Draft

Total Maximum Daily Load

Evaluation

for

Twenty Stream Segments

in the

Oconee River Basin

for

Sediment

(Fish Community Impacted)

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EXECUTIVE SUMMARY

The state of Georgia assesses its water bodies for compliance with water quality criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list, as required by that section of the CWA that defines the assessment process and are published in *Water Quality in Georgia 2018-2019* (GA EPD, 2020). This document is available on the Georgia Environmental Protection Division (GA EPD) website.

The subset of the water bodies that do not meet designated uses on the 305(b) list are also assigned to Georgia's 303(d) list, named after that section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of *Water Quality in Georgia*. Water bodies on the 303(d) list are denoted as Category 5, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDLs in this document are based on the 2020 303(d) list, which is available on the GA EPD website. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

The state of Georgia has identified twenty (20) stream segments located in the Oconee River Basin as Biota Impacted. The Biota Impacted designation indicates that studies have shown a degradation of the biological populations in the fish community of each stream. The water use classification of all the impacted streams or rivers is Fishing. The general and specific water quality criteria for Fishing, Recreation, and Drinking Water streams are stated in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03, Sections (5) and (6) (GA EPD, 2021).

Starting in 1998 and continuing periodically through 2020, the Georgia Department of Natural Resources (GA DNR) Wildlife Resources Division (GA WRD) has conducted studies of fish populations in rivers and streams across the state. GA WRD used the Index of Biotic Integrity (IBI) to classify fish populations as Excellent, Good, Fair, Poor, or Very Poor. For this TMDL evaluation, twenty (20) stream segments in the Oconee River Basin have fish populations rated as Poor or Very Poor. For these stream segments, the criterion violated is listed as Bio F, denoting Biota Impacted (Fish Community). These stream segments are included on the list of streams not supporting their designated use and placed in Category 5. These streams are water quality limited due to sedimentation. Forty-one (41) stream segments in the Oconee River Basin were rated as Excellent or Good and assessed as supporting their designated use. These Excellent and Good rated supporting stream segments were used to set the sediment yield target for the not supporting streams.

The most common cause of low IBI (fish) scores is the lack of in-stream habitat due to stream sedimentation and hydrological modifications. However, high levels of heavy metals, ammonia, chlorine, elevated temperatures, low dissolved oxygen levels, and extreme pH levels are possible sources of toxicity, and can adversely affect the aquatic communities. These parameters are typically due to point source discharges and are regulated through National Pollutant Discharge Elimination System (NPDES) permits. They are not the focus of this TMDL evaluation.

To determine the relationship between the in-stream water quality and the source loadings, each watershed was modeled. The analysis performed to develop sediment TMDLs for the not supporting stream segments and their watersheds utilized the Universal Soil Loss Equation (USLE). The USLE predicts the total annual soil loss caused by sheet and rill erosion. The USLE method considers the characteristics of the watershed including land use, soil type, ground slope, and rainfall intensity. NPDES permitted discharges were also considered in the final sediment load reduction calculations. Modeling assumptions were considered to be conservative and provide the necessary implicit margin of safety for the TMDL.

This TMDL evaluation determined the sediment loads that can enter the 303(d) listed streams in the Oconee River Basin without causing sediment impairments to the streams. This is based on the hypothesis that if an impaired watershed has a total annual sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and will not be biologically impaired due to sediment. For fish populations, Georgia's 305(b)/303(d) Listing Assessment Methodology defines a stream as supporting its designated use when a biological assessment results in an IBI narrative rating of Excellent, Good, or Fair.

The USLE was applied to the supporting watersheds, as well as the not supporting 303(d) listed watersheds in the same ecoregion, to determine both the existing sediment yields and the sediment load reductions needed to support the beneficial uses (i.e., least impacted conditions). In this TMDL, fish community health rankings are analyzed and compared at an ecoregion level (Level III). Table 1 provides the average, minimum, and maximum modeled sediment yield for the ecoregions in which fish communities have been monitored and observed.

Table 1. Modeled Sediment Yield Summary for Fish Bioassessment Streams

Modeled Sediment Yield (Tons/Acre/Yr)						
Ecoregion	**Supporting Streams**			**Not Supporting Streams**		
	Average	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**
Piedmont – 45	0.93	0.20	2.69	0.94	0.35	2.60
Southeastern Plains - 65	0.85	0.65	1.05	0.83	0.83	0.83

Currently, agricultural lands may be the major source of sediment to the state's rivers and streams. However, over the last century there has been a significant decrease in the amount of land farmed in Georgia. Since 1950, there has been a 57 percent reduction in farmland. With the reduction in farmland, there has also been a decrease in the amount of soil erosion. This suggests that the sedimentation observed in the impaired stream segments may be legacy sediment resulting from past land use practices. It is believed that if sediment loads are maintained at acceptable levels, the streams will repair themselves over time.

In the case of fish watersheds evaluated, the average sediment yield of supporting watersheds was utilized to formulate the total allowable sediment load for the not supporting watersheds. The total allowable sediment loads for the not supporting fish watersheds are summarized in Table 3 along with required sediment load reductions.

Table 2. Total Allowable Sediment Loads and the Required Sediment Load Reductions

Stream Segment Assessment Unit ID	Station ID	Current Load				TMDL		
		WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	Total Allowable Sediment Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	Percent Reduction Required
Not Supporting Segments - Fish Community								
Beaverdam Creek GAR030701010910	WRD 1270			1310.5	1310.5	1310.5	169.8	0.0%
Bowden Creek GAR030701011108	WRD 1258			3490.9	3490.9	3490.9	452.4	0.0%
Buckeye Creek GAR030701020802	WRD 1388			20170.9	20170.9	20170.9	532.5	0.0%
Cedar Creek (Clarke Co.) GAR030701010601	WRD 1424		476.0	462.2	938.2	938.2	121.6	0.0%
Cedar Creek (Jasper Co.) GAR030701011705	WRD 1274			12559.9	12559.9	12559.9	1627.8	0.0%
Fishing Creek GAR030701010708	WRD 1409			1514.3	1514.3	1514.3	196.2	0.0%
Greenbrier Creek GAR030701010704	WRD 1319		4.8	7192.0	7196.8	7196.8	932.7	0.0%
Horse Branch GAR030701011314	WRD 1326	0.46		1480.5	1520.9	1480.9	191.9	2.6%
Kimbro Creek GAR030701011210	WRD 618			1082.5	1082.5	1082.5	140.3	0.0%
Lane Creek GAR030701011010	WRD 1300			892.1	892.1	892.1	115.6	0.0%
Little Creek GAR030701010912	WRD 1269			2024.1	2896.8	2024.1	262.3	30.1%
Little River GAR030701011410	WRD 1268	29.7		2204.1	2371.7	2233.8	289.5	5.8%
Tributary to Little River (#2) GAR030701011501	WRD 1329	16.7		2619.7	4564.3	2636.4	341.7	42.2%
Lowry Branch GAR030701011604	WRD 1392			1176.6	2854.1	1176.6	152.5	58.8%
Marburg Creek (aka Marbury Creek) GAR030701010806	WRD 1320	18.3		12416.8	12453.4	12435.1	1611.6	0.1%

Stream Segment Assessment Unit ID	Station ID	Current Load				TMDL		
		WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	Total Allowable Sediment Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	Percent Reduction Required
Tributary to Mulberry River GAR030701010211	WRD 1430		473.5	2134.7	7292.9	2608.3	338.0	64.2%
North Fork Wolf Creek GAR030701011616	WRD 1366			4315.3	4315.3	4315.3	559.3	0.0%
North Sugar Creek GAR030701011313	WRD 1271	30.6		4692.7	4923.5	4723.3	612.1	4.1%
Stewarts Creek GAR030701011107	WRD 1257			3488.4	3488.4	3488.4	452.1	0.0%
Wildcat Creek GAR030701010609	WRD 1373			269.5	269.5	269.5	34.9	0.0%

Definitions:

Total Load - Sum of modeled sediment load and approved waste load allocations (WLA)
WLA - waste load allocation for discrete point sources
WLA_{sw} - waste load allocation associated with storm water discharges from a municipal separate storm sewer system (MS4)
LA - portion of the total allowable sediment load attributed to nonpoint sources and natural background sources of sediment
Total Allowable Sediment Load - allowable sediment load calculated using the target sediment yield and the stream's watershed area
Maximum Allowable Daily Load - total allowable sediment load (annual) converted to a daily figure based on the bankfull sediment transport relationship
Percent Reduction Required - percent reduction applied to current load in order to meet total allowable sediment load

Management practices that may be used to help maintain and/or reduce the total allowable sediment loads include:

- Compliance with NPDES (wastewater, construction, industrial stormwater, and/or MS4) permit limits and requirements;
- Implementation of recommended Water Quality management practices in the *Upper Oconee Regional Water Plan* (GA EPD, 2017), *Middle Ocmulgee Regional Water Plan* (GA EPD, 2017), *Altamaha Regional Water Plan* (GA EPD, 2017), and *Savannah-Upper Ogeechee Regional Water Plan* (GA EPD, 2017);
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2019);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of National Resource Conservation Service (NRCS) Conservation Practices for agriculture;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;

- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2016)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2016) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.
- Where applicable, implementation of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* (CCSMPC, 2009).

Although the measurement of sediment delivered to a stream is difficult to determine, by monitoring the implementation of these practices, their anticipated effects will contribute to improving stream habitats and water quality, and thus be an indirect measurement of the TMDLs.

1) INTRODUCTION

1.1 Background

The state of Georgia performs a detailed water quality assessment every two years by comparing water quality and biological monitoring data collected throughout the state against water quality standards established for all water bodies. Water quality standards consist of a water body's designated use(s) and applicable general and specific water quality criteria, in addition to an antidegradation policy meant to protect waters, as required by the Federal Clean Water Act (CWA). Depending on water quality assessment results, water bodies are placed into one of three broad categories that reflect their overall attainment of water quality standards, supporting designated use(s), not supporting designated use(s), or assessment pending. The complete set of assessed water bodies constitutes Georgia's 305(b) list, named after the corresponding section of the CWA that defines the assessment process.

On the same two-year cycle, Georgia compiles a list of water bodies that do not support designated uses and require a Total Maximum Daily Load (TMDL) formulation for the pollutant(s) that are contributing to water quality standard violations. This list is a subset of water bodies on the 305(b) list, and is referred to as the 303(d) list, named after the corresponding section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of the Integrated 305(b)/303(d) Report, titled *Water Quality in Georgia 2018-2019* (GA EPD, 2020). This document and supporting information is available on the Georgia Environmental Protection Division (GA EPD) website. Water bodies on the 303(d) list are denoted as Category 5 on the Integrated 305(b)/303(d) List. The TMDLs in this document are based on the 2020 Integrated 305(b)/303(d) list, which is available on the GA EPD website. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

1.2 Fish Community Sampling

During the years 1998 through 2020, the Georgia Department of Natural Resources Wildlife Resources Division (GA WRD) conducted studies of fish community populations in several streams in the Oconee River Basin. From the data collected, two indices of fish community health were established and used to assess the biotic integrity of the aquatic systems: the Index of Biotic Integrity (IBI) and the modified Index of Well-Being (IWB). The IBI and IWB numerical scores were developed by analyzing field data collected at each sampling site according to ecoregion-specific scoring criteria developed by GA WRD. These numerical scores were further classified into the integrity classes of Excellent, Good, Fair, Poor, or Very Poor.

According to the 2020 305(b)/303(d) Listing Assessment Methodology in Appendix A of *Water Quality in Georgia 2018-2019* (GA EPD, 2020, fish sampling sites and their corresponding stream segments with fish population IBI rated as Poor or Very Poor do not support their designated uses. Starting in the 2014 305(b)/303(d) listing cycle, the IWB is no longer used in assessment and listing decisions. The fish sampling sites and corresponding stream segments that do not support their designated use are included in the Integrated 305(b)/303(d) List with the criterion violated noted as Biota Impacted - Fish Community, and the segments are placed in Category 5 until a TMDL is completed.

In the Oconee River Basin, Nineteen (19) stream segments in the Piedmont ecoregion and one (1) segment in the Southeastern Plains ecoregion are rated as Poor or Very Poor, and are on the 303(d) list as not supporting their designated use, and are scheduled for a TMDL evaluation, as presented in Table 3. Thirty-nine (39) stream segments in the Piedmont ecoregion and two (2) stream segments in the Southeastern Plains are rated as Excellent or Good, and assessed as supporting their designated use. The supporting stream segments rated Excellent and Good are used to set the sediment yield target from which the total allowable sediment load for the not supporting stream segments is calculated.

Table 3. Stream Segments on the 2020 303(d) List as Biota Impacted - Fish Community

Stream Segment	Location	Assessment Unit ID	Segment Length (mi)	Ecoregion	Designated Use
Beaverdam Creek	Headwaters to Big Sandy Creek	GAR030701010910	9	Piedmont	Fishing
Bowden Creek	Unnamed tributary at I-20 to Beaverdam Creek	GAR030701011108	4	Piedmont	Fishing
Buckeye Creek	Fords Creek to Kellams Creek	GAR030701020802	5	Southeastern Plains	Fishing
Cedar Creek	Headwaters to Oconee River, Athens	GAR030701010601	4	Piedmont	Fishing
Cedar Creek	King Branch to Big Cedar Creek	GAR030701011705	14	Piedmont	Fishing
Fishing Creek	Pond at headwaters to McWhorter Creek	GAR030701010708	6	Piedmont	Fishing
Greenbriar Creek	Salem Scull Shoals Road to Lake Oconee	GAR030701010704	8	Piedmont	Fishing
Horse Branch	Headwaters to North Sugar Creek	GAR030701011314	4	Piedmont	Fishing
Kimbro Creek	Headwaters to Hightower Creek	GAR030701011210	4	Piedmont	Fishing
Lane Creek	Pond 0.6 miles upstream of Snows Mill Road to pond 0.9 miles downstream of Lane Creek Road	GAR030701011010	2	Piedmont	Fishing
Little Creek	Headwaters to Big Sandy Creek	GAR030701010912	5	Piedmont	Fishing
Little River	Social Circle to I-20	GAR030701011410	4	Piedmont	Fishing
Tributary to Little River (#2)	Eatonton to Little River	GAR030701011501	3	Piedmont	Fishing
Lowry Branch	Jasper County	GAR030701011604	3	Piedmont	Fishing, Drinking Water

Stream Segment	Location	Assessment Unit ID	Segment Length (mi)	Ecoregion	Designated Use
Marburg Creek (aka Marbury Creek)	Masseys Lake to Apalachee River	GAR030701010806	7	Piedmont	Fishing
Tributary to Mulberry River	Headwaters to Mulberry River	GAR030701010211	5	Piedmont	Fishing
North Fork Wolf Creek	Headwaters to South Fork Wolf Creek	GAR030701011616	9	Piedmont	Fishing
North Sugar Creek	Unnamed tributary 0.2 miles upstream of Plainview Road to South Sugar Creek	GAR030701011313	4	Piedmont	Fishing
Stewarts Creek	Pond 0.5 miles downstream of Billy Merritt Road to Lake Oconee	GAR030701011107	6	Piedmont	Fishing
Wildcat Creek	Headwaters to tributary 0.8 miles downstream of Kirkland Rd	GAR030701010609	2	Piedmont	Fishing

1.3 Water Quality Criteria

The stream segments listed in Table 3 have the water use classification of Fishing and Drinking Water. The general criteria for all waters and specific criteria meant to protect relevant water use classifications are stated in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Sections (5) and (6) (GA EPD, 2021). The listed criterion violated is Biota Impacted (Fish Community) and is a violation of Georgia's general criteria, 391-3-6-.03(5)(c).

> "*All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.*"

Studies conducted by GA WRD indicate significantly degraded fish communities. The potential causes listed include nonpoint sources (NP), unknown sources, and urban runoff/urban effects (UR).

1.4 Watershed Description

The twenty (20) not supporting fish community stream segments and their associated watersheds, located in the Oconee River Basin, are within the boundaries of Barrow, Clarke, Greene, Jackson, Jasper, Johnson, Laurens, Morgan, Newton, Oconee, Oglethorpe, Putnam, Walton, and Washington Counties. The forty-one (41) supporting stream segments and their associated watersheds are located in Baldwin, Banks, Barrow, Clarke, Greene, Gwinnett, Hall, Hancock, Jackson, Jasper, Jones, Laurens, Madison, Morgan, Newton, Oconee, Putnam, Taliaferro, Treutlen, Twiggs, Walton, and Wilkinson Counties.

Figure 1 shows a state-level view of the fourteen river basins in Georgia, with the Oconee River Basin highlighted in yellow. Figure 2 shows a detailed view of the Oconee River Basin, its USGS 8-digit subbasins, major streams and waterbodies, counties, and county seats. Figures 3 and 4 show the not supporting stream segments and their associated watersheds where fish communities were. All supporting and not supporting watersheds are located either in the Piedmont or Southeastern Plains ecoregions.

1.4.1 Ecoregions

In Georgia, the criteria and metrics used to evaluate the health of fish communities has been developed for geographically specific regions due to the diverse terrestrial landscape and aquatic habitats found throughout the state. GA EPD, in collaboration with other state and federal agencies, have worked to establish a general-purpose, geographical framework that categorizes the state into logical divisions of similar geology, physiography, soils, vegetation, land use, and water quality.

This collaborative group of agencies, led by the United States Environmental Protection Agency (USEPA), established and further refined a nationwide framework of ecological regions for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These ecological regions, or ecoregions, denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The current level III ecoregions were refined from the dataset created in 1987 by James Omernik at the USEPA National Health and Environmental Effects Research Laboratory. Level IV ecoregions, or subecoregions, are a further subdivision of the level III ecoregions that display details at a high resolution (Griffith et al. 2001). The six level III ecoregions established in Georgia are listed in Table 4. Figure 5 shows the distribution of Level III ecoregions in Georgia. When fish community health is being studied and evaluated, ecoregions are used as a means to divide the state into geographic areas with similar characteristics.

Table 4. Ecoregions in Georgia

Ecoregion Name	Ecoregion ID	Ecoregion Description
Piedmont	**45**	The Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast. It is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected irregular plains and some hills. The soils tend to be finer-textured than in coastal plain regions. Once largely cultivated, much of this region has reverted to pine and hardwood woodlands, and, more recently, spreading urban- and suburbanization.
Southeastern Plains	**65**	These irregular plains with broad interstream areas have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is mostly oak-hickory-pine and Southern mixed forest, and soils consist of Cretaceous or Tertiary-age sands, silts, and clays. Elevations and relief are greater than in the Southern Coastal Plain (75), but generally less than in much of the Piedmont. Streams in this area are relatively low-gradient and sandy-bottomed.
Blue Ridge	**66**	The Blue Ridge varies from narrow ridges to hilly plateaus to more massive mountainous areas with high peaks. The mostly forested slopes, high-gradient, cool, clear streams, and rugged terrain occur on a mix of igneous, metamorphic, and sedimentary geology. The southern Blue Ridge is one of the richest centers of biodiversity in the eastern U.S.
Ridge and Valley	**67**	This is a relatively low-lying region between the Blue Ridge (66) to the east and the Southwestern Appalachians (68) on the west. As a result of extreme folding and faulting events, the roughly parallel ridges and valleys come in a variety of widths, heights, and geologic materials. Springs and caves are relatively numerous. Land cover is mixed and present-day forests cover about 50% of the region. Forested ridges, and valleys with pasture and cropland, are typical. Its diverse habitats contain many unique species of terrestrial and aquatic flora and fauna.

Ecoregion Name	Ecoregion ID	Ecoregion Description
Southwestern Appalachians	**68**	These low mountains contain a mosaic of forest and woodland with some cropland and pasture. The mixed mesophytic forest is restricted mostly to the deeper ravines and escarpment slopes, and the summit or tableland forests are dominated by mixed oaks with shortleaf pine.
Southern Coastal Plain	**75**	This is a heterogeneous region containing barrier islands, coastal lagoons, marshes, and swampy lowlands along the Gulf and Atlantic coasts. This ecoregion is generally lower in elevation with less relief and wetter soils than ecoregion 65. Once covered by a variety of forest communities that included trees of longleaf pine, slash pine, pond pine, beech, sweetgum, southern magnolia, white oak, and laurel oak, land cover in the region is now mostly slash and loblolly pine with oak-gum-cypress forest in some low lying areas, citrus groves, pasture for beef cattle, and urban.

1.4.2 State Water Planning

The Georgia Legislature enacted the Metropolitan North Georgia Water Planning District Act in 2001 to create the Metropolitan North Georgia Water Planning District (MNGWPD) to preserve and protect water resources in the 15-county metropolitan Atlanta area. The MNGWPD is charged with the development of comprehensive regional and watershed specific water resource management plans to be implemented by local governments in the metropolitan Atlanta area. The MNGWPD issued its first water resource management plan documents in 2003.

In 2004, the Georgia Legislature enacted the Comprehensive State-wide Water Management Planning Act to ensure management of water resources in a sustainable manner to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens on a state-wide level. GA EPD later developed the 2008 Comprehensive State-wide Water Management Plan, which established Georgia's ten Regional Water Planning Councils (RWPCs) and laid the groundwork for the RWPCs to develop their own Regional Water Plans. The boundaries of these ten RWPCs, in addition to the MNGWPD, are shown in Figure 6.

In 2011, each RWPC finished development of individualized Regional Water Plans, which were later adopted following GA EPD review. These Regional Water Plans identify a range of actions or management practices to help meet the state's water quality and water supply challenges. The MNGWPD and each RWPC subsequently updated and revised their respective management plan documents in 2017. Implementation of these plans is critical to meeting Georgia's water resource challenges. The specific Regional Water Plan(s) applicable to this TMDL are discussed in Sections 6 and 7.

1.4.3 Land Use

The land use characteristics of the Oconee River Basin watersheds were determined using data from the 2015 Georgia Land Use Trends (GLUT). This raster land use trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1974, 1985, 1991, 1998, 2001, 2005, 2008, and 2015. The raster data sets were developed from Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+), with a resolution of 30 meters.

The distribution and percent land uses for stream segments and their associated watersheds assessed for fish communities are given in Table 5. This table includes information for both

supporting and not supporting stream segments. This table is divided into sections by use support and ecoregion.

1.4.4 Soils

The soil characteristics of the Oconee River Basin watersheds were determined using data from the Soil Survey Geographic (SSURGO) database. SSURGO soil data represents a higher spatial resolution and degree of detail when compared to the State Soil Geographic (STATSGO) Database used in previous sediment TMDLs drafted by GA EPD. Currently, SSURGO soil data represents the most detailed level of soil geographic data available from the NRCS within the United States Department of Agriculture (USDA).

This database provides detailed soil map units characterized by hydrologic soil group; percentages of clay, silt, sand, and organic matter; soil erodibility factor (K-factor); and soil hydraulic conductivity (K_{sat}). Table 6 provides a summary of the hydrologic soil groups in each watershed associated with stream segments not supporting and supporting designated uses that were evaluated for fish community health. The detailed soil data for each individual soil map unit is not included in this document due to the sheer volume of tabular data. The complete soils data is available upon request from GA EPD.

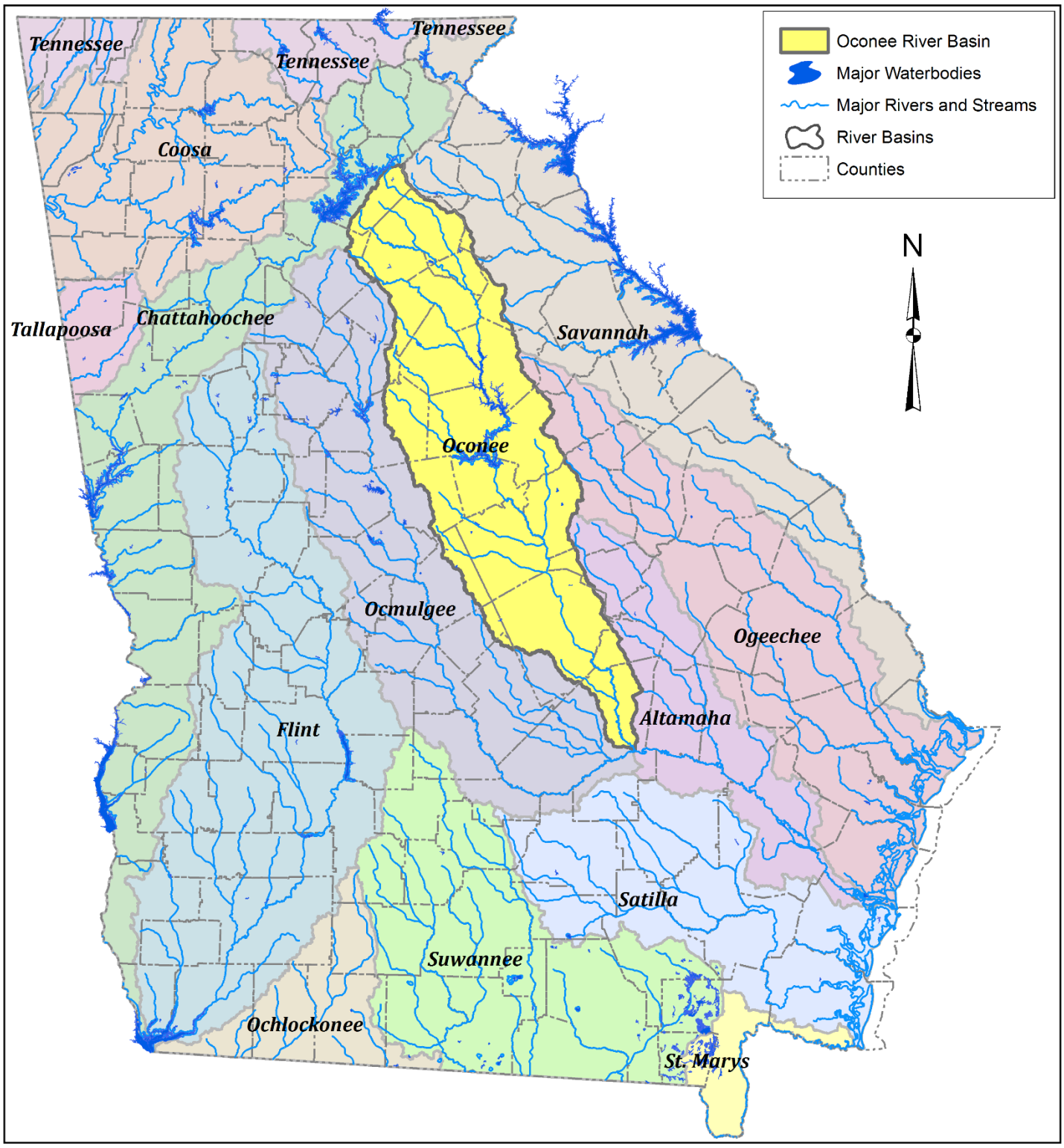

Figure 1. Oconee River Basin and the River Basins of Georgia

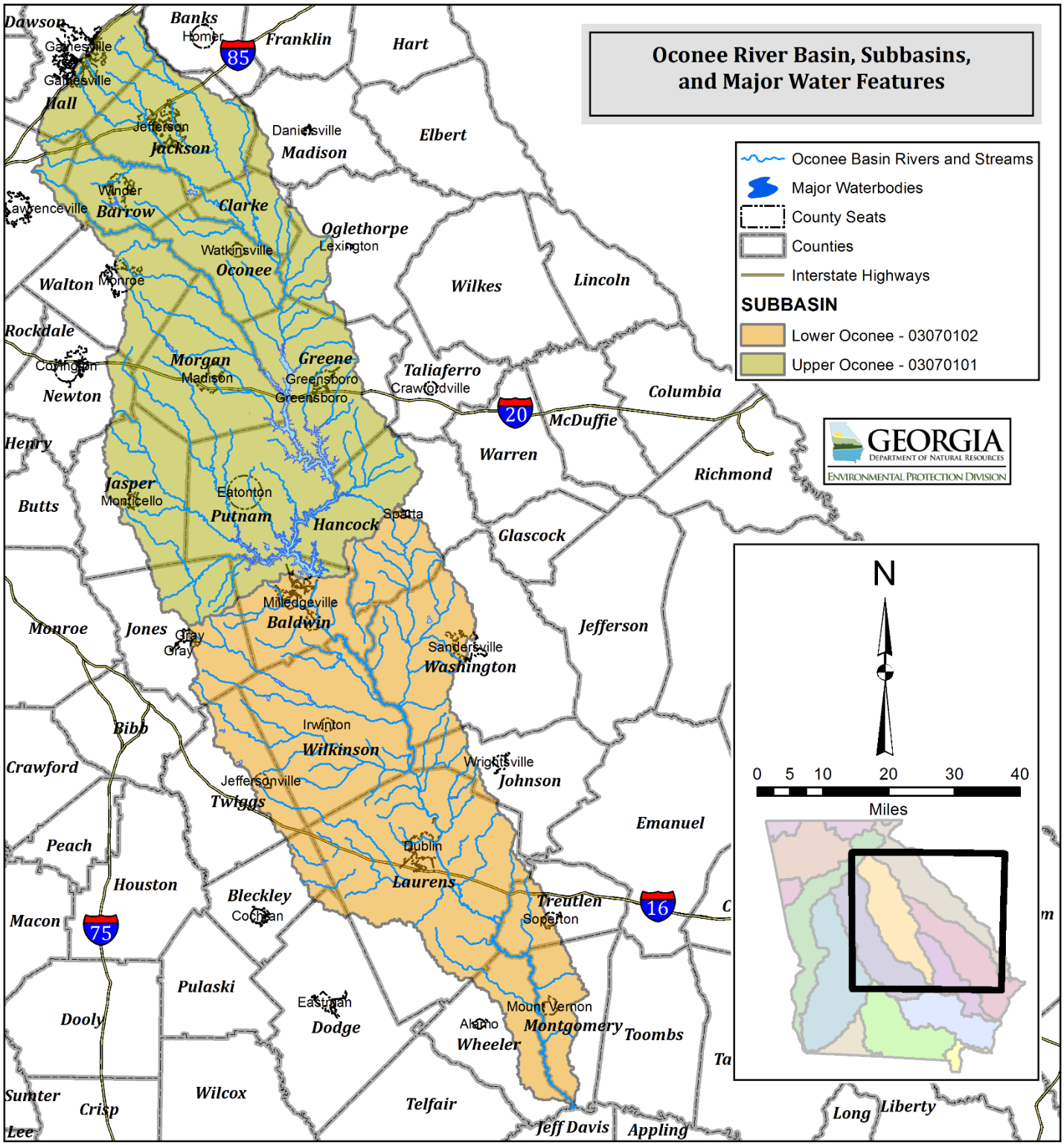

Figure 2. Oconee River Basin
Major Water Features and Political Boundaries

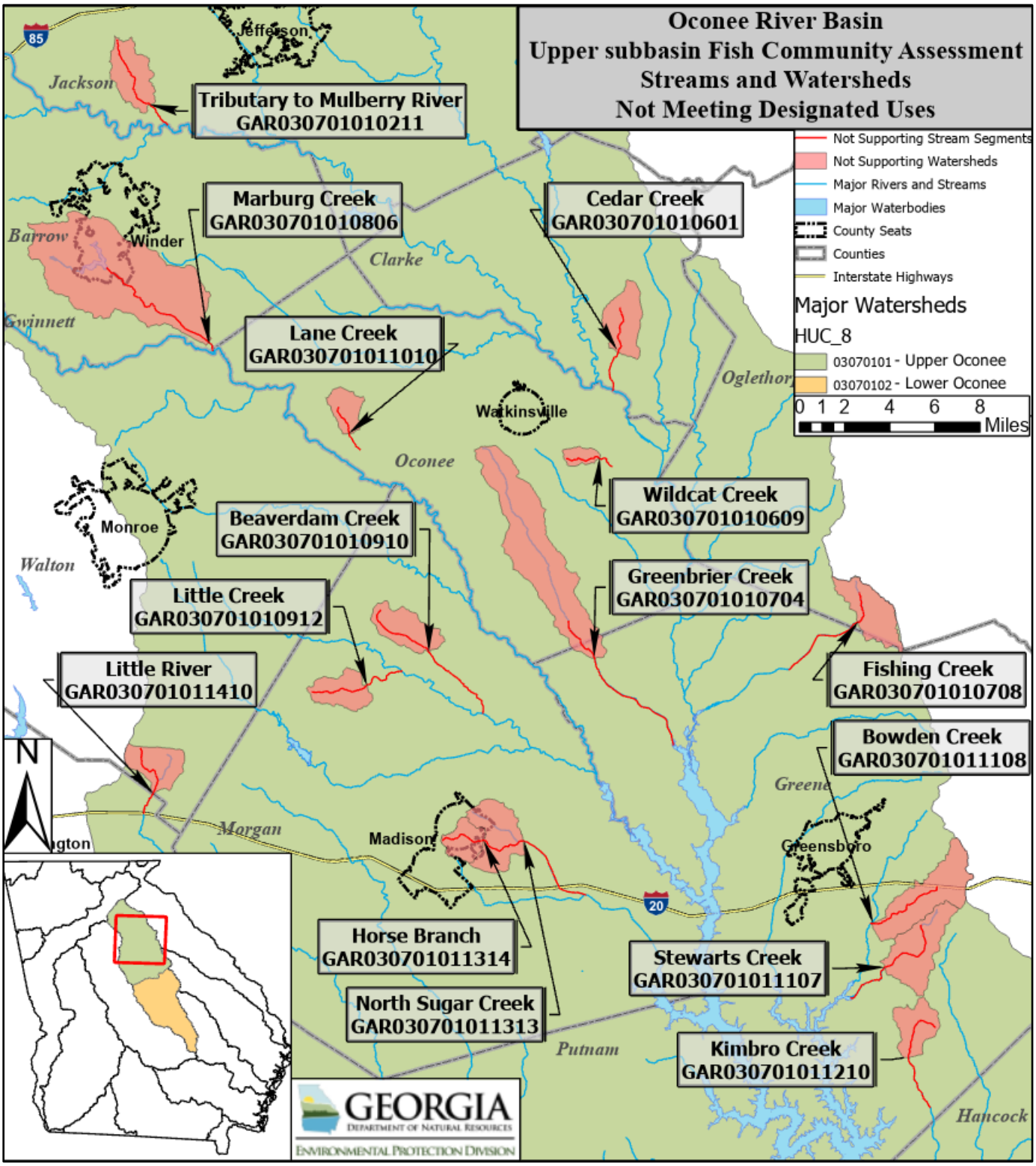

Figure 3. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Upper Oconee Subbasin

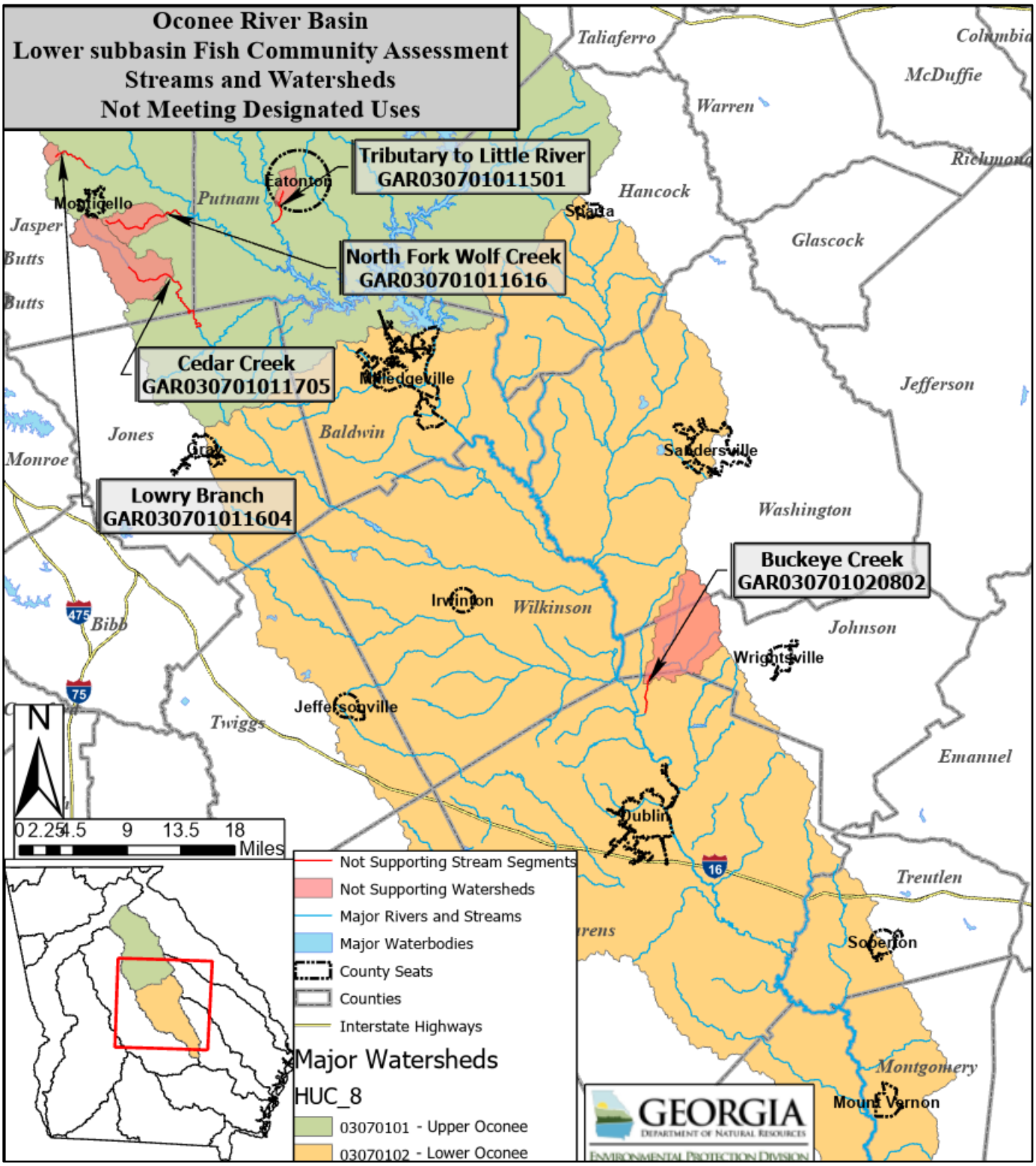

Figure 4. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Lower Oconee Subbasin

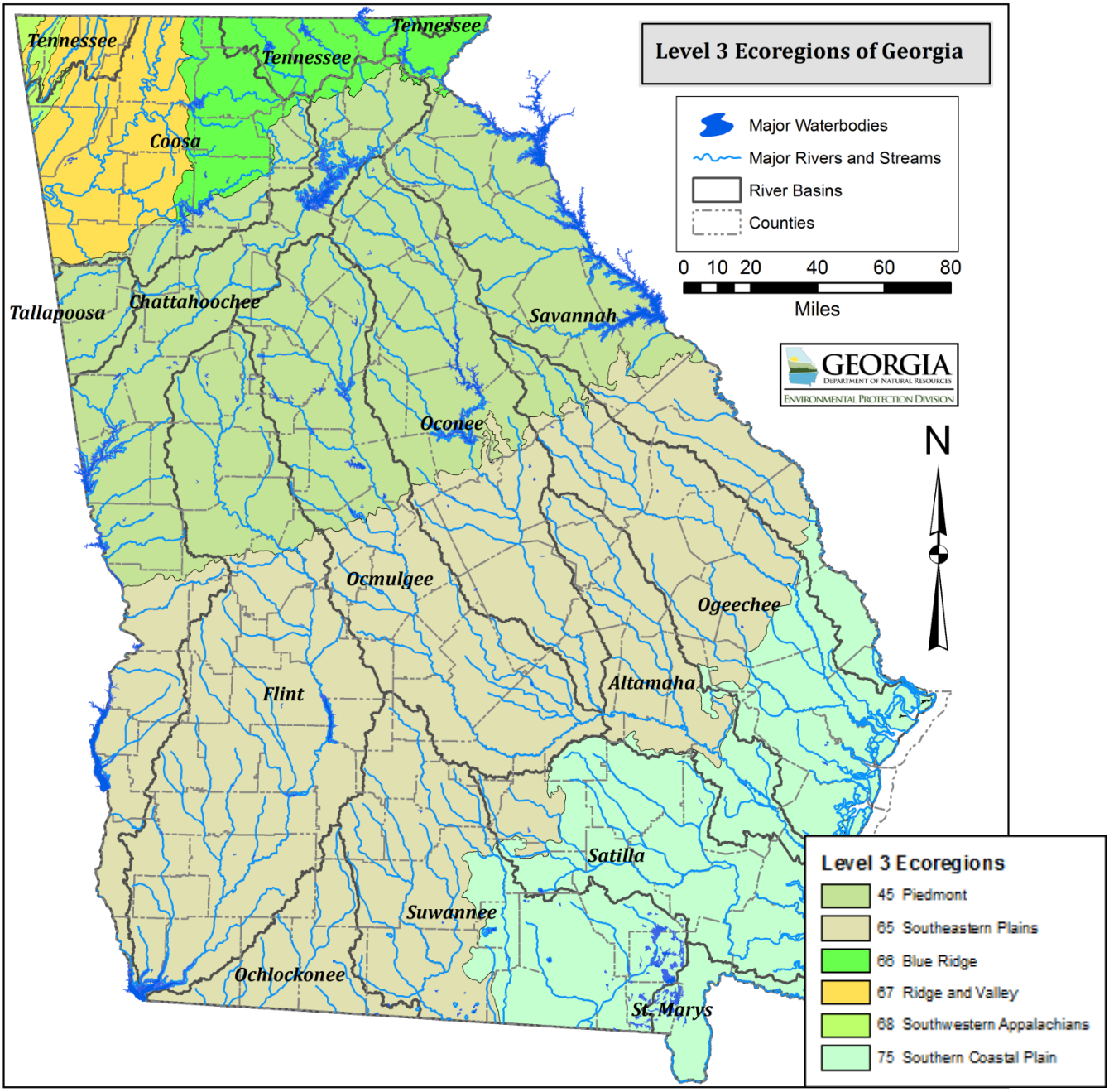

Figure 5.
Level III Ecoregions in the State of Georgia

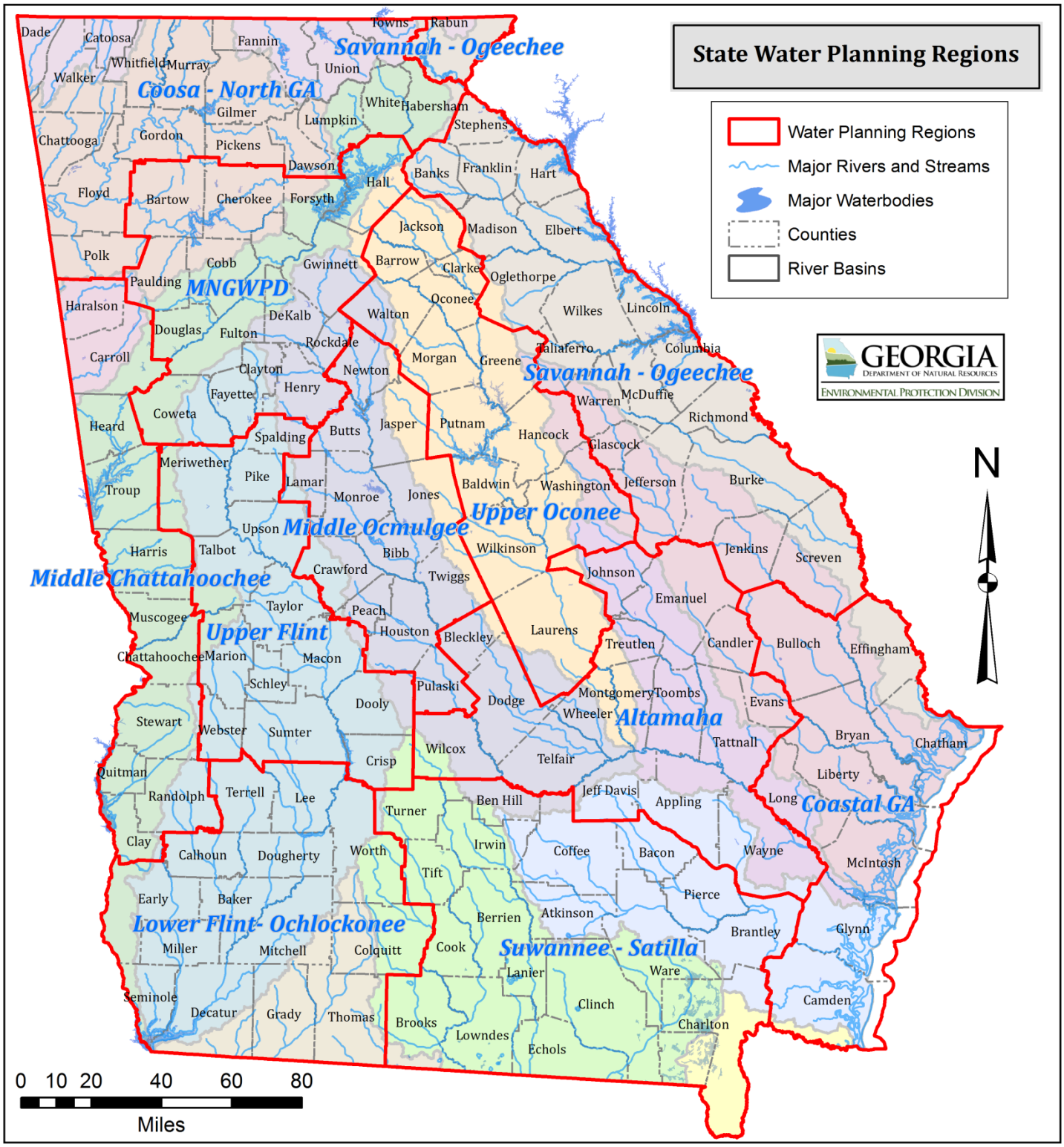

Figure 6. Water Planning Regions in Georgia

Table 5. Land Use Distribution and Percentages for Fish Community Assessment Streams

Stream Segment and Station ID	Land Uses (acres)																		
	Beaches, Dunes, Mud	Open Water	Utility Swaths	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Piedmont Ecoregion (45) - Not Supporting Stream Segments																			
Beaverdam Creek	1.3	10.7	0.0	227.1	145.7	8.2	2.0	24.5	0.0	0.0	445.0	118.5	9.3	0.0	1444.7	128.5	106.3	0.4	2672.3
WRD 1270	0.0%	0.4%	0.0%	8.5%	5.5%	0.3%	0.1%	0.9%	0.0%	0.0%	16.7%	4.4%	0.3%	0.0%	54.1%	4.8%	4.0%	0.0%	100%
Bowden Creek	7.8	10.5	0.0	348.3	168.1	22.2	3.3	296.9	91.8	0.0	1106.2	1731.6	196.8	0.0	770.2	0.9	116.1	0.0	4870.7
WRD 1258	0.2%	0.2%	0.0%	7.2%	3.5%	0.5%	0.1%	6.1%	1.9%	0.0%	22.7%	35.6%	4.0%	0.0%	15.8%	0.0%	2.4%	0.0%	100%
Cedar Creek (Clarke Co.)	1.1	4.7	0.0	892.7	705.4	204.4	147.4	53.8	0.0	0.0	448.1	87.8	28.5	0.0	84.1	0.0	34.5	0.0	2692.5
WRD 1424	0.0%	0.2%	0.0%	33.2%	26.2%	7.6%	5.5%	2.0%	0.0%	0.0%	16.6%	3.3%	1.1%	0.0%	3.1%	0.0%	1.3%	0.0%	100%
Cedar Creek (Jasper Co.)	6.7	119.6	0.0	1002.8	134.8	56.3	53.4	889.4	1.1	0.0	6471.5	5871.0	559.5	0.0	1534.7	1.8	970.3	0.0	17672.8
WRD 1274	0.0%	0.7%	0.0%	5.7%	0.8%	0.3%	0.3%	5.0%	0.0%	0.0%	36.6%	33.2%	3.2%	0.0%	8.7%	0.0%	5.5%	0.0%	100%
Fishing Creek	0.0	8.2	0.0	83.6	14.2	2.4	1.8	120.1	0.0	0.0	605.6	1840.1	116.1	0.0	115.6	21.3	152.3	0.4	3081.9
WRD 1409	0.0%	0.3%	0.0%	2.7%	0.5%	0.1%	0.1%	3.9%	0.0%	0.0%	19.6%	59.7%	3.8%	0.0%	3.8%	0.7%	4.9%	0.0%	100%
Greenbrier Creek	1.6	14.2	23.4	533.3	224.8	35.8	5.1	387.6	0.0	0.0	3109.3	2145.0	288.7	0.0	3073.5	117.0	558.7	2.0	10519.9
WRD 1319	0.0%	0.1%	0.2%	5.1%	2.1%	0.3%	0.0%	3.7%	0.0%	0.0%	29.6%	20.4%	2.7%	0.0%	29.2%	1.1%	5.3%	0.0%	100%
Horse Branch	0.2	20.5	18.0	296.0	221.5	65.6	36.7	140.1	0.0	0.0	343.8	238.4	17.3	0.0	137.7	0.0	55.2	0.0	1591.0
WRD 1326	0.0%	1.3%	1.1%	18.6%	13.9%	4.1%	2.3%	8.8%	0.0%	0.0%	21.6%	15.0%	1.1%	0.0%	8.7%	0.0%	3.5%	0.0%	100%
Kimbro Creek	0.0	0.0	0.0	105.0	25.1	3.6	0.4	145.9	58.5	139.0	331.4	1245.4	71.4	0.0	34.9	0.0	87.6	0.0	2248.2
WRD 618	0.0%	0.0%	0.0%	4.7%	1.1%	0.2%	0.0%	6.5%	2.6%	6.2%	14.7%	55.4%	3.2%	0.0%	1.6%	0.0%	3.9%	0.0%	100%
Lane Creek	9.8	21.3	0.0	86.7	135.4	22.2	2.4	22.9	0.0	0.0	110.1	118.8	2.4	0.0	715.9	129.0	61.2	0.2	1438.4
WRD 1300	0.7%	1.5%	0.0%	6.0%	9.4%	1.5%	0.2%	1.6%	0.0%	0.0%	7.7%	8.3%	0.2%	0.0%	49.8%	9.0%	4.3%	0.0%	100%
Little Creek	2.4	23.8	0.0	81.2	80.3	1.1	0.2	112.3	0.0	0.0	337.8	130.8	11.3	0.0	1099.3	157.2	136.8	0.0	2174.6
WRD 1269	0.1%	1.1%	0.0%	3.7%	3.7%	0.1%	0.0%	5.2%	0.0%	0.0%	15.5%	6.0%	0.5%	0.0%	50.6%	7.2%	6.3%	0.0%	100%

Land Uses (acres)																			
Stream Segment and Station ID	**Beaches, Dunes, Mud**	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Developed, Low Intensity**	**Developed, Medium Intensity**	**Developed, High Intensity**	**Transitional, Clearcut, Sparse**	**Quarries, Strip Mines**	**Rock Outcrop**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture, Hay**	**Row Crops**	**Forested Wetlands**	**Non-Forested Wetlands (Freshwater)**	**Total**
Little River	0.0	2.7	0.0	183.5	209.1	104.7	61.6	147.9	0.0	0.0	513.3	373.0	18.9	0.0	679.6	25.1	80.5	0.0	2399.9
WRD 1268	0.0%	0.1%	0.0%	7.6%	8.7%	4.4%	2.6%	6.2%	0.0%	0.0%	21.4%	15.5%	0.8%	0.0%	28.3%	1.0%	3.4%	0.0%	100%
Tributary to Little River (#2)	0.7	3.8	50.9	536.2	286.7	103.4	64.9	405.9	0.0	0.0	796.6	228.2	80.1	0.0	248.2	0.0	26.9	0.0	2832.4
WRD 1329	0.0%	0.1%	1.8%	18.9%	10.1%	3.7%	2.3%	14.3%	0.0%	0.0%	28.1%	8.1%	2.8%	0.0%	8.8%	0.0%	1.0%	0.0%	100%
Lowry Branch	0.0	1.1	0.0	85.4	42.7	0.0	0.0	242.0	0.0	0.0	276.7	257.8	12.7	0.0	305.8	0.0	40.0	0.0	1264.1
WRD 1392	0.0%	0.1%	0.0%	6.8%	3.4%	0.0%	0.0%	19.1%	0.0%	0.0%	21.9%	20.4%	1.0%	0.0%	24.2%	0.0%	3.2%	0.0%	100%
Marburg Creek (aka Marbury Creek)	9.3	308.9	72.9	1402.4	2165.7	689.4	444.3	430.1	168.6	0.0	3322.1	2366.7	92.5	134.3	4250.9	1.8	610.3	3.3	16473.7
WRD 1320	0.1%	1.9%	0.4%	8.5%	13.1%	4.2%	2.7%	2.6%	1.0%	0.0%	20.2%	14.4%	0.6%	0.8%	25.8%	0.0%	3.7%	0.0%	100%
Tributary to Mulberry River	0.7	7.3	0.0	660.7	319.4	54.7	20.9	321.6	0.0	0.0	603.8	135.2	5.8	0.0	579.1	0.0	91.2	1.8	2802.2
WRD 1430	0.0%	0.3%	0.0%	23.6%	11.4%	2.0%	0.7%	11.5%	0.0%	0.0%	21.5%	4.8%	0.2%	0.0%	20.7%	0.0%	3.3%	0.1%	100%
North Fork Wolf Creek	3.8	14.5	0.0	211.7	50.0	1.6	0.0	246.9	0.0	0.0	2204.6	1912.4	163.5	0.0	1814.5	0.0	223.5	0.0	6846.9
WRD 1366	0.1%	0.2%	0.0%	3.1%	0.7%	0.0%	0.0%	3.6%	0.0%	0.0%	32.2%	27.9%	2.4%	0.0%	26.5%	0.0%	3.3%	0.0%	100%
North Sugar Creek	2.7	28.7	44.5	640.7	444.1	135.0	70.1	361.6	0.0	0.0	1247.9	629.6	91.8	0.0	1070.2	72.3	235.3	0.0	5074.4
WRD 1271	0.1%	0.6%	0.9%	12.6%	8.8%	2.7%	1.4%	7.1%	0.0%	0.0%	24.6%	12.4%	1.8%	0.0%	21.1%	1.4%	4.6%	0.0%	100%
Stewarts Creek	13.3	9.1	0.0	208.4	40.5	3.3	0.0	412.1	0.0	0.0	867.3	1457.1	222.8	0.0	740.8	0.0	80.1	0.0	4054.9
WRD 1257	0.3%	0.2%	0.0%	5.1%	1.0%	0.1%	0.0%	10.2%	0.0%	0.0%	21.4%	35.9%	5.5%	0.0%	18.3%	0.0%	2.0%	0.0%	100%
Wildcat Creek	0.0	0.0	0.0	16.9	10.5	4.9	0.7	2.2	0.0	0.0	127.0	29.1	7.1	0.0	466.6	10.0	7.6	0.0	682.5
WRD 1373	0.0%	0.0%	0.0%	2.5%	1.5%	0.7%	0.1%	0.3%	0.0%	0.0%	18.6%	4.3%	1.0%	0.0%	68.4%	1.5%	1.1%	0.0%	100%
Southeastern Plains Ecoregion (65) - Not Supporting Stream Segments																			
Buckeye Creek	5.3	19.8	0.0	618.9	91.6	27.6	4.7	863.1	3.6	0.0	7278.8	6743.7	325.6	0.0	3401.3	3209.2	1664.4	33.4	24316.0
WRD 1388	0.0%	0.1%	0.0%	2.5%	0.4%	0.1%	0.0%	3.5%	0.0%	0.0%	29.9%	27.7%	1.3%	0.0%	14.0%	13.2%	6.8%	0.1%	100%

Stream Segment and Station ID	Land Uses (acres)																		
	Beaches, Dunes, Mud	Open Water	Utility Swaths	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Piedmont Ecoregion (45) - Supporting Stream Segments																			
Allen Creek	0.2	5.1	63.4	512.2	757.7	512.0	570.9	340.3	0.0	0.0	3697.1	244.2	20.7	0.0	764.8	0.0	58.9	0.0	7547.4
WRD 668	0.0%	0.1%	0.8%	6.8%	10.0%	6.8%	7.6%	4.5%	0.0%	0.0%	49.0%	3.2%	0.3%	0.0%	10.1%	0.0%	0.8%	0.0%	100%
Apalachee River	99.2	1011.0	848.2	12541.7	13680.6	3619.5	1248.7	5798.7	320.9	1.3	37250.9	28119.6	2405.2	425.7	43248.2	1846.1	8794.6	36.0	161296.3
WRD 96	0.1%	0.6%	0.5%	7.8%	8.5%	2.2%	0.8%	3.6%	0.2%	0.0%	23.1%	17.4%	1.5%	0.3%	26.8%	1.1%	5.5%	0.0%	100%
Big Bear Creek	2.0	3.3	0.0	303.8	371.6	50.9	31.6	104.1	0.0	0.0	693.4	245.5	26.0	0.0	1110.2	0.0	41.4	0.0	2983.9
WRD 664	0.1%	0.1%	0.0%	10.2%	12.5%	1.7%	1.1%	3.5%	0.0%	0.0%	23.2%	8.2%	0.9%	0.0%	37.2%	0.0%	1.4%	0.0%	100%
Black Spring Branch	0.0	0.9	0.0	175.7	50.0	3.3	0.0	26.0	0.0	0.0	1262.3	618.3	67.2	0.0	10.0	77.6	12.0	0.0	2303.3
WRD 2	0.0%	0.0%	0.0%	7.6%	2.2%	0.1%	0.0%	1.1%	0.0%	0.0%	54.8%	26.8%	2.9%	0.0%	0.4%	3.4%	0.5%	0.0%	100%
Calls Creek	7.1	26.5	0.0	1001.2	846.2	252.9	105.9	230.0	0.0	0.0	1177.4	390.7	35.6	0.0	1385.7	4.0	63.8	0.0	5527.0
WRD 644	0.1%	0.5%	0.0%	18.1%	15.3%	4.6%	1.9%	4.2%	0.0%	0.0%	21.3%	7.1%	0.6%	0.0%	25.1%	0.1%	1.2%	0.0%	100%
Candler Creek	0.9	3.6	36.7	338.9	390.5	64.7	22.5	268.9	0.0	0.0	2941.6	411.0	4.0	0.0	2630.0	0.0	97.6	6.9	7217.8
WRD 1428	0.0%	0.0%	0.5%	4.7%	5.4%	0.9%	0.3%	3.7%	0.0%	0.0%	40.8%	5.7%	0.1%	0.0%	36.4%	0.0%	1.4%	0.1%	100%
Cane Creek	0.2	0.0	0.0	99.6	75.2	37.4	6.7	42.0	0.0	0.0	562.2	782.2	89.6	0.0	381.6	0.0	48.7	0.0	2125.4
WRD 1427	0.0%	0.0%	0.0%	4.7%	3.5%	1.8%	0.3%	2.0%	0.0%	0.0%	26.5%	36.8%	4.2%	0.0%	18.0%	0.0%	2.3%	0.0%	100%
Cedar Creek	0.9	2.0	0.0	74.7	31.1	19.3	21.6	30.7	0.0	0.0	271.5	339.2	23.4	0.0	71.6	0.0	49.8	0.0	935.8
WRD 12	0.1%	0.2%	0.0%	8.0%	3.3%	2.1%	2.3%	3.3%	0.0%	0.0%	29.0%	36.2%	2.5%	0.0%	7.7%	0.0%	5.3%	0.0%	100%
Cedar Creek	4.4	34.9	63.8	823.1	1647.5	354.5	259.3	189.3	26.7	0.0	1330.6	615.4	19.3	0.0	1278.3	0.0	149.4	1.3	6797.9
WRD 667	0.1%	0.5%	0.9%	12.1%	24.2%	5.2%	3.8%	2.8%	0.4%	0.0%	19.6%	9.1%	0.3%	0.0%	18.8%	0.0%	2.2%	0.0%	100%
Copeland Creek	2.0	12.7	20.0	122.3	45.1	0.2	0.0	340.5	0.0	0.0	717.2	1210.7	141.9	0.0	370.3	0.0	50.9	0.4	3034.4
WRD 66	0.1%	0.4%	0.7%	4.0%	1.5%	0.0%	0.0%	11.2%	0.0%	0.0%	23.6%	39.9%	4.7%	0.0%	12.2%	0.0%	1.7%	0.0%	100%
Crooked Creek	9.8	50.5	36.0	503.9	234.6	17.6	5.3	563.1	0.0	0.0	3746.0	2044.3	272.2	0.0	4126.1	241.5	227.7	7.6	12086.3
WRD 1325	0.1%	0.4%	0.3%	4.2%	1.9%	0.1%	0.0%	4.7%	0.0%	0.0%	31.0%	16.9%	2.3%	0.0%	34.1%	2.0%	1.9%	0.1%	100%
East Sandy Creek	9.1	42.0	152.1	434.3	213.3	22.0	8.9	124.1	0.0	0.0	2166.6	440.1	102.5	0.0	1357.7	97.9	113.9	3.1	5287.7
WRD 1372	0.2%	0.8%	2.9%	8.2%	4.0%	0.4%	0.2%	2.3%	0.0%	0.0%	41.0%	8.3%	1.9%	0.0%	25.7%	1.9%	2.2%	0.1%	100%

Land Uses (acres)																			
Stream Segment and Station ID	**Beaches, Dunes, Mud**	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Developed, Low Intensity**	**Developed, Medium Intensity**	**Developed, High Intensity**	**Transitional, Clearcut, Sparse**	**Quarries, Strip Mines**	**Rock Outcrop**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture, Hay**	**Row Crops**	**Forested Wetlands**	**Non-Forested Wetlands (Freshwater)**	**Total**
Floyd Creek trib	0.0	0.0	0.0	118.5	124.8	51.4	28.5	52.5	0.0	0.0	841.5	38.7	23.1	0.0	14.0	0.0	8.9	0.0	1301.9
WRD 1381	0.0%	0.0%	0.0%	9.1%	9.6%	3.9%	2.2%	4.0%	0.0%	0.0%	64.6%	3.0%	1.8%	0.0%	1.1%	0.0%	0.7%	0.0%	100%
Hardeman Creek	3.6	37.8	0.0	206.2	160.6	100.3	84.1	154.8	0.0	0.0	1162.5	455.7	34.7	0.0	1211.8	40.3	84.5	0.0	3736.7
WRD 1422	0.1%	1.0%	0.0%	5.5%	4.3%	2.7%	2.2%	4.1%	0.0%	0.0%	31.1%	12.2%	0.9%	0.0%	32.4%	1.1%	2.3%	0.0%	100%
Hog Creek	5.6	64.9	79.2	703.7	156.6	11.8	0.2	902.3	0.0	0.0	3864.3	4227.9	434.3	0.0	2231.1	2.4	481.0	2.4	13167.8
WRD 1273	0.0%	0.5%	0.6%	5.3%	1.2%	0.1%	0.0%	6.9%	0.0%	0.0%	29.3%	32.1%	3.3%	0.0%	16.9%	0.0%	3.7%	0.0%	100%
Indian Creek	7.8	17.6	0.0	492.6	458.8	121.2	65.2	114.1	0.0	0.0	1351.3	292.7	21.3	0.0	2235.3	4.2	155.0	5.3	5342.4
WRD 1323	0.1%	0.3%	0.0%	9.2%	8.6%	2.3%	1.2%	2.1%	0.0%	0.0%	25.3%	5.5%	0.4%	0.0%	41.8%	0.1%	2.9%	0.1%	100%
Indian Creek	3.3	16.2	0.0	205.3	167.7	10.2	0.9	84.7	0.0	0.0	749.9	565.8	133.7	0.0	1423.5	268.7	239.3	2.0	3871.2
WRD 1432	0.1%	0.4%	0.0%	5.3%	4.3%	0.3%	0.0%	2.2%	0.0%	0.0%	19.4%	14.6%	3.5%	0.0%	36.8%	6.9%	6.2%	0.1%	100%
Little Indian Creek trib	5.3	39.1	0.0	89.8	76.1	14.2	1.1	43.6	0.0	0.0	339.8	68.3	23.4	0.0	912.0	14.2	34.9	2.2	1664.2
WRD 1410	0.3%	2.4%	0.0%	5.4%	4.6%	0.9%	0.1%	2.6%	0.0%	0.0%	20.4%	4.1%	1.4%	0.0%	54.8%	0.9%	2.1%	0.1%	100%
Little Mullberry River	9.8	53.8	0.0	972.3	1782.5	951.0	81.8	424.3	0.0	0.0	2802.6	850.4	69.2	162.6	1472.0	0.0	224.0	0.0	9856.3
WRD 1383	0.1%	0.5%	0.0%	9.9%	18.1%	9.6%	0.8%	4.3%	0.0%	0.0%	28.4%	8.6%	0.7%	1.6%	14.9%	0.0%	2.3%	0.0%	100%
Little River	1.3	4.9	0.0	394.3	274.7	120.1	63.2	223.5	0.0	0.0	1055.3	1053.9	59.4	0.0	1101.1	25.1	138.6	0.0	4515.3
WRD 1333	0.0%	0.1%	0.0%	8.7%	6.1%	2.7%	1.4%	5.0%	0.0%	0.0%	23.4%	23.3%	1.3%	0.0%	24.4%	0.6%	3.1%	0.0%	100%
Little Sandy Creek	1.6	28.0	27.4	373.4	264.4	10.7	2.0	76.3	0.0	0.0	795.5	906.0	46.5	0.0	3520.7	528.0	387.4	0.0	6967.9
WRD 1324	0.0%	0.4%	0.4%	5.4%	3.8%	0.2%	0.0%	1.1%	0.0%	0.0%	11.4%	13.0%	0.7%	0.0%	50.5%	7.6%	5.6%	0.0%	100%
Log Dam Creek	0.0	2.0	0.0	71.6	28.9	1.6	0.0	185.7	0.0	0.0	1012.1	1151.8	77.8	0.0	20.7	122.5	24.5	0.0	2699.2
WRD 7	0.0%	0.1%	0.0%	2.7%	1.1%	0.1%	0.0%	6.9%	0.0%	0.0%	37.5%	42.7%	2.9%	0.0%	0.8%	4.5%	0.9%	0.0%	100%
Lollis Creek	5.1	20.9	0.0	603.4	1059.0	390.1	59.8	372.5	145.7	0.0	2158.6	393.6	10.2	0.0	887.6	0.9	33.4	0.9	6141.7
WRD 1431	0.1%	0.3%	0.0%	9.8%	17.2%	6.4%	1.0%	6.1%	2.4%	0.0%	35.1%	6.4%	0.2%	0.0%	14.5%	0.0%	0.5%	0.0%	100%
Mulberry Creek	1.3	0.0	0.0	665.4	1062.6	239.1	58.5	232.8	0.0	0.0	2665.6	272.2	8.9	0.0	705.9	0.0	3.1	0.0	5915.5
WRD 669	0.0%	0.0%	0.0%	11.2%	18.0%	4.0%	1.0%	3.9%	0.0%	0.0%	45.1%	4.6%	0.2%	0.0%	11.9%	0.0%	0.1%	0.0%	100%

Land Uses (acres)																			
Stream Segment and Station ID	**Beaches, Dunes, Mud**	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Developed, Low Intensity**	**Developed, Medium Intensity**	**Developed, High Intensity**	**Transitional, Clearcut, Sparse**	**Quarries, Strip Mines**	**Rock Outcrop**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture, Hay**	**Row Crops**	**Forested Wetlands**	**Non-Forested Wetlands (Freshwater)**	**Total**
Murder Creek	52.0	638.5	209.1	4751.0	1719.8	206.4	87.0	5307.2	0.0	0.0	21649.9	25472.0	1555.0	6.2	16714.8	365.2	4870.4	3.6	83608.0
WRD 101	0.1%	0.8%	0.3%	5.7%	2.1%	0.2%	0.1%	6.3%	0.0%	0.0%	25.9%	30.5%	1.9%	0.0%	20.0%	0.4%	5.8%	0.0%	100%
North Oconee River	1.1	4.9	14.0	328.7	348.5	48.3	20.0	318.0	0.0	0.0	1681.7	309.8	26.2	0.0	697.7	0.0	14.7	0.0	3813.6
WRD 1429	0.0%	0.1%	0.4%	8.6%	9.1%	1.3%	0.5%	8.3%	0.0%	0.0%	44.1%	8.1%	0.7%	0.0%	18.3%	0.0%	0.4%	0.0%	100%
North Oconee River	21.6	240.0	170.8	4257.1	3626.1	868.0	367.0	2404.8	41.8	0.0	28134.5	4534.9	393.2	0.0	16582.4	12.5	1856.6	43.4	63554.4
WRD 1285	0.0%	0.4%	0.3%	6.7%	5.7%	1.4%	0.6%	3.8%	0.1%	0.0%	44.3%	7.1%	0.6%	0.0%	26.1%	0.0%	2.9%	0.1%	100%
Redstone Creek	1.3	18.2	39.4	212.6	153.9	55.8	6.0	95.4	0.0	0.0	1490.7	242.4	22.7	0.0	1170.7	14.2	140.6	0.0	3664.0
WRD 1423	0.0%	0.5%	1.1%	5.8%	4.2%	1.5%	0.2%	2.6%	0.0%	0.0%	40.7%	6.6%	0.6%	0.0%	32.0%	0.4%	3.8%	0.0%	100%
Robinson Creek	3.6	138.1	0.0	771.5	451.2	72.1	18.9	643.8	0.0	0.0	3351.7	1709.1	192.6	0.0	3565.9	135.9	244.4	1.3	11300.1
WRD 1275	0.0%	1.2%	0.0%	6.8%	4.0%	0.6%	0.2%	5.7%	0.0%	0.0%	29.7%	15.1%	1.7%	0.0%	31.6%	1.2%	2.2%	0.0%	100%
Rock Creek	0.0	0.0	0.0	166.6	3.3	0.0	0.0	26.9	0.0	0.0	1375.3	1255.4	95.9	0.0	6.2	0.0	78.7	0.0	3008.3
WRD 1365	0.0%	0.0%	0.0%	5.5%	0.1%	0.0%	0.0%	0.9%	0.0%	0.0%	45.7%	41.7%	3.2%	0.0%	0.2%	0.0%	2.6%	0.0%	100%
Rooty Creek	7.1	34.5	21.8	366.3	276.7	115.0	60.3	164.1	0.0	0.0	1518.3	529.3	147.4	0.0	2052.5	285.6	22.0	8.5	5609.2
WRD 164	0.1%	0.6%	0.4%	6.5%	4.9%	2.0%	1.1%	2.9%	0.0%	0.0%	27.1%	9.4%	2.6%	0.0%	36.6%	5.1%	0.4%	0.2%	100%
South Sugar Creek	1.1	13.8	9.1	252.0	137.4	104.7	86.3	66.7	0.0	0.0	785.9	977.9	60.5	0.0	625.4	152.1	155.2	0.0	3428.2
WRD 1194	0.0%	0.4%	0.3%	7.3%	4.0%	3.1%	2.5%	1.9%	0.0%	0.0%	22.9%	28.5%	1.8%	0.0%	18.2%	4.4%	4.5%	0.0%	100%
Trail Creek	6.7	34.2	27.8	1238.1	1302.1	714.8	499.1	159.7	0.0	0.0	1900.8	837.8	227.3	0.0	884.9	99.0	205.7	3.3	8141.2
WRD 1222	0.1%	0.4%	0.3%	15.2%	16.0%	8.8%	6.1%	2.0%	0.0%	0.0%	23.3%	10.3%	2.8%	0.0%	10.9%	1.2%	2.5%	0.0%	100%
Turkey Creek	0.2	14.2	0.0	290.2	184.6	38.0	24.0	93.2	0.0	0.0	856.9	975.0	53.6	0.0	1560.1	46.3	335.6	0.0	4471.9
WRD 1425	0.0%	0.3%	0.0%	6.5%	4.1%	0.9%	0.5%	2.1%	0.0%	0.0%	19.2%	21.8%	1.2%	0.0%	34.9%	1.0%	7.5%	0.0%	100%
Walnut Creek	7.3	41.6	286.4	2435.7	2902.9	723.9	387.6	1007.2	0.2	0.0	10571.1	1331.0	132.1	276.4	4157.0	5.3	241.3	33.4	24540.6
WRD 1136	0.0%	0.2%	1.2%	9.9%	11.8%	2.9%	1.6%	4.1%	0.0%	0.0%	43.1%	5.4%	0.5%	1.1%	16.9%	0.0%	1.0%	0.1%	100%
Walnut Creek	2.0	18.5	176.6	850.7	903.6	416.8	300.7	281.6	0.0	0.0	4047.4	412.1	57.8	135.9	744.4	1.6	55.2	1.1	8405.6
WRD 1322	0.0%	0.2%	2.1%	10.1%	10.7%	5.0%	3.6%	3.3%	0.0%	0.0%	48.2%	4.9%	0.7%	1.6%	8.9%	0.0%	0.7%	0.0%	100%

Land Uses (acres)																			
Stream Segment and Station ID	**Beaches, Dunes, Mud**	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Developed, Low Intensity**	**Developed, Medium Intensity**	**Developed, High Intensity**	**Transitional, Clearcut, Sparse**	**Quarries, Strip Mines**	**Rock Outcrop**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture, Hay**	**Row Crops**	**Forested Wetlands**	**Non-Forested Wetlands (Freshwater)**	**Total**
West Fork Trail Creek	2.2	13.1	0.0	416.3	378.5	196.8	52.9	69.6	0.0	0.0	771.5	296.7	116.5	0.0	333.8	10.2	59.8	1.8	2719.9
WRD 1421	0.1%	0.5%	0.0%	15.3%	13.9%	7.2%	1.9%	2.6%	0.0%	0.0%	28.4%	10.9%	4.3%	0.0%	12.3%	0.4%	2.2%	0.1%	100%
Wheeler Creek	0.2	0.0	0.0	90.7	203.5	97.9	52.9	44.9	0.0	0.0	177.0	51.8	2.0	0.0	114.3	0.0	2.2	0.0	837.5
WRD 1296	0.0%	0.0%	0.0%	10.8%	24.3%	11.7%	6.3%	5.4%	0.0%	0.0%	21.1%	6.2%	0.2%	0.0%	13.6%	0.0%	0.3%	0.0%	100%
Wildcat Creek	1.1	5.8	0.0	249.5	63.6	23.1	4.7	53.2	0.0	0.0	1502.5	442.8	68.5	0.0	1310.6	74.3	30.5	0.0	3830.1
WRD 1299	0.0%	0.2%	0.0%	6.5%	1.7%	0.6%	0.1%	1.4%	0.0%	0.0%	39.2%	11.6%	1.8%	0.0%	34.2%	1.9%	0.8%	0.0%	100%
Southeastern Plains Ecoregion (65) - Supporting Stream Segments																			
Little Red Bluff Creek	4.9	18.9	0.0	440.3	300.0	107.0	35.4	765.7	0.0	0.0	1088.4	1595.0	330.5	0.0	1240.1	491.9	344.7	3.1	6768.4
WRD 250	0.1%	0.3%	0.0%	6.5%	4.4%	1.6%	0.5%	11.3%	0.0%	0.0%	16.1%	23.6%	4.9%	0.0%	18.3%	7.3%	5.1%	0.0%	100%
Turkey Creek	16.5	79.0	0.0	1261.4	388.1	76.1	27.8	1618.1	0.0	0.0	17179.1	10780.6	1179.1	0.0	4832.4	2242.9	3421.3	14.5	43123.0
WRD 1387	0.0%	0.2%	0.0%	2.9%	0.9%	0.2%	0.1%	3.8%	0.0%	0.0%	39.8%	25.0%	2.7%	0.0%	11.2%	5.2%	7.9%	0.0%	100%

Table 6. Hydrologic Soil Group Distribution for Fish Community Assessment Streams

Stream Segment	Station ID	A				B				C				D				Other	
		Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%
Piedmont Ecoregion (45) - Not Supporting Stream Segments																			
Beaverdam Creek	WRD 1270	0.0	0.0	0.00	0.00	2417.0	90.4	0.20	0.28	101.3	3.8	0.19	0.32	142.6	5.3	0.28	0.28	12.3	0.5
Bowden Creek	WRD 1258	0.0	0.0	0.00	0.00	4282.7	88.0	0.21	0.28	458.3	9.4	0.18	0.29	32.1	0.7	0.18	0.23	95.3	2.0
Cedar Creek (Clarke Co.)	WRD 1424	0.0	0.0	0.00	0.00	2565.1	95.3	0.08	0.34	86.1	3.2	0.24	0.26	28.3	1.1	0.28	0.28	12.9	0.5
Cedar Creek (Jasper Co.)	WRD 1274	0.0	0.0	0.00	0.00	15314.6	86.6	0.17	0.33	1900.6	10.8	0.13	0.31	8.4	0.0	0.26	0.26	452.1	2.6
Fishing Creek	WRD 1409	0.0	0.0	0.00	0.00	2761.4	89.6	0.10	0.35	309.3	10.0	0.18	0.29	0.2	0.0	0.23	0.23	11.2	0.4
Greenbrier Creek	WRD 1319	0.0	0.0	0.00	0.00	9701.1	92.2	0.08	0.34	651.5	6.2	0.22	0.29	141.4	1.3	0.18	0.29	28.3	0.3
Horse Branch	WRD 1326	0.0	0.0	0.00	0.00	1490.6	93.8	0.20	0.28	66.7	4.2	0.28	0.32	1.1	0.1	0.28	0.28	30.7	1.9
Kimbro Creek	WRD 618	0.0	0.0	0.00	0.00	1756.2	78.1	0.21	0.27	330.3	14.7	0.18	0.29	162.9	7.2	0.00	0.00	0.0	0.0
Lane Creek	WRD 1300	0.0	0.0	0.00	0.00	1267.8	88.1	0.17	0.34	109.4	7.6	0.24	0.26	12.5	0.9	0.28	0.28	49.8	3.5
Little Creek	WRD 1269	0.0	0.0	0.00	0.00	1992.3	91.5	0.20	0.28	167.3	7.7	0.17	0.32	5.0	0.2	0.28	0.28	11.9	0.5
Little River	WRD 1268	0.0	0.0	0.00	0.00	2238.8	93.3	0.02	0.34	151.7	6.3	0.22	0.27	0.0	0.0	0.00	0.00	10.2	0.4
Tributary to Little River (#2)	WRD 1329	0.0	0.0	0.00	0.00	1639.1	57.8	0.16	0.29	1183.3	41.7	0.08	0.29	0.0	0.0	0.00	0.00	13.3	0.5
Lowry Branch	WRD 1392	0.0	0.0	0.00	0.00	1214.7	96.1	0.25	0.28	49.5	3.9	0.31	0.31	0.0	0.0	0.00	0.00	0.0	0.0
Marburg Creek (aka Marbury Creek)	WRD 1320	0.0	0.0	0.00	0.00	15202.6	92.3	0.09	0.34	935.9	5.7	0.24	0.31	0.0	0.0	0.00	0.00	339.8	2.1
Tributary to Mulberry River	WRD 1430	0.0	0.0	0.00	0.00	2615.7	93.4	0.21	0.28	165.1	5.9	0.24	0.30	0.0	0.0	0.00	0.00	21.1	0.8
North Fork Wolf Creek	WRD 1366	0.0	0.0	0.00	0.00	6306.8	92.1	0.20	0.33	531.1	7.8	0.13	0.31	0.0	0.0	0.00	0.00	8.6	0.1
North Sugar Creek	WRD 1271	0.0	0.0	0.00	0.00	4545.7	89.6	0.20	0.28	458.1	9.0	0.19	0.32	19.4	0.4	0.28	0.28	49.8	1.0
Stewarts Creek	WRD 1257	0.0	0.0	0.00	0.00	3298.4	81.4	0.21	0.27	706.0	17.4	0.18	0.22	0.0	0.0	0.00	0.00	46.1	1.1

Stream Segment	Station ID	A				B				C				D				Other	
		Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%
Wildcat Creek	WRD 1373	0.0	0.0	0.00	0.00	637.4	93.3	0.08	0.34	34.3	5.0	0.26	0.26	11.0	1.6	0.28	0.28	0.5	0.1
Southeastern Plains Ecoregion (65) - Not Supporting Stream Segments																			
Buckeye Creek	WRD 1388	2451.8	10.1	0.10	0.21	17266.7	71.0	0.17	0.36	1384.7	5.7	0.17	0.29	2951.9	12.1	0.11	0.23	258.8	1.1
Piedmont Ecoregion (45) - Supporting Stream Segments																			
Allen Creek	WRD 668	0.0	0.0	0.000	0.000	7400.9	98.0	0.09	0.34	130.8	1.7	0.24	0.26	0	0.00	0.00	0.00	17	0.22
Apalachee River	WRD 96	47.7	0.0	0.100	0.115	146611.9	90.9	0.02	0.34	11633.6	7.2	0.17	0.32	1367	0.85	0.28	0.30	1641	1.02
Big Bear Creek	WRD 664	0.0	0.0	0.000	0.000	2949.7	98.8	0.21	0.34	24.2	0.8	0.24	0.24	0	0.00	0.00	0.00	12	0.40
Black Spring Branch	WRD 2	4.7	0.2	0.100	0.100	2001.0	86.9	0.18	0.30	285.0	12.4	0.08	0.29	0	0.00	0.00	0.00	12	0.53
Calls Creek	WRD 644	0.0	0.0	0.000	0.000	5357.9	96.9	0.17	0.34	92.8	1.7	0.24	0.26	23	0.42	0.29	0.29	53	0.96
Candler Creek	WRD 1428	0.0	0.0	0.000	0.000	6669.2	92.4	0.09	0.34	530.3	7.3	0.20	0.30	0	0.00	0.00	0.00	17	0.24
Cane Creek	WRD 1427	0.0	0.0	0.000	0.000	2123.3	99.9	0.21	0.34	0.0	0.0	0.00	0.00	0	0.00	0.00	0.00	3	0.14
Cedar Creek	WRD 12	0.0	0.0	0.000	0.000	859.6	91.9	0.17	0.28	76.2	8.1	0.28	0.31	0	0.00	0.00	0.00	0	0.00
Cedar Creek	WRD 667	0.0	0.0	0.000	0.000	6591.4	97.0	0.09	0.34	136.5	2.0	0.24	0.31	0	0.00	0.00	0.00	69	1.01
Copeland Creek	WRD 66	0.0	0.0	0.000	0.000	1106.7	36.5	0.08	0.49	559.3	18.4	0.18	0.20	1139	37.5	0.15	0.22	228	7.51
Crooked Creek	WRD 1325	0.0	0.0	0.000	0.000	9469.2	78.3	0.26	0.29	2308.2	19.1	0.08	0.29	51	0.42	0.29	0.29	260	2.15
East Sandy Creek	WRD 1372	0.0	0.0	0.000	0.000	4913.7	92.9	0.10	0.34	287.5	5.4	0.20	0.26	0	0.00	0.00	0.00	79	1.50
Floyd Creek trib	WRD 1381	0.0	0.0	0.000	0.000	1304.1	100	0.09	0.34	0.0	0.0	0.00	0.00	0	0.00	0.00	0.00	0	0.00
Hardeman Creek	WRD 1422	0.0	0.0	0.000	0.000	3363.2	90.0	0.09	0.34	312.1	8.4	0.24	0.31	0	0.00	0.00	0.00	60	1.62
Hog Creek	WRD 1273	0.0	0.0	0.000	0.000	11831.4	89.8	0.18	0.30	1006.3	7.6	0.08	0.29	218	1.66	0.29	0.29	118	0.89
Indian Creek	WRD 1323	0.0	0.0	0.000	0.000	4711.2	88.1	0.18	0.34	584.5	10.9	0.24	0.30	0	0.00	0.00	0.00	49	0.91
Indian Creek	WRD 1432	0.0	0.0	0.000	0.000	3473.0	89.8	0.02	0.28	348.1	9.0	0.19	0.30	11	0.29	0.28	0.30	37	0.95
Little Indian Creek trib	WRD 1410	0.0	0.0	0.000	0.000	1474.5	88.5	0.20	0.28	161.6	9.7	0.17	0.32	0	0.00	0.00	0.00	29	1.77

Stream Segment	Station ID	A				B				C				D				Other	
		Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%
Little Mullberry River	WRD 1383	0.0	0.0	0.000	0.000	9004.4	91.4	0.09	0.34	754.5	7.7	0.16	0.31	26	0.26	0.04	0.29	72	0.73
Little River	WRD 1333	0.0	0.0	0.000	0.000	4211.3	93.3	0.02	0.34	281.2	6.2	0.22	0.27	3	0.08	0.25	0.25	20	0.44
Little Sandy Creek	WRD 1324	0.0	0.0	0.000	0.000	6312.0	90.6	0.02	0.34	469.9	6.7	0.17	0.32	114	1.64	0.28	0.30	71	1.02
Log Dam Creek	WRD 7	481.4	17.8	0.093	0.093	1397.6	51.8	0.17	0.49	433.4	16.1	0.18	0.22	152	5.62	0.15	0.22	235	8.70
Lollis Creek	WRD 1431	0.0	0.0	0.000	0.000	5825.6	94.9	0.09	0.34	211.7	3.4	0.21	0.31	0	0.00	0.00	0.00	104	1.70
Mulberry Creek	WRD 669	0.0	0.0	0.000	0.000	5793.0	97.9	0.09	0.34	115.9	2.0	0.26	0.26	0	0.00	0.00	0.00	8	0.13
Murder Creek	WRD 101	0.0	0.0	0.000	0.000	75499.0	90.3	0.13	0.34	7123.8	8.5	0.13	0.31	120	0.14	0.25	0.26	714	0.85
North Oconee River	WRD 1429	0.0	0.0	0.000	0.000	3729.0	97.8	0.09	0.34	68.5	1.8	0.24	0.26	0	0.00	0.00	0.00	14	0.37
North Oconee River	WRD 1285	0.0	0.0	0.000	0.000	58918.6	92.7	0.09	0.34	4368.5	6.9	0.20	0.31	0	0.00	0.00	0.00	263	0.41
Redstone Creek	WRD 1423	0.0	0.0	0.000	0.000	3530.6	96.4	0.09	0.34	104.2	2.8	0.24	0.30	0	0.00	0.00	0.00	29	0.80
Robinson Creek	WRD 1275	0.0	0.0	0.000	0.000	10640.4	94.1	0.08	0.34	507.1	4.5	0.24	0.26	15	0.13	0.28	0.29	140	1.24
Rock Creek	WRD 1365	0.0	0.0	0.000	0.000	2896.2	96.3	0.26	0.29	106.9	3.6	0.08	0.28	0	0.00	0.00	0.00	3	0.10
Rooty Creek	WRD 164	0.0	0.0	0.000	0.000	4021.1	71.7	0.16	0.29	1360.3	24.3	0.08	0.29	113	2.01	0.29	0.29	114	2.04
South Sugar Creek	WRD 1194	0.0	0.0	0.000	0.000	3140.8	91.6	0.20	0.28	267.5	7.8	0.17	0.32	0	0.00	0.00	0.00	22	0.63
Trail Creek	WRD 1222	4.6	0.1	0.115	0.115	7565.0	92.9	0.08	0.34	354.9	4.4	0.24	0.26	79	0.98	0.28	0.29	137	1.68
Turkey Creek	WRD 1425	0.0	0.0	0.000	0.000	4021.8	89.9	0.02	0.34	399.9	8.9	0.22	0.30	20	0.44	0.28	0.30	31	0.68
Walnut Creek	WRD 1136	0.0	0.0	0.000	0.000	23875.6	97.3	0.09	0.34	546.0	2.2	0.24	0.31	0	0.00	0.00	0.00	115	0.47
Walnut Creek	WRD 1322	0.0	0.0	0.000	0.000	8206.4	97.6	0.09	0.34	159.4	1.9	0.26	0.26	0	0.00	0.00	0.00	39	0.47
West Fork Trail Creek	WRD 1421	0.0	0.0	0.000	0.000	2501.2	92.0	0.17	0.34	155.2	5.7	0.24	0.26	31	1.15	0.28	0.29	32	1.19
Wheeler Creek	WRD 1296	0.0	0.0	0.000	0.000	759.1	90.6	0.09	0.34	50.7	6.1	0.21	0.31	4.5	0.5	0.28	0.28	23.2	2.8
Wildcat Creek	WRD 1299	26.7	0.7	0.115	0.115	3704.4	96.8	0.08	0.34	72.8	1.9	0.24	0.26	13.0	0.3	0.28	0.28	10.9	0.3

Stream Segment	Station ID	A				B				C				D				Other	
		Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%
Southeastern Plains Ecoregion (65) - Supporting Stream Segments																			
Little Red Bluff Creek	WRD 250	1296.9	19.2	0.13	0.1	2690.7	39.75	0.2	0.3	1036.8	15.3	0.1	0.31	128.0	1.9	0.26	0.3	1615.8	23.9
Turkey Creek	WRD 1387	7643.2	17.7	0.10	0.2	26443.9	61.32	0.2	0.4	3134.8	7.3	0.2	0.29	5645.5	13.1	0.10	0.3	210.7	0.5

2) WATER QUALITY ASSESSMENT

2.1 Fish Community Sampling

The GA WRD conducted studies of fish community populations at a number of monitoring sites in the Oconee River Basin. Biological monitoring of fish communities is a method used to evaluate the health of a biological system to assess degradation from various sources, both point and nonpoint. GA WRD's biological monitoring of fish communities is based on direct observations of the aquatic communities within a stream. The results of these studies were the basis for the listings of Biota Impacted - Fish Community stream segments on Georgia's 303(d) list.

The work performed by the GA WRD consisted of looking at patterns of fish communities within the various ecoregions in Georgia. From this, GA WRD has established reference sampling sites within each ecoregion. These sampling sites represent the least impacted sites that exist given the prevalent land use within the ecoregion.

Of all the sampling sites GA WRD evaluated in the Oconee River Basin, forty-one (41) least impacted sites were used in this TMDL evaluation. Tables 7, 8, and 9 provide the data collected during the field investigations and subsequent laboratory analysis. All sampling sites had to be accessible, wadeable, and representative of the stream under investigation. The length of each fish sampling site was thirty-five times the mean stream width, up to a maximum length of 500 meters. This sampling length has been found to be long enough to include the major habitat types present. Electrofishing and seining techniques were used for sampling the fish population (GA WRD, 2005a).

From the data collected, two indices of fish community health were established and used to assess the biotic integrity of the aquatic systems: the Index of Biotic Integrity (IBI) and the modified Index of Well-Being (IWB). The IBI and IWB numerical scores were developed by analyzing field data collected at each sampling site according to ecoregion-specific scoring criteria developed by GA WRD. These numerical scores were further classified into the integrity classes of Excellent, Good, Fair, Poor, or Very Poor.

The IBI assesses the biotic integrity of aquatic communities based on the functional and compositional attributes of the fish community. The IBI consists of twelve measurements or metrics that assess three facets of the fish population: 1) species richness and composition, 2) trophic composition and dynamics, and 3) fish abundance and condition. For each sampling site, each metric is calculated by comparing the site value of a particular scoring criterion to that of the regional reference site. Factors that affect the structure and function of a fish community include stream location and size. Thus, the metrics were developed for ecoregional drainage basins. To account for the fact that streams with larger drainage basins normally have greater species richness, Maximum Species Richness plots were developed for the species richness metrics.

The modified IWB measures the health of the aquatic community based on the abundance and diversity of the fish community. The IWB is calculated based on four parameters: 1) the relative density of fish, 2) the relative biomass of fish, 3) the Shannon-Wiener Index of Diversity based on number, and 4) the Shannon-Wiener Index of Diversity based on biomass (GA WRD, 2005b). As of April 2013, the modified IWB is no longer calculated or used for listing assessment decisions. This has resulted in all streams receiving an IBI rating of Fair being placed in the supporting designated use list.

Table 7 summarizes GA WRD's fish community study scores. The IBI and Habitat Assessment scores are listed for each study watershed and are grouped according to supporting or not supporting status. In addition, the table includes the drainage areas upstream of the monitoring sites and the county in which the monitoring sites are located.

To supplement the findings of the fish community data, visual habitat assessments were performed at each sampling site. Habitat scores evaluate the in-stream habitat, morphology, and riparian characteristics of a stream as they affect and influence the quality of the water resource and its resident aquatic community. These scores may help clarify the results of the biotic indices. The visual habitat assessment was developed by personnel within the Watershed Protection Branch (WPB) of GA EPD and is a modification of the USEPA Rapid Bioassessment Protocol (GAWPB, 2000). It incorporates different assessment parameters for riffle/run prevalent streams and glide/pool prevalent streams. In Georgia, streams in the Blue Ridge, Piedmont, Ridge and Valley, and Southwestern Appalachian ecoregions are considered riffle/run prevalent streams, while streams in the Southeastern Plains and Southern Coastal Plain ecoregions are considered glide/pool prevalent streams.

The visual habitat assessment evaluates the stream's physical parameters and is broken into three levels. Level one describes in-stream characteristics that directly affect biological communities (bottom substrate / available cover, pool substrate characterization, and pool variability). Level two describes the channel morphology (channel sinuosity, channel alteration, sediment deposition, and channel flow status). Level three describes the riparian zone surrounding the stream that indirectly affects the type of habitat and food resources available in the stream (bank vegetative protection, bank stability, and riparian vegetation zone width). Table 8 provides detailed habitat assessment scores for both supporting and not supporting streams.

During the fish community studies, physical characteristics of the stream were measured at the monitoring sites. These characteristics included the number of pools, depth of the deepest pool, number of bends, average stream depth, and average stream width. In addition, water quality measurements were taken at the time of the fish sampling. The parameters measured included water temperature, dissolved oxygen, conductivity, pH, turbidity, total hardness, and alkalinity. Table 9 provides a summary of these field measurements.

Table 7. GA WRD Fish Community Study Scores

Stream Name	GAWRD Site ID	Drainage Area upstream from the monitoring point (sq miles)	County	Sampling Date	IBI Score	IBI Category	Habitat Score Total (Max: 200)
Piedmont Ecoregion – Not Supporting Stream Segments							
Beaverdam Creek	1270	4.17	Morgan	9/21/2012	28	Poor	88.7
Bowden Creek	1258	7.61	Greene	8/29/2012	12	Very Poor	64
Cedar Creek (Clarke Co.)	1424	4.21	Clarke	9/20/2017	24	Very Poor	93.7
Cedar Creek (Jasper Co.)	1274	27.60	Jasper	9/27/2012	28	Poor	69
Fishing Creek	1409	4.81	Oglethorpe	7/18/2017	18	Very Poor	76.7
Greenbrier Creek (aka Greenbriar Creek)	1319	16.43	Greene	9/3/2015	28	Poor	82
Horse Branch	1326	2.48	Morgan	10/13/2015	30	Poor	115.8
Kimbro Creek	618	3.51	Greene	5/28/2003	40	Fair	73.3
Kimbro Creek	618	3.51	Greene	7/12/2016	30	Poor	67.3
Lane Creek	1300	2.25	Oconee	8/29/2013	26	Poor	84.2
Little Creek	1269	3.40	Morgan	9/21/2012	12	Very Poor	63.2
Little River	1268	3.75	Walton	9/20/2012	28	Poor	75
Tributary to Little River (#2)	1329	4.43	Putnam	10/14/2015	26	Poor	90.7
Lowry Branch	1392	1.97	Jasper	5/9/2017	30	Poor	94.3
Marburg Creek (aka Marbury Creek)	1320	25.73	Barrow	9/3/2015	22	Very Poor	70.3
Tributary to Mulberry River	1430	4.37	Jackson	10/18/2017	20	Very Poor	69
North Fork Wolf Creek	1366	10.69	Jasper	7/14/2016	24	Very Poor	66.9
North Sugar Creek	1271	7.92	Morgan	9/21/2012	24	Very Poor	79.8
Stewarts Creek	1257	6.33	Greene	8/29/2012	22	Very Poor	92.7
Stewarts Creek	1257	6.33	Greene	7/13/2016	32	Poor	81.4
Wildcat Creek	1373	1.07	Oconee	8/11/2016	32	Poor	91
Southeastern Plains Ecoregion – Not Supporting Stream Segments							
Buckeye Creek	1388	37.99	Laurens	9/29/2016	30	Poor	95.3
Piedmont Ecoregion - Supporting Stream Segments							
Allen Creek	668	11.79	Hall	8/27/2003	44	Good	88.9
Apalachee River	96	251.86	Morgan	9/17/1999	56	Excellent	131
Apalachee River	96	251.86	Morgan	10/5/2000	54	Excellent	144.7
Apalachee River	96	251.86	Morgan	10/4/2001	52	Excellent	116.1
Big Bear Creek	664	4.66	Barrow	8/7/2003	48	Good	55.1

Stream Name	GAWRD Site ID	Drainage Area upstream from the monitoring point (sq miles)	County	Sampling Date	IBI Score	IBI Category	Habitat Score Total (Max: 200)
Black Spring Branch	2	3.60	Baldwin	4/20/1999	48	Good	92.8
Calls Creek	644	8.63	Oconee	8/11/2016	48	Good	108
Candler Creek	1428	11.27	Jackson	10/17/2017	48	Good	83
Cane Creek	1427	3.32	Jackson	10/17/2017	56	Excellent	109
Cedar Creek	12	1.46	Jasper	4/21/1999	48	Good	81.3
Cedar Creek	667	10.61	Barrow	8/14/2003	48	Good	139.7
Cedar Creek	667	10.61	Barrow	5/29/2007	44	Good	130.1
Cedar Creek	667	10.61	Barrow	9/14/2016	48	Good	130.2
Copeland Creek	66	4.74	Hancock	8/24/1998	48	Good	128
Copeland Creek	66	4.74	Hancock	7/15/1999	58	Excellent	116.9
Copeland Creek	66	4.74	Hancock	9/19/2000	50	Good	130.9
Copeland Creek	66	4.74	Hancock	9/6/2001	48	Good	107
Copeland Creek	66	4.74	Hancock	10/1/2002	44	Good	103.4
Copeland Creek	66	4.74	Hancock	9/24/2015	40	Fair	132
Copeland Creek	66	4.74	Hancock	7/12/2016	46	Good	103.2
Crooked Creek	1325	18.88	Putnam	9/24/2015	46	Good	101.7
East Sandy Creek	1372	8.26	Clarke	8/10/2016	48	Good	82.4
Floyd Creek trib	1381	2.04	Hall	9/13/2016	48	Good	110
Hardeman Creek	1422	5.83	Jackson	9/19/2017	48	Good	115
Hog Creek	1273	20.57	Jones	9/27/2012	44	Good	78
Indian Creek	1323	8.34	Jackson	9/23/2015	48	Good	109.6
Indian Creek	1432	6.04	Walton	10/25/2017	52	Excellent	139.7
Little Indian Creek trib	1410	2.60	Morgan	7/19/2017	50	Good	72.3
Little Mullberry River	1383	15.39	Barrow	9/15/2016	44	Good	77.5
Little River	1333	7.05	Newton	10/23/2015	44	Good	84.3
Little Sandy Creek	1324	10.88	Morgan	9/23/2015	50	Good	142.7
Log Dam Creek	7	4.22	Hancock	4/19/1999	44	Good	108.6
Lollis Creek	1431	9.59	Hall	10/19/2017	52	Excellent	79.5
Mulberry Creek	669	9.24	Hall	8/27/2003	44	Good	72.3
Mulberry Creek	669	9.24	Hall	9/15/2016	50	Good	85.7
Murder Creek	101	130.54	Jasper	9/21/1999	50	Good	56.1
Murder Creek	101	130.54	Jasper	9/12/2013	46	Good	70.7
North Oconee River	1429	5.95	Hall	10/18/2017	52	Excellent	144.3

Stream Name	GAWRD Site ID	Drainage Area upstream from the monitoring point (sq miles)	County	Sampling Date	IBI Score	IBI Category	Habitat Score Total (Max: 200)
North Oconee River	1285	99.23	Jackson	10/18/2012	46	Good	94
Redstone Creek	1423	5.72	Jackson	9/19/2017	46	Good	115
Robinson Creek	1275	17.65	Oconee	9/28/2012	46	Good	92.3
Rock Creek	1365	4.69	Putnam	7/14/2016	48	Good	110.4
Rooty Creek	164	8.76	Putnam	10/14/2015	44	Good	73
South Sugar Creek	1194	5.36	Morgan	5/20/2010	46	Good	73.8
Trail Creek	1222	12.72	Clarke	5/24/2011	48	Good	88
Turkey Creek	1425	6.98	Walton	9/20/2017	46	Good	86.2
Walnut Creek	1136	38.31	Jackson	10/22/2008	44	Good	79.7
Walnut Creek	1322	13.12	Hall	9/22/2015	46	Good	114.3
West Fork Trail Creek	1421	4.25	Clarke	9/19/2017	44	Good	83.2
Wheeler Creek	1296	1.31	Gwinnett	7/2/2013	46	Good	100
Wildcat Creek	1299	5.98	Oconee	8/11/2016	46	Good	93.7
Southeastern Plains Ecoregion - Supporting Stream Segments							
Little Red Bluff Creek	250	10.58	Treutlen	4/12/2000	44	Good	120.7
Turkey Creek	1387	67.36	Laurens	9/29/2016	46	Good	113.3

Table 8. GA WRD Fish Community Habitat Assessment Scores - High Gradient Streams

Stream Name	GAWRD Site ID	Sampling Date	Instream Epifauna	Instream Cover	Epifauna Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Score Total (Max: 200)
Piedmont Ecoregion – Not Supporting Stream Segments																		
Beaverdam Creek	1270	9/21/2012	10.3	0	0	9	5.7	12	14	5	4	4.3	4.3	2.3	2.3	7.3	8	88.7
Bowden Creek	1258	8/29/2012	7	0	0	7.3	3.7	0	14	3.3	4	4	4	2.7	2.7	7	4.3	64
Cedar Creek (Clarke Co.)	1424	9/20/2017	7.7	0	0	15	2	13	15.7	4.3	9.7	3.7	4	2.2	2.2	6.3	8	93.7
Cedar Creek (Japser Co.)	1274	9/27/2012	9.7	0	0	8	2	0	15	1.7	3.3	5	5	3	3	6.7	6.7	69
Fishing Creek	1409	7/18/2017	6	0	0	8.7	2.7	0	14	3.7	11	4	3.3	3	2.3	9	9	76.7
Greenbrier Creek (aka Greenbriar Creek)	1319	9/3/2015	5.3	0	0	9	1.3	0	16	1	15	6	6	2.7	3	8.3	8.3	82
Horse Branch	1326	10/13/2015	15	0	0	13.7	5.1	15	14.7	6.7	15	4.3	5.3	3.7	4	5.3	8	115.8
Kimbro Creek	618	5/28/2003	5.1	0	0	8.1	2	0	15.9	3.1	8.3	3.1	2.9	4.8	3.9	7.2	8.8	73.3
Kimbro Creek	618	7/12/2016	5.7	0	0	10	2.7	0	9.7	1.7	9	4.5	4.7	3.5	4.2	3.8	8	67.3
Lane Creek	1300	8/29/2013	9.3	0	0	9	6.5	2	13.7	5	12.3	7	6.7	2.8	2.5	4.7	2.7	84.2
Little Creek	1269	9/21/2012	3.7	0	0	4.3	1.8	0	15.7	2	3.7	4.3	5	3.3	3.3	7.3	8.7	63.2
Little River	1268	9/20/2012	5.7	0	0	7	7	0	14.3	7	9	3.7	3.7	2	2	5.3	8.3	75
Tributary to Little River (#2)	1329	10/14/2015	4	0	0	12	2	0	15.7	1	16	8	8	2.3	2	10	9.7	90.7
Lowry Branch	1392	5/9/2017	9	0	0	10.3	5.3	0	17	6.7	13.3	4.3	4.2	3.5	4.3	8.7	7.7	94.3
Marburg Creek (aka Marbury Creek)	1320	9/3/2015	7.3	0	0	8.3	2.7	0	8.3	3.5	15.3	4.3	6.7	2.3	2.3	3.3	5.8	70.3
Tributary to Mulberry River	1430	10/18/2017	5.3	0	0	12.7	0.7	0	16	2.3	17	3.7	3.7	2	2.3	1.7	1.7	69
North Fork Wolf Creek	1366	7/14/2016	10	0	0	10	2.3	0	16	3.7	9	2.3	2.1	1.8	2.1	3.8	3.8	66.9

Stream Name	GAWRD Site ID	Sampling Date	Instream Epifauna	Instream Cover	Epifauna Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Score Total (Max: 200)
North Sugar Creek	1271	9/21/2012	10.3	0	0	10.2	4	0	14	2.3	7.7	4.7	4.7	3.7	3.3	8	7	79.8
Stewarts Creek	1257	8/29/2012	11.7	0	0	9.3	5	2	13.7	3.7	6.3	7	7.3	4.7	5.7	8.3	8	92.7
Stewarts Creek	1257	7/13/2016	7.3	0	0	10	4	0	16.3	2.3	9.3	3.4	4.2	3.2	3.9	8.7	8.7	81.4
Wildcat Creek	1373	8/11/2016	10	0	0	10	5	10	16.7	4	7	3.9	4.9	2.9	3.2	4.3	9	91
Southeastern Plains Ecoregion – Not Supporting Stream Segments																		
Buckeye Creek	1388	9/29/2016	0	0	0	0	0	0	18	6.3	6	3.7	3.7	4.2	4.2	8.3	6.7	95.3
Piedmont Ecoregion - Supporting Stream Segments																		
Allen Creek	668	8/27/2003	12.1	0	0	14.4	7.7	9	13.8	6.9	11.1	2.7	1.9	2.4	2.3	1.4	3.1	88.9
Apalachee River	96	9/17/1999		16	8.6		13	20	17.8	9.2	7.5	5	6.5	6.3	7.5	6	8.2	131
Apalachee River	96	10/5/2000		17	13.6		12.3	19	16.8	12.3	12.4	6.1	6.3	7.1	7.3	5.3	8.8	144.7
Apalachee River	96	10/4/2001	15.2	0	0	12.5	12.3	0	15.9	10.1	11	5.9	5.9	6.2	5.8	7.1	8.2	116.1
Big Bear Creek	664	8/7/2003	5.6	0	0	9.7	2.2	0	13.1	3.7	9.5	2.3	2.3	2.7	3	0.7	0.5	55.1
Black Spring Branch	2	4/20/1999		10	9.5		4.7	10	14.2	3.9	8.8	3.9	4.4	3.3	3.6	8.3	8.3	92.8
Calls Creek	644	8/11/2016	12.3	0	0	10	7.7	19	18	6	9.3	5	5	2.2	2.2	5.7	5.7	108
Candler Creek	1428	10/17/2017	13	0	0	15	4.7	0	14	7	11	3	4	2.3	2.7	1.7	4.7	83
Cane Creek	1427	10/17/2017	13.3	0	0	15	9.3	12	16.7	9.7	9.3	6.3	3.3	3.3	1.7	7.3	1.7	109
Cedar Creek	12	4/21/1999		5	9.6		2.5	6.5	15.9	3	8.5	3.6	3.6	3.6	3.7	7.3	8.3	81.3
Cedar Creek	667	8/14/2003	14.9	0	0	12.4	12.6	19	16.7	9.3	13.6	6.8	6.7	6.9	6.1	7	7.6	139.7
Cedar Creek	667	5/29/2007	13.9	0	0	12.9	12.1	19	18	9.4	10.1	4.2	3.6	6.5	5.8	6.9	7.8	130.1
Cedar Creek	667	9/14/2016	15.7	0	0	10	7.3	19	17.7	8.8	13.7	5.7	5.7	6.3	6.7	7.7	6	130.2

Stream Name	GAWRD Site ID	Sampling Date	Instream Epifauna	Instream Cover	Epifauna Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Score Total (Max: 200)
Copeland Creek	66	8/24/1998		10	15		16.7	15	10.7	12	12.7	6.3	5.7	5.3	5	9	4.3	128
Copeland Creek	66	7/15/1999		9	9		11.8	19	16.3	10.2	11.3	3.9	3.3	4.8	3.9	8.9	5.7	116.9
Copeland Creek	66	9/19/2000		8	11.4		14.2	18	16.3	14.2	7.9	6.2	5.8	6.1	6.2	8.8	7.8	130.9
Copeland Creek	66	9/6/2001	9.8	0	0	10.3	12.7	14	15.9	10.3	6.3	2.9	1.8	2.7	2.5	9.6	8.2	107
Copeland Creek	66	10/1/2002	9.2	0	0	9.8	9.3	14	17.3	7.5	7.4	2.2	1.7	3.6	3.2	9.4	9.2	103.4
Copeland Creek	66	9/24/2015	17.3	0	0	14.3	10.7	15	15.7	7.3	15.7	6	6.7	2.7	3.7	8	9	132
Copeland Creek	66	7/12/2016	12.7	0	0	10	7	12	15.7	5.5	12	3	3.7	3	4.2	5.8	8.7	103.2
Crooked Creek	1325	9/24/2015	14.3	0	0	14.7	6.7	0	16	3.7	14.3	6.7	7.3	4	2.3	5	6.7	101.7
East Sandy Creek	1372	8/10/2016	12.7	0	0	12.3	3.3	12	10.7	3.7	5	3.6	3.4	2.7	3.3	9	0.7	82.4
Floyd Creek trib	1381	9/13/2016	13.3	0	0	10	8	15	17.7	6.7	7	5	5.3	2.7	2.7	8	8.7	110
Hardeman Creek	1422	9/19/2017	14	0	0	14.7	10.7	14	16.7	9	11.3	5.3	2	4.3	3.3	8.3	1.3	115
Hog Creek	1273	9/27/2012	11.7	0	0	9.3	4.7	2	16	3.3	5.7	4.2	4.2	2.7	2.7	8	3.7	78
Indian Creek	1323	9/23/2015	14.3	0	0	15	7.7	13	13.7	4.3	16.3	3.7	7	2	2.2	1.3	9	109.6
Indian Creek	1432	10/25/2017	13.3	0	0	10	15	17	18.3	12	13.7	5.3	5.3	6.7	6.7	7.7	8.7	139.7
Little Indian Creek trib	1410	7/19/2017	12.3	0	0	12	4.3	0	16	4	10.7	3.2	3.2	1.3	1.3	2.3	1.7	72.3
Little Mullberry River	1383	9/15/2016	10.3	0	0	9.3	4	0	16	2.7	7	2.3	2.8	2.7	2.3	8.7	9.3	77.5
Little River	1333	10/23/2015	11	0	0	9.3	4	0	16	1.7	12.7	4.3	4.7	3.3	3.3	6.7	7.3	84.3
Little Sandy Creek	1324	9/23/2015	16.7	0	0	18	5	20	16	4.7	12	8.7	8.7	7	6.7	9.7	9.7	142.7
Log Dam Creek	7	4/19/1999		10	10.7		8.7	18	14	9.2	8.7	5.4	6	5.2	4.6	5.6	2.3	108.6
Lollis Creek	1431	10/19/2017	9.3	0	0	14.3	3.2	0	12	5.3	13	3.7	4	4	4	3	3.7	79.5

Stream Name	GAWRD Site ID	Sampling Date	Instream Epifauna	Instream Cover	Epifauna Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Score Total (Max: 200)
Mulberry Creek	669	8/27/2003	6.7	0	0	9.8	3.5	14	13.9	3	7.3	2.4	2	2.4	1.9	0.9	4.9	72.3
Mulberry Creek	669	9/15/2016	14.7	0	0	13	4.7	7	12.3	5.3	7.3	4	3.7	2.3	2	4.3	5	85.7
Murder Creek	101	9/21/1999		7	2		1.2	0	15.3	4.7	6.1	2.6	2	1.9	1.5	8.7	3.4	56.1
Murder Creek	101	9/12/2013	9	0	0	13.3	3	0	10.7	2	9	3.7	3.3	2.3	1.3	7	6	70.7
North Oconee River	1429	10/18/2017	18	0	0	17.3	12.7	14	19.3	11.3	10.3	6.1	6.9	6.3	7.7	4.9	9.3	144.3
North Oconee River	1285	10/18/2012	11	0	0	17	3.3	0	15.3	1.3	12	6	6	2	2	9	9	94
Redstone Creek	1423	9/19/2017	13.3	0	0	13	7	19	17	4	10.7	5.7	4.3	4.2	2.8	5	9	115
Robinson Creek	1275	9/28/2012	13	0	0	11	7.3	0	16	5.3	4.3	5.7	5.7	2.7	3	9.3	9	92.3
Rock Creek	1365	7/14/2016	16.7	0	0	10	9.3	14	17.3	9	8.3	2.5	1.6	2.1	1.6	9	9	110.4
Rooty Creek	164	10/14/2015	4.3	0	0	12.3	2	0	12	1.7	18	6	5.3	1.7	1.7	4	4	73
South Sugar Creek	1194	5/20/2010	11.7	0	0	10	3.4	2	13.7	3.3	9	4.7	4.3	3	2.7	2.3	3.7	73.8
Trail Creek	1222	5/24/2011	13	0	0	11	7	0	6	7	7	9	5	8	3	8	4	88
Turkey Creek	1425	9/20/2017	13.3	0	0	15	4.8	0	16	4	11.7	3.3	2.3	2.3	2	9	2.3	86.2
Walnut Creek	1136	10/22/2008	9.3	0	0	11	4	8	13.7	3.3	7	2.8	3.3	2.2	2.2	5.5	7.3	79.7
Walnut Creek	1322	9/22/2015	14	0	0	16.3	5.7	20	12.7	5.3	11.7	5.3	5.7	2	2	5	8.7	114.3
West Fork Trail Creek	1421	9/19/2017	10.7	0	0	10	3.2	0	15	5	12.7	5.7	5.5	5.8	5	2.5	2.2	83.2
Wheeler Creek	1296	7/2/2013	9.3	0	0	12.7	7.7	11	14.7	4.3	11.7	4.7	4.7	3.8	4.5	2.3	8.7	100
Wildcat Creek	1299	8/11/2016	10.3	0	0	9.7	3	0	16	4	6.3	6.7	6.2	6.7	6.5	9.3	9	93.7
Southeastern Plains Ecoregion - Supporting Stream Segments																		
Little Red Bluff Creek	250	4/12/2000		0	0		0	0	14.3	13.9	14.2	6.7	7.3	7	7.6	9.4	5	120.7

Stream Name	GAWRD Site ID	Sampling Date	Instream Epifauna	Instream Cover	Epifauna Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Score Total (Max: 200)
Turkey Creek	1387	9/29/2016	0	0	0	0	0	0	17.3	6.3	5.7	3.8	4.2	5	4.7	8.7	8.7	113.3

Table 9. GA WRD Fish Community Field Measurements

Stream Name	GAWRD Site ID	Sampling Date	Sampling Reach Length (m)	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)	# of Individual Fish
Piedmont Ecoregion – Not Supporting Stream Segments																
Beaverdam Creek	1270	9/21/2012	91	2.6	0.1	0	0	3	19.2	7.8	82.5	7	4.89	26	30	174
Bowden Creek	1258	8/29/2012	63	1.78	0.04	0	0	0	23.8	7.2	66.6	7	4.35	17	35	35
Cedar Creek (Clarke Co.)	1424	9/20/2017	146	4.19	0.11	2	0.6	2	20.3	6.92	69.2	7	4.53	23	30	413
Cedar Creek (Jasper Co.)	1274	9/27/2012	112	3.19	0.08	0	0	0	20.4	6.1	131.7	7.5	7.79	68.4	80	184
Fishing Creek	1409	7/18/2017	148	4.24	0.08	0		0	23.4	6.8	156.2	7	16.1	39	60	21
Greenbrier Creek (aka Greenbriar Creek)	1319	9/3/2015	220	6.29	0.1	2	0.71	0	21.3	7.13	74.2	7.01	17.4	27	25	204
Horse Branch	1326	10/13/2015	147	4.15	0.15	0		5	19.36	6.62	150	6.31	7.99	28	33	315
Kimbro Creek	618	5/28/2003	135	3.9	0.21	2	0.64	0	19	8.7	36	6.5	9.5	10	20	225
Kimbro Creek	618	7/12/2016	105	3.02	0.08	0		0	25.1	6.3	51.4	7	3.62	11	20	156
Lane Creek	1300	8/29/2013	102	2.92	0.12	1	0.55	1	24.5	6	58.1	7	21.1	18	25	117
Little Creek	1269	9/21/2012	77	2.2	0.09	0	0	0	18.9	8	83.8	7	3.8	27	50	5
Little River	1268	9/20/2012	102	2.94	0.09	0	0	0	20.7	8	289	7.5	4.09	24	30	235
Tributary to Little River (#2)	1329	10/14/2015	74	2.14	0.07	0	-	0	16.41	8.43	178	6.85	7.34	49	48	207
Lowry Branch	1392	5/9/2017	93	2.65	0.06	1	0.61	1	16.6	9.47	57.4	7	4.11	3	25	135
Marburg Creek (aka Marbury Creek)	1320	9/3/2015	262	7.48	0.12	1	0.8	0	23.8	6.84	84.3	7.17	7.1	23	25	185
Tributary to Mulberry River	1430	10/18/2017	83	2.36	0.3	4	0.82	0	14.6	9.5	95.9	7	5.53	34	40	52
North Fork Wolf Creek	1366	7/14/2016	105	2.99	0.09	2	0.97	0	24.5	6.48	111.1	7.5	-	39	50	186
North Sugar Creek	1271	9/21/2012	107	2.78	0.11	0	0	0	21.1	7.6	131.9	7	7.46	33	40	355
Stewarts Creek	1257	8/29/2012	101	2.85	0.11	2	0.8	1	24.4	6.7	68	7	4.56	19	35	435

Stream Name	GAWRD Site ID	Sampling Date	Sampling Reach Length (m)	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)	# of Individual Fish
Stewarts Creek	1257	7/13/2016	105	2.97	0.08	1	0.6	0	22.8	6.85	64.3	7	2.77	15	25	532
Wildcat Creek	1373	8/11/2016	85	2.4	0.12	1	0.5	3	22.7	7.32	56.2	7	6.79	11	20	326
Southeastern Plains Ecoregion – Not Supporting Stream Segments																
Buckeye Creek	1388	9/29/2016	116	3.34	0.2	2	0.95	-	23.3	7.7	106.6	7.5	5.08	42	35	243
Piedmont Ecoregion - Supporting Stream Segments																
Allen Creek	668	8/27/2003	254	7.27	0.34	14	1.25	2	22.2	8.02	84	7.25	6.65	34.2	30	478
Apalachee River	96	9/17/1999	500	24.48	0.43	5	1.5	3	18.1	7.72	78.5	7.3	7.9	16	30	3560
Apalachee River	96	10/5/2000	500	34.72	0.57	13	2	3	18.1	9.14	68.1	7.5	8.62	20	30	4545
Apalachee River	96	10/4/2001	500	34.14	0.64	4	2	1	-	-	-	-	-	-	-	2659
Big Bear Creek	664	8/7/2003	182	5.21	0.16	1	0.52	2	22.5	8.92	48.4	7	5.29	14	15	718
Black Spring Branch	2	4/20/1999	132	3.77	0.11	0	0	4	15	9.2	45.5	7.26	4.78	13	25	811
Calls Creek	644	8/11/2016	238	6.83	0.15	1	0.58	8	25	8.02	182.9	7.5	9.7	24	30	916
Candler Creek	1428	10/17/2017	202	5.78	0.19	5	0.89	0	16.2	8.54	95.1	7	6.2	35	32	999
Cane Creek	1427	10/17/2017	102	2.92	0.13	3	1.05	3	13.8	8.54	49.2	7	2.23	16	20	461
Cedar Creek	12	4/21/1999	98	2.79	0.13	2	0.78	2	16.2	8.3	147.7	7.33	30	57	-	428
Cedar Creek	667	8/14/2003	321	9.15	0.27	13	1.2	11	23.8	8.37	148.9	7.5	9.29	41	35	1045
Cedar Creek	667	5/29/2007	287	8.23	0.18	3	0.85	10	20	7.86	261.5	7.5	30.7	48	35	819
Cedar Creek	667	9/14/2016	308	8.81	0.13	8	0.75	12	22.4	8.2	381.3	7	3.05	41	35	1327
Copeland Creek	66	8/24/1998	137	3.88	0.13	6	0.71	6	20.3	8.33	95.1	7.55	5.69	-	-	508
Copeland Creek	66	7/15/1999	175	4.99	0.17	2	0.72	8	20.2	8.01	78.4	6.39	14.5	31	40	757
Copeland Creek	66	9/19/2000	137	3.89	0.14	1	0.75	7	16.9	7.77	142.6	7.25	5.39	51.3	55	383
Copeland Creek	66	9/6/2001	147	4.18	0.15	1	0.7	5	22.2	7.56	94.5	7	4.3	34	80	305

Stream Name	GAWRD Site ID	Sampling Date	Sampling Reach Length (m)	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)	# of Individual Fish
Copeland Creek	66	10/1/2002	133	3.77	0.13	1	0.9	5	20.7	6.58	104.6	7.5	5.3	32	60	406
Copeland Creek	66	9/24/2015	126	3.55	0.18	3	0.77	2	19.81	4.42	108	6.19	11.4	35	45	405
Copeland Creek	66	7/12/2016	140	4.01	0.16	2	0.72	3	22.4	5.5	105.3	7	4.72	37	50	245
Crooked Creek	1325	9/24/2015	161	4.63	0.18	2	1.1	0	20.65	6.82	138	6.92	12.7	44	53	696
East Sandy Creek	1372	8/10/2016	161	4.6	0.12	1	1.16	2	23.7	5.73	47.7	6.5	16	13	15	205
Floyd Creek trib	1381	9/13/2016	130	3.68	0.1	1	0.64	6	21.7	8.17	58.7	7	11.3	18	25	198
Hardeman Creek	1422	9/19/2017	156	4.46	0.15	3	0.69	3	21.8	6.61	61.2	7	10.9	20	25	156
Hog Creek	1273	9/27/2012	136	3.91	0.12	2	0.55	1	21.3	7.2	107.8	7.5	13.1	44	60	257
Indian Creek	1323	9/23/2015	217	6.24	0.17	6	1.06	2	17.47	-	103	7.27	7.68	29	32	738
Indian Creek	1432	10/25/2017	100	2.86	0.1	0	-	5	13.3	8.76	61	6.5	8.7	12	20	160
Little Indian Creek trib	1410	7/19/2017	95	2.7	0.15	1	0.75	0	24.9	6.2	106.1	7	13.9	33	30	194
Little Mullberry River	1383	9/15/2016	217	6.21	0.15	4	0.72	0	19.9	8.2	71.4	7.5	5	18	15	614
Little River	1333	10/23/2015	144	4.11	0.1	0		0	-	-	230	-	-	21	31	355
Little Sandy Creek	1324	9/23/2015	224	6.41	0.23	10	99	8	16.67	9.09	70	5.79	6.42	18	20	926
Log Dam Creek	7	4/19/1999	137	3.91	0.14	1	0.6	4	14.5	10.17	37.8	6.98	11.8	13	25	331
Lollis Creek	1431	10/19/2017	184	5.26	0.25	6	1.15	0	16.1	8.81	188.2	7.3	3.18	35	45	643
Mulberry Creek	669	8/27/2003	187	5.3	0.23	9	1.1	2	22.5	8.51	62.9	7	4.69	34.2	30	437
Mulberry Creek	669	9/15/2016	192	5.47	0.19	7	1.05	2	22.7	6.5	76.2	7.5	1.38	25	30	1187
Murder Creek	101	9/21/1999	298	8.47	0.24	9	1.11	0	19.2	7.43	81	7.28	6.8	31	40	576
Murder Creek	101	9/12/2013	416	11.95	0.56	16	99	0	22.1	7.1	91.6	7.5	6.8	33	40	728
North Oconee River	1429	10/18/2017	177	5.05	0.16	3	0.68	4	11.9	10.72	69.2	7.5	4.88	28	35	555
North Oconee River	1285	10/18/2012	364	10.4	0.22	7	1.2	0	14.3	9.1	77.1	7.5	5.86	51.3	45	1150

Stream Name	GAWRD Site ID	Sampling Date	Sampling Reach Length (m)	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS/cm)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)	# of Individual Fish
Redstone Creek	1423	9/19/2017	142	4.05	0.11	1	0.59	2	20.7	7.6	38.7	7	2.99	16	25	321
Robinson Creek	1275	9/28/2012	150	4.34	0.1	2	0.56	0	17.1	7.9	57	7	5.63	23	35	1061
Rock Creek	1365	7/14/2016	156	4.35	0.18	4	0.62	5	23.1	4.88	113.2	7.5	3.83	39	50	225
Rooty Creek	164	10/14/2015	84	2.36	0.07	1	0.72	0	17.8	8.35	202	7.16	8.4	57	64	302
South Sugar Creek	1194	5/20/2010	98	2.84	0.11	0	0	2	17.76	9.32	69	6.78	10	27	35	370
Trail Creek	1222	5/24/2011	266	7.57	0.17	8	0.8	3	23.12	8.89	66	7.2	13.7	34.2	25	578
Turkey Creek	1425	9/20/2017	197	5.62	0.11	5	0.86	1	20.9	7.9	63	7	3.92	27	30	478
Walnut Creek	1136	10/22/2008	280	8.05	0.23	17	1.31	2	11.75	11.1	56	7.17	3.3	27	35	1033
Walnut Creek	1322	9/22/2015	158	4.5	0.24	2	0.85	1	20.94	6.01	130	6.03	2.45	25	29	667
West Fork Trail Creek	1421	9/19/2017	100	2.74	0.12	0		0	19.9	7.08	74.1	6.5	9.54	19	40	173
Wheeler Creek	1296	7/2/2013	119	3.27	0.18	4	0.89	3	21.4	8.1	61.4	7	6.5	16	20	298
Wildcat Creek	1299	8/11/2016	133	3.78	0.09	1	0.5	0	23.1	8.2	64	7	4.9	18	25	245
Southeastern Plains Ecoregion - Supporting Stream Segments																
Little Red Bluff Creek	250	4/12/2000	206	5.93	0.72	4	2	-	19	5.66	53.7	6.5	7.51	25	20	307
Turkey Creek	1387	9/29/2016	145	4.49	0.32	5	1.12	-	21.6	7	113.6	7	15.4	54	50	282

3) SOURCE ASSESSMENT

A healthy aquatic ecosystem requires a healthy habitat. The major disturbance to stream habitats is erosion and sedimentation. As sediment is carried into the stream, it changes the stream bottom and smothers sensitive organisms. Turbidity associated with sediment loads may also impair recreational and drinking water uses (GA EPD, 1998).

A source assessment characterizes the known and suspected sources of sediment in the watershed for use in a water quality model and the development of the TMDL. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of pollutants on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. There are two basic kinds of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated stormwater discharges.

3.1.1 Wastewater Treatment Facilities

In general, municipal and industrial wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or on water quality standards (water quality-based limits).

The United States Environmental Protection Agency (USEPA) has developed technology-based guidelines, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

The USEPA and the states have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

For purposes of this TMDL, NPDES permitted wastewater treatment facilities will be considered point sources. Discharges from municipal, industrial, private and federal NPDES permitted facilities are the primary point sources of sediment as total suspended solids (TSS) and/or turbidity. Based on a GIS analysis of currently available permitting databases, there are five (5) permitted NPDES facilities discharging effluent within the watersheds upstream from the not supporting stream segments covered in the TMDL document.

Table 10 provides the current permitted flow and TSS concentrations for the NPDES permittees located within the watershed of stream segments not supporting their designated uses due to

impaired fish communities. Where available, the average levels (whether daily or monthly) and the maximum levels (whether daily or weekly) discharged over the last three years (2018-2020) are also given. These data were obtained from available Discharge Monitoring Reports (DMRs) or Operation Monitoring Reports (OMRs).

Table 10. Current NPDES Permit limits for Facilities that discharge within the watershed of Fish Community Not Supporting Streams (1)

Facility	NPDES Permit No.	Facility Type	Receiving Water / Not Supporting Stream Segment	Data Source	FLOW (MGD)		TSS (mg/L)	
					Monthly Average	Weekly Average	Monthly Average	Weekly Average
City of Madison Water Treatment Plant (WTP)	GAG640018	Municipal	Horse Branch, North Sugar Creek (1)	Permit Limit	report	report	30	45
				Actual Data	0.01	0.02	1.79	1.79
City of Madison Southside Water Pollution Control Plant (WPCP)	GA0023141	Municipal	North Sugar Creek	Permit Limit	0.66	0.83	30	45
				Actual Data	0.37	0.46	4.47	7.28
City of Winder Marburg Creek WPCP	GA0023191	Municipal	Marbury Creek	Permit Limit	0.6	0.75	20	30
				Actual Data	0.42	0.55	3.03	5.72
City of Social Circle Little River WPCP	GA0026107	Municipal	Little River	Permit Limit	0.65	0.81	30	45
				Actual Data	0.31	0.38	14.25	19.92
City of Eatonton Putnam Water & Sewer Authority Westside WPCP	GA0032263	Municipal	Tributary to Little River	Permit Limit	0.55	0.69	20	30
				Actual Data	0.19	0.25	3.56	7.47

Notes:
report = report value only, no limit

(1) The City of Madison WTP facility (GAG640018) discharges to Horse Branch, which is a tributary to North Sugar Creek. The WLA for this facility will be included in WLA for both not supporting segments in Table 21.

It is unknown if any of the point sources have contributed to the biota impairments in the Oconee River Basin watersheds by discharging TSS or other pollutants. Heavy metals, ammonia, chlorine, elevated temperatures, low dissolved oxygen levels, and extreme pH levels are possible sources of toxicity, and high levels of these parameters can adversely affect the aquatic communities. These parameters are regulated through NPDES permits.

3.1.2 Regulated Storm Water Discharges

Certain sources of storm water runoff are covered under the NPDES Permit Program and are considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe pollutant limits, storm water NPDES permits establish controls intended to reduce the quantity of pollutants storm water picks up and carries into storm sewer systems during rainfall events. Currently, regulated storm water discharges include those associated with industrial activities,

construction sites one acre or greater, large and medium municipal separate storm sewer systems (MS4s), and small MS4s serving urbanized areas.

3.1.2.1 Industrial General Storm Water NPDES Permits

Storm water discharges associated with industrial activities are currently covered under the 2017 NPDES General Permit for Stormwater Discharges Associated with Industrial Activity (GAR050000) also called the Industrial General Permit (IGP). This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), preparation of a Storm Water Pollution Prevention Plan (SWPPP), and annual reporting. The IGP requires that stormwater discharging into an impaired stream segment or within one linear mile upstream of, and within the same watershed as, any portion of an impaired stream segment identified as "not supporting" its designated use(s), must satisfy the requirements of Appendix C of the 2017 IGP if the pollutant(s) of concern for which the impaired stream segment has been listed may be exposed to stormwater as a result of industrial activity at the site. If a facility is covered under Appendix C of the IGP, then benchmark monitoring for the pollutant(s) of concern is required. Delineations of both supporting and not supporting waterbodies are provided on the GA EPD website, and are available in ESRI ArcGIS shapefile format or in KMZ format for use in Google Earth. Interested parties may evaluate their proximity to not supporting waterbodies by utilizing these geospatial files.

Table 11 provides a list of those facilities in the Oconee River Basin that have submitted a Notice of Intent to be covered under Georgia's Industrial General Storm Water NPDES Permit, that also discharge into streams with impaired fish communities. At this time, it is unknown whether these facilities are contributing sediment to the watershed.

Table 11. Facilities Covered Under Georgia's General Industrial Storm Water NPDES Permit within watersheds with Impaired Fish Communities

Stream Segment	Site ID	Facility Name/Owner	Permit #
Buckeye Creek	**WRD 1388**	Advanced Disposal Services, LLC – Hurst Rd Transfer	12455
Cedar Creek	**WRD 1274**	Fowler-Flemister Concrete, Inc	14090
		Georgia-Pacific Wood Products, LLC	942
		Georgia Pacific Corp - Monticello MDFPanelboard	1137
Little River	**WRD 1268**	Goodyear Tire and Rubber Company	1709
		Darrco – IsoNova Technologies, LLC	517
Tributary to Little River (#2)	**WRD 1329**	Advanced Disposal Services Middle Georgia, LLC	12410
		Grow Tec Inc.	11043
Marburg Creek	**WRD 1320**	BFI Waste Services, LLC – United Robertson Services	10175
		Republic Services of Georgia, LP – Oak Grove Sanitary Landfill	2660

Source: Nonpoint Source Program, GA EPD, 2021

3.1.2.2 NPDES MS4 Permits

The collection, conveyance, and discharge of diffuse storm water to local water bodies by a public entity is regulated in Georgia by the NPDES MS4 permits. These MS4 permits have been issued under two phases. Phase I MS4 permits cover medium and large cities, and counties with populations over 100,000. Each individual Phase I MS4 permit requires the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. A program to monitor and control pollutants in storm water discharges from industrial facilities, construction sites, and highly visible pollutant sources that exist within the MS4 area must be implemented under the permit. Additionally, monitoring of not supporting streams, public education and involvement, post-construction storm water controls, low impact development, and annual reporting requirements must all be addressed by the permittee on an ongoing basis.

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. As of 2021, Seventy-three (73) municipalities, thirty-five (36) counties, five (6) Department of Defense facilities, and the Georgia Department of Transportation (GDOT) are permitted under the Phase II storm water regulations in Georgia. All municipal Phase II permitees are authorized to discharge under Storm Water General Permit GAG610000. Department of Defense facilities are authorized to discharge under Storm Water General Permit GAG480000. GDOT owned or operated facilities are authorized to discharge under Storm Water General Permit GAR041000. Under these general permits, each permittee must design and implement a SWMP that incorporates BMPs that focus on public education and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction storm water management, and pollution prevention in municipal operations. Table 12 lists the permitted MS4s that discharge into stream segments not supporting their designated use for biota.

Table 12. Permitted MS4s in the Oconee River Basin Discharging to Not Supporting Streams

MS4 Permittee	Permit Number	Permit Phase	Not Supporting Stream(s)
Athens-Clarke County	GAG610003	2	Cedar Creek (GAR030701010601)
Barrow County	GAG610005	2	Marburg Creek
Jackson County	GAG610056	2	Tributary to Mulberry River
Oconee County	GAG610075	2	Greenbrier Creek, Lane Creek, Wildcat Creek
Walton County	GAG610102	2	Little River

Source: Nonpoint Source Program, GA EPD, 2019

The total area of each not supporting watershed and the percentage of urbanized area in the permitted MS4 area contained within each watershed are provided in Table 13. The land use types considered urbanized include 1) developed open space, 2) developed low intensity, 3) developed medium intensity, 4) developed high intensity, 5) utility swaths, and 6) golf courses.

Table 13. Percentage of Watersheds Located in urbanized MS4 Areas

Stream Segment	Site ID	Watershed Area (Acres)	Percentage Urbanized MS4	MS4 Permittee
Fish Community Not Supporting Segments				
Beaverdam Creek	WRD 1270	2672.3	0.0%	
Bowden Creek	WRD 1258	4870.7	0.0%	
Buckeye Creek	WRD 1388	24316.0	0.0%	
Cedar Creek	WRD 1424	2692.5	72.5%	Athens-Clarke County
Cedar Creek	WRD 1274	17672.8	0.0%	
Fishing Creek	WRD 1409	3081.9	0.0%	
Greenbriar Creek	WRD 1319	10519.9	0.1%	Oconee County
Horse Branch	WRD 1326	1591.0	0.0%	
Kimbro Creek	WRD 618	2248.2	0.0%	
Lane Creek	WRD 1300	1438.4	0.0%	Oconee County
Little Creek	WRD 1269	2174.6	0.0%	
Little River	WRD 1268	2399.9	0.0%	Walton County
Tributary to Little River (#2)	WRD 1329	2832.4	0.0%	
Lowry Branch	WRD 1392	1264.1	0.0%	
Marburg Creek	WRD 1320	16473.7	0.0%	Barrow County
Tributary to Mulberry River	WRD 1430	2802.2	25.9%	Jackson County
North Fork Wolf Creek	WRD 1366	6846.9	0.0%	
North Sugar Creek	WRD 1271	5074.4	0.0%	
Stewarts Creek	WRD 1257	4054.9	0.0%	
Wildcat Creek	WRD 1373	682.5	0.0%	Oconee County

Source: Nonpoint Source Program, GA EPD, 2019

3.1.2.3 Construction General Stormwater NPDES Permits

Soil erosion from construction sites has historically been a major source of sediment in Georgia's streams. Georgia requires construction sites over one acre to have a General Storm Water NPDES permit. General permits have been created to cover construction projects that fall into three distinct categories; stand-alone construction projects (May 2018 General Permit No. GAR100001), infrastructure construction projects (May 2018 General Permit No. GAR100002), and construction that occurs under a common plan of development where the primary permittee

chooses to use secondary permittees for land disturbance activities (May 2018 General Permit No. GAR100003). Since construction sites are regulated by NPDES permits, they are considered point sources. It is unknown if there are any construction sites in the not supporting watersheds of the Oconee River Basin.

3.2 Nonpoint Source Assessment

Eroded soils from forests, cropland, mining sites, and other land can be transported to Georgia streams through runoff. Excessive sediment that reaches the water bodies can cause a variety of changes to the stream. It can make the streams shallower and wider, affecting the stream's temperature, dissolved oxygen, flow rate, and velocity. It can cause increased flooding. It can affect the ability of the stream to assimilate pollutants. Excessive sediment can change the diversity of fish populations and other biological communities. In addition, harmful pollutants can attach to the sediment and be transported to rivers and streams.

3.2.1 Silviculture

Georgia has 23.6 million acres of commercial forests. This represents approximately 64 percent of all of Georgia's land use. Approximately 68 percent of the commercial forests are privately owned, 25 percent are owned by industry, and 7 percent are publicly held (GA EPD, 1999).

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, and during reforestation. Once the forest is re-established, very little soil erosion occurs. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Both hardwoods and pines are harvested throughout Georgia. A minimum harvest is usually ten acres and the percent of forest that is harvested each year varies from county to county. The Georgia Forestry Commission (GFC) was consulted for information and parameters regarding silviculture activities. Table 14 lists the percent timberland and percent harvested per year for counties that contain modeled watersheds.

Table 14. Timberland, Growing Stock and Annual Removal

County	Forest Area (acres)	Timberland (acres)	Net Growing Stock Volume (ft^3) [a]	Annual Average Harvest Removal (ft^3)	Impaired Watershed(s)
Baldwin	118,386	118,386	225,231,614	7,242,446	
Banks	83,118	83,118	120,076,027	3,463,726	
Barrow	46,526	46,526	145,105,765	825,814	Marburg Creek
Bleckley	80,222	80,222	148,073,373	1,091,238	
Clarke	25,086	25,086	52,656,180	-	Cedar Creek (WRD 1424)
Dodge	241,866	241,866	274,486,005	29,069,238	
Greene	189,780	189,780	406,015,166	11,881,895	Bowden Creek, Fishing Creek, Greenbrier Creek, Kimbro Creek, Stewarts Creek
Gwinnett	68,696	68,696	178,813,147	9,342,256	

County	Forest Area (acres)	Timberland (acres)	Net Growing Stock Volume (ft^3) [a]	Annual Average Harvest Removal (ft^3)	Impaired Watershed(s)
Hall	97,039	97,039	213,566,030	2,674,643	
Hancock	274,187	274,187	434,632,978	17,082,932	
Jackson	110,485	110,485	250,587,673	6,380,610	Tributary to Mulberry River
Jasper	184,994	173,083	378,040,748	5,236,535	Cedar Creek (WRD 1274), Lowry Branch, North Fork Wolf Creek
Johnson	161,345	161,345	147,598,201	10,985,512	Buckeye Creek
Jones	204,883	181,539	313,434,744	7,538,516	
Laurens	369,090	369,090	492,217,931	35,912,010	Buckeye Creek
Madison	82,548	82,548	163,128,153	4,757,584	
Montgomery	140,838	140,838	213,319,922	7,740,894	
Morgan	160,994	160,994	381,557,778	6,998,833	Beaverdam Creek, Horse Branch, Little Creek, North Sugar Creek
Newton	73,827	73,827	167,269,583	4,339,095	Little River
Oconee	62,177	62,177	138,135,839	3,338,319	Greenbrier Creek, Lane Creek, Wildcat Creek
Oglethorpe	232,193	232,193	559,500,120	9,758,189	Fishing Creek
Putnam	147,095	147,095	245,496,142	11,121,692	Tributary to Little River
Taliaferro	122,063	122,063	206,904,359	9,003,718	
Treutlen	105,076	105,076	174,629,825	12,683,538	
Twiggs	201,123	196,746	231,625,223	11,288,408	
Walton	126,040	126,040	284,734,994	3,520,785	Little River
Washington	319,987	319,987	509,571,767	27,349,059	Buckeye Creek
Wheeler	156,363	156,363	219,722,933	11,335,930	
Wilkinson	264,835	264,835	319,993,092	16,046,822	

[a] - Estimate - does not include trees less than 5" diameter at breast height (DBH).
Source: Forest Inventory EVALIDator web-application, USDA-FS, Northern Research Station, 2021

3.2.2 Agriculture

Agriculture can be a significant contributor of nonpoint pollutants to rivers and streams including sediment and nutrients. Cropland is one of the major sources of soil loss due to sheet and rill erosion. The NRCS was consulted for information and parameters regarding agricultural activities. Over the last century there has been a significant decrease in the amount of land farmed in Georgia. In 1950, there were approximately 198,000 farms encompassing 25.7 million acres in Georgia (U.S. Bureau of the Census, 1954). In 1982, there were approximately 12.3 million acres of farmland in Georgia, with the number of farms estimated to be 50,000 and the average farm size being approximately 248 acres. This represents a 52 percent reduction in farmland acreage. The number and acreage of farms has continued to decrease as time has gone on. In 2012, it

was reported that approximately 42,000 farms covering 9.6 million acres existed in Georgia, which represents a 63 percent reduction from 1950 (USDA-NASS, 2012). In 2017, there were approximately 42,400 farms covering 10.0 million acres existed in Georgia, which represents a 61 percent reduction from 1950 (USDA-NASS, 2018).

With the reduction in farmland, there has also been a decrease in the amount of soil erosion from agricultural lands. The National Resources Inventory found the total wind and water erosion on cropland and Conservation Reserve Program land in Georgia declined 38 percent, from 3.1 billion tons per year in 1982 to 1.9 billion tons per year in 1997 (USDA-NRCS, 1997). This suggests that the source of sediment in many of the not supporting streams in the Oconee River Basin may be the result of past land use practices. Thus, it is believed that if sediment loads are maintained at acceptable levels, streams will repair themselves over time.

3.2.3 Grazing Areas

Farm animals grazing on pastureland can leave areas of ground with little or no vegetative cover. During a rainfall runoff event, soil in the pastures is eroded and transported to nearby streams, typically by gully erosion. The amount of soil loss from gully erosion is generally less than that caused by sheet and rill erosion. Work in small grazed catchments in New Mexico found that gully erosion contributed only 1.4 percent of the total sediment load as compared to sheet and rill erosion. Other research has found that gully erosion typically contributes less than 30 percent of the total sediment load; however, contributions can range from 0 to 89 percent (USEPA, 2001b).

Beef cattle spend most of their time grazing in pastures, while dairy cattle and hogs are confined periodically. Hog farms confine the animals or allow them to graze in small pastures or pens. On dairy farms, the cows are confined for a limited period each day, during which time they are fed and milked. In addition, cattle and other unconfined animals often have direct access to streams that flow through pastures. As these animals walk down to the stream, they often damage stream banks. Stream bank vegetation is destroyed, and the banks often collapse, resulting in increased sedimentation to the waterway.

3.2.4 Mining Sites

Minerals, rocks, and ores are found in natural deposits on or in the earth. Kaolin, clays, granite, marble, sand, gravel, and other mineral products are the materials primarily mined in Georgia. Surface mining involves the activities and processes used to remove minerals, ores, or other solid material. Tunnels, shafts, and dimension stone quarries are not considered to be surface mines. Surface mining encompasses a variety of activities ranging from sand dredging to open pit clay mining to hard rock aggregate quarrying.

Removal of vegetation, displacement of soils, and other significant land disturbing activities are typically associated with surface mining. These operations can result in accelerated erosion and sedimentation of surface waters.

3.2.5 Roads

Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. Road erosion occurs when soil particles are loosened and carried away from the roadway, ditch or road bank by water, wind or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface or surface drainage, poor roadbed construction, roadway shape, and inadequate runoff discharge outlets or “turn-outs” from

the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion.

Exposed soils, high runoff velocities and volumes, and poor road compaction all increase the potential for erosion. Loose soil particles are often carried from the roadbed into roadway drainage ditches. Some of these particles settle out satisfactorily, but usually they settle out poorly, causing diminished ditch carrying capacity resulting in roadway flooding and, subsequently, more roadway erosion (Choctawhatchee, et. al, 2000).

3.2.6 Urban Development

Soil erosion from land disturbing activities is a major source of sediment in Georgia's streams. Land-disturbing activities are defined as any activity that may result in soil erosion and the movement of sediments into state waters or on lands of the state. Examples of land disturbing activities include clearing, grading, excavating, or filling of land. The following activities are unconditionally exempt from the provisions of the Erosion and Sedimentation Act: surface mining, granite quarrying, minor land-disturbing activities such as home gardens and landscaping, agricultural and silvicultural operations, and any project carried out under the technical supervision of the NRCS.

Conversion of forest to urban land use is often associated with water quality degradation. It is unknown whether the amount of forest land within the Oconee River Basin has significantly decreased. It should be noted that forest undergoing conversion to another land use is not considered silviculture, but rather a land disturbing activity.

Storm water runoff from newly developed and existing urban areas also has an impact on the transport of sediment to and within streams. As urbanization increases imperviousness across a watershed, the resulting hydrological response is almost always seen as an increase in the runoff volume and erosive force delivered to streams and other waterbodies over a shorter amount of time. As these compressed duration, high volume, high velocity stormwater discharges enter streams from the built environment they tend to cause stream bank erosion and stream bottom down cutting, further compounding sedimentation issues downstream.

Table 15 provides the amount and overall percentage of impervious cover within the watershed of each not supporting stream segment covered in this TMDL document. These data were extracted from the 2015 Georgia Land Use Trends (GLUT). This raster impervious cover trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1991, 2001, 2005, and 2008, and 2015. The raster data sets were developed from 1-meter aerial photography, and Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) datasets, with a resolution of 30 meters.

Table 15. Amount and Percentage of Impervious Area in Not Supporting Watersheds

Stream Segment	Station ID	Total Area (Acres)	Impervious Area (Acres)	% Impervious Area
Not Supporting Segments - Fish Community Assessment				
Beaverdam Creek	WRD 1270	2671.2	51.5	1.9%
Bowden Creek	WRD 1258	4868.6	78.0	1.6%
Buckeye Creek	WRD 1388	24305.6	97.0	0.4%
Cedar Creek (Jasper Co.)	WRD 1274	17665.3	141.6	0.8%
Cedar Creek (Clarke Co.)	WRD 1424	2691.4	477.4	17.7%
Fishing Creek	WRD 1409	3080.6	9.5	0.3%
Greenbriar Creek	WRD 1319	10515.5	95.1	0.9%
Horse Branch	WRD 1326	1590.3	135.0	8.5%
Kimbro Creek	WRD 618	2247.2	13.0	0.6%
Lane Creek	WRD 1300	1437.8	46.4	3.2%
Little Creek	WRD 1269	2173.6	21.2	1.0%
Little River	WRD 1268	2398.8	179.5	7.5%
Lowry Branch	WRD 1392	1263.6	12.9	1.0%
Marburg Creek	WRD 1320	16466.7	1399.6	8.5%
North Fork Wolf Creek	WRD 1366	6844.0	26.2	0.4%
North Sugar Creek	WRD 1271	5072.2	263.5	5.2%
Stewarts Creek	WRD 1257	4053.2	16.7	0.4%
Tributary to Little River (#2)	WRD 1329	2831.2	216.6	7.7%
Tributary to Mulberry River	WRD 1430	2801.0	167.7	6.0%
Wildcat Creek	WRD 1373	682.2	4.3	0.6%

4) MODELING APPROACH

Establishing the relationship between the in-stream water quality and the source loadings is an important component of TMDL development. It provides for the identification of sources and their relative contribution, as well as the examination of potential water quality changes resulting from varying management options used to meet the water quality standards. This relationship can be developed using a variety of techniques ranging from simple methods based on scientific principles to more complex numerical computer modeling techniques.

In this section, the numerical modeling techniques developed to simulate sediment fate and transport in the watershed are discussed. The limited amount of sediment loading data and in-stream sediment information available prevents GA EPD from using a dynamic watershed runoff model to determine the daily sediment loads since these models require a great deal of data for model development and calibration. Instead, GA EPD has determined the annual sediment loads delivered to a stream from the watersheds. This TMDL document does not address in-stream sedimentation processes, such as bank erosion and stream bottom downcutting, since computer models that simulate these processes are not available at this time.

4.1 Model Selection

The Agricultural Research Station (ARS) developed the Universal Soil Loss Equation (USLE) over 40 years ago. It is the most widely accepted and used soil loss equation. It was designed as a method to predict average annual soil loss caused by sheet and rill erosion. The USLE can estimate long-term soil loss, and can assist in choosing proper cropping, management, and conservation practices. However, it cannot be used to determine erosion for a specific year or specific storm. Because of its wide acceptance by the forestry, agricultural, and academic communities, the USLE was selected as the tool for estimating long-term annual soil erosion, assessing the impacts of various land uses, and evaluating the benefits of various BMPs.

4.2 Universal Soil Loss Equation

For each of the watersheds monitored in the Oconee River Basin, the existing annual sediment load was estimated using the USLE. The USLE predicts the average annual soil loss caused by sheet and rill erosion. Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall events. It is the major source of soil loss from crop production and animal grazing areas, logging areas, mine sites, unpaved roads, and construction sites. The equation used for estimating average annual soil erosion is:

$$A = RKLSCP$$

Where:

A = average annual soil loss, in tons / acre
R = rainfall erosivity index
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cover management factor
P = conservation practice factor

4.2.1 Rainfall Erosivity Index

The R factor, or rainfall erosivity index, is a measure of the cumulative erosive force of individual precipitation events. When other factors are constant, soil losses from storm rainfall are directly proportional to the product of the total kinetic energy of the storm (E) times its maximum 30-minute intensity (I_{30}); this is termed the single-storm erosion index (EI_{30}). The mean annual R-factor represents the sum of EI_{30} values for all storms in a year, averaged over all years of record (Daly and Taylor, 2002). Daily rain-gauge data for the period 1971-2000 were used to compute R-factor values for the conterminous United States. The R-factor values are specified by a raster dataset with a spatial resolution of 2.5 minutes (about 4 km cell size), which was produced by the Spatial Climate Analysis Service at Oregon State University. R factor varies geographically and ranges from 253 to 337 within the Oconee River Basin. Table 16 provides the rainfall statistics from six meteorological stations located throughout Georgia and shows the variability of rainfall frequency and amount.

Table 16. Georgia Meteorological Rainfall Statistics

Station	Normal Monthly Precipitation (in.) / Avg. Days of Precipitation (0.1 in. or more)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Athens, GA	4.6/11	4.4/9	5.5/11	4.0/8	4.4/9	3.9/9	4.9/11	3.7/9	3.4/8	3.3/7	3.7/8	4.1/10
Atlanta, GA	4.8/11	4.8/10	5.8/11	4.3/9	4.3/9	3.6/10	5.0/12	3.7/10	3.4/8	3.1/6	3.9/8	4.3/10
Augusta, GA	4.1/10	4.3/9	4.7/10	3.3/8	3.8/9	4.1/9	4.2/11	4.5/10	3.0/7	2.8/6	2.5/7	3.4/9
Columbus, GA	4.6/10	4.9/10	5.8/10	4.3/8	4.2/8	4.1/9	5.5/13	3.7/10	3.2/8	2.2/5	3.6/8	5.0/10
Macon, GA	4.6/11	4.7/10	4.8/10	3.5/7	3.6/9	3.6/10	4.3/13	3.6/11	2.8/8	2.2/6	2.7/7	4.3/9
Savannah, GA	3.6/9	3.2/9	3.8/9	3.0/7	4.1/9	5.7/10	6.4/14	7.5/13	4.5/10	2.4/6	2.2/6	3.0/8

4.2.2 Soil Erodibility Factor

The K-factor, or soil erodibility factor, represents the susceptibility of soil to be eroded. This factor quantifies the cohesive or bonding character of the soil and ability of the soil to resist detachment and transport during a rainfall event. The factor reflects the fact that different soils erode at different rates when the other factors that affect erosion (e.g., infiltration rate, permeability, total water capacity, dispersion, rain splash, and abrasion) are the same. Texture is the principal factor affecting erodibility, but structure, organic matter, and permeability also contribute (Goldman et al. 1986).

The soil erodibility factor is a raster dataset generated for each modeled watershed from the SSURGO database. The erodibility of the soil horizons and components of each soil map unit are proportioned and summed to compute the overall K-factor for each soil map unit. Soil map units are the basic geographic unit utilized in the SSURGO database. Table 6 provides a summary of hydrologic soil groups in each supporting and not supporting watershed that was modeled and the corresponding range of K-factors.

4.2.3 Slope Length and Steepness Factors

L is the slope length factor, representing the effect of slope length on erosion. It is the ratio of soil loss from the field slope length to that from a unit plot length on the same soil type and gradient. In practice, slope length is the distance from the origin of overland flow along its flow path to the location of either concentrated flow or deposition. Longer slopes generally accumulate more runoff from larger areas and also result in higher overflow velocities. The slope length factor is computed with the equation:

$$L = (x_i^{m+1} - x_{i-1}^{m+1})/[\lambda_u^m (x_i - x_{i-1})]$$

Where:

x_i = distance to the lower end of the segment

x_{i-1} = distance to the upper end of the segment

λ_u = length of the unit plot (72.6 ft)

m = $\frac{\beta}{1+\beta}$ = slope length exponent

β = $\left[\frac{k_r}{k_i}\right] * \left[\frac{c_r}{c_i}\right] * \left[\frac{expexp\ (-0.05\ G_c)}{expexp\ (-0.025\ G_c)}\right] * \left[\frac{\left(\frac{sinsin\ \theta}{0.0896}\right)}{\left[3\left(\frac{sinsin\ \theta}{0.896}\right)^{0.8} + 0.56\right]}\right]$

$\left[\frac{k_r}{k_i}\right]$ = the ratio of rill erodibility to interrill erodibility, assumed to be 1

$\left[\frac{c_r}{c_i}\right]$ = the ratio for below ground effects for rill and interrill erosion, assumed to be 1

$\left[\frac{expexp\ (-0.05\ G_c)}{expexp\ (-0.025\ G_c)}\right]$ = ratio of the ground cover effect on rill and interrill erosion, assumed to be 1

θ = slope angle of the segment

S is the slope steepness factor, representing the effect of slope steepness on erosion. Steeper slopes generally produce higher overland flow velocities. Soil loss increases more rapidly with slope steepness than it does with slope length. The slope steepness factor is computed by the equation:

$$S = 10.8\ sin\ sin\ \theta\ + 0.03 \qquad \text{for slopes} < 9\%$$
$$S = 16.8\ sin\ sin\ \theta\ - 0.50 \qquad \text{for slopes} \geq 9\%$$

Both the L and S factor equations depend on the slope angle (θ) of the given watershed. Slope angle is calculated using digital elevation model (DEM) data obtained from the United States Geological Survey (USGS) National Elevation Dataset (NED).

4.2.4 Cropping Factor

The C-factor, or cover management factor, is a dimensionless number, ranging between 0 and 1, that represents the degree of protection from erosion provided by crops, vegetation, and other soil cover. For this application of USLE, the C-factor has been utilized to convey the inherent erosion potential of the different land covers in each modeled watershed.

For agricultural lands, the C-factor incorporates the effects of tillage, crop type, cropping history, and crop yield on both soil erosivity and erodibility. ARS has continually refined C-factor values for specific crop and pasture types throughout the years. These values are easily obtained and well distributed. A review of available literature yielded generalized C-factor values for all land cover types and is given in Table 17.

Table 17. C-Factor for Land Cover types in Georgia

Land Cover Type	C-factor
Open Water/Beaches/Dunes/Mud	0
Utilities Swaths / Golf Courses	0.011
Developed	0.003
Clearcut/Sparse	0.2
Quarries/Strip Mines	0.2
Rock Outcrops	0
Forested	0.001
Pasture	0.011
Row Crops	0.2
Wetland	0.011

Source: Soil & Water Assessment Tool Documentation, 2012

4.2.5 Conservation Practice Factor

The P factor or conservation practice factor represents the effects of conservation practices on erosion. The conservation practices include BMPs such as contour farming, strip cropping and terraces. In all cases, it was assumed that no BMPs were used and the P factor for all land uses was 1.0.

4.3 WCS Sediment Tool

USEPA and Tetra Tech developed the ArcView-based Watershed Characterization System (WCS) to provide tools for characterizing various watersheds. WCS was used to display and analyze geographic information system (GIS) data, including land use, soil type, ground slope, road networks, point source discharges, and watershed characteristics. The Sediment Tool extension, which utilized the USLE, was used to estimate the potential sediment delivery to a defined water body of concern. This original version of WCS was used for modeling of sediment TMDLs issued by GA EPD through 2012.

GA EPD has updated and modernized the code and originally developed by USEPA and Tetra Tech. The original WCS program and code was evaluated to determine what functionality and features should be incorporated into the updated system.

The utilization of a GIS-based platform was considered a high priority so large amounts of high-resolution geospatial data could be efficiently analyzed for water quality limited streams. The Natural Resources Spatial Analysis Lab (NARSAL), within the College of Agricultural and Environmental Sciences, at the University of Georgia was contracted to update the GIS-based platform that would allow for similar analyses of the original WCS and its Sediment Tool.

The GIS software platform chosen was ArcGIS. The GA EPD Watershed Characterization System (GAWCS) was developed to run in ArcMap 10.x and utilize widely available and regularly updated state-wide geospatial datasets. Within the ArcGIS toolbox, two source code scripts, written in the open-source Python coding language, generate required datasets based on DEM data, and evaluate a selected watershed utilizing a sediment budget model based on the Revised Universal Soil Loss Equation, Version 2 (RUSLE2). The sediment budget model provides the estimated annual average soil loss due to sheet and rill erosion. A tabular summary of land cover, soil, stream, and demographic attributes of the selected watershed is provided to fully characterize a watershed, aid in water quality evaluation, and identify potential sources of impairment.

The DEM Process script utilizes the highest resolution DEM dataset available to generate three raster datasets that are subsequently used in the sediment budget calculation process. First, a state-wide slope angle raster data file is generated by calculating the slope angle from the raw DEM raster data. Following the generation of the slope angle raster, the DEM raster is hydrologically corrected such that modeled streamflow always flows along accurate stream paths to the edge of the DEM dataset. In this process, the streams from the USGS National Hydrography Dataset (NHD) NHD Flowline Feature Class are rasterized, snapped, and “burned” into the DEM. The “burn” process is essentially subtracting the stream pixels from the DEM, thus making an artificial gully and forcing the subsequently calculated flow accumulation and flow direction to follow the NHD streams. The DEM raster is then filled to remove any sinks. Finally, a state-wide flow direction raster and flow accumulation raster are generated, based on the edited DEM raster file. As higher resolution DEM datasets become available, the DEM processing script can be used to generate state-wide slope angle, flow direction, and flow accumulation raster datasets with a higher degree of accuracy.

The Watershed Characterization script evaluates a user-defined watershed that can either be based on a manual watershed delineation provided by the user or the script can delineate a watershed based on a user-selected pour point. Once the watershed is delineated, a variety of statistics describing land cover, population, and soil makeup are calculated and exported in tabular form.

Following the tabulation of watershed statistics, the Watershed Characterization script initiates the sediment erosion calculation process. A 30-meter by 30-meter grid is superimposed over the watershed to form the basic framework from which the sediment erosion estimate is calculated. This grid size represents the spatial resolution of the most land cover datasets, including the National Land Cover Dataset (NLCD) produced by USGS, and the Georgia Land Use Trends (GLUT) dataset produced by NARSAL. For each grid cell within the watershed, the Watershed Characterization script extracts or calculates the individual USLE factors based on the geospatial data provided through the ArcMap interface. Based on the specific cell characteristics and individual factors, the potential erosion for each grid cell is calculated using the USLE.

After the annual soil loss is computed for each grid cell in the watershed, areas of deposition and erosion are identified. Only areas of erosion are assumed to contribute to the total sediment yield of the watershed. Curvature of the watershed is computed along with a 3x3 focal mean slope. Areas of deposition are defined where slope is concave and less than ½ the mean slope. All other areas are defined as eroding. To compute the total sediment yield (tons/acre/year), a weighted flow accumulation is computed excluding the areas of deposition. The calculated sediment yields (tons/acre/year) are recalculated based on the actual watershed size to get an absolute sediment yield (tons/year).

5) TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving water body without exceeding the applicable water quality criteria; in this case, the narrative water quality criteria for aquatic life. This TMDL determines the range of sediment loads that can enter the Oconee River Basin watersheds not supporting their designated use without causing additional impairment to the stream. This range is based on the hypothesis that if a not supporting watershed has an annual average sediment loading rate similar to a watershed supporting its biology, then the receiving stream will remain stable and not be biologically impaired due to sediment. In the Oconee River Basin, the average sediment yield in the watersheds supporting fish communities in the Piedmont ecoregion is 0.93 tons/acre/yr and the average sediment yield in the watersheds supporting fish communities in the Southeastern Plains ecoregion is 0.85 tons/acre/yr. This TMDL establishes allowable pollutant loadings, and thereby provides the basis to establish water quality-based controls. For some pollutants, TMDLs are expressed on a mass loading basis.

A TMDL is the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and natural background (40 CFR 130.2). The sum of these components may not result in an exceedance of water quality criteria for a water body. To protect against exceedances, the TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. Conceptually, a TMDL can be expressed as follows:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The following sections describe the various TMDL components.

5.1 Waste Load Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources including industrial facilities, municipal treatment plants, and private and institutional development (PID) facilities. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits. The maximum allocated sediment load for these facilities is dependent on the discharge flow. The WLA given is a concentration or a range of daily average and daily maximum TSS limits for these facilities; however, a load can be calculated based on the permitted (where available) or design flows, and the permitted TSS concentrations.

The WLA, as a load, can be represented by the following equation:

$$WLA = C_{permitted} * Q$$

Where:

WLA = Wasteload Allocation sediment load

$C_{permitted}$ = permitted concentration, in TSS (mg / L)

Q = permitted flow (where available) or design discharge flow

There are five (5) permitted NDPES facilities in the Oconee River Basin watersheds that discharge into a stream segment or upstream of a stream segment not supporting its designated use for biota. Table 18 provides the permitted WLAs for these facilities.

Table 18. Permitted Waste Load Allocations for Facilities discharging to or upstream of not supporting segments

Facility	NPDES Permit No.	Facility Type	Receiving Water / Not Supporting Stream Segment	WLA (tons/yr)	FLOW (MGD)		TSS (mg/L)	
					Monthly Average	Weekly Average	Monthly Average	Weekly Average
Madison, City of (Madison WTP)	GAG640018	Municipal	Horse Branch, North Sugar Creek (1)	0.5	report	report	20	30
Madison, City of (Southside WPCP)	GA0023141	Municipal	North Sugar Creek	30.1	0.66	0.83	20	30
Winder, City of (Marburg Creek WPCP)	GA0023191	Municipal	Marbury Creek	18.3	0.6	0.75	20	30
Social Circle, City of (Little River WPCP)	GA0026107	Municipal	Little River	29.7	0.65	0.81	20	30
Eatonton - Putnam Water & Sewer Authority (Westside WPCP)	GA0032263	Municipal	Tributary to Little River	30.6	0.55	0.69	20	30

Note: Existing permitted facilities that discharge to the not supporting segments covered in this TMDL and that may have been erroneously omitted from this WLA table shall be given TSS limits that correspond to those similar to the omitted facility's type during permit reissuance.

(1) The City of Madison WTP facility (GAG640018) discharges to Horse Branch, which is a tributary to North Sugar Creek. The WLA for this facility will be included in WLA for both not supporting segments in Table 21.

It is recognized that effluent from biological treatment systems that have TSS limits of 20 mg/L or less are not expected to contribute to stream sedimentation. If there is available assimilative capacity, a new facility may be allowed, or for an existing facility may be able to expand. Any discharge into a stream without any assimilative capacity will be evaluated on a case-by-case basis and increases will be allowed, dependent on engineering and biological integrity study results.

State and federal rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects:1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not have wastewater treatment plants that control specific pollutants to meet numerical limits.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment.

For stormwater permits, compliance with the terms and conditions of the permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDL. EPD acknowledges that progress with the assumptions and requirements of the TMDL by stormwater permittees may take one or more permit iterations. Achieving the TMDL reductions may constitute compliance with a storm water management plan (SWMP) or a storm water pollution prevention plan (SWPPP), provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

The waste load allocations from storm water discharges associated with MS4s (WLA_{sw}) are estimated based on the percentage of urban area in each watershed covered by the MS4 storm water permit. At this time, the portion of each watershed that goes directly to a permitted storm sewer and that which goes through non-permitted point sources, or is sheet flow or agricultural runoff, has not been clearly defined. Thus, it is assumed that approximately 70 percent of storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

The storm water discharges associated with industrial facilities that are not covered under individual NPDES permits are regulated by a Georgia NPDES General Permit No. GAR050000 for Storm Water Discharges Associated with Industrial Activities. The general permit requires that storm water discharges into an stream segment not supporting its designated use or within one linear mile upstream of and within the same watershed as any portion of an impaired stream segment identified as “not supporting” its designated use(s), must satisfy the requirements given in Appendix C of the permit if the impaired stream segment has been listed for criteria violated, “Bio F” (Impaired Fish Community). Tables 10 and 11 list the industrial facilities that are covered under Georgia NPDES General Permit for Storm Water Discharges Associated with Industrial Activity in the Oconee River Basin, that are contained within watersheds of not supporting streams segments.

Georgia requires all construction sites over one acre to have a NPDES General Storm Water permit for construction activities. These General Permits authorizes the discharge of storm water associated with construction activity to the waters of the state in accordance with the limitations, monitoring requirements, and other conditions set forth in Parts III through V of each permit. The conditions set forth in each of these permits were established to assure that the storm water runoff from these sites does not cause or contribute sediment to the stream. Each Georgia NPDES General Permit for Storm Water Associated with Construction Activities can be considered a water quality-based permit in that the numeric limits in the permit, if met, will not cause a water quality problem. The sediment load allocation from future construction sites within the watershed have to meet requirements outlined in the Georgia NPDES General Permit for Storm Water Associated with Construction Activities.

5.2 Load Allocations

The USLE was applied to those watersheds that have streams that are biologically impaired and to watersheds and corresponding streams considered least impacted to determine the current sediment loading rates to the streams. The annual sediment load in tons/year for fish community assessment not supporting and least impacted watersheds is reported in Table 19.

The watersheds are grouped by those biologically impaired (not supporting designated uses), and those least impacted (supporting designated uses). For comparison purposes, the annual average sediment load per acre, or sediment yield, was calculated for each watershed and is also given in Table 19. For streams sampled for fish community integrity, the average sediment yield of the Oconee River Basin watersheds located in the Piedmont ecoregion not supporting their designated uses is 0.94 tons/acre/yr, while the average sediment yield of the supporting watersheds located within the Piedmont ecoregion is 0.93 tons/acre/yr. For streams sampled for fish community integrity, the average sediment yield of the Oconee River Basin watersheds located in the Southeastern Plains ecoregion not supporting their designated uses is 0.83 tons/acre/yr, while the average sediment yield of the supporting watersheds located within the Southeastern Plains ecoregion is 0.85 tons/acre/yr.

Fish community assessment scores are based on a specific set of metrics for each ecoregion. A target sediment yield was established in each ecoregion by averaging the sediment yield of all watersheds where the associated stream integrity class was either “Good” or “Excellent”. The sediment yield per acre for each watershed was then compared with the average target sediment yield for the corresponding ecoregion. In cases where the not supporting yields exceeded the average target yield, the Total Allowable Sediment Load was calculated as a tons/year load based on the average target yield multiplied by the total acres for the not supporting watershed. Where the yields were less than the target yield, the Total Allowable Sediment Load was given as the current annual sediment load in tons/year.

Table 19. Annual Sediment Yield for Fish Community Assessment Segments

Stream Segment	Station ID	Watershed Area (acres)	Total Sediment (tons/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Piedmont Ecoregion (45) - Not Supporting - Fish Community Assessment					
Beaverdam Creek GAR030701010910	WRD 1270	2672.3	1310.5	27.2	0.49
Bowden Creek GAR030701011108	WRD 1258	4870.7	3490.9	83.0	0.72
Cedar Creek (Clarke Co.) GAR030701010601	WRD 1424	2692.5	938.2	141.8	0.35
Cedar Creek (Jasper Co.) GAR030701011705	WRD 1274	17672.8	12559.9	313.3	0.71
Fishing Creek GAR030701010708	WRD 1409	3081.9	1514.3	12.5	0.49
Greenbriar Creek GAR030701010704	WRD 1319	10519.9	7196.8	362.9	0.68
Horse Branch GAR030701011314	WRD 1326	1591.0	1520.5	150.1	0.96
Kimbro Creek GAR030701011210	WRD 618	2248.2	1082.5	16.2	0.48
Lane Creek GAR030701011010	WRD 1300	1438.4	892.1	15.2	0.62
Little Creek GAR030701010912	WRD 1269	2174.6	2896.8	35.8	1.33
Little River GAR030701011410	WRD 1268	2399.9	2342.1	94.7	0.98

Stream Segment	Station ID	Watershed Area (acres)	Total Sediment (tons/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Tributary to Little River (#2) GAR030701011501	WRD 1329	2832.4	4547.5	121.2	1.61
Lowry Branch GAR030701011604	WRD 1392	1264.1	2854.1	35.9	2.26
Marburg Creek (aka Marbury Creek) GAR030701010806	WRD 1320	16473.7	12435.1	497.4	0.75
Tributary to Mulberry River GAR030701010211	WRD 1430	2802.2	7292.9	117.0	2.60
North Fork Wolf Creek GAR030701011616	WRD 1366	6846.9	4315.3	143.7	0.63
North Sugar Creek GAR030701011313	WRD 1271	5074.4	4892.9	258.7	0.96
Stewarts Creek GAR030701011107	WRD 1257	4054.9	3488.4	88.7	0.86
Wildcat Creek GAR030701010609	WRD 1373	682.5	269.5	1.5	0.39
Southeastern Plains Ecoregion (65) - Not Supporting - Fish Community Assessment					
Buckeye Creek GAR030701020802	WRD 1388	24316.0	20170.9	576.6	0.83
Piedmont Ecoregion (45) - Supporting - Fish Community Assessment					
Allen Creek	WRD 668	7547.4	11586.8	210.1	1.54
Apalachee River	WRD 96	161296.3	116563.0	4964.6	0.72
Big Bear Creek	WRD 664	2983.9	2106.1	154.2	0.71
Black Spring Branch	WRD 2	2303.3	1189.6	78.1	0.52
Calls Creek	WRD 644	5527.0	3816.0	363.3	0.69
Candler Creek	WRD 1428	7217.8	8877.4	144.1	1.23
Cane Creek	WRD 1427	2125.4	928.0	49.5	0.44
Cedar Creek	WRD 12	935.8	515.4	11.9	0.55
Cedar Creek	WRD 667	6797.9	4350.1	168.0	0.64
Copeland Creek	WRD 66	3034.4	3352.0	49.2	1.10
Crooked Creek	WRD 1325	12086.3	9774.7	90.6	0.81
East Sandy Creek	WRD 1372	5287.7	3674.9	122.8	0.69
Floyd Creek trib	WRD 1381	1301.9	2922.4	65.8	2.24
Hardeman Creek	WRD 1422	3736.7	3417.1	109.9	0.91
Hog Creek	WRD 1273	13167.8	15441.6	256.5	1.17
Indian Creek	WRD 1323	5342.4	3210.3	122.0	0.60
Indian Creek	WRD 1432	3871.2	2775.3	24.1	0.72
Tributary to Little Indian Creek	WRD 1410	1664.2	1199.9	21.7	0.72
Little Mullberry River	WRD 1383	9856.3	10929.9	386.3	1.11
Little River	WRD 1333	4515.3	3558.5	144.1	0.79
Little Sandy Creek	WRD 1324	6967.9	4708.4	81.6	0.68

Stream Segment	Station ID	Watershed Area (acres)	Total Sediment (tons/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Log Dam Creek	WRD 7	2699.2	2144.1	52.2	0.79
Lollis Creek	WRD 1431	6141.7	14591.4	211.6	2.38
Mulberry Creek	WRD 669	5915.5	8152.5	212.8	1.38
Murder Creek	WRD 101	83608.0	78213.8	2086.7	0.94
North Oconee River	WRD 1429	3813.6	10268.9	195.3	2.69
North Oconee River	WRD 1285	63554.4	80102.8	2111.6	1.26
Redstone Creek	WRD 1423	3664.0	2240.5	51.5	0.61
Robinson Creek	WRD 1275	11300.1	10725.8	518.8	0.95
Rock Creek	WRD 1365	3008.3	605.5	13.6	0.20
Rooty Creek	WRD 164	5609.2	4724.9	181.1	0.84
South Sugar Creek	WRD 1194	3428.2	2193.6	63.7	0.64
Trail Creek	WRD 1222	8141.2	3226.4	198.8	0.40
Turkey Creek	WRD 1425	4471.9	1952.6	97.8	0.44
Walnut Creek	WRD 1136	24540.6	30689.6	1014.4	1.25
Walnut Creek	WRD 1322	8405.6	9366.1	250.0	1.11
West Fork Trail Creek	WRD 1421	2719.9	1004.9	49.3	0.37
Wheeler Creek	WRD 1296	837.5	846.2	14.0	1.01
Wildcat Creek	WRD 1299	3830.1	1773.6	47.9	0.46
Southeastern Plains Ecoregion (65) - Supporting - Fish Community Assessment					
Little Red Bluff Creek	WRD 250	6768.4	7137.0	383.4	1.05
Turkey Creek	WRD 1387	43123.0	27846.4	1250.3	0.65

Once the Total Allowable Sediment Load for each not supporting watershed is calculated, the nonpoint source loads (LA) for each watershed is calculated by subtracting the WLA and WLA_{sw} from the Total Allowable Sediment Load. It is recognized that there may be additional assimilative capacity in the cases where there is no required reduction in the sediment load and future dischargers (WLA) may be allowed. In the watersheds that have exceeded the total allowable sediment load, new dischargers (WLA) may be allowed if there is sufficient reduction in the nonpoint source loads (LA).

5.3 Seasonal Variation

Sediment is expected to fluctuate according to the amount and distribution of rainfall. Since rainfall is greatest in the spring and winter seasons, it is expected that sediment loadings would be highest during these seasons. However, these seasonal fluctuations and other short-term variability in loadings due to episodic events are usually evened out by the response of the biological community to habitat alteration, which is a long-term process. Therefore, the annual sediment load was determined to be appropriate for the TMDL.

5.4 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions

to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, the MOS was implicitly incorporated in the use of conservative modeling assumptions, including the selection of average USLE factors, the use of the average sediment loading rates for the numeric targets, and the assumption that no BMPs were used.

5.5 Total Sediment Load

The total allowable sediment load was determined by adding the WLA (WLA + WLA_{sw}) and the LA. The MOS, as described above, was implicitly included in the TMDL analysis and does not factor directly into the TMDL equation.

The USLE method used calculates a total annual sediment load, as opposed to a daily load. The total allowable annual sediment load expressed in terms of tons per year is intended to prevent the cumulative impacts of excessive run-off related sediment in the watershed. The maximum daily allowable sediment load is a subcomponent of the allowable annual load. It is based upon the critical flow event that represents the maximum sediment load capacity for the stream. Research conducted by the ARS National Sedimentation Laboratory and USEPA Region 4 has determined that the bankfull flow is the critical flow that has the maximum daily sediment carrying capacity, and therefore has the maximum daily sediment loading capacity. Bankfull flow can be estimated using the one-day flow event that occurs once every one and a half years, 1Q1.5, determined by the Log Pearson recurrence interval statistical analysis.

The National Sedimentation Laboratory has correlated, by ecoregion, a relationship between the annual average sediment yield and the bankfull flow sediment yield for stable or unimpaired streams. Table 20 provides the mean bankfull flow (Q1.5) sediment yield expressed as tons per day per square kilometer for each ecoregion in the Oconee River basin, compared to the mean annual average sediment yield discharged into a stable, unimpaired stream. The coefficient is the ratio of the maximum daily yield to the total annual yield. These relationships were used to transform total allowable sediment loads to daily maximum sediment loads (USDA-ARS, 2006).

Table 20. Suspended-Sediment Transport Rates Comparing Bankfull Flow Yield to Mean Annual Yield

Ecoregion	Sediment Yield at Q1.5 (Tons/d/km^2)	Mean Annual Sediment Yield (Tons/yr/km^2)	Annual to Daily Max Coefficient
Piedmont – 45	2.54	19.6	0.1296
Southeastern Plains – 65	0.228	8.64	0.0264

The total allowable sediment loads and daily maximum sediment loads for the not supporting watersheds are summarized in Table 21, along with any required sediment load reductions. The WLAs (WLA + WLA_{sw}) provided in Table 21 are for accounting purposes. A Summary Memorandum for each watershed is provided in Appendix A

Table 21. Total Allowable Sediment Loads and the Required Sediment Load Reductions

Stream Segment Assessment Unit ID	Station ID	Current Load				TMDL		
		WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	Total Allowable Sediment Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	Percent Reduction Required
Not Supporting Segments - Fish Community								
Beaverdam Creek GAR030701010910	WRD 1270			1310.5	1310.5	1310.5	169.8	0.0%
Bowden Creek GAR030701011108	WRD 1258			3490.9	3490.9	3490.9	452.4	0.0%
Buckeye Creek GAR030701020802	WRD 1388			20170.9	20170.9	20170.9	532.5	0.0%
Cedar Creek (Clarke Co.) GAR030701010601	WRD 1424		476.0	462.2	938.2	938.2	121.6	0.0%
Cedar Creek (Jasper Co.) GAR030701011705	WRD 1274			12559.9	12559.9	12559.9	1627.8	0.0%
Fishing Creek GAR030701010708	WRD 1409			1514.3	1514.3	1514.3	196.2	0.0%
Greenbrier Creek GAR030701010704	WRD 1319		4.8	7192.0	7196.8	7196.8	932.7	0.0%
Horse Branch GAR030701011314	WRD 1326	0.46		1480.5	1520.9	1480.9	191.9	2.6%
Kimbro Creek GAR030701011210	WRD 618			1082.5	1082.5	1082.5	140.3	0.0%
Lane Creek GAR030701011010	WRD 1300			892.1	892.1	892.1	115.6	0.0%
Little Creek GAR030701010912	WRD 1269			2024.1	2896.8	2024.1	262.3	30.1%
Little River GAR030701011410	WRD 1268	29.7		2204.1	2371.7	2233.8	289.5	5.8%
Tributary to Little River (#2) GAR030701011501	WRD 1329	16.7		2619.7	4564.3	2636.4	341.7	42.2%
Lowry Branch GAR030701011604	WRD 1392			1176.6	2854.1	1176.6	152.5	58.8%
Marburg Creek (aka Marbury Creek) GAR030701010806	WRD 1320	18.3		12416.8	12453.4	12435.1	1611.6	0.1%

Stream Segment Assessment Unit ID	Station ID	Current Load				TMDL		
		WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	Total Allowable Sediment Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	Percent Reduction Required
Tributary to Mulberry River GAR030701010211	WRD 1430		473.5	2134.7	7292.9	2608.3	338.0	64.2%
North Fork Wolf Creek GAR030701011616	WRD 1366			4315.3	4315.3	4315.3	559.3	0.0%
North Sugar Creek GAR030701011313	WRD 1271	30.6		4692.7	4923.5	4723.3	612.1	4.1%
Stewarts Creek GAR030701011107	WRD 1257			3488.4	3488.4	3488.4	452.1	0.0%
Wildcat Creek GAR030701010609	WRD 1373			269.5	269.5	269.5	34.9	0.0%

Definitions:

Total Load - Sum of modeled sediment load and approved waste load allocations (WLA)
WLA - waste load allocation for discrete point sources
WLA_{sw} - waste load allocation associated with storm water discharges from a municipal separate storm sewer system (MS4)
LA - portion of the total allowable sediment load attributed to nonpoint sources and natural background sources of sediment
Total Allowable Sediment Load - allowable sediment load calculated using the target sediment yield and the stream's watershed area
Maximum Allowable Daily Load - total allowable sediment load (annual) converted to a daily figure based on the bankfull sediment transport relationship
Percent Reduction Required - percent reduction applied to current total load in order to meet total allowable sediment load

6) RECOMMENDATIONS

The TMDL process consists of an evaluation of the sub-watersheds for each 303(d) listed stream segment to identify, as best as possible, the sources of sediment causing the stream to be impaired for the narrative criteria for aquatic life. The TMDL analysis was performed using the best available data to specify WLAs and LAs that will meet the narrative aquatic life criteria so as to support the use classification specified for the listed segment.

This TMDL represents part of a long-term process to reduce loading of sediment to meet water quality standards in the Oconee River Basin. Implementation strategies will be reviewed and the TMDLs will be refined as necessary. The phased approach will support progress toward water quality standards attainment in the future. In accordance with USEPA TMDL guidance, these TMDLs may be revised based on the results of future monitoring and source characterization data efforts. The following recommendations emphasize further source identification and involve the collection of data to support the current allocations and subsequent source reductions.

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. Based on monitoring conducted by GA WRD and GA EPD in the Oconee River Basin, these segments are listed as not supporting their designated use due to biological impairments. Additional monitoring sites are added as necessary.

In the case where a watershed-based plan has been developed for a listed stream segment, an appropriate water quality monitoring program will be outlined. The monitoring program will be developed to help identify the various sediment sources. The monitoring program may be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where limited data resulted in the listing.

6.2 Sediment Management Practices

The following management practices are recommended to reduce, or at a minimum, maintain the total allowable sediment loads at current levels.

- Compliance with NPDES (wastewater, construction, industrial stormwater, and/or MS4) permit limits and requirements;
- Implementation of recommended Water Quality management practices in the *Upper Oconee Regional Water Plan* (GA EPD, 2017), *Middle Ocmulgee Regional Water Plan* (GA EPD, 2017), *Altamaha Regional Water Plan* (GA EPD, 2017), and *Savannah-Upper Ogeechee Regional Water Plan* (GA EPD, 2017);
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2019);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of National Resource Conservation Service (NRCS) Conservation Practices for agriculture;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;
- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;

- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2016)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2016) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.
- Where applicable, implementation of the *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* (CCSMPC, 2009).

6.3 Reasonable Assurance

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. Reasonable assurance ensures that a TMDL's wasteload and load allocations are properly distributed to meet the applicable water quality standards. Without such distribution, a TMDL's ability to serve as an effective guidepost for water quality improvement is significantly diminished. Federal regulations implementing the CWA require that effluent limits in permits be consistent with "the assumptions and requirements of any available [WLA]" in an approved TMDL [40 CFR 122.44(d)(1)(vii)(B)]. NPDES point source permits will be given effluent limits in the permit consistent with the individual WLAs specified in the TMDL.

The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia works with local governments, agricultural and forestry agencies, such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

A thirty-day public notice will be provided for this TMDL. During that time, the TMDL will be available on the GA EPD website, a copy of the TMDL will be provided upon request, and the public will be invited to provide comments on the TMDL.

7) INITIAL TMDL IMPLEMENTATION PLAN

This plan identifies applicable state-wide programs and activities that may be employed to manage point and nonpoint sources of sediment loads for twenty (20) segments in the Oconee River Basin. Local watershed planning and management initiatives will be fostered, supported or developed through a variety of mechanisms. Implementation may be addressed by Watershed-Based Plans or other assessments funded by Section 319 (h) grants, the local development of watershed protection plans, or "Targeted Outreach" initiated by GA EPD. These initiatives will supplement or possibly replace this initial implementation plan. Implementation actions should also be guided by the recommended management practices and actions contained within each applicable Regional Water Plan developed as part of Georgia's Comprehensive State-wide Water Management Plan implementation (Georgia Water Council, 2008).

7.1 Not Supporting Segments

This initial plan is applicable to the following water bodies that were added to Georgia's 2020 Integrated 305(b)/303(d) list of not supporting waters in *Water Quality in Georgia 2018-2019* (GA EPD, 2020) available on the GA EPD website. Table 22 summarizes the descriptive information provided in the 303(d) list.

Table 22. Stream Segments on the 2020 303(d) List as Biota Impacted - Fish Community

Stream Segment	Location	Reach ID	Segment Length (mi)	Ecoregion	Designated Use
Beaverdam Creek	Headwaters to Big Sandy Creek	GAR030701010910	9	Piedmont	Fishing
Bowden Creek	Unnamed tributary at I-20 to Beaverdam Creek	GAR030701011108	4	Piedmont	Fishing
Buckeye Creek	Fords Creek to Kellams Creek	GAR030701020802	5	Southeastern Plains	Fishing
Cedar Creek	Headwaters to Oconee River, Athens	GAR030701010601	4	Piedmont	Fishing
Cedar Creek	King Branch to Big Cedar Creek	GAR030701011705	14	Piedmont	Fishing
Fishing Creek	Pond at headwaters to McWhorter Creek	GAR030701010708	6	Piedmont	Fishing
Greenbrier Creek	Salem Scull Shoals Road to Lake Oconee	GAR030701010704	8	Piedmont	Fishing
Horse Branch	Headwaters to North Sugar Creek	GAR030701011314	4	Piedmont	Fishing
Kimbro Creek	Headwaters to Hightower Creek	GAR030701011210	4	Piedmont	Fishing

Stream Segment	Location	Reach ID	Segment Length (mi)	Ecoregion	Designated Use
Lane Creek	Pond 0.6 miles upstream of Snows Mill Road to pond 0.9 miles downstream of Lane Creek Road	GAR030701011010	2	Piedmont	Fishing
Little Creek	Headwaters to Big Sandy Creek	GAR030701010912	5	Piedmont	Fishing
Little River	Social Circle to I-20	GAR030701011410	4	Piedmont	Fishing
Tributary to Little River (#2)	Eatonton to Little River	GAR030701011501	3	Piedmont	Fishing
Lowry Branch	Jasper County	GAR030701011604	3	Piedmont	Fishing, Drinking Water
Marburg Creek (aka Marbury Creek)	Masseys Lake to Apalachee River	GAR030701010806	7	Piedmont	Fishing
Tributary to Mulberry River	Headwaters to Mulberry River	GAR030701010211	5	Piedmont	Fishing
North Fork Wolf Creek	Headwaters to South Fork Wolf Creek	GAR030701011616	9	Piedmont	Fishing
North Sugar Creek	Unnamed tributary 0.2 miles upstream of Plainview Road to South Sugar Creek	GAR030701011313	4	Piedmont	Fishing
Stewarts Creek	Pond 0.5 miles downstream of Billy Merritt Road to Lake Oconee	GAR030701011107	6	Piedmont	Fishing
Wildcat Creek	Headwaters to tributary 0.8 miles downstream of Kirkland Rd	GAR030701010609	2	Piedmont	Fishing

The GA EPD developed TMDLs in 2021 for sediment in the Oconee River Basin due to a "Bio F" criteria violation on Georgia's 2020 Integrated 305(b)/303(d) List. These streams have shown a degradation of the biological community, which is generally caused by habitat loss due to stream sedimentation. The purpose of the general criteria is to prevent objectionable conditions that interfere with legitimate water uses, as stated in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03(5)(c):

> "*All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.*"

7.2 Potential Sources

A healthy aquatic ecosystem requires a healthy habitat. The major disturbance to stream habitats is erosion and sedimentation. As sediment is carried into the stream, it settles to the stream bottom and smothers sensitive organisms. Turbidity associated with sediment loads may also impair recreational and drinking water uses (GA EPD, 1998).

A source assessment characterizes the known and suspected sediment sources in the watershed. The general sediment sources are point and nonpoint. NPDES permittees discharging treated wastewater are the primary point sources of sediment as TSS. It is recognized that effluent from biological treatment systems that have TSS limits of 20 mg/L or less are not expected to contribute to stream sedimentation. Nonpoint sources of sediment are diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land use activities that contribute sediment to streams during a rainfall runoff event.

Prior to the implementation of this plan, a detailed assessment of the potential sources should be carried out. This will better determine what best management practices are needed and where they should be installed. A watershed assessment will also help when requesting funding assistance for the implementation of this plan. GA EPD is available to provide assistance in completing a watershed survey of the potential sources of impairment.

Through water quality modeling, it has been determined that the sediment loading found in eight (8) of the twenty (20) segments needs to be reduced. This sediment may be due to land disturbing activities including, but not limited to land development, agriculture, impervious surfaces, commercial forestry, and others. It is believed that, if sediment loads are not reduced, these streams will continue to degrade over time. Remedies exist for addressing excess sediment, from both point and non-point sources, in streams. They will be discussed in this plan.

Based on modeling, some segments have been found to need 0% reductions in sediments loads. This occurs if the estimated sediment yield (tons/acre/year) for these not supporting segments is below the average sediment yield for the least impacted stream segments within the Oconee River Basin. It is likely that the impairment in these segments is due to past land use practices and is referred to as “legacy” sediment. It is believed that these streams will repair themselves over time if sediment loads are maintained at current levels.

7.3 Sediment Controls

It has been determined that most of the sediment found in the Oconee River Basin streams is due to past land use practices and is referred to as “legacy” sediment. Therefore, it is recommended that there be no net increase in sediment delivered to the not supporting stream segments, so that these streams will recover over time.

The measurement of sediment delivered to a stream is difficult, if not impossible, to determine. Setting a numeric TMDL may be ineffective given the difficulty in measuring it. In addition, habitat and aquatic communities can be slow to respond to changes in sediment loading. Thus, this TMDL recommends compliance with NPDES permits and implementation of Best Management Practices (BMPs) to control sediment produced from non-point sources such as the erosion of stream banks, paved surfaces, roofs, and other sources, which are not regulated or subjected to most enforcement actions. BMPs may be used to help reduce average annual sediment loads and achieve water quality criteria and improve the over aquatic health of the system. The anticipated effects of compliance with NPDES permits and implementation of BMPs will be the improvement of stream habitats and water quality, and thus be an indirect measurement of the TMDL.

Table 23 lists examples of BMPs that address excess sediment. This is not a complete list and additional management measures may be proposed that will be considered as implementing non-point source controls consistent with this plan.

Table 23. Examples of BMPs for Use in Controlling Sediment from Non-Point Sources

Name of BMP	Type (Ag., Forestry, Urban, Other.)
Vegetated Filter Strips	Agriculture
Reduced / No Tillage Systems	Agriculture
Livestock Exclusion	Agriculture
Minimize Stream Crossings / Construct Open Bottom Culvert or Timber Bridges where crossings are required	Forestry
Establish Stream Management Zones / Minimize Soil Compaction	Forestry
Erosion Control / Revegetation	Forestry
Sediment Basin	Urban
Porous Pavement	Urban
Bioretention/Biofiltration systems	Urban
Bioswales/Infiltration Basins	Urban
Streambank Protection and Restoration	Ag, Forestry, Urban, Other
Vegetated Stream Buffers	Ag, Forestry, Urban, Other
Additional Ordinances	Ag, Forestry, Urban, Other

The GA EPD Non-Point Source Program should be consulted when selecting appropriate management practices for addressing the TMDL, particularly when determining the best practices for specific watersheds.

7.3.1 Point Source Approaches

Point sources are defined as discharges of treated wastewater or storm water into rivers and streams at discrete locations. Treated wastewater tends to be discharged at relatively stable rates, whereas, storm water is discharged at irregular, intermittent rates, depending on precipitation and runoff. The NPDES permit program provides a basis for developing municipal, industrial, and storm water permits; monitoring and compliance with limitations; and appropriate enforcement actions for violations. In accordance with GA EPD rules and regulations, all NPDES dischargers in the watershed are required to meet their current NPDES permit limits at all times.

It is recommended that there be no authorized increase in the concentration of TSS above that identified in the TMDL. However, if there is available assimilative capacity, new discharges may be allowed based on engineering evaluations and current stream biological integrity studies.

The removal of mined material involves water pumped from the mine pit, and mineral processing involves the disposal of process waters. These waters are treated through sedimentation ponds or detention basins prior to being discharged to the stream and are regulated by NPDES permits. It is recommended that the peak flow from mining sites be maintained at pre-development levels in order to control bank erosion and instabilities in the receiving stream. In addition, monitoring

frequencies should be such that the total annual sediment loads coming from mining facilities can be characterized.

GA EPD has developed a Georgia NPDES General Permit for Storm Water Associated with Construction Activities. Coverage under a General Permit is required for all construction sites disturbing one or more acres. General permits have been created to cover construction projects that fall into three distinct categories; stand-alone construction projects (General Permit No. GAR100001), infrastructure construction projects (General Permit No. GAR100002), and construction that occurs under a common plan of development where the primary permittee chooses to use secondary permittees for land disturbance activities (General Permit No. GAR100003). Regardless of the type of construction project, all sites required to have a coverage permit are authorized to discharge storm water associated with construction activity to the waters of the state in accordance with the limitations, monitoring requirements, and other conditions set forth in Parts III through V of each NPDES General Permit for Storm Water Associated with Construction Activities. The permit requires all sites to have an Erosion and Sedimentation Control Plan; to implement, inspect and maintain BMPs; and to monitor storm water for turbidity. Georgia's General Storm Water Permit can be considered a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem.

The NPDES General Storm Water Permits for Construction Activity also require that storm water discharges into a stream segment not supporting its designated use or a stream segment within one linear mile upstream of and within the same watershed as, any portion of a stream segment not supporting its designated use, must address any site-specific condition or requirement in a TMDL implementation plan and must include at least four additional BMPs from a list provided in Part III. C. of the Permit. This condition only applies to streams with impairments for "Bio F" (fish community) and with the listed potential cause of either "NP" (nonpoint source) or "UR" (urban runoff).

For stormwater permits, compliance with the terms and conditions of the permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP) and demonstrates consistency with the assumptions and requirements of the TMDL. GA EPD acknowledges that progress with the assumptions and requirements of the TMDL by stormwater permittees may take one or more permit iterations. Achieving the TMDL reductions may constitute compliance with a storm water management plan (SWMP) or a storm water pollution prevention plan (SWPPP), provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

7.3.2 Nonpoint Source Land Use Approaches

GA EPD is the lead agency for implementing the state's Nonpoint Source Management Program, as described in Georgia's *Statewide Nonpoint Source Management Plan* (GA EPD, 2019). The *Statewide Nonpoint Source Management Plan* combines regulatory and non-regulatory approaches, in cooperation with other state and Federal agencies, local and regional governments, state colleges and universities, businesses and industries, nonprofit organizations, and individual citizens. The 2019 document represents a revision of the *Statewide Nonpoint Source Management Plan* last updated in 2014. This revision provides an update to reflect new priorities and practices of nonpoint source pollution control in Georgia. It represents Georgia's plan for making progress toward meeting the ultimate goal of the Clean Water Act of achievement of water quality standards for fishable and swimmable waters. Regulatory responsibilities include

establishing water quality criteria and use classifications, assessing and reporting water quality conditions, issuing point source permits, issuing water withdrawal and ground water permits, and regulating land-disturbing activities. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of BMPs that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality. The following sections describe in more detail the specific measures to reduce nonpoint sources of sediment by land use type.

7.3.2.1 Forested Land

In 1978, GA EPD designated the Georgia Forestry Commission (GFC) to be the lead agency in managing and implementing the silvicultural portion of Georgia's Nonpoint Source Management Program. The GFC is responsible for coordinating water quality issues with regard to forested land in Georgia. The GFC is basically responsible for:

- Developing Best Management Practices (BMPs) for the forestry industry,
- Educating the forestry community on BMPs, and
- Conducting site inspections for compliance with the established BMPs.

The GFC formed a Forestry Nonpoint Source Pollution Technical Task Force (FNSPTTF) to assess the extent of water pollution caused by forestry practices, and to develop recommendations for reducing or eliminating erosion and sedimentation. After a three-year field study, the task force developed a set of BMPs that address all aspects of silviculture, including forest road construction, timber harvesting, site preparation, and forest regeneration. The task force recommended the BMPs be implemented through a voluntary program, exempt from permitting under the Georgia Erosion and Sedimentation Control Act, emphasizing educational and training programs instead. In 1997, the original BMP document was revised to incorporate the 1989 Wetland BMP manual developed by the Georgia Forestry Association. This comprehensive BMP manual, *Georgia's Best Management Practices for Forestry* was released in January 1999. Additional guidance has been developed by the FNSPTTF since 1999. The current version of Georgia's forestry BMP manual, *Georgia's Best Management Practices for Forestry,* was released in January 2019 (GFC, 2019).

It is the responsibility of the GFC to educate and inform the forest community (landowners, procurement and land management foresters, consulting foresters, loggers, site prep and tree planting contractors) on the importance of BMPs. The GFC statewide program coordinator and the four regional specialists conduct educational programs across the state. The regional specialists receive specialized training in erosion and sediment control, forest road layout and construction, stream habitat assessment, wetland delineation, and fluvial geomorphology. The GFC has developed training videos, slide programs, tabletop exhibits, and BMP billboards that are displayed at wood yards across the state. For the benefit of private landowners selling timber, the GFC has developed a Sample Forest Products Sale Agreement, which includes fill in the blank spaces for specific BMP incorporation. Since December 1995, the GFC has been cooperating with the University of Georgia's School of Forest Resources, the Georgia Forestry Association, and American Forest and Paper Association (AFPA) member companies in the ongoing education of loggers and timber buyers through the Sustainable Forestry Initiative (SFI) Master Timber Harvester program. This includes an intensive training session on the BMPs conducted by the GFC. Since publication of the first BMP manual in 1981, the GFC has given

2,672 BMP talks to over 86,500 persons and participated in 492 field demonstrations of BMPs (through June 2013). The education process is ongoing, with workshops routinely provided for foresters, timber buyers and loggers through the Sustainable Forestry Initiative® (SFI®) Program in Georgia.

To determine if educational efforts have been successful and if the BMPs are effective at minimizing erosion and sedimentation, the GFC conducted BMP Implementation and Compliance Surveys in 1991, 1992, 1998, 2002, 2004, 2007, 2009, 2011, 2013, 2015, 2017, and 2019. In 1997, the Southern Group of State Foresters (SGSF) Task Force completed a newly developed and more rigorous survey protocol document titled *Silviculture Best Management Practices Implementation Monitoring – A Framework for State Forestry Agencies*. In 2002, this document was revised and re-published. Starting with the 1998 BMP implementation survey and every one thereafter, surveys were conducted using this protocol recommended by the SGSF Task Force. The GFC sampled about 10 percent of the forestry operations that occur annually. The number of samples taken in each county was based on the volume of wood harvested as reported in the state's latest Product Drain Report. Sites were randomly selected to reflect various forest types (non-industrial private forest, forest industry, and publicly owned lands). The statewide average BMP implementation has ranged from 65 percent in 1991 to the current rate of 90 percent. In 1991, approximately 86 percent of the acres evaluated were in compliance. This total acreage percentage increased to 92 percent compliance in 1992, 98 percent compliance in 1998, and over 99 percent compliance in 2013.

The GFC also investigates and mediates complaints or concerns involving forestry operations on behalf of the GA EPD and the Army Corps of Engineers (COE) when stream water quality and wetlands are involved, respectively. Complaints from citizens are common, particularly in counties growing in population where landowners are living close to commercial forestry operations. After notifying the forest owner, the GFC District Coordinator conducts a field inspection to determine if BMPs were followed, if the potential for water quality problems exists, and who is the responsible party. If the complaint is valid, GFC will work with the responsible party until the problem is corrected. However, the GFC has no regulatory authority. In situations where the GFC cannot get satisfactory compliance, the case is turned over to GA EPD or COE for enforcement actions under the Georgia Water Quality Control Act or Section 404 of the Federal Clean Water Act.

It is recommended that the GFC continue to encourage BMP implementation, educational training programs, and site compliance surveys. The numbers of individuals trained, and site compliance inspections should be recorded each year. In addition, the number of complaints received, the actions taken, and enforcement actions written should be recorded.

7.3.2.2 Agricultural Land

There are a number of agricultural organizations that work to support Georgia's more than 40,000 farms. The following three organizations have primary responsibility for working with farmers to promote soil and water conservation:

- The University of Georgia - Cooperative Extension Service
- Georgia Soil and Water Conservation Commission
- Natural Resources Conservation Service

The University of Georgia (UGA) has faculty, County Cooperative Extension Agents, and technical specialists who provide services in several key areas relating to agricultural impacts on

water quality. These include classroom instruction, basic and applied research, consulting assistance, and information on nonpoint source water quality impacts.

The Georgia Soil and Water Conservation Commission (GSWCC) was created in 1937 by a Georgia Legislative Act. In 1977, GA EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the state. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses. In September 1994, the GSWCC developed a BMP manual, *Agricultural Best Management Practices for Protecting Water Quality in Georgia,* for the agricultural community (GSWCC, 1994). To incorporate advances in BMP technology and include estimates of BMP effectiveness and cost, the GSWCC compiled and published a new BMP document in 2007 titled, *Best Management Practices for Georgia Agriculture*. In 2013, GSWCC published the 2nd edition of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013), which included an expanded section on nutrient management planning.

The Natural Resources Conservation Service (NRCS) cooperates with federal, state, and local governments to provide financial and technical assistance to farmers. NRCS develops standards and specifications for BMPs that are to be used to improve, protect, or maintain our state's natural resources. Practice standards establish the minimum level of acceptable quality for planning, designing, installing, operating, and maintaining BMPs. Practice specifications describe the technical details and workmanship required to install a BMP and the quality and extent of materials to be used in a BMP.

The NRCS provides Conservation Practice Standards, found in the electronic Field Office Technical Guide (FOTG); on their website (https://efotg.sc.egov.usda.gov/). Some of these BMPs may be used for farming operations to reduce soil erosion. It is recommended that the agricultural communities with cropland close to not supporting streams, and pastureland where grazing animals have access to the stream, investigate the various BMPs available to them in order to reduce soil erosion and bank collapse.

The 1996 Farm Bill and PL83-566 Small Watershed Program provided new financial assistance programs to address high priority environmental protection goals. Some programs that specifically address erosion and sedimentation are:

- The Environmental Quality Incentives Program
- Conservation Reserve Program
- Small Watershed Program

The Environmental Quality Incentives Program (EQIP) is a USDA cost-share program available to farmers to address natural resource problems. EQIP offers financial, educational and technical assistance funding for installing BMPs that reduce soil erosion, improve water quality, or enhance wildlife habitats.

The Conservation Reserve Program (CRP) was originally designed to provide incentive and offer assistance to farmers to convert highly erodible and other environmentally sensitive land normally devoted to crop production, to land with other long-term resource-conserving cover. CRP has been expanded to place eligible acreage into filter strips, riparian buffers, grassed waterways, or contour grass strips. Each of these practices helps to reduce erosion and sedimentation and improve water quality.

The Small Watershed Program provides financial and technical assistance funding for the installation of BMPs in watersheds less than 250,000 acres. This program is used to augment ongoing conservation programs where serious natural resource degradation has or is occurring. Agricultural water management, which includes projects that reduce soil erosion and sedimentation and improve water quality, is one of the eligible purposes of this program. NRCS is authorized by Public Law 83-566 to conduct river basin surveys and investigations. The NRCS River Basin Planning Program is designed to collect data on natural resource conditions within river basins of focus. NRCS is providing technical assistance to the GSWCC and the GA EPD with the Georgia River Basin Planning Program. Planning activities associated with this program will describe conditions of the agricultural natural resource base once every five years.

Every five years, the NRCS conducts the National Resources Inventory (NRI). The NRI is a statistically based sample of land use and natural resource conditions and trends, and it covers non-federal land in the United States. The NRI found that the total wind and water erosion on cropland and Conservation Reserve Program land in Georgia declined from 3.1 billion tons per year in 1982 to 1.9 billion tons per year in 1997, a reduction of 38 percent (USDA-NRCS, 1997).

NRCS also provides a web-based database application (Performance Results System, PRS) so conservation partners and the public can gain fast and easy access to the accomplishments and the progress made toward strategies and performance goals. The web site is http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/

It is recommended that the GSWCC and the NRCS continue to encourage BMP implementation, education efforts, and river basin surveys with regard to River Basin Planning. The five-year National Resources Inventory should be continued, and GA EPD supports the PRS website.

7.3.2.3 Mine Sites

Surface mining and mineral processing present two threats to surface waters. The first threat is the wastewater produced from mining and mineral processing operations. These discharges are considered point sources and are therefore regulated by NPDES permits. The second threat involves mine reclamation activities. Reclamation occurs throughout the mining operation. From the first cut to the last, overburden is moved twice. With each movement of the soil and rock debris, the overburden must be managed to prevent soil and mineral erosion. Until the mine is re-vegetated, and hence reclaimed, BMPs must be implemented to prevent nonpoint source pollution.

The Georgia Surface Mining Act of 1968 provides for the issuance of mining permits at the discretion of the Director of GA EPD. These permits are administered by the Land Protection Branch of GA EPD. The surface mining permit application must include a Surface Mining Land Use Plan, reclamation strategies, and surety bond requirements to guarantee proper management and reclamation of surface mined areas. The Surface Mining Land Use Plan specifies activities prior to, during, and following mining to dispose of refuse and control erosion and sedimentation. The reclamation strategy includes the use of operational BMPs and procedures. The BMPs used are drawn from the *Manual for Erosion and Sedimentation Control in Georgia*, *Georgia's Best Management Practices for Forestry*, and from other states. Thus, the issuance of a surface mining permit in effect addresses BMPs to control nonpoint source pollutants. The regional GA EPD offices monitor and inspect surface mining sites to assess permit compliance.

It is recommended that special attention be given to those facilities located in not supporting watersheds. The implementation and maintenance of BMPs used to control erosion should be reviewed during the site inspections.

The Georgia Mining Association (GMA) is an informal trade association of the mining industry. It serves more than 200 members, 47 mining companies and over 150 associate companies. The association monitors legislative developments and coordinates industry response. It educates miners about laws and regulations that affect them and provides a forum for the exchange of ideas. Through its newsletters, seminars, workshops, and annual conventions, the GMA serves as a source for mining industry information. It has several committees, including the Environmental Committee, that meet three to four times a year. The mining industry is conducting informal discussions on the potential of developing industry-wide standards for BMPs to prevent and reduce nonpoint source pollution. If these standards are adopted, the mining industry would likely conduct demonstration projects to gauge the effectiveness of the BMPs.

7.3.2.4 Roads

Unpaved roads can be a major contributor of sediment to our waterways if not properly managed. Under the Georgia Better Back Roads Program, the Georgia Resource Conservation and Development Council (GARC&D) led a partnership of natural resource agencies and County Administrators that developed the *Georgia Better Back Roads Field Manual* in 2009 (GA RCDC, 2009). In addition to publishing Georgia's first unpaved road improvement field manual with the goal of improving water quality through the identification of cost-effective techniques/materials for stabilizing road surfaces and ditches, the Georgia Better Back Roads Program has worked to establish statewide demonstration sites and provides statewide training opportunities for public works officials responsible for maintaining unpaved roads. USEPA has also distributed *Recommended Practices Manual, A Guideline for Maintenance and Service of Unpaved Roads* (Choctawhatchee, et. al, 2000) as guidance for the maintenance and service of unpaved roadways, drainage ditches, and culverts to be used to minimize roadway erosion.

Disturbances to unpaved roadway surfaces and ditches, and poor road surface drainage, result in deterioration of the road surface. This leads to increased roadway erosion and, thus, stream sedimentation. Unpaved roads are typically maintained by blading and/or scraping of the roads to remove loose material. Proper, timely, and selective surface maintenance can prevent and minimize erosion of unpaved roadways. This in turn lengthens the life of the road and reduces maintenance costs. Roadway blading that occurs during periods when there is enough moisture content allows for immediate re-compaction. In addition, roadwork performed near streams or stream-crossings during "dry" months of the year can reduce the amount of sediment that enters a stream.

Roadside ditches convey storm water runoff to an outlet. A good drainage ditch is shaped and lined with appropriate vegetative or structural material. A well-vegetated ditch slows, controls, and filters the storm water runoff, providing an opportunity for sediments to be removed from the runoff before it enters surface waters. Energy dissipating structures to reduce velocity, dissipate turbulence or flatten flow grades in ditches are often necessary. Efficient disposal of runoff from the road helps preserve the roadbed and banks. Properly installed "turn-outs" or intermittent discharge points help to maintain a stable velocity and proper flow capacity within the ditch by timely outleting water from them. This in turns alleviates roadway flooding, erosion, and maintenance problems. Properly placed "turn-outs" distribute roadway runoff and sediments over

a larger vegetative filtering area, helping to reduce roadside ditch maintenance to remove accumulated sediment.

Culverts are conduits used to convey water from one side of a road to another. Installation, modification, and/or improvements of culverts when stream flows and expected rainfall is low can reduce the amount of sediment that enters a stream. If the entire installation process, from beginning to end, can be completed before the next rainfall event, stream sedimentation can be minimized. Diverting all existing or potential stream flows while the culvert is being installed can also help reduce or avoid sedimentation below the installation. The culvert design can have a significant impact on the biological community if the size and species of fish passing through it are not considered. Changes in water velocities and the creation of vertical barriers affect the biological communities.

7.3.2.5 Urban Development

The Erosion and Sedimentation Act, established in 1975, provides the mechanism for controlling erosion and sedimentation from land-disturbing activities. This Act establishes a permitting process for land-disturbing activities. Many local governments and counties have adopted erosion and sedimentation ordinances and have been given authority to issue and enforce permits for land-disturbing activities. Approximately 100 counties and 220 municipalities in Georgia have been certified as the local issuing authority (GSWCC, 2021). In areas where local governments have not been certified as an issuing authority, the GA EPD is responsible for permitting, inspecting, and enforcing the Erosion and Sedimentation Act.

To receive a land-disturbing permit, an applicant must submit an erosion and sedimentation control plan that incorporates specific conservation and engineering BMPs. The *Manual for Erosion and Sediment Control in Georgia*, developed by the Georgia Soil and Water Conservation Commission, may be used as a guide to develop erosion and sedimentation control plans (GSWCC, 2016)

Local governments, with oversight by the GA EPD, and the Soil and Water Conservation Districts, are primarily responsible for implementing the Georgia Erosion and Sedimentation Act, O.C.G.A. §12-7-1 (amended in 2003). Reports of suspected violations are made to the agency that issued the permit. In cases with local issuing authority, if the violation continues, the complaint is referred to the appropriate Soil and Water Conservation District. If the situation remains unresolved, the complaint is then referred to GA EPD for enforcement action. Enforcement may include administrative orders, injunctions, and civil penalties. It is recommended that the local and state governments continue to work to implement the provisions of the Georgia Erosion and Sedimentation Act across Georgia.

Storm water runoff from developed urban areas (post-construction) can also have an impact on the transport of sediment to and within streams. Urbanization increases imperviousness, resulting in an increase in the volume of runoff that enters the streams. In addition, the stream flow rates may increase significantly from pre-construction rates. These changes in the stream flow can result in stream bank erosion and stream bottom down cutting.

It is recommended that local governments review and consider implementation of practices presented in following planning and management documents. Up-to-date versions of these documents may be found online.

- *Georgia Stormwater Management Manual* (the "Blue Book") (ARC, 2016), the development of the Blue Book was facilitated by the Atlanta Regional Commission in 2001 for use as a multi-volume document designed to provide guidance on stormwater management policy, technical design standards and pollution prevention. The Blue Book was thoroughly revised in 2016.
- *Coastal Stormwater Supplement to the Georgia Stormwater Management Manual* (CCSMPC, 2009), the development of the CSS was facilitated by the Chatham County-Savannah Metropolitan Planning Commission for use in the 24-county coastal region of Georgia. It provides comprehensive guidance on an integrated, green infrastructure-based approach to natural resource protection, stormwater management and site design that can be used by Georgia's coastal communities.
- Georgia's Coastal Management Program developed *Green Growth Guidelines, Edition II* (GA CMP, 2014), which outlines the environmental, social, and economic benefits from use of low impact development (LID) strategies when compared to today's conventional development approach.
- *Land Development Provisions to Protect Georgia Water Quality* (GA EPD, 1997).

Compliance with NPDES permits, the Erosion and Sedimentation Control Act, and local ordinances related to land disturbing activities will contribute to controlling sediment delivery from regulated activities and may help to achieve the reductions necessary to meet the TMDL. Using federal, state, and local laws, enforcement actions are available as a remedy for excess sediment coming from regulated sources. These may include land clearing for non-agricultural use, construction, wastewater discharges, and excessive sediment run-off from other land disturbing activities. The local issuing authority typically enforces these laws. However, the enforcement may be deferred to GA EPD if the local city or county government is not the issuing authority or further and action is needed.

7.4 Public Education

Public education efforts target individual stakeholders to provide information regarding the use of BMPs to protect water quality. GA EPD will continue efforts to increase awareness and educate the public about the impact of human activities on water quality.

The GAEPD's Non-Point Source Program (NPSP) provides assistance with non-point source pollution management grants, TMDL and watershed planning resources, and environmental education, outreach, and resources. Grant information can be found here: http://epd.georgia.gov/section-319h-georgias-nonpoint-source-implementation-grant. Outreach programs such as Rivers Alive, Adopt-A-Stream, Project WET, and River of Words can be found here: https://epd.georgia.gov/outreach/outreach-educational-programs.

7.5 Monitoring

Monitoring of sediment through the measurement of total settable solids or TSS may be carried out through GA EPD's Adopt-A-Stream program. If it is determined through stakeholder involvement that this type of monitoring should take place, GA EPD will work with the entity that assumes responsibility for monitoring activities by providing the necessary training and taking the needed steps to establish a well-organized monitoring program.

7.6 Future Action

This Initial TMDL Implementation Plan includes a general approach to pollutant source identification as well as management practices to address pollutants. In the future, GA EPD will continue to determine and assess the appropriate point and non-point source management measures needed to achieve the TMDLs and also to protect and restore water quality in not supporting water bodies.

For point sources, any wasteload allocations for wastewater treatment plant facilities will be implemented in the form of water-quality based effluent limitations in NPDES permits. Any wasteload allocations for regulated storm water will be implemented in the form of best management practices in the NPDES permits. Contributions of sediment from regulated communities may also be managed using permit requirements such as watershed assessments, watershed protection plans, and long-term monitoring. These measures will be directed through current point source management programs.

GA EPD will work to support watershed restoration, improvement and protection projects that address non-point source pollution. This is a process whereby GA EPD and/or Regional Commissions or other agencies or local governments, under a contract with GA EPD, will develop a watershed management plan intended to address water quality at the small watershed level (HUC 10 or smaller). These plans will be developed as resources and willing partners become available. The development of these plans may be funded via several grant sources including but not limited to Clean Water Act Section 319(h), Section 604(b), and/or Section 106 grant funds. These plans are intended for implementation upon completion.

Any watershed management plan that specifically address water bodies contained within this TMDL will supersede the Initial TMDL Implementation Plan for that water body, once GA EPD accepts and/or approves the plan. Watershed management plans intended to address this TMDL and other water quality concerns, written by GA EPD and for which GA EPD and/or the GA EPD Contractor are responsible, will contain at a minimum the USEPA's 9-Key Elements of Watershed Planning:

1) An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load allocations or achieve water quality criteria. Sources should be identified at the subcategory level (with estimates of the extent to which they are present in the watershed (e.g., X numbers of cattle feedlots needing upgrading, Y acres of row crops needing improved sediment control, or Z linear miles of eroded streambank needing remediation);

2) An estimate of the load reductions expected for the management measures;

3) A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality criteria;

4) An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5) An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6) A schedule for implementing the management measures that is reasonably expeditious;

7) A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8) A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality criteria and, if not, the criteria for determining whether the plan needs to be revised; and;

9) A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8).

The public will be provided an opportunity to participate in the development of watershed management plans that address water bodies not supporting their designated uses that are listed in this TMDL and to comment on them before they are finalized.

GA EPD will continue to offer technical and financial assistance (when and where available) to complete watershed management plans that address the water bodies not supporting their designated uses listed in this and other TMDL documents. Assistance may include but will not be limited to:

- Assessments of pollutant sources within watersheds;
- Determinations of appropriate management practices to address impairments;
- Identification of potential stakeholders and other partners;
- Developing a plan for outreach to the general public and other groups;
- Assessing the resources needed to implement the plan upon completion; and
- Other needs determined by the lead organization responsible for plan development.

GA EPD will also make this same assistance available, if needed, to proactively address water quality concerns. This assistance may be in the way of financial, technical, or other aid and may be requested and provided outside of the TMDL process or schedule.

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APPENDIX A

Total Allowable Sediment Load Summary Memorandum

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Beaverdam Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Morgan**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Beaverdam Creek**
Location:	**Headwaters to Big Sandy Creek**
Stream Length:	**9 miles**
Watershed Area:	**4.2 square miles**
Reach ID:	**GAR030701010910**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**1310.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1310.5 tons/yr**
Maximum Allowable Daily Load:	**169.8 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Bowden Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Greene**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Bowden Creek**
Location:	**Unnamed tributary at I-20 to Beaverdam Creek**
Stream Length:	**4 miles**
Watershed Area:	**7.6 square miles**
Reach ID:	**GAR030701011108**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**3491.0 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**3491.0 tons/yr**
Maximum Allowable Daily Load:	**452.4 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Buckeye Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Johnson, Laurens, Washington**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Buckeye Creek**
Location:	**Fords Creek to Kellams Creek**
Stream Length:	**5 miles**
Watershed Area:	**38.0 square miles**
Reach ID:	**GAR030701020802**
Ecoregion:	**Southeastern Plains**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**20170.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**20170.9 tons/yr**
Maximum Allowable Daily Load:	**532.5 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Cedar Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Clarke**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Cedar Creek**
Location:	**Headwaters to Oconee River, Athens**
Stream Length:	**4 miles**
Watershed Area:	**4.2 square miles**
Reach ID:	**GAR030701010601**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**462.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**938.2 tons/yr**
Maximum Allowable Daily Load:	**121.6 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Cedar Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jasper, Jones**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Cedar Creek**
Location:	**King Branch to Big Cedar Creek**
Stream Length:	**14 miles**
Watershed Area:	**27.6 square miles**
Reach ID:	**GAR030701011705**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**12559.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**12559.9 tons/yr**
Maximum Allowable Daily Load:	**1627.8 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Fishing Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Greene, Oglethorpe**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Fishing Creek**
Location:	**Pond at headwaters to McWhorter Creek**
Stream Length:	**6 miles**
Watershed Area:	**4.8 square miles**
Reach ID:	**GAR030701010708**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**1514.3 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1514.3 tons/yr**
Maximum Allowable Daily Load:	**196.2 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Greenbrier Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Greene, Oconee**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Greenbrier Creek**
Location:	**Salem Scull Shoals Road to Lake Oconee**
Stream Length:	**8 miles**
Watershed Area:	**16.4 square miles**
Reach ID:	**GAR030701010704**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**7192.1 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**7196.8 tons/yr**
Maximum Allowable Daily Load:	**932.7 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Horse Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Morgan**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Horse Branch**
Location:	**Headwaters to North Sugar Creek**
Stream Length:	**4 miles**
Watershed Area:	**2.5 square miles**
Reach ID:	**GAR030701011314**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**0.5 tons/yr**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**1480.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1480.9 tons/yr**
Maximum Allowable Daily Load:	**191.9 tons/day**
% Reduction:	**2.6%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Kimbro Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Greene**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Kimbro Creek**
Location:	**Headwaters to Hightower Creek**
Stream Length:	**4 miles**
Watershed Area:	**3.5 square miles**
Reach ID:	**GAR030701011210**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**1082.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1082.5 tons/yr**
Maximum Allowable Daily Load:	**140.3 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Lane Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Oconee
Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: Lane Creek
Location: Pond 0.6 miles upstream of Snows Mill Road to pond 0.9 miles downstream of Lane Creek Road
Stream Length: 2 miles
Watershed Area: 2.3 square miles
Reach ID: GAR030701011010
Ecoregion: Piedmont

Violation: Bio F
Constituent(s) of Concern: Sediment

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Criteria:
All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling: Universal Soil Loss Equation was used to determine the average annual sediment load

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA): N/A
Industrial Sites: Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls
Future Construction Sites Meet requirements of NPDES General Storm Water Permit

Load Allocation (LA): 892.1 tons/yr

Margin of Safety (MOS): implicit

Total Allowable Sediment Load: 892.1 tons/yr
Maximum Allowable Daily Load: 115.6 tons/day
% Reduction: 0.0%

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Morgan**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Little Creek**
Location:	**Headwaters to Big Sandy Creek**
Stream Length:	**5 miles**
Watershed Area:	**3.4 square miles**
Reach ID:	**GAR030701010912**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**2024.1 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2024.1 tons/yr**
Maximum Allowable Daily Load:	**262.3 tons/day**
% Reduction:	**30.1%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little River

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Newton, Walton**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Little River**
Location:	**Social Circle to I-20**
Stream Length:	**4 miles**
Watershed Area:	**3.8 square miles**
Reach ID:	**GAR030701011410**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**29.7 tons/yr**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**2204.1 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2233.8 tons/yr**
Maximum Allowable Daily Load:	**289.5 tons/day**
% Reduction:	**5.8%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Tributary to Little River (#2)

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Putnam**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Tributary to Little River (#2)**
Location:	**Eatonton to Little River**
Stream Length:	**3 miles**
Watershed Area:	**4.4 square miles**
Reach ID:	**GAR030701011501**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**16.7 tons/yr**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**2619.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2636.4 tons/yr**
Maximum Allowable Daily Load:	**341.7 tons/day**
% Reduction:	**42.2%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Lowry Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jasper**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Lowry Branch**
Location:	**Jasper County**
Stream Length:	**3 miles**
Watershed Area:	**2.0 square miles**
Reach ID:	**GAR030701011604**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing, Drinking Water (not supporting Fishing designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**1176.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1176.6 tons/yr**
Maximum Allowable Daily Load:	**152.5 tons/day**
% Reduction:	**58.8%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Marburg Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Barrow**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Marburg Creek**
Location:	**Masseys Lake to Apalachee River**
Stream Length:	**7 miles**
Watershed Area:	**25.7 square miles**
Reach ID:	**GAR030701010806**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**18.3 tons/yr**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**12416.8 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**12435.1 tons/yr**
Maximum Allowable Daily Load:	**1611.6 tons/day**
% Reduction:	**0.1%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Tributary to Mulberry River

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jackson**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Tributary to Mulberry River**
Location:	**Headwaters to Mulberry River**
Stream Length:	**5 miles**
Watershed Area:	**4.4 square miles**
Reach ID:	**GAR030701010211**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	**N/A**
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**2134.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2608.3 tons/yr**
Maximum Allowable Daily Load:	**338.0 tons/day**
% Reduction:	**64.2%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
North Fork Wolf Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jasper**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**North Fork Wolf Creek**
Location:	**Headwaters to South Fork Wolf Creek**
Stream Length:	**9 miles**
Watershed Area:	**10.7 square miles**
Reach ID:	**GAR030701011616**
Ecoregion:	**Piedmont**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Industrial Sites:	**Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls**
Future Construction Sites	**Meet requirements of NPDES General Storm Water Permit**
Load Allocation (LA):	**4315.3 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**4315.3 tons/yr**
Maximum Allowable Daily Load:	**559.3 tons/day**
% Reduction:	**0.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
North Sugar Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Morgan
Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: North Sugar Creek
Location: Unnamed tributary 0.2 miles upstream of Plainview Road to South Sugar Creek
Stream Length: 4 miles
Watershed Area: 7.9 square miles
Reach ID: GAR030701011313
Ecoregion: Piedmont

Violation: Bio F
Constituent(s) of Concern: Sediment

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Criteria:
All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling: Universal Soil Loss Equation was used to determine the average annual sediment load

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA): 30.6 tons/yr
Industrial Sites: Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls
Future Construction Sites Meet requirements of NPDES General Storm Water Permit

Load Allocation (LA): 4692.7 tons/yr

Margin of Safety (MOS): implicit

Total Allowable Sediment Load: 4723.3 tons/yr
Maximum Allowable Daily Load: 612.1 tons/day
% Reduction: 4.1%

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Stewarts Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Greene
Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: Stewarts Creek
Location: Pond 0.5 miles downstream of Billy Merritt Road to Lake Oconee
Stream Length: 6 miles
Watershed Area: 6.3 square miles
Reach ID: GAR030701011107
Ecoregion: Piedmont

Violation: Bio F
Constituent(s) of Concern: Sediment

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Criteria:
All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling: Universal Soil Loss Equation was used to determine the average annual sediment load

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA): N/A
Industrial Sites: Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls
Future Construction Sites Meet requirements of NPDES General Storm Water Permit

Load Allocation (LA): 3488.5 tons/yr

Margin of Safety (MOS): implicit

Total Allowable Sediment Load: 3488.4 tons/yr
Maximum Allowable Daily Load: 452.1 tons/day
% Reduction: 0.0%

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Wildcat Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Oconee
Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: Wildcat Creek
Location: Headwaters to tributary 0.8 miles downstream of Kirkland Rd
Stream Length: 2 miles
Watershed Area: 1.1 square miles
Reach ID: GAR030701010609
Ecoregion: Piedmont

Violation: Bio F
Constituent(s) of Concern: Sediment

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Criteria:
All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling: Universal Soil Loss Equation was used to determine the average annual sediment load

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA): N/A
Industrial Sites: Meet requirements of NPDES General Industrial Storm Water Permit, Utilize BCT/BAT Controls
Future Construction Sites Meet requirements of NPDES General Storm Water Permit

Load Allocation (LA): 269.5 tons/yr

Margin of Safety (MOS): implicit

Total Allowable Sediment Load: 269.5 tons/yr
Maximum Allowable Daily Load: 34.9 tons/day
% Reduction: 0.0%