*Section 2*

# River Basin Characteristics

Effective management of the Flint River Basin starts with an understanding of the salient features of this geographic management unit. These provide the context, constraints, and opportunities for management actions. Important aspects include:

- *River basin characteristics* (Section 2.1): the physical features and natural processes of the basin, which determine how waters within the basin respond to conditions;
- *Population and land use* (Section 2.2): the sociological features of the basin, including the types of human activities which may impact water quality;
- *Local governments and jurisdictions* (Section 2.3): identification of the local authorities whose decisions may influence man's impact on water quality;
- *Water use classifications* (Section 2.4): the expression in the state regulatory framework of best uses and baseline goals for management of waters within the basin.

## *2.1 River Basin Description*

This section describes the important geographical, geological, hydrological, and biological characteristics of the Flint River Basin. It is largely adapted from Couch et al., (1996). Additional material is drawn from EPD (1996), and other sources.

The physical characteristics of the Flint River Basin includes its location, physiography and geology, geochemistry, soils, climate, surface water and groundwater resources, and natural water quality. These physical factors provide the natural template that influences the basin's biological habitats and diversity, and the way in which people use the basin's land and water resources.

### 2.1.1 River Basin Boundaries

The Flint River Basin is located in the western third of the state and extends from Atlanta to the Florida state line (Figure 2-1). The basin is long and narrow. The length of the main stem of the Flint River is 349 river miles and drains an area of 8,460 square miles ($mi^2$). The Flint River, which is contained entirely within the state of Georgia, originates from the southern edge of the Atlanta Metropolitan Area, in Clayton County, and flows southerly in a wide eastward arc to Decatur County in southwestern Georgia, where it flows into Lake Seminole near the Florida line. Lake Seminole is formed by a dam placed below the confluence of the Flint and Chattahoochee Rivers. The outflow from Lake Seminole forms the Appalichicola River in Florida, which ultimately discharges to the Gulf of Mexico at Apalichicola Bay.

The USGS has divided the Flint basin into six subbasins, or Hydrologic Unit Codes (HUCs) (see Table 2-1). These HUCs are referred to throughout this report to distinguish conditions in different sub-parts of the basin. Figure 2-2 shows the location of these subbasins and the counties within each subbasin. For discussion purposes these subbasins are grouped into three

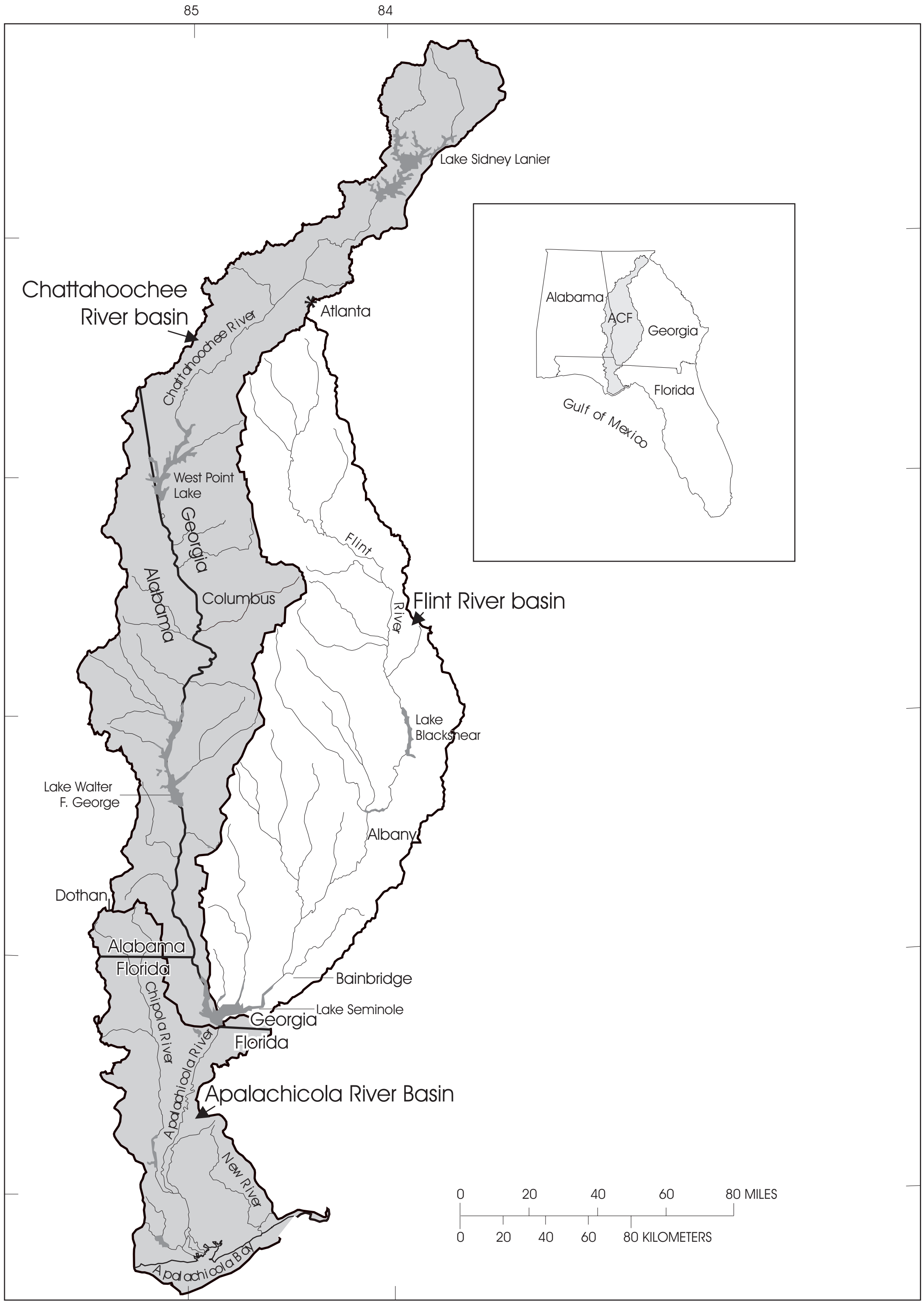


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**Figure 2-1. Location of the Flint River Basin within the Apalachicola-Chattahoochee-Flint River Basin (modified from Couch et al., 1996)**

**Table 2-1. Hydrologic Unit Codes (HUCs) of the Flint River Basin**

| HUC | Associated Areas |
|---|---|
| 03130005 | Upper Flint, extending from the headwaters in southeastern Atlanta to the confluence of Whitewater Creek in Macon County. |
| 03130006 | Middle Flint, Whitewater Creek to Flint River Dam in Dougherty County. |
| 03130007 | Middle Flint, Headwaters of Muckalee and Kinchafoonee Creeks to Lake Worth Dam. |
| 03130008 | Lower Flint, Flint River Dam to the Jim Woodruff Dam. |
| 03130009 | Lower Flint, Headwaters of Ichawaynochaway Creek to the confluence of the Flint River. |
| 03130010 | Lower Flint, Headwaters of Spring Creek at Fish Pond Drain to the confluence of Lake Seminole. |

major categories based on their similarities in geography, land use patterns, and pollutants of concern—the Upper Flint, Middle Flint, and the Lower Flint.

### 2.1.2 Climate

The Flint River Basin is characterized by a warm and humid, temperate climate. Major factors influencing climate variability in the basin are latitude, altitude, and proximity to the Gulf of Mexico.

Average annual temperature ranges from about 60 °F in the north to 70 °F in the south. Average daily temperatures in the basin for the month of January range from about 40 °F to 50 °F, and for July from 75 °F to 80 °F. In the winter, cold winds from the northwest cause the minimum temperature to dip below freezing for only short periods. Summer temperatures commonly range from the 70s to the 90s.

Precipitation is greatest at the north end of the basin, and at the south end near the Gulf of Mexico as a result of the availability of moist air. Average annual precipitation in the basin, primarily as rainfall, is about 50 inches (in.), but ranges from a low of 45 in. in the east-central part of the basin to a high of 55 in. in the southern region of the basin (U.S. Geological Survey, 1986).

Evapotranspiration generally increases from north to south and ranges from about 32 to 42 in. per year. In the east-central part of the basin, precipitation and evapotranspiration are about equal. Average annual runoff ranges from 15 to almost 25 in. Areal distribution of average annual runoff from 1951 to 1980 reflects basinwide patterns in precipitation and soil-runoff potential. Runoff is greatest in a small region just below the Fall Line (see section 2.1.3) around Marion and Schley counties, and at the northern and southernmost ends of the basin (Gebert et al, 1987).

### 2.1.3 Physiography and Geology

The Flint River Basin contains parts of the Piedmont and Coastal Plain physiographic provinces, which extend throughout the southeastern United States. The Upper Flint subbasin contains both the Piedmont and Coastal Plain Provinces while the remaining subbasins lie entirely within the Coastal Plain. Similar to much of the Southeast, the basin's physiography reflects a geologic history of mountain building in the Appalachian Mountains, and long periods of repeated land submergence in the Coastal Plain Province. Glaciers, which influenced the physiography of much of North America, never extended to the southeastern United States.

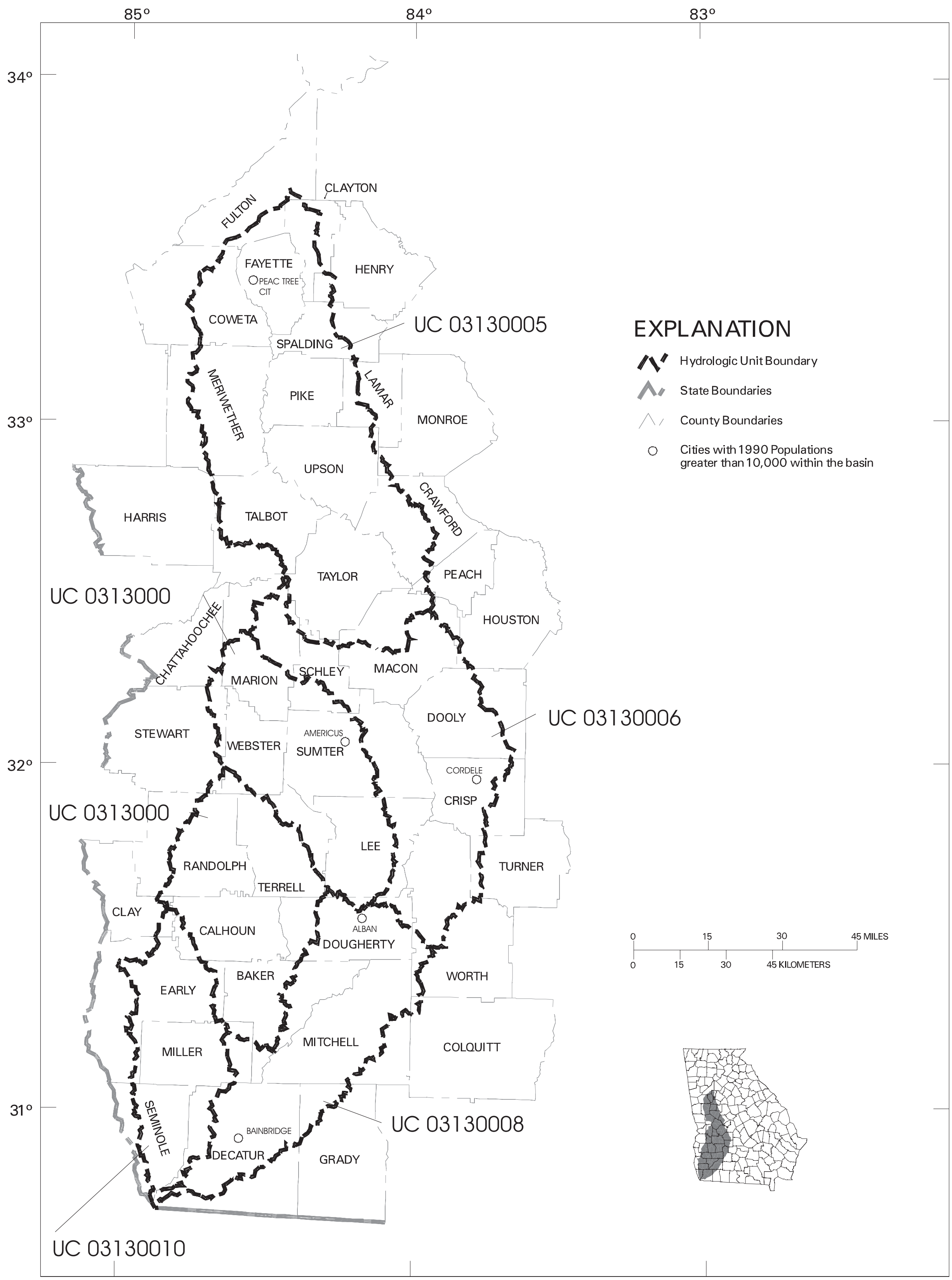



**Figure 2-2. Hydrologic Units and Counties of the Flint River Basin**

The Piedmont Province is underlain by mostly Precambrian and older Paleozoic crystalline rocks that include mica schist, felsic gneiss and schist, and granite gneiss. Less extensive outcrops of quartzites are also present.

The Fall Line is the boundary between the Piedmont and Coastal Plain Provinces. This boundary approximately follows the contact between crystalline rocks of the Piedmont Province and the unconsolidated Cretaceous and Tertiary sediments of the Coastal Plain Province. As implied by the name, streams flowing across the Fall Line can undergo abrupt changes in gradient, which are marked by the presence of rapids and shoals. Geomorphic characteristics of streams differ between the Piedmont and Coastal Plain Provinces. In the Coastal Plain, streams typically lack the riffles and shoals common to streams in the Piedmont and exhibit greater floodplain development and increased sinuosity.

The Coastal Plain Province contains two distinct regions – a hilly region immediately below the Fall Line (Fall Line Hills District or Georgia Sand Hills); and a region of karst topography. The Fall Line Hills District is highly dissected with relief ranging 50-250 ft. Cretaceous sediments lie in a band immediately below the Fall Line and crop out into younger Eocene-Paleocene sediments of the low-lying Dougherty Plain District.

A significant feature in the eastern edge of the Flint River Basin is the Dougherty Plain. The Dougherty Plain is characterized by outcrops of limestone that results in karst topography. The Dougherty Plain slopes southwestward with altitudes of 300 ft in the northeast to less than 100 ft near Lake Seminole. The flat to very gently rolling topography contains numerous sinkholes and associated marshes and ponds. Small streams in the Dougherty Plain District are frequently intermittent during the summer (Couch et al., 1996).

### *Geology*

The geology of the Flint River Basin strongly influences its physiography, geochemistry, soils, surface and ground water resources (Cocker, in review). The Flint River Basin in Georgia is underlain by older (Precambrian and Paleozoic) crystalline rocks in the northern 25 percent of the basin and by younger (Cretaceous and Tertiary) sedimentary rocks in the southern 75 percent of the basin. The crystalline rocks are predominantly schists (10 percent of the basin), gneiss (8 percent), and granites (4 percent), with lesser amounts of metamorphosed volcanic rocks (2 percent) and metamorphosed sedimentary rocks (1 percent). Important regional structures that consist of intensely sheared or crushed rock include the Towaliga Fault Zone and the Goat Rock Fault Zone.

The Inner Piedmont geologic terrane underlies the northern part of the basin north of the Towaliga Fault Zone. The Pine Mountain terrane lies between the Towaliga Fault Zone and the Goat Rock Fault Zone. Between the Goat Rock Fault Zone and the Fall Line is the Uchee terrane. The Inner Piedmont terrane generally contains metamorphosed sedimentary rocks such as gneisses, schists and quartzites. Granitic intrusions in the Atlanta area are important sources of crushed stone. The Pine Mountain terrane contains metamorphosed sedimentary rocks such as quartzites and schists, and granitic rocks. Quartzites underlie the ridges of Pine Mountain. The Uchee terrane contains metamorphosed volcanic rocks that are mainly amphibolites and gneisses. Higher concnetrations of metals may be associated with metamorphosed volcanic rocks of the Uchee terrane. Rock units in the Piedmont are generally aligned to the northeast parallel to these regional structures. In the northern part of the basin, the Flint River cuts southward across both resistant and less resistant rock units of the Piedmont and the Coastal

Plain. Local drainage patterns in the northern part of the basin are affected by resistant rock units and faults. Pegmatite (mica) mines and crushed stone quarries have been the principal mining operations in the northern part of the Flint River Basin.

Deep weathering of Piedmont rocks produced a residuum referred to as saprolite. Saprolites may serve as local aquifers in the Piedmont. Soils are developed through weathering of the near-surface portions of the saprolite.

The southern third of the basin is underlain by Cretaceous and Tertiary sedimentary rocks of the Coastal Plain. These rocks are predominantly older sands and clays near the Fall Line and younger carbonate rocks in the southernmost part of the basin. These rocks dip gently on the order of a few tens of feet per mile to the southeast. Several important aquifers are associated with the more permeable rock units. Recharge areas for these aquifers are generally located where these rock units crop out in the northern part of the Coastal Plain. Rock composition and permeability have a strong influence on water that flows through them. A large portion of the Coastal Plain in the Flint River Basin is underlain by carbonate rocks. Karst terrain that consists of sinkholes, ephemeral streams and caverns are developed in this region. Iron ores, kaolin, and bauxite are found and have been mined from the northern part of the Coastal Plain, and limestones and attapulgite (“fuller’s earth”) have been mined in the southern portion of the Coastal Plain.

Quaternary alluvium deposits are found in stream and river valleys with the larger and thicker deposits in the major river valleys. Commonly, these underlie the floodplains of the river systems.

### *Geochemistry*

Background stream sediment and stream geochemistry of the Flint River Basin has been documented and analyzed by Cocker (in review) using data collected as part of the U.S. Department of Energy’s National Uranium Resource Evaluation (NURE) program. Data was collected and analyzed for the period 1976 to 1978. The number of sample sites for this river basin is 660. Geochemical data included aluminum, barium, beryllium, cobalt, chromium, copper, iron, magnesium, manganese, nickel, lead, silver, titanium, vanadium, zinc, pH, alkalinity, and conductivity. Geochemical data were contoured and spatially related to specific rock units shown on the Geologic Map of Georgia (Georgia Geologic Survey, 1976) with the aid of a Geographical Information System (GIS).

The Flint River Basin cuts across five regions that differ in stream pH, conductivity and alaklinity and that are spatially coincident with regional geology and related stream sediment geochemical trends particularly in the Coastal Plain. Two regions in the basin have higher pH (greater than 7), higher conductivity (greater than 43 micromhos/cm), and higher alkalinity (greater than 0.3 meq/L) and separate regions of lower pH, conductivity and alkalinity. These parameters may affect or measure the amount of dissolved metals in the surface and ground water. Streams in the northernmost part of the Coastal Plain that is underlain by permeable sands and clays have very low pH (4.1 to 6.7), conductivities (1 to 45 micromhos/cm) and alkalinities (0.02 to 0.10 meq/L). Stream and river pH, alkalinity, and conductivity increase south of Montezuma as a result of dissolution of the carbonate rocks underlying this portion of the basin (Cocker, in review).

Primary pollutant data from stream sediments are available for only 220 of the 660 samples, and the distribution of those 220 samples does not provide a good representation of the basin. Some of the data suggest that stream sediments with anomalous metals may be spatially related to particular geologic units. Data from a few sample sites may be influenced anthropogenic sources (Cocker, in review).

***Soils***

Soils of the Flint River Basin are divided into three major land-resource areas (formerly called soil provinces), which generally reflect the physiographic provinces and are shown in Figure 2-3. These are the Southern Piedmont, Georgia Sand Hills, and the Southern Coastal Plain areas.

Two major soil orders, ultisols and entisols, are present in the Flint basin. The Southern Piedmont land resource area is dominated by ultisols. Piedmont ultisol soils are acidic, are low in nitrogen and phosphorus, and generally lack the original topsoil. Topsoil erosion began with intensive cultivation of cotton in the 1800's (Wharton, 1978). Ultisols are characterized by sandy or loamy surface horizons and loamy or clayey subsurface horizons. These deeply weathered soils are derived from underlying crystalline rock.

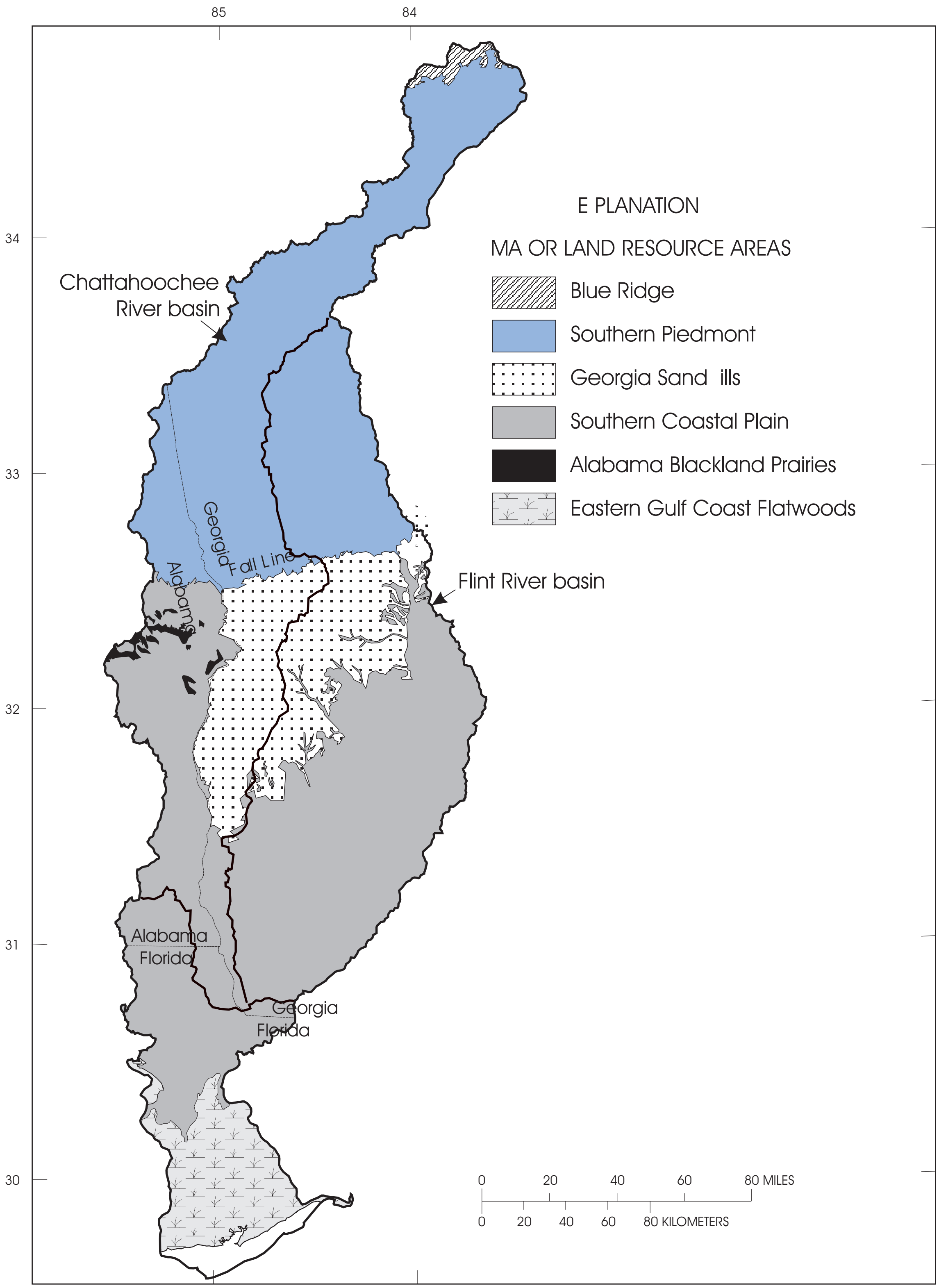
Soils in the Southern Coastal Plain and the Georgia Sand Hills land-resource areas are derived from marine and fluvial sediments eroded from the Appalachian and Piedmont Plateaus. Ultisols are found throughout the Southern Coastal Plain, with the exception of some areas in the Georgia Sand Hills where entisols are present. Entisols are young soils with little or no change from parent material and with poorly developed subhorizons. These soils are frequently infertile and dry because they are deep, sandy, well-drained, and subject to active erosion.

Basinwide patterns in soil leaching and runoff potential provide information on areas that may be susceptible to greater contaminant transport through infiltration or runoff. Maps of soil leaching and runoff potential have been constructed for soils in the Flint River Basin using data from the digital State Soil Geographic Database (STATSGO) of the U.S. Department of Agriculture, Natural Resources Conservation Service (formerly called the Soil Conservation Service) (see Couch et al., 1996). A high leaching rate is assigned to soils with a permeability of 6.0 inches per hour or more (Brown et al., 1991). Soils with high leaching rates are concentrated in the sandy Cretaceous sediments below the Fall Line.

Runoff ratings are based on the inherent capacity of bare soil to permit infiltration, and consider slope, frequency of flooding during the growing season, and permeability (Brown et al., 1991). Soils with high runoff ratings are distributed throughout the basin, but are concentrated in areas having low permeability, steep slopes; or where flooding is frequent or the water table is near the surface, such as in floodplains and other low-lying areas. In the Flint River Basin, soils with the highest runoff ratings are found near the Fall Line.

## 2.1.4 Surface Water Resources

The Flint River is about 349 miles long and drains an area of 8,460 $mi^2$. Many large tributaries are located in the Coastal Plain Province of the Flint River system. These tributaries include the Ichawaynochaway Creek, Chickasawhatchee Creek, Kinchafoonee Creek, and Muckalee Creek. The Flint River has one of only 42 free-flowing river reaches longer than 125 mi remaining in the contiguous 48 states (Couch et al, 1996).




Base modified from U.S. Geological Survey digital files

**Figure 2-3. Major Land-Resource Areas in the Apalachicola-Chattahoochee-Flint River Basin (modified from Couch et al., 1996)**

Spring Creek, formerly a Flint River tributary that now discharges directly into Lake Seminole, drains 585 $mi^2$ in a region of karst topography. As implied by its name, flow in Spring Creek is dominated by groundwater discharge directly into its limestone bed. Stream networks within the six subbasins of the Flint basin are shown in Figures 2-4 through 2-9.

From 1956 to 1996, the median discharge of the Flint River, based on mean daily flows at Newton, Georgia, was 4,780 cubic feet per second ($ft^3/s$). Newton is located between Albany and Bainbridge, and is the southernmost active USGS gaging station located on the Flint mainstem, representing a drainage area of 5,740 $mi^2$, or about 68% of the Flint River Basin. Mean daily discharge ranged from a low of 922 $ft^3/s$ in 1990 to a high of 100,000 $ft^3/s$ in 1994, as summarized in Figure 2-10. The highest daily flow occurred following the passage of Tropical Storm Alberto on July 3-7, 1994, which resulted in record flooding on the Flint and Ocmulgee Rivers.

Higher flows during winter months are evident in the Flint River, Ichawaynochaway Creek, and Spring Creek. During winter months, Coastal Plain streams, such as Ichawaynochaway and Spring Creeks, flow for sustained periods through their floodplains.

### *Reservoirs*

The Flint basin contains three major dams and associated impoundments (including Lake Seminole, which is an impoundment of the Apalachicola River below the confluence of the Chattahoochee and Flint Rivers), as shown in Table 2-2 and Figure 2-11. The two hydropower dams located on the Flint River impound run-of-the-river reservoirs and do not appreciably influence the flow of the Flint River.

Lake Blackshear was formed in 1930 after the construction of the concrete-earthern Warwick Dam and hydroelectric power station on the Flint River near Warwick, Georgia. The Crisp County Power Commission is the controlling authority. Lake surface area has been reported between 8,525-8,700 acres, with a total drainage area at the Warwick Dam of approximately 3,764 square miles. In addition to the Flint River, inflow to Lake Blackshear is contributed by the Turkey, Lime, Limestone, Spring, Gum, Gulley, Cedar and Swift Creek watersheds, other local small streams, and an undetermined quantity of groundwater discharge/recharge that occurs through springs located within the body of the impoundment. Normal pool elevation is 237 feet (mean sea level), and lake levels typically vary by less than one foot except during the drawdowns conducted to achieve dock repair and shoreline maintenance (2 year cycle, during October-November, drawdown ≈ 3 feet). A principal use of Lake Blackshear is power generation, but lake levels are managed primarily to support recreational uses, including sport fishing. The Georgia DNR operates the Georgia Veterans State Park, which has approximately 5 miles of shoreline along the lake, with various recreational facilities provided.

Lake Blackshear is a run-of-river impoundment, having average and maximum depths of approximately 17 and 45 feet, respectively, and backwater areas and embayments characterized by shallows and many small islands. The theoretical mean hydraulic retention time is 16 days. Analysis of bottom profile data has been cited by investigators as indicating that during low to medium inflow periods the old river channel likely carries the majority of flow, short circuiting, with little dispersion through the side channels and embayments of the lake. The Warwick Dam was badly damaged in the 1994 flood, requiring the lake to be drained for nearly two years while repairs were made.

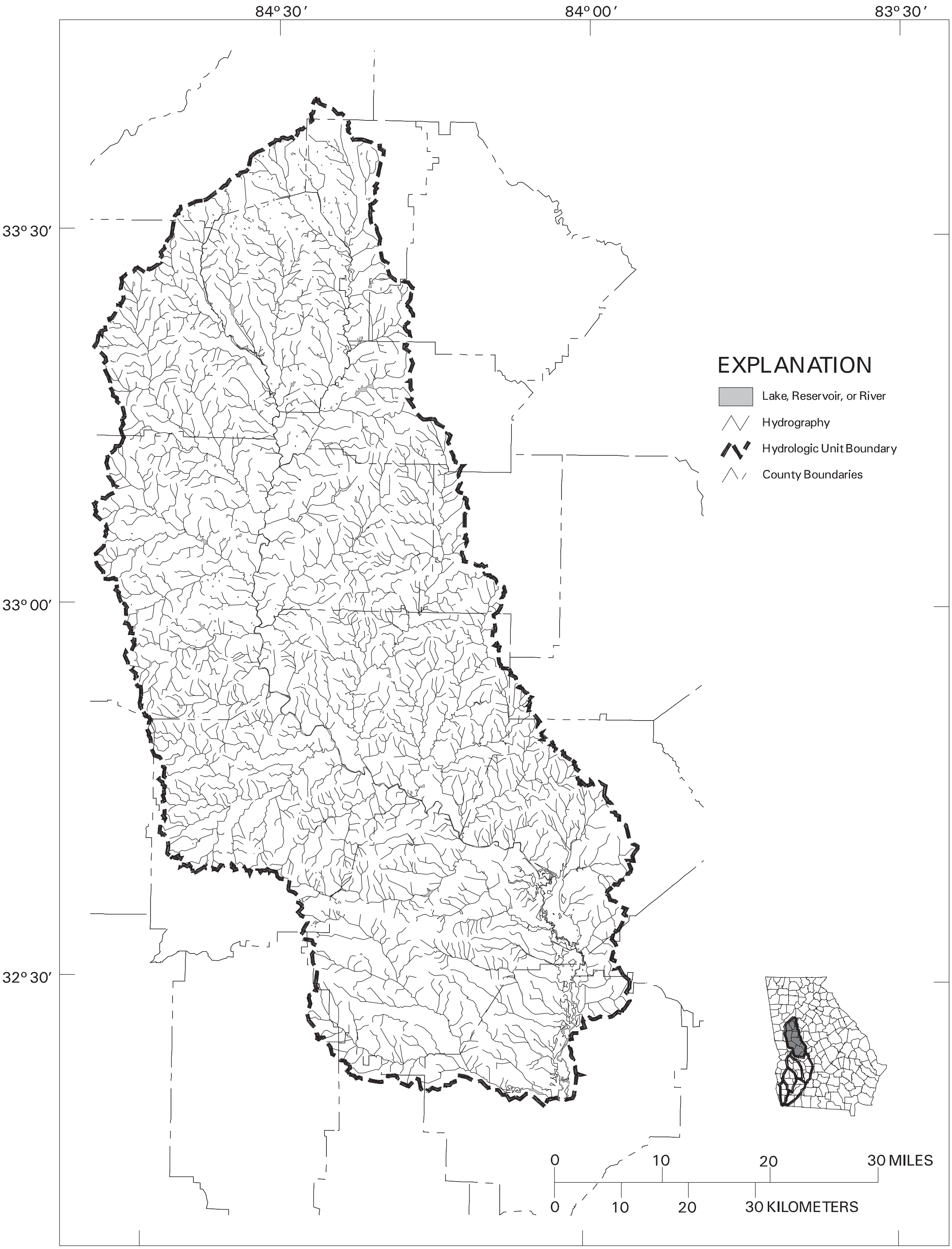



**Figure 2-4. Hydrography, Upper Flint River Basin, HUC 03130005**

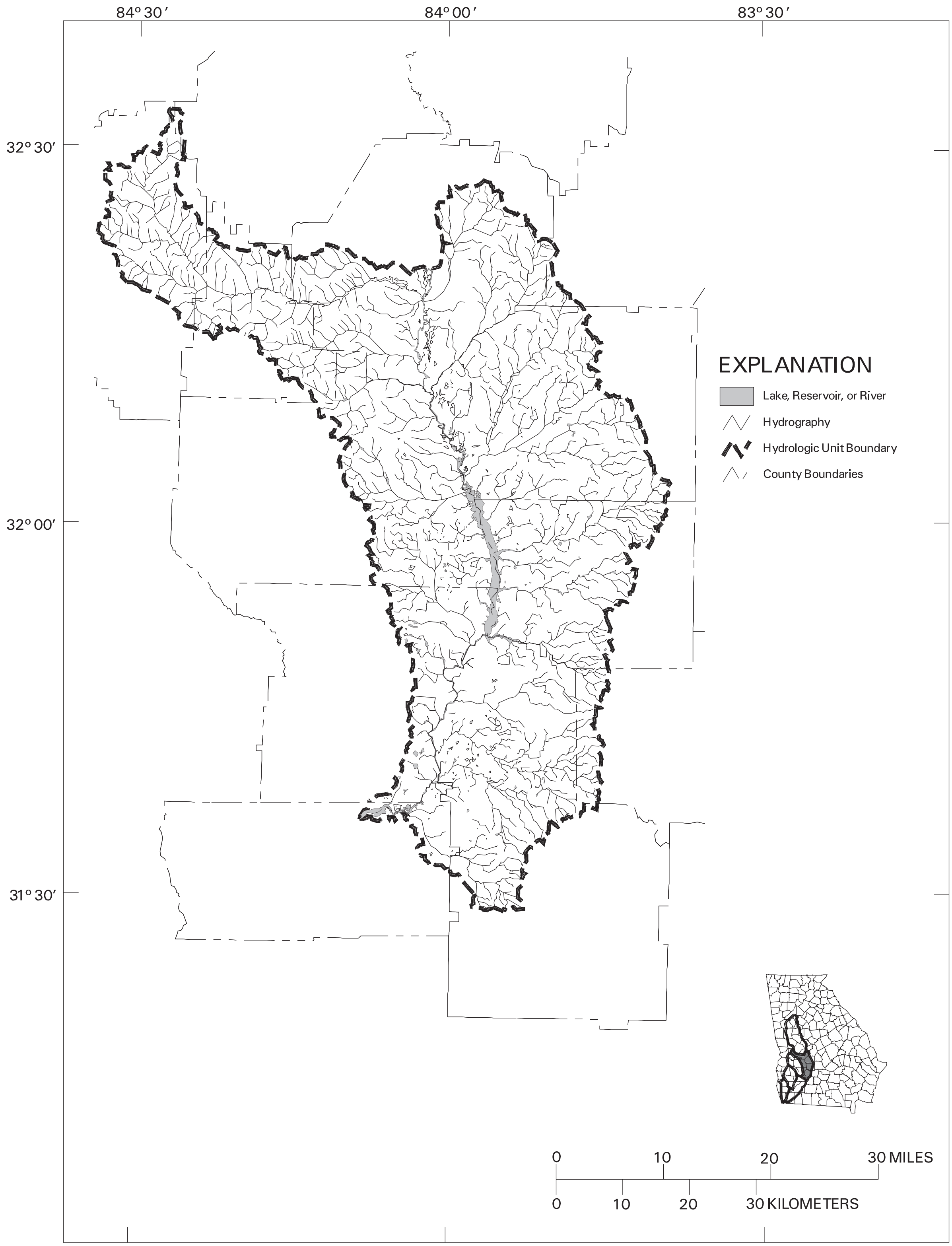



**Figure 2-5. Hydrography, Middle Flint River Basin, HUC 03130006**

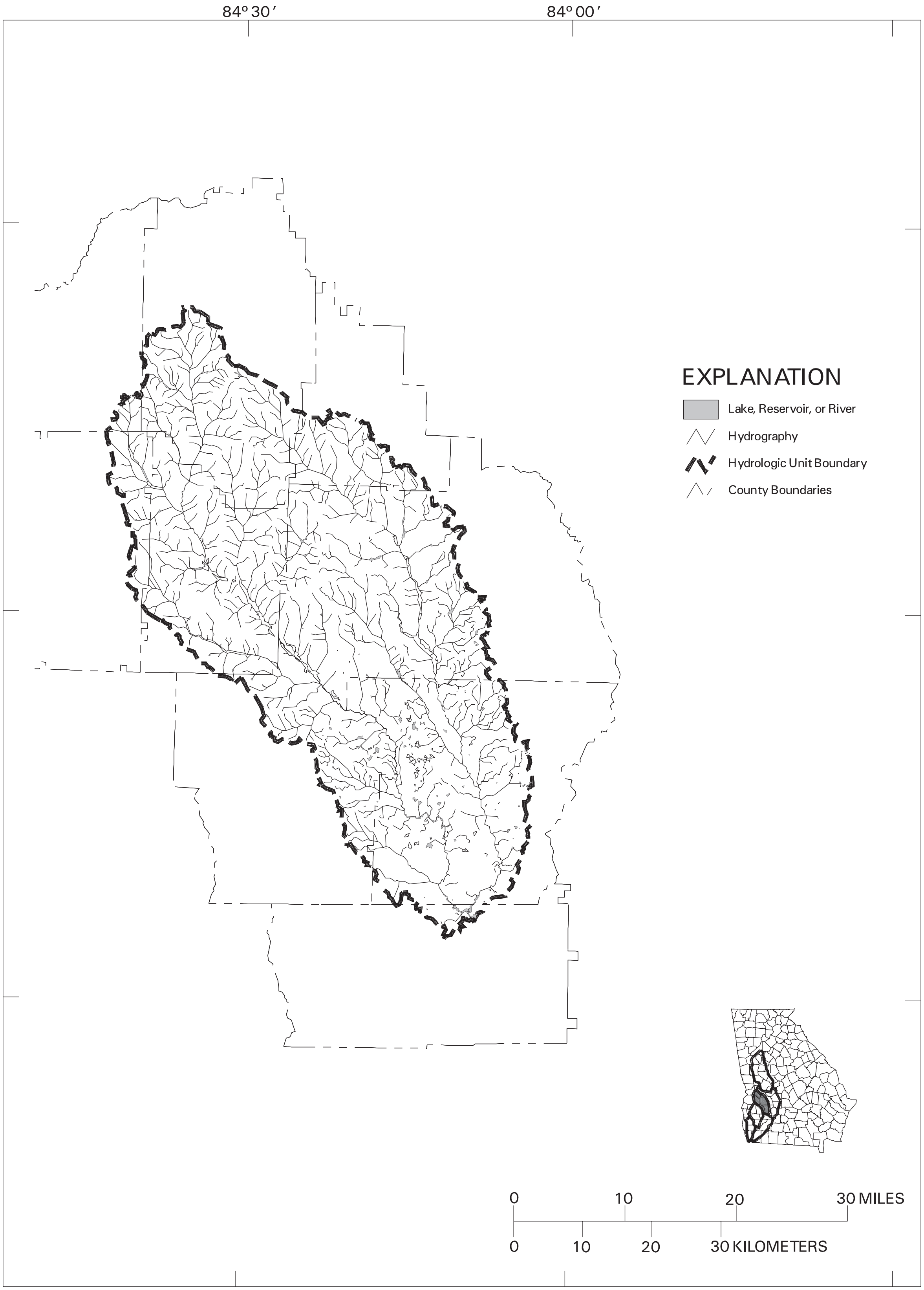



**Figure 2-6. Hydrography, Kinchafoonee-Muckalee Creeks Basin, HUC 03130007**

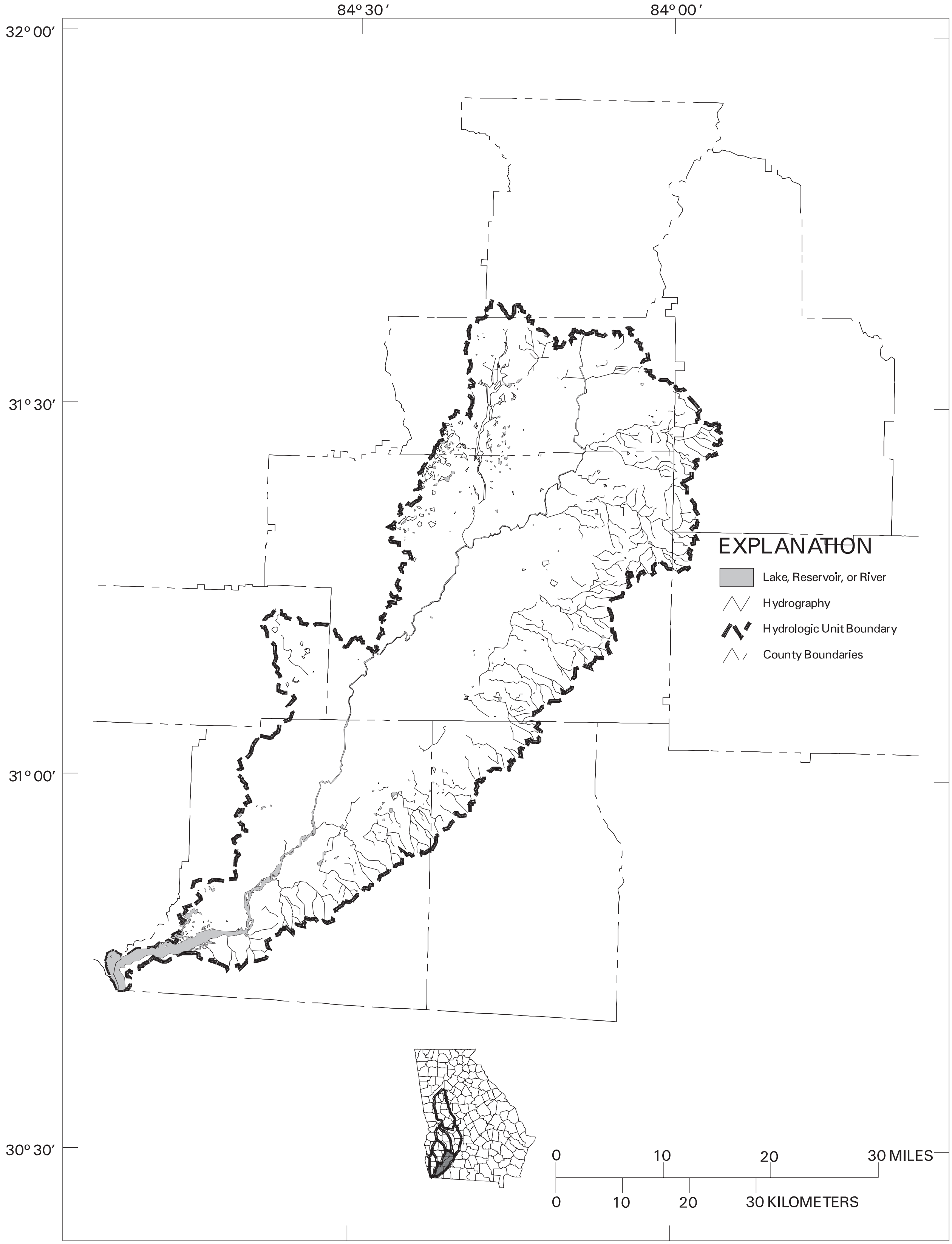



**Figure 2-7. Hydrography, Lower Flint River Basin, HUC 03130008**

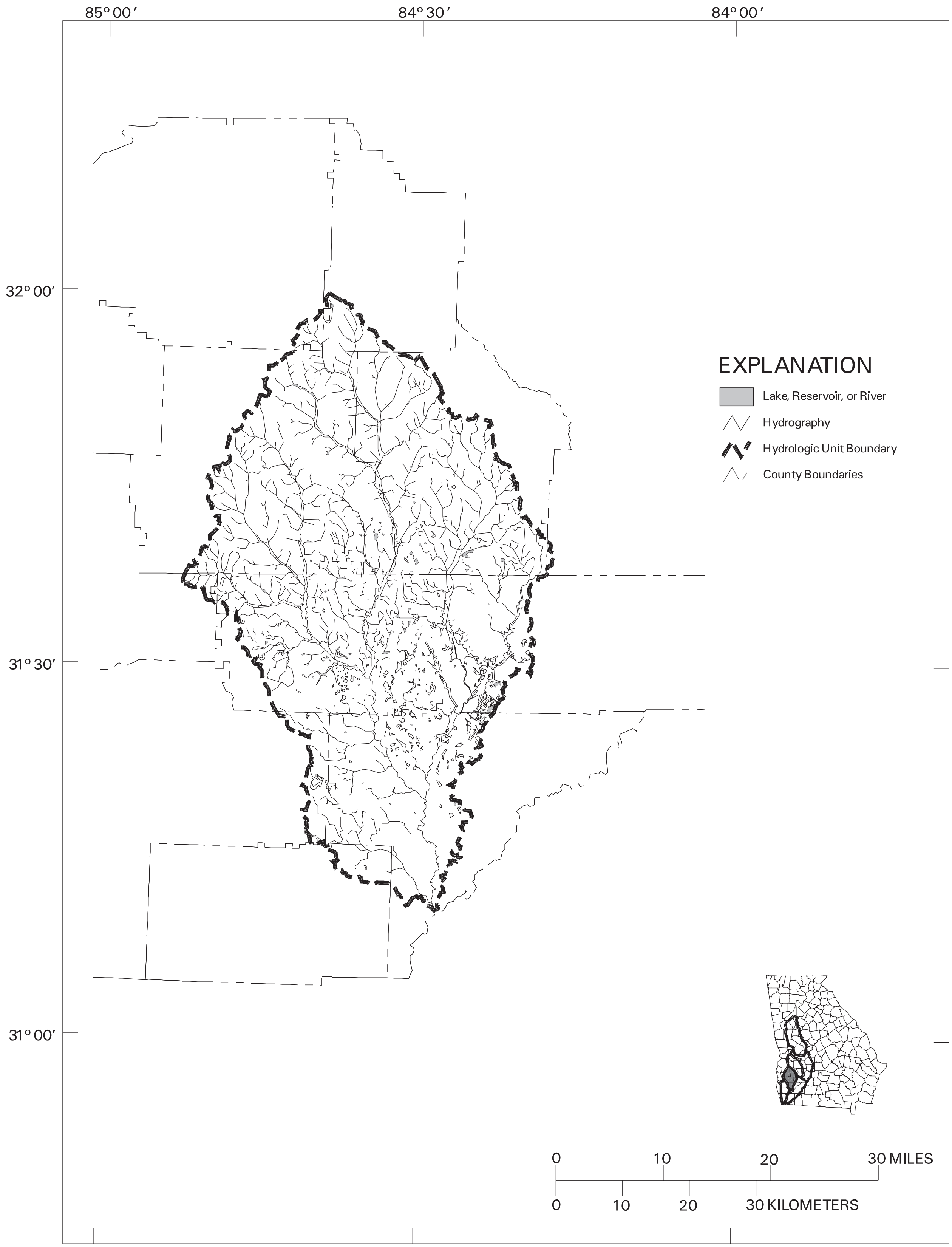



**Figure 2-8. Hydrography, Ichawaynochaway Creek Basin, HUC 03130009**

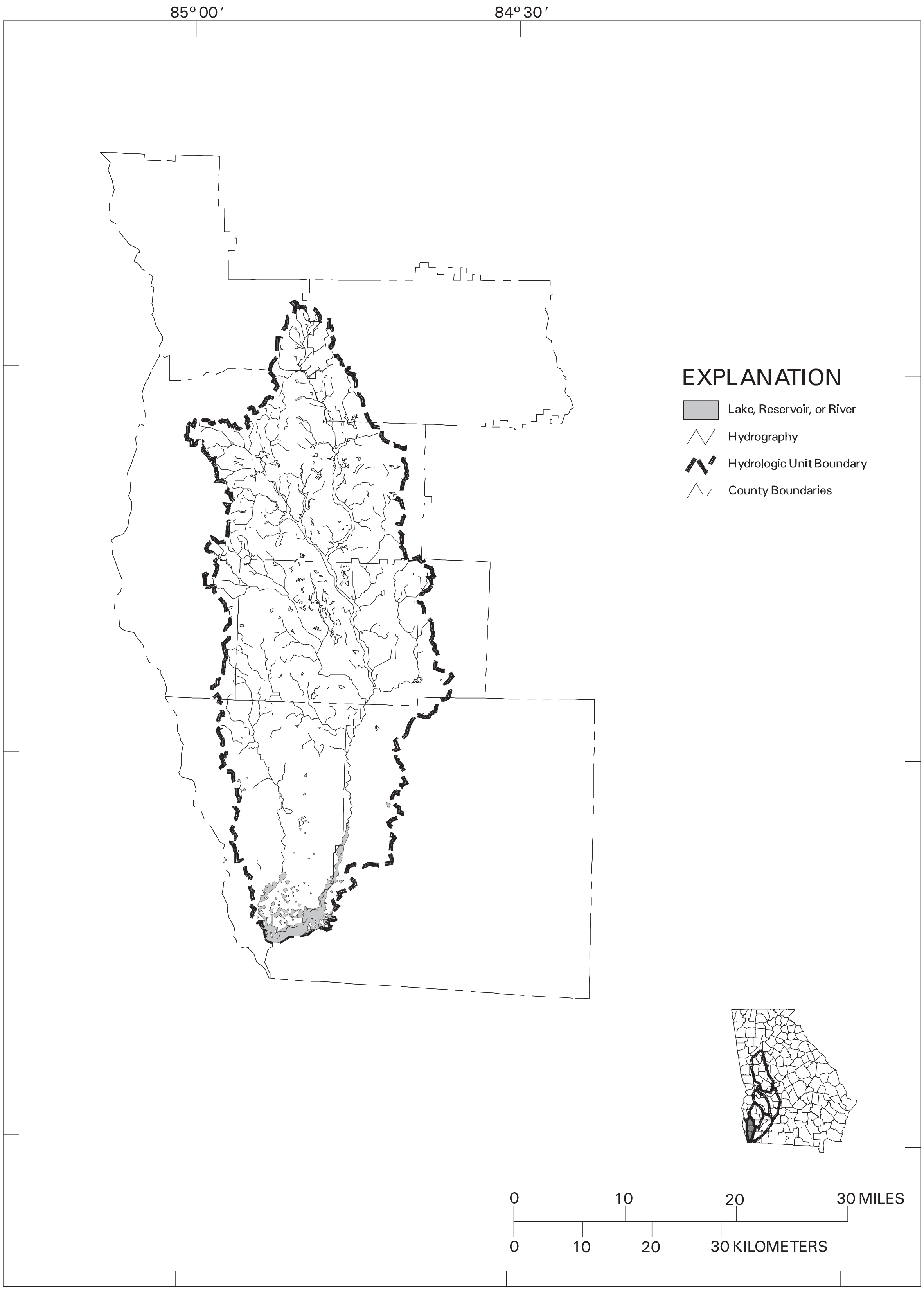



**Figure 2-9. Hydrography, Spring Creek Basin, HUC 03130010**

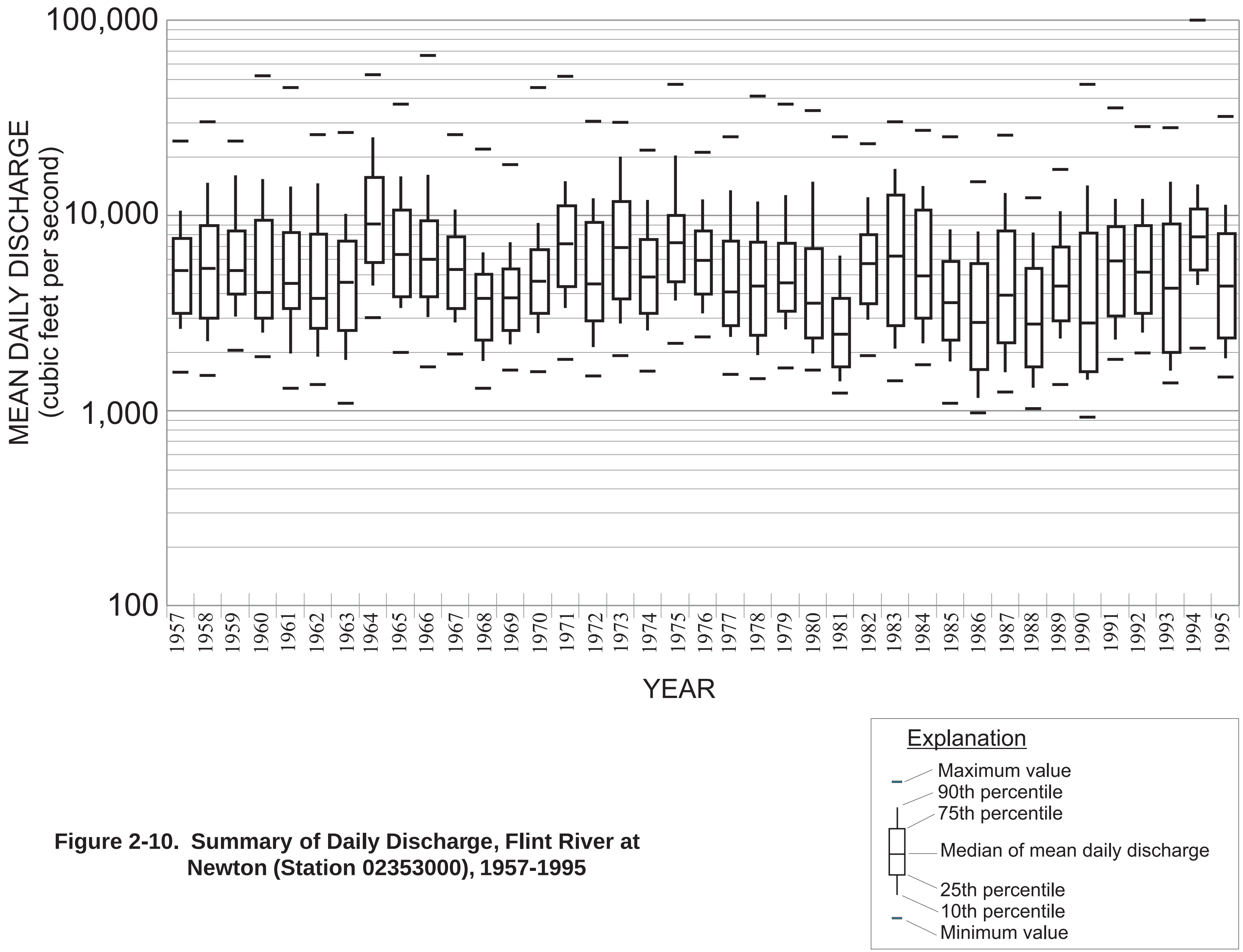



**Figure 2-10. Summary of Daily Discharge, Flint River at Newton (Station 02353000), 1957-1995**

**Table 2-2. Major Dams and Impoundments in the Flint River Basin**

| Project Name | Owner / Year Initially Completed | River mile | Drainage Area (mi$^2$) | Reservoir Size (Ac) | Reservoir Storage Volume (Ac-Ft) | Normal Lake Elevation (ft) |
|---|---|---|---|---|---|---|
| Warwick Dam / Lake Blackshear | Crisp County / 1903 | 134.8 | 3,764 | 8,600 | 5,700 | 237.0 |
| Flint River Dam / Lake Worth | Georgia Power / 1920 | 104.1 | 5,310 | 1,400 | -- | 182.3 |
| Jim Woodruff Lock and Dam / Lake Seminole | COE / 1957 | -- | 17,230 | 37,500 | 367,320 | 77.0 |

Lake Worth was originally formed with the construction of the Muckafoonee Diversion Dam begun in 1905 forming a run-of-river impoundment of Muckalee and Kinchafoonee Creeks. A second dam was constructed on the Flint River (Flint River Dam) forming the Flint River Reservoir and became operational in 1920 with a dredged canal providing a direct connection of the two impoundments. The Georgia Power Company operates both, referring to the combined reservoir as the Flint River Project, and individually as Lake Worth and the Flint River Reservoir (Lake Worth / Flint River). The Flint River Project is considered run-of-river with the operational objective to match unit discharge with reservoir inflow, and lake water levels remain fairly constant as a result. The Muckafoonee Diversion Dam was used for power generation from 1906 to 1938 and provides an additional discharge point (during high input flow periods when capacity of Flint River Dam turbines exceeded), to the Flint River 0.2 miles downstream of the Flint River Dam, via Muckafoonee Creek. During normal flows, inflow from Muckalee and Kinchafoonee Creeks enters the Flint River Reservoir via the open channel connection.

The total surface area of both Lake Worth impoundments is approximately 1400 acres at the normal full pool elevation of 182.3 feet with an upstream drainage area at the Flint River Dam of approximately 5,310 square miles. The principal use of Lake Worth (Flint) is power generation. Chehaw City Park (previously a State Park) is located along the Muckalee Creek arm. The Flint River Dam was also heavily damaged during the 1994 flood, requiring the lake to be drained for several months.

Lake Seminole is located in the extreme southwestern corner of Georgia, formed at the junction of the Chattahoochee and Flint Rivers, and has a surface area of 37,500 acres. The reservoir, impounded by Jim Woodruff Dam (Apalachicola River Mile 107.6) is operated by the Corps of Engineers for navigation, power generation, recreation, and fish and wildlife purposes. Lake Seminole is addressed as part of the Chattahoochee River Basin Plan.

### 2.1.5 Ground Water Resources

The Flint River Basin is a dynamic hydrological system containing interactions between aquifers, streams, reservoirs, floodplains, and estuaries. Many principal rivers receive a substantial contribution of water from groundwater baseflow during dry periods. Five major aquifers, listed below in order of descending stratigraphy and increasing age, underlie the Flint River Basin. Generalized outcrop areas and the stratigraphy of aquifers underlying the Coastal Plain Province are shown in Figure 2-12. These aquifers are generally separated by confining units.

- The Floridan aquifer system is one of the most productive groundwater reservoirs in the United States. This system supplies about 50 percent of the groundwater used in

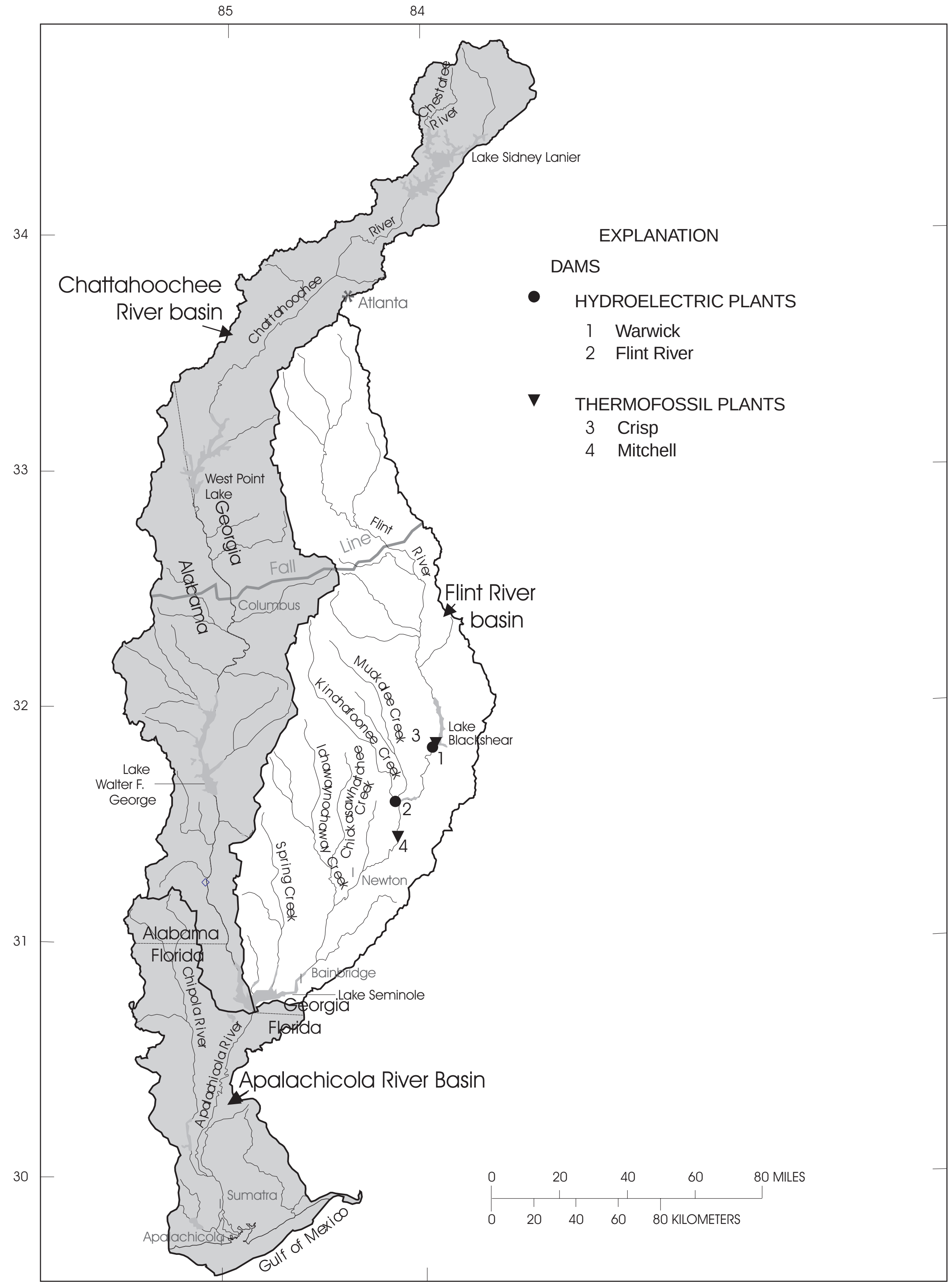



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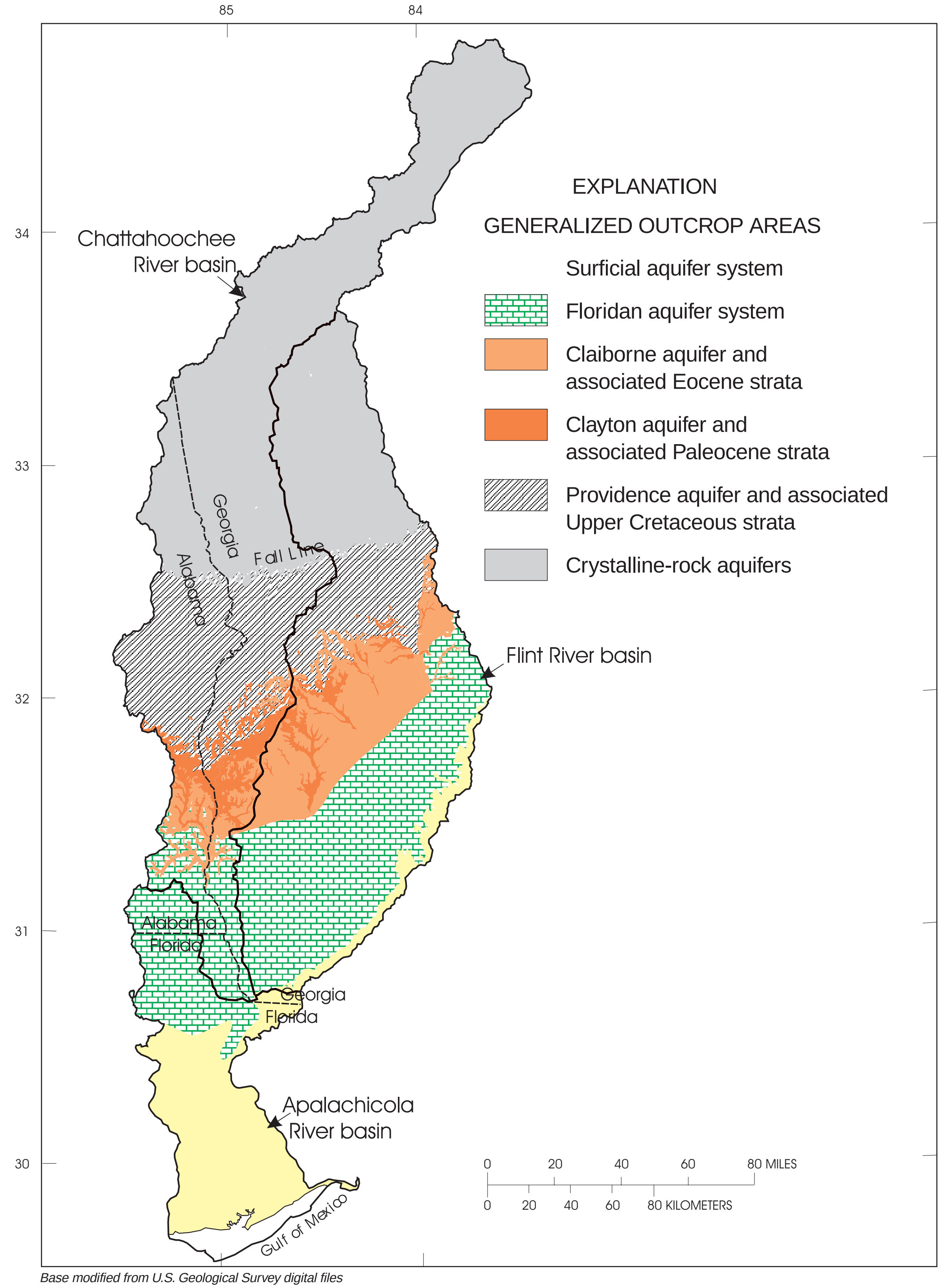
**Figure 2-11. Location of Mainstem Dams and Power-Generating Plants in the Flint River Basin (modified from Couch et al., 1996)**




*Base modified from U.S. Geological Survey digital files*

**Figure 2-12. Hydrogeologic Units Underlying the Apalachicola-Chattahoochee-Flint River Basin (modified from Couch et al., 1996)**

the state. It is used as a major water source throughout the Coastal Plain region of the state. The Floridan aquifer system consists primarily of limestone, dolostone, and calcareous sand. It is generally confined, but is semiconfined to unconfined near its northern limit. Wells in this aquifer are generally high-yielding and are extensively used for irrigation, municipal supplies, industry, and private domestic supply.

- The Claiborne aquifer is an important source of water in part of southwestern Georgia. It is made up of sand and sandy limestone and is mostly confined. It supplies industrial and municipal users in Dougherty, Crisp, and Dooly counties and provides irrigation water north of the Dougherty Plain.

- The Clayton aquifer is another important source of water in southwestern Georgia. It is made up of sand and limestone and is generally confined. The majority of water pumped from this aquifer is used for public supply and irrigation. Due to increased pumping from this aquifer during the 1970s and 1980s, water levels have dropped, particularly in the Albany area. There is some concern now about overuse of this aquifer.

- The Providence aquifer system is the deepest of the principle aquifers in South Georgia. It serves as a major source of water in the northern one-third of the Coastal Plain. The aquifer system consists of sand and gravel that locally contains layers of clay and silt which function as confining beds. These confining beds locally separate the aquifer system into two or more aquifers. In southwestern Georgia, the Providence aquifer is part of the Cretaceous system.

- The Piedmont Province section of the Upper Flint River Basin is underlain by bedrock consisting primarily of granite, gneiss, schist, and quartzite. These rock formations make up the crystalline rock aquifers which are generally unconfined and not laterally extensive. These rocks tend to be impermeable, and thus where groundwater is present, it is stored in joints and fractures in the rock.

Presently, the crystalline rock aquifers are used primarily for private water supplies and livestock watering. It is commonly believed that groundwater in this part of the state is not sufficient to supply such uses as municipal supplies and industry.

North of the Fall Line (which extends through Columbus, Macon, and Augusta) the primary aquifers of the Chattahoochee and Flint River Basins are relatively low-yielding, with wells typically yielding about 20 gallons per minute. This hydrogeologic province is the Piedmont/Blue Ridge, and here water is stored in a mantle of soil and saprolite (i.e., decomposed rock) and transmitted to wells via fractures or other geologic discontinuities in the bedrock. Each surface water drainage basin or watershed is also a ground water drainage basin or watershed; surface and ground water are in such close hydraulic interconnection, they can be considered as a single and inseparable system. In the Piedmont, the decomposed rock or saprolite contains considerable clay that acts as a barrier to ground water pollution. This section of the Chattahoochee and Flint River Basins has below average pollution susceptibility.

South of the Fall Line, the Chattahoochee and Flint rivers flow through the Coastal Plain hydrogeologic province. Here, the aquifers are porous sands and carbonates, and include alternating units of sand, clay, sandstone, dolomite, and limestone that dip gently and thicken to the southeast. Several of these are prolific producers of ground water. Unlike the Piedmont, ground water is the dominant source of water. In this area, the aquifers are of two types: unconfined and confined. The unconfined aquifers are hydraulically interconnected to surface water bodies and the two form a single system; the confined or artesian aquifers, however, are buried and hydraulically isolated from surface water bodies. Confining units between these aquifers are mostly silt and clay. The unconfined aquifers in this area are susceptible to pollution. Generally, the unconfined Chattahoochee River basin aquifers of the Coastal Plain have average pollution susceptibility, whereas the unconfined Flint River Basin aquifers have above average pollution susceptibility. The confined aquifers of both river basins, because they buried and isolated, are somewhat immune to pollution from ground level activities.

From the Fall Line to Lake Seminole, progressively younger sediments crop out and overlie older sediments. The complex interbedded clastic rocks and sediments of Coastal Plain aquifers range in age from Quaternary to Cretaceous. Because of gradational changes in hydrologic properties, aquifer and stratigraphic boundaries are not always coincident.

The regional direction of ground-water flow in the Coastal Plain is from north to south; however, local flow directions vary, especially in the vicinity of streams and areas having large ground-water withdrawals. Rivers and streams in the Coastal Plain Province commonly are deeply incised into underlying aquifers and receive substantial amounts of ground-water discharge. Strata associated with the Floridan aquifer system are exposed along sections of the both the Flint and Chattahoochee Rivers (Maslia and Hayes, 1988). As a result of the greater hydraulic connection between the Floridan aquifer system and the Flint River, however, ground-water discharge contributes more significantly to baseflow in the Flint River than in the Chattahoochee River. Aquifer discharge to the Flint River is estimated to be five times that to the Chattahoochee River (Torak et al., 1991).

### 2.1.6 Biological Resources

Human activity has transformed much of the Flint River Basin; yet, the basin's environment is noteworthy for its remaining biological diversity. The uniqueness of the basin’s environment and biological diversity is a consequence of the basin’s relation to regional, ecological, and zoogeographic patterns. The Flint River Basin contains parts of the Piedmont and Southeastern Plains Ecoregions (Omernik, 1987). The Piedmont Ecoregion is contained within the northern part of the Flint River Basin. The Southeastern Plains Ecoregion encompasses all of the Flint River Basin in the Piedmont and Coastal Plain Provinces. These ecoregions are intended to identify areas of relatively homogeneous ecological systems and are partially based on the distribution of terrestrial biota.

#### *Terrestrial Habitats*

The health of aquatic ecosystems is linked to the health of terrestrial ecosystems. Many parts of the Flint River Basin have been subject to varying degrees of forest-cover alteration. Small-scale disturbance of native forests began with American Indians, who used fire to manage pinelands and create fields for cultivation. Forest disturbance was greatly accelerated by European settlers, who logged throughout the basin and extensively cleared land for agriculture in the Piedmont and Coastal Plain.

Prior to European settlement, the Flint River Basin was mostly forested. Native forests in the Piedmont Province were dominantly deciduous hardwoods and mixed stands of pine and hardwoods. The Coastal Plain supported oak-sweetgum-pine forests, with gum-cypress in floodplain forests. Parts of the lower Coastal Plain were vegetated by open savannahs of wiregrass and longleaf pine (Wharton, 1978).

The Piedmont Province, located in the northern part of the Flint River Basin, experienced three phases of land abandonment—(1) after the Civil War, (2) during the agricultural depression of the late 1880s, and (3) after the bollweevil infestation in the late 1920s. Cotton production in the Piedmont Province left the land relatively infertile and almost devoid of topsoil. Nearly all the topsoil in the Piedmont Province had been eroded by 1935. Abandoned agricultural lands were replaced by the secondary forests that cover most of the Piedmont today.

Forest cover probably reached a low between 1910 and 1919 basinwide when agriculture was at a peak acreage. By the 1920s, about 87 percent of the Piedmont had been cultivated. By the mid-1970's, approximately 59 percent of the land cover in the entire Apalachicola-Chattahoochee-Flint River Basin was forests of second growth stands and large acreages of planted pine (U.S. Geological Survey, 1972-78).

### *Wetland Habitats*

Wetlands are transitional lands between terrestrial and deep-water habitats where the water table is at or near the land surface or the land is covered by shallow water (Cowardin et al., 1979). Most wetlands in the Flint River Basin are forested wetlands located in the floodplains of streams and rivers. Forested-floodplain wetlands are maintained by the natural flooding regime of rivers and streams and, in turn, influence the water and habitat quality of riverine ecosystems.

The Flint River Basin contains many wetlands of significant size (see Figures 2-14 through 2-19 in section 2.2.3). Using satellite imagery, total wetland acreage in the Flint basin has been estimated at about 412,000 acres (see section below on wetland inventories); approximately 90,000 acres are in the forested floodplain of the Flint River Basin and floodplains and swamps associated with Chickasawhatchee and Spring Creeks.

*Wetlands Inventories.* Assessments of wetland resources in Georgia have been carried out with varying degrees of success by the Natural Resources Conservation Service (Soil Conservation Service-USDA), the US Fish and Wildlife Service National Wetland Inventory, and Georgia's Department of Natural Resources.

Hydric soils as mapped in county soil surveys are useful indicators of the location and extent of wetlands for the majority of Georgia counties. The dates of photography from which the survey maps are derived vary widely across the state, and no effort has been made to develop digital databases at the soil mapping unit level. However, soil surveys have proven useful in wetland delineation in the field and in the development of wetland inventories. County acreage summaries provide useful information on the distribution of wetlands across the state.

The National Wetland Inventory (NWI) of the U.S. Fish and Wildlife Service utilizes soil survey information during photo-interpretation in the development of the 7.5 minute, 1:24,000 scale products of this nationwide wetland inventory effort. Wetlands are classified according to the Cowardin system, providing some level of detail as to the characterization of individual wetlands. Draft products are available for the 1,017 7.5 minute quadrangles in the state of Georgia, and many final map products have been produced. More than 100 of these quadrangles are available in a digital format. Although not intended for use in jurisdictional determinations of wetlands, these products are invaluable for site surveys, trends analysis, and land-use planning.

A complementary database was completed by Georgia DNR in 1991 and is based on classification of Landsat Thematic Mapper (TM) satellite imagery taken during 1988-1990 (see Figures 2-20 through 2-25 in section 2.2.3). Due to the limitations of remote sensing technology, the classification scheme is simplified in comparison to the Cowardin system used with NWI. Total wetland acreage based on Landsat TM imagery is 412,365 acres or about 8 percent of land area in the Flint basin. These data underestimate the acreage of forested wetlands in the Piedmont and Coastal Plain, where considerable acreage may have been classified as hardwood or mixed forest.

***Aquatic Fauna***

This section focuses on aquatic or wetland species including fishes, amphibians, aquatic reptiles, and aquatic invertebrates. However, the Flint River Basin is rich in many other fauna that rely on the water resources of the basin, including many species of breeding birds and mammals. Although a description of these bird and mammal species is beyond the scope of this report, the water needs of these species, such as bald eagles, fish-eating mammals, and migratory water fowl, should be considered in water-resource planning and management.

*Fish Fauna.* The Apalachicola-Chattahoochee-Flint (ACF) basin has the largest diversity of fish fauna among the Gulf Coast river drainages east of the Mississippi River. The Flint River Basin is dominated by a warm-water fishery. Warm-water species of recreational importance include largemouth bass, white bass, hybrid striped bass, shoal bass, spotted bass, crappie, yellow perch, pickerel, flathead catfish, channel catfish, and several varieties of sunfish and suckers.

The diverse fish fauna of the Flint River Basin includes 85 extant species representing 19 families. The largest number of species (22) are in the minnow family Cyprinidae. Minnows are small fish that can be seen darting around in streams. Other families with large numbers of species are the sunfishes (Centrachidae), the catfishes (Ictalaridae), and the suckers (Catostomidae). Species that have the largest numbers of individuals living in streams typically are minnows and suckers. These species are often not well known because unlike sunfish, black bass, and catfish, people do not fish for them, although certain minnows may be used as bait. Minnows have an important role in the aquatic food chain as prey for larger fish, snakes, turtles, and wading birds such as herons. Suckers can grow to more than one foot long and are named for their down-turned mouth that they use to "vacuum" food from stream bottoms. Although suckers are not popular game fish, they are ecologically important because they often account for the largest fish biomass in streams.

Seventeen species have been introduced into the ACF basin by humans. Introduced species include the rainbow and brown trout, white catfish, flathead catfish, black bullhead, goldfish, carp, rough shiner, red shiner, white bass, spotted bass, bock bassappie, yellow perch, sauger, and walleye.

There are several lakes within the Flint River Basin that provide excellent habitat for various freshwater fisheries. The Wildlife Resources Division owns and manages Big Lazer Public Fishing Area, a 195 acre lake on a tributary of the Flint River in Talbot County. This lake offers excellent fishing for bluegill, channel catfish, and largemouth bass. The lake lies within the Big

Lazer Creek Wildlife Management Area, a 5,850 acre tract of state-owned land managed primarily for public hunting.

Lake Blackshear, a Crisp County Power Commission lake on the Flint River, is a shallow impoundment built for electric power production. The Lake Blackshear dam was badly damaged in the 1994 flood, requiring the lake to be drained for nearly two years while repairs were made. The fish population is therefore much like that in a new reservoir. Historically, the lake has had good fisheries for largemouth bass, hybrid bass, catfish, and crappie. Lake Blackshear is currently being stocked with Gulf strain striped bass in an effort to develop a successful spawning run up the Flint River and thus aid in maintaining the strain in its native river system.

Downstream from Lake Blackshear, the Flint River flows for about 30 miles before being impounded again by the Flint River Dam, a small Georgia Power Company dam in Albany. This dam forms the 1,400 acre Lake Worth. This dam was also heavily damaged during the 1994 flood, and had to be drained for several months. Lake Worth supports a modest recreational fishery for largemouth bass, hybrid bass, sunfish, and catfish.

Below Albany, the Flint River flows unabated to Lake Seminole. This section of the Flint River is the only portion in Georgia where gulf race striped bass are known to successfully reproduce. Striped bass in excess of 50 pounds have been documented in this river section. These large fish are highly dependent on groundwater springs along the Flint River that provide cool water refuges during the summer months. Maintenance of this species is a high priority for the Wildlife Resources Division.

*Amphibians and Reptiles.* In addition to the diversity of fish fauna, the Flint River is noteworthy for its diversity of amphibians and reptiles. The lower part of the Flint River Basin, together with the upper part of the Apalachicola basin, has the highest species density of amphibians and reptiles on the continent north of Mexico. Means (1977) provides a checklist of amphibian and reptile species in the Apalachicola River basin, and Martof (1956) provides a checklist with distributional notes for species in Georgia. These checklists indicate that the Apalichicola-Chattahoochee-Flint River Basin is inhabited by 16 species of freshwater aquatic turtles, 21 species of salamanders, 26 species of frogs, and the American alligator. All require freshwater to complete or sustain their lifecycles. In addition, numerous species of snakes and lizards inhabit streams and wetlands.

Fifteen species of amphibians or reptiles are noteworthy because of their rarity or protected status. The alligator snapping turtle, the worlds largest freshwater turtle, is designated as threatened as a result of commercial overharvesting for its meat. Barbour's map turtle, a federal candidate species under the Endangered Species Act, is endemic to the Coastal Plain part of the ACF basin. The natural range of the turtle was decreased by the formation of Lake Seminole, which caused a decline in the population. Its population has further declined because of harvesting for meat.

*Aquatic Invertebrate Fauna.* With the possible exception of the mollusc (Heard, 1977) and crayfish species (Hobbs, 1942, 1981), knowledge of the number and distribution of aquatic invertebrate species that inhabit the Flint River Basin is limited. The largest diversity of macrofaunal aquatic organisms occurs among the insects. Hobbs (1942, 1981) lists 20 species of crayfish that occur in the Chattahoochee or Flint River Basins.

### *Aquatic Vegetation*

The Georgia Natural Heritage Program has identified 92 Special Concern plant species occurring in the Flint River Basin. Among these, there are 24 wetland or aquatic species with state threatened or endangered status, as listed in Table 2-3.

Throughout the Flint River Basin, aquatic vegetation and algae can exhibit uncontrolled or noxious growth in response to changes in water quality such as nutrient enrichment or altered hydraulic conditions. These problems are most likely to occur in reservoirs in the Coastal Plain

**Table 2-3. Threatened or Endangered Wetland and Aquatic Plant Species in the Flint Basin**

| Common Name | Species | Status | Habitat |
|---|---|---|---|
| Variable-Leaf Indian-Plantain | *Amoglossum diversifolium* | T | Calcareous swamps |
| Harper Fimbry | *Fimbristylis perpusilla* | E | Exposed muddy margins of pineland ponds |
| Dwarf Witch-Alder | *Fothergilla gardenii* | T | Openings in low woods; swamps |
| Shoals Spiderlily | *Hymenocallis coronaria* | E | River shoals |
| Florida Anise-Tree | *Illicium floridanum* | E | Steepheads; floodplain forests |
| Pondberry | *Lindera melissifolia* | E | Pond margins and wet savannas |
| Pondspice | *Litsea aestivalis* | T | Cypress ponds; swamp margins |
| Curtiss Loosestrife | *Lythrum curtisii* | T | Openings in calcareous swamps |
| Lax Water-milfoil | *Myriophyllum laxum* | T | Bluehole spring runs; shallow, sandy, swift-flowing creeks; clear, cool ponds |
| Canby Dropwort | *Oxypolis canbyi* | E | Cypress ponds and sloughs; wet savannas |
| Hirst Panic Grass | *Panicum hirstii* | E | Cypress ponds; wet savannas and sloughs |
| False Dragon-Head | *Physostegia leptophylla* | T | Wet savannas; bogs; freshwater marshes |
| Southern Butterwort | *Pinguicula primuliflora* | T | Sandy, clearwater streams and seeps; Atlantic white cedar swamps |
| Whitetop Pitcherplant | *Sarracenia leucophylla* | E | Wet savannas, pitcherplant bogs |
| Green Pitcherplant | *Sarracenia oreophila* | E | Wet meadows; upland bogs |
| Parrot Pitcherplant | *Sarracenia psittacina* | T | Wet savannas, pitcherplant bogs |
| Purple Pitcherplant | *Sarracenia purpurea* | E | Swamps, wet rhododendron thickets |
| Sweet Pitcherplant | *Sarracenia rubra* | E | Atlantic white cedar swamps; wet meadows |
| Bay Starvine | *Schisandra glabra* | T | Stream terraces |
| Chaffseed | *Schwalbea americana* | E | Pond margins and wet savannas; upland ridge forests |
| Swamp Buckthorn | *Sideroxylon thornei* | E | Forested limesink depressions; calcareous swamps |
| Cooley Meadowrue | *Thalictrum cooleyi* | E | Pond margins and wet savannas |
| Piedmont Barren Strawberry | *Waldsteinia lobata* | T | Stream terraces and adjacent gneiss outcrops |

Province, where stable water levels, shallow depths, sedimentation, excessive nutrient inputs, and a mild climate provide conditions favorable to the proliferation of aquatic vegetation, particularly introduced species. In the Flint River Basin, Lakes Blackshear and Seminole have experienced noxious growths of aquatic plants.

The problem is severe in Lake Seminole, where as much as 80 percent of the lake's surface area has been covered by aquatic plants. Noxious growth of aquatic plants in Lake Seminole began in 1955 at the time water began to be impounded. In 1973, an aquatic plant survey of Lake Seminole identified more than 400 species, of which 70 were classified as noxious or potentially noxious plants. Several introduced species have established themselves, including Eurasian milfoil (*Myriophyllum spicatum*), giant cutgrass (*Zizaniopsis miliacea*), water hyacinth *(Eichorina crassipes*), and Hydrillae (*Hydrilla verticillata*).

## *2.2 Population and Land Use*

### 2.2.1 Population

Population of the Flint River Basin was estimated at about 640,000 people as of 1990, with about 251,000 occupied housing units (EPA Geographic Information Query System). Population distribution in the basin at the time of the 1990 Census is shown in Figure 2-13. Metropolitan Atlanta, the largest metropolitan area in the southeastern United States, is partly within the northern portion of the Flint River Basin. The two other major population centers in the Flint River Basin include Albany, with a population of 85,000, and Bainbridge, with a population of almost 11,000. A summary of 1990 population estimates by HUC units based on census tract/block centroids (EPA Geographic Information Query System) is shown in Table 2-4.

Between 1985 and 1995, the population in the Flint River Basin increased 1.3 percent per year. With moderate job creation expected, the population resident within the Flint basin is expected to continue to increase (DRI/McGraw-Hill, 1996). Basin population is projected to increase by 1.1 percent per year through 2010. The largest increases in population are projected for the Metropolitan Atlanta area. The predominantly rural counties of the southern part of the basin are projected to have nearly stable or somewhat declining populations (DRI/McGraw-Hill, 1996).

### 2.2.2 Employment

Since 1975, employment in the Flint River Basin has risen at a fairly vigorous 3.6 percent annual rate. The Flint River Basin definitionally runs the gamut from the near-urbanized metropolitan counties of Atlanta in the north to the southwestern rural counties of Georgia, including the city of Albany. Thus, the basin captures some of the high employment growth of Atlanta and the more moderate employment growth of Albany.

Manufacturing employment is projected to decline sharply over the next few decades, from a 28.2 percent share of total employment within the basin to a 4.7 percent share by 2050. Textiles will be a major source of the job cutbacks, potentially dropping 8,000 positions between 1995 and 2050. Industrial production will be strong overall, with other nondurables production growing more than 450 percent and durables production more than tripling. Despite the reduction in employment, textile production will double. Meanwhile, the nonmanufacturing sector will surge, led by significant gains within the service sector. Service-related employment

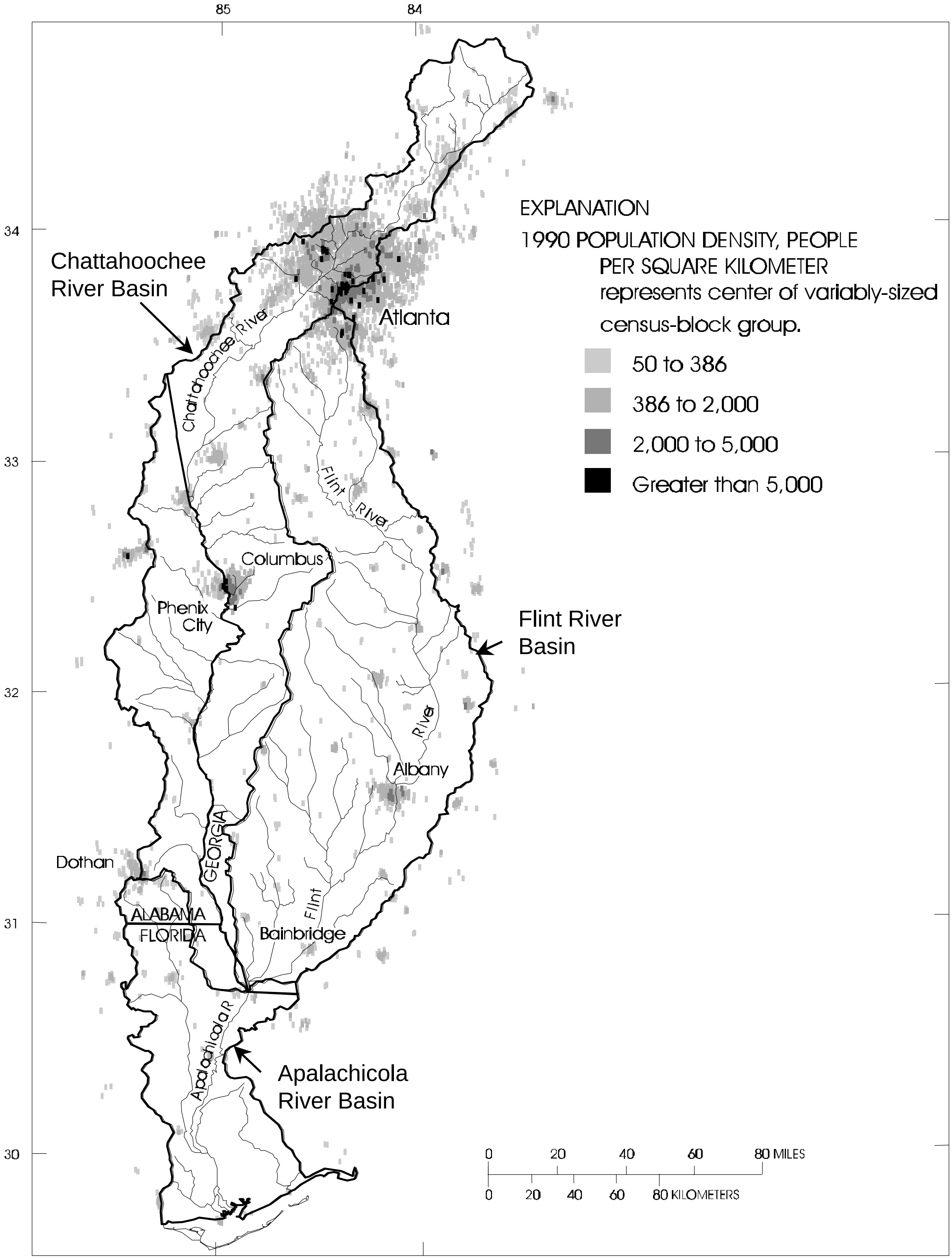



**Figure 2-13. Population Density in the Apalachicola-Chattahoochee-Flint River Basin, 1990 (modified from Couch et al., 1996)**

**Table 2-4. Population Estimates by HUC Unit (1990)**

| HUC | Population | Household Units |
|---|---|---|
| 03130005 | 355,455 | 140,299 |
| 03130006 | 67,505 | 26,560 |
| 03130007 | 51,427 | 19,047 |
| 03130008 | 119,446 | 46,499 |
| 03130009 | 22,391 | 8,844 |
| 03130010 | 23,715 | 9,728 |
| *Total* | *639,939* | *250,977* |

will experience a rise in the share of jobs from 10.2 percent in 1975 to 29.8 percent share in 2050 (DRI / McGraw-Hill, 1996).

## 2.2.3 Land Cover and Use

The land use activities in the Flint River Basin are primarily agriculture and forestry-related. Urban land cover is mostly found adjacent to the population centers of Atlanta, Albany, and Bainbridge. Forested lands are concentrated in the upper half of the basin, while agricultural lands are predominantly located in the lower half of the basin.

Land use / land cover classification has been determined for the Flint River Basin based on high-altitude aerial photography for 1972-76 (U.S. Geological Survey, 1972-78). Subsequently in 1991 land cover data were developed based on interpretation of Landsat TM satellite image data obtained during 1988-90, leaf-off conditions. These two coverages differ significantly. Aerial photography allows identification of both land cover and land uses. Satellite imagery, however, detects primarily land cover and not use. It also tends to be less accurate than aerial photography. The targeted accuracy level for the overall landcover assessment using Landsat imagery was 85%. However, the percent error was not necessarily distributed equally throughout all classes.

The 1972-76 classification indicates that 48 percent of the basin land area was forest, 42 percent was agriculture, and 3 percent was urban land cover, with 7 percent in other land uses, including about 5 percent wetlands (Figures 2-14 through 2-19). In contrast to the Piedmont Province, agriculture comprised a larger percentage of land cover in the Coastal Plain. Urban land cover was concentrated in the upper part of the Flint River Basin in the Metropolitan Atlanta area.

The 1991 land cover interpretation showed 50% of the basin in forest cover, 7.1 % in wetlands, 1.4 % in urban land cover, and 40% in agriculture (Figures 2-20 through 2-25). Statistics for 15 landcover classes in the Flint basin are presented in Table 2-5.

***Forestry***

The Flint River Basin contains approximately 3.6 million acres of commercial forest land according to the U.S. Forest Service's Forest Statistics for Georgia, 1989 report. This represents about 55 percent of the total land area in the basin. (Note that these U.S. Forest Service statistics include data for entire counties instead of exact watershed boundaries, which leads to some inconsistency with figures based on the land use and land cover assessments previously described.) Private landowners account for 81 percent of the ownership, while the forest industry companies account for 18 percent. Governmental entities account for about 1 percent

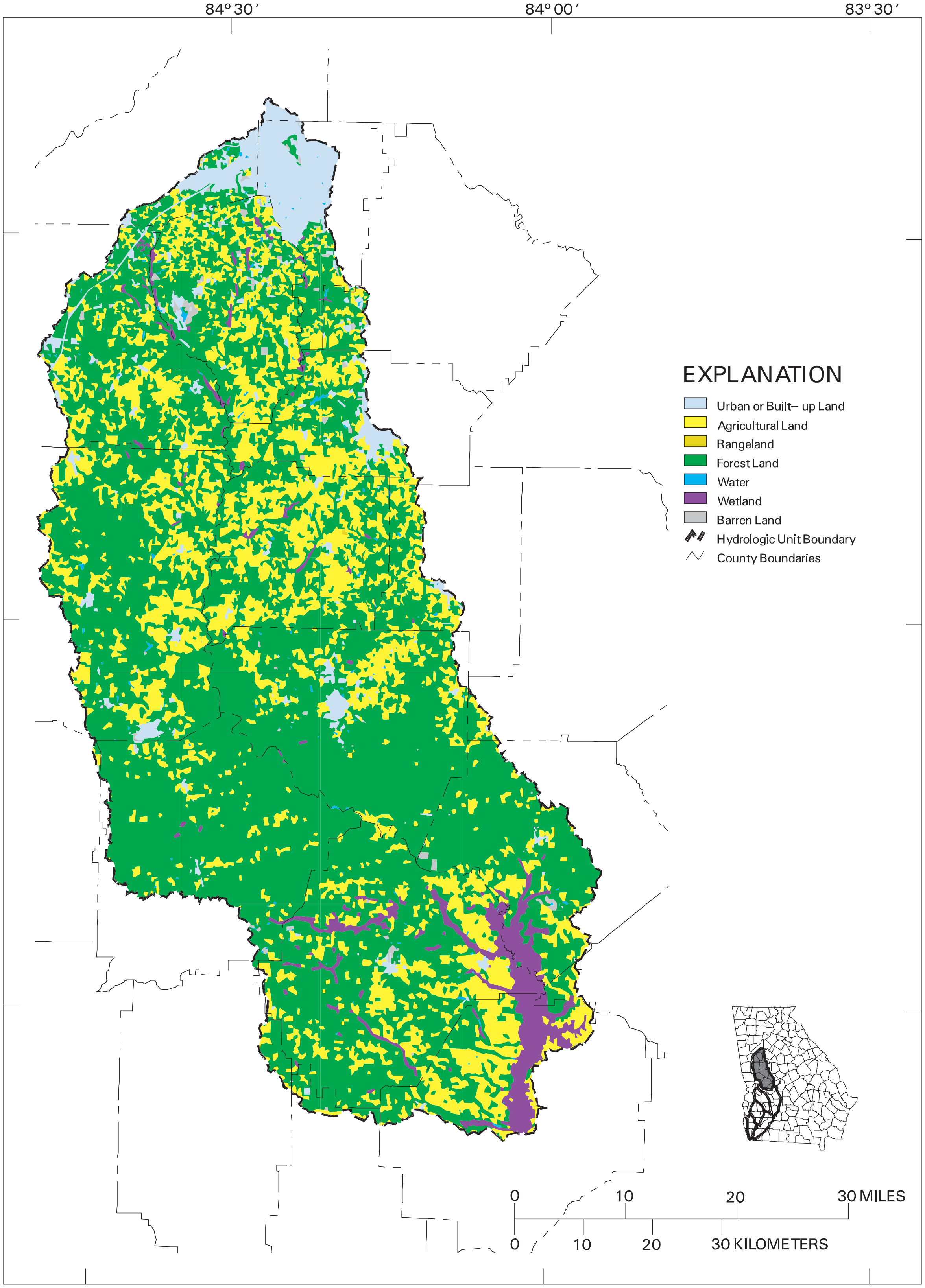



**Figure 2-14. Land Use, Upper Flint River Basin, HUC 03130005, USGS 1972-76 Classification Updated with 1990 Urban Areas**

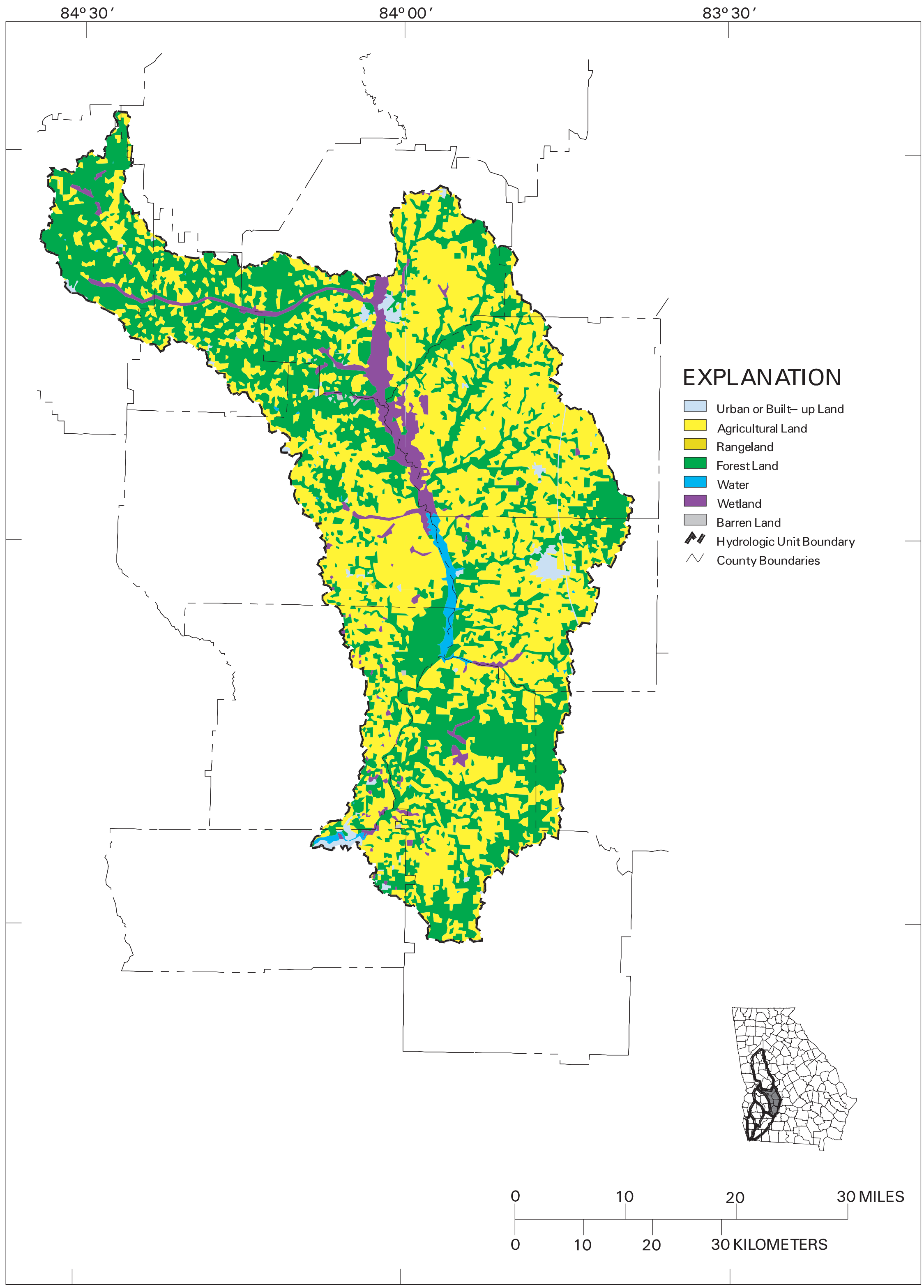



**Figure 2-15. Land Use, Middle Flint River Basin, HUC 03130006, USGS 1972-76 Classification Updated with 1990 Urban Areas**

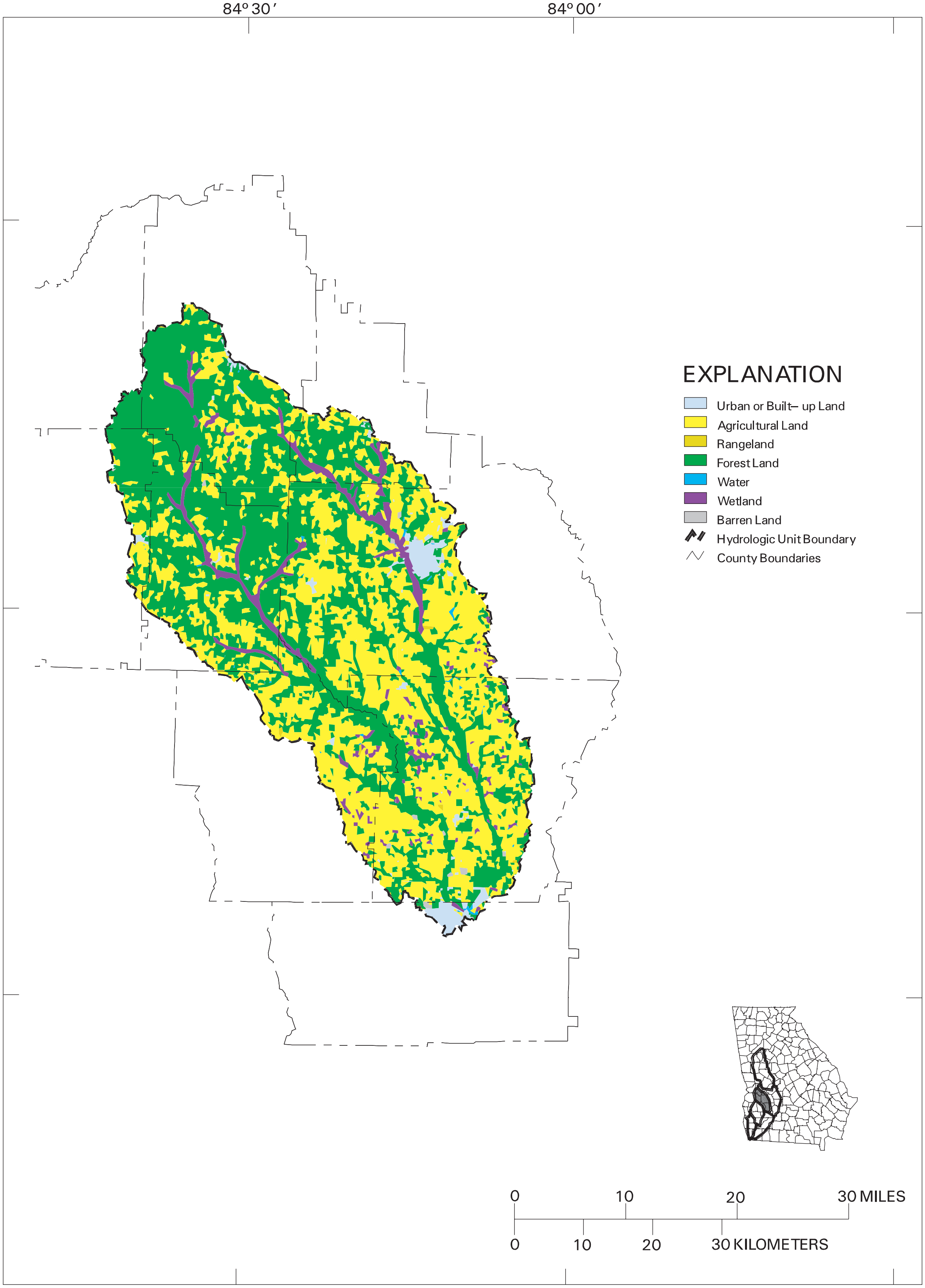



**Figure 2-16. Land Use, Kinchafoonee-Muckalee Creeks, HUC 03130007, USGS 1972-76 Classification Updated with 1990 Urban Areas Basin**

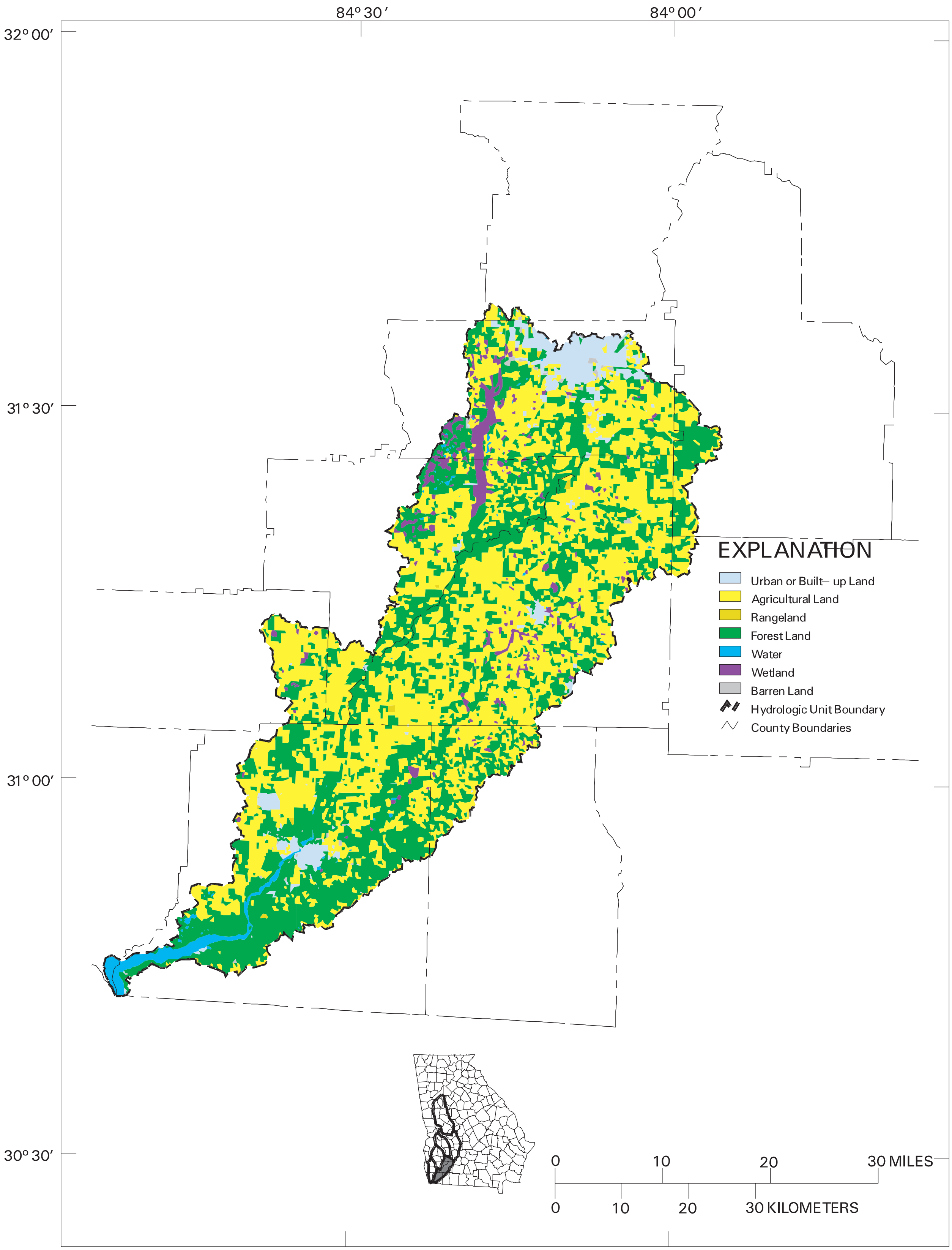



**Figure 2-17. Land Use, Lower Flint River Basin, HUC 03130008, USGS 1972-76 Classification Updated with 1990 Urban Areas**

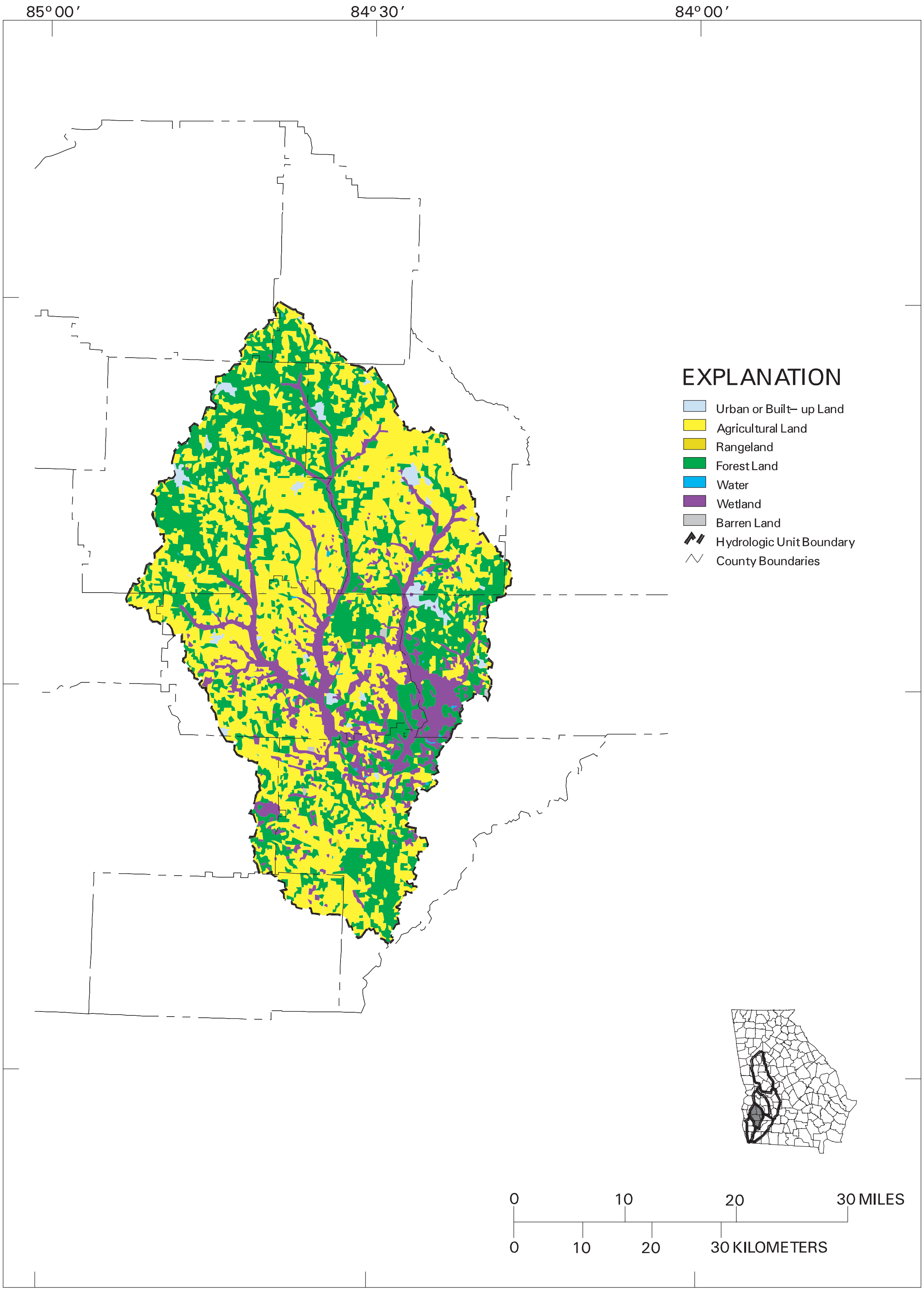



**Figure 2-18. Land Use, Ichawaynochaway Creek Basin, HUC 03130009, USGS 1972-76 Classification Updated with 1990 Urban Areas**

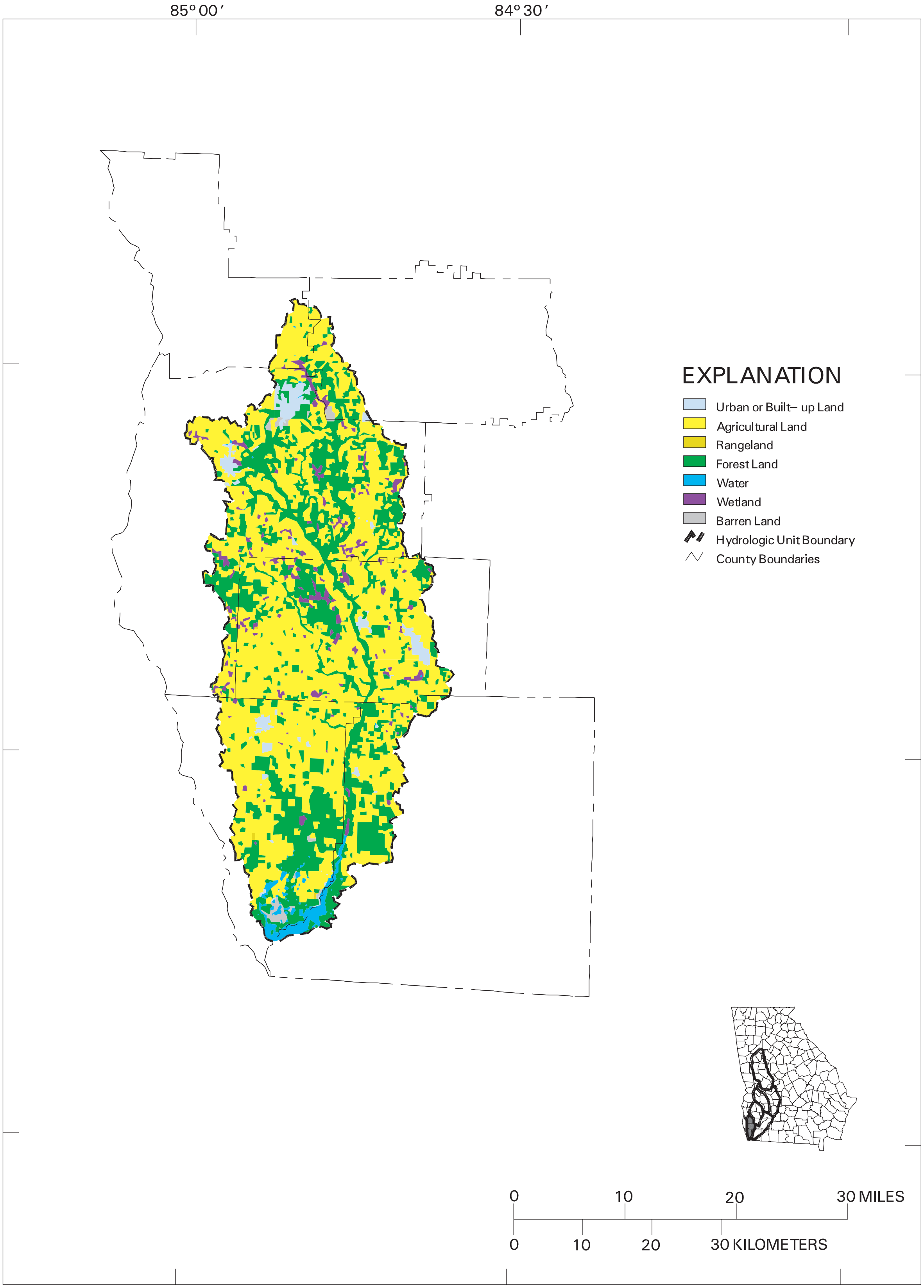



**Figure 2-19. Land Use, Spring Creek Basin, HUC 03130010, USGa 1972-76 Classification Updated with 1990 Urban Areas**

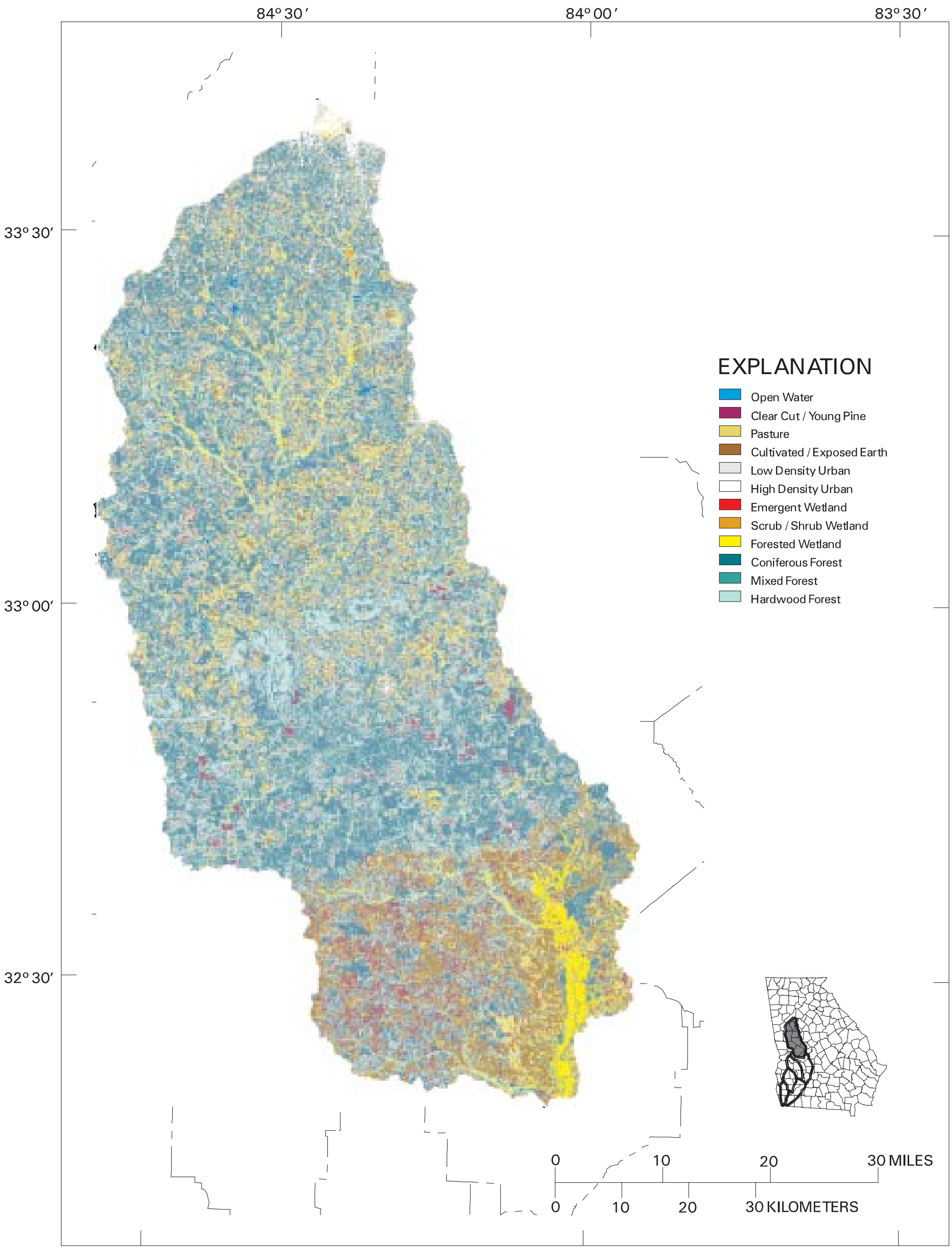



**Figure 2-20. Land Cover 1990, Upper Flint River Basin, HUC 03130005**

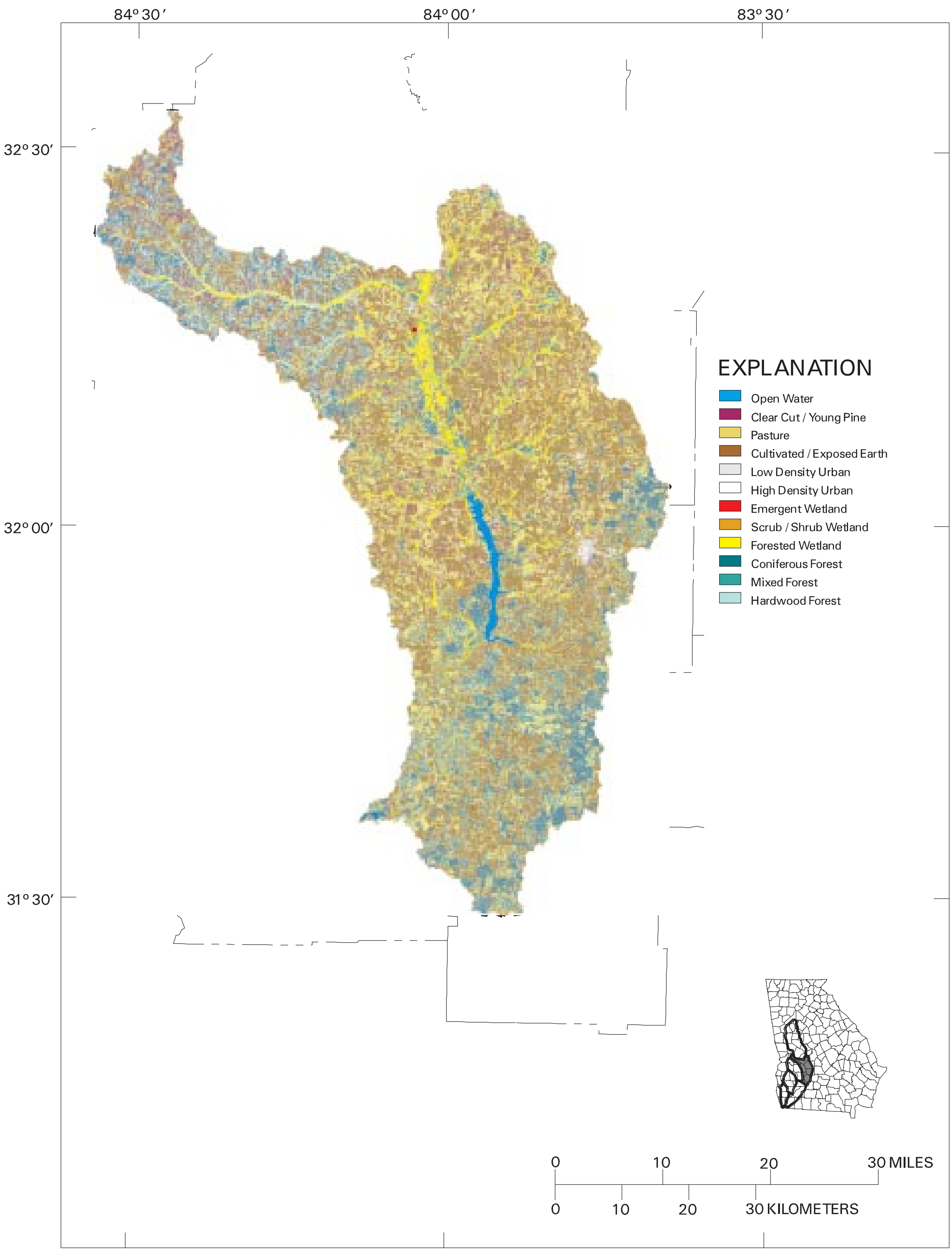
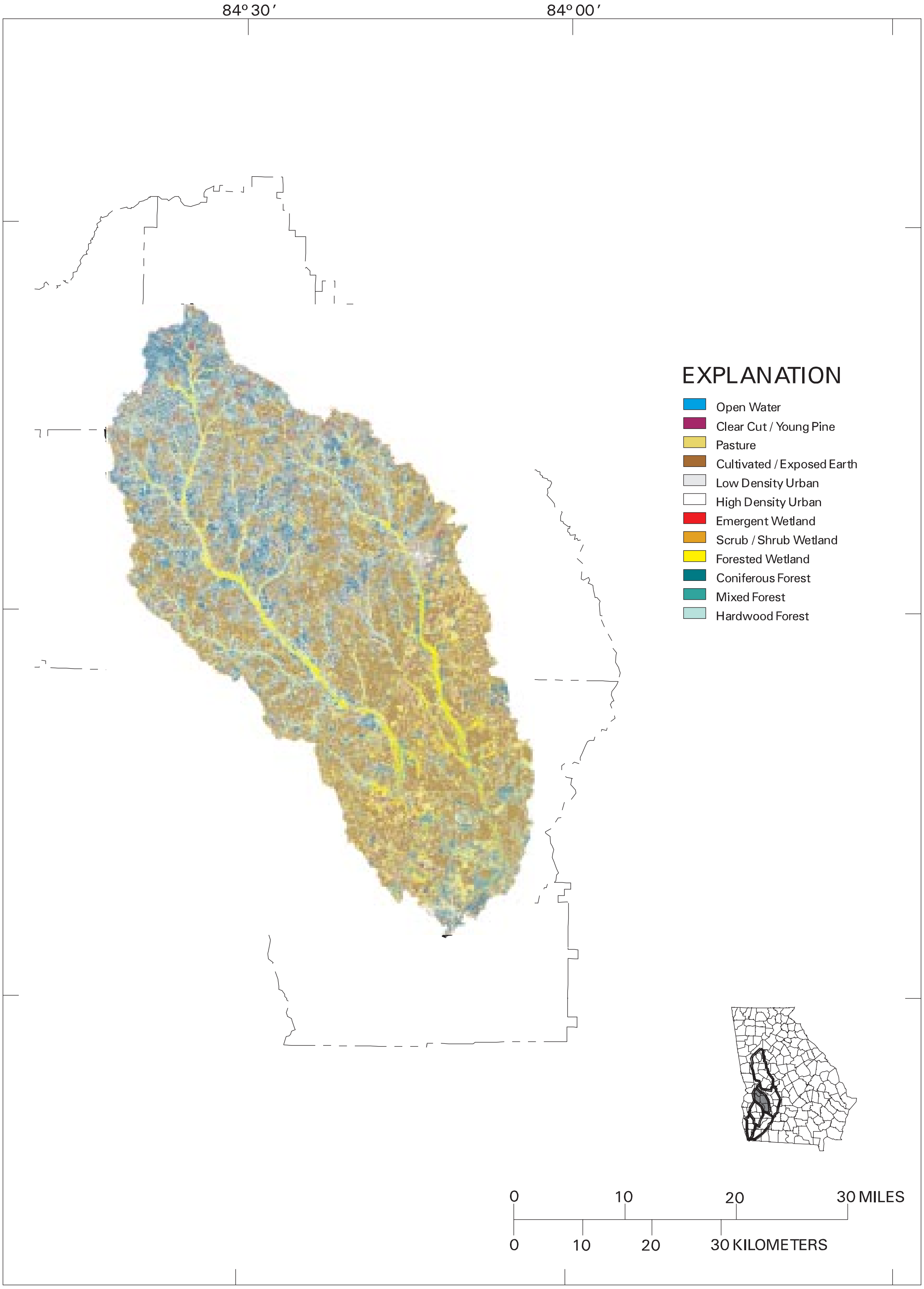



**Figure 2-21. Land Cover 1990, Middle Flint River Basin, HUC 03130006**




**Flint 2-22. Land Cover 1990, Kinchafoonee-Muckalee Creeks Basin, HUC 03130007**

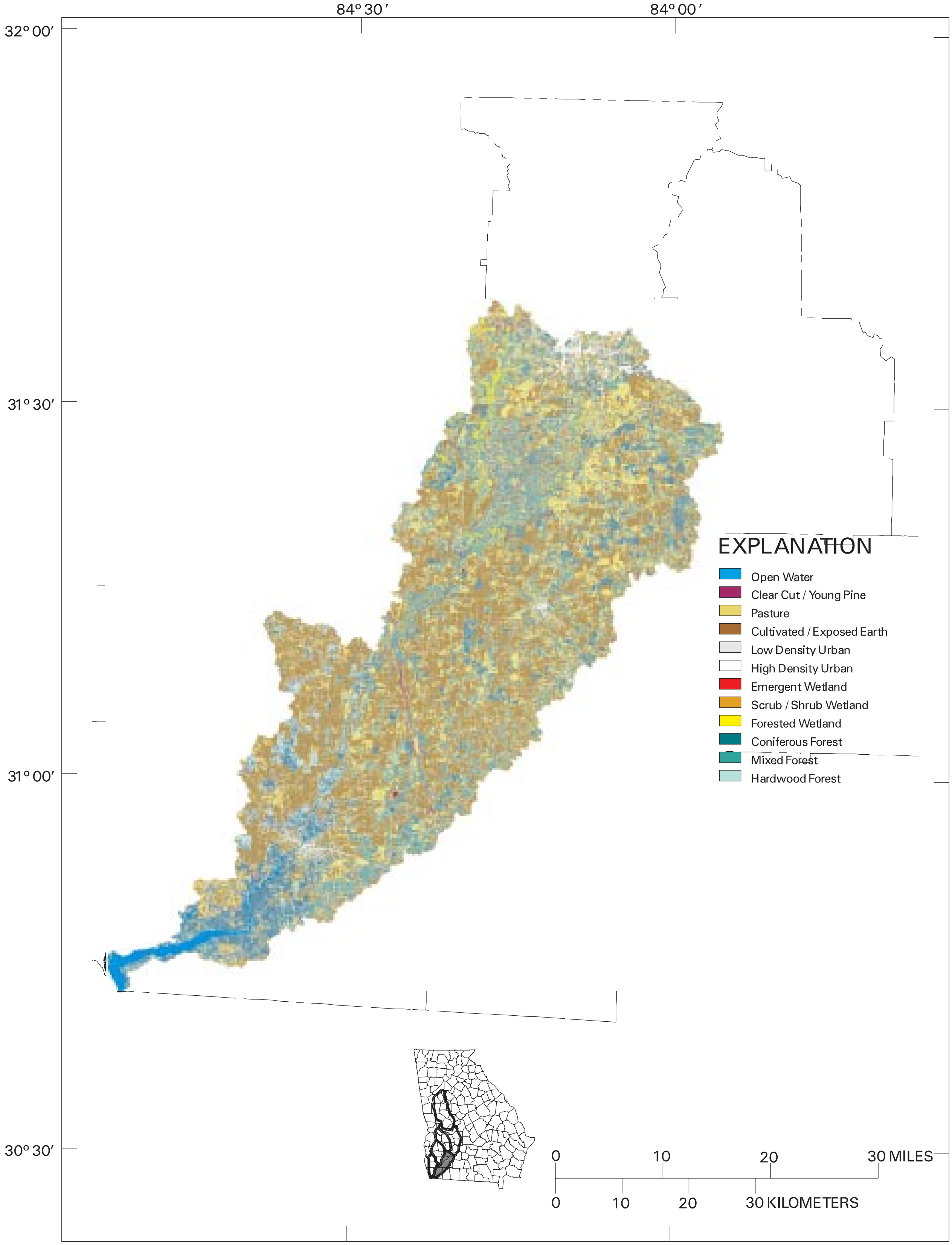



**Figure 2-23. Land Cover 1990, Kinchafoonee-Muckalee Creeks Basin, HUC 03130008**

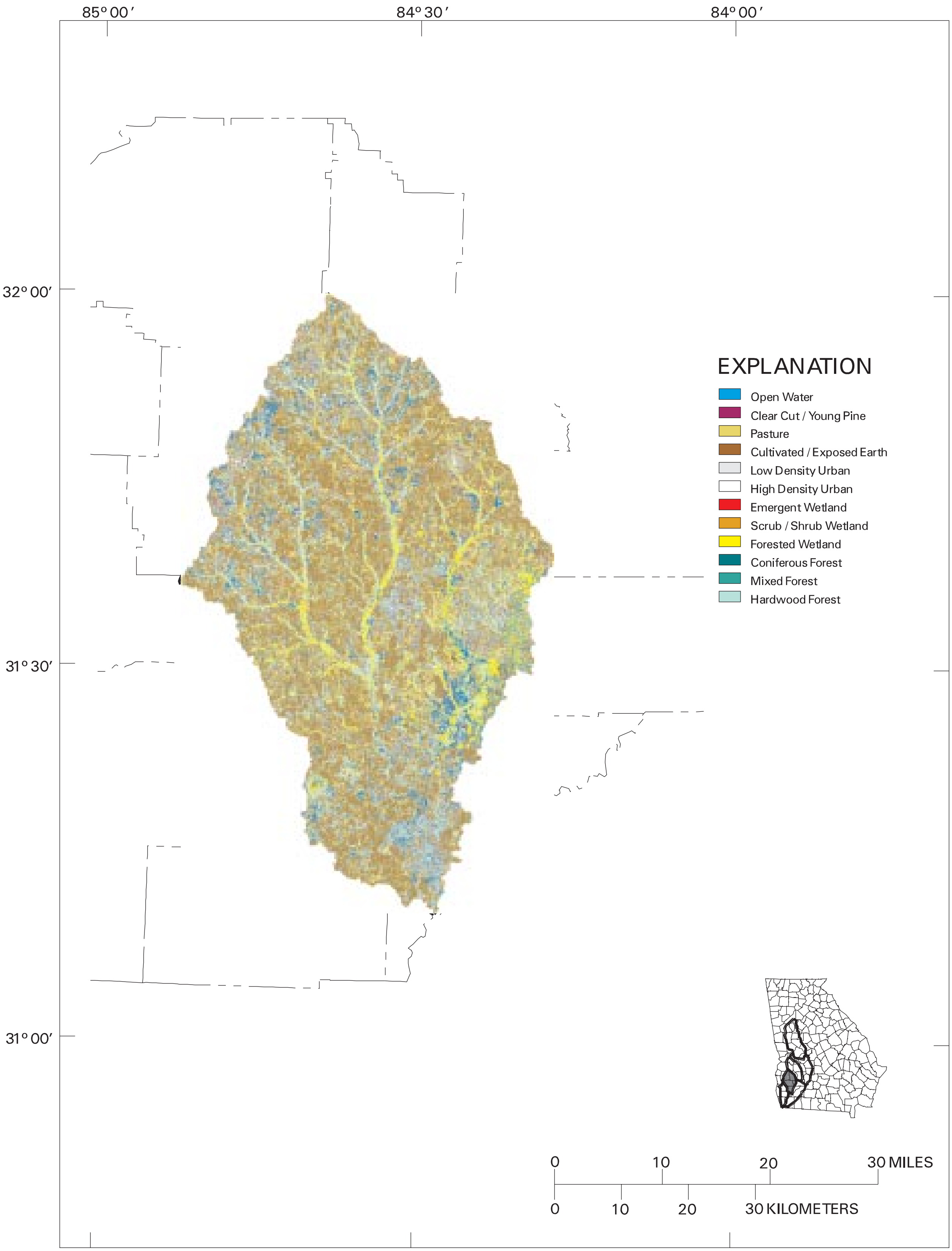



**Figure 2-24. Land Cover 1990, Ichawaynochaway Creek Basin, HUC 03130009**

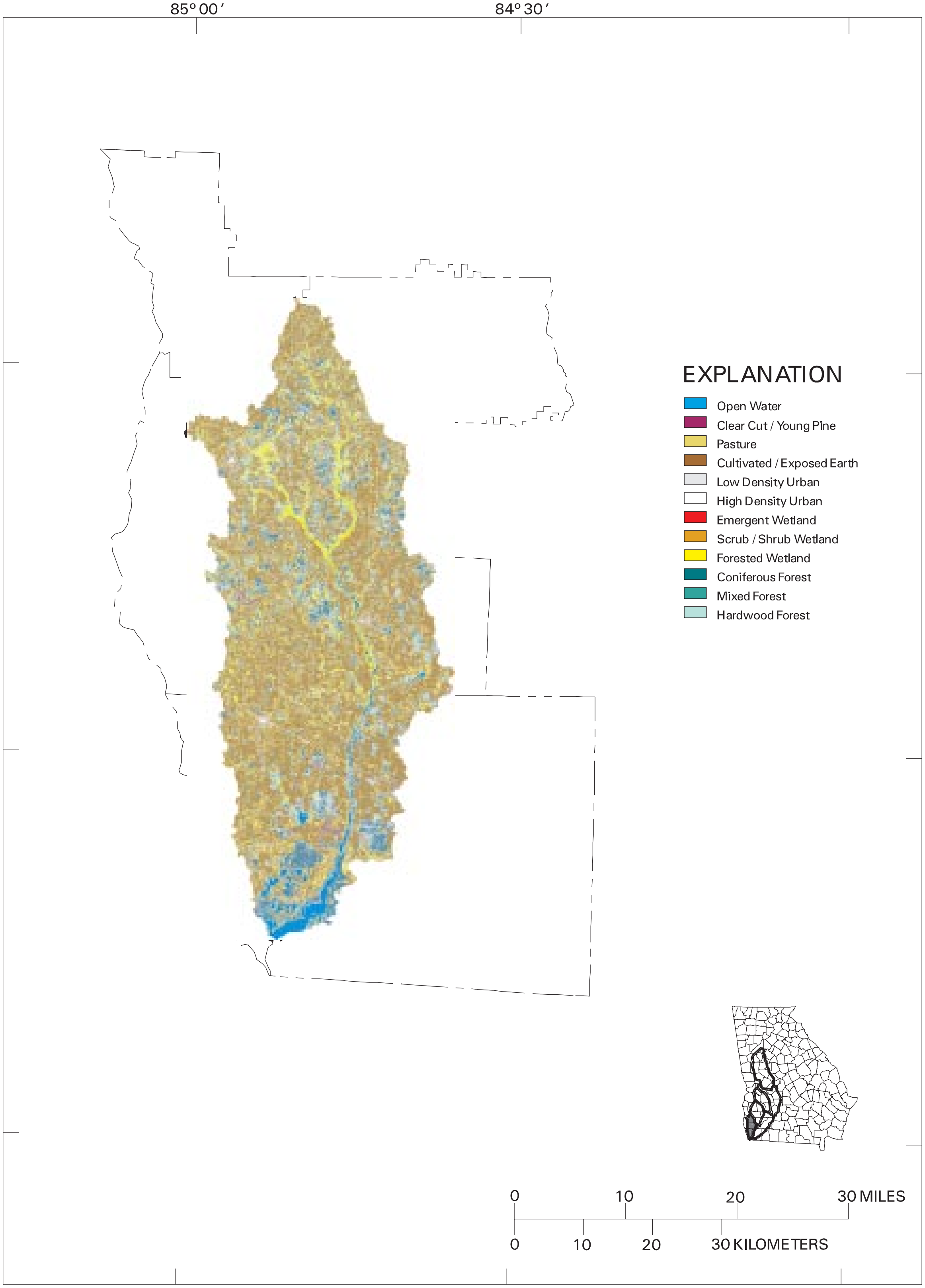



**Figure 2-25. Land Cover 1990, Spring Creek Basin, HUC 03130010**

**Table 2-5. Land Cover Statistics for the Flint River Basin**

| Class Name | Percent % | Acres |
|---|---|---|
| Open Water | 1.5 | 81,067.4 |
| Clear Cut/Young Pine | 7.1 | 383,525.9 |
| Pasture | 13.7 | 745,054.5 |
| Cultivated/Exposed Earth | 26.3 | 1,423,399.0 |
| Low Density Urban | 1.0 | 55,524.6 |
| High Density Urban | 0.4 | 23,392.2 |
| Emergent Wetland | 0.5 | 26,264.6 |
| Scrub/Shrub Wetland | 0.6 | 31,061.7 |
| Forested Wetland | 6.6 | 355,039.1 |
| Coniferous Forest | 12.2 | 662,356.3 |
| Mixed Forest | 15.1 | 817,954.7 |
| Hardwood Forest | 15.1 | 818,097.9 |
| Salt Marsh | 0.00 | 0.00 |
| Brackish Marsh | 0.00 | 0.00 |
| Tidal Flats/Beaches | 0.00 | 0.00 |
| **Total** | **100.0** | **5,422,872.0** |

of the forest land. The basin's forest cover consists chiefly of second-growth hardwoods and natural pine. The silvicultural land use is concentrated in the upper half of the Flint basin, above and below the Fall Line (Figure 2-26).

Timber is the leading cash crop in the Flint basin. Markets for forest products afford landowners excellent investment opportunities to manage and sell their timber, pine straw, naval stores, etc., products. Statewide, the forest industry output for 1996 grew to approximately $ 17.3 billion dollars. The value added by this production, which includes wages, profits, interest, rent, depreciation and taxes paid into the economy reached a record high $ 7.9 billion dollars. Georgians are benefitted directly by 177,000 job opportunities created by the manufacture of paper, lumber, furniture and various other wood products as well as benefitting the consumers of these products.

Other benefits of the forest include hunting, fishing, aesthetics, wildlife watching, hiking, camping and other recreational opportunities as well as providing important environmental benefits such as clean air and water and wildlife habitat.

Since 1982, there has been a statewide trend of loss of forest acreage, resulting from both conversion to urban and related uses and clearing for agricultural uses. Within the Flint basin itself, commercial forest land has actually increased by 108,622 acres over this same period. Since 1982 the area classified as pine type (plantation and natural) has increased 47,356 acres (3 percent) from 1,520,196 acres to 1,567,552 acres, of which 731,231 acres are plantation pine and 836,321 acres are natural pine stands. The area classified as oak-pine type increased 30,131 acres (7.6 percent) from 394,578 acres to 424,709 acres. Upland hardwood acreage increased 41,776 acres (4 percent) from 1,027,079 acres to 1,068,855 acres. Bottomland hardwood acres decreased 10,641 acres (1.6 percent) from 645,799 acres to 635,158 acres.

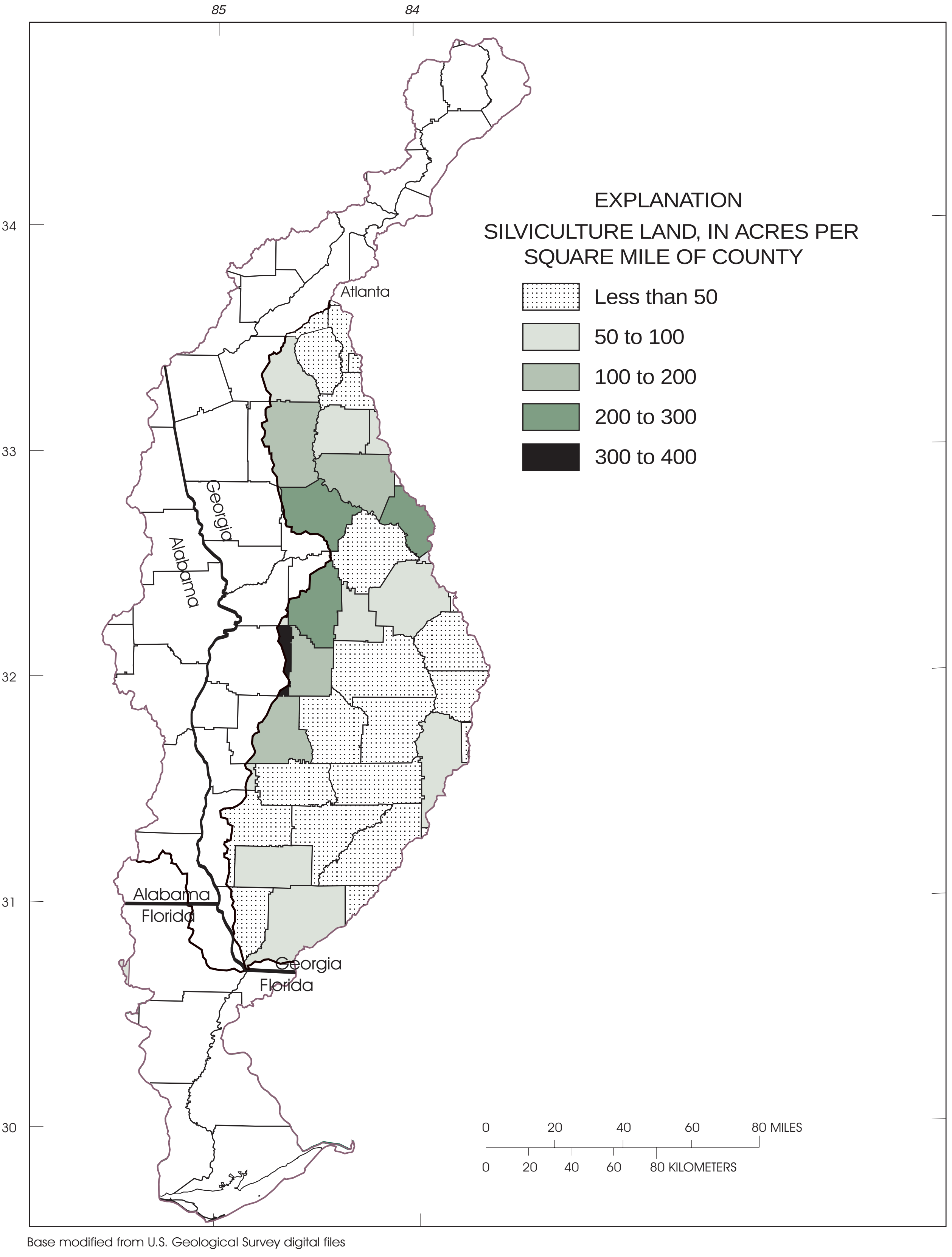



**Figure 2-26. Silvicultural Land in the Flint River Basin (modified from Couch et al, 1996)**

A comparison of the 1989 net annual growth versus net annual removals by species in the basin shows that removals of pine exceeds growth by 130 percent and removals of hardwoods exceeds growth by 103 percent.

***Agriculture***

Agricultural operations in the basin include poultry production, milk production, and beef production, along with crop, orchard, and vegetable production. Figure 2-27 displays the percent of counties in farmland in the Flint River Basin. The Coastal Plain Province (south of Cordele) is the predominant agricultural region of the Flint basin, containing over half of the total acres devoted to harvestable commodities and 70 percent of the irrigated acreage. Row crops and orchards dominate agricultural land use in the Coastal Plain Province. The dominant agricultural land uses in the Piedmont Province are pasture and confined feeding for poultry and livestock production, and hay production.

In 1991, approximately 32 million broiler chickens, 248 thousand cattle, and 125 thousand swine were produced in the basin (see Table 2-6). Approximately 1.3 million acres, about 24 percent of the total land area of the Flint River Basin, are devoted to the production of crops, orchards, forages, nursery, and turf.

Crops with the largest harvested acreage include peanuts, corn, soybeans, and cotton. Other important crops include wheat, hay, vegetables, and tobacco. In 1987, 80,000 acres were planted in orchards. The orchard crop with most acres is pecans. Peaches are also grown in the basin. The ranking of harvested acres among these crops varies from year to year in response to market conditions, government subsidy programs, and weather.

## *2.3 Local Governments and Jurisdictions*

Many aspects of basin management and water quality depend on decisions regarding zoning, land use, and land management practices. These are particularly important for the control of nonpoint pollution — pollution which arises in stormwater runoff from agriculture, development, and other land uses. The authority and responsibility for planning and control of these factors lies primarily with local governments, making local governments and jurisdictions important partners in basin management.

The Department of Community Affairs (DCA) is the state's principal department with responsibilities for implementing the coordinated planning process established by the Georgia Planning Act. Responsibilities include promulgation of minimum standards for preparation and implementation of plans by local governments, review of local and regional plans, certification of qualified local governments, development of a state plan, and provision of technical assistance to local governments. Activities under the Planning Act are coordinated with the Environmental Protection Division (EPD), Regional Development Centers, and local governments.

### 2.3.1 Counties and Municipalities

Local governments in Georgia consist of counties and incorporated municipalities. As entities with Constitutional responsibility for land management, local governments have a significant role in the management and protection of water quality. The role of local governments include enacting and enforcing zoning, stormwater and development ordinances; undertaking water

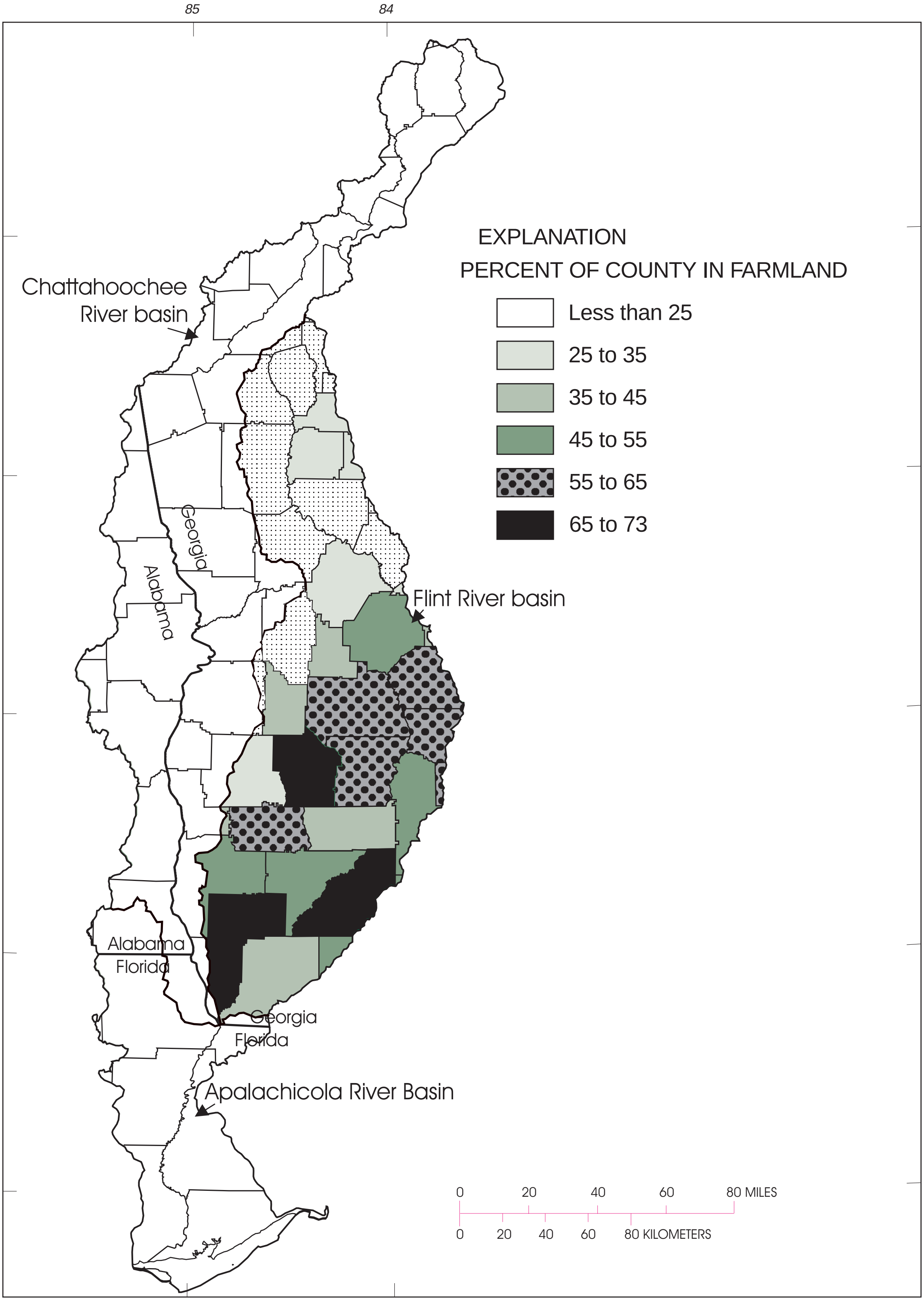



**Figure 2-27. Agricultural Land in the Flint River Basin (modified from Couch et al., 1996)**

**Table 2-6. Agricultural Operations in the Flint River Basin, 1987-1991**

| Element | HUC 03130005 | HUC 03130006 | HUC 03130007 | HUC 03130008 | HUC 03130009 | HUC 03130010 | Total for Basin |
|---|---|---|---|---|---|---|---|
| Dairy Cows | 9,043 | 9,254 | 6,649 | 4,032 | 330 | 0 | 29,308 |
| Beef Cows | 67,957 | 26,065 | 24,393 | 38,027 | 27,864 | 34,671 | 218,977 |
| Hogs | 11,864 | 28,529 | 14,370 | 35,349 | 17,078 | 17,333 | 124,523 |
| Layer Hens | 90,000 | 2,000 | 0 | 333 | 0 | 1,667 | 94,000 |
| Broilers (millions) | 10.553 | 9.946 | 9.850 | 0.450 | 1.265 | 0 | 32.065 |
| Turkeys | 83,333 | 0 | 0 | 0 | 0 | 0 | 83,333 |
| Row Crops (acres) | 96,436 | 295,047 | 127,138 | 192,802 | 189,360 | 156,941 | 1,057,724 |
| Orchard (acres) | 8,754 | 15,797 | 9,193 | 29,531 | 6,650 | 1,623 | 71,548 |
| Hay (acres) | 60,993 | 14,365 | 14,964 | 24,021 | 16,974 | 18,686 | 150,003 |
| Total Agriculture (acres) | 353,381 | 449,589 | 254,021 | 349,707 | 304,118 | 269,214 | 1,980,030 |

(data supplied by NRCS)

supply and wastewater treatment planning; and participating in programs to protect wellheads and significant groundwater recharge areas.

The Flint Basin includes part or all of 42 Georgia counties (Table 2-7 and Figure 2-2); however, only ten counties are entirely within the basin, and six counties have an insignificant fraction of their land area within the basin. There are thus a total of 36 counties with significant jurisdictional authority in the basin.

Municipalities or cities are communities officially incorporated by the General Assembly. Georgia has over 530 municipalities. Table 2-8 lists the municipalities in the basin.

### 2.3.2 Regional Development Centers

Regional Development Centers are agencies of local governments, with memberships consisting of all the cities and counties within each RDC's territorial area. There are currently 17 RDCs in Georgia. RDCs facilitate coordinated and comprehensive planning at local and regional levels, assist their member governments with conformity with minimum standards and procedures, and can have a key role in promoting and supporting management of urban runoff, including watershed management initiatives. RDCs also serve as liaisons with state and federal agencies for local governments in each region. Funding sources include members' dues and funds available through DCA.

RDCs including counties within the Flint basin are summarized in Table 2-9.

## *2.4 Water Use Classifications*

### 2.4.1 Georgia's Water Use Classification System

The Board of Natural Resources was authorized through the Rules and Regulations for Water Quality Control promulgated under the Georgia Water Quality Control Act of 1964, as

**Table 2-7. Georgia Counties in the Flint River Basin**

| Counties Entirely within the Flint Basin | Counties Partially within the Flint Basin | | Counties with Insignificant Area within the Basin |
|---|---|---|---|
| Baker | Clay | Meriwether | Chattahoochee |
| Calhoun | Clayton | Mitchell | Colquitt |
| Dougherty | Coweta | Peach | Harris |
| Fayette | Crawford | Randolph | Henry |
| Lee | Crisp | Seminole | Houston |
| Miller | Decatur | Spalding | Monroe |
| Pike | Dooly | Stewart | |
| Schley | Early | Talbot | |
| Sumter | Fulton | Taylor | |
| Terrell | Grady | Turner | |
| | Lamar | Upson | |
| | Macon | Webster | |
| | Marion | Worth | |

amended, to establish water use classifications and water quality standards for the surface waters of the State.

The water use classifications and standards were first established by the Georgia Water Quality Control Board in 1966. Georgia was the second state in the nation to have its water use classifications and standards for intrastate waters approved by the federal government in 1967.

**Table 2-8. Georgia Municipalities in the Flint River Basin**

| | | | |
|---|---|---|---|
| Albany | Concord | Lake City | Riverdale |
| Aldora | Cordele | Leesburg | Roberta |
| Americus | Culloden | Leslie | Sasser |
| Andersonville | Cuthbert | Luthersville | Senoia |
| Arabi | Damascus | Manchester | Shellman |
| Arlington | Dawson | Marshallville | Smithville |
| Attapulgus | Donalsonville | Meansville | Talbotton |
| Baconton | Edison | Montezuma | Thomaston |
| Bainbridge | Ellaville | Morgan | Turin |
| Barnesville | Fayetteville | Morrow | Tyrone |
| Brinson | Forest Park | Newton | Union City |
| Bronwood | Gay | Oglethorpe | Vienna |
| Brooks | Greenville | Parrott | Warm Springs |
| Butler | Griffin | Peachtree City | Warwick |
| Buena Vista | Hapeville | Pelham | Williamson |
| Byromville | Ideal | Pinehurst | Woodbury |
| Camilla | Iron City | Plains | Woodland |
| College Park | Jonesboro | Preston | Woosley |
| Colquitt | Junction City | Reynolds | Zebulon |

**Table 2-9. Regional Development Centers in the Flint River Basin**

| Regional Development Center | Member Counties with Land Area in the Flint Basin |
|---|---|
| Atlanta Regional Commission | Fulton, Clayton, Fayette, Henry |
| Chattahoochee Flint RDC | Coweta, Meriwether |
| McIntosh Trail RDC | Spalding, Pike, Lamar, Upson |
| Middle Georgia RDC | Crawford, Peach, Monroe, Houston |
| Lower Chattahoochee RDC | Chattahoochee, Clay, Harris, Randolph, Stewart, Talbot |
| Middle Flint RDC | Marion, Taylor, Macon, Schley, Dooly, Crisp, Sumter, Webster |
| Southwest Georgia RDC | Early, Seminole, Terrell, Lee, Worth, Calhoun, Dougherty, Baker, Mitchell, Miller, Decatur, Grady, Colquit |
| South Georgia RDC* | Turner |

* The South Georgia RDC has an insignificant portion of its area within the Flint basin.

For each water use classification, water quality standards or criteria were developed which established a framework to be used by the Water Quality Control Board and later the Environmental Protection Division in making water use regulatory decisions.

The water use classification system was applied to interstate waters in 1972 by EPD. Georgia was again one of the first states to receive federal approval of a statewide system of water use classifications and standards. Table 2-10 provides a summary of water use classifications and criteria for each use.

In the latter 1960s through the mid-1970s, there were many water quality problems in Georgia. Many stream segments were classified for the uses of navigation, industrial, or urban stream. Major improvements in wastewater treatment over the years have allowed the stream segments to be raised to the uses of fishing or coastal fishing, which include more stringent water quality standards. The final two segments in Georgia were upgraded as a part of the triennial review of standards completed in 1989. All of Georgia's waters are currently classified as fishing, recreation, drinking water, wild river, scenic river, or coastal fishing.

**Table 2-10. Georgia Water Use Classifications and Instream Water Quality Standards for Each Use**

| Use Classification[1] | Bacteria (fecal coliform) | | Dissolved Oxygen (other than trout streams)[2] | | pH | Temperature (other than trout streams)[2] | |
|---|---|---|---|---|---|---|---|
| | 30-Day Geometric Mean[3] (no/100 ml) | Maximum (no./100ml) | Daily Average (mg/l) | Minimum (mg/l) | Std. Units | Maximum Rise above Ambient (°F) | Maximum (°F) |
| Drinking Water requiring treatment | 1,000 (Nov-April) 200 (May-October) | 4,000 (Nov-April) | 5.0 | 4.0 | 6.0-8.5 | 5 | 90 |
| Recreation | 200 (Freshwater) 100 Coastal) | -- | 5.0 | 4.0 | 6.0-8.5 | 5 | 90 |
| Fishing Coastal Fishing[4] | 1,000 (Nov-April) 200 (May-October) | 4,000 (Nov-April) | 5.0 | 4.0 | 6.0-8.5 | 5 | 90 |
| Wild River | No alteration of natural water quality | | | | | | |
| Scenic River | No alteration of natural water quality | | | | | | |

1 Improvements in water quality since the water use classifications and standards were originally adopted in 1972 provided the opportunity for Georgia to upgrade all stream classifications and eliminate separate use designations for "Agriculture", "Industrial", "Navigation", and "Urban Stream" in 1993.
2 Standards for Trout Streams for dissolved oxygen are an average of 6.0 mg/l and a minimum of 5.0 mg/l. No temperature alteration is allowed in Primary Trout Streams and a temperature change of 2°F is allowed in Secondary Trout Streams.
3 Geometric means should be "based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours." The geometric mean of a series of N terms is the Nth root of their product. Example: the geometric mean of 2 and 18 is the square root of 36.
4 Standards are same as fishing with the exception of dissolved oxygen which is site specific.

Congress made changes to the Clean Water Act in 1987 that required each state to adopt numeric limits for toxic substances for the protection of aquatic life and human health. To comply with these requirements, the Board of Natural Resources adopted 31 numeric standards for protection of aquatic life and 90 numeric standards for the protection of human health.

Appendix B provides a summary of toxic substance standards that apply to all waters in Georgia. Water quality standards are discussed in more detail in Section 5.2.1.

### 2.4.2 Water Use Classifications for the Flint River Basin

All of the waters within the Flint basin are classified as fishing, drinking water, or recreation. The majority of the waters are classified as fishing. Table 2-11 lists those waters which are classified as drinking water or recreation.

**Table 2-11. Waters in the Flint River Basin Classified as Drinking Water or Recreation**

| Waterbody | Description of Segment | Use Classification |
|---|---|---|
| Flint River | Woolsey Road (Fayette and Clayton Counties) to Georgia Hwy. 16 | Drinking Water |
| Flint River | Georgia Hwy. 27 to Flint River Dam at Lake Worth, Albany (includes both Lake Blackshear and Lake Worth) | Recreation |
| Flint River | Bainbridge, U.S. Hwy. 84 Bridge to Jim Woodruff Dam, Lake Seminole | Recreation |

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