Total Maximum Daily Load

Evaluation

for

Twenty-eight Stream Segments

in the

Flint River Basin

For Sediment

(Biota Impacted)

Submitted to:

The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses, 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* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list 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 TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

The State of Georgia has identified twenty-eight (28) stream segments located in the Flint River Basin as water quality limited (i.e. 303(d) listed as Biota Impacted) due to sedimentation. The water use classification of all of the impacted streams is Fishing. The general water quality criteria not being met states:

> 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.

The Biota Impacted designation indicates that studies have shown a modification of the biological community, more specifically, fish. In 1990, 1998, 1999, and 2000 the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations. WRD used the Index of Biotic Integrity (IBI) and modified Index of Well-Being (IWB) to identify affected fish populations. The IBI and IWB values were used to classify the population as Excellent, Good, Fair, Poor, or Very Poor. Stream segments with fish populations rated as Poor or Very Poor were included in the partially supporting list. As a result, twenty-eight stream segments in the Flint River Basin were added to the State's 303(d) list and scheduled for a TMDL evaluation. Forty-two stream segments, assessed and rated as Excellent, Good, and/or Fair, were considered as supporting uses.

The general cause of low IBI scores is the lack of fish habitat due to stream sedimentation. 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 303(d) listed watersheds utilized the Universal Soil Loss Equation (USLE). The USLE predicts the average annual soil loss caused by erosion. The USLE method considered the characteristics of the watershed including land use, soil type, ground slope, and road surface. National Pollutant Discharge Elimination System (NPDES) permitted discharges were also considered. Modeling assumptions were considered conservative and provide the necessary implicit margin of safety for the TMDL.

The USLE was applied to both the 303(d) listed watersheds and those not biologically impacted to determine both the existing sediment loading rates and the sediment load reductions needed to support beneficial use (i.e. unimpacted conditions). The average sediment loads in the 303(d) listed watersheds in the Piedmont and Southeastern Plains ecoregions are 0.72 tons/acre/yr (ranging from 0.42 to 0.99 tons/acre/yr) and 1.04 tons/acre/yr (ranging from 0.41 to 1.87 tons/acre/yr), respectively. The average sediment loads of the watersheds in the Piedmont and Southeastern Plains ecoregions not on the 303(d) list are 0.37 tons/acre/yr (ranging from 0.10 to 0.53 tons/acre/yr) and 1.10 tons/acre/yr (ranging from 0.39 to 3.61 tons/acre/yr), respectively. These values represent sediment load contributions from all land uses within unimpaired watersheds. Note that the average annual sediment loads for both watershed groups are generally within the same range.

Table 1 shows that approximately 92.37 percent of the average sediment load in the Flint River Basin watersheds modeled results from row crops with an average sediment load of 3.65 tons/acre/yr. Approximately 0.74 percent of the total sediment load is from pastureland with an average load of 0.06 tons/acre/yr. In the modeled Flint River Basin watersheds, mining activities contribute approximately 2.03 percent of the total sediment load with an average load of 15.06 tons/acre/yr. Roads contribute approximately 2.93 percent of the total sediment load, forests make up about 0.24 percent of the total load with an average load of 0.004 tons/acre/year, and urban land contributes approximately 0.27 percent of the total sediment load with an average load of 0.23 tons/acre/yr. Estimates of the sediment contribution from construction are not available, but could represent a relatively high sediment load per acre.

Table 1. Summary of Current Conditions in the Flint River Basin

Land Use	Average Percent Land Use	Average Percent Sediment Load	Average Sediment Load (tons/acre/yr)
Open Water	0.72%	0.00%	0.00
Urban	1.07%	0.27%	0.23
Bare Rock, Sand and Clay	0.00%	0.00%	0.00
Quarries, Strip Mines, Gravel Pits	0.12%	2.03%	15.06
Transitional Land	4.56%	0.17%	0.03
Forest	50.43%	0.24%	0.004
Pasture/Hay	10.30%	0.74%	0.06
Row Crops	22.59%	92.37%	3.65
Grasses, Wetland	10.22%	1.24%	0.11
Roads		2.93%	

These data indicate that row crops are the major source of sediment to our rivers and streams. However, over the last century there has been a dramatic 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, streams will repair themselves over time.

This TMDL determines the allowable sediment loads to the impaired Flint River Basin streams and is based on the hypothesis that an impaired watershed having an annual average sediment loading rate similar to the biological reference watersheds will remain stable and not be biologically impaired due to sediment. The average sediment loads of the reference watersheds in the Piedmont and Southeastern Plains ecoregions within the Chattahoochee and Flint River basins are 0.63 tons/acre/yr (ranging from 0.30 to 1.26 tons/acre/yr) and 1.10 tons/acre/yr (ranging from 0.28 to 1.84 tons/acre/yr), respectively. The annual average sediment loads for each of the impaired watersheds are summarized in the table below with any required sediment load reductions.

Annual Average Sediment Loads and the Required Sediment Load Reductions

Name	Current Load (tons/yr)	WLA (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	% Reduction
Basin Creek	2,968		2,527	2,527	15%
Heads Creek	7,520	3.0	7,517	7,520	0%
Lewis Creek	830		830	830	0%
North Branch	591		591	591	0%
Potato Creek middle	11,400	91.3	9,260	9,351	17%
Town Branch low	1,457		1,205	1,205	17%
Whitewater Creek	3,269		3,269	3,269	0%
Willingham Spring Creek	2,189		1,425	1,425	35%
Angelica Creek	10,396		6,430	6,430	38%
Avera Creek	766		766	766	0%
Bailey Branch	10,156		5,982	5,982	41%
Baptist Branch	1,366	60.0	1,306	1,366	0%
Beaver Creek	2,135		2,135	2,135	0%
Cooleewahee Creek	40,460		40,460	40,460	0%
Gum Creek	26,546	229.0	17,511	17,740	33%
Lee Creek	3,497		2,877	2,877	18%
Little Whitewater Ck	22,102		22,102	22,102	0%
Mercer Mill Creek	34,297		29,945	29,945	13%
Middle Creek	3,025		3,025	3,025	0%
Muckaloochee Creek	21,589		21,589	21,589	0%
Patsiliga Creek	12,273		12,273	12,273	0%
Pessell Creek	5,532	5.5	5,527	5,532	0%
Rambulette Creek	2,778		2,778	2,778	0%
Shoal Creek	17,700		17,700	17,700	0%
Spring Creek	52,232	13.7	52,219	52,232	0%
Sweetwater Creek	31,605	1.6	24,086	24,087	24%
Whitewater Creek	2,503		2,221	2,221	11%
Wolf Creek	9,116		9,116	9,116	0%

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

- Compliance with the requirements of the NPDES permit program
- Implementation of Georgia Forestry Commission (GFC) Best Management Practices for forestry
- Adoption of Natural Resources Conservation Service (NRCS) Conservation Practices
- Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit Application
- Adoption of proper unpaved road maintenance practices
- Implementation of Erosion and Sedimentation Control Plans for land disturbing activities
- Mitigation and prevention of stream bank erosion due to increased streamflow velocities caused by urban runoff

The amount of sediment delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, their effects will improve stream habitats and water quality, and represent a beneficial measure of TMDL implementation.

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses 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 addresses the assessment process, and are published in *Water Quality in Georgia* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list 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 TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

In 1990, 1998, 1999, and 2000, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations at a number of monitoring sites in the Flint River Basin. WRD used the Index of Biotic Integrity (IBI) and modified Index of Well-Being (IWB) to identify affected fish populations. The IBI and IWB values were used to classify the populations as Excellent, Good, Fair, Poor, or Very Poor. Stream segments with fish populations rated as Poor or Very Poor were listed as Biota Impacted. The Biota Impacted designation indicates that studies have shown a significant modification of the biological community. Twenty-eight stream segments (see Table 2) were rated as Poor or Very Poor, placed on the 303(d) list as partially supporting their designated water use, and scheduled for TMDL evaluation. Forty-two stream segments were rated as Excellent, Good, or Fair and assessed as supporting their designated water use.

1.2 Watershed Description

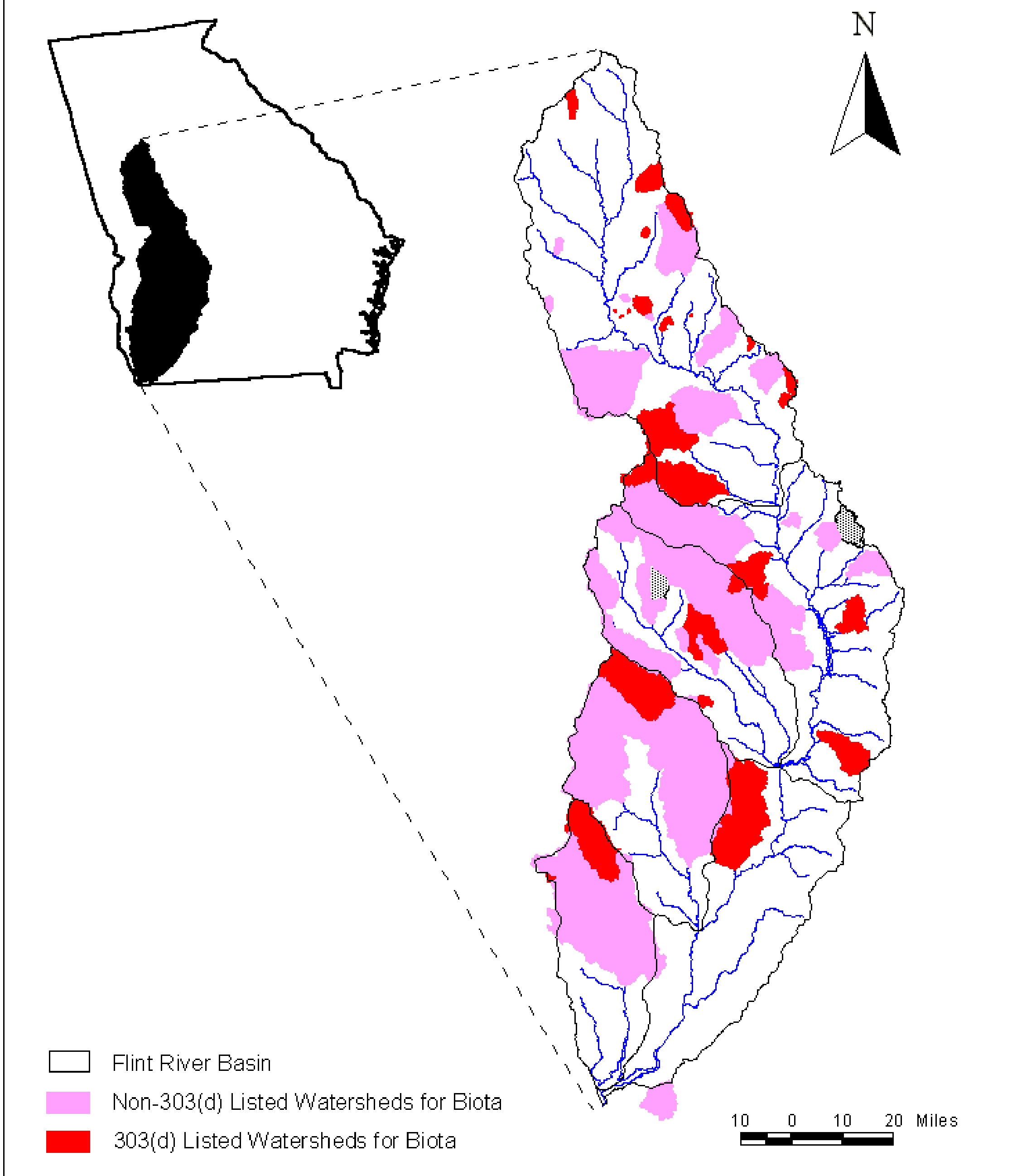
The twenty-eight impaired stream segments (made up of thirty watersheds) are located in the Flint River Basin in middle and southwest Georgia. These watersheds incorporate the following counties: Baker, Calhoun, Clay, Crawford, Crisp, Dooly, Dougherty, Early, Fayette, Fulton, Lamar, Lee, Macon, Marion, Pike, Randolph, Schley, Spaulding, Stewart, Sumter, Talbot, Taylor, Terrell, Upson, Webster, and Worth (see Figure 1). The forty-two unimpaired watersheds are located in Baker, Calhoun, Chattahoochee, Clay, Crawford, Decatur, Dooly, Dougherty, Early, Harris, Houston, Lamar, Lee, Macon, Marion, Meriwether, Miller, Monroe, Pike, Randolph, Schley, Seminole, Spaulding, Stewart, Sumter, Talbot, Taylor, Terrell, Upson, and Webster Counties.

The land use characteristics of the Flint River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 3 lists the land use distribution of the eighty-six watersheds WRD monitored in 1998 through 2000. The watersheds are grouped by

Table 2. 303(d) Listed Stream Segments located in the Flint River Basin

STREAM	STATUS	LOCATION	MILES
Angelica Creek	Partially Supporting	Unnamed Tributary 1.9 miles u/s US Hwy 19 to Lake Collins (Sumter Co)	2
Avera Creek	Partially Supporting	Headwaters to Beaver Creek (Crawford Co)	4
Bailey Branch	Partially Supporting	Headwaters to Little Lime Creek (Sumter Co)	8
Baptist Branch	Partially Supporting	Downstream Blakely (Early Co)	2
Basin Creek	Partially Supporting	Upson County	6
Beaver Creek	Partially Supporting	Headwaters to Spring Creek (Crawford Co)	11
Cooleewahee Creek	Not Supporting	Piney Woods Branch to Flint River near Newton (Dougherty/Baker Co)	16
Gum Creek	Not Supporting	Downstream Cordele to Lake Blackshear (Crisp Co)	6
Heads Creek	Partially Supporting	D/S Griffin Reservoir to Wildcat Creek (Spalding Co)	2
Lee Creek	Partially Supporting	D/S Lake Henry to Beaver Creek (Crawford Co)	1
Lewis Creek	Partially Supporting	Pike County	2
Little Whitewater Creek	Partially Supporting	Black Creek to Whitewater Creek (Taylor Co)	6
Mercer Mill Creek (Mill Ck)	Partially Supporting	Boy Scout Road to Flint River (Worth Co)	7
Middle Creek	Partially Supporting	Headwaters to Kinchafoonee Creek (Terrell Co)	8
Muckaloochee Creek	Partially Supporting	Little Muckaloochee Creek to Smithville Pond (Sumter Co)	5
North Branch	Partially Supporting	Crawford County	4
Patsiliga Creek	Partially Supporting	Headwaters to McCants Mill Pond (Talbot/Taylor Co)	15
Pessell Creek	Partially Supporting	Headwaters to Kinchafoonee Creek (Sumter Co)	8
Potato Creek	Partially Supporting	Headwaters to US Hwy 333 (Spalding/Lamar Co)	11
Rambulette Creek	Partially Supporting	Headwaters to Whitewater Creek (Taylor Co)	9
Shoal Creek	Partially Supporting	Little Shoal Creek to Little Creek (Marion Co)	3
Spring Creek	Partially Supporting	SR 62 near Arlington to Aycocks Creek (Early/Miller Co)	22
Sweetwater Creek	Not Supporting	Headwaters to Flint River, Andersonville (Sumter/Macon Co)	9
Town Branch	Partially Supporting	Thomaston (Upson Co)	4
Whitewater Creek	Partially Supporting	Upstream Lee Lake (Fayette Co)	6
Whitewater Creek	Partially Supporting	Headwaters to Little Whitewater Creek (Taylor Co)	9
Willingham Spring Creek	Partially Supporting	Upson County	3
Wolf Creek	Partially Supporting	Headwaters to Ichawaynochaway Creek (Terrell Co)	9

Source: GAEPD, 1998-1999. *Water Quality in Georgia, 1998-1999,* Georgia Department of Natural Resource, Environmental Protection Division.



TMDL Evaluation - Biota Flint River Basin	Figure 1. Non-303(d) Listed and 303(d) Listed Watersheds Monitored in the Flint River Basin for Biota

those that are not on the 303(d) list and those that are on the 303(d) list, as well as by ecoregion (Piedmont and Southeastern Plain). Any impaired upstream watersheds that contribute to an impaired listed downstream watershed are shaded gray. Table 4 lists the land use percentages for all the Flint River Basin watersheds monitored. The data show that the watersheds are predominately forested with approximately 56.97 percent (ranging from 13.27 to 94.45 percent) in forest use. Agriculture is the next predominate land use with approximately 17.51 percent cropland (ranging from 0.63 – 59.26 percent) and approximately 10.87 percent pasture land (ranging from 0.75 to 38.42 percent).

The soil characteristics of the Flint River Basin watersheds were determined using data from the State Soil Geographic (STATSGO) coverage. This coverage provides major soil type classifications. Table 5 lists the soil type distribution of the monitored watersheds.

1.3 Water Quality Standard

The water use classification for the impaired watersheds in the Flint River Basin is Fishing. The criterion violated is listed as Biota Impacted, which indicates studies have shown a significant impact to fish. The potential cause(s) listed include urban runoff, nonpoint sources, unknown sources, and industrial facilities. The purpose of the narrative standard 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.

Table 3. Land Use Distribution (Unimpaired – Piedmont Ecoregion)

	Area (acres)															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Total
Auchumpkee Creek	99.9	11.8	1.1	31.4	0.4		1,821.6	8,050.4	9,320.0	3,175.5	2,340.2	547.5	28.9	1,653.4	9.8	27,091.8
Baroucho Creek	6.4	0.2		0.7				461.9	78.9	223.1	28.9	5.1	1.1	2.4		808.8
Big Lazer Creek	378.7	221.7	33.4	151.9			4,415.3	39,335.1	28,175.1	24,359.6	5,233.0	2,353.1	143.0	2,768.5	57.4	107,625.7
Brittens Creek		0.4		3.3			3.1	677.4	711.4	496.1	329.8	110.5				2,332.2
Five Mile Creek	1.6			11.6				288.0	188.4	215.3	191.0	41.8	0.4	4.0		942.0
Kendall Creek	40.5	4.7	1.1	0.7			50.0	872.4	757.7	660.9	183.7	40.7	0.2	13.3		2,625.9
Lazer Creek	102.3	67.6	2.7	25.8			1,275.6	8,763.6	4,376.1	4,081.9	1,070.1	490.4	34.5	180.8	0.4	20,471.8
Mock Woodall Branch	6.2			0.7				556.2	95.0	268.6	200.4	48.9		4.2		1,180.2
Potato Creek low	689.0	1,195.3	199.3	813.9		117.9	209.0	13,569.8	8,472.9	12,983.4	13,240.7	3,612.5	407.9	3,419.4	57.2	58,988.1

Table 3. Land Use Distribution (Unimpaired – Southeastern Plains Ecoregion)

	Area (acres)														
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Total
Bear Creek	266.0	36.7	14.0	28.0	2.0		1,620.8	6,457.2	6,202.4	6,775.7	3,135.7	13,982.8	12.5	3,246.6	58.3	41,838.5
Beaver Creek	117.2	17.3	13.3	104.1	1.1	169.5	760.1	2,841.0	2,765.2	1,876.3	237.7	1,041.9	36.2	476.1	15.3	10,472.4
Brantley Creek	79.4	468.3	68.1	156.3			367.2	1,357.5	764.1	999.9	1,623.6	2,567.5	121.0	1,096.4	19.6	9,688.7
Buck Creek	216.2	77.8	25.4	239.7		24.9	7,430.8	43,844.3	21,092.5	24,185.0	3,646.0	18,846.2	14.2	7,261.8	184.8	127,089.7
Camp Creek upper	2.2			40.0			165.7	1,330.1	689.6	465.5	183.9	481.0	16.9	91.2	0.9	3,467.0
Camp Creek lower	42.3	3.1		51.8		78.1	1,074.8	8,870.1	2,797.9	3,741.9	908.5	2,891.0	16.9	1,309.4	10.7	21,796.4
Cedar Creek	34.7	0.9		15.1			2,298.8	19,448.0	7,695.9	9,527.3	995.6	4,735.5	9.3	463.5	2.7	45,227.3
Chickasawhatchee Ck up	484.6	499.9	70.7	210.8			1,639.9	5,812.1	1,953.7	3,318.9	7,603.4	11,835.4	176.8	5,020.8	231.9	38,859.0
Chickasawhatchee Ck	3,299.6	550.6	73.4	296.0	25.1		8,161.6	34,688.6	16,419.1	25,114.8	21,166.3	37,893.4	258.2	47,268.3	1,673.9	196,889.0
Chokee Creek	123.0	112.3	11.6	52.0	10.9		667.2	3,356.7	1,472.6	1,410.4	5,690.0	15,461.9	90.1	2,963.5	204.8	31,627.0
Chokeelagee Creek	34.5			1.3			189.9	1,331.2	140.5	614.7	2,087.1	1,845.6	0.9	939.1	29.6	7,214.5
Culpepper Creek upper	11.3			2.9			38.9	575.5	923.4	147.2	20.7	75.6				1,795.6
Culpepper Creek lower	77.8	110.1	28.0	171.5			2,010.6	7,123.1	4,842.3	1,759.3	751.9	1,272.3	43.1	1,174.4	68.1	19,432.4
Ichaway-Nochaway Ck up	315.6	165.5	3.3	42.5			4,253.4	13,271.8	10,166.0	11,995.3	6,851.3	19,577.4	28.5	5,857.4	113.2	72,641.1
Ichaway-Nochaway low	718.1	249.7	17.3	141.0	2.7		7,117.3	23,373.5	19,323.2	21,463.7	16,005.4	39,926.0	125.4	12,269.8	269.1	141,002.2
Kinchafoonee Creek	48.7	29.1	7.3	38.9			2,619.3	5,207.4	6,756.3	3,828.2	158.8	1,163.1	8.5	1,391.9	24.5	21,282.0
Lanahassee Creek	59.6	4.4		30.7			2,141.4	8,821.6	7,440.2	7,588.1	788.1	2,896.6	10.9	1,770.2	15.1	31,566.9
Lime Creek	223.5	9.1		16.7	1.3		1,160.2	7,195.8	2,029.1	2,802.1	6,970.9	13,893.6	21.3	4,285.8	266.9	38,876.4
Little Muchalee Creek	46.0	52.0	10.0	38.3			710.1	2,398.2	1,166.0	1,544.0	459.5	1,497.8	9.8	363.6	12.2	8,307.5
Little Pachitla Creek	68.9	0.9		10.2			314.5	1,905.2	1,653.4	1,915.4	891.5	3,907.6	4.2	806.6	14.7	11,493.2
Muckalee Creek upper	60.5	60.3	35.4	56.9	0.2		1,339.2	5,567.9	4,372.1	4,583.6	919.1	3,605.3	16.0	705.4	18.2	21,340.3
Muckalee Creek lower	1,051.7	1,683.9	360.9	938.3	0.7		8,495.4	37,609.4	19,500.0	28,337.2	19,941.0	32,700.7	426.1	10,916.8	363.2	162,325.1
North Mosquito Creek	85.0	122.3	0.7	45.8			1749.3	971.8	4629.0	2067.8	1198.9	7769.8	3.1	2128.9	238.8	21011.6
Pachitla Creek	790.1	252.6	104.3	208.6			4,366.1	20,670.2	15,508.8	17,944.8	12,203.7	31,492.4	77.2	9,878.9	239.3	113,737.1
Patsiliga Creek lower	540.2	25.4	14.5	181.2	2.7	765.0	2,937.7	24,556.2	13,372.1	13,908.3	2,936.8	6,049.8	36.5	5,934.0	329.4	71,589.7
Sandy Mount Creek	53.8	21.6		121.6	3.6		507.9	905.6	885.8	419.6	2,878.4	9,877.3	32.5	955.6	3.6	16,666.8
Slaughter Creek	53.4	3.3		99.6			2,519.2	8,807.4	6,270.0	7,343.0	599.1	1,685.0	0.7	1,592.1	10.0	28,982.8
Spring Creek Macon	7.8	41.6	40.3	58.9	1.6		36.2	229.1	155.7	162.3	1,188.7	1,883.0	41.8	111.6	43.6	4,002.1
Spring Creek lower	2,021.5	743.4	170.1	371.6	4.2		11,567.7	35,941.5	24,934.0	33,731.0	37,340.5	113,017.	336.7	39,809.5	2,022.2	302,011.3
Town Creek	37.1	464.3	120.5	256.2			288.4	1,067.2	414.3	820.6	389.4	709.4	60.7	73.6	0.9	4,702.8
Town Creek	68.3	186.4	80.7	113.9			240.4	1,160.9	840.6	1,197.3	243.7	741.4	39.6	120.3	2.4	5,036.0
Turkey Creek	75.6	12.5	0.7	0.7	12.9		1,070.8	2,937.7	1,399.3	1,082.6	6,425.2	12,940.3	17.3	3,655.6	4.2	29,635.3
Ty Ty Creek	12.7	0.4		1.8			232.4	988.7	683.4	718.5	711.6	806.4		245.7	0.4	4,402.1

Table 3. Land Use Distribution (Impaired – Piedmont Ecoregion)

Name	Area (acres)															
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Total
Basin Creek	5.3	0.2		6.4			7.1	1,894.7	433.0	899.3	421.4	182.8	2.2	159.2		4,011.9
Heads Creek	300.9	613.3	138.8	128.5			3.8	2,909.0	2,620.4	3,099.0	2,411.6	767.0	171.5	374.9	0.7	13,539.4
Lewis Creek	53.6			2.4				225.9	201.0	173.7	586.0	129.2		152.3	1.1	1,525.4
North Branch	8.5	0.2		4.0			84.5	628.2	360.9	196.1	80.1	32.5				1,395.0
Potato Creek upper	13.1	963.8	177.9	345.6		101.0	18.0	1,026.1	721.9	1,151.1	484.6	151.2	305.6	204.2		5,664.0
Potato Creek middle upper	63.6	968.5	179.0	353.2		101.0	18.0	1,479.8	1,026.1	1,717.9	1,139.7	290.9	308.0	390.3	4.4	8,040.4
Potato Creek	218.6	1,156.2	196.4	504.2		102.7	18.0	3,023.8	2,082.7	3,178.1	2,611.7	723.2	362.9	657.6	6.9	14,843.0
Town Branch	14.2	341.1	68.9	165.9				303.1	216.6	384.5	203.7	91.8	79.4	42.3	1.1	1,912.8
Whitewater Creek	20.0	486.6	124.3	346.0			2.2	1,155.7	1,367.5	1,209.3	473.0	224.4	165.7			5,574.8
Willingham Spring Creek	17.8	0.9		6.2				1,020.3	228.2	428.1	278.9	186.8		94.1		2,261.2

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 3. Land Use Distribution (Impaired – Southeastern Plains Ecoregion)

Name	Area (acres)															
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Total
Angelica Creek	6.7	4.4	3.8	87.6			246.8	1,082.4	704.7	663.8	895.6	1,956.1	37.8	155.9	0.2	5,845.9
Avera Creek				0.7			338.7	231.1	99.9	66.7	16.5	87.0				840.4
Bailey Branch	58.0	2.4		4.7			199.7	1,366.3	645.6	672.3	625.1	1,536.9	6.4	301.1	19.3	5,438.0
Baptist Branch	1.6	220.8	63.4	39.4			113.0	206.8	149.9	316.5	175.0	338.5	96.7	38.3	13.8	1,773.5
Beaver Creek	8.5			2.7			742.3	2,426.9	1,081.5	622.9	60.7	203.0		42.5		5,191.0
Cooleewahee Creek	1,469.8	1,186.9	281.3	303.8	8.5	2.2	2,642.8	10,316.5	11,608.8	12,960.0	9,938.9	24,934.5	287.8	17,147.8	2,662.2	95,751.8
Gum Creek	60.5	70.9	48.3	71.2	14.5		1,009.6	1,564.3	1,406.4	642.9	3,055.4	7,174.9	18.0	984.3	6.7	16,127.7
Lee Creek	48.9	0.7		7.3		127.0	117.0	1,038.3	474.6	374.1	215.0	212.8				2,615.7
Little Whitewater Creek	186.8	1.6		144.8		477.7	791.3	10,447.3	3,333.8	2,180.7	280.0	2,678.2	0.7	1,808.9	121.9	22,453.5
Mercer Mill Creek	121.4	38.0		18.7	15.3	1.6	2,677.5	1,743.3	5,843.7	1,520.9	4,054.6	10,554.9	54.3	573.8	5.1	27,223.1
Middle Creek	51.4	3.3		1.6			125.6	509.3	199.7	304.0	537.3	1,096.4	2.0	322.0	24.9	3,177.5
Muckaloochee Creek	76.3	23.8	2.4	46.7			733.9	5,640.2	2,633.1	3,467.5	5,024.4	4,373.2	32.0	2,039.7	32.0	24,125.2
Patsiliga Creek	162.6	5.3	1.1	32.0	0.2	318.9	440.5	6,779.0	2,928.2	4,099.0	320.7	1,240.3		1,231.1	20.0	17,579.0
Pessell Creek	19.6	39.8	12.2	4.4	0.2		379.6	2,005.9	910.2	1,423.3	972.9	1,396.4	18.2	419.0	6.4	7,608.3
Rambulette Creek	12.9	0.2		11.8			183.5	3,302.0	871.1	1,034.5	124.3	499.3		12.5		6,052.0
Shoal Creek	31.8	0.4		82.1			815.3	7,297.0	2,611.5	1,862.5	409.4	3,502.4		204.6	12.0	16,828.9
Spring Creek	718.3	59.4	9.1	24.7	1.8		2,969.1	9,683.6	2,839.4	5,736.5	6,815.9	20,056.0	30.2	8,497.4	462.1	57,903.6
Sweetwater Creek	249.7	29.6	0.4	60.5		372.1	1,692.1	6,047.1	2,603.5	4,027.2	1,924.8	3,820.6	42.9	1,019.4	7.6	21,897.6
Whitewater Creek	1.6			0.7			195.7	892.2	172.3	194.6	127.9	434.1				2,019.1
Wolf Creek	15.8	0.9		3.1			247.5	1,036.3	352.7	598.4	2,165.2	3,402.1		737.7	6.7	8,566.3

Table 4. Land Use Percentages (Unimpaired – Piedmont Ecoregion)

	Percent Total Land Use														
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands
Auchumpkee Creek	0.4%	0.0%	0.0%	0.1%	0.0%		6.7%	29.7%	34.4%	11.7%	8.6%	2.0%	0.1%	6.1%	0.0%
Baroucho Creek	0.8%	0.0%		0.1%				57.1%	9.8%	27.6%	3.6%	0.6%	0.1%	0.3%	
Big Lazer Creek	0.4%	0.2%	0.0%	0.1%			4.1%	36.5%	26.2%	22.6%	4.9%	2.2%	0.1%	2.6%	0.1%
Brittens Creek		0.0%		0.1%			0.1%	29.0%	30.5%	21.3%	14.1%	4.7%			
Five Mile Creek	0.2%			1.2%				30.6%	20.0%	22.9%	20.3%	4.4%	0.0%	0.4%	
Kendall Creek	1.5%	0.2%	0.0%	0.0%			1.9%	33.2%	28.9%	25.2%	7.0%	1.5%	0.0%	0.5%	
Lazer Creek	0.5%	0.3%	0.0%	0.1%			6.2%	42.8%	21.4%	19.9%	5.2%	2.4%	0.2%	0.9%	0.0%
Mock Woodall Branch	0.5%			0.1%				47.1%	8.0%	22.8%	17.0%	4.1%		0.4%	
Potato Creek low	1.2%	2.0%	0.3%	1.4%		0.2%	0.4%	23.0%	14.4%	22.0%	22.4%	6.1%	0.7%	5.8%	0.1%

Table 4. Land Use Percentages (Unimpaired – Southeastern Plains Ecoregion)

	Percent Total Land Use														
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands
Bear Creek	0.6%	0.1%	0.0%	0.1%	0.0%		3.9%	15.4%	14.8%	16.2%	7.5%	33.4%	0.0%	7.8%	0.1%
Beaver Creek	1.1%	0.2%	0.1%	1.0%	0.0%	1.6%	7.3%	27.1%	26.4%	17.9%	2.3%	9.9%	0.3%	4.5%	0.1%
Brantley Creek	0.8%	4.8%	0.7%	1.6%			3.8%	14.0%	7.9%	10.3%	16.8%	26.5%	1.2%	11.3%	0.2%
Buck Creek	0.2%	0.1%	0.0%	0.2%		0.0%	5.8%	34.5%	16.6%	19.0%	2.9%	14.8%	0.0%	5.7%	0.1%
Camp Creek upper	0.1%			1.2%			4.8%	38.4%	19.9%	13.4%	5.3%	13.9%	0.5%	2.6%	0.0%
Camp Creek lower	0.2%	0.0%		0.2%		0.4%	4.9%	40.7%	12.8%	17.2%	4.2%	13.3%	0.1%	6.0%	0.0%
Cedar Creek	0.1%	0.0%		0.0%			5.1%	43.0%	17.0%	21.1%	2.2%	10.5%	0.0%	1.0%	0.0%
Chickasawhatchee Ck up	1.2%	1.3%	0.2%	0.5%			4.2%	15.0%	5.0%	8.5%	19.6%	30.5%	0.5%	12.9%	0.6%
Chickasawhatchee Ck	1.7%	0.3%	0.0%	0.2%	0.0%		4.1%	17.6%	8.3%	12.8%	10.8%	19.2%	0.1%	24.0%	0.9%
Chokee Creek	0.4%	0.4%	0.0%	0.2%	0.0%		2.1%	10.6%	4.7%	4.5%	18.0%	48.9%	0.3%	9.4%	0.6%
Chokeelagee Creek	0.5%			0.0%			2.6%	18.5%	1.9%	8.5%	28.9%	25.6%	0.0%	13.0%	0.4%
Culpepper Creek upper	0.6%			0.2%			2.2%	32.1%	51.4%	8.2%	1.2%	4.2%			
Culpepper Creek lower	0.4%	0.6%	0.1%	0.9%			10.3%	36.7%	24.9%	9.1%	3.9%	6.5%	0.2%	6.0%	0.4%
Ichaway-Nochaway Ck up	0.4%	0.2%	0.0%	0.1%			5.9%	18.3%	14.0%	16.5%	9.4%	27.0%	0.0%	8.1%	0.2%
Ichaway-Nochaway low	0.5%	0.2%	0.0%	0.1%	0.0%		5.0%	16.6%	13.7%	15.2%	11.4%	28.3%	0.1%	8.7%	0.2%
Kinchafoonee Creek	0.2%	0.1%	0.0%	0.2%			12.3%	24.5%	31.7%	18.0%	0.7%	5.5%	0.0%	6.5%	0.1%
Lanahassee Creek	0.2%	0.0%		0.1%			6.8%	27.9%	23.6%	24.0%	2.5%	9.2%	0.0%	5.6%	0.0%
Lime Creek	0.6%	0.0%		0.0%	0.0%		3.0%	18.5%	5.2%	7.2%	17.9%	35.7%	0.1%	11.0%	0.7%
Little Muchalee Creek	0.6%	0.6%	0.1%	0.5%			8.5%	28.9%	14.0%	18.6%	5.5%	18.0%	0.1%	4.4%	0.1%
Little Pachitla Creek	0.6%	0.0%		0.1%			2.7%	16.6%	14.4%	16.7%	7.8%	34.0%	0.0%	7.0%	0.1%
Muckalee Creek upper	0.3%	0.3%	0.2%	0.3%	0.0%		6.3%	26.1%	20.5%	21.5%	4.3%	16.9%	0.1%	3.3%	0.1%
Muckalee Creek lower	0.6%	1.0%	0.2%	0.6%	0.0%		5.2%	23.2%	12.0%	17.5%	12.3%	20.1%	0.3%	6.7%	0.2%
North Mosquito Creek	0.4%	0.6%	0.0%	0.2%			8.3%	4.6%	22.0%	9.8%	5.7%	37.0%	0.0%	10.1%	1.1%
Pachitla Creek	0.7%	0.2%	0.1%	0.2%			3.8%	18.2%	13.6%	15.8%	10.7%	27.7%	0.1%	8.7%	0.2%
Patsiliga Creek lower	0.8%	0.0%	0.0%	0.3%	0.0%	1.1%	4.1%	34.3%	18.7%	19.4%	4.1%	8.5%	0.1%	8.3%	0.5%
Sandy Mount Creek	0.3%	0.1%		0.7%	0.0%		3.0%	5.4%	5.3%	2.5%	17.3%	59.3%	0.2%	5.7%	0.0%
Slaughter Creek	0.2%	0.0%		0.3%			8.7%	30.4%	21.6%	25.3%	2.1%	5.8%	0.0%	5.5%	0.0%
Spring Creek Macon	0.2%	1.0%	1.0%	1.5%	0.0%		0.9%	5.7%	3.9%	4.1%	29.7%	47.0%	1.0%	2.8%	1.1%
Spring Creek lower	0.7%	0.2%	0.1%	0.1%	0.0%		3.8%	11.9%	8.3%	11.2%	12.4%	37.4%	0.1%	13.2%	0.7%
Town Creek	0.8%	9.9%	2.6%	5.4%			6.1%	22.7%	8.8%	17.4%	8.3%	15.1%	1.3%	1.6%	0.0%
Town Creek	1.4%	3.7%	1.6%	2.3%			4.8%	23.1%	16.7%	23.8%	4.8%	14.7%	0.8%	2.4%	0.0%
Turkey Creek	0.3%	0.0%	0.0%	0.0%	0.0%		3.6%	9.9%	4.7%	3.7%	21.7%	43.7%	0.1%	12.3%	0.0%
Ty Ty Creek	0.3%	0.0%		0.0%			5.3%	22.5%	15.5%	16.3%	16.2%	18.3%		5.6%	0.0%

Table 4. Land Use Percentages (Impaired – Piedmont Ecoregion)

Name	Percent Total Land Use														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands
Basin Creek	0.1%	0.0%		0.2%			0.2%	47.2%	10.8%	22.4%	10.5%	4.6%	0.1%	4.0%	
Heads Creek	2.2%	4.5%	1.0%	0.9%			0.0%	21.5%	19.4%	22.9%	17.8%	5.7%	1.3%	2.8%	0.0%
Lewis Creek	3.5%			0.2%				14.8%	13.2%	11.4%	38.4%	8.5%		10.0%	0.1%
North Branch	0.6%	0.0%		0.3%			6.1%	45.0%	25.9%	14.1%	5.7%	2.3%			
Potato Creek upper	0.2%	17.0%	3.1%	6.1%		1.8%	0.3%	18.1%	12.7%	20.3%	8.6%	2.7%	5.4%	3.6%	
Potato Creek middle upper	0.8%	12.0%	2.2%	4.4%		1.3%	0.2%	18.4%	12.8%	21.4%	14.2%	3.6%	3.8%	4.9%	0.1%
Potato Creek	1.5%	7.8%	1.3%	3.4%		0.7%	0.1%	20.4%	14.0%	21.4%	17.6%	4.9%	2.4%	4.4%	0.0%
Town Branch	0.7%	17.8%	3.6%	8.7%				15.8%	11.3%	20.1%	10.6%	4.8%	4.2%	2.2%	0.1%
Whitewater Creek	0.4%	8.7%	2.2%	6.2%			0.0%	20.7%	24.5%	21.7%	8.5%	4.0%	3.0%		
Willingham Spring Creek	0.8%	0.0%		0.3%				45.1%	10.1%	18.9%	12.3%	8.3%		4.2%	

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 4. Land Use Percentages (Impaired – Southeastern Plains Ecoregion)

Name	Percent Total Land Use														
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands
Angelica Creek	0.1%	0.1%	0.1%	1.5%			4.2%	18.5%	12.1%	11.4%	15.3%	33.5%	0.6%	2.7%	0.0%
Avera Creek				0.1%			40.3%	27.5%	11.9%	7.9%	2.0%	10.3%			
Bailey Branch	1.1%	0.0%		0.1%			3.7%	25.1%	11.9%	12.4%	11.5%	28.3%	0.1%	5.5%	0.4%
Baptist Branch	0.1%	12.5%	3.6%	2.2%			6.4%	11.7%	8.5%	17.8%	9.9%	19.1%	5.5%	2.2%	0.8%
Beaver Creek	0.2%			0.1%			14.3%	46.8%	20.8%	12.0%	1.2%	3.9%		0.8%	
Cooleewahee Creek	1.5%	1.2%	0.3%	0.3%	0.0%	0.0%	2.8%	10.8%	12.1%	13.5%	10.4%	26.0%	0.3%	17.9%	2.8%
Gum Creek	0.4%	0.4%	0.3%	0.4%	0.1%		6.3%	9.7%	8.7%	4.0%	18.9%	44.5%	0.1%	6.1%	0.0%
Lee Creek	1.9%	0.0%		0.3%		4.9%	4.5%	39.7%	18.1%	14.3%	8.2%	8.1%			
Little Whitewater Creek	0.8%	0.0%		0.6%		2.1%	3.5%	46.5%	14.8%	9.7%	1.2%	11.9%	0.0%	8.1%	0.5%
Mercer Mill Creek	0.4%	0.1%		0.1%	0.1%	0.0%	9.8%	6.4%	21.5%	5.6%	14.9%	38.8%	0.2%	2.1%	0.0%
Middle Creek	1.6%	0.1%		0.0%			4.0%	16.0%	6.3%	9.6%	16.9%	34.5%	0.1%	10.1%	0.8%
Muckaloochee Creek	0.3%	0.1%	0.0%	0.2%			3.0%	23.4%	10.9%	14.4%	20.8%	18.1%	0.1%	8.5%	0.1%
Patsiliga Creek	0.9%	0.0%	0.0%	0.2%	0.0%	1.8%	2.5%	38.6%	16.7%	23.3%	1.8%	7.1%		7.0%	0.1%
Pessell Creek	0.3%	0.5%	0.2%	0.1%	0.0%		5.0%	26.4%	12.0%	18.7%	12.8%	18.4%	0.2%	5.5%	0.1%
Rambulette Creek	0.2%	0.0%		0.2%			3.0%	54.6%	14.4%	17.1%	2.1%	8.2%		0.2%	
Shoal Creek	0.2%	0.0%		0.5%			4.8%	43.4%	15.5%	11.1%	2.4%	20.8%		1.2%	0.1%
Spring Creek	1.2%	0.1%	0.0%	0.0%	0.0%		5.1%	16.7%	4.9%	9.9%	11.8%	34.6%	0.1%	14.7%	0.8%
Sweetwater Creek	1.1%	0.1%	0.0%	0.3%		1.7%	7.7%	27.6%	11.9%	18.4%	8.8%	17.4%	0.2%	4.7%	0.0%
Whitewater Creek	0.1%			0.0%			9.7%	44.2%	8.5%	9.6%	6.3%	21.5%			
Wolf Creek	0.2%	0.0%		0.0%			2.9%	12.1%	4.1%	7.0%	25.3%	39.7%		8.6%	0.1%

Table 5. Soil Type Distribution (Unimpaired – Piedmont Ecoregion)

Soil Type **Area (acres)**																										
NAME	GA129	GA101	GA062	GA061	GA060	GA059	GA057	GA054	GA053	GA052	GA051	GA050	GA049	GA048	GA046	GA043	GA041	GA040	GA039	GA038	GA037	GA034	GA031	GA030	GA026	GA025
K-Factor	**0.14**	**0.25**	**0.20**	**0.18**	**0.11**	**0.25**	**0.15**	**0.14**	**0.18**	**0.13**	**0.12**	**0.15**	**0.14**	**0.28**	**0.16**	**0.21**	**0.17**	**0.14**	**0.13**	**0.15**	**0.27**	**0.25**	**0.24**	**0.27**	**0.25**	**0.27**
Auchumpkee Creek																							812		19501	6358
Baroucho Creek																						217			486	101
Big Lazer Creek																		200				8678		164	45300	50657
Brittens Creek		545																								1786
Five Mile Creek																						366				566
Kendall Creek																										2669
Lazer Creek																						3034			7713	9278
Mock Woodall Branch																						97				1100
Potato Creek low		2687																				1397				57544

Table 5. Soil Type Distribution (Unimpaired – Southeastern Plains Ecoregion)

	Soil Type **Area (acres)**																									
NAME	GA129	GA101	GA062	GA061	GA060	GA059	GA057	GA054	GA053	GA052	GA051	GA050	GA049	GA048	GA046	GA043	GA041	GA040	GA039	GA038	GA037	GA034	GA031	GA030	GA026	GA025
K-Factor	**0.14**	**0.25**	**0.20**	**0.18**	**0.11**	**0.25**	**0.15**	**0.14**	**0.18**	**0.13**	**0.12**	**0.15**	**0.14**	**0.28**	**0.16**	**0.21**	**0.17**	**0.14**	**0.13**	**0.15**	**0.27**	**0.25**	**0.24**	**0.27**	**0.25**	**0.27**
Bear Creek							1625				307			1			20945	3186		15213						
Beaver Creek																		5260	5127							
Brantley Creek				1489			3751								4516											
Buck Creek											6181						22054	52580	19820	23755						
Camp Creek upper																	1621			1876						
Camp Creek lower																	10423	18		11257						
Cedar Creek																	1242	16566	10420	16090						
Chickasawhatchee up				6708			17128								15031											
Chickasawhatchee low			816	36468			27008		10251	1736					118544											
Chokee Creek				1444			11980	331		147					17704											
Chokeelagee Creek										25	462				6854											
Culpepper Creek upper																		12	591				975	224		
Culpepper Creek lower																	1684	7200	6283				2353	224		6193
Ichaway-Nochaway up				1342			2411							27	598		4202			516	587					
Ichaway-Nochaway low				8511			3387			1428				27	23262		11960			28154	587					
Kinchafoonee Creek														16264			3285	127		1240						
Lanahassee Creek											115				3352		5430	21642		707						
Lime Creek						4331	260				2688				31197											
Little Muchalee Creek											15						5868	2376								
Little Pachitla Creek				339		1671									5952		3454									
Muckalee Creek upper											212						7557	7661	2082	3501						
Muckalee Creek lower				8787		4232	3251			7851	9177				66625		27414	17996	3113	11482						
North Mosquito Creek			3089	814	3894							9790	3412		41											
Pachitla Creek				3943		8639						1215		1085	35639		41088			20273						
Patsiliga Creek lower																	9400	26456	19497	7186			6829	24	130	928
Sandy Mount Creek											2037	14053			486											
Slaughter Creek											1130			8319			4492	5302	9314	167						
Spring Creek Macon										540		102			3389											
Spring Creek lower				51651	14351				1284	30767		116474			82361											
Town Creek						1256									3441					125						
Town Creek						579								1085			3175			219						
Turkey Creek											1736	13692			13923											
Ty Ty Creek										629	599				3285											

Table 5. Soil Type Distribution (Impaired – Piedmont Ecoregion)

	Soil Type **Area (acres)**																								
NAME	GA129	GA101	GA062	GA061	GA060	GA059	GA057	GA054	GA053	GA052	GA051	GA050	GA048	GA046	GA043	GA041	GA040	GA039	GA038	GA037	GA034	GA031	GA030	GA026	GA025
K-Factor	**0.14**	**0.25**	**0.20**	**0.18**	**0.11**	**0.25**	**0.15**	**0.14**	**0.18**	**0.13**	**0.12**	**0.15**	**0.28**	**0.16**	**0.21**	**0.17**	**0.14**	**0.13**	**0.15**	**0.27**	**0.25**	**0.24**	**0.27**	**0.25**	**0.27**
Basin Creek																					1381			402	2148
Heads Creek																								1322	12072
Lewis Creek																									1514
North Branch																						762	523		145
Potato Creek upper																									5587
Potato Creek middle up																									8031
Potato Creek																									14891
Town Branch																								951	4761
Whitewater Creek	792																			628					4143
Willingham Spring Creek																					432			113	1717

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 5. Soil Type Distribution (Impaired – Southeastern Plains Ecoregion)

	Soil Type **Area (acres)**																								
NAME	GA129	GA101	GA062	GA061	GA060	GA059	GA057	GA054	GA053	GA052	GA051	GA050	GA048	GA046	GA043	GA041	GA040	GA039	GA038	GA037	GA034	GA031	GA030	GA026	GA025
K-Factor	**0.14**	**0.25**	**0.20**	**0.18**	**0.11**	**0.25**	**0.15**	**0.14**	**0.18**	**0.13**	**0.12**	**0.15**	**0.28**	**0.16**	**0.21**	**0.17**	**0.14**	**0.13**	**0.15**	**0.27**	**0.25**	**0.24**	**0.27**	**0.25**	**0.27**
Angelica Creek											319			4870					691						
Avera Creek																	184	702							
Bailey Branch						1607								3848											
Baptist Branch									49			430		1386											
Beaver Creek														185			2224	2756							
Cooleewahee Creek			1420	12364	7250									73634											
Gum Creek				1165			14583			43				385											
Lee Creek														738			1508	387							
Little Whitewater Ck																	8853	12985	324						
Mercer Mill Creek							19236			1677					6118										
Middle Creek							2521				458			229											
Muckaloochee Creek						2632				347	3133			17770											
Patsiliga Creek																6895	5275	4530	475					130	3
Pessell Creek						52				164	852			6616											
Rambulette Creek																156	3656	2160	200						
Shoal Creek																567	4041	2296	9836						
Spring Creek				12750					1235			6805		36286											
Sweetwater Creek						2961					1876			8139		2880			5866						
Whitewater Creek																	1045	816	187						
Wolf Creek				1227			2377							591		3851			516						

2.0 WATER QUALITY ASSESSMENT

2.1 Fish Sampling

In 1990, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish communities in the Piedmont ecoregion. Biological monitoring is a method used to evaluate the health of a biological system in order to assess degradation from various sources. It is based on direct observations of aquatic communities. The results of these studies were the basis for the original listing of Biota Impacted stream segments on Georgia's 1996 303(d) list. In 1998 and 1999, WRD re-evaluated the stream segments in the Piedmont ecoregion and in 2000, WRD evaluated stream segments in the Southeastern Plains ecoregion.

The work performed by the WRD looked at patterns of fish communities within the various ecoregions. An ecoregion is a region of relative homogeneity in ecological systems or in relationships between organisms and their environment. Seven major ecoregions have been identified in Georgia based upon the soil types, potential natural vegetation, land surface form, and predominant land uses. These include the Blue Ridge Mountains, Ridge and Valley, Southwestern Appalachians, Piedmont, Middle Atlantic Coastal Plain, Southeastern Plains, and Southern Coastal Plain.

Reference sites within the Piedmont and Southeastern Plains ecoregions were established. These sites represented the least impacted sites that exist given the prevalent land use within the ecoregion. Eighty-six sites were sampled within the Flint River Basin (see Tables 6, 7, and 8). These sites had to be accessible, wadeable, and representative of the stream under investigation. The length of the fish sampling site was thirty-five times the mean stream width up to 500 meters. This sampling length was found to be long enough to include the major habitat types present. Electrofishing and seining techniques were used for sampling the fish population (GAWRD, 2000).

Two indices of fish community health were used to assess the biotic integrity of the aquatic systems: the modified Index of Well-Being (IWB) and the Index of Biotic Integrity (IBI). The IWB and IBI scores were classified as Excellent, Good, Fair, Poor, or Very Poor. Segments with fish populations rated as Poor or Very Poor were listed as Biota Impacted.

The modified IWB measures the health of the aquatic community based on the density and diversity or structural attributes of the fish community. The IWB is calculated based on four parameters: the relative density of fish, the relative biomass of fish, the Shannon-Wiener Index of Diversity based on number, and the Shannon-Wiener Index of Diversity based on biomass.

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, which assess three facets of the fish population: species richness and composition, trophic composition and dynamics, and fish abundance and condition. Each metric is scored by comparing its value to the value 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 regional drainage basins, e.g. the Apalachicola drainage basin, which includes the Chattahoochee and Flint River 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 metric (GAWRD, 2000).
To supplement the findings of the fish community data, habitat assessments were performed at each sampling site. Habitat scores evaluate the physical surroundings of a stream as they affect

and influence the quality of the water resource and its resident aquatic community. These data may also help clarify the results of the biotic indices. The habitat assessment used was developed by personnel with the Water Protection Branch (WPB) of the Georgia Environmental Protection Division and is a modification of the EPA Rapid Bioassessment Protocol III (GAWPB, 2000). It incorporates different assessment parameters for riffle/run and glide/pool prevalent streams.

The 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 (in-stream cover, epifaunal substrate, embeddedness, and riffle frequency). Level two describes the channel morphology (channel alteration, sediment deposition and channel flow status). Level three describes the riparian zone surrounding the stream, which indirectly affects the type of habitat and food resources available in the stream (bank vegetation, bank stability, and riparian zone width). The total habitat scores obtained for each sampling station are compared to a site-specific control or regional reference site. The ratio between the station of interest and the reference site provides a percent comparability that can be used to classify the stream.

Table 6 summarizes WRD's study scores. The IBI, IWB, and Habitat Assessment scores are listed and the watersheds are grouped by those that were not 303(d) listed streams and those that were, as well as by ecoregions (Piedmont and Southeastern Plains). In addition, the table includes the drainage areas upstream of the monitoring points, the county in which the monitoring points are located, and the pollutant source (nonpoint source [NPS], or point source [PS]) or stream type (reference [REF]). Table 7 provides the detailed habitat assessment scores. Any impaired upstream watersheds that contribute to an impaired listed downstream watershed are shaded gray.

During the fish community studies, physical characteristics of the stream were measured at the monitoring sites. These characteristics included the number of bends, number of riffles, number of pools, depth of the deepest pool, average stream depth, and average stream width. In addition, stream 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 8 provides a summary of these field measurements.

2.2 Macroinvertebrate Sampling

Beginning in March 2000, the Department of Natural Resources (DNR) Environmental Protection Division (EPD) collected water quality samples at a number of locations in the Piedmont ecoregion monitored by WRD including all the 303(d) listed streams in that ecoregion. Samples were analyzed to provide data to assess for the presence or absence of chemical pollution. The following analyses were conducted on each sample: dissolved oxygen (DO), temperature, conductivity, pH, turbidity, 5-day biochemical oxygen demand (BOD_5), nitrate-nitrite, ammonia, total phosphorus, total alkalinity, total suspended solids (TSS), total organic carbon (TOC), metals, semi-volatile organics, pesticides, and PCBs. The results are summarized in Table 9. The watersheds are grouped by those that were not 303(d) listed and those that were. Any impaired upstream watersheds that contribute to an impaired listed downstream watershed are shaded gray.

Table 6. 1998-2000 WRD's Fish Community Study Scores (Unimpaired – Piedmont Ecoregion)

Name	Drainage Area upstream from the monitoring point (sq mile)	County	Source/Type	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Auchumpkee Creek	43.08	Upson	REF	50	Good	8.7	Good	64.49
Baroucho Creek	1.31	Upson	NPS	34	Fair	6.3	Fair	130.42
Big Lazer Creek	169.60	Talbot		42	Fair	8.6	Good	118.93
Brittens Creek	3.76	Meriwether	REF	40	Fair	7.4	Good	141.37
Brittens Creek	3.76	Meriwether	REF	52	Excellent	9	Excellent	146.66
Five Mile Creek	1.46	Pike	NPS	36	Fair	7.2	Fair	110.51
Kendall Creek	4.40	Meriwether	F	46	Good	7.4	Good	55.50
Lazer Creek	32.30	Talbot	REF	52	Excellent	8.9	Good	118.13
Mock Woodall Branch	1.93	Upson	NPS	36	Fair	7.2	Fair	103.41
Potato Creek low	94.41	Lamar	NPS	36	Fair	7.7	Fair	41.50

Table 6. 1998-2000 WRD's Fish Community Study Scores (Unimpaired – Southeastern Plains Ecoregion)

Name	Drainage Area upstream from the monitoring point (sq mile)	County	Source/Type	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Bear Creek	66.68	Terrell	REF	54	Excellent	7.7	Fair	120.99
Beaver Creek	16.80	Taylor	REF	54	Excellent	8	Good	128.07
Brantley Creek	15.76	Terrell		38	Fair	6.4	Fair	118.56
Buck Creek	200.89	Macon		42	Fair	6.7	Fair	131.33
Camp Creek upper	5.65	Schley		42	Fair	7.1	Fair	98.32
Camp Creek lower	35.10	Macon		50	Good	7.5	Fair	87.49
Cedar Creek	39.50	Macon		36	Fair	5.6	Very Poor	129.35
Chickasawhatchee up	62.78	Terrell		46	Good	7.8	Fair	106.05
Chickasawhatchee low	314.70	Baker		48	Good	8.6	Excellent	117.30
Chokee Creek	51.06	Lee		42	Fair	7.9	Good	99.06
Chokeelagee Creek	11.86	Lee		44	Good	7.2	Fair	109.73
Culpepper Creek upper	2.90	Crawford		36	Fair	7.6	Good	82.43
Culpepper Creek lower	31.00	Crawford		46	Good	8.3	Good	92.92
Ichaway-Nochaway up	115.08	Terrell		36	Fair	6.5	Poor	105.81
Ichaway-Nochaway low	224.30	Randolph	REF	50	Good	7.6	Good	126.00
Kinchafoonee Creek	33.80	Marion		48	Good	7.9	Good	89.93
Lanahassee Creek	30.37	Webster		44	Good	7.3	Fair	104.34
Lime Creek	62.20	Sumter		44	Good	7.6	Fair	68.51
Little Muchalee Creek	13.34	Schley		42	Fair	7.6	Good	80.66
Little Pachitla Creek	18.44	Calhoun		46	Good	7.5	Good	127.66
Muckalee Creek upper	33.94	Schley		42	Fair	8.1	Good	124.74
Muckalee Creek lower	258.30	Lee		48	Good	8.1	Good	136.83
North Mosquito Creek	34.00	Decatur	REF	54	Excellent	8.3	Good	131.59
Pachitla Creek	180.80	Calhoun		48	Good	8	Good	120.29
Patsiliga Creek lower	113.80	Taylor	REF	52	Excellent	7.8	Fair	118.58
Sandy Mount Creek	26.80	Dooly		36	Fair	7.8	Good	115.59
Slaughter Creek	46.13	Webster		46	Good	7.3	Fair	71.38
Spring Creek Macon	6.50	Macon		34	Fair	7.3	Fair	130.41
Spring Creek lower	479.60	Decatur		42	Fair	9.2	Excellent	114.24
Town Creek	8.17	Randolph		46	Good	7.8	Good	134.65
Town Creek	7.79	Sumter		34	Fair	6.1	Fair	84.77
Turkey Creek	18.80	Dooly		38	Fair	8.1	Excellent	113.47
Ty Ty Creek	7.29	Sumter		36	Fair	5.8	Fair	109.38

Table 6. 1998-2000 WRD's Fish Community Study Scores (Impaired – Piedmont Ecoregion)

Name	Drainage Area upstream from the monitoring point (sq mile)	County	Source/Type	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Basin Creek	6.33	Upson	NPS	26	Poor	6.6	Fair	116.50
Heads Creek	21.60	Spalding	NPS	30	Poor	7.7	Fair	75.10
Lewis Creek	2.44	Pike	NPS	28	Poor	5.4	Poor	84.30
North Branch	2.45	Crawford	NPS	28	Poor	7	Fair	41.20
Potato Creek upper	9.02	Lamar-Spalding	PS	20	Very Poor	6.2	Fair	35.20
Potato Creek middle up	12.97	Lamar	PS	24	Very Poor	7.3	Fair	83.70
Potato Creek	24.05	Lamar	PS	24	Very Poor	7.8	Fair	70.70
Town Branch	3.19	Upson	NPS	16	Very Poor	0.5	Very Poor	63.90
Whitewater Creek	9.10	Fayette	PS	24	Very Poor	6.6	Fair	95.20
Willingham Spring Creek	3.66	Upson	NPS	26	Poor	5.4	Poor	108.00

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 6. 1998-2000 WRD's Fish Community Study Scores (Impaired – Southeastern Plains Ecoregion)

Name	Drainage Area upstream from the monitoring point (sq mile)	County	Source/Type	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Angelica Creek	9.50	Sumter		32	Poor	5.7	Poor	127.33
Avera Creek	1.30	Crawford		24	Very Poor	3	Very Poor	74.85
Bailey Branch	8.80	Sumter		28	Poor	6.2	Fair	92.00
Baptist Branch	3.01	Early		18	Very Poor	4.6	Very Poor	87.27
Beaver Creek	8.30	Crawford		30	Poor	5.7	Poor	88.50
Cooleewahee Creek	152.96	Baker		30	Poor	7.1	Poor	116.96
Gum Creek	26.10	Crisp		22	Very Poor	5.6	Poor	117.80
Lee Creek	4.30	Crawford		18	Very Poor	1.3	Very Poor	60.43
Little Whitewater Ck	35.08	Taylor		26	Poor	5.4	Very Poor	128.86
Mercer Mill Creek	43.70	Worth		30	Poor	7.3	Fair	122.64
Middle Creek	5.18	Terrell		32	Poor	4.3	Very Poor	126.74
Muckaloochee Creek	38.59	Sumter		26	Poor	6.2	Poor	128.03
Patsiliga Creek	28.00	Taylor		22	Very Poor	6.8	Fair	116.36
Pessell Creek	12.41	Sumter		30	Poor	5.4	Poor	114.01
Rambulette Creek	10.00	Taylor		26	Poor	5.2	Poor	134.33
Shoal Creek	27.04	Marion		22	Very Poor	4.3	Very Poor	128.93
Spring Creek	92.20	Early		28	Poor	6	Poor	91.27
Sweetwater Creek	35.10	Macon		22	Very Poor	4.6	Very Poor	127.71
Whitewater Creek	3.31	Taylor		20	Very Poor	4.8	Very Poor	136.57
Wolf Creek	13.83	Terrell		28	Poor	6.4	Fair	124.90

Table 7. 1998-2000 WRD's Habitat Assessment Scores (Unimpaired – Piedmont Ecoregion)

Name	Bottom Substrate	Pool Substrate	Pool Variability	Channel Sinuosity	Instream Cover	Epifaunal Substrate	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 Total
Auchumpkee Creek					10.00	0.33	0.10	0.00	17.33	4.23	7.90	3.43	4.13	3.40	3.30	4.77	5.57	64.49
Baroucho Creek					8.66	16.60	8.66	11.60	11.33	11.00	12.60	7.66	7.66	7.33	8.00	9.66	9.66	130.42
Big Lazer Creek					11.00	10.13	10.87	0.00	17.33	12.63	9.58	7.57	7.72	7.40	7.50	9.27	7.93	118.93
Brittens Creek					13.00	13.73	15.60	18.00	16.00	16.50	8.57	6.60	5.57	7.93	6.60	9.10	4.17	141.37
Brittens Creek					17.00	15.33	16.00	17.33	6.00	14.00	16.00	9.00	7.67	9.00	7.33	9.67	2.33	146.66
Five Mile Creek					9.00	12.68	8.83	14.50	16.17	11.17	8.23	5.00	3.93	3.73	4.90	6.17	6.20	110.51
Kendall Creek					6.00	0.70	1.30	0.00	3.70	2.30	8.70	4.70	4.70	2.70	2.70	9.00	9.00	55.50
Lazer Creek					9.00	7.73	12.33	9.00	18.00	8.40	9.33	7.77	7.43	6.37	6.27	8.27	8.23	118.13
Mock Woodall Branch					6.00	7.82	6.00	16.00	16.67	8.23	7.43	3.83	4.63	4.63	6.03	8.07	8.07	103.41
Potato Creek low					4.00	1.67	1.00	0.00	11.00	0.67	7.33	2.67	2.83	2.50	2.00	3.50	2.33	41.50

Table 7. 1998-2000 WRD's Habitat Assessment Scores (Unimpaired – Southeastern Plains Ecoregion)

Name	Bottom Substrate	Pool Substrate	Pool Variability	Channel Sinuosity	Instream Cover	Epifaunal Substrate	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 Total
Bear Creek	11.43	9.00	11.67	12.00					20.00	9.00	9.33	5.90	6.00	5.33	5.23	9.67	6.43	120.99
Beaver Creek	14.57	13.27	6.33	14.00					15.77	10.83	7.87	7.20	7.47	6.50	6.93	8.90	8.43	128.07
Brantley Creek	14.27	9.33	5.33	15.00					18.67	7.83	7.57	6.33	6.33	5.77	5.57	8.23	8.33	118.56
Buck Creek	14.17	9.70	16.33	18.00					17.50	11.80	8.83	4.20	4.43	4.97	4.47	8.43	8.50	131.33
Camp Creek upper	11.00	2.33	0.00	10.00					16.00	6.00	8.00	7.00	7.33	7.33	6.67	8.33	8.33	98.32
Camp Creek lower	7.33	2.33	0.00	15.00					14.67	5.33	6.33	5.33	6.17	4.00	4.33	8.67	8.00	87.49
Cedar Creek	15.17	12.90	12.07	15.00					17.53	6.82	11.02	5.23	5.23	6.15	6.28	6.97	8.98	129.35
Chickasawhatchee up	8.33	8.00	6.37	15.00					18.10	8.40	8.90	3.67	3.67	5.90	6.57	5.37	7.77	106.05
Chickasawhatchee low	10.40	9.97	11.00	17.00					15.00	13.83	7.67	4.33	3.10	5.67	4.73	8.00	6.60	117.30
Chokee Creek	10.40	9.08	4.15	9.00					17.57	7.98	7.33	6.00	5.05	6.00	5.40	5.33	5.77	99.06
Chokeelagee Creek	7.23	9.20	11.00	17.00					15.67	6.83	7.33	6.40	6.40	4.17	4.17	7.33	7.00	109.73
Culpepper Creek upper	8.00	11.00	2.50	0.00					15.33	13.33	4.33	4.08	4.33	4.80	4.10	5.40	5.23	82.43
Culpepper Creek lower	8.67	9.67	4.00	15.00					16.00	6.33	4.50	3.42	3.08	3.50	3.42	7.50	7.83	92.92
Ichaway-Nochaway up	7.00	7.00	3.80	16.00					17.67	6.67	5.90	5.57	4.67	7.77	8.00	8.43	7.33	105.81
Ichaway-Nochaway low	14.90	9.57	11.67	16.00					17.43	11.67	7.00	5.73	5.50	5.33	5.50	8.93	6.77	126.00
Kinchafoonee Creek	7.92	9.32	5.77	0.00					15.67	5.00	9.25	5.18	5.32	4.50	4.75	8.67	8.58	89.93
Lanahassee Creek	6.00	7.07	8.33	10.00					15.90	9.10	7.33	7.23	7.10	3.67	4.17	9.67	8.77	104.34
Lime Creek	7.00	7.33	5.67	0.00					6.00	6.17	7.00	3.67	3.67	3.67	3.67	7.33	7.33	68.51
Little Muchalee Creek	5.67	5.67	3.67	10.00					13.67	6.00	6.67	3.67	3.23	3.00	3.57	8.17	7.67	80.66
Little Pachitla Creek	14.67	11.33	6.67	14.00					15.00	10.00	11.33	6.67	6.00	7.33	6.33	9.33	9.00	127.66
Muckalee Creek upper	11.37	8.87	4.53	16.00					17.43	10.50	9.87	6.93	6.47	7.17	7.27	9.23	9.10	124.74
Muckalee Creek lower	15.25	10.80	13.00	16.00					18.23	14.23	10.27	4.83	5.35	5.97	5.90	8.50	8.50	136.83
North Mosquito Creek	13.67	9.07	13.33	19.00					18.67	10.00	7.00	5.67	5.67	6.50	5.67	8.67	8.67	131.59
Pachitla Creek	13.99	9.43	10.10	15.00					18.00	12.00	6.33	4.97	5.57	5.17	5.30	7.33	7.10	120.29
Patsiliga Creek lower	12.25	12.80	11.33	18.00					15.67	10.90	7.47	2.83	3.23	4.37	3.93	7.93	7.87	118.58
Sandy Mount Creek	12.10	15.27	8.10	8.00					14.33	12.10	8.53	6.13	6.90	5.87	6.30	5.63	6.33	115.59
Slaughter Creek	3.23	0.00	0.00	12.00					16.00	0.67	6.17	6.50	6.17	6.07	6.40	4.60	3.57	71.38
Spring Creek Macon	13.33	9.23	6.67	17.00					13.00	8.50	10.67	8.67	8.67	8.67	8.67	8.33	9.00	130.41
Spring Creek lower	11.27	11.67	10.50	16.00					12.50	11.50	6.77	4.50	4.60	5.10	4.73	7.27	7.83	114.24
Town Creek	7.67	7.00	5.00	16.00					5.50	2.60	8.83	8.00	7.67	7.00	7.00	1.00	1.50	84.77
Town Creek	11.50	10.33	10.00	19.00					12.67	9.10	13.37	8.17	8.33	7.17	7.67	8.67	8.67	134.65
Turkey Creek	11.03	9.67	6.77	19.00					17.80	9.77	8.23	3.10	3.77	3.80	4.43	7.33	8.77	113.47
Ty Ty Creek	5.33	6.43	4.10	19.00					19.67	5.00	9.00	6.67	6.67	4.17	4.00	9.67	9.67	109.38

Table 7. 1998-2000 WRD's Habitat Assessment Scores (Impaired – Piedmont Ecoregion)

Name	Bottom Substrate	Pool Substrate	Pool Variability	Channel Sinuosity	Instream Cover	Epifaunal Substrate	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 Total
Basin Creek					11.30	9.80	12.00	18.00	15.60	9.60	11.40	5.30	5.30	6.40	7.00	2.80	2.00	116.50
Heads Creek					7.50	1.80	1.70	0.00	16.00	4.20	7.70	4.20	5.00	4.00	5.80	8.20	9.00	75.10
Lewis Creek					3.70	8.20	3.10	0.00	17.00	2.30	9.70	6.90	6.20	7.60	7.20	4.10	8.30	84.30
North Branch					5.00	1.70	0.70	0.00	4.70	1.70	7.70	1.30	1.30	1.70	1.70	8.70	5.00	41.20
Potato Creek upper					2.70	1.30	0.70	0.00	5.70	0.70	8.00	2.00	2.00	0.70	0.70	9.00	1.70	35.20
Potato Creek middle up					7.40	0.00	0.20	0.00	14.30	0.90	12.50	7.20	7.20	8.80	8.80	9.00	7.40	83.70
Potato Creek					5.40	3.00	3.90	0.00	16.00	4.20	9.50	2.50	2.50	2.90	2.80	9.00	9.00	70.70
Town Branch					6.30	3.00	1.30	0.70	7.70	3.30	7.30	5.70	5.70	3.30	3.30	8.00	8.30	63.90
Whitewater Creek					7.00	0.70	1.30	0.00	15.70	2.20	17.00	8.30	8.30	9.10	8.80	8.40	8.40	95.20
Willingham Spring Creek					11.40	12.20	9.70	15.00	17.90	9.80	12.40	2.60	4.00	3.80	5.10	1.90	2.20	108.00

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 7. 1998-2000 WRD's Habitat Assessment Scores (Impaired – Southeastern Plains Ecoregion)

Name	Bottom Substrate	Pool Substrate	Pool Variability	Channel Sinuosity	Instream Cover	Epifaunal Substrate	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 Total
Angelica Creek	15.33	12.33	4.00	18.00					17.33	7.67	9.00	4.67	6.00	6.67	7.67	9.33	9.33	127.33
Avera Creek	3.33	0.00	0.00	0.00					4.67	2.67	15.00	7.83	7.83	7.33	7.33	9.43	9.43	74.85
Bailey Branch	9.33	9.33	7.00	0.00					12.00	7.67	7.67	5.33	5.33	6.00	6.67	7.67	8.00	92.00
Baptist Branch	15.17	7.43	1.17	0.00					3.00	14.00	8.33	4.67	5.83	8.00	8.00	3.00	8.67	87.27
Beaver Creek	7.83	0.00	0.00	0.00					16.30	10.83	11.77	6.60	6.07	5.77	5.50	9.00	8.83	88.50
Cooleewahee Creek	9.67	13.10	11.00	18.00					19.00	10.60	5.83	3.93	4.00	4.10	3.93	6.93	6.87	116.96
Gum Creek	11.90	13.10	7.83	19.00					16.67	10.57	6.90	3.83	3.43	4.83	4.47	7.17	8.10	117.80
Lee Creek	3.43	0.00	0.00	0.00					4.67	4.67	3.17	7.00	7.17	5.83	5.83	9.33	9.33	60.43
Little Whitewater Ck	13.00	9.00	13.53	17.00					17.60	11.17	8.03	4.67	4.73	5.93	5.80	9.20	9.20	128.86
Mercer Mill Creek	11.70	8.73	11.83	17.00					15.83	9.00	10.77	6.70	7.17	7.37	7.77	4.80	3.97	122.64
Middle Creek	10.00	13.40	9.90	12.00					16.90	13.50	7.67	4.73	4.73	7.40	7.17	9.67	9.67	126.74
Muckaloochee Creek	15.67	11.20	15.00	0.00					15.67	13.67	10.43	8.33	8.63	7.43	7.67	5.33	9.00	128.03
Patsiliga Creek	12.43	8.00	11.00	17.00					19.33	8.47	8.23	3.00	3.23	4.00	4.67	8.33	8.67	116.36
Pessell Creek	6.50	5.83	3.33	19.00					18.00	5.00	8.67	7.17	7.17	7.00	7.00	9.67	9.67	114.01
Rambulette Creek	12.33	9.00	0.00	16.00					17.33	15.00	13.00	8.67	8.67	8.67	8.33	9.00	8.33	134.33
Shoal Creek	10.77	7.83	10.90	16.00					18.67	12.20	10.40	5.00	4.53	7.10	6.87	9.33	9.33	128.93
Spring Creek	9.67	8.77	6.00	2.00					12.00	6.50	5.33	4.67	4.67	7.50	7.50	8.33	8.33	91.27
Sweetwater Creek	13.97	7.10	7.77	18.00					16.90	12.00	10.53	8.33	8.74	7.97	7.97	3.20	5.23	127.71
Whitewater Creek	12.75	13.92	8.33	16.00					14.08	14.58	13.67	5.73	5.70	7.22	7.47	8.40	8.72	136.57
Wolf Creek	10.00	10.15	7.00	19.00					16.65	8.00	8.30	7.00	7.15	6.40	6.25	9.50	9.50	124.90

Table 8. 1998-2000 WRD's Field Measurements (Unimpaired –Piedmont Ecoregion)

Name	Number of Bends	Number of Riffles	Number of Pools	Deepest Pool (m)	Average Stream Depth (m)	Average Stream Width (m)	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Auchumpkee Creek		0	9	1.50	0.48	9.0	23.2	5.86	74.8	7.22	18.50	27.0	35.0
Baroucho Creek		7	5	0.55	0.10	2.1	20.0	8.72		6.80	14.10		
Big Lazer Creek		2	18	1.65	0.45	38.9	22.2	7.79	59.9	7.38	6.50	15.0	30.0
Brittens Creek		7	2	1.05	0.12	4.2				7.46	8.28	21.0	25.0
Brittens Creek		7	7	1.30	0.11	5.5	21.0	8.73	53.0	7.22	11.70		
Five Mile Creek		4	2	0.60	0.14	2.5	13.5	8.26	29.9		7.13	8.0	20.0
Kendall Creek													
Lazer Creek		2	5	1.02	0.35	8.7	24.0	7.66	44.3	7.45	5.80	12.00	25.00
Mock Woodall Branch		4	1	0.50	0.13	2.6	17.2	7.94	30.1	6.74	8.54	9.00	15.00
Potato Creek low		0	0	0.00	0.12	12.8	25.3	6.17	81.2	6.93	3.82	19.0	30.0

Table 8. 1998-2000 WRD's Field Measurements (Unimpaired – Southeastern Plains Ecoregion)

Name	Number of Bends	Number of Riffles	Number of Pools	Deepest Pool (m)	Average Stream Depth (m)	Average Stream Width (m)	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Bear Creek	3.00		7	1.20	0.31	5.9	25.4	7.80	46.4	6.50	4.97	18.0	15.0
Beaver Creek	3.00		6	0.78	0.24	5.9	23.2	9.17	16.5	6.50	8.51	3.0	5.0
Brantley Creek	2.00		2	0.68	0.07	2.5	23.2	5.93	288.3	7.50	6.48	68.4	100.0
Buck Creek	5.00		12	1.50	0.58	8.4	22.7	6.96	21.5	6.50	12.30	7.00	5.0
Camp Creek upper	3.00		0	0.00	0.10	1.8	23.9	7.16	47.6	6.50	10.10	19.0	15.0
Camp Creek lower	5.00		0	0.00	0.22	3.9	21.9	7.33	28.4	6.25	8.44	9.0	10.0
Cedar Creek	5.00		13	1.58	0.72	9.0	21.7	7.70	15.3	5.50	5.32	3.0	5.0
Chickasawhatchee up	5.00		3	1.00	0.27	5.7	24.8	6.72	245.5	7.25	14.10	68.4	75.0
Chickasawhatchee low	4.00		4	1.60	0.61	14.2	26.6	6.01	259.9	7.5	1.14	136.8	160.0
Chokee Creek	4.00		5	0.95	0.28	7.4	21.9	7.67	251.9	7.40	4.76	136.8	115.0
Chokeelagee Creek	6.00		8	1.05	0.28	4.40	23.5	7.8	59.50	6.0	6.03	34.00	10.0
Culpepper Creek upper	1.00		0	0.00	0.05	2.6	28.1	9.22	82.4	7.50	4.43	34.2	60.0
Culpepper Creek lower	3.00		0	0.00	0.12	3.1	25.5	7.41	49.1	7.20	6.98	19.0	25.0
Ichaway-Nochaway up	3.00		2	0.61	0.20	4.8	23.8	7.33		6.50	4.5	13.0	10.0
Ichaway-Nochaway low	5.00		18	2.00	0.57	11.3	24.4	7.97	51.3	7.00	2.53	51.0	40.0
Kinchafoonee Creek	1.00		4	1.02	0.24	6.0	22.1	7.06	24.0	6.00	23.90	6.0	10.0
Lanahassee Creek	2.00		4	1.45	0.13	3.40	23.8	7.9	64.80	7.0	10.40	51.30	40.0
Lime Creek	0.00		3	1.00	0.33	5.8	23.4	5.29	64.4	7.00	7.79	34.0	30.0
Little Muchalee Creek	2.00		7	0.83	0.24	5.0	23.6	4.21	59.8	6.50	7.41	26.0	35.0
Little Pachitla Creek	4.00		7	1.24	0.42	7.4	22.1	4.97	108.8	6.50	11.40	33.0	30.0
Muckalee Creek upper	6.00		7	0.75	0.34	7.4	23.3	6.86	91.2	7.00	12.80	34.2	35.0
Muckalee Creek lower	5.00		10	1.93	0.68	11.5	26.1	7.61	88.5	7.50	9.76	24.0	30.0
North Mosquito Creek	9.00		10	1.48	0.40	6.7	19.8	7.80	51.3	7.00	6.06	34.2	40.0
Pachitla Creek	4.00		7	1.40	0.48	9.7	24.8	7.74	48.8	6.75	11.70	13.0	15.0
Patsiliga Creek lower	6.00		16	1.40	0.34	10.0	23.3	8.30	21.9	6.00	6.54	8.0	10.0
Sandy Mount Creek	2.00		5	0.91	0.27	8.2	22.0	6.76	201.7	7.80	5.47		110.0
Slaughter Creek	3.00		0	0.00	0.12	4.5	26.4	6.70	26.6	6.25	14.10	9.0	10.0
Spring Creek Macon	5.00		5	0.95	0.31	3.8				7.50	3.81	68.4	60.0
Spring Creek lower	5.00		8	1.50	0.44	11.2	27.0	5.96	234.5	7.50	5.52	154.0	160.0
Town Creek	4.00		1	0.65	0.19	4.6	26.7	6.76	70.4		4.98	15.00	20.00
Town Creek	7.00		3	1.25	0.57	4.0	26.4	2.45	219.5	6.50	48.80	85.50	90.0
Turkey Creek	5.00		9	1.18	0.31	5.9	21.7	6.10	144.4	7.00	6.69	102.6	100.0
Ty Ty Creek	2.00		2	0.60	0.15	2.8	24.6	7.21	50.1	6.00	12.20	21.0	10.0

Table 8. 1998-2000 WRD's Field Measurements (Impaired –Piedmont Ecoregion)

Name	Number of Bends	Number of Riffles	Number of Pools	Deepest Pool (m)	Average Stream Depth (m)	Average Stream Width (m)	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Basin Creek		6	3	1.40	0.10	5.1	22.3	7.60	21.6	7.10	17.60	6.0	15.0
Heads Creek		0	3	1.50	0.40	2.90	21.0	5.6	82.10	6.9	12.00	36.00	50.0
Lewis Creek		1	0	0.00	8.10	2.9	15.3	8.49	38.0		14.80	14.0	20.0
North Branch		0	3	0.62	0.10	2.0	19.6	6.76	111.9	7.30	3.69		
Potato Creek upper		0	4	0.74	0.10	5.2	26.1	7.52	100.2	7.26	3.63	26.0	30.0
Potato Creek middle up		0	8	1.50	0.30	9.2	25.8	1.10	245.3	6.9	9.98	44.0	80.0
Potato Creek		1	8	0.80	0.30	8.8	23.0	2.43	149.0	7.23	11.50	31.0	45.0
Town Branch		1	2	0.47	0.10	2.9	20.2	7.68	62.3	6.84	7.77		
Whitewater Creek		0	11	1.20	0.40	4.1	23.7	0.57	89.5	6.05	23.30	33.0	50.0
Willingham Spring Creek		3	4	0.70	0.20	3.90	17.2	8.5	12.20	6.6	9.56	2.00	10.0

Impaired upstream watersheds that contribute to an impaired downstream watershed

Impaired downstream watersheds

Table 8. 1998-2000 WRD's Field Measurements (Impaired – Southeastern Plains Ecoregion)

Name	Number of Bends	Number of Riffles	Number of Pools	Deepest Pool (m)	Average Stream Depth (m)	Average Stream Width (m)	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Angelica Creek	9.00		3	1.17	0.25	4.0	22.3	7.65	31.6	65.50	7.70	10.0	10.0
Avera Creek			0	0.00	0.10	2.0	22.7	7.01	16.7	5.42	21.50	3.0	5.0
Bailey Branch	0.00		5	1.01	0.27	4.3	20.5	7.52	34.5	6.50	23.70	31.0	30.0
Baptist Branch	1.00		1	0.55	0.26	3.1	20.7	6.50	292.6	7.50	4.25	42.0	120.0
Beaver Creek			4	0.78	0.28	3.4	22.9	7.55	15.0	6.04	5.67	6.0	5.0
Cooleewahee Creek	5.00		7	1.40	0.24	6.2	26.6	5.41	205.2	7.50	11.60	120.0	100.0
Gum Creek	10.00		9	1.20	0.35	7.3	25.4	6.74	295.8	8.00	3.76		115.0
Lee Creek			0	0.00	0.21	2.2	22.8	5.65	51.7	6.36	4.34	26.0	35.0
Little Whitewater Ck	4.00		12	1.28	0.57	8.1	23.0	9.05	12.1	6.00	3.10	4.0	5.0
Mercer Mill Creek	6.00		12	1.70	0.51	8.1	25.7	5.93	190.0	7.10	0.98	102.6	80.0
Middle Creek	3.00		1	0.50	0.16	2.7	23.2	6.53	208.1	7.50	8.20	136.8	160.0
Muckaloochee Creek	1.00		9	1.30	0.45	5.2	22.5	8.15	29.7	6.25	11.10	9.0	10.0
Patsiliga Creek	6.00		9	1.50	0.63	5.6	23.0	5.89	26.1	6.00	9.45	8.00	5.00
Pessell Creek	8.00		1	0.60	0.20	6.1	24.0	8.20	31.7	6.50	11.80	8.0	10.0
Rambulette Creek	4.00		0	0.00	0.14	4.4	24.5	8.41	9.1	6.00	30.70	3.0	5.0
Shoal Creek	6.00		14	1.20	0.43	5.7	21.8	7.49	11.2	6.00	4.80	4.0	5.0
Spring Creek	8.00		7	1.10	0.44	8.0	21.9	6.89	226.5	7.50	4.48	120.0	160.0
Sweetwater Creek	3.00		15	1.22	0.44	6.9	24.4	7.24	106.6	6.00	4.14	51.3	10.0
Whitewater Creek	4.00		4	0.65	0.28	2.3	24.7	9.09	19.1	6.30	2.41	5.0	5.0
Wolf Creek	3.00		5	0.70	0.22	3.7	23.4	7.77	35.5	6.50	5.74	14.0	15.0

Table 9. 2000 EPD's Field Measurements and Water Chemistry (Piedmont Ecoregion)

Name	Depth (m)	Width (m)	DO (mg/L)	Water Temperature (deg C)	pH	Conductivity (umohs/cm)	Turbidity (NTU)	TSS (mg/L)	Chemical Violations
Lazar Creek	0.39	8.49	9.13	19.93	7.71	43.3	no chemical samples		
Basin Creek	0.31	4.26	5.93	23.85	6.76	35	9	6	None
Heads	0.19	2.75	5.33	24.2	6.87	141	11	10	None
Lewis Creek	0.51	1.26	7.14	21.53	7.05	63	10	8	None
North Branch	Dry Creek		8.54	16.44	7.02	79	48	26	None
Potato Creek upper	0.18	3.79	8.01	19.69	6.83	102	31	12	None
Potato Creek	0.39	6.89	4.69	19.64	6.72	145	14	18	None
Town Branch	0.09	2.08	7.23	23.26	6.67	89	48	28	None
Whitewater Creek	0.57	5.7	0.54	22.61	6.23	140	26	9	None; DO of 0.54 mg/l
Willingham Spring Creek	0.175	2.57	7.82	19.88	7.93	21	6	7	None

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

EPD also conducted macroinvertebrate sampling at several of the locations to provide additional information and insight concerning water quality conditions. Macroinvertebrate sampling was conducted using a modified version of EPA's Rapid Bioassessment Protocol III. Macroinvertebrate data results were evaluated using seven metrics as a measure of diversity, community composition (e.g., prevalence of tolerant or intolerant organisms), and environmental stress from a variety of possible sources. These data and metric calculation results were compared to those from reference streams located in the Piedmont ecoregion (GAWPB, 2000). In conjunction with macroinvertebrate sampling, habitat assessments were performed. The habitat assessments were conducted using the same procedures described in the previous section.

All WRD impaired sites in the Piedmont ecoregion were monitored by EPD. Table 10 summaries EPD's macroinvertebrate study scores and includes the IBI, IBW, Benthic and Habitat Assessment scores. The watersheds are grouped by those that were not 303(d) listed and those that were, as well as by ecoregions (Piedmont and Southeastern Plains). Table 11 provides EPD's detailed habitat assessment scores. Habitat scores are subjective measurements that can vary between evaluators, as well as temporally and spatially. In general, each habitat assessment score is the average of three independent values that are determined on the same day. WRD performed their habitat assessments from April through September. EPD performed their assessment from mid-August through early October. The correlation between WRD and EPD habitat scores is 63.75 percent.

Field personnel also performed a pebble count at those sampling locations where macroinvertebrate samples were collected. Pebble counts were conducted to document streambed particle-size distribution. The modified Wolman Pebble Count procedure was used, where 100 random particle samples are measured. A zig-zag collection technique was used that allows a longitudinal stream reach, incorporating pools and riffles, to be collected along a continuum instead of individual cross-sections (GAWPB, 2000). The results of the Pebble Count are given in Table 12.

Visual observations of the stream and watershed were also made by EPD personnel. The type of land use and the extent of land-disturbing activities and other pertinent features of the watershed were systematically observed from all available road accesses and were recorded. This information was used to determine the potential sources of eroded soils and other possible contaminants.

Table 10. 2000 EPD's Macroinvertebrate Community Study Scores (Piedmont Ecoregion)

Name	County	Drainage Basin Area (sq miles)	IBI Score	IBI Category	IWB Score	IWB Category	Benthic Score	Rank	Habitat Total
Lazar Creek	Talbot	32.30	52	Excellent	8.9	Good	31	Poor	131.0
Basin Creek	Upson	6.33	26	Poor	6.6	Fair	40	Poor	83.0
Heads	Spalding	21.60	30	Poor	7.7	Fair	21	Very Poor	65.0
Lewis Creek	Pike	2.44	28	Poor	5.4	Poor	59	Fair	87.3
North Branch	Crawford	2.45	28	Poor	7	Fair	Creek was dry		
Potato Creek upper	Lamar-Spalding	9.02	20	Very Poor	6.2	Fair	23	Very Poor	39.6
Potato Creek	Lamar	24.05	24	Very Poor	7.8	Fair	22	Very Poor	73.6
Town Branch	Upson	3.19	16	Very Poor	0.5	Very Poor	0	Very Poor	61
Whitewater Creek	Fayette	9.10	24	Very Poor	6.6	Fair	17	Very Poor	100.8
Willingham Spring Creek	Upson	3.66	26	Poor	5.4	Poor	56	Fair	74.5

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 11. 2000 EPD's Habitat Assessment Scores (Piedmont Ecoregion)

Name	Instream Cover	Epifaunal Substrate	Embeddedness	Channel Alteration	Sediment Deposition	Riffle Frequency	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Assessment Score
Lazar Creek	12.7	10	12	16.7	14	13.3	8.7	8	7	6.7	7	6.3	8.7	131.0
Basin Creek	9.5	4.5	5	16	4.5	2.5	7	6	6.5	5.5	6	3	7	83.0
Heads	5.5	0.25	3.25	17	3.3	0	6.5	4.8	5.8	2.3	2.8	5.3	8.5	65.0
Lewis Creek	8	2.5	5.75	17.3	6.8	1	7	6.8	6.8	4.8	5	9.3	6.5	87.3
North Branch	Creek was dry													
Potato Creek upper	5.4	1.4	1.4	10.4	1.6	0	6.8	2.4	2.6	2	2	2.6	1	39.6
Potato Creek	6.6	3.2	3.2	13.6	5.2	2	6.2	4.4	4.4	3.6	3.8	8.8	8.6	73.6
Town Branch	4.5	1	2	16	2	0	3	4	7	3	6	3.5	9	61
Whitewater Creek	5.3	0.3	3.8	17.5	6	0	13.3	10	10	8	8.25	9.3	9.3	100.8
Willingham Spring Creek	6	5	5.5	16	4.5	3.5	8	6.5	3.5	5.5	4.5	4	2	74.5

Table 12. Pebble Counts (Piedmont Ecoregion)

Name	Silt/Clay/Sand 0.062-0.125mm	Fine 0.125-0.25 mm	Medium 0.25-0.5 mm	Coarse 0.5-1 mm	Very Coarse 1-2 mm	Fine Gravel I 4-6 mm	Fine Gravel 6-8 mm	Medium Gravel 8-10 mm	Coarse to Very Coarse >10 mm	Small Cobble 64 - 127 mm	Large Cobble 128-255 mm	Small Boulder 256-511 mm	Medium Boulder 512-1023 mm	Large Boulder 1024-2047 mm	Very Large Boulder	Bedrock	Total
Lazar Creek	24	3	7	7			1	4		5	1					48	100
Basin Creek	14	4	24	7	3					1	1	3			43		100
Heads	16	7	18	29	10	6	5	8	1								100
Lewis Creek	33	5	16	15	8	6	8	6	1							2	100
North Branch	Creek was dry																
Potato Creek upper	1	6	20	37	29		4	2	1								100
Potato Creek	26	5	5	7	3	1	8	16	27	2							100
Town Branch			89	7	4												100
Whitewater Creek	Creek to deep to sample																
Willingham Spring Creek	43	7	16	10	6	2	3	5			3	1	1		3		100

Impaired upstream watersheds that contribute to an impaired downstream watershed

Impaired downstream watersheds

3.0 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 (GAEPD, 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. The general sources of sediment are point and nonpoint sources. National Pollutant Discharge Elimination System (NPDES) permittees discharging treated wastewater are the primary point sources of sediment as total suspended solids (TSS) and/or turbidity.

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. Nonpoint sources of sediment included in the source assessment analysis are:

- Silviculture,
- Agriculture,
- Grazing areas,
- Mining sites,
- Roads, and
- Urban Development

For nonpoint sources involving silviculture, the Georgia Forestry Commission (GFC) was consulted for information and parameters regarding silviculture activities. The Natural Resources Conservation Service (NRCS) was consulted for information and parameters regarding agricultural activities.

3.1 Point Source Assessment

For purposes of this TMDL, facilities permitted under the National Pollutant Discharge Elimination System (NPDES) will be considered point sources. Discharges from municipal and industrial facilities may contribute sediment to receiving waters as TSS and/or turbidity. There are eight permitted NPDES discharges identified in the Flint River Basin watersheds upstream from the listed segments. Table 13 provides the permitted flow and TSS concentrations for the NPDES permits located in the impaired Flint River Basin watersheds. The levels discharged over the last six years are given, as well as the calculated TSS load. These data were determined from analysis of the available Discharge Monitoring Reports (DMR).

Andersonville WPCP, Blakely WPCP, Cordele Gum Creek WPCP, and Griffin Potato Creek WPCP report metals in their DMRs as a requirement of their NPDES permits. The City of Andersonville discharges to an unnamed tributary of Sweetwater Creek. In September 2001, monitoring requirements for copper, lead, and zinc were added to this facility's permit, but no discharge limitations were specified. The average metal concentrations reported are 0.022 mg/L Cu, 0.001 mg/L Pb, and 0.033 mg/L Zn. The Blakely WPCP discharges to Baptist Branch. This facility is permitted to discharge 0.004 mg/L total recoverable cadmium and exceeded its permit limit during all of 1996, every month except March of 1997, all of 1998, all of 1999, and April 2000. In addition, the City of Blakely's NPDES permit requires monitoring for lead and zinc, but there are no discharge limits. Average metal concentrations reported since

Table 13. NPDES Permit Limits For Facilities in the Impaired Watersheds of the Flint River Basin

FACILITY	NPDES PERMIT NO	FACILITY TYPE	RECEIVING WATER	FLOW (MGD)		TSS (mg/L)		TSS Load	
				Monthly Average	Weekly Average	Monthly Average	Weekly Average	Monthly Average (lbs/day)	Annual (ton/yr)
Andersonville WPCP	GA0033669	Municipal	Unnamed trib to	0.03	0.04	30.00	45.00		
			Sweetwater Creek	0.02		13.56		1.63	0.30
Arlington Pond #1	GA0026204	Municipal	Perry Creek trib to	0.10	0.13	90.00	120.00		
			Spring Creek	0.09		35.11	330.00	15.65	2.86
Beaverbrook Elementary School	GA0034380	Private	Unnamed trib to	0.01	0.01	30.00	45.00		
			Heads Creek	0.01		15.75		0.79	0.14
Blakely WPCP	GA0025585	Municipal	Baptist Branch	1.32	1.64	30.00	45.00		
				0.84		6.41		50.01	9.13
Cordele WPCP	GA0024503	Municipal	Gum Creek	NA	NA	30.00	45.00		
				2.77		8.75		225.08	41.08
Griffin - Potato Creek WPCP	GA0030791	Municipal	Potato Creek	NA	NA	30.00	45.00		
				1.41		7.81	7	101.62	18.54
Plains WPCP	GA0020931	Municipal	Pessell Creek trib	0.12	0.15	30.00	45.00		
				0.07		9.93		6.18	1.13
Timber Creek MHP	GA0023531	Private	Unnamed trib to	0.02	0.02	90.00	120.00		
			Heads Creek	0.01		41.29		2.17	0.40

permit limits
actual data from monthly DMR

1996 are 0.012 mg/L Cu, 0.039 mg/L Pb, and 0.034 mg/L Zn. The City of Cordele discharges to Gum Creek. Its DMRs indicate this facility exceeded its permitted zinc limit of 0.064 mg/L in December 1996 and June 1997. The City of Griffin discharges to Potato Creek and is permitted to discharge 0.0652 mg/L zinc. The Griffin WPCP facility exceeded this limit four times in December 1996, January 1999, March 1999, and December 2001. This facility is also required to monitor the discharge for copper with no identified discharge limitation. The average reported effluent copper concentration since June 1967 is 0.024 mg/L. The exceedences of the facilities' metal limits may have affected the fish communities in the listed streams.

The ammonia concentrations discharged from four municipal facilities, Blakely, Cordele, Griffin, and Plains, were also reviewed. Allowable effluent ammonia concentrations to protect against ammonia toxicity were developed for these facilities according to the 1999 Ambient Water Quality Criteria for Ammonia (USEPA, 1999a). The City of Blakely WPCP, which discharges to Baptist Branch, has a monthly ammonia permit limit of 2 mg/L. This is protective of the stream based on the 1999 ammonia criteria. Blakely exceeded its permitted limit once in December 2000, but has never exceeded the calculated 1999 ammonia criteria limit of 3.08 mg/L. The City of Cordele Gum Creek WPCP has a monthly ammonia permit limit of 2 mg/L, and the calculated 1999 ammonia criteria limit is 3.14 mg/L. This facility has never exceeded its permit limit or the calculated 1999 ammonia criteria limit. The City of Griffin Potato Creek WPCP has monthly ammonia limits ranging from 4.1 to 17.4 mg/L. Monthly ammonia limits calculated using the 1999 Ambient Water Quality Criteria for Ammonia range from 3.23 to 12.8 mg/L. Based on available DMR data, this facility has exceeded both its permitted ammonia limits and the 1999 ammonia criteria limits on five occasions: May 1996, June 1996, August 1996, May 1998, and August 2000. The City of Plains WPCP discharges to a tributary of Pessell Creek. This facility is required to report ammonia under its permit but has no permit limits. The calculated 1999 ammonia criteria limit for this facility is 5.87 mg/L, which was exceeded in March 1997, March 1998, June 1998, and July 1999. The ammonia concentrations in these discharges may have affected the fish communities in the listed streams.

Total residual chlorine (TRC) concentrations are reported at the following municipal facilities: Blakely, Cordele, Griffin, and Plains. TRC criteria at these facilities are daily maximum limitations and are measured to a specific detection limit of 0.10 mg/L. The City of Blakely WPCP is permitted to discharge 0.011 mg/L TRC, and the maximum daily limit was exceeded during all of 1996, in March 1997, and in April 1999. The City of Cordele WPCP has a TRC limit of 0.012 mg/L, which was exceeded in all months from January 1996 through May 1999. The daily TRC limit for the City of Griffin Potato Creek WPCP is 0.011 mg/L and this limit was exceeded in all months from January 1996 to September 1997, and in April 1998. The City of Plains WPCP is not required to monitor TRC in its effluent, but has reported effluent TRC values in their DMRs from 1996 through 2001. The TRC effluent concentration would need to be 0.02 mg/L in order not to exceed an instream concentration of 11 ug/L. Over the last six years, the average daily TRC discharge from the Plains WPCP has been 0.54 mg/L. The high TRC discharges from these municipal facilities may have affected the fish communities in the listed streams.

Soil erosion from construction sites is a major source of sediment in Georgia's streams. Georgia requires construction sites over five acres to have a General Storm Water NPDES permit. A Notice of Intent (NOI) must be submitted to the State for each construction site over five acres in order for its storm water to be covered under this permit. The permit 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 the permit. All sites are required to have an Erosion and Sedimentation Control Plan; to implement, inspect and maintain BMPs; and to monitor storm water for turbidity. In March 2003, this permit will also cover all construction sites disturbing between one and five acres.

3.2 Nonpoint Source Assessment

Eroded soils from forests, cropland, mining sites, and other land are transported to Georgia streams through runoff. Excessive sediment that reaches streams can cause several changes. It can make streams shallower and wider, affecting the stream's temperature, dissolved oxygen, flow rate and velocity. It can affect the ability of the stream to assimilate pollutants. It can change the diversity of fish populations and other biological communities. It can also cause increased flooding. In addition, harmful pollutants attached to the sediment can 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 (GAEPD, 1999).

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, as well as 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. Table 14 lists the percent timberland and percent harvested per year by county.

3.2.2 Agriculture

Agriculture can be a significant contributor of nonpoint pollutants to rivers and streams. Sediment and nutrients are the major pollutants of concern and cropland is one of the major sources of soil loss due to sheet and rill erosion. Over the last century there has been a dramatic decrease in the amount of land farmed in Georgia. In 1950, there were 208,000 farms encompassing 26 million acres in Georgia (U.S. Department of Agriculture, National Agricultural Statistics Service website). In 2000, there were approximately 11.1 million acres of farmland in Georgia, with the number of farms estimated to be 50,000 and the average farm size being approximately 222 acres. This represents a 57 percent reduction in farmland.

With the reduction in farmland, there has also been a decrease in the amount of soil erosion. 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 in 1997. This suggest that the source of sediment in many of the impaired streams in the Flint 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.

Table 14. Percent Timberland and Percent Harvested per Year by County

County	Total Area (1000 acres)	Timberland (1000 acres)	Percent Timberland	Growing Stock Volume (million ft^3) [a]	Annual Volume Removal (million ft^3)	Annual percent Removal
Baker	219.7	114.9	52.30%	134.0	2.8	2.09%
Calhoun	179.3	94.3	52.59%	120.7	4.1	3.40%
Chattahoochee	159.2	142.0	89.20%	168.6	5.0	2.97%
Clay	124.9	82.0	65.65%	105.2	3.1	2.95%
Crawford	208.1	163.2	78.42%	119.3	9.5	7.96%
Crisp	175.3	68.5	39.08%	72.1	4.7	6.52%
Decatur	382.0	201.1	52.64%	117.8	1.2	1.02%
Dooly	251.5	110.5	43.94%	151.8	5.2	3.43%
Dougherty	211.0	110.3	52.27%	190.6	5.9	3.10%
Early	327.2	151.5	46.30%	156.8	8.9	5.68%
Fayette	126.3	59.6	47.19%	99.3	3.9	3.93%
Fulton	338.4	123.8	36.58%	372.3	14.9	4.00%
Harris	296.8	238.4	80.32%	260.3	10.0	3.84%
Houston	241.1	122.9	50.97%	167.0	2.6	1.56%
Lamar	119.6	91.7	76.67%	119.0	5.0	4.20%
Lee	227.7	99.2	43.57%	114.5	3.9	3.41%
Macon	258.1	154.8	59.98%	200.5	5.7	2.84%
Marion	234.9	188.2	80.12%	126.3	5.3	4.20%
Meriwether	322.1	230.7	71.62%	234.2	21.1	9.01%
Miller	181.2	62.9	34.71%	79.1	1.2	1.52%
Monroe	253.2	194.3	76.74%	261.8	9.0	3.44%
Pike	139.8	81.0	57.94%	113.6	3.1	2.73%
Randolph	274.7	180.7	65.78%	166.6	8.7	5.22%
Schley	107.3	78.3	72.97%	80.5	5.6	6.96%
Seminole	152.4	45.4	29.79%	52.4	1.3	2.48%
Spalding	126.7	66.9	52.80%	95.9	11.4	11.89%
Stewart	293.6	253.7	86.41%	203.1	20.7	10.19%
Sumter	310.6	161.9	52.12%	174.1	10.4	5.97%
Talbot	251.7	219.5	87.21%	195.0	15.4	7.90%
Taylor	241.6	190.4	78.81%	121.6	7.2	5.92%
Terrell	214.7	103.1	48.02%	98.7	5.1	5.17%
Upson	208.3	153.8	73.84%	227.3	6.7	2.95%
Webster	134.1	91.3	68.08%	67.5	6.1	9.04%
Worth	364.7	194.0	53.19%	276.6	15.8	5.71%

[a] Estimate - does not include trees less than 5" DBH.
Source: Thomas, Michael T., 1997. Forest Statistics for Georgia

3.2.3 Grazing Areas

Farm animals grazing on pasture land can leave areas of ground with little or no vegetative cover. During a rainfall runoff event, the 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 had found that gully erosion typically contributes less than 30 percent of the total sediment load; however, contributions have ranged from 0 to 89 percent (USEPA, 2001b).

Beef cattle spend all 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 pass 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 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. Table 15 lists the active, inactive, and exploratory mines located in the watersheds monitored in the Flint River Basin.

3.2.5 Roads

Erosion from unpaved roadways can be a significant source of sediment to our rivers and streams. It 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 and/or surface drainage, poor road bed 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 road bed into the 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).

Table 15. Mines Located in the Flint River Basin Watersheds

Name	Company	Type	County	Current Status	Material Mined
Americus		Surface	Sumter	Exp Prospect	Aluminum Hi-Alumina Clay
Clark Property		Unknown	Macon	Exp Prospect	Clay - Kaolin (China Clay)
Coggins Prospect		Surf-Underground	Lamar	Exp Prospect	Mica
Doc Irwin Prospect		Unknown	Lamar	Exp Prospect	Mica
E.J. Kleckley Property		Surface	Macon	Exp Prospect	Aluminum Bauxite
G.W. Holloway Property		Unknown	Schley	Exp Prospect	Aluminium Bauxite
Gammage Property		Surface	Macon	Exp Prospect	Aluminum Bauxite
Helen Mcdonald Prospect		Unknown	Upson	Exp Prospect	Mica
Hodges Property		Surface	Sumter	Exp Prospect	Aluminum Bauxite
Holloway Property		Unknown	Macon	Exp Prospect	Aluminum Bauxite
Rooks Property		Unknown	Sumter	Exp Prospect	Clay - Kaolin (China Clay)
Unnamed Deposit		Unknown	Macon	Exp Prospect	Clay - Kaolin (China Clay)
Unnamed Deposit		Unknown	Macon	Exp Prospect	Clay - Kaolin (China Clay)
W.H. Childers Property		Surface	Schley	Exp Prospect	Aluminum
Walker Property		Unknown	Spalding	Exp Prospect	Iron
Williams Property		Unknown	Schley	Exp Prospect	Aluminum Bauxite
Andersonville Plant	American Cyanamid Co	Proc Plant	Sumter	Past Producer	Aluminum Bauxite
Battles Mine		Underground	Monroe	Past Producer	Mica
Cavender Mine	American Cyanamid Co	Surface	Macon	Past Producer	Aluminum Hi-Alumina Clay
Chatfield Mine		Underground	Monroe	Past Producer	Mica
Easterlin Mine		Surface	Sumter	Past Producer	Aluminum Bauxite
Harris City Mine		Surface	Meriwether	Past Producer	Stone Granite Cb
Ideal Mine		Surface	Macon	Past Producer	Aluminium Bauxite
Johnson Mine		Surf-Underground	Upson	Past Producer	Mica
Joiner Lot 251	Mullite Co. Of America	Surface	Sumter	Past Producer	Aluminum Bauxite
Lone Star Mine	Lone Star Industries	Surface	Talbot	Past Producer	Sand & Gravel
Macon County Mines	Mullite Co Of America	Surface	Macon	Past Producer	Aluminum Bauxite
Mulcoa Plant No 1	Mullite Company Of America	Proc Plant	Sumter	Past Producer	Aluminum Bauxite
Mullite North Pit (Lot 278)	Mullite Co. Of America	Surface	Sumter	Past Producer	Aluminum Bauxite
Mullite South Pit (Lot 315)	Mullite Co. Of America	Surface	Sumter	Past Producer	Aluminum Bauxite
Reeves Sand Mine	Reeves Construction Co	Surface	Sumter	Past Producer	Sand & Gravel
Spring Creek Quarry	Georgia Rock Products Co	Surface	Early	Past Producer	Stone Limestone Cb
Sumter County Mine	Mullite Company Of America	Surface	Sumter	Past Producer	Clay
Tomlin Mine		Underground	Upson	Past Producer	Mica
Webb Pit No. M3	American Cyanamid Co	Surface	Macon	Past Producer	Clay
Colquitt Peat Mine	Shep Peat Co.	Surface	Miller	Producer	Coal Peat
Georgia Silica Div	Jessie S Morie & Son Inc	Surface	Marion	Producer	Sand & Gravel
Howard Mine	Howard Sand Company	Surface	Taylor	Producer	Sand & Gravel
Junction City Mine	Brown Brothers Sand Co	Surface	Talbot	Producer	Sand & Gravel
Junction City Sand Pit	Moore Jesse S. And Son	Surface	Marion	Producer	Sand & Gravel
Plant Number 2	Howard Sand Company	Surface	Talbot	Producer	Sand & Gravel
J W Brown Deposit		Unknown	Lamar	Raw Prospect	Mica
Unnamed Outcrop		Unknown	Macon	Raw Prospect	Aluminum Bauxite

Source: USEPA, 2001a. Watershed Characterization System (WCS) Data, Georgia, US. Tetra Tech, Environmental Protection Agency, Region IV, Atlanta, Georgia , Jan 31, 2001.

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. From 1982 through 1989, the area classified as commercial forest within the Flint River Basin decreased by approximately 1053 acres or 0.0045 percent (GAEPD, 1998). 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 developed urban areas 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 entering the streams. In addition, the streamflow rates may increase significantly from pre-construction rates causing stream bank erosion and stream bottom down cutting.

4.0 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 both the identification of sources, and their relative contribution, as well as the examination of potential water quality changes resulting from varying management options to meet the water quality standard. 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 prevents EPD from using a dynamic watershed runoff model, which requires a great deal of data for model development and calibration. Instead, EPD determined the annual sediment loads delivered to the stream from the surrounding watershed. This TMDL does not address in-stream sedimentation processes, such as bank erosion and stream bottom down cutting, 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 30 years ago. It is the most widely accepted and most 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 the 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 Best Management Practices (BMPs).

4.2 Universal Soil Loss Equation

For each of the watersheds monitored in the Flint 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
LS = topographic factor
- L = slope length
- S = slope

C = cropping factor
P = conservation practice factor

4.2.1 Rainfall Erosivity Index

The R factor or rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. It varies geographically and Table 16 gives the R factors for the counties with modeled watersheds within the Flint River Basin.

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 the ability of the soil to resist detachment and transport during a rainfall event. It is a function of the soil type, which is provided by the STATSGO data. Table 5 provides a breakdown of the soil type within each modeled watershed and the corresponding K factor. STATSGO soil data has a resolution of 1:250,000 and is available for all of Georgia. A higher-resolution (1:25,000) soil data, SSURGO, is available for fourteen Georgia counties. For consistency, it was decided that STATSGO data would be used for the first round or phase of sediment TMDLs because of its availability for all of Georgia. During the second phase of sediment TMDLS, if SSURGO data is available for all of Georgia, it may be used.

4.2.3 Topographic Factor

The LS factor or topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate more runoff from larger areas and also result in higher overflow velocities. The slope length and slope is based on the grid size and ground slope provided by the USGS 30 by 30 meter Digital Elevation Model (DEM) grids downloaded from the State GIS clearinghouse.

4.2.4 Cropping factor

The C factor or cropping factor represents the effect plants, soil cover, soil biomass, and soil disturbing activities have on erosion. It is the most complicated of the USLE factors. It incorporates effects of tillage, crop type, cropping history, and crop yield. Cropping factors for forested, agricultural, and urban lands were provided by the Georgia Forestry Commission (GFC), Natural Resources Conservation Service (NRCS), and U.S. Environmental Protection Agency (EPA), respectively.

Forested land includes both mature trees and those being harvested. The forest C factor for each watershed was calculated based on the percent of forest harvested in each county (see Table 14). If a watershed is in multiple counties, the percent forest harvested is determined by area-weighting the forested area within each county.

C factors for cropland and pastureland for each county were developed by NRCS under the National Resource Inventory Program and are listed in Table 17. These values were developed based on the 1995 MRLC data. Low-level aerial photography was performed and the photographs are interpreted to identify land features. If data were not available for a given county, the C factor was calculated by averaging the C factors from all the surrounding counties. The crop and pasture land C factors for watersheds in multiple counties were determined by area-weighting the agricultural land use within each county.

Table 16. R factors by County

County	R factor
Baker	362.5
Calhoun	362.5
Chattahoochee	350.0
Clay	362.5
Crawford	300.0
Crisp	337.5
Decatur	412.5
Dooly	325.0
Dougherty	350.0
Early	400.0
Fayette	300.0
Fulton	300.0
Houston	300.0
Lamar	300.0
Lee	350.0
Macon	325.0
Marion	337.5
Meriwether	325.0
Miller	400.0
Mitchell	362.5
Monroe	300.0
Pike	312.5
Randolph	350.0
Schley	325.0
Seminole	425.0
Spalding	300.0
Sumter	325.0
Talbot	325.0
Taylor	325.0
Terrell	350.0
Upson	325.0
Webster	350.0
Worth	350.0

Source: USEPA, 2001a. Watershed Characterization System (WCS) Data, Georgia, US. Tetra Tech, Environmental Protection Agency, Region IV, Atlanta, Georgia, Jan 31, 2001.

Table 17. Cropland and Pasture C factors by County

County	C factor	
	Cropland	Pasture
Baker	0.328	0.003
Calhoun	0.363	0.003
Chattahoochee	0.418	0.003
Clay	0.307	0.004
Crawford	0.479	0.011
Crisp	0.409	0.004
Decatur	0.367	0.037
Dooly	0.496	0.003
Dougherty	0.345	0.006
Early	0.408	0.004
Fayette	0.194	0.003
Fulton	0.476	0.007
Harris	0.418	0.006
Houston	0.436	0.028
Lamar	0.306	0.026
Lee	0.419	0.006
Macon	0.490	0.008
Marion	0.336	0.003
Meriwether	0.360	0.004
Miller	0.404	0.008
Monroe	0.298	0.003
Pike	0.193	0.014
Randolph	0.391	0.003
Schley	0.353	0.003
Seminole	0.393	0.003
Spalding	0.410	0.005
Stewart	0.408	0.003
Sumter	0.382	0.003
Talbot	0.384	0.003
Taylor	0.404	0.003
Terrell	0.343	0.003
Upson	0.364	0.016
Webster	0.353	0.003
Worth	0.429	0.018

Source: USDA-NCRS, 1997. National Resources Inventory; USDA-NCRS Athens, Georgia

C factors for the road networks were determined based on the road surface and are given in Table 18. Road information, including road surface, was provided by the Georgia Department of Transportation (DOT). Data gaps were filled based on adjacent road surfaces and road types (i.e., state, county, private).

Table 18. Road C factors

Road Surface	Type	C factor
Rigid and High Flexible Road	1	0.13
Bituminous Surfaced Road	2	0.25
Gravel or Stone Road	3	0.65
Soil-Surfaced Road	4	0.75
Primitive or Unimproved Road	5	0.75

C factors for other land uses including urban, mining, transitional, grass, and wetlands are listed in Table 19. These values were provided by the U.S. Environmental Protection Agency (EPA) and are used in all watersheds.

Table 19. Various Land Use C factors

Land Use	C factor
Water	0
Low Intensity Residential	0.02
High Intensity Residential	0.005
High Intensity Commercial, Industrial, Transportation	0.003
Bare rock, sand, clay	0
Quarries, strip mines, gravel pits	0.75
Transitional	0.002
Other Grasses	0.003
Woody Wetlands	0.011
Emergent Herbaceous Wetlands	0.003

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 Best Management Practices (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

EPA 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.

An extension of WCS is the Sediment Tool, which incorporates the USLE. The Sediment Tool can be used to perform the following tasks:

- Estimate the extent and distribution of potential soil erosion within a watershed.
- Estimate the potential sediment delivery to the receiving water body.
- Evaluate the effects of land use, BMPs, and road networks on erosion and sediment delivery.

The watersheds of interest were delineated based on the RF3 stream coverage and elevation data. If there was no RF3 segment within the delineated watershed, the WCS Sediment Tool could not be used.

A stream grid for each delineated watershed was created based on elevation data. The stream grid corresponded to a stream network with twenty-five 30 by 30 meter headwater cells (5.5 acres). The stream grid network incorporates flow and has the ability to accumulate flow.

For each 30 by 30 meter grid cell within the watershed, the WCS Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

- Distance-based equation

  $$Md = M * (1-0.97 * D/L)$$

  where Md = mass moved (tons/acre/yr)
  M = sediment mass eroded (ton)
  D = least cost distance from a cell to the nearest stream grid (ft)
  L = maximum distance the sediment may travel (ft)

- Distance Slope-based equation

  $$DR = \exp(-0.4233 * L * Sf)$$

  where DR = sediment delivery ration
  Sf = exp (-16.1 * r/L+ 0.057)) - 0.6
  L = distance to the stream (m)
  r = relief to the stream (m)

- Area-based equation

  $$DR = 0.417762 * A^{(-0.134958)} - 1.27097, \qquad DR <= 1.0$$

  where DR = sediment delivery ratio
  A = area (sq miles)

- WEPP-based regression equation

$$Z = 0.9004 - 0.1341 * X - 0.0465 * X^2 + 0.00749 * X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$$

where Z = percent of source sediment passing to the next grid cell
X = cumulative distance downslope
Y = percent slope in the grid cell

Based on work previously performed by EPA on the Chattooga River Watershed, it was determined that the distance slope-based equation provided the best prediction of the sediment delivery (USEPA, 2001b).

The WCS Sediment Tool estimates the total annual soil erosion and sediment delivered to the stream from each grid cell according to its land use cover and the grids representing roads.

5.0 TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard; in this case the narrative water quality standard for aquatic life. A TMDL is the sum of the individual waste load allocations (WLAs) and load allocations (LAs) for nonpoint sources and natural background (40 CFR 130.2) for a given waterbody. 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. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For sediment, the TMDLS are expressed as tons/yr.

Conceptually, a TMDL can be expressed as follows:

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

This TMDL determines the allowable sediment loads to the impaired Flint River Basin streams and is based on the hypothesis that an impaired watershed having an annual average sediment loading rate similar to the biological reference watersheds will remain stable and not be biologically impaired due to sediment. The average sediment loads of the reference watersheds in the Piedmont and Southeastern Plains ecoregions within the Chattahoochee and Flint River basins are 0.63 tons/acre/yr (ranging from 0.30 to 1.26 tons/acre/yr) and 1.07 tons/acre/yr (ranging from 0.04 to 1.84 tons/acre/yr), respectively. The following sections describe the various sediment 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. Waste load allocations are provided to the point sources from municipal and industrial wastewater treatment systems. There are eight NPDES permitted facilities in the Flint River Basin watersheds. The daily maximum and annual allocated TSS loads for the eight NPDES facilities are given in Table 20.

Table 20. Waste Load Allocations

FACILITY	NPDES PERMIT NO	RECEIVING WATER	COUNTY	TSS LOAD	
				Daily Max (lbs/day)	Annual (ton/yr)
Andersonville WPCP	GA0033669	Unnamed trib to Sweetwater Creek	Sumter	8.5	1.6
Arlington Pond #1	GA0026204	Perry Creek trib to Spring Creek	Early	75.1	13.7
Beaverbrook Elementary School	GA0034380	Unnamed trib to Heads Creek	Spadling	2.5	0.5
Blakely WPCP	GA0025585	Baptist Branch	Early	329.0	60.0
Cordele WPCP	GA0024503	Gum Creek	Crisp	1254.6	229.0
Griffin - Potato Creek WPCP	GA0030791	Potato Creek	Lamar	500.5	91.3
Plains WPCP	GA0020931	Pessell Creek trib	Sumter	30.0	5.5
Timber Creek MHP	GA0023531	Unnamed trib to Heads Creek	Spalding	13.5	2.5

Average annual load assumes discharge every day at average daily flow

The WLA loads were calculated based on the design flow and average monthly permitted TSS concentration for the municipal facilities.

The sediment load allocation from future construction sites within the watershed will have to meet the requirements outlined in the Georgia General Storm Water NPDES Permit for Construction Activities. This permit 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 I through VII of the Georgia Storm Water Permit. The conditions of the permit were established to assure that the storm water runoff from these sites does not cause or contribute sediment to the stream. Georgia's General Storm Water Permit 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.

5.2 Load Allocations

The USLE was used to determine the relative sediment contributions from each significant land use. The USLE was applied to those watersheds that are biologically impaired and those that are not, to estimate the current sediment loading rates to the streams. The current sediment load allocation for each stream by land use, including roads, is reported in Table 21. The watersheds are grouped according to 303(d) listing. For comparison purposes, the total sediment load in tons per acre per year is also given. Table 22 gives each source's percent contribution to the total sediment load.

Understanding the potential sediment sources and the changes in land use that have occurred over the last century provides insight into the streams' current water quality issues. The average annual sediment load per unit area for the unimpaired and impaired watersheds are generally within the same range. Over the last century there has been a dramatic 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, streams will repair themselves over time.

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 is usually evened out by the response of the biological community to habitat alteration, a long-term process. Therefore, the average annual sediment load was considered to be an adequate indicator of potential stream impairment due to sediment.

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 and the use of no conservation practices (P factor = 1.0) for all land uses. In addition, average reference watershed sediment loading rates were used for the numeric targets.

Table 21. Sediment Load Allocations (Unimpaired – Piedmont Ecoregion)

	Sediment Load (tons/yr)																	
Name	**Open Water**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial/ Industrial Transportation**	**Bare Rock Sand and Clay**	**Quarries Strip Mines Gravel Pits**	**Transitional**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Pasture/Hay**	**Row Crops**	**Other Grasses (Urban Recreational)**	**Woody Wetland**	**Emergent Herbaceous Wetlands**	**Road**	**Total**	**load (tons/acre/yr)**
Auchumpkee Creek	0.0	4.9	0.1	2.7	0.0		160.3	62.6	61.0	22.7	665.3	5907.8	1.8	494.2	0.6	647.1	8031.1	0.30
Baroucho Creek	0.0	0.3		0.0				4.6	0.3	1.2	21.2	37.4	0.0	1.4		16.5	82.9	0.10
Big Lazer Creek	0.0	149.2	4.2	14.7			379.3	445.9	220.3	216.7	490.9	29100.6	11.9	1025.4	6.1	5123.1	37188.4	0.35
Brittens Creek	0.0	0.2		0.3			0.0	5.8	5.8	4.0	26.6	779.2				88.4	910.2	0.39
Five Mile Creek	0.0			0.5				1.9	0.8	0.9	69.1	210.4	0.0	0.8		70.6	355.0	0.38
Kendall Creek	0.0	1.5	0.2	0.0			4.7	13.1	10.7	8.8	31.2	630.6	0.0	5.3		152.9	859.0	0.33
Lazer Creek	0.0	57.4	0.3	3.2			122.1	124.8	39.1	43.8	139.1	7540.8	3.0	111.3	0.0	1180.3	9365.2	0.46
Mock Woodall Branch	0.0			0.1				4.1	0.4	1.5	74.0	427.5		1.8		28.7	538.1	0.46
Potato Creek low	0.0	608.5	20.7	49.9		2797.2	9.6	90.8	45.5	71.3	4050.6	19935.1	26.2	797.8	4.0	2983.7	31490.8	0.53

Table 21. Sediment Load Allocations (Unimpaired – Southeastern Plains Ecoregion)

	Sediment Load (tons/yr)																	
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road	Total	load (tons/acre/yr)
Bear Creek	0.0	6.7	0.5	1.2	0.0		49.1	34.9	26.1	28.6	107.3	51849.8	0.3	598.1	3.6	1011.8	53718.0	1.28
Beaver Creek	0.0	3.4	0.5	3.6	0.0	2422.6	28.8	10.1	8.5	6.4	10.9	6449.9	1.1	72.5	1.0	186.0	9205.1	0.88
Brantley Creek	0.0	62.9	2.1	3.4			5.6	2.3	1.3	1.7	35.7	6068.8	2.6	84.9	0.2	248.6	6520.0	0.67
Buck Creek	0.0	23.1	1.5	9.9		1011.7	323.5	198.4	90.2	111.3	188.3	108209.6	0.7	1345.4	11.2	3700.1	115225.0	0.91
Camp Creek upper	0.0			0.6			6.1	5.4	2.4	1.8	4.6	1666.6	0.2	22.0	0.1	31.6	1741.3	0.50
Camp Creek lower	0.0	1.7		1.5		1097.8	41.2	38.1	10.9	15.6	47.5	15943.4	0.2	290.9	0.7	636.9	18126.4	0.83
Cedar Creek	0.0	0.4		0.9			75.6	71.7	26.5	35.5	36.5	30209.6	0.2	84.1	0.1	1300.5	31841.7	0.70
Chickasawhatchee up	0.0	67.6	2.2	4.6			24.3	9.5	3.2	5.7	162.6	26859.0	3.8	337.3	2.7	705.2	28187.7	0.73
Chickasawhatchee low	0.0	72.7	2.3	5.6			88.3	39.2	17.9	28.1	405.8	72489.8	5.3	2274.5	19.7	2062.6	77511.9	0.39
Chokee Creek	0.0	11.2	0.3	0.8	0.0		6.5	4.2	1.7	1.6	132.7	32060.6	1.3	232.0	2.1	414.1	32869.3	1.04
Chokeelagee Creek	0.0			0.0			2.8	2.3	0.3	1.1	50.2	5388.9	0.0	90.5	1.0	84.4	5621.6	0.78
Culpepper Creek upper	0.0			0.2			1.3	3.0	5.8	0.9	3.5	733.8				20.3	768.8	0.43
Culpepper Creek lower	0.0	23.3	1.3	5.8			72.9	36.0	27.4	8.8	100.7	7234.3	1.2	110.9	2.5	377.1	8002.2	0.41
Ichaway-Nochaway Ck	0.0	78.0	0.2	1.8			161.1	60.7	47.2	63.2	195.5	69548.2	0.7	1094.6	9.1	1628.1	72888.4	1.00
Ichaway-Nochaway Ck	0.0	88.4	0.5	4.6			239.2	96.0	80.8	100.4	405.3	132236.6	2.6	1845.6	12.2	2775.0	137887.1	0.98
Kinchafoonee Creek	0.0	9.2	0.5	2.6			187.1	37.1	48.2	26.2	11.5	9855.7	0.3	442.9	2.0	561.0	11184.2	0.53
Lanahassee Creek	0.0	2.7	0.0	1.8			81.1	39.6	30.6	32.9	31.9	16998.6	0.6	317.8	0.8	488.4	18026.8	0.57
Lime Creek	0.0	3.8	0.0	0.9	0.0		36.2	26.8	7.6	10.8	277.9	76879.5	0.8	716.8	13.6	524.1	78498.8	2.02
Little Muchalee Creek	0.0	7.5	0.2	0.7			21.5	9.0	3.7	6.1	12.5	5979.1	0.2	79.6	0.5	256.7	6377.2	0.77
Little Pachitla Creek	0.0	0.2		0.4			9.4	8.3	6.5	8.5	29.7	16959.6	0.1	214.9	0.7	224.1	17462.5	1.52
Muckalee Creek upper	0.0	19.3	2.4	2.1	0.0		53.5	23.8	17.9	19.6	46.7	19881.7	0.6	111.2	0.8	521.2	20700.6	0.97
Muckalee Creek lower	0.0	605.2	31.6	45.6	0.0		260.8	129.7	66.1	100.3	712.8	153045.6	17.6	1395.3	9.9	3426.7	159847.3	0.98
North Mosquito Creek	0.0	31.8	0.0	1.3			56.0	3.6	20.2	9.5	194.6	33422.7	0.1	645.1	17.0	923.7	35325.7	1.68
Pachitla Creek	0.0	64.5	4.9	8.9	0.0	0.0	135.0	85.1	61.1	79.6	349.2	127002.1	2.0	1697.4	12.3	2327.2	131829.2	1.16
Patsiliga Creek lower	0.0	6.5	0.5	6.4	0.0	8820.1	100.9	110.7	49.1	56.0	131.6	42296.2	1.1	829.9	10.8	1917.0	54336.8	0.76
Sandy Mount Creek	0.0	7.3		4.3	0.0		12.1	2.0	2.1	1.0	98.1	54722.6	1.5	120.5	0.1	551.9	55523.4	3.33
Slaughter Creek	0.0	1.0		5.6			133.1	59.9	49.6	44.3	27.7	13093.3	0.0	483.7	0.8	1224.7	15123.8	0.52
Spring Creek Macon	0.0	8.6	1.5	1.7	0.0		0.7	0.4	0.3	0.3	141.6	14087.8	1.1	26.7	2.5	159.8	14433.1	3.61
Spring Creek lower	0.0	141.0	7.2	9.0	0.0	0.0	162.0	52.3	31.8	46.8	1480.8	285722.6	8.6	2965.1	42.0	8380.8	299050.1	0.99
Town Creek	0.0	246.9	13.6	13.9			9.9	4.4	1.9	3.6	21.5	4519.2	2.7	25.7	0.0	302.7	5166.3	1.10
Town Creek	0.0	49.4	3.9	3.9			8.7	6.0	4.0	6.8	14.7	5413.2	1.2	39.8	0.1	298.9	5850.6	1.16
Turkey Creek	0.0	1.6	0.0	0.0	0.0		23.6	6.5	3.1	2.3	293.4	73548.7	0.7	431.8	0.1	883.5	75195.3	2.54
Ty Ty Creek	0.0	0.3		0.1			5.1	3.2	2.0	2.4	17.2	2830.3		60.8	0.0	66.4	2987.7	0.68

Table 21. Sediment Load Allocations (Impaired – Piedmont Ecoregion)

Name	Sediment Load (tons/yr)																	
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road	Total	load (tons/acre/yr)
Basin Creek	0.0	0.1		0.5			0.6	14.7	2.2	4.9	240.6	2442.3	0.1	64.5		197.0	2967.6	0.74
Heads Creek	0.0	268.1	13.1	7.5			0.1	20.5	20.0	22.1	218.9	6180.7	8.5	95.0	0.0	661.9	7516.5	0.56
Lewis Creek	0.0			0.1				0.7	0.5	0.5	164.4	495.1		64.4	0.1	104.1	830.0	0.54
North Branch	0.0	0.1		0.5			6.4	5.2	2.6	1.5	26.1	512.4				36.2	590.8	0.42
Potato Creek upper	0.0	527.2	19.0	22.0		2673.0	1.2	9.1	6.2	10.3	59.4	1683.8	22.0	42.9		527.8	5604.0	0.99
Potato Creek mid upper	0.0	528.6	19.0	22.5		2673.0	1.2	11.3	7.7	13.2	310.6	2833.1	22.2	69.9	0.1	600.0	7112.4	0.88
Potato Creek middle	0.0	594.6	20.6	31.7		2683.0	1.2	20.5	13.4	20.7	922.8	5942.3	24.6	128.1	0.3	905.2	11309.0	0.76
Town Branch low	0.0	166.9	6.7	11.0			0.0	0.8	0.7	1.2	91.9	956.2	5.3	17.0	0.1	198.7	1456.7	0.76
Whitewater Creek	0.0	199.3	11.2	18.5			0.1	6.9	7.8	6.8	74.2	2595.5	11.7			336.5	3268.6	0.59
Willingham Spring Creek	0.0	0.4		0.5				10.5	0.9	2.2	119.7	1932.2		28.9		93.8	2189.1	0.97

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 21. Sediment Load Allocations (Impaired – Southeastern Plain Ecoregion)

	Sediment Load (tons/yr)																	
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road	Total	load (tons/acre/yr)
Angelica Creek	0.0	1.2	0.3	3.4			5.9	2.8	2.0	2.0	38.9	10201.1	1.0	30.3	0.0	107.1	10396.1	1.78
Avera Creek				0.1			14.5	1.3	0.5	0.4	3.3	727.1				18.6	765.7	0.91
Bailey Branch	0.0	0.9		0.1			8.0	6.5	2.4	3.4	33.0	9933.2	0.2	82.4	1.0	85.3	10156.4	1.87
Baptist Branch	0.0	45.3	2.7	1.0			2.0	0.4	0.3	0.6	6.2	1121.1	2.5	4.0	0.3	120.0	1306.4	0.74
Beaver Creek	0.0			0.1			34.2	13.0	5.7	3.4	12.3	1944.7		6.2		115.5	2134.9	0.41
Cooleewahee Creek	0.0	154.2	8.8	5.3	0.0	12.9	25.5	4.9	5.9	6.6	240.6	38074.0	5.2	806.5	34.8	1075.2	40460.3	0.42
Gum Creek	0.0	10.2	1.8	1.4	0.0		18.8	2.8	2.6	1.1	118.6	25769.3	0.3	82.4	0.2	307.2	26316.6	1.63
Lee Creek	0.0	0.2		0.5		1865.4	4.6	6.0	2.6	2.2	32.7	1559.9				22.8	3497.0	1.34
Little Whitewater Ck	0.0	1.0		4.1		4440.9	27.7	32.7	10.2	7.9	13.2	16735.9	0.0	387.8	6.6	434.2	22102.3	0.98
Mercer Mill Creek	0.0	15.7		0.6	0.0	15.5	54.1	3.2	14.0	3.2	589.6	32590.6	2.9	41.8	0.2	965.8	34297.2	1.26
Middle Creek	0.0	0.3		0.0			2.0	1.0	0.4	0.6	13.4	2900.9	0.0	24.3	0.3	81.8	3025.1	0.95
Muckaloochee Creek	0.0	2.8	0.1	1.4			19.9	17.4	9.1	11.0	176.8	20557.4	0.9	243.2	1.5	547.0	21588.6	0.89
Patsiliga Creek	0.0	2.1	0.0	1.1	0.0	3389.9	13.9	24.8	10.5	14.8	15.4	7993.7		185.5	1.2	619.7	12272.6	0.70
Pessell Creek	0.0	5.7	0.5	0.1	0.0		8.9	5.0	2.3	3.9	23.1	5248.1	0.4	71.0	0.4	157.6	5526.8	0.73
Rambulette Creek	0.0	0.0		0.7			5.2	12.7	3.5	4.5	5.9	2595.9		1.5		148.4	2778.2	0.46
Shoal Creek	0.0	0.1		2.1			27.5	23.0	7.9	5.8	15.8	16832.5		39.1	0.5	745.3	17699.8	1.05
Spring Creek	0.0	11.5	0.4	0.5	0.0		42.7	15.0	3.8	8.2	175.4	49662.2	0.8	688.8	10.1	1599.2	52218.6	0.90
Sweetwater Creek	0.0	13.4	0.0	3.6		7648.7	72.1	25.7	10.8	17.4	102.8	23067.9	1.6	230.6	0.4	407.8	31602.9	1.44
Whitewater Creek	0.0			0.0			10.8	3.1	0.7	0.9	3.7	2438.1				45.3	2502.5	1.24
Wolf Creek	0.0	0.1		0.1			4.8	2.4	0.9	1.6	47.9	8813.0		69.3	0.1	176.1	9116.3	1.06

Table 22. Sediment Load Percentages (Unimpaired – Piedmont Ecoregion)

	Percent Total Sediment Load															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road
Auchumpkee Creek	0.00%	0.06%	0.00%	0.03%	0.00%		2.00%	0.78%	0.76%	0.28%	8.28%	73.56%	0.02%	6.15%	0.01%	8.06%
Baroucho Creek	0.00%	0.34%		0.02%				5.49%	0.41%	1.48%	25.62%	45.12%	0.03%	1.64%		19.84%
Big Lazer Creek	0.00%	0.40%	0.01%	0.04%	0.00%	0.00%	1.02%	1.20%	0.59%	0.58%	1.32%	78.25%	0.03%	2.76%	0.02%	13.78%
Brittens Creek	0.00%	0.02%		0.03%			0.00%	0.64%	0.64%	0.43%	2.92%	85.60%				9.71%
Five Mile Creek	0.00%			0.14%				0.52%	0.23%	0.25%	19.46%	59.27%	0.01%	0.23%		19.89%
Kendall Creek	0.00%	0.17%	0.02%	0.00%			0.55%	1.53%	1.24%	1.02%	3.64%	73.41%	0.00%	0.61%		17.80%
Lazer Creek	0.00%	0.61%	0.00%	0.03%			1.30%	1.33%	0.42%	0.47%	1.49%	80.52%	0.03%	1.19%	0.00%	12.60%
Mock Woodall Branch	0.00%			0.01%				0.77%	0.07%	0.29%	13.75%	79.45%		0.34%		5.33%
Potato Creek low	0.00%	1.93%	0.07%	0.16%	0.00%	8.88%	0.03%	0.29%	0.14%	0.23%	12.86%	63.30%	0.08%	2.53%	0.01%	9.47%

Table 22. Sediment Load Percentages (Unimpaired – Southeastern Plains Ecoregion)

	Percent Total Sediment Load															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road
Bear Creek	0.00%	0.01%	0.00%	0.00%	0.00%		0.09%	0.07%	0.05%	0.05%	0.20%	96.52%	0.00%	1.11%	0.01%	1.88%
Beaver Creek	0.00%	0.04%	0.00%	0.04%	0.00%	26.32%	0.31%	0.11%	0.09%	0.07%	0.12%	70.07%	0.01%	0.79%	0.01%	2.02%
Brantley Creek	0.00%	0.96%	0.03%	0.05%			0.09%	0.04%	0.02%	0.03%	0.55%	93.08%	0.04%	1.30%	0.00%	3.81%
Buck Creek	0.00%	0.02%	0.00%	0.01%	0.00%	0.88%	0.28%	0.17%	0.08%	0.10%	0.16%	93.91%	0.00%	1.17%	0.01%	3.21%
Camp Creek upper	0.00%			0.04%			0.35%	0.31%	0.14%	0.10%	0.26%	95.71%	0.01%	1.26%	0.00%	1.82%
Camp Creek lower	0.00%	0.01%	0.00%	0.01%	0.00%	6.06%	0.23%	0.21%	0.06%	0.09%	0.26%	87.96%	0.00%	1.60%	0.00%	3.51%
Cedar Creek	0.00%	0.00%		0.00%			0.24%	0.23%	0.08%	0.11%	0.11%	94.87%	0.00%	0.26%	0.00%	4.08%
Chickasawhatchee up	0.00%	0.24%	0.01%	0.02%	0.00%	0.00%	0.09%	0.03%	0.01%	0.02%	0.58%	95.29%	0.01%	1.20%	0.01%	2.50%
Chickasawhatchee low	0.00%	0.09%	0.00%	0.01%	0.00%	0.00%	0.11%	0.05%	0.02%	0.04%	0.52%	93.52%	0.01%	2.93%	0.03%	2.66%
Chokee Creek	0.00%	0.03%	0.00%	0.00%	0.00%		0.02%	0.01%	0.01%	0.00%	0.40%	97.54%	0.00%	0.71%	0.01%	1.26%
Chokeelagee Creek	0.00%			0.00%			0.05%	0.04%	0.00%	0.02%	0.89%	95.86%	0.00%	1.61%	0.02%	1.50%
Culpepper Creek upper	0.00%			0.03%			0.16%	0.39%	0.75%	0.12%	0.45%	95.46%				2.65%
Culpepper Creek lower	0.00%	0.29%	0.02%	0.07%	0.00%	0.00%	0.91%	0.45%	0.34%	0.11%	1.26%	90.40%	0.01%	1.39%	0.03%	4.71%
Ichaway-Nochaway Ck	0.00%	0.11%	0.00%	0.00%	0.00%	0.00%	0.22%	0.08%	0.06%	0.09%	0.27%	95.42%	0.00%	1.50%	0.01%	2.23%
Ichaway-Nochaway Ck	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.17%	0.07%	0.06%	0.07%	0.29%	95.90%	0.00%	1.34%	0.01%	2.01%
Kinchafoonee Creek	0.00%	0.08%	0.00%	0.02%			1.67%	0.33%	0.43%	0.23%	0.10%	88.12%	0.00%	3.96%	0.02%	5.02%
Lanahassee Creek	0.00%	0.02%	0.00%	0.01%	0.00%	0.00%	0.45%	0.22%	0.17%	0.18%	0.18%	94.30%	0.00%	1.76%	0.00%	2.71%
Lime Creek	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.03%	0.01%	0.01%	0.35%	97.94%	0.00%	0.91%	0.02%	0.67%
Little Muchalee Creek	0.00%	0.12%	0.00%	0.01%			0.34%	0.14%	0.06%	0.10%	0.20%	93.76%	0.00%	1.25%	0.01%	4.03%
Little Pachitla Creek	0.00%	0.00%		0.00%			0.05%	0.05%	0.04%	0.05%	0.17%	97.12%	0.00%	1.23%	0.00%	1.28%
Muckalee Creek upper	0.00%	0.09%	0.01%	0.01%	0.00%		0.26%	0.12%	0.09%	0.09%	0.23%	96.04%	0.00%	0.54%	0.00%	2.52%
Muckalee Creek lower	0.00%	0.38%	0.02%	0.03%	0.00%	0.00%	0.16%	0.08%	0.04%	0.06%	0.45%	95.74%	0.01%	0.87%	0.01%	2.14%
North Mosquito Creek	0.00%	0.09%	0.00%	0.00%			0.16%	0.01%	0.06%	0.03%	0.55%	94.61%	0.00%	1.83%	0.05%	2.61%
Pachitla Creek	0.00%	0.05%	0.00%	0.01%	0.00%	0.00%	0.10%	0.06%	0.05%	0.06%	0.26%	96.34%	0.00%	1.29%	0.01%	1.77%
Patsiliga Creek lower	0.00%	0.01%	0.00%	0.01%	0.00%	16.23%	0.19%	0.20%	0.09%	0.10%	0.24%	77.84%	0.00%	1.53%	0.02%	3.53%
Sandy Mount Creek	0.00%	0.01%		0.01%	0.00%		0.02%	0.00%	0.00%	0.00%	0.18%	98.56%	0.00%	0.22%	0.00%	0.99%
Slaughter Creek	0.00%	0.01%		0.04%			0.88%	0.40%	0.33%	0.29%	0.18%	86.57%	0.00%	3.20%	0.01%	8.10%
Spring Creek Macon	0.00%	0.06%	0.01%	0.01%	0.00%		0.00%	0.00%	0.00%	0.00%	0.98%	97.61%	0.01%	0.19%	0.02%	1.11%
Spring Creek lower	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.05%	0.02%	0.01%	0.02%	0.50%	95.54%	0.00%	0.99%	0.01%	2.80%
Town Creek	0.00%	4.78%	0.26%	0.27%			0.19%	0.09%	0.04%	0.07%	0.42%	87.48%	0.05%	0.50%	0.00%	5.86%
Town Creek	0.00%	0.84%	0.07%	0.07%			0.15%	0.10%	0.07%	0.12%	0.25%	92.52%	0.02%	0.68%	0.00%	5.11%
Turkey Creek	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.01%	0.00%	0.00%	0.39%	97.81%	0.00%	0.57%	0.00%	1.17%
Ty Ty Creek	0.00%	0.01%		0.00%			0.17%	0.11%	0.07%	0.08%	0.58%	94.73%		2.03%	0.00%	2.22%

Table 22. Sediment Load Percentages (Impaired – Piedmont Ecoregion)

	Percent Total Sediment Load															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road
Basin Creek	0.00%	0.00%		0.02%			0.02%	0.50%	0.08%	0.16%	8.11%	82.30%	0.00%	2.17%		6.64%
Heads Creek	0.00%	3.57%	0.17%	0.10%			0.00%	0.27%	0.27%	0.29%	2.91%	82.23%	0.11%	1.26%	0.00%	8.81%
Lewis Creek	0.00%			0.02%				0.08%	0.07%	0.06%	19.81%	59.65%		7.76%	0.01%	12.54%
North Branch	0.00%	0.01%		0.08%			1.08%	0.88%	0.44%	0.25%	4.41%	86.73%				6.12%
Potato Creek upper	0.00%	9.41%	0.34%	0.39%		47.70%	0.02%	0.16%	0.11%	0.18%	1.06%	30.05%	0.39%	0.77%		9.42%
Potato Creek mid upper	0.00%	7.43%	0.27%	0.32%	0.00%	37.58%	0.02%	0.16%	0.11%	0.19%	4.37%	39.83%	0.31%	0.98%	0.00%	8.44%
Potato Creek middle	0.00%	5.26%	0.18%	0.28%	0.00%	23.72%	0.01%	0.18%	0.12%	0.18%	8.16%	52.55%	0.22%	1.13%	0.00%	8.00%
Town Branch low	0.00%	11.46%	0.46%	0.75%	0.00%	0.00%	0.00%	0.06%	0.05%	0.08%	6.31%	65.64%	0.37%	1.17%	0.01%	13.64%
Whitewater Creek	0.00%	6.10%	0.34%	0.57%			0.00%	0.21%	0.24%	0.21%	2.27%	79.41%	0.36%			10.30%
Willingham Spring Creek	0.00%	0.02%		0.02%				0.48%	0.04%	0.10%	5.47%	88.26%		1.32%		4.29%

Impaired upstream watersheds that contribute to an impaired downstream watershed
Impaired downstream watersheds

Table 22. Sediment Load Percentages (Impaired – Southeastern Plains Ecoregion)

	Percent Total Sediment Load															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road
Angelica Creek	0.00%	0.01%	0.00%	0.03%			0.06%	0.03%	0.02%	0.02%	0.37%	98.12%	0.01%	0.29%	0.00%	1.03%
Avera Creek				0.01%			1.89%	0.17%	0.06%	0.05%	0.43%	94.96%				2.43%
Bailey Branch	0.00%	0.01%		0.00%			0.08%	0.06%	0.02%	0.03%	0.32%	97.80%	0.00%	0.81%	0.01%	0.84%
Baptist Branch	0.00%	3.47%	0.20%	0.08%			0.15%	0.03%	0.02%	0.05%	0.48%	85.82%	0.19%	0.31%	0.02%	9.18%
Beaver Creek	0.00%			0.01%			1.60%	0.61%	0.27%	0.16%	0.58%	91.09%		0.29%		5.41%
Cooleewahee Creek	0.00%	0.38%	0.02%	0.01%	0.00%	0.03%	0.06%	0.01%	0.01%	0.02%	0.59%	94.10%	0.01%	1.99%	0.09%	2.66%
Gum Creek	0.00%	0.04%	0.01%	0.01%	0.00%		0.07%	0.01%	0.01%	0.00%	0.45%	97.92%	0.00%	0.31%	0.00%	1.17%
Lee Creek	0.00%	0.01%		0.02%		53.34%	0.13%	0.17%	0.07%	0.06%	0.94%	44.61%				0.65%
Little Whitewater Ck	0.00%	0.00%		0.02%		20.09%	0.13%	0.15%	0.05%	0.04%	0.06%	75.72%	0.00%	1.75%	0.03%	1.96%
Mercer Mill Creek	0.00%	0.05%		0.00%	0.00%	0.05%	0.16%	0.01%	0.04%	0.01%	1.72%	95.02%	0.01%	0.12%	0.00%	2.82%
Middle Creek	0.00%	0.01%		0.00%			0.07%	0.03%	0.01%	0.02%	0.44%	95.89%	0.00%	0.80%	0.01%	2.71%
Muckaloochee Creek	0.00%	0.01%	0.00%	0.01%			0.09%	0.08%	0.04%	0.05%	0.82%	95.22%	0.00%	1.13%	0.01%	2.53%
Patsiliga Creek	0.00%	0.02%	0.00%	0.01%	0.00%	27.62%	0.11%	0.20%	0.09%	0.12%	0.13%	65.13%		1.51%	0.01%	5.05%
Pessell Creek	0.00%	0.10%	0.01%	0.00%	0.00%		0.16%	0.09%	0.04%	0.07%	0.42%	94.96%	0.01%	1.28%	0.01%	2.85%
Rambulette Creek	0.00%	0.00%		0.02%			0.19%	0.46%	0.13%	0.16%	0.21%	93.44%		0.05%		5.34%
Shoal Creek	0.00%	0.00%		0.01%			0.16%	0.13%	0.04%	0.03%	0.09%	95.10%		0.22%	0.00%	4.21%
Spring Creek	0.00%	0.02%	0.00%	0.00%	0.00%		0.08%	0.03%	0.01%	0.02%	0.34%	95.10%	0.00%	1.32%	0.02%	3.06%
Sweetwater Creek	0.00%	0.04%	0.00%	0.01%		24.20%	0.23%	0.08%	0.03%	0.05%	0.33%	72.99%	0.01%	0.73%	0.00%	1.29%
Whitewater Creek	0.00%			0.00%			0.43%	0.12%	0.03%	0.03%	0.15%	97.42%				1.81%
Wolf Creek	0.00%	0.00%		0.00%			0.05%	0.03%	0.01%	0.02%	0.53%	96.67%		0.76%	0.00%	1.93%

5.5 Total Sediment Load

The average sediment loads of the reference watersheds in the Piedmont and Southeastern Plains ecoregions within the Chattahoochee and Flint River basins are 0.63 tons/acre/yr (ranging from 0.30 to 1.26 tons/acre/yr) and 1.10 tons/acre/yr (ranging from 0.28 to 1.84 tons/acre/yr), respectively. The total maximum daily load of sediment was determined by adding the WLA and the LA. The MOS, as described above, was implicitly included in the TMDL analysis and does not factor directly in the TMDL equation as shown above. The annual average sediment loads for each of the impaired watersheds are summarized in Table 23 and includes any required sediment load reduction. A Summary Memorandum for each watershed is provided in Appendix A.

The USLE method used indicates that the largest sediment loads come from areas with close proximity to the stream grid, especially dirt roads and croplands. The model does not account for any BMPs that are currently being used to control erosion from these areas, and thus may over estimate some sediment loads.

Table 23. Annual Average Sediment Loads and the Required Sediment Load Reductions

Name	Current Load (tons/yr)	WLA (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	% Reduction
Basin Creek	2,968		2,527	2,527	15%
Heads Creek	7,520	3.0	7,517	7,520	0%
Lewis Creek	830		830	830	0%
North Branch	591		591	591	0%
Potato Creek middle	11,400	91.3	9,260	9,351	17%
Town Branch low	1,457		1,205	1,205	17%
Whitewater Creek	3,269		3,269	3,269	0%
Willingham Spring Creek	2,189		1,425	1,425	35%
Angelica Creek	10,396		6,430	6,430	38%
Avera Creek	766		766	766	0%
Bailey Branch	10,156		5,982	5,982	41%
Baptist Branch	1,366	60.0	1,306	1,366	0%
Beaver Creek	2,135		2,135	2,135	0%
Cooleewahee Creek	40,460		40,460	40,460	0%
Gum Creek	26,546	229.0	17,511	17,740	33%
Lee Creek	3,497		2,877	2,877	18%
Little Whitewater Ck	22,102		22,102	22,102	0%
Mercer Mill Creek	34,297		29,945	29,945	13%
Middle Creek	3,025		3,025	3,025	0%
Muckaloochee Creek	21,589		21,589	21,589	0%
Patsiliga Creek	12,273		12,273	12,273	0%
Pessell Creek	5,532	5.5	5,527	5,532	0%
Rambulette Creek	2,778		2,778	2,778	0%
Shoal Creek	17,700		17,700	17,700	0%
Spring Creek	52,232	13.7	52,219	52,232	0%
Sweetwater Creek	31,605	1.6	24,086	24,087	24%
Whitewater Creek	2,503		2,221	2,221	11%
Wolf Creek	9,116		9,116	9,116	0%

6.0 RECOMMENDATIONS

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. GAEPD has adopted a basin approach to water quality management; an approach that divides Georgia's major river basins into five groups. This approach provides for additional monitoring to be focused on one of the five basin groups each year. The Chattahoochee River Basin along with the Flint River Basin were the basins of focused monitoring in 2000 and will again receive focused monitoring in 2005. Focused basin monitoring is to continue to monitor 303(d) listed waters. Therefore, additional monitoring of these streams will be initiated, as appropriate, during the next monitoring cycle to determine if there has been improvement in the biological communities.

6.2 Sediment Management Practices

Based on the findings of the source assessment, it was determined that most of the sediment found in the Flint 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 impaired stream segments, in order that these streams recover over time.

The measurement of sediment delivered to a stream is difficult, if not impossible, to determine. Therefore, setting a numeric TMDL may be ineffective given the difficulty in measuring it. In addition, habitat and aquatic communities are usually slow to respond, which is why monitoring will continue according to the five-year monitoring cycle. Thus, this TMDL recommends the compliance with NPDES permits and the implementation of BMPs. The effects of compliance with NPDES permits and implementation of BMPs will contribute to the improvement of stream habitats and water quality, and will represent a beneficial measure of TMDL implementation.

Management practices recommended include:

- Compliance with NPDES permit limits and requirements
- Implementation of GFC Best Management Practices for forestry
- Adoption of NRCS Conservation Practices
- Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit Application
- Adoption of proper unpaved road maintenance practices
- Implementation of Erosion and Sedimentation Control Plans for land disturbing activities
- Mitigation and prevention of stream bank erosion due to increased streamflow and velocities caused by urban runoff

6.2.1 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 municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GAEPD rules and regulations, all NPDES dischargers in the watershed are required to meet their current NPDES permit limits. It is recommended that there be no authorized increase in the mass loading of sediment (TSS) above those in the current NPDES permits, in order to maintain the current sediment loads in the impaired streams. 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 either sedimentation ponds or detention basins prior to being discharged to the stream and are regulated by NPDES permits. For mining facilities located within the impaired watersheds, it is recommended that monitoring frequencies be increased in order to better characterize the total annual sediment loads coming from these facilities.

Georgia EPD has developed a General Storm Water NPDES Permit for Construction Activities. The current permit is required for all construction sites disturbing five or more acres. In 2003, this permit will cover all construction sites disturbing one or more acres. All sites required to have this 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 I through VII of the Georgia Storm Water Permit. 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.

It is recommended that construction sites within impaired watersheds that are located within 100 feet of the impaired stream or its tributaries use DIRT II techniques to model and manage storm water runoff from these sites. In addition, all construction sites will monitor their storm water runoff as required by the General Storm Water NPDES Permit for Construction Activities.

6.2.2 Nonpoint Source Land Use Approaches

The Georgia EPD is responsible for administering and enforcing laws to protect the waters of the State. EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities include establishing water quality standards 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, and 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 that address nonpoint source pollution. In addition, public education efforts are being targeted at individual stakeholders to provide information regarding the use of best management practices to protect water quality. The following sections describe in more detail the specific measures to reduce nonpoint sources of sediment by land use type.

6.2.2.1 Forested Land

In 1978, 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 to assess the extent of water pollution caused by forestry practices, and develop recommendations to reduce or eliminate 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. The current BMP manual, *Georgia's Best Management Practices for Forestry,* was developed and became effective June 1, 1999 (GAEPD, 1999).

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 coordinator and the twelve district coordinators conduct the educational programs across the state. The district coordinators receive specialized training in erosion and sediment control, forest road layout and construction, stream habitat assessment, rapid bioassessment (macroinvertebrate) monitoring, 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 School of Forest Resources, the Georgia Forestry Association, and the 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.

To determine if educational efforts have been successful and if the BMPs are effective at minimizing erosion and sedimentation, the GFC conducted BMP compliance surveys in 1991 and 1992. In 1998, another BMP survey was conducted using a newly developed and more rigorous protocol recommended by a Southern Group of State Foresters (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 survey results show that of the number of acres evaluated, the number in BMP compliance for the most part was very good. In 1991, approximately 86 percent of the acres evaluated were in compliance. In 1992, the figure increased to 92 percent compliance and in 1998, compliance rose to 98 percent.

The GFC also investigates and mediates complaints or concerns involving forestry operations on behalf of the EPD and the Army Corps of Engineers (COE) when stream water quality and wetlands are involved, respectively. Complaints from citizens are received, 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 the identity of 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 can not get satisfactory compliance, the case is turned over to Georgia 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.

6.2.2.2 Agricultural Land

There are a number of agricultural organizations that work to support Georgia's more than 40,000 farmers. 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, Georgia 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 Protection of Water Quality in Georgia,* for the agricultural community (GSWCC, 1994).

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 and Job Sheets on their website (www.ga.nrcs.usda.gov/ga/gapas/FOTG/Section _4/). Some of these BMPs may be used for farming operations to reduce soil erosion. It is recommended that the agricultural communities with crop land close to impaired streams, and pasture land 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 into 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 USDA Natural Resources Conservation Service conducts the National Resources Inventory (NRI). The NRI is a statistically based sample of land use and natural resource conditions and trends, covering non-federal land in the United States. 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 in 1997 (USDA NRCS, 1998).

NRCS also provides a web-based database application (Performance and Results Measurement System, PRMS) so that 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://sugarberry.itc.nrcs.usda.gov/Netdynamics/deeds/index.html.

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 GAEPD supports the PRMS website.

6.2.2.3 Mine Sites

Surface mining and mineral processing present two threats to surface waters. The first threat is the wastewater from mining and mineral processing operations. These discharges are considered point sources and therefore are regulated by NPDES permits and were discussed in Section 6.2.1 above. 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 Georgia EPD. These permits are administered by the Land Protection Branch. The surface mining permit application must include a Mined Land Use Plan, reclamation strategies, and surety bond requirements to guarantee proper management and reclamation of surface mined areas. The Mined 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 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 impaired 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 Georgia Mining Association 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.

6.2.2.4 Roads

Unpaved roads can be a major contributor of sediment to our waterways if not properly managed. The following guidance for the maintenance and service of unpaved roadways, drainage ditches, and culverts can be used to minimize roadway erosion. One publication that may include some additional guidance is *Recommended Practices Manual, A Guideline for Maintenance and Service of Unpaved Roads* (Choctawhatchee, et. al, 2000).

Disturbances to unpaved roadway surfaces and ditches, and poor road surface drainage, results in deterioration of the road surface. This leads to increased roadway erosion and thus stream sedimentation. Unpaved roads are typically maintained by the 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 and dissipate turbulence 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 sediment over a larger vegetative filtering area, helping to reduce road side 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 streamflows 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 streamflows 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 also effect the biological communities.

6.2.2.5 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 adapted erosion and sedimentation ordinances and have been given authority to issue and enforce permits for land-disturbing activities. Approximately 32 counties and 240 municipalities in Georgia have been certified as the local issuing authority. In areas where local governments have not been certified as an issuing authority, the Georgia 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 *Field Manual for Erosion and Sediment Control in Georgia,* developed by the State Soil and Water Conservation Commission, may be used as a guide to develop erosion and sedimentation control plans (GSWCC, 1997).

Local governments, with oversight by the Georgia EPD, and the Soil and Water Conservation Districts, are primarily responsible for implementing the Erosion and Sedimentation Act. Reports of suspected violations are made to the agency that issued the permit. In cases with local issuing authority, if the violation continues, the compliant is referred to the appropriate Soil and Water Conservation District. If the situation remains unresolved, the compliant is then referred to Georgia 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 revised June 2001 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 streamflow rates may increase significantly from pre-construction rates. These changes in the streamflow 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 the *Land Development Provisions to Protect Georgia Water Quality* (GAEPD, 1997).

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. Georgia is working with local governments, and 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 was provided for this TMDL. During this time the availability of the TMDL was public noticed, a copy of the TMDL was provided as requested, and the public was invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of BMPs and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL, while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs), or other EPD contractors (hereinafter, “EPD Contractors”), will develop expanded plans (hereinafter, “Revised TMDL Implementation Plans”).

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The “Management Measure Selector Table” shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. [See 40 C.F.R. § 122.44(d)(1)(vii)(B)]. NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

2. EPD and the EPD Contractor will select and implement one or more BMP demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major pollutant categories of concern for the respective River Basin as identified in the TMDLs. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA’s “Best Management Practices Handbook,” the “NRCS National Handbook of Conservation Practices,” or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled “Watershed Wisdom -- Georgia’s TMDL Program” will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL. Also, a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL Implementation Plan development.

4. If for any reason the EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan is the end of August 2004.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:

   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Agriculture	1. Sediment & Erosion Control	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	1. Preharvest Planning				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				
	10. Wetlands Forest Management	_	_	_		_		_		

Land Use	**Management Measures**	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

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APPENDIX A

Annual Average Sediment Load
Summary Memorandum

SUMMARY MEMORANDUM
Annual Average Sediment Load
Angelica Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Sumter

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130007

Waterbody Name: Angelica Creek
Location: Unnamed tributary 1.9 miles u/s US Hwy 19 to Lake Collins
Stream Length: 2 miles
Watershed Area: 9.50 square miles
Tributary to: Muckalee Creek
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA) : 6,430 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 6,430 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Avera Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Crawford**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Avera Creek**
Location:	**Headwaters to Beaver Creek**
Stream Length:	**4 miles**
Watershed Area:	**1.30 square miles**
Tributary to:	**Beaver Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**766 tons/yr**	
Land Use		**747 tons/yr**
Road		**19 tons yr**

Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**766 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Bailey Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Sumter

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130006

Waterbody Name: Bailey Branch
Location: Headwaters to Little Lime Creek
Stream Length: 8 miles
Watershed Area: 8.80 square miles
Tributary to: Lime Creek
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA) : 5,982 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 5,982 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Baptist Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Early**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130010**
Waterbody Name:	**Baptist Branch**
Location:	**Downstream Blakely**
Stream Length:	**2 miles**
Watershed Area:	**3.01 square miles**
Tributary to:	**Spring Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:

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):	
Blakely WPCP	**60.0 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**1,306 tons/yr**
Land Use	**1,186 tons/yr**
Road	**120 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**1,366 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Basin Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Upson**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Basin Creek**
Location:	**Upson County**
Stream Length:	**6 miles**
Watershed Area:	**6.33 square miles**
Tributary to:	**Potato Creek**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**2,527 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**2,527 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Beaver Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Crawford**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Beaver Creek**
Location:	**Headwaters to Spring Creek**
Stream Length:	**11 miles**
Watershed Area:	**8.30 square miles**
Tributary to:	**Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**2,135 tons/yr**	
Land Use		**2,019 tons/yr**
Road		**116 tons yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**2,135 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Cooleewahee Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Dougherty/Baker**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130008**
Waterbody Name:	**Cooleewahee Creek**
Location:	**Piney Woods Branch to Flint River**
Stream Length:	**16 miles**
Watershed Area:	**152.96 square miles**
Tributary to:	**Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):		
Future Construction Sites	**Meet requirements of General Storm Water Permit**	
Load Allocation (LA):	**40,460 tons/yr**	
Land Use		**39,385 tons/yr**
Road		**1,075 tons yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**40,460 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Gum Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Crisp**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130006**
Waterbody Name:	**Gum Creek**
Location:	**Downstream Cordele to Lake Blackshear**
Stream Length:	**6 miles**
Watershed Area:	**26.10 square miles**
Tributary to:	**Lake Blackshear/Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Cordele WPCP	**229.0 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**17,511 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**17,740 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Heads Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Spalding

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Heads Creek
Location: D/S Griffin Reservoir to Wildcat Creek
Stream Length: 2 miles
Watershed Area: 21.60 square miles
Tributary to: Wildcat Creek
Ecoregion: Piedmont

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):

Beaverbrook Elementary	0.5 tons/yr
Timber Creek MHP	2.5 tons/ yr
Future Construction Sites	Meet requirements of General Storm Water Permit

Load Allocation (LA): 7,517 tons/yr

Land Use	6,855 tons/yr
Road	662 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 7,520 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Lee Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Crawford

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Lee Creek
Location: Downstream from Lake Henry to Beaver Creek
Stream Length: 1 miles
Watershed Area: 4.30 square miles
Tributary to: Flint River
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 2,877 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 2,877 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Lewis Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Pike

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Lewis Creek
Location: Pike County
Stream Length: 2 miles
Watershed Area: 2.44 square miles
Tributary to: Elkins Creek
Ecoregion: Piedmont

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 830 tons/yr
Land Use — 726 tons/yr
Road — 104 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 830 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Little Whitewater Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Taylor

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Little Whitewater Creek
Location: Black Creek to Whitewater Creek
Stream Length: 6 miles
Watershed Area: 35.08 square miles
Tributary to: Whitewater Creek
Ecoregion: Southeaster Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 22,102 tons/yr
Land Use 21,668 tons/yr
Road 434 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 22,102 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Mercer Mill Creek (Mill Creek)

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Worth**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130006**
Waterbody Name:	**Mercer Mill Creek (Mill Creek)**
Location:	**Boy Scout Road to Flint River**
Stream Length:	**7 miles**
Watershed Area:	**43.70 square miles**
Tributary to:	**Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**29,945 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**29,945 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Middle Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Terrell**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130007**
Waterbody Name:	**Middle Creek**
Location:	**Headwaters to Kinchafoonee Creek**
Stream Length:	**8 miles**
Watershed Area:	**5.18 square miles**
Tributary to:	**Kinchafoonee Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**3,025 tons/yr**	
Land Use		**2,943 tons/yr**
Road		**82 tons yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**3,025 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Muckaloochee Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Sumter**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130007**
Waterbody Name:	**Muckaloochee Creek**
Location:	**Little Muckaloochee Creek to Smithville Pond**
Stream Length:	**5 miles**
Watershed Area:	**38.59 square miles**
Tributary to:	**Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**21,589 tons/yr**
Land Use	**21,042 tons/yr**
Road	**547 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**21,589 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
North Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Crawford**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**North Branch**
Location:	**Crawford County**
Stream Length:	**4 miles**
Watershed Area:	**2.45 square miles**
Tributary to:	**Ulcohatchee Creek**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):
Future Construction Sites — **Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**591 tons/yr**
Land Use	**555 tons/yr**
Road	**36 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**591 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Patsiliga Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Talbot/Taylor**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Patsiliga Creek**
Location:	**Headwaters to McCants Mill Pond**
Stream Length:	**15 miles**
Watershed Area:	**28.00 square miles**
Tributary to:	**Flint River**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**12,273 tons/yr**	
Land Use		**11,653 tons/yr**
Road		**620 tons yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**12,273 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Pessell Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Sumter**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Pessell Creek**
Location:	**Headwaters to Kinchafoonee Creek**
Stream Length:	**8 miles**
Watershed Area:	**12.41 square miles**
Tributary to:	**Kinchafoonee Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):	
Plains WPCP	**5.5 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**5,527 tons/yr**
Land Use	**5,369 tons/yr**
Road	**158 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**5,532 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Potato Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Spalding/Lamar

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Potato Creek
Location: Headwaters to US Hwy 333
Stream Length: 11 miles
Watershed Area: 24.05 square miles
Tributary to: Flint River
Ecoregion: Piedmont

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Griffin Potato Creek WPCP 91.3 tons/yr
Future Construction Sites Meet requirements of General Storm Water Permit

Load Allocation (LA): 9,260 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 9,351 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Rambulette Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Taylor**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Rambulette Creek**
Location:	**Headwaters to Whitewater Creek**
Stream Length:	**9 miles**
Watershed Area:	**10.00 square miles**
Tributary to:	**Whitewater Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):
Future Construction Sites **Meet requirements of General Storm Water Permit**

Load Allocation (LA):	**2,778 tons/yr**
Land Use	**2,630 tons/yr**
Road	**148 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**2,778 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Shoal Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Marion**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Shoal Creek**
Location:	**Little Shoal Creek To Little Creek**
Stream Length:	**3 miles**
Watershed Area:	**27.04 square miles**
Tributary to:	**Buck Creek**
Ecoregion:	**Southeastern Plains**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):		
Future Construction Sites	**Meet requirements of General Storm Water Permit**	
Load Allocation (LA):	**17,700 tons/yr**	
Land Use		**16,955 tons/yr**
Road		**745 tons yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**17,700 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Spring Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Early/Miller

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130010

Waterbody Name: Spring Creek
Location: SR 62 near Arlington to Aycocks Creek
Stream Length: 22 miles
Watershed Area: 92.20 square miles
Tributary to: Lake Seminole/Flint River
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Arlington Pond #1 — 13.7 tons/yr
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 52,219 tons/yr
Land Use — 50,620 tons/yr
Road — 1,599 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 52,232 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Sweetwater Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Sumter/Macon

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130006

Waterbody Name: Sweetwater Creek
Location: Headwaters to Flint River, Andersonville
Stream Length: 9 miles
Watershed Area: 35.10 square miles
Tributary to: Flint River
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Andersonville WPCP 1.6 tons/yr
Future Construction Sites Meet requirements of General Storm Water Permit

Load Allocation (LA): 24,086 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 24,087 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Town Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Upson**
Major River Basin:	**Flint**
8-Digit Hydrologic Unit Code(s):	**03130005**
Waterbody Name:	**Town Branch**
Location:	**Thomaston**
Stream Length:	**4 miles**
Watershed Area:	**3.19 square miles**
Tributary to:	**Turkey Creek**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**1,205 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**1,205 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Whitewater Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Fayette

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Whitewater Creek
Location: Upstream from Lee Lake
Stream Length: 6 miles
Watershed Area: 9.10 square miles
Tributary to: Line Creek
Ecoregion: Piedmont

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 3,269 tons/yr
Land Use 2,932 tons/yr
Road 337 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 3,269 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Whitewater Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Taylor

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Whitewater Creek
Location: Headwaters to Little Whitewater Creek
Stream Length: 9 miles
Watershed Area: 3.31 square miles
Tributary to: Flint River
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 2,221 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 2,221 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Willingham Spring Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Upson

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Willingham Spring Creek
Location: Upson County
Stream Length: 3 miles
Watershed Area: 3.66 square miles
Tributary to: Tenmile Creek a tributary to Potato Creek
Ecoregion: Piedmont

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 1,425 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 1,425 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Wolf Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Terrell

Major River Basin: Flint
8-Digit Hydrologic Unit Code(s): 03130005

Waterbody Name: Wolf Creek
Location: Headwaters to Ichawaynochaway Creek
Stream Length: 9 miles
Watershed Area: 13.83 square miles
Tributary to: Ichawaynochaway Creek
Ecoregion: Southeastern Plains

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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):
Future Construction Sites — Meet requirements of General Storm Water Permit

Load Allocation (LA): 9,116 tons/yr
Land Use 8,940 tons/yr
Road 176 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 9,116 tons/yr