Total Maximum Daily Load

Evaluation

for

Twenty-One Stream Segments

in the

Ogeechee River Basin

for

Fecal Coliform

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 three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years.

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

The State of Georgia has identified twenty-one (21) stream segments located in the Ogeechee River Basin as water quality limited due to fecal coliform. A stream is placed on the partial support list if more than 10% of the samples exceed the fecal coliform criteria and on the not support list if more than 25% of the samples exceed the standard. Water quality samples collected within a 30-day period that have a geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1000 counts per 100 milliliters during the period November through April, are in violation of the bacteria water quality standard. There is also a single sample maximum criteria (4000 counts per 100 milliliters) for the months of November through April. The water use classification of all of the impacted streams is Fishing.

An important part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of fecal coliform bacteria on land surfaces that wash off as a result of storm events.

The process of developing fecal coliform TMDLs for the Ogeechee River Basin listed segments includes the determination of the following:

- The current critical fecal coliform load to the stream under existing conditions;
- The TMDL for similar conditions under which the current critical load was determined; and
- The percent reduction in the current critical fecal coliform load necessary to achieve the TMDL.

The calculation of the fecal coliform load at any point in a stream requires the fecal coliform concentration and stream flow. The availability of water quality and flow data varies considerably among the listed segments. The Loading Curve Approach was used to determine the current fecal coliform load and TMDL. The fecal coliform loads and required reductions for each of the listed segments are summarized in the table below.

Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days)[1]	WLAsw (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Big Creek	7.71E+12			3.04E+12	3.38E+11	3.38E+12	56
Buckhead Creek	1.35E+13	4.09E+10		5.41E+12	6.06E+11	6.06E+12	55
Canoochee River	7.22E+13	3.37E+10		2.98E+13	3.32E+12	3.32E+13	54
Casey Canal - Head of Canal to DeRenne Ave, Savannah	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Casey Canal - DeRenne Ave to Montgomery Crossroad, Savannah	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Cedar Creek	1.18E+10			1.32E+09	1.47E+08	1.47E+09	88
Fifteenmile Creek	1.54E+14			3.21E+13	3.57E+12	3.57E+13	77
Hayners Creek (known upstream as Casey Canal)	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Horse Creek	6.46E+10			3.63E+10	4.04E+09	4.04E+10	38
Little Ogeechee River -Two Mile Creek to Hamburg Pond nr Culverton	1.35E+12			1.29E+12	1.44E+11	1.44E+12	0
Little Ogeechee River - Little Ogeechee Pond to below US Hwy 17	2.08E+13	4.53E+10	1.46E+12	2.68E+12	4.65E+11	4.65E+12	78
Nevills Creek	4.00E+12			3.53E+12	3.93E+11	3.93E+12	2
North Fork Ogeechee River	1.58E+12	3.34E+10		2.14E+11	2.75E+10	2.75E+11	83
Ogeechee River	8.26E+12			1.78E+12	1.98E+11	1.98E+12	76
Peacock Creek	1.08E+10		9.53E+08	4.99E+09	6.60E+08	6.60E+09	39
Rocky Comfort Creek - Joes Creek to Ivey Branch near Edgehill	5.48E+12	1.39E+10		2.99E+12	3.34E+11	3.34E+12	39
Rocky Comfort Creek - Duhart Creek to Ogeechee River, Louisville	1.33E+13	2.87E+10		1.07E+13	1.19E+12	1.19E+13	10
Sculls Creek	3.35E+13			1.81E+13	2.01E+12	2.01E+13	40
Tenmile Creek	7.04E+12			1.48E+12	1.64E+11	1.64E+12	77
Williamson Swamp Creek - Hwy 24 to Limestone Creek, Davisboro	1.66E+13			5.28E+12	5.87E+11	5.87E+12	65
Williamson Swamp Creek - Mill Creek to Ogeechee River, Wadley	4.78E+13	2.82E+10		3.41E+12	3.82E+11	3.82E+12	92

Notes: [1] The assigned fecal coliform load from each NPDES permitted facility for WLA was determined as the product of the fecal coliform permit limit and the facility average monthly discharge at the time of the critical load.

Management practices that may be used to help reduce fecal coliform source loads include:

- Compliance with NPDES permit limits and requirements;
- Adoption of NRCS Conservation Practices; and
- Application of Best Management Practices (BMPs) appropriate to reduce nonpoint sources.

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

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that addresses the assessment process, and are published in *Water Quality in Georgia* every two years (GA EPD, 2002-2003).

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

The list identifies the waterbodies as either partially supporting or not supporting their designated use classifications, due to exceedances of water quality standards for fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. Table 1 presents the streams of the Ogeechee River Basin included on the 303(d) list for exceedances of the fecal coliform standard criteria. A total of seven stream segments were listed as partially supporting their designated use and fourteen stream segments were listed as not supporting their designated use.

1.2 Watershed Description

The Ogeechee River Basin is located in mid to southeastern Georgia, encompassing approximately 5,540 square miles. The Ogeechee River Basin is bordered by the Oconee and Altamaha River Basins to the west and the Savannah River Basin to the east. The Ogeechee River originates in Greene County, in central Georgia. In the headwaters, the North and South Forks of the Ogeechee River join to form the Ogeechee River. The River then flows approximately 245 miles southeast toward the Atlantic Ocean. The Canoochee River originates in Emanuel County and flows southeast to join the Ogeechee River near Richmond Hill where it then flows to the Atlantic Ocean. The Ogeechee River Basin contains parts of Piedmont and Coastal Plain physiographic provinces, which extend throughout the southeastern United States.

Table 1. Water Bodies Listed for Fecal Coliform Bacteria in the Ogeechee River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Big Creek	Kelley's Pond to Ogeechee River, Louisville (Jefferson Co)	5	Fishing	PS
Buckhead Creek	Downstream Spring Mill Branch to Ogeechee River, Millen (Jenkins Co)	4	Fishing	NS
Canoochee River	GA Hwy 192 to Fifteen Mile Creek near Metter (Emanuel/Candler Co)	21	Fishing	PS
Casey Canal	Head of Canal to DeRenne Ave, Savannah (Chatham Co)	3	Fishing	NS
Casey Canal	DeRenne Ave to Montgomery Crossroad, Savannah (Chatham Co)	3	Fishing	NS
Cedar Creek	Water Hole Creek to Canoochee River, Claxton (Evans Co)	6	Fishing	NS
Fifteenmile Creek	Stocking Head Branch to Canoochee River near Metter (Candler Co)	6	Fishing	NS
Hayners Creek (known upstream as Casey Canal)	Casey Canal (Montgomery Crossroad) to Vernon River (Chatham Co)	2	Fishing	NS
Horse Creek	Little Horse Creek to Ogeechee River near Rocky Ford (Screven Co)	5	Fishing	NS
Little Ogeechee River	Two Mile Creek to Hamburg Pond near Culverton (Hancock/Washington Co)	9	Fishing	PS
Little Ogeechee River	Little Ogeechee Pond to below US Hwy 17 near Burroughs (Chatham Co)	6	Fishing	PS
Nevills Creek	Bay Gull Creek to Ogeechee River near Rocky Ford (Bulloch Co)	3	Fishing	NS
North Fork Ogeechee River	Hwy 77 to Ogeechee River near Crawfordville (Greene/Taliaferro Co)	13	Fishing	NS
Ogeechee River	Powell Creek to Beaverdam Creek near Powelton (Hancock Co)	5	Fishing	NS
Peacock Creek	Hwy 144 to North Newport River near McIntosh (Liberty Co)	17	Fishing	PS
Rocky Comfort Creek	Joes Creek to Ivey Branch near Edgehill (Glascock/Jefferson Co)	10	Fishing	PS
Rocky Comfort Creek	Duhart Creek to Ogeechee River, Louisville (Jefferson Co)	6	Fishing	PS
Sculls Creek	Richardson Creek to Ogeechee River near Scarboro (Jenkins Co)	4	Fishing	NS
Tenmile Creek	Upstream Canoochee River, Excelsior (Candler Co)	3	Fishing	NS
Williamson Swamp Creek	Hwy 24 to Limestone Creek, Davisboro (Washington/Jefferson Co)	12	Fishing	NS
Williamson Swamp Creek	Mill Creek to Ogeechee River, Wadley (Jefferson Co)	9	Fishing	NS

Notes:
PS = Partially Supporting designated uses
NS = Not Supporting designated uses

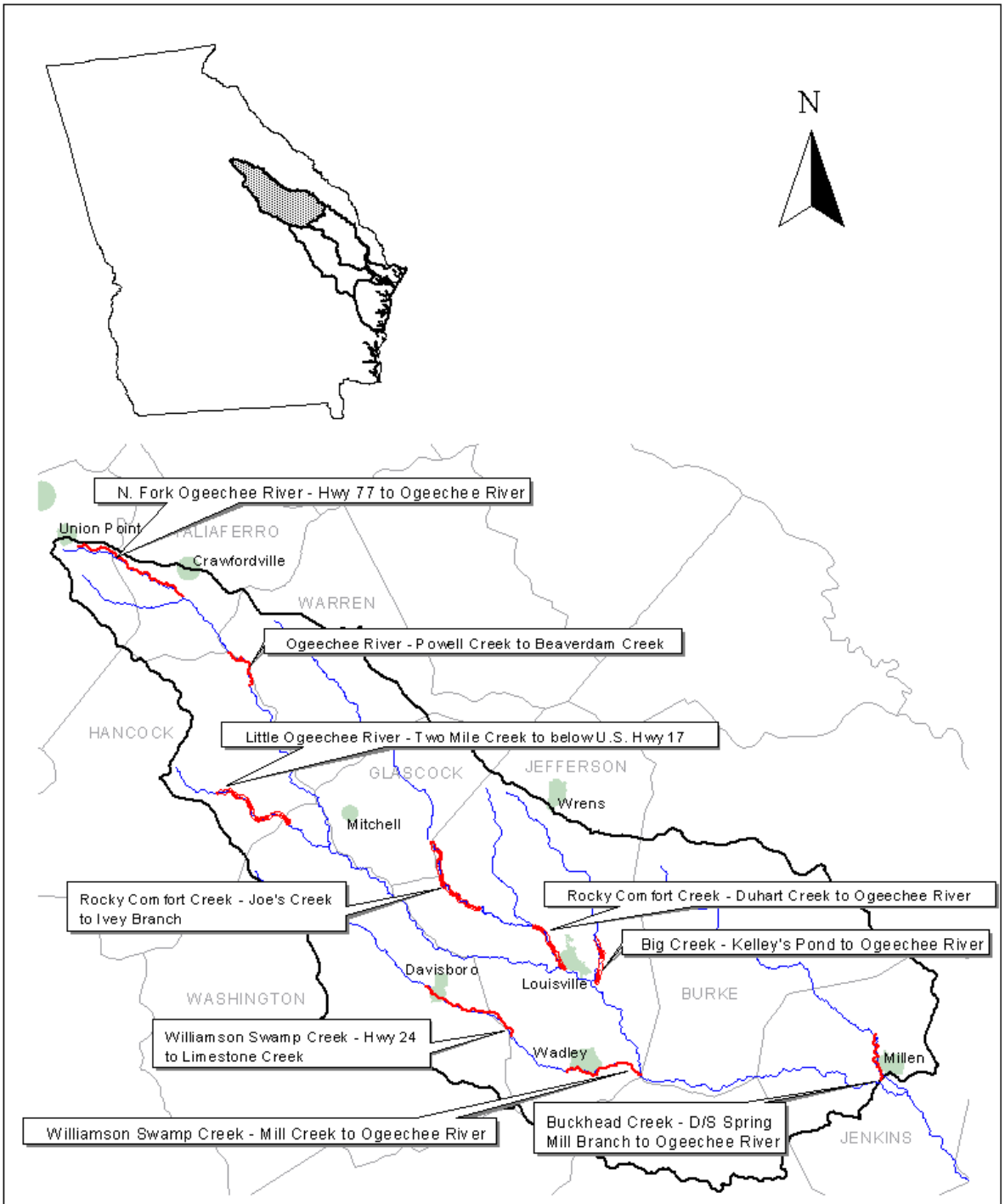
The USGS has divided the Ogeechee basin into four sub-basins, or Hydrologic Unit Codes (HUCs). Figures 1 through 3 show the locations of these sub-basins, the impaired segments within each sub-basin, and the associated counties within each sub-basin.

The land use characteristics of the Ogeechee River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. Land use classification is based on a modified Anderson level one and two system. Table 2 lists the watershed land coverage distribution of the 32 stream segments on the 303(d) list.

1.3 Water Quality Standard

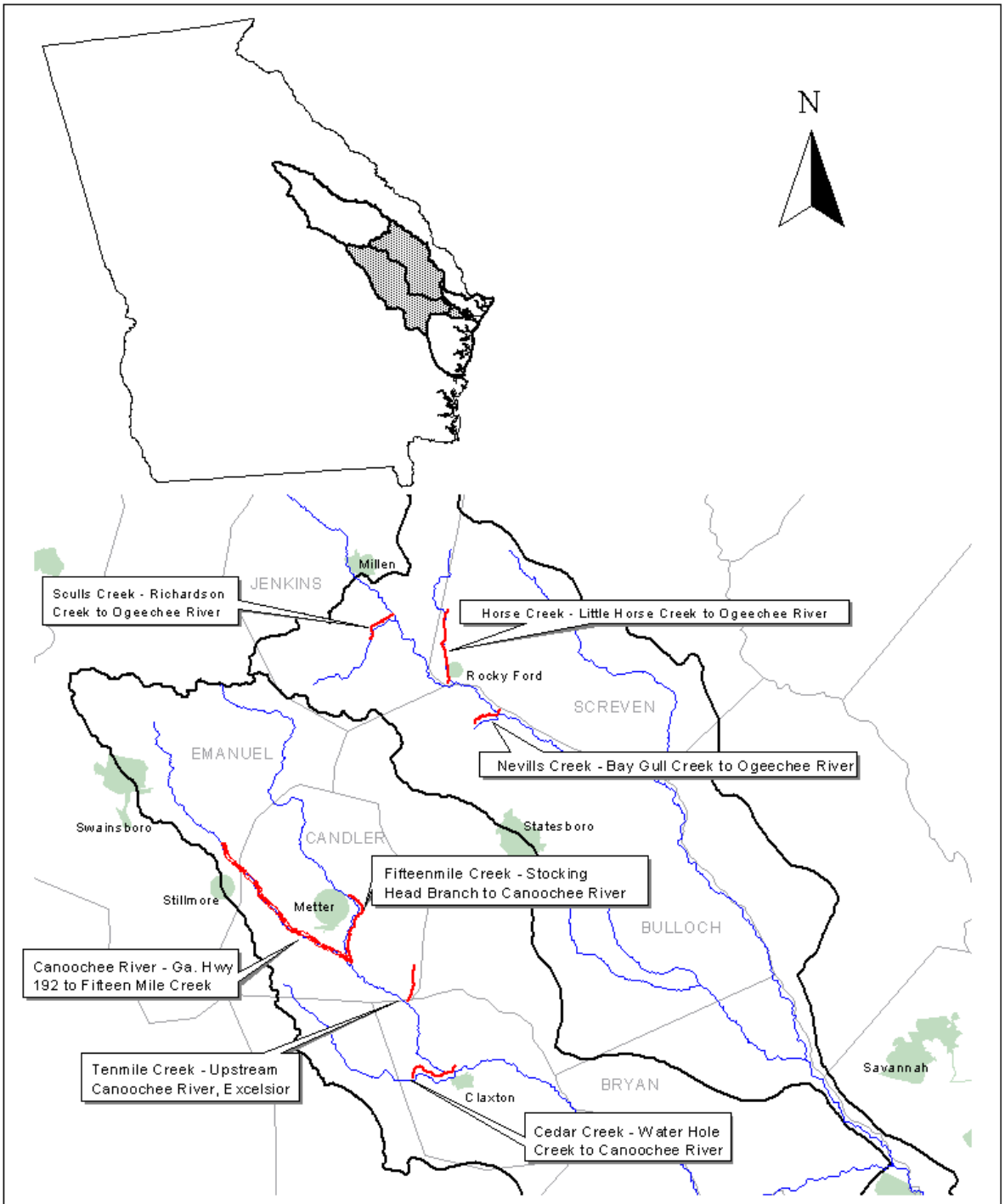
The water use classification for the listed stream segments in the Ogeechee River Basin is Fishing. The criterion violated is listed as fecal coliform. The potential cause(s) listed include urban runoff, nonpoint sources, and municipal facilities. The use classification water quality standards for fecal coliform bacteria, as stated in the *State of Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (GA EPD, 2002), are:

Bacteria: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample. The State does not encourage swimming in surface waters since a number of factors, which are beyond the control of any State regulatory agency, contribute to elevated levels of fecal coliform. For waters designated as approved shellfish harvesting waters by the appropriate State agencies, the requirements will be consistent with those established by the State and Federal agencies responsible for the National Shellfish Sanitation Program. The requirements are found in the National Shellfish Sanitation Program Manual of Operation, Revised 1988, Interstate Shellfish Sanitation Conference, U. S. Department of Health and Human Services (PHS/FDA), and the Center for Food Safety and Applied Nutrition. Streams designated as generally supporting shellfish are listed in Paragraph 391-3-6-.03(14).



TMDL Evaluation - Fecal Coliform
Ogeechee River Basin

Figure 1. Impaired Stream Segments in HUC 03060201



TMDL Evaluation - Fecal Coliform
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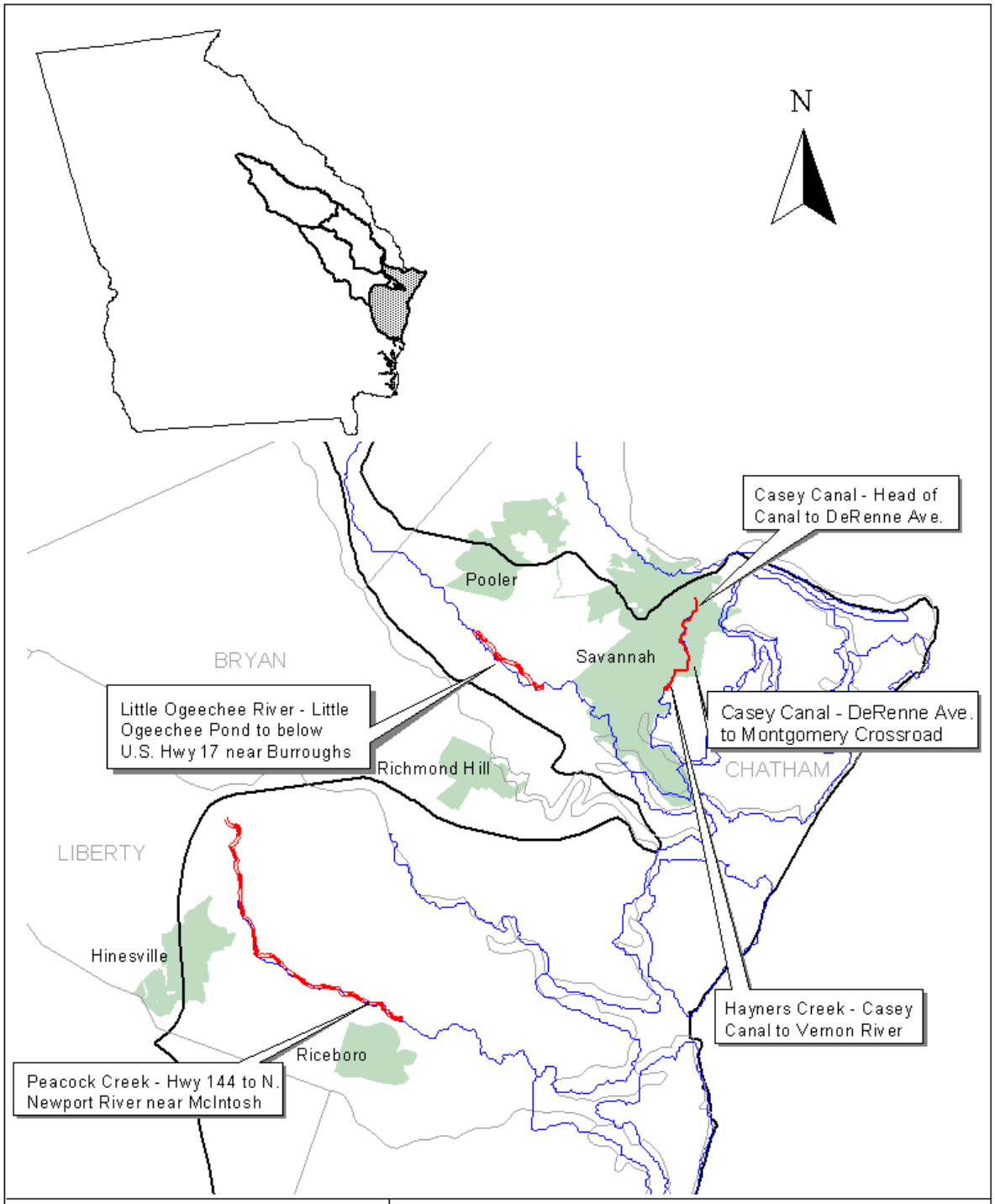
Figure 2. Impaired Stream Segments in HUCs 03060202 and 03060203



TMDL Evaluation - Fecal Coliform
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Figure 3. Impaired Stream Segments in HUC 03060204

Table 2. Ogeechee River Basin Land Coverage

Stream/Segment	Landuse Categories - Acres (Percent)													
	Open Water	Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Big Creek	252	20	21	43	3	2,307	28,720	23,867	1,710	3	6,801	17	63,763	NLCD
	(0.4)	(0.0)	(0.0)	(0.1)	(0.0)	(3.6)	(45.0)	(37.4)	(2.7)	(0.0)	(10.7)	(0.0)		
Buckhead Creek	725	636	376	80	-	8,147	60,605	77,190	8,003	106	27,785	174	183,827	NLCD
	(0.4)	(0.3)	(0.2)	(0.0)	(0.0)	(4.4)	(33.0)	(42.0)	(4.4)	(0.1)	(15.1)	(0.1)		
Canoochee River	1,228	874	542	82	346	14,572	69,887	36,879	3,659	137	9,722	46	137,974	NLCD
	(0.9)	(0.6)	(0.4)	(0.1)	(0.3)	(10.6)	(50.7)	(26.7)	(2.7)	(0.1)	(7.0)	(0.0)		
Casey Canal	5	2,760	783	10	-	238	382	96	24	54	161	1	4,513	NLCD
Head of Canal to DeRenne Ave, Savannah	(0.1)	(61.2)	(17.3)	(0.2)	(0.0)	(5.3)	(8.5)	(2.1)	(0.5)	(1.2)	(3.6)	(0.0)		
Casey Canal	125	4,433	1,607	27	-	576	1,358	456	43	422	555	18	9,618	NLCD
DeRenne Ave to Montgomery Crossroad, Savannah	(1.3)	(46.1)	(16.7)	(0.3)	(0.0)	(6.0)	(14.1)	(4.7)	(0.4)	(4.4)	(5.8)	(0.2)		
Cedar Creek	482	278	97	32	-	2,267	14,471	16,166	2,806	28	3,168	14	39,808	NLCD
	(1.2)	(0.7)	(0.2)	(0.1)	(0.0)	(5.7)	(36.4)	(40.6)	(7.0)	(0.1)	(8.0)	(0.0)		
Fifteenmile Creek	1,162	394	377	45	1	5,981	37,621	38,626	4,240	87	7,727	9	96,270	NLCD
	(1.2)	(0.4)	(0.4)	(0.0)	(0.0)	(6.2)	(39.1)	(40.1)	(4.4)	(0.1)	(8.0)	(0.0)		
Hayners Creek (known upstream as Casey Canal)	144	4,630	1,631	27	-	593	1,490	458	43	429	559	87	10,092	NLCD
	(1.4)	(45.9)	(16.2)	(0.3)	(0.0)	(5.9)	(14.8)	(4.5)	(0.4)	(4.3)	(5.5)	(0.9)		
Horse Creek	218	10	3	16	-	2,679	27,066	14,771	1,437	1	3,326	139	49,666	NLCD
	(0.4)	(0.0)	(0.0)	(0.0)	(0.0)	(5.4)	(54.5)	(29.7)	(2.9)	(0.0)	(6.7)	(0.3)		
Little Ogeechee River	173	138	94	16	92	1,392	23,937	3,648	1,524	37	146	2	31,199	NLCD
Two Mile Creek to Hamburg Pond near Culverton	(0.6)	(0.4)	(0.3)	(0.1)	(0.3)	(4.5)	(76.7)	(11.7)	(4.9)	(0.1)	(0.5)	(0.0)		
Little Ogeechee River	296	468	259	30	79	1,657	17,215	2,143	425	33	12,092	187	34,884	NLCD
Little Ogeechee Pond to below US Hwy 17 near Burroughs	(0.8)	(1.3)	(0.7)	(0.1)	(0.2)	(4.8)	(49.3)	(6.1)	(1.2)	(0.1)	(34.7)	(0.5)		
Nevills Creek	275	7	2	16	1	2,255	13,622	13,264	1,129	-	3,493	18	34,082	NLCD
	(0.8)	(0.0)	(0.0)	(0.0)	(0.0)	(6.6)	(40.0)	(38.9)	(3.3)	(0.0)	(10.2)	(0.1)		
North Fork Ogeechee River	32	257	184	25	-	578	16,202	1,135	658	59	53	3	19,185	NLCD
	(0.2)	(1.3)	(1.0)	(0.1)	(0.0)	(3.0)	(84.5)	(5.9)	(3.4)	(0.3)	(0.3)	(0.0)		
Ogeechee River	129	594	443	80	2	3,250	72,021	3,923	3,352	152	184	3	84,134	NLCD
	(0.2)	(0.0)	(0.7)	(0.5)	(0.1)	(0.0)	(3.9)	(85.6)	(4.7)	(4.0)	(0.2)	(0.2)		

Stream/Segment	Landuse Categories - Acres (Percent)													
	Open Water	Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Landuse Source
Peacock Creek	120	1,906	564	25	46	1,477	15,496	695	131	437	10,290	514	31,701	NLCD
	(0.4)	(6.0)	(1.8)	(0.1)	(0.1)	(4.7)	(48.9)	(2.2)	(0.4)	(1.4)	(32.5)	(1.6)		
Rocky Comfort Creek	769	711	265	107	297	12,159	74,106	26,171	4,514	103	6,321	12	125,535	NLCD
Joes Creek to Ivey Branch near Edgehill	(0.6)	(0.6)	(0.2)	(0.1)	(0.2)	(9.7)	(59.0)	(20.8)	(3.6)	(0.1)	(5.0)	(0.0)		
Rocky Comfort Creek	1,050	832	350	151	297	15,439	95,865	51,821	6,622	120	11,584	68	184,199	NLCD
Duhart Creek to Ogeechee River, Louisville	(0.6)	(0.5)	(0.2)	(0.1)	(0.2)	(8.4)	(52.0)	(28.1)	(3.6)	(0.1)	(6.3)	(0.0)		
Sculls Creek	216	15	7	16	-	2,358	20,131	15,491	1,183	10	3,823	6	43,255	NLCD
	(0.5)	(0.0)	(0.0)	(0.0)	(0.0)	(5.5)	(46.5)	(35.8)	(2.7)	(0.0)	(8.8)	(0.0)		
Tenmile Creek	530	34	238	23	-	1,149	9,806	14,296	1,510	3	2,544	34	30,166	NLCD
	(1.8)	(0.1)	(0.8)	(0.1)	(0.0)	(3.8)	(32.5)	(47.4)	(5.0)	(0.0)	(8.4)	(0.1)		
Williamson Swamp Creek	523	827	337	66	28	5,885	40,410	31,724	4,950	110	9,195	6	94,062	NLCD
Hwy 24 to Limestone Creek, Davisboro	(0.6)	(0.9)	(0.4)	(0.1)	(0.0)	(6.3)	(43.0)	(33.7)	(5.3)	(0.1)	(9.8)	(0.0)		
Williamson Swamp Creek	802	1,402	514	95	101	8,633	62,962	58,951	7,078	160	24,913	13	165,624	NLCD
Mill Creek to Ogeechee River, Wadley	(0.5)	(0.8)	(0.3)	(0.1)	(0.1)	(5.2)	(38.0)	(35.6)	(4.3)	(0.1)	(15.0)	(0.0)		

2.0 WATER QUALITY ASSESSMENT

Stream segments are placed on the 303(d) list as partially supporting or not supporting their water use classification based on water quality sampling data. A stream is placed on the partial support list if more than 10% of the samples exceed the fecal coliform criteria and on the not support list if more than 25% of the samples exceed the standard. Water quality samples collected within a 30-day period that have a geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1000 counts per 100 milliliters during the period November through April, are in violation of the bacteria water quality standard. There is also a single sample maximum criterion (4000 counts per 100 milliliters) for the months of November through April.

Fecal coliform data were collected during calendar years 1997, 1998, 2002, and 2003. Sources of these data include the following:

- United States Geological Survey (USGS) basin water quality data, 1997, 1998, and 2002;
- Georgia Environmental Protection Division (GA EPD) Trend Monitoring data, 2002; and
- Chatham County and City of Savannah Water Quality Reassessment, 2003.

These sources contained enough information to calculate a 30-day geometric mean and the data used for these TMDLs are presented in Appendix A.

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of fecal coliform bacteria on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. Basically, there are two categories of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated storm water discharges.

3.1.1 Wastewater Treatment Facilities

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

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

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

Municipal and industrial wastewater treatment facilities' discharges may contribute fecal coliform to receiving waters. There are sixteen NPDES permitted discharges with flows greater than 0.1 MGD identified in the Ogeechee River Basin that discharge treated municipal wastewater. Table 3 provides the monthly average discharge flows and fecal coliform concentrations for the municipal and industrial treatment facilities, obtained from calendar year 2002 Discharge Monitoring Report (DMR) data. The permitted flow and fecal coliform concentrations for these facilities are also included in this table.

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to the wastewater treatment plant. These are considered a component of municipal wastewater treatment facilities. When the combined sewage exceeds the capacity of the wastewater treatment plant, the excess is diverted to a combined sewage overflow (CSO) discharge point. There are no permitted CSO outfalls in the Ogeechee River Basin.

Table 3. NPDES Facilities Discharging Fecal Coliform in the Ogeechee River Basin

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2002 Discharge		NPDES Permit Limits		Number of Violations July 1998-June 2002
			Average Monthly Flow (MGD)[1]	Geometric Mean (No./ 100 mL)[2]	Average Monthly Flow (MGD)	Average Monthly FC (No./ 100mL)	
Darien WPCP	GA0033529	Cathead Creek Tributary	0.24	8.5	0.6	200	0
Gibson WPCP	GA0021849	Rocky Comfort Creek	0.06	Not measured	0.21	No FC permit limit	0
Hinesville/Fort Stewart WPCP	GA0047180	Canoochee Cr Tributary	5.13	62.3	7.15	200	1
Larchmont Estates	GA0034819	Larchmont Canal	0.20	32.8	0.2	200	0
Louisville Pond #1	GA0021580	Rocky Comfort Creek	0.22	Not measured	0.56	No FC permit limit	0
Millen WPCP	GA0031879	Buckhead Creek	0.19	6050.0	0.457	200	0
Midville WPCP	GA0020028	Ogeechee River	0.02	Not measured	0.167	No FC permit limit	0
Pembroke Pond	GA0033588	Unnamed Tributary to Mill Creek Tributary	0.13	Not measured	0.15	No FC permit limit	0
Pooler/Bloomingdale Reg.	GA0047066	Hardin Canal	0.68	14.2	0.98	200	0
Richmond Hill - Elbow Swamp WPCP	GA0037648	Elbow Swamp To Sterling Creek	0.99	Not measured	1.5	No FC permit limit	0
Savannah Georgetown WPCP	GA0046418	Ogeechee River	1.37	2.1	2.45	25	0
Statesboro WPCP	GA0023108	Little Lotts Creek	3.22	5.2	10	200	0
Twin City WPCP	GA0048666	Thick Creek-Canoochee Creek	0.25	Not measured	1	No FC permit limit	0
Union Point WPCP	GA0025429	North Fork Ogeechee River	0.16	1.8	0.45	200	0
Wadley Pond	GA0021024	Williamson Swamp Creek	0.19	Not measured	0.215	No FC permit limit	0
Warrenton South WPCP	GA0032786	Rocky Comfort Creek	0.11	Not measured	0.295	No FC permit limit	0

Source: EPA PCS Website (2002) and the GA EPD Regional Offices

Notes: [1] Values shown are the annual average of the monthly average flows.
[2] Values shown are the annual average of the monthly geometric means.

3.1.2 Regulated Storm Water Discharges

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 "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain fecal coliform bacteria consist of those associated with industrial activities including construction sites disturbing one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES Permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), and record keeping.

Storm water discharges from MS4s are very diverse in pollutant loadings and frequency of discharge. At present, all cities and counties within the state of Georgia that had a population of greater than 100,000 at the time of the 1990 Census, are permitted for their storm water discharge under Phase I. This includes 60 permittees in Georgia, with about 45 located in the greater Atlanta metro area. Table 4 lists those counties and communities located in the Ogeechee River Basin that are covered by the Phase I General Storm Water Permits.

Table 4. Phase I Permitted MS4s in the Ogeechee River Basin

Name	Permit No.	Watershed
Chatham County	GAS000206	Ogeechee, Savannah
Garden City	GAS000208	Ogeechee, Savannah
Pooler	GAS000209	Ogeechee, Savannah
Savannah	GAS000205	Ogeechee, Savannah
Thunderbolt	GAS000211	Ogeechee
Tybee	GAS000212	Ogeechee, Savannah

Source: Nonpoint Source Program, GA EPD, 2003

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.

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 entity 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 counties and 56 communities are permitted under the Phase II regulations in Georgia. Table 5 lists those counties and communities located in the Ogeechee River Basin that are covered by the Phase II General Storm Water Permit, GAG610000.

Table 5. Phase II Permitted MS4s in the Ogeechee River Basin

Name	Watershed
Allenhurst	Ogeechee
Fleming	Ogeechee
Hinesville	Ogeechee
Vernonburg	Ogeechee
Walthourville	Ogeechee

Source: Nonpoint Source Program, GA EPD, 2004

3.1.3 Confined Animal Feeding Operations

Confined livestock and confined animal feeding operations (CAFOs) are characterized by high animal densities. This results in large quantities of fecal material being contained in a limited area. Processed agricultural manure from confined hog, dairy cattle, and select poultry operations is generally collected in lagoons. It is then applied to pastureland and cropland as a fertilizer during the growing season, at rates that often vary monthly.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). Table 6 presents the swine and non-swine (primarily dairies) CAFOs located in the Ogeechee River Basin that are registered or have land application permits.

Table 6. Registered CAFOs in the Ogeechee River Basin

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Bay Branch Farms	Claxton	Evans	Swine	2,495	GAU700000
Bell's Dairy	Greensboro	Greene	Dairy	200	GAU700000
Cabaniss Dairy L.L.C.	Maxeys	Oglethorpe	Dairy	1,200	GAG930006
C-M Farms/Orangeburg Foods, Inc.	Register	Candler	Swine	2,400	GAU700000
Drayben Dairy	White Plains	Taliaferro	Dairy	340	GAU700000
Dunn Sausage Company	Mitchell	Glascock	Swine		GAU700000
Eley Acres Farm	White Plains	Greene	Dairy	185	GAU700000
Franks' Farm	Waynesboro	Burke	Dairy	225	GAU700000
G & S Dairy	Warrenton	Warren	Dairy	260	GAU700000
J.B. Gay & Son Inc.	Garfield	Emanuel	Dairy	300	GAU700000
J.B. Gay & Son Inc.	Millen/Garfield	Jenkins	Swine	1,100	GAU700000
JAA Dunrovin Farm	Mitchell	Glascock	Swine	1,600	GAU700000
Larry Holdeman Dairy	Bartow	Jefferson	Dairy	170	GAU700000
Long Branch Dairy	White Plains	Taliaferro	Dairy	350	GAU700000
Pineland Dairy	Waynesboro	Burke	Dairy	699	GAU700000
Sandhill Farms (ex-Webb Brothers)	Twin City	Candler	Swine	6,400	GA0038261
Saxon Dairy	Perkins	Jenkins	Dairy	400	GAU700000

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Scattered Acres Farm	Claxton	Evans	Swine	2,495	GAU700000
Smith-Healy Farms, Inc.	Statesboro	Bulloch	Swine	5,000	GA0038199
Visscher Dairy	Stapleton	Jefferson	Dairy	650	GAU700000
W. W. Ball Farms	Statesboro	Bulloch	Swine	2,000	GAU700000
Walnut Branch Farm	Davisboro	Washington	Dairy/Beef	673	GAU700000

Source: Permitting Compliance and Enforcement Program, EPD, GA EPD, 2004

3.2 Nonpoint Source Assessment

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of fecal coliform bacteria include:

- Wildlife
- Agricultural Livestock
  - Animal grazing
  - Animal access to streams
  - Application of manure to pastureland and cropland
- Urban Development
  - Leaking sanitary sewer lines
  - Leaking septic systems
  - Land Application Systems
  - Landfills

In urban areas, a large portion of storm water runoff may be collected to storm sewer systems and discharged through distinct outlet structures. For large urban areas, these storm sewer discharge points may be regulated as described in Section 3.1.2.

3.2.1 Wildlife

The importance of wildlife as a source of fecal coliform bacteria in streams varies considerably, depending on the animal species present in the subwatersheds. Based on information provided by the Wildlife Resources Division (WRD) of GA DNR, the animals that spend a large portion of their time in or around aquatic habitats are the most important wildlife sources of fecal coliform. Waterfowl, most notably ducks and geese, are considered to potentially be the greatest contributors of fecal coliform. This is because they are typically found on the water surface, often in large numbers, and deposit their feces directly into the water. Other potentially important animals regularly found around aquatic environments include racoons, beavers, muskrats, and to a lesser extent, river otters and minks. Population estimates of these animal species in Georgia are currently not available.

White-tailed deer have a significant presence throughout the Ogeechee River Basin. The 2001 deer census for counties in the Ogeechee River Basin is presented in Table 7.

Table 7. Deer Census Data in the Ogeechee River Basin

County	2001-2005 Optimum population (number/sq mi)
Bryan	20
Bulloch	30
Burke	35
Candler	30
Chatham	20
Effingham	35
Emanuel	35
Evans	30
Glascock	35
Greene	35
Hancock	35
Jefferson	35
Jenkins	35
Liberty	20
Long	20
McIntosh	20
Screven	35
Taliaferro	35
Tattnall	30
Warren	35
Washington	35

Source: Wildlife Resources Division, GA DNR, 2001

Fecal coliform bacteria contributions from deer to water bodies are generally considered less significant than that of waterfowl, racoons, and beavers. This is because a greater portion of their time is spent in terrestrial habitats. This also holds true for other terrestrial mammals such as squirrels and rabbits, and terrestrial birds (GA WRD, 2002). However, feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff events. It should be noted that between storm events, considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers. This is especially true in the warm, humid environments typical of the southeast.

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Ogeechee River Basin. The animals grazing on pastureland deposit their feces onto land surfaces, where it can be transported during storm events to nearby streams. Animal access to pastureland varies monthly, resulting in varying fecal coliform loading rates throughout the year. Beef cattle spend all of their time in pastures, while dairy cattle and hogs are periodically confined. In addition, agricultural livestock will often have direct access to streams that pass through their pastures, and can thus impact water quality in a more direct manner (USDA, 2002).

Table 8 provides the estimated number of beef cattle, dairy cattle, goats, horse, swine, sheep, and chickens by category reported by county. These data were provided by the Natural Resources Conservation Service (NRCS) and are based on 2003 data.

Table 8. Estimated Agricultural Livestock Populations in the Ogeechee River Basin

County	Livestock								
	Beef Cattle	Dairy Cattle	Goats	Horses	Hogs	Sheep	Chickens-Layers	Chickens-Broilers Sold	Chickens-Breeders
Bryan	612	-	300	135	-		-	-	-
Bulloch	10,110	-	1,700	2,450	3,315	80	702,000	-	-
Burke	10,950	2,500	1,200	550	50	25	-	-	-
Candler	6,500	75	208	60	7,700	246	200,000	-	-
Chatham	400	-		60	-		-	-	-
Effingham	3,500	-	800	850	400		-	-	-
Emanuel	12,400	-	2,000	480	600		-	-	-
Evans	4,920	-	400	125	1,250		1,404,000	96,000	40,000
Glascock	4,000	-	500	55	150		-	-	-
Greene	8,190	3,100	175	305	-		1,434,000	-	-
Hancock	4,650	150	500	475	-		-	-	-
Jefferson	11,800	1,200	2,500	80	500	10	-	-	-
Jenkins	4,574	2,300	300	25	1,000		-	50,000	-
Liberty	1,600	-	20	40	-		-	-	-
Long	2,300	-	80	50	80		536,000	20,000	-
McIntosh	150	-	40	-	30		-	-	-
Screven	8,000	200	2,000	300	600	100	-	-	-
Taliaferro	-	-		-	-		-	-	-
Tattnall	13,200	-	3,500	650	1,050	700	8,892,000	-	66,000
Warren	8,260	1,450	1,950	2,200	1,050		-	-	-
Washington	7,000	600	3,500	650	50		-	-	-

Source: NRCS, 2003

3.2.3 Urban Development

Fecal coliform from urban areas are attributable to multiple sources, including: domestic animals, leaks and overflows from sanitary sewer systems, illicit discharges, leaking septic systems, runoff from improper disposal of waste materials, and leachate from both operational and closed landfills.

Urban runoff can contain high concentrations of fecal coliform from domestic animals and urban wildlife. Fecal coliform enter streams by direct washoff from the land surface, or the runoff may be diverted to a storm water collection system and discharged through a discrete outlet structure. For large, medium, and small urban areas (populations greater than 50,000), the storm water outlets are regulated under MS4 permits (see Section 3.1.2). For smaller urban areas, the storm water discharge outlets currently remain unregulated.

In addition to urban animal sources of fecal coliform, there may be illicit connections to the storm sewer system. As part of the MS4 permitting program, municipalities are required to conduct dry-weather monitoring to identify and then eliminate these illicit discharges.

Fecal coliform may also enter streams from leaky sewer pipes, or during storm events when combined sewer overflows discharge.

3.2.3.1 Leaking Septic Systems

A portion of the fecal coliform in the Ogeechee River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 9 presents the number of septic systems in each county of the Ogeechee River Basin existing in 1990, based on U.S. 1990 Census Data, and the number existing in 2002, based on the Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems installed and repaired during the twelve-year period from 1990 to 2002 is given.

Table 9. Number of Septic Systems in the Ogeechee River Basin

County	Existing Septic Systems (1990)	Existing Septic Systems (2002)	No. of Septic Systems Installed (1990 to 2002)	No. of Septic Systems Repaired (1990 to 2002)
Bryan	4,943	7,765	2,822	107
Bulloch	8,873	16,668	7,795	629
Burke	7,992	10,352	2,360	288
Candler	1,012	2,192	1,180	75
Chatham	11,987	14,183	2,196	750
Effingham	7,547	14,047	6,500	1,300
Emanuel	4,672	7,129	2,457	273
Evans	2,065	3,296	1,231	75
Glascock	708	918	210	6
Greene	2,759	5,129	2,370	228
Hancock	2,488	3,754	1,256	41
Jefferson	3,551	5,051	1,500	45
Jenkins	1,026	1,801	775	17
Liberty	7,002	10,260	3,258	32
Long	2,638	4,127	1,489	27
McIntosh	957	1,951	994	NA
Screven	6,005	7,383	1,378	29
Taliaferro	551	691	140	NA
Tattnall	3,926	6,310	2,384	80
Warren	1,395	1,825	430	72
Washington	4,065	5,951	1,886	40

Source: 1990 Census Data, and the Georgia Dept. of Human Resources, Div. of Public Health, 2004

These data show that a substantial increase in the number of septic systems has occurred in several counties. This is generally a reflection of population increases outpacing the expansion of sewage collection systems during this period. Hence, a large number of septic systems are installed to contain and treat the sanitary waste. It is estimated that there are approximately 2.37 people per household on septic systems (EPA, personal communication).

3.2.3.2 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewaters. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non-discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing fecal coliform bacteria to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying the wastewater, resulting in surface runoff from the field. If not properly bermed, this runoff, which probably contains fecal coliform bacteria, may discharge to nearby surface waters. There are fifteen permitted LAS systems located in the Ogeechee River Basin (Table 10).

Table 10. Permitted Land Application Systems in the Ogeechee River Basin

LAS Name	County	Permit No.	Type	Flow (MGD)
Bartow LAS	Jefferson	GA02-215	Municipal	0.05
Chatham County Pine Barren	Chatham	GA02-285	Municipal	0.06
Chemtall Inc.	Liberty	GA01-403	Industrial	0.0383
Claxton LAS	Evans	GA02-111	Municipal	0.52
Claxton Poultry	Evans	GA01-415	Industrial	1.6
Claxton Poultry Farms Inc.	Evans	GA01-380	Industrial	1.15
Davisboro LAS	Washington	GA02-242	Municipal	0.3
Metter LAS	Candler	GA02-185	Municipal	1.0
Midway Industrial Park	Liberty	GA02-094	Municipal	0.05
Midway LAS	Liberty	GA02-131	Municipal	0.5
Sandhill Farms	Candler	GA01-355	Private	0.66
Skidaway Island Utilities	Chatham	GA03-941	Private	1.25
USA Army Fort Stewart/Camp Oliver	Evans	GA03-624	Federal	0.07
USA Army Fort Stewart/Wright Army Airfield	Liberty	GA03-834	Federal	0.0018
Waterford Landing Development	Bryan	GA03-768	Private	0.152

Source: Permitting Compliance and Enforcement Program, GA EPD, 2004

3.2.3.3 Landfills

Leachate from landfills may contain fecal coliform bacteria that may at some point discharge into surface waters. Sanitary (or municipal) landfills are the most likely to serve as a source of fecal coliform bacteria. These types of landfills receive household wastes, animal manure, offal, hatchery and poultry processing plant wastes, dead animals, and other types of wastes. Older sanitary landfills were not lined and most have been closed. Those that remain active and have not been lined operate as construction/demolition landfills. Currently active sanitary landfills are lined and have leachate collection systems. All landfills, excluding inert landfills, are now required to install environmental monitoring systems for groundwater and methane sampling. There are 101 known landfills in the Ogeechee River Basin (Table 11). Of these, ten are active

landfills and 91 are inactive or closed. As shown in the Table 11, many of the older, inactive landfills were never permitted.

Table 11. Landfills in the Ogeechee River Basin

Name	County	Permit No.	Type	Status
Bryan County - Hwy 17	Bryan		Not Applicable	Inactive
Bryan County - Hwy 204	Bryan		Not Applicable	Inactive
Bryan County - Northwest	Bryan		Not Applicable	Inactive
Bryan County - Richmond Hill	Bryan		Not Applicable	Inactive
Bryan County - SR 144 Spur Phase 1	Bryan	015-005D	Dry Trash Landfill	Closed
Bryan County - SR 144 Spur Phase 2	Bryan	015-008D	Dry Trash Landfill	Closed
Bryan County -US 280 / Mill Creek	Bryan	015-004D	Sanitary Landfill	Closed
Ellabell	Bryan		Not Applicable	Inactive
Grovetown (or Groveland)	Bryan		Not Applicable	Inactive
Keller	Bryan		Not Applicable	Inactive
Lanier	Bryan		Not Applicable	Inactive
Pembroke (new site)	Bryan		Not Applicable	Inactive
Pembroke (old site)	Bryan		Not Applicable	Inactive
Tac - X - Ft. Stewart	Bryan		Not Applicable	Inactive
Brooklet	Bulloch	016-005D	Dry Trash Landfill	Inactive
Portal	Bulloch		Not Applicable	Inactive
Statesboro - Lakeview Road	Bulloch	016-011P	Not Applicable	Inactive
Statesboro - Lakeview Road	Bulloch	016-007D	Sanitary Landfill	Closed
Stilson	Bulloch		Not Applicable	Inactive
Gough	Burke		Not Applicable	Inactive
Midville	Burke		Not Applicable	Inactive
Candler County - SR 121 Metter Sanitary	Candler	021-001D	Sanitary Landfill	Closed
Candler County - SR 121 PH2 Construction & Demolition Landfill	Candler	021-005D	Construction and Demolition Landfill	Closed
Candler County - SR 121 Phase 2 Municipal Solid Waste Landfill	Candler	021-006D	Municipal Solid Waste Landfill	Active
C.L. Lewis Landfill	Chatham		Not Applicable	Inactive
Carter - Quacco Road	Chatham	025-063D	Dry Trash Landfill	Closed
Chatham County - Chevis Road	Chatham	025-038D	Dry Trash Landfill	Ceased accepting waste
Chatham County - I-16 Bloomingdale	Chatham	025-040D	Dry Trash Landfill	Closed
Chatham County - Sharon Park	Chatham	025-057D	Dry Trash Landfill	Ceased accepting waste
Chatham County - SR 367 Wilmington Island	Chatham	025-058D	Dry Trash Landfill	Closed
Chatham County - Thomas Ave.	Chatham	025-056D	Dry Trash Landfill	Active
Clay - Ric - US 80/ Dean Forest Road	Chatham	025-065D	Dry Trash Landfill	Inactive
Clifton - Site #3 (Hwy 17)	Chatham	025-044D	Dry Trash Landfill	Inactive
Crosby - Quacco Road	Chatham	025-068D	Dry Trash Landfill	Closed
Greenbriar Subdivision	Chatham	025-003D	Dry Trash Landfill	Inactive
Hunter Army Air Field	Chatham		Not Applicable	Inactive
MacMillan - Dean Forest Road	Chatham	025-066D	Dry Trash Landfill	Inactive
Metro Waste	Chatham	025-016D	Dry Trash Landfill	Inactive
Savannah	Chatham	025-004D	Sanitary Landfill	Inactive

Name	County	Permit No.	Type	Status
Savannah - Bacon Park	Chatham	025-010D	Dry Trash Landfill	Closed
Savannah - Dean Forest Road	Chatham	025-051D	Sanitary Landfill	Active
Savannah - U.S. 17	Chatham	025-043D	Sanitary Landfill	Inactive
Savannah Phase II and III	Chatham	025-021D	Sanitary Landfill	Inactive
Superior Landfill and Recycling Center	Chatham	025-070D	Municipal Solid Waste Landfill	Active
Superior Sanitation - Little Neck Road	Chatham	025-045D	Sanitary Landfill	Closed
Tennessee Ave. - Savannah	Chatham	025-011D	Dry Trash Landfill	Inactive
Tuten - Middleground Road	Chatham	025-042D	Dry Trash Landfill	Inactive
Wilmington Island	Chatham	025-039D	Dry Trash Landfill	Inactive
Effingham County - SR 17 Guyton	Effingham	051-005D	Sanitary Landfill	Ceased accepting waste
Guyton	Effingham		Not Applicable	Inactive
Yarbrough	Effingham		Not Applicable	Inactive
Emanuel County - US 80	Emanuel		Not Applicable	Inactive
Garfield	Emanuel	053-003D	Dry Trash Landfill	Closed
Twin City	Emanuel		Not Applicable	Inactive
Evans County - Little Bull Creek	Evans	APL-0542	Construction and Demolition Landfill	Inactive
Evans County - Sikes Branch Claxton	Evans	054-005D	Dry Trash Landfill	Active
Evans County - U.S. 301 Claxton	Evans	054-004D	Sanitary Landfill	Closed
Gibson - CR 50 Phase 1	Glascock	062-002D	Sanitary Landfill	Closed
Jefferson County - Materials Recovery Facility	Jefferson	081-010P	Materials Recovery Facility	Inactive
Jefferson County - U.S. 1 - Avera Road	Jefferson	081-006D	Sanitary Landfill	Ceased accepting waste
Jefferson County - CR 138 Municipal Solid Waste Landfill	Jefferson	081-011D	Municipal Solid Waste Landfill	Active
Wadley - Artesian Street	Jefferson	081-008D	Dry Trash Landfill	Closed
Wrens - Industrial Street	Jefferson	081-009D	Sanitary Landfill	Ceased accepting waste
Jenkins County - CR 54 Phase 2 MSWL & C&D Site	Jenkins	082-005D	Sanitary Landfill	Active
Jenkins County - CR 54 SL	Jenkins	082-004D	Sanitary Landfill	Ceased accepting waste
Jenkins County - Old Louisville Road	Jenkins	082-002D	Sanitary Landfill	Closed
Millen - U.S. 25 S	Jenkins	082-003D	Dry Trash Landfill	Closed
City of Hinesville	Liberty	089-008D	Dry Trash Landfill	Inactive
Hinesville (new site)	Liberty		Not Applicable	Inactive
Hinesville (old site)	Liberty		Not Applicable	Inactive
Liberty County - CR 194 #3	Liberty	089-014P	Not Applicable	Inactive
Liberty County - Hinesville (Hwy 196)	Liberty		Not Applicable	Inactive
Liberty County - Limerick Road	Liberty	089-013P	Not Applicable	Inactive
Liberty County - CR 194 No. 3	Liberty	089-011D	Dry Trash Landfill	Closed
Liberty County - Limerick Road L	Liberty	089-016D	Dry Trash Landfill	Closed
Liberty County - Limerick Road SL	Liberty	089-003D	Sanitary Landfill	Closed
Midway	Liberty		Not Applicable	Inactive
Sunbury	Liberty		Not Applicable	Inactive
U.S. Army – Ft. Stewart Main Cantonment (L)	Liberty	089-020D	Dry Trash Landfill	Active

Name	County	Permit No.	Type	Status
U.S. Army – Ft. Stewart Main Cantonment	Liberty	089-010D	Sanitary Landfill	Active
Yellow Bluff	Liberty		Not Applicable	Inactive
Crescent	McIntosh		Not Applicable	Inactive
Darien - US 17 North	McIntosh	098-004D	Dry Trash Landfill	Closed
DNR, Sapelo Island #2	McIntosh	098-005D	Dry Trash Landfill	Closed
Eulonia	McIntosh		Not Applicable	Inactive
McIntosh County - King Road	McIntosh	098-003D	Sanitary Landfill	Active
Meridian	McIntosh		Not Applicable	Inactive
Shellman Bluff	McIntosh		Not Applicable	Inactive
Townsend	McIntosh		Not Applicable	Inactive
Young Man Road	McIntosh		Not Applicable	Inactive
Youngs Island	McIntosh		Not Applicable	Inactive
Rocky Ford MSWL Site No. 2	Screven	124-005D	Municipal Solid Waste Landfill	Inactive
Screven County - Rocky Ford Road	Screven	124-003D	Sanitary Landfill	Closed
Crawfordville	Taliaferro		Not Applicable	Inactive
Manassas - Old Bellville Road	Tattnall		Not Applicable	Inactive
Tattnall Co. - Hwy 23	Tattnall		Not Applicable	Inactive
Warren County - Shoal Street No. 2	Warren	149-008D	Sanitary Landfill	Closed
Warren County - SR 16	Warren	149-002D	Sanitary Landfill	Inactive
Warrenton	Warren		Not Applicable	Inactive
Davisboro	Washington		Not Applicable	Inactive
Riddleville	Washington		Not Applicable	Inactive

Source: Land Protection Branch, GA DNR, 2003

4.0 ANALYTICAL APPROACH

The process of developing fecal coliform TMDLs for the Ogeechee River Basin listed segments includes the determination of the following:

- The current critical fecal coliform load to the stream under existing conditions;
- The TMDL for similar conditions under which the current load was determined; and
- The percent reduction in the current critical fecal coliform load necessary to achieve the TMDL.

The calculation of the fecal coliform load at any point in a stream requires the fecal coliform concentration and stream flow. The Loading Curve Approach was used to determine the current fecal coliform load and the TMDL. For the listed segments, fecal coliform sampling data were sufficient to calculate at least one 30-day geometric mean to compare with the regulatory criteria (see Appendix A).

4.1 Loading Curve Approach

For those segments in which sufficient water quality data were collected to calculate at least one 30-day geometric mean that was above the regulatory standard, the loading curve approach was used. This method involves comparing the current critical load to summer and winter seasonal TMDL curves.

As mentioned in Section 2.0, the USGS monitored many of the listed segments and collected stream flow information concurrently with water quality samples. Stream depths were measured and used to determine stream flows, based on rating curves developed by the USGS for each sampling location.

In cases where no stream flow measurements were available, flow on the day the fecal coliform samples were collected was estimated using data from a nearby gaged stream. The nearby stream had relatively similar watershed characteristics, including landuse, slope, and drainage area. The stream flows were estimated by multiplying the gaged flow by the ratio of the listed stream drainage area to the gaged stream drainage area. Table 12 lists those segments for which no flow data were available and indicates the gaged station that was used to estimate the flow.

Table 12. Monitoring Stations with Estimated Flow

Monitoring Station	USGS Station Name	Station No.
Little Ogeechee at US Hwy 17 near Burroughs	Black Creek near Blitchton, GA	02202600
Peacock Creek at Lewis Fraser Rd near Midway	Black Creek near Blitchton, GA	02202600

The current critical loads were determined using fecal coliform data collected within a 30-day period to calculate the geometric means, and multiplying these values by the arithmetic means of the flows measured at the time the water quality samples were collected. Georgia's instream fecal coliform standards are based on a geometric mean of samples collected over a 30-day period, with samples collected at least 24 hours apart. To reflect this in the load calculation, the

fecal coliform loads are expressed as 30-day accumulated loads with units of counts per 30 days. This is described by the equation below:

$$L_{critical} = C_{geomean} * Q_{mean}$$

Where:

$L_{critical}$ = current critical fecal coliform load
$C_{geomean}$ = fecal coliform concentration as a 30-day geometric mean
Q_{mean} = stream flow as an arithmetic mean

The current estimated critical load is dependent on the fecal coliform concentrations and stream flows measured during the sampling events. The number of events sampled is usually 16 events per year. Thus, these loads do not represent the full range of flow conditions or loading rates that can occur. Therefore, it must be kept in mind that the current critical loads used only represent the worst-case scenario that occurred among the time periods sampled.

The maximum fecal coliform load at which the instream fecal coliform criteria will be met can be determined using a variation of the equation above. By setting C equal to the seasonal, instream fecal coliform standards, the load will equal the TMDL. However, the TMDL is dependent on stream flow. Figures in Appendix A graphically illustrate that the TMDL is a continuum for the range of flows (Q) that can occur in the stream over time. There are two TMDL curves shown in these figures. One represents the summer TMDL for the period May through October when the 30-day geometric mean standard is 200 counts/100 mL. The second curve represents the winter TMDL for the period November through April when the 30-day geometric mean standard is 1,000 counts/100 mL. The equations for these two TMDL curves are:

$$TMDL_{summer} = 200 \text{ counts (as a 30-day geometric mean)/100 mL} * Q$$

$$TMDL_{winter} = 1{,}000 \text{ counts (as a 30-day geometric mean)/100 mL} * Q$$

The graphs show the relationship between the current critical load ($L_{critical}$) and the TMDL. The TMDL for a given stream segment is the load for the mean flow corresponding to the current critical load. This is the point where the current load exceeds the TMDL curve by the greatest amount. This critical TMDL can be represented by the following equation:

$$TMDL_{critical} = C_{standard} * Q_{mean}$$

Where:

$TMDL_{critical}$ = critical fecal coliform TMDL load
$C_{standard}$ = seasonal fecal coliform standard (as a 30-day geometric mean)
summer - 200 counts/100 mL
winter - 1,000 counts/ 100 mL
Q_{mean} = stream flow as an arithmetic mean (same as used for $L_{critical}$)

A 30-day geometric mean load that plots above the respective seasonal TMDL curve represents an exceedance of the instream fecal coliform standard. The difference between the current critical load and the TMDL curve represents the load reduction required for the stream segment to meet the appropriate instream fecal coliform standard. There is also a single sample maximum criterion (4,000 counts per 100 milliliters) for the months of November through April.

If a single sample exceeds the maximum criterion, and the seasonal geometric mean criteria is also exceeded, then the TMDL is based on the criteria exceedance requiring the largest load reduction. The load reduction can be expressed as follows:

$$\text{Load Reduction} = \frac{L_{critical} - TMDL_{critical}}{L_{critical}} * 100$$

5.0 TOTAL MAXIMUM DAILY LOADS

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard; in this case, the seasonal fecal coliform standards. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) for nonpoint sources, as well as natural background (40 CFR 130.2) for a given waterbody. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For fecal coliform bacteria, the TMDLs are expressed as counts per 30 days as a geometric mean.

A TMDL is expressed as follows:

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

The TMDL calculates the WLAs and LAs with margins of safety to meet the stream's water quality standards. The allocations are based on estimates that use the best available data and provide the basis to establish or modify existing controls so that water quality standards can be achieved. In developing a TMDL, it is important to consider whether adequate data are available to identify the sources, fate, and transport of the pollutant to be controlled.

TMDLs may be developed using a phased approach. Under a phased approach, the TMDL includes: 1) WLAs that confirm existing limits and controls or lead to new limits, and 2) LAs that confirm existing controls or include implementing new controls (USEPA, 1991). A phased TMDL requires additional data be collected to determine if load reductions required by the TMDL are leading to the attainment of water quality standards.

The TMDL Implementation Plan establishes a schedule or timetable for the installation and evaluation of point and nonpoint source control measures, data collection, assessment of water quality standard attainment, and if needed, additional modeling. Future monitoring of the listed segment water quality will then be used to evaluate this phase of the TMDL, and if necessary, to reallocate the loads.

The fecal coliform loads calculated for each listed stream segment include the sum of the total loads from all point and nonpoint sources for the segment. The load contributions to the listed segment from unlisted upstream segments are represented in the background loads, unless the unlisted segment contains point sources that had permit violations for fecal coliform. In these cases, the upstream point sources are included in the wasteload allocations for the listed segment. In situations where two or more adjacent segments are listed, the fecal coliform loads to each segment are individually evaluated on a localized watershed basis. Point source loads originating in upstream segments are included in the background loads of the downstream segment. The following sections describe the various fecal coliform 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. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits. There are seven active NPDES permitted facilities with fecal coliform permit limits in the Ogeechee River Basin

watershed that discharge into listed segments or have permit violations upstream of a listed segment. The maximum allocated fecal coliform loads for these municipal wastewater treatment facilities are given in Table 13. These WLA loads were calculated from the permitted or design flows and permitted fecal coliform concentrations. If the permit had no fecal coliform limit, a concentration of 200 counts/100 mL was used. These were expressed as accumulated loads over a 30-day period, and presented in units of counts per 30 days. If a facility expands its capacity and the permitted flow increases, the wasteload allocation for the facility would increase in proportion to the flow.

Table 13. WLAs for the Ogeechee River Basin

Facility Name	Permit No.	Receiving Stream	Listed Stream Segment	WLA (counts/30 days)
Gibson WPCP	GA0021849	Rocky Comfort Creek	Rocky Comfort Creek - Joes Creek to Ivey Branch near Edgehill	4.78E+10
Larchmont Estates	GA0034819	Little Ogeechee River	Little Ogeechee River - Little Ogeechee Pond to below US Hwy 17 near Burroughs	4.55E+10
Louisville Pond #1	GA0021580	Rocky Comfort Creek	Rocky Comfort Creek - Duhart Creek to Ogeechee River, Louisville	1.27E+11
Millen WPCP	GA0031879	Buckhead Creek	Buckhead Creek - Downstream Spring Mill Branch to Ogeechee River, Millen	1.04E+11
Twin City WPCP	GA0048666	Thick Creek	Canoochee River - GA Hwy 192 to Fifteen Mile Creek near Metter	2.28E+11
Union Point WPCP	GA0025429	North Fork Ogeechee River	North Fork Ogeechee River - Hwy 77 to Ogeechee River near Crawfordville	1.02E+11
Wadley Pond	GA0021024	Williamson Swamp Creek	Williamson Swamp Creek - Mill Creek to Ogeechee River, Wadley	4.89E+10

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.

CAFOs are located within the Ogeechee River Basin (see Section 3.1.3). These facilities are either included under an LAS General Permit or an NPDES General Permit. A small number have an individual NPDES permit. However, presently no CAFOs discharge wastewater and therefore, they were not provided a WLA.

This TMDL will use a phased approach. Future phases of TMDL development will attempt to further define the sources of pollutants and the portion that enters the permitted storm sewer systems. As more information is collected and these TMDLs are implemented, it will become clearer as to which BMPs are needed and how the water quality standards can be achieved.

5.2 Load Allocations

The load allocation is the portion of the receiving water's loading capacity that is attributed to existing or future nonpoint sources or to natural background sources. Nonpoint sources are identified in 40 CFR 130.6 as follows:

- Residual waste;
- Land disposal;
- Agricultural and silvicultural;
- Mines;
- Construction;
- Saltwater intrusion; and
- Urban storm water (non-permitted).

The LA is calculated as the remaining portion of the TMDL load available, after allocating the WLA and the MOS, using the following equation:

$$\Sigma \text{ LA} = \text{TMDL} - (\Sigma \text{ WLA} + \Sigma \text{ WLAsw} + \Sigma \text{MOS})$$

As described above, there are two types of load allocations: loads to the stream independent of precipitation, including sources such as failing septic systems, leachate from landfills, animals in the stream, and leaking sewer system collection lines, or background loads; and loads associated with fecal coliform accumulation on land surfaces that is washed off during storm events, including runoff from saturated LAS fields. At this time, it is not possible to partition the various sources of load allocations. Table 14 presents the total load allocation expressed as counts per 30 days, or as winter instantaneous maximum counts for the 303(d) listed streams located in the Ogeechee River Basin for the current critical condition. In the future, after additional data has been collected, it may be possible to partition the load allocation by source.

5.3 Seasonal Variation

The Georgia fecal coliform criteria are seasonal. One set of criteria applies to the summer season, while a different set applies to the winter season. To account for seasonal variations, the critical loads for each listed segment were determined from sampling data obtained during both summer and winter seasons, when possible. However, in some cases, the available data was limited to a single season for the calculation of the critical load. The TMDL and percent reduction given in Table 14 for each listed segment was based on the season in which the critical load occurred. The TMDLs for each season, for any given flow, are presented as equations in Section 5.5.

Analyses of the available fecal coliform data and corresponding flows were performed to determine if the fecal coliform violations occurred during wet weather (high flow) or dry weather (low flow) conditions. The flow data from each sampling site were normalized by dividing the measured flow by the product of the average annual runoff (cfs/sq mile), published in Open-File Report 82-577, and the appropriate drainage area (Carter, 1982). Plots of the normalized flows (Q/Q_o) versus fecal coliform are shown in Appendix B. The plots do not show a consistent relationship between fecal coliform concentrations and flow. The summer and winter plots show that the fecal coliform violations occur during both high (wet weather) and low (dry weather) flow conditions.

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 modeling 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, an explicit MOS of 10 percent of the TMDL was used. The MOS values are presented in Table 14.

5.5 Total Fecal Coliform Load

The fecal coliform TMDL for the listed stream segment is dependent on the time of year, the stream flow, and the applicable state water quality standard. No listed stream segments are interstate waters.

The maximum seasonal fecal coliform loads for Georgia are given below:

$$TMDL_{summer} = 200 \text{ counts (as a 30-day geometric mean)}/100 \text{ mL} * Q$$

$$TMDL_{winter} = 1{,}000 \text{ counts (as a 30-day geometric mean)}/100 \text{ mL} * Q$$

$$TMDL_{winter} = 4{,}000 \text{ counts (instantaneous)} /100 \text{ mL} * Q$$

For purposes of determining necessary load reductions required to meet the instream water quality criteria, the current critical TMDL was determined. This load is the product of the applicable seasonal fecal coliform standard and the mean flow used to calculate the current critical load. It represents the sum of the allocated loads from point and nonpoint sources located within the immediate drainage area of the listed segment, the NPDES-permitted point discharges with recorded fecal coliform violations from the nearest upstream subwatersheds, and a margin of safety (MOS). For these calculations, the fecal load contributed by each facility to the WLA was not the maximum presented in Table 13, but rather was the product of the fecal coliform permitted limit and the average monthly discharge at the time of the critical load. The current critical loads and corresponding TMDLs, WLAs, LAs, MOSs, and percent load reductions for the Ogeechee River Basin 303(d) listed stream segments are presented in Table 14.

The relationships of the current critical loads to the TMDLs are shown graphically in Appendix A. The vertical distance between the two values represents the load reductions necessary to achieve the TMDLs. If no TMDL or Critical Load is given on the graphs in Appendix A, the TMDL given in Table 14 is based on the instantaneous maximum standard. As a consequence of the localized nature of the load evaluations, the calculated fecal coliform load reductions

pertain to point and nonpoint sources occurring within the immediate drainage area of the listed segment. These current critical values represent a worst-case scenario for the limited set of data. Thus, the load reductions required are conservative estimates, and should be sufficient to prevent exceedances of the instream fecal coliform standard for a wide range of conditions.

Evaluation of the relationship between instream water quality and the potential sources of pollutant loading is an important component of TMDL development, and is the basis for later implementation of corrective measures and BMPs. For the current TMDLs, the association between fecal coliform loads and the potential sources occurring within the subwatersheds of each segment was examined on a qualitative basis.

Table 14. Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days)[1]	WLAsw (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Big Creek	7.71E+12			3.04E+12	3.38E+11	3.38E+12	56
Buckhead Creek	1.35E+13	4.09E+10		5.41E+12	6.06E+11	6.06E+12	55
Canoochee River	7.22E+13	3.37E+10		2.98E+13	3.32E+12	3.32E+13	54
Casey Canal - Head of Canal to DeRenne Ave, Savannah	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Casey Canal - DeRenne Ave to Montgomery Crossroad, Savannah	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Cedar Creek	1.18E+10			1.32E+09	1.47E+08	1.47E+09	88
Fifteenmile Creek	1.54E+14			3.21E+13	3.57E+12	3.57E+13	77
Hayners Creek (known upstream as Casey Canal)	5.81E+15		1.59E+14	6.82E+13	2.52E+13	2.52E+14	96
Horse Creek	6.46E+10			3.63E+10	4.04E+09	4.04E+10	38
Little Ogeechee River -Two Mile Creek to Hamburg Pond nr Culverton	1.35E+12			1.29E+12	1.44E+11	1.44E+12	0
Little Ogeechee River -Little Ogeechee Pond to below US Hwy 17	2.08E+13	4.53E+10	1.46E+12	2.68E+12	4.65E+11	4.65E+12	78
Nevills Creek	4.00E+12			3.53E+12	3.93E+11	3.93E+12	2
North Fork Ogeechee River	1.58E+12	3.34E+10		2.14E+11	2.75E+10	2.75E+11	83
Ogeechee River	8.26E+12			1.78E+12	1.98E+11	1.98E+12	76
Peacock Creek	1.08E+10		9.53E+08	4.99E+09	6.60E+08	6.60E+09	39
Rocky Comfort Creek - Joes Creek to Ivey Branch near Edgehill	5.48E+12	1.39E+10		2.99E+12	3.34E+11	3.34E+12	39
Rocky Comfort Creek - Duhart Creek to Ogeechee River, Louisville	1.33E+13	2.87E+10		1.07E+13	1.19E+12	1.19E+13	10
Sculls Creek	3.35E+13			1.81E+13	2.01E+12	2.01E+13	40
Tenmile Creek	7.04E+12			1.48E+12	1.64E+11	1.64E+12	77
Williamson Swamp Creek - Hwy 24 to Limestone Creek, Davisboro	1.66E+13			5.28E+12	5.87E+11	5.87E+12	65
Williamson Swamp Creek - Mill Creek to Ogeechee River, Wadley	4.78E+13	2.82E+10		3.41E+12	3.82E+11	3.82E+12	92

Notes: [1] The assigned fecal coliform load from each NPDES permitted facility for WLA was determined as the product of the fecal coliform permit limit and the facility average monthly discharge at the time of the critical load.

6.0 RECOMMENDATIONS

The TMDL process consists of an evaluation of the 303(d) listed stream segments' subwatersheds to identify, as best as possible, the sources of the fecal coliform loads causing the stream to exceed instream standard. The TMDL analysis was performed using the best available data to specify WLAs and LAs that will meet fecal coliform water quality criteria so as to support the use classification specified for each listed segment.

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

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the state each year. The GA EPD has adopted a basin approach to water quality management 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 and Ogeechee River Basins were the subjects of focused monitoring in 2002 and will again receive focused monitoring in 2007.

The TMDL Implementation Plan will outline an appropriate water quality-monitoring program for the listed streams in the Ogeechee River Basin. The monitoring program will be developed to help identify the various fecal coliform sources. The monitoring program may be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where no data, old data, or spill data resulted in the listing.

6.2 Fecal Coliform Management Practices

Based on the findings of the source assessment, NPDES point source fecal coliform loads from wastewater treatment facilities do not significantly contribute to the impairment of the listed stream segments. This is because most facilities are required to treat to levels corresponding to instream water quality criteria. Fecal coliform loads from NPDES permitted MS4 areas may be significant, but these sources cannot be easily segregated from other storm water runoff. Other sources of fecal coliform in urban areas include wastes that are attributable to domestic animals, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from both operational and closed landfills. In agricultural areas, potential sources of fecal coliform may include CAFOs, animals grazing in pastures, dry manure storage facilities and lagoons, chicken litter storage areas, and direct access of livestock to streams. Wildlife and waterfowl can be an important source of fecal coliform bacteria.

Management practices are recommended to reduce fecal coliform source loads to the listed 303(d) stream segments, with the result of achieving the instream fecal coliform standard criteria. These recommended management practices include:

- Compliance with NPDES permit limits and requirements;
- Adoption of NRCS Conservation Practices; and
- Application of Best Management Practices (BMPs) appropriate to agricultural or urban land uses, whichever applies.

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. The NPDES permit program provides a basis for municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GA EPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times. In the future, all municipal and industrial wastewater treatment facilities with the potential for the occurrence of fecal coliform in their discharge will be given end-of-pipe limits equivalent to the water quality standard of 200 counts/100 mL. An exception is constructed wetland systems, which have a natural level of fecal coliform input from animals attracted to the artificial wetlands. In addition, the permits will include routine monitoring and reporting requirements.

6.2.2 Nonpoint Source Approaches

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia 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 to 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, recommendations to reduce nonpoint source loads of fecal coliform bacteria in Georgia's surface waters.

6.2.2.1 Agricultural Sources

The GA EPD should coordinate with other agencies that are responsible for agricultural activities in the state to address issues concerning fecal coliform loading from agricultural lands. It is recommended that information (e.g., livestock populations by subwatershed, animal access to streams, manure storage and application practices, etc.) be periodically reviewed so that watershed evaluations can be updated to reflect current conditions. It is also recommended that BMPs be utilized to reduce the amount of fecal coliform bacteria transported to surface waters from agricultural sources to the maximum extent practicable.

The following three organizations have primary responsibility for working with farmers to promote soil and water conservation, and to protect water quality:

- University of Georgia (UGA) - Cooperative Extension Service;
- Georgia Soil and Water Conservation Commission (GSWCC); and
- Natural Resources Conservation Service (NRCS).

UGA has faculty, County Cooperative Extension Agents, and technical specialists who provide services in several key areas relating to agricultural impacts on water quality.

The 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.

The NRCS works with federal, state, and local governments to provide financial and technical assistance to farmers. The NRCS develops standards and specifications for BMPs that are to be used to improve, protect, and/or maintain our state's natural resources. In addition, 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 that covers non-federal land in the United States.

The NRCS is also 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. 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.

6.2.2.2 Urban Sources

Both point and nonpoint sources of fecal coliform bacteria can be significant in the Ogeechee River Basin urban areas. Urban sources of fecal coliform can best be addressed using a strategy that involves public participation and intergovernmental coordination to reduce the discharge of pollutants to the maximum extent practicable. Management practices, control techniques, public education, and other appropriate methods and provisions may be employed. In addition to water quality monitoring programs, discussed in Section 6.1, the following activities and programs conducted by cities, counties, and state agencies are recommended:

- Uphold requirements that all new and replacement sanitary sewage systems be designed to minimize discharges into storm sewer systems;

- Further develop and streamline mechanisms for reporting and correcting illicit connections, breaks, surcharges, and general sanitary sewer system problems;

- Sustained compliance with storm water NPDES permit requirements; and

- Continue efforts to increase public awareness and education towards the impact of human activities in urban settings on water quality, ranging from the consequences of industrial and municipal discharges to the activities of individuals in residential neighborhoods.

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. Georgia is working with both federal and state agencies, such as the NRCS and the GSWCC, and with local governments, to foster the implementation of BMPs to address nonpoint sources. In addition, public education efforts will be targeted at individual stakeholders to provide information regarding the use of BMPs to protect water quality.

6.4 Public Participation

A thirty-day public notice will be provided for this TMDL. During this time, the availability of the TMDL will be public noticed, a copy of the TMDL will be provided upon request, and the public will be invited to provide comments on the TMDL. This TMDL will be modified to address the comments received.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

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

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

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table" shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations 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. NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

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

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

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

5. The deadline for development of a Revised TMDL Implementation Plan is the end of December 2006.

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

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

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

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan once GA EPD approves the Revised TMDL Implementation Plan.

Management Measure Selector Table

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

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

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Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

Figure A-1
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02200900 Big Creek at State Road 17 near Louisville, Georgia

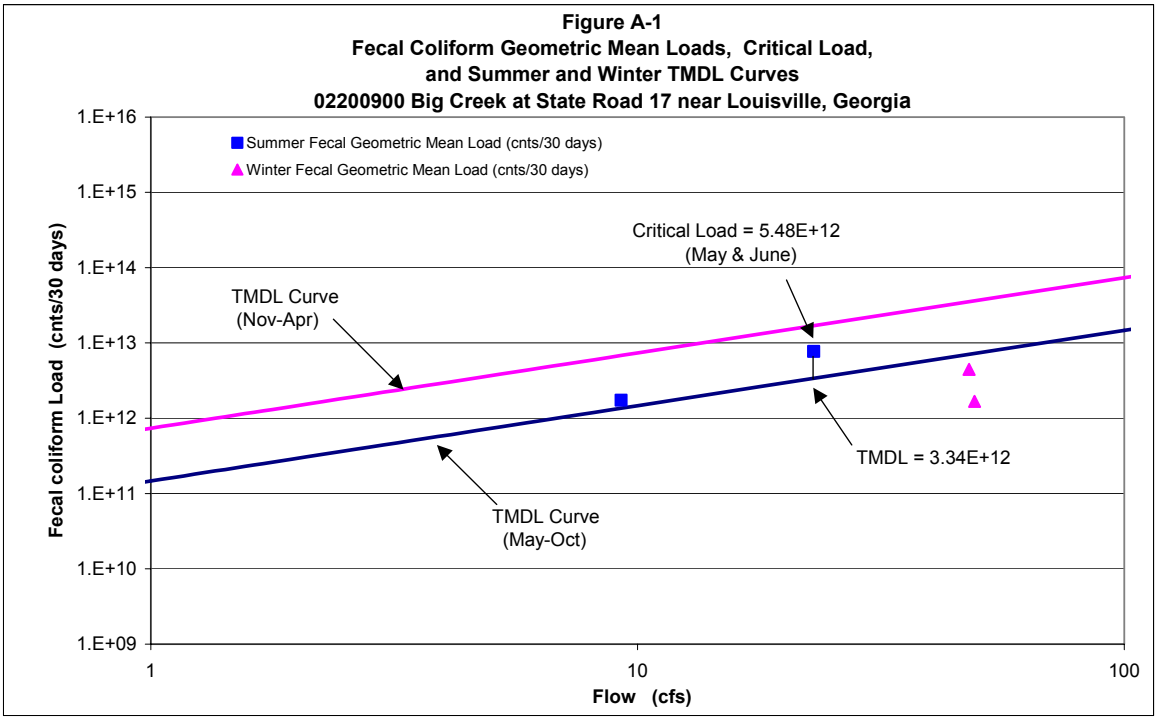


Table A-1. Data for Figure A-1

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	80	45.0				
6-Mar-02	260	56.0				
12-Mar-02	110	47.0				
20-Mar-02	110	44.0	126	48.0	4.44E+12	3.52E+13
22-May-02	130	12.0				
4-Jun-02	220					
12-Jun-02	310					
19-Jun-02	4900	34.0	457	23.0	7.71E+12	3.38E+12
21-Aug-02	330	2.5				
27-Aug-02	220	16.0				
10-Sep-02	230		256	9.3	1.74E+12	1.36E+12
21-Nov-02	230	53.0				
3-Dec-02	50	41.0				
10-Dec-02	20	44.0				
17-Dec-02	20	59.0	46	49.3	1.67E+12	3.61E+13

Figure A-2
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02201430 Buckhead Creek at State Road 17 at Millen, Georgia

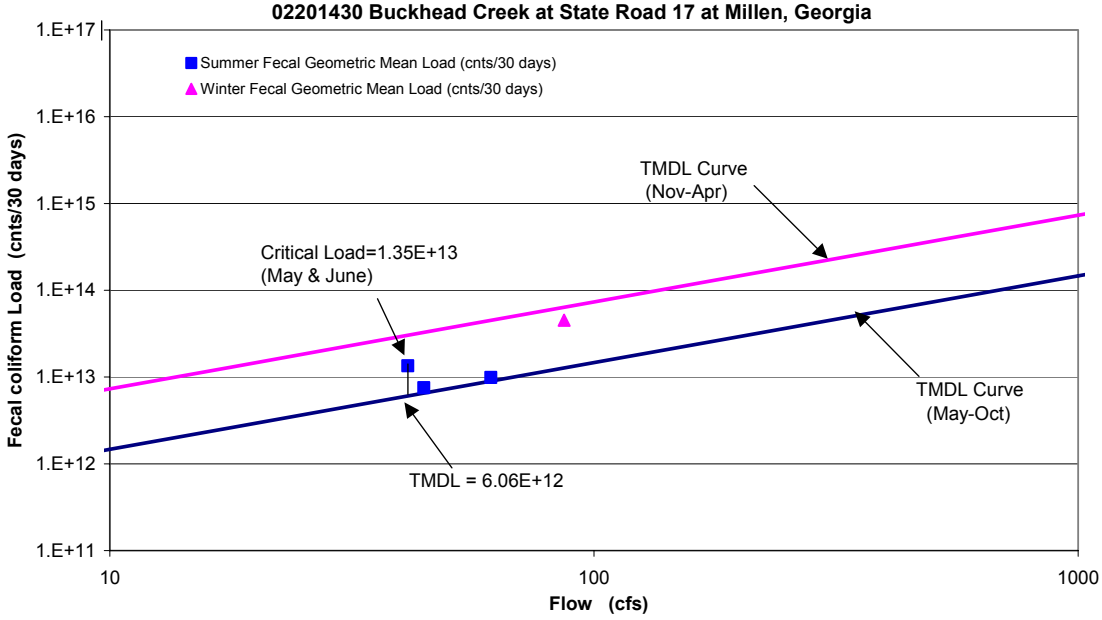


Table A-2. Data for Figure A-2

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
12-Feb-02	1300	111.0				
19-Feb-02	330	86.0				
26-Feb-02	170	61.0				
5-Mar-02	3500	89.0	711	86.8	4.53E+13	6.37E+13
28-May-02	330	39.0				
11-Jun-02	330	40.0				
18-Jun-02	110	41.0				
25-Jun-02	3300	45.0	446	41.3	1.35E+13	6.06E+12
6-Aug-02	230	44.0				
13-Aug-02	170	44.0				
20-Aug-02	220	44.0				
3-Sep-02	330	46.0	231	44.5	7.54E+12	6.53E+12
2-Oct-02	130	57.0				
8-Oct-02	3300	53.0				
16-Oct-02	50	70.0				
22-Oct-02	110	65.0	220	61.3	9.91E+12	8.99E+12

Figure A-3
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202835 Canoochee River at State Road 192 near Stillmore, Georgia

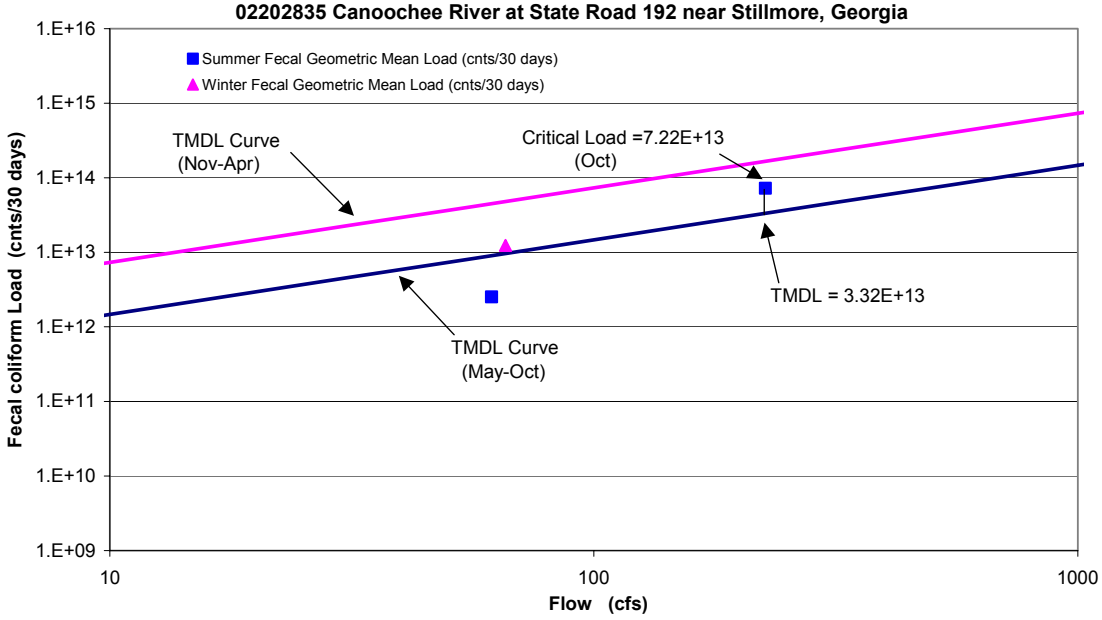


Table A-3. Data for Figure A-3

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
18-Aug-97	170	155.0				
20-Aug-97	230	82.0				
26-Aug-97	220	20.0				
10-Sep-97	510	5.9	257	65.7	1.24E+13	9.65E+12
15-Oct-97	170	4.6				
22-Oct-97	1300	130.0				
29-Oct-97	330	480.0				
13-Nov-97	490	290.0	435	226.2	7.22E+13	3.32E+13
13-Feb-02	20	77.0				
20-Feb-02	170	28.0				
27-Feb-02	82	21.0				
6-Mar-02	330	120.0	98	61.5	2.52E+12	3.85E+13
15-Oct-02	50	28.0				
22-Oct-02	170	42.0				
13-Nov-02		337.0				

Figure A-4
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
022035408 Casey Canal South at Montgomery Crossroad at Savannah, Georgia

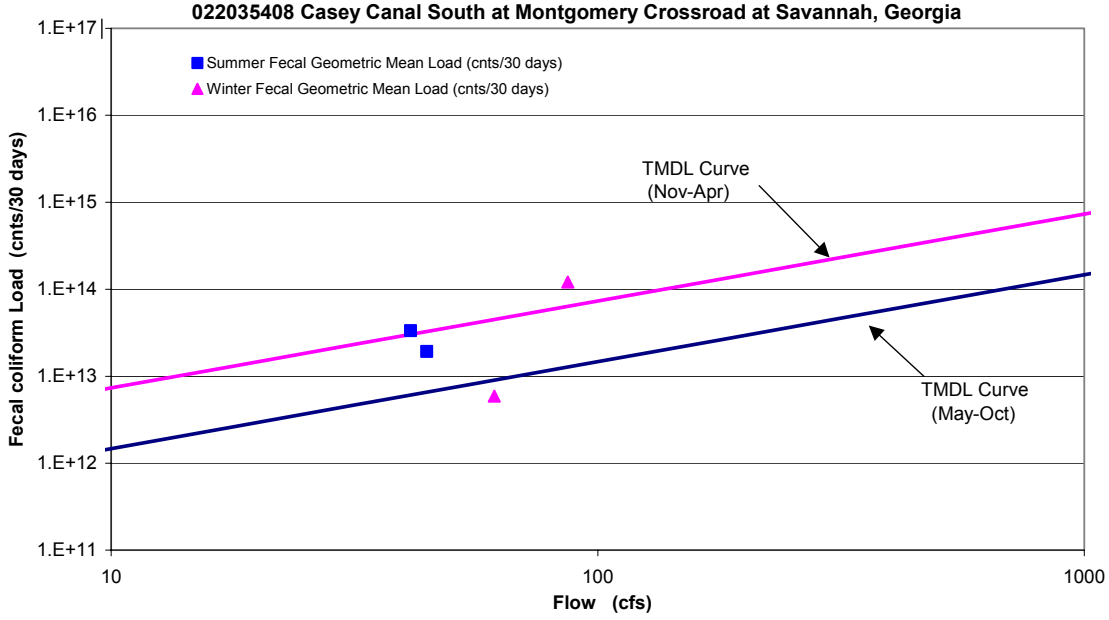


Table A-4. Data for Figure A-4

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	1300	111.0				
5-Mar-02	**92000**	86.0				
12-Mar-02	330	61.0				
26-Mar-02	330	89.0	1900	86.8	1.21E+14	6.37E+13
14-May-02	330	39.0				
21-May-02	3300	40.0				
4-Jun-02	80	41.0				
11-Jun-02	17000	45.0	1103	41.3	3.34E+13	6.06E+12
9-Jul-02	490	44.0				
16-Jul-02	1100	44.0				
23-Jul-02	490	44.0				
1-Aug-02	460	46.0	590	44.5	1.93E+13	6.53E+12
20-Nov-02	790	57.0				
5-Dec-02	20	53.0				
10-Dec-02	20	70.0				
17-Dec-02	940	65.0	131	61.3	5.90E+12	4.50E+13

Figure A-5
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202969 Cedar Creek at State Road 129 at Claxton, Georgia

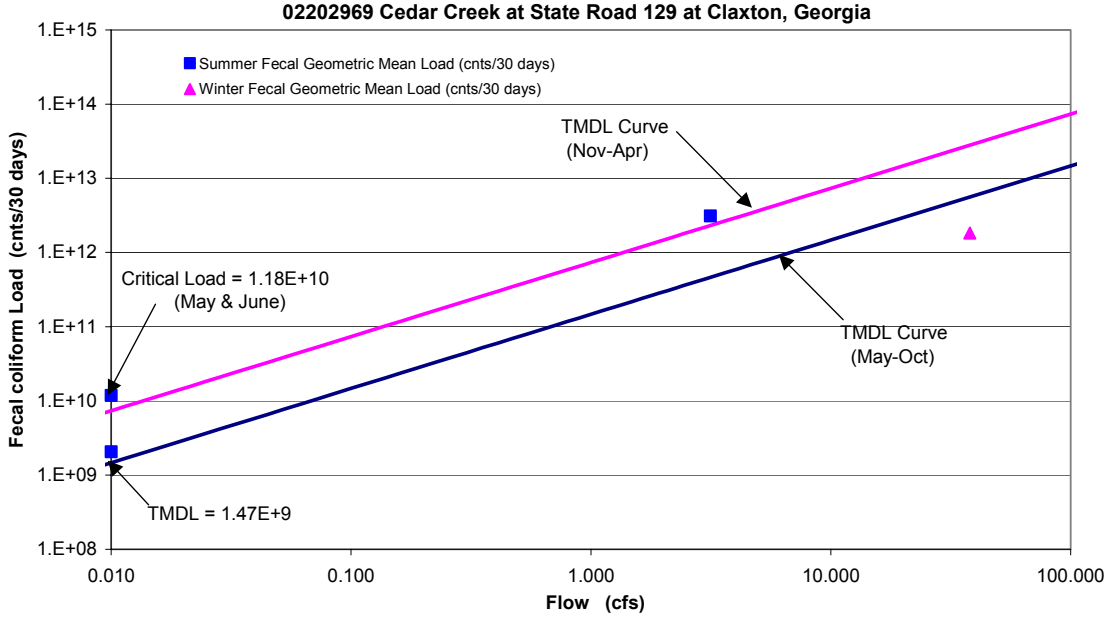


Table A-5. Data for Figure A-5

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
13-Feb-02	50	39.0				
20-Feb-02	20	30.0				
27-Feb-02	80	31.0				
6-Mar-02	230	52.0	65	38.0	1.83E+12	2.79E+13
29-May-02	130	0.0				
12-Jun-02	1700	0.0				
19-Jun-02	9200	0.0				
26-Jun-02	3300	0.0	1609	0.0	1.18E+10	1.47E+09
7-Aug-02	170	0.0				
14-Aug-02	460	0.0	280	0.0	2.05E+09	1.47E+09
1-Oct-02	790	1.3				
15-Oct-02	2300	5.0	1348	3.2	3.12E+12	2.31E+12

Figure A-6
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202903 Fifteenmile Creek at Candler County Road 28 near Metter, Georgia

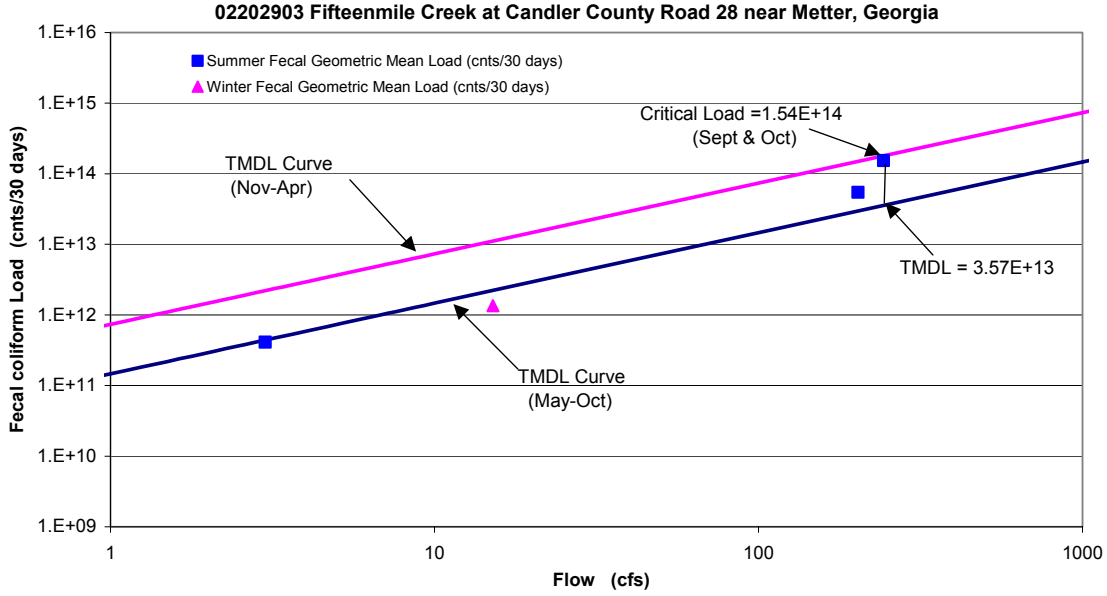


Table A-6. Data for Figure A-6

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Jul-97	330	400.0				
11-Aug-97	230	163.0				
18-Aug-97	490	240.0				
25-Aug-97	490	8.5	367	202.9	5.47E+13	2.98E+13
29-Sep-97	3500	237.0				
6-Oct-97	220	30.0				
20-Oct-97	330	325.0				
27-Oct-97	2200	380.0	865	243.0	1.54E+14	3.57E+13
13-Feb-02	20	12.0				
20-Feb-02	130	2.6				
27-Feb-02	170	4.0				
6-Mar-02	490	42.0	121	15.2	1.35E+12	1.11E+13
29-May-02	20	0.0				
12-Jun-02	130	0.0				
19-Jun-02	50	0.0				
26-Jun-02	9400	12.0	187	3.0	4.12E+11	4.40E+11

Figure A-7
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202080 Horse Creek at State Road 17 near Rocky Ford, Georgia

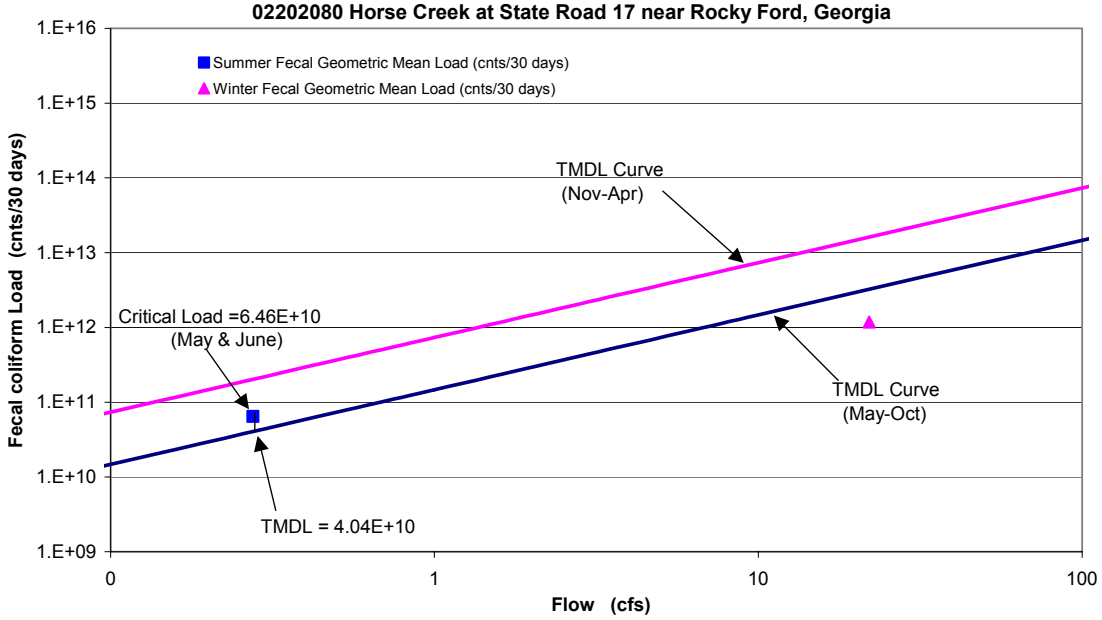


Table A-7. Data for Figure A-7

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
12-Feb-02	90	19.0				
19-Feb-02	80	22.0				
26-Feb-02	50	23.0				
5-Mar-02	80	24.0	73	22.0	1.18E+12	1.61E+13
28-May-02	490	1.1				
11-Jun-02	90	0.0				
18-Jun-02	140	0.0				
25-Jun-02	1700	0.0	320	0.3	6.46E+10	4.04E+10

Figure A-8
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02200085 Little Ogeechee River at Road S1098 near Culverton, Georgia

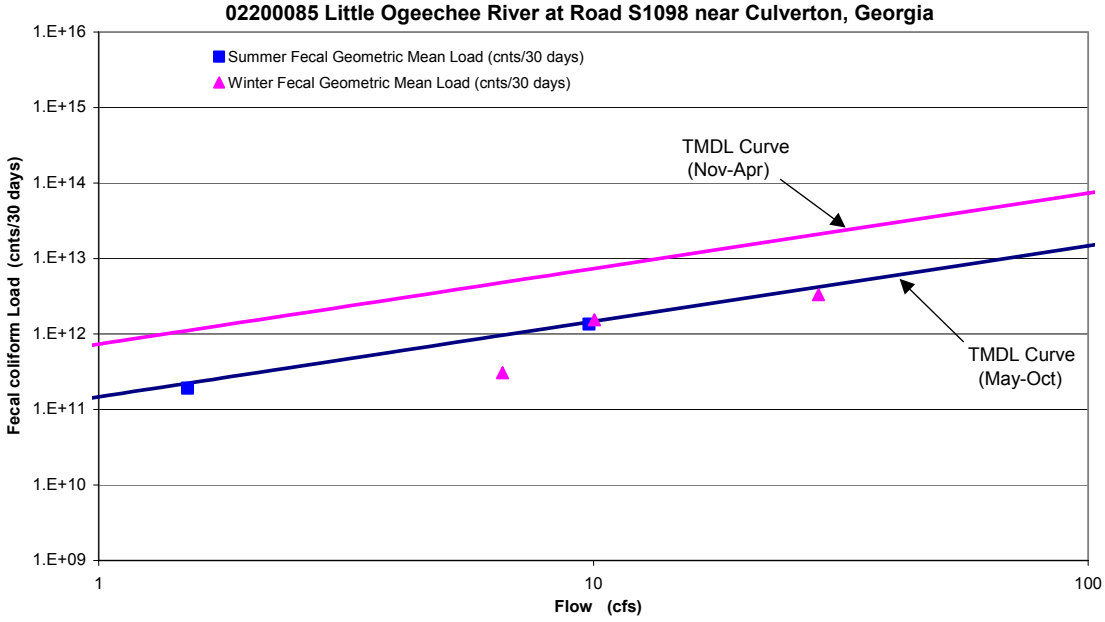


Table A-8. Data for Figure A-8

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
16-Sep-97	20	0.2				
22-Sep-97	170	0.1				
29-Sep-97	790*	36.0				
14-Oct-97	460*	2.9	187	10	1.35E+12	1.44E+12
4-Nov-97	1700	15.0				
18-Nov-97	110	26.0				
23-Nov-97	20	35.0				
2-Dec-97	170	38.0	159	29	3.32E+12	2.09E+13
25-Feb-02	170	4.4				
5-Mar-02	70	18.0				
11-Mar-02	490	8.4				
19-Mar-02	330	9.4	209	10	1.54E+12	7.38E+12
21-May-02	330	3.7				
6-Jun-02	70	0.8				
11-Jun-02	220	0.1	172	2	1.91E+11	2.22E+11
19-Nov-02	20	7.3				
4-Dec-02	80	3.0				
9-Dec-02	80	3.9				
16-Dec-02	130	12.0	64	7	3.07E+11	4.81E+12

* These values exceeded the EPA assessment criteria for 303(d) listings

Figure A-9
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02203538 Little Ogeechee River at U.S. Highway 17 near Burroughs, Georgia

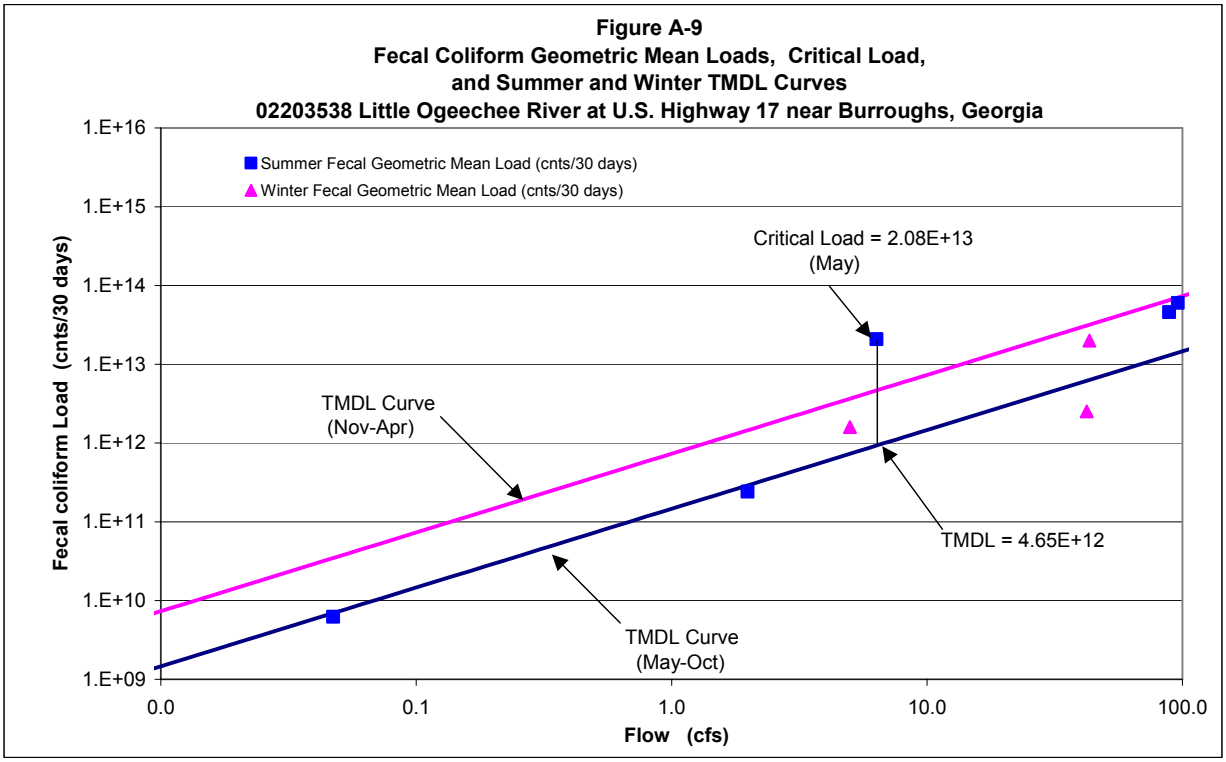


Table A-9. Data for Figure A-9

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	110	0.7				
5-Mar-02	3300	11.9				
12-Mar-02	490	2.8				
26-Mar-02	202	4.5	435	5.0	1.60E+12	3.67E+12
14-May-02	80	0.05				
21-May-02	220	0.06				
4-Jun-02	130	0.04				
11-Jun-02	460	0.04	180	0.05	6.24E+09	6.93E+09
9-Jul-02	170	0.6				
16-Jul-02	130	0.8				
23-Jul-02	20	6.1				
1-Aug-02	1700	0.4	166	2.0	2.41E+11	2.91E+11
20-Nov-02	330	78.3				
5-Dec-02	20	13.3				
10-Dec-02	20	20.2				
17-Dec-02	330	56.9	81	42.2	2.51E+12	3.09E+13
13-Feb-03	250	27.7				
19-Feb-03	480	43.4				
24-Feb-03	950	44.5				
28-Feb-03	880	57.1	563	43.2	2.00E+13	3.55E+13
26-Mar-03	200	170.1				
28-Mar-03	1100	89.8				
17-Apr-03	2800	72.3				
28-Apr-03	400	22.6	705	88.7	4.59E+13	6.51E+13
16-May-03	28000	2.2				
19-May-03	250	6.6				
20-May-03	3800	7.6				
21-May-03	15000	8.9	4469	6.3	2.08E+13	4.65E+12
11-Jun-03	1000	127.6				
13-Jun-03	1000	61.5				
23-Jun-03	1800	75.9				
8-Jul-03	300	118.7	857	95.9	6.03E+13	7.04E+13

Figure A-10
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202128 Nevills Creek at Bulloch County Road 578 near Rocky Ford, Georgia

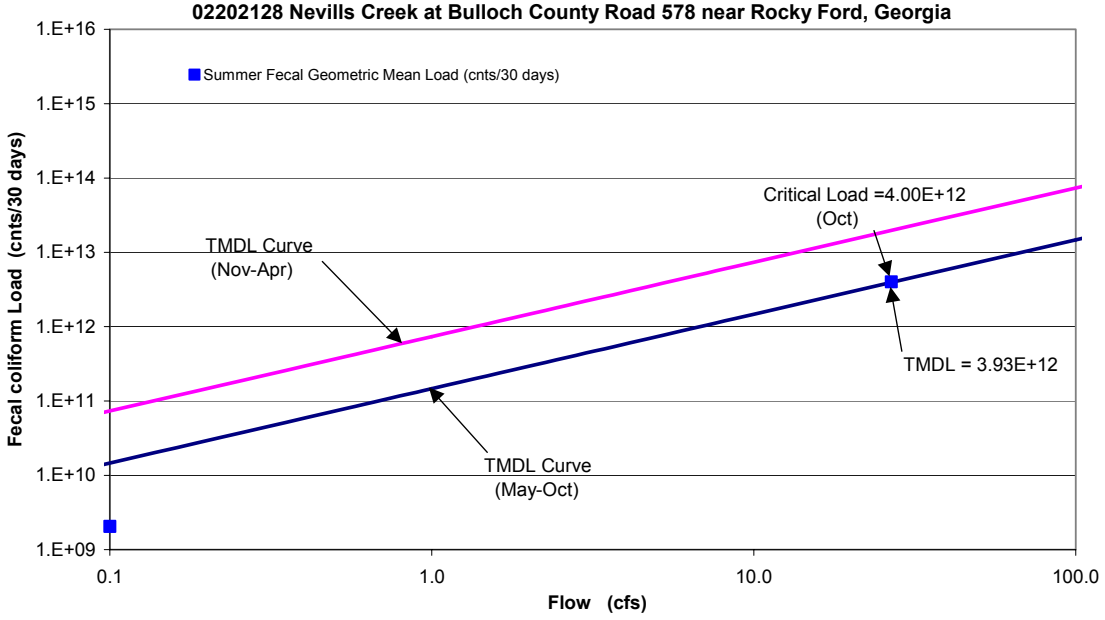


Table A-10. Data for Figure A-10

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-May-02	80	0.2				
11-Jun-02	40	0.0				
18-Jun-02	20	0.0	40	0.1	2.06E+09	1.03E+10
2-Oct-02	130	22.0				
8-Oct-02	3300	24.0				
16-Oct-02	50	36.0				
22-Oct-02	80	25.0	204	26.8	4.00E+12	3.93E+12

Figure A-11
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02199660 North Fork Ogeechee River at State Road 22 near Crawfordville, Georgia

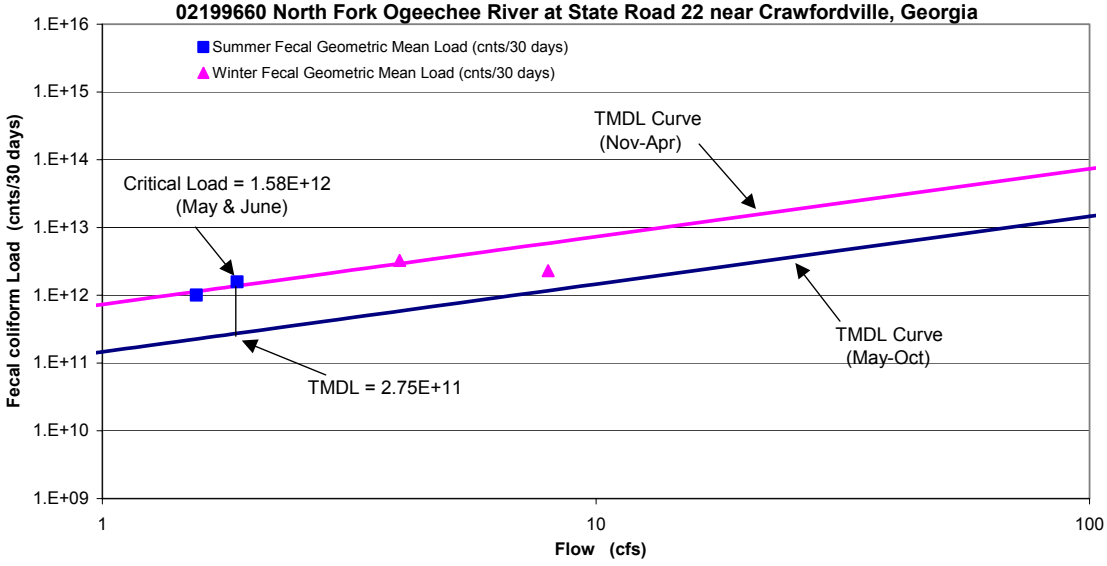


Table A-11. Data for Figure A-11

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
25-Feb-02	230	6.7				
5-Mar-02	460	17.0				
11-Mar-02	490	6.8				
19-Mar-02	1100	6.1	489	9.2	3.28E+12	6.72E+12
21-May-02	1300	3.5				
6-Jun-02	790	1.2				
11-Jun-02	1300	1.2				
17-Jun-02	1300	1.6	1148	1.9	1.58E+12	2.75E+11
20-Aug-02	4600	1.6				
28-Aug-02	170	1.5	884	1.6	1.01E+12	2.28E+11
19-Nov-02	490	10.0				
4-Dec-02	70	8.3				
9-Dec-02	490	11.0				
16-Dec-02	330	17.0	273	11.6	2.32E+12	8.50E+12

Figure A-12
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02199750 Ogeechee River at Hancock County Road 28 near Powelton, Georgia

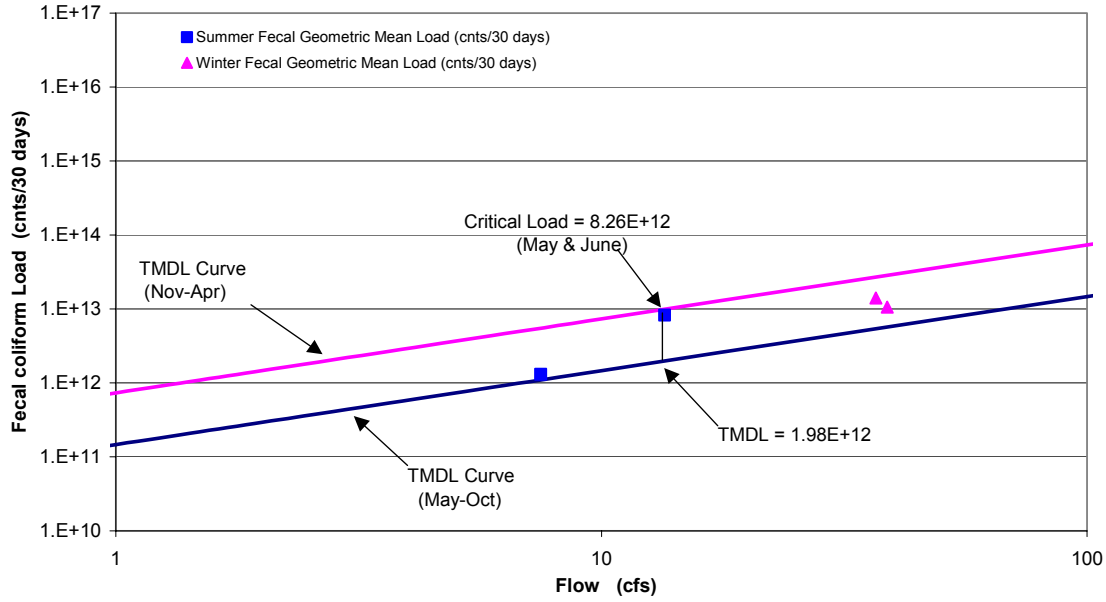


Table A-12. Data for Figure A-12

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
25-Feb-02	460	24.0				
5-Mar-02	490	38.0				
11-Mar-02	330	49.0				
19-Mar-02	260	44.0	373	39	1.06E+13	2.84E+13
21-May-02	490	21.0				
6-Jun-02	1300	12.0				
11-Jun-02	3300	11.0				
17-Jun-02	230	10.0	834	14	8.26E+12	1.98E+12
13-Aug-02	70	4.0				
20-Aug-02	490	12.0				
26-Aug-02	202	8.0				
10-Sep-02	460	6.0	238	8	1.31E+12	1.10E+12
19-Nov-02	790	49.0				
4-Dec-02	310	18.0				
9-Dec-02	230	22.0				
16-Dec-02	1300	58.0	520	37	1.40E+13	2.70E+13

Figure A-13
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02203561 Peacock Creek at Lewis Fraser Road near Midway, Georgia

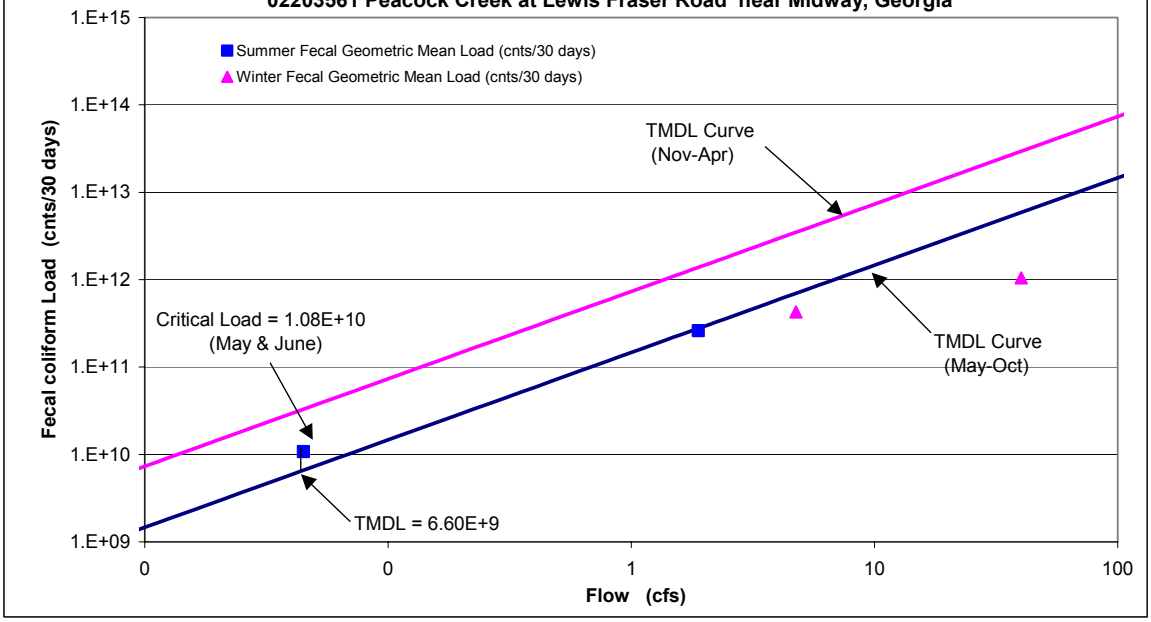


Table A-13. Data for Figure A-13

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	130	0.7				
5-Mar-02	490	11.3				
12-Mar-02	50	2.7				
26-Mar-02	70	4.3	122	4.8	4.26E+11	3.49E+12
14-May-02	116	0.0				
21-May-02	230	0.1				
4-Jun-02	790	0.04				
11-Jun-02	548	0.04	328	0.04	1.08E+10	6.60E+09
9-Jul-02	584	0.6				
16-Jul-02	130	0.8				
23-Jul-02	80	5.8				
1-Aug-02	210	0.4	189	1.9	2.62E+11	2.77E+11
20-Nov-02	80	74.5				
5-Dec-02	20	12.7				
10-Dec-02	20	19.2				
17-Dec-02	50	54.1	36	40.1	1.05E+12	2.95E+13

Figure A-14
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02200395 Rocky Comfort Creek at Fred Williams Road near Edgehill, Georgia

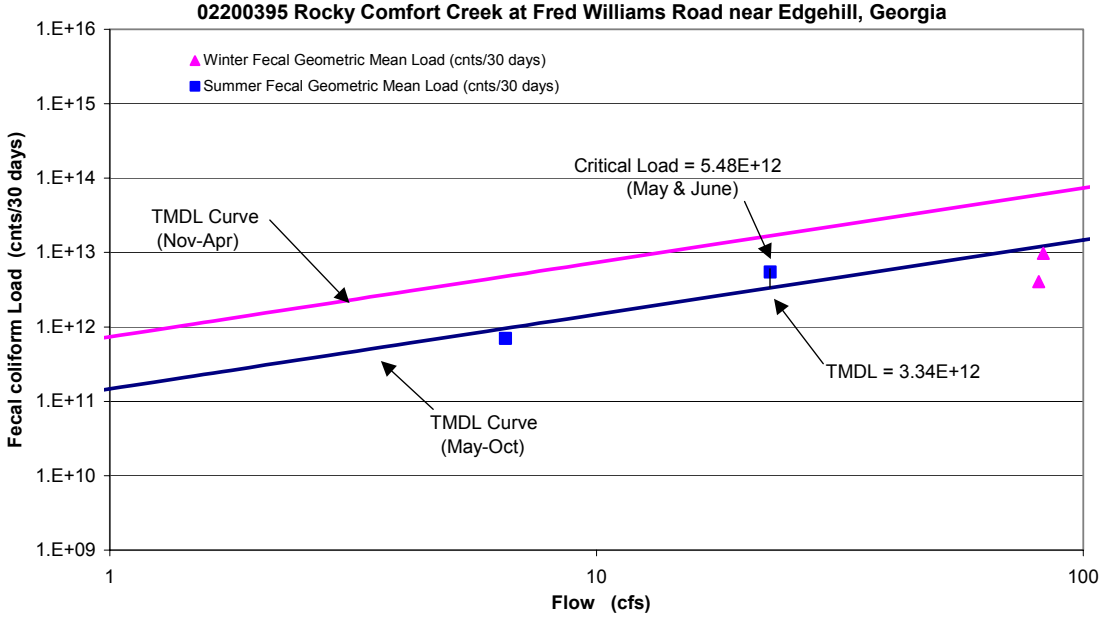


Table A-14. Data for Figure A-14

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
25-Feb-02	80	43				
05-Mar-02	790	154				
11-Mar-02	40	72				
19-Mar-02	260	62	160	82.8	9.73E+12	6.07E+13
21-May-02	220	58				
06-Jun-02	940	14				
11-Jun-02	330	12				
17-Jun-02	170	7	328	22.8	5.48E+12	3.34E+12
26-Aug-02	70	6				
10-Sep-02	310	7	147	6.5	7.03E+11	9.54E+11
19-Nov-02	50	102				
04-Dec-02	20	40				
09-Dec-02	130	49				
16-Dec-02	170	133	69	81.0	4.08E+12	5.95E+13

Figure A-15
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02200395 Rocky Comfort Creek at Jefferson County Road 255 at Louisville, Georgia

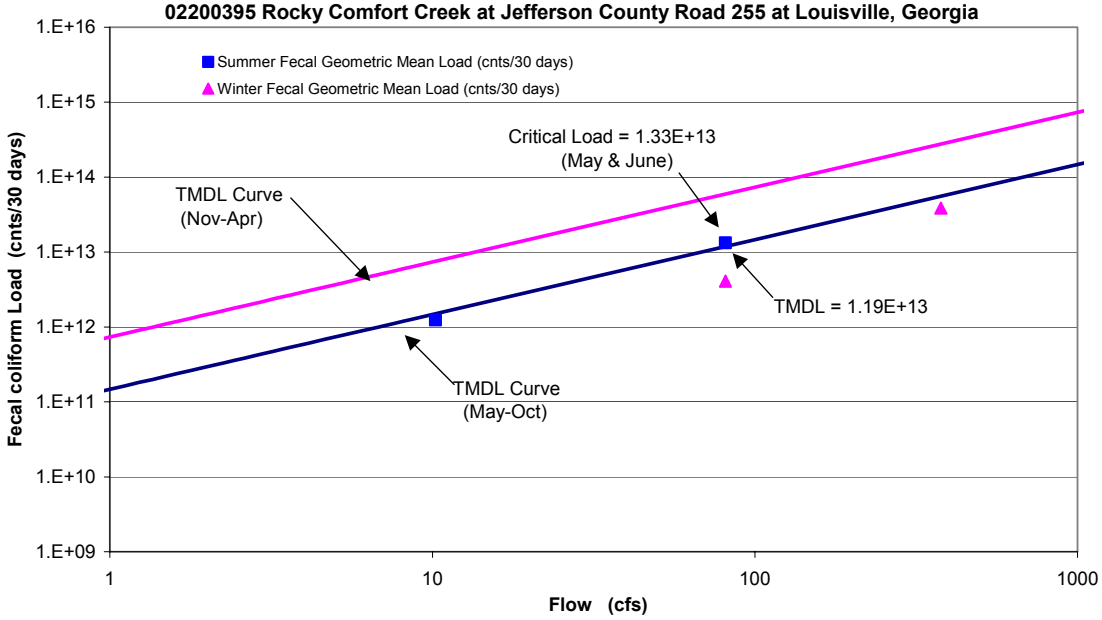


Table A-15. Data for Figure A-15

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	20	198.0				
6-Mar-02	1300	711.0				
12-Mar-02	130	315.0				
20-Mar-02	110	283.0	139	376.8	3.84E+13	2.77E+14
22-May-02	790	257.0				
4-Jun-02	80	48.0				
12-Jun-02	170	8.2				
19-Jun-02	230	11.0	223	81.1	1.33E+13	1.19E+13
14-Aug-02	790	1.0				
21-Aug-02	130	17.0				
27-Aug-02	80	17.0				
10-Sep-02	90	5.9	165	10.2	1.24E+12	1.50E+12
19-Nov-02	50	102.0				
4-Dec-02	20	40.0				
9-Dec-02	130	49.0				
16-Dec-02	170	133.0	69	81.0	4.08E+12	5.95E+13

Figure A-16
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02201848 Sculls Creek at Jenkins County Road 200 near Millen, Georgia

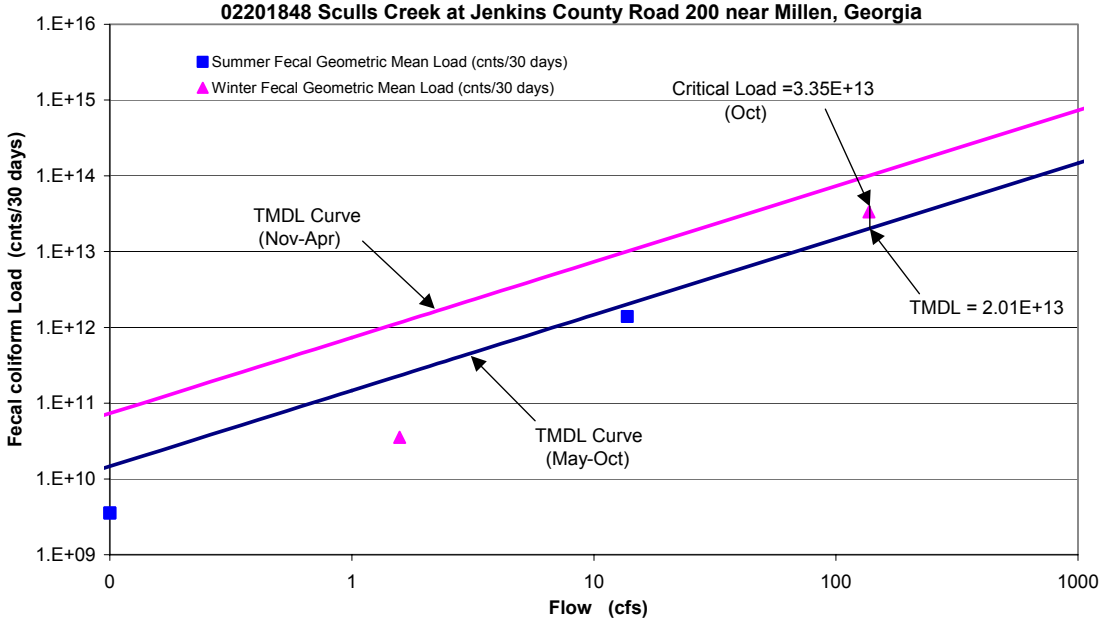


Table A-16. Data for Figure A-16

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
12-Aug-97		54.0				
19-Aug-97	170	0.7				
25-Aug-97	70	0.3				
9-Sep-97	220	0.0	138	13.8	1.39E+12	2.02E+12
14-Oct-97	790	0.1				
21-Oct-97	220	32.0				
28-Oct-97	310	350.0				
12-Nov-97	230	165.0	334	136.8	3.35E+13	2.01E+13
12-Feb-02	110	1.8				
19-Feb-02	20	1.5				
26-Feb-02	20	1.8				
5-Mar-02	20	1.2	31	1.6	3.54E+10	1.16E+12
28-May-02	20	0.1				
11-Jun-02	20	0.1				
18-Jun-02	60	0.1				
25-Jun-02	230	0.1	48	0.1	3.56E+09	1.47E+10

Figure A-17
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02202920 Tenmile Creek at Road S2242 (Adabelle Road) near Excelsior, Georgia

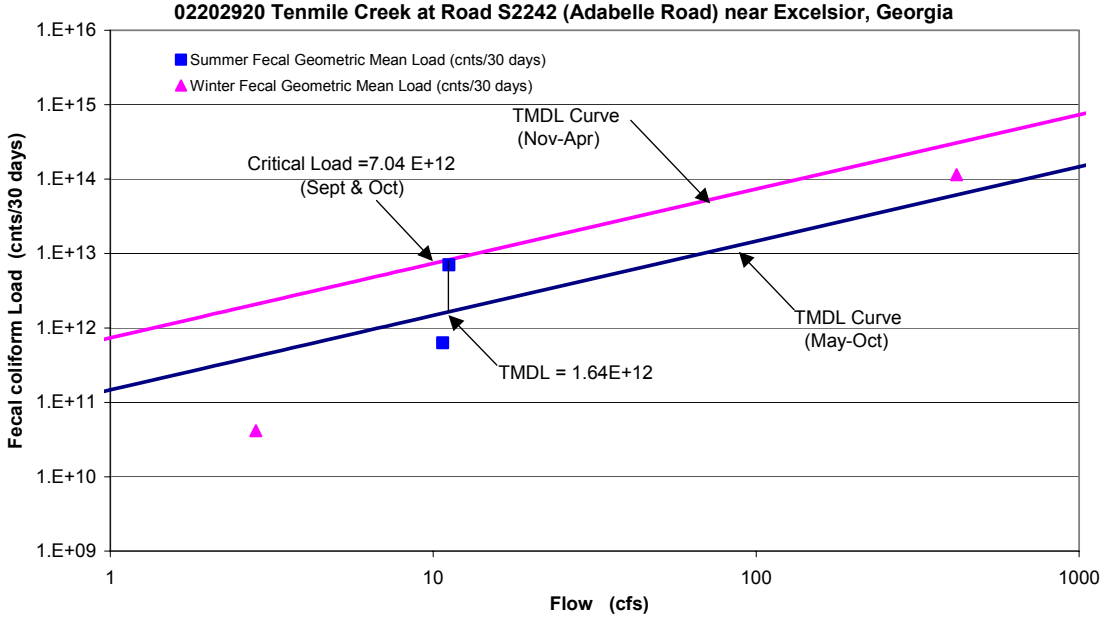


Table A-17. Data for Figure A-17

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Jul-97	70	0.8				
11-Aug-97	230	28.0				
18-Aug-97	130	11.0				
25-Aug-97	20	3.0	80	10.7	6.32E+11	1.57E+12
29-Sep-97	1700	0.1				
6-Oct-97	310	0.1				
20-Oct-97	1300	2.5				
27-Oct-97	790	42.0	858	11.2	7.04E+12	1.64E+12
8-Jan-98	1100	270.0				
22-Jan-98	60	200.0				
28-Jan-98	130	440.0				
4-Feb-98	2300	760.0	375	417.5	1.15E+14	3.06E+14
13-Feb-02	20	2.8				
20-Feb-02	20	2.8				
27-Feb-02	20	2.8				
6-Mar-02	20	2.9	20	2.8	4.15E+10	2.07E+12

Figure A-18
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02201000 Williamson Swamp Creek GA Highway 231 at Davisboro, Georgia

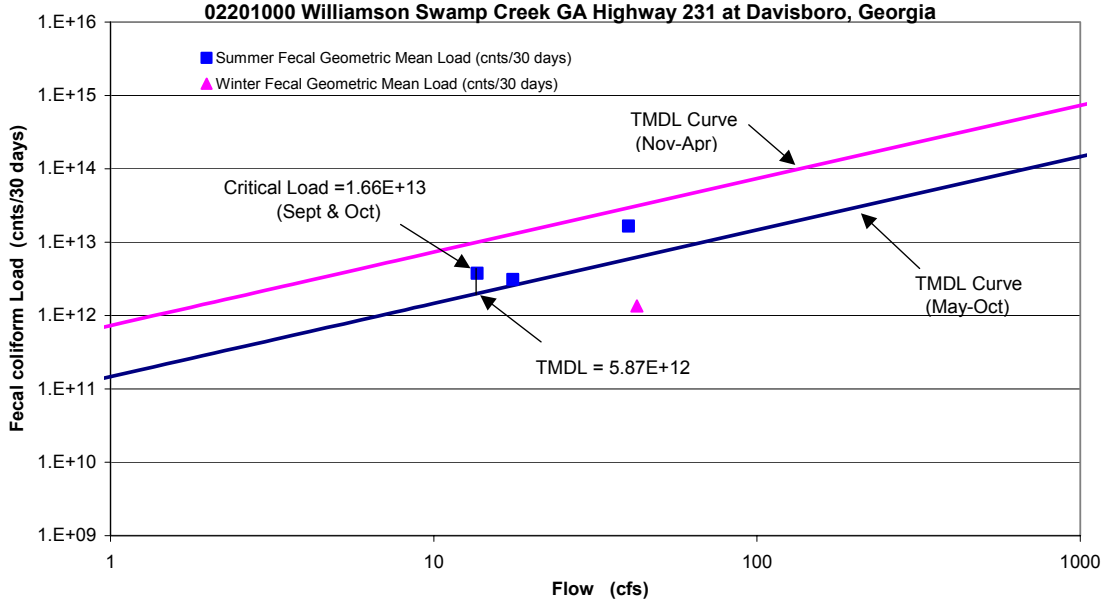


Table A-18. Data for Figure A-18

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
17-Sep-97	1300	16.0				
23-Sep-97	700	19.0				
30-Sep-97	490	94.0				
15-Oct-97	230	31.0	566	40.0	1.66E+13	5.87E+12
5-Feb-02	40	32.0				
13-Feb-02	110	56.0				
20-Feb-02	40	42.0				
25-Feb-02	20	40.0	43	42.5	1.35E+12	3.12E+13
8-May-02	100	18.0				
14-May-02	500	23.0				
21-May-02	365	20.0				
28-May-02	185	9.2	241	17.6	3.11E+12	2.58E+12
6-Aug-02	300	10.0				
13-Aug-02	800	9.4				
19-Aug-02	170	9.1				
27-Aug-02	500	26.0	378	13.6	3.78E+12	2.00E+12

Figure A-19
Fecal Coliform Geometric Mean Loads, Critical Load, and Summer and Winter TMDL Curves
02201151 Williamson Swamp Creek at U.S. Highway 1 East at Wadley, Georgia

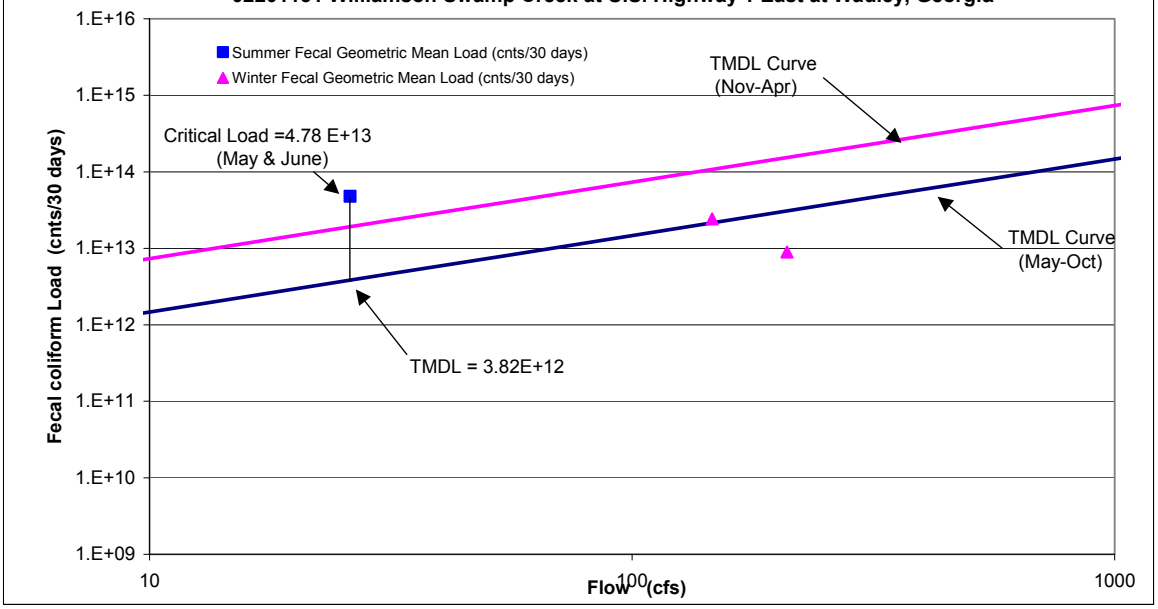
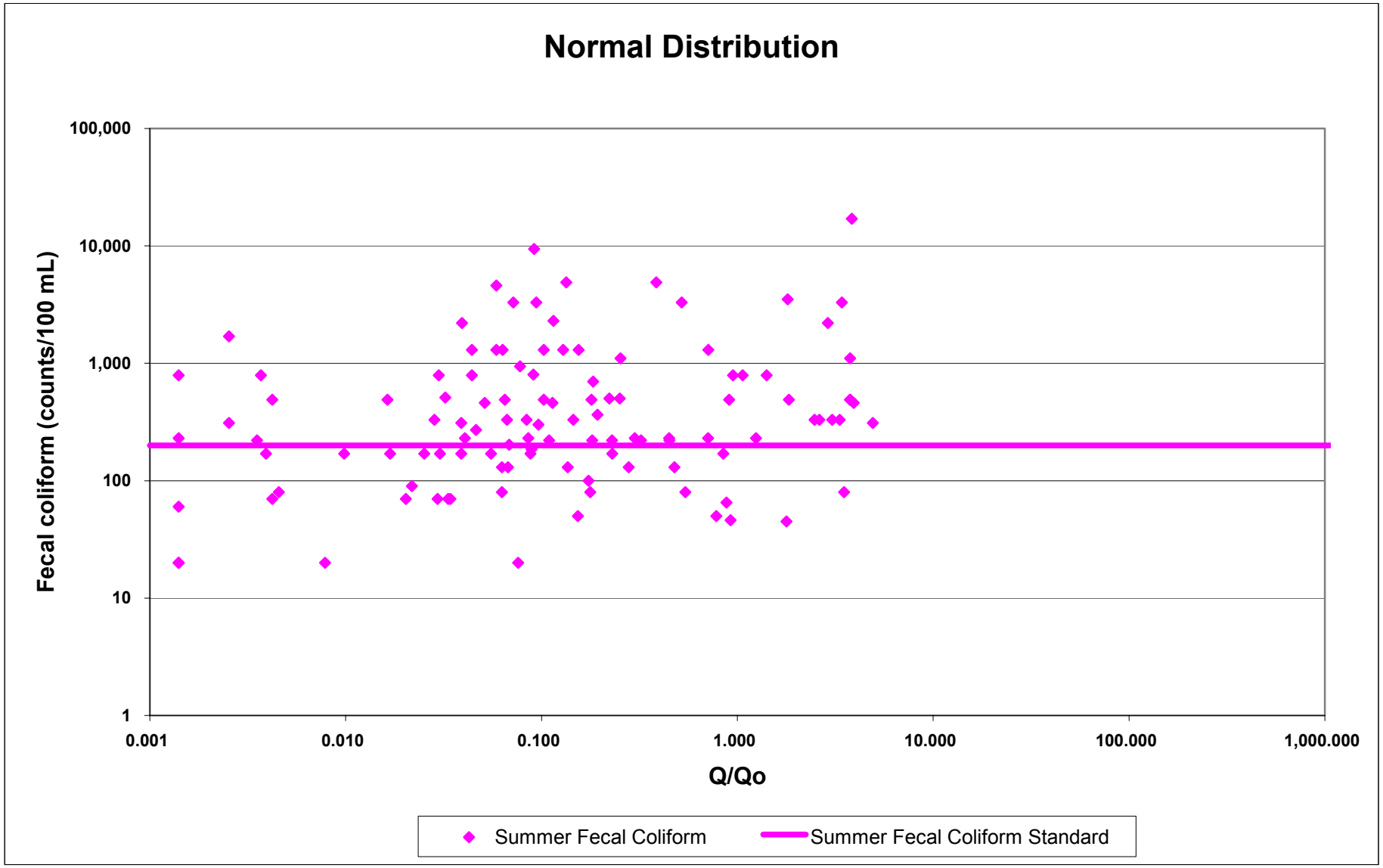


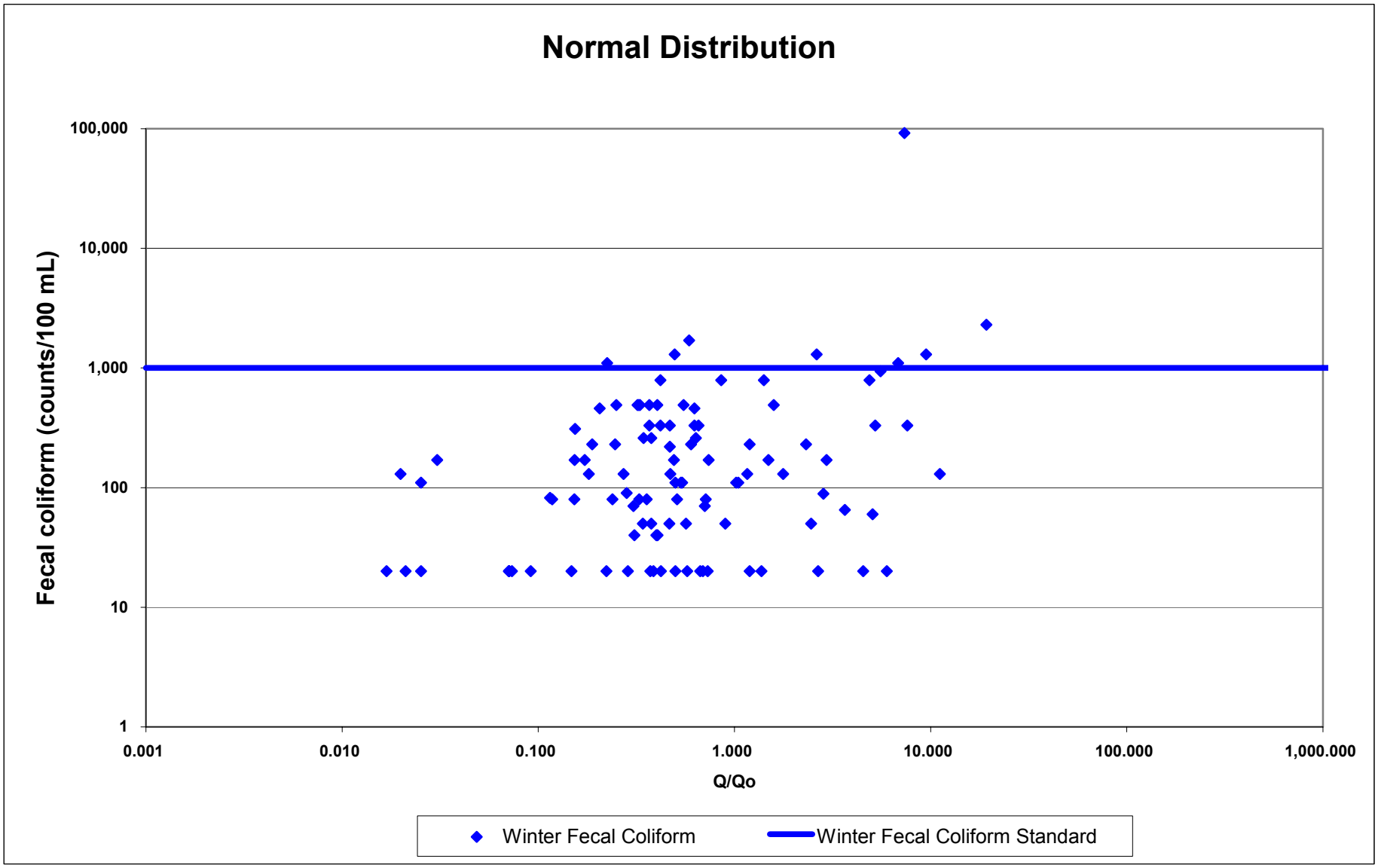
Table A-19. Data for Figure A-19

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
26-Feb-02	20	78.0				
6-Mar-02	790	295.0				
12-Mar-02	490	115.0				
20-Mar-02	330	98.0	225	146.5	2.42E+13	1.08E+14
22-May-02	1100	53.0				
4-Jun-02	4900	28.0				
12-Jun-02	2200	8.2				
19-Jun-02	3300	15.0	2501	26.1	4.78E+13	3.82E+12
27-Aug-02	160000	13.0				
21-Nov-02	20	250.0				
3-Dec-02	220	98.0				
10-Dec-02	20	120.0				
17-Dec-02	130	370.0	58	209.5	8.94E+12	1.54E+14

Appendix B

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
Fecal coliform (counts/100 mL)
100,000
10,000
1,000
100
10
1
0.001
0.010
0.100
1.000
10.000
100.000
1,000.000
Q/Qo
Summer Fecal Coliform
Summer Fecal Coliform Standard


Normal Distribution
Fecal coliform (counts/100 mL)
100,000
10,000
1,000
100
10
1
0.001
0.010
0.100
1.000
10.000
100.000
1,000.000
Q/Qo
Winter Fecal Coliform
Winter Fecal Coliform Standard