Total Maximum Daily Load

Evaluation

for

Ten Stream Segments

in the

Savannah 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 one of two categories, 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* (GA EPD, 2006-2007).

Some of the 305(b) 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 restore and maintain water quality.

The State of Georgia has identified ten (10) stream segments located in the Savannah River Basin as water quality limited (i.e., 303(d) listed as Biota Impacted) due to sedimentation. The water use classification of the impacted streams is Fishing. The general and specific water quality criteria for Fishing and Drinking Water streams are stated in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03, Sections (5) and (6).

The Biota Impacted designation indicates that studies have shown a modification of the biological community; more specifically, fish. During 2000-2004, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations in the Savannah 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. Ten (10) stream segments in the Piedmont ecoregion with fish populations rated as Poor or Very Poor, were listed as Biota Impacted and were included in the not supporting list. Seventeen (17) stream segments in the Piedmont and Southeastern Plain ecoregions were rated as Excellent, Good or Fair and assessed as supporting their designated use.

The most common cause of low IBI scores is the lack of fish habitat due to stream sedimentation. However, high levels of heavy metals, ammonia, or chloride, elevated temperatures, low dissolved oxygen levels and/or extreme pH levels are possible sources of toxicity and can adversely affect the aquatic communities. These parameters are regulated through NPDES permits and are not the focus of this TMDL evaluation. To determine the relationship between the in-stream water quality and the source loadings, each watershed was modeled. The analysis performed to develop sediment TMDLs for the 303(d) listed watersheds utilized the Universal Soil Loss Equation (USLE). The USLE predicts the total 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 the not supporting 303(d) listed watersheds, as well as the unimpaired watersheds in the same ecoregion, 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 load of the Savannah River Basin impaired watersheds located in the Piedmont ecoregion is 0.13 tons/acre/yr. The average sediment load of the unimpaired watersheds located within the Piedmont ecoregion is 0.12 tons/acre/yr, and the average sediment load of the unimpaired watersheds located within the Southeastern Plains ecoregion is 0.17 tons/acre/yr. These values represent sediment load contributions from all land uses within the unimpaired watersheds.

Table 1 shows that approximately 20.36 percent of the total sediment load in the Savannah River Basin is from row crops, while only accounting for an average of 3.09 percent of the land use in modeled watersheds. Approximately 13.08 percent of the total sediment load results from roads. Pastureland contributes approximately 22.87 percent of the total sediment load, grasses and wetlands make up about 8.44 percent, and urban lands contribute approximately 24.75 percent of the total sediment load. 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 Savannah River Basin

Land Use	Average Percentage of Land Use	Average Percentage of Total Sediment Load	Average Sediment Load (ton/acre/yr)
Open Water	0.66%	0.00%	0.00
Urban	13.98%	24.75%	0.70
Bare Rock, Sand, Clay	0.00%	0.00%	0.00
Quarries, Strip Mines, Gravel Pits	0.18%	7.68%	1.43
Forest	56.95%	2.81%	0.01
Pasture / Hay	21.02%	22.87%	0.14
Row Crops	3.09%	20.36%	0.83
Grasses, Wetlands	4.12%	8.44%	0.42
Roads		13.08%	

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

This TMDL determines the sediment loads that can enter the impaired Savannah River Basin streams without causing sediment impairment to the streams. This is based on the hypothesis that if an impaired watershed has a total annual sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and not be biologically impaired due to sediment. The average sediment load in the Savannah River Basin unimpaired watersheds located in the Piedmont ecoregion is 0.12 tons/acre/yr, and the average sediment load in the unimpaired watersheds located in the Southeastern Plains ecoregion is 0.17 tons/acre/yr. The total allowable sediment loads for the impaired watersheds are summarized in Table 2, along with any required sediment load reductions.

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

Name	Current Load (tons/yr)	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction Required
Little Coldwater Creek	312.1	-	-	158.6	158.6	20.5	49.2%
Little Cedar Creek	221.7	-	-	189.3	189.3	24.4	14.6%
Big Toms Creek/Toms Creek	625.3	4.5	-	225.7	230.2	29.7	63.2%
Eastanollee Creek	606.4	82.3	-	134.5	216.8	28.0	64.2%
Nancytown Creek	80.9	-	-	80.9	80.9	10.4	0.0%
Little Shoal Creek	469.3	-	-	375.4	375.4	48.4	20.0%
Grove Creek	246.6	4.1	-	238.4	242.5	31.3	1.7%
Dove Creek	1137.8	-	-	515.4	515.4	66.5	54.7%
Mattox Creek	784.4	-	-	784.4	784.4	101.2	0.0%
Panther Creek (Big Panther Creek)	350.0	-	-	278.7	278.7	36.0	20.4%

Management practices that may be used to help maintain the total allowable sediment loads at current levels include:

- Compliance with the requirements of the NPDES permit program;
- 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; and
- Evaluation of the effects of increased flow due to urban runoff on stream bank erosion.

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

1.0 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 one of two categories, 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* (GA EPD, 2006-2007).

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During 2000 through 2004, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations in the Savannah 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, and were included in the not supporting list. Ten (10) stream segments in the Piedmont ecoregion were rated as Poor or Very Poor, placed on the 303(d) list as not supporting their designated use, and scheduled for a TMDL evaluation (Table 3). Seventeen (17) stream segments in the Piedmont and Southeastern Plains ecoregions were rated as Excellent, Good, or Fair and assessed as supporting their designated use.

Table 3. Stream Segments Located in the Savannah River Basin on the 2008 303(d) List as Biota Impacted

Name	Location	Designated Use	Stream Miles
Big Toms Creek/Toms Creek	Ayers Pond/Reservoir 14 to North Fork Broad River	Fishing	6
Dove Creek	Headwaters to Little Dove Creek	Fishing	6
Eastanollee Creek	Toccoa to Lake Hartwell	Fishing	14
Grove Creek	Headwaters to South Fork Broad River	Fishing	12
Little Cedar Creek	Headwaters to Cedar Creek	Fishing	5
Little Coldwater Creek	Headwaters to Boyds Creek	Fishing	5
Little Shoal Creek	Headwaters to Lake Hartwell	Fishing	6
Mattox Creek	Headwaters to Big Creek	Fishing	9
Nancytown Creek	Headwaters to Nancytown	Fishing	3
Panther Creek (Big Panther Creek)	Upstream Lake Yonah	Fishing	9

1.2 Watershed Description

The ten (10) impaired stream segments and their associated watersheds that are located in the Savannah River Basin are located in Elbert, Franklin, Habersham, Hart, McDuffie, Oglethorpe, and Stephens Counties. The seventeen (17) unimpaired stream segments and their associated watersheds are located in Banks, Burke, Columbia, Elbert, Franklin, Greene, Habersham, Hart, Jackson, Jenkins, Madison, McDuffie, Richmond, Stephens, Taliaferro, and Warren Counties. Figure 1 shows a state-level view of the USGS 8-digit hydrologic units contained within the Savannah River Basin. Figures 2 through 4 show detail views of the impaired stream segments within the Savannah River Basin.

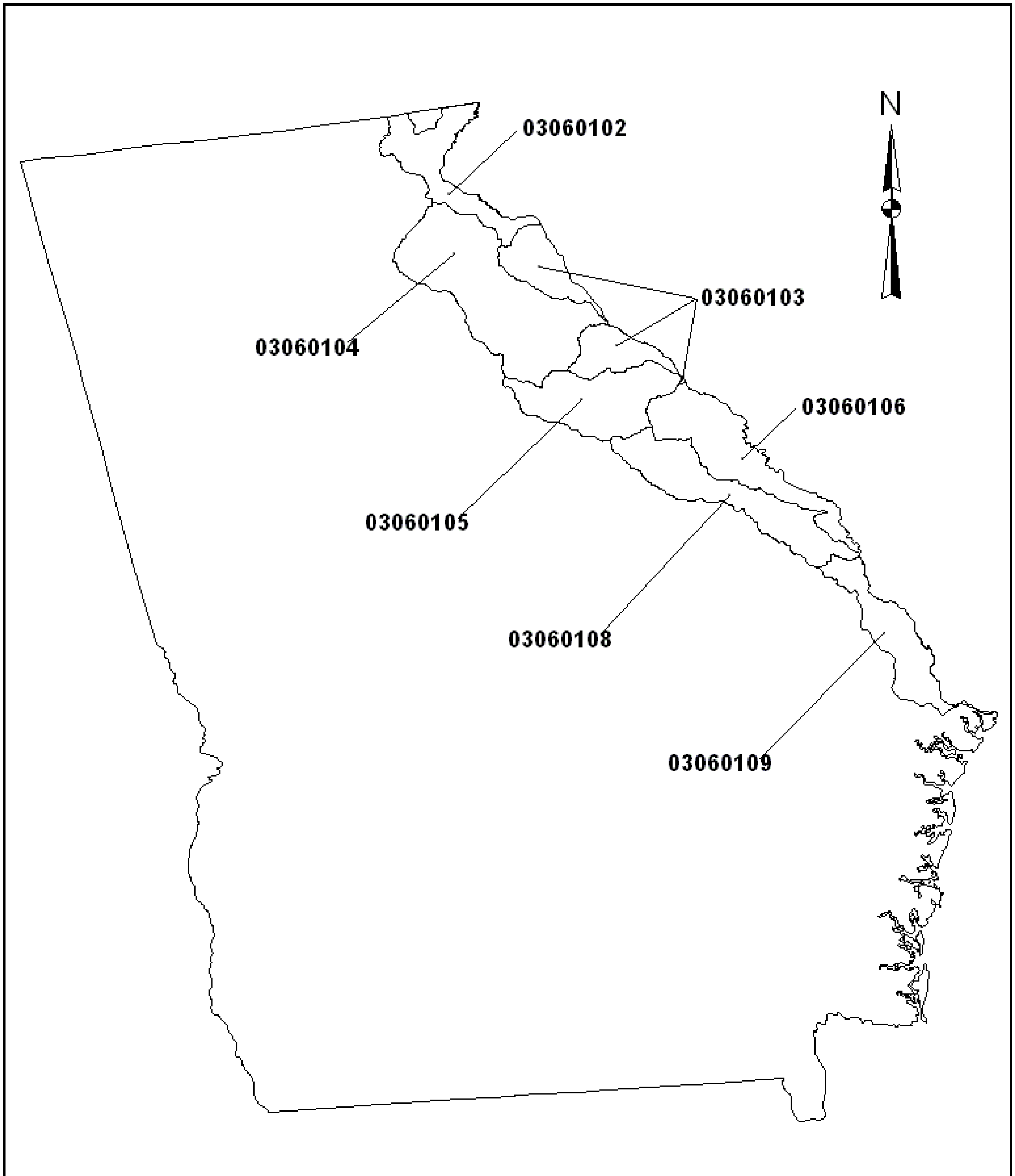

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Figure 1. USGS 8 Digit HUCs in the Savannah River Basin

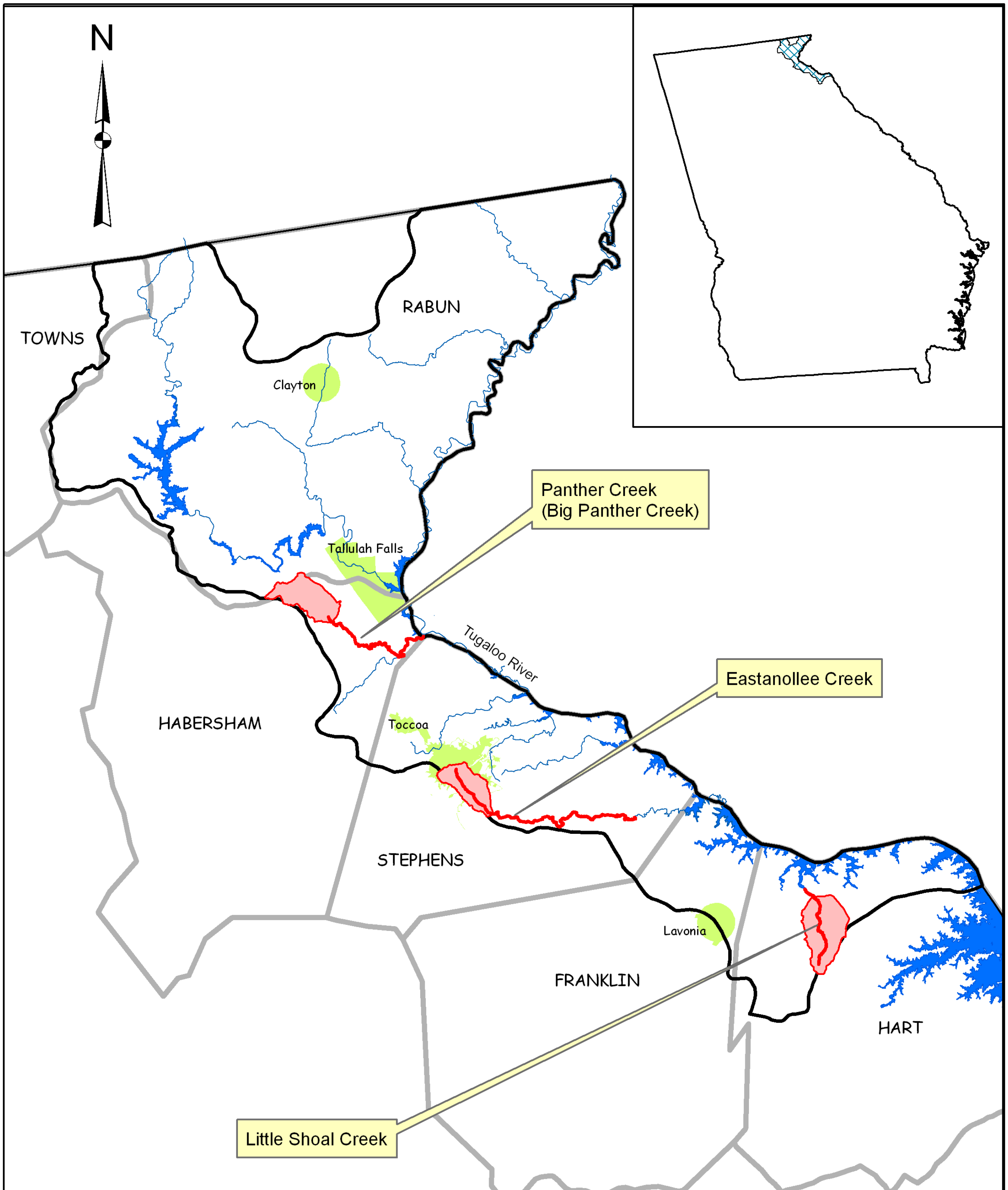

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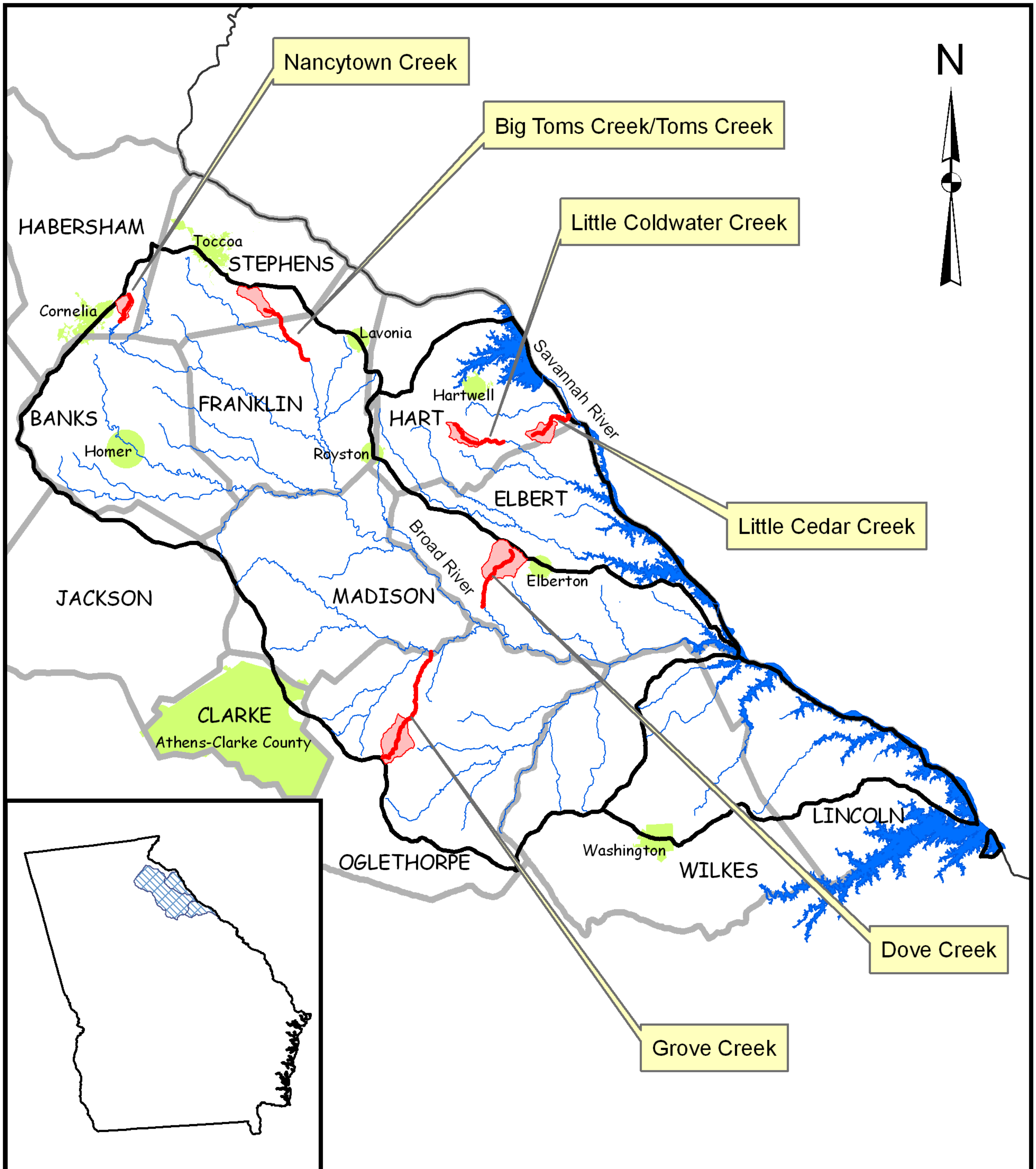
Figure 2. Impaired Stream Segments in HUC 03060102



TMDL Evaluation - Biota Savannah River Basin	Figure 3. Impaired Stream Segments in HUCs 03060103 and 03060104

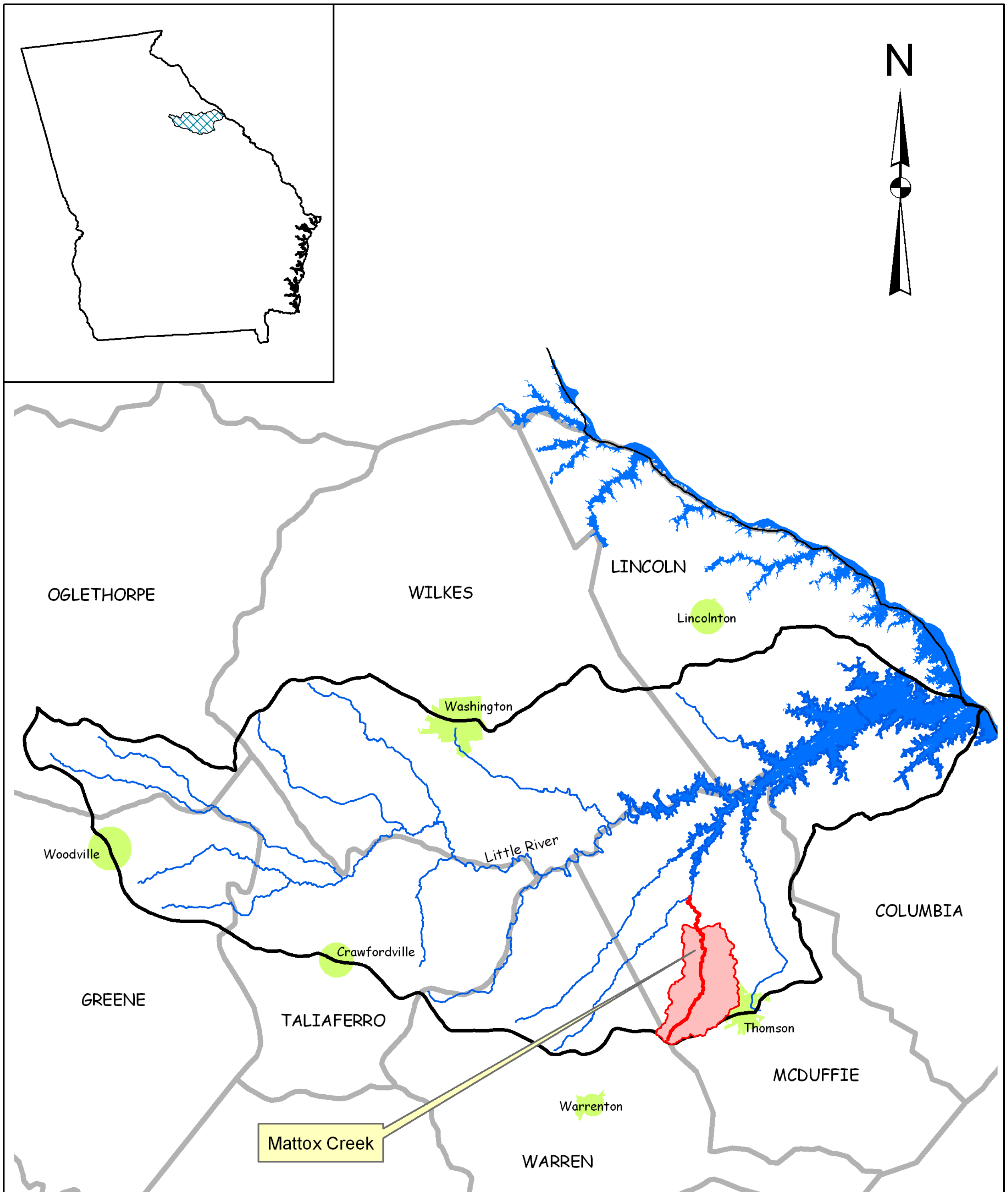


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Figure 4. Impaired Stream Segments in HUC 03060105

The land use characteristics of the Savannah River Basin watersheds were determined using data from the Georgia Land Use Trends (GLUT) for Year 2005. This raster land use trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1974, 1985, 1991, 1998, 2001 and 2005. The raster data sets were developed from Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+). Some of the NARSAL land use types were reclassified, aggregated into similar land use types, and were used in the final watershed characterization.

Table 4 lists the land use distribution of the watersheds located in the Piedmont and Southeastern Plains ecoregions. The watersheds are grouped according to those that are unimpaired, followed by those that are impaired, for each ecoregion. In a similar fashion, Table 5 lists the land use percentages for all the Savannah River Basin watersheds that were monitored. These data show that the watersheds are predominately forested with approximately 56.95 percent (ranging from 19.70 to 88.83 percent) in forest use. Agriculture is the next predominate land use at approximately 24.11 percent, consisting of approximately 21.02 percent pastureland (ranging from 0.30 to 52.54 percent) and approximately 1.55 percent row crops (ranging from 0.0 to 24.86 percent).

The soil characteristics of the Savannah River Basin watersheds were determined using data from the State Soil Geographic (STATSGO) coverage. This coverage provides major soil type classifications. Table 6 lists the soil type distribution of the monitored watersheds.

1.3 Water Quality Standard

The water use classification for the impaired watersheds in the Savannah River Basin is Fishing. The criterion violated is listed as Biota Impacted, which indicates that studies have shown a significant impact on fish. The potential cause(s) listed include urban runoff or urban effects, nonpoint/unknown sources, and residual from industrial sources. The general and specific criteria for Fishing streams are stated in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03, Sections (5) and (6).

Table 4. Land Use Distribution (Unimpaired - Piedmont Ecoregion)

	Area (acres)																	
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**	**Total**
Lightwood Log Creek	7.3	61.6	66.3	55.4	6.2	3.6	41.8	-	-	1115.7	208.6	91.2	-	1226.7	47.1	6.2		2937.7
Boyds Creek	15.1	47.1	100.1	91.4	17.8	9.1	95.6	95.0	-	851.1	250.2	85.2	-	1363.0	106.1	17.3	-	3144.1
Nails Creek	6.7	19.6	46.0	22.9	6.4	0.9	36.5	-	-	415.9	83.4	47.6	-	624.9	-	28.7	-	1339.4
Hannah Creek	14.2	-	179.0	135.7	29.4	5.3	168.6	-	-	1777.3	146.1	122.1	-	1666.1	49.6	22.2	-	4315.6
Little Dove Creek	34.2	28.5	151.7	38.5	3.1	1.6	242.8	-	-	1572.1	939.8	235.1	-	1616.5	90.7	72.1	-	5026.6
Little Beaverdam Creek	102.1	85.6	378.9	262.4	70.7	29.4	267.1	-	4.0	2367.5	488.4	167.2	-	4999.3	201.5	91.6	-	9515.7
Ragsdale Creek	13.3	37.4	240.8	66.3	8.7	-	307.1	-	-	2058.9	225.5	161.2	-	1773.1	-	175.5	0.2	5068.0
Grove Creek	465.0	92.5	976.1	506.4	89.2	22.7	1079.9	-	-	10951.0	2206.1	952.7	-	6523.1	-	801.7	-	24666.3
Middle Creek	213.9	147.4	831.9	256.4	77.2	9.1	2132.9	110.5	10.5	2540.8	10016.3	1615.0	-	2057.1	133.2	788.1	1.8	20942.2
Hart Creek	73.2	152.6	418.1	75.8	22.5	-	949.4	-	-	1017.6	5575.5	860.2	-	1015.6	31.1	490.6	0.7	10682.8
Chill Creek/ Factory Creek	18.9	4.7	151.4	3.8	-	-	854.9	-	-	482.4	2778.9	422.3	-	231.7	0.2	266.2	0.4	5215.9
Germany Creek	348.9	49.6	859.3	531.7	146.1	87.0	1399.7	-	-	2461.4	4418.2	979.6	29.6	2753.2	1352.1	968.3	10.0	16394.6
South Fork Little River	205.3	183.5	958.5	84.1	4.0	0.2	2901.0	-	-	4518.5	13613.2	2380.2	-	2557.7	-	1354.6	0.4	28761.1
Davidson Creek	31.6	-	355.2	52.5	5.6	1.1	169.9	-	-	3986.1	1269.4	1184.4	-	377.8	-	27.4	-	7460.9

Table 4. Land Use Distribution (Unimpaired - Southeastern Plains Ecoregion)

	Area (acres)																	
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**	**Total**
Fitz Branch	6.7	80.9	212.4	68.9	9.6	0.7	262.2	-	-	613.8	1844.7	38.3	-	14.7	1211.6	502.1	6.7	4873.2
Boggy Gut Creek	88.3	-	445.4	69.2	5.3	1.3	684.5	-	-	787.7	4549.8	4205.8	-	337.1	629.1	1061.9	9.3	12874.9
Beaverdam Creek	68.5	60.3	823.5	179.7	42.3	0.4	3277.1	-	-	3047.4	9641.8	427.2	-	340.3	6150.6	3541.3	29.4	27629.6

Table 4. Land Use Distribution (Impaired - Piedmont Ecoregion)

	Area (acres)																	
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**	**Total**
Little Coldwater Creek	7.3	75.6	61.8	40.7	10.9	-	41.1	-	-	453.0	199.7	41.4	-	706.7	115.6	7.8	-	1761.7
Little Cedar Creek	14.5	-	54.5	27.1	0.7	-	107.9	-	-	505.0	396.5	59.8	-	875.3	54.5	7.8	-	2103.6
Big Toms Creek/Toms Creek	25.8	56.0	94.3	64.5	12.2	12.2	261.1	-	-	955.8	316.9	139.2	-	503.9	-	116.1	-	2558.1
Eastanollee Creek	3.6	13.1	514.8	750.6	226.8	136.5	41.1	-	-	301.1	124.1	49.4	-	230.4	-	17.1	-	2408.7
Nancytown Creek	1.8	-	20.9	13.8	4.9	0.2	50.7	-	-	778.1	218.4	182.6	-	48.7	-	7.3	-	1327.4
Little Shoal Creek	25.1	-	99.6	65.6	8.7	4.4	113.2	-	-	1660.8	525.9	264.2	-	1279.6	64.0	59.6	-	4170.9
Grove Creek	26.5	45.1	211.3	89.0	14.2	2.4	127.2	-	-	928.0	1814.2	482.8	-	873.5	29.8	152.8	-	4796.9
Dove Creek	33.6	81.4	310.5	145.0	58.7	15.6	268.4	75.2	-	1881.8	1751.3	426.8	-	447.2	26.2	204.6	-	5726.2
Mattox Creek	220.8	70.1	836.8	580.0	250.0	162.3	1115.5	-	-	1366.1	4206.7	867.3	30.0	2254.8	60.7	497.9	0.7	12519.7
Panther Creek (Big Panther Creek)	1.6	0.9	192.8	10.9	0.2	-	56.5	-	-	2190.7	265.8	272.6	-	89.4	-	15.6	-	3097.0

Table 5. Land Use Percentages (Unimpaired - Piedmont Ecoregion)

	Percent Total Landuse																
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**
Lightwood Log Creek	0.25%	2.10%	2.26%	1.88%	0.21%	0.12%	1.42%	-	-	37.98%	7.10%	3.10%	-	41.76%	1.60%	0.21%	0.00%
Boyds Creek	0.48%	1.50%	3.18%	2.91%	0.57%	0.29%	3.04%	3.02%	-	27.07%	7.96%	2.71%	-	43.35%	3.37%	0.55%	-
Nails Creek	0.50%	1.46%	3.44%	1.71%	0.48%	0.07%	2.72%	-	-	31.05%	6.23%	3.55%	-	46.65%	-	2.14%	-
Hannah Creek	0.33%	-	4.15%	3.14%	0.68%	0.12%	3.91%	-	-	41.18%	3.39%	2.83%	-	38.61%	1.15%	0.52%	-
Little Dove Creek	0.68%	0.57%	3.02%	0.77%	0.06%	0.03%	4.83%	-	-	31.27%	18.70%	4.68%	-	32.16%	1.81%	1.43%	-
Little Beaverdam Creek	1.07%	0.90%	3.98%	2.76%	0.74%	0.31%	2.81%	-	0.04%	24.88%	5.13%	1.76%	-	52.54%	2.12%	0.96%	-
Ragsdale Creek	0.26%	0.74%	4.75%	1.31%	0.17%	-	6.06%	-	-	40.62%	4.45%	3.18%	-	34.99%	-	3.46%	0.00%
Grove Creek	1.89%	0.38%	3.96%	2.05%	0.36%	0.09%	4.38%	-	-	44.40%	8.94%	3.86%	-	26.45%	-	3.25%	-
Middle Creek	1.02%	0.70%	3.97%	1.22%	0.37%	0.04%	10.18%	0.53%	0.05%	12.13%	47.83%	7.71%	-	9.82%	0.64%	3.76%	0.01%
Hart Creek	0.68%	1.43%	3.91%	0.71%	0.21%	-	8.89%	-	-	9.53%	52.19%	8.05%	-	9.51%	0.29%	4.59%	0.01%
Chill Creek/ Factory Creek	0.36%	0.09%	2.90%	0.07%	-	-	16.39%	-	-	9.25%	53.28%	8.10%	-	4.44%	0.00%	5.10%	0.01%
Germany Creek	2.13%	0.30%	5.24%	3.24%	0.89%	0.53%	8.54%	-	-	15.01%	26.95%	5.98%	0.18%	16.79%	8.25%	5.91%	0.06%
South Fork Little River	0.71%	0.64%	3.33%	0.29%	0.01%	0.00%	10.09%	-	-	15.71%	47.33%	8.28%	-	8.89%	-	4.71%	0.00%
Davidson Creek	0.42%	-	4.76%	0.70%	0.07%	0.01%	2.28%	-	-	53.43%	17.01%	15.88%	-	5.06%	-	0.37%	-

Table 5. Land Use Percentages (Unimpaired - Southeastern Plains Ecoregion)

	Percent Total Land Use																
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**
Fitz Branch	0.14%	1.66%	4.36%	1.41%	0.20%	0.01%	5.38%	-	-	12.60%	37.85%	0.78%	-	0.30%	24.86%	10.30%	0.14%
Boggy Gut Creek	0.69%	-	3.46%	0.54%	0.04%	0.01%	5.32%	-	-	6.12%	35.34%	32.67%	-	2.62%	4.89%	8.25%	0.07%
Beaverdam Creek	0.25%	0.22%	2.98%	0.65%	0.15%	0.00%	11.86%	-	-	11.03%	34.90%	1.55%	-	1.23%	22.26%	12.82%	0.11%

Table 5. Land Use Percentages (Impaired - Piedmont Ecoregion)

	Percent Total Land Use																
Name	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial / Industrial / Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**
Little Coldwater Creek	0.42%	4.29%	3.51%	2.31%	0.62%	0.00%	2.34%	0.00%	0.00%	25.71%	11.34%	2.35%	0.00%	40.12%	6.56%	0.44%	0.00%
Little Cedar Creek	0.69%	0.00%	2.59%	1.29%	0.03%	0.00%	5.13%	0.00%	0.00%	24.01%	18.85%	2.84%	0.00%	41.61%	2.59%	0.37%	0.00%
Big Toms Creek/Toms Creek	1.01%	2.19%	3.69%	2.52%	0.48%	0.48%	10.21%	0.00%	0.00%	37.36%	12.39%	5.44%	0.00%	19.70%	0.00%	4.54%	0.00%
Eastanollee Creek	0.15%	0.54%	21.37%	31.16%	9.42%	5.67%	1.71%	0.00%	0.00%	12.50%	5.15%	2.05%	0.00%	9.57%	0.00%	0.71%	0.00%
Nancytown Creek	0.13%	0.00%	1.57%	1.04%	0.37%	0.02%	3.82%	0.00%	0.00%	58.62%	16.45%	13.75%	0.00%	3.67%	0.00%	0.55%	0.00%
Little Shoal Creek	0.60%	0.00%	2.39%	1.57%	0.21%	0.11%	2.71%	0.00%	0.00%	39.82%	12.61%	6.33%	0.00%	30.68%	1.54%	1.43%	0.00%
Grove Creek	0.55%	0.94%	4.40%	1.85%	0.30%	0.05%	2.65%	0.00%	0.00%	19.35%	37.82%	10.06%	0.00%	18.21%	0.62%	3.18%	0.00%
Dove Creek	0.59%	1.42%	5.42%	2.53%	1.03%	0.27%	4.69%	1.31%	0.00%	32.86%	30.58%	7.45%	0.00%	7.81%	0.46%	3.57%	0.00%
Mattox Creek	1.76%	0.56%	6.68%	4.63%	2.00%	1.30%	8.91%	0.00%	0.00%	10.91%	33.60%	6.93%	0.24%	18.01%	0.48%	3.98%	0.01%
Panther Creek (Big Panther Creek)	0.05%	0.03%	6.23%	0.35%	0.01%	0.00%	1.82%	0.00%	0.00%	70.74%	8.58%	8.80%	0.00%	2.89%	0.00%	0.50%	0.00%

Table 6. Soil Type Distribution (Unimpaired - Piedmont Ecoregion)

NAME	Drainage Area (sq mi)	Soil Types (acres) GA025	GA026	GA030	GA031	GA032	GA033	GA038	GA125
K-Factor		0.27	0.25	0.27	0.24	0.43	0.43	0.15	0.25
Lightwood Log Creek	4.6	3352	-	-	-	-	-	-	-
Boyds Creek	4.9	2604	691	-	-	-	-	-	-
Nails Creek	2.1	619	768	-	-	-	-	-	-
Hannah Creek	6.7	1686	2769	-	-	-	-	-	-
Little Dove Creek	7.9	3958	1308	-	-	-	-	-	-
Little Beaverdam Creek	14.9	7442	2501	-	-	-	-	-	-
Ragsdale Creek	7.9	3089	2113	-	-	-	-	-	-
Grove Creek	38.5	9147	15855	-	-	-	-	-	-
Middle Creek	32.7	12144	4343	-	-	1581	3212	-	-
Hart Creek	16.7	3911	-	-	-	6317	755	-	-
Chill Creek/ Factory Creek	8.1	4187	1255	-	-	-	-	-	-
Germany Creek	25.6	10879	-	-	-	1238	-	4738	-
South Fork Little River	44.9	18296	2726	3157	3209	2064	-	-	-
Davidson Creek	11.7	-	7197	-	-	-	-	-	380

Table 6. Soil Type Distribution (Unimpaired - Southeastern Plains Ecoregion)

NAME	Drainage Area (sq mi)	Soil Types (acres) GA038	GA040	GA043	GA046	GA049	GA050	GA051	GA052
K-Factor		0.15	0.14	0.21	0.16	0.14	0.15	0.12	0.13
Fitz Branch	7.6	236	-	-	669	-	4225	-	-
Boggy Gut Creek	20.1	11477	1920	-	-	-	-	214	-
Beaverdam Creek	43.2	-	-	7793	-	13469	1983	3687	1139

Table 6. Soil Type Distribution (Impaired – Piedmont Ecoregion)

Soil Types (acres)						
NAME	**Drainage Area (sq mi)**	**GA015**	**GA019**	**GA025**	**GA026**	**GA038**
K-Factor		**0.25**	**0.25**	**0.27**	**0.25**	**0.15**
Little Coldwater Creek	2.8	-	-	1912	26	-
Little Cedar Creek	3.3	-	-	1961	290	-
Big Toms Creek/Toms Creek	4.0	-	-	-	2661	-
Eastanollee Creek	3.8	-	-	1213	1366	-
Nancytown Creek	2.1	-	-	451	1002	-
Little Shoal Creek	6.5	-	-	3502	797	-
Grove Creek	7.5	-	-	4067	988	-
Dove Creek	8.9	-	-	2580	3360	-
Mattox Creek	19.6	-	-	10629	1972	401
Panther Creek (Big Panther Creek)	4.8	983	137	-	2096	-

2.0 WATER QUALITY ASSESSMENT

2.1 Fish Sampling

From 2000 to 2004, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations at a number of monitoring sites in the Savannah River Basin. 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 listings of Biota Impacted stream segments on Georgia's 303(d) list.

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 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 ecoregion were established. These sites represent the least impacted sites that exist given the prevalent land use within the ecoregion.

Twenty-seven (27) sites were sampled within the Savannah River Basin in this ecoregion (see Tables 7, 8, and 9). These sites had to be accessible, wadeable, and representative of the stream under investigation. The length of the fish sampling site was established as thirty-five times the mean stream width, up to a maximum length of 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 abundance and diversity 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. For each sampling site, each metric is calculated by comparing the site value of a particular scoring criterion to that of the regional reference site. Factors that affect the structure and function of a fish community include stream location and size. Thus, the metrics were developed for regional drainage basins. To account for the fact that streams with larger drainage basins normally have greater species richness, Maximum Species Richness plots were developed for the species richness 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 scores may also help clarify the results of the biotic indices. The habitat assessment used was developed by personnel within the Watershed Protection Branch (WPB) of the Georgia Environmental Protection Division (GA EPD) and is a modification of the EPA Rapid Bioassessment Protocol III (GAWPB, 2000). It incorporates different assessment parameters for riffle / run 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 7 summarizes WRD's fish community study scores. The IBI, IWB, and Habitat Assessment scores are listed for each of the study watersheds, and are grouped according to unimpaired or impaired status. In addition, the table includes the drainage areas upstream of the monitoring points and the county in which the monitoring points are located.

During the fish community studies, physical characteristics of the stream were measured at the monitoring sites. These characteristics included the number of pools, depth of the deepest pool, number of riffles, average stream depth, and average stream width. Table 8 provides the detailed habitat assessment scores.

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 9 provides a summary of these field measurements.

WRD personnel also made visual observations of the stream and watershed. The type of land use and the extent of land-disturbing activities, as well as 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 possible sources of eroded soils and other potential contaminants.

Table 7. WRD's Fish Community Study Scores (Unimpaired – Piedmont Ecoregion)

Stream Name	Drainage Area Upstream of the Monitoring Point (sq miles)	Date	County	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Lightwood Log Creek	5.9	6/26/2003	Hart	38	Fair	7.3	Good	93.7
Boyds Creek	5.1	5/13/2003	Hart	38	Fair	8.3	Excellent	51.4
Nails Creek	2.2	6/9/2003	Banks	34	Fair	6.7	Fair	84.9
Hannah Creek	7.0	6/26/2003	Madison	46	Good	7.4	Good	86.2
Little Dove Creek	8.2	7/16/2003	Elbert	46	Good	7.1	Fair	124.3
Little Beaverdam Creek	15.5	7/17/2003	Hart	34	Fair	7.8	Fair	67.5
Ragsdale Creek	8.1	7/17/2003	Franklin	40	Fair	7.6	Good	62.2
Grove Creek	39.1	8/28/2003	Banks	40	Fair	8.2	Fair	72.2
Middle Creek	33.2	9/29/2003	McDuffie	42	Fair	8.1	Fair	98.3
Hart Creek	17.2	9/29/2003	McDuffie	42	Fair	7.6	Fair	73.8
Chill Creek/ Factory Creek	8.5	9/29/2003	McDuffie	34	Fair	7.2	Fair	65.7
Germany Creek	26.3	9/29/2003	McDuffie	38	Fair	8.2	Fair	75.7
South Fork Little River	45.8	10/13/2003	Taliaferro	42	Fair	8.0	Fair	85.4
Davidson Creek	11.8	9/30/2004	Stephens	48	Good	8.8	Excellent	137.2

Table 7. WRD's Fish Community Study Scores (Unimpaired – Southeastern Plains Ecoregion)

Stream Name	Drainage Area Upstream of the Monitoring Point (sq miles)	Date	County	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Fitz Branch	8.0	6/13/2002	Burke	34	Fair	7.3	Fair	110.9
Boggy Gut Creek	21.4	8/8/2000	Richmond	40	Fair	7.3	Fair	111.5
Beaverdam Creek	43.9	8/8/2000	Burke	40	Fair	7.4	Fair	106.4

Table 7. WRD's Fish Community Study Scores (Impaired – Piedmont Ecoregion)

Stream Name	Drainage Area Upstream of the Monitoring Point (Sq miles)	Date	County	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Little Coldwater Creek	3.0	5/13/2003	Hart	26	Poor	5.7	Fair	66.5
Little Cedar Creek	3.5	5/13/2003	Hart	24	Very Poor	6.7	Fair	67.0
Big Toms Creek/Toms Creek	4.2	6/9/2003	Stephens	26	Poor	4.6	Very Poor	67.2
Eastanollee Creek	4.0	6/9/2003	Stephens	16	Very Poor	5.3	Poor	54.1
Nancytown Creek	2.3	6/25/2003	Habersham	30	Poor	5.8	Fair	123.5
Little Shoal Creek	6.7	6/26/2003	Hart	30	Poor	6.3	Fair	97.7
Grove Creek	7.9	7/16/2003	Oglethorpe	32	Poor	6.7	Fair	67.2
Dove Creek	9.3	7/16/2003	Elbert	20	Very Poor	5.2	Poor	67.5
Mattox Creek	20.3	9/29/2003	McDuffie	30	Poor	6.8	Fair	50.3
Panther Creek (Big Panther Creek)	5.0	9/30/2004	Habersham	22	Very Poor	4.8	Very Poor	138.7

Table 8. WRD's Habitat Assessment Scores (Unimpaired – Piedmont Ecoregion)

Stream Name	Date	Epifaunal Substrate / Instream Cover	Embeddedness	Velocity / Depth Combinations	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 Total
Lightwood Log Creek	6/26/2003	8.2	5.2	10.6	17.8	7.9	0.0	9.5	4	4	3.5	3.8	9.7	9.7	93.7
Boyds Creek	5/13/2003	6.3	1	9.2	9.1	2.9	0.0	8.3	3.2	3	3.2	2.9	1.2	1.1	51.4
Nails Creek	6/9/2003	6.5	7.3	8.7	12.7	6.8	14.5	9.0	3.3	3	3	3.5	0.7	6.0	84.9
Hannah Creek	6/26/2003	7.1	4.3	11.4	18.3	8.1	8.5	9.8	2.2	2.5	1.9	2.7	3.9	5.3	86.2
Little Dove Creek	7/16/2003	12.2	11.7	11.2	15.3	12.0	15.0	9.0	2.9	4.3	4.9	5.7	10.0	10.0	124.3
Little Beaverdam Creek	7/17/2003	7.8	1.3	10.8	14.9	3.4	0.0	9.3	2	2	2.2	2.2	5.9	5.7	67.5
Ragsdale Creek	7/17/2003	9.7	1.2	12.4	14.7	4.0	4.0	8.8	1.5	1.5	1.1	1.5	3.0	2.8	62.2
Grove Creek	8/28/2003	10.7	1.2	10.6	14	5.7	0.0	12.1	1.8	1.6	2.1	1.7	6.6	4.1	72.2
Middle Creek	9/29/2003	13.4	2.9	12.6	16.3	3.8	15.5	9.1	2.3	2.4	1.9	2.2	6.4	9.4	98.3
Hart Creek	9/29/2003	9.6	4.3	12.6	12.3	4.1	4.0	7.3	1.2	1.4	1.1	1.4	5.3	9.2	73.8
Chill Creek/ Factory Creek	9/29/2003	8.2	0.2	8.9	14.7	2.2	0.0	8.2	2.9	2	3	1.9	9.3	4.2	65.7
Germany Creek	9/29/2003	7.0	4	10.2	17	2.0	8.0	5.7	1.3	1.7	1.3	1.5	8.3	7.7	75.7
South Fork Little River	10/13/2003	9.3	0.5	11.2	16.7	2.8	17.0	8.3	1.7	1.5	1.6	1.4	5.6	7.7	85.4
Davidson Creek	9/30/2004	15.8	11.4	15.7	16.8	12.2	18.0	17.2	3.7	3.6	4.2	4	5.0	9.6	137.2

Table 8. WRD's Habitat Assessment Scores (Unimpaired – Southeastern Plains Ecoregion)

Stream Name	Date	Bottom Substrate / Available Cover	Pool Substrate Characterization	Pool Variability	Channel Alteration	Sediment Deposition	Channel Sinuosity	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Total
Fitz Branch	6/13/2002	10.3	10.5	6.3	17.7	9.7	13.0	6.3	3.7	4.4	4.5	5.2	9.3	10.0	110.9
Boggy Gut Creek	8/8/2000	15.3	14.1	7.3	10.3	9.8	10.5	8.6	6.2	5.8	5.8	4.6	5.9	7.3	111.5
Beaverdam Creek	8/8/2000	10.7	9.6	8.6	17.8	5.4	16.0	7.5	3.5	2.9	4.6	4.5	8.0	7.8	106.4

Table 8. WRD's Habitat Assessment Scores (Impaired – Piedmont Ecoregion)

Stream Name	Date	Epifaunal Substrate / Instream Cover	Embeddedness	Velocity / Depth Combinations	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 Total
Little Coldwater Creek	5/13/2003	7.2	1.3	7.3	15.9	2.7	0.0	7.4	3.8	3.1	3.7	2.5	9.9	1.7	66.5
Little Cedar Creek	5/13/2003	5.9	0.7	7.9	17.8	2.5	0.0	11.0	0.8	1.4	0.2	0.8	9.4	8.6	67.0
Big Toms Creek/Toms Creek	6/9/2003	8.1	0.7	6.9	12.7	2.3	0.0	11.7	4.9	4.9	3.7	3.4	1.0	6.9	67.2
Eastanollee Creek	6/9/2003	6.8	0.8	10.5	12.7	1.7	0.0	9.2	2.3	2.4	2.4	2.3	1.6	1.4	54.1
Nancytown Creek	6/25/2003	13.1	10.9	11.5	17.1	12.4	17.5	11.4	2.7	1.9	5.2	5.2	9.8	4.8	123.5
Little Shoal Creek	6/26/2003	7.7	0	2.7	20	3.0	0.0	16.0	7.3	7.7	8.3	8.3	8.3	8.3	97.7
Grove Creek	7/16/2003	7.1	1.3	8.9	17.4	3.0	0.0	8.0	1.8	1.6	2.1	1.8	9.9	4.3	67.2
Dove Creek	7/16/2003	4.7	1	9.5	16.7	1.0	0.0	7.0	1.7	1.7	1.9	2.2	10.0	10.0	67.5
Mattox Creek	9/29/2003	4.5	0.0	6.0	15.2	0.7	0.0	4.2	1.4	1.2	2	1.5	5.2	8.5	50.3
Panther Creek (Big Panther Creek)	9/30/2004	16.4	11.3	15.4	15.1	14.9	19.0	16.2	3.8	3.3	5.1	5.1	6.3	6.8	138.7

Table 9. WRD's Field Measurements
(Unimpaired – Piedmont Ecoregion)

Stream Name	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number of Riffles	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Lightwood Log Creek	6/26/2003	6.36	0.14	0	---	1	22.0	8.25	110.5	6.5	6.3	10	15
Boyds Creek	5/13/2003	4.68	0.27	7	0.8	0	16.7	9.72	34.6	6.5	8.7	8	15
Nails Creek	6/9/2003	3.12	0.18	3	0.6	2	19.5	7.56	61.2	7.0	21.2	23	25
Hannah Creek	6/26/2003	5.93	0.19	3	0.6	1	18.8	8.46	50.5	6.8	2.6	12	15
Little Dove Creek	7/16/2003	5.68	0.22	2	0.7	4	22.9	8.07	52.9	7.0	19.9	16	20
Little Beaverdam Creek	7/17/2003	7.63	0.24	6	1	1	22.6	7.25	47.2	6.5	33.3	11	15
Ragsdale Creek	7/17/2003	4.66	0.25	10	99	1	21.9	7.13	64.3	7.0	25.0	20	25
Grove Creek	8/28/2003	13.82	0.45	4	99	0	29.8	6.92	76.5	8.0	12.1	23	30
Middle Creek	9/29/2003	7.67	0.30	9	99	3	16.6	7.53	89.9	7.0	7.87	32	35
Hart Creek	9/29/2003	5.88	0.37	11	1.25	1	16.5	8.24	56.6	7.0	11.5	20	30
Chill Creek/ Factory Creek	9/29/2003	5.36	0.26	6	0.85	0	16.8	8.36	82.4	7.5	6.28	31	35
Germany Creek	9/29/2003	4.76	0.17	5	0.72	1	19.3	6.67	70.8	7.0	9.33	26	30
South Fork Little River	10/13/2003	4.74	0.21	7	1	1	17.8	7.44	120.0	7.5	5.06	58	70
Davidson Creek	9/30/2004	7.77	0.20	8	0.73	7	16.8	9.33	24.8	6.5	7.37	11	15

Table 9. WRD's Field Measurements
(Unimpaired – Southeastern Plains Ecoregion)

Stream Name	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number of Bends	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Fitz Branch	6/13/2002	3.57	0.22	2	1.1	4	20.7	6.44	110.3	7.5	6.5	68.4	100
Boggy Gut Creek	8/8/2000	4.69	0.34	9	1.09	2	30.1	6.14	14.0	6.5	2.87	2	5
Beaverdam Creek	8/8/2000	5.01	0.28	6	1.5	6	25.5	6.01	264.2	7.5	9.3	153.9	125

Table 9. WRD's Field Measurements (Impaired – Piedmont Ecoregion)

Stream Name	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number of Riffles	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Little Coldwater Creek	5/13/2003	3.72	0.16	0	---	1	21.3	8.69	32.2	6.5	11.7	10	15
Little Cedar Creek	5/13/2003	4.35	0.24	8	1.04	0	15.0	10.02	40.4	7.0	11.2	12	20
Big Toms Creek/Toms Creek	6/9/2003	4.14	0.40	10	0.85	0	24.6	6.88	77.8	7.0	21.2	24	30
Eastanollee Creek	6/9/2003	5.97	0.13	4	0.65	0	21.5	7.82	344.2	7.0	10.7	31	25
Nancytown Creek	6/25/2003	4.64	0.22	3	0.85	7	20.8	8.73	129.6	7.0	8.9	8	20
Little Shoal Creek	6/26/2003	4.89	0.56	4	1.1	0	24.0	7.91	53.2	7.0	6.5	17	30
Grove Creek	7/16/2003	5.43	0.19	6	0.85	0	21.9	7.95	71.2	7.0	23.9	29	45
Dove Creek	7/16/2003	5.80	0.14	1	0.6	0	24.3	7.52	66.6	7.0	21.3	20	25
Mattox Creek	9/29/2003	4.19	0.08	1	0.8	0	18.3	7.96	85.3	7.5	4.27	30	40
Panther Creek (Big Panther Creek)	9/30/2004	5.24	0.22	7	0.6	10	17.9	9.17	12.5	6.5	6.74	4	5

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 (GA EPD, 1998).

A source assessment characterizes the known and suspected sources of sediment in the watershed for use in a water quality model and the development of the TMDL. 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). 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.

3.1 Point Source Assessment

For purposes of this TMDL, NPDES permitted facilities will be considered point sources. Discharges from municipal, industrial, private and federal NPDES permitted facilities may contribute sediment to receiving waters as TSS and / or turbidity. There are six (6) permitted NPDES discharges identified in the Savannah River Basin watersheds upstream from the listed segments. Table 10 provides the permitted flow and TSS concentrations for the NPDES permittees located in the impaired Savannah River Basin watersheds. The average levels (whether daily or monthly) and the highest maximum levels (whether daily or weekly) discharged over the last three years (2006-2008) are also given. These data were determined from analysis of the available Discharge Monitoring Reports (DMRs) or Operation Monitoring Reports (OMRs). Where the facility's permitted flow is less than 0.1 MGD, the 2006-2008 values are not given.

It is unknown if any of the point sources have contributed to the biota impairments in the Savannah watersheds by discharging total suspended solids or other pollutants. High levels of heavy metals, ammonia, or chloride, elevated temperatures, low dissolved oxygen levels and/or extreme pH levels are possible sources of toxicity and can adversely affect the aquatic communities. These parameters are regulated through NPDES permits.

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls. Currently, regulated storm water discharges include those associated with industrial activities, construction sites one acre or greater, and large and medium municipal separate storm sewer systems (MS4s).

Storm water discharges associated with industrial activities are currently covered under Georgia's General Industrial Storm Water NPDES Permit (GAR000000). This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), and record keeping. Table 11 provides a list of those facilities in the Savannah River Basin that have submitted a Notice of Intent to be covered under Georgia's Industrial General Storm Water NPDES Permit, which also discharge into impaired streams. It is unknown at this time whether these facilities are contributing sediment to the watershed.

Table 10. NPDES Permit Limits for Facilities in the Impaired Watersheds of the Savannah River Basin

Facility	NPDES Permit No.	Facility Type	Receiving Water	FLOW (MGD)		TSS (mg/L)	
				Monthly Average	Weekly Average	Monthly Average	Weekly Average
Toccoa - Eastanollee Creek WPCP	GA0021814	Municipal	Eastanollee Creek	1.45	1.81	30	45
				0.78	0.90	9.67	13.36
Crawford - Eastside WPCP	GA0033693	Municipal	Grove Creek	0.03	0.038	90	120
Dogwood Lane Mobile Home Park	GA0034282	PID	Trib to Eastanollee Creek	0.025	0.022	90	120
Old Eastanollee Elementary School	GAG550000	PID	Eastanollee Creek	0.01	0.01	30	45
				FLOW (MGD)		TSS (mg/L)	
				Daily Average	Daily Max	Daily Average	Daily Max
Milliken - Avondale Plant	GA0024368	Industrial	Trib to Big Toms Creek	-	-	-	45
Roselane Development Co. (Wilbros, LLC) [1]	GA0002038	Industrial	Eastonollee Creek	-	-	20	-

permit limits
actual data from monthly Monitoring Reports

[1] Roselane Development Co. is being taken over by Wilbros, LLC and has requested a new WLA as of 12/08. Only daily averages for TSS were given in the WLA. This daily average TSS limit and the facility's design flow were used for TMDL Loading calculations.

Table 11. Facilities Covered Under Georgia's General Industrial Storm Water NPDES Permit in the Savannah River Basin that Discharge to Impaired Streams

Facility	NOI	County	Impaired Stream
B & L Enterprises - Elberton Quarry	10402	Elbert	Dove Creek
Caterpillar Seals Metalcasting Facility	04418	Stephens	Eastanollee Creek
Eaton Aerospace Fluid Conveyance	04352	Stephens	Eastanollee Creek
Oldcastle Precast - Toccoa	04392	Stephens	Toms/Big Toms Creek
North American Packaging Corporation	01609	Stephens	Eastanollee Creek
Roselane Development Co. (Wilbros, LLC)	00825	Stephens	Eastanollee Creek

The MS4 permits have been issued under two phases. Phase I MS4 permits require the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. There are eight (8) Phase I MS4s in the Savannah River Basin (Table 12).

Table 12. Phase I Permitted MS4s in the Savannah River Basin

Name	Permit No.	Watershed
Bloomingdale	GAS000207	Savannah
Chatham County	GAS000206	Ogeechee, Savannah
Garden City	GAS000208	Ogeechee, Savannah
Pooler	GAS000209	Ogeechee, Savannah
Port Wentworth	GAS000210	Savannah
Augusta-Richmond County	GAS000200	Savannah
Savannah	GAS000205	Ogeechee, Savannah
Tybee	GAS000212	Ogeechee, Savannah

Source: Nonpoint Source Permitting Program, GA DNR, 2009

As of March 10, 2003, small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Thirty (30) counties and fifty-six (56) communities are permitted under the Phase II regulations in Georgia. All Phase II permitees are covered under General Stormwater Permit GAG-610000. There are three (3) counties or communities located in the Savannah River Basin that are covered by the Phase II General Storm Water Permit (Table 13).

Table 13. Phase II Permitted MS4s in the Savannah River Basin

Name	Watershed
Columbia County	Savannah
Grovetown	Savannah
Hephzibah	Savannah

Source: Nonpoint Source Permitting Program, GA DNR, 2008

Table 14 provides the total area of each impaired watershed and the percentage of the watershed that is in either a permitted MS4 area or an urban area. The land use types that are considered urban are 1) developed open space, 2) low intensity residential, 3) high intensity residential, 4) high intensity commercial, industrial, or transportation, and 5) transitional, clearcut, or sparse.

Table 14. Percentage of Watersheds Located in MS4 Areas or Urban Areas

Name	Total Area (sq mi)	% in MS4 Area	% in Urban Area
Little Coldwater Creek	2.8	0.0%	8.8%
Little Cedar Creek	3.3	0.0%	9.0%
Big Toms Creek/Toms Creek	4.0	0.0%	17.4%
Eastanollee Creek	3.8	0.0%	69.3%
Nancytown Creek	2.1	0.0%	6.8%
Little Shoal Creek	6.5	0.0%	7.0%
Grove Creek	7.5	0.0%	9.3%
Dove Creek	8.9	0.0%	13.9%
Mattox Creek	19.6	0.0%	23.5%
Panther Creek (Big Panther Creek)	4.8	0.0%	8.4%

Soil erosion from construction sites is also a major source of sediment in Georgia's streams. Georgia requires construction sites over one acre to have a General Storm Water NPDES permit. Since construction sites are regulated by NPDES permits, they will be considered as point sources. It is unknown if there are any construction sites in the impaired watersheds of the Savannah River Basin.

3.2 Nonpoint Source Assessment

Eroded soils from forests, cropland, mining sites, and other land can be transported to Georgia streams through runoff. Excessive sediment that reaches the water bodies can cause a variety of changes to the stream. It can make the streams shallower and wider, affecting the stream's temperature, dissolved oxygen, flow rate and velocity. It can 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

The Georgia Forestry Commission (GFC) was consulted for information and parameters regarding silviculture activities. Georgia has 23.6 million acres of commercial forests. This represents approximately 64 percent of all of Georgia's land use. Approximately 68 percent of the commercial forests are privately owned, 25 percent are owned by industry, and 7 percent are publicly held (GA EPD, 1999).

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, and during reforestation. Once the forest is re-established, very little soil erosion occurs. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Both hardwoods and pines are harvested throughout Georgia. A minimum harvest is usually ten acres and the percent of forest that is harvested each year varies from county to county. Table 15 lists the percent timberland and percent harvested per year by county.

Table 15. 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
Banks	149.6	103.0	68.9%	149.1	5.5	3.7%
Burke	531.6	338.7	63.7%	336.2	25.7	7.6%
Chatham	281.9	86.6	30.7%	153.0	7.3	4.8%
Effingham	306.9	235.0	76.6%	257.4	17.5	6.8%
Elbert	236.0	165.3	70.0%	234.9	6.7	2.9%
Franklin	168.5	90.6	53.8%	145.7	4.5	3.1%
Glascock	92.3	71.8	77.8%	82.1	4.1	5.0%
Greene	248.6	197.7	79.5%	267.1	26.2	9.8%
Habersham	178.0	121.7	68.4%	263.7	5.3	2.0%
Hart	148.6	65.8	44.3%	124.7	0.2	0.2%
Jackson	219.1	126.8	57.9%	161.8	8.0	4.9%
Jefferson	337.7	214.1	63.4%	335.5	10.1	3.0%
Jenkins	223.9	150.5	67.2%	176.8	16.9	9.6%
Lincoln	135.1	105.1	77.8%	186.7	7.5	4.0%
Madison	182.0	111.8	61.4%	178.7	1.9	1.1%
McDuffie	166.3	109.1	65.6%	182.9	7.9	4.3%
Oglethorpe	282.3	225.7	80.0%	309.9	23.0	7.4%
Rabun	237.5	190.4	80.2%	470.8	1.1	0.2%
Richmond	207.4	121.2	58.4%	154.4	4.8	3.1%
Screven	415.1	247.4	59.6%	399.7	24.0	6.0%
Stephens	114.7	80.1	69.8%	118.7	5.7	4.8%
Taliaferro	125.1	107.9	86.3%	136.4	7.9	5.8%
Warren	182.7	153.9	84.2%	192.8	12.8	6.6%
Wilkes	301.7	230.9	76.5%	320.0	22.5	7.0%

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

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. The Natural Resources Conservation Service (NRCS) was consulted for information and parameters regarding agricultural activities. Over the last century there has been a significant decrease in the amount of land farmed in Georgia. In 1950, there were 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 per year in 1997 (USDA-NRCS, 1997). This suggests that the source of sediment in many of the impaired streams in the Savannah River Basin may be the result of past land use practices. Thus, it is believed that if sediment loads are maintained at acceptable levels, streams will repair themselves over time.

3.2.3 Grazing Areas

Farm animals grazing on pastureland can leave areas of ground with little or no vegetative cover. During a rainfall runoff event, soil in the pastures is eroded and transported to nearby streams, typically by gully erosion. The amount of soil loss from gully erosion is generally less than that caused by sheet and rill erosion. Work in small grazed catchments in New Mexico found that gully erosion contributed only 1.4 percent of the total sediment load as compared to sheet and rill erosion. Other research 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 most of their time grazing in pastures, while dairy cattle and hogs are confined periodically. Hog farms confine the animals or allow them to graze in small pastures or pens. On dairy farms, the cows are confined for a limited period each day, during which time they are fed and milked.

In addition, cattle and other unconfined animals often have direct access to streams that flow through pastures. As these animals walk down to the stream, they often damage stream banks. Stream bank vegetation is destroyed and the banks often collapse, resulting in increased sedimentation to the waterway.

3.2.4 Mining Sites

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

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

3.2.5 Roads

Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. Road erosion occurs when soil particles are loosened and carried away from the roadway, ditch or road bank by water, wind or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface or surface drainage, poor 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 roadbed into roadway drainage ditches. Some of these particles settle out satisfactorily, but usually they settle out poorly, causing diminished ditch carrying capacity that results in roadway flooding and, subsequently, more roadway erosion (Choctawhatchee, et. al, 2000).

3.2.6 Urban Development

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

Conversion of forest to urban land use is often associated with water quality degradation. For the period from 1982 through 1989, there forested acreage within the Savannah River Basin decreased by approximately 4 percent (GA EPD, 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 stream flow 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 GA EPD from using a dynamic watershed runoff model, which requires a great deal of data for model development and calibration. Instead, GA 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 40 years ago. It is the most widely accepted and used soil loss equation. It was designed as a method to predict average annual soil loss caused by sheet and rill erosion. The USLE can estimate long-term soil loss, and can assist in choosing proper cropping, management and conservation practices. However, it cannot be used to determine erosion for a specific year or specific storm. Because of its wide acceptance by the forestry, agricultural, and academic communities, the USLE was selected as the tool for estimating long-term annual soil erosion, assessing the impacts of various land uses, and evaluating the benefits of various BMPs.

4.2 Universal Soil Loss Equation

For each of the watersheds monitored in the Savannah 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 ranges from 250 to 300 within the Savannah River Basin. The R Factors by county are provided in Table 16.

Table 16. R Factors by County

County	R Factor
Banks	300
Burke	262.5
Chatham	350
Effingham	350
Elbert	250
Franklin	300
Glascock	250
Greene	250
Habersham	300
Hart	275
Jackson	275
Jefferson	262.5
Jenkins	300
Lincoln	250
Madison	275
McDuffie	250
Oglethorpe	250
Rabun	300
Richmond	250
Screven	300
Stephens	300
Taliaferro	250
Warren	250
Wilkes	250

4.2.2 Soil Erodibility Factor

The K factor, or soil erodibility factor, represents the susceptibility of soil to be eroded. This factor quantifies the cohesive or bonding character of the soil and ability of the soil to resist detachment and transport during a rainfall event. It is a function of the soil type, which is provided by the STATSGO data. Table 6 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. Once 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.

The cropland and pastureland C factors for each county were developed by NRCS under the National Resource Inventory Program. Table 17 lists the C factors by county for forest, cropland, and pastureland. These values were developed based on the 2001 NLCD and GFC 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 cropland and pastureland C factors for watersheds in multiple counties were determined by area-weighting the agricultural land use within each county.

Table 17. Forest, Cropland and Pastureland C Factors by County

County	C Factor		
	Forested	Row Crops	Pasture
Banks	0.000163	0.070	0.013
Burke	0.000230	0.405	0.007
Chatham	0.000181	0.429	0.004
Effingham	0.000216	0.448	0.004
Elbert	0.000148	0.155	0.011
Franklin	0.000153	0.1438	0.007
Glascock	0.000185	0.193	0.005
Greene	0.000267	0.241	0.005
Habersham	0.000134	0.2751	0.012
Hart	0.000103	0.189	0.009
Jackson	0.000184	0.130	0.013
Jefferson	0.000151	0.328	0.005
Jenkins	0.000263	0.357	0.041
Lincoln	0.000168	0.090	0.006
Madison	0.000118	0.1428	0.012
McDuffie	0.000173	0.173	0.006
Oglethorpe	0.000226	0.130	0.020

County	C Factor		
	Forested	Row Crops	Pasture
Rabun	0.000104	0.510	0.006
Richmond	0.000153	0.132	0.013
Screven	0.000202	0.350	0.003
Stephens	0.000182	0.1725	0.019
Taliaferro	0.000198	0.202	0.003
Warren	0.000213	0.349	0.009
Wilkes	0.000220	0.150	0.004

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. The Georgia Department of Transportation (DOT) provided Road information, including road surface types. 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
Transitional, Clearcut, Sparse	0.002
Quarries, Strip Mines, Gravel Pits	0.75
Bare Rock, Sand, Clay	0
Developed Open Space, Golf Courses, Utility Swaths	0.003

Land Use	C factor
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 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; and
- 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. 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 has flow and can accumulate flow. For each 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

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

  Where: $S_f = \exp(-16.1 * r / L + 0.057) - 0.6$
  DR = sediment delivery ratio
  L = distance to the stream (m)
  r = relief to the stream (m)

- Area-based equation

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

  Where: DR = sediment delivery ratio
  A = area (sq miles)

- WEPP-based regression equation

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

  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 soil erosion and sediment delivered to the stream from each grid cell due to land use cover and from 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 water body without exceeding the applicable water quality standard; in this case, the narrative water quality standard for aquatic life. TMDLs establish allowable pollutant loadings that are less than or equal to the TMDL, and thereby provide the basis to establish water quality based controls. For some pollutants, TMDLs are expressed on a mass loading basis.

This TMDL determines the range of sediment load that can enter the impaired Savannah River Basin watersheds without causing additional impairment to the stream. This is based on the hypothesis that if an impaired watershed has an annual average sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and not be biologically impaired due to sediment. In the Savannah River Basin, the average sediment load in the unimpaired watersheds in the Piedmont ecoregion is 0.12 tons/acre/yr, and the average sediment load in the unimpaired watersheds in the Southeastern Plains ecoregion is 0.17 tons/acre/yr.

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

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

The following sections describe the various TMDL components.

5.1 Waste Load Allocations

The waste load allocation is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. There are six (6) permitted facilities in the Savannah River Basin watersheds that discharge into listed segments or upstream of a listed segment. These include industrial facilities, municipal treatment plants, and private and institutional development (PID) facilities. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits.

The maximum allocated sediment load for these facilities is dependent on the discharge flow. Table 20 provides the WLAs for these facilities. The WLA loads are given as concentrations or as a range of daily average and daily maximum TSS limits for these facilities; however, a load can be calculated based on the permitted (where available) or design flows, and the permitted TSS concentrations.

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

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

Where:

WLA = Wasteload Allocation sediment load
$C_{permitted}$ = permitted concentration, in TSS (mg / L)
Q = permitted flow (where available) or design discharge flow

Table 20. Waste Load Allocations for Permits with TSS Limits

Facility	NPDES Permit No.	Receiving Water	TSS (mg/L)	
			Monthly Average	Daily Average
Toccoa - Eastanollee Creek WPCP	GA0021814	Eastonollee Creek	30	45
Crawford - Eastside WPCP	GA0033693	Grove Creek	90	120
Dogwood Lane Mobile Home Park	GA0034282	Trib to Eastanollee Creek	90	120
Old Eastanollee Elementary School	GAG550000	Eastonollee Creek	30	45
			Daily Average	Daily Max
Milliken - Avondale Plant	GA0024368	Trib to Big Toms Creek	-	45
Roselane Development Co. (Wilbros, LLC)[1]	GA0002038	Eastonollee Creek	20	-

[1] Roselane Dev. Co. is being taken over by Wilbros, LLC and has requested a new WLA as of 12/08. Only daily averages were given in the WLA. They were used for TMDL Loading calculations.

It is recognized that effluent from biological treatment systems that have TSS limits of 20 mg/L or less are not expected to contribute to stream sedimentation. If there is available assimilative capacity, a new facility may be allowed, or it may be acceptable for an existing facility to expand. Any discharge into a stream with no assimilative capacity will be evaluated on a case-by-case basis and increases will be allowed, dependent on engineering and biological integrity study results.

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

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

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

The stormwater discharges associated with industrial facilities that are not covered under individual NPDES permits are regulated by a Georgia Industrial General Storm Water NPDES Permit (GAR000000). The general permit requires that storm water discharges into an impaired stream segment or within one linear mile upstream of and within the same watershed as, any portion of an Impaired Stream Segment identified as "not supporting" its designated use(s), must satisfy the requirements of Part III.C. of the permit if the Impaired Stream Segment has been listed for criteria violated, "Bio F" (Impaired Fish Community) and/or "Bio M" (Impaired Macroinvertebrate Community) within Category 4a, 4b or 5 and the potential cause is either "NP"(nonpoint source) or "UR" (urban runoff). Table 11 lists the industrial facilities that are covered under the Georgia General Stormwater NPDES Permit in the Savannah River Basin, which discharge into impaired streams.

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 determine the current sediment loading rates to the streams. The current annual sediment load in tons/year for each watershed by land use, including roads, is reported in Table 21. The watersheds are grouped by: those that are biologically unimpaired and those that are biologically impaired (on the 303(d) list). For comparison purposes, the current per acre sediment load was calculated for each watershed and is also given in Table 21. The average sediment load of the Savannah River Basin impaired watersheds located in the Piedmont ecoregion is 0.13 tons/acre/yr, while the average sediment load of the unimpaired watersheds located within the Piedmont ecoregion is 0.12 tons/acre/yr. Also, the average sediment load of the unimpaired watersheds located within the Southeastern Plains ecoregion is 0.17 tons/acre/yr.

For the entire Piedmont ecoregion, the WCS Sediment Tool modeling results from previous years were combined with current results from the Savannah River Basin and an average of the per acre sediment loads for the unimpaired watersheds with the highest IBI scores (greater than or equal to 45) was calculated. This average per acre sediment load was then set as a target for each of the impaired watersheds in the same ecoregion. The target per acre load in the Piedmont ecoregion was 0.09 tons/acre/yr. The per acre sediment loads for the impaired watersheds were then compared with the target. In cases where the loads exceeded the target, the Total Allowable Load was calculated as a tons/year load based on the target per acre load multiplied by the total acres for the impaired watershed. Where the loads were less than the target, the Total Allowable Load was given as the current annual sediment load in tons/year.

However, it is recognized that there may be additional assimilative capacity in these cases and future dischargers (WLA) may be allowed. In the watersheds that have exceeded the total allowable load, new dischargers (WLA) may be allowed if there is sufficient reduction in the nonpoint source loads (LA).

Once the Total Allowable Load for each impaired watershed is calculated, the LA for each watershed is calculated by subtracting the WLA and WLAsw from the Total Allowable 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 significant decrease in the amount of land farmed in Georgia. Since 1950, there has been a 57 percent reduction in farmland. With the reduction in farmland, there has also been a decrease in the amount of soil erosion. This suggests that the sedimentation observed in the impaired stream segments may be legacy sediment resulting from past land use practices. It is believed that if sediment loads are maintained at acceptable levels, 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 are usually evened out by the response of the biological community to habitat alteration, which is a long-term process. Therefore, the annual sediment load was determined.

5.4 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, the MOS was implicitly incorporated in the use of conservative modeling assumptions, including the selection of average USLE factors, the use of the average sediment loading rates for the numeric targets, and the assumption that no BMPs were used.

5.5 Total Sediment Load

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

The USLE method used calculates a total annual sediment load, as opposed to a daily load. The R factor from the USLE (the rainfall erosivity index) 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. Table 23 provides the rainfall statistics from six meteorological stations located throughout Georgia, and shows the variability of rainfall frequency and amount.

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

The National Sediment Laboratory has correlated, by ecoregion, a relationship between the annual average sediment load and the bankfull flow sediment load for stable or unimpaired streams. For the Piedmont ecoregion, the median bankfull flow sediment load expressed as tons per day per square kilometer is 2.54. This is 12.9 percent of the median annual average sediment load of 19.6 tons per year per square kilometer discharged into a stable unimpaired stream. These relationships were used to transform total allowable sediment loads to daily maximum sediment loads.

The total allowable sediment loads and daily maximum sediment loads for the impaired watersheds are summarized in Table 24, along with any required sediment load reductions. The WLAs (WLA + WLAsw) provided in Table 24 are for accounting purposes. 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 overestimate some sediment loads.

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

NAME	Sediment Load (ton/yr)																			
	Open Water	Utility Swaths	Developed, Open Space	Low Intensity Residential	High Intensity Residential	High Intensity Commercial / Industrial / Transportation	Transitional, Clearcut / Sparse	Quarries, Strip Mines, Gravel Pits	Bare Rock, Sand and Clay	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture / Hay	Row Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Roads	Total	Load (ton/acre/yr)
Lightwood Log Creek	0.0	2.9	3.3	12.1	0.2	0.2	19.3	-	-	4.4	0.5	0.3	-	192.2	52.9	3.5	-	44.5	336.2	0.11
Boyds Creek	0.0	2.9	2.4	6.9	0.2	0.1	32.0	606.5	-	2.1	0.4	0.2	-	96.9	129.1	3.3	-	23.1	906.0	0.29
Nails Creek	0.0	2.1	1.4	3.8	0.3	0.0	18.2	-	-	2.1	0.3	0.5	-	134.3	-	4.0	-	6.6	173.3	0.13
Hannah Creek	0.0	-	6.2	14.6	1.2	0.0	259.6	-	-	8.9	1.2	0.8	-	289.8	193.6	17.1	-	106.2	899.3	0.21
Little Dove Creek	0.0	0.6	2.6	2.6	0.0	0.0	73.0	-	-	2.3	1.0	0.3	-	124.6	75.9	16.8	-	45.4	345.1	0.07
Little Beaverdam Creek	0.0	3.0	10.4	27.9	1.6	0.2	119.9	-	0.0	5.9	0.7	0.4	-	450.9	274.6	34.3	-	169.4	1099.2	0.12
Ragsdale Creek	0.0	3.3	10.8	10.7	0.2	-	141.9	-	-	12.3	1.1	1.3	-	349.8	-	51.1	0.0	269.5	851.9	0.17
Grove Creek	0.0	8.0	50.2	110.2	6.6	0.9	590.4	-	-	100.8	15.2	10.9	-	1703.7	-	166.1	-	278.5	3041.7	0.12
Middle Creek	0.0	5.3	19.8	40.9	3.1	0.2	577.9	2196.7	0.0	8.9	29.0	5.8	-	123.8	293.3	209.0	0.1	202.3	3716.1	0.18
Hart Creek	0.0	4.1	5.8	6.0	0.3	-	145.1	-	-	2.4	9.5	1.9	-	31.2	15.5	118.3	0.1	64.3	404.4	0.04
Chill Creek/ Factory Creek	0.0	0.0	2.7	0.9	-	-	144.8	-	-	1.2	5.9	0.9	-	12.1	0.0	65.5	0.0	18.6	252.7	0.05
Germany Creek	0.0	1.8	14.6	55.7	2.9	0.9	257.4	-	-	4.7	9.5	2.4	1.0	94.7	895.2	204.0	0.2	185.1	1730.2	0.11
South Fork Little River	0.0	4.9	15.1	5.5	0.2	0.0	676.6	-	-	15.5	44.7	9.6	-	92.6	-	253.8	0.0	235.5	1354.0	0.05
Davidson Creek	0.0	-	86.9	14.1	0.1	0.1	263.7	-	-	40.2	39.0	17.3	-	90.4	-	36.7	-	109.9	698.4	0.09

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

NAME	Sediment Load (ton/yr)																			
	Open Water	Utility Swaths	Developed, Open Space	Low Intensity Residential	High Intensity Residential	High Intensity Commercial / Industrial / Transportation	Transitional, Clearcut / Sparse	Quarries, Strip Mines, Gravel Pits	Bare Rock, Sand and Clay	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture / Hay	Row Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Roads	Total	Load (ton/acre/yr)
Fitz Branch	0.0	1.0	1.6	1.6	0.1	0.0	17.5	-	-	0.5	1.5	0.0	-	0.1	645.1	36.8	0.0	6.4	712.0	0.15
Boggy Gut Creek	0.0	-	6.8	3.8	0.0	0.0	105.6	-	-	1.6	7.2	4.9	-	16.4	447.1	201.9	0.5	47.8	843.8	0.07
Beaverdam Creek	0.0	0.8	7.8	9.5	0.5	0.0	278.9	-	-	2.7	7.0	0.4	-	10.3	7340.8	182.5	0.4	281.2	8122.8	0.29

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

	Sediment Load (ton/yr)																			
NAME	Open Water	Utility Swaths	Developed, Open Space	Low Intensity Residential	High Intensity Residential	High Intensity Commercial / Industrial / Transportation	Transitional, Clearcut / Sparse	Quarries, Strip Mines, Gravel Pits	Bare Rock, Sand and Clay	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture / Hay	Row Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Roads	Total	Load (ton/acre/yr)
Little Coldwater Creek	0.0	4.6	1.4	2.8	0.1	-	19.6	-	-	0.9	0.2	0.1	-	59.6	206.3	1.0	-	15.4	312.1	0.18
Little Cedar Creek	0.0	-	0.6	0.8	0.0	-	38.3	-	-	0.6	0.6	0.1	-	69.2	79.1	1.7	-	30.8	221.7	0.11
Big Toms Creek/Toms Creek	0.0	10.2	6.0	21.3	1.6	0.8	167.7	-	-	10.9	2.1	1.6	-	243.6	-	61.9	-	93.1	620.8	0.24
Eastanollee Creek	0.0	0.9	25.8	204.9	8.4	1.6	15.2	-	-	1.6	0.6	0.3	-	99.8	-	3.2	-	161.7	524.1	0.22
Nancytown Creek	0.0	-	1.3	0.6	0.2	0.0	39.6	-	-	7.0	2.3	2.8	-	9.7	-	8.4	-	8.8	80.9	0.06
Little Shoal Creek	0.0	-	4.0	7.8	0.1	0.0	43.7	-	-	4.5	0.7	0.6	-	175.7	171.6	21.8	-	38.8	469.3	0.11
Grove Creek	0.0	1.6	5.0	7.9	0.4	0.0	27.9	-	-	2.9	3.9	1.3	-	97.1	20.8	45.4	-	28.3	242.5	0.05
Dove Creek	0.0	2.2	7.6	17.5	0.6	0.1	49.4	926.2	-	3.9	2.1	0.7	-	24.8	17.4	50.3	-	35.0	1137.8	0.20
Mattox Creek	0.0	5.7	24.0	75.8	6.5	2.7	279.7	-	-	4.2	10.8	2.4	0.4	111.9	42.5	79.1	0.0	138.9	784.4	0.06
Panther Creek (Big Panther Creek)	0.0	0.0	28.5	4.8	0.1	-	57.3	-	-	24.0	1.6	1.5	-	28.1	-	16.4	-	187.7	350.0	0.11

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

	Percent Sediment Load																	
NAME	**Open Water**	**Utility Swaths**	**Developed, Open Space**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial/ Industrial/Transportation**	**Transitional, Clearcut / Sparse**	**Quarries, Strip Mines, Gravel Pits**	**Bare Rock, Sand and Clay**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Golf Courses**	**Pasture / Hay**	**Row Crops**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**	**Roads**
Lightwood Log Creek	0.00%	0.88%	0.97%	3.60%	0.06%	0.05%	5.75%	-	-	1.30%	0.14%	0.10%	-	57.16%	15.72%	1.04%	-	13.24%
Boyds Creek	0.00%	0.31%	0.26%	0.76%	0.03%	0.01%	3.54%	66.94%	-	0.23%	0.04%	0.03%	-	10.69%	14.25%	0.37%	-	2.55%
Nails Creek	0.00%	1.19%	0.80%	2.17%	0.20%	0.01%	10.48%	-	-	1.19%	0.15%	0.26%	-	77.47%	-	2.29%	-	3.81%
Hannah Creek	0.00%	-	0.69%	1.62%	0.13%	0.00%	28.87%	-	-	0.99%	0.13%	0.09%	-	32.23%	21.53%	1.90%	-	11.81%
Little Dove Creek	0.00%	0.17%	0.74%	0.74%	0.01%	0.01%	21.17%	-	-	0.67%	0.29%	0.10%	-	36.09%	22.01%	4.86%	-	13.15%
Little Beaverdam Creek	0.00%	0.27%	0.95%	2.54%	0.15%	0.02%	10.91%	-	0.00%	0.53%	0.07%	0.03%	-	41.02%	24.98%	3.12%	-	15.41%
Ragsdale Creek	0.00%	0.39%	1.27%	1.25%	0.02%	-	16.65%	-	-	1.44%	0.13%	0.15%	-	41.06%	-	6.00%	0.00%	31.63%
Grove Creek	0.00%	0.26%	1.65%	3.62%	0.22%	0.03%	19.41%	-	-	3.32%	0.50%	0.36%	-	56.01%	-	5.46%	-	9.16%
Middle Creek	0.00%	0.14%	0.53%	1.10%	0.08%	0.01%	15.55%	59.11%	0.00%	0.24%	0.78%	0.16%	-	3.33%	7.89%	5.62%	0.00%	5.44%
Hart Creek	0.00%	1.02%	1.45%	1.48%	0.06%	-	35.88%	-	-	0.58%	2.35%	0.46%	-	7.72%	3.83%	29.25%	0.02%	15.89%
Chill Creek/ Factory Creek	0.00%	0.01%	1.08%	0.37%	-	-	57.33%	-	-	0.46%	2.34%	0.36%	-	4.77%	0.01%	25.92%	0.01%	7.35%
Germany Creek	0.00%	0.10%	0.85%	3.22%	0.17%	0.05%	14.88%	-	-	0.27%	0.55%	0.14%	0.06%	5.48%	51.74%	11.79%	0.01%	10.70%
South Fork Little River	0.00%	0.36%	1.12%	0.41%	0.02%	0.00%	49.97%	-	-	1.15%	3.30%	0.71%	-	6.84%	-	18.74%	0.00%	17.39%
Davidson Creek	0.00%	-	12.44%	2.01%	0.01%	0.02%	37.75%	-	-	5.76%	5.59%	2.48%	-	-	12.95%	-	5.26%	-

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

	Percent Sediment Load																	
NAME	Open Water	Utility Swaths	Developed, Open Space	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial/Transportation	Transitional, Clearcut / Sparse	Quarries, Strip Mines, Gravel Pits	Bare Rock, Sand and Clay	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture / Hay	Row Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Roads
Fitz Branch	0.00%	0.14%	0.22%	0.22%	0.01%	0.00%	2.46%	-	-	0.08%	0.21%	0.00%	-	0.01%	90.60%	5.17%	0.00%	0.89%
Boggy Gut Creek	0.00%	-	0.81%	0.45%	0.01%	0.00%	12.51%	-	-	0.20%	0.85%	0.58%	-	1.94%	52.99%	23.93%	0.06%	5.67%
Beaverdam Creek	0.00%	0.01%	0.10%	0.12%	0.01%	0.00%	3.43%	-	-	0.03%	0.09%	0.00%	-	0.13%	90.37%	2.25%	0.00%	3.46%

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

NAME	Percent Sediment Load																	
	Open Water	Utility Swaths	Developed, Open Space	Low Intensity Residential	High Intensity Residential	High Intensity Commercial / Industrial / Transportation	Transitional, Clearcut / Sparse	Quarries, Strip Mines, Gravel Pits	Bare Rock, Sand and Clay	Deciduous Forest	Evergreen Forest	Mixed Forest	Golf Courses	Pasture / Hay	Row Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Roads
Little Coldwater Creek	0.00%	1.48%	0.44%	0.90%	0.04%	-	6.27%	-	-	0.29%	0.07%	0.02%	-	19.10%	66.11%	0.34%	-	4.93%
Little Cedar Creek	0.00%	-	0.27%	0.38%	0.00%	-	17.26%	-	-	0.26%	0.25%	0.03%	-	31.19%	35.68%	0.77%	-	13.91%
Big Toms Creek/Toms Creek	0.00%	1.64%	0.97%	3.43%	0.26%	0.13%	27.02%	-	-	1.76%	0.33%	0.25%	-	39.24%	-	9.97%	-	14.99%
Eastanollee Creek	0.00%	0.17%	4.92%	39.10%	1.60%	0.30%	2.91%	-	-	0.31%	0.11%	0.06%	-	19.05%	-	0.61%	-	30.86%
Nancytown Creek	0.00%	-	1.57%	0.80%	0.25%	0.01%	48.99%	-	-	8.67%	2.90%	3.49%	-	11.97%	-	10.41%	-	10.93%
Little Shoal Creek	0.00%	-	0.85%	1.66%	0.03%	0.00%	9.31%	-	-	0.95%	0.16%	0.14%	-	37.44%	36.57%	4.64%	-	8.27%
Grove Creek	0.00%	0.64%	2.06%	3.25%	0.15%	0.00%	11.52%	-	-	1.19%	1.63%	0.55%	-	40.02%	8.59%	18.73%	-	11.67%
Dove Creek	0.00%	0.19%	0.67%	1.54%	0.05%	0.01%	4.34%	81.40%	-	0.34%	0.18%	0.06%	-	2.18%	1.53%	4.42%	-	3.08%
Mattox Creek	0.00%	0.72%	3.05%	9.67%	0.83%	0.34%	35.65%	-	-	0.53%	1.37%	0.30%	0.06%	14.26%	5.42%	10.08%	0.00%	17.71%
Panther Creek (Big Panther Creek)	0.00%	0.01%	8.13%	1.38%	0.03%	-	16.36%	-	-	6.87%	0.45%	0.43%	-	8.04%	-	4.69%	-	53.61%

Table 23. Georgia Meteorological Rainfall Statistics

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

Table 24. Total Allowable Sediment Loads and the Required Sediment Load Reductions

Name	Current Load (tons/yr)	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction Required
Little Coldwater Creek	312.1	-	-	158.6	158.6	20.5	49.2%
Little Cedar Creek	221.7	-	-	189.3	189.3	24.4	14.6%
Big Toms Creek/Toms Creek	625.3	4.5	-	225.7	230.2	29.7	63.2%
Eastanollee Creek	606.4	82.3	-	134.5	216.8	28.0	64.2%
Nancytown Creek	80.9	-	-	80.9	80.9	10.4	0.0%
Little Shoal Creek	469.3	-	-	375.4	375.4	48.4	20.0%
Grove Creek	246.6	4.1	-	238.4	242.5	31.3	1.7%
Dove Creek	1137.8	-	-	515.4	515.4	66.5	54.7%
Mattox Creek	784.4	-	-	784.4	784.4	101.2	0.0%
Panther Creek (Big Panther Creek)	350.0	-	-	278.7	278.7	36.0	20.4%

6.0 RECOMMENDATIONS

6.1 Monitoring

Monitoring is conducted at a number of locations across the State each year. GA EPD 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 sampling work to be focused on one of the five basin groups each year and offers a five-year planning and assessment cycle. The Savannah River Basin, along with the Ogeechee River Basin, will again receive focused monitoring in 2012. One goal of the 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

It has been determined that most of the sediment found in the Savannah 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, so that these streams will 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 can be slow to respond to changes in sediment loading, which is why monitoring will continue according to the five-year monitoring cycle. Thus, this TMDL recommends that compliance with NPDES permits and implementation of Best Management Practices (BMPs) be monitored. The anticipated effects of compliance with NPDES permits and implementation of BMPs will be the improvement of stream habitats and water quality, and thus be an indirect measurement of the TMDL.

Management practices recommended to maintain the total allowable sediment loads at current levels 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; and
- Mitigation and prevention of stream bank erosion due to increased stream flow 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 developing municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GA EPD rules and regulations, all NPDES dischargers in the watershed are required to meet their current NPDES permit limits. It is recommended that there be no authorized increase in the concentration of TSS above that identified in the TMDL. However, if there is available assimilative capacity, new discharges may be allowed based on engineering evaluations and current stream biological integrity studies.

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

The GA EPD has developed a General Storm Water NPDES Permit for Construction Activities. The permit is required for 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 III through V 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.

The General Storm Water NPDES Permit for Construction Activity also requires that storm water discharges into an impaired stream segment or a segment within one linear mile upstream of and within the same watershed as, any portion of an impaired stream segment, must address any site-specific condition or requirement in a TMDL implementation plan and must include at least four additional BMPs from a list provided in Part III C of the Permit. This condition only applies to streams with impairments for "Bio F" (fish community) and /or "Bio M" (macroinvertebrate Community), and with the listed potential cause of either "NP" (nonpoint source) or "UR" (urban runoff).

6.2.2 Nonpoint Source Land Use Approaches

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. GA 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, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of BMPs that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality. The following sections describe in more detail the specific measures to reduce nonpoint sources of sediment by land use type.

6.2.2.1 Forested Land

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

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

The GFC formed a Forestry Nonpoint Source Pollution Technical Task Force to assess the extent of water pollution caused by forestry practices, and to develop recommendations for reducing or eliminating erosion and sedimentation. After a three-year field study, the task force developed a set of BMPs that address all aspects of silviculture, including forest road construction, timber harvesting, site preparation, and forest regeneration. The task force recommended the BMPs be implemented through a voluntary program, exempt from permitting under the Georgia Erosion and Sedimentation Control Act, emphasizing educational and training programs instead. In 1997, the original BMP document was revised to incorporate the 1989 Wetland BMP manual developed by the Georgia Forestry Association. The current BMP manual, *Georgia's Best Management Practices for Forestry,* was developed and became effective January 1, 1999 (GA EPD, 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 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 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 GA EPD and the Army Corps of Engineers (COE) when stream water quality and wetlands are involved, respectively. Complaints from citizens are common, particularly in counties growing in population where landowners are living close to commercial forestry operations. After notifying the forest owner, the GFC District Coordinator conducts a field inspection to determine if BMPs were followed, if the potential for water quality problems exists, and who is the responsible party. If the complaint is valid, GFC will work with the responsible party until the problem is corrected. However, the GFC has no regulatory authority. In situations where the GFC cannot get satisfactory compliance, the case is turned over to GA EPD or COE for enforcement actions under the Georgia Water Quality Control Act or Section 404 of the Federal Clean Water Act.

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

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, GA EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the State. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses. In September 1994, the GSWCC developed a BMP manual, *Agricultural Best Management Practices for Protecting Water Quality in Georgia,* for the agricultural community (GSWCC, 1994).

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

The NRCS provides Conservation Practice Standards, found in the electronic Field Office Technical Guide (FOTG), on their website (http://www.nrcs.usda.gov/technical/efotg/). Some of these BMPs may be used for farming operations to reduce soil erosion. It is recommended that the agricultural communities with cropland close to impaired streams, and pastureland where grazing animals have access to the stream, investigate the various BMPs available to them in order to reduce soil erosion and bank collapse.

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

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

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

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

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

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

NRCS also provides a web-based database application (Performance Results System, PRS) so conservation partners and the public can gain fast and easy access to the accomplishments and the progress made toward strategies and performance goals. The web site is http://ias.sc.egov.usda.gov/prshome/default.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 GA EPD supports the PRS 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 are therefore 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 GA EPD. These permits are administered by the Land Protection Branch of GA EPD. 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 GA EPD offices monitor and inspect surface mining sites to assess permit compliance.

It is recommended that special attention be given to those facilities located in 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 GMA serves as a source for mining industry information. It has several committees, including the Environmental Committee, that meet three to four times a year. The mining industry is conducting informal discussions on the potential of developing industry-wide standards for BMPs to prevent and reduce nonpoint source pollution. If these standards are adopted, the mining industry would likely conduct demonstration projects to gauge the effectiveness of the BMPs.

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

Roadside ditches convey storm water runoff to an outlet. A good drainage ditch is shaped and lined with appropriate vegetative or structural material. A well-vegetated ditch slows, controls and filters the storm water runoff, providing an opportunity for sediments to be removed from the runoff before it enters surface waters. Energy dissipating structures to reduce velocity, dissipate turbulence or flatten flow grades in ditches are often necessary. Efficient disposal of runoff from the road helps preserve the roadbed and banks. Properly installed "turn-outs" or intermittent discharge points help to maintain a stable velocity and proper flow capacity within the ditch by timely outleting water from them. This in turns alleviates roadway flooding, erosion, and maintenance problems. Properly placed "turn-outs" distribute roadway runoff and sediments over a larger vegetative filtering area, helping to reduce 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 stream flows and expected rainfall is low can reduce the amount of sediment that enters a stream. If the entire installation process, from beginning to end, can be completed before the next rainfall event, stream sedimentation can be minimized. Diverting all existing or potential stream flows while the culvert is being installed can also help reduce or avoid sedimentation below the installation. The culvert design can have a significant impact on the biological community if the size and species of fish passing through it are not considered. Changes in water velocities and the creation of vertical barriers affect the biological communities.

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 113 counties and 227 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 GA EPD is responsible for permitting, inspecting, and enforcing the Erosion and Sedimentation Act.

To receive a land-disturbing permit, an applicant must submit an erosion and sedimentation control plan that incorporates specific conservation and engineering BMPs. The *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 GA EPD, and the Soil and Water Conservation Districts, are primarily responsible for implementing the Georgia Erosion and Sedimentation Act, O.C.G.A. §12-7-1 (amended in 2003). Reports of suspected violations are made to the agency that issued the permit. In cases with local issuing authority, if the violation continues, the complaint is referred to the appropriate Soil and Water Conservation District. If the situation remains unresolved, the complaint is then referred to GA EPD for enforcement action. Enforcement may include administrative orders, injunctions, and civil penalties. It is recommended that the local and State governments continue to work to implement the provisions of the Georgia Erosion and Sedimentation Act across Georgia.

Storm water runoff from developed urban areas (post-construction) can also have an impact on the transport of sediment to and within streams. Urbanization increases imperviousness, resulting in an increase in the volume of runoff that enters the streams. In addition, the stream flow rates may increase significantly from pre-construction rates. These changes in the stream flow can result in stream bank erosion and stream bottom down cutting. It is recommended that local governments review and consider implementation of practices presented in the *Land Development Provisions to Protect Georgia Water Quality* (GA EPD, 1997). Additional information on site design and best management practices to address stormwater run-off may be found in the *Georgia Stormwater Management Manual* (the "Blue Book") (ARC, 2001) and Georgia's *Green Growth Guidelines* (GADNR, 2005), both of which are available electronically via the internet.

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. An allocation to a point source discharger does not automatically result in a permit limit or monitoring requirement. Through its NPDES permitting process, GA EPD will determine whether a new or existing discharger has a reasonable potential of discharging sediment levels equal to or greater than the total allocated load. The results of this reasonable potential analysis will determine the specific requirements in an individual facility's NPDES permit. As part of its analysis, the GA EPD will use its EPA approved 2003 NPDES Reasonable Potential Procedures to determine whether monitoring requirements or effluent limitations are necessary.

Georgia is working with local governments, agricultural and forestry agencies, such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of 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 is being provided for this TMDL. During that time, the availability of the TMDL will be public noticed, a copy of the TMDL will be provided as requested, and the public is invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

July 2009

7.1 Initial TMDL Implementation Plan

This plan identifies applicable State-wide programs and activities that may be employed to manage point and nonpoint sources of bacteria loads for three segments in the Ogeechee River Basin. Local watershed planning and management initiatives will be fostered, supported or developed through a variety of mechanisms. Implementation may be addressed by GA EPD initiated Watershed Improvement Projects, assessments for Section 319 (h) grant projects, the local development of watershed assessment and protection plans, and GA EPD "Targeted Outreach" to foster and support local watershed management initiatives. These procedures would supplant or replace this initial implementation plan.

7.2 Impaired Segments

This initial plan is applicable to the following waterbodies that were added to Georgia's 305(b) list of impaired waters in *Water Quality in Georgia* (GA EPD, 2006 – 2007) available on the EPD website:

Stream Segments Located in the Savannah River Basin on the 2008 303(d) List as Biota Impacted

Stream Segment	Location	Segment Length (miles)	Designated Use
Big Toms Creek/Toms Creek	Ayers Pond/Reservoir 14 to North Fork Broad River	6	Fishing
Dove Creek	Headwaters to Little Dove Creek	6	Fishing
Eastanollee Creek	Toccoa to Lake Hartwell	14	Fishing
Grove Creek	Headwaters to South Fork Broad River	12	Fishing
Little Cedar Creek	Headwaters to Cedar Creek	5	Fishing
Little Coldwater Creek	Headwaters to Boyds Creek	5	Fishing
Little Shoal Creek	Headwaters to Lake Hartwell	6	Fishing
Mattox Creek	Headwaters to Big Creek	9	Fishing
Nancytown Creek	Headwaters to Nancytown Lake	3	Fishing
Panther Creek (Big Panther Creek)	Upstream Lake Yonah	9	Fishing

The GA EPD developed TMDLs in 2009 for sediment in the Savannah River Basin due to a "biota/habitat-impacted" designation on Georgia's 2008 Section 303(d) list. These streams have shown a degradation of the biological community, which is generally caused by habitat loss due to stream sedimentation. The purpose of the narrative sediment 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."

7.3 Potential Sources

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

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

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

Through water quality modeling, it has been determined that the sediment loading found in 8 of these 10 segments needs to be reduced. This sediment may be due to land disturbing activities including, but not limited to land development, agriculture, impervious surfaces, commercial forestry, and others. It is believed that, if sediment loads are not reduced, these streams will continue to degrade over time. Remedies exist for addressing excess sediment, from both point and non-point sources, in streams. They will be discussed in this plan.

Based on modeling, some segments have been found to need 0% reductions in sediments loads. This occurs if the current loading for these segments is below the TMDL. It has been determined that the impairment in these segments is due to past land use practices and is referred to as "legacy" sediment. It is believed that these streams will repair themselves over time if sediment loads are maintained at current levels.

7.4 Management Practices and Activities

Compliance with NPDES permits, the Erosion and Sedimentation Control Act, and local ordinances related to land disturbing activities will contribute to controlling sediment delivery from regulated activities and may help to achieve the reductions necessary to meet the TMDL.

Using federal, state, and local laws, enforcement actions are available as a remedy for excess sediment coming from regulated sources. These may include land clearing for non-agricultural use, construction, wastewater discharges, and excessive sediment run-off from other land disturbing activities. The local issuing authority typically enforces these laws. However, the enforcement may be deferred to EPD if the local city or county government is not the issuing authority or further and action is needed.

Sediment produced from non-point sources such as the erosion of stream banks, paved surfaces, roofs, and others are not regulated. Therefore, these are not subject to most enforcement actions. Best Management Practices (BMPs) may be used to help reduce average annual sediment loads and achieve water quality standards, and improve the over aquatic health of the system. The table below lists examples of BMPs that address excess sediment. This is not a complete list and additional management measures may be proposed that will be considered as implementing non-point source controls consistent with this plan.

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

Name of BMP	Type (Ag., Forestry, Urban, Other.)
Filter Strips	Agriculture
Reduced Tillage System	Agriculture
Exclusion	Agriculture
Timber Bridges	Forestry
Revegetation	Forestry
Sediment Basin	Urban
Porous Pavement	Urban
Wet Detention Pond	Urban
Organic Filter	Urban
Streambank Protection and Restoration	Ag, Forestry, Urban, Other
Stream Buffers	Ag, Forestry, Urban, Other
Additional Ordinances	Ag, Forestry, Urban, Other

Management practices that may be used to help maintain average annual sediment loads at current levels include:

- Compliance with NPDES (wastewater and/or MS4) permit limits and requirements;
- Implementation of the Georgia Forestry Commission's BMPs for Forestry;
- Application of Georgia and NRCS agricultural BMPs;
- 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 and Ordinances for land disturbing activities;
- Adherence to DNR River Corridor Protection guidelines;
- Mitigation and prevention of stream bank erosion due to increased stream flow and velocities caused by urban runoff.

- Promulgation and enforcement of local natural resource protection ordinances such as: land development, stormwater, water protection, protection of environmentally sensitive areas, and other.

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

The GA EPD Watershed Improvement Program should be consulted when selecting appropriate management practices for addressing the TMDL, particularly when determining the best practices for specific watersheds.

7.5 Monitoring

Monitoring of sediment through the measurement of total settable solids or TSS may be carried out through GA EPD's Adopt-A-Stream program. Additional opportunities for monitoring aquatic habitat through macro-invertebrate assessments may be available in the future. If it is determined through stakeholder involvement that either of these types of monitoring should take place, GA EPD will work with the entity that assumes responsibility for monitoring activities by providing the necessary training and taking the needed steps to establish a well-organized monitoring program.

7.6 Future Action

This Initial TMDL Implementation Plan includes a general approach to pollutant source identification as well as management practices to address pollutants. In the future, GA EPD will continue to determine and assess the appropriate point and non-point source management measures needed to achieve the TMDLs and also to protect and restore water quality in impaired waterbodies.

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

GA EPD will work to develop Watershed Improvement Projects (WIPs), to address non-point source pollution. This is a process whereby GA EPD and/or Regional Commissions or other agencies or local governments, under a contract with GA EPD, will develop a Watershed Improvement Plan intended to address water quality at the small watershed level (HUC 12). These plans will be developed as resources, needs, and willing partners become available. The development of these plans may be funded via several grant sources including but not limited to Clean Water Act Section 319(h), Section 604(b), and/or Section 106 grant funds. These plans are intended for implementation upon completion.

Any Watershed Improvement Plan that specifically address waterbodies contained within this TMDL will supersede the Initial TMDL Implementation Plan once GA EPD accepts the plan. Future Watershed Improvement Plans intended to address this TMDL and other water quality concerns, written by GA EPD and for which GA EPD and/or the GA EPD Contractor are responsible, will contain at a minimum the US EPA's 9-Key Elements of Watershed Planning :

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

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

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

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

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

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

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

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

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

The public will be provided an opportunity to participate in the development of Watershed Improvement Plans that address impaired waters and to comment on them before they are finalized.

GA EPD will continue to offer technical and financial assistance (when and where available) to complete Watershed Improvement Plans that address the impaired waterbodies listed in this and other TMDL documents. Assistance may include but will not be limited to:

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

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

7.7 References

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APPENDIX A

Total Allowable Sediment Load Summary Memorandum

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Big Toms Creek/Toms Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Stephens**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060104**
Waterbody Name:	**Big Toms Creek/Toms Creek**
Location:	**Ayers Pond/Reservoir 14 to North Fork Broad River**
Stream Length:	**6 miles**
Watershed Area:	**4.2 square miles**
Tributary to:	**North Fork of the Broad River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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):	**4.5 tons/yr**
Milliken - Avalon Plant	**45 mg/L (4.5 tons/yr)**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**225.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**230.2 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Dove Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Elbert**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060104**
Waterbody Name:	**Dove Creek**
Location:	**Headwaters to Little Dove Creek**
Stream Length:	**6 miles**
Watershed Area:	**9.3 square miles**
Tributary to:	**Broad River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**515.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**515.4 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Eastanollee Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Stephens**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060102**
Waterbody Name:	**Eastanollee Creek**
Location:	**Toccoa to Lake Hartwell**
Stream Length:	**14 miles**
Watershed Area:	**4.0 square miles**
Tributary to:	**Lake Hartwell**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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):	**82.3 tons/yr**
Eastanollee Creek WPCP	**30 mg/L (66.2 tons/yr)**
Wilbros, LLC	**20 mg/L (12.2 tons/yr)**
Dogwood Lane MHP	**90 mg/L (3.4 tons/yr)**
Old Eastanollee Elementary	**30 mg/L (0.5 tons/yr)**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**134.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**216.8 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Grove Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Oglethorpe**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060104**
Waterbody Name:	**Grove Creek**
Location:	**Headwaters to South Fork Broad River**
Stream Length:	**12 miles**
Watershed Area:	**7.9 square miles**
Tributary to:	**South Fork of the Broad River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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):	**4.1 tons/yr**
Crawford - Eastside WPCP	**90 mg/L (4.1 tons/yr)**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**238.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**242.5 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little Cedar Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Hart**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060103**
Waterbody Name:	**Little Cedar Creek**
Location:	**Headwaters to Cedar Creek**
Stream Length:	**5 miles**
Watershed Area:	**3.5 square miles**
Tributary to:	**Savannah River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**189.3 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**189.3 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little Coldwater Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Hart**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060103**
Waterbody Name:	**Little Coldwater Creek**
Location:	**Headwaters to Boyds Creek**
Stream Length:	**5 miles**
Watershed Area:	**3.0 square miles**
Tributary to:	**Lake Russell**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**158.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**158.6 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little Shoal Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Hart**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060102**
Waterbody Name:	**Little Shoal Creek**
Location:	**Headwaters to Lake Hartwell**
Stream Length:	**6 miles**
Watershed Area:	**6.7 square miles**
Tributary to:	**Lake Hartwell**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**375.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**375.4 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Mattox Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**McDuffie**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03150105**
Waterbody Name:	**Mattox Creek**
Location:	**Headwaters to Big Creek**
Stream Length:	**9 miles**
Watershed Area:	**20.3 square miles**
Tributary to:	**Little River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**784.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**784.4 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Nancytown Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Habersham**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060104**
Waterbody Name:	**Nancytown Creek**
Location:	**Headwaters to Nancytown Lake**
Stream Length:	**3 miles**
Watershed Area:	**2.3 square miles**
Tributary to:	**Middle Fork of the Broad River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**80.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**80.9 tons/yr**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Panther Creek (Big Panther Creek)

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Habersham**
Major River Basin:	**Savannah**
8-Digit Hydrologic Unit Code(s):	**03060102**
Waterbody Name:	**Panther Creek (Big Panther Creek)**
Location:	**Upstream Lake Yonah**
Stream Length:	**9 miles**
Watershed Area:	**5.0 square miles**
Tributary to:	**Tugalo River**
Ecoregion:	**Piedmont**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not 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) :	**278.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**278.7 tons/yr**