists. The identification of a significant natural heritage area conveys no protection; these lands are the responsibility of the landowner.

The Little Tennessee basin has over 90 designated significant natural heritage areas; twelve of these are aquatic significant natural heritage areas, as listed below in Table 25.

Table 25 Little Tennessee River Basin Aquatic Significant Natural Heritage Areas

Aquatic Significant Natural Heritage Area	Significance
Cartoogechaye Creek	State
Cheoah River	State
Cullasaja River/Ellijay Creek	State
Little Tennessee River (Lower)	National
Little Tennessee River (Upper)	State
Oconaluftee River	State
Raven Fork	Regional
Santeetlah Creek	Regional
Snowbird Creek	Regional
Tuckasegee River	National
Upper Nantahala River	Regional
Whiteoak Creek	State

There are several nationally significant natural heritage areas that have a direct effect on the quality of aquatic systems in the basin. The majority of the **Great Smoky Mountains National Park** in North Carolina is located in the Little Tennessee River basin. The park affords great protection to headwater streams in the basin, which are vital to the proper functioning of downstream areas.

The **floodplains of the Cheoah River** provide protection for aquatic species such as Appalachian elktoe, in addition to providing habitat for several salamanders, including seepage, Junaluska, and longtail. Additionally, there are several rare plant species associated with this habitat such as the federally threatened Virginia spiraea.

Joyce Kilmer Wilderness Area is over 13,000 acres of largely old-growth forest and provides protection to the headwaters of Little Santeetlah and Slickrock Creeks. This area is one of the best examples of old-growth forests in the Southern Appalachians. Cove forests in this area contain massive trees, including tulip poplars and hemlocks. Additional extensive protected acreage of younger forests occurs in the other watersheds in the designated wilderness area.

Granitic domes with steep slopes, rugged gorges, unusual flat-bottomed valleys, and sandy meandering streams with bogs and potholes characterize the remote **Panthertown Valley Natural Area**. Wetland communities are present in part of the flat valley bottom, including several examples of the rare Southern Appalachian Bog community and a Swamp Forest-Bog Complex. The bogs have a generally open character with sedges, broomsedge, rushes, and sundews growing over a dense mat of peatmoss. An excellent Spray Cliff occurs near the scenic Schoolhouse Falls, and supports several rare plant species. The tract encompasses the headwaters of Tuckasegee River formed by Panthertown, Greenland and Flat Creeks. Panthertown Creek has excellent water quality and a high diversity of invertebrates.

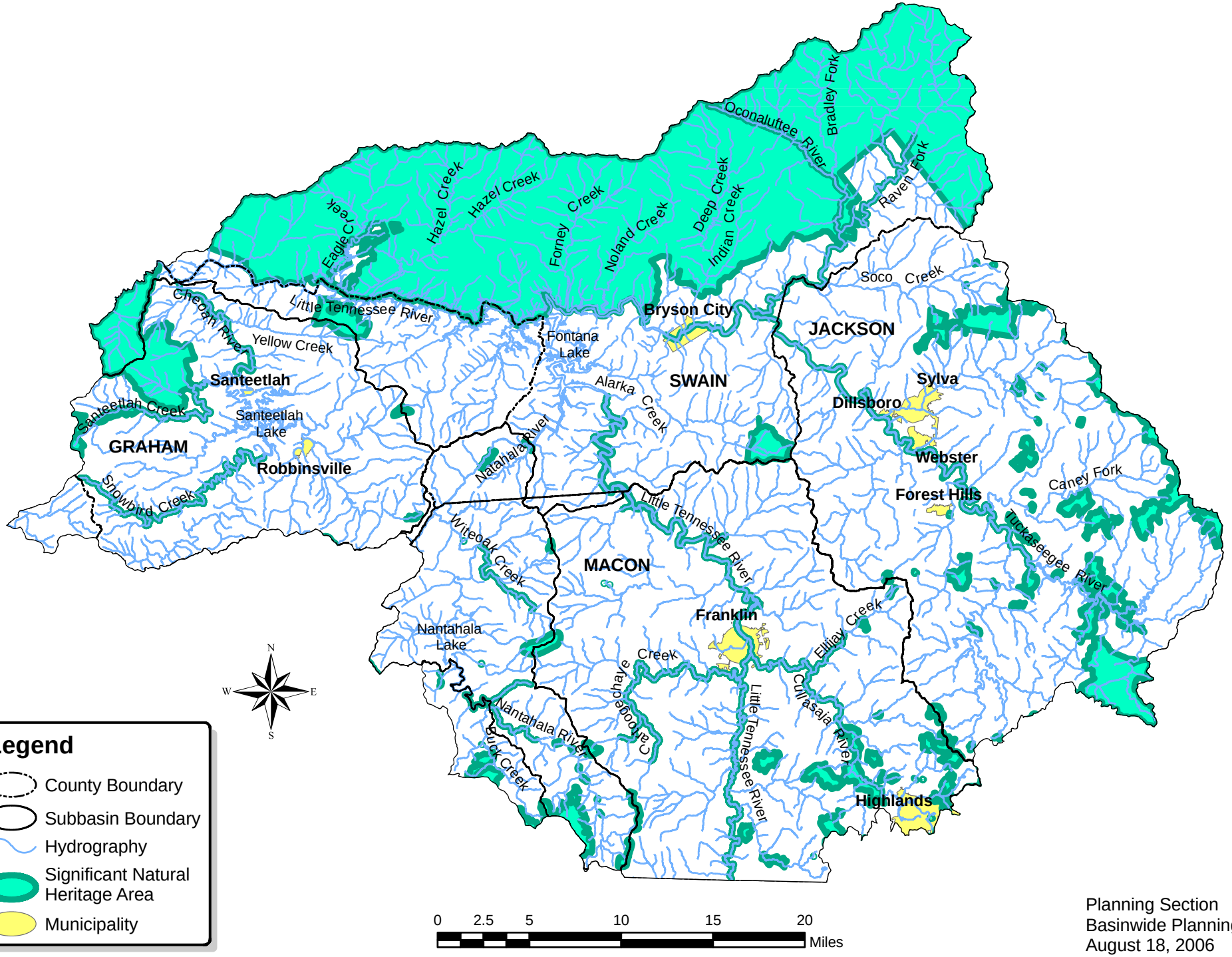
The **Nantahala River Bogs Natural Area** includes five of the few remaining high quality montane wetlands, with high diversity of plant species and good examples of two rare mountain bog natural communities. Several of the bogs support bog turtles (*Glyptemys muhlenbergii*) and the proximity of sites may be important for dispersal and survival of this species. Several rare plant species occur in the site as well. Beaver are present at the Big Indian Creek Bog and White Oak Bottoms sites, and may be an important part of the ecological dynamics of these poorly understood communities.

12.4 Public Lands

Over 2 million acres in the Little Tennessee River basin are comprised of the Great Smoky Mountains National Park and the Nantahala National Forest. The presence of these large and fairly contiguous segments of well-preserved lands has no doubt played a vital role in maintaining the impressive ecological diversity present within the basin.

An extremely important addition of state-owned land in the Little Tennessee basin occurred in January 2004. The Needmore Tract, 4500 acres, was purchased after four years of extensive partnership activities between local governments, residents, state and federal agencies, sportspersons, and environmentalists. The Tract protects 26 miles of river-front property along the Little Tennessee, 37 miles of tributary streams, and serves as a corridor between the Nantahala and Cowee mountain ranges. Over half of the extraordinarily diverse section of the Little Tennessee River between Franklin and Fontana Lake is protected by the Needmore Tract and efforts are under way by local land trusts to gain additional land holdings adjacent to the Tract. The Needmore Tract is managed by the NC Wildlife Resources Commission.

Figure 16 Significant Natural Heritage Areas in the Little Tennessee River Basin



Planning Section
Basinwide Planning Unit
August 18, 2006

Chapter 13
Water Quality Initiatives

13.1 The Importance of Local Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-4. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

In an effort to provide water quality information and gain public input, DWQ partnered with local watershed associations, the National Resource Conservation Service, and Soil and Water Conservation Districts to host the Western North Carolina Basinwide Water Quality Conference in 2005. The purpose of the conference was to educate people about water quality concerns specific to the mountain region and show how participation in the Basinwide Planning process can benefit local initiatives.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rulemaking process, and many others.

These local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities are available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. A few of the local organizations are highlighted in Table 26. Specific projects are described in the subbasin chapters (Chapters 1 – 4). Nonpoint source program descriptions and contact, Soil and Water Conservation District (SWCD), NC Cooperative Extension Service and USDA Natural Resources Conservation Service (NRCS) contact information can be found in Appendix VII.

DWQ applauds the foresight and proactive response to potential water quality problems in the watersheds listed above. Federal and State government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs. The distribution of several grantors is discussed below.

Table 26 Local Water Quality Initiatives

Little Tennessee Watershed Association (LTWA)

Franklin, North Carolina

The Little Tennessee Watershed Association is a nonprofit organization dedicated to protecting and restoring water quality and habitat in the Little Tennessee Watershed. The LTWA formed as a volunteer organization in 1994, as a result of local citizens' concerns about declining water quality. Based in Franklin, NC, the LTWA is a community-based conservation organization with a long history of working with local landowners, other nonprofits and government agencies with a common interest in water quality and habitat issues.

197 Thomas Heights Road,
Franklin, NC 28734

Phone: 828-369-6402
Email: information@ltwa.org

www.ltwa.org

Accomplishments/Projects:

- Long term biological monitoring
- Stream bank restoration
- Education

Land Trust for the Little Tennessee (LTLT)

Franklin, North Carolina

The Land Trust for the Little Tennessee is dedicated to conserving the waters, forests, farms, and heritage of the Upper Little Tennessee and Hiwassee River Valleys. We work in partnership with private landowners, public agencies, and others to conserve land, insuring that the natural beauty, ecological integrity, and rural character of our region are preserved for generations to come.

88 East Main Street
P. O. Box 1148
Franklin, NC 28744-1148

Phone: 828-524-2711
Email: bmartin@ltlt.org

www.ltlt.org

Accomplishments/Projects:

- Rural Land Conservation
- Land Stewardship
- Outreach and Education

Jackson-Macon Conservation Alliance (JMCA)

Highlands, North Carolina

Jackson-Macon Conservation Alliance is a grassroots conservation organization whose mission is to address environmental issues affecting the Highlands-Cashiers area through education, advocacy, hand-on initiatives and collaboration with like-minded organizations.

Peggy Crosby Center
348 South Fifth Street
Highlands, NC 28741

Phone: 828-526-9938
Email: jmca@dnet.net

Accomplishments/Projects:

- Outreach and Education

Upper Cullasaja Watershed Association (UCWA)
Highlands, North Carolina

UCWA promotes the responsible management of water resources on the Highlands Plateau in order to maintain and enhance our environment and quality of life.

PO Box 1508
Highlands, NC 28741

Phone (828)526-9938 ext230
Email: ucwa@earthlink.net

http://www.ucwatershed.org/

Accomplishments/Projects:

- Assessment of Mill Creek (303)d and Monger Creek;
- Watershed Strategy and Action Plan;
- Long term rainfall data collection
- Volunteer water quality monitoring
- Public education
- Erosion and sediment control consulting

Watershed Association of the Tuckasegee River (WATR)
Bryson City, North Carolina

The Watershed Association of the Tuckasegee River is a grassroots organization working to improve water quality and habitat of the Tuckasegee River.

835 Main Street
Bryson City, NC 28713

Phone: 828-488-8418
Email: info@watrnc.org

http://www.watrnc.org/

Accomplishments/Projects:

- Long term biological monitoring
- Volunteer water quality monitoring
- Watershed Planning
- Education

Little Tennessee Non Point Source Team (LTNPST)

The LTNPST is a dynamic partnership of government agencies, nonprofit organizations, and citizen's groups, working to enhance and conserve the natural resources in the Little Tennessee River Basin by coordinating resources and activities, employing scientific knowledge, and promoting public awareness.

http://www.littletbasin.org/

Accomplishments/Projects:

- Regular Roundtable discussions among resource professionals and nonprofit organizations
- Sediment and Erosion Impact Education
- 2006 Basinwide Planning Conference

13.2 Federal Initiatives

13.2.1 Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. Through annual base funding, there is approximately $1 million available for demonstration and education projects across the state. An additional $2 million is available annually through incremental funds for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution

(NPS). Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm. Descriptions of projects and general Section 319 Program information are available at http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm.

Many 319 projects are demonstration projects and educational programs that allow for the dissemination of information to the public through established programs at NC State University (NCSU) and the NC Cooperative Extension Service. Other projects fund stream restoration activities that improve water quality. Between 1999 and 2003, there were three projects in the Little Tennessee River basin funded through the Section 319 Program totaling $105,064.00.

13.3 State Initiatives

13.3.1 North Carolina Ecosystem Enhancement Program (NCEEP)

The North Carolina Ecosystem Enhancement Program (NCEEP) is responsible for providing ecologically effective compensatory mitigation in advance of permitted impacts associated with road projects and other development activities. The fundamental mission of the program is to restore, enhance and protect key watershed functions in the 17 river basins across the state. This is accomplished through the implementation of wetlands, streams and riparian buffer projects within selected local watersheds. The vital watershed functions that NCEEP seeks to restore and protect include water quality, floodwater conveyance and storage, fisheries and wildlife habitat.

The NCEEP is not a grant program, but can implement its restoration projects cooperatively with other state or federal programs such as the Section 319 Program. Combining NCEEP-funded restoration or preservation projects with 319 or other local watershed initiatives (e.g., those funded through the Clean Water Management Trust Fund or local/regional Land Trusts) increases the potential to improve the water quality, hydrologic and habitat functions within selected watersheds.

The selection of optimal sites for NCEEP mitigation projects is founded on a basinwide and local watershed planning approach, which results, respectively, in the development of *River Basin Restoration Priorities* and *Local Watershed Plans*.

In developing *River Basin Restoration Priorities (RBRP)* (formerly called *Watershed Restoration Plans*), the NCEEP identifies local watersheds (14-digit hydrologic units) with the greatest need and opportunity for restoration, enhancement or preservation projects. These high-priority watersheds are called "targeted local watersheds" (*TLW*s). Targeted local watersheds are identified, in part, using information compiled by DWQ's programmatic activities (e.g., *Basinwide Assessment Reports*). Local factors considered in the selection of *TLW*s include: water quality impairment, habitat degradation, the presence of critical habitat or significant natural heritage areas, the presence of water supply watersheds or other high-quality waters, the status of riparian buffers, estimates of impervious cover, existing or planned transportation projects, and the opportunity for local government partnerships. Recommendations from local resource agency professionals and the presence of existing or planned watershed projects are given significant weight in the selection of *TLW*s. In essence, targeted local watersheds represent those areas within a river basin where NCEEP resources can be focused for maximum benefit to local watershed functions.

The *RBRP* for the Little Tennessee River Basin can be found on the NCEEP website at http://www.nceep.net/services/restplans/watershedplans.html. A revised *RBRP* with updated selections for *Targeted Local Watersheds* will be posted to this website by summer 2006.

The NCEEP also develops *Local Watershed Plans (LWP*s*)*, usually within targeted local watersheds identified in the *RBRPs*. Through the local watershed planning process, NCEEP conducts watershed characterization and field assessment tasks to identify critical stressors in local watersheds. The NCEEP planners and their consultants coordinate with local resource professionals and local governments to identify optimal watershed projects and management strategies to address the major functional stressors identified. The *LWP*s prioritize restoration/enhancement projects, preservation sites, and best management practices (BMP) projects that will provide water quality improvement, habitat protection and other environmental benefits to the local watershed.

Although there is presently no NCEEP-funded Local Watershed Planning initiative in the Little Tennessee River River basin, it is possible that such an effort will be undertaken in the future. Decisions regarding the possible need for new LWP initiatives within a given basin are made annually by NCEEP planners.

NCEEP Projects in the Little Tennessee River Basin

In the Little Tennessee River Basin, NCEEP has four on-going or completed stream or wetland restoration/preservation projects. These include: (1) Cat Creek, which will include 8,000 ft of stream restoration, thirteen acres of wetland restoration, and two acres of wetland preservation; (2) the Lost Bridge area, which preserves approximately 11,000 ft of high quality tributaries to the Little Tennessee River near the Macon and Swain County border; (3) the Needmore Tract, which includes approximately 96,000 ft of high quality stream and 30 acres of high quality wetland preservation; and (4) Tulula Bog, which preserves 121 acres of wetland.

For additional information about NCEEP's Project Implementation efforts, go to: http://www.nceep.net/services/implementation/project_implementation.htm. For additional information about NCEEP in general, including its various program activities and products, visit http://www.nceep.net/.

13.3.2 Clean Water Management Trust Fund

The CWMTF offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Little Tennessee River basin, -- projects have been funded for a total of $25,893,967 (Table 27). For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 27 Projects in the Little Tennessee River Basin Funded by the Clean Water Management Trust Fund

Project Number	Application Name	Proposed Project Description	Amount Funded
1997A-006	Macon County & SAHC-Stream and Wetlands Restoration/Little Tennessee River	A: Restore 55 ac wetlands, stabilize 54,000 sq ft of streambanks, & purchase 2 miles of riparian land along 6-mile Central Watershed Greenway in Franklin. B: Begin streambank stab and buffer program in Little Tenn River, Cullasaja & Cartoogechaye Rivers.	$3,885,000
1997A-024	Swain Co Economic Dev-Acq/Env Cleanup/Bank Stab/Planning/Tuckasegee River	A: Acquire, clean up and preserve riparian buffer on 1.7 acres, and 1,060 linear feet of Tuckasegee River as part of River-Walk Project. B:Stabilize streambanks and develop greenway/downtown revitilization plan as part of Tuckasegee River-Walk Project.	$195,900
1997A-034	Bryson City, Town of - Sewer System Rehabilitation & Stormwater Plan	Remove antiquated sewer line from stream bed, prepare stormwater management plan and local ordinances, and I&I study.	$80,000
1997A-128	Tuckasegee Water and Sewer Authority- Wastewater Collection System	Construct 3.3 miles of 10" gravity trunk sewer line along Scotts Creek. Purpose is to eliminate failing septic tanks and illegal straight pipes. No "on-site" remedy and best solution is to connect to Sylva WWTP.	$1,200,767
1997B-201	Conservation Fund/Southern App High Cons-CE/Tuckasegee River	Acquire a permanent conservation easement on 600 acres along the Tuckasegee River and Bracken Creek.	$294,300
1998A-002	Southern Appalachain Highlands Conservancy - Little Tennessee River Acq	Acquire through fee simple purchase and permanent conservation easements 66 acres along the Tennessee River and Tessentee Creek.	$222,000
1998A-604	Jackson County- Revolving Fund/Failing Septic Systems	Capitalize a revolvoing loan fund to eliminate failing septic tanks and straight piping into tributaries along Scotts Creek. Complements an earlier Tuckasegee project. Initial goal of fixing 125 of 500 homes with failing or illegal systems.	$452,000
2001A-028	Southwestern NC RC&D, Inc. - Trout buyout/Santeetlah Lake	Acquire up to four trout farm operations and associated property and place purchased tracts under conservation easements. Remove all improvements related to the trout farm operation and restore buffers with natural vegetation.	$1,250,000
2001A-803	Jackson County- Planning/ Greenway Feasibility	Conduct a study to determine the feasibility of a greenway system along Scott Creek. Also includes landowner outreach, stream restoration prioritization, and preparation of the greenway master plan.	$25,000
2002A-001	Bryson City, Town of - Acq/ Lands Creek	Purchase permanent conservation easement on 462 riparian acres along Lands Creek. The Town will donate a conservation easement on an additional 398 acres to protect a total of 860 acres. The tract is adjacent to the Great Smoky Mountains National Park.	$1,531,000

2002A-005	Conservation Fund - Acq/ Scott Creek	Purchase permanent conservation easements on 4,931 acres along tributaries to Scott Creek. CWMTF funds to pay for riparian easements only on approx 2,000 acres. Tract is located between the Balsam Mt Preserve and the Blue Ridge Parkway.	$4,057,000
2002A-029	Southern Appalachian Highlands Conservancy - Acq/ Tuckasegee	Acquire permanent conservation easement on 230 acres along the Tuckasegee River and its headwaters. CWMTF funds to purchase 189 riparian acres.	$368,000
2002B-016	NC Wildlife Resources Commission - Acq./Needmore Tract	Acquire through fee simple purchase 4,468 acres along the Little Tennessee River and tributaries. This tract would create buffers along 27 miles of the Little Tennessee River and along 37 miles its tributaries.	$6,660,000
2003A-514	Tuckasegee Water and Sewer Authority- Wastewater/ Dix Gap Creek Collection	Replace 3,650 linear feet of a severely deteriorated sewer line along Dix Gap Creek, which drains through Western Carolina University to Cullawhee Creek. The Tuckasegee Water and Sewer Authority would maintain the system.	$353,000
2004A-409	Macon Soil & Water Conservation District - Rest./ Little Tennessee Restoration Program	Design, permit & construct natural channel stream restoration project along 1,600 ft of Iotla Creek, install revetments on 10,000 ft of streams & plant 25 acres of buffers along 27,000 ft in the Little Tennessee watershed. Monitor results.	$721,000
2004A-510	Partnership for Bryson City/Swain Co., Inc. - Wastewater/ Marina Waste Management, Fontana Reservoir	Provide start-up funds to purchase boats for the collection and transport of wastes from nearly 400 houseboats located on Fontana Reservoir. Upgraded Robinsville and Bryson City WWTPs to receive septage.	$325,000
2004A-805	Sylva, Town of - Planning/ Stormwater, Tuckasegee River	Develop a stormwater master plan to retain and treat stormwater discharges entering Scotts Creek, a tributary of the Tuckasegee River.	$40,000
2004B-020	Land Trust for the Little Tennessee - Acq/ Macon County Tracts	Protect 133 acres along the Little Tennessee River through fee simple purchase (70 ac) & permanent conservation easements (63 ac). Most of easements through USDA Farmland Preservation Program. River is home to endangered & protected aquatic species.	$635,000
2004D-018	Southern Appalachian Highlands Conservancy - Donated Minigrant, Hotaling, Wolf Creek	Minigrant to pay for transactional costs for a donated permanent conservation easement on 137 acres along Wolf Creek.	$25,000
2004M-001	Land Trust for the Little Tennessee - Minigrant/ Little Tennessee R	Minigrant to pay for pre-acquisition costs associated with the fee simple purchase of three tracts totaling 70 acres and conservation easements on two additional tracts totaling 63 acres along the main stem of the Little Tennessee River.	$25,000
2005A-604	Swain County - Septic/ Bryson Branch, Tuckasegee River	Eliminate fecal coliform and nutrient delivery to Bryson Branch from septic tanks by hooking up 30 failing systems to the Bryson City WWTP. Design, permit and construct 3,800 LF of sewer lines, 30 sewer connections, and 15 manholes.	$50,000

2005A-810	Upper Callasaja Watershed Association - Plan/Rest/ Watershed Protection Plan	Develop a watershed protection plan to identify and prioritize areas for restoration and stormwater BMPs in the Upper Cullasaja River and Mill Creek.	$40,000
2005A-811	Watershed Association of the Tuckasegee River - Plan/Rest/ Savannah Creek Watershed Action Plan	Develop a watershed action plan for the Green Creek watershed. Conduct water quality sampling to help identify and prioritize restoration needs.	$40,000
2005B-014	Land Trust for the Little Tennessee - Acq/ Carter Branch Tract	Protect through fee simple 17 ac of the Carter Branch tract along the Little Tennessee River and tribs. CWMTF funds to purchase the riparian 11 ac. Tract is part of an extensive and growing effort to protect this Nationally Significant Aquatic Habitat.	$208,000
2005B-015	Land Trust for the Little Tennessee - Acq/ Cowee Mound Tract, Little Tennessee River	Protect through fee simple purchase 68 acres of the Cowee Mound Tract along the Little Tennessee River. CWMTF funds to purchase the riparian 22 acres along this Nationally Significant Aquatic Habitat.	$471,000
2005B-017	Land Trust for the Little Tennessee - Acq/ Needmore Expansion, Phase II	Protect through fee simple purchase 97.6 acres along Queens Creek and the Little Tennessee River. Tract expansions the Needmore acquisition and protects this Nationally Significant Aquatic Habitat.	$727,000
2005B-515	Tuckasegee Water and Sewer Authority - WW/ Collection System Rehabilitation, Cope Creek	Rehabilitate or replace 37,000 linear feet of collection and sewer service lines and install 163 manholes to address chronic raw sewage discharges to Cope and Scotts Creeks and the Tuckasegee River. Serves 162 residences.	$2,000,000
2005M-005	Land Trust for the Little Tennessee - Minigrant, Sylva, Fisher Creek Tract	Minigrant to pay for pre-acquisition costs associated with the purchase of a permanent conservation easement on 1200 acres in the Plott Balsam Mountains along Fisher Creek.	$13,000
		Total Funded	**$25,893,967**

NOTES:
(1) The entire Little Tennessee River basin is within CWMTF's Mountain Region
(2) Three regional and statewide projects were funded in areas that include the Little Tennessee basin. These projects include a riparian corridor planning project, a watershed assessment and restoration planning study, and a regional straight pipe and septic system discharge elimination program.

13.3.3 Clean Water Bonds – NC Rural Center

Outdated wastewater collection systems, some more than 70 years old, allow millions of gallons of untreated or partially treated wastewater to spill into the state's rivers and streams. The NC Rural Economic Development Center, Inc. (Rural Center) has taken the lead role in designing public policy initiatives to assist rural communities in developing and expanding local water and sewer infrastructure. The Rural Center is a private, nonprofit organization. The Rural Center's mission is to develop sound, economic strategies that improve the quality of life in North Carolina, while focusing on people with low to moderate incomes and communities with limited resources.

To support local economic growth and ensure a reliable supply of clean water, the Rural Center administers three Water and Sewer Grant Programs to help rural communities develop water and sewer systems. The *Supplemental Grants Program* allows local governments and qualified nonprofit corporations to improve local water and sewer systems by addressing critical needs for public health, environmental protection and/or economic development. The maximum grant amount is $400,000 and must be used to match other project funds. The *Capacity Building Grants Program* provides funding for local governments to undertake planning efforts to support strategic investment in water and sewer facilities. Projects typically include preliminary engineering reports, master water/sewer plans, capital improvement plans, feasibility studies, and rate studies. The maximum grant amount is $400,000. The *Unsewered Communities Grants Program* funds the planning and construction of new central, publicly owned sewer systems. This grant is designed to cover 90 percent of the total cost of a project, not to exceed $3 million. Qualifying communities for this program must not be served by an existing wastewater collection or treatment system. For each grant program, priority is given to projects from economically distressed counties of the state as determined by the NC Department of Commerce (www.nccommerce.com).

The water and sewer grants listed above are made possible through appropriations from the NC General Assembly and through proceeds from the Clean Water Bonds. In 1998, North Carolina voters approved an $800 million clean water bond referendum that provided $330 million to state grants to help local governments repair and improve water supply systems and wastewater collection and treatment. The grants also address water conservation and water reuse projects. Another $300 million was made available as clean water loans.

Since the program's beginning, the Rural Center has awarded nearly 500 communities and counties more than $64 million to plan, install, expand, and improve their water and sewer systems. As a result, these communities have served new residential and business customers, created and preserved thousands of jobs, and leveraged millions of dollars in other water and sewer funds. Table 28 lists the grants that were awarded in the Little Tennessee River Basin between 1999 and 2005. For more information on the Water and Sewer Grants administered by the Rural Center visit www.ncruralcenter.org/grants/water.htm.

Table 28 Clean Water Bonds Awarded in the Little Tennessee River Basin

County	Recipient	Grant Amount	Grant Type	Year Awarded
Jackson	Tuckasegee W/S Authority	$400,000	Supplemental	August 2004
Macon	Town of Franklin	$40,000	Capacity	August 2004
Macon	Macon County	$40,00	Capacity	February 2004
Graham	Town of Robbinsville	$398,315	Supplemental	August 2003
Swain	Swain County	$400,000	Supplemental	August 2003
Macon	Town of Highlands	$400,000	Supplemental	June 2003
Macon	City of Franklin	$400,000	Supplemental	December 2002
Swain	Governor's Island Water District	$1,249,126	Unsewered	August 2002
Graham	Graham County	$400,000	Supplemental	March 2002
Graham	Town of Robbinsville	$34,150	Capacity	March 2002
Graham	Town of Lake Santeetlah	$26,970	Capacity	March 2002
Swain	Swain County	$24,720	Capacity	August 2001
Swain	Whittier Sanitary District	$3,000,000	Unsewered	February 2001
Jackson	Tuckasegee Water & Sewer Authority	$300,000	Supplemental	February 2001
Macon	Franklin	$200,000	Supplemental	August 2000
Swain	Bryson City	$200,000	Supplemental	August 2000
Cherokee, Clay, Graham, Swain	Bryson City	$31,000	Capacity	August 2000
Macon	Macon County	$40,000	Capacity	August 2000
Graham	Town of Robbinsville	$189,236	Supplemental	December 1999
Swain	Town of Bryson City	$199,031	Supplemental	December 1999
Macon	Town of Franklin	$20,000	Capacity	December 1999

13.3.4 U.S. Fish and Wildlife Service – Private Stewardship Grants Program

The Private Stewardship Program provides grants and other assistance on a competitive basis to individuals and groups engaged in local, private, and voluntary conservation efforts that benefit federally listed, proposed, or candidate species, or other at-risk species. Diverse panels of representatives from State and Federal Government, conservation organizations, agriculture and development interests, and the science community assess applications and make recommendations to the Secretary of the Interior, who awards the grants. The Private Stewardship Program was initiated during Fiscal Year 2002, with grants first awarded during Fiscal Year 2003.

For 2006, the Service awarded more than 6.9 million in Federal funding under the Private Stewardship Program. A ten percent (10%) match of cash or through in-kind contributions is required. The program is available to private landowners and their partners. DWQ encourages interested landowners to pursue these grants to protect threatened and endangered species in the Little Tennessee River Basin.
http://www.fws.gov/endangered/grants/private_stewardship/index.html

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Appendix I

Population and Growth Trends in the Little Tennessee River Basin

Population and Growth Trends

Below are three different ways of presenting population data for the Little Tennessee River basin. The data presented by basin allow for 2000 population data to be presented by subbasin. Population data presented by county allow for analysis of projected growth trends in the basin based on information from the Office of State Planning (April-May, 2001). Data presented by municipality summarizes information on past growth of large urban areas in the basin. While the three different sets of information cannot be directly compared, general conclusions are apparent by looking at the information. Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

Basin Population and Population Density

Information on population density at a watershed scale is useful in determining what streams are likely to have the most impacts as a result of population growth. This information is also useful in identifying stream segments that have good opportunities for preservation or restoration. This information is presented to estimate population and population density by each subbasin and for the entire basin. It is assumed that county populations are distributed evenly throughout each county; therefore, subbasins that are within counties with large urban areas may overestimate the actual population in that portion of the basin. The overall population of the basin based on 2000 Census data is 49,653, with approximately 66 persons/square mile. (See the map of hydrologic units and population density.) The overall population and persons/square mile is estimated based on the percent of the county land area that is partially or entirely within the basin.

County Population and Growth Trends

The following table and map show the projected population for 2020 and the change in growth between 1990 and 2020 for counties that are partially or entirely contained within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Little Tennessee River basin. This information is intended to present an estimate of expected population growth in counties that have some land area in the Little Tennessee River basin. For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://demog.state.nc.us.

County	Percent of County in Basin ♦	County Population 1990	County Population 2000	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Cherokee	2	20,170	24,298	20.5%	30,660	26.2%
Clay	10	7,155	8,775	22.6%	11,916	35.8%
Graham	100	7,196	7,993	11.1%	8,723	9.1%
Jackson	88	26,835	33,121	23.4%	43,630	31.7%
Macon	94	23,504	29,811	26.8%	40,288	35.1%
Swain	100	11,268	12,968	15.1%	15,728	21.3%
Subtotals		96,128	116,966	119.5%	150,945	159.2%

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.

Note: The numbers reported reflect county population; however, these counties are not entirely within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

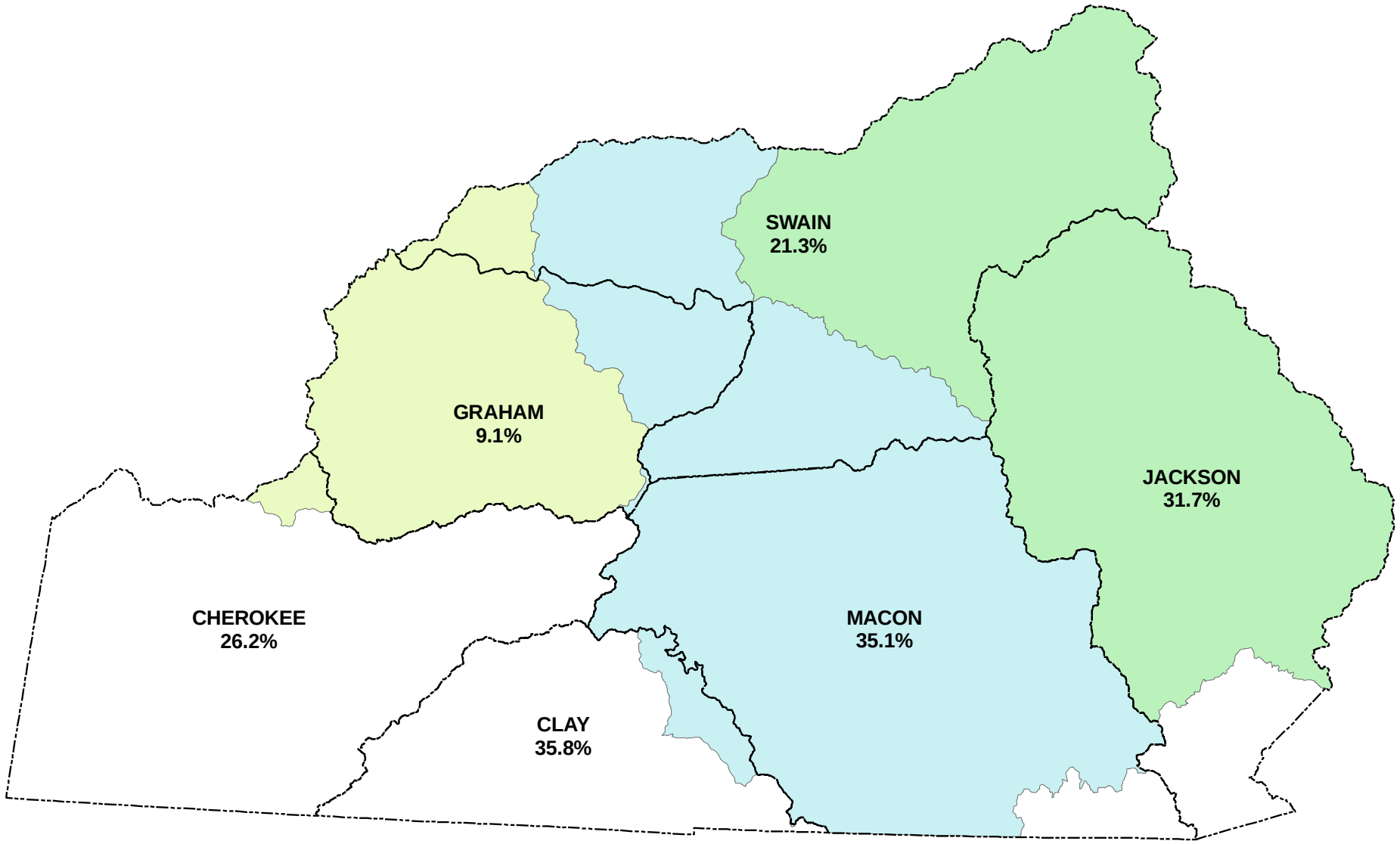
Municipal Population and Growth Trends

The table below presents population data from Office of State Planning for municipalities located partially or entirely in the basin. These data represent six municipalities in the basin.

Municipality	County	Apr-80	Apr-90	Apr-2000	% Change (1980-1990)	% Change (1990-2000)
Bryson City	Swain	1,556	1,145	1,411	-26.4	23.2
Dillsboro	Jackson	179	121	205	-32.4	69.4
Forest Hills	Jackson	…	…	330	…	…
Franklin	Macon	2,640	2,873	3,490	8.8	21.5
Highlands *	Jackson, Macon	653	948	909	45.2	-4.1
Robbinsville	Graham	814	709	747	-12.9	5.4
Santeetlah	Graham	80	47	67	-41.3	42.6
Sylva	Jackson	1,699	1,809	2,435	6.5	34.6
Webster	Jackson	200	410	486	105.0	18.5

- - The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

Projected Population by County (2000-2020) and 8-Digit HU for Little Tennessee River Basin



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November 20, 2006

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Appendix II

Local Governments and Planning Jurisdictions in the Little Tennessee River Basin

Local Governments and Planning Jurisdictions in the Basin

The Little Tennessee River basin encompasses all or portions of six counties and nine municipalities. The following table provides a listing of these local governments, along with the regional planning jurisdiction (Council of Governments). The majority of Cherokee County and Clay County are located in the Hiwassee River Basin. One municipality is located in more than one major river basin.

County	Region	Municipalities
Cherokee	A	None
Clay	A	None
Graham	A	Robbinsville, Santeetlah
Jackson	A	Dillsboro, Forest Hills, Highland♦, Sylva, Webster
Macon	A	Franklin, Highland♦
Swain	A	Bryson

♦ Located in more than one major river basin.

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2 percent) is located in that basin, unless a municipality is located in that county.

Region	Name	Location
A	Southwestern Commission Council of Government	Bryson City

The Little Tennessee River basin also encompasses the Qualla Boundary, home of the Eastern Band of Cherokee Indians (EBCI). The EBCI are a self-governing tribe and are treated like a separate state by the United States government. The Cherokee reservation lies at the foot of the Great Smokey Mountains National Park and contains six communities: Big Cove, Birdtown, Painttown, Snowbird, Wolftown and Yellowhill.

Appendix III

Land Cover
in the
Little Tennessee River Basin

Land Cover

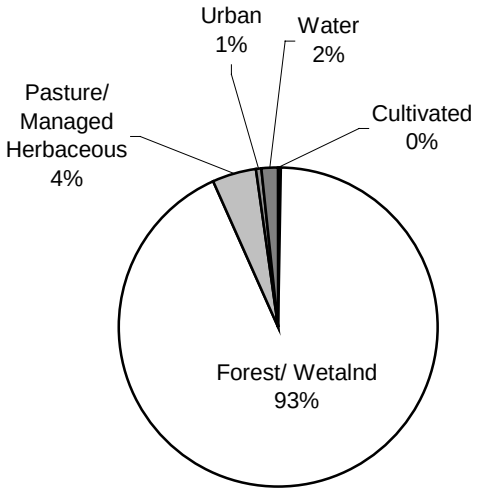
Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not available. The information below describes two different ways of presenting land cover in the Little Tennessee River basin.

The state's Center for Geographic Information and Analysis (CGIA) land cover information is useful in providing a snapshot of land cover in the basin from 1993 to 1995. This information is also available in a GIS format so it can be manipulated to present amounts of the different land covers by subbasin or at the watershed scale. The Natural Resources Inventory (NRI) land cover information is presented only at a larger scale (8-digit hydrologic unit), but the collection methods allow for between year comparisons. The two datasets cannot be compared to evaluate land cover data. This information is presented to provide a picture of the different land covers and some idea of change in land cover over time. In the future, it is hoped that land cover information like the GIS formatted dataset will be developed to make more meaningful assessments of the effects of land use changes on water quality. This dataset would also be useful in providing reliable and small-scale information on land cover changes that can be used in water quality monitoring, modeling and restoration efforts.

CGIA Land Cover

The North Carolina Corporate Geographic Database contains land cover information for the Little Tennessee River basin based on satellite imagery from 1993-1995. CGIA developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in the following table. The chart provides an illustration of the relative amount of land area that falls into each major cover type for the Little Tennessee River basin.

Land Cover Type	Land Cover Description
Urban	Greater than 50 percent coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated Cropland	Areas that are covered by crops that are cultivated in a distinguishable pattern.
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and forested areas (i.e., needleleaf evergreens, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock and areas of sand or silt adjacent to tidal waters and lakes.



Little Tennessee River Basin Land Cover (1993-1995)

NRI Land Cover Trends

Land cover information in this section is from the most current National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, updated June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.

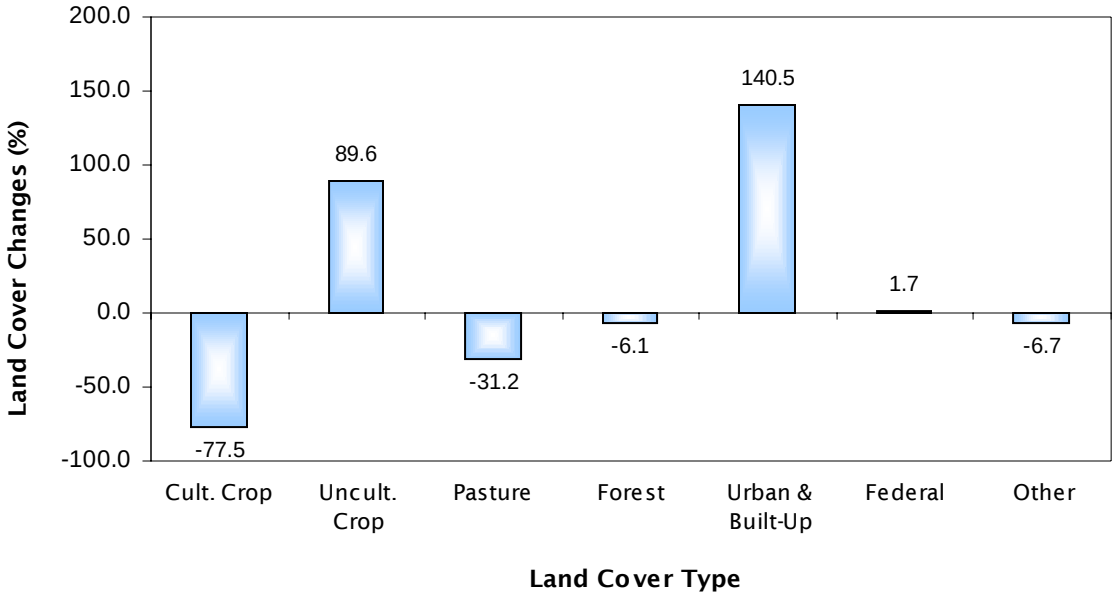
The following table summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the land cover to 1982 land cover. Definitions of the different land cover types are also presented.

LAND COVER	MAJOR WATERSHED AREAS										
	Upper Little Tennessee		Tuckasegee River		Lower Little Tennessee		1997 TOTALS		1982 TOTALS		% Change Since 1982
	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cult. Crop	0.0	0.0	2.5	0.6	0.6	0.3	3.1	0.3	13.8	1.2	-77.5
Uncult. Crop	4.8	0.9	9.1	2.0	0.7	0.4	14.6	1.3	7.7	0.7	89.6
Pasture	12.7	2.4	6.8	1.5	5.9	3.4	25.4	2.2	36.9	3.2	-31.2
Forest	141.0	27.0	177.7	39.2	39.6	22.8	358.3	31.2	381.6	33.2	-6.1
Urban & Built-Up	25.2	4.8	23.5	5.2	3.0	1.7	51.7	4.5	21.5	1.9	140.5
Federal	319.9	61.2	221.2	48.8	119.3	68.7	660.4	57.4	649.4	56.5	1.7
Other	18.8	3.6	12.9	2.8	4.6	2.6	36.3	3.2	38.9	3.4	-6.7
Totals	522.4	100.0	453.7	100.0	173.7	100.0	1149.8		1149.8		
% of Total Basin		45.4		39.5		15.1		100.0		100.0	
SUBBASINS	04-04-01 04-04-03		04-04-02		04-04-04						
8-Digit Hydraulic Units	06010202		06010203		06010204		05050001				

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size, which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas, private roads to farmsteads, logging roads and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres; streams less than 0.5 mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 mile in width. *Minor Land*: Lands that do not fall into one of the other categories.

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

Data from 1982 are also provided for a comparison of change over 15 years. During this period, urban and built-up land cover increased by over 30,000 acres (140.5 percent). Uncultivated cropland increased by nearly 90,000 acres (89.6 percent). Pastureland decreased by over 11,000 acres (31.2 percent). Forest cover decreased by over 23,000 acres (6.1 percent), and cultivated cropland cover decreased by almost 11,000 acres (77.5 percent). Most land cover change is accounted for in the areas surrounding the local municipalities in the Little Tennessee River basin. Below is a graph that presents changes in land cover between 1982 and 1997.



Source: USDA-NRCS, NRI, updated June 2001

Appendix IV

DWQ Water Quality Monitoring Programs in the Little Tennessee River Basin

DWQ Water Quality Monitoring Programs in the Little Tennessee River Basin

Staff in the Environmental Sciences Section (ESS) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in Little Tennessee River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Little Tennessee River basin, available from the Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

DWQ monitoring programs for the Little Tennessee River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Aquatic Toxicity Monitoring
- Lake Assessment
- Ambient Monitoring System

Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories: Excellent, Good, Good-Fair, Fair and Poor.

Overview of Benthic Macroinvertebrate Data

Based on benthic macroinvertebrate data, water quality in the Little Tennessee River basin is Excellent to Good. Since 1999, 80 benthic macroinvertebrate basinwide samples have been collected with 48 (60%) receiving Excellent bioclassifications, 24 (30%) resulting in Good bioclassifications, five (6%) receiving Good-Fair bioclassifications, and three (4%) receiving Fair bioclassifications. Comparisons of benthos data from 1999 to 2004 between repeat sites show that three sites (Cowee Creek, Whiteoak Creek, and the Tuckasegee River) improved from Good to Excellent, one site (Little Tennessee River off SR 1629) improved from Fair to Good-Fair, one site improved from Good-Fair to Good (Little Tennessee River at SR 1651), and Middle Creek improved from Good-Fair to Excellent. However, nine sites (Cullasaja River at US64/SR 1688 and at SR 1678, Cartoogechaye Creek, Conley Creek, Noland Creek, Panther Creek, Stecoah Creek, Tulula Creek, and Cheoah Creek) declined from Excellent to Good. Overall water quality in the Little Tennessee River is generally unchanged since 1999.

Several rare invertebrate taxa were collected in the Little Tennessee River basin in 2004 including the mayflies Serratella spiculosa (Turtle Pond Creek), Rhithrogena fuscifrons (Turtle Pond Creek, Bradley Fork, Hazel Creek), Rhithrogena exilis (Cullowhee Creek, Nantahala River, Whiteoak Creek, Deep Creek) Nixie, (Bradley Fork), the caddisflies Molanna tryphena, Agarodes (Iotla Creek), Mayatrichia ayama, Oecetis avara (Snowbird Creek), Rhyacophila amicis, Neotrichia (Hazel Creek), Micrasema rickeri (Cheoah River), and the stoneflies Agnetina flavescens (Oconaluftee River, Forney Creek, Hazel Creek, Deep Creek), and Beloneuria (Whiteoak Creek). Of particular interest, Caney Fork at SR 1740 set the second highest EPT diversity (54) and total species diversity (107) ever recorded in the Little Tennessee River basin. For detailed information regarding the samples collected during this assessment period, refer to the tables at the end of this appendix.

Assessing Benthic Macroinvertebrate Communities in Small Streams

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

Presently, a designation of Not Impaired may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width) but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of Supporting. However, DWQ will use the monitoring information from small streams to identify potential impacts to small streams even in cases when a use support rating cannot be assigned.

DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

Fish Assessments

Twenty two sites were sampled from mid-May to early June 2004; 19 of the sites had not been previously sampled. Fish communities in the basin were last sampled in 1995. The most commonly collected species in 2004 was the mottled sculpin (collected at all sites); the central stoneroller and the northern hog sucker were collected at 21 of the 22 sites. The mottled sculpin was also the most abundant species, representing about one-third of all the fish collected.

Seventeen of the 22 streams were evaluated using the North Carolina Index of Biotic Integrity (NCIBI). NCIBI ratings ranged from Fair to Excellent with the scores ranging from 38 to 58. The streams rated Fair and Excellent were the Little Tennessee River and Burningtown Creek, respectively. The remaining five streams were not evaluated using the NCIBI, were considered trout streams, and were not assigned a rating. However, Stecoah Creek did show signs of being degraded.

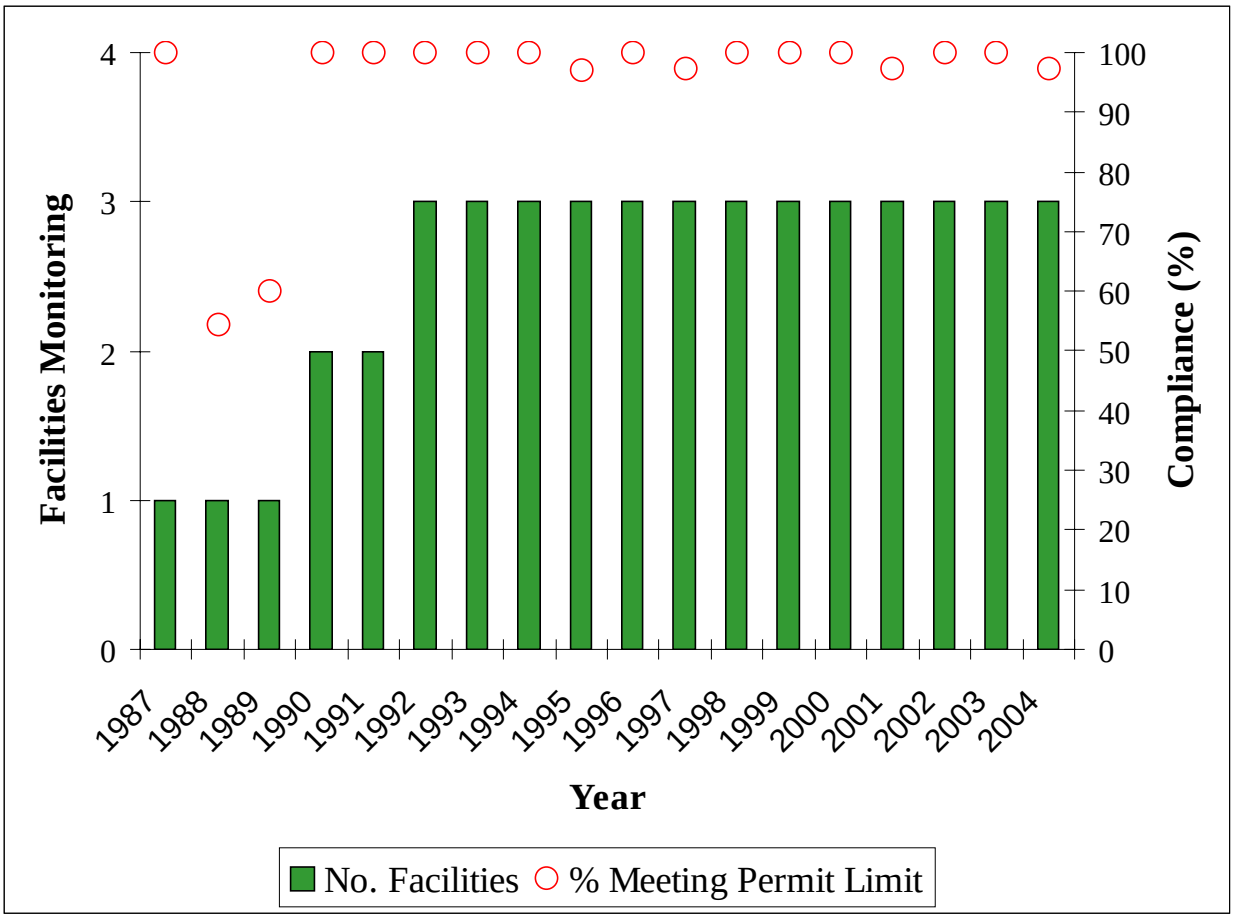
For detailed information regarding the samples collected during this assessment period, refer to the tables at the end of this Appendix.

Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Three facility permits in the Little Tennessee River basin currently require whole effluent toxicity (WET) monitoring. All three facility permits have a WET limit.
Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1996, the compliance rate has stabilized at approximately 90 percent. The following graph summaries WET monitoring compliance in the Little Tennessee River basin from 1987 to 2002. Facilities with toxicity problems during the most recent two-year review period are discussed in subbasin chapters.



Lakes Assessment Program

Ten lakes were sampled in the Little Tennessee River Basin by DWQ in 2004. All of these lakes were sampled three times during the summer (June, July and August). Lake Sequoyah and Wolf Creek Reservoir were also sampled in September as part of an extended sampling period special study. Data collected during this sampling effort determined sedimentation concerns related to construction are a factor at several of the lakes. Local efforts need to be directed towards preventing sedimentation into the tributaries of these lakes. Lakes with noted water quality impacts are discussed in the appropriate subbasin chapter.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide, including 7 stations in the Little Tennessee River basin, although 2 of those stations were discontinued in 2000. Between 23 and 32 parameters are collected monthly at each station. The locations of these stations are listed in the following table and shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2005 Little Tennessee Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Locations of Ambient Monitoring Stations in the Roanoke River Basin by Subbasin

Subbasin/ Station ID	Location	Class	Lat.	Long.	County	Map ID
01	**Little Tennessee River, Cullasaja River, and Cartoogechaye Creek**					
G0035000	Little Tennessee River at SR 1651 near Prentiss	C	35.1221	-83.3743	Macon	A1
G0130000[1]	Cartoogechaye Creek at SR 1152 near Franklin	B Tr	35.1580	-83.3920	Macon	A2
G2000000	Little Tennessee River at NC 28 at Iotla	B	35.2349	-83.3958	Macon	A3
02	**Oconaluftee River, Tuckasegee River, Hazel Creek, and Deep Creek**					
G8550000[2]	Oconaluftee River at SR 1359 at Birdtown	C Tr	35.4610	-83.3540	Jackson	A4
G8600000	Tuckasegee River at SR 1364 at Bryson City	B	35.4284	-83.4460	Swain	A5
03	**Nantahala River**					
G3500000	Nantahala River at US 64 near Rainbow Springs	B Tr ORW	35.0942	-83.5599	Macon	A6
04	**Cheoah River**					
G9550000	Cheoah River at SR 1138 at Robbinsville	C Tr	35.3291	-83.8098	Graham	A7

[1]Station G0130000 ceased sample collection on 5/25/2000.
[2]Station G8550000 ceased sample collection on 5/23/2000.

Benthic Macroinvertebrate Data Collected in the Little Tennessee River Basin, 1999 – 2004 (Current basinwide sampling sites are in **bold** print.)

Sub/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
040401									
L Tennessee R	SR 1629	Macon	2-(1)	7/21/2004	70	22	5.59	3.81	Good-Fair
				9/11/2000	67	15	6.29	3.99	Fair
				8/12/1999	60	14	6.23	4.75	Fair
L Tennessee R	SR 1651	Macon	2-(1)	7/22/2004	93	37	5.46	3.95	Good
				10/20/1999	62	29	4.42	3.49	Good-Fair
L Tennessee R	NC 28	Macon	2-(1)	7/22/2004	70	32	5.3	4.28	Good-Fair
				8/24/1999	86	32	5.3	3.75	Good-Fair
Middle Cr	SR 1635	Macon	2-(8)	7/22/2004	---	43	---	2.93	Excellent
				8/24/1999	---	25	---	4.15	Good-Fair
Tessentee Cr	SR 1684	Macon	2- 9	7/22/2004	---	47	---	3.02	Excellent
Coweeta Cr	SR 1114	Macon	2-10	7/22/2004	---	45	---	2.62	Excellent
				8/21/1999	---	39	---	3.01	Excellent
Cartoogechaye Cr	SR 1146	Macon	2-19-(1)	7/21/2004	---	31	---	3.70	Good
				8/24/1999	---	41	---	3.05	Excellent
Jones Cr	SR 1303	Macon	2-19-2	7/21/2004	---	38	---	3.07	Excellent
Cullasaja R	US 64	Macon	2-21-(0.5)	7/21/2004	58	14	5.74	4.67	Fair
				7/25/2001	41	10	6.55	5.93	Fair
				8/28/2000	65	18	6.34	5.13	Fair
				6/23/1999	47	14	5.70	4.97	Fair
Cullasaja River	River Court	Macon	2-21 (0.5)	7/26/2001	56	16	5.77	4.64	Not Rated
				5/16/2000	61	25	4.85	3.71	Not Impaired
Cullasaja River	US 64, ab Dry Falls	Macon	2-21 (0.5)	8/11/2000	20	20	4.17	4.17	Good-Fair
UT Cullasaja River	US 64	Macon		7/25/2001	46	23	3.32	2.39	Not Impaired
Salt Rock Branch	Highlands Falls	Macon	2- 21 1	7/26/2001	43	5	6.54	5.52	Not Rated
Ammons Branch	Spruce Lane	Macon	2-21 2	7/25/2001	47	20	2.94	1.15	Not Impaired
Mill Creek	5th Street	Macon	2-21 3	8/29/2000	41	11	6.14	5.36	Not Rated
				5/17/2000	37	13	5.54	4.51	Not Rated
Mill Creek	Brookside Lane	Macon	2-21 3	8/28/2000	47	17	5.48	4.51	Not Rated
Big Creek	SR1538	Macon	2-21 5 1 (0.5)	7/25/2001	49	29	2.86	2.22	Good
				8/29/2000	103	41	3.52	2.44	Excellent
Big Creek	SR 1548, Ab WTP	Macon	2-21 5 1(0.5)	9/11/2000	30	30	2.92	2.92	Good
Houston Branch	Simon Speed Rd	Macon	2-21 5 1 3 (2)	8/29/2000	47	25	2.65	1.95	Not Impaired
Cullasaja R	Off US 64, Jackson H	Macon	2-21 (5.5)	8/5/2004	77	36	4.21	3.44	Good
				6/22/1999		49	2.70	2.86	Excellent
Cullasaja R	US 64/SR 1668	Macon	2-21 (5.5)	8/5/2004	86	42	4.68	3.84	Good
				8/10/1999	99	51	3.94	3.32	Excellent
N Skitty Creek	N Cliffside Rec Area	Macon	2-21 6 1	8/29/2000	45	28	2.35	1.62	Not Impaired
Turtle Pond Cr	SR 1620	Macon	2-21 8	7/23/2004	---	49	---	2.10	Excellent

				6/22/1999	---	42	---	1.90	Excellent
Walnut Cr	SR 1533	Macon	2-21 17	8/6/2004	68	38	2.94	2.16	Excellent
				6/21/1999	34	34	2.04	2.04	Good
Iotla Cr	SR 1372	Macon	2-27	7/22/2004	73	32	4.8	3.94	Good
				8/10/1999	---	35	---	3.84	Good
Iotla Cr	SR 1485	Macon	2-27	7/22/2004	48	35	3.9	3.53	Good
Cowee Cr	NC 28	Macon	2-29	7/22/2004	---	38	---	3.24	Excellent
				8/10/1999	---	35	---	3.06	Good
Burningtown Cr	SR 1371	Macon	2-38	8/3/2004	---	43	---	3.12	Excellent
				8/10/1999	---	39	---	3.20	Excellent
Burningtown Cr	SR 1392	Macon	2 38	8/3/2004	68	34	3.18	2.51	Good
Tellico Cr	SR 1367	Macon	2 40	8/3/2004	93	44	3.62	2.68	Excellent
				8/9/1999	108	54	3.57	2.62	Excellent
040402									
L Tennessee R	off SR 1113	Swain	2-(1)	8/5/2004	95	42	4.33	3.35	Good
				8/9/1999	75	31	4.74	3.67	Good
Alarka Cr	SR 1185	Swain	2-69-(2.5)	8/2/2004	101	46	3.80	2.67	Excellent
				8/9/1999	86	51	3.66	3.11	Excellent
Tuckasegee R	SR 1140	Jackson	2-79-(0.5)	8/2/2004	36	36	1.83	1.83	Excellent
				7/19/1999	46	46	1.96	1.96	Excellent

Sub/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
Caney Fk	SR 1740	Jackson	2-79-28-(2.5)	8/2/2004	107	54	3.63	2.68	Excellent
				7/20/1999	97	53	3.68	3.03	Excellent
Moses Cr	SR 1739	Jackson	2-79-28-8	8/2/2004	46	46	1.71	1.71	Excellent
				7/20/1999	37	37	1.91	1.91	Excellent
Cullowhee Cr	SR 1001	Jackson	2-79-31	8/4/2004	---	47	---	2.61	Excellent
				7/20/1999	43	43	2.96	2.96	Excellent
Savannah Cr	SR 1367	Jackson	2-79-36	8/4/2004	91	40	4.15	3.11	Good
				7/21/1999	53	32	3.80	3.48	Good
Tuckasegee R	off SR 1378	Jackson	2-79-(38)	8/4/2004	84	44	4.27	3.44	Excellent
				7/21/1999	75	40	4.39	3.82	Good
Scott Cr	SR 1556	Jackson	2-79-39	8/4/2004	74	35	4.07	3.23	Good
				7/21/1999	70	36	4.14	3.22	Good
Conley Cr	off SR 1177	Swain	2-79-39	8/3/2004	34	34	2.82	2.82	Good
				7/21/1999	---	44	---	3.17	Excellent
Bradley Fk	off US 441	Swain	2-79-55-12-(11)	8/3/2004	79	47	2.59	2.02	Excellent
				7/22/1999	67	39	2.67	1.87	Excellent
Oconaluftee R	SR 1359	Swain	2-79-55-(16.5)	8/5/2004	106	51	3.96	2.97	Excellent
				7/22/1999	104	53	3.93	3.20	Excellent
Deep Cr	AB Campground	Swain	2-79-63-(16)	8/2/2004	---	43	---	2.13	Excellent
				8/9/1999	---	47	---	2.67	Excellent
Deep Cr	SR 1340	Swain	2-79-63-(21)	8/2/2004	---	38	---	2.18	Excellent
				8/9/1999	---	45	---	2.95	Excellent
Noland Cr	near mouth	Swain	2 90	8/3/2004	---	35	---	1.92	Good
				8/11/1999	---	40	---	1.98	Excellent
Forney Cr	near mouth	Swain	2 97	8/3/2004	78	44	2.58	1.80	Excellent
				8/11/1999	81	46	2.66	1.68	Excellent
Panther Cr	SR 1233	Graham	2 115	8/4/2004	---	35	---	2.07	Good
				8/10/1999	---	39	---	2.24	Excellent
Stecoah Cr	SR 1237	Graham	2 130	8/4/2004	---	30	---	2.94	Good
				8/11/1999	---	39	---	3.02	Excellent
Hazel Cr	near mouth	Swain	2-146-(19)	8/3/2004	96	46	3.26	2.17	Excellent
				8/11/1999	106	56	2.95	1.97	Excellent
Twenty Mile Cr	NC 28	Swain	2-178-(4)	8/4/2004	---	29	---	2.15	Good
040403									
Nantahala R	FSR 437	Macon	2-57-(0.5)	7/21/2004	92	49	3.2	1.93	Excellent
				8/24/1999	100	49	3.4	2.45	Excellent
Nantahala R	US 19/74	Swain	2-57-(22.5)	7/20/2004	83	35	4.2	2.26	Good
				8/23/1999	---	35	---	2.29	Good
Dicks Cr	off SR 1401	Macon	2-57-42	7/21/2004	---	27	---	1.59	Good-Fair
				8/13/1999	---	34	---	1.93	Good
Whiteoak Cr	SR 1397	Macon	2-57-45	7/21/2004	63	26	4.3	2.33	Good-Fair
Whiteoak Cr	off SR 1310	Macon		7/20/2004	78	34	3.5	1.68	Excellent
				8/13/1999	---	31	---	2.14	Good
040404									

Tulula Cr	SR 1275	Graham	2-190-2-(0.5)	7/19/2004	61	31	4.0	3.24	Good
Cheoah R	off SR 1138	Graham	2-190-(3.5)	7/19/2004	84	38	4.0	3.14	Good
				8/12/1999	89	48	3.5	2.84	Excellent
Snowbird Cr	SR 1120	Graham	2-190-9-(15.5)	7/20/2004	---	48	---	2.06	Excellent
				8/12/1999	---	52	---	2.56	Excellent
L Santeetlah Cr	Ab Footbridge	Graham	2-190-19-7	7/20/2004	59	32	2.9	1.65	Good
Cheoah R	SR 1147	Graham	2-190-(22)	7/4/2005	54	19	5.7	3.92	Fair
Cheoah R	At gauge	Graham	2-190-(22)	08/04/2004	---	42	---	3.00	Excellent

Fish Community Structure Data Collected in the Little Tennessee Basin, 1993 – 2003
(Current basinwide sampling sites are in **bold** print.)

Subbasin/Waterbody	Location	County	Index No.	*Date*	NCIBI Score	NCIBI Rating
040401						
Little Tennessee R	off SR 1683	Macon	2-(1)	05/17/04	38	Fair
Middle Cr	SR 1635 - 2nd bridge	Macon	2-8	05/17/04	56	Good
Middle Cr	SR 1635 - 1st bridge	Macon	2-8	05/03/95	46	Good-Fair
Tessentee Cr	SR 1636	Macon	2-9	05/18/04	52	Good
				05/03/95	56	Good
Coweeta Cr	SR 1119	Macon	2-10	05/20/04	56	Good
Coweeta Cr	US 23/441	Macon	2-10	05/01/95	44	Good-Fair
Cartoogechaye Cr	SR 1146	Macon	2-19-(1)	05/18/04	56	Good
Cartoogechaye Cr	SR 1168	Macon	2-19-(10.5)	05/02/95	56	Good
Cullasaja R	SR 1677	Macon	2-21-(5.5)	10/19/99	50	Good
				10/15/96	52	Good
Cullasaja R	SR 1653	Macon	2-21-(5.5)	10/20/99	46	Good-Fair
				10/16/96	34	Fair
Walnut Cr	SR 1533	Macon	2-21-17	05/18/04	---	Not Rated
Ellijay Cr	SR 1524	Macon	2-21-23	05/20/04	56	Good
Rabbit Cr	SR 1504	Macon	2-23	05/20/04	44	Good-Fair
Iotla Cr	SR 1372	Macon	2-27	05/03/95	22	Poor
Iotla Cr	off SR 1378	Macon	2-27	05/19/04	44	Good-Fair
Cowee Cr	SR 1340	Macon	2-29	05/19/04	56	Good
Burningtown Cr	SR 1364	Macon	2-38	05/21/04	58	Excellent
Tellico Cr	SR 1367	Macon	2-40	05/21/04	50	Good
040402						
Brush Cr	off SR 1129	Swain	2-46	05/19/04	50	Good
Alarka Cr	SR 1185	Swain	2-69-(2.5)	06/03/04	46	Good-Fair
Caney Fk	SR 1738	Jackson	2-79-28-(2.5)	06/01/04	56	Good
Cullowhee Cr	SR 1545	Jackson	2-79-31	06/02/04	46	Good-Fair
Savannah Cr	NC 116	Jackson	2-79-36	06/02/04	50	Good
Scott Cr	SR 1527	Jackson	2-79-39	06/01/04	---	Not Rated
Conley Cr	SR 1183	Swain	2-79-52	06/02/04	---	Not Rated
Panther Cr	SR 1233	Graham	2-115	06/03/04	---	Not Rated
Stecoah Cr	SR 1237	Graham	2-130	06/03/04	---	Not Rated
040403						
Nantahala R	SR 1401	Macon	2-57-(22.5)	11/15/93	---	Not Rated
Whiteoak Cr	SR 1310/1404	Macon	2-57-45	11/15/93	---	Not Rated
Silvermine Cr	SR 1103	Swain	2-57-55	11/16/93	---	Not Rated
040404						
Tulula Cr	SR 1260	Graham	2-190-2-(0.5)	06/04/04	46	Good-Fair

Appendix V

NPDES Discharges
and
Stormwater Permits

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0021407	Town of Highlands	Highlands WWTP	Macon	Asheville	Municipal, < 1MGD	Minor	1500000	40401	Cullasaja River
NC0021547	Town of Franklin	Franklin WWTP	Macon	Asheville	Municipal, Large	Major	1650000	40401	LITTLE TENNESSEE RIVER (Including backwaters of Fontana Lake at normal pool elevation 1708 feet MSL)
NC0032778	Town of Highlands	4th Street WTP	Macon	Asheville	Water Treatment Plant	Minor	not limited	40401	Big Creek
NC0036692	Robert A Nass	Skyline Lodge & Village WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	10000	40401	Big Creek
NC0051381	Highlands Falls Community Association	Highlands Falls Country Club WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	135000	40401	Saltrock Branch
NC0059552	Highlands Falls Community Association	Highlands Falls WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	3000	40401	Cullasaja River (Ravenel Lake)
NC0060844	Laurel Hills Homeowners Association	Laurel Hills WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	9000	40401	Norton Branch (East side of Little Tennessee River)
NC0067300	Macon County Schools	Macon Middle School WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	10000	40401	Cullasaja River
NC0067326	Macon County Schools	Cullasaja School	Macon	Asheville	100% Domestic < 1MGD	Minor	2000	40401	Cullasaja River
NC0070394	Indian Bend Properties Inc	Willowbrook Park WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	24600	40401	Coweeta Creek
NC0075612	Wildcat Cliffs Country Club	Wildcat Cliffs Country Club WWTP	Macon	Asheville	100% Domestic < 1MGD	Minor	50000	40401	Cullasaja River (Ravenel Lake)
NC0074250	Warner Bradley	Gateway Chevron WWTP	Jackson	Asheville	100% Domestic < 1MGD	Minor	5000	40402	Camp Creek
NC0000264	Jackson Development Corporation Inc	Jackson County Industrial Park	Jackson	Asheville	100% Domestic < 1MGD	Minor	5000	40402	Tuckasegee River

NPDES Dischargers in the Little Tennessee River Basin (2007)

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0020214	Tuckaseigee Water & Sewer Authority	Sylva WWTP	Jackson	Asheville	Municipal, < 1MGD	Minor	500000	40402	Scott Creek
NC0023086	Peppertree Fontana Village	Peppertree Fontana Village	Graham	Asheville	Industrial Process & Commercial	Minor	300000	40402	LITTLE TENNESSEE RIVER (Cheoah Lake, Calderwood Lake)
NC0023281	Tapoco Lodge Inc	Tapoco Lodge & Village WWTP	Graham	Asheville	100% Domestic < 1MGD	Minor	20000	40402	LITTLE TENNESSEE RIVER (Cheoah Lake, Calderwood Lake)
NC0025101	USDI National Park Service	Smokemont WWTP	Swain	Asheville	100% Domestic < 1MGD	Minor	30000	40402	Oconaluftee River
NC0026557	Town of Bryson CIty	Bryson City WWTP	Swain	Asheville	Municipal, < 1MGD	Minor	600000	40402	Tuckasegee River
NC0027341	Tennessee Valley Authority	Fontana Hydro Plant	Graham	Asheville	Industrial Process & Commercial	Minor	not limited	40402	LITTLE TENNESSEE RIVER (Cheoah Lake, Calderwood Lake)
NC0032808	Bailey M Ensley & Cindy Ensley	Ensley Adult Care Center WWTP	Jackson	Asheville	100% Domestic < 1MGD	Minor	8500	40402	Blanton Branch
NC0037737	Mountain Ventures Limited Partnership	Nantahala Village	Swain	Asheville	Industrial Process & Commercial	Minor	7800	40402	Nantahala River [Nantahala Lake (Aquone Lake)]
NC0038687	Curtis P Cooper	Singing Waters Camping Resort	Jackson	Asheville	100% Domestic < 1MGD	Minor	7500	40402	Trout Creek
NC0039578	Tuckaseigee Water & Sewer Authority	Jackson County WWTP	Jackson	Asheville	Municipal, Large	Major	1500000	40402	Tuckasegee River
NC0057193	Nantahala Outdoor Center	Nantahala Outdoor Center	Swain	Asheville	100% Domestic < 1MGD	Minor	40000	40402	Nantahala River [Nantahala Lake (Aquone Lake)]
NC0059200	Trillium Links & Village LLC	Trillium Links & Village LLC	Jackson	Asheville	100% Domestic < 1MGD	Minor	40000	40402	Hurricane Creek (Hurricane Lake)
NC0061620	Hide Away Campground Inc	Hide Away Campground WWTP	Swain	Asheville	100% Domestic < 1MGD	Minor	10000	40402	Tuckasegee River

NPDES Dischargers in the Little Tennessee River Basin (2007)

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0066958	Jackson County Board of Education	Blue Ridge School	Jackson	Asheville	100% Domestic < 1MGD	Minor	10000	40402	Hurricane Creek (Hurricane Lake)
NC0074624	Western Carolina University	Western Carolina University WTP	Jackson	Asheville	Water Treatment Plant	Minor	500	40402	Tuckasegee River
NC0075736	Whiteside Estates Inc	Whiteside Estates Incorporated	Jackson	Asheville	100% Domestic < 1MGD	Minor	100000	40402	Grassy Camp Creek
NC0084441	Smoky Mountain Country Club Estates	Smoky Mountain Country Club	Swain	Asheville	100% Domestic < 1MGD	Minor	120000	40402	Conley Creek (Connelly Creek)
NC0087700	The Hampton Club Inc	Wade Hampton Horizons Estate	Jackson	Asheville	100% Domestic < 1MGD	Minor	82200	40402	Trout Creek
NC0067318	Macon County Schools	Nantahala School	Macon	Asheville	100% Domestic < 1MGD	Minor	2000	40403	Partridge Creek
NC0025879	Town of Robbinsville	Robbinsville WWTP	Graham	Asheville	Municipal, < 1MGD	Minor	630000	40404	Long Creek
NC0079090	Coldwater Farms, Inc.	Coldwater Trout Farm	Graham	Asheville	Industrial Process & Commercial	Minor	not limited	40404	Snowbird Creek
NC0083071	Town of Robbinsville	Robbinsville WTP	Graham	Asheville	Water Treatment Plant	Minor	10000	40404	Rock Creek

COC Number	Facility Name	Receiving Stream	Subbasin	County
NCG020146	Sheffield Mine	Cowee Creek	# 04-04-01	Macon
NCG050260	Cr Industries	Potts Creek	# 04-04-01	Macon
NCG050335	Caterpillar Precision Seals	Cartoogechaye Creek	# 04-04-01	Macon
NCG070136	Cemex-Franklin-Little Tennessee River	LITTLE TENNESSEE RIVER (Including backwaters of Lake Emory and the backwaters of Fontana Lake at normal pool elevation 1708 feet MSL)	# 04-04-01	Macon
NCG080179	United Parcel Service-Franklin	Cartoogechaye Creek	# 04-04-01	Macon
NCG080546	NC Nat Gd- Franklin	Cartoogechaye Creek	# 04-04-01	Macon
NCG080728	Franklin Bin	Crawford Branch	# 04-04-01	Macon
NCG160033	Apac Tennessee Inc- Franklin Asphalt	Cartoogechaye Creek	# 04-04-01	Macon
NCG210008	Franklin Kiln & Lumber Co Inc	Wallace Branch	# 04-04-01	Macon
NCG210171	Cook Brothers Lumber Co Incorporated	Cullasaja River	# 04-04-01	Macon
NCG020247	Dillsboro Quarry	Tuckasegee River (East Fork Lake, Bear Creek Lake, Cedar Cliff Lake)	# 04-04-02	Jackson
NCG050249	Consolidated Metco Inc-Swain	Cochran Branch	# 04-04-02	Swain
NCG080191	United Parcel Service-Sylva	Yellow Bird Branch	# 04-04-02	Jackson
NCG080520	NC Nat Gd- Sylva	Mill Creek	# 04-04-02	Jackson
NCG080731	Sylva Bin	Savannah Creek	# 04-04-02	Jackson
NCG100168	Dr Automotive	Scott Creek	# 04-04-02	Jackson
NCG140113	Southern Concrete Mat-Bryson C	Toot Hollow Branch	# 04-04-02	Swain
NCG140158	Southern Concrete Mat-Sylva	Scott Creek	# 04-04-02	Jackson
NCG160031	Apac Tennessee Inc- Dillsboro	Tuckasegee River	# 04-04-02	Jackson
NCG210055	Dehart Lumber Co	Wolf Creek	# 04-04-02	Graham
NCG210095	Powell Lumber & Kiln Co Incorporated	Tuckasegee River	# 04-04-02	Swain
NCG210112	Maness Manufacturing Company	Tuckasegee River	# 04-04-02	Swain
NCG210134	T&S Hardwoods Incorporated	Scott Creek	# 04-04-02	Jackson
NCG180053	Stanley Furniture Co-Robbinsville	Long Creek	# 04-04-04	Graham
NCG200437 (pending)	Graham County Recycling Facility	Atoah Creek	# 04-04-04	Graham

Appendix VI

303(d) Listing
and
Reporting Methodology

Integrated 305(b) and 303(d) Report Summary

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports of previous years. The *305(b) Report* is compiled biennially to update the assessment of water quality in North Carolina and to meet the Section 305(b) reporting requirement of the Clean Water Act. The 305(b) reports present how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely causes (e.g., sediment, nutrients) and potential sources of impairment. The term "Use Support" refers to the process mandated by 305(b). The *303(d) List* is a comprehensive public accounting of all Impaired waterbodies that is derived from the 305(b) Report/Use Support. An Impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgement along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 is considered when evaluating the ability of a waterbody to serve its uses.

Section 303(d) of the federal Clean Water Act (CWA) which Congress enacted in 1972 required States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of Impaired waterbodies and TMDLs to the US Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a Total Maximum Daily Load (TMDL) must be developed. TMDLs are not required for waters Impaired by pollution. Here, pollution is defined by the EPA as, “man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water,” and is related to water control structures (i.e., dams).

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated " Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated " Supporting" and the other use support categories are rated "Not Rated" or “No Data”. Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support

categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct sub-categories:

> **Category 4a: TMDL has been completed**. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.
>
> **Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future**. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.
>
> **Category 4c: Impairment is not caused by a pollutant**. This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological

materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 6: Impaired based on biological data. This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL. As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

For this integrated list, Categories 1 and 2 are considered fully supporting any assessed uses. This portion of the integrated list is extensive (thousands of segments); thus, a printed copy is not provided. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm). **Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina**.

Delisting Waters

In general, waters will move from Categories 5, 6 or 7 when data show that uses are fully supported or when a TMDL has been approved by EPA. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- An updated 305(b) use support rating of Supporting, as described in the basinwide management plans.
- Applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.

- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).
- EPA has approved a TMDL.

Scheduling TMDLs

Category 5 waters, those for which a TMDL is needed, are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

North Carolina has prioritized TMDL development for waters Impaired due to bacteria or turbidity. The approach of prioritizing TMDL development based on pollutant has been successfully used in other states. Limited resources are used more effectively with a focus on a particular pollutant. Waters Impaired by other pollutants (i.e., not bacteria) are not excluded from the schedule. However, the majority of waters prioritized for the next few years are associated with bacterial contamination. Compliance with TMDL development schedules provided in the Integrated Report depends upon DWQ and EPA resources.

North Carolina uses biological data to place the majority of waterbody assessment units on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Category 6 is to be expected. It is important to understand that the identification of waters in Category 6 does not mean that they are low priority waters. The assessment of these waters is a high priority for the State of North Carolina. However, it may take significant resources and time to determine the environmental stressors and potentially a cause of impairment. Assigning waters to Category 6 is a declaration of the need for more data and time to adequately define the problems and whether pollution, pollutants or a combination affects waters.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a “high, medium or low” manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 10 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- Year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies.
- Reason for listing. (Applicable to Category 5 AUs only) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development.

- Classification. AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies.
- Basinwide Planning Schedule. (Applicable to Category 6 AUs only). The basinwide schedule is utilized to establish priority for stressor studies.

Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- A change of a water quality standard (e.g., fecal coliform to Echerichia coli). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required;
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling;
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.

Appendix VII

Little Tennessee River Basin Nonpoint Source Program Description and Contacts

Agriculture

USDA Natural Resources Conservation Service:

Part of the U.S. Department of Agriculture (USDA), formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification. www.nc.nrcs.usda.gov/

County	Phone	Address
Area 1 Conservationist	828-456-6341	589 Raccoon Road, Suite 246, Waynesville NC 28786
Graham	828-837-6417 ext. 3	225 Valley River Ave., Suite J, Murphy, NC 28906
Jackson	828-586-6344	538 Scotts Creek Road, Suite 110, Sylva, NC 28779
Macon	828-524-3311 ext. 3	191 Thomas Heights Road, Macon Agri. Service Center, Franklin, NC 28734
Swain	828-586-6344	538 Scotts Creek Road, Suite 110, Sylva, NC 28779

Soil and Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality.

Graham County SWCD	828-837-6417	225 Valley River Ave., Suite J, Murphy, NC 28906
Jackson County SWCD	828-586-6344	538 Scotts Creek Road, Suite 110, Sylva, NC 28779
Macon County SWCD	828-524-3311	191 Thomas Heights Road, Macon Agri. Service Center, Franklin, NC 28734
Swain County SWCD	828-488-3785	PO Box 731, Bryson City, NC 28713

Division of Soil and Water Conservation:

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil and Water Conservation Districts, provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee. www.enr.state.nc.us/DSWC/

Central Office	919-733-2302	512 N Salisbury Street, Raleigh NC 27604
Asheville Region *	828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778

NCDA&CS Regional Agronomists:

The NC Department of Agriculture & Consumer Services (NCDA&CS) technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor, and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program*, and enforce the state pesticide handling and application laws with farmers. www.ncagr.com/

Central Office	919-733-2655	4300 Reedy Creek Road, Raleigh NC 27607
Region 13	828-456-3943	

Education

NC Cooperative Extension Service:

Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. www.ces.ncsu.edu

Graham		828-479-7979	39 S Main Street, Smith Howell Building, Robbinsville, NC 28771
Jackson		828-586-4009	538 Scotts Creek Rd/suite 205, Sylva, NC 28779
Macon		828-349-2046	193 Thomas Heights Rd, Franklin, NC 28734
Swain		828-488-3848	60 Almond School Rd, Bryson City, NC 28713

Forestry

DENR Division of Forest Resources:

Develop, protect, and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources. www.dfr.state.nc.us

District Office (DFR District 9)	Service Forester	828-586-4007	443 Hwy. 116, Sylva, NC 28779-8513
Region III Mountains	Regional Forester or Asst. Regional Forester	828-251-6509	14 Gaston Mountain Road, Asheville NC 28806-9101
Raleigh Central Office (Statewide)	Forest Hydrologist, NPS Unit	919-733-2162 ext. 206	1616 Mail Service Center, Raleigh NC 27699-1616
Griffiths Forestry Center (Statewide)	Water Quality & Wetlands Forester	919-553-6178 ext. 230	2411 Old U.S. Hwy 70 West, Clayton NC 27250

Construction/Mining

DENR Division of Land Resources:

Administers the NC Erosion and Sedimentation Control Program for construction and mining operations. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources. www.dlr.enr.state.nc.us

Central Office		919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Asheville Region *		828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778

Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances. For a listing of the most recently approved local programs visit www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html

City of Highlands		828-526-2118	PO Box 460, Highlands, NC 28741
Jackson County		828-631-2256	401 Grindstaff Cove Road, Suite 110, Sylva, NC 28779
Macon County		828-349-2560	1834 Lakeside Drive, Franklin, NC 28734
Swain County		828-488-9134	PO Box 2321, Bryson City, NC 28713

General Water Quality

DENR DWQ Planning Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Neuse and Tar-Pamlico River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities. http://h2o.enr.state.nc.us/pb/index.html

Planning Section Chief	919-733-5083 x 570	1617 Mail Service Center, Raleigh NC 27699
NPS Planning	919-733-5083 x 356	1617 Mail Service Center, Raleigh NC 27699
Modeling/TMDL	919-733-5083 x 505	1617 Mail Service Center, Raleigh NC 27699
Classifications and Standards	919-733-5083 x 579	1617 Mail Service Center, Raleigh NC 27699
Basinwide Planning	919-733-5083 x 354	1617 Mail Service Center, Raleigh NC 27699
Groundwater Planning	919-733-5083 x 522	1617 Mail Service Center, Raleigh NC 27699

DWQ Regional Offices:

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring. http://www.enr.state.nc.us/html/regionaloffices.html

Asheville Region *	828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778

NC Wildlife Resources Commission:

To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state, and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner. www.ncwildlife.org

Central Office	Wildlife Management	919-707-0050	1722 Mail Service Center, Raleigh NC 27699

U.S. Army Corps of Engineers:

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits. www.usace.army.mil

Asheville Field Office	828-271-7980	151 Patton Ave, Room 208, Asheville NC 28801

Solid Waste		
DENR Division of Waste Management: Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund, and the Resident Inspectors Program. http://wastenot.enr.state.nc.us		
Central Office	919-508-8409	401 Oberlin Road, Suite 150, Raleigh NC 27605
Asheville Region *	828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778
On-Site Wastewater Treatment		
Division of Environmental Health and County Health Departments: Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust. Services include: training of and delegation of authority to local environmental health specialists concerning on-site wastewater; engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface; and technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems. www.deh.enr.state.nc.us		
Central Office	919-715-3274	2728 Capital Boulevard, Raleigh NC 27604
Asheville Region *	828-397-5152	2090 U.S. Highway 70, Swannanoa NC 28778
Graham	828-479-6232	PO Box 546, Robbinsville, NC 28771
Jackson	828-586-8994	538 Scotts Creek Road, Suite 100, Sylva, NC 28779
Macon	828-349-2489	1830 Lakeside Drive, Franklin, NC 28734
Swain	828-488-1207	PO Box 546, Bryson City, NC 28713

* **DENR Asheville Regional Office covers the following counties:** Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Rutherford, Swain, Transylvania and Yancey

Appendix VIII

Use Support Methodology

Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single body of water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (15A NCAC 2b .0100 and .0200). Information can also be found within each basin plan and at http://h2o.enr.state.nc.us/csu/.

Use Support Categories

Primary Classification	Ecosystem Approach	Human Health Approach			
	Aquatic Life	Fish Consumption	Recreation	Water Supply	Shellfish Harvesting
C	X	X	X	N/A	N/A
SC	X	X	X	N/A	N/A
B	X	X	X	N/A	N/A
SB	X	X	X	N/A	N/A
SA	X	X	X	N/A	X
WS I – WS IV	X	X	X	X	N/A

Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for

use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

Assessment Units

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

Interpretation of Data and Information

It is important to understand the associated limitations and degree of uncertainty when interpreting use support ratings. Although these use support methods are based on data analysis and other information, some best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

Assessment Methodology

Introduction

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database. Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land

cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

Basis of Assessment

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating. Evaluated ratings are used when there are no site-specific data.

Rating Basis	Use Support Category	Assessment Applicability*
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	DHHS has established a site-specific advisory for fish consumption and fish tissue data are available.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice. AU has a site-specific advisory and there is no fish tissue data available.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensive and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note: S/M = Supporting/Monitored I/M = Impaired/Monitored NR/M = Not Rated/Monitored
S/E = Supporting/Evaluated I/E = Impaired/Evaluated NR/E = Not Rated/Evaluated
ND = No Data
AL = Aquatic Life REC = Recreation FC = Fish Consumption
SH = Shellfish Harvesting WS = Water Supply
AU = Assessment Unit WET = Whole Effluent Toxicity
DEH = Division of Environmental Health
DHHS = Department of Health and Human Services
* = for lakes assessments, see page 16

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

Stressors

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion).

Aquatic Life Category

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

Biological Data

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are assessed for use support ratings. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit.

Benthic Macroinvertebrate Criteria

Criteria have been developed to assign bioclassifications to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera, Plecoptera* and *Trichoptera* (EPTs); and the Biotic Index (BI), which summarizes tolerance data for all taxa in each sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

Waterbody Sample Type or Criteria	Benthic Bioclassification	Use Support Rating
Mountain, piedmont, coastal A[3]	Excellent	Supporting
Mountain, piedmont, coastal A[3]	Good	Supporting
Swamp[1]	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair[2]	Not Impaired	Supporting
Swamp[1]	Moderate Stress	Supporting
Mountain, piedmont, coastal A[3]	Fair	Impaired
Swamp[1]	Severe Stress	Impaired
Mountain, piedmont, coastal A[3]	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

1 Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

2 This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

3 Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

Fish Community Criteria

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

NCIBI	Use Support Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a). NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin -- all waters except for those draining the Sandhills in Moore, Lee and Harnett counties, and the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, except for the south and southwest portions of Johnston County and eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, coldwater temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All nonwadeable and large streams and rivers throughout the state.

Ambient Water Quality Monitoring Criteria

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

Ratings Criteria	Rating
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard for Class C waters is a daily average of 5 mg/l and an instantaneous value of 4 mg/l. Because DWQ does not collect daily DO levels at the ambient stations, the instantaneous value is used for assessment criteria. In areas with

continous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

Multiple Monitoring Sites

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

NPDES Wastewater Whole Effluent Toxicity (WET) Information

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

NPDES Discharger Daily Monitoring Report (DMR) Information

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. Because discharger effluent data is not a direct measure of water quality and data confidence is not as high as for stream monitoring data, the assessment units are considered evaluated rather than monitored. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments.

Fish Consumption Category

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish consumption advice or advisory at the time of use support assessment. The advice and

advisories are based on DHHS epidemiological studies and on DWQ fish tissue data. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory or advice for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a site-specific fish consumption advisory is posted at the time of assessment, the water is Impaired on either a monitored or evaluated basis dependent upon the availability of monitoring data. The DHHS has developed statewide fish consumption advice for certain fish species shown to have elevated levels of mercury in their tissue. All waters of the state are therefore Impaired/Evaluated in the fish consumption category.

Recreation Category

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. These waters are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the state's fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period. Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support.

Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria

As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, Class B, SB and SA waters will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

Shellfish Harvesting Use Support

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to assign use support ratings for shellfish waters.

Division of Environmental Health (DEH) Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation shoreline surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH bacteria

sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows.

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90th percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to DWQ Class SA (shellfish harvesting) waters. It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. This will result in a difference of acreage between DEH areas classified as CAC, PRO and RES, and DWQ waters rated as Impaired. For example, if DEH classifies a 20-acre area CAC, but only 10 acres are Class SA, only those 10 acres of Class SA waters are rated as Impaired.

The DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

Sources of fecal coliform bacteria are more difficult to separate out for Class SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by these sources. Therefore, in the past, DEH identified the same sources for all Class SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this information will continue to be used. A point source discharge is only listed as a potential source when NPDES permit limits are exceeded.

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting frequency of closures. In the interim, DWQ has been identifying the frequency of closures in Class SA waters using an interim methodology (see below) based on existing databases and GIS shapefiles. There will be changes in reported acreages in future assessments using the permanent methods and tools that result from this project.

Past Interim Frequency of Closure-Based Assessment Methodology

The interim method was used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and PRO/RES**	Impaired

* Approved waters are closed only during extreme meteorological events (hurricanes).

** CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ worked with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during the assessment period. For each growing area with CAO Class SA waters, DEH and DWQ defined subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed was determined using DEH proclamation summary sheets and the original proclamations.

The number of days that APP areas in the growing area were closed due to preemptive closures because of named storms was not counted. For example, all waters in growing area E-9 were preemptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (CAO) was reopened September 30, 1996. This area was considered closed for ten days after the APP waters were reopened.

Current Assessment Methodology

Use support assessment is now conducted such that only the DEH classification will be used to assign a use support rating. By definition, CAO areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas will be rated Impaired, along with CAC and PRO/RES areas. Only APP areas will be rated Supporting.

Growing areas that have been reclassified by DEH during the assessment period from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to any other classification during the assessment period will be rated Impaired.

Over the next few years, DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a database with georeferenced (GIS)

shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. Using the new database with georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to large or named storms.

Water Supply Use Support

This human health related use support category is used to assess all Class WS waters for the ability of water suppliers to provide potable drinking water. Water quality standards established for drinking water apply to water delivered to consumers after it has been treated to remove potential contaminants that may pose risks to human health. Ambient standards established by states under the Clean Water Act are not intended to ensure that water is drinkable without treatment. Modern water treatment technologies are required to purify raw water to meet drinking water standards as established by the North Carolina Division of Environmental Health.

Water supply use support is assessed by DWQ using information from the seven DEH regional water treatment plant consultant staff. Each January, the DEH staff consultants are asked to submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information, and the reason for the closure or switch.

The spreadsheets are reviewed by DWQ staff to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. Using these criteria, North Carolina's surface water supplies are currently rated Supporting on an Evaluated basis. Specific criteria for rating waters Impaired are to be determined on a case-by-case basis.

Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments			
Criteria	**Level 1**	**Level 2**	**Level 3**
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

Lakes and Reservoir Use Assessment

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina's Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports
- Fish kill reports

- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
    - Taste and odor
    - Sheens
    - Odd colors
    - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category	
Assessment Type	**Criteria**
EUTROPHICATION	
Water Quality Standards (a minimum of 10 samples is required for use support assessment)	
Chl *a*	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
Other Data	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
Trophic Status Index (TSI)	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Test ≥5 mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp
Sediments	Clogging intakes - dredging program necessary.

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Appendix IX

Glossary

Glossary

7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
ACOE	United States Army Corps of Engineers.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient over enrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
conductivity	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
DEH	Department of Environmental Health

degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
DENR	Department of Environment and Natural Resources.
DHHS	Department of Health and Human Services.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
EEP	Ecosystem Enhancement Program (EEP)
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FDA	Unites States Food and Drug Administration.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975

	square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
Impaired	Term that applies to a water body that is not meeting the designated use criteria.
impervious	Incapable of being penetrated by water; non-porous.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NOV	Notices of Violation. An NOV serve to alert the permittee of permit infractions and request that whatever caused the violation be corrected immediately. Many times these will not include a fine. Depending upon the severity of the violation, the permittee may receive a Notice of Violation and Assessment of a Civil Penalty, which will include a fine.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.

ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
PCBs	Polychlorinated Biphenyls. PCBs are man-made chemicals that persist in the environment. There are a number of adverse health effect associated with exposure to PCBs.
pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are

	common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams.
SWCD	Soil and Water Conservation District
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.
TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
USGS	United States Geological Survey
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WTP	Water Treatment Plant
WWTP	Wastewater treatment plant.