LAKE CHATUGE WATERSHED ACTION PLAN

March 2007

Lake Chatuge
Watershed Action Plan

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This document is intended to guide restoration efforts in the Lake Chatuge watershed in Towns County, GA and Clay County, NC for the purpose of returning it to good ecological health over the next 10-15 years. The Hiwassee River Watershed Coalition and Tennessee Valley Authority developed the plan cooperatively with input from citizens, community leaders, and local officials.

The *Draft Handbook for Developing Watershed Plans to Restore and Protect Our Waters* was used extensively during plan development and the document addresses each of the nine required components outlined therein.

Cover design: Leslie Gray

Cover photograph by Callie D. Moore:
Lake Chatuge from the Clay County Recreation Park

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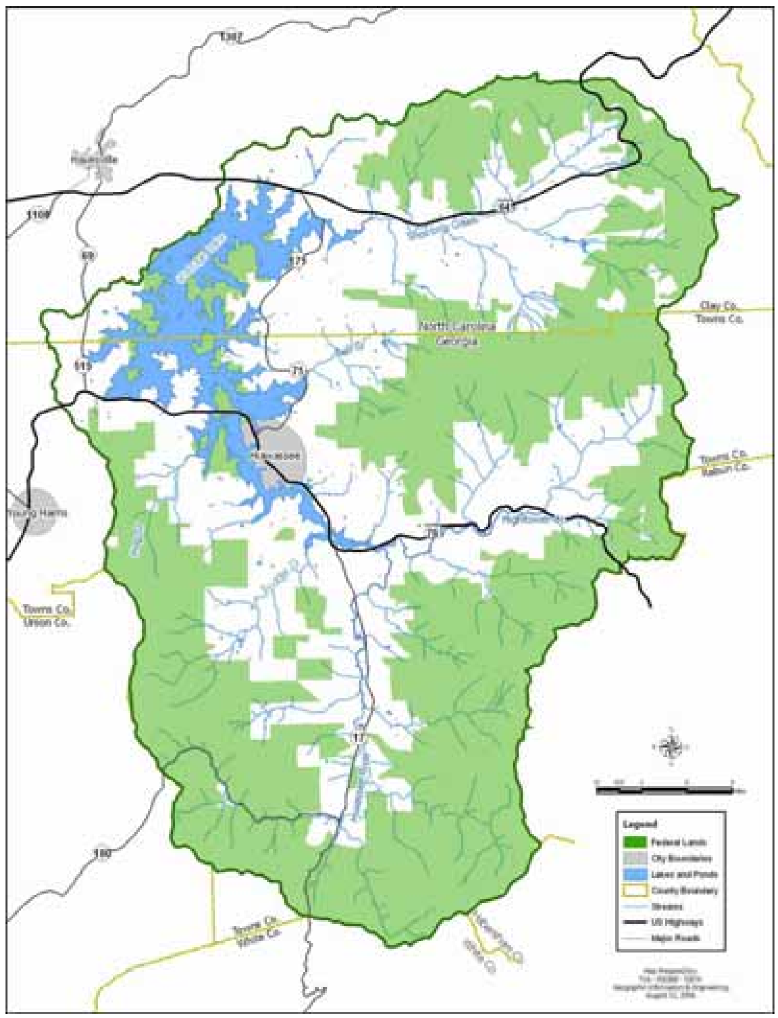
General Description of the Lake and Watershed

Lake Chatuge is a 7,000-acre impoundment of the Hiwassee River located in the Blue Ridge Mountains of North Georgia and Western North Carolina. The reservoir straddles the border of the two states and the area of land draining to the dam lies wholly within Towns County, GA and Clay County, NC. The Lake Chatuge dam is the uppermost of four dams on the Hiwassee River, three of which were built and are still owned by the Tennessee Valley Authority (TVA).

Lake Chatuge lies within three hours of drive time from four major cities in four different states: Atlanta, Georgia; Chattanooga, Tennessee; Greenville, South Carolina; and Asheville, North Carolina. Hiawassee, GA is the only municipality that lies within the watershed; however, Young Harris, GA and Hayesville, NC are located just a few miles outside the watershed boundary.



More than 37 percent of the Lake Chatuge watershed (70.3 mi^2) lies within two National Forests: Nantahala National Forest in North Carolina and Chattahoochee National Forest in Georgia. The headwaters of the Hiwassee River and several major tributary streams lie within this federally protected forestland and feed Lake Chatuge, offering substantial water quality protection.

Lake Chatuge makes up about six percent of the drainage area above Chatuge Dam. The watershed is primarily forested (80.4%) and in 2002 there were still more than 10,000 acres (9.1%) of land in agricultural uses including pasture, cropland, and hay land. Developed land is increasing and, as of 2002, represented more than four percent of the drainage area (about 5,000 acres). The vast majority of the agricultural lands in the watershed are pastures and hay lands; there are less than 50 acres of traditional row crops.

The Lake Chatuge watershed and surrounding area experienced explosive growth in the 1990s and the population continues to grow at rates higher than the states in which it lies. Between 1990 and 2000, the population of Towns County increased by 38.0%; Clay County's population increased 22.6% over the same period. As of 2005, the population of Towns County, GA is estimated by the U.S. Census Bureau to be 10,315, a 10.7% increase over the past five years. The Clay County, NC population is estimated to be 9,765 in 2005, an increase of 11.3% since 2000 (U.S. Census Bureau, 2006b). Roughly 25% of the population of Clay County and 80% of the Towns County population lives in the Lake Chatuge watershed for a total estimated 2005 population of 10,692.

Purpose of the Action Plan

TVA regularly monitors five indicators of ecological health in each of its reservoirs, assigning a numerical score, called an Ecological Health Rating, at each assessment. The five monitored indicators are: dissolved oxygen, chlorophyll, fish community, bottom life, and sediment quality. Lake Chatuge has been monitored annually since 1998. During the 1990s, TVA's Reservoir Ecological Health Rating for Lake Chatuge declined from "Good" in 1994 and 1996 with scores in the low to mid-70s to "Poor" starting in 1998 with scores in the mid-40s and low 50s. TVA has monitored Lake Chatuge annually since 1998 and, with the exception of one "Fair" rating in 2001, the reservoir has continually been rated Poor.

The scope of the Lake Chatuge Watershed Action Plan encompasses a wide variety of water quality concerns within the 189-square mile drainage area of Lake Chatuge. Although the water quality concerns are described and discussed in detail, the purpose of the Plan is to *recommend actions* that, if implemented properly, will result in an improvement in Lake Chatuge's ecological health rating as determined by TVA's Reservoir Vital Signs Monitoring Program.

The Action Plan is based on an extensive study undertaken by the Hiwassee River Watershed Coalition (HRWC), the methods and results of which are reported herein. However, this document is not intended to be a report on the study. It is intended to be an active document that all watershed stakeholders can use for facilitating water quality improvements in Lake Chatuge over the next 5-15 years.

Study of Lake Chatuge and its Watershed

Physical/chemical data were collected in the Lake Chatuge watershed between December 2002 and November 2003. Stream samples were collected biweekly from December 2002 through April 2003, and monthly May through November 2003 at six sites located on major tributaries to the lake and analyzed for 12 water quality parameters. Lake samples were collected from five locations on a monthly basis from April 2003 through November 2003 and analyzed for 13 water quality parameters.

Low-altitude, color infrared aerial photography was taken of the Lake Chatuge watershed in 2002 by TVA. Over a period of several months, the photography was interpreted by experienced photo-analysts for geographic features that contribute or are suspected to contribute nonpoint source pollution within the watershed. Geographic Information System (GIS) attributes that describe the set of geographic features were then generated.

The Hydrological Simulation Program-Fortran (HSPF) model was used to calibrate the nutrient and organic concentrations flowing into Lake Chatuge from the watershed with stream field measurements collected during the 2003 sampling. Then a two-dimensional CE-QUAL-W2 water quality model of Chatuge reservoir was calibrated using lake field data collected in 2003. The reservoir model (CE-QUAL-W2) used the output of the watershed model (HSPF) as the initial input. Calibration was performed to match model output to measured water quality parameters in the reservoir.

Study Results

The water quality study of Lake Chatuge shows that an excess of nutrients is the leading cause of low ecological health ratings. This result was expected due to elevated concentrations of algae in the lake. However, the study provided a much larger volume of data and the ability to determine which sources were contributing most to the problem.

One way that excess nutrients are entering the lake is through stormwater runoff from developed areas. Sources of nutrients in developed areas include soil erosion associated with cuts and slopes behind businesses and homes and commercial applications of fertilizer on lawns, ball fields, golf courses, and landscaping. Excess nutrients also come from large domesticated populations of Canada geese that are often fed by homeowners and allowed to nest on residential and publicly owned property around the lake shoreline. Often there is not enough woody vegetation along the shoreline of Lake Chatuge (or stream banks of tributaries) to filter runoff from these areas.

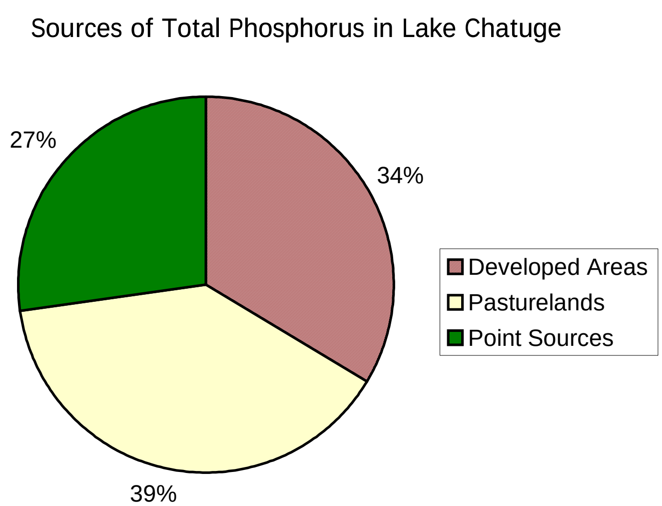
Impervious surfaces associated with developed areas also contribute heavily to the ecological health problems in Lake Chatuge. Impervious cover does not allow water to sink into the soil; examples are roads, rooftops, driveways, and parking lots. These hardened surfaces cause a larger quantity of water to run off the land at a much faster rate. Typically stormwater from developed areas is channeled into drainage systems (ditches, pipes, etc.), which carry pollutants directly into streams (or the lake). Due to the velocity of the water, runoff from impervious areas causes accelerated erosion of streambeds and banks, carrying nutrient-laden sediment into the lake. And because these surfaces absorb sunlight, the water is often heated as well. Areas of impervious cover are concentrated along the Lake's shoreline and streams, as well as in highway corridors throughout the watershed.

In 2003, nearly 2.5% (2,943.8 acres) of the Lake Chatuge watershed was covered with impervious surfaces; roads comprised half of the impervious area (1,444.7 acres). Although the 189 square mile watershed is only 2.5% covered with impervious surfaces, many localized areas within the larger watershed contain well over 50% impervious cover!

Nutrients from agricultural lands come from fertilizers (commercially-prepared or locally-generated) that are applied to the land to produce better grasses for grazing and crops of hay for winter-feeding of livestock. Nutrients also come directly from animal waste; in some areas livestock have direct access to long lengths of streams. As is the case in residential areas, there is often not enough vegetation along streams to filter runoff from these lands.

Discharges of treated wastewater, even when facilities are operating in full compliance with state and federal permits, are currently significant sources of nutrient loading to Lake Chatuge. Septic systems that are located in unsuitable areas, are improperly installed, or have not been operated and/or maintained properly, can also 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.

Both nitrogen and phosphorus (the two most significant nutrients related to algae growth) are of concern in Lake Chatuge. However, phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir.



In 2003, Lake Chatuge was receiving 9,600 pounds of phosphorus per year. There are three broadly described sources of phosphorus (pictured left), each representing about one-third of the load: pasturelands/livestock (39%), residential/commercial developed areas (34%), and treated wastewater discharges (27%).

The graphed data seem to indicate that if phosphorus in runoff from agricultural areas within the Lake Chatuge watershed is eliminated, the water quality situation could be controlled. However, upon closer examination in light of land use information, the data show that roughly 3,700 pounds of phosphorus per year is coming from 10,000 acres of agricultural land (0.37lbs/acre), but nearly the same amount (3,300 pounds per year) is coming from only 4,800 acres of developed land (0.69lbs/acre)!

Computer modeling efforts indicate that a 30% reduction in both phosphorus and nitrogen is needed to once again achieve a Good Ecological Health Rating for Lake Chatuge. Phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir. And, when actions are taken to reduce phosphorus from nonpoint sources of pollution, nitrogen is usually reduced as well.

Finally, phosphorus doesn't go through as many processes in the environment (exchange with the atmosphere, etc.) that occur with nitrogen, making it easier to measure and predict. For these reasons, HRWC has chosen phosphorus as the parameter for which to target reductions. Actions are also recommended to reduce sediment, indirectly reducing the attached nutrients as well.

Recommended Actions

Eighteen broad objectives for plan implementation were identified based on the causes and sources of degradation for Lake Chatuge. The recommended actions listed here are based on these objectives. Please visit the Hiwassee River Watershed Coalition's website for a more detailed discussion of each recommendation: http://www.hrwc.net/lakechatuge.htm or contact the HRWC office if you prefer to be mailed a hard copy.

A. Federal and NC/GA State Government Agencies should:

- Enforce applicable water quality rules and regulations and sediment/erosion control laws
- Provide increased monitoring of streams and the lake
- Provide basin-wide insight into watershed health on a regular basis
- Provide funding for management measures outlined in this plan
- Provide assistance to local governments who are trying to manage growth (technology, training & funding)
- Provide an awareness of relevant tools as they become available
- Avoid implementation of "blanket" rules and regulations
- Improve the TMDL program and implementation plans to make them meaningful

B. Local Governments should:

- Establish a local sediment/erosion control program
- Evaluate your own properties for potential BMPs to retain/treat stormwater
- Provide funding for management measures outlined in this plan
- Review and potentially revise subdivision ordinances based on North GA Growth Readiness Consensus Recommendations
- Consider adopting a stormwater ordinance
- Plan for wastewater treatment for new development/increased population
- Consider conducting a regional planning initiative

In addition, Towns County government should:

- Continue working to regain status as a Qualified Local Government

And, the City of Hiawassee government should:

- Install and maintain best available technology at the existing wastewater treatment facility to significantly reduce nutrient loading to Lake Chatuge
- Design and implement a proactive program for handling reports of wastewater leaks and spills

And, the Clay County government should:

- Consider passing a "Mountain Protection" ordinance similar to that of Towns County

C. Lake Chatuge Watershed Residents should:

- Educate yourself & others about the issues
- Report erosion control problems to the appropriate authorities
- Restore and/or maintain a woody riparian buffer along streams and the lake
- Evaluate your home site for ways to retain or treat stormwater
- Evaluate your practices at home to find ways to minimize water usage and runoff
- If you have a septic tank, ensure that it is being maintained properly
- Encourage businesses that you patronize to implement stormwater BMPs
- Support your local governments in their efforts to implement water quality protection measures
- Don't feed or encourage nesting of domesticated populations of Canada geese
- Support HRWC

D. Developers/Builders/Grading-Clearing Contractors should:

- Educate yourself and co-workers/staff about erosion control and stormwater issues
- Design roads to follow natural contours of the land and such that no slopes are greater than 15 percent grade
- Place home sites in locations that minimize earthwork
- Design developments and home sites with stormwater and water quality in mind (minimize impervious surfaces & protect sensitive areas)
- Avoid creating cut/fill slopes that are greater than 1.5H:1V
- Restore/maintain woody riparian buffers along all waters
- Install and maintain appropriate BMPs during and after construction
- Limit underbrushing and clearing, particularly prior to sale of a property
- If you have the opportunity, educate new residents about these matters

E. Realtors should:

- Educate yourself about the value of riparian buffers and conservation-based developments
- Seek to sell responsibly developed properties first
- Limit clearing, underbrushing and grading of property
- Educate buyers/new residents about how to be sensitive to our mountain environment

F. Commercial Business/Property Owners should:

- Educate yourself about impervious surfaces and impacts to water quality
- Restore/maintain a woody riparian buffer (if your property borders water)
- Evaluate your property and/or business practices for the potential to retain/treat stormwater runoff
- Implement stormwater BMPs
- Support HRWC

G. Farmers & the Agricultural Community should:

- Rotate livestock and implement BMPs for winter feeding as needed to prevent loss of vegetation and overgrazing
- Restrict livestock access to waters by installing fencing, stream crossings, and alternative watering sources
- Restore/maintain a woody riparian buffer (if your property borders water)
- Practice good nutrient management by following an NRCS-approved nutrient management plan or recommendations of bi-annual soil analysis
- Reduce soil requirements for nitrogen amendments by sowing nitrogen-fixing legumes (e.g. clover) with grasses
- Practice no-till or minimal-till techniques when seeding or planting crops
- Consider converting steeply sloping pasture or cropland to orchard/horticulture or harvestable timber
- Consider restoring prior-converted wetlands

H. The Tennessee Valley Authority should:

- Continue to conduct lake monitoring annually
- Provide an easy to read and readily available report for the public of reservoir ecological health ratings
- Continue to provide support (and consider increasing the level of support) for annual HRWC operating expenses
- Provide funding for, and technical assistance with, BMP implementation
- Assist with education (see HRWC)

I. The Hiwassee River Watershed Coalition should:

- Provide residents, developers, builders, grading-clearing contractors, realtors and commercial businesses with educational opportunities and materials
- Seek funding to assist willing landowners with evaluation of properties and BMP implementation
- Assist local governments in drafting, adopting, and implementing ordinances and in planning
- Serve as a "clearinghouse" for information from state and federal agencies
- Assist with distribution of publications and create public awareness about available programs, funding, educational materials, and other tools available to watershed stakeholders

Measurable Results & Implementation

Although all of the recommended actions listed above will help accomplish the goals of the Plan, for implementation purposes it is necessary to develop more specific, measurable management *strategies* for the watershed. If accomplished, the strategies discussed in this section should return Lake Chatuge to Good Ecological Health as assessed by TVA's Reservoir Vital Signs Monitoring Program. The strategies were chosen based on the following:

- identified objectives and suggested management measures;
- ability to help achieve needed nutrient load reductions to the lake;
- cost effectiveness and relative ease of implementation;
- ability to measure the results

Six measurable management strategies were selected:

1. Reduce the Total Phosphorus load from the Hiawassee WWTP by 50%
2. Restrict from streams and/or the lake, and provide appropriate alternative watering for, a minimum of 125 animals (25%) that currently have unrestricted access
3. Improve 40% of pastures considered to be in fair condition to good condition (about 2,500 acres)
4. Improve 50% of the most degraded pasture areas to a minimum of conditions considered fair (about 440 acres)
5. Reduce the Total Phosphorus load by 30% from existing commercial areas (about 1000 acres)
6. Reduce TP load by 5% from existing residential areas (nearly 7,000 acres)

There are other combinations of actions that will also accomplish the desired results. However, these are the strategies that were deemed by the planning team to produce the largest improvements for the resources invested, based on the above criteria. In addition to these strategies, efforts must also be undertaken to ensure that new development is better development in terms of watershed and water quality protection.

A 15-year timeline spanning three phases of implementation is presented. Year 1 will begin when funding first becomes available. Strategies during the first five years (Phase I) generally involve implementation of nutrient reduction strategies at the Hiawassee wastewater treatment plant, development of a plan for handling sewage leaks and spills from the sanitary sewer system, locating and prioritizing sites for agricultural, residential, and commercial best management practices (BMPs), and beginning practice installation. During Phase I, approximately 900 acres of pasture, 240 acres of commercial development, and 1750 acres of residential development will be treated. In addition, 30 acres of critically eroding bare areas will be re-vegetated and 3,000 linear feet of riparian buffer re-planted. At the end of Phase I, funding, participation, and accomplishments will be reviewed, along with water quality data, and this plan will be re-evaluated before proceeding into Phases II and III.

HRWC will evaluate progress by tracking:

- Sites reviewed for possible BMP installation
- Practices planned
- Practices installed
- Reductions anticipated for targeted parameters associated with installed practices

In addition to sites selected for BMP installation through the formal process, HRWC plans to set up a system (hopefully online) whereby anyone can input actions taken (from the list of recommendations) watershed-wide. This way practices will be accounted for down to the smallest backyard buffer planting or rain garden installation; the system would also allow all stakeholders to fully participate in the restoration process! New local ordinances or changes to existing ordinances that positively impact water quality will also be tracked.

Actual water quality data will be a key component of measuring success of the Action Plan. Major streams flowing into Lake Chatuge will continue to be monitored monthly for 14 parameters including turbidity, Total Suspended Solids, phosphorus, nitrogen, and nitrate/nitrite. Data throughout the life of the restoration effort will be compared periodically to more than four years of baseline data collected at the existing locations. The Tennessee Valley Authority will continue to assess the lake annually as part of its Reservoir Vital Signs Monitoring Program.

Overall project success will be determined by one or more of the following:

- Implementation of BMPs such that the targeted phosphorus reductions are met.
- Improvement in stream water quality is observed as measured by the HRWC volunteer monitoring program.
- Chlorophyll-*a* concentrations do not exceed state water quality standards.
- Improvement in TVA's Ecological Health Rating for Lake Chatuge is observed.

Funding & Technical Assistance

During the first five years of Action Plan implementation (Phase I), nearly $2.0 million dollars will be spent by the Towns County Water and Sewer Authority to upgrade (and expand) the Hiawassee wastewater treatment plant. Implementation of other management strategies planned for Phase I is estimated to cost $600,000. Costs include: $267,000 for pastureland improvements and agricultural BMPs, $168,000 for retrofit stormwater BMPs for commercial and residential areas, $25,000 for re-vegetation of critically eroding areas and riparian buffer plantings, $10,000 for an education program, and $50,000 for monitoring and evaluation. The estimated cost also includes $100,000 over the 5-year period ($20,000/year) for project management to help support a Lake Chatuge Watershed Restoration Coordinator; HRWC will also provide support for this position.

The total cost of restoring Lake Chatuge to "Good" ecological health – the primary goal of this Action Plan – is estimated at $3.8 million. Approximately $2.1 million is yet to be secured. Project leadership, including acquisition of funds, identification of sites for best management practices, installation oversight, monitoring, and evaluation will be provided by the Hiwassee River Watershed Coalition in cooperation with TVA, local officials, and community leaders.

SECTION 1
INTRODUCTION

1.1 Overview of the Plan/Study Area

Lake Chatuge is a 7,000-acre impoundment of the Hiwassee River located in the Blue Ridge Mountains of North Georgia and Western North Carolina (Figure 1). The reservoir straddles the border of the two states and the area of land draining to it lies wholly within Towns County, GA and Clay County, NC. An area of land that drains to a specific point, in this case Chatuge Dam is called a watershed. The Lake Chatuge watershed (outlined in red on Figure 1) is the land area for which this plan is written.

The Lake Chatuge dam is the uppermost of four dams on the Hiwassee River, three of which were built and are still owned by the Tennessee Valley Authority (TVA). Nearby reservoirs include Lake Burton to the southeast in Rabun County, GA, Lake Nottely to the west in Union County, GA, Nantahala Lake to the northeast in Macon County, NC and Hiwassee and Apalachia Lakes to the northwest in Cherokee County, NC.

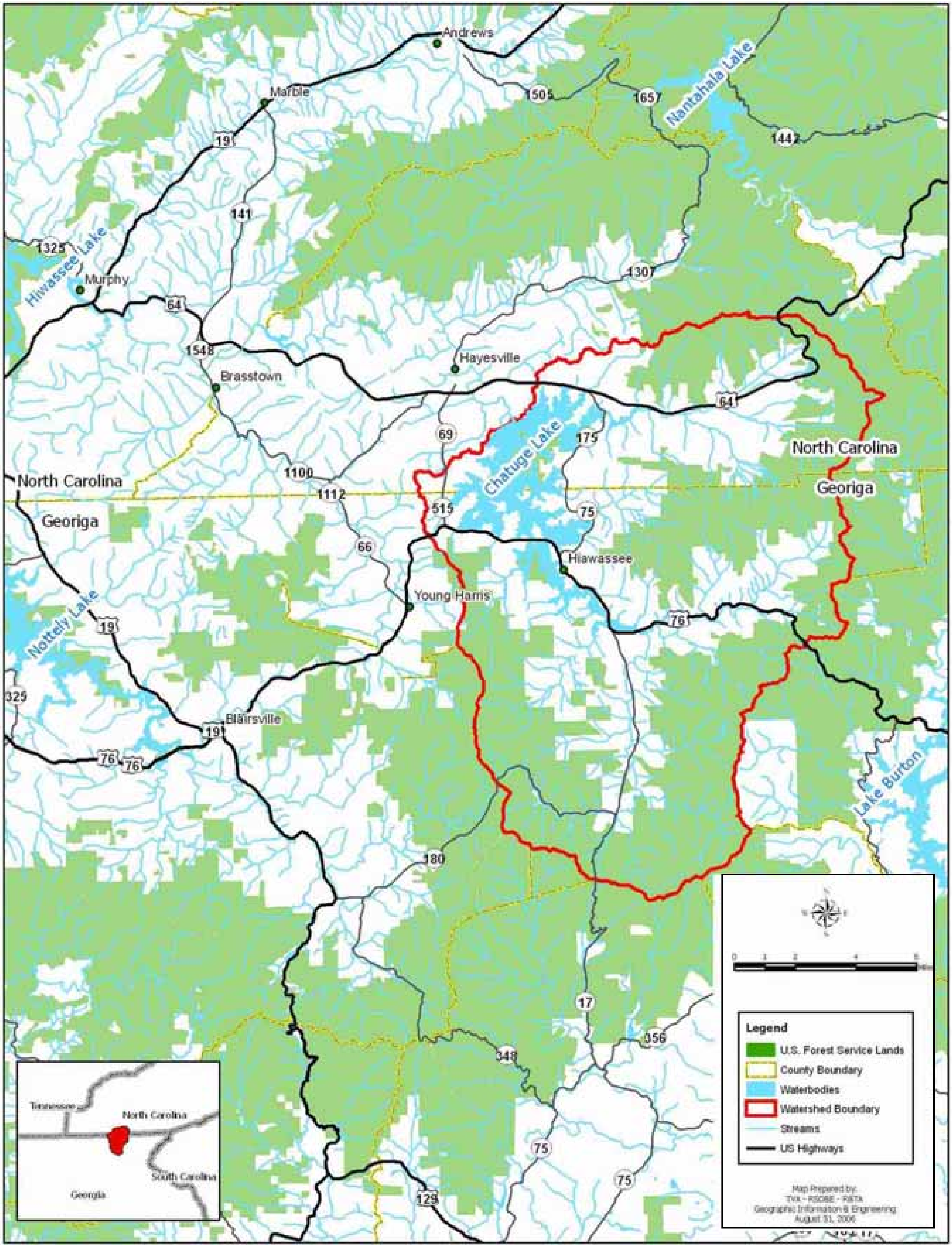
Lake Chatuge lies within three hours of drive time from four major cities in four different states: Atlanta, Georgia; Chattanooga, Tennessee; Greenville, South Carolina; and Asheville, North Carolina. Hiawassee, GA is the only municipality that lies within the watershed; however, Young Harris, GA and Hayesville, NC are located just a few miles outside the watershed boundary. A more in-depth description of Lake Chatuge and its watershed is provided in Section 2 beginning on page 7.

1.2 Plan Scope and Purpose

The scope of the Lake Chatuge Watershed Action Plan encompasses a wide variety of water quality concerns within the 189-square mile watershed (drainage area) of Lake Chatuge. Although the water quality concerns are described and discussed, the purpose of the Plan is to *recommend actions* that, if implemented properly, will result in an improvement in Lake Chatuge's ecological health rating as determined by TVA's Reservoir Vital Signs Monitoring Program.

The Action Plan is based on an extensive study undertaken by the Hiwassee River Watershed Coalition (HRWC), the methods and results of which are reported herein. However, this document is not intended to be a report on the study. It is intended to be an active document that all watershed stakeholders can use for facilitating water quality improvements in Lake Chatuge over the next 5-15 years.

Figure 1. Overview of the Lake Chatuge Watershed Action Plan Area



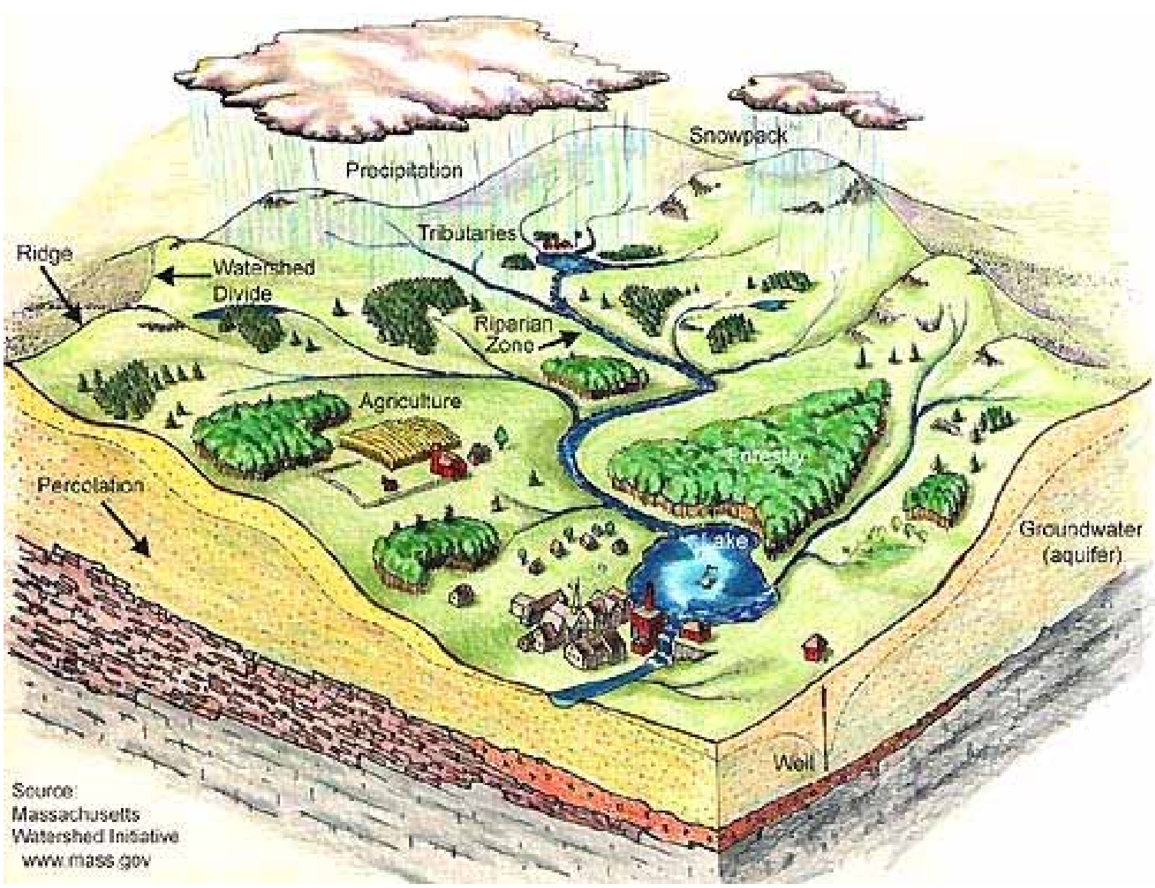
1.3 HRWC Approach to Water Quality Improvements

1.3.1 Watershed-Based Study & Plan

Depending on where each of us lives, we may cross several creeks, streams, branches, or maybe even rivers as we go about our business each day. Each stream we cross is part of a massive network of perhaps three million streams that drain to the rivers and, ultimately, to the sea. Each stream has its own watershed that encompasses all of the land that drains to the point where we cross it. Collectively, these small watersheds provide critical natural services that sustain or enrich our daily lives: they supply our drinking water, provide critical habitat for plants and animals, areas of natural beauty, and water bodies for recreation and relaxation. Our streams, rivers and lakes are important elements of our local geography, and confer a strong sense of place in our community.

Because streams, rivers, and reservoirs are interconnected (Figure 2), problems that arise must be addressed on a watershed basis. In other words, Lake Chatuge cannot be separated from the land that drains into it. All 189 square miles must be considered and cared for if Lake Chatuge is to be ecologically healthy and sustain good water quality.

Figure 2. Diagram of a Watershed



HRWC takes a "watershed approach" to investigating problems and implementing solutions. A watershed approach is a flexible framework for managing water resource quality and quantity within specified watersheds that includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process works within this framework by using a series of steps to characterize existing conditions, identify and prioritize problems, define management objectives, suggest protection or restoration strategies, and implement the necessary actions. The planning process involves understanding:

- land uses in the watershed and how they are changing;
- watershed residents and the economy;
- current water quality and stream/lake habitat conditions;
- threats to water quality and stream/lake habitat conditions; and
- actions needed to restore and protect water quality and stream/lake habitat conditions.

It took four years of study for HRWC to achieve this understanding of Lake Chatuge and its watershed but having a plan that is based on sound science is critical to the success of watershed restoration and protection!

1.3.2 Partnerships

Partnerships are critical to the all of work of the Hiwassee River Watershed Coalition, but particularly so when developing a watershed plan. HRWC was founded as a partnership between local residents, county governments, and the soil and water conservation districts with help from TVA and Natural Resources Conservation Service (NRCS) staff members. These commitments that date more than a decade remain viable and are largely responsible for the organization's success.

Six years ago HRWC partnered with TVA to begin a "Lake Studies" program of work. The preliminary goal of the program was to "restore" Nottely and Chatuge Reservoirs to a "Good" ecological health rating. In 2001, HRWC received an appropriation from the Georgia legislature for the Lake Chatuge and Nottely work and over the last five years, TVA has more than matched the state "grant" with in-kind services and cash. TVA professionals collected the water quality data, conducted the computer modeling, and worked with HRWC staff to provide support for the publication of this Action Plan. This work would have likely taken much longer to accomplish without TVA's help due to the time it takes HRWC to raise the needed funds for such a project. We are grateful.

A sound scientific study is not complete without field verification of data and peer review. In October 2002, before the professionals began collecting samples in December, HRWC began a volunteer monitoring program at the same locations included in the study, as well as several others. For 12 months, both the professionals and the volunteers collected samples monthly from the same locations. The volunteers' samples were analyzed independently at the University of North Carolina-Asheville (UNCA). The local volunteer/UNCA data are closely comparable to the data collected by TVA. The volunteers have continued to monitor 10 sites in the Lake Chatuge watershed, insuring that the data used to calibrate the computer models still portrays an accurate picture of what's going on in the watershed.

As for the computer modeling work, the models that were used are commonly accepted, widely-used models for reservoir watershed modeling and were independently deemed appropriate for use in this watershed. A copy of the calibration report that TVA produced was sent by HRWC to the supervisors of the modeling sections of the Water Protection Branch of the GA Environmental Protection Division and the Division of Water Quality of the NC Department of Environment & Natural Resources for independent review.

HRWC also worked closely with the City of Hiawassee, GA (and its consultants) and Towns County government associated with this project. HRWC wishes to thank the more than 50 local volunteers that have gone out on the third Saturday of every month for more than four years to collect water samples! HRWC recognizes that there are those who may read this document that have misgivings about TVA as an agency and do not know the dedicated individuals that are involved with this project. However, for decades TVA has provided significant financial and technical resources to the upper Hiwassee River watershed to further the cause of improved water quality, aquatic habitat, and biological communities, as well as environmental education. The list of partnerships associated with all of our activities, projects and programs is too long to publish in this document; however, more information is located on our website: http://www.hrwc.net.

1.3.3 Public Input

HRWC did solicit public comments and recommendations during the planning process; however, input from the general public was limited. The HRWC membership and staff of partner agencies and organizations provided invaluable information about their concerns regarding Lake Chatuge and recommendations that they have for improvements. But a well-advertised public meeting held in October 2005 at the Towns County High School auditorium only brought out 16 people. A few other presentations have since been made to various community groups including the Towns County Homeowners Association and the Young Harris College Institute for Continuing Learning. Several newspaper articles have also been published. However, HRWC estimates that only about 10% of the population of the Lake Chatuge watershed is aware of the results of the study.

Almost all of the public input received was through Community Input Surveys, which HRWC distributed at the public meeting and at other speaking engagements. The survey asked five questions:

1. What do you like about living here?
2. What do you think our communities will look like in 10 years?
3. Do you think these are positive or negatives changes? Why?
4. How would you like the future picture to be different?

The community input surveys show that Lake Chatuge, the surrounding mountains, and the streams that feed the lake are a large part of the reason people choose to live here. Every survey that was returned mentioned the beauty of the area; every respondent was concerned about the way in which development was happening. The majority of the respondents were not native to the area and many indicated that they moved here because of the relatively unpolluted/unspoiled natural resources. All expressed concern about the health of Lake Chatuge. The survey remains available on the Coalition's website: http://www.hrwc.net/lakechatuge.htm.

1.4 Organization of the Plan

The remainder of this document is organized as follows:

- Section 2 describes the Lake Chatuge watershed providing a brief history of the area, discussing physical characteristics, land uses, and population.
- Section 3 discusses the need for this intensive study and Action Plan for improving the ecological health of Lake Chatuge.
- Section 4 describes methods for data collection and computer modeling of the watershed that were used during the 4-year study of Lake Chatuge.
- Section 5 presents the results and conclusions from the study of Lake Chatuge.
- Section 6 provides recommendations to various watershed "stakeholders" for improving the ecological health rating of Lake Chatuge.
- Section 7 outlines measurable management measures, a schedule for implementation, and milestones by which successful implementation of the Plan can be measured. It also discusses evaluation of progress.
- Section 8 discusses funding and sources of technical assistance.
- A Glossary is included beginning on page 55 after the References section.

SECTION 2
CHARACTERIZATION OF THE LAKE CHATUGE WATERSHED

2.1 Historical Background

The upper Hiwassee River basin has been inhabited by humans for hundreds of years and was a major population center for the Cherokee Nation when white settlers began to arrive in the early 1800s. Written references to the Appalachian Mountains and the Cherokee first occurred in the journals recording Hernando DeSoto's march through the South in the mid-sixteenth century. By 1716, trading between the Cherokee and merchants in Charleston, South Carolina in deer-hides was strong; later ginseng was also traded. White settlement of the area began in the early 1800s and the discovery of gold in North Georgia in 1828 significantly increased the influx of settlers (Homan, 2002).

In 1835, after years of court battles and debate, representatives of the Cherokee signed the Treaty of New Echota that traded all of their land in the east for land in the Indian Territory of Oklahoma. Congress ratified the Treaty in 1836 despite a substantial Cherokee petition declaring the agreement fraudulent, and in 1838 passed the Indian Removal Act when it became apparent that the Cherokee were not going to leave their land. The United States Army then forced most all of the remaining Cherokee from the Southern Appalachians in a harsh journey now known as the "Trail of Tears" (Homan, 2002). During the removal, a site located near present-day Hiawassee, GA was used to concentrate Cherokee people into groups for the journey west (*Roadside Georgia*, 10/24/2006).

By 1840, much of the area was owned by white settlers drawn by land lotteries, which awarded 40- and 160-acre tracts to homesteaders (Homan, 2002). The earliest white settlers in the area were hardy, Scotch-Irish immigrants. The people were very self-sufficient, raising their own crops and livestock for both food and clothing (Clay County Chamber of Commerce, 2006).

One of Georgia's early north-south roads passed through the Lake Chatuge watershed. The "Unicoi Road" was an upgraded Cherokee Trading Path that ran from the present-day Maryville, Tennessee area, over the Great Smoky Mountains, to the Tugaloo, GA area. The road made the Hiwassee River watershed land more valuable because it gave residents better access to markets for their crops. Towns County was formed in 1856 from parts of Rabun and Union counties; in 1861 Clay County was formed from parts of Cherokee and Macon counties (*Roadside Georgia*, 10/24/2006).

This remote and fairly isolated area was relatively undisturbed by the Civil War and "Reconstruction" following the war also had little effect on the two counties. Commercial development in Towns County in the late 1800s was hindered by the lack of an east-west road and the lack of a rail route. After World War I, when automobiles became a common mode of transportation for Americans, a road was proposed to connect Chattanooga, Tennessee, and Spartanburg, South Carolina. Today the road is known as U. S. 76; this route gave Towns County a much-needed east-west connector and better opportunities for commercial development (*Roadside Georgia*, 10/24/2006).

All of the forestland in the Lake Chatuge watershed was heavily logged at one time or another in the early 1900s. By 1930, large-scale commercial cutting had ceased, however, small timber companies and individual landowners continued to take out old growth trees and salvage dead chestnut until the early 1960s. Timber companies sold large tracts of logged forestland to the U.S. Forest Service between 1910 and 1930, although they sometimes retained the right to continue to remove trees larger than 14 inches in diameter (Homan, 2002). To a trained eye, evidence of this widespread timbering is still evident in forestlands of the Lake Chatuge watershed.

Despite the timber boom in the early years, agriculture remained the basis of the local economy throughout much of the 20th Century. Due to the remoteness of the area from major population centers, traditional manufacturing and industrial activity has been limited. Tourism has only in recent decades become an important economic factor (Clay County Chamber of Commerce, 2006). Currently, the Lake Chatuge watershed is growing in population fairly rapidly (see part 2.4.1 for details) and also experiences significant seasonal population fluctuations due to an influx of summer residents and to recreational travel and tourism activities.

2.2 Hydrologic Features

2.2.1 Chatuge Dam

Lake Chatuge is a 7,000-acre man-made impoundment of the Hiwassee River located in the Blue Ridge Mountains of North Georgia and Western North Carolina. Congress authorized the Chatuge Reservoir project in 1941 for emergency power production associated with national defense during World War II. When the dam was built by TVA in 1942 it did not have hydropower generating capability, but was operated to store and release water as required for maximizing power production at Hiwassee Dam and others downstream. At the time, storage of water in Chatuge and neighboring Nottely Reservoirs combined to add an additional 60,000 kilowatts of generating capacity to the TVA system (TVA, June 1992b).

In 1945, Chatuge became a “multi-purpose” reservoir and was operated for downstream navigation and flood control, in addition to power production. Releases from Chatuge then helped maintain favorable navigation conditions in the Tennessee River between Knoxville and Chattanooga and helped to prevent flooding of downtown Chattanooga (TVA, June 1992b). Chatuge Dam is still operated by TVA to assist with these functions today.

In 1954, a single hydro-generating unit was placed into operation. Chatuge Dam has the smallest power capacity of any of the power-generating TVA dams, representing less than 0.3% of the total conventional hydropower in the TVA system (TVA, June 1992b). TVA continues to own and operate Chatuge Dam. Recently, as a result of the system-wide Reservoir Operations Study in 2003-2004, recreation has been added to the list of “multipurposes" and seasonal variations in lake levels are more strictly regulated to provide for this benefit to the local economy.

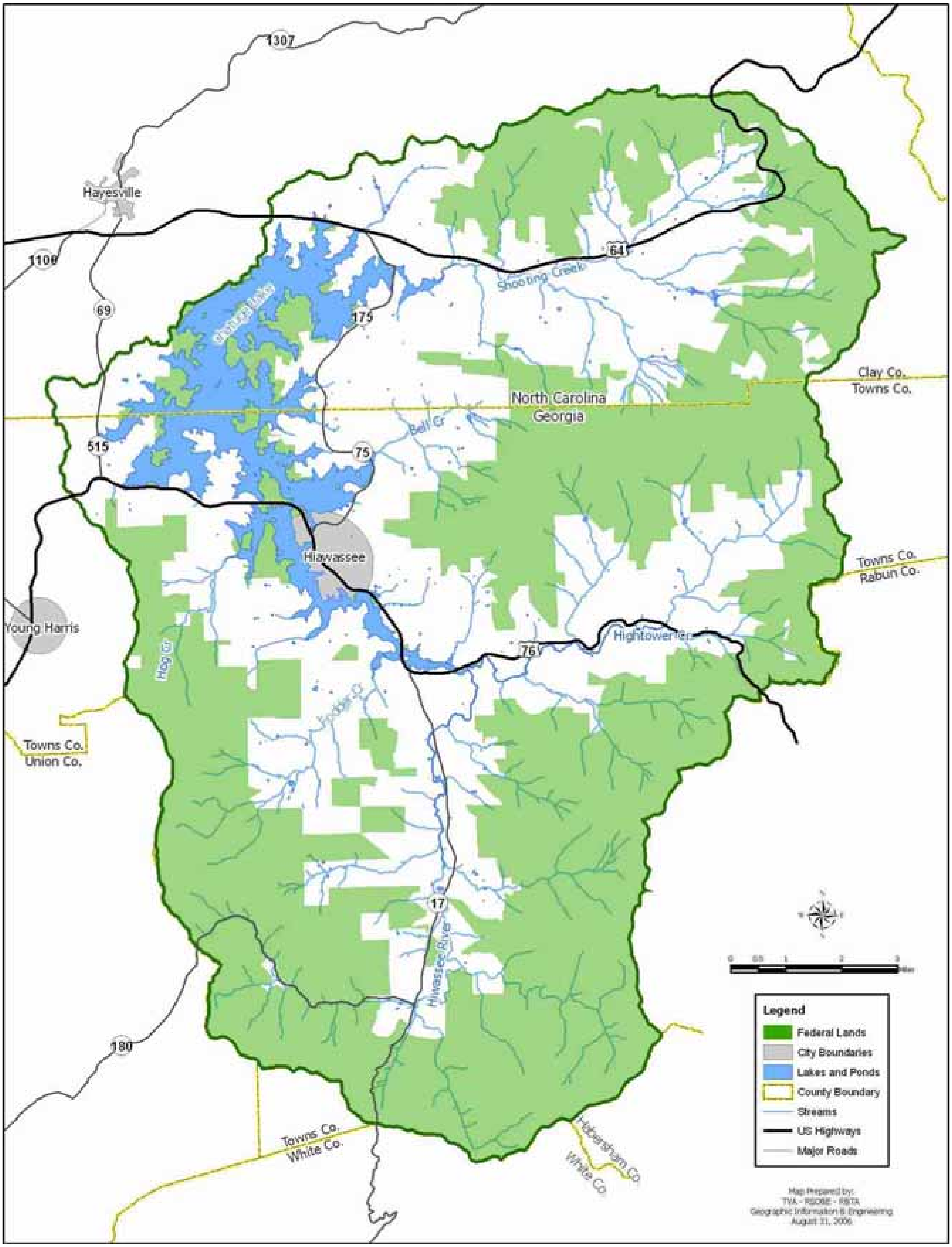
2.2.2 Lake Chatuge Watershed

The Hiwassee River flows north from the southern part of Towns County and forms Lake Chatuge at the confluence with Hightower Creek (Figure 3). The area of land that drains into the Hiwassee River and Lake Chatuge above Chatuge Dam is called the Lake Chatuge watershed. The Lake Chatuge watershed is approximately 189 square miles and is located entirely within Towns County, GA and Clay County, NC. Hiawassee, GA is the only municipality; however, Young Harris, GA and Hayesville, NC lie just outside the western watershed boundary.

More than 37 percent of the Lake Chatuge watershed (70.3 mi^2) lies within two National Forests in the watershed: Nantahala National Forest in North Carolina and Chattahoochee National Forest in Georgia. The headwaters of the Hiwassee River and several major tributary streams lie within this federally protected forestland and feed Lake Chatuge, offering substantial water quality protection.

Major streams within the watershed include Hightower, Scataway, Fodder, Hog and Bell Creeks in Georgia and Shooting, Eagle Fork, and Giesky Creeks in North Carolina. There are two major east-west highways that cross the watershed. US Highway 64 lies along the northern sections of Lake Chatuge and Shooting Creek; US Highway 76 follows the southern border of the lake, crosses at one of the narrowest portions near Hiawassee, and then follows Hightower Creek to the west.

Figure 3. General Map of the Lake Chatuge Watershed



2.2.3 Stream Network and Project Sub-watershed Delineation

There are 365 miles of streams in the Lake Chatuge watershed. In most reservoirs, the largest amount of water flowing in comes from the upstream end of the watershed with relatively small flows entering between it and the dam. However, the primary inflow to Lake Chatuge, the Hiwassee River, drains less than half (44%) of the watershed. The Shooting Creek drainage area makes up nearly one quarter (23%) of the Lake Chatuge watershed, entering just above the dam (TVA, August 1991). The Shooting Creek Embayment can be treated almost like a second smaller lake because the water from the Shooting Creek watershed never really impacts the rest of Lake Chatuge and vice versa.

For the purposes of the HRWC study and to make implementation of water quality improvement projects easier in the future, the watershed was broken into 49 sub-watersheds (Figure 4). Each sub-watershed is a hydrologically correct area meaning that any runoff within that sub-watershed drains to the downstream point where the stream and the sub-watershed boundary meet. The size of the sub-watersheds is determined based on the land cover at the time of the study (2003), the location of point source discharges, as well as whether the water is free-flowing in a stream, part of the lake body, or stream channels that are sometimes influenced by reservoir operations (i.e. backwaters). For example, if the land cover over a large area is predominantly forest with some light residential development and contains all free-flowing streams, then the sub-watershed can be fairly large (e.g. Hightower Creek headwaters – 0905). But in an area that is not free flowing all year with significant water level fluctuation due to reservoir operations, the sub-watershed might be very small (e.g. Fodder Creek embayment – 0801). The Hiawassee Wastewater Treatment Plant discharge is isolated in a very small area so that impacts can be separated from other land uses (05).

The sub-watershed numbering system breaks the watershed into a "tree structure" that allows users of the computer model to determine the relative geographic position of each sub-watershed. In the computer database the pollutant loadings for a sub-watershed represent all of the nonpoint sources in the sub-watershed that accumulate at the point where the stream intersects the sub-watershed boundary. A key to the sub-watershed codes is found in Table 1 (page 13).

Figure 4. Project Sub-Watersheds Delineated for Planning Purposes

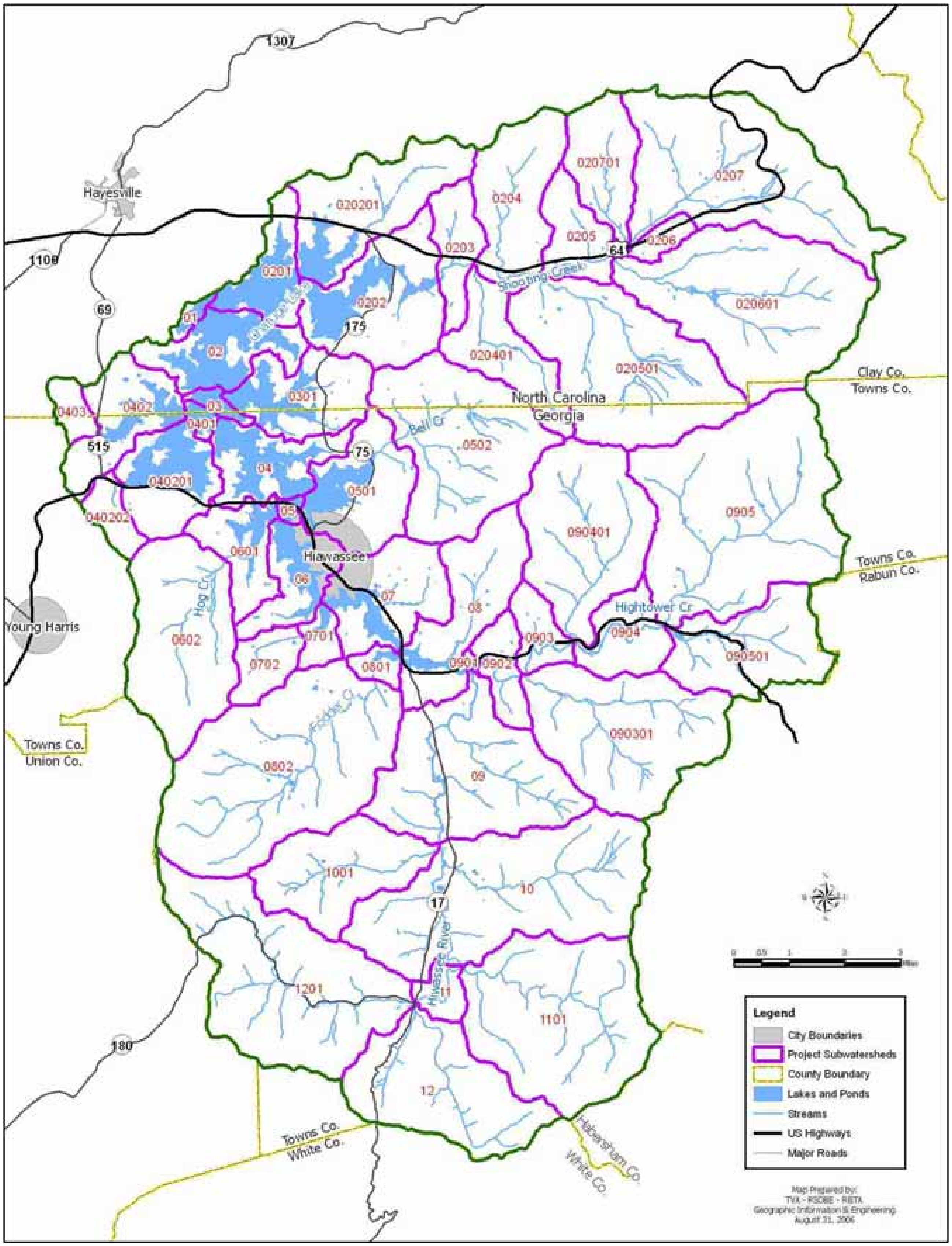


Table 1. Key to Project Sub-Watersheds Presented in Figure 4.

Sub-Watershed Code	Major Waterbody or Drainage Area	Sub-Watershed Name	State in which a majority lies
01	Lake Chatuge	Chatuge Dam	NC
02	Lake Chatuge	Lower Lake Chatuge	NC
0201	Lake Chatuge	Lower Shooting Cr Embayment	NC
0202	Lake Chatuge	Upper Shooting Cr Embayment	NC
020201	Lake Chatuge	Licklog Creek	NC
0203	Shooting Creek	Rocking Chair	NC
0204	Shooting Creek	Pounding Mill	NC
020401	Shooting Creek	Hothouse Branch	NC
0205	Shooting Creek	Jackie Cove	NC
020501	Shooting Creek	Giesky Creek	NC
0206	Shooting Creek	Old 64/New 64	NC
020601	Shooting Creek	Eagle Fork	NC
0207	Shooting Creek	Shooting Cr Headwaters	NC
020701	Shooting Creek	Vineyard	NC
03	Lake Chatuge	Chatuge at State Line	NC/GA
0301	Lake Chatuge	Sneaking Creek	NC
04	Lake Chatuge	Middle Lake Chatuge	GA
0401	Lake Chatuge	Cedar Cliff	GA/NC
0402	Lake Chatuge	Woods Creek Embayment	NC/GA
040201	Lake Chatuge	Ramey Mountain	GA
040202	Long Bullet Creek	Mining Gap	GA
0403	Woods Creek	Woods Creek	NC/GA
05	Lake Chatuge	Fairgrounds	GA
0501	Lake Chatuge	Lower Bell	GA
0502	Bell Creek	Upper Bell	GA
06	Lake Chatuge	Hiawassee	GA
0601	Lake Chatuge	Hog Cr Embayment	GA
0602	Hog Creek	Hog Creek	GA
07	Lake Chatuge	Upper Lake Chatuge	GA
0701	Lake Chatuge	Transfer Station	GA
0702	Woodring Branch	Woodring Branch	GA
08	Bearmeat Creek	Bearmeat Creek	GA
0801	Lake Chatuge	Fodder Cr Embayment	GA
0802	Fodder Creek	Fodder Creek	GA
0901	Hightower Creek	Hightower Embayment	GA
0902	Hightower Creek	Lower Hightower Cr	GA
0903	Hightower Creek	Middle Hightower Cr	GA
090301	Hightower Creek	Swallow Creek	GA
0904	Hightower Creek	Upper Hightower	GA
090401	Hightower Creek	Scataway Creek	GA
0905	Hightower Creek	Hightower Cr Headwaters	GA
090501	Hightower Creek	Little Hightower	GA
09	Hiwassee River	Cynth Creek	GA
10	Hiwassee River	Mill Creek	GA
1001	Hiwassee River	Owl	GA
11	Hiwassee River	Upper Hiwassee River	GA
1101	Hiwassee River	Corbin Creek	GA
12	Hiwassee River	Hiwassee River Headwaters	GA
1201	Hiwassee River	Soapstone	GA

2.3 Physical Characteristics of the Lake & Watershed

2.3.1 Reservoir Characteristics

Lake Chatuge is approximately 7,000 acres at normal maximum pool (elevation 1,927 feet) and holds 233,500 acre-feet of water. At minimum pool (elevation 1,905) the lake is just less than 4,000 acres and holds 118,000 acre-feet. It is smaller than average in size, but close to the median, when compared with other TVA reservoirs on tributaries to the Tennessee River (TVA, June 1992b).

Only 23% of the lake is less than 10 feet deep at normal pool. The impoundment is 13 miles long and an average of 30-33 feet deep at minimum and maximum pool respectively. The theoretical average retention time of water in the lake is 198 days (TVA, June 1992b).

2.3.2 Geology and Soils

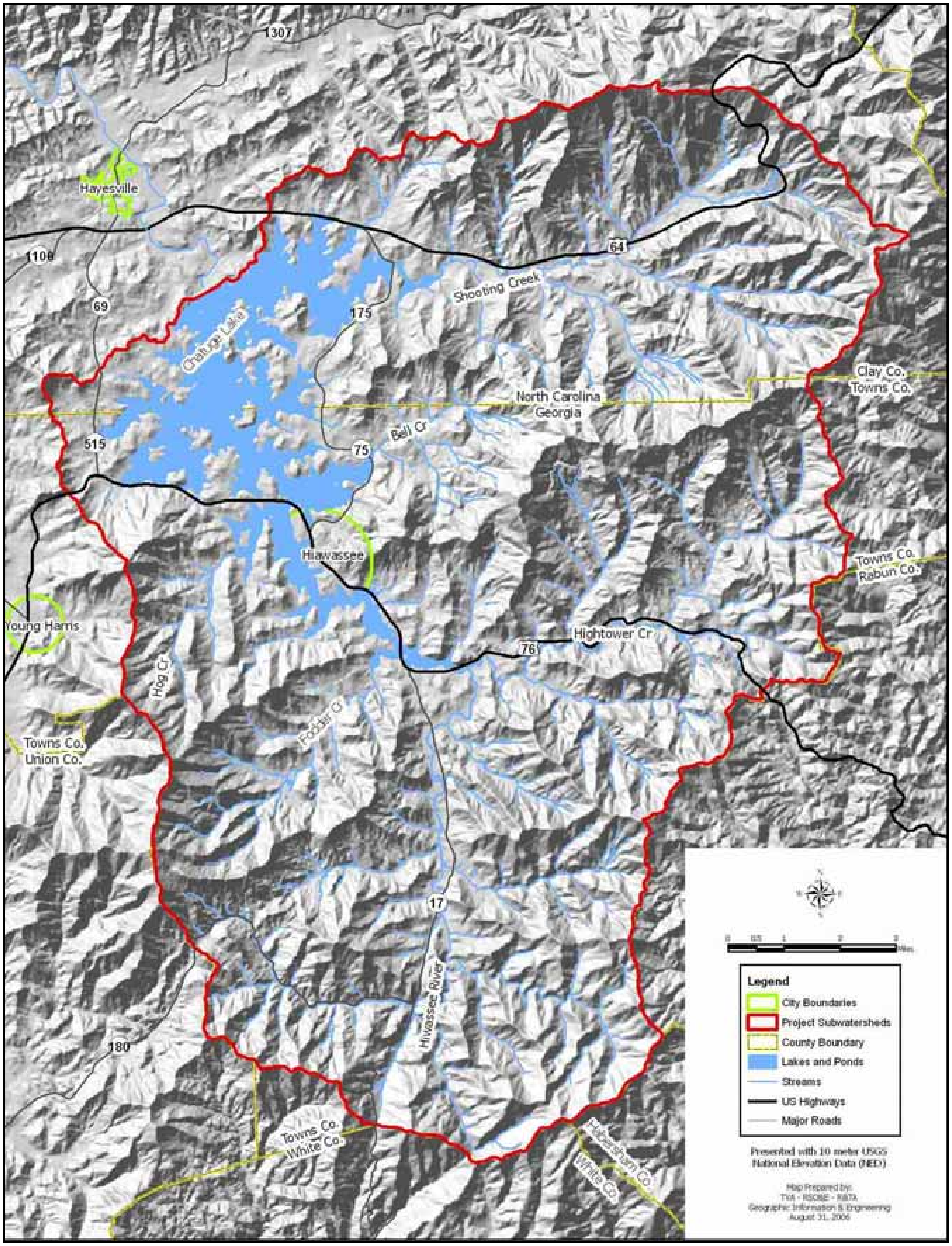
The Lake Chatuge watershed lies within the Blue Ridge Mountain physiographic province. The area is underlain predominantly by Carolina and Roan gneiss, metamorphic rocks that are similar in chemical composition to granite. Mineral resources include mica, quartzite, gold, and corundum (TVA, June 1992b).

Most soils in Towns and Clay counties are strongly acidic loam or sandy loam. Land that comprises the shoreline area of Lake Chatuge is most commonly Hayesville fine sandy loam or Dyke loam. Chatuge loam is predominant along the Hiwassee River above Lake Chatuge. All of these soil types pose moderate to severe limitations for septic systems (TVA, June 1992b).

2.3.3 Topography

The topography of the Lake Chatuge watershed is unique in that the steepest slopes do not occur at the very top of the watershed in the Hiwassee River headwaters. Although the Unicoi Mountains of southern Towns County are approximately 2,500 feet high and divide the Hiwassee River basin from the Chattahoochee, they are not as rugged as mountains in the northern part of the county and in North Carolina (Figure 5). The steepest slopes in the Lake Chatuge watershed are found in the mountains that divide Hightower Creek and Shooting Creek in the northern part of Towns County and the Chunky Gal Mountain along the northern boundary of the watershed in Clay County. The mountains that surround Fodder and Owl Creeks in the southeastern portion of the watershed also contain steep slopes. In general, the southern side of each mountain range within the watershed contains steeper slopes than the northern side. Valleys along streams in the Lake Chatuge watershed are very narrow when compared with the neighboring Brasstown and Tusquitee Creek watersheds to the west and north, respectively.

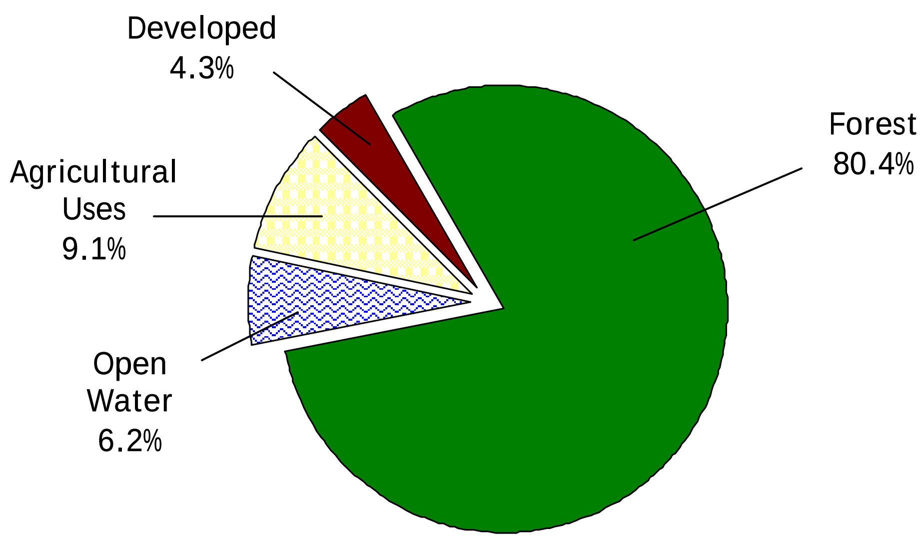
Figure 5. Topography of the Lake Chatuge Watershed



2.3.4 Land Cover and Land Use

Lake Chatuge makes up about six percent of the drainage area above Chatuge Dam (Figure 6). The watershed is primarily forested (80.4%) and in 2002 there were still more than 10,000 acres (9.1%) of land in agricultural uses including pasture, cropland, and hay land. Developed land is increasing and, as of 2002, represented more than four percent of the drainage area (about 5,000 acres).

Figure 6. General Land Cover above Lake Chatuge Dam by Percentage (2002)

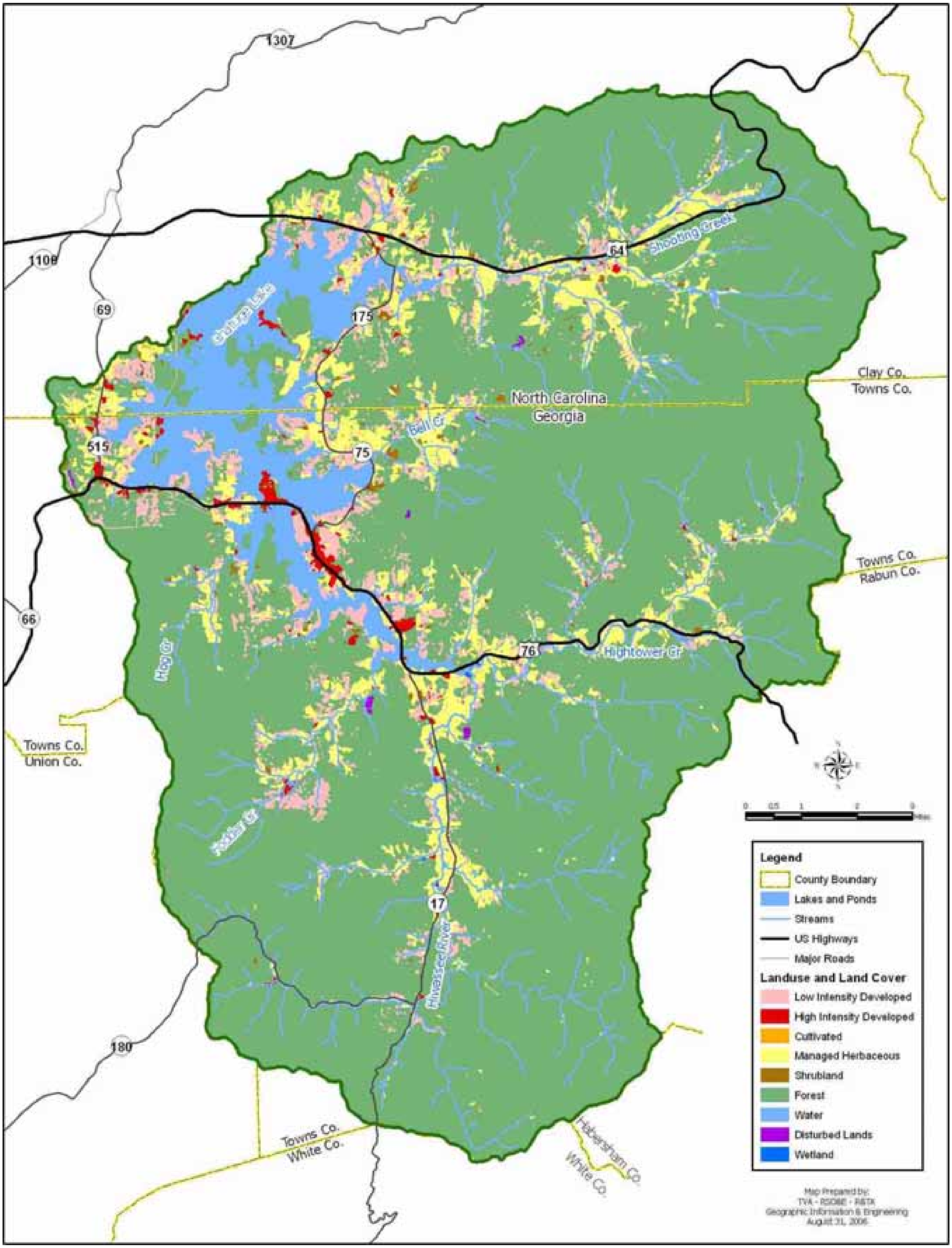


Detailed land use/cover information was obtained in 2002 for the Lake Chatuge watershed (Figure 7) as part of the Integrated Pollutant Source Identification (IPSI) analysis conducted prior to computer modeling. [Section 4.2 contains more information about IPSI.] The vast majority of the agricultural lands in the watershed are pastures and hay lands; there are less than 50 acres of traditional row crops. Golf courses (included with developed areas on Figure 7) cover 250 acres.

High intensity developed areas are primarily located along highway corridors and contain mostly commercial businesses. Low density developed areas are most commonly associated with residential subdivisions. The difference between the two types involves the amount of impervious surfaces associated with the development. [Section 5.2 contains more information about the impacts of imperviousness.]

Many of the areas presented on Figure 7 as pasture lands (managed herbaceous) and some forested areas have been developed since these data were collected in 2002, particularly in the Shooting and Hightower Creek watersheds along the major highway corridors. However, it was imperative that the land use data and water quality data be collected reasonably close together so that the computer models could be correctly calibrated. Today we have the tools to estimate the impacts of land use changes as a result. [Section 4 discusses the data collection and modeling methods used during the Coalition's intensive study of the Lake Chatuge watershed in more detail.]

Figure 7. Map of Land Use/Cover for the Lake Chatuge Watershed (2002)



Lake Chatuge has approximately 132 miles of shoreline, of which 76 miles (58%) is privately owned. Of the eight TVA reservoirs in the Hiwassee River basin, Chatuge has the largest amount of privately owned shoreline. TVA estimated that 45% (34.2 miles) of privately owned shoreline was developed as of 1990 (TVA, June 1992b). Based on the 2002 IPSI analysis, almost all of the privately owned shoreline has now been developed.

2.3.5 Protected and Ecologically Sensitive Areas

Public Lands

More than 37 percent of the Lake Chatuge watershed (70.3 mi^2) lies within two National Forests in the watershed: Nantahala National Forest in North Carolina and Chattahoochee National Forest in Georgia. Other public lands include shoreline tracts and islands owned/managed by TVA and shoreline tracts owned/managed by the NC Wildlife Resources Commission, Clay County, Towns County, and the City of Hiawassee.

Ecologically Sensitive Areas

Ecologically sensitive areas include rare, threatened and endangered wildlife habitats, rare natural communities, significant land forms and geological features, floodplains, wetlands, headwater streams, and other such areas that are particularly vulnerable to physical or biological alteration. The Georgia Nongame Conservation Section identifies 15 animals and 19 plants of special concern in the Tennessee River basin (of which the Hiwassee River/Lake Chatuge watershed is a part). Of these, six animals and six plants are state protected species and one animal (Bog turtle) and two plants (Swamp pink and Small whorled pogonia) are federally-protected species. Aquatic species of concern include: Hiwassee headwaters crayfish, Eastern hellbender, Silver shiner, Gilt darter, Fatlips minnow, and River redhorse. Although three natural communities have been identified in the larger Tennessee River basin in Georgia, none are reported to exist in Towns County (GADNR, 2007).

The North Carolina Natural Heritage Program identifies 9 animals and 7 plants of special concern in the Lake Chatuge watershed. Aquatic species of concern include the Hiwassee headwaters crayfish, Eastern hellbender, Seepage salamander, Bog turtle, Waterfan lichen, Large purple-fringed orchid, and Green pitcher plant. Only the Bog turtle is currently protected. Five significant natural communities are known to exist in the watershed; the Swamp forest-bog complex and the Southern Appalachian bog are aquatic communities. Additionally, there are four Significant Natural Heritage Areas that are protected in the North Carolina portion of the Lake Chatuge watershed: White Oak Stamp, Glade Gap Slopes, and Chunky Gal/Riley Knob are found within the Nantahala National Forest in the headwaters of the Shooting Creek watershed; Eller Seep is near the NC/GA state line near the lake and owned by The Nature Conservancy (NCNHP, 2007).

Lands at higher elevations contain headwater streams, springs, and seeps. Degradation of water quality and aquatic habitat in these high elevation areas significantly impacts larger streams and rivers downstream. Recognizing this, local governments in Georgia (including Towns County) have adopted “Mountain Protection” ordinances at the State’s recommendation. Under these ordinances, more stringent regulations associated with vegetative clearing and development are applied to lands situated at elevations greater than 2,200 feet in elevation. Figure 8 presents federal and non-federal lands within the Lake Chatuge watershed that lie at or above 2,200 feet above sea level. Approximately 27% of land in the Lake Chatuge watershed that lies above 2,200 feet is privately owned.

2.4 Population Description & Trends

There are more than 3,000 counties in the United States. According to the U.S. Census Bureau, Georgia had five of the top 10 (50%) fastest growing counties in the United States between April 1 and July 1, 2003. Georgia also had 20 of the top 100 (20%) fastest growing counties for the same period. Between 2000 and 2015, the resident population in 48 of Georgia's 159 counties is projected to grow more than 34%. Towns and Union counties in the northeast Georgia mountains are among them (U.S. Census Bureau, 2006b).

The Lake Chatuge watershed and surrounding area experienced explosive growth in the 1990s and the population continues to grow at rates higher than the states in which it lies. Between 1990 and 2000, the population of Towns County increased by 38.0%; Clay County's population increased 22.6% over the same period. As of 2005, the population of Towns County, GA is estimated by the U.S. Census Bureau to be 10,315, a 10.7% increase over the past five years. The Clay County, NC population is estimated to be 9,765 in 2005, an increase of 11.3% since 2000 (U.S. Census Bureau, 2006b). Roughly 25% of the population of Clay County and 80% of the Towns County population lives in the Lake Chatuge watershed for a total estimated 2005 population of 10,692.

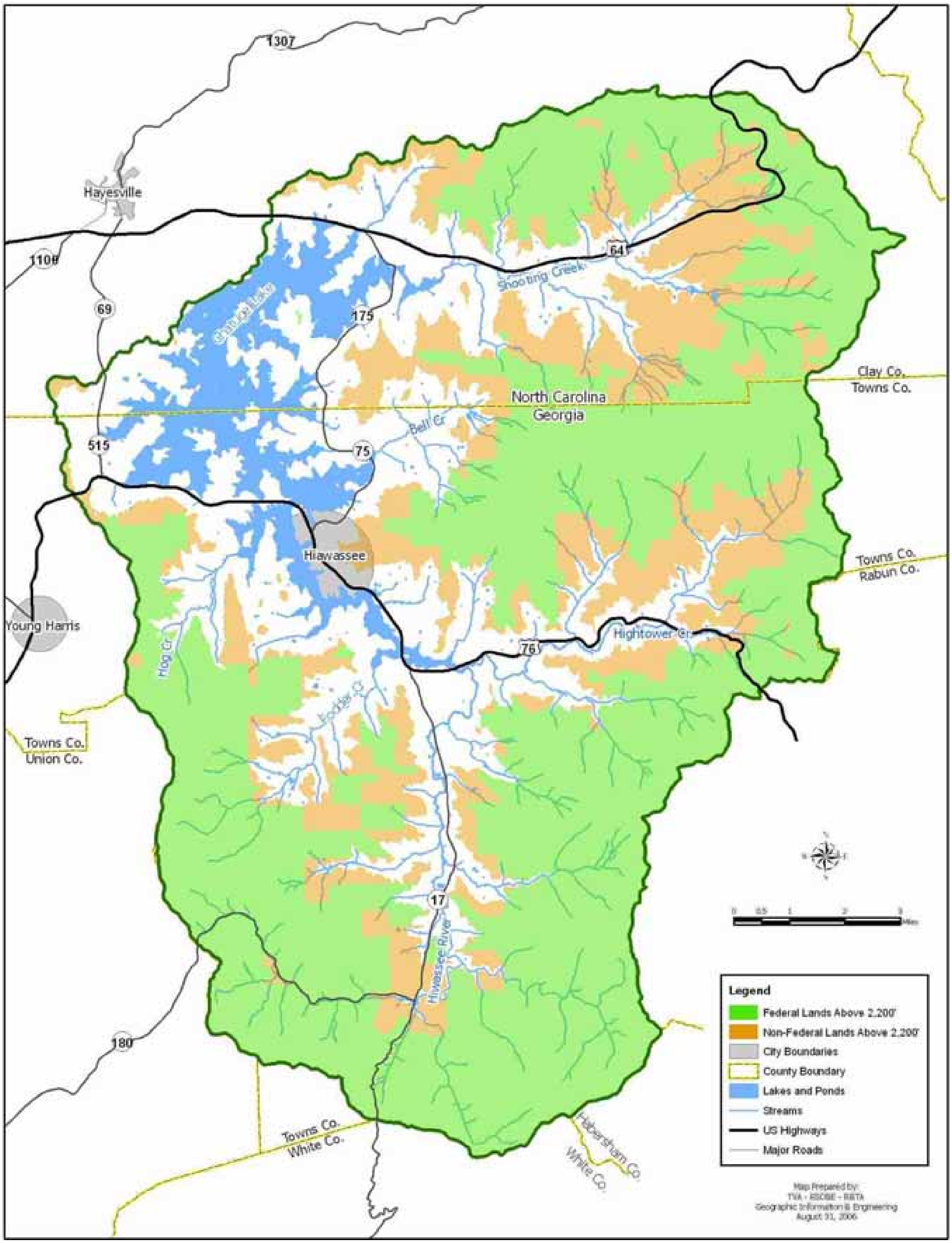
Over 98% of the watershed population is white; however, there is an ever-growing population of Hispanic immigrants that is severely underreported by the Census. Only 1% of the population is black and approximately 0.3% is American Indian (U.S. Census Bureau, 2006b).

In general, the population of Towns and Clay counties is older than population of the United States as a whole. Towns County has more than double the US average percentage of residents over the age of 65; Clay County has nearly double the US average percentage of senior citizens. Table 2 presents age data from the 2000 Census (U.S. Census Bureau, 2006a).

Table 2. Age of Residents in the Lake Chatuge Watershed.

	Clay County, NC	**Towns County, GA**	**United States**
Median Age	46.7	48.6	35.3
Under 5 years	4.2%	4.4%	6.8%
18 years and over	81.4%	83.7%	74.3%
65 years and over	22.7%	25.9%	12.4%

Figure 8. Map of Land in the Watershed Lying At or Above 2,200 Feet in Elevation



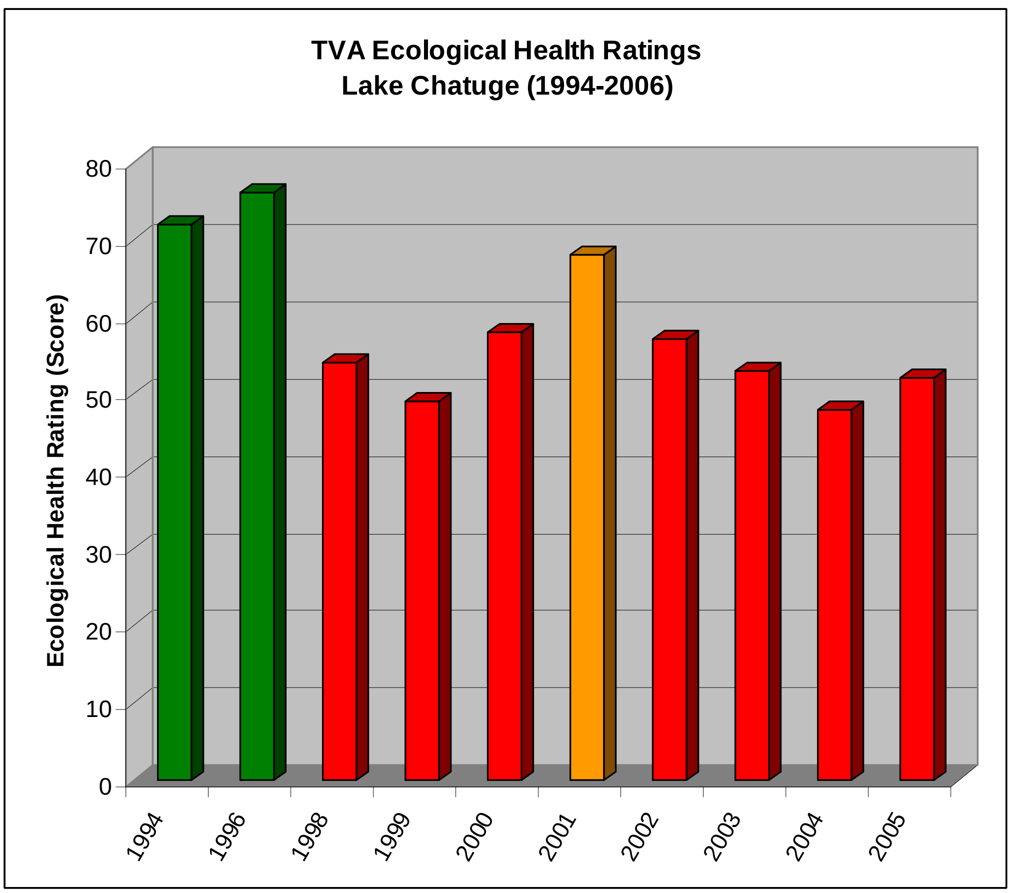
SECTION 3
JUSTIFICATION FOR LAKE CHATUGE STUDY & PLAN

3.1 Decline in TVA Reservoir Ecological Health Ratings

TVA regularly monitors five indicators of ecological health in each of its reservoirs, assigning a numerical score, called an Ecological Health Rating, at each assessment. The five monitored indicators are: dissolved oxygen, chlorophyll, fish community, bottom life, and sediment quality. Lake Chatuge has been monitored annually since 1998; the scores are presented in Figure 9. Appendix I contains more information about the TVA reservoir rating system including a description of each of the five indicators.

During the 1990s, TVA's Reservoir Ecological Health Rating for Lake Chatuge declined from "Good" in 1994 and 1996 with scores in the low to mid-70s to "Poor" starting in 1998 with scores in the mid-40s and low 50s. TVA has monitored Lake Chatuge annually since 1998 and, with the exception of one "Fair" rating in 2001, the reservoir has continually been rated Poor: http://www.tva.com/environment/ecohealth/chatuge.htm

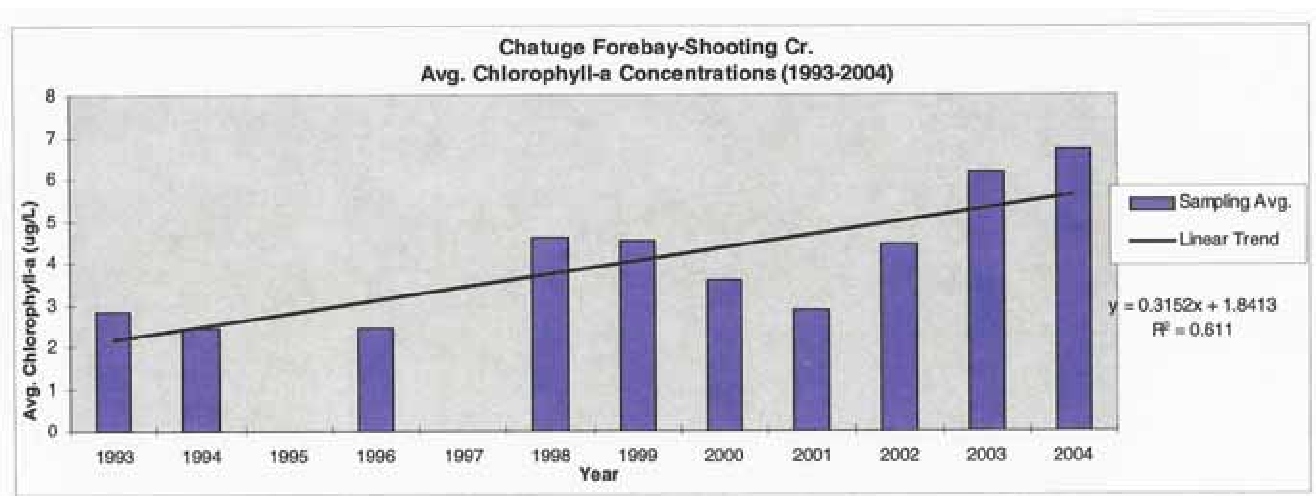
Figure 9. TVA Reservoir Ecological Health Ratings for Lake Chatuge (1994-2005)



In 2005, no one indicator received a rating higher than "Fair" at any location in Lake Chatuge. Four out of five of the indicators were rated "Poor" in the Shooting Creek Embayment. The two indicators that have the biggest influence on the Poor ecological health ratings for Lake Chatuge are dissolved oxygen and chlorophyll. Dissolved oxygen concentrations are very low in the bottom levels of Lake Chatuge for extended periods of time in the late summer and fall. Low dissolved oxygen can be a result of decomposition processes (the breakdown of organic material such as leaves or dead algae) or the introduction of oxygen-consuming wastes (such as biological oxygen demand from a wastewater treatment plant discharge). Low dissolved oxygen affects both the organisms that live on the bottom of the lake (bottom life indicator) and the fish communities as both require adequate concentrations of oxygen in the water for survival. The more organic material and/or oxygen-consuming waste in the lake, the larger the zone of low dissolved oxygen over a longer period of time. For Lake Chatuge, the low dissolved oxygen conditions also result in an odor below the dam in the fall due to the hypolimnetic (bottom layer) release from the dam.

Chlorophyll is the component of plants that gives them their green color. An increase in chlorophyll concentrations generally indicates an increase in the amount of algae living in the water. Not only can certain types of algae interfere with recreation activities in the lake and cause aesthetic problems, but there is also an impact from excess algae on dissolved oxygen concentrations. When algae in the reservoir die, they decompose and through this process, consume oxygen. According to TVA reservoir experts, average chlorophyll concentrations are increasing in Lake Chatuge (Figure 10).

Figure 10. Average Chlorophyll-*a* Concentrations in the Lake Chatuge-Shooting Creek Forebay and Linear Trend



Although average concentrations of chlorophyll-*a* have roughly doubled over the past decade, levels are still well below state and federal guidelines and criterion for consideration of "use impairment". When compared with reservoirs in other part of Georgia and North Carolina, Lake Chatuge is still considered by both state governments to be in good condition. If the concentrations of algae continue to increase, one result could be a use impairment designation by one or both states at which point regulatory measures could be used to reverse the trend. Often, by the time waters reach the point of state/federal impairment, it is too late to recover water quality without tremendous expense and community sacrifice.

3.2 Community Concerns

HRWC members and others throughout the Lake Chatuge community became very concerned in the late 1990s when the reservoir ecological health rating dropped from 76 to 54 in just two years. And, HRWC continued to be concerned when at the height of a four-year regional drought; the score still did not rebound to early 1990s levels. [Drought typically improves reservoir ratings because fewer nutrients and less organic material are carried into the lake from runoff resulting in lower chlorophyll concentrations and higher dissolved oxygen.] People in the community had different ideas about what was causing the low scores with runoff from leaky or failing septic systems and the Hiawassee wastewater treatment plant discharge being the most often identified "culprits". However at the time, no data existed to truly document the sources of the increased chlorophyll and low dissolved oxygen concentrations.

3.3 HRWC Groundwork for Response

Those working with HRWC in the late 1990s understood that water quality problems must be addressed on a watershed basis. In other words, Lake Chatuge cannot be separated from the land that drains into it and all 189 square miles of the watershed must be considered and if Lake Chatuge is to be returned to an ecologically healthy condition, sustaining good water quality.

In 2001, HRWC worked with the late Representative Ralph Twiggs and former Senator Carol Jackson to obtain a $216,000 appropriation from the Georgia legislature to determine, based on sound science, the causes and sources related to the increased algae and low dissolved oxygen. HRWC then began to take a very holistic look at the watershed, contracting for intensive professional water quality monitoring of the lake and its major tributaries, and partnering with TVA for a detailed land use analysis and computer modeling of the lake and watershed. [Section 4 details the data collection and computer modeling methods used in this intensive 4-year study of Lake Chatuge; Section 5 summarizes the results.] The purpose of this Action Plan is to recommend management strategies that, if properly implemented, will begin the process of returning Lake Chatuge to good ecological health.

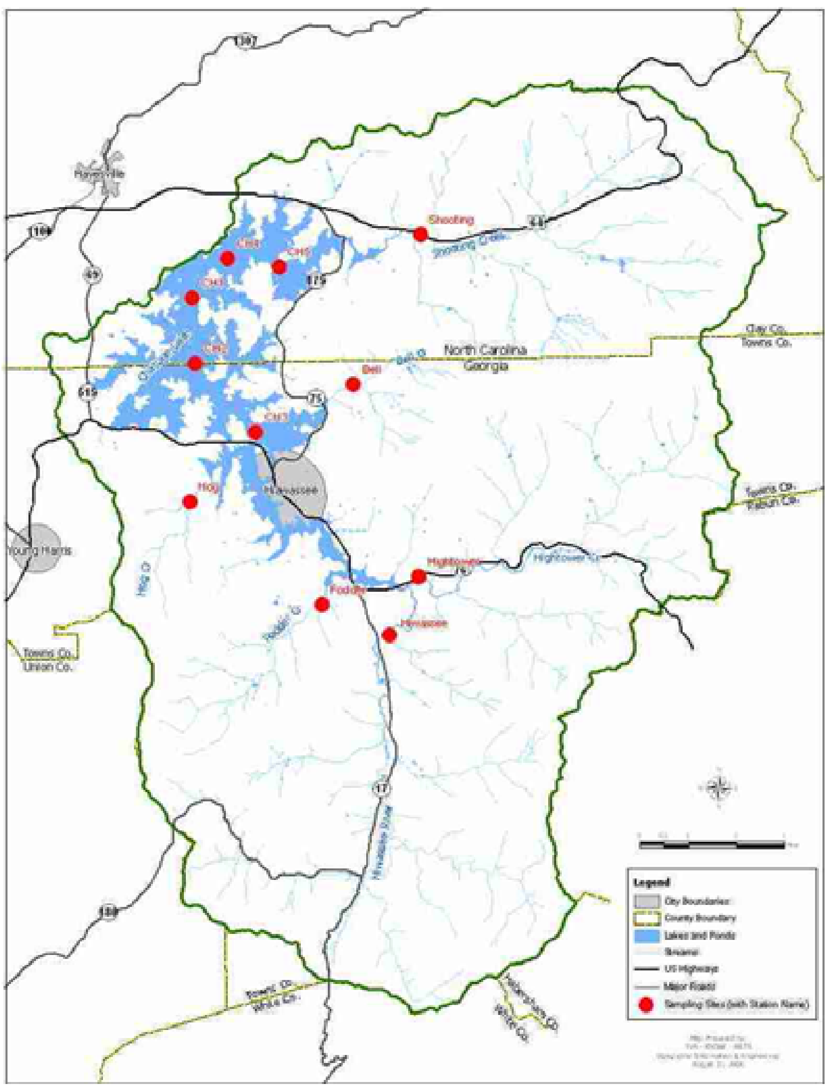
SECTION 4
DATA COLLECTION AND MODELING METHODS

4.1 Physical/Chemical Data

4.1.1 Site Selection

Prior to the HRWC study, annual water quality data only existed from two locations near the lower end of Lake Chatuge (CH1 and CH4). The water quality monitoring program was developed not only to have additional baseline data before any watershed improvements were made, but also to provide data inputs for the computer models discussed in Section 4.3. Monitoring sites were selected to provide the best representation of the water quality and pollutant loading of Lake Chatuge. A total of eleven sites were monitored in the Lake Chatuge watershed as part of the study (Fig 11).

Figure 11. Sites Sampled During Intensive Study of Lake Chatuge.



Site selection was based on physiographic features such as land uses, reservoir length and width, the number and size of major tributary streams, and the location of wastewater treatment plant discharges. Five of the sites were in the lake and Shooting Creek embayment; five sites were on major streams flowing into the lake: Hiwassee River, Hightower Creek, Fodder Creek, Hog Creek, and Bell Creek in Georgia and Shooting Creek in North Carolina. Table 3 presents information about the sampling sites, including what types of data were collected at each location.

Table 3. Sampling Locations and Type of Monitoring

Station	Drainage Area*/ (% of total)	Location	Flow Monitoring	Water Quality Monitoring
Lake Samples				
CH1	N/A	Hiwassee River Mile 122.0	☒	✓
CH2	N/A	Hiwassee River Mile 123.7	☒	✓
CH3	N/A	Hiwassee River Mile 126.0	☒	✓
CH4	N/A	Shooting Creek Mile 1.5	☒	✓
CH5	N/A	Shooting Creek Mile 3.0	☒	✓
Stream Samples				
Shooting Creek	50.7 mi^2/ (26.8%)	On Hwy. 64 just past Little Brook Rd.	✓	✓
Bell Creek	8.0 mi^2/ (4.2%)	Off Upper Bell Creek Rd. in Bell Creek Estates	✓	✓
Hightower Creek	33.2 mi^2/ (17.6%)	On Hwy. 76 across from Bearmeat Rd.	✓	✓
Hiwassee River	26.7 mi^2/ (14.1%)	On GA Hwy. 75 just upstream from Rice bridge	✓	✓
Fodder Creek	10.6 mi^2/ (5.6%)	On Fodder Creek Rd. under bridge just past rock quarry	✓	✓
Hog Creek	8.0 mi^2/ (4.2%)	At Hog Creek Rd. just upstream from the first bridge crossing	✓	✓

Note:
✓ Indicates monitoring of this parameter at this location.
☒ Indicates that this parameter was not monitored at this location.
* Calculated by TVA from USGS Quadrangle Maps (1942).
N/A Not Applicable

4.1.2 Methodology

<u>Lake Sampling</u>

Eight sampling events were conducted at each of the five lake sampling locations for the following 13 parameters: temperature, pH, conductivity, dissolved oxygen, chlorophyll-

a, total suspended solids, total dissolved solids, total organic carbon, biological oxygen demand, Ortho-phosphate, nitrate-nitrite, bicarbonate alkalinity, and total Kjeldahl nitrogen. Three discrete grab samples were collected on a monthly basis from each of the sampling locations at various depths to address lake stratification. All three discrete samples were analyzed for each of the parameters with the exception of chlorophyll-*a*; only one sample was collected from the top 1.5 meters of the lake surface for chlorophyll-*a* analysis (very little growth occurs below this depth due to limited light penetration). The *Monitoring Plan for the Lake Chatuge Eutrophication Study* contains details about sample collection and analysis, including quality assurance and quality control procedures (HRWC, March 2003b).

<u>Stream Sampling</u>

Nineteen sampling events were conducted at each of the six stream sampling locations for the following 12 parameters: temperature, pH, conductivity, dissolved oxygen, total suspended solids, total dissolved solids, total organic carbon, bicarbonate alkalinity, Ortho-phosphate, nitrate-nitrite, ammonia, and total Kjeldahl nitrogen. In addition to these routine, “ambient” samples, two additional wet-weather sampling events were also conducted during this period. A qualifying wet-weather event had a minimum rainfall of over 0.10 inches and result in an increase in flow depth at the sampling locations. Qualifying wet-weather events will also have a minimum of a 72-hour dry period preceding the rainfall event. Rainfall events less than 0.1 inches are considered dry-weather periods. The *Monitoring Plan for the Lake Chatuge Eutrophication Study* contains details about sample collection and analysis, including quality assurance and quality control procedures (HRWC, March 2003b).

4.1.3 Time Frame and Other Considerations

Physical/chemical data were collected in the Lake Chatuge watershed between December 2002 and November 2003. Stream samples were collected biweekly from December 2002 through April 2003, and monthly May through November 2003. Lake samples were collected on a monthly basis from April 2003 through November 2003 (HRWC, March 2003b). Although the area experienced a moderate drought between 1999 and 2001, the area had recovered by fall of 2002 and 2003 was considered a normal flow year in terms of precipitation and runoff.

4.2 Land Use Data Collection and Analysis

4.2.1 Integrated Pollutant Source Identification (IPSI)

Integrated Pollutant Source Identification (IPSI) is a geographic database and set of tools designed to aid citizens and planners in implementing water quality improvement and protection projects within a watershed. The geographic database consists of information on watershed features, such as land use/land cover, stream bank erosion sites, and other suspected sources of nonpoint pollution. Information for the database is generated by interpretation of low-altitude color infrared aerial photography (TVA, 1992).

The IPSI process generates a unique database for the study area and provides a means to screen areas by land activities and conditions that can affect water quality. The data is managed using commercially available geographic information system (GIS) software (TVA, 1992).

4.2.2 Methodology

Low-altitude, color infrared aerial photography was taken of the Lake Chatuge watershed by TVA. Over a period of several months, the photography was interpreted by experienced photo-analysts for geographic features that contribute or are suspected to contribute nonpoint source pollution within the watershed. GIS attributes that describe the set of geographic features were then generated (HRWC, March 2003b).

Components of the Lake Chatuge IPSI include:

- Land cover information
- Road conditions
- Riparian buffer conditions
- Impervious cover
- Soil loss estimates
- Nutrient loading rates

HRWC staff and partners field-verified much of the Lake Chatuge IPSI data to insure its viability for use in the study. Figures presented in Sections 2 and 5 display land cover (Fig 7), impervious area (Fig 12), and riparian condition (Fig 13) data developed as part of the IPSI analysis for the Lake Chatuge watershed.

4.2.3 Time Frame and Other Considerations

The Lake Chatuge watershed IPSI database was completed in 2003 based on aerial photographs that were acquired in early spring 2002.

4.3 Modeling

4.3.1 Watershed Model

The Hydrological Simulation Program-Fortran (HSPF) model was used to calibrate the nutrient and organic concentrations flowing into Lake Chatuge from the watershed with field measurements collected during the 2003 sampling. HSPF uses hydrology and land use data inputs to model runoff rates and concentrations of sediment and nutrients, as well as a wide variety of other substances carried in the runoff. HSPF divides precipitation that reaches the ground into surface runoff, interflow (water moving through the soil and/or rock beneath the ground surface), and groundwater. The water that reaches a stream, after losses from evaporation, transpiration and storage, is routed through the stream network to simulate discharge rates.

Rainfall detaches sediment in the model based on soil and land cover characteristics. The sediment is carried by surface runoff to the channel, where it is subject to settling and re-suspension processes while being routed with the water flow. HSPF also simulates nitrogen and phosphorus cycles, and the transport of nutrients by water to streams. Alkalinity, pH, biological oxygen demand, and organic carbon can also be tracked using the model (TVA, December 2004).

4.3.2 Reservoir Model

CE-QUAL-W2 (Version 2) is a two-dimensional, longitudinal/vertical, hydrodynamic and water quality model. Because the model assumes lateral homogeneity, it is best suited for relatively long and narrow waterbodies exhibiting longitudinal and vertical water quality gradients. The model predicts water surface elevations, velocities, temperatures, and 21 water quality parameters including nutrient/phytoplankton/ dissolved oxygen interactions under anoxic conditions (TVA, December 2004).

A two-dimensional CE-QUAL-W2 water quality model of Chatuge reservoir was calibrated using field data collected in 2003. Calibration results showed that the model well reproduced the measured seasonal temperature and dissolved oxygen patterns. However, the computed algal productivity is not considered validated due to poor pH calibration (TVA, December 2004).

4.3.3 Confidence in Results

The goal of watershed model (HSPF) calibration was to match model output with measured flows and actual water quality data while accurately accounting for the physical processes in the watershed and attributing pollutant loads to the correct sources. A “weight of evidence” approach was used for calibration. The model was run repeatedly to test sensitivity of the many different factors and to match concentrations of the water quality parameters to the various sub-watersheds based on the land uses within the particular sub-watershed. The reservoir model (CE-QUAL-W2) used the output of the watershed model as the initial input. Again, calibration was performed to match model output to measured water quality parameters in the reservoir.

Because good models that are well calibrated accurately capture the most important physical processes in the watershed and reservoir, it becomes possible to predict the response of the system to management changes. These models are accepted and state-of-the-art. The calibration was performed based on reliable, professionally-collected data and discussions with local natural resource personnel. Modelers with experience and insight into the appropriate processes ran both the calibration and management scenarios.

SECTION 5
LAKE CHATUGE STUDY RESULTS

Prior to the HRWC study, annual reservoir monitoring data collected by TVA showed a substantial increase in algae in Lake Chatuge between 1994 and 2004. Other ecological health indicators such as bottom life and dissolved oxygen concentrations also rated poorly. These general ecological health "issues" are discussed in Section 3. Section 5.1 below details the reasons for the increase in algae and low dissolved oxygen in terms of the types of pollutants in the watershed and the processes in the lake that are causing problems. Section 5.2 discusses the sources of these pollutants; 5.3 outlines their relative contributions; and 5.4 presents their general location within the watershed.

5.1 Causes of Degradation

5.1.1 Excess Nutrients

The most significant nutrients for growth of plants, including algae, are nitrogen and phosphorus. Algae are relatively sparse when nutrient concentrations are low in the lake. In contrast, high concentrations of nutrients may be accompanied by excessive growths of algae and other aquatic plants, which can cause the water to look like "pea soup", form surface scum, or have an unpleasant odor. Typically, reservoirs in the Blue Ridge Mountains would contain very low concentrations of nutrients and would be relatively clear with only a small amount of green coloration. Because this natural condition exists a seemingly small amount of nutrients can cause a relatively large amount of algae growth.

The water quality study of Lake Chatuge shows that an excess of nutrients is the leading cause of low ecological health ratings. This result was expected due to elevated concentrations of algae in the lake. However, the study provided a much larger volume of data and the ability to determine which sources were contributing most to the problem (discussed in Section 5.3).

5.1.2 Excess Sediment

One of the main ways in which nutrients are delivered to the lake is attached to soil particles carried in stormwater runoff. An excess of soil erosion in the watershed produces an excess of sediment deposited in streams and lakes and also contributes to an excess of nutrients. Excess sediment suspended in the water can clog the gills of fish and other aquatic life and also degrades or destroys bottom life in the streams and lake. Further, when sediment fills in shallow areas of the lake, these areas become warmer because there is light penetration to the lake bottom over a larger area. This creates prime conditions for algae growth, especially when nutrients are attached to the newly deposited sediment particles. Excess sediment is the leading cause of water quality problems in streams in the Lake Chatuge watershed and is also a large part of the low ecological health ratings for the lake.

5.1.4 Increased Temperature

Like many other green plants, algae grow better in warmer temperatures. When excess sediment is deposited in the lake, these areas become more shallow and therefore, warmer. The lake is also warmed when shoreline vegetation is removed and replaced with large rock (rip-rap) and when vegetation is removed from the banks of streams flowing into it. Summer temperatures in many tributary streams are warmer than what is desirable for mountain trout streams and therefore contribute to the warming of Lake Chatuge. In addition to improving conditions for algae growth, increased temperature also affects dissolved oxygen concentrations. Warmer water holds less dissolved oxygen than cooler water. Therefore, higher water temperatures in the lake also directly affect fish and other aquatic life living in it.

5.2 Sources of Degradation

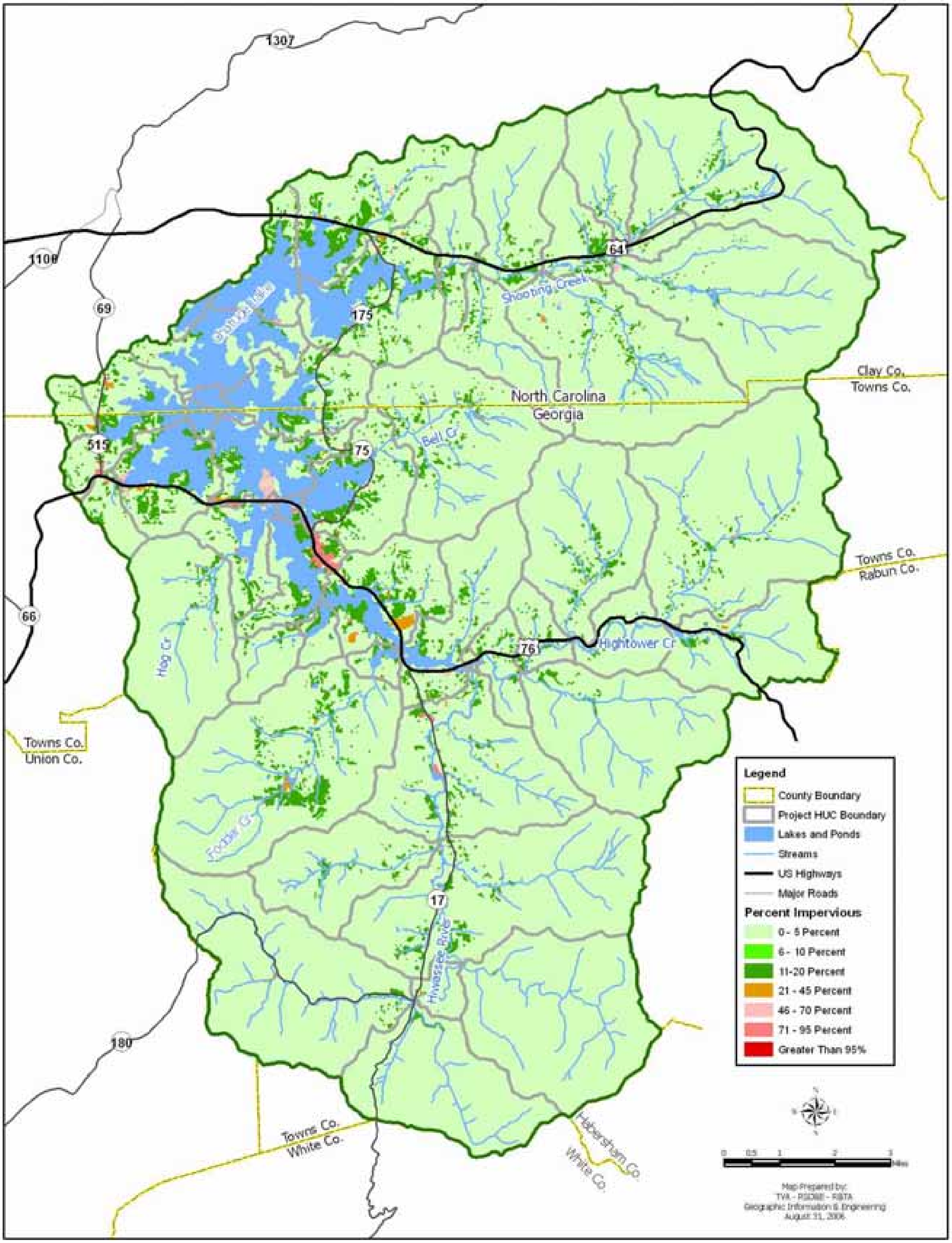
5.2.1 Developed Areas

There are approximately 4,800 acres of developed areas in the Lake Chatuge watershed, primarily along the highway corridors and in the City of Hiawassee. Excess nutrients in stormwater runoff from developed areas comes from soil erosion associated with cuts and slopes behind businesses and homes, as well as from commercial applications of fertilizer on lawns, ball fields, golf courses, and landscaping. Excess nutrients also come from domesticated populations of Canada geese that are often fed by homeowners and allowed to nest on residential and publicly owned property around the lake shoreline. Often there is not enough woody vegetation along the shoreline of Lake Chatuge (or stream banks of tributaries) to filter runoff from these areas.

Impervious surfaces associated with developed areas also contribute heavily to the ecological health problems in Lake Chatuge. Impervious cover does not allow water to sink into the soil; examples are roads, rooftops, driveways, and parking lots. These hardened surfaces cause a larger quantity of water to run off the land at a much faster rate. Typically stormwater from developed areas is channeled into drainage systems (ditches, pipes, etc.), which carry pollutants directly into streams (or the lake). Due to the velocity of the water, runoff from impervious areas causes accelerated erosion of streambeds and banks, carrying nutrient-laden sediment into the lake. And, because these surfaces absorb sunlight, the water is often heated as well. Figure 12 presents impervious cover data for the Lake Chatuge watershed. Areas of impervious cover are concentrated along the Lake's shoreline and streams, as well as in highway corridors throughout the watershed.

The Center for Watershed Protection (CWP), a national non-profit organization that provides consultation and education on preserving stream health, reports that based on numerous studies across the United States, a sharp decrease in ecological health is observed when impervious cover reaches 15-20 percent or more in a given watershed. The Center also states that 10% impervious cover is often the "tipping point" for a watershed to maintain healthy aquatic life in streams (Center for Watershed Protection, 2006).

Figure 12. Impervious Cover by Percentage for the Lake Chatuge Watershed (2002)



In 2003, nearly 2.5% (2,943.8 acres) of the Lake Chatuge watershed was covered with impervious surfaces; roads comprised half of the impervious area (1,444.7 acres). Although the 189 square mile watershed is only 2.5% covered with impervious surfaces, many localized areas within the larger watershed contain well over 50% impervious cover!

Table 4 presents 2003 impervious cover data for larger tributary watersheds, as well as the Lake's shoreline. The Woods Creek watershed on the western side of the lake in Georgia and the Licklog Creek watershed on the north side in North Carolina are rapidly approaching the 10% mark as is the area immediately surrounding Lake Chatuge, when taken as a whole. As the health of smaller sub-watersheds declines, so will the ecological health of Lake Chatuge continue to decline as a result of these impacts.

Table 4. Impervious Cover Data for Tributary Watersheds and the Shoreline (2003)

Name	Total Acres	Impervious Acres	Percent Impervious
Shooting Creek	28,452	583	2.0
Licklog Creek	2,882	147	5.1
Woods Creek	2,249	133	5.9
Bell Creek	6,778	224	3.3
Hog Creek	5,172	99	1.9
Bearmeat Creek	2,586	86	3.3
Fodder Creek	7,398	181	2.4
Hiwassee River	29,591	379	1.3
Hightower Creek	17,347	225	1.3
Scataway Creek	3,982	49	1.2
Shoreline Area	14,574	838	5.7

5.2.2 Agricultural Lands

The Lake Chatuge watershed still contains approximately 10,000 acres of pastures and hay lands; there are less than 50 acres of traditional row crops. Nutrients from these lands come from fertilizers (commercially-prepared or locally-generated) that are applied to the land to produce better grasses for grazing and crops of hay for winter-feeding of livestock. Nutrients also come directly from animal waste; in some areas livestock have direct access to long lengths of streams.

As is the case in residential areas, there is often not enough vegetation along streams to filter runoff from these lands. The lack of riparian vegetation and historic or current livestock access combine on agricultural lands to create stream banks that are easily eroded. When erosion of stream banks occurs, nutrients are carried directly into the lake on particles of sediment and become dissolved in the lake. Additionally, many streams have been moved and/or straightened in the past to better accommodate crops and to prevent flooding. Science has since taught us that the natural channel design is most efficient at moving water through the watershed network without causing additional problems. Water flowing through these altered streams has a much higher velocity;

causing erosion of the streambed and banks much like is associated with runoff from impervious surfaces.

5.2.3 New Development

The most urgent impact of new development in the Lake Chatuge watershed is from sedimentation associated with construction activities. Over the past 10 ten years, very few developers, builders, or grading/clearing contractors have installed and maintained the needed best management practices (BMPs) for controlling erosion, particularly during road construction in the watershed. Under these circumstances, large amounts of sediment leave the site, flowing into streams and ultimately the lake. Likewise, there has been very little enforcement of erosion control laws in either state in order to improve the situation. In addition to sedimentation during construction, often roads are not properly planned within a development, leading to ongoing erosion (and maintenance) problems for years after home sites are stabilized with vegetation. Many of these roads are privately-owned and homeowners lack the ability to correct the problems. Often erosion from new development takes place on land that was formerly in agriculture where the soil is nutrient-rich, adding to problems with excess nutrients, as well as excess sediment in the lake.

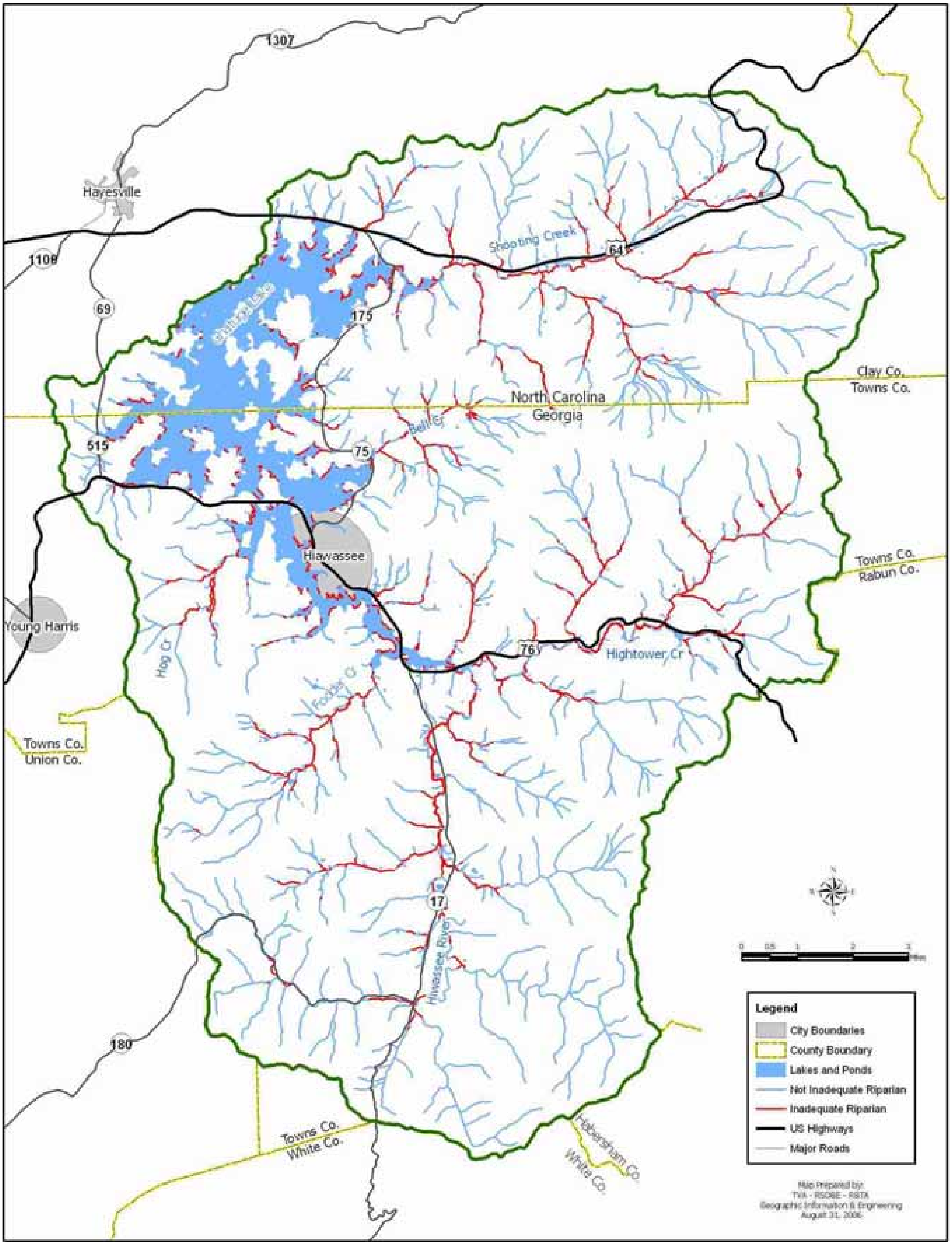
Whereas historically development occurred along highways, near towns, and along the inside edge of river valleys (base of slopes), new development is occurring in floodplains directly adjacent to streams and the lake and on ridges. Due to these new patterns of development, more impervious cover is spread over a much larger area in the watershed. Roads are longer (to get up the mountains) and homes are larger, creating more impervious surface per lot. The impacts of this increased impervious cover are discussed in part 5.2.1. Because much of the new development is located directly adjacent to the lake and streams throughout the watershed, woody vegetation in the riparian buffer areas is reduced as well.

5.2.4 Inadequate Riparian Buffers

Many reaches of tributary streams and miles of the Lake Chatuge shoreline contain very little, if any, woody vegetation (tree and shrubs). The riparian buffer is an area measured 30-150 feet from the top of the stream bank or from the water's edge at full pool (for the lake). Figure 13 shows areas within the Lake Chatuge watershed that lack an adequate riparian buffer (minimum of 30 feet of woody vegetation). For streams, a stream is shown in red if riparian buffers on one or both sides are inadequate.

A lack of woody vegetation was noted in each of the above parts as contributing to the problems with excess sediment and nutrients due to erosion. However, woody vegetation also naturally shades the stream and shoreline of the lake. When the vegetation is removed, the water temperature increases. And when the vegetation is replaced with rock (rip-rap or walls), the rock absorbs sunlight, further heating the water. Re-planting or maintaining woody vegetation along streams and the lake shoreline is one of the best, easiest, and most cost-effective ways to improve the ecological health of Lake Chatuge.

Figure 13. Inadequate Riparian Buffers in the Lake Chatuge Watershed (2002)



5.2.5 Point Sources Discharges

Point source discharges are those that enter surface waters at a discrete, well-defined location, such a pipe, from a specific facility and are required to apply for and obtain a National Discharge Elimination System (NPDES) permit from the state. There are very few point source discharges in the Lake Chatuge watershed and only two that empty directly into the lake. These discharges are associated with wastewater treatment plants for the City of Hiawassee and the US Forest Service-Jackrabbit Campground. The NPDES permit establishes discharge limits for flow (quantity discharged), conventional pollutants (BOD, pH, TSS, fecal coliform/E. coli, oil & grease, etc.), toxicants (metals, volatile organic compounds, etc.), and non-conventional pollutants such as ammonia and nutrients where appropriate. States have the authority to establish state water quality standards that are more stringent than the federal standards established by the Environmental Protection Agency (EPA).

Generally, the primary pollutants from point sources are oxygen-consuming wastes, nutrients, color, and toxic substances including chlorine, ammonia and metals. However, nutrients are the only current issue associated with the two wastewater treatment plants discharging into Lake Chatuge. Planning for future wastewater treatment is needed to protect and improve Lake Chatuge's ecological health.

5.2.6 Improperly Functioning Septic Systems

Development of rural land in areas not served by sewer systems is occurring rapidly in the upper Hiwassee 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 (considered a nutrient compound) 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 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).

5.3 Summary of Causes & Sources Linked with Preliminary Plan Goals

The primary goal of the study of Lake Chatuge was to determine the actions needed to return the lake to "Good" Ecological Health as determined by TVA's Reservoir Vital Signs Monitoring program. This goal also became a goal of the Lake Chatuge Watershed Action Plan. Table 5 links the indicators of ecological degradation and the causes and sources discussed in Sections 5.2 and 5.3 with the preliminary plan goals. The "Target Values" shown in the table are discussed in Section 5.5.

5.4 Distribution of Nutrient/Sediment Load by Source & Location

Both nitrogen and phosphorus (the two most significant nutrients related to algae growth) are of concern in Lake Chatuge. However, phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir. [Blue Ridge Lake in Fannin County, GA serves as a regional reference lake for mountain tributary reservoirs in the Tennessee Valley system. Most of the watershed draining into Blue Ridge Lake lies within the Chattahoochee National Forest.]

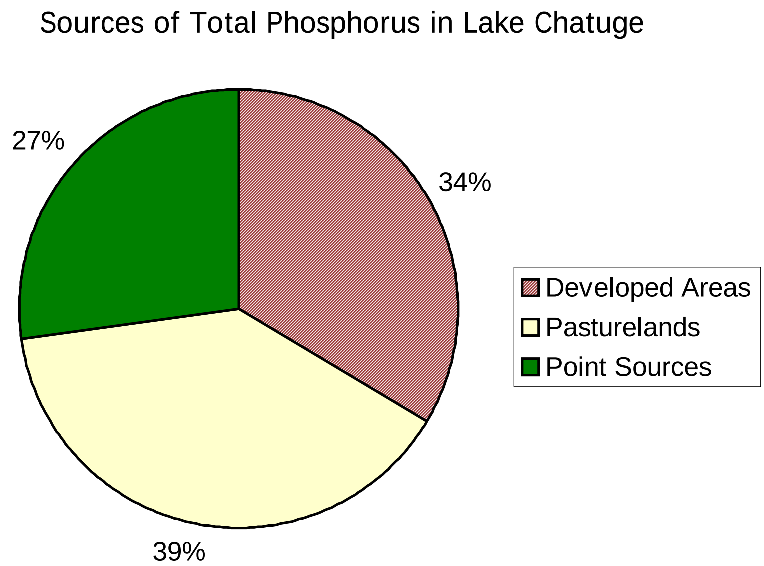
In 2003, Lake Chatuge was receiving 9,600 pounds of phosphorus per year. There are three broadly described sources of phosphorus (Figure 14), each representing about one-third of the load: pasturelands/livestock (39%), residential/commercial developed areas (34%), and treated wastewater discharges (27%). The graphed data seem to indicate that if phosphorus in runoff from agricultural areas within the Lake Chatuge watershed is eliminated, the water quality situation could be controlled. However, upon closer examination in light of land use information presented in Section 2.3.4, the data show that roughly 3,700 pounds of phosphorus per year is coming from 10,000 acres of agricultural land (0.37lbs/acre), but nearly the same amount (3,300 pounds per year) is coming from only 4,800 acres of developed land (0.69lbs/acre)!

Table 5. Plan Goals Linked to Indicators of Degradation and Causes and Sources of Impacts

Preliminary Goals	Indicators	Target Values (if applicable)	Causes of Impacts	Sources of Impacts
• Return Lake Chatuge to "Good" Ecological Health • Prevent noxious algae blooms • Prevent Lake Chatuge from becoming "Impaired" according to state Water Quality Standards	• Total Phosphorus • Total Nitrogen • Chlorophyll a • Hypolimnetic Dissolved Oxygen	• 30% reduction in TP and TN loading to the lake • reduce average annual chlorophyll a in the lake to <5 ug/l • decrease area of DO <5.0mg/l in the lake by 10%	• Excess nutrients • Excess sediment • Increased Temperature • Increased algae growth • Low DO	• Lack of enforcement of erosion/sediment control laws • Untreated post-construction stormwater runoff from commercial and residential developed areas • Lack of adequate riparian buffers • Runoff from pasturelands • Unrestricted livestock access to streams • Leaky or failing septic systems • Lack of nutrient limits for NPDES permitted discharges • Excess fertilizer runoff from lawns • Waste from pets and wildlife
• Protect and restore wooded shoreline and riparian buffers	• Miles of shoreline with adequate buffer • Miles of stream with adequate buffer • Temperature	Can track number of stream and shoreline miles replanted, enhanced, and/or protected with easements, however numeric targets are not appropriate.*	• Excess sediment • Increased Temperature • Decreased aquatic and small game/bird habitat • Excess nutrients	• Removal of streamside and shoreline vegetation during development of property or associated with agricultural activities • Construction of homes or buildings within 50 feet of lake shoreline or stream banks • Damage to vegetation by livestock • Erosion of stream banks associated with stormwater impacts and natural events (e.g. storms, floods) • Proximity of roads to streams
• Improve stormwater management in commercially developed areas & along highways	• Total Phosphorus • Total Nitrogen • Total Suspended Solids	Can track reductions in all three indicators from individual sites based on performance of implemented BMPs, however, additional numeric targets are not appropriate. *	• Excess sediment • Increased runoff associated with rain/snow events • Excess nutrients • Increased Temperature	• Lack of adequate erosion control practices implemented and/or maintained during construction • Construction of buildings and/or parking lots within 50 feet of lake shoreline or stream banks • Untreated post-construction stormwater runoff from developed areas and roads/highways • Removal of streamside and shoreline vegetation during development of property
• Better manage future growth in the watershed	• Local ordinances • Adequate enforcement of existing laws	Not applicable.*	All of the above	• Lack of enforcement of erosion/sediment control laws • Untreated post-construction stormwater runoff from developed areas and roads/highways • Lack of adequate riparian buffers • No plans for handling an ever-increasing burden of wastewater treatment • Leaky or failing septic systems • Construction of homes or buildings within 50 feet of lake shoreline or stream banks

*Efforts in this regard will assist in meeting numeric targets associated with the first two goals.

Figure 14. Broadly Described Sources of Total Phosphorus in the Lake Chatuge Watershed by Percent (2003)



Figures 15, 16 and 17 present ranges of Total Phosphorus (TP), Nitrogen (N) and Total Suspended Solids (TSS) delivered to the lake from each of the sub-watersheds identified in Section 2.2.3. [A map and key to the sub-watersheds is located on pages 12 and 13.]

Table 6 presents a summary of this information by sub-watershed. A priority level for implementation of the Action Plan has been assigned by HRWC based on these data and information about trends in new development; these priorities are also listed in Table 6.

Figure 15. Total Phosphorus (lbs/yr) Loading by Sub-Watershed (2003)

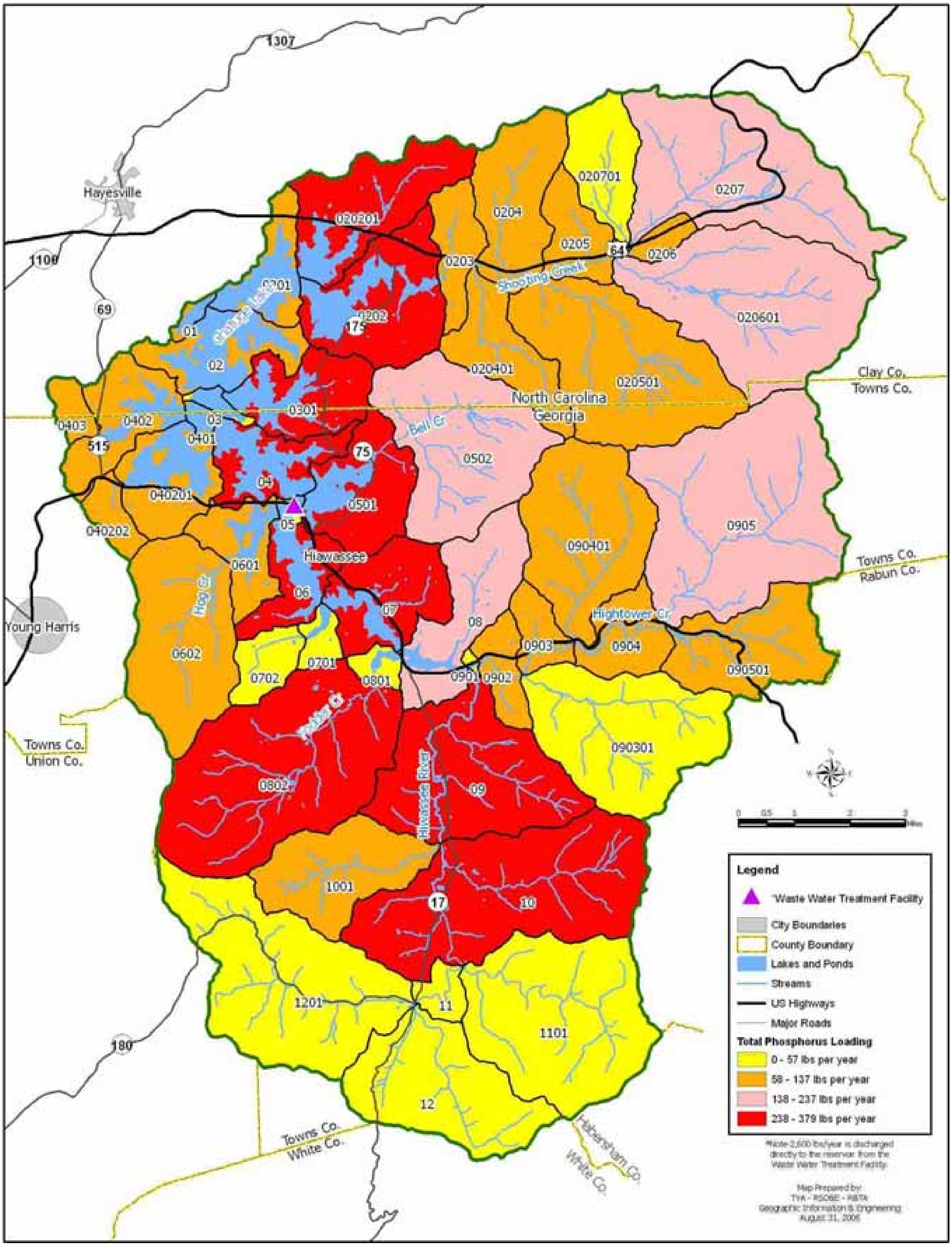


Figure 16. Total Nitrogen (lbs/yr) Loading by Sub-Watershed (2003)

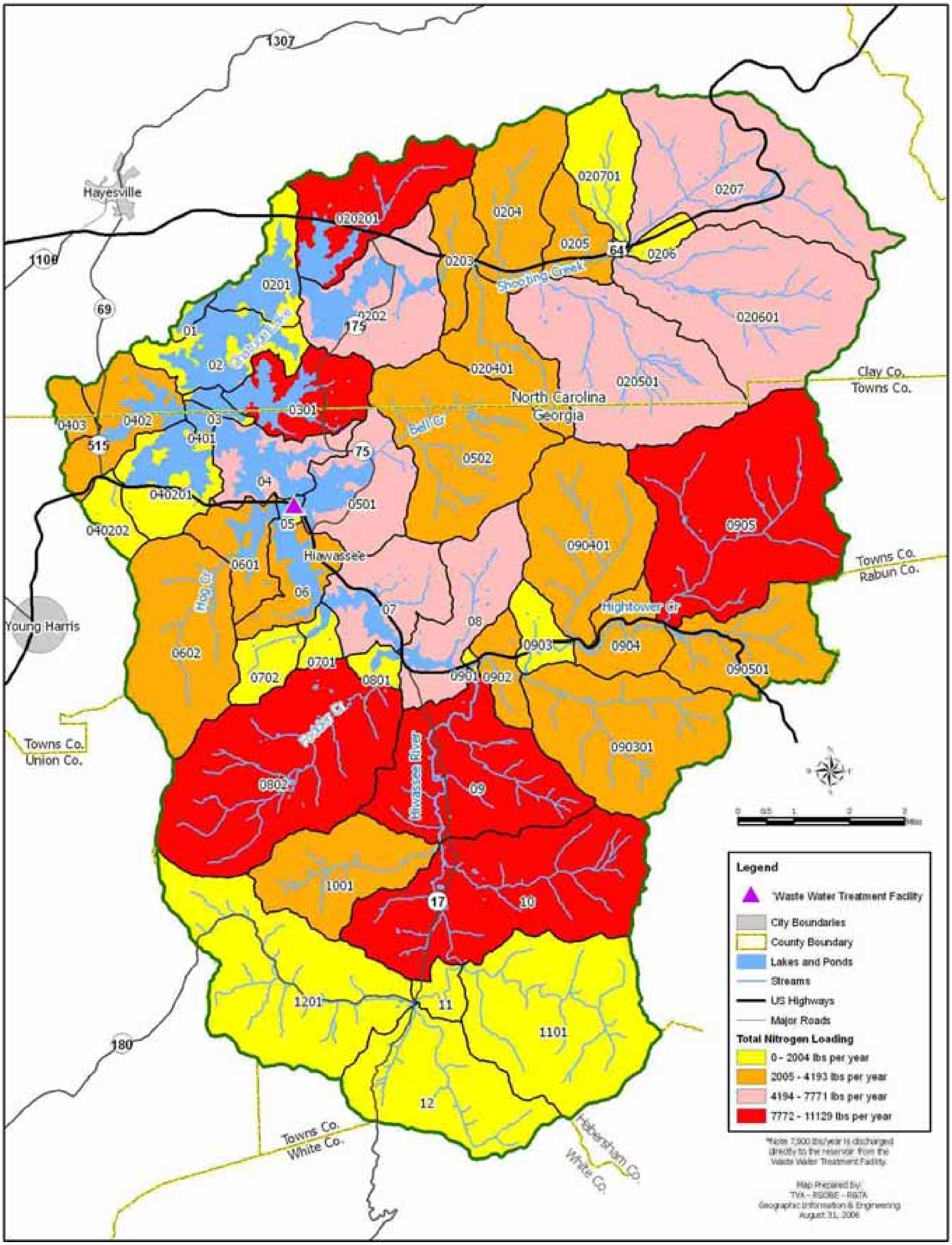


Figure 17.Total Suspended Solids (lbs/yr) Loading by Sub-Watershed (2003)

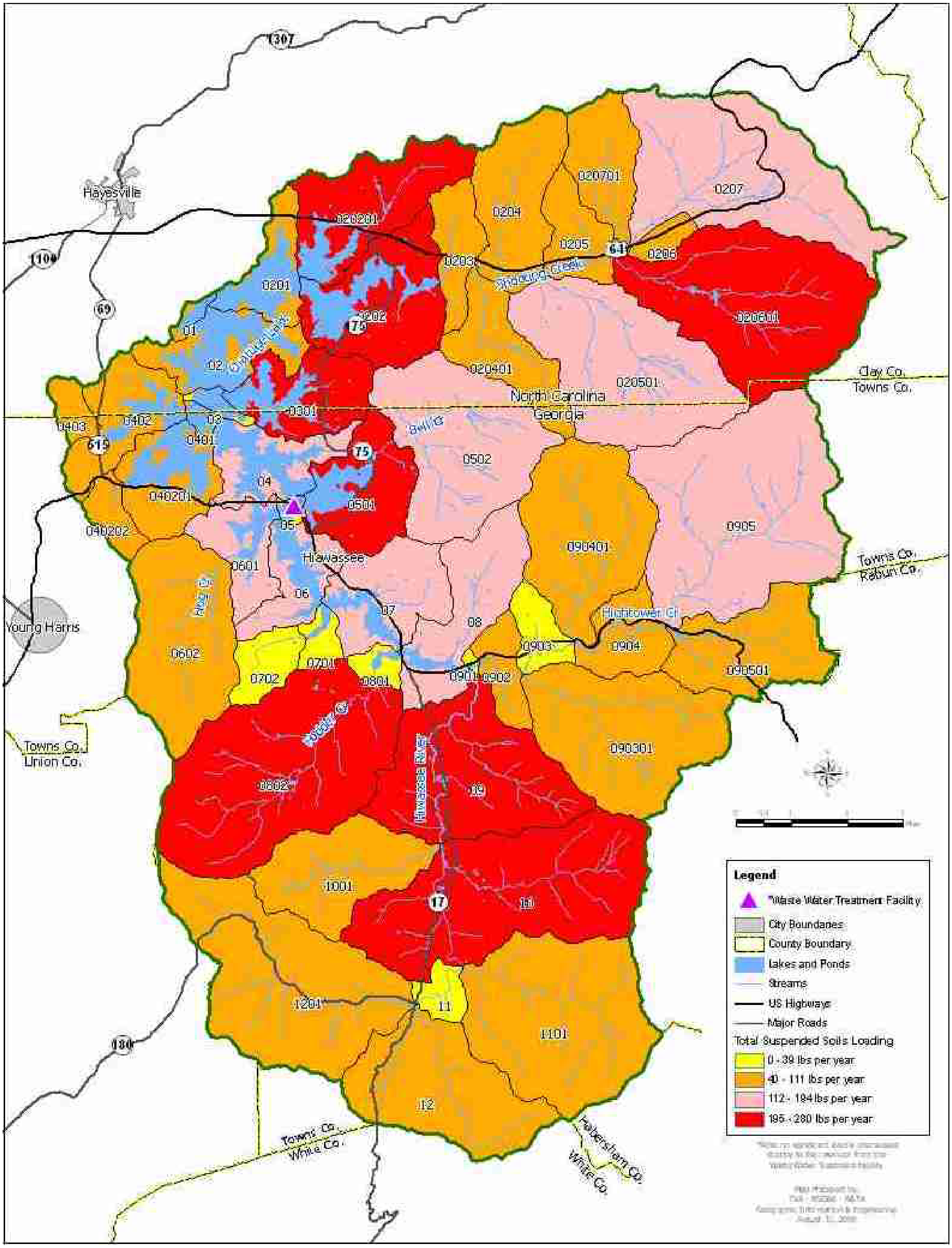


Table 6. Summary of Total Phosphorus (TP), Total Nitrogen (TN), and Total Suspended Solids (TSS) By Sub-Watershed (2003) with Assigned Priorities

Sub Code	Sub-Watershed Name	TP	TN	TSS	Priority
01 *	Chatuge Dam	2	1	2	Low
02	Lower Lake Chatuge	2	1	2	Low
0201	Lower Shooting Cr Embayment	2	1	2	Medium
0202	Upper Shooting Cr Embayment	4	3	4	High
020201	Licklog Creek	4	4	4	High
0203	Rocking Chair	2	2	2	Medium
0204	Pounding Mill	2	2	2	Medium
020401	Hothouse Branch	2	2	2	Medium
0205	Jackie Cove	2	2	2	Medium
020501	Giesky Creek	2	3	3	High
0206 *	Old 64/New 64	2	1	2	Medium
020601	Eagle Fork	3	3	4	High
0207	Shooting Cr Headwaters	3	3	3	High
020701	Vineyard	1	1	2	Medium
03 *	Chatuge at State Line	1	1	1	Low
0301	Sneaking Creek	4	4	4	High
04	Middle Lake Chatuge	4	3	3	High
0401	Cedar Cliff	2	2	2	Medium
0402	Woods Creek Embayment	2	2	2	Medium
040201	Ramey Mountain	2	1	2	Low
040202	Mining Gap	2	1	2	Low
0403	Woods Creek	2	2	2	Medium
05 *	Fairgrounds	1	1	1	Medium
0501	Lower Bell	4	3	4	High
0502	Upper Bell	3	2	3	High
06	Hiawassee	4	2	3	High
0601	Hog Cr Embayment	2	2	3	Low
0602	Hog Creek	2	2	2	Low
07	Upper Lake Chatuge	4	3	3	High
0701 *	Transfer Station	1	1	1	Low
0702	Woodring Branch	1	1	1	Low
08	Bearmeat Creek	3	3	3	High
0801 *	Fodder Cr Embayment	1	1	1	High
0802	Fodder Creek	4	4	4	High
0901 *	Hightower Embayment	1	1	1	Low
0902	Lower Hightower Cr	2	2	2	Medium
0903	Middle Hightower Cr	2	1	1	Medium
090301	Swallow Creek	1	2	2	Medium
0904	Upper Hightower	2	2	2	Medium
090401	Scataway Creek	2	2	2	Medium
0905	Hightower Cr Headwaters	3	4	3	High
090501	Little Hightower	2	2	2	Medium
09	Cynth Creek	4	4	4	High
10	Mill Creek	4	4	4	High
1001	Owl	2	2	2	Low
11	Upper Hiwassee River	1	1	1	Low
1101	Corbin Creek	1	1	2	Low
12	Hiwassee River Headwaters	1	1	2	Low
1201	Soapstone	1	1	2	Low

* Sub-watershed area is very small.

The priorities assigned in the last column of Table 6 will simply direct the Hiwassee River Watershed Coalition's actions as outlined in Section 7. It is provided here so that other entities might also make use of it when setting priorities for funding and attention. HRWC has no intention of ignoring the sub-watersheds marked as low priority; in order to restore Lake Chatuge to good ecological health, the entire watershed must be cared for. These priorities are so that we may begin our efforts by focusing in areas where the biggest "bang for the buck" can be achieved.

5.5 Target Reductions

Computer modeling efforts indicate that a 30% reduction in both phosphorus and nitrogen is needed to once again achieve a Good Ecological Health Rating for Lake Chatuge. Phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir. And, when actions are taken to reduce phosphorus from non-point sources of pollution, nitrogen is usually reduced as well. Finally, phosphorus doesn't go through as many processes in the environment (exchange with the atmosphere, etc.) that occur with nitrogen, making it easier to measure and predict. For these reasons, HRWC has chosen phosphorus as the parameter for which to target reductions. Actions are also recommended to reduce sediment, indirectly reducing the attached nutrients as well. Section 6 presents recommended actions for all segments of the community such that we can all work together to achieve the goal of "Good" ecological health for Lake Chatuge. Section 7 details measurable management strategies for which funding will be sought to improve Lake Chatuge.

SECTION 6
RECOMMENDED ACTIONS FOR LAKE IMPROVEMENT

Recommended actions are only listed in this section. Please visit the Hiwassee River Watershed Coalition's website for a more detailed discussion of each recommendation: http://www.hrwc.net or contact the HRWC office if you prefer to be mailed a hard copy.

6.1 Recommendations for Federal and NC/GA State Government Agencies

- 6.1.1 Enforce applicable water quality rules and regulations and sediment/erosion control laws
- 6.1.2 Provide increased monitoring of streams and the lake
- 6.1.3 Provide basin-wide insight into watershed health on a regular basis
- 6.1.4 Provide funding for management measures outlined in this plan
- 6.1.5 Provide assistance to local governments who are trying to manage growth (technology, training & funding)
- 6.1.6 Provide an awareness of relevant tools as they become available
- 6.1.7 Avoid implementation of "blanket" rules and regulations
- 6.1.8 Improve the TMDL program and implementation plans to make them meaningful

6.2 Recommendations for Local Governments

- 6.2.1 Establish a local sediment/erosion control program
- 6.2.2 Evaluate your own properties for potential BMPs to retain/treat stormwater
- 6.2.3 Provide funding for management measures outlined in this plan
- 6.2.4 Review and potentially revise subdivision ordinances based on North GA Growth Readiness Consensus Recommendations
- 6.2.5 Consider adopting a stormwater ordinance
- 6.2.6 Plan for wastewater treatment for new development/increased population
- 6.2.7 Consider conducting a regional planning initiative

<u>Additional Recommendation for Towns County</u>

- Continue working to regain status as a Qualified Local Government in order to implement recommendation 6.2.1 above and to acquire funds in support of Action Plan implementation

<u>Additional Recommendations for City of Hiawassee</u>

- Install and maintain best available technology at the existing wastewater treatment facility to significantly reduce nutrient loading to Lake Chatuge
- Design and implement a proactive program for handling reports of wastewater leaks and spills

Additional Recommendation for Clay County

- Consider passing a "Mountain Protection" ordinance similar to that of Towns County

6.3 Recommendations for Residents

6.3.1 Educate yourself & others about the issues
6.3.2 Report erosion control problems to the appropriate authorities
6.3.3 Restore and/or maintain a woody riparian buffer along streams and the lake
6.3.4 Evaluate your home site for ways to retain or treat stormwater
6.3.5 Evaluate your practices at home to find ways to minimize water usage and runoff
6.3.6 If you have a septic tank, ensure that it is being maintained properly
6.3.7 Encourage businesses that you patronize to implement stormwater BMPs
6.3.8 Support your local governments in their efforts to implement water quality protection measures
6.3.9 Support HRWC

6.4 Recommendations for Developers/Builders/Grading-Clearing Contractors

6.4.1 Educate yourself and co-workers/staff about erosion control and stormwater issues
6.4.2 Design roads to follow natural contours of the land and such that no slopes are greater than 15 percent grade
6.4.3 Place home sites in locations that minimize earthwork
6.4.4 Design developments and home sites with stormwater and water quality in mind (minimize impervious surfaces & protect sensitive areas)
6.5.5 Avoid creating cut/fill slopes that are greater than 1.5H:1V
6.4.6 Restore/maintain woody riparian buffers along all waters
6.4.7 Install and maintain appropriate BMPs during and after construction
6.4.8 Limit underbrushing and clearing, particularly prior to sale of a property
6.4.9 If you have the opportunity, educate new residents about these matters

6.5 Recommendations for Realtors

6.5.1 Educate yourself about the value of riparian buffers and conservation-based developments
6.5.2 Seek to sell responsibly developed properties first
6.5.3 Limit clearing, underbrushing and grading of property
6.5.4 Educate buyers/new residents about how to be sensitive to our mountain environment

6.6 Recommendations for Commercial Business/Property Owners

6.6.1 Educate yourself about impervious surfaces and impacts to water quality
6.6.2 Restore/maintain a woody riparian buffer (if your property borders water)
6.6.3 Evaluate your property and/or business practices for the potential to retain/treat stormwater runoff
6.6.4 Implement stormwater BMPs
6.6.5 Support HRWC

6.7 Recommendations for Farmers & the Agricultural Community

6.7.1 Rotate livestock and implement BMPs for winter feeding as needed to prevent loss of vegetation and overgrazing
6.7.2 Restrict livestock access to waters by installing fencing, stream crossings, and alternative watering sources
6.7.3 Restore/maintain a woody riparian buffer (if your property borders water)
6.7.4 Practice good nutrient management by following an NRCS-approved nutrient management plan or recommendations of bi-annual soil analysis
6.7.5 Reduce soil requirements for nitrogen amendments by sowing nitrogen-fixing legumes (e.g. clover) with grasses
6.7.6 Practice no-till or minimal-till techniques when seeding or planting crops
6.7.7 Consider converting steeply sloping pasture or cropland to orchard/horticulture or harvestable timber
6.7.8 Consider restoring prior-converted wetlands

6.8 Recommendations for TVA

6.8.1 Continue to conduct lake monitoring annually
6.8.2 Provide an easy to read and readily available report for the public of reservoir ecological health ratings
6.8.3 Continue to provide support (and consider increasing the level of support) for annual HRWC operating expenses
6.8.4 Provide funding for, and technical assistance with, BMP implementation
6.8.5 Assist with education (see HRWC)

6.9 Recommendations for HRWC

- Provide residents, developers, builders, grading-clearing contractors, realtors and commercial businesses with educational opportunities and materials
- Seek funding to assist willing landowners with evaluation of properties and BMP implementation
- Assist local governments in drafting, adopting, and implementing ordinances and in planning
- Serve as a “clearinghouse” for information from state and federal agencies
- Assist with distribution of publications and create public awareness about available programs, funding, educational materials, and other tools available to watershed stakeholders

SECTION 7
MEASURABLE MILESTONES & EVALUATION OF PROGRESS

7.1 Management Strategies to Achieve Targeted Reductions

Eighteen broad objectives were identified based on the causes and sources of degradation for Lake Chatuge (discussed in Section 5). These objectives are presented in Table 7. The recommended actions listed in Section 6 are based on these objectives. Although all of the recommendations will help accomplish the goals of the Plan, for implementation purposes it is necessary to develop more specific, measurable management *strategies* for the watershed. If accomplished, the strategies discussed in this section should return Lake Chatuge to Good Ecological Health as assessed by TVA's Reservoir Vital Signs Monitoring Program. The strategies were chosen based on the following:

- identified objectives and suggested management measures;
- ability to help achieve needed nutrient load reductions to the lake;
- cost effectiveness and relative ease of implementation;
- ability to measure the results

Six measurable management strategies were selected:

7. Reduce the Total Phosphorus load from the Hiawassee WWTP by 50%
8. Restrict from streams and/or the lake, and provide appropriate alternative watering for, a minimum of 125 animals (25%) that currently have unrestricted access
9. Improve 40% of pastures considered to be in fair condition to good condition (about 2,500 acres)
10. Improve 50% of the most degraded pasture areas to a minimum of conditions considered fair (about 440 acres)
11. Reduce the Total Phosphorus load by 30% from existing commercial areas (about 1000 acres)
12. Reduce TP load by 5% from existing residential areas (nearly 7,000 acres)

There are other combinations of actions that will also accomplish the desired results. However, these are the strategies that were deemed by the planning team to produce the largest improvements for the resources invested, based on the above criteria. In addition to these strategies, efforts must also be undertaken to ensure that new development is better development in terms of watershed and water quality protection.

7.2 Implementation Schedule

A 15-year timeline spanning three phases of implementation is presented in Table 8. Year 1 will begin when funding first becomes available. Sub-watersheds identified as high and medium priority on Table 6 (pg. 42) will be prioritized for BMP implementation.

Table 7. Summary of Management Objectives Identified for the Lake Chatuge Watershed

Causes	Sources	Management Objectives
• Excess nutrients • Increased growth of algae • Low dissolved oxygen	• Lack of nutrient limits for NPDES permitted discharges • Runoff from pasturelands • Unrestricted livestock access to streams • Leaky or failing septic systems • Untreated post-construction stormwater runoff from commercial and residential developed areas • Excess fertilizer runoff from lawns • Waste from pets and wildlife	1. Implement nutrient reduction strategies for permitted wastewater treatment plant discharges. 2. Reduce runoff from pasturelands. 3. Restrict livestock access to waters by installing fencing, stream crossings, and alternative watering sources. 4. Identify leaking and failing septic systems within the watershed and repair or replace them as needed. 5. Install retrofit stormwater BMPs when possible for existing commercially developed areas and residences to provide treatment of stormwater runoff. 6. Incorporate appropriate stormwater BMPs for new commercial and residential development within the watershed at the time of construction. 7. Reduce nutrient loads from excess lawn fertilizers and waste from pets and wildlife.
• Excess Sediment	• Lack of adequate erosion control practices implemented and/or maintained during construction • Lack of enforcement of existing laws • Overgrazing and damage to stream banks by livestock • Erosion of stream banks associated with stormwater impacts and natural events (e.g. storms, floods)	8. Improve implementation of erosion/sediment control BMPs on construction sites within the watershed. 9. Employ and equip personnel for adequate enforcement of existing laws and rules pertaining to water quality protection. 10. Rotate livestock and implement BMPs for winter-feeding as needed to prevent loss of vegetation and overgrazing. 11. Reduce impervious surfaces to minimize impacts from storms.
• Increased Temperature	• Lack of adequate riparian buffers • Removal of streamside and shoreline vegetation during development of property or associated with agricultural activities • Damage to vegetation by livestock • Large amounts of impervious surfaces	12. Restore and protect wooded shoreline and riparian buffers. 13. Limit removal of streamside and shoreline vegetation during development and associated with agricultural activities. 14. Prevent damage to riparian vegetation by livestock. 15. Limit imperviousness in the watershed.
• Increased runoff associated with rain/snow events	• Proximity of roads to streams • Uncontrolled stormwater runoff from commercially developed areas and roads/highways	16. Avoid building roads right next to streams. 17. Control stormwater runoff from commercially developed areas and roads and highways and prevent concentrated flows directly into streams and the lake.
• Decreased aquatic and small game/bird habitat	• Construction of homes or buildings within 50 feet of lake shoreline or stream banks • Lack of adequate riparian buffers	18. Limit construction of homes or buildings within 50 feet of the lake shoreline and stream banks.

Table 8. Implementation Schedule for the Lake Chatuge Watershed Action Plan

Action Plan Strategies*	**YR 1**	**YR 2**	**YR 3**	**YR 4**	**YR 5**	**YR 6**	**YR 7**	**YR 8**	**YR 9**	**YR 10**	**YR 11**	**YR 12**	**YR 13**	**YR 14**	**YR 15**
Implement aggressive nutrient reduction strategies at the Hiawassee WWTP		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Develop a proactive plan for handling sewage leaks and spills		X	X												
Identify sites for agricultural BMPs	X	X	X												
Eliminate unrestricted cattle access from streams/lake (50 animals)		X	X	X		X	X	X	X		X	X	X		
Improve "Fair" pastures to "Good" (250 ac)		X	X	X		X	X	X	X	X	X	X			
Improve "Poor" pastures to "Fair" (50 ac)		X	X	X		X	X	X	X	X	X	X			
Identify sites for commercial BMPs	X	X	X												
Install stormwater BMPs for TP reduction in existing commercial areas (80 ac)			X	X	X	X	X	X	X	X	X	X	X	X	X
Identify sites for residential BMPs	X	X	X	X											
Install stormwater BMPs for TP reduction in existing residential areas (585 ac)			X	X	X	X	X	X	X	X	X	X	X	X	
Identify demonstration sites for watershed-friendly new developments		X					X					X			
Revegetate bare, eroding cuts behind homes/buildings (1 ac/10 buildings)		X	X	X			X	X	X			X	X	X	
Plant 1000 linear ft of riparian buffer		X	X	X			X	X	X			X	X	X	
Bi-annual newsletter project updates	X	X	X												
Annual project status report				X		X	X	X	X		X	X	X	X	
Develop educational materials	X	X	X												
Monthly stream monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Assess the ecological health of the lake	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Re-evaluate and update the Action Plan					X					X					X

* Numerical values represent quantities restored <u>per year</u>

Strategies during the first five years (Phase I) generally involve implementation of nutrient reduction strategies at the Hiawassee wastewater treatment plant, development of a plan for handling sewage leaks and spills from the sanitary sewer system, locating and prioritizing sites for agricultural, residential, and commercial best management practices (BMPs), and beginning practice installation. During Phase I, approximately 900 acres of pasture, 240 acres of commercial development, and 1750 acres of residential development will be treated. In addition, 30 acres of critically eroding bare areas will be re-vegetated and 3,000 linear feet of riparian buffer re-planted. At the end of Phase I, funding, participation, and accomplishments will be reviewed, along with water quality data, and this plan will be re-evaluated before proceeding into Phases II and III.

7.3 Evaluation of Progress

HRWC will evaluate progress by tracking:

(1) Sites reviewed for possible BMP installation
(2) Practices planned
(3) Practices installed
(4) Reductions anticipated for targeted parameters associated with installed practices

In addition to sites selected for BMP installation through the formal process, HRWC plans to set up a system (hopefully online) whereby anyone can input actions taken (from the list of recommendations) watershed-wide. This way practices will be accounted for down to the smallest backyard buffer planting or rain garden installation; the system would also allow all stakeholders to fully participate in the restoration process! New local ordinances or changes to existing ordinances that positively impact water quality will also be tracked.

7.4 Measures of Success

Actual water quality data will be a key component of measuring success of the Action Plan. Major streams flowing into Lake Chatuge will continue to be monitored monthly for 14 parameters including turbidity, Total Suspended Solids, phosphorus, nitrogen, and nitrate/nitrite. Data throughout the life of the restoration effort will be compared periodically to more than four years of baseline data collected at the existing locations. The Tennessee Valley Authority will continue to assess the lake annually as part of its Reservoir Vital Signs Monitoring Program.

Overall project success will be determined by one or more of the following:

(1) Implementation of BMPs such that the targeted reductions outlined in Section 5.5 are met.
(2) Improvement in stream water quality is observed as measured by the HRWC volunteer monitoring program.
(3) Chlorophyll-*a* concentrations do not exceed state water quality standards.
(4) Improvement in TVA's Ecological Health Rating for Lake Chatuge is observed.

SECTION 8
FUNDING & TECHNICAL ASSISTANCE FOR PLAN IMPLEMENTATION

8.1 Financial Needs for Implementation

During the first five years of Action Plan implementation (Phase I), several million dollars will be spent by the Towns County Water and Sewer Authority to upgrade (and expand) the Hiawassee wastewater treatment plant. Implementation of other management strategies planned for Phase I is estimated to cost $600,000. Costs include: $267,000 for pastureland improvements and agricultural BMPs, $168,000 for retrofit stormwater BMPs for commercial and residential areas, $25,000 for re-vegetation of critically eroding areas and riparian buffer plantings, $10,000 for an education program, and $50,000 for monitoring and evaluation. The estimated cost also includes $100,000 over the 5-year period ($20,000/year) for project management to help support a Lake Chatuge Watershed Restoration Coordinator; HRWC will also provide support for this position.

Phases II and III are projected to cost $865,000 and $650,000, respectively. During Years 6-10 (Phase II), activity will focus more heavily on residential and commercial post-construction stormwater BMPs and less so on agricultural activities. Less will be spent on education in the second and third phases, but the level and intensity of monitoring and evaluation will not change. A detailed, long-term budget is presented as Appendix III.

The total cost of restoring Lake Chatuge to "Good" ecological health – the primary goal of this Action Plan – is estimated at $3.8 million. Approximately $2.1 million is yet to be secured.

8.2 Sources of Funding

The Hiwassee River Watershed Coalition (HRWC), with assistance from its agency advisory team, will take the lead in identifying and helping to secure funding implementation of the Action Plan. Sources of funding will likely include: Georgia Department of Natural Resources (GADNR), North Carolina Department of Environment & Natural Resources (NCDENR), the Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), TVA, Resource and Development Councils (RC&Ds), Soil & Water Conservation Districts, local governments, HRWC, private Foundations, local businesses, and individuals. Additionally, TVA, HRWC, local governments, individuals, and others are likely to make significant in-kind contributions of time and materials toward plan implementation.

8.3 Technical Assistance for Implementation

Project leadership, including acquisition of funds, identification of sites for best management practices, installation oversight, monitoring, and evaluation will be provided by the Hiwassee River Watershed Coalition in cooperation with TVA, local officials, and community leaders. Technical assistance is also available through numerous agencies with active programs in the Hiwassee River watershed. These include, but are not limited to:

GA Department of Community Affairs
GA Department of Natural Resources
Georgia Mountain Research & Education Center
Natural Resources Conservation Service
NC Agricultural Cost Share Program
NC Cooperative Extension Service
NC Department of Environment & Natural Resources
NC Wildlife Resources Agency
NCSU Water Quality Group
UGA Cooperative Extension
US Forest Service

REFERENCES

"Archives of Towns County" from the editors of *Roadside Georgia*. ? Copyright 1994-1999 by Golden Ink. Woodstock, GA. All Rights Reserved. Used with permission. Electronic document, http://roadsidegeorgia.com/county/towns.html, accessed October 24, 2006

Clay County Chamber of Commerce. 2006. History of Clay County. Electronic document, http://www.claycounty-nc-chamber.com/history.htm, accessed October 24.

Center for Watershed Protection (CWP). 2006. The Importance of Imperviousness. Electronic document, http://www.cwp.org/tools_protection.htm, accessed May 12.

Ehle, John. 1988. Trail of Tears: The Rise and Fall of the Cherokee Nation. Anchor Books, New York.

Georgia Department of Natural Resources (GADNR). Wildlife Resources Division. Nongame Conservation Section. February 2007. "Known Occurrences of Special Concern Plants, Animals and Natural Communities in Tennessee River watershed (HUC8: 06010202). Electronic document, http://georgiawildlife.dnr.state.ga.us/, accessed March 28.

Hiwassee River Watershed Coalition (HRWC). March 2003(a). Water Quality Study of Nottely and Chatuge Reservoirs: Interim Report.

Homan, Tim. 2002. Hiking Trails of the Southern Nantahala Wilderness, Ellicott Rock Wilderness, and Chattooga National Wild and Scenic River. Peachtree Publishers, Ltd., Atlanta, Georgia.

HRWC. March 2003(b). Monitoring Plan for the Lake Chatuge Eutrophication Study.

New Jersey Department of Environmental Protection (NJDEP). Division of Water Quality. Bureau of Nonpoint Pollution Control. August 2002. Onsite Wastewater Management Program Question: "What are the Approval Requirements to Build 50 or More Realty Improvements on a Single Subdivision?" Electronic document, http://www.state.nj.us/dep/dwq/sep50mor.htm, accessed on November 10, 2006.

North Carolina Department of Environment and Natural Resources (NCDENR). Division of Water Quality (DWQ). Planning Branch. September 2000. A Citizen's Guide to Water Quality Management in North Carolina. Raleigh, NC.

Pennsylvania Association of Conservation Districts, Inc. (PACD). 2003. Water Pollution Solutions – Septic Systems. Electronic document, http://www.pacd.org/resources/, accessed on November 10, 2006.

Smith, Dr. Matt, Dr. Mark Risse, and Hillary Smith Tanner. August 2004. *On-site Wastewater Management Systems and their Environmental Impacts.* Bulletin 1242-4. University of Georgia. Biological and Agricultural Engineering Department.

Tennessee Valley Authority (TVA). December 2004. Water Quality Study in Chatuge Reservoir. WR2004-2-17-107. Knoxville, Tennessee.

TVA. June 1992(a). Status of Chatuge Reservoir: An Overview of Reservoir Conditions and Uses. TVA/WR/WQ—92/3. Chattanooga, Tennessee.

TVA. June 1992(b). Water Resources Review: Chatuge Reservoir – 1991. TVA/WR/WQ—92/2. Chattanooga, Tennessee.

TVA. August 1991. Upper Hiwassee River Basin Reservoirs. 1989 Water Quality Assessment. TVA/WR/WQ—92/1. Chattanooga, Tennessee.

United States Department of Commerce. U.S. Census Bureau (US Census Bureau). 2006a. Fast Facts for Congress. Electronic document, http://fastfacts.census.gov/, accessed March 6.

U.S. Census Bureau. 2006b. State & County Quickfacts. Electronic document, http://quickfacts.census.gov/, accessed October 23.

acre-feet	The volume of water that would cover one acre to a depth of one foot.
algae	Nonvascular aquatic plants or plantlike organisms, most of which contain chlorophyll. [*Alga, singular. Algal, adjective.*]
anoxic	Relating to or marked by a severe deficiency of oxygen.
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.
basin	The watershed of a major river system.
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).
benthic	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are currently determined to be effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but area not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. BMPs are typically, applied as a system of practices; rarely just one at a time.
CE-QUAL-W2	A two-dimensional, longitudinal/vertical, hydrodynamic and water quality model. The model predicts water surface elevations, velocities, temperatures, and 21 water quality parameters including nutrient/phytoplankton/dissolved oxygen interactions under anoxic conditions.
chlorophyll	A chemical constituent in plants and leaves that gives them their green color and is essential to photosynthesis.
chlorophyll *a*	A specific form of chlorophyll ($C_{55}H_{72}MgN_4O_5$) that is bluish-black. High levels of chlorophyll *a* in a waterbody, most often a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient enrichment or eutrophication.
confluence	The place where two streams flow together or join.
DO	Dissolved oxygen.
decomposition	The break up of matter into its constituent parts by a chemical process.

degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
deposition	The process by which particles (e.g., sediment, organic matter, etc.) fall out of the water.
drainage area	An alternate name for a watershed.
ecology	The scientific study of the interactions that determine the distribution and abundance of living plants and animals.
erosion	The process whereby soil is worn away by the action of water, wind, or glacial ice.
eutrophication	Physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment. The corresponding excessive growth of algae can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scum on the water surface and result in taste and odor problems.
GIS	Geographic Information System. A computer application used to store, view, and analyze geographical information, especially maps.
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.
HSPF	Hydrological Simulation Program-Fortran model. HSPF uses hydrology and land use data inputs to model runoff rates and concentrations of sediment and nutrients, as well as a wide variety of other substances carried in the runoff. The model was used to calibrate the nutrient and organic concentrations flowing into Lake Chatuge from the watershed.
hypolimnion	The layer of water in a thermally stratified lake that lies below the thermocline (typically on the very bottom), does not circulate, and remains perpetually cold.
impoundment	Another term for reservoir. An area created for the accumulation and storage of water.
impervious	Incapable of being penetrated by water; non-porous.
IPSI	Integrated Pollutant Source Identification. IPSI is a geographic database and set of tools designed to aid citizens and planners in implementing water quality improvement and protection projects within a watershed. The geographic database consists of information on watershed features, such as land use/land cover, stream bank erosion sites, and other suspected sources of nonpoint pollution.

loading	Refers to the amount of pollutants entering a waterbody. "Loads" of pollutants are usually expressed in terms of a weight and a time frame, such as pounds per year (lbs/yr).
NPDES	National Pollutant Discharge Elimination System.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of this type of pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows.
pH	A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The pH scale commonly in use ranges from 0 to 14.
physiographic	Related to the physical features of the earth's surface.
point source	A discrete discharge of pollutants as through a pipe or similar conveyance.
pollutant	A waste material that contaminates air, soil or water.
reservoir	A man-made lake used for the storage and regulation of water.
riparian zone	Vegetated corridor immediately adjacent to a stream or river.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
sedimentation	The sinking and deposition of particles (e.g., soil, algae and dead organisms) carried by water.
Sub-watershed	A smaller watershed nested within a larger watershed.
TN	Total Nitrogen.
TP	Total Phosphorus.
TSS	Total Suspended Solids.
thermocline	The layer in a lake that sharply separates regions differing in temperature. The thermocline typically separates the upper layer which mixes (warmer) and the lower layer which does not (colder).
topography	Graphic representation of the surface features of a place or region on a map, indicating their relative positions and elevations.
TMDL	Total Maximum Daily Load. A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDL also represents the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources (the allocation of the maximum calculation).
tributary	A stream that flows into a larger stream, a lake or other waterbody.

watershed	The land area draining into a body of water (such as a stream, river, pond, lake, or bay). 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.
watershed divide or boundary	A ridge of land on either side of which water flows into a different waterbody.
WWTP	wastewater treatment plant

Definitions for the Glossary were drafted with assistance from the following sources:

Dictionary.com. 2007. Electronic document, http://dictionary.reference.com/, accessed on March 22.

North Carolina Department of Environment & Natural Resources. Division of Water Quality. Planning Branch. September 2000. A Citizen's Guide to Water Quality Management in North Carolina. Raleigh, NC.

The Free Dictionary by Farlex. 2006. Electronic document, http://www.thefreedictionary.com/, accessed on October 17.

APPENDIX I
TVA Reservoir Rating Method

TVA monitors ecological conditions at 69 sites on 31 reservoirs throughout the Tennessee River Valley. Each site is monitored every other year unless a substantial change in the ecological health score occurs during a two-year cycle. If that occurs, the site is monitored the next year to confirm that the change was not temporary. Roughly half the sites are sampled each year on an alternating basis.

The overall health rating of TVA reservoirs is based on five ecological indicators:

- **Dissolved oxygen.** A good rating means there is enough oxygen dissolved in the water to support a healthy population of fish and other aquatic life. Oxygen is as important to aquatic life as it is to life on land. Dissolved oxygen is monitored monthly from spring to autumn (April through September).
- **Chlorophyll.** Chlorophyll is a measure of the amount of algae in the water. A good rating means that growth of algae is within the expected range. If levels of algae are too low, the reservoir's food web can be affected. If levels are too high, water treatment costs may increase, and oxygen supplies in the bottom layer of water may be depleted by decaying algae. Growth of algae depends primarily on the amounts of nitrogen, phosphorus, and other nutrients in the water. Both dissolved oxygen and chlorophyll are measured from the mid-channel of the reservoir. Chlorophyll-*a*, like dissolved oxygen, is measured monthly from spring to autumn.
- **Fish.** A good rating means there is a large number and variety of healthy fish. Sampling is conducted near the shoreline or littoral zone. Fish assemblage sampling is conducted in autumn (September – November).
- **Bottom life.** A good rating means that a variety of animals live on the reservoir bottom (worms, insects, and snails, for example). Benthic macroinvertebrates are collected from transects across the full width of the sample area, including overbanks if present. From 1990 through 1994, benthic macroinvertebrates were sampled in early spring (February – April) to avoid aquatic insect emergence. Sampling was switched to autumn/early winter (October through early December) beginning in 1995.
- **Sediment.** The quality of the sediment at mid-channel is based on chemical analysis and examination. A good rating means that the reservoir bottom is free of pesticides and PCBs and that concentrations of metals are within expected background levels. Sediments are monitored once in mid-summer.

TVA reservoirs are divided into 4 classes to evaluate fish and benthos. One class includes the reservoirs on the Tennessee River plus two navigable reservoirs on tributaries of the Tennessee River. The remaining three classes include the reservoirs in the Blue Ridge Ecoregion, those in the Ridge and Valley Ecoregion, and those on the Interior Plateau Ecoregion. Run of the river reservoirs were not subdivided by ecoregion because most of the water flowing through them comes from upstream and does not originate within the ecoregion where the reservoir is physically located.

When monitoring ecological conditions at each reservoir, TVA takes samples from up to four locations, depending on the reservoir's size. These sites are classified as:

- **Forebay**. The deep, still water near a dam.
- **Mid-reservoir**. The middle part of a reservoir, where a transition occurs from a river-like environment to a reservoir-like environment.
- **Embayment.** A very large slough or cove. (TVA monitors only four embayments: Hiwassee River on Chickamauga Reservoir; Big Sandy River on Kentucky; Bear Creek on Pickwick; and Elk River on Wheeler.)
- **Inflow.** The river-like area at the extreme upper end of a reservoir.

Ecological Health Rating Methods

This evaluation system looks at each of the five key indicators separately, then combines these ratings into a single composite score for the reservoir.

Dissolved Oxygen – Rating is based on a multidimensional approach that includes dissolved oxygen concentrations throughout the water column (WCDO) and near the bottom (BDO) of the reservoir. The dissolved oxygen rating (ranging from 1 or "poor" to 5 or "good") at each sampling location is based on monthly measurements (April through September for the run-of-the-river reservoirs and from May through October for tributary reservoirs). The WDO rating is the six month average of the portion of the reservoir cross-sectional area at the sample location that has a dissolved oxygen concentration less than 2.0 mg/L. The BDO rating is the six month average of portion of the reservoir cross-sectional bottom length that has a dissolved oxygen concentration less than 2.0 mg/L. The final dissolved oxygen rating is the combination of the WDO and BDO average.

Chlorophyll – Scoring criteria were created separately for each of the two classes of reservoirs. The rating scale is based on expected levels of productivity for each reservoir. Reservoirs that are expected to be oligotrophic receive the highest ratings for low chlorophyll concentrations while reservoirs expected to be mesotrophic receive the highest ratings for an intermediate range of chlorophyll values. For reservoirs expected to be mesotrophic, the rating is reduced for high chlorophyll concentration and low chlorophyll concentrations if an environmental factor (such as turbidity, toxicity, and/or retention time) inhibits primary production. A sliding scale is used to evaluate the seasonal average chlorophyll concentration for each reservoir class.

Fish Assemblage – Twelve metrics are used to determine the Reservoir Fish Assemblage Index (RFAI). The same 12 metrics are used for all reservoirs, while specific scoring ranges for each metric may vary by reservoir class.

Benthic Macroinvertebrates – Seven characteristics or metrics are used to evaluate benthic macroinvertebrates in all reservoirs. The scoring criteria for each metric were developed from the data base on TVA reservoirs. Some specific metrics vary between tributary and run-of-the-river reservoirs due to differences in thermal stratification and dissolved oxygen concentrations.

Sediment Quality – Since 1995, sediment quality scoring criteria have been based on sediment analysis for metals (As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn), organochlorine pesticides, and PCBs. Results for sediment analysis are compared with sediment guidelines adapted from EPA Region 5 to determine the sediment quality rating.

The ecological health scoring method is designed such that four of the indicators (dissolved oxygen, chlorophyll, benthos, and fish) are equally weighted, with each indicator assigned a rating ranging from 1 (poor) to 5 (excellent). The fifth indicator, sediment quality, receives half the weight of the other indicators and is assigned a rating ranging from 0.5 (poor) to 2.5 (excellent).

The overall reservoir health rating is determined by taking the sum of the ratings from all sites, dividing by the maximum possible rating for that reservoir, and expressing the result as a percentage. A percentage basis is used because the number of sites monitored varies according to the reservoir size and configuration. Only the forebay is monitored in small tributary reservoirs and up to four sites (forebay, transition zone, inflow, and embayment) are sampled in selected run-of-the-river reservoirs. Also, the number of indicators varies at different sites (i.e., sediment and chlorophyll are not sampled at the inflows on run-of-the-river reservoirs). This approach provides a range of scores from 22 to 100 percent and applies to all reservoirs regardless of the number of indicators or sites sampled. This range is divided into three categories: Poor (less than 59), Fair (59-72), and Good (greater than 72).

APPENDIX II
Overview of the HRWC Volunteer Monitoring Program

HRWC began a volunteer monitoring program in the fall of 2002. Currently, a group of about 50 volunteers called Ani'ama', a Cherokee word meaning, "The Water People", collect and test water samples on the third Saturday of each month as part of western North Carolina's Volunteer Water Information Network (VWIN). The Coalition has two teams: One group samples 11 sites on streams in the Lake Chatuge watershed; the second samples 10 sites in the Lake Nottely watershed.

Volunteers record the time and date of collection, air and water temperature, rainfall in the past three days, the observed water flow rate, and general condition of the stream. They test the dissolved oxygen level at the site and collect six bottles of water to be transported to Asheville under refrigeration on the following Monday. The laboratory at the University of North Carolina at Asheville (UNCA) tests for ammonia, nitrates, phosphates, turbidity, total suspended solids (TSS), conductivity, alkalinity, pH, copper, lead, and zinc. The lab staff also calculates dissolved oxygen saturation, a function of temperature and altitude.

The results of the testing done at UNCA are sent via e-mail to the Coalition office each month. The teams gather biannually for a presentation of the data and to discuss issues within monitored watersheds. HRWC receives a report annually from the UNCA Environmental Quality Institute summarizing the data and comparing it to other sites across the southern Appalachian region. Currently, the Coalition has more than four years of data from the sites located on tributaries to Lake Chatuge. Many of these monitoring locations (indicated by an asterisk) are sites where professional water quality sampling was also conducted for the study discussed in Section 4 of this document:

Hiwassee River*
Hightower Creek*
Scataway Creek
Upper Bell Creek*
Fodder Creek*
Hog Creek*
Woods Creek
Upper Shooting Creek
Geisky Creek
Eagle Fork Creek
Lower Shooting Creek*

A free copy of the most recent report may be obtained by contacting the Coalition office: hrwcoalition@brmemc.net or (828) 837-5414; toll-free 877-863-7388.

History of VWIN

In February of 1990, volunteers began monthly sampling of 27 stream sites in Buncombe County, NC. The program expanded to 45 sites by November of that same year. Today, there are more than 220 monthly monitoring sites in western NC and north GA spread across the southern Appalachian region. The University of North Carolina at Asheville, Environmental Quality Institute supports the VWIN program, providing technical assistance through laboratory analysis of water samples, statistical analysis of water quality results, and written interpretation of the data. There are 10 organizations with a collective total of more than 600 volunteers involved.

APPENDIX III
Detailed Project Budget for all Three Phases of Implementation

	Action Plan Management Strategies	Phase I (Yrs 1-5)	Phase II (Yrs 6-10)	Phase III (Yrs 11-15)	Match & In-Kind	TOTAL
Point Source Strategies	Implement aggressive nutrient reduction strategies at the Hiawassee WWTP	*	*	*	$1,500,000	$1,500,000
	Develop a proactive plan for handling sewage leaks and spills	$1,000	-	-	$500	$1,500
Agricultural Strategies	Identify sites for agricultural BMPs	$7,500	-	-		$7,500
	Eliminate unrestricted cattle access from streams/lake (50 animals)	$50,000	$50,000	$50,000		$150,000
	Improve "Fair" pastures to "Good" (250 ac)	$75,000	$125,000	$40,000		$240,000
	Improve "Poor" pastures to "Fair" (50 ac)	$135,000	$200,000	$90,000		$425,000
Development Strategies	Identify sites for commercial BMPs	$8,000	-	-		$8,000
	Install stormwater BMPs for TP reduction in existing commercial areas (80 ac)	$90,000	$170,000	$170,000	$50,500	$480,500
	Identify sites for residential BMPs	$10,000	-	-		$10,000
	Install stormwater BMPs for TP reduction in existing residential areas (585 ac)	$60,000	$130,000	$100,000	$25,000	$315,000
	Identify demonstration sites for watershed-friendly new developments	$500	$500	$500		$1,500
General Re-Vegetation	Revegetate bare, eroding cuts behind homes/buildings (1 ac/10 buildings)	$16,700	$16,000	$16,500		$49,200
	Plant 1000 linear ft of riparian buffer	$8,300	$8,000	$8,000		$24,300
Project Mgmt. & Education	Bi-annual newsletter project updates	$2,500	-	-		$2,500
	Annual project status report	$500	$2,000	$2,000		$4,500
	Restoration Coordinator Position	$100,000	$140,000	$150,000	$40,000	$430,000
	Education program	$10,000	-	-		$10,000
Monitoring & Evaluation	Monthly stream monitoring	$17,000	$17,000	$18,000		$52,000
	Assess the ecological health of the lake	*	*	*	$100,000	$100,000
	Re-evaluate and update the Action Plan	$8,000	$6,500	$5,000		$19,500
		$600,000	**$865,000**	**$650,000**	**$1,716,000**	**$3,831,000**

APPENDIX IV
General Contact Information for Agencies

Agriculture

USDA Natural Resources Conservation Service:

Part of the US Department of Agriculture (USDA), formerly called the Soil Conservation Service. Technical specialists work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation plans 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.

County, State	District Conservationist	Phone	Email	Address
Towns/Union, GA	Doug Towery	706-745-2794 x3	doug.towery@ga.usda.gov	185 Welborn Street, Box 3 Blairsville, GA 30512
Cherokee/Clay, NC	Glenn Carson	828-837-6417 x3	glenn.carson@nc.usda.gov	225 Valley River Ave., Ste. J Murphy, NC 28906
Chestatee-Chattahoochee RC&D Council	Joe Riley (Acting)	706-894-1591	joe.riley@ga.usda.gov	170 Scoggins Drive Demorest, GA 30535
Southwestern NC RC&D Council	Tim Garrett	828-452-2519	tim.garrett@nc.usda.gov	P. O. Box 1230, Waynesville, NC 28786

Soil & Water Conservation Districts:

Boards and staff under the administration of the GA or NC Soil and Water Conservation Commissions. In NC, Districts are responsible for: administering the *NC Agricultural Cost Share Program* 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.

County	Local Contact	Email	Phone	Address
Towns/Union, GA	Jim Dobson Board Chairman	none	706-745-2517	PO Box 925 Blairsville, GA 30512
Cherokee Co., NC	Michael Stiles ACSP Technician	micheal.stiles@ cherokeecounty-nc.gov	828-837-6417 x3	225 Valley River Ave., Ste. J Murphy, NC 28906
Clay Co., NC	Glen Cheeks ACSP Technician	glen.cheeks@ nc.nacdnet.net	828-389-9764	PO Box 57 Hayesville, NC 28904

Construction/Stormwater

The following agencies and contacts are currently responsible for administration of erosion and sediment control programs associated with construction operations. [Please note that Union County, GA has a local sediment & erosion control officer that should be contacted prior to contacting the GA EPD.]

County	Contact	Email	Phone	Address
Towns County, GA	GADNR – Environmental Protection Division	Matt.Sherwood@dnr.state.ga.us Bert.Langley@dnr.state.ga.us	(770) 387-4935 (770) 387-4929	16 Center Road Cartersville, GA 30121 [PO Box 3250, 30120]
Clay County, NC	NCDENR – Division of Land Resources	Rick.Allred@ncmail.net Janet.Boyer@ncmail.net	(828) 296-4500	2090 U.S. Highway 70 Swannanoa, NC 28778
Clay County, NC	NCDENR – Division of Water Quality	Starr.Silvis@ncmail.net Roger.Edwards@ncmail.net	(828) 296-4500	2090 U.S. Highway 70 Swannanoa, NC 28778

Education

These agencies provide practical, research-based information and programs to help individuals, families, farms, businesses and communities.

County	Contact	Email	Phone	Address
Towns County, GA	Robert Brewer	rbrewer@uga.edu	(706) 896-2024	67 Lakeview Circle Hiawassee, GA 30546 [PO Box 369]
Clay County, NC	Silas Brown	silas_brown@ncsu.edu	(828)389-6305	55 Riverside Circle Room 108 Hayesville, NC 28904
	GA Mtn. Research & Education Center	gamtnstn@uga.edu	(706) 745-2655	2564 GA Mountain Experiment Station Rd. Blairsville, GA 30512
	Institute for Continuing Learning	icl@yhc.edu	(706) 379-5194	Young Harris College P. O. Box 68 Young Harris, GA 30582

General Water Quality

Agency	Contact	Email	Phone	Address
NC Division of Water Quality – Basinwide Planning Program	Dave Toms	dave.toms@ncmail.net	(919) 733-5083 ext. 577	1617 Mail Service Center Raleigh, NC 27699-1617
GA Environmental Protection Division – Watershed Protection	Becky Champion	becky.champion@dnr.state.ga.us	(770) 387-4935	16 Center Road Cartersville, GA 30121 [PO Box 3250, 30120]
Tennessee Valley Authority	Linda Harris Scott Lea	lbharris@tva.gov jslea@tva.gov	(423) 876-4178 (423) 876-6739	1101 Market St., PSC 1E Chattanooga, TN 37402

APPENDIX V
HRWC History, Services Provided & Governance

HRWC is a local, non-governmental, conservation nonprofit organization that works to facilitate water quality improvements in lakes and streams throughout the upper Hiwassee River watershed within Towns and Union counties in north GA and Cherokee and Clay counties in NC. For more than 10 years HRWC has provided water quality education, funding for and implementation of voluntary watershed restoration projects, services in coordinating communication between various agencies working in our area, watershed planning, and opportunities for citizens to volunteer. The HRWC leadership believes that for water resources to truly be protected, citizens within a watershed must understand and participate in protection and restoration efforts. However, the organization does not get involved in legislative or political campaign advocacy.

HRWC currently has four major program areas: Watershed Restoration, Lake/Watershed Planning, Water Quality Education, and Volunteer Opportunities. Overall goals have been established as follows:

- Accomplish actual on-the-ground water quality/habitat improvements within priority watersheds;
- Plan for future water quality improvements using a watershed-based approach;
- Educate watershed residents about local water quality issues and encourage behavior that results in positive watershed/water quality responses; and
- Give citizens within the watershed opportunities to get directly involved in the protection and improvement of water quality.
- Maintain and grow an efficient, effective, fiscally sound organization.

The Coalition provides the following "services" to the 4-county coverage area:

- √ conducts ongoing studies and maintains a general awareness of ecological conditions of the watershed area,
- √ collects water quality data and acts as a clearinghouse for data collected by various agencies within the watershed,
- √ coordinates stream restoration work and other water quality improvement projects in priority watersheds,
- √ facilitates communication between government agencies for a range of activities within the Hiwassee River basin,
- √ provides technical assistance to local governments and the general public,
- √ maintains an active volunteer program, and
- √ provides general public outreach and environmental education.

Additional services provided to HRWC members include:

- √ provides technical assistance associated with permitting and implementation of construction and post-construction-stormwater best management practices,
- √ provides guidance for permitting associated with 404/401 issues and assistance in locating mitigation sites,
- √ maintains current list of local contractors and engineering firms with a good track record for compliance with governmental rules and regulations,
- √ generates significant publicity directed to the regional conservation community and beyond,
- √ helps in locating funding sources for water quality improvements associated with specific projects within the watershed area,
- √ sometimes provides a forum for communication between government agencies and businesses and sometimes acts as a liaison, and
- √ provides general technical assistance and programming related to water quality.

The HRWC Board of Directors is composed of at least nine members to include an appointed representative from the Cherokee (1), Clay (1), and Blue Ridge Mountain (2) Soil & Water Conservation Districts and the Cherokee, Clay, Towns and Union County Commissions. The eight appointed representatives then appoint at least one At-Large Director. Up to six additional At-Large Directors may also be appointed to ensure adequate representation of the communities served by the Coalition, as long as geographic diversity is not compromised and Directors residing in one county do not constitute a majority. The 10-member **2007 HRWC Board of Directors** is as follows:

Gilbert Nicolson, Chairperson
Appointed by Clay County Board of Commissioners
Clay County, NC

Norm Bennett, Vice-Chairperson
Appointed by Blue Ridge Mountain Soil & Water Conservation District
Towns County, GA

Andrew Blankenship, Secretary
Appointed by the Clay County Soil & Water Conservation District
Clay County, NC

Brenda Hull, Treasurer
At-Large
Clay County, NC

Silas Allen
Appointed by the Cherokee County Board of Commissioners
Cherokee County, NC

Eddie Bradley
Appointed by the Towns County Commissioner
Towns County, GA

Jim Carringer
Appointed by the Cherokee County Soil & Water Conservation District
Cherokee County, NC

Harold Coleman
At-Large
Cherokee County, NC

Jim Dobson
Appointed by the Blue Ridge Mountain Soil & Water Conservation District
Union County, GA

Bud Hill
Appointed by the Union County Commissioner
Union County, GA

FACILITATING WATER QUALITY IMPROVEMENTS IN THE HIWASSEE RIVER WATERSHED

Hiwassee River Watershed Coalition, Inc.
1853 NC Hwy 141, Murphy, NC 28906
http://www.hrwc.net
NC Residents: 837-5414
GA Residents: (877) 863-7388 toll free