Chapter 2 -
Basin Overview

2.1 General Overview

The headwaters of the Hiwassee River basin originate in the mountains of northern Georgia and flow north through North Carolina before veering west into Tennessee to join the waters of the Tennessee River. Water from the Tennessee River flows to the Gulf of Mexico via the Ohio and Mississippi Rivers (Figure A-4). The entire Hiwassee River watershed drains 2,700 square miles of land, much of which lies in the Chattahoochee (Georgia), Nantahala (North Carolina) and Cherokee (Tennessee) National Forests. In the North Carolina portion of the basin, the Hiwassee River and its two major tributaries, the Nottely and Valley Rivers, drain more than 400,000 acres (644 square miles) of Clay and Cherokee counties in the southwestern corner of the state (Figure A-5).

Hiwassee River Basin Statistics

Total Area: 644 mi^2
Stream Miles: 967.6
No. of Counties: 2
No. of Municipalities: 3
No. of Subbasins: 2
Population (2000): 31,271*
Estimated Pop. (2020): 40,063*
% Increase (2000-2020): 28.1%
Pop. Density (1990): 43 persons/sq. mi.

* Based on % of county land area estimated to be within the basin.

The Hiwassee River's name is derived from "Ayuhwasi", a Cherokee word that signifies a savanna or meadow. This name also referred to at least two important Cherokee settlements, one in Tennessee and the other at the confluence of Peachtree Creek and the Hiwassee River near Murphy (Ellison, November 1999). Water flow is regulated by the Tennessee Valley Authority (TVA) for flood control and the production of hydroelectric power via three impoundments: Chatuge Lake on the Georgia-North Carolina state line near Hayesville; Hiwassee Lake near Murphy; and Apalachia Lake adjacent to the Tennessee border.

Population of the basin, based on 2000 census data, is estimated to be 31,271. Population is expected to increase approximately 28 percent to 40,063 over the next twenty years. While the resident population may be fairly low, the basin experiences significant seasonal population fluctuations from recreation and tourist travel. There are two counties and three municipalities located wholly or partly within the basin in North Carolina.

Almost 70 percent of the basin is forested, and only about three percent of land falls into the urban/built-up category. Over a 15-year period between 1982 and 1997, the amount of forest and cultivated cropland in the basin decreased significantly, while the amount of developed land more than doubled (+14,700 acres). Land used for pasture also increased over the 15-year time frame (+4,000 acres).

The Hiwassee River basin contains 72 plant and animal species that are endangered, threatened, of special concern, or considered significantly rare by the NC Natural Heritage Program. Twenty-five of these are aquatic, including several endemic species that rely on good water quality as well as the basin's unique ecological conditions.

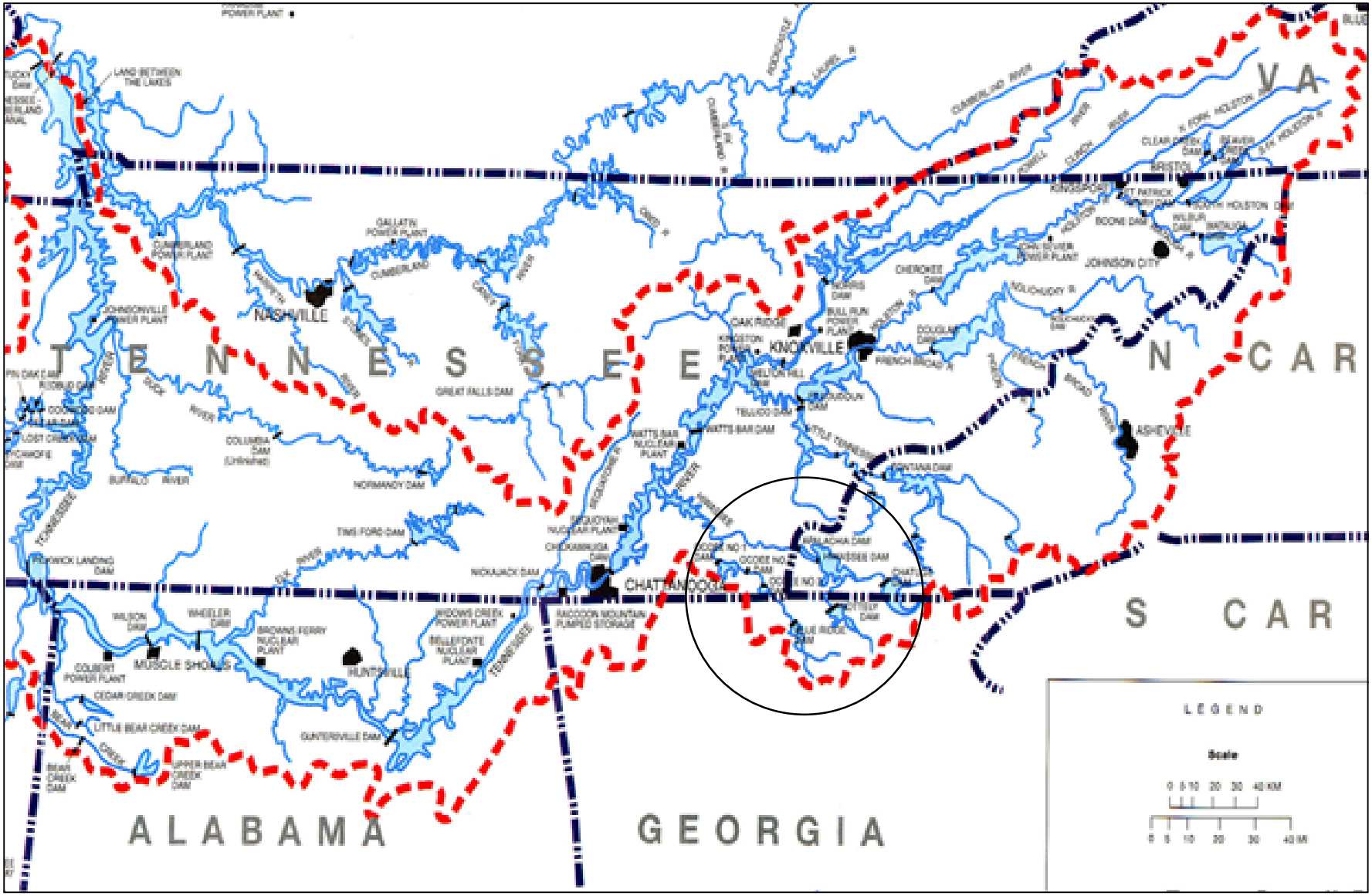

Figure A-4 General Map of the Entire Tennessee River Valley Including the Hiwassee River Basin

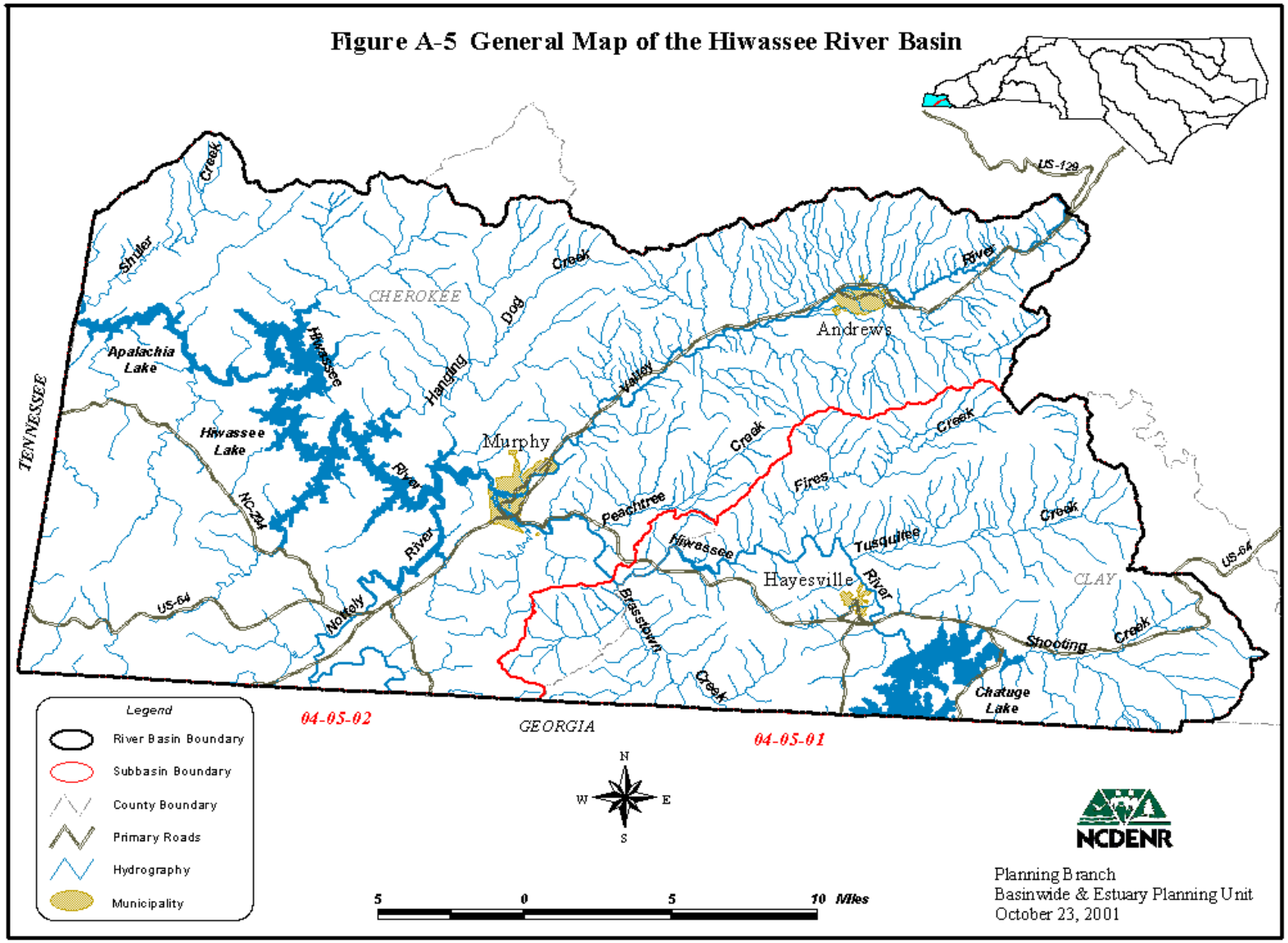

Figure A-5 General Map of the North Carolina Portion of the Hiwassee River Basin

2.2 Local Governments and Planning Jurisdictions in the Basin

The basin encompasses all or part of the following two counties and three municipalities (Table A-3). Both counties are included within the Southwestern Commission Council of Governments (Region A) located in Bryson City (http://www.regiona.org/).

Table A-3 Local Governments and Planning Units within the Hiwassee River Basin

County	Municipalities
Cherokee	Murphy and Andrews
Clay	Hayesville

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2%) is located in that basin, unless a municipality is located in that county.

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey and the Natural Resources Conservation Service (NRCS), use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under the federal system, the Hiwassee River basin is made up of two hydrologic areas referred to as hydrologic units. DWQ has a two-tiered system in which the state is divided into 17 major river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The Hiwassee River basin is subdivided by DWQ into two subbasins (shown on Figure A-5). Maps of each subbasin are included in Section B of this plan.

Table A-4 Hydrologic Subdivisions in the Hiwassee River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ 6-digit Subbasin Codes
Hiwassee River	06020002	04-05-01 and 04-05-02
Chatuge Lake		04-05-01
Hiwassee Lake, Apalachia Lake		04-05-02
Valley River, Nottely River		04-05-02
Ocoee Drainage	06020003	04-05-02

In this basin, 967.6 miles of freshwater streams drain 644 square miles in portions of Clay and Cherokee counties. The basin is located entirely within the Blue Ridge physiographic province. The NC Blue Ridge Province is a mountainous area of steep ridges, inter-mountain basins and valleys that intersect at all angles. A larger number of streams drain smaller areas of land in this region compared with the piedmont and coastal plain portions of the state.

Hydrologic Features

Water flow in the Hiwassee River basin is regulated by the Tennessee Valley Authority (TVA) for flood control and the production of hydroelectric power via three man-made reservoirs: Chatuge Lake on the Georgia-North Carolina state line near Hayesville; Hiwassee Lake northwest of Murphy; and Apalachia Lake adjacent to the Tennessee border. Hiwassee Lake is one of 16 lakes selected by DWQ throughout the state as representative of minimally impacted lakes. Apalachia Lake, located immediately downstream of Hiwassee Lake, is a run-of-the-river reservoir located almost entirely within the Nantahala National Forest. Table A-5 outlines surface area, average depth and watershed area for each of these reservoirs.

Table A-5 Statistics for Major Lakes (Entire Size Calculations) in the Hiwassee River Basin

Subbasin/ Lake	County	Classification	Surface Area (ac)	Mean Depth (ft)	Watershed (mi^2)	Retention Time (days)
04-05-01						
Chatuge Lake	Clay	B	6,950	36	187	260
04-05-02						
Hiwassee Lake	Cherokee	B, C	6,275	154	968	116
Apalachia Lake	Cherokee	B, C	1,100	59	1,006	12

Despite its location near an area of the state that receives the highest amount of annual rainfall, the Hiwassee River basin has only two significant waterfalls. These are the Leatherwood Falls (Fires Creek Wildlife Management Area of the Nantahala National Forest) in Clay County and the falls on the Tellico River (Nantahala National Forest) in Cherokee County. Although the mountain slopes are steep, the river valleys are broad. Therefore, by the time the flow of these streams is large enough to create waterfalls, they begin to fan out into the valley below. This pattern of topography, in addition to more resistant rock types, explains the low abundance of waterfalls (Adams, 1994).

2.4 Land Cover

Land cover information in this section is from the most recent National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA-NRCS, NRI, updated June 2001). The National Resources Inventory (NRI) is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time – 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory*, provides guidance for use and interpretation of current NRI data:

> "The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data published for the 1982, 1987 and 1992 NRI may provide erroneous results, because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected."

Table A-6 summarizes acreage and percentage of land cover from the 1997 NRI for the North Carolina portion of the basin, as defined by the USGS 8-digit hydrologic units. Data from 1982 are also provided for a comparison of change over 15 years. During this period, the amount of forest (-12,900 acres) and cultivated cropland (-6,500 acres) in the basin decreased significantly, while the amount of developed land more than doubled (+14,700 acres). Land used for pasture also increased over the 15-year time frame (+4,800 acres). Figure A-6 presents these land cover changes. Descriptions of land cover types identified by the NRI are found in Table A-7.

Table A-6 Land Cover in the Hiwassee River Basin by Major Watersheds – 1982 vs. 1997 (Source: USDA-NRCS, NRI, updated June 2001)

	MAJOR WATERSHED AREAS *								
	Hiwassee River Watershed		Ocoee Watershed		1997 TOTALS		1982 TOTALS		% change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	since 1982
Cult. Crop	1.8	0.4	0.0	0.0	1.8	0.4	8.4	2.0	-78.6
Uncult. Crop	1.9	0.5	0.0	0.0	1.9	0.5	2.3	0.6	-17.4
Pasture	25.7	6.3	1.2	15.6	26.9	6.5	22.1	5.3	21.7
Forest	147.7	36.3	5.9	76.6	153.6	37.1	166.5	40.2	-7.7
Urban & Built-Up	23.9	5.9	0.4	5.2	24.3	5.9	12.1	2.9	100.8
Federal	188.3	46.3	0.0	0.0	188.3	45.5	185.5	44.8	1.5
Other	17.3	4.3	0.2	2.6	17.5	4.2	17.4	4.2	0.6
Totals	406.6	100.0	7.7	100.0	414.3	100.0	414.3	100.0	
% of Total Basin		98.1		1.9		100.0			
SUBBASINS	04-05-01 04-05-02		04-05-02						
8-Digit Hydraulic Units	06020002		06020003						

* = Watershed areas defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

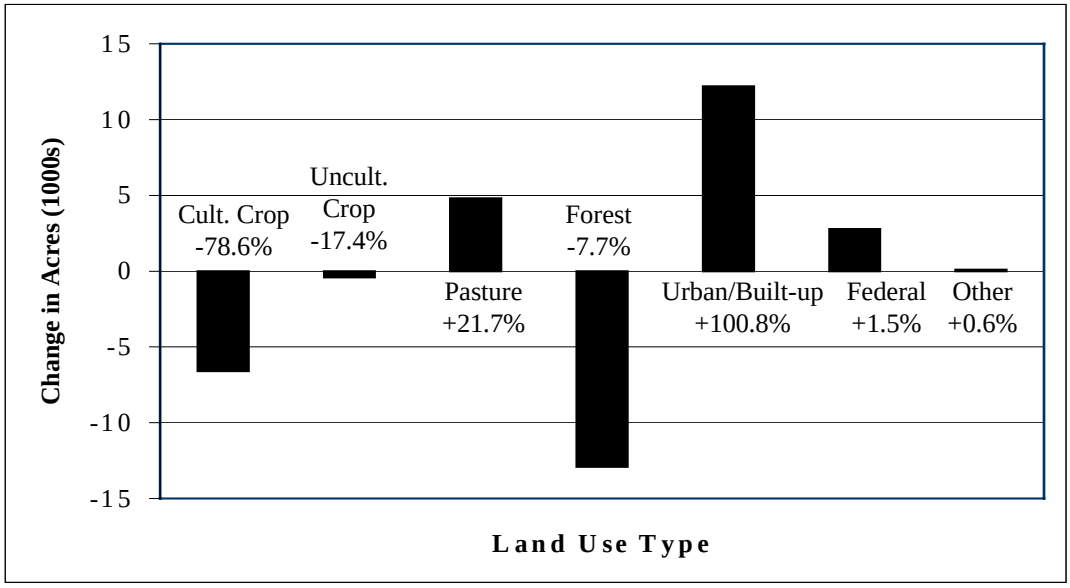

Figure A-6 Land Cover Changes from 1982 to 1997 for the Hiwassee River Basin (Source: USDA-NRCS, NRI, updated June 2001)

Table A-7 Description of Land Cover Types (Source: USDA-NRCS, NRI, updated June 2001)

Land Use Type	Land Use Description
Cultivated Cropland	Harvestable crops including row crops, small grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Forage plants for livestock grazing, including land that has a vegetative cover of grasses, legumes and /or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size, which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre; must be at least 1,000 feet wide.
Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres in size and streams less than one-half mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. *Minor Land*: Lands not in one of the other categories.

The North Carolina Corporate Geographic Database contains land cover information for the Hiwassee River basin based on satellite imagery from 1993-1995. The state's Center for Geographic Information and Analysis (CGIA) developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-8. An important distinction between this land cover dataset and that of the NRI is that there is no actual groundtruthing of the satellite-generated data.

Figure A-7 provides an illustration of the relative amount of land area that falls into each major cover type for the Hiwassee River basin. Section B of this plan provides land cover data specific to each subbasin.

Table A-8 Description of Major CGIA Land Cover Categories

Land Cover Type	Land Cover Description
Urban	Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated	Areas that are covered by crops that are cultivated in a distinguishable pattern (such as rows).
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, conifers, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

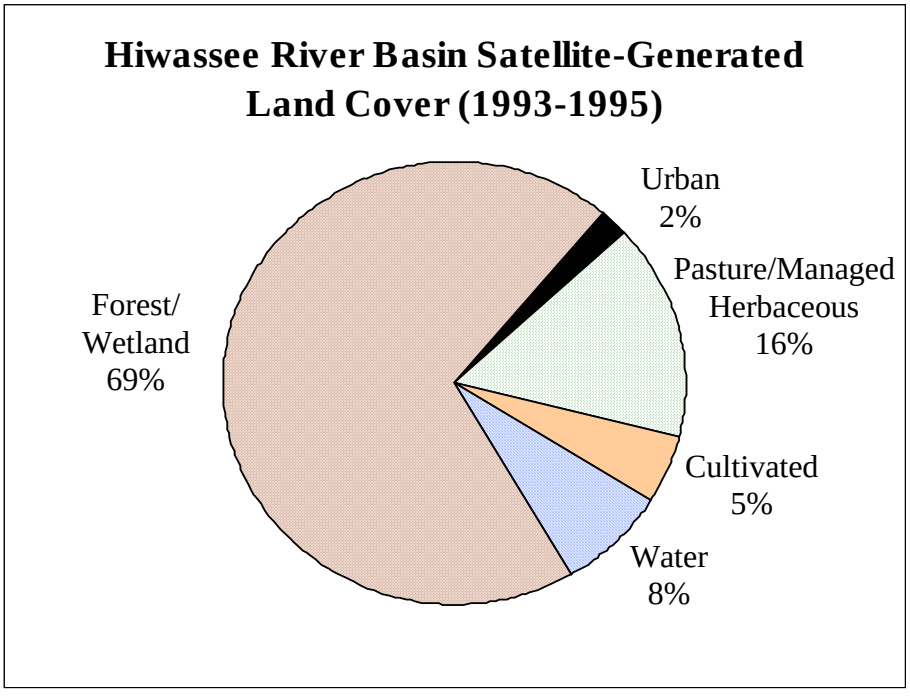

Figure A-7 Percentages within Major CGIA Land Cover Categories in the Hiwassee River Basin

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not possible to establish trends in land cover changes by comparing this data set to previously attained land cover data. However, it is anticipated that comparisons will be possible with future satellite data since a strong consensus-based effort was made to develop the classification system that was used with the 1993-1995 data.

2.5 Population and Growth Trends

Population

Following the 1990 census, North Carolina population data were compared with subbasin boundaries in an attempt to better estimate actual river basin population. Based on this comparison, the Hiwassee River basin had an estimated population of 26,723. Table A-9 presents census data, by subbasin, for 1970, 1980 and 1990 census data.

In using these data, it should be noted that the census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate is made on the percentage of the population that is located in the subbasin. This was done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it to the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change every ten years, so comparisons between years must be considered approximate. This analysis to determine river basin population has not yet been conducted for the recently released 2000 census data.

Table A-9 also includes population densities (persons/square mile) based on the *land area* (excludes open water) for each subbasin. Most of the basin's population is located in subbasin 04-05-02 in and around the Murphy and Andrews areas.

Table A-9 Hiwassee River Subbasin Population, Densities (1970, 1980 and 1990) and Land Area Summaries

	POPULATION [1] (Number of Persons)			POPULATION DENSITY [2] (Persons/Square Mile)			LAND AND WATER AREAS [3]			
							Total Land and Water Area		Water Area	Land Area
SUBBASIN	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
04-05-01	5,236	6,839	7,445	27	35	38	128,717	201	6	195
04-05-02	15,694	18,102	19,278	36	42	45	282,981	442	11	431
TOTALS	20,930	24,941	26,723	33	40	43	411,698	643	17	626

[1] Population estimated based on US census data and percentage of census block that falls within the subbasin.

[2] Population density based on land area only. Large wetlands (swamps) not included in area used to calculate density.

[3] Information generated by the NC Center for Geographic Information Analysis.

Growth Trends

Table A-10 presents population data for municipalities, located wholly or partially within the basin. The population of Andrews decreased significantly between 1990 and 2000 (-949 persons) to a population less than that recorded in 1980. Murphy's population decreased only slightly (-7 persons), while the population of Hayesville grew 6.5 percent (+18 persons). This information was obtained from the Office of State Planning (April and May 2001).

Table A-10 Population and Percent Change for Municipalities Located Wholly or Partly in the Basin

Municipality	County	Apr-80	Apr-90	Apr-2000	% Change (1980-1990)	% Change (1990-2000)
Andrews	Cherokee	1,621	2,551	1,602	57.4	-37.2
Hayesville	Clay	376	279	297	-25.8	6.5
Murphy	Cherokee	2,070	1,575	1,568	-23.9	-0.4

Table A-11 shows the projected population and percent change in growth between 2000 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not usually coincide with county boundaries, these numbers are not directly applicable to the Hiwassee River basin. Even though 98 percent of Cherokee County is contained within the basin, only 85 percent of Clay County is encompassed.

Table A-11 Past and Projected Population (1990, 2000, 2020) and Population Change by County

County	% of County in Basin*	1990	2000	1990-2000 Pop Change	Estimated Population 2020	Estimated Pop Change 2000-2020
Cherokee	98	20,170	24,298	4,128	31,053	6,755
Clay	85	7,155	8,775	1,620	11,331	2,556

* Source: North Carolina Center for Geographic Information and Analysis

Note: The numbers reported reflect county population; however, the county may not be entirely contained within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://www.ospl.state.nc.us/demog/.

2.6 Natural Resources

The Hiwassee River basin contains 72 plant and animal species that are endangered, threatened, of special concern, or considered significantly rare by the NC Natural Heritage Program. Twenty-five of these are aquatic, including several endemic species (found no other place in the world). Biologists note that the Hiwassee system is unique because, though technically located

in the Blue Ridge Province, it hosts some plants and animals that are usually associated with the Piedmont.

2.6.1 Rare Aquatic and Wetland-Dwelling Species

Table A-12 presents rare aquatic and wetland-dwelling species. This information was obtained from the NC Natural Heritage Program, Division of Parks and Recreation.

Table A-12 Rare Aquatic and Wetland-Dwelling Species (as of November 2000)

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
fish	Sicklefin redhorse	*Moxostoma sp 1*	SR	FSC
fish	Olive darter	*Percina squamata*	SC	FSC
fish	Tangerine darter	*Percina aurantiaca*	WL	
fish	Sauger	*Stizostedion canadense*	SR	
invertebrate	Caddisfly (no common name)	*Helicopsyche paralimnella*	SR	FSC
invertebrate	Caddisfly (no common name)	*Matrioptila jeanae*	SR	
invertebrate	Caddisfly (no common name)	*Psilotreta frontalis*	SR	
invertebrate	Caddisfly (no common name)	*Psilotreta labida*	SR	
invertebrate	Caddisfly (no common name)	*Rhyacophila melita*	SR	
invertebrate	Caddisfly (no common name)	*Micrasema burksi*	SR	
invertebrate	Mayfly (no common name)	*Timpanoga lita*	SR	
invertebrate	Mayfly (no common name)	*Leptohyphes robacki*	SR	
invertebrate	Stonefly (no common name)	*Diploperla morgani*	SR	
invertebrate	Brown drake mayfly	*Litobrancha recurvata*	SR	
mussel	Littlewing pearlymussel	*Pegias fabula*	E	E
mussel	Tennessee heelsplitter	*Lasmigona holstonia*	E	FSC
mussel	Spike	*Elliptio dilatata*	SC	
mussel	Mountain creekshell	*Villosa vanuxemensis*	T	
mussel	Rainbow	*Villosa iris*	SC	
mussel	Tennessee clubshell	*Pleurobema oviforme*	SR	FSC
mussel	Wavy-rayed lampmussel	*Lampsilis fasciola*	SC	
crustacean	Hiwassee crayfish	*Cambarus hiawasseensis*	WL	
crustacean	Hiwassee headwaters crayfish	*Cambarus parrishi*	SR	FSC
snail	Knotty elimia	*Goniobasis interrupta*	E	
salamander	Hellbender	*Cryptobranchus alleganiensis*	SC	FSC
turtle	Bog turtle	*Clemmys muhlenbergii*	T	
turtle	Loggerhead musk turtle	*Sternotherus minor*	SC	
plant	Lichen (no common name)	*Hydrothyria venosa*	C	

Rare Species Listing Criteria

E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
C =	Candidate (very rare in North Carolina and likely to merit listing as endangered or threatened)
WL =	Watch List (declining populations, threats to populations, or inadequate information to assess its rarity in NC)
SR =	Significantly Rare (rare in North Carolina, but not yet officially listed as threatened or endangered)
SC =	Special Concern (have limited numbers in North Carolina and vulnerable populations in need of monitoring)
FSC =	Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)

The status of two aquatic species that were listed as significantly rare in the 1997 Basinwide Plan, the Hiwassee crayfish and the Tangerine darter, has been changed. Both species are now on the Watch List, and although the Watch List status is defined as a "species believed to be of conservation concern in the state because of scarcity, declining populations, threats to populations, or inadequacy of information to assess its rarity", the status is an increment above the previous designation of Significantly Rare. The Hiwassee crayfish, the Knotty Elimia and the Hiwassee headwaters crayfish are all endemic to the Hiwassee River basin, meaning they are found no other place in the world.

Freshwater Mussels

The number of mussels with rare state status in the Hiwassee River basin increased over the last five years from three to seven. Here, as in other river basins, freshwater mussels are one of the most threatened groups of species. A number of factors contribute to the decline of mussel populations. Mussels feed by filtering detritus, diatoms, phytoplankton and zooplankton out of the water. Sediment in the stream significantly affects mussels' ability to feed, and their sensitivity to other forms of pollution and habitat degradation also impact populations. Also, many mussels have an interesting aspect in their life history which involves parasitizing fish for larval development. Mussels have developed a clever method of attaching their larvae to the gills or fins of a specific fish species. The host fish provide a source of food and shelter while the mussels are in their most vulnerable stage of life. After the larvae have developed, they drop from the fish and metamorphose into juveniles. The survival of mussel populations is directly linked to the health and presence of certain fish species.

The Littlewing pearlymussel (state and federally Endangered), a small, chalky-white mussel, prefers to live in transition zones between riffles and pools in small to medium streams with low turbidity. The Tennessee heelsplitter (state Endangered and a federal Species Of Concern) generally prefers small streams. The Spike (state Special Concern) is found in a range of habitats, from small streams to large rivers and in substrates from sand to gravel and cobble.

The long-term survival of these Hiwassee mussel populations is questionable. The Littlewing pearlymussel has not been observed in the Hiwassee River basin for many years. The Tennessee heelsplitter was last observed in the Hiwassee River basin in 1991, but there are few previous records of the species. Although populations of Spikes are still found in the basin, they are susceptible to pollution, especially from sedimentation, which has a major impact on their populations.

Management Strategies for Federally Threatened and Endangered Species

Because the Littlewing pearlymussel is federally endangered, the watershed in which it was observed could be subject to a new rule (Administrative Code: 15A NCAC 02B .0110) requiring the development of a site-specific management strategy. The intent of the strategy would be to provide for maintenance and recovery of the water quality conditions required to sustain the species. As was mentioned previously, a number of factors can contribute to the decline of mussel populations. Therefore, the development of such a management strategy would be difficult. Implementation of the strategy could be even more complex. If it is determined that a management strategy should be developed for the watershed(s) in which the Littlewing pearlymussel is found, it would be accomplished during the next basinwide planning cycle for the Hiwassee River basin (2003-2007).

2.6.2 Significant Natural Heritage Areas in the Hiwassee River Basin

In addition to tracking the status of individual species, the North Carolina Natural Heritage Program identifies areas that have outstanding conservation value, either because they contain rare or endangered species, or because they provide an excellent, intact example of an ecological community which naturally occurs in the state. The Hiwassee River basin contains a number of unique natural areas, including several important aquatic and riparian areas, presented on Figure A-8 and discussed below.

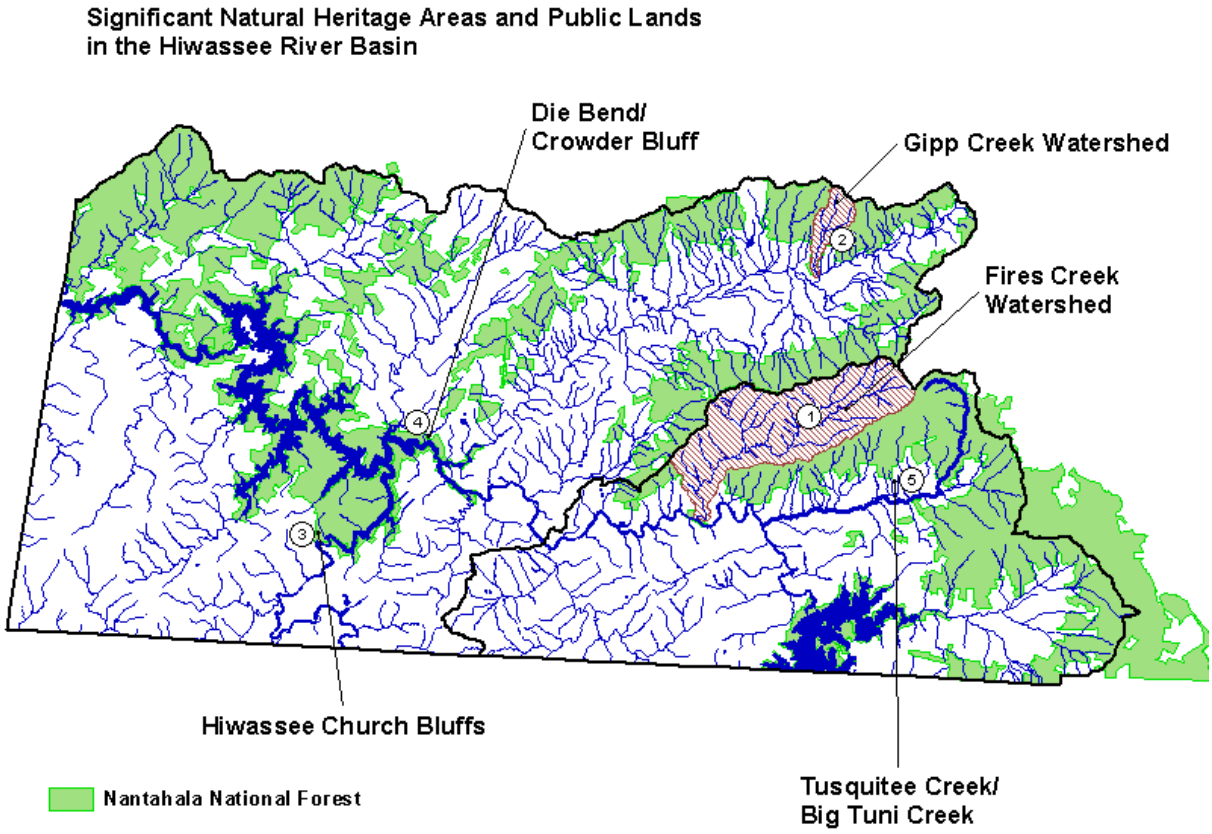

Figure A-8 Natural Heritage Areas and Public Lands in the Hiwassee River Basin

Fires Creek Watershed

The maturing forest of the Fires Creek watershed (Figure A-8) is considered significant because it is less fragmented than many remaining forest areas. The watershed is classified Outstanding Resource Waters, indicating excellent water quality as well as its unique ecological and protected status. Groups of semi-aquatic animals such as amphibians (frogs, toads, salamanders) require the overall damp nature of a forest throughout their life cycle, in addition to access to water for at least one stage of their lives. The Hiwassee River basin is home to a large number of amphibians, including one frog and five salamander species that are considered significantly rare or are of special concern.

Gipp Creek

The Gipp Creek watershed is a high quality aquatic community set in a rich cove forest. The stable slopes and abundant and mature vegetation of the understory provide a magnificent display of seasonal wildflowers, in addition to having a positive effect on water quality.

Hiwassee Church Bluffs

The Hiwassee Church Bluffs are rocky cliffs along the Hiwassee River that are not only scenic, but may represent migration corridors for plant species. This is one explanation for the occurrence of the terrestrial species prostrate eryngo (*Eryngium prostratum*) in the mountains, since it is generally distributed in the piedmont and coastal plain.

Die Bend/Crowder Bluff

The NC Natural Heritage Program has identified Die Bend/Crowder Bluff as a unique area because of the piedmont/mountain alluvial forest and floodplain pools found here. These areas contain an unusual mixture of piedmont and coastal plain species not typically found in the mountains of the Blue Ridge.

Tusquitee-Big Tuni Creek

Close to the Fires Creek watershed is the Tusquitee-Big Tuni Creek natural heritage area. Within the waters of Fires, Tusquitee and Big Tuni Creeks lives an outstanding assemblage of rare aquatic insects, including 10 species considered Significantly Rare in North Carolina (refer to Table A-11). Hellbenders are also found here.

Mountain Bogs

Less than 500 acres of mountain bogs exist within North Carolina, while the entire Appalachian Highlands (which includes the Appalachian Plateau, Ridge and Valley, and Blue Ridge provinces of Alabama, Georgia, Tennessee, North Carolina, Virginia and West Virginia) contain less than 6,175 acres (Moorhead and Rossell, 1998). Mountain bogs in North Carolina are generally small, isolated and rare wetlands largely concentrated in two areas: a band between Henderson and Clay counties in the southern mountains; and in Avery, Watuaga, Ashe and Alleghany counties in the northern mountains (Early, 1989).

North Carolina's mountain bogs host 77 species of rare, threatened or endangered plants such as the bunched arrowhead, swamp pink and Gray's lily. In addition to harboring important plant species, the state's mountain bogs also host five species of rare, threatened or endangered animals (Murdock, 1994), most notably the bog turtle (*Clemmys muhlenbergii*). Of the estimated 500 acres of mountain bogs in North Carolina, less than half support bog turtles (Herman, 1994).

Little research has investigated the hydrology of these bogs, but they may be found in four principle positions on the landscape: 1) headwater regions of mountain streams; 2) slopes intercepting the water table and subject to constant groundwater seepage; 3) stream valleys no longer subject to flooding; and 4) isolated systems over resistant rock strata (Walbridge, 1991; Weakley and Schafale, 1994). Although these wetlands are groundwater fed, technically called "fens" in classifications based on water source, they are locally known as bogs and have been called that in most publications within the state. The groundwater in fens tends to be acidic and nutrient poor, because of the rock and soil types it flows through. Groundwater in these areas of the Savannah River basin is less rich than is typical of most northern fens; therefore, the vegetation is more "bog-like" (Pohlman, September 2001).

Historically ditched and drained for farms, ponds and pastures, mountain bogs today are also imperiled by development activities. Active management of some mountain bogs has focused on protecting or enhancing habitat for bog turtles or rare plants (Moorhead and Rossell, 1998). Since many bogs are privately owned and not actively managed or protected (Weakley and Moorhead, 1991), educating landowners on the value and significance of mountain bogs is an important first step in their protection.

2.6.3 Public Lands in the Hiwassee River Basin

While there are no state parks in the Hiwassee River basin, the Nantahala National Forest (Tusquitee Ranger District) encompasses 134,730 acres, representing 32 percent of total land area in the basin (Figure A-8). Much of the public land is not connected; therefore, it is rare that an entire watershed falls within public ownership. The Fires Creek watershed is an exception where, other than a small amount of private property near the mouth, the US Forest Service (USFS) owns the entire watershed. Here, as well as in other significant natural areas that occur on National Forest land, the USFS has been asked to manage the land so as to protect the natural features that make this area unique.

2.7 Permitted Wastewater and Stormwater Discharge Facilities

Discharges that enter surface waters through a pipe, ditch or other well-defined point are broadly referred to as "point sources". Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for

The primary pollutants associated with point source discharges are:

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

municipalities which serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

2.7.1 Wastewater Discharges in the Hiwassee River Basin

There are 11 permitted discharges in the Hiwassee River basin. Table A-13 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. A list of all facilities can be found in Appendix I.

Type of Wastewater Discharge

Major Facilities: Municipal wastewater treatment plants with flows ≥1 MGD (million gallons per day) and some industrial facilities (depending on flow and potential impacts on public health and water quality).

Minor Facilities: Any facilities not meeting the definition of Major.

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

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

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

More than half of the NPDES permitted discharges in the Hiwassee River basin are from wastewater treatment plants serving communities and schools. Most of them are small facilities with less than one million gallons of flow per day. However, there are a few larger discharges as well. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter in Section B.

Figure A-9 shows the location of major and minor permitted wastewater discharges within the basin. The number of sites on the map depicting major discharges may differ from the number of major facilities listed in Table A-13. Since some major facilities have more than one outfall point, each outfall received a symbol on the map.

Table A-13 Summary of NPDES Dischargers and Permitted Flows for the Hiwassee River Basin (as of February 2001)

	Subbasin		
Facility Categories	**04-05-01**	**04-05-02**	**TOTAL**
Total Facilities	3	8	11
Total Permitted Flow (MGD)	0.1	2.5	2.6
Major Discharges	0	2	2
Total Permitted Flow (MGD)	0.0	2.4	2.4
Minor Discharges	3	6	9
Total Permitted Flow (MGD)	0.1	0.1	0.2
100% Domestic Waste	2	4	6
Total Permitted Flow (MGD)	0.1	0.1	0.2
Municipal Facilities	1	2	3
Total Permitted Flow (MGD)	0.1	2.4	2.5
Non-municipal Facilities	2	6	8
Total Permitted Flow (MGD)	0.02	0.1	0.12

2.7.2 Stormwater Discharges in the Hiwassee River Basin

Amendments were made to the Clean Water Act in 1990 and most recently in 1999 pertaining to permit requirements for stormwater discharges associated with industrial activities and municipal separate storm sewer systems (MS4s). DWQ administers these regulations in North Carolina through the state's NPDES stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent pollution via stormwater runoff by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. No municipalities in the Hiwassee River basin were required to obtain a NPDES permit for stormwater sewer systems under the Phase I

EPA Stormwater Rules

Phase I – December 1990

- Requires a NPDES permit for municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – December 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are larger than 1 acre.

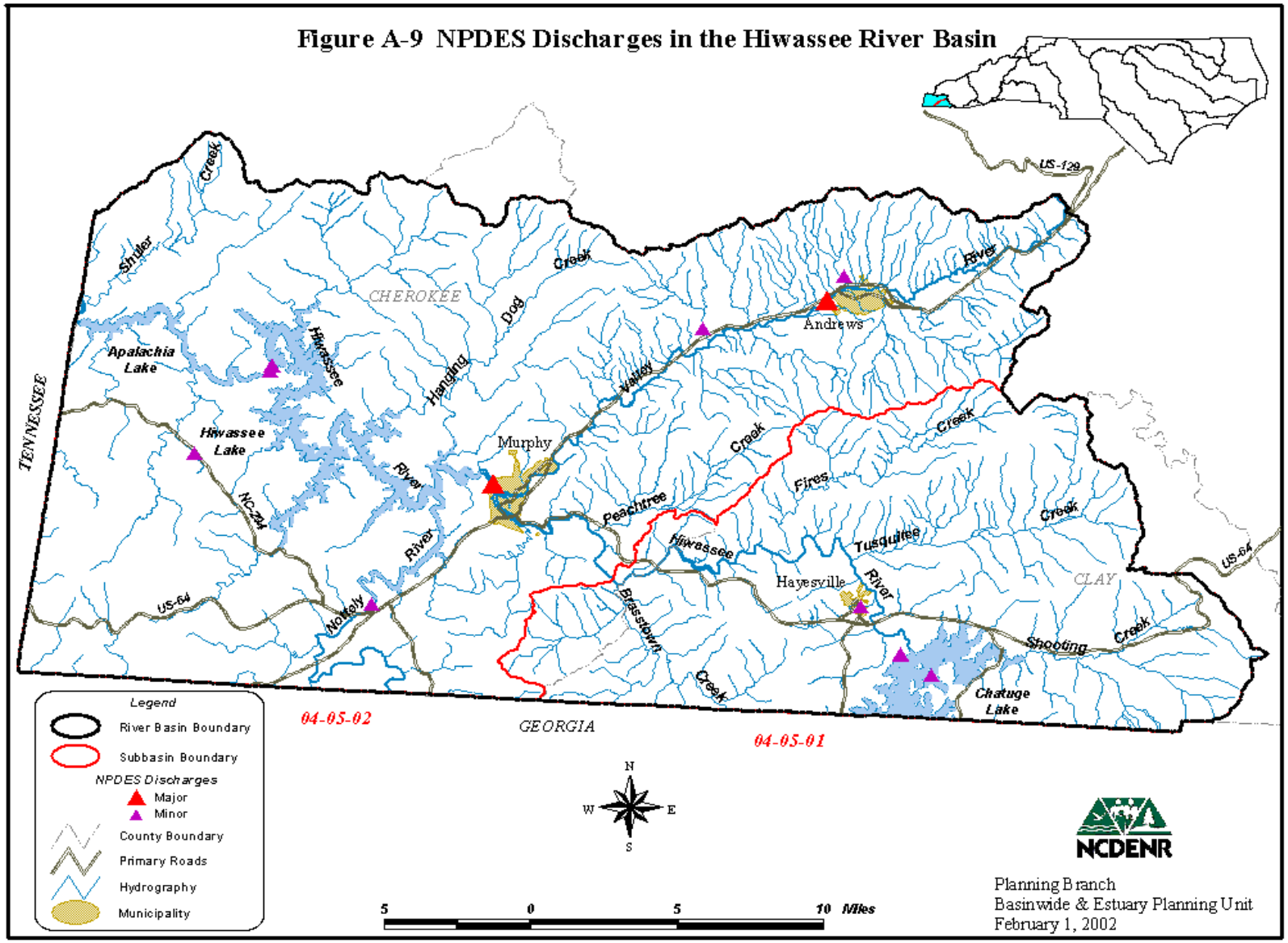

Figure A-9 Location of NPDES Permitted Dischargers in the Hiwassee River Basin

rules (population >100,000). Additionally, no municipalities in the basin are automatically required (US Census designated Urban Areas) to obtain a NPDES stormwater permit under the Phase II rules. DWQ is currently developing criteria that will be used to determine what local governments should be required to obtain a NPDES stormwater permit.

Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 18 general stormwater permits active within the Hiwassee River basin. Currently, there are no individual stormwater permits held in the basin.

The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. Poor housekeeping can lead to significant contributions of sediment and other water quality pollutants. To address these issues, each NPDES stormwater permitted facility must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities identified as having significant potential to impact water quality may also be required to conduct analytical monitoring to characterize pollutants in stormwater discharges.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in 20 coastal counties and on lands statewide that drain to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area on a project and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of structural best management practices to control and treat stormwater runoff from the site. Surface waters in the Hiwassee River basin where development activities are regulated under these special rules are presented on Figure A-11 (page 35).

2.8 Animal Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. Within the past five years, there have been several additional pieces of legislation enacted that affect animal operations in North Carolina.

There are only two registered animal operations in the Hiwassee River basin, containing a total of 320 cattle (448,000 pounds Steady State Live Weight). There are no registered poultry and swine operations. Information on animal capacity by subbasin (Table A-14) was provided by the USDA for operations (registered and unregistered) in the Hiwassee River basin. A small percentage of the state's total capacity for dairy is found in the Hiwassee River basin. Overall, swine and dairy production in the Hiwassee River basin decreased from 1994 to 1998 while poultry production increased by four percent.

Table A-14 Estimated Populations of Swine, Dairy and Poultry in the Hiwassee River Basin (1998 and 1994)

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
04-05-01	460	516	-11	403	546	-26	130,100	86,105	51
04-05-02	81	214	-62	625	736	-15	1,057,300	1,056,739	0
TOTALS	541	730	-26	1,028	1,282	-20	1,187,400	1,142,844	4
% of State Total	<1%	<1%		1%	1%		<1%	<1%	

2.9 Water Use and Minimum Streamflow

2.9.1 Local Water Supply Planning

The North Carolina General Assembly mandated a local and state water supply planning process in 1989 to assure that communities have an adequate supply of potable water for future needs. Under this statute, all units of local government that provide, or plan to provide, public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs.

Surface water is used to meet 85 percent of overall water needs in the North Carolina portion of the Hiwassee River basin. In 1997, four public water systems used water from the basin, providing 1.8 million gallons per day to 9,070 people. Water demand from these public systems is projected to increase 40 percent by 2020. Two systems reported that by 2020 demand levels will exceed 80 percent of available supply.

Not everyone gets water from public water supply systems. Many households and farms supply their own water from both surface and groundwater sources in the basin. The US Geological Survey estimates that self-supplied users, excluding power-generating facilities, account for 86 percent of the total water used in the Hiwassee River basin. Water used for livestock and irrigation purposes comprises the majority of self-supplied water use in the basin (Figure A-10).

The State Water Supply Plan is a compilation of over 500 LWSPs developed by local government water systems in North Carolina. More detailed information is available in the plan about water supply and water usage in the Hiwassee River basin. This plan is available online at the Division of Water Resources website at http://www.dwr.ehnr.state.nc.us or by calling (919) 733-4064.

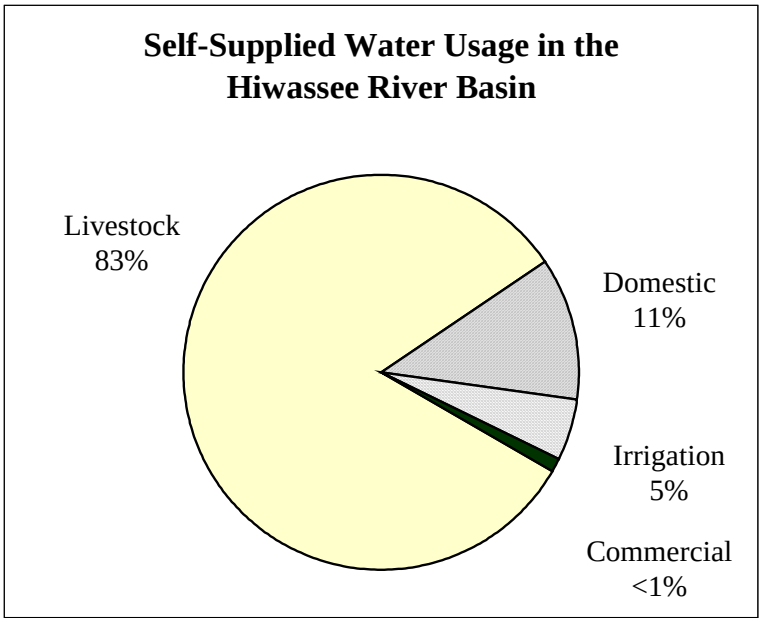

Figure A-10 Estimated Self-Supplied Water Use in the Hiwassee River Basin (Source: NCDENR-DWR, January 2001)

2.9.2 Water Withdrawals

Prior to 1999, North Carolina required water users to register their water withdrawals with the Division of Water Resources (DWR) only if the amount was 1,000,000 gallons or more of surface or groundwater per day. In 1999, the registration threshold for all water users except agriculture was lowered to 100,000 gallons per day. Table A-15 presents registered withdrawals.

Table A-15 Registered Water Withdrawals in the Hiwassee River Basin

County	1999 Average (MGD)	1999 Maximum (MGD)	Source of Withdrawal	Facility
Cherokee	0.027	0.076	Groundwater	Carolina Water Service – Bear Paw
Cherokee	0.864	0.864	Owl Creek	Craig's Trout Farm Inc.
Clay	0.005	0.010	Unnamed Stream	Harrison Construction – Hayesville Quarry
Cherokee	0	0	Unnamed Stream	Harrison Construction – Cherokee County Quarry

There are four registered water withdrawals in the North Carolina portion of the Hiwassee River basin. Three of these (75 percent) are surface water withdrawals. Excluding public water systems or power generating facilities, there is a cumulative permitted capacity to withdraw 874,000 gallons of surface water per day.

2.9.3 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State. These boundaries differ slightly from the 17 major river basins delineated by DWQ.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. Currently, there are no certified or known potential interbasin transfers in the Hiwassee River basin.

2.9.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to the release of flows to satisfy minimum instream flow requirements. The permits are issued by the Division of Land Resources. Table A-16 summarizes minimum flow requirements in the Hiwassee River basin.

Table A-16 Minimum Streamflow Projects in the Hiwassee River Basin

Name	Location	Waterbody	Drainage Area (sq. mi.)	Min. Release (cu.ft/sec)
Hydroelectric Dams:				
Chatuge Dam	Near the NC/GA state line near Hayesville, NC	Hiwassee River	187	83
Mission	Clay County near the Clay/Cherokee county line	Hiwassee River		280[1]
Hiwassee Dam	Cherokee county NW of Murphy below Beaverdam Cr.	Hiwassee River	968	
Apalachia Dam	Near the NC/TN state line	Hiwassee River	1,006	
Nottely Dam	In Georgia near the NC/GA state line	Nottely River		50

[1] If inflow is less than the specified minimum release, the release must be equal to the inflow. In other words, the project must operate in a run-of-river mode (i.e., instantaneous inflow equals instantaneous outflow) until the inflow becomes greater than the specified minimum release.

Hydroelectric Project Relicensing

As presented in Table A-16, there are five hydroelectric dams that affect streamflow and, to some extent, water quality in the Hiwassee River basin. The license issued by the Federal Energy Regulatory Commission (FERC) to the Nantahala Power and Light Division of Duke Energy for the operation of the Mission Project expires in 2005. During relicensing, Duke Energy will examine project operations and equipment technology to prevent deviations from the run-of-river mode during low flow events and project maintenance activities. Several other studies have also been proposed. For further information, visit the website at http://www.nantahalapower.com/relicensing/actionlist.html/.