ATTACHMENT 1

Upper Chattahoochee River Basin Profile

The Metro Water District represents 57 percent of the overall Upper Chattahoochee River Hydrologic Unit Code (HUC)-8 Basin, while that portion of this HUC-8 within the District represents 18 percent of the total District area. In spite of the small proportion of the Metro Water District it represents, this area supplies drinking water and serves as the primary receiving water for treated wastewater effluent for over 3.5 million people in the Metro Water District (Atlanta Regional Commission [ARC], 2010). Lake Sidney Lanier, managed by the U.S. Army Corps of Engineers (USACE), and the Chattahoochee River National Recreation Area, managed by the National Park Service, are major recreational destinations within the region and Southeast U.S.

Physical and Natural Features

Geography

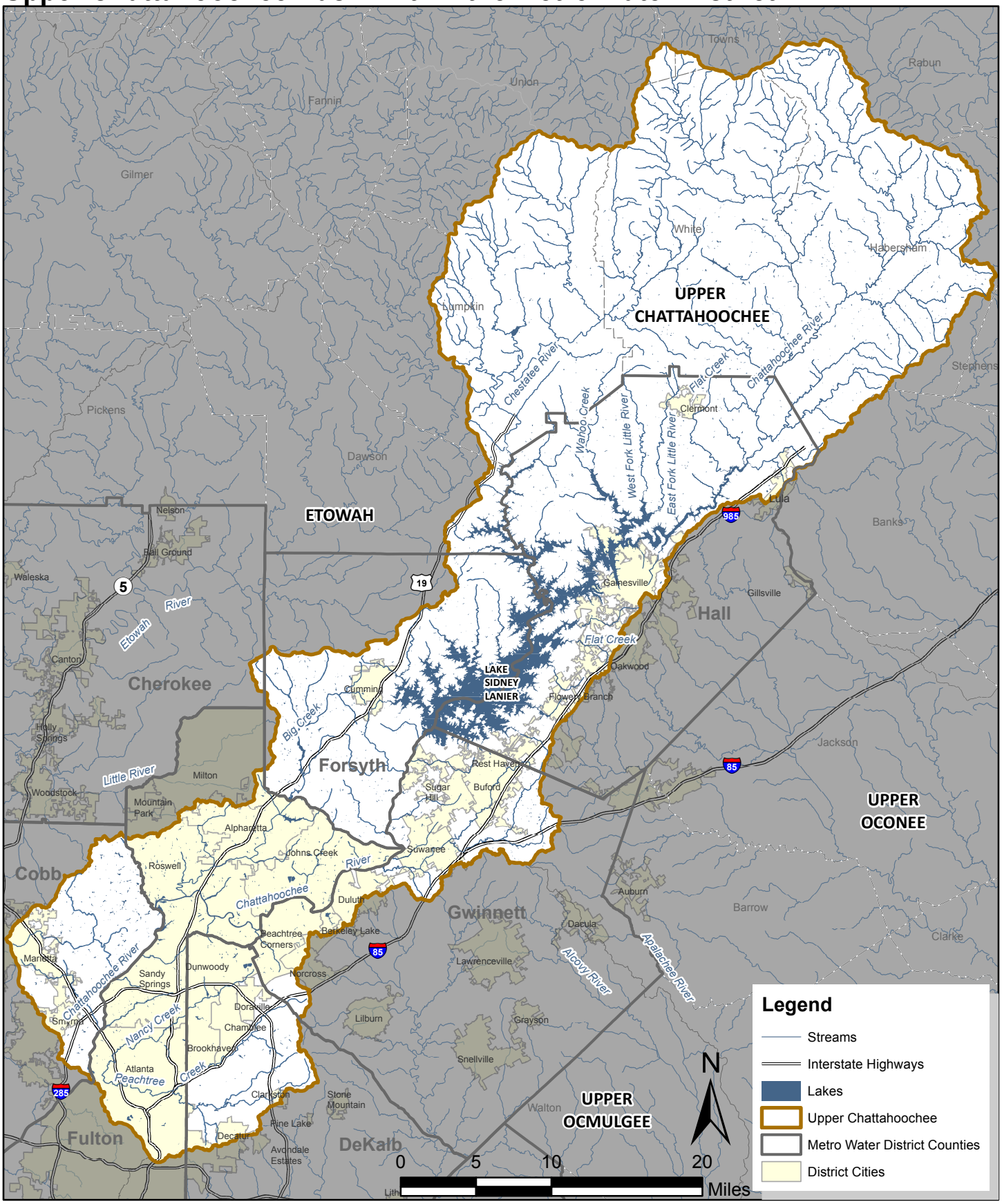
The Upper Chattahoochee River Basin has its headwaters in the Blue Ridge Mountains northeast of the Metro Water District, flowing southwest to the confluence of the Chattahoochee River with Peachtree Creek. Approximately 43 percent, or 680 square miles, of this HUC-8 Basin is located upstream of the Metro Water District before it occupies a relatively narrow corridor through the center of the Metro Water District, averaging about 40 miles wide, starting in the northeast corner and extending to the southwest corner (Figures A-1 and UC-1). The Chattahoochee River is entirely within the Piedmont province, which consists of a series of rolling hills and occasional isolated mountains. The Upper Chattahoochee River Basin includes portions of the Gainesville Ridge, Central Highlands and the Winder Slope physiographic districts (Metro Water District and CH2M HILL Engineers, Inc., 2002).

Portions of 29 cities and 7 counties are within the Metro Water District-portion of the Upper Chattahoochee River Basin, including Cherokee, Cobb, DeKalb, Forsyth, Fulton, Gwinnett and Hall. All of northern Fulton County is now incorporated within the Upper Chattahoochee River Basin, which also includes just over one-third, 35 percent, of the City of Atlanta as well as the newly incorporated City of Brookhaven in DeKalb County and the City of Peachtree Corners in Gwinnett County. The Upper Chattahoochee Basin covers 1,823 square miles and, when combined with the Middle Chattahoochee River - Lake Harding HUC-8, described in the next subsection, is the largest river basin within the Metro Water District. As new cities have been created, additional levels of coordination should be implemented to ensure proper watershed management across each basin.

Hydrology and Soils

The Chattahoochee River joins the Flint River in southern Georgia to form the Apalachicola River, which flows to the Gulf of Mexico. The main tributaries feeding the Upper Chattahoochee River Basin through the Metro Water District include the Chestatee River, Wahoo Creek, Suwanee Creek, Big Creek, Sope Creek, Rottenwood Creek and Peachtree Creek. In contrast to the mainstem Chattahoochee River, all of the natural tributaries remain free-flowing within this basin. Groundwater availability is limited due to geologic conditions, which restrict the potential yield for water supply.

FIGURE UC-1
Upper Chattahoochee Basin within the Metro Water District



The flow of the Chattahoochee River through the Metro Water District is regulated primarily by Buford Dam, a federal impoundment forming Lake Lanier, which is operated by USACE. Lake Lanier has a drainage area of 1,040 square miles, and extends from Buford Dam about 44 miles up the Chattahoochee River and about 19 miles up the Chestatee River. Constructed in the 1950s, Lake Lanier is a multi-purpose reservoir that provides flood protection, power production, water supply, navigation, recreation and fish and wildlife management. It is the largest reservoir in the Metro Water District (as well as Georgia) and provides the majority of the Metro Water District's water supply, either through direct withdrawals or downstream releases. Morgan Falls Dam, a second smaller downstream dam operated by Georgia Power, is a run-of-the-river project that provides minor regulation of the river. West Point Lake, also a USACE reservoir, is the second major reservoir on the Chattahoochee River system, located just south of the Metro Water District. Average monthly flows in the Chattahoochee River at Atlanta range from a low of 859 cubic feet per second (cfs) to a high of 8,959 cfs, with a mean flow of 2,509 cfs based on 59 years of records (U.S. Geological Survey, 2015). Rainfall ranges from an average of 60 inches per year in the northeastern part of the basin to 53 inches in the southwestern part.

The Metro Water District lies almost completely within the Piedmont and the Blue Ridge (Ridge and Valley) geologic provinces. The aquifers in these provinces overlie crystalline rocks that crop out in the northern portion of the basin and extend to the Fall Line. The rock is overlain with deposits of weathered, unconsolidated rock debris (regolith) that make up the available aquifer spaces. These deposits are thickest in valleys, but generally provide insufficient yield for uses other than very low density residential and thus surface water is the primary source of potable water for the Metro Water District. The Georgia Geologic Survey Hydrologic Atlas 18 database identifies approximately 84 areas, representing about 15 percent of the Metro Water District, likely to contain thick soils considered to be an indicator of significant groundwater recharge areas. The recharge areas were mapped based on outcrop area, lithology, soil type and thickness, slope, density of lithologic contacts, geologic structure, the presence of karst and potentiometric surfaces. There are approximately 172 square miles, 9 percent of the total basin area, of potential recharge areas within the Upper Chattahoochee River Basin, as listed in Table UC-1.

Table UC-1. Groundwater Recharge Areas within the Upper Chattahoochee River Basin

Recharge Area Type	County	Square Miles of Recharge Area Type within County
Probable Areas of Thick Soil	Cobb [a]	40
	DeKalb	13
	Forsyth	38
	Fulton [a]	66
	Gwinnett	11
	Hall	3
Total Recharge Areas		171 [b]

[a] Portions of Cobb and Fulton Counties overlap the basin boundary.

[b] Minor differences in mapping methodologies may cause basin totals to vary slightly from county totals.

An assessment of the availability of groundwater resources in select prioritized aquifers of Georgia was completed as part of Georgia's Comprehensive State-wide Water Management Plan (Georgia EPD, 2010). None of the Chattahoochee River Basin within the Metro Water District was selected as a priority aquifer for assessment; however, a water budget approach was used to provide a planning level assessment of groundwater resource sustainability in the Chattahoochee River-Chickamauga Creek and Soque River Basins, which cover 315 square miles upstream of the Metro Water District in portions of Habersham, Towns, Union and White Counties. It found that there are small amounts of additional groundwater available from the

Paleozoic rock aquifer in the northwestern Georgia study basin and from the crystalline-rock aquifer in the Piedmont and Blue Ridge.

There are four soil associations that describe the soil types in the Upper Chattahoochee River Subbasin: Cecil-Madison-Pacolet, Madison-Davidson-Pacolet, Riverview-Chewacla-Cartecay and the "urban" soils that start in north Fulton County (Table UC-2). The Cecil-Madison-Pacolet and Madison-Davidson-Pacolet associations were the most abundant, with the former types associated with moderate rolling hills and the latter with steeper terrain. These soils are well drained and highly weathered, having a red to yellowish-red subsoil (Brock, 1977: Jordan et al., 1973; Murphy, 1979; Thomas and Tate, 1973; USDA, 1976; Thomas, 1982; Wells, 1961; Robertson et al., 1960; USDA, 1958; Tate, 1967; Thomas and Tate, 1964). The Riverview-Chewacla-Cartecay association was found along the banks of some of the major rivers, particularly the lower half of the Chattahoochee River. These soils are variable and less well drained than soils on higher elevations (Thomas and Tate, 1973; USDA, 1976; Thomas, 1982; Thomas, 1982 and USDA, 1958).

Table UC-2. Major Soil Associations within the Upper Chattahoochee River Basin

Soil Association	Significance to Watershed Management
Cecil-Madison-Pacolet	Characteristics: Associated with moderate rolling hills, well drained, highly weathered. Significance to Watershed Management: Sloping surfaces may be more susceptible to increased erosion due to stormwater runoff from impervious surfaces; well-drained soils may be more permeable, which increases infiltration capacity in areas without impervious cover, also may improve feasibility of infiltration practices.
Madison-Davidson-Pacolet	Characteristics: Associated with steep terrain, well drained, highly weathered. Significance to Watershed Management: Steep terrain may be more susceptible to increased erosion due to stormwater runoff from impervious surfaces; well-drained soils may be more feasible for infiltration practices.
Riverview-Chewacla-Cartecay	Characteristics: Found along the banks of some of the major rivers; less well drained. Significance to Watershed Management: Located near waterbodies, this soil type is characterized by flat terrain less susceptible to erosion due to stormwater runoff velocities from impervious surfaces; poor-drained soils are less feasible for infiltration.
Urban Soils	Characteristics: Highly disturbed and compacted soils. Significance to Watershed Management: Compacted soils; poor-drained, soils are less feasible for infiltration, restricted water drainage.
Areas of Bedrock	Infiltration practices may be limited in areas of contiguous bedrock.

Protected Species

Protected species include all species listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service, and those listed as endangered, threatened, rare or unusual by the State of Georgia. The USFWS also may designate critical habitat for a federally listed species, which provides protection for the habitat as well as the species itself. The current listings of these endangered species, including their status, range and habitat, can be accessed via the USFWS's automated Information, Planning and Conservation System (IPaC, http://ecos.fws.gov/ipac/).

Native Species

The Metro Water District is home to a number of native species that are considered threatened or endangered. Protecting watershed health is more than protecting water quality; it also includes protection of biological resources. Within the Metro Water District, there are a number of protected animal species that spend all or part of their life cycle in rivers and streams or depend on streams for a significant portion of

their life history. In addition, there are protected plants that are either aquatic or semi-aquatic and grow within or along the margins of rivers and streams. Table UC-3 lists the 8 protected species potentially found within the counties of the Upper Chattahoochee River Basin of the Metro Water District.

Table UC-3. Aquatic and Semi-Aquatic Protected Species in the Upper Chattahoochee River Basin

Fauna Type	Common Name	Status	Cherokee	Cobb	DeKalb	Forsyth	Fulton	Gwinnett	Hall
Invertebrates	Shinyrayed Pocketbook	US					X		
Bird	Bald Eagle	GA	X						X
Bird	Bachman's Sparrow	GA					X		
Bird	Peregrine Falcon	GA					X		
Fish	Bluestripe Shiner	GA					X		X
Fish	Highscale Shiner	GA		X			X		
Invertebrates	Chattahoochee Crayfish	GA		X	X	X	X		X
Invertebrates	Delicate Spike	GA		X			X		

Trout Streams

Trout streams are classified in accordance with the primary and secondary designations and criteria defined in Section 15 of Georgia's Water Use Classifications and Water Quality Standards (391-3-6-.03). Streams designated as Primary Trout Streams are waters supporting a self-sustaining population of Rainbow, Brown or Brook Trout. Streams designated as Secondary Trout Streams are those with no evidence of natural trout reproduction, but are capable of supporting trout throughout the year. The Chattahoochee River upstream from Interstate 285 West Bridge is the only water designated as a secondary trout stream within the Metro Water District of the Upper Chattahoochee River Basin.

Land Use and Impaired Waterbodies Characteristics

Drinking Water Supply

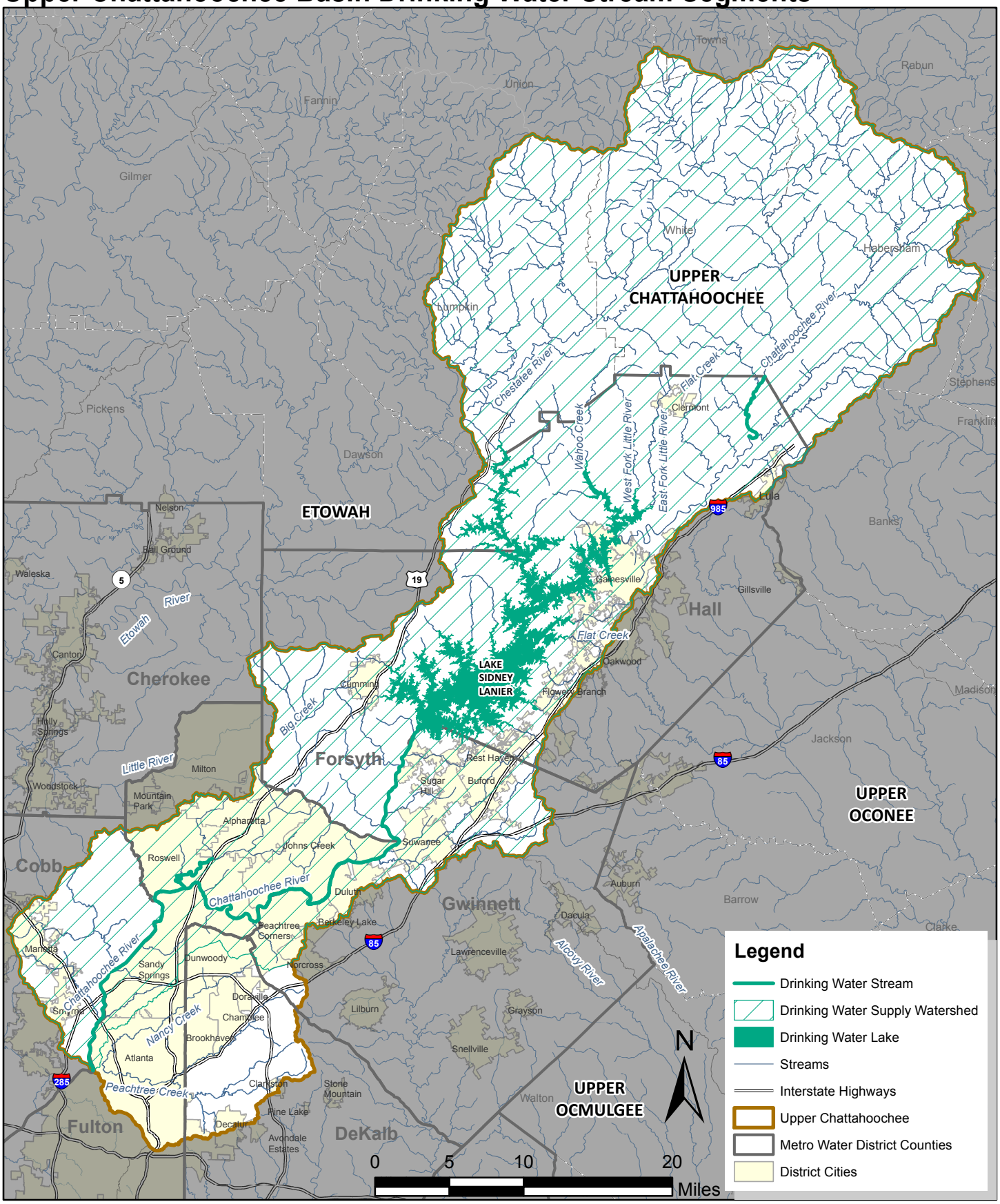
The Upper Chattahoochee River Basin is the primary drinking water supply source for the Metro Water District, providing water to all or parts of eight District counties, including the four most populous: Cobb, DeKalb, Fulton and Gwinnett. Withdrawals from this basin account for 72 percent of the District's total public water supplies. Recognizing the linkage between watershed management and water quality for water supply, the Georgia Planning Act of 1989 includes environmental planning criteria (or Part V criteria) to protect natural resources, such as wetlands, stream buffers, water supply watershed areas, groundwater recharge areas, protected rivers and protected mountains. Table UC-4 lists the water supply sources and Figure UC-2 shows those waters that are designated to meet state drinking water criteria within the Upper Chattahoochee River Basin.

Table UC-4. Upper Chattahoochee River Basin Drinking Water Supply Sources

Water Supply Source	Owner/Operator Utilizing Source
Chattahoochee River	Cobb County-Marietta Water Authority
	DeKalb County
	City of Atlanta

	Atlanta - Fulton County Water Resources Commission
Lake Lanier	City of Cumming
	Forsyth County
	Gwinnett County
	City of Buford
	City of Gainesville
Big Creek	City of Roswell

FIGURE UC-2
Upper Chattahoochee Basin Drinking Water Stream Segments



Source water assessments were performed for all drinking water supplies within the Upper Chattahoochee River Basin as required by EPA. The source water assessments determined the potential for pollution based on a number of watershed characteristics and assigned a susceptibility ranking to each source. The susceptibility rankings throughout the basin were generally medium to high depending on the location of the water source. These susceptibility rankings indicate the urban and suburban nature of most of the watersheds within the Upper Chattahoochee River Basin.

Land Cover/Land Use

The southern extent of the Upper Chattahoochee River Basin, downstream of Lake Lanier, transitions from a predominantly suburban character in Forsyth, Gwinnett and North Fulton to the more densely developed employment areas of Perimeter Center and Cobb Galleria. In addition to including stretches of all of the major transportation corridors, auto and rail, in the region, portions of Peachtree Creek drain some of the most densely developed areas in the Metro Water District, encompassing downtown and midtown Atlanta, Buckhead and Decatur. Overall, the basin within the District is predominantly residential (37 percent) with about the same percentage of forested area (Table UC-5, Figure UC-3).

Table UC-5. Upper Chattahoochee River Basin Land Cover / Land Use within the Metro Water District

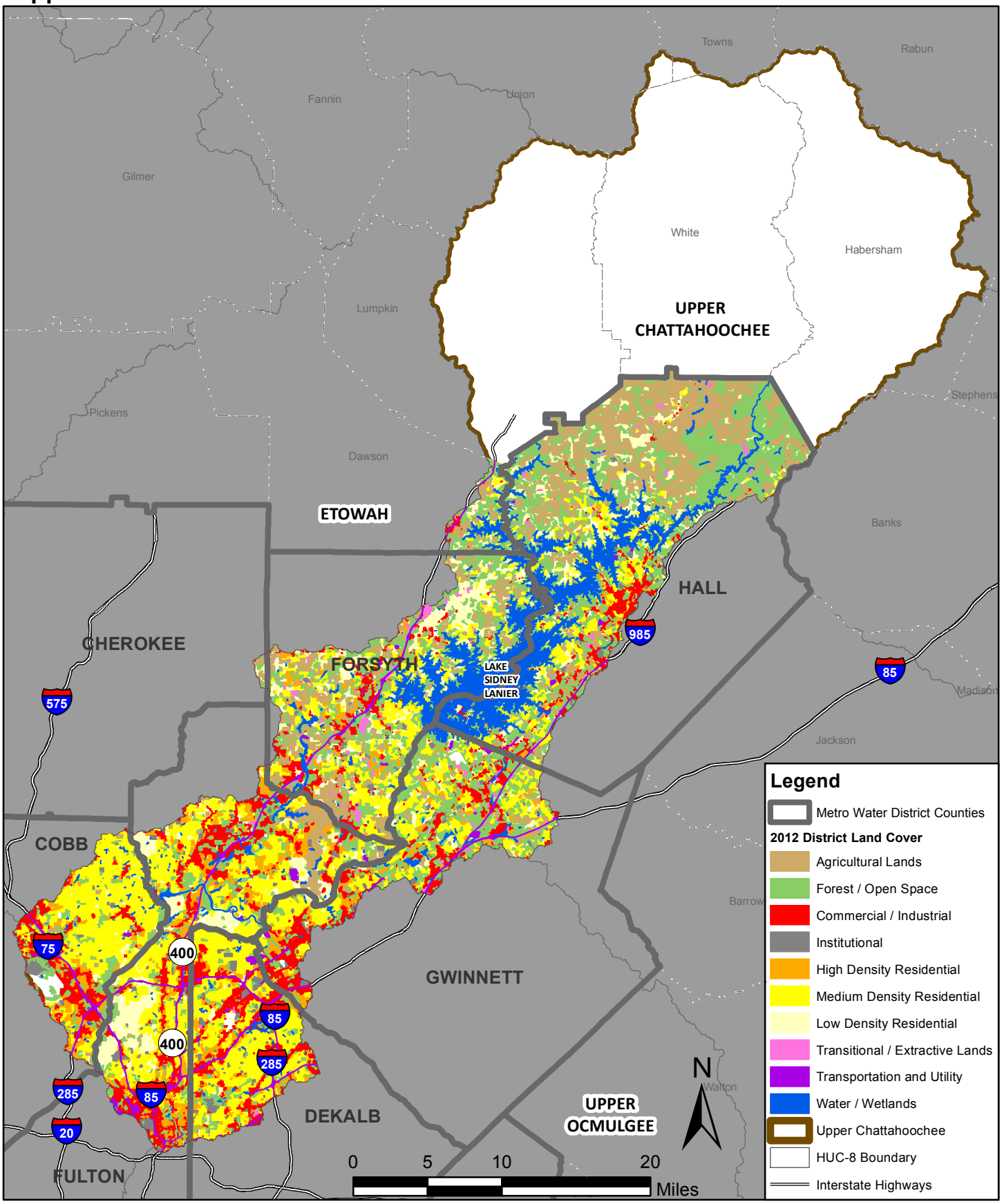
Land Cover/Land Use	2012 Existing (%)
Agricultural Lands	9
Commercial	13
Forest/Open Space	35
High Density Residential	4
Industrial/Institutional	1
Low Density Residential	9
Medium Density Residential	24
Transitional/Extractive Lands	2
Transportation and Utilities	2
Water/Wetlands	1
Undeveloped	46
Developed	54

Notes: Undeveloped = Agricultural, Forest / Open Space and Water / Wetlands

Data Source: Aggregated Land Cover categories from ARC's 2012 LandPro Geographic Information System (GIS)

Over the course of the planning horizon, the basin is expected to have steady growth based on population projections. Much of this growth is anticipated to occur in the northeast portion of the basin in Forsyth, Gwinnett and Hall Counties while infill development and redevelopment resulting in increased density is expected to continue in Cobb, DeKalb and Fulton Counties based on current land-use data.

FIGURE UC-3
Upper Chattahoochee Basin 2012 Land Cover



Effective Impervious Areas

The level of watershed imperviousness has long been linked to impacts on changes in hydrologic regimes that lead to increased intensity and frequency of peak stormwater flows, which affect stream stability, water quality and aquatic habitat and biotic community integrity. In general, the most sensitive aquatic organisms are affected at impervious levels greater than 10 percent. Between 11 and 25 percent of most stream communities become impacted, and over 25 percent of streams are generally no longer able to support viable biotic communities (Schueler, 2001).

Impervious surfaces (such as roofs, streets, parking lots) have a significantly different hydrologic response from pervious surfaces (lawns, forests); therefore, it is important to clearly define terms and assumptions related to the calculation of pervious and impervious areas for the purposes of watershed management. "Total impervious area" quantifies all of the land surfaces impervious to rainfall for the particular land cover category while "effective impervious area" (EIA) refers to the directly connected impervious area used for water quality and stormwater conveyance modeling. For the 2003 District-wide Plan, EIA values were initially defined based on previous studies, including the local watershed assessments, and then further refined based on calibration using available water quality data. For the 2016 District-wide Plan, the EIA of the HUC-12 subwatersheds within the Metro Water District was calculated using the same methodology as in 2003, but using the 2010 land use / land cover. Attachment 10 lists HUC-12 watershed numbers and descriptions.

Of the 41 HUC-12s within the Metro Water District portion of Upper Chattahoochee River Basin, 23 had an EIA greater than 10 percent, primarily those HUCs that either straddle a major transportation corridor such as Georgia 400 or Interstate 85 or the HUCs located within the more densely urbanized area of I-285. Upstream of Buford Dam, the Lake Lanier drainage area had two HUC-12s greater than 10 percent EIA, including Flat Creek in Gainesville and the subwatershed just to the east of the City of Cumming, which includes Buford Dam. There is one HUC-12, Level Creek, located in Gwinnett County in the Upper Chattahoochee Basin downstream of Buford Dam, that does not have an EIA greater than 10 percent. The effects of the region's transporation corridors are also apparent as most of the subwatersheds encompassing Interstate 85, Interstate 75 and Interstate 20 have EIAs greater than 20 percent (Figure UC-4).

Combined-sewer Overflow Areas

Combined-sewer overflow (CSO) areas within the Upper Chattahoochee River Basin are limited to two small drainage areas within the Peachtree Creek (HUC-12 # 031300011204) subwatershed in the City of Atlanta. Major infrastructure improvement projects related to potential CSO overflows from the Tanyard Creek and Clear Creek areas during storm events as well as sanitary sewer overflows (SSOs) from the wastewater conveyance systems are ongoing and continue to reduce the bacteria contributions from these sources.

Impaired Waterbodies

The Georgia EPD determines whether a waterbody is supporting its designated uses by collecting water quality data and comparing these data against the water quality criteria. Georgia EPD describes their listing methodology and "preferred minimum dataset" at http://epd.georgia.gov/georgia-305b303d-list-documents. This methodology is important to understand the sample size, extent and timeframe of the dataset that was used to list a waterbody. Feedback can be given to Georgia EPD if additional data or information are known that may affect future sampling or listing evaluations.

Of the 399 stream miles assessed in the Metro Water District portion of the Upper Chattahoochee River Basin, 343 miles or 86 percent, did not meet state water quality standards based on the 2014 303(d) list. The streams listed as not supporting are summarized in Table UC-6 by parameter and graphically shown in

Figure UC-5. Several streams are listed for violations of more than one parameter, therefore the summation of impaired miles by parameter will not equal the miles of not supporting stream.

The majority of assessed streams (75 percent) in the Upper Chattahoochee River Basin do not meet water quality standards for fecal coliform bacteria as a result of nonpoint source pollution. These bacteria enter the stream from both anthropogenic and non-anthropogenic sources, including SSOs, leaking sewer lines, failing septic systems and pet/ wildlife waste. Fecal coliform typically is found in both developed and undeveloped watersheds, and monitoring programs in Georgia have found levels that exceed state standards in urban, agricultural and forested areas (Georgia EPD, 2011). While fecal coliform is ubiquitous in streams across the country (Georgia EPD, 2011), concentrations of bacteria can increase as a result of the higher density of potential pollutant sources and decreased stormwater filtration and stormwater treatment from population growth and development. Biota listings typically indicate high sediment loads in streams, which decrease habitat quality for benthic macroinvertebrates and fish. Sediment sources include runoff from construction sites as well as from streambank erosion due to accelerated streamflow velocities from impervious cover associated with urbanization.

Woodall Creek, a three-mile long tributary to Peachtree Creek in Atlanta, is listed for fecal coliform, copper, zinc, lead and tetrachloroethylene (PCE) violations while a one-mile long tributary to Woodall Creek is also listed for copper, zinc and alpha-benzene hexachloride (BHC) and beta-BHC, byproducts of the production of the insecticide lindane (γ-HCH). PCE is the predominant chemical solvent used in dry cleaning.

Tributary #2 to Sope Creek in Cobb County is also listed for PCEs.

The Chattahoochee River from Morgan Falls Dam to West Point Lake, downstream of the Metro Water District, is listed for Fish Consumption Guidance as a result of legacy polychlorinated biphenyl (PCB) levels.

FIGURE UC-4
Upper Chattahoochee Basin HUC-12 Effective Impervious Areas (EIA)

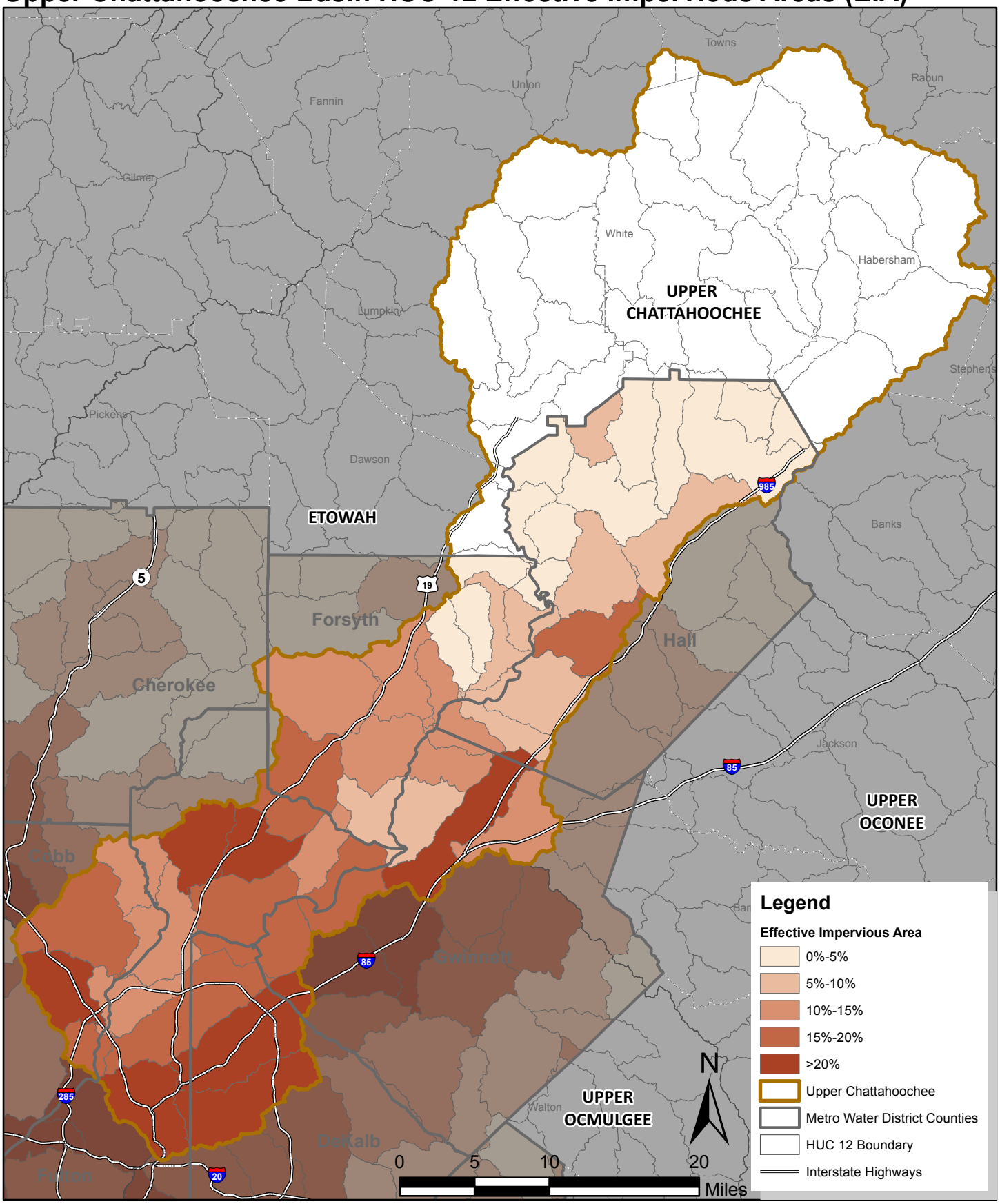
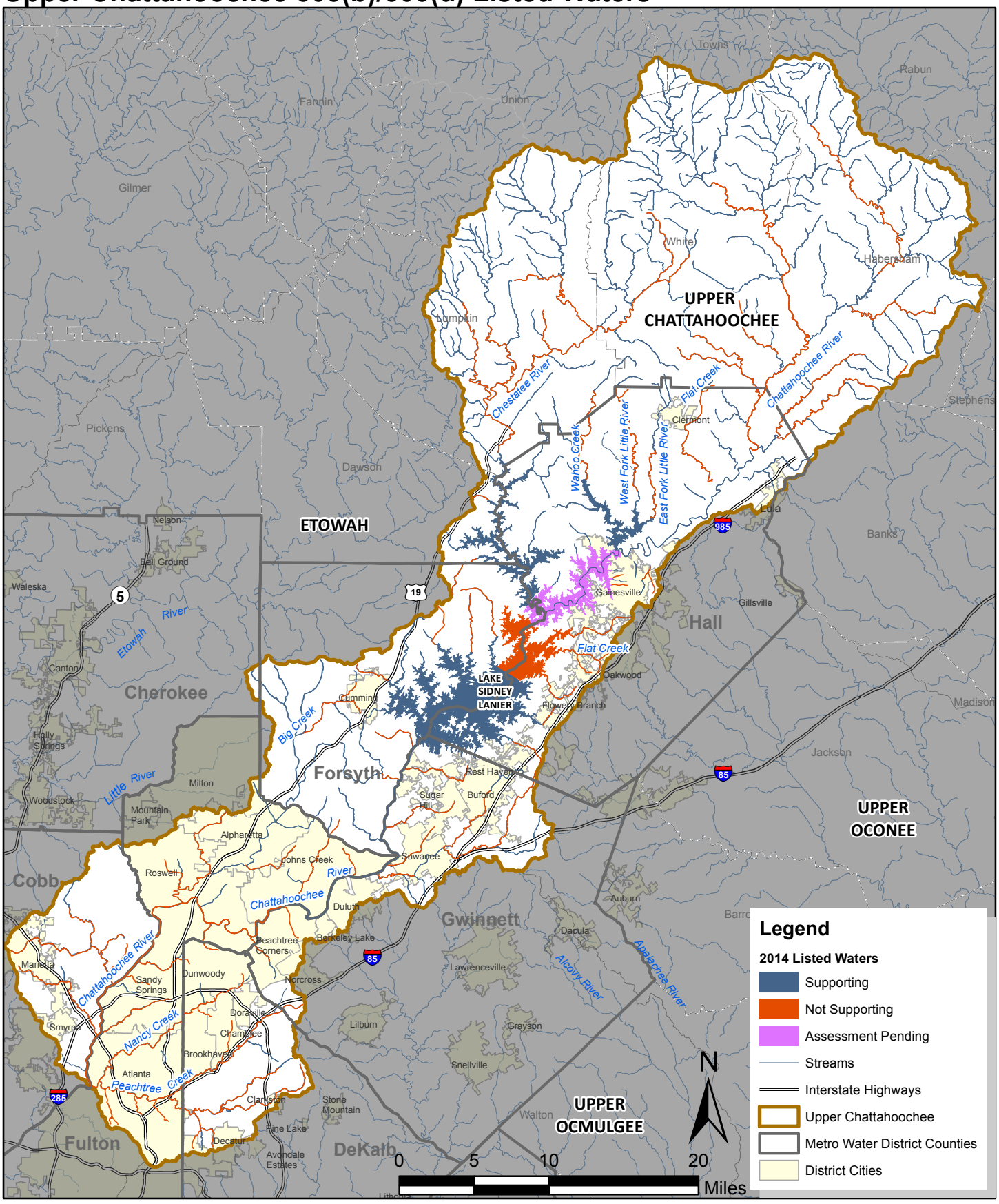


Table UC-6. Upper Chattahoochee River Basin Summary of Impaired Streams

Criterion Violated	Miles of Stream	% of 2014 Assessed Streams
Fecal Coliform Bacteria	301	75
Biota (Fish Community)	152	38
Biota (Macroinvertebrate Community)	38	10
Fish Consumption Guidance (PCBs)	12	3
1,1-Dichloroethylene	6	1
Toxicity	6	2
PCE	5	1
Copper	4	1
Lead	3	1
Dissolved Oxygen	3	1
Zinc	3	1
Alpha-BHC and Beta-BHC	1	<1
Total Impaired Stream Mileage[a]	343	86
Total Mileage Assessed for Possible Impairment	399	

[a] Several streams are listed for violations of multiple parameters within the same stream segment; therefore, the total of impaired miles by parameter will not equal the total stream mileage of impaired streams.

FIGURE UC-5
Upper Chattahoochee 305(b)/303(d) Listed Waters



Lake Lanier has a designated use of Recreation and Drinking Water with corresponding chlorophyll a and total nitrogen criteria. Sixteen percent of Lake Lanier at Browns Bridge Road (SR 369) is listed as not supporting its designated uses of Recreation and Drinking Water due to not meeting state water quality standards for chlorophyll a. An additional 13 percent of the lake (at Lanier Bridge Road) is pending assessment. A total of 68 percent of Lake Lanier is listed as supporting its designated use. Georgia EPD conducted modeling to establish Total Maximum Daily Loads (TMDLs) to address these exceedances and Georgia EPD found the growing season average chlorophyll a criteria at Browns Bridge and Flowery Branch needed to be revised based on modeling an all forested watershed. Georgia EPD has reevaluated and revised the chlorophyll a criteria at these locations (Georgia EPD, 2013).

TMDLs and TMDL Implementation Plans have been developed to help jurisdictions address impaired streams and lakes and specific parameters of concern. More information on specific TMDLs in the Upper Chattahoochee River Basin can be found on the Georgia EPD website https://epd.georgia.gov/total-maximum-daily-loadings.

Management Issues and Recommendations

Initial Screening of Priority Areas

Within the Metro Water District, the proposed implementation actions will vary among basins depending on the existing land uses, water quality, stream and waterbody condition and other watershed-specific management issues. The timeframe for implementation will also vary based on a variety of factors such as TMDL listings, presence of source water watersheds and potential for significant development in the future. Priority areas, also known as critical areas per EPA guidance, were identified at the Metro Water District level by HUC-12 watershed as an initial screening to enable communities to perform more detailed prioritizations on a subwatershed basis. The priority areas were identified at the HUC-12 level in Table UC-7 if they include a stream or waterbody with a TMDL, water supply watersheds or existing EIA greater than 10 percent.

Table UC-7. Upper Chattahoochee River Basin Initial Screening of Priority Areas Based on HUC-12 Watersheds

Total HUC-12 Watersheds (Upper Chattahoochee River Basin)	Watersheds that include a TMDL	Water Supply Watersheds [a]	Existing Effective Impervious Cover (EIA > 10%)
41	37	37	23
Percent of Total Watersheds	90%	90%	56%

[a] Water Supply Watersheds represent HUC-12 watersheds that drain to a water supply intake. Many of the HUC-12s do not actually contain any water supply intakes.

Management Issues and Recommended Strategies

Table UC-8 outlines management issues and strategies for the Upper Chattahoochee River Basin within the Metro Water District. The recommended strategies presented in Table UC-8 are based on data presented within this River Basin Profile. These strategies are provided to further describe the potential causes and potential solutions to the watershed issues. They provide a foundation for guidance, but are not presented here as mandatory requirements.

Table UC-8. Upper Chattahoochee River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Source water quality	Source water watershed protection of Lake Lanier, Chattahoochee River and small water supply watersheds.	• Implement source water protection measures in all subwatersheds draining to Lake Lanier. • Implement source water protection measures in all subwatersheds. • Continue collaborative efforts in small drinking water supply watersheds, such as Big Creek, to protect the viability of these supplies.
Nutrient loading	TMDL nutrient concentrations in Lake Lanier Portions of Lake Lanier have not met the chlorophyll a standards. Urban nutrient loading reductions will potentially be needed to restore Lake Lanier to its designated use. Agricultural nutrient loading reductions will potentially be needed to restore Lake Lanier to its designated use (Georgia EPD, 2013).	• Implement post-construction stormwater controls and infiltration practices to reduce NPS pollutants associated with multiple land uses, particularly suburban/urban and agricultural. • Educate the public on NPS pollution reduction and proper fertilizer application and the impacts of excess nutrients on the lake and local economy. • Evaluate restrictions on sale of certain fertilizers. • Coordinate with Georgia EPD NPS Program to develop nutrient management plans and strategies to reduce nutrient loading from animal feeding operations in concentrated production regions. • Participate in efforts to educate agricultural stakeholders about the importance of implementing Best Management Practices for Georgia Agriculture Manual for animal production facilities (poultry) and grazing operations. • Coordinate with Georgia Department of Agriculture Livestock/Poultry Section on inspections, complaint investigations, nutrient management plan reviews, permit administrative support and enforcement assistance (Georgia EPD, 2014). • Coordinate with counties upstream of Lake Lanier (Dawson, Habersham and White Counties) in nutrient management efforts.
Increases in impervious cover (new development)	Increases in impervious cover can lead to a change in the hydrologic regime of a watershed by causing more intense, high-velocity stormwater flows and increased erosion and sedimentation. 23 (56%) HUC-12 watersheds with EIA of > 10% 12% shift from undeveloped to developed land cover (2010 - 2040).	• Nonpoint source pollution management • Adopt and enforce the post-construction stormwater control ordinance and use of Georgia Stormwater Management Manual design standards. • Watershed improvement projects, such as stream restoration and bank stabilization, are recommended in areas to reduce instream sediment load contributions.

Table UC-8. Upper Chattahoochee River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Inadequate stormwater controls on existing impervious cover	Much of the development in the basin occurred prior to current Georgia Stormwater Management Manual design standards. Limited resources and cost of maintaining and repairing stormwater infrastructure Varying local strategies of funding stormwater management	• Implement an asset management program to identify and prioritize maintenance and capital improvement projects to maximize benefit • Consider updating stormwater controls during redevelopment • Identify opportunities for watershed improvement projects to retrofit or install updated stormwater controls, green infrastructure, stormwater treatment or other controls. • Consider dedicated funding sources, such as stormwater utilities, and seek out opportunities for grants, loans and partnerships.
Aquatic resources	The Chattahoochee River upstream from I-285 West Bridge is a designated secondary trout stream.	• Balance nonpoint source temperature inputs from its tributaries with cold water releases from Buford Dam to meet secondary trout stream criteria.
Biota TMDLs	38% of assessed instream fish communities and 10% of the benthic macroinvertebrate communities are impaired. Biota impairment in this basin are the result of high sediment loads, primarily associated with existing development with inadequate stormwater controls, which is a concern for drinking water source supplies, biota and recreation.	• Enforce post-construction stormwater ordinance on new development and seek opportunities to retrofit stormwater controls to maximize water quality and channel protection. • Recommend watershed improvement projects, such as stream restoration and streambank stabilization, in areas with failing stream banks to reduce instream sediment load contributions.
Bacteria TMDLs	75% of assessed stream segments in the Chattahoochee River Basin (within the Metro Water District) are listed for fecal coliform.	• Identify bacteria sources through inspections, monitoring, source tracing and stream walks. • Educate public on pollution prevention, proper septic system maintenance and reporting a potential illicit discharge. • Address fecal coliform bacteria contributions from SSOs as outlined in the Wastewater Management Plan. • Address bacteria loads from agricultural sources as they are identified. • Perform regular maintenance to ensure proper functioning of decentralized systems (such as septic tanks). • Ongoing infrastructure improvement projects related to reduction of potential CSO overflows.

NPS = nonpoint source pollution

Table UC-8. Upper Chattahoochee River Basin Management Issues and Recommended Strategies

Management Issue	Description	Recommended Strategies
Lake management	Lake Lanier is the largest lake within this basin, but there are other public and privately-held and managed lakes that play a significant role in meeting designated uses and downstream hydrologic regimes and water quality.	• Develop a central inventory of lakes, ownership and management practices to facilitate pollutant source identification both up and downstream of the lake. • Coordinate available water quality data and management activities for inventoried lakes. • Implement shoreline protection and upstream sediment management to prevent excessive nutrients and sedimentation within the lake. • Facilitate proper maintenance and management, particularly of small lakes by providing resources, links or other materials to assist with periodic activities such as inspections, water quality sampling or dredging. • Conduct public education and involvement activities to promote watershed stewardship to protect lake quality.

Identify Indicators and Monitoring to Measure Implementation Success

A critical component of any watershed management program is the ability to assess progress and determine if management strategies are effectively addressing issues. This Plan includes implementation actions related to watershed monitoring and conducting condition assessments to evaluate implementation success. These implementation actions include long-term ambient trend monitoring (5.F.1) and habitat and biological monitoring (5.F.2), as well as resource-specific implementation actions for TMDL Management (4.H.2). Communities may choose to conduct project-specific monitoring associated with a watershed improvement project, such as biological or geomorphological monitoring to evaluate success.

As included in EPA (2008), a monitoring program should "…track progress in meeting load reduction goals and attaining water quality standards and other goals. Measurable progress is critical to ensuring continued support of watershed projects, and progress is best demonstrated with the use of monitoring data that accurately reflect water quality conditions relevant to the identified problems. Monitoring programs should include baseline (before), project-specific (during) and post-project (after) monitoring."

Some potential indicators to measure implementation success for the Upper Chattahoochee River Basin are listed as follows, but this list is not exhaustive:

- Select representative monitoring stations within the watershed to monitor for pollutants of concern and other water quality or biological parameters.
- Use U.S. Geological Survey stream gage data or collect data to establish stream stage-discharge relationships and calculate or model water quality pollutant loads and potential reductions.
- Calculate or model improvements to hydrologic and hydraulic conditions based on structural project implementation.
- Estimate stream/lake bank stability and habitat improvement based on annual stream cross section surveys and bank erosion monitoring.
- Conduct stream/lake walks or structure inspections to inventory structure condition and performance, streambank stability and riparian condition over time.
- Conduct project monitoring to establish pre-, during- and post-project conditions, as well as upstream/downstream monitoring during the same time period to reduce the effects of environmental variability.

- To determine if water quality degradation is being prevented, conduct GIS analysis to identify high-activity areas of a watershed using aerial overlays, work orders, facility inspection, erosion and sedimentation control or new construction inspection data. Identify if monitoring data and GIS data follow similar patterns.
- Track number, location, size or features (that is, drainage area treated or linear feet of restored stream) of watershed improvement, green infrastructure or other nonpoint source reduction projects.
- Compare percentage of TMDL stream/lake segments over time.
- Track implementation actions by jurisdiction within the basin, and their measured effectiveness.
- Track enforcement actions by category and location.
- Track stream/lake buffer variances and local permits issued.
- Conduct public surveys for pollution prevention awareness or education effectiveness, particularly pre- and post-data associated with an education event.
- Compare existing water quality modeled loads against future water quality modeled loads.
- Spectral analysis is an emerging option to assess water quality.

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