Total Maximum Daily Load

Evaluation

for

Twelve Stream Segments

in the

Suwannee 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 two categories with respect to designated uses: supporting or 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* (GA EPD, 2006 – 2007). This document is available on the Georgia Environmental Protection Division (GA EPD) website.

Some of the 305(b) not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDLs in this document are based on the 2008 303(d) listing, which is available on the GA EPD website. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

Every water in the State has one or more designated uses and every designated use has water quality criteria established to protect them. The State of Georgia has placed twelve stream segments in the Suwannee River Basin on the 303(d) list of impaired waters because they were assessed as "not supporting" their designated use of "Fishing" due to violation of the fecal coliform water quality criteria. The water quality criteria for fecal coliform bacteria for a water with a designated use of fishing are as follows: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform counts are 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. For the months of November through April, fecal coliform counts are 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. A water is assessed as "not supporting" its use if more than 10% of the geometric means exceeded the water quality criteria cited above. If no geometric means are available, a water is assessed as "not supporting" its use if more than 10 percent of individual samples exceed the fecal coliform criteria.

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 accumulated fecal coliform bacteria that wash off land surfaces as a result of storm events.

The process of developing fecal coliform bacteria TMDLs for the Suwannee 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.

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 bacteria 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.

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)	
Alapahoochee River	5.84E+12	6.60E+11	1.91E+10	3.36E+12	4.48E+11	4.48E+12	23
Morrison Creek	4.80E+14	-	-	7.99E+13	8.88E+12	8.88E+13	81
Mule Creek	2.11E+14	-	-	1.19E+13	1.32E+12	1.32E+13	94
Okapilco Creek Upstream SR S1540 to U.S. Hwy 319	3.40E+13	-	-	9.71E+12	1.08E+12	1.08E+13	68
Okapilco Creek SR 37 to Hog Creek, S. of Moultrie	2.19E+15	-	-	2.15E+14	2.39E+13	2.39E+14	89
Okapilco Creek Little Creek to Rainy Creek	5.87E+10	-	-	1.32E+10	1.47E+09	1.47E+10	75
Okapilco Creek Rainy Creek to Mule Creek	2.86E+13	-	-	3.96E+12	4.40E+11	4.40E+12	85
Piscola Creek	5.83E+13	-	-	1.41E+13	1.56E+12	1.56E+13	73
Tatum Creek	1.07E+12	1.59E+10	-	1.78E+11	2.15E+10	2.15E+11	80
Warrior Creek	1.10E+13	-	-	5.72E+12	6.35E+11	6.35E+12	42
Willacoochee River	9.52E+14	-	-	1.07E+14	1.19E+13	1.19E+14	88
Withlacoochee River	1.40E+13	-	-	2.52E+12	2.80E+11	2.80E+12	80

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.

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 categorized with respect to designated uses as supporting or 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* (GA EPD, 2006 – 2007). This document is available on the Georgia Environmental Protection Division (GA EPD) website.

Some of the 305(b) not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDLs in this document are based on the 2008 303(d) listing, which is available on the GA EPD website. 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 that are 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 twelve streams of the Suwannee River Basin included on the 2008 303(d) list for exceedances of the fecal coliform standard criteria.

Table 1. Water Bodies Listed on the 2008 303(d) List for Fecal Coliform Bacteria in the Suwannee River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use
Alapahoochee River	Confluence of Mud Creek and Grand Bay Creek to Stateline	11	Fishing
Morrison Creek	Adel	2	Fishing
Mule Creek	Headwaters to Reedy Creek near Pavo	8	Fishing
Okapilco Creek	Upstream SR S1540 to U.S. Hwy. 319, Moultrie	10	Fishing
Okapilco Creek	SR 37 to Hog Creek, S. of Moultrie	10	Fishing
Okapilco Creek	Little Creek to Rainy Creek	10	Fishing
Okapilco Creek	Rainy Creek to Mule Creek	5	Fishing
Piscola Creek	Downstream Whitlock Branch @ Ozell Road to Okapilco Creek near Boston	25	Fishing
Tatum Creek	Dickerson Millpond to Tower Road	6	Fishing
Warrior Creek	Horse Creek to Rock Creek near Norman Park	10	Fishing
Withlacoochee River	Headwaters (Hardy Mill Creek) to New River	17	Fishing
Willacoochee River	SR 158 to Alapaha River	11	Fishing

1.2 Watershed Description

The Suwannee River Basin is located in south-central Georgia and north-central Florida. The total basin occupies an area of approximately 10,000 square miles with approximately 5,560 square miles of the basin within Georgia. The basin lies within the Coastal Plain physiographic province, which extends throughout the southeastern United States. The Suwannee River drains into the Gulf of Mexico.

The USGS has divided the Suwannee River Basin into six sub-basins, or Hydrologic Unit Codes (HUCs), four of which are located in Georgia (Figure 1). Figures 2 and 3 show the listed segments and the associated counties within each sub-basin.

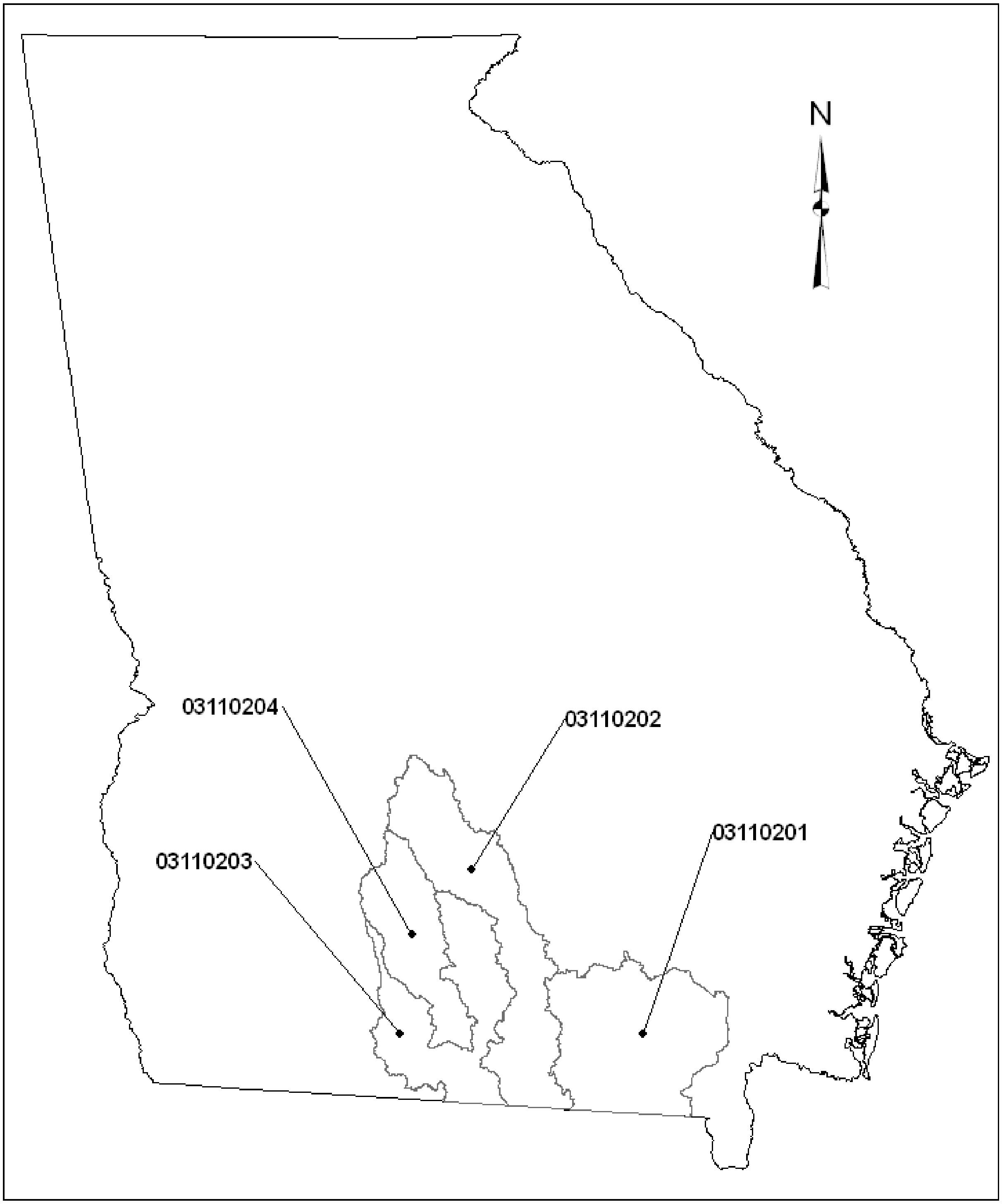
The land use characteristics of the Suwannee River Basin watersheds were determined using data from the Georgia Land Use Trends (GLUT) for Year 2008. This raster land use trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1974, 1985, 1991, 1998, 2001, 2005 and 2008. The raster data sets were developed from Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+). Some of the NARSAL land use types were reclassified, aggregated into similar land use types, and were used in the final watershed characterization. Table 2 lists the watershed land use distribution for the drainage areas of the twelve stream segments.

1.3 Water Quality Standard

The water use classification for the listed stream segments in the Suwannee River Basin is Fishing. The criterion violated is listed as fecal coliform. The potential causes 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, 2009), are:

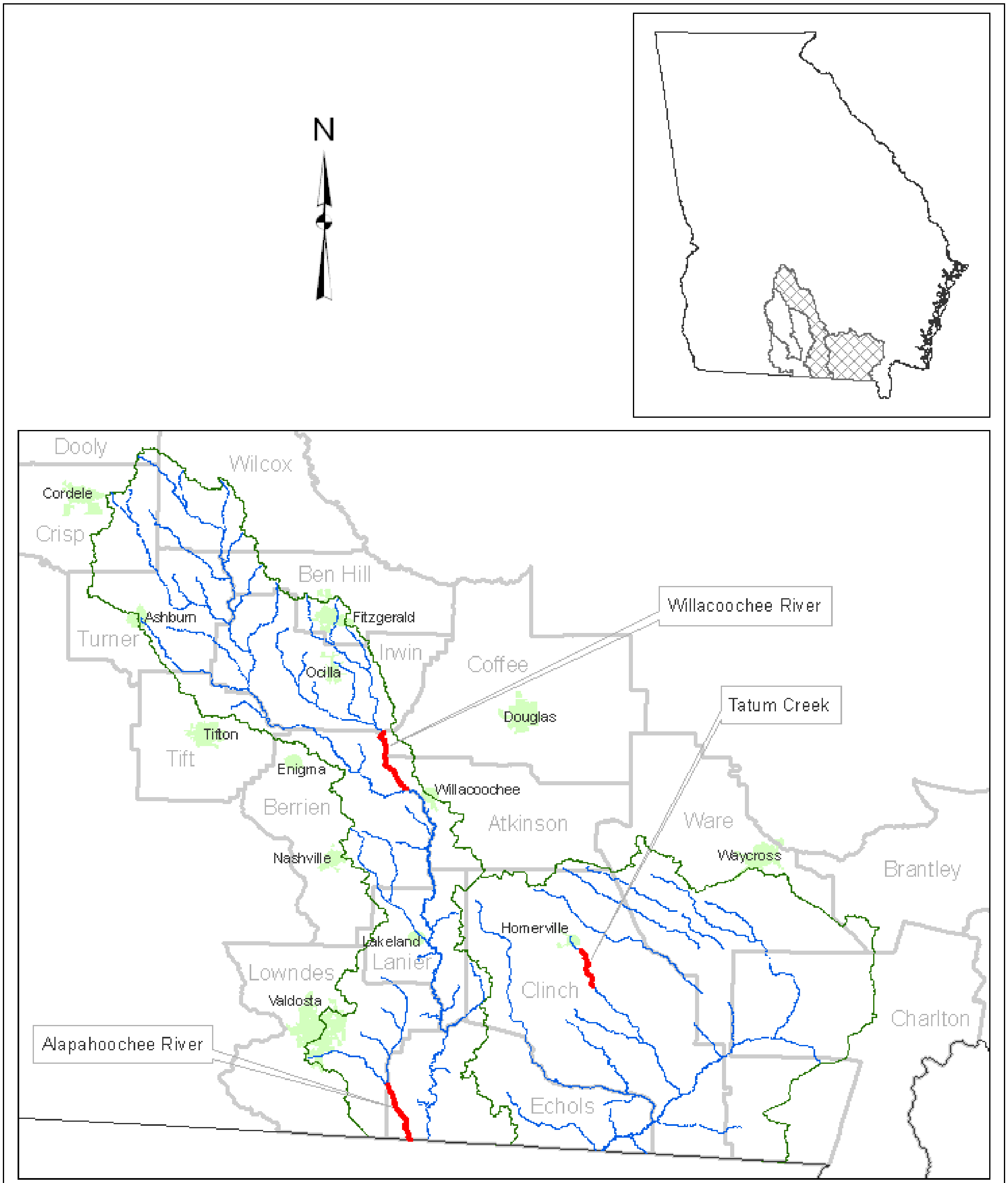
(c) Fishing: Propagation of Fish, Shellfish, Game and Other Aquatic Life; secondary contact recreation in and on the water; or for any other use requiring water of a lower quality:

(iii) 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
Suwannee River Basin

Figure 1. USGS 8-Digit HUCs for Suwannee River Basin



TMDL Evaluation - Fecal Coliform
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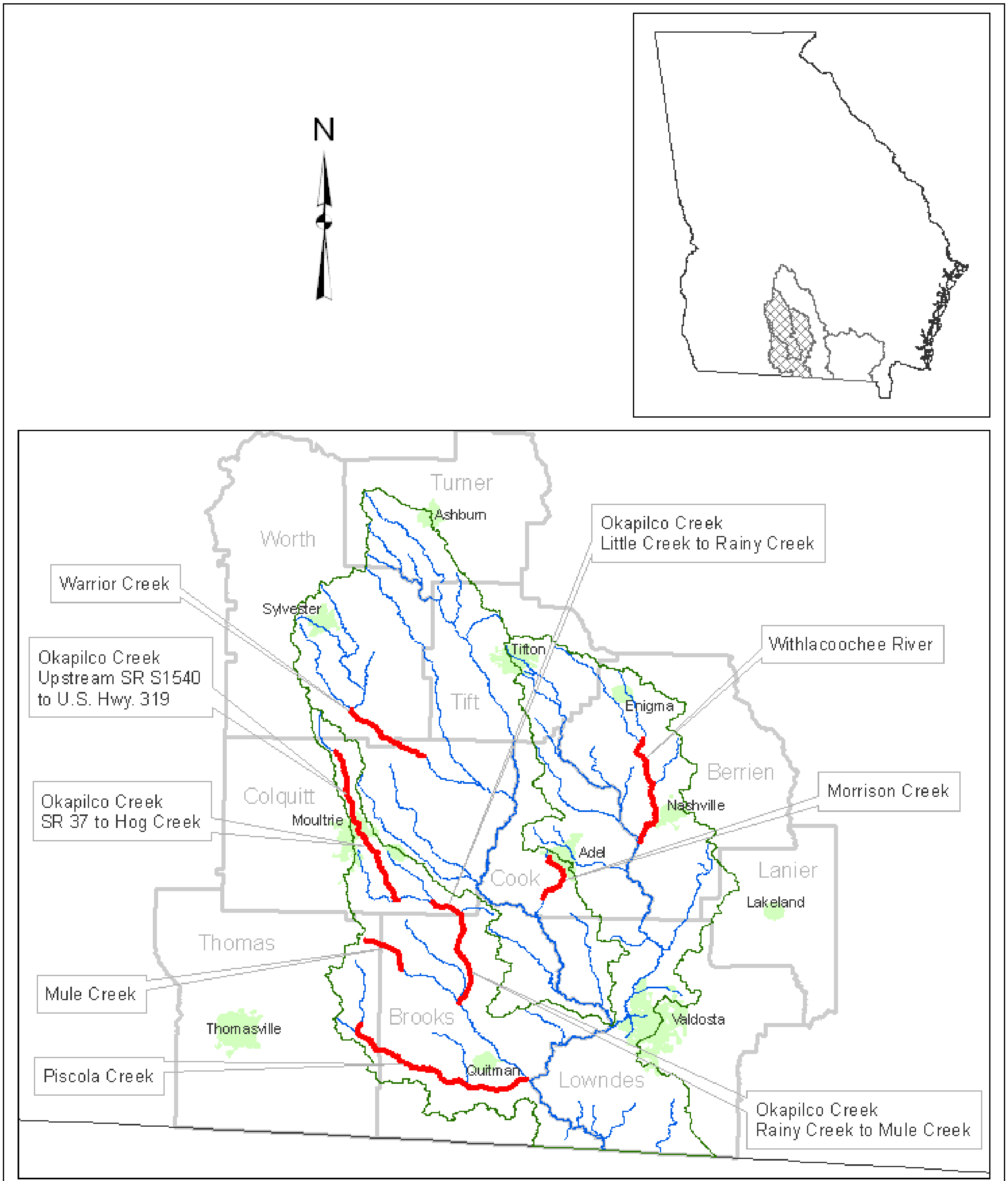
Figure 2. 303(d) Listed Streams in HUCs 03110201 and 03110202



TMDL Evaluation - Fecal Coliform Suwannee River Basin	Figure 3. 303(d) Listed Streams in HUCs 03110203 and 03110204

Table 2. Suwannee River Basin Land Coverage

Stream/Segment	Land Use Categories - Acres (Percent)													
	Open Water	Low Intensity Residential	High Intensity 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
Alapahoochee River	2,519 (1.4)	4,711 (2.7)	1,905 (1.1)	1,820 (1.0)	72 (0.0)	46 (0.0)	4,876 (2.8)	70,209 (40.1)	25,451 (14.5)	4,558 (2.6)	8,579 (4.9)	49,573 (28.3)	917 (0.5)	175,236 (100.0)
Morrison Creek	43 (0.6)	239 (3.5)	186 (2.7)	212 (3.1)	18 (0.3)	0 (0.0)	68 (1.0)	801 (11.7)	3,019 (44.1)	595 (8.7)	440 (6.4)	1,196 (17.5)	34 (0.5)	6,852 (100.0)
Mule Creek	45 (0.5)	116 (1.2)	6 (0.1)	5 (0.05)	20 (0.2)	0 (0.0)	60 (0.6)	2,895 (29.9)	4,046 (41.8)	1,030 (10.6)	434 (4.5)	985 (10.2)	38 (0.4)	9,680 (100.0)
Okapilco Creek - Upstream SR S1540 to U.S. Hwy. 319	277 (1.4)	617 (3.2)	200 (1.0)	84 (0.4)	99 (0.5)	0 (0.0)	208 (1.1)	4,355 (22.4)	9,653 (49.5)	1,113 (5.7)	746 (3.8)	2,046 (10.5)	80 (0.4)	19,478 (100.0)
Okapilco Creek - SR 37 to Hog Cr	349 (1.1)	1,361 (4.5)	596 (2.0)	450 (1.5)	127 (0.4)	0 (0.0)	442 (1.5)	7,742 (25.5)	12,065 (39.7)	1,669 (5.5)	1,570 (5.2)	3,917 (12.9)	103 (0.3)	30,389 (100.0)
Okapilco Creek - Little Creek to Rainy Creek	1,035 (1.1)	2,761 (3.0)	936 (1.0)	655 (0.7)	266 (0.3)	0 (0.0)	1,236 (1.3)	25,405 (27.5)	37,484 (40.6)	5,957 (6.4)	4,874 (5.3)	11,394 (12.3)	369 (0.4)	92,370 (100.0)
Okapilco Creek - Rainy Creek to Mule Creek	1,127 (1.0)	2,887 (2.6)	950 (0.9)	655 (0.6)	294 (0.3)	0 (0.0)	1,580 (1.4)	29,578 (27.1)	44,742 (41.0)	7,775 (7.1)	5,569 (5.1)	13,468 (12.3)	432 (0.4)	109,055 (100.0)
Piscola Creek	619 (0.6)	1,363 (1.3)	203 (0.2)	79 (0.1)	153 (0.1)	0 (0.0)	1,255 (1.2)	34,741 (32.9)	38,726 (36.6)	7,114 (6.7)	5,094 (4.8)	15,661 (14.8)	661 (0.6)	105,670 (100.0)
Tatum Creek	9 (0.0)	938 (4.5)	176 (0.8)	130 (0.6)	5 (0.02)	0 (0.0)	1,656 (8.0)	10,015 (48.2)	566 (2.7)	322 (1.5)	1,070 (5.1)	5,848 (28.1)	49 (0.2)	20,784 (100.0)
Warrior Creek	1,371 (1.4)	3,044 (3.0)	482 (0.5)	277 (0.3)	400 (0.4)	0 (0.0)	1,130 (1.1)	34,428 (34.0)	38,417 (37.9)	5,030 (5.0)	4,525 (4.5)	11,801 (11.7)	335 (0.3)	101,239 (100.0)
Willacoochee River	2,075 (1.4)	3,989 (2.7)	743 (0.5)	608 (0.4)	627 (0.4)	0 (0.0)	2,930 (2.0)	33,462 (22.4)	65,913 (44.2)	7,387 (4.9)	8,151 (5.5)	22,580 (15.1)	814 (0.5)	149,282 (100.0)
Withlacoochee River	1,158 (1.3)	1,791 (2.0)	335 (0.4)	212 (0.2)	272 (0.3)	0 (0.0)	1,208 (1.4)	30,956 (34.9)	32,607 (36.7)	2,805 (3.2)	3,788 (4.3)	13,292 (15.0)	317 (0.4)	88,743 (100.0)

2.0 WATER QUALITY ASSESSMENT

Stream segments are placed on the 303(d) list as not supporting their water use classification based on water quality sampling data. A stream is placed on the not support list if more than 10% of the samples exceed the fecal coliform criteria. 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 used for TMDLs developed in this document were collected during calendar years 2003 through 2008 by GA EPD as part of the trend monitoring program. These data 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 United States Environmental Protection Agency (USEPA) has developed technology-based guidelines, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

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

Discharges from municipal and industrial wastewater treatment facilities can contribute fecal coliform to receiving waters. The City of Valdosta Mud Creek and Homerville Industrial Park wastewater treatment facilities are the only NPDES permitted discharges with a flow greater than 0.1 MGD identified in the Suwannee River Basin that could potentially impact streams on the 2008 303(d) list for fecal coliform bacteria. Table 3 provides the monthly average discharge flow and fecal coliform concentrations for these facilities. This data was obtained from calendar year 2008 Discharge Monitoring Reports (DMR). The permitted fecal coliform concentrations 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 Suwannee River Basin.

Table 3. NPDES Facilities Discharging Fecal Coliform Bacteria into Suwannee River Basin 303(d) Listed Stream Segments

Facility Name	NPDES Permit No.	Receiving Stream	303(d) Listed Segment	Actual 2008 Discharge		NPDES Permit Limits		Number of Fecal Coliform/ Flow Violations 2006 –2008
				Average Monthly Flow (MGD)[a]	Geometric Mean (No./100 ml)[b]	Average Monthly Flow (MGD)	Average Monthly FC (No./100mL)	
Homerville Industrial Park	GA0037460	Tatum Creek	Tatum Creek	No Discharge	No Discharge	0.25	200	2
Valdosta Mud Creek WPCP	GA0020222	Mud Creek	Alapahoochee River	3.48	24.5	3.22	200	7 (flow)

Source: GA EPD Regional Offices

Notes: [a] Values shown are the annual average of the monthly average flows.

[b] 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. The industrial general permit requires that storm water discharging into an impaired stream segment or within one linear mile upstream of and within the same watershed as any portion of an impaired stream segment identified as “not supporting” its designated use(s), must satisfy the requirements of Part III.C. if the pollutant(s) of concern for which the impaired stream segment has been listed may be exposed to stormwater. Sampling must be conducted for the pollutant(s) from nonpoint sources identified in the TMDL as causing the impairment. 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 58 permittees in Georgia.

Phase I MS4 permits require the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. There are no Phase I MS4s in the Suwannee River Basin.

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Twenty nine counties and 58 communities are permitted under the Phase II regulations in Georgia. There is one community located in the Suwannee River Basin that is covered by the Phase II General Storm Water Permit (Table 4).

Table 4. Phase II Permitted MS4s in the Suwannee River Basin

Name	Watershed
Valdosta	Suwannee

Source: Nonpoint Source Program, GA EPD, 2010

Table 5 lists the Phase I or Phase II MS4 city or county urbanized areas upstream of listed segments in the Suwannee River Basin. The table provides the total area of this watershed, and the percentage of the watershed that is MS4 city or county urbanized area.

Table 5. Percentage of Drainage of the Listed Segment of the Alapahoochee River Located in MS4 City or County Urbanized Areas

Stream Segment	Location	Total Area (square miles)	% in MS4 area
Alapahoochee River	Confluence of Mud Creek and Grand Bay Creek to Stateline	270.5	6.2

3.1.3 Confined Animal Feeding Operations

Under the Clean Water Act, Concentrated Animal Feeding Units (CAFOs) are defined as point sources of pollution and are therefore subject to NPDES permit regulations. From 1999 through 2001, Georgia adopted rules for permitting swine and non-swine liquid manure animal feeding operations (AFOs). Georgia rules require medium size AFOs with more than 300 animal units (AU) but less than 1000 AU to apply for a non-discharge State land application system (LAS) waste disposal permit. Large operations with more than 1000 AU must apply for an NPDES permit (also non-discharge) as a CAFO. Table 6 presents the swine and non-swine liquid manure CAFOs located upstream of the listed segments in the Suwannee River Basin that are registered or have land application permits.

Table 6. Registered Liquid Manure CAFOs Upstream of 303(d) Listed Segments in the Suwannee River Basin

Name	303(d) Listed Stream Segment	County	Animal Type	Total Number of Animals	Permit No.
Jumping Gully Dairy	Mule Creek	Brooks	Dairy	101419	Pending
Grass Flats Dairy, LLC	Okapilco Creek Little Creek to Rainy Creek	Brooks	Dairy	48306	GAU700000
	Okapilco Creek Rainy Creek to Mule Creek				
Wynn Swine Farm (Levi Unit)	Okapilco Creek SR 37 to Hog Creek	Colquitt	Swine	84148	GAU700000
	Okapilco Creek Little Creek to Rainy Creek				
	Okapilco Creek Rainy Creek to Mule Creek				
Claude Butler Farm	Piscola Creek	Brooks	Swine	94562	GAU700000
Jackson & Wortman Dairy	Piscola Creek	Brooks	Dairy	72940	GAG930000
Roger T (Herbert) Price-Hog Operation	Piscola Creek	Brooks	Swine	96555	GAU700000
Franz Rowland Floor	Piscola Creek	Thomas	Swine	89889	GAU700000
Messer Dairy Inc.	Piscola Creek	Thomas	Dairy	72917	GAU700000
Danforth Hog Farms	Withlacoochee River	Berrien	Swine	86682	GA0038270
Steve Williams Farm	Withlacoochee River	Irwin	Swine	91933	GAU700000

Source: GA Dept. of Agriculture, 2010

In 2002, the USEPA promulgated expanded NPDES permit regulations for CAFOs that added dry manure poultry operations larger than 125,000 broilers or 82,000 layers. Georgia is consistently among the top three states in the U.S. in terms of poultry operations. The majority of poultry farms are dry manure operations where the manure is stored for a time and then land applied. Freshly stored litter can be a nonpoint source for fecal coliform. However, land applied litter that was previously stored for an extended length of time typically exhibits very low fecal coliform levels. Current federal regulations require that large poultry farms operate under NPDES permits. Table 7 presents the dry manure poultry operations located upstream of the listed segments in the Suwannee River Basin that have submitted an application for the General NPDES Permit GAG930000.

Table 7. Registered Dry Manure Poultry Operations Upstream of 303(d) Listed Segments in the Suwannee River Basin

Name	303(d) Listed Stream Segment	County	Number of Animals (thousands)	Permit Status
Jeffery Ross Hall	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	138	NAI
Kenneth Bennett	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	184	NAI
Lee Poultry, LLC	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	230.4	I
M & C Poultry	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	172.8	I
Pierce Poultry, LLC	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	230.4	I
Rainbow Farms, Inc.	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	172.8	I
Sean Tai Farms, Inc	Okapilco Creek Little Creek to Rainy Creek Okapilco Creek Rainy Creek to Mule Creek	Colquitt	172.8	I
Daniel A. Niewoehner	Piscola Creek	Brooks	165	I
Rowland Chickens	Piscola Creek	Brooks	172.8	I

Source: GA Dept. of Agriculture, 2010
Notes: I = Issued
P = permit pending
NAI = needs additional information for application

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 in 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 watersheds. 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. Recently, rapidly expanding feral swine populations have become a significant presence in the floodplain areas of all the major rivers in Georgia. Population estimates of these animal species in Georgia are currently not available.

White-tailed deer populations are abundant throughout the Suwannee River Basin. Fecal coliform bacteria contributions to water bodies from deer are generally considered to be 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 for terrestrial birds (GA WRD, 2007). However, feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff events. Between storm events, considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers.

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Suwannee River Basin. The animals grazing on pastureland deposit their feces onto land surfaces, where it can then 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, horses, swine, sheep, and chickens reported by county. These data were provided by the Natural Resources Conservation Service (NRCS).

Table 8. 2008 Estimated Agricultural Livestock Populations in the Suwannee River Basin

County	Livestock							
	Beef Cattle	Dairy Cattle	Swine	Sheep	Horses	Goats	Chickens Layers	Chickens-Broilers Sold
Atkinson	5,100	-	315	-	8	4,300	52,800	16,112,000
Ben Hill	2,750	-	100	-	400	1,600	-	2,904,000
Berrien	8,200	500	1,235	20	120	1,200	286,000	10,511,000
Brantley	2,700	-	50	-	200	500	-	-
Brooks	11,000	8,000	300	250	450	1,500	80,000	3,240,000
Charlton	1,700	-	175	-	30	325	-	964,800
Clinch	900	-	-	25	40	250	-	195,000
Coffee	8,700	-	5,750	100	200	7,500	39,000	31,653,960
Colquitt	14,600	500	1,800	-	892	1,275	294,000	61,991,050
Cook	2,700	90	-	50	48	700	80,000	4,752,000
Crisp	3,900	-	3,580	-	100	1,300	-	10,951,200
Dooly	2,000	275	800	-	25	200	-	36,744,000
Echols	700	-	-	-	-	-	-	-
Irwin	10,000	-	3,680	-	100	2,000	20,000	1,265,000
Lanier	4,500	-	150	25	100	600	45,000	-
Lowndes	4,000	-	-	-	600	3,500	-	-
Thomas	14,550	635	185	25	1,562	107	40,000	3,289,000
Tift	7,500	300	125	25	180	2,000	-	-
Turner	8,000	-	50	60	350	2,000	-	4,400,000
Ware	1,000	900	40	-	100	450	106,000	2,412,000
Wilcox	4,200	650	360	-	10	530	72,000	16,830,000
Worth	7,500	825	15	-	70	2,175	20,000	2,070,000

Source: NRCS, 2010

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 bacteria 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 bacteria may also enter streams from leaky sewer pipes, or during storm events when inflow and infiltration can cause sewer overflows.

3.2.3.1 Leaking Septic Systems

A portion of the fecal coliform contributions in the Suwannee 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 Suwannee River Basin existing in 2003 and the number existing in 2008, based in part on U.S. Census data, and 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 five- year period from 2004 through 2008 is given. These data show an increase in the number of septic systems in all of the counties. Often, this is a reflection of population increases outpacing the expansion of sewage collection systems.

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

County	Existing Septic Systems (2003)	Existing Septic Systems (2008)	Number of Septic Systems Installed (2004 to 2008)	Number of Septic Systems Repaired (2004 to 2008)
Atkinson	2,400	2,652	252	2
Ben Hill	4,000	4,930	930	27
Berrien	4,512	5,246	734	47
Brantley	7,621	8,482	861	35
Brooks	5,104	5,696	592	86
Charlton	3,439	3,678	239	94
Clinch	1,455	1,614	159	16
Coffee	10,953	12,811	1,858	79
Colquitt	10,921	12,525	1,604	560
Cook	3,602	4,159	557	88
Crisp	4,961	5,468	507	89
Dooly	2,460	2,515	55	31
Echols	1,194	1,330	136	25
Irwin	2,641	2,911	270	7
Lanier	2,651	3,154	503	22
Lowndes	14,866	17,289	2,423	189
Thomas	10,409	11,949	1,540	338
Tift	7,593	8,773	1,180	153
Turner	1,883	2,053	170	7
Ware	8,645	9,526	882	206
Wilcox	2,225	2,356	131	0
Worth	6,707	7,466	760	179

Source: The Georgia Dept. of Human Resources, Division of Public Health, 2010

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 4 permitted LAS systems located upstream of the listed streams in the Suwannee River Basin (Table 10).

Table 10. Permitted Land Application Systems Upstream of 303(d) Listed Segments in the Suwannee River Basin

LAS Name	303(d) Listed Stream Segment	County	Permit No.	Type	Flow (MGD)
Sanderson Farm LAS	Okapilco Creek SR 37 to Hog Creek	Colquitt	GA01-333	Industrial	1.7
	Okapilco Creek Little Creek to Rainy Creek				
	Okapilco Creek Rainy Creek to Mule Creek				
Sylvester LAS	Warrior Creek	Worth	GA02-132	Municipal	North 0.54 South 0.64
Ocilla LAS	Willacoochee RIver	Irwin	GA02-180	Municipal	0.85
Nashville LAS	Withlacoochee RIver	Berrien	GA02-049	Municipal	1.0

Source: Permitting Compliance and Enforcement Program, GA EPD, Atlanta, Georgia, 2010

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 85 known landfills in the Suwannee River Basin. Of these, 6 are active landfills, 2 are in the process of being closed and 77 are inactive or closed. Table 11 presents the landfills that are upstream of the 303(d) listed stream segments. As shown in Table 11, many of the older, inactive landfills were never permitted.

Table 11. Landfills Upstream of 303(d) Listed Segments in the Suwannee River Basin

Name	303(d) Listed Stream Segment	County	Permit No.	Type	Status
Moody Air Force Base	Alapahoochee River	Lowndes	-	NA	Inactive
Naylor	Alapahoochee River	Lowndes	-	NA	Inactive
Lowndes County SL at Lake Park	Alapahoochee River	Lowndes	092-008D(SL)	Sanitary Landfill	Inactive
Adel - Cook Co.	Morrison Creek	Cook	-	NA	Inactive
Cook County - Taylor Road PH1	Morrison Creek	Cook	037-006D(SL)	Sanitary Landfill	Ceased accepting waste
Cook Co-Taylor Road Adel	Morrison Creek	Cook	037-008D(L)	Construction and Demolition Landfill	Operating
Cook Co-Taylor Road Site 2	Morrison Creek	Cook	037-010D(MSWL)	Municipal Solid Waste Landfill	Operating
Pavo	Mule Creek	Thomas	-	NA	Inactive
Moultrie - 1st Street	Okapilco Creek Upstream SR 1540	Colquitt	035-003D(SL)	Sanitary Landfill	Inactive
Hopewell Church	Okapilco Creek SR 37 to Hog Creek	Colquitt	-	NA	Inactive
Berlin	Okapilco Creek Little Creek to Rainy Creek	Colquitt	-	NA	Inactive
Moultrie west side N/S Runway - Spence Field	Okapilco Creek Little Creek to Rainy Creek	Colquitt	035-013D(L)	Dry Trash Landfill	Inactive
Barwick	Piscola Creek	Brooks	-	NA	Inactive
Quitman - SR 333 PH1	Piscola Creek	Brooks	014-003D(SL)	Sanitary Landfill	Closed
Brooks Co. - Quitman	Piscola Creek	Brooks	014-004P(INC)	Incineration Landfill	Inactive
Homerville	Tatum Creek	Clinch	-	NA	Inactive
SR 112 Sylvester PH1	Warrior Creek	Worth	159-004D(SL)	Sanitary Landfill	Closed
Fitzgerald	Willacoochee River	Ben Hill	-	NA	Inactive
Alapaha	Willacoochee River	Berrien	-	NA	Inactive
Ocilla	Willacoochee River	Irwin	-	NA	Inactive
City of Ocilla SR 32	Willacoochee River	Irwin	077-002D(SL)	Sanitary Landfill	Inactive
Berrien Co. - SR547	Withlacoochee River	Berrien	-	NA	Inactive
Nashville	Withlacoochee River	Berrien	-	NA	Inactive
Berrien County - Brogdon Road	Withlacoochee River	Berrien	010-007D(L)	Dry Trash Landfill	Closed

Source: Land Protection Branch, GA DNR, 2009

4.0 ANALYTICAL APPROACH

The process of developing fecal coliform TMDLs for the Suwannee 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 ten of the twelve 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.

The available field measurements and water quality data used to develop the TMDLs for this document did not include stream flow data at all of the sites. In addition, several of the sites that did include stream flow data were missing flow data for some of the sample dates. Therefore, stream flows for these sites were estimated using data from a nearby USGS 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 provides the USGS stream gages used to estimate the flows for each of the listed stream segments.

Table 12. Stream Segments with Estimated Flows and Corresponding USGS Flow Gages

Stream Segment	Location	USGS Station Name	Station No.
Alapahoochee River	Confluence of Mud Creek and Grand Bay Creek to Stateline	Average of Alapaha River and Withlacoochee River	02316000 & 02319000
Piscola Creek	Downstream Whitlock Branch @ Ozell Road to Okapilco Creek near Boston	Piscola Creek at GA 38	02318778
Tatum Creek	Dickerson Millpond to Tower Road	Suwannee River at US 441	02314500
Warrior Creek	Horse Creek to Rock Creek near Norman Park	Little River near Adel, GA	02318000
Willacoochee River	SR 158 to Alapaha River	Alapaha River near Alapaha, GA	02316000
Withlacoochee River	Headwaters (Hardy Mill Creek) to New River	Withlacoochee River at McMillan Rd	023177483

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:

$$L_{critical} = C_{geomean} \times Q_{mean}$$

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 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 standard, 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:

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

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

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:

$$TMDL_{critical} = C_{standard} \times Q_{mean}$$

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 percent load reduction can be expressed as follows:

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

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, which in this case, is the seasonal fecal coliform standards. A TMDL is the sum of the individual waste load allocations (WLAs) for 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:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

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 with flows greater than 0.1 MGD from municipal and industrial wastewater treatment systems with NPDES effluent limits for fecal coliform bacteria. There are two of these facilities in the Suwannee River Basin watershed that discharge into or upstream of a listed segment. The maximum allocated fecal coliform load for these wastewater treatment facilities is 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 Suwannee River Basin

Facility Name	Permit No.	Receiving Stream	Listed Stream Segment	WLA (counts/30 days)
Homerville Industrial Park	GA0037460	Tatum Creek	Tatum Creek	7.33E+11
Valdosta Mud Creek WPCP	GA0020222	Mud Creek	Alapahoochee River	5.69E+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.

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

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, WLAsw, 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, leaking sewer system collection lines, and 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 for the 303(d) listed streams located in the Suwannee 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. 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 (Carter, 1982), and the appropriate drainage area. 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.

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

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

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

$TMDL_{winter}$ = 4,000 counts (instantaneous) /100 mL x 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 (WLA and WLA_{sw}) and nonpoint (LA) 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 the permitted 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 (WLA and WLA_{sw}), LAs, MOSs, and percent load reductions for the Suwannee River Basin 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. 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)	
Alapahoochee River	5.84E+12	6.60E+11	1.91E+10	3.36E+12	4.48E+11	4.48E+12	23
Morrison Creek	4.80E+14	-	-	7.99E+13	8.88E+12	8.88E+13	81
Mule Creek	2.11E+14	-	-	1.19E+13	1.32E+12	1.32E+13	94
Okapilco Creek Upstream SR S1540 to U.S. Hwy 319	3.40E+13	-	-	9.71E+12	1.08E+12	1.08E+13	68
Okapilco Creek SR 37 to Hog Creek, S. of Moultrie	2.19E+15	-	-	2.15E+14	2.39E+13	2.39E+14	89
Okapilco Creek Little Creek to Rainy Creek	5.87E+10	-	-	1.32E+10	1.47E+09	1.47E+10	75
Okapilco Creek Rainy Creek to Mule Creek	2.86E+13	-	-	3.96E+12	4.40E+11	4.40E+12	85
Piscola Creek	5.83E+13	-	-	1.41E+13	1.56E+12	1.56E+13	73
Tatum Creek	1.07E+12	1.59E+10	-	1.78E+11	2.15E+10	2.15E+11	80
Warrior Creek	1.10E+13	-	-	5.72E+12	6.35E+11	6.35E+12	42
Willacoochee River	9.52E+14	-	-	1.07E+14	1.19E+13	1.19E+14	88
Withlacoochee River	1.40E+13	-	-	2.52E+12	2.80E+11	2.80E+12	80

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 subwatersheds for each 303(d) listed stream segment to identify, as best as possible, the sources of the fecal coliform loads causing the stream to exceed instream standards. 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 part of a long-term process to reduce fecal coliform loading to meet water quality standards in the Suwannee 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 Ochlockonee, Saint Marys, Satilla, and Suwannee River Basins will again receive focused monitoring in 2013.

The TMDL Implementation Plan will outline an appropriate water quality monitoring program for the listed streams in the Suwannee 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 usually 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. 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, especially waterfowl can be a significant 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, where applicable.

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 Suwannee 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;
- Sustain 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. An allocation to a point source discharger does not automatically result in a permit limit or a monitoring requirement. Through its NPDES permitting process, GA EPD will determine whether a new or existing discharger has a reasonable potential of discharging fecal coliform levels equal to or greater than the total allocated load. The results of this reasonable potential analysis will determine the specific type of requirements in an individual facility's NPDES permit. As part of its analysis, the GA EPD will use its USEPA approved 2003 NPDES Reasonable Potential Procedures to determine whether monitoring requirements or effluent limitations are necessary.

Georgia is working with local governments, agricultural and forestry agencies, such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

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

7.0 INITIAL TMDL IMPLEMENTATION PLAN

7.1 Initial TMDL Implementation Plan

This plan identifies applicable State-wide programs and activities that may be employed to manage point and nonpoint sources of bacteria loads for twelve segments in the Suwannee River Basin. Local watershed planning and management initiatives will be fostered, supported, or developed through a variety of mechanisms. Implementation may be addressed by Watershed Improvement Projects, assessments for Section 319 (h) grants, the local development of watershed protection plans, or “Targeted Outreach” initiated by EPD. These initiatives will supplement or possibly replace this initial implementation plan.

7.2 Impaired Segments

This initial plan is applicable to the following waterbodies that were added to Georgia’s 303(d) list available on the EPD website (www.gaepd.org):

Water Bodies Listed on the 2008 303(d) List for Fecal Coliform Bacteria in the Suwannee River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use
Alapahoochee River	Confluence of Mud Creek and Grand Bay Creek to Stateline	11	Fishing
Morrison Creek	Adel	2	Fishing
Mule Creek	Headwaters to Reedy Creek near Pavo	8	Fishing
Okapilco Creek	Upstream SR S1540 to U.S. Hwy. 319, Moultrie	10	Fishing
Okapilco Creek	SR 37 to Hog Creek, S. of Moultrie	10	Fishing
Okapilco Creek	Little Creek to Rainy Creek	10	Fishing
Okapilco Creek	Rainy Creek to Mule Creek	5	Fishing
Piscola Creek	Downstream Whitlock Branch @ Ozell Road to Okapilco Creek near Boston	25	Fishing
Tatum Creek	Dickerson Millpond to Tower Road	6	Fishing
Warrior Creek	Horse Creek to Rock Creek near Norman Park	10	Fishing
Withlacoochee River	Headwaters (Hardy Mill Creek) to New River	17	Fishing
Willacoochee River	SR 158 to Alapaha River	11	Fishing

Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. The current water quality standard [*State of Georgia’s Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (GA EPD, 2009)] states that four or more water samples collected within a 30-day period that have a geometric mean for fecal coliform either in excess of 200 Colony Forming Units (CFU) per 100 milliliters from May through October, or in excess of 1000 (CFU) per 100 milliliters from November through April are in violation of the bacteria water quality standard. In addition, a single sample in excess of 4000 (CFU) per 100 milliliters from November through April can also provide a basis for adding a stream segment to the 303(d) listing.

7.3 Potential Sources

An important part of the TMDL analysis is the identification of potential source categories. A source assessment characterizes the known and suspected bacteria sources in the watershed.

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. Point sources of bacteria include NPDES permittees discharging treated wastewater and stormwater. Nonpoint sources of bacteria are diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land use activities that contribute bacteria to streams during a rainfall runoff event.

NPDES point source fecal coliform loads from wastewater treatment facilities usually do not contribute to impairments. This is because these facilities are required to treat to levels corresponding to instream water quality criteria. However, point sources can and do fail, which may contribute to bacteria loads through leaks and overflows from sanitary sewer systems, CAFOs, or leachate from operational landfills.

Nonpoint sources of fecal coliform in urban areas include wastes that are attributable to domestic animals, illicit discharges of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from closed landfills. In non-urban areas, potential sources of fecal coliform may include animals grazing in pastures, dry manure storage facilities and lagoons, chicken litter storage areas, and direct access of livestock to streams. Wildlife, especially waterfowl can be a significant source of fecal coliform bacteria.

7.4 Management Practices and Activities

GA EPD is responsible for administering and enforcing laws to protect the waters of the State and is the lead agency for implementing the State's Nonpoint Source Management Program. Georgia is working with local governments, agricultural and forestry agencies such as the Georgia Department of Agriculture, the Natural Resource Conservation Service (NRCS), the Georgia Soil and Water Conservation Commission (GSWCC), and the Georgia Forestry Commission (GFC) to foster implementation of BMPs that address nonpoint source pollution. The following management practices are recommended to reduce fecal coliform loads to stream segments:

- Sustained compliance with NPDES permit limits and requirements where applicable;
- Adoption of NRCS Conservation Practices for primarily agricultural lands;
- Application of BMPs appropriate to specific non-urban and urban land uses;
- Further development and streamlining of local jurisdictional mechanisms for identifying, reporting, and correcting illicit connections, breaks, and other sanitary sewer system problems;
- Adoption of local ordinances that address local water quality such as septic tanks, stormwater, and others; and
- Ongoing public education efforts on the sources of fecal coliform and common sense approaches to lessen the impact of this contaminant on surface waters.

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

7.5 Monitoring

GA EPD encourages local governments and municipalities to develop water quality monitoring programs. These programs can help pinpoint various fecal coliform sources, as well as verify the 303(d) stream segment listings. This will be particularly valuable for those segments where listing was based on limited data. In addition, regularly scheduled sampling will determine if there has been some improvement in the water quality of the listed stream segments. GA EPD is available to assist in completing a monitoring plan, preparing a Sampling Quality Assurance Plan (SQAP), and/or providing necessary training as needed.

7.6 Future Action

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

2003 Through 2008 Water Quality Monitoring Stations

Stream Segment	Location	GAEPD Monitoring Station No.	Monitoring Station Description
Alapahoochee River	Confluence of Mud and Grand Bay Cr. to Stateline	0902110302	Alapahoochee River at State Road 135 near Statenville, GA
Morrison Creek	Adel	0904050202	Morrison Creek at County Road 243 near Adel, GA
Mule Creek	Headwaters to Reedy Cr. near Pavo	0903060101	Mule Creek at County Road 274 near Barwick, GA
Okapilco Creek	Upstream SR S1540 to U.S. Hwy. 319, Moultrie	0903050101	Okapilco Creek at County Road 182 (James Buckner Road) near Moultrie, GA
Okapilco Creek	SR 37 to Hog Cr., S. of Moultrie	0903050202	Okapilco Creek at County Road 121 near Moultrie, GA
Okapilco Creek	Little Creek to Rainy Creek	0903050203	Okapilco Creek at Wesley Chapel Road near Berlin, GA
Okapilco Creek	Rainy Creek to Mule Creek	0903050402	Okapilco Creek at Coffee Road near Morven, GA
Piscola Creek	Downstream Whitlock Branch @ Ozell Road to Okapilco Creek near Boston	0903070201	Piscola Creek at State Road 38 near Dixie, GA
Piscola Creek	Downstream Whitlock Branch @ Ozell Road to Okapilco Creek near Boston	0903070303	Piscola Creek at State Road 333 below Quitman, GA
Tatum Creek	Dickerson Millpond to Tower Road	0901020101	Tatum Creek at CR 37 (Clarence Smith Rd.) near Homerville, GA
Warrior Creek	Horse Cr. to Rock Cr. near Norman Park	0904030502	Warrior Creek at State Road 256 near Norman Park, GA
Willacoochee River	SR 158 to Alapaha River	0902050401	Willacoochee River at St. Luke Church Road near Alapaha, GA
Withlacoochee River	Headwaters (Hardy Mill Creek) to New River	0903010401	Withlacoochee River at State Rd 76 (Adel Rd.) near Nashville, GA

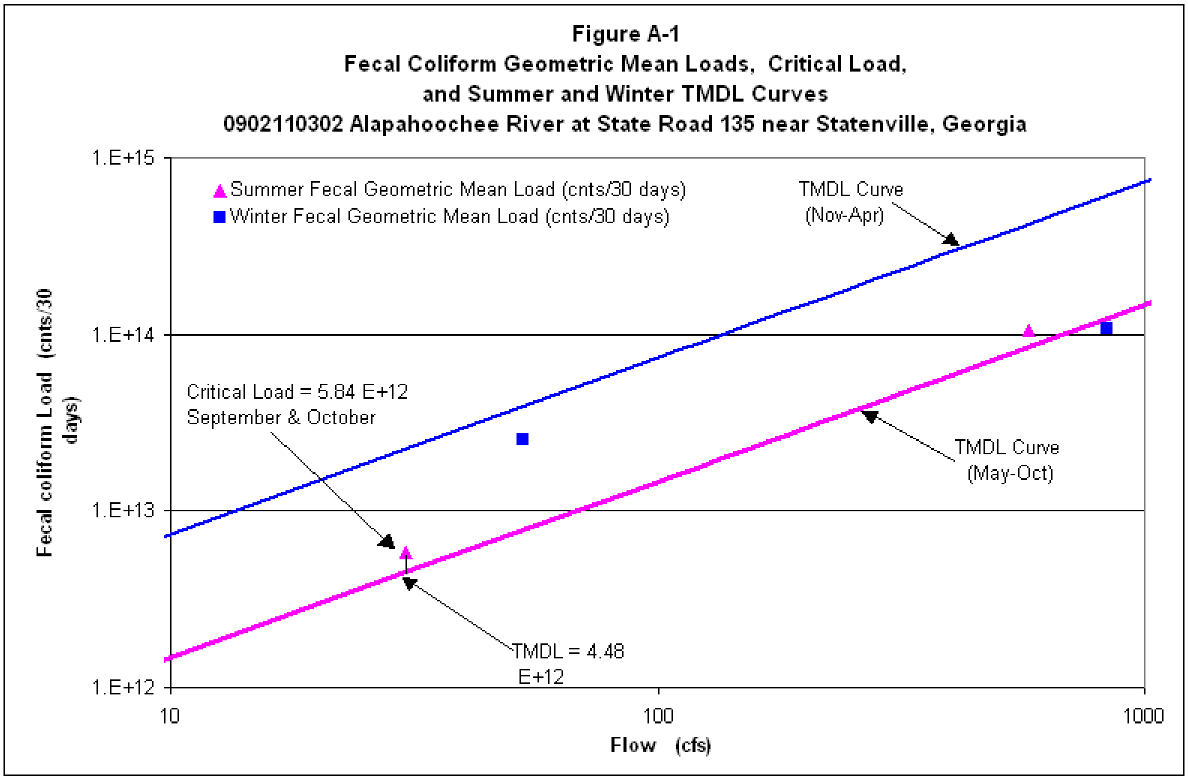


Table A-1. Data for Figure A-1

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)
3/21/2005	170	568.1				
3/23/2005	2400	773.2				
3/29/2005	110	1177.4				
4/19/2005	20	842.0	173.1	840.2	1.07E+14	6.17E+14
6/20/2005	105	915.5				
6/29/2005	1300	256.2				
7/5/2005	95	492.5				
7/13/2005	300	646.4	249.7	577.6	1.06E+14	8.48E+13
9/20/2005	300	31.4				
9/28/2005	170	27.9				
10/3/2005	300	25.9				
10/11/2005	300	37.0	**260.3**	**30.5**	**5.84E+12**	**4.48E+12**
11/28/2005	270	20.8				
12/6/2005	3700	22.9				
12/12/2005	800	60.8				
12/20/2005	230	107.7	654.8	53.0	2.55E+13	3.89E+13

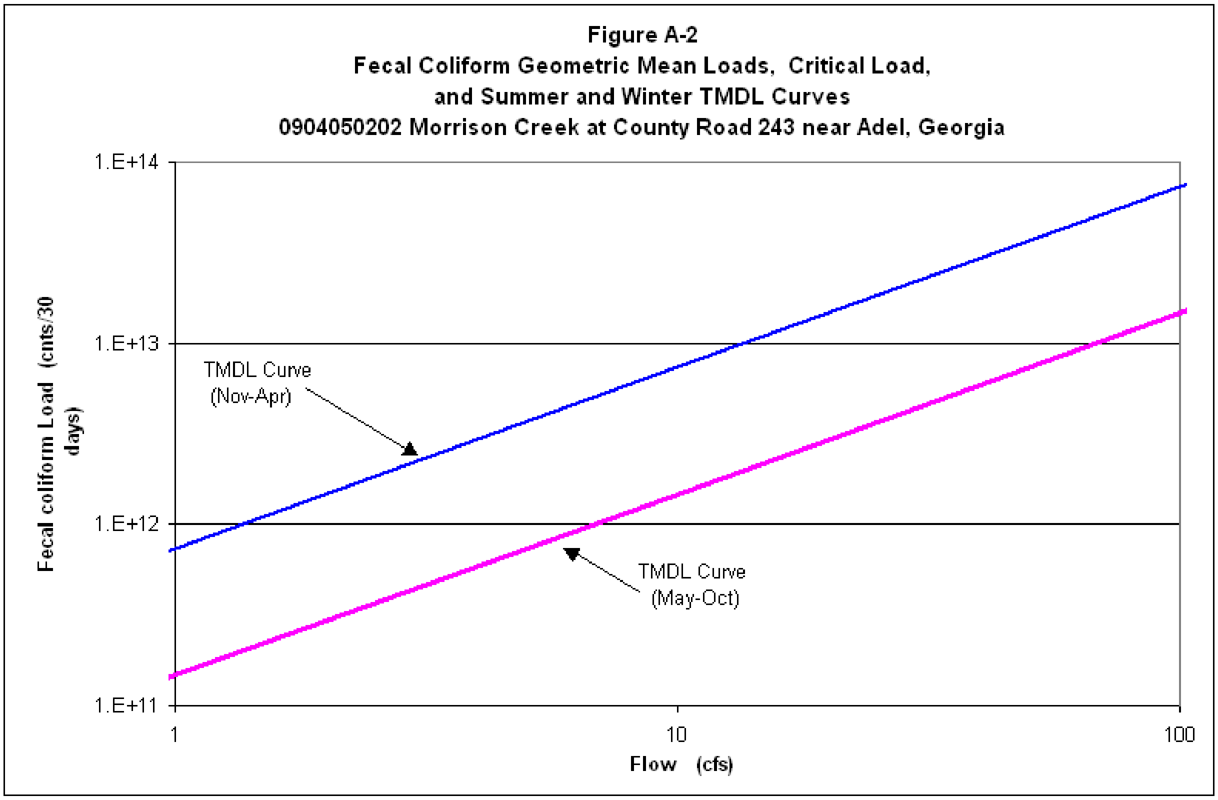


Table A-2. Data for Figure A-2

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)
2/24/2003	700	4.8				
3/3/2003	310	96.0				
3/13/2003	40	64.0				
3/17/2003	140	36.0	186.7	50.2	6.88E+12	3.68E+13
4/1/2003	130	27.0				
4/10/2003	5400	121.0				
4/15/2003	230	32.0	387.7	54.0	1.54E+13	3.96E+13
7/22/2003	230	3.0				
8/6/2003	790	46.0				
8/12/2003	460	12.0				
8/19/2003	170	63.0	**345.3**	**31.0**	**7.86E+12**	**4.55E+12**
9/9/2003	40	19.0				
9/16/2003	20	2.3				
9/23/2003	70	3.0				
10/7/2003	70	0.4	44.5	6.2	2.02E+11	9.06E+11
4/10/2003	**5400**	**121.0**	**5400.0**	**121.0**	**4.80E+14**	**8.88E+13**

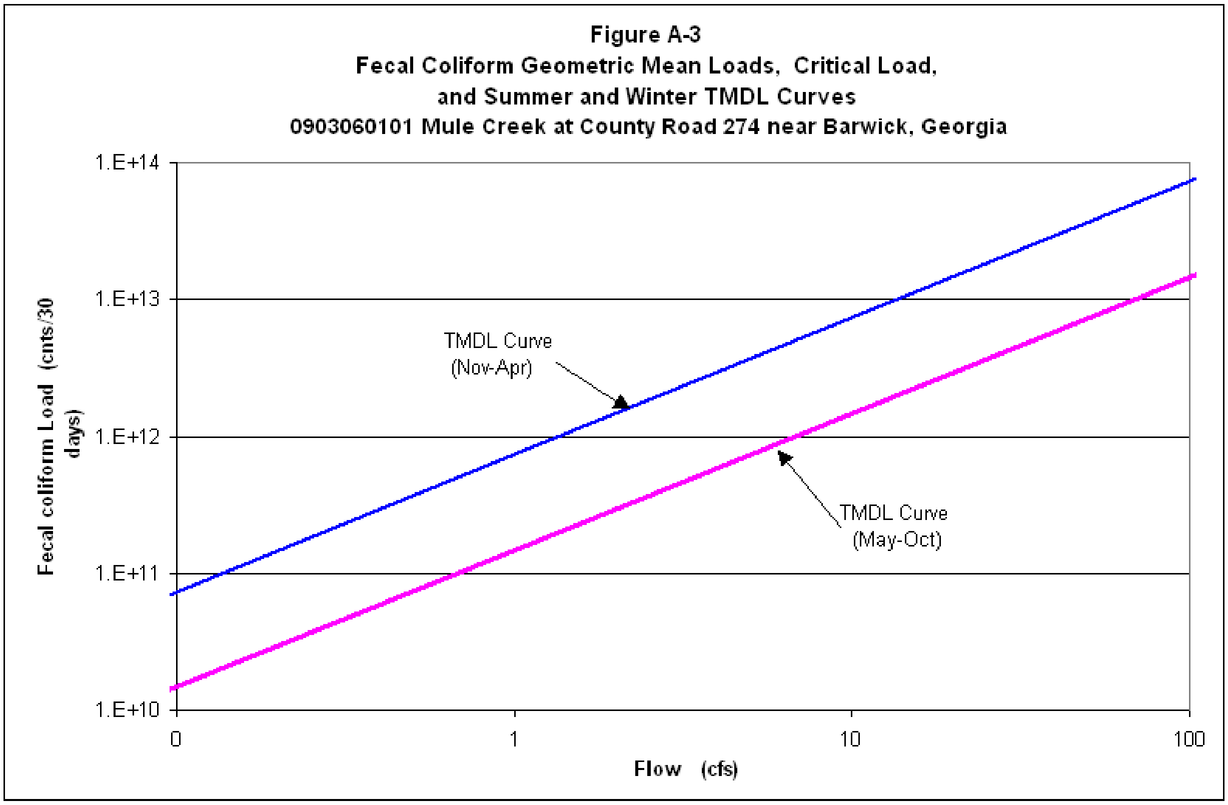


Table A-3. Data for Figure A-3

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)
2/25/2003	130	0.9				
3/4/2003	490	18.0				
3/12/2003	20	4.6				
3/18/2003	16000	18.0	377.9	10.4	2.88E+12	7.62E+12
4/2/2003	80	1.1				
4/9/2003	20	14.0				
4/16/2003	50	0.4				
7/23/2003	940	0.5				
8/5/2003	1800	0.1				
8/14/2003	330	0.2				
8/19/2003	330	0.2	655.2	0.2	1.12E+11	3.41E+10
9/10/2003	20	0.3				
9/16/2003	110	0.1				
10/8/2003	20	0.0	35.3	0.1	2.68E+09	1.52E+10
3/18/2003	**16000**	**18.0**	**16000.0**	**18.0**	**2.11E+14**	**1.32E+13**

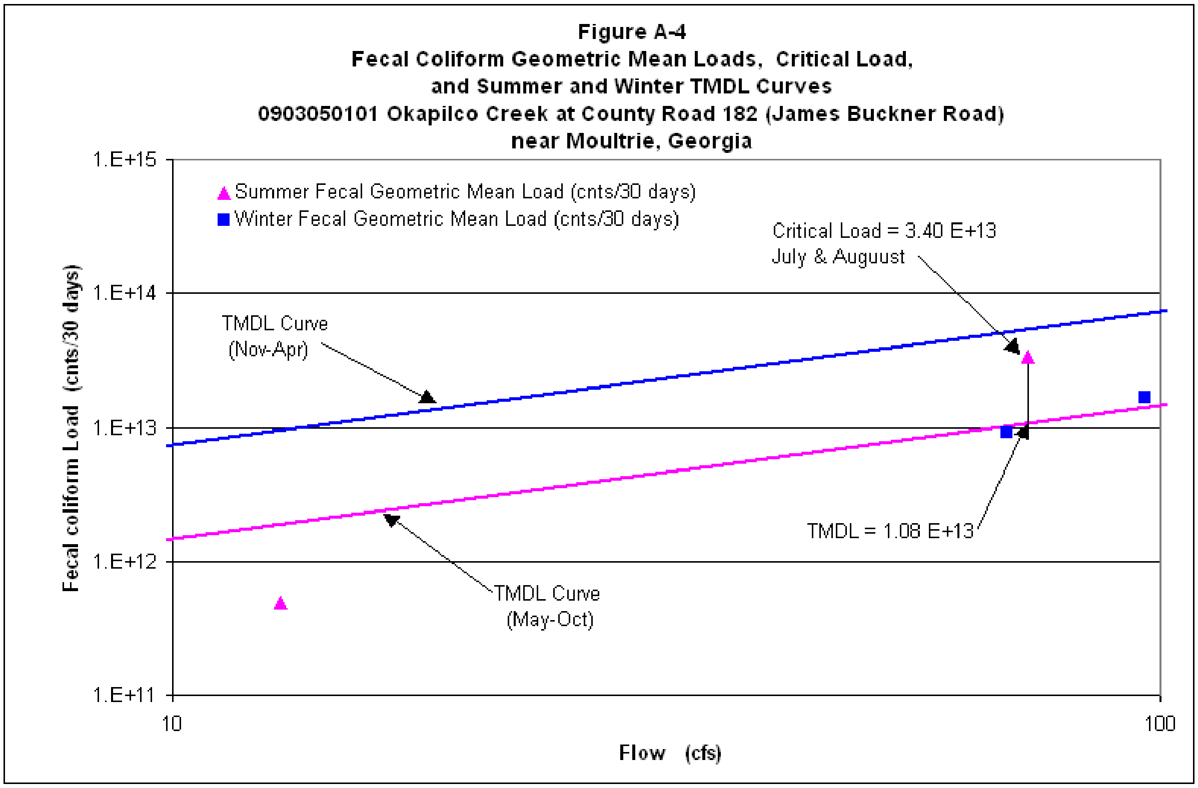


Table A-4. Data for Figure A-4

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)
24-Feb-03	140	39.0				
3-Mar-03	330	183.0				
13-Mar-03	50	65.0				
17-Mar-03	1300	99.0	234.1	96.5	1.66E+13	7.08E+13
1-Apr-03	20	23.0				
9-Apr-03	490	131.0				
15-Apr-03	80	27.0	178.7	70.0	9.18E+12	5.14E+13
22-Jul-03	16000	30.0				
6-Aug-03	230	101.0				
12-Aug-03	130	79.0				
19-Aug-03	330	84.0	**630.3**	**73.5**	**3.40E+13**	**1.08E+13**
9-Sep-03	20	37.0				
16-Sep-03	20	5.8				
23-Sep-03	110	7.7				
7-Oct-03	170	0.9	52.3	12.9	4.93E+11	1.89E+12

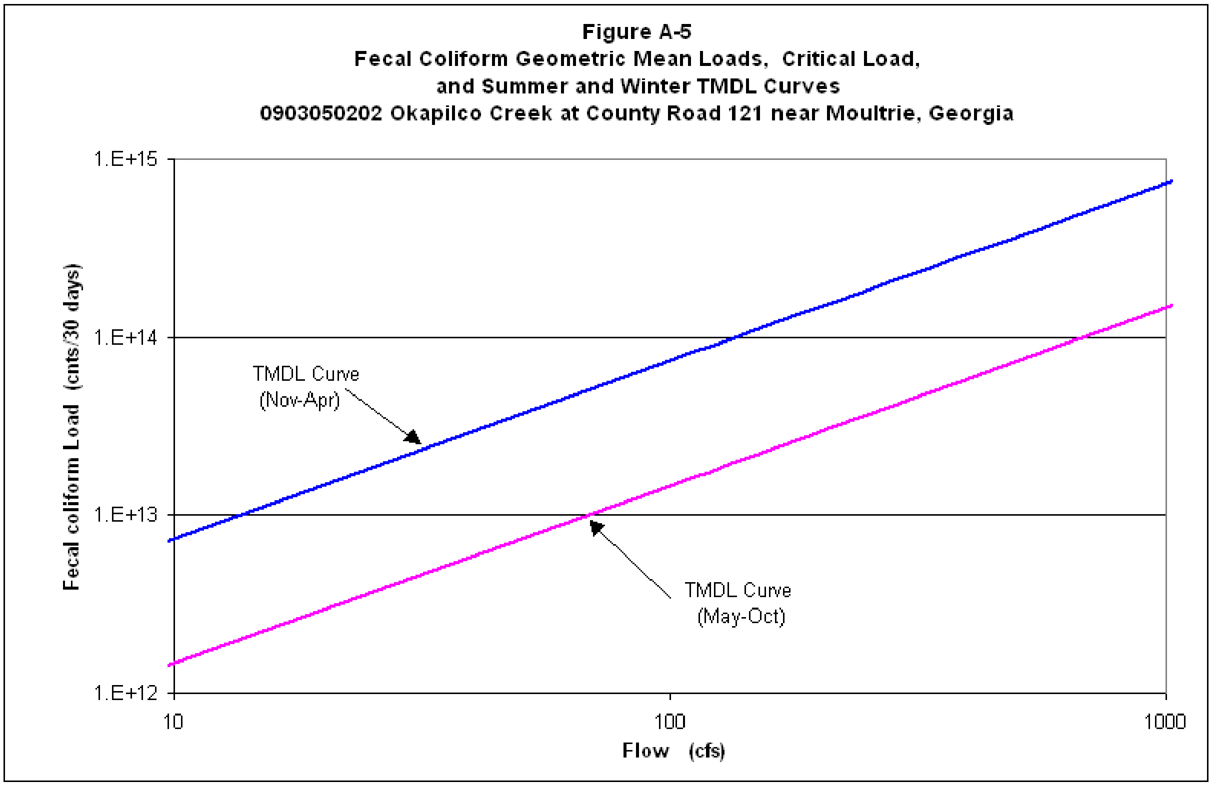


Table A-5. Data for Figure A-5

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)
2/24/2003	1700	169.0				
3/3/2003	1100	505.0				
3/13/2003	130	171.0				
3/17/2003	790	126.0	662.0	242.8	1.18E+14	1.78E+14
4/1/2003	130	67.0				
4/10/2003	9200	325.0				
4/15/2003	80	48.0	524.3	141.5	5.45E+13	1.04E+14
7/22/2003	330	5.2				
8/6/2003	330	273.0				
8/12/2003	170	143.0				
8/19/2003	330	363.0	279.6	196.1	4.02E+13	2.88E+13
9/9/2003	50	160.0				
9/16/2003	40	9.9				
9/23/2003	20	6.4				
10/7/2003	230	3.1	55.1	44.9	1.81E+12	6.58E+12
4/10/2003	**9200**	**325.0**	**9200.0**	**325.0**	**2.19E+15**	**2.39E+14**

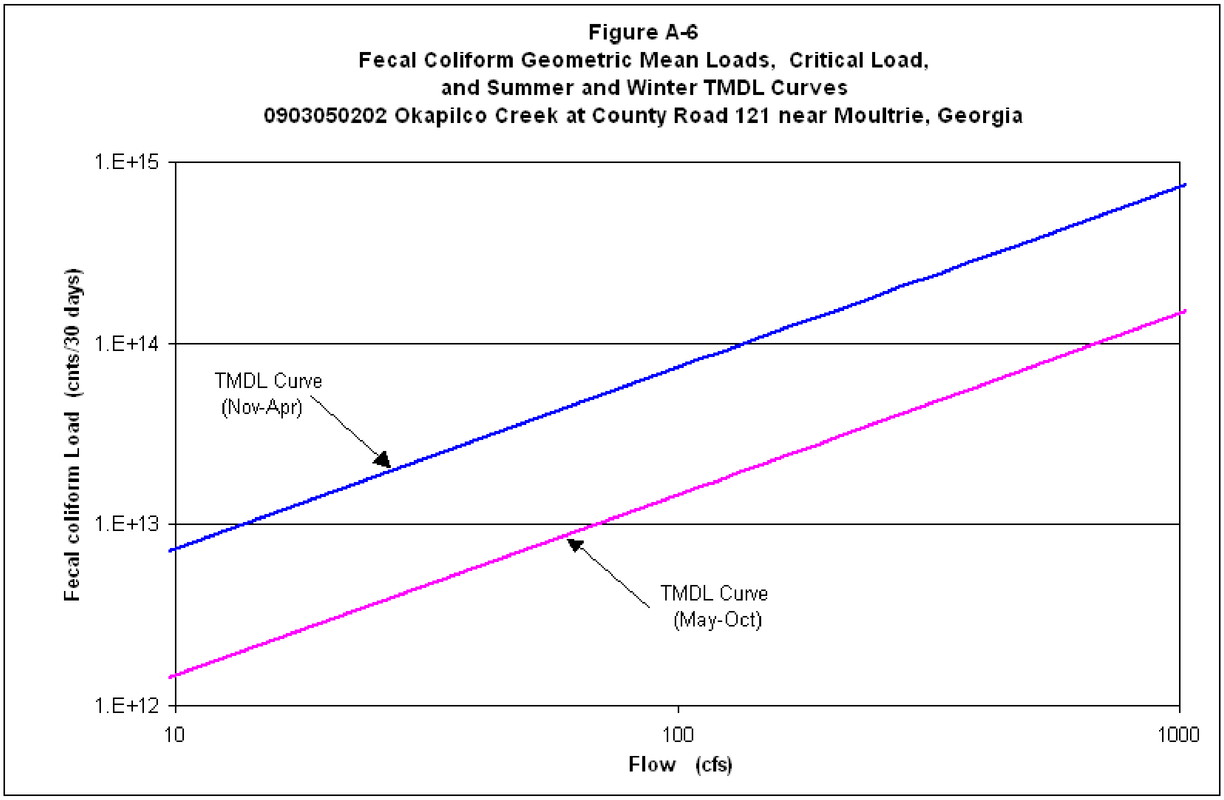


Table A-6. Data for Figure A-6

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Fecal Coliform (counts/100 ml)	Flow (cfs)	Fecal Coliform Loading (counts/30 days)	TMDL Fecal Coliform Loading (counts/30 days)
1/17/2008	500	76.0				
1/29/2008	70	122.0				
2/5/2008	80	98.0				
2/13/2008	70	53.0				
3/5/2008	330	220.0				
3/12/2008	40	239.0				
4/2/2008	80	28.0				
5/13/2008	**800**	**0.1**	**800.0**	**0.1**	**5.87E+10**	**1.47E+10**
5/21/2008	130	0.2				
8/27/2008	800	702.0				
9/9/2008	300	252.0				
9/16/2008	70	39.0				

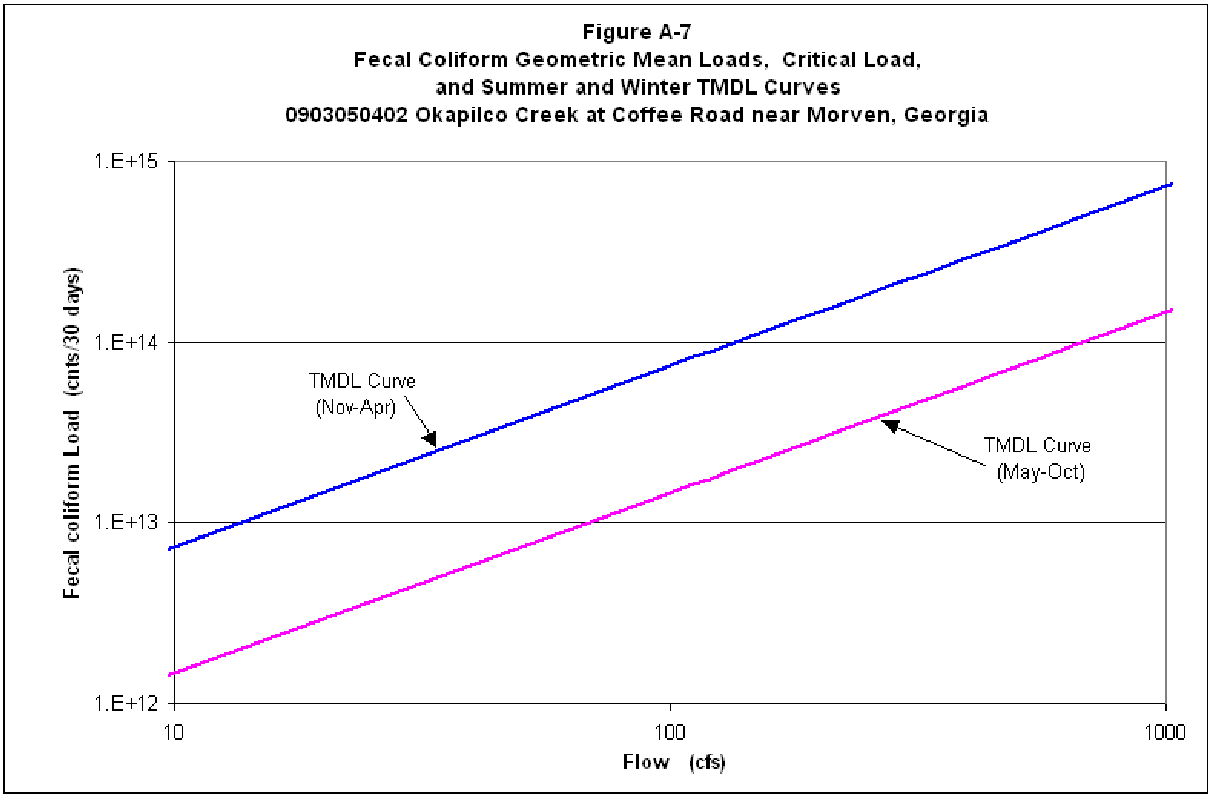


Table A-7. Data for Figure A-7

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)
1/17/2008	80	60.0				
1/28/2008	130	119.0				
2/7/2008	60	109.0				
2/13/2008	40	71.0				
3/5/2008	1700	164.0				
3/11/2008	80	351.0				
4/2/2008	20	36.0				
5/21/2008	**1300.0**	**30.0**	**1300.0**	**30.0**	**2.86E+13**	**4.40E+12**
5/21/2008	1300	30.0				
8/27/2008	800	443.0				
9/10/2008	800	228.0				
9/16/2008	70	82.0				

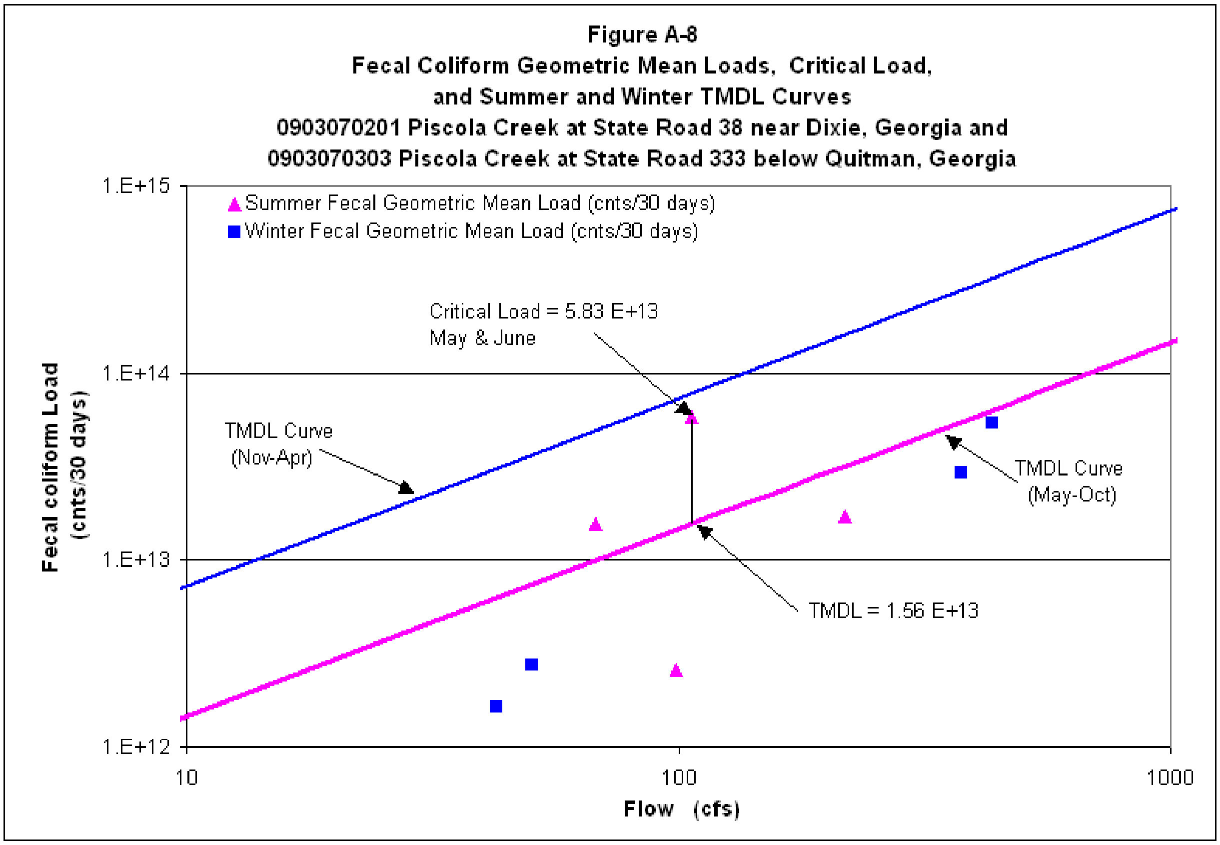


Table A-8-a. Data for Figure A-8 Sample Site 0903070201

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)
2/27/2003	230	143.0				
3/5/2003	20	455.0				
3/11/2003	330	455.0				
3/20/2003	80	455.0	105.0	377.0	2.90E+13	2.77E+14
5/20/2003	24000	16.0				
6/3/2003	60	1.3				
6/10/2003	130	208.0				
6/17/2003	50	47.0	311.0	68.1	1.55E+13	9.99E+12
7/15/2003	50	24.0				
7/29/2003	80	215.0				
8/5/2003	20	99.0				
8/12/2003	20	59.0	35.6	99.3	2.59E+12	1.46E+13
11/18/2003	20	7.0				
12/2/2003	110	49.0				
12/9/2003	20	35.0				
12/16/2003	170	80.0	52.3	42.8	1.64E+12	3.14E+13

Table A-8-b. Data for Figure A-8+L27 Sample Site 0903070303

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)
2/27/2003	940	277.0				
3/5/2003	330	500.0				
3/11/2003	130	500.0				
3/20/2003	20	466.0	168.5	435.8	5.39E+13	3.20E+14
5/20/2003	24000	62.0				
6/3/2003	170	5.0				
6/10/2003	330	221.0				
6/17/2003	230	138.0	**746.0**	**106.5**	**5.83E+13**	**1.56E+13**
7/15/2003	50	32.0				
7/29/2003	110	448.0				
8/5/2003	140	126.0				
8/12/2003	170	264.0	107.0	217.5	1.71E+13	3.19E+13
11/18/2003	20	9.0				
12/2/2003	80	56.0				
12/9/2003	40	30.0				
12/16/2003	490	106.0	74.8	50.3	2.76E+12	3.69E+13

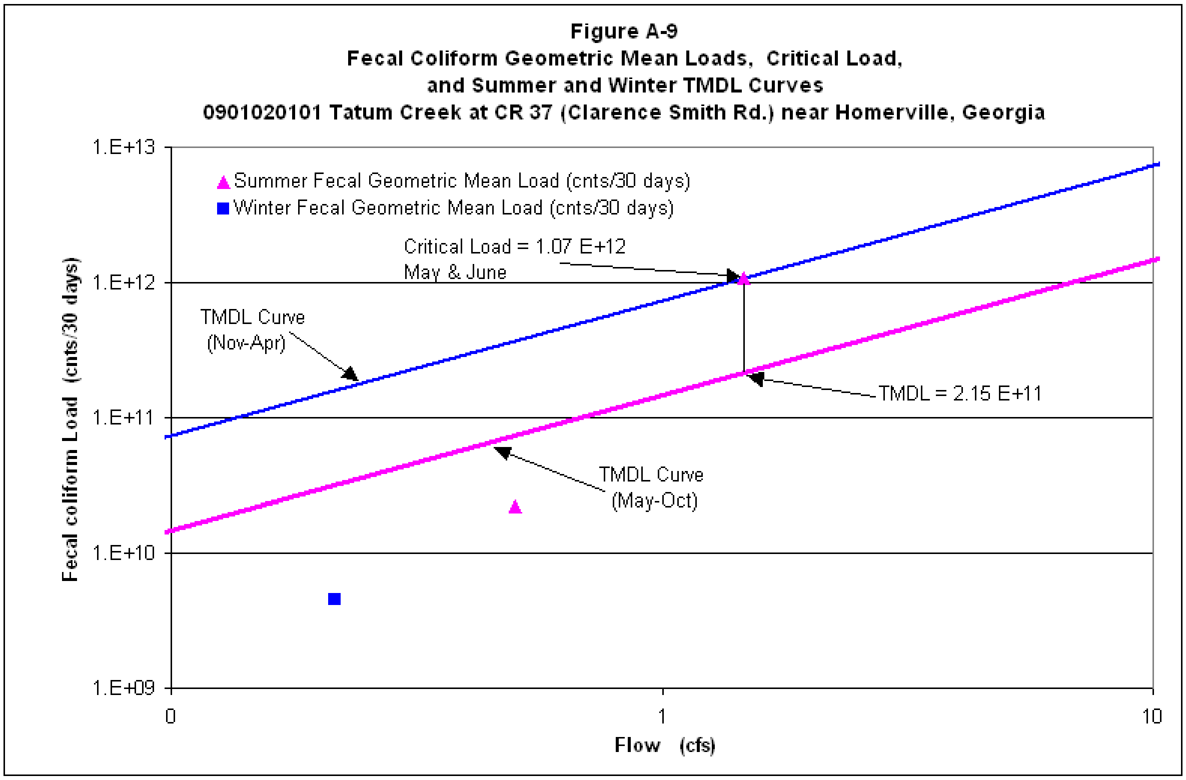


Table A-9. Data for Figure A-9

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)
5/16/2006	5000	2.2				
5/23/2006	950	1.6				
6/6/2006	80	0.9				
6/13/2006	2600	1.1	**997.0**	**1.5**	**1.07E+12**	**2.15E+11**
8/15/2006	20	0.5				
8/22/2006	260	0.6				
9/6/2006	20	0.4				
9/12/2006	130	0.5	60.6	0.5	2.24E+10	3.69E+11
11/6/2006	40	0.3				
11/14/2006	40	0.2				
11/29/2006	20	0.2				
12/6/2006	20	0.2	28.3	0.2	4.47E+09	1.58E+11

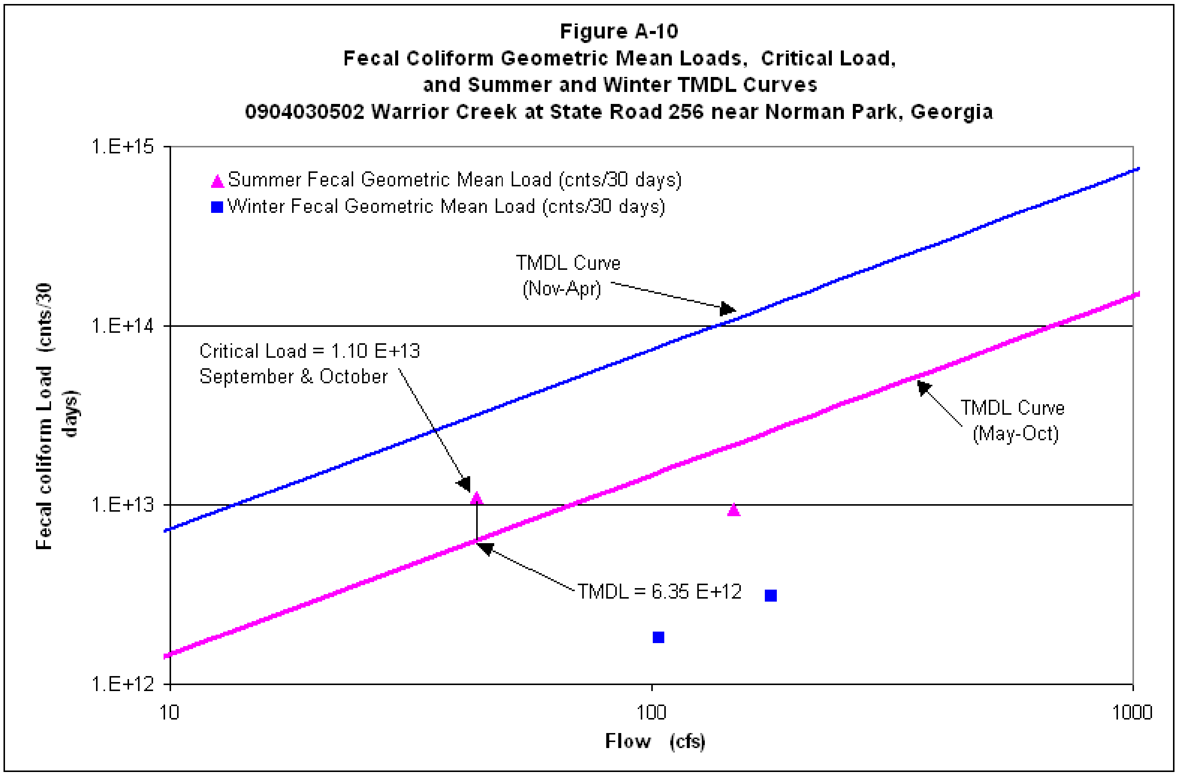


Table A-10. Data for Figure A-10

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)
1/14/2003	20	113.0				
1/30/2003	20	69.0				
2/5/2003	40	69.0				
2/11/2003	20	163.0	23.8	103.5	1.81E+12	7.60E+13
3/25/2003	20	33.0				
4/3/2003	20	145.0				
4/9/2003	20	328.0				
4/15/2003	40	202.0	23.8	177.0	3.09E+12	1.30E+14
8/20/2003	50	184.0				
9/3/2003	330	77.0				
9/10/2003	20	290.0				
9/17/2003	170	43.0	86.5	148.5	9.43E+12	2.18E+13
9/24/2003	790	93.0				
10/8/2003	330	6.0				
10/15/2003	330	31.0	**347.8**	**43.3**	**1.10E+13**	**6.35E+12**

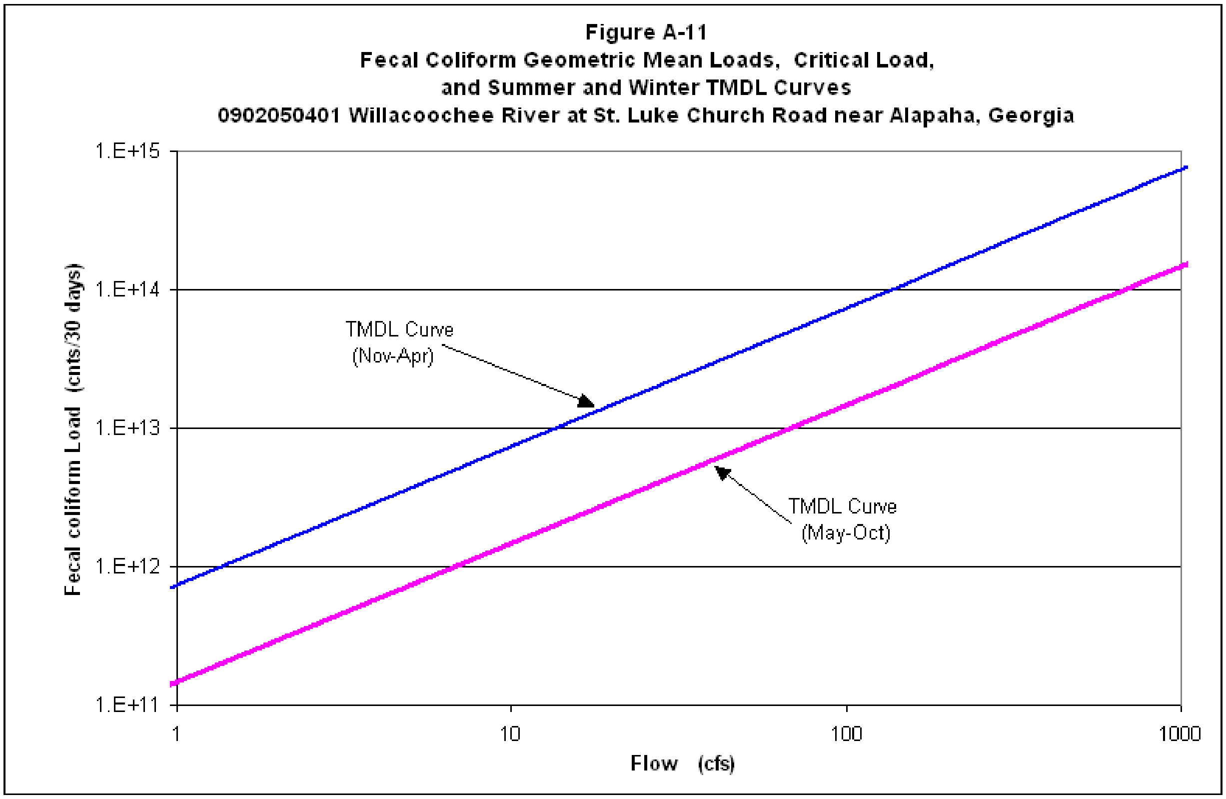


Table A-11. Data for Figure A-11

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)
2/18/2008	2300	338.4				
2/25/2008	80	889.8				
3/3/2008	50	640.1				
3/10/2008	70	770.3	159.3	659.6	7.71E+13	4.84E+14
5/13/2008	50	4.6				
5/20/2008	1100	3.9				
6/3/2008	1800	7.0				
6/10/2008	20	4.9	210.9	5.1	7.90E+11	7.49E+11
8/19/2008	20	1.4				
8/26/2008	110	4.9				
9/4/2008	400	6.0				
9/8/2008	170	3.1	110.6	3.8	3.11E+11	5.63E+11
11/3/2008	220	9.5				
11/18/2008	40	1.9				
12/1/2008	8000	162.1	412.9	57.9	1.75E+13	4.25E+13
12/1/2008	**8000**	**162.1**	**8000.0**	**162.1**	**9.5E+14**	**1.2E+14**

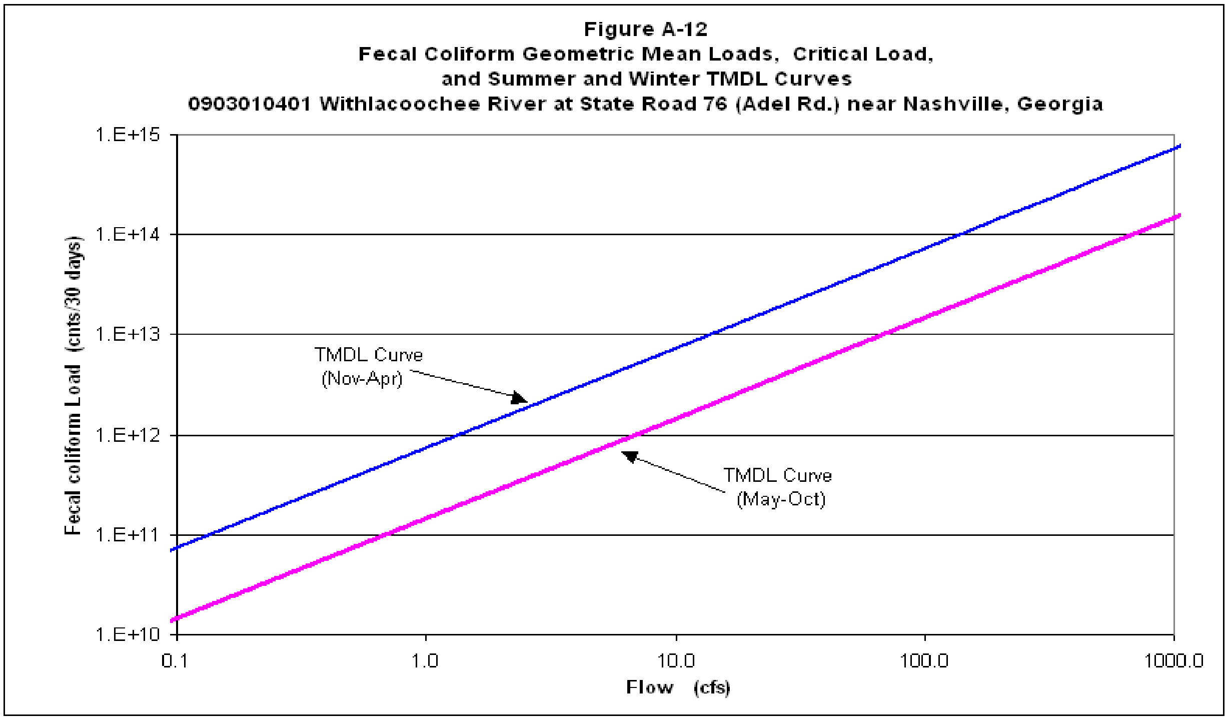


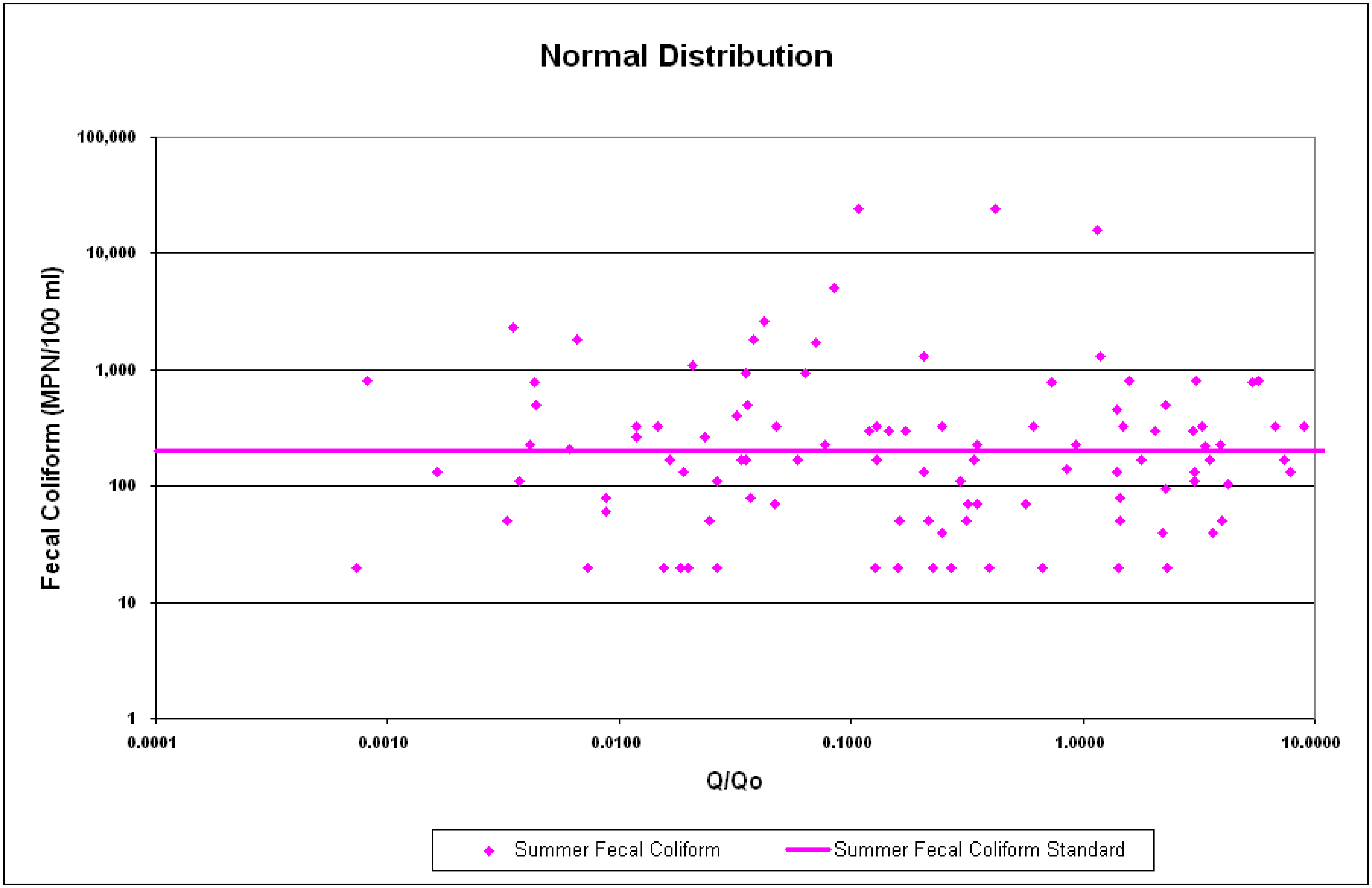
Table A-12. Data for Figure A-12

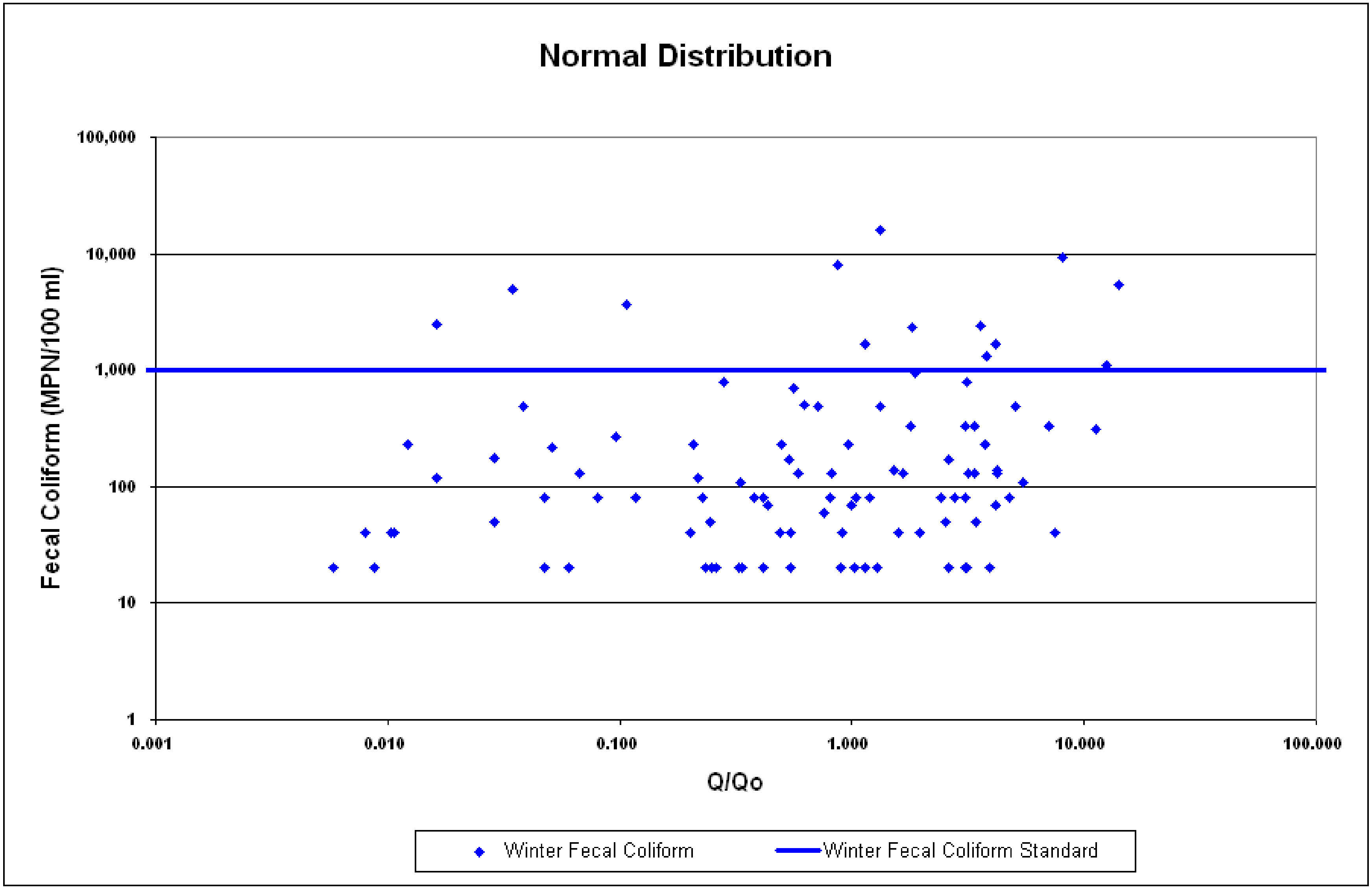
Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
1/15/2003	20	46.0				
1/27/2003	50	27.0				
2/5/2003	20	36.0				
2/13/2003	130	65.0	40	43.5	1.28E+12	3.19E+13
3/27/2003	80	309.0				
5/12/2003	170	6.5				
5/19/2003	1700	7.8				
6/2/2003	210	0.7				
6/9/2003	490	254.0	415	67.2	2.05E+13	9.87E+12
7/7/2003	220	374.0				
7/21/2003	20	14.0				
7/28/2003	40	406.0				
8/4/2003	130	869.0	69	415.8	2.11E+13	6.10E+13
11/17/2003	120	24.0				
12/1/2003	230	23.0				
12/8/2003	80	13.0				
12/15/2003	40	101.0	97	40.3	2.86E+12	2.95E+13
2/18/2008	2500	1.8				
2/25/2008	80	5.2				
3/3/2008	175	3.2				
3/10/2008	490	4.3	362	3.6	9.62E+11	2.66E+12
5/13/2008	790	0.5				
5/20/2008	490	0.5				
6/3/2008	2300	0.4				
6/10/2008	50	0.4	459	0.4	1.45E+11	6.29E+10
8/19/2008	230	0.5				
8/26/2008	500	3.9				
9/4/2008	260	1.3				
9/8/2008	80	1.0	221	1.7	2.72E+11	2.46E+11
11/3/2008	230	1.4				
11/18/2008	120	1.8				
12/1/2008	5000	3.8	517	2.3	8.83E+11	1.71E+12
12/1/2008	**5000**	**3.8**	**5000**	**3.8**	**1.40E+13**	**2.80E+12**

.

Appendix B

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
Fecal Coliform (MPN/100 ml)
100,000
10,000
1,000
100
10
1
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
Q/Qo
Summer Fecal Coliform
Summer Fecal Coliform Standard


Normal Distribution
Fecal Coliform (MPN/100 ml)
100,000
10,000
1,000
100
10
1
0.001
0.010
0.100
1.000
10.000
100.000
Q/Qo
Winter Fecal Coliform
Winter Fecal Coliform Standard