Total Maximum Daily Load

Evaluation

for

Fifty-Eight Stream Segments

in the

Coosa River Basin

for

Fecal Coliform

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

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

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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years (GA EPD, 2000-2001).

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

The State of Georgia has identified fifty-eight (58) stream segments located in the Coosa River Basin as water quality limited due to fecal coliform. A stream is placed on the partial support list if more than 10% of the samples exceed the fecal coliform criteria and on the not support list if more than 25% of the samples exceed the standard. Water quality samples collected within a 30-day period that have a geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1000 counts per 100 milliliters during the period November through April are in violation of the bacteria water quality standard. There is also a single sample maximum criteria (4000 counts per 100 milliliters) for the months of November through April. The water use classifications of all of the impacted streams are Fishing, Recreation, or Drinking Water.

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

The process of developing fecal coliform TMDLs for the Coosa 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 availability of water quality and flow data varies considerably among the listed segments. The Loading Curve Approach was used to determine the current fecal coliform load and TMDL. The fecal coliform loads and required reductions for each of the listed segments are summarized in the table below.

Fecal Loads and Required Fecal 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)	
Acworth Creek	1.43E+11		1.55E+10	6.63E+09	2.45E+09	2.45E+10	83
Allatoona Creek	4.03E+12		3.63E+11	5.15E+11	9.76E+10	9.76E+11	76
Amicalola Creek	1.81E+14			4.24E+13	4.71E+12	4.71E+13	74
Armuchee Creek	4.01E+14			5.45E+13	6.06E+12	6.06E+13	85
Beech Creek	4.96E+12		3.60E+10	7.03E+11	8.21E+10	8.21E+11	83
Big Cedar Creek/Cedar Creek	8.99E+13	3.52E+11		1.51E+13	1.72E+12	1.72E+13	81
Big Dry Creek	8.58E+12		5.26E+11	1.45E+12	2.20E+11	2.20E+12	74
Butler Creek	3.19E+12		6.69E+11	6.13E+11	1.42E+11	1.42E+12	55
Cane Creek	2.88E+12			1.61E+12	1.78E+11	1.78E+12	38
Cartecay River	3.59E+15			1.64E+15	1.82E+14	1.82E+15	49
Chattooga River - Cane Creek, Trion to Henry Branch	4.45E+13	3.07E+11		1.74E+13	1.97E+12	1.97E+13	56
Chattooga River - Henry Branch to Lyerly	4.98E+13	8.99E+11		2.14E+13	2.48E+12	2.48E+13	50
Coahula Creek	4.08E+16		7.60E+14	3.44E+15	4.67E+14	4.67E+15	89
Conasauga River - Hwy. 286 to Holly Creek	2.31E+16		2.37E+14	4.65E+15	5.43E+14	5.43E+15	76
Conasauga River - Holly Creek to Oostanaula River	1.37E+14		3.57E+12	5.87E+13	6.92E+12	6.92E+13	50
Coosa River	1.28E+16	4.60E+12	1.50E+14	5.69E+15	6.49E+14	6.49E+15	49
Coosawattee River	2.18E+14	5.10E+11		5.02E+13	5.64E+12	5.64E+13	74
Ellijay River	6.01E+13			1.00E+13	1.11E+12	1.11E+13	82
Etowah River - Clear Creek to Forsyth Co. Line	7.59E+13			2.29E+13	2.54E+12	2.54E+13	67
Etowah River - Settingdown Creek to Long Swamp Creek	1.51E+14		8.71E+12	6.33E+13	8.00E+12	8.00E+13	47
Etowah River - Lake Allatoona to Richland Creek	4.54E+14	2.09E+12	1.98E+12	2.11E+14	2.39E+13	2.39E+14	47
Etowah River - Euharlee Creek to US Hwy 411	1.28E+14		3.21E+12	1.10E+14	1.25E+13	1.25E+14	2
Etowah River - Hwy. 411 to Coosa River	4.14E+16		6.04E+14	1.56E+16	1.80E+15	1.80E+16	57
Euharlee Creek	5.46E+13	2.23E+11		1.11E+13	1.26E+12	1.26E+13	77
Flat Creek	9.90E+12			3.82E+12	4.25E+11	4.25E+12	57
Holly Creek	1.25E+13			4.00E+12	4.44E+11	4.44E+12	65
Lake Acworth	7.14E+12		6.92E+11	2.20E+12	3.21E+11	3.21E+12	55
Lake Allatoona - Little River Embayment	4600				4.00E+02	4000	13
Lake Allatoona - Carter's Creek Embayment	Improperly listed	-	-	-	-	-	0
Lake Allatoona - Tanyard Creek Embayment	Improperly listed	-	-	-	-	-	0

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)	
Little Allatoona Creek	1.30E+12		5.23E+11	3.32E+11	9.50E+10	9.50E+11	27
Little Noonday Creek	3.27E+12		6.54E+11	3.43E+11	1.11E+11	1.11E+12	66
Long Swamp Creek	8.94E+13	9.90E+08		1.70E+13	1.89E+12	1.89E+13	79
Mountaintown Creek	2.72E+13			8.92E+12	9.91E+11	9.91E+12	64
Oostanaula River - Oothkalooga Creek to Hwy 156	2.19E+14	1.66E+12	4.70E+12	1.39E+14	1.61E+13	1.61E+14	26
Oostanaula River - Hwy 156 to Hwy. 140	3.83E+14		6.92E+12	2.24E+14	2.56E+13	2.56E+14	33
Oostanaula River - Hwy 140 to Coosa River	3.83E+14		7.93E+12	2.23E+14	2.56E+13	2.56E+14	33
Owl Creek	7.16E+11		1.51E+11	1.33E+11	3.17E+10	3.17E+11	56
Pine Log Creek	5.85E+13			1.02E+13	1.14E+12	1.14E+13	81
Proctor Creek	3.32E+12		5.81E+11	5.59E+11	1.27E+11	1.27E+12	62
Pumpkinvine Creek	4.50E+14	1.32E+11	3.98E+12	4.12E+13	5.04E+12	5.04E+13	89
Raccoon Creek - U/S Chattooga River, Berryton	1.21E+13			2.01E+12	2.24E+11	2.24E+12	81
Raccoon Creek - Pegamore Lake to Etowah River	2.36E+13			3.98E+12	4.42E+11	4.42E+12	81
Rocky Creek	2.27E+12		6.17E+11	5.22E+11	1.27E+11	1.27E+12	44
Rubes Creek	4.78E+12	1.03E+11	1.10E+12	9.30E+11	2.37E+11	2.37E+12	50
Sharp Mountain Creek	1.02E+14	9.72E+10		1.72E+13	1.92E+12	1.92E+13	81
Silver Creek	1.21E+13		6.26E+11	2.94E+12	3.96E+11	3.96E+12	67
Spring Creek - Walker/Chattooga County	1.88E+13			3.20E+12	3.56E+11	3.56E+12	81
Spring Creek - Etowah River Tributary	1.26E+15			2.06E+14	2.29E+13	2.29E+14	82
Tails Creek	2.65E+13			1.37E+13	1.52E+12	1.52E+13	43
Talking Rock Creek	2.78E+13			1.17E+13	1.30E+12	1.30E+13	53
Tanyard Creek	5.04E+11		1.05E+11	9.28E+10	2.20E+10	2.20E+11	56
Tributary to Allatoona Creek	4.74E+11		1.22E+11	1.63E+11	3.17E+10	3.17E+11	33
Tributary to Oothkalooga Creek	1.69E+12			2.89E+11	3.21E+10	3.21E+11	81
Tributary to Pettit Creek	2.30E+12			1.32E+11	1.47E+10	1.47E+11	94
Two Run Creek	2.18E+14	2.07E+10		4.09E+13	4.55E+12	4.55E+13	79
Webb Creek	3.27E+12			3.37E+11	3.74E+10	3.74E+11	89
Woodward Creek	3.23E+14			5.28E+13	5.87E+12	5.87E+13	82

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.
[2] Units are in counts/100 mL.

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

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

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

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that addresses the assessment process, and are published in *Water Quality in Georgia* every two years (GA EPD, 2000-2001).

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

The Environmental Protection Agency (EPA) Region 4 approved Georgia's final 2002 303(d) list on April 30, 2002. The list identifies the waterbodies as either partially supporting or not supporting their designated use classifications, due to exceedances of water quality standards for fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. Table 1 presents the streams of the Coosa River Basin included on the 303(d) list for exceedances of the fecal coliform standard criteria. A total of 23 stream segments were listed as partially supporting their designated use, 30 stream segments were listed as not supporting their designated use, and five reservoir segments were listed as not fully supporting their designated uses.

1.2 Watershed Description

The Coosa River originates in Tennessee as the Conasauga River and in the north Georgia mountains as the Etowah, Coosawattee, and Chattooga Rivers. The Conasauga River flows south from Tennessee where it converges with the Coosawattee River near Resaca, Georgia, to form the Oostanaula River. The Coosawattee River originates in Ellijay, Georgia, by the merging of the Ellijay and Cartecay Rivers. The Coosawattee flows west from Ellijay, joins with Mountain Creek and then flows into Carter's Lake. From Carter's Lake, the Coosawattee River flows west toward Resaca where it meets the Conasauga to form the Oostanaula River The Etowah River flows southwest from Lumpkin County to Lake Allatoona. From there it flows west toward Rome, Georgia, where it merges with the Oostanaula River to form the Coosa River. The Coosa River then flows west into Alabama to Lake Weiss. The Chattooga River originates in Walker County and flows southwest into Alabama to Lake Weiss. The Coosa River flows from Lake Weiss through several other lakes and eventually flows into the Alabama River, which ultimately discharges to the Gulf of Mexico. The Coosa River Basin contains parts of the Blue Ridge, Piedmont, and Ridge and Valley physiographic provinces that extend throughout the southeastern United States.

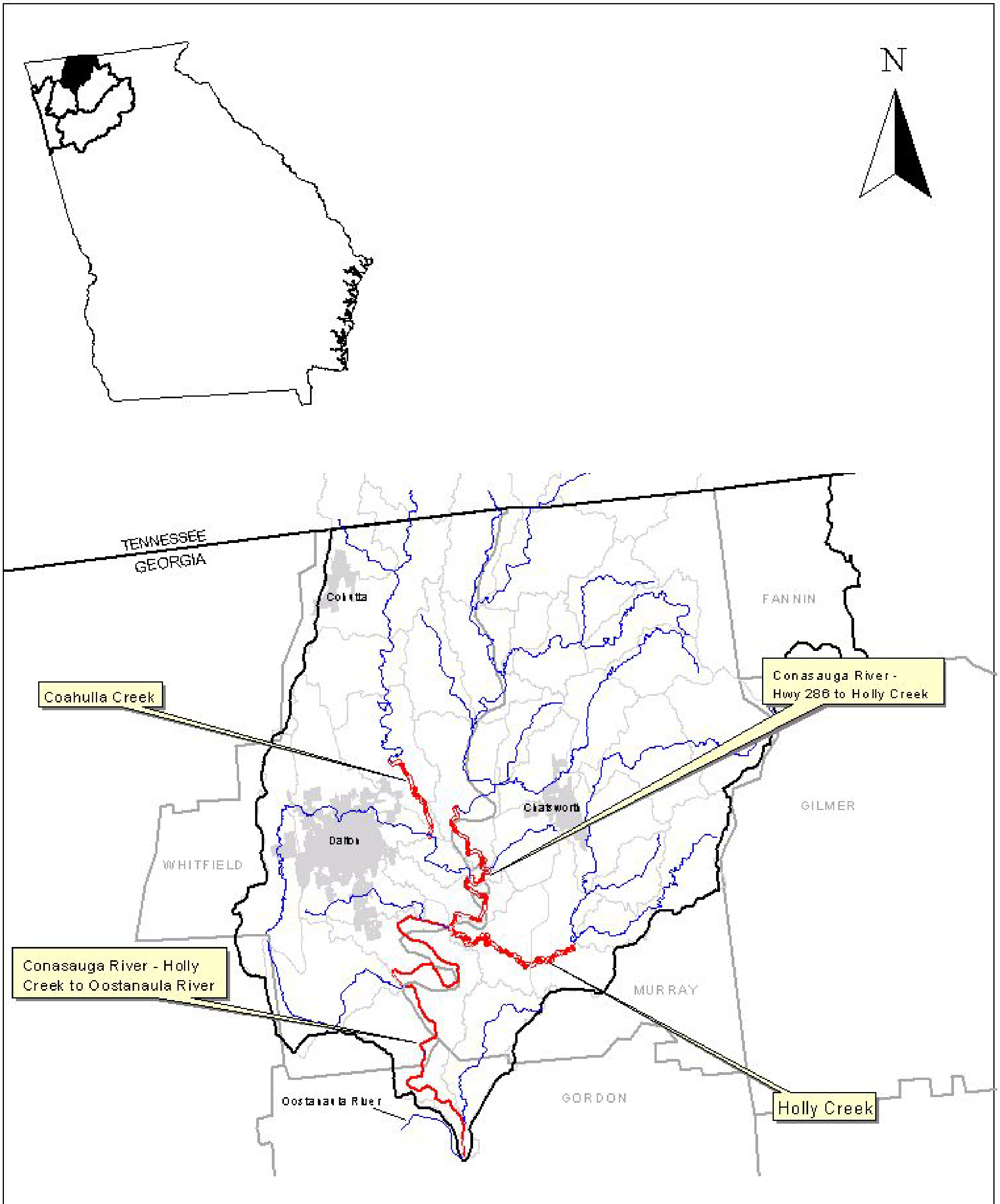
Table 1. Water Bodies Listed for Fecal Coliform Bacteria in the Coosa River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Acworth Creek	Tributary to Lake Acworth (Cobb Co.)	1	Fishing	NS
Allatoona Creek	Cobb County	9	Fishing	PS
Amicalola Creek	Headwaters near Hwy 52 to Etowah River (Dawson Co.)	24	Fishing	PS
Armuchee Creek	Oostanaula River Tributary (Floyd Co.)	20	Fishing	NS
Beech Creek	Downstream Hicks Lake, near Rome (Floyd Co.)	10	Fishing	NS
Big Cedar Creek/Cedar Creek	Cedar Creek Headwaters, Cedartown to Coosa River, Lake Weiss (Polk/Floyd Co.)	35	Fishing	NS
Big Dry Creek	Rome (Floyd Co.)	3	Fishing	NS
Butler Creek	Cobb County	6	Fishing	NS
Cane Creek	Dry Creek to Chattooga River (Walker/Chattooga Co.)	7	Fishing	PS
Cartecay River	Owltown Creek to Coosawattee River (Gilmer Co.)	3	Fishing	PS
Chattooga River	Cane Creek, Trion to Henry Branch (Chattooga Co.)	7	Fishing	NS
Chattooga River	Henry Branch to Lyerly (Chattooga Co.)	8	Fishing	PS
Coahulla Creek	Below 728 Road to Mill Creek (Whitfield Co.)	5	Fishing	PS
Conasauga River	Hwy 286 to Holly Creek (Whitfield/Murray Co.)	18	Fishing/ Drinking Water	PS
Conasauga River	Holly Creek to Oostanaula River (Murray/Gordon Co.)	24	Fishing	NS
Coosa River	Rome to Hwy 100 (Floyd Co.)	16	Fishing	NS
Coosawattee River	Confluence with Ellijay River to Mountaintown Creek (Gilmer Co.)	9	Fishing	NS
Ellijay River	Upstream Coosawattee River (Gilmer Co.)	2	Fishing	NS
Etowah River	Clear Creek to Forsyth Co. Line (Dawson Co.)	24	Fishing	PS
Etowah River	Settingdown Creek to Long Swamp Creek (Cherokee Co.)	6	Fishing	PS
Etowah River	Lake Allatoona to Richland Creek (Bartow Co.)	12	Fishing	NS
Etowah River	Euharlee Creek to US Hwy 411 (Bartow Co.)	10	Fishing	NS
Etowah River	Hwy 411 to Coosa River (Bartow/Floyd Co.)	21	Fishing	NS
Euharlee Creek	Hills Creek to upstream Plant Bowen (Bartow Co.)	4	Fishing	PS
Flat Creek	Upstream Coosawattee River (Gilmer Co.)	1	Fishing	NS
Holly Creek	Rock Creek to Conasauga River (Murray Co.)	8	Fishing	PS
Lake Acworth	Upper/Mid-Lake (Cobb County)	194 ac	Fishing	NFS
Lake Allatoona	Carter’s Creek Embayment (Bartow County)	255 ac	Recreation/ Drinking Water	NFS
Lake Allatoona	Little River Embayment (Cherokee Co.)	950 ac	Recreation/ Drinking Water	NFS
Lake Allatoona	Tanyard Creek Embayment (Bartow County)	84 ac	Recreation/ Drinking Water	NFS
Little Allatoona Creek	Cobb County	3	Recreation/ Drinking Water	NFS
Little Noonday Creek	Cobb County	3	Fishing	NS
Long Swamp Creek	Hwy 53 to Etowah River Near Ball Ground (Pickens/Gilmer Co.)	8	Fishing	PS
Mountaintown Creek	Hwy 282 to Coosawattee River (Gilmer Co.)	5	Fishing	PS
Oostanaula River	Oothkalooga Creek to Hwy 156 (Gordon Co.)	5	Fishing	PS

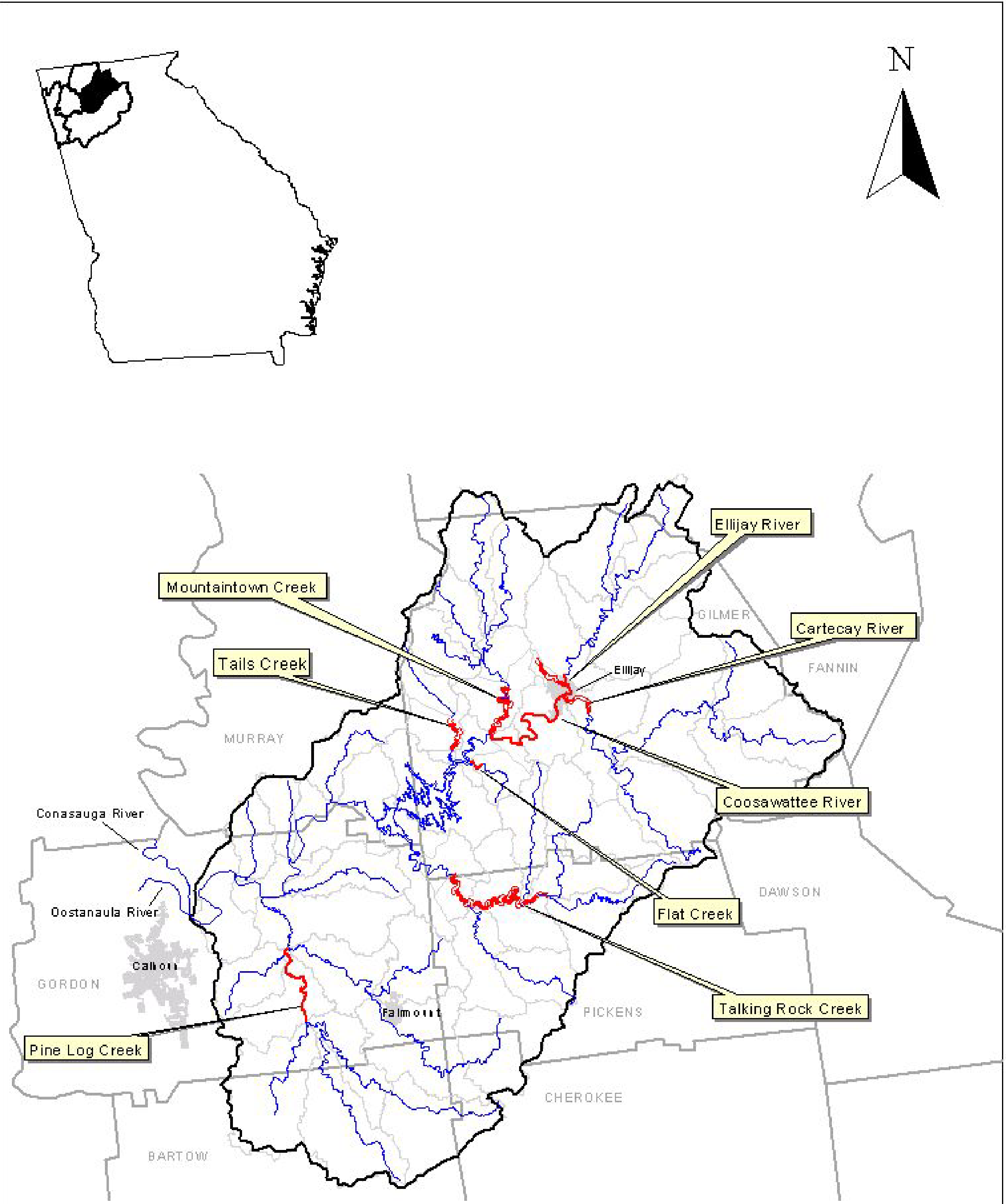
Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Oostanaula River	Hwy 156 to Hwy 140 (Gordon/Floyd Co.)	18	Fishing	PS
Oostanaula River	Hwy 140 to Coosa River (Floyd Co.)	14	Fishing	NS
Owl Creek	Lake Allatoona Tributary (Cherokee Co.)	2	Fishing	NS
Pine Log Creek	Cedar Creek to Salacoa Creek (Gordon Co.)	6	Fishing	NS
Proctor Creek	Cobb County	4	Fishing	NS
Pumpkinvine Creek	Little Pumpkinvine Creek to Etowah River (Paulding/Bartow Co.)	15	Fishing	PS
Raccoon Creek	U/S Chattooga River, Berryton (Chattooga Co.)	3	Fishing	PS
Raccoon Creek	Pegamore Lake to Etowah River (Paulding/Bartow Co.)	13	Fishing	PS
Rocky Creek	Fulton County	1	Fishing	PS
Rubes Creek	Cobb/Cherokee Counties	7	Fishing	NS
Sharp Mountain Creek	Rock Creek to Etowah River (Cherokee Co.)	14	Fishing	PS
Silver Creek	Rome (Floyd Co.)	9	Fishing	NS
Spring Creek	Walker/Chattooga County	5	Fishing	NS
Spring Creek	Etowah River Tributary (Floyd Co.)	2	Fishing	NS
Tails Creek	Hwy 282 to Carters Lake (Gilmer Co.)	3	Fishing	PS
Talking Rock Creek	Ga. Hwy 136 to Pickens/Gilmer County Line (Pickens Co.)	19	Fishing	PS
Tanyard Creek	White Lake to Lake Allatoona (Cobb Co.)	4	Fishing	NS
Tributary to Allatoona Creek	Cobb County (Midway Road)	2	Fishing	NS
Tributary to Oothkalooga Creek	Peters Street to Oothkalooga Creek, Calhoun (Gordon Co.)	1	Fishing	PS
Tributary to Pettit Creek	Cartersville (Bartow Co.)	1	Fishing	NS
Two Run Creek	Clear Creek to Etowah River (Bartow Co.)	10	Fishing	NS
Webb Creek	Coosa River Tributary (Floyd Co.)	4	Fishing	NS
Woodward Creek	Oostanaula River Tributary (Floyd Co.)	8	Fishing	NS

Notes:
PS = Partially Supporting designated uses
NS = Not Supporting designated uses
NFS = Not Fully Supporting designated uses
ac = acres

The USGS has divided the Coosa basin into five sub-basins, or Hydrologic Unit Codes (HUCs). Figures 1 through 5 show the locations of these sub-basins, the impaired segments within each sub-basin, and the associated counties within each sub-basin.

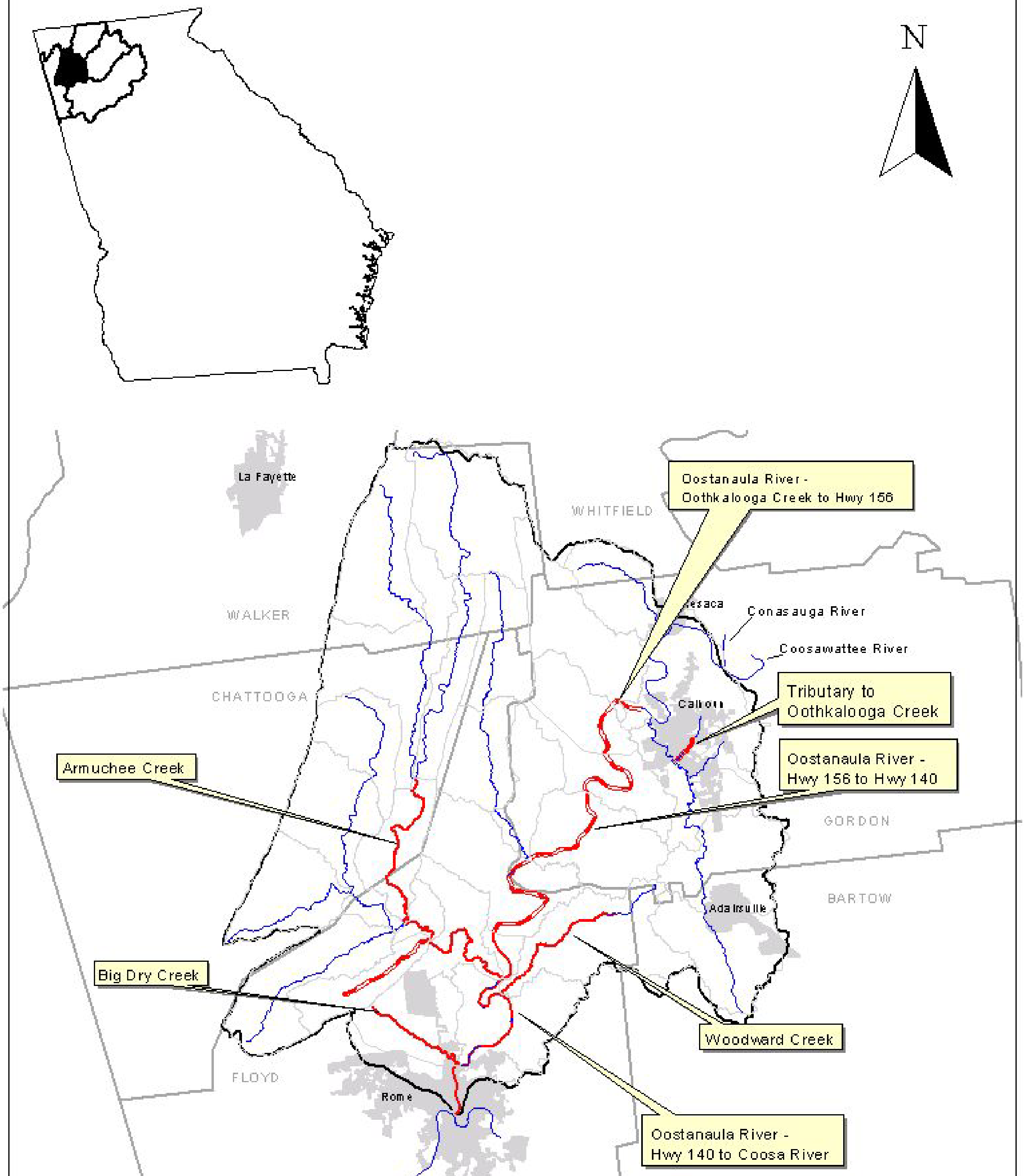


TMDL Evaluation - Fecal Coliform Coosa River Basin	Figure 1. Impaired Stream Segments in HUC 03150101



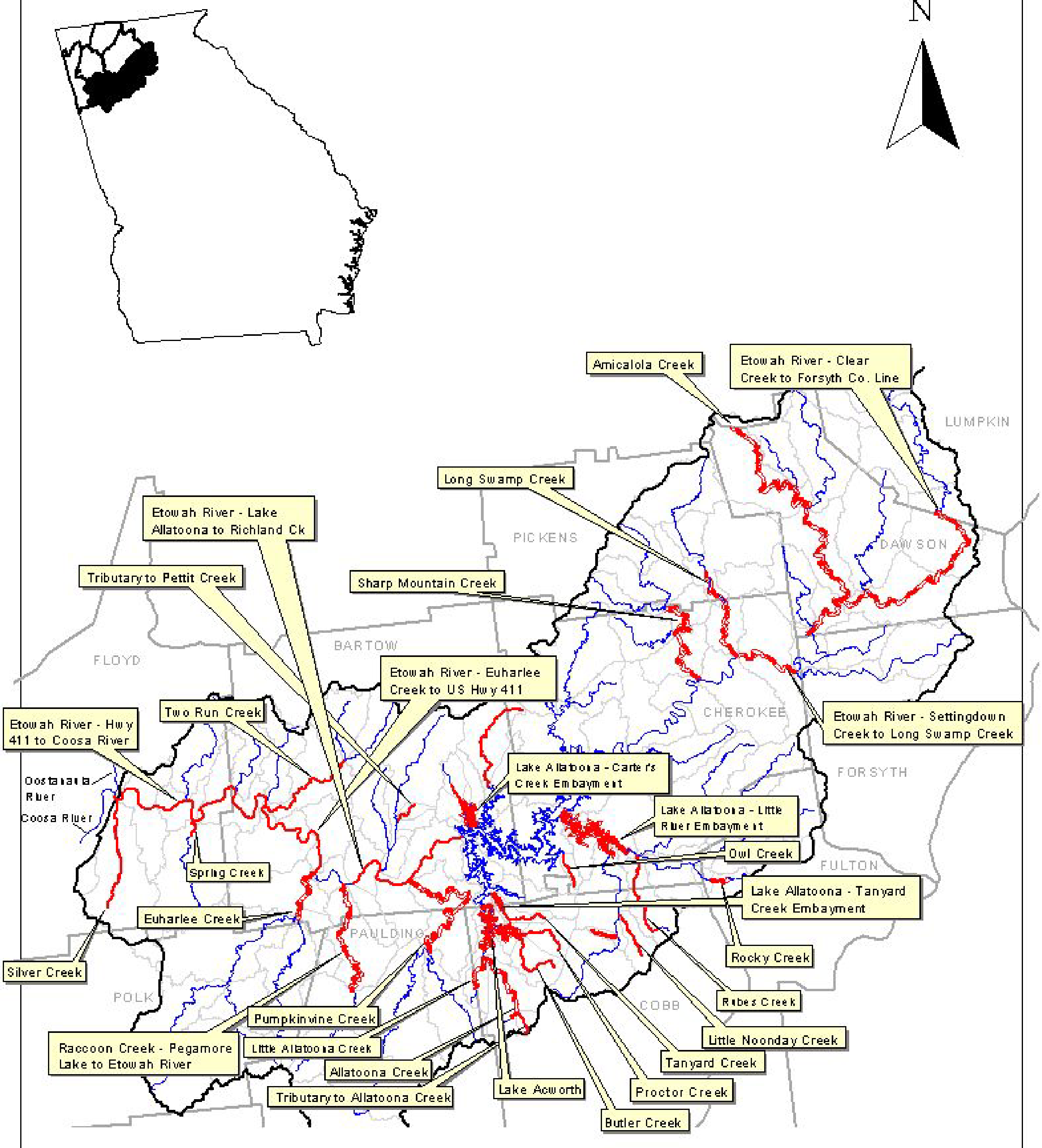
TMDL Evaluation - Fecal Coliform
Coosa River Basin

Figure 2. Impaired Stream Segments in HUC 03150102

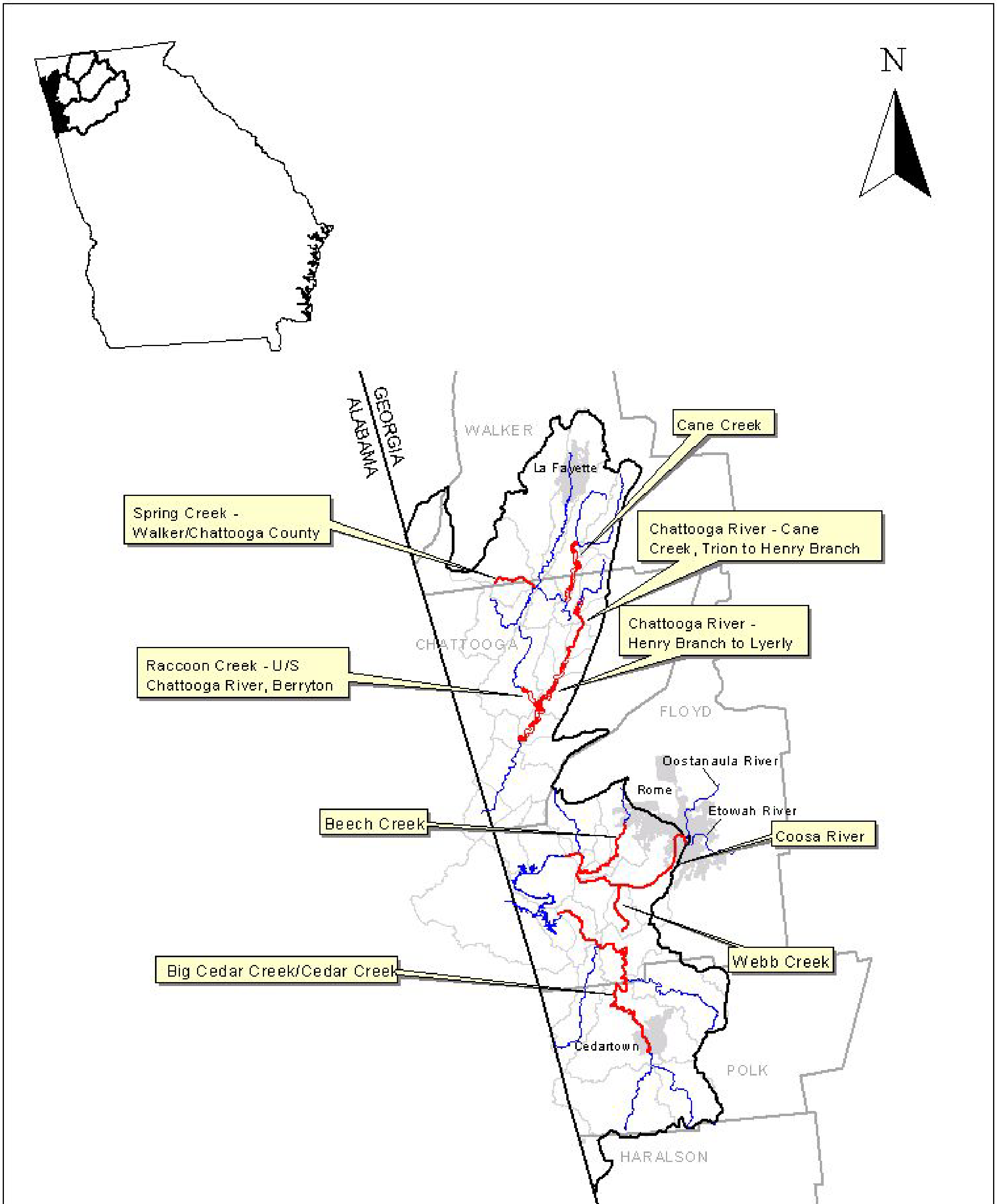


TMDL Evaluation - Fecal Coliform
Coosa River Basin

Figure 3. Impaired Stream Segments in HUC 03150103



TMDL Evaluation - Fecal Coliform Coosa River Basin	Figure 4. Impaired Stream Segments in HUC 03150104



TMDL Evaluation - Fecal Coliform
Coosa River Basin

Figure 5. Impaired Stream Segments in HUC 03150105

The land use characteristics of the Coosa River Basin watersheds were determined using data from Georgia's National Land Cover Dataset (NLCD). This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. For the thirteen metro Atlanta counties, the Atlanta Regional Commission (ARC) Landuse Coverage was used, which was derived from digital images developed in 2000. Land use classification is based on a modified Anderson level one and two system. Table 2 lists the watershed land coverage distribution of the 58 stream segments on the 303(d) list.

1.3 Water Quality Standard

The water use classifications for the listed stream segments in the Coosa River Basin are Drinking Water, Recreation, or Fishing. The criterion violated is listed as fecal coliform. The potential cause(s) listed include urban runoff, nonpoint sources, and municipal facilities. The use classification water quality standards for fecal coliform bacteria, as stated in *Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(a), 391-3-6-.03(6)(b), and 391-3-6-.03(6)(c), are:

(a) Drinking Water Supplies: Those waters approved as a source for public drinking water systems permitted or to be permitted by the Environmental Protection Division. Waters classified for drinking water supplies will also support the fishing use and any other use requiring water of a lower quality.
(i) 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.

(b) Recreation: General recreational activities such as water skiing, boating, and swimming, or for any other use requiring water of a lower quality, such as recreational fishing. These criteria are not to be interpreted as encouraging water contact sports in proximity to sewage or industrial waste discharges regardless pf treatment requirements:
(i) Bacteria: Fecal coliform not to exceed the following geometric means based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours
(1) Coastal waters 100 per 100 ml
(2) All other recreational waters 200 per 100 ml
(3) Should water quality and sanitary studies show natural fecal coliform levels exceed 200/100 ml (geometric mean) occasionally in high quality recreational waters, then the allowable geometric mean fecal coliform level shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing fresh water streams.

(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).

Table 2. Coosa River Basin Land Coverage

Stream/Segment	Landuse 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	Landuse Source
Acworth Creek	0	47	0	44	0	0	0	7	0	0	0	0	0	99	ARC
	(0.3)	(47.9)	(0.0)	(44.8)	(0.0)	(0.0)	(0.0)	(7.0)	(0.0)	(0.0)	(0.0)	(0.0)		(100.0)	
Allatoona Creek	41	6,545	0	391	0	0	475	3,981	1,232	0	85	9		12,759	ARC
	(0.3)	(51.3)	(0.0)	(3.1)	(0.0)	(0.0)	(3.7)	(31.2)	(9.7)	(0.0)	(0.7)	(0.1)		(100.0)	
Amicalola Creek	70	0	14	24	0	0	1,103	58,454	245	2,669	0	0	0	62,580	NLCD
	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(1.8)	(93.4)	(0.4)	(4.3)	(0.0)	(0.0)	(0.0)	(100.0)	
Armuchee Creek	803	0	85	189	0	823	3,928	115,231	5,851	16,686	131	491	17	144,235	NLCD
	(0.6)	(0.0)	(0.1)	(0.1)	(0.0)	(0.6)	(2.7)	(79.9)	(4.1)	(11.6)	(0.1)	(0.3)	(0.0)	(100.0)	
Beech Creek	86	0	600	185	0	78	38	13,085	826	1,327	162	110	18	16,516	NLCD
	(0.5)	(0.0)	(3.6)	(1.1)	(0.0)	(0.5)	(0.2)	(79.2)	(5.0)	(8.0)	(1.0)	(0.7)	(0.1)	(100.0)	
Big Cedar Creek/Cedar Creek	277	0	1,436	639	0	0	2,731	97,797	6,482	20,334	843	70	0	130,609	NLCD
	(0.2)	(0.0)	(1.1)	(0.5)	(0.0)	(0.0)	(2.1)	(74.9)	(5.0)	(15.6)	(0.6)	(0.1)	(0.0)	(100.0)	
Big Dry Creek	14	0	365	147	0	0	782	8,343	268	944	166	0	0	11,030	NLCD
	(0.1)	(0.0)	(3.3)	(1.3)	(0.0)	(0.0)	(7.1)	(75.6)	(2.4)	(8.6)	(1.5)	(0.0)	(0.0)	(100.0)	
Butler Creek	0	3,659	87	445	0	0	118	1,395	77	0	43	12		5,837	ARC
	(0.0)	(62.7)	(1.5)	(7.6)	(0.0)	(0.0)	(2.0)	(23.9)	(1.3)	(0.0)	(0.7)	(0.2)		(100.0)	
Cane Creek	18	0	156	39	0	0	2	20,502	564	3,528	40	0	0	24,850	NLCD
	(0.1)	(0.0)	(0.6)	(0.2)	(0.0)	(0.0)	(0.0)	(82.5)	(2.3)	(14.2)	(0.2)	(0.0)	(0.0)	(100.0)	
Cartecay River	109	0	121	72	0	30	332	81,346	233	4,606	10	0	0	86,859	NLCD
	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.4)	(93.7)	(0.3)	(5.3)	(0.0)	(0.0)	(0.0)	(100.0)	
Chattooga River	536	0	2,197	928	0	79	1,419	115,118	5,517	27,552	1,275	97	3	154,721	NLCD
Cane Creek, Trion to Henry Branch	(0.3)	(0.0)	(1.4)	(0.6)	(0.0)	(0.1)	(0.9)	(74.4)	(3.6)	(17.8)	(0.8)	(0.1)	(0.0)	(100.0)	
Chattooga River	425	0	1,302	606	0	79	546	87,762	4,042	21,240	744	53	3	116,802	NLCD
Henry Branch to Lyerly	(0.4)	(0.0)	(1.1)	(0.5)	(0.0)	(0.1)	(0.5)	(75.1)	(3.5)	(18.2)	(0.6)	(0.0)	(0.0)	(100.0)	
Coahulla Creek	143	0	1,742	485	0	334	959	49,837	4,334	21,304	845	5	0	79,988	NLCD
	(0.2)	(0.0)	(2.2)	(0.6)	(0.0)	(0.4)	(1.2)	(62.3)	(5.4)	(26.6)	(1.1)	(0.0)	(0.0)	(100.0)	
Conasauga River	719	0	5,589	2,972	0	457	4,973	241,951	16,769	51,056	2,324	547	8	327,365	NLCD
Hwy 286 to Holly Creek	(0.2)	(0.0)	(1.7)	(0.9)	(0.0)	(0.1)	(1.5)	(73.9)	(5.1)	(15.6)	(0.7)	(0.2)	(0.0)	(100.0)	
Conasauga River	1,497	0	7,728	5,658	1	515	9,124	320,504	19,766	61,196	3,119	647	8	429,763	NLCD
Holly Creek to Oostanaula River	(0.3)	(0.0)	(1.8)	(1.3)	(0.0)	(0.1)	(2.1)	(74.6)	(4.6)	(14.2)	(0.7)	(0.2)	(0.0)	(100.0)	

Stream/Segment	Landuse 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	Landuse Source
Coosa River	8,219	17,137	18,226	15,046	4	3,060	35,685	1,131,142	81,026	202,183	8,359	4,815	254	1,525,155	ARC/
	(0.5)	(1.1)	(1.2)	(1.0)	(0.0)	(0.2)	(2.3)	(74.2)	(5.3)	(13.3)	(0.5)	(0.3)	(0.0)	(100.0)	NLCD
Coosawattee River	314	0	641	446	0	178	370	147,449	386	7,043	110	0	0	156,937	NLCD
	(0.2)	(0.0)	(0.4)	(0.3)	(0.0)	(0.1)	(0.2)	(94.0)	(0.2)	(4.5)	(0.1)	(0.0)	(0.0)	(100.0)	
Ellijay River	89	0	203	151	0	117	1	56,470	139	1,858	50	0	0	59,078	NLCD
	(0.2)	(0.0)	(0.3)	(0.3)	(0.0)	(0.2)	(0.0)	(95.6)	(0.2)	(3.1)	(0.1)	(0.0)	(0.0)	(100.0)	
Etowah River	209	0	120	169	0	0	3,563	177,747	1,036	9,030	46	0	0	191,920	NLCD
Clear Creek to Forsyth Co. Line	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(1.9)	(92.6)	(0.5)	(4.7)	(0.0)	(0.0)	(0.0)	(100.0)	
Etowah River	618	10,199	128	930	16	150	4,769	205,526	23,405	10,266	304	144	0	256,455	ARC/
Settingdown Ck to Long Swamp Ck	(0.2)	(4.0)	(0.0)	(0.4)	(0.0)	(0.1)	(1.9)	(80.1)	(9.1)	(4.0)	(0.1)	(0.1)	(0.0)	(100.0)	NLCD
Etowah River	874	14,982	2,198	2,901	0	440	1,202	105,448	10,471	8,952	1,010	1,063	61	149,602	ARC/
Lake Allatoona to Richland Creek	(0.6)	(10.0)	(1.5)	(1.9)	(0.0)	(0.3)	(0.8)	(70.5)	(7.0)	(6.0)	(0.7)	(0.7)	(0.0)	(100.0)	NLCD
Etowah River	1,906	16,580	2,990	3,567	2	1,028	5,461	235,760	23,649	34,881	1,466	1,966	145	329,401	ARC/
Euharlee Creek to US Hwy 411	(0.6)	(5.0)	(0.9)	(1.1)	(0.0)	(0.3)	(1.7)	(71.6)	(7.2)	(10.6)	(0.4)	(0.6)	(0.0)	(100.0)	NLCD
Etowah River	2,672	16,580	5,432	4,896	2	1,050	8,102	347,738	29,608	52,847	2,415	2,156	145	473,498	NLCD
Hwy 411 to Coosa River	(0.6)	(3.5)	(1.1)	(1.0)	(0.0)	(0.2)	(1.7)	(73.4)	(6.3)	(11.2)	(0.5)	(0.5)	(0.0)	(100.0)	
Euharlee Creek	443	0	711	502	2	338	1,695	79,331	9,444	19,640	432	716	78	113,332	ARC
	(0.4)	(0.0)	(0.6)	(0.4)	(0.0)	(0.3)	(1.5)	(70.0)	(8.3)	(17.3)	(0.4)	(0.6)	(0.1)	(100.0)	
Flat Creek	8	0	1	6	0	0	0	3,807	21	571	1	0	0	4,413	ARC
	(0.2)	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(86.3)	(0.5)	(12.9)	(0.0)	(0.0)	(0.0)	(100.0)	
Holly Creek	53	0	520	282	0	58	2,747	65,142	803	4,730	68	102	0	74,504	NLCD
	(0.1)	(0.0)	(0.7)	(0.4)	(0.0)	(0.1)	(3.7)	(87.4)	(1.1)	(6.3)	(0.1)	(0.1)	(0.0)	(100.0)	
Lake Acworth	611	15,651	168	2,550	0	0	1,173	10,496	1,930	0	532	81	27,360	60,552	ARC
	(1.0)	(25.8)	(0.3)	(4.2)	(0.0)	(0.0)	(1.9)	(17.3)	(3.2)	(0.0)	(0.9)	(0.1)	(45.2)	(100.0)	
Lake Allatoona	257	0	73	34	0	0	97	14,135	108	527	23	0	33	15,287	NLCD
Carter's Creek Embayment	(1.7)	(0.0)	(0.5)	(0.2)	(0.0)	(0.0)	(0.6)	(92.5)	(0.7)	(3.4)	(0.2)	(0.0)	(0.2)	(100.0)	
Lake Allatoona	1,620	57,516	1,034	10,489	0	301	3,065	37,920	21,136	178	3,009	700	0	136,968	ARC
Little River Embayment	(1.2)	(42.0)	(0.8)	(7.7)	(0.0)	(0.2)	(2.2)	(27.7)	(15.4)	(0.1)	(2.2)	(0.5)	(0.0)	(100.0)	

Stream/Segment	Landuse 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	Landuse Source
Lake Allatoona	33	0	495	154	0	0	7	1,978	16	44	77	0	1	2,805	ARC/
Tanyard Creek Embayment	(1.2)	(0.0)	(17.6)	(5.5)	(0.0)	(0.0)	(0.2)	(70.5)	(0.6)	(1.6)	(2.7)	(0.0)	(0.0)	(100.0)	NLCD
Little Allatoona Creek	13	1,389	0	96	0	0	171	1,758	275	0	154	0	0	3,856	ARC
	(0.3)	(36.0)	(0.0)	(2.5)	(0.0)	(0.0)	(4.4)	(45.6)	(7.1)	(0.0)	(4.0)	(0.0)	(0.0)	(100.0)	
Little Noonday Creek	22	3,585	143	616	0	0	0	220	79	0	92	0	0	4,756	ARC
	(0.5)	(75.4)	(3.0)	(12.9)	(0.0)	(0.0)	(0.0)	(4.6)	(1.7)	(0.0)	(1.9)	(0.0)	(0.0)	(100.0)	
Long Swamp Creek	267	559	221	103	0	256	359	46,044	90	1,222	70	0	0	49,191	ARC/
	(0.5)	(1.1)	(0.4)	(0.2)	(0.0)	(0.5)	(0.7)	(93.6)	(0.2)	(2.5)	(0.1)	(0.0)	(0.0)	(100.0)	NLCD
Mountaintown Creek	78	0	14	15	0	0	96	45,348	40	1,053	2	0	0	46,646	NLCD
	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.2)	(97.2)	(0.1)	(2.3)	(0.0)	(0.0)	(0.0)	(100.0)	
Oostanaula River	2,989	557	10,546	8,631	2	575	20,740	552,987	37,732	112,730	4,763	1,042	31	753,325	NLCD
Oothkalooga Creek to Hwy 156	(0.4)	(0.1)	(1.4)	(1.1)	(0.0)	(0.1)	(2.8)	(73.4)	(5.0)	(15.0)	(0.6)	(0.1)	(0.0)	(100.0)	
Oostanaula River	3,692	557	10,671	8,919	2	575	22,715	605,858	41,175	122,026	4,826	1,557	55	822,628	NLCD
Hwy 156 to Hwy 140	(0.4)	(0.1)	(1.3)	(1.1)	(0.0)	(0.1)	(2.8)	(73.6)	(5.0)	(14.8)	(0.6)	(0.2)	(0.0)	(100.0)	
Oostanaula River	4,828	557	11,002	9,528	2	1,524	27,261	736,823	48,439	143,638	5,421	2,095	74	991,191	NLCD
Hwy 140 to Coosa River	(0.5)	(0.1)	(1.1)	(1.0)	(0.0)	(0.2)	(2.8)	(74.3)	(4.9)	(14.5)	(0.5)	(0.2)	(0.0)	(100.0)	
Owl Creek	7	894	128	124	0	0	4	251	118	0	1	0		1,525	ARC
	(0.4)	(58.6)	(8.4)	(8.1)	(0.0)	(0.0)	(0.3)	(16.4)	(7.7)	(0.0)	(0.0)	(0.0)		(100.0)	
Pine Log Creek	152	0	70	145	0	0	2,153	59,349	3,368	15,822	167	4	0	81,230	NLCD
	(0.2)	(0.0)	(0.1)	(0.2)	(0.0)	(0.0)	(2.7)	(73.1)	(4.1)	(19.5)	(0.2)	(0.0)	(0.0)	(100.0)	
Proctor Creek	6	2,060	81	1,067	0	0	383	1,155	217	0	83	0	0	5,054	ARC
	(0.1)	(40.8)	(1.6)	(21.1)	(0.0)	(0.0)	(7.6)	(22.9)	(4.3)	(0.0)	(1.6)	(0.0)	(0.0)	(100.0)	
Pumpkinvine Creek	287	14,832	159	989	0	257	931	65,696	5,314	763	131	828	9	90,196	ARC/
	(0.3)	(16.4)	(0.2)	(1.1)	(0.0)	(0.3)	(1.0)	(72.8)	(5.9)	(0.8)	(0.1)	(0.9)	(0.0)	(100.0)	NLCD
Raccoon Creek	38	0	43	39	0	0	873	12,939	662	4,042	51	0	0	18,687	NLCD
U/S Chattooga River, Berryton	(0.2)	(0.0)	(0.2)	(0.2)	(0.0)	(0.0)	(4.7)	(69.2)	(3.5)	(21.6)	(0.3)	(0.0)	(0.0)	(100.0)	
Raccoon Creek-	86	1,425	20	35	0	0	621	30,270	1,301	1,400	0	29	0	35,187	ARC/
Pegamore Lake to Etowah River	(0.2)	(4.0)	(0.1)	(0.1)	(0.0)	(0.0)	(1.8)	(86.0)	(3.7)	(4.0)	(0.0)	(0.1)	(0.0)	(100.0)	NLCD
Rocky Creek	38	2,333	14	129	0	0	55	458	315	0	137	20	0	3,497	ARC
	(1.1)	(66.7)	(0.4)	(3.7)	(0.0)	(0.0)	(1.6)	(13.1)	(9.0)	(0.0)	(3.9)	(0.6)	(0.0)	(100.0)	
Rubes Creek	24	6,314	79	733	0	0	228	1,472	449	0	110	250	0	9,660	ARC
	(0.3)	(65.4)	(0.8)	(7.6)	(0.0)	(0.0)	(2.4)	(15.2)	(4.6)	(0.0)	(1.1)	(2.6)	(0.0)	(100.0)	

	Landuse 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	Landuse Source
Sharp Mountain Creek	100 (0.2)	2,158 (4.5)	494 (1.0)	1,053 (2.2)	0 (0.0)	12 (0.0)	385 (0.8)	37,153 (77.0)	4,085 (8.5)	2,655 (5.5)	182 (0.4)	0 (0.0)	0 (0.0)	48,277 (100.0)	ARC/ NLCD
Silver Creek	103 (0.4)	0 (0.0)	1,110 (4.3)	495 (1.9)	0 (0.0)	0 (0.0)	92 (0.4)	19,093 (74.5)	957 (3.7)	3,379 (13.2)	407 (1.6)	0 (0.0)	0 (0.0)	25,635 (100.0)	NLCD
Spring Creek - Walker/Chattooga County	30 (0.2)	0 (0.0)	5 (0.0)	16 (0.1)	0 (0.0)	0 (0.0)	99 (0.6)	12,312 (78.7)	495 (3.2)	2,690 (17.2)	0 (0.0)	0 (0.0)	0 (0.0)	15,647 (100.0)	NLCD
Spring Creek - Etowah River Tributary	119 (0.5)	0 (0.0)	38 (0.2)	87 (0.4)	0 (0.0)	0 (0.0)	263 (1.1)	19,219 (78.2)	772 (3.1)	4,044 (16.5)	38 (0.2)	0 (0.0)	0 (0.0)	24,580 (100.0)	NLCD
Tails Creek	77 (0.5)	0 (0.0)	4 (0.0)	9 (0.1)	0 (0.0)	0 (0.0)	287 (1.7)	16,233 (96.6)	0 (0.0)	187 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	16,797 (100.0)	NLCD
Talking Rock Creek	116 (0.1)	0 (0.0)	186 (2.0)	200 (0.3)	0 (0.0)	52 (0.1)	1,697 (2.1)	69,653 (87.8)	611 (0.8)	6,737 (8.5)	50 (0.1)	0 (0.0)	0 (0.0)	79,304 (100.0)	NLCD
Tanyard Creek	6 (0.3)	1,103 (51.6)	82 (3.8)	168 (7.9)	0 (0.0)	0 (0.0)	218 (10.2)	485 (22.7)	16 (0.7)	10 (0.5)	51 (2.4)	0 (0.0)	0 (0.0)	2,139 (100.0)	ARC/ NLCD
Tributary to Allatoona Creek	0 (0.0)	639 (44.4)	0 (0.0)	100 (6.9)	0 (0.0)	0 (0.0)	88 (6.1)	192 (13.3)	367 (25.5)	0 (0.0)	53 (3.7)	0 (0.0)	0 (0.0)	1,439 (100.0)	ARC
Tributary to Oothkalooga Creek	1 (0.1)	0 (0.0)	391 (19.4)	115 (5.7)	0 (0.0)	0 (0.0)	0 (0.0)	1,182 (58.6)	47 (2.3)	169 (8.4)	113 (5.6)	0 (0.0)	0 (0.0)	2,018 (100.0)	NLCD
Tributary to Pettit Creek	1 (0.1)	0 (0.0)	162 (11.4)	210 (14.7)	0 (0.0)	0 (0.0)	0 (0.0)	802 (56.3)	119 (8.4)	62 (4.4)	69 (4.8)	0 (0.0)	0 (0.0)	1,425 (100.0)	NLCD
Two Run Creek	64 (0.2)	0 (0.0)	153 (0.5)	257 (0.8)	0 (0.0)	22 (0.1)	637 (2.0)	25,988 (79.9)	1,217 (3.7)	4,027 (12.4)	69 (0.2)	77 (0.2)	0 (0.0)	32,511 (100.0)	NLCD
Webb Creek	12 (0.2)	0 (0.0)	1 (0.0)	6 (0.1)	0 (0.0)	0 (0.0)	29 (0.5)	4,068 (74.0)	371 (6.8)	867 (15.8)	0 (0.0)	139 (2.5)	1 (0.0)	5,494 (100.0)	NLCD
Woodward Creek	37 (0.2)	0 (0.0)	42 (0.2)	162 (0.9)	0 (0.0)	34 (0.2)	601 (3.5)	12,148 (70.4)	808 (4.7)	3,360 (19.5)	45 (0.3)	10 (0.1)	5 (0.0)	17,253 (100.0)	NLCD

2.0 WATER QUALITY ASSESSMENT

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

Fecal coliform data were collected during calendar years 2000 and 2001. Sources of these data include the following:

- United States Geological Survey (USGS) basin water quality data, 2001 and 2002;
- Georgia Environmental Protection Division (GA EPD) Trend Monitoring data, 2001 and 2002; and
- Town of Trion Fecal Coliform Bacteria Data, 2000 and 2001.

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

For a number of listed stream segments, available data were not sufficient to calculate a 30-day geometric mean. Many of these stream segments had been placed on the 303(d) list as a result of data collected prior to 2000. These data were assembled from a variety of sources, which included:

- Calhoun - Oothkalooga Creek spill data, 1996;
- Carter's Lake WPMP monitoring data, 1996;
- Cartersville - Pettit Creek spill data 1997;
- Cherokee County monitoring data ;
- Cobb County water quality sampling data, 1995 – 1997;
- Kennesaw State College Study – 1994;
- Lake Acworth water quality sampling data, 1996-1997;
- Lake Allatoona Clean Lakes Study;
- Rocky Creek Fulton County, 1994-1995; and
- Rome WPCP monitoring data.

Summaries of these data are presented in Appendix B.

3.0 SOURCE ASSESSMENT

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

3.1 Point Source Assessment

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

3.1.1 Wastewater Treatment Facilities

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

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

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

Municipal and industrial wastewater treatment facilities discharges may contribute fecal coliform to receiving waters. There are 34 NPDES permitted discharges with effluent limits for fecal coliform bacteria identified in the Coosa River Basin Watershed upstream from the listed segments. Table 3 provides the monthly average discharge flows and fecal coliform concentrations for the municipal and industrial treatment facilities, obtained from calendar year 2001 Discharge Monitoring Report (DMR) data. The permitted flow and fecal coliform concentrations for these facilities are also included in this table.

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

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

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2001 Discharge		NPDES Permit Limits		Number of Violations July 1998-June 2001
			Average Monthly Flow (MGD)[1]	Geometric Mean (No./ 100 mL)[2]	Average Monthly Flow (MGD)	Average Monthly FC (No./ 100mL)	
Adairsville North	GA0046035	Oothkalooga Creek	0.24	16.6	1	200	1
Adairsville South	GA0032832	Oothkalooga Creek Tributary	0.30	30.8	0.5	200	0
Bartow Co. Southeast	GA0037664	Etowah River	0.005	Not measured	0.1	No FC permit limit	0
Bartow Co. Two Run	GA0020702	Two Run Creek	0.06	Not measured	0.1	No FC permit limit	0
Big Canoe WPCP	GA0030252	Blackwell Creek	0.03	2.0	0.25	30	0
Calhoun WPCP	GA0030333	Oostanaula River	8.06	56.6	16	200	0
Canton WPCP	GA0025674	Etowah River	1.16	38.9	1.89	200	3
Cartersville WPCP	GA0024091	Etowah River	8.19	6.8	12.1	200	0
Cave Spring WPCP	GA0025721	Little Cedar Creek	0.19	6.9	0.22	200	0
Cedartown WPCP	GA0024074	Cedar Creek	1.70	38.9	3.5	200	0
Chatsworth WPCP	GA0032492	Holly Creek	1.72	16.3	3	200	7
Cherokee Co. Water & Sewer	GA0046451	Lake Allatoona	3.01	3.4	4	50	2
Cobb Co. Noonday	GA0024988	Noonday Creek	9.38	3.8	12	200	0
Cobb Co. Northwest	GA0046761	Lake Allatoona	5.62	3.5	10	50	3
Con Agra Poultry Company	GA0001724	Blankets Creek	1.04	28.4	Report	400	0
Dallas North WPCP	GA0026034	Lawrence Creek Tributary	0.19	30.7	0.5	200	1
Dallas West WPCP	GA0026026	Weaver Creek Tributary	0.28	42.9	0.9	200	3
Ellijay WPCP	GA0021369	Coosawattee River	2.16	3.1	2.5	200	0
Emerson Pond	GA0026115	Pumpkinvine Creek	0.14	Not measured	0.172	No FC permit limit	0
Fairmount	GA0046388	Salacoa Creek Tributary	0.13	Not measured	0.14	No FC permit limit	0
Fulton Co Little River WPCP	GA0033251	Little River	0.72	1.1	1	200	1
Gold Kist Pork Facility	GA0038164	Connesenna Creek Tributary	0.19	15.8	Report	200	0
Gold Kist Poultry Byproducts	GA0000728	Etowah River	0.019	15.4	Report	400	0

Facility Name	NPDES Permit No.	Receiving Stream	Actual 2001 Discharge		NPDES Permit Limits		Number of Violations July 1998-June 2001
			Average Monthly Flow (MGD)[1]	Geometric Mean (No./ 100 mL)[2]	Average Monthly Flow (MGD)	Average Monthly FC (No./ 100mL)	
Jasper	GA0032204	Hammond's Creek	0.42	6.9	0.8	200	1
Lafayette WPCP	GA0025712	Chattooga Creek	2.13	27.3	3.5	200	7
Menlo WPCP	GA0047023	Alpine Creek Tributary - Lake Weiss	0.06	0.8	0.1	200	0
Polk Co. Aragon	GA0026182	Euharlee Creek	0.05	3.5	0.17	200	2
Rockmart WPCP	GA0026042	Euharlee Creek	1.01	7.8	3	200	0
Rome Coosa WPCP	GA0024341	Coosa River	0.97	1.1	2	200	0
Rome WPCP	GA0024112	Coosa River	11.92	1.8	18	200	0
Summerville WPCP	GA0025704	Chattooga River	1.50	159.0	2	200	20
Trion WPCP	GA0025607	Chattooga River	3.97	1.1	5	200	1
Whitfield Mt View Acres	GA0047848	Stone Branch	0.07	10.8	0.084	200	0
Woodstock WPCP	GA0026263	Rubes Creek Tributary	0.44	5.7	0.5	200	2

Source: EPA PCS Website (2001) and the GA EPD Regional Offices

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

[2] Values shown are the annual average of the monthly geometric means.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain fecal coliform bacteria consist of those associated with industrial activities including construction sites five acres or greater, and large and medium municipal separate storm sewer systems (MS4s) that serve populations of 100,000 or more.

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

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

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

Name	Permit No.	Watershed
Acworth	GAS000101	Coosa
Cobb County	GAS000108	Chattahoochee, Coosa
Fulton County	GAS000117	Chattahoochee, Coosa, Flint, Ocmulgee
Forsyth County	GAS000300	Chattahoochee, Coosa
Kennesaw	GAS000121	Coosa

Source: Nonpoint Source Permitting Program, GA DNR, 2001

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.

On March 10, 2003, small MS4s serving urbanized areas were required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. It is estimated that 30 counties and 56 communities will be permitted under the Phase II regulations. Table 5 lists those counties and communities located in the Coosa River Basin that will be covered by the Phase II General Storm Water Permit, GAG610000.

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

Name	Watershed
Bartow County	Coosa
Canton	Coosa
Cherokee County	Coosa
Dallas	Coosa
Dalton	Coosa
Emerson	Coosa
Floyd County	Coosa
Holly Springs	Coosa
Mountain Park	Coosa
Paulding County	Chattahoochee, Coosa, Tallapoosa
Rome	Coosa
Varnell	Coosa
Walker County	Coosa, Tennessee
Whitfield County	Coosa, Tennessee
Woodstock	Coosa

Source: Nonpoint Source Permitting Program, GA DNR, 2003

3.1.3 Confined Animal Feeding Operations

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

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

Table 6. Registered CAFOs in the Coosa River Basin

Name	County	Type	Total No. of Animals	Permit No.
Gold Kist Pork Facility	Bartow	Swine	4,990	GA0038164
Hard Rock Cattle Co.	Bartow	Beef cattle	3,000	GAG930000
Bagwell Dairy	Floyd	Dairy	300	GAU700000
Bridges Bros. Farms, Inc.	Floyd	Swine	2,600	GA0038202
Calvin Evans Dairy	Gilmer	Dairy	200	GAU700000
Franklin B. Wright Co., Inc.	Gilmer	Dairy	250	GAU700000
Talona Farms, Inc.	Gilmer	Swine	2,400	GAU700000
Rocky Hill Farm	Gordon	Swine	1,850	GAU700000
Pettys' Dairy, Inc.	Murray	Dairy	400	GAU700000
Big Ridge Farms, Inc.	Pickens	Swine	300	GAU700000

Source: Permitting and Compliance Program, Environmental Protection Division, GA EPD, 2001

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 septic systems
  - Land Application Systems
  - Landfills

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

3.2.1 Wildlife

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

White-tailed deer have a significant presence throughout the Coosa River Basin. The 2001 deer census for counties in the Coosa River Basin is presented in Table 7. Fecal coliform bacteria contributions from deer to water bodies are generally considered less significant than that of waterfowl, racoon, and beaver. This is because a greater portion of their time is spent in terrestrial habitats. This also holds true for other terrestrial mammals such as squirrels and rabbits, and terrestrial birds (Georgia WRD, 2002). However, feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff events. It should be noted that between storm events, considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers. This is especially true in the warm, humid environments typical of the southeast.

Table 7. 2001 Deer Census Data in the Coosa River Basin

County	Deer Density (number/sq mi)
Bartow	40
Chattooga	40
Cherokee	40
Cobb	35
Dade	40
Dawson	40
Fannin	25
Floyd	40
Forsyth	40
Fulton	35
Gilmer	40
Gordon	40
Haralson	40
Lumpkin	25
Murray	25
Paulding	40
Pickens	25
Polk	40
Walker	40
Whitfield	25

Source: Wildlife Resource Division, GA DNR, 2001

3.2.2 Agricultural Livestock

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

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

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

County	Livestock							
	Beef Cattle	Dairy Cattle	Swine	Sheep	Horses	Goats	Chickens Layers	Chickens-Broilers Sold
Bartow	11,400	50	2,200	100	4,200	800	12,000	11,960,000
Chattooga	9,300	80	NA	NA	930	350	NA	180,000
Cherokee	9,000	125	NA	50	NA	800	NA	3,513,000
Cobb	NA	NA	NA	NA	NA	NA	NA	NA
Dade	3,600	NA	300	40	800	250	190,000	892,000
Dawson	3,500	NA	NA	150	1,200	300	NA	5,177,600
Fannin	4,300	200	20	15	60	25	160,000	1,140,000
Floyd	11,750	210	3,500	150	250	350	218,000	2,744,000
Forsyth	7,500	NA	NA	NA	500	NA	9,000	4,663,988
Fulton	5,500	NA	NA	NA	NA	NA	NA	NA
Gilmer	5,000	1,050	3,450	NA	NA	400	550,000	13,560,000
Gordon	19,000	560	2,600	120	1,480	NA	819,045	10,304,000
Haralson	6,350	100	NA	50	150	300	NA	2,080,000
Lumpkin	3,610	200	175	20	185	75	730,000	3,808,000
Murray	1,850	300	NA	NA	20	NA	132,000	3,180,000
Paulding	3,100	100	NA	200	750	500	NA	NA
Pickens	4,200	NA	300	25	349	800	NA	4,396,000
Polk	7,153	370	NA	25	950	500	NA	1,300,000
Walker	12,800	900	200	40	1,110	450	30,000	2,364,000
Whitfield	15,000	320	NA	10	1,825	200	40,000	2,704,000

Source: NRCS, 2001

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 of sanitary waste, leaking septic systems, runoff from improper disposal of waste materials, and leachate from both operational and closed landfills.

Urban runoff can contain high concentrations of fecal coliform from domestic animals and urban wildlife. Fecal coliform enter streams by direct washoff from the land surface, or the runoff may be diverted to a storm water collection system and discharged through a discrete outlet structure. For larger urban areas (populations greater than 100,000), 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 sanitary sewer connections to the storm sewer system. As part of the MS4 permitting program, municipalities are required to conduct dry-weather monitoring to identify and then eliminate these illicit discharges. Fecal coliform may also enter streams from leaky sewer pipes, or during storm events when the combined sewer overflows discharge.

3.2.3.1 Leaking Septic Systems

Some fecal coliform in the Coosa 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 Coosa River Basin existing in 1990, based on U.S. 1990 Census Data, and the number existing in 2001, based on the Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems repaired during the eleven-year period from 1990 to 2001 is given.

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

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

County	Total Septic Systems	No. of Septic Systems Installed 1990 to 2000	No. of Septic Systems Repaired 1990 to 2000
Bartow	22,361	8,747	638
Chattooga	7,625	1,823	184
Cherokee	35,624	10,015	1,689
Cobb	33,557	4,926	4,601
Dade	5,342	1,317	63
Dawson	8,515	4,459	338
Fannin	11,999	5,086	402
Floyd	16,981	4,411	987
Forsyth	40,882	24,799	965
Fulton	30,312	8,827	2,647
Gilmer	12,538	6,730	120
Gordon	13,888	4,201	610
Haralson	8,933	3,369	365
Lumpkin	8,525	3,627	158
Murray	14,606	6,230	582
Paulding	29,629	16,544	578
Pickens	10,467	5,121	579
Polk	10,073	2,384	217
Walker	19,097	3,608	600
Whitfield	23,385	6,444	1,422

Source: 1990 Census Data, and the Georgia Dept. of Human Resources, Div. of Public Health, 2001

3.2.3.2 Land Application Systems

Many smaller communities use land application systems (LASs) 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 likely contains fecal coliform bacteria, may discharge to nearby surface waters. There are twenty permitted LAS systems located in the Coosa River Basin (Table 10).

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

LAS Name	County	Permit No.	Type
Anheuser Busch, Inc.	Bartow	GA02-130	Industrial
DNR Red Top Mountain State Park	Bartow	GA020237	Municipal
City of Lyerly	Chattooga	GA02-277	Municipal
Chapel Knoll	Cherokee	GA03-944	Private
Cherokee Little River	Cherokee	GA02-278	Municipal
Freehome Village Shopping Center	Cherokee	GA03-848	Private
Lake Arrowhead Utility Co.	Cherokee	GA03-819	Private
Amicalola Falls State Park	Dawson	GA02-045	Municipal
Dawsonville LAS	Dawson	GA02-179	Municipal
Etowah Water & Sewer Authority	Dawson	GA02-232	Municipal
Forsyth County Landfill	Forsyth	GA02-247	Municipal
Lacey Champion Carpets, Inc.	Gordon	GA01-521	Industrial
Max V. Tolbert Elementary School	Gordon	GA02-218	Municipal
USA Camp Frank D. Merrill	Lumpkin	GA03-727	Federal
Dalton Utilities	Murray	GA02-056	Municipal
Paulding County Board of Commissioners	Paulding	GA02-296	Municipal
Bent Tree Community Golf Course	Pickens	GA03-782	Private
Young Life, Inc.	Pickens	GA03-954	Private
Whitfield County Board of Education	Whitfield	GA02-254	Municipal
Wishy Washy Car Wash	Whitfield	GA03-605	Private

Source: Permitting and Compliance Program, GA EPD, 2003

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, except inert landfills, are now required to install environmental monitoring systems for groundwater sampling and methane. There are 104 known landfills in the Coosa River Basin (Table 11). Of these, 14 are active landfills, and 90 are landfills that are inactive or closed. As shown in the Table 11, many of the older, inactive landfills were never permitted.

Table 11. Landfills in the Coosa River Basin

Name	County	Permit No.	Type	Status
Adairsville	Bartow		Not Applicable	No Record
Bartow Co. - SR140 Adairsville	Bartow	008-012D	Sanitary Landfill	Closed
Cartersville	Bartow		Not Applicable	No Record
SR 294 Emerson MSWL PH2&3	Bartow	008-016D	Municipal Solid Waste Landfill	Active
SR 394 Emerson PH1 C&D	Bartow	008-008D	Construction and Demolition Landfill	Active
Tidwell Plumbing Inc.	Bartow	008-017P	Not Applicable	No Record
Penn Bridge Rd. PH1	Chattooga	027-006D	Sanitary Landfill	Closed
Ballground	Cherokee		Not Applicable	No Record
Blalock Rd. PH3	Cherokee	028-015D	Sanitary Landfill	Closed
Blalock Rd. PH4	Cherokee	028-017D	Sanitary Landfill	Ceased Accepting Waste
Blalock Rd. PH6	Cherokee	028-041D	Not Applicable	No Record
Brown - SR 92W Woodstock	Cherokee	028-012D	Dry Trash Landfill	Closed
Canton - Ridge Rd. PH2	Cherokee	028-014D	Sanitary Landfill	Closed
Canton - Ridge Road	Cherokee	028-004D	Not Applicable	No Record
Carter - Bascomb Road	Cherokee		Not Applicable	No Record
Cherokee Co. - Woodstock - Blalock Rd.	Cherokee	028-006D	Not Applicable	No Record
Cherokee Construction And Demolition Landfill	Cherokee	028-043D	Construction and Demolition Landfill	
Gravely - Bells Ferry Road	Cherokee		Not Applicable	No Record
Kendrick - Arnold Mill Rd. PH1	Cherokee	028-013D	Dry Trash Landfill	Closed
Kuykendall - Earney Rd.	Cherokee	028-032D	Dry Trash Landfill	Closed
Pine Bluff Landfill Inc.	Cherokee	028-039D	Municipal Solid Waste Landfill	Active
SWIMS - SR 92 (Dixie) PH1&2	Cherokee	028-030D	Dry Trash Landfill	Closed
SWIMS - SR 92 (Dixie) PH3	Cherokee	028-034D	Dry Trash Landfill	Ceased Accepting Waste
SWIMS - SR 92 (Dixie) PH4	Cherokee	028-040D	Construction and Demolition Landfill	Active
Univeter Rd.	Cherokee	028-007D	Dry Trash Landfill	Closed
Voyles - Hwy 5	Cherokee		Not Applicable	No Record
Woodstock	Cherokee		Not Applicable	No Record
3 - Way Campers	Cobb		Not Applicable	No Record
Cheatham Rd. PH2	Cobb	033-038D	Sanitary Landfill	Ceased Accepting Waste
Cheatham Road Balefill (area 1) and Phase 2 (SL)	Cobb	033-005D	Not Applicable	No Record
Cheatham Road Balefill (area 1) and Phase 2 (SL)	Cobb	033-027D	Not Applicable	No Record
R.B. Ingram - old Hwy 41	Cobb		Not Applicable	No Record
Dawson Co. (Hwy. 19)	Dawson		Not Applicable	No Record
Shoal Hole Rd	Dawson	042-002D	Sanitary Landfill	Ceased Accepting Waste
Berry Hill Rd.	Floyd	057-009D	Sanitary Landfill	Ceased Accepting Waste
Cave Spring	Floyd		Not Applicable	No Record
Cave Spring - Hwy 411	Floyd		Not Applicable	No Record

Name	County	Permit No.	Type	Status
Cave Spring - Perry Road	Floyd		Not Applicable	No Record
City of Rome	Floyd	057-004D	Not Applicable	No Record
D.C. McCoy Landfill	Floyd		Not Applicable	No Record
Floyd Co. - Rome Walker Mtn. Rd. C/D Landfill	Floyd	057-021D	Construction and Demolition Landfill	
Jack Morgan	Floyd		Not Applicable	No Record
Jones Mill Rd.	Floyd	057-011D	Not Applicable	No Record
Potts Road	Floyd		Not Applicable	No Record
Rome - Walker Mtn Rd. PH1&2&3	Floyd	057-013D	Sanitary Landfill	Closed
Rome - Walker Mtn. Rd. Site 2	Floyd	057-020D	Municipal Solid Waste Landfill	Active
Sarah Chandler Property - Disp Areas 1 & 3	Floyd	057-012D	Not Applicable	No Record
Anglin - Francis Rd.	Forsyth	058-005D	Dry Trash Landfill	Closed
Eagle Point Landfill	Forsyth	058-012D	Municipal Solid Waste Landfill	
Hightower Rd. PH1	Forsyth	058-006D	Sanitary Landfill	Closed
Hightower Rd. PH3	Forsyth	058-009D	Sanitary Landfill	Closed
Hightower Rd. PH4	Forsyth	058-010D	Municipal Solid Waste Landfill	Closed
Brookfield West - Mtn. Park	Fulton		Not Applicable	No Record
Chadwick Road Landfill	Fulton	060-072D	Dry Trash Landfill	Active
Honea - C&R Landfill (Francis Rd.)	Fulton	060-059D	Dry Trash Landfill	Closed
Garland Lumber	Gilmer		Not Applicable	No Record
Gilmer Co. - US 76 NTV Tower Ph. 4	Gilmer	061-003D	Not Applicable	No Record
SR 52N / TV Tower PH1-5	Gilmer	061-010D	Sanitary Landfill	Closed
Calhoun	Gordon		Not Applicable	No Record
Calhoun - Harris Rd. Ph. 4	Gordon	064-013D	Not Applicable	No Record
Calhoun - Harris Rd. PH4	Gordon	064-014D	Dry Trash Landfill	Active
Calhoun - SR 156	Gordon	064-003D	Not Applicable	No Record
Fairmount	Gordon		Not Applicable	No Record
Gordon Co. - Harris Rd.	Gordon	064-008D	Not Applicable	No Record
Gordon Co. - US 411	Gordon	064-002D	Not Applicable	No Record
Harris Rd. PH2	Gordon	064-011D	Sanitary Landfill	Closed
Lick Creek Road Ranger (SL)	Gordon	064-010D	Sanitary Landfill	Closed
Redbone Ridges Rd.	Gordon	064-016D	Municipal Solid Waste Landfill	Active
US 411	Gordon	064-009D	Not Applicable	No Record
Camp Merrill - US Army	Lumpkin	093-004D	Sanitary Landfill	Closed
US Army - Camp Merrill No. 6	Lumpkin	093-005D	Sanitary Landfill	Ceased Accepting Waste
Chatsworth	Murray		Not Applicable	No Record
Murray County - US. 411 Westside's Site 2 MS	Murray	105-014D	Municipal Solid Waste Landfill	Active
US 411 Dennis Mill Rd.	Murray	105-004D	Sanitary Landfill	Closed
US 411 Westside (L)	Murray	105-012D	Dry Trash Landfill	Ceased Accepting Waste
US 411 Westside (SL)	Murray	105-011D	Sanitary Landfill	Ceased Accepting Waste
Gulledge Rd. N. Tract 1	Paulding	110-005D	Sanitary Landfill	Active
Hwy 92 Old Acworth site	Paulding		Not Applicable	No Record
Paulding Co. - SR 92 Spur Holden Rd.	Paulding		Not Applicable	No Record
Cove Rd.	Pickens		Not Applicable	No Record
Jasper - Hood Rd.	Pickens		Not Applicable	No Record

Name	County	Permit No.	Type	Status
Jones Mtn. Rd. PH3	Pickens	112-006D	Sanitary Landfill	Closed
Jones Mtn. Rd. Westside	Pickens	112-007D	Sanitary Landfill	Ceased Accepting Waste
Pickens Co. - Ludville	Pickens		Not Applicable	No Record
Pickens Co. - Jasper	Pickens		Not Applicable	No Record
Pickens Co. - Long Branch Rd.	Pickens		Not Applicable	No Record
Cedartown	Polk		Not Applicable	No Record
Grady Rd.	Polk	115-008D	Municipal Solid Waste Landfill	Active
Polk Co. - US278 Cedartown Ph. 2	Polk	115-003D	Not Applicable	No Record
Rockmart	Polk		Not Applicable	No Record
US 278 Cedartown PH2	Polk	115-005D	Sanitary Landfill	Closed
LaFayette	Walker		Not Applicable	No Record
LaFayette - Coffman Springs Rd.	Walker	146-013D	Dry Trash Landfill	Active
Dalton	Whitfield		Not Applicable	No Record
Dalton - McGaughey Ch/Coahulla Cr.	Whitfield	155-043D	Dry Trash Landfill	Closed
Dalton - Old Dixie Hwy PH2	Whitfield	155-021D	Sanitary Landfill	Active
Dalton - Old Dixie Hwy PH4	Whitfield	155-027D	Sanitary Landfill	Closed
Dalton - Old Dixie Hwy PH5	Whitfield	155-044D	Sanitary Landfill	Ceased Accepting Waste
Dalton - Waugh St. PH1	Whitfield	155-034D	Dry Trash Landfill	Closed
Dalton - Waugh St. PH2	Whitfield	155-037D	Dry Trash Landfill	Closed
McGaughey Chapel Road	Whitfield	155-012D	Not Applicable	No Record
Old Dixie Highway	Whitfield	155-018D	Not Applicable	No Record
South Side	Whitfield		Not Applicable	No Record
Whitfield Co. - Dalton Old Dixie Hwy. PH6	Whitfield	155-047D	Municipal Solid Waste Landfill	Active

Source: Land Protection Branch, GA DNR, 2001

4.0 ANALYTICAL APPROACH

The process of developing fecal coliform TMDLs for the Coosa 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 TMDL. For the listed segments, fecal coliform sampling data were sufficient to calculate at least one 30-day geometric mean to compare with the regulatory criteria (see Appendix A).

4.1 Loading Curve Approach

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

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

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

Table 12. Monitoring Stations with Estimated Flow

Monitoring Station	USGS Station Name	Station No.
Beech Creek at May Bridge Road near Rome	Heath Creek near Armuchee, GA	02388320
Racoon Creek at GA Hwy 113 near Stillsboro	Two Run Creek near Kingston, GA	02395120
Webb Creek at Black Bluff Rd near Rome	Heath Creek near Armuchee, GA	02388320

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 accumulation loads with units of counts per 30 days. This is described by the equation below:

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

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

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

The maximum fecal load at which the instream fecal coliform criteria will be met can be determined using a variation of the equation above. By setting C equal to the seasonal, instream fecal coliform standards, the load will equal the TMDL. However, the TMDL is dependent on stream flow. Figures in Appendix A graphically illustrate that the TMDL is a continuum for the range of flows (Q) that can occur in the stream over time. There are two TMDL curves shown in these figures. One represents the summer TMDL for the period May through October when the 30-day geometric mean standard is 200 counts/ 100 mL. The second curve represents the winter TMDL for the period November through April when the 30-day geometric mean standard is 1000 counts/ 100 mL. The equations for these two TMDL curves are:

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

$$TMDL_{winter} = 1000 \text{ counts (as a 30-day geometric mean)/100 mL} * Q$$

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

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

Where:
$TMDL_{critical}$ = critical fecal coliform TMDL load
$C_{standard}$ = seasonal fecal coliform standard (as a 30-day geometric mean)
summer - 200 counts/100 mL
winter - 1000 counts/ 100 mL
Q_{mean} = stream flow as 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. The load reduction can thus be expressed as follows:

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

4.2 Equivalent Site Approach

TMDLs must be developed for a number of listed segments for which sufficient data are not available to calculate the 30-day geometric mean fecal coliform concentrations. Although there may be sampling data for many of these streams, there are not enough data within a 30-day period to directly calculate geometric means. In these cases, an equivalent site approach is used to estimate the current and TMDL loads. This approach involves calculating loads for the stream segments that lack sufficient data based on a relationship to other, similar, equivalent site(s) that have data. This method provides estimates that can be refined in the future as additional data are collected.

Development of loads using the equivalent site approach addresses three key issues:

1. Site-specific monitoring data should be used, even if it is insufficient for direct estimation of geometric means. The site-specific and equivalent site monitoring data should be combined in a weighted approach that reflects the relative accuracy of information provided by each data source.

2. Equivalent site selection has a potential impact on the resulting load estimates. In the case where a TMDL has already been prepared for a downstream segment within the same watershed, the equivalent site selection is obvious. For other segments, multiple sites within the same general region may be available for use.

3. Different land uses result in different fecal coliform concentrations. An equivalent site with a perfect land use match is unlikely to be available. Differences in land uses among watersheds should be addressed through use of a regionalization model that identifies the extent to which variability in fecal coliform concentrations can be explained by changes in land use.

In translating data from an equivalent site to a listed segment, it is important to account for changes in fecal coliform runoff concentrations associated with different land uses, and for changes in flow associated with different drainage areas. The critical load at site *i* can be estimated in relations to the calculated critical loads at other equivalent sites *j* using the following equation:

$$\text{Load}_{\text{critical}} = \frac{1}{n}\sum_{j=1}^{n}\left[A_{ij} \cdot C_j \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j}\right]$$

Where:

$L_{critical}$ = estimated critical fecal coliform load at site *i*
n = number of equivalent sites
A_{ij} = translation factor
C_j = fecal coliform concentration (as a 30-day geometric mean) at site(s) *j*
Q_j = stream flow (as an arithmetic mean) at site(s) *j*
DA_i = drainage area above site *i*
DA_j = drainage area above site *j*

The A_{ij} factor relates the geometric mean fecal coliform concentration at site *i* to that at site(s) *j.* It is expressed in log space, since a geometric mean is used. It is expected that this factor will vary with land use, but may exhibit strong site-specific characteristics. For example, a given site might exhibit higher fecal coliform concentrations relative to an equivalent site than are expected from land use differences alone.

A method is needed that provides an appropriate weighing between limited site-specific data and a land use based regression of equivalent sites. An empirical Bayes analysis is the mathematical technique ideally suited for this circumstance. This analysis combines two important concepts: maximum likelihood techniques for combining data sources, and hierarchical regionalization techniques. The data combination step assumes that both equivalent site data and site-specific data provide information on the true local geometric mean. The two data sources are weighted in accordance with their degree of precision or accuracy. The regionalization step assumes that the true mean at any site is a result of random variability and a regional regression model on land use. Empirical Bayes techniques provide statistically optimal methods for computing both the data combination and regionalization steps from observed data.

In the empirical Bayes analysis, it is assumed that the long-term geometric mean fecal coliform concentration at a given site is a function of watershed land use and site-specific factors that are represented by random noise. A sample realization of the geometric mean at site *i*, X_i, is assumed to be normally distributed about a true mean, Θ_i, with standard error of the estimate given by σ_ι. In statistical notation:

$$X_i \sim N(\Theta_i, \sigma_\iota^2)$$

The desired translation factor is then: $A_c = \Theta_i / \Theta_j$. Full technical details on the implementation of the empirical Bayes approach are provided in Appendix C. Table 13 list the equivalent sites used for the listed segments that did not have sufficient data to calculate a 30-day geometric mean.

Table 13. List of Equivalent Sites

Limited-Data Site	Equivalent Site
Acworth Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Big Dry Creek	Armuchee Creek at Old Dalton Road near Rome
	Woodward Creek at Bells Ferry Road near Rome
	Silver Creek at Cresent Avenue near Rome
	Spring Creek at GA Hwy 20 near Rome

Limited-Data Site	Equivalent Site
Butler Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Flat Creek	Talking Rock Creek near Blaine
	Tails Creek at GA Hwy 282 near Ellijay
	Ellijay River at US Hwy 76 at Ellijay
	Mountaintown Creek at GA Hwy282 near Ellijay
Lake Acworth	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Little Allatoona	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Little Noonday Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Owl Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Proctor Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Rocky Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Rubes Creek	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Tanyard Creek	Euharlee Creek near Stillesboro
	Spring Creek at GA Hwy 20 near Rome
	Woodward Creek at Bells Ferry Road near Rome

Limited-Data Site	Equivalent Site
Trib to Allatoona	Allatoona Creek at McClain Road near Acworth
	Level Creek
	Willeo Creek
	Kelly Mill Branch
	Mobley Creek
Trib to Oothkalooga Creek	Oostanaula River near Calhoun
	Woodward Creek at Bells Ferry Road near Rome
	Pine Log Creek at Sonoraville
Trib to Pettit Creek	Euharlee Creek near Stillsboro
	Spring Creek at GA Hwy 20 near Rome
	Woodward Creek at Bells Ferry Road near Rome

The estimated TMDL for the stream segments with insufficient data can be calculated using the following equation:

$$TMDL = \frac{1}{n}\sum_{j=1}^{n}\left[C_{STANDARD} \bullet Q_j \bullet \frac{DA_i}{DA_j}\right]$$

Where:

TMDL = fecal coliform TMDL load at site *i*
n = number of equivalent sites
$C_{STANDARD}$ = seasonal fecal coliform standard (as a 30-day geometric mean)
summer - 200 counts/100 mL
winter - 1000 counts/ 100 mL
Q_j = stream flow (as an arithmetic mean) at site(s) *j* (cfs)
DA_i = drainage area above site *i* (acres)
DA_j = drainage area above site *j* (acres)

The DA_i / DA_j ratio, as mentioned in the previous section, adjusts the flow from site *j* to site *i*. In the case where flow data are available, the actual arithmetic mean flow associated with the estimated 30-day geometric mean fecal coliform concentration can be used.

As in the loading curve approach, the estimated percent load reduction needed at site *i* can be expressed as follows:

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

5.0 TOTAL MAXIMUM DAILY LOADS

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

A TMDL is expressed as follows:

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

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

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

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

The fecal coliform loads calculated for each listed stream segment include the sum of the total loads from all point and nonpoint sources for the segment. The load contributions to the listed segment from unlisted upstream segments are represented in the background loads, unless the unlisted segment contains point sources that had permit violations for fecal coliform. In these cases, the upstream point sources are included in the wasteload allocations for the listed segment. In situations where two or more adjacent segments are listed, the fecal coliform loads to each segment are individually evaluated on a localized watershed basis. Point source loads originating in upstream segments are included in the background loads of the downstream segment. The following sections describe the various fecal coliform TMDL components.

5.1 Waste Load Allocations

The waste load allocation is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems that have NPDES effluent limits. There are 24 active NPDES permitted facilities with fecal coliform permit limits in the Coosa River Basin watershed that discharge into listed segments or have permit violations upstream of a listed segment. The maximum allocated fecal coliform loads for these municipal wastewater treatment facilities are given in Table 14. 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 14. WLAs for the Coosa River Basin

Facility Name	Permit No.	Receiving Stream	Listed Stream Segment	WLA (cnts/30 days)
Adairsville North WPCP	GA0046035	Oothkalooga Creek	Oostanaula River -Oothkalooge Creek to Hwy 156	2.28E+11
Bartow Co. Southeast WPCP	GA0037664	Etowah River	Etowah River - Lake Allatoona to Richland Ck	2.28E+10
Bartow Co Two Run WPCP	GA0020702	Two Run Creek	Two Run Creek	2.28E+10
Big Canoe WPCP	GA0030252	Blackwell Creek	Long Swamp Creek	8.53E+09
Calhoun WPCP	GA0030333	Oostanaula River	Oostanaula River - Oothkalooge Creek to Hwy 156	3.64E+12
Cartersville WPCP	GA0024091	Etowah River	Etowah River - Lake Allatoona to Richland Ck	2.75E+12
Cave Spring WPCP	GA0025721	Little Cedar Creek	Big Cedar Creek/Cedar Creek	5.01E+10
Cedartown WPCP	GA0024074	Cedar Creek	Big Cedar Creek/Cedar Creek	7.96E+11
Chatsworth WPCP	GA0032492	Holly Creek	Holly Creek - Rock Creek to Conasauga River	6.83E+11
Dallas North WPCP	GA0026034	Lawrence Creek Trib	Pumpkinvine Creek	1.14E+11
Dallas West WPCP	GA0026026	Weaver Creek Trib	Pumpkinvine Creek	2.05E+11
Ellijay WPCP	GA0021369	Coosawattee River	Coosawattee River	5.69E+11
Emerson Pond WPCP	GA0026115	Pumpkinvine Creek	Pumpkinvine Creek	3.91E+10
ulton Co. Little River WPCP	GA0033251	Little River	Lake Allatoona – Little River Embayment	2.28E+11
Jasper WPCP	GA0032204	Hammond's Creek	Sharp Mountain Creek	1.82E+11
Lafayette WPCP	GA0025712	Chattooga Creek	Chattooga River - Cane Creek, Trion to Henry Br	7.96E+11
Polk Co. Aragon WPCP	GA0026182	Euharlee Creek	Euharlee Creek	3.87E+10
Rockmart WPCP	GA0026042	Euharlee Creek	Euharlee Creek	6.83E+11
Rome Coosa WPCP	GA0024341	Coosa River	Coosa River - Rome to Hwy 100	4.55E+11
Rome WPCP	GA0024112	Coosa River	Coosa River - Rome to Hwy 100	4.10E+12
Summerville WPCP	GA0025704	Chattooga River	Chattooga River - Henry Br. to Lyerly	4.55E+11
Trion WPCP	GA0025607	Chattooga River	Chattooga River - Cane Creek, Trion to Henry Br	1.14E+12
Woodstock WPCP	GA0026263	Rubes Creek Trib	Rubes Creek	1.14E+11

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 try 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 the 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 the storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

CAFOs are located within the Coosa River Basin (see Section 5.1.3). These facilities are either included under an LAS General Permit or a NPDES General Permit. A small number have an individual NPDES permit. None of these facilities discharge wastewater. Therefore, they were not provided a WLA.

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

5.2 Load Allocations

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

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

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

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

As described above, there are two types of load allocations: loads to the stream independent of precipitation, including sources such as failing septic systems, leachate from landfills, animals in the stream, and leaking sewer system collection lines or background loads; and loads associated with fecal coliform accumulation on land surfaces that is washed off during storm events including runoff from saturated LAS fields. At this time, it is not possible to partition the various sources of load allocations. Table 15 presents the total load allocation expressed as counts per 30 days, or as winter instantaneous maximum counts for the 303(d) listed streams located in the Coosa River Basin for the current critical condition. In the future, after additional data has been collected, it may be possible to partition the load allocation by source.

5.3 Seasonal Variation

The Georgia fecal coliform criteria are seasonal. One set of criteria applies to the summer season, while a different set applies to the winter season. To account for seasonal variations, the critical loads for each listed segment were determined from sampling data obtained during both summer and winter seasons, when possible. However, in some cases, the available data was limited to a single season for the calculation of the critical load. The TMDL and percent reduction given in Table 15 for each listed segment was based on the season in which the critical load occurred. The TMDLs for each season, for any given flow, are presented as equations in Section 5.5.

Analyses of the available fecal coliform data and corresponding flows were performed to determine if the fecal coliform violations occurred during wet weather (high flow) or dry weather (low flow) conditions. The flow data from each sampling site were normalized by dividing the measured flow by the product of the average annual runoff (cfs/ sq mile), published in Open-File Report 82-577, and the appropriate drainage area (Carter, 1982). Plots of the normalized flows (Q/Q_o) versus fecal coliform are shown in Appendix D. 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 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 15.

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. There are no interstate waters that are listed segments.

The maximum seasonal fecal loads for Georgia are given below:

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

$$TMDL_{winter} = 1000 \text{ counts (as a 30-day geometric mean)/100 mL} * Q$$

$$TMDL_{winter} = 4000 \text{ counts (instantaneous) /100 mL} * Q$$

For purposes of determining necessary load reductions required to meet the instream water quality criteria, the current critical TMDL was determined. This load is the product of the applicable seasonal fecal coliform standard and the mean flow used to calculate the current critical load. It represents the sum of the allocated loads from point and nonpoint sources located within the immediate drainage area of the listed segment, the NPDES-permitted point discharges with recorded fecal coliform violations from the nearest upstream subwatersheds, and a margin of safety (MOS). For these calculations, the fecal load contributed by each facility to the WLA was not the maximum presented in Table 15, but rather was the product of the fecal coliform permitted limit and the average monthly discharge at the time of the critical load. The current critical loads and corresponding TMDLs, WLAs, LAs, MOSs, and percent load reductions for the Coosa River Basin 303(d) listed streams are presented in Table 15.

The relationships of the current critical loads to the current critical TMDLs are shown graphically in Appendix A. The vertical distance between the two values represents the load reductions necessary to achieve the TMDLs. If no TMDL or Critical Load is given on the graphs in Appendix A, the current critical TMDL given in Table 15 is based on the instantaneous maximum standard. As a consequence of the localized nature of the load evaluations, the calculated fecal 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 in stream 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 15. Fecal Loads and Required Fecal 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)	
Acworth Creek	1.43E+11		1.55E+10	6.63E+09	2.45E+09	2.45E+10	83
Allatoona Creek	4.03E+12		3.63E+11	5.15E+11	9.76E+10	9.76E+11	76
Amicalola Creek	1.81E+14			4.24E+13	4.71E+12	4.71E+13	74
Armuchee Creek	4.01E+14			5.45E+13	6.06E+12	6.06E+13	85
Beech Creek	4.96E+12		3.60E+10	7.03E+11	8.21E+10	8.21E+11	83
Big Cedar Creek/Cedar Creek	8.99E+13	3.52E+11		1.51E+13	1.72E+12	1.72E+13	81
Big Dry Creek	8.58E+12		5.26E+11	1.45E+12	2.20E+11	2.20E+12	74
Butler Creek	3.19E+12		6.69E+11	6.13E+11	1.42E+11	1.42E+12	55
Cane Creek	2.88E+12			1.61E+12	1.78E+11	1.78E+12	38
Cartecay River	3.59E+15			1.64E+15	1.82E+14	1.82E+15	49
Chattooga River - Cane Creek, Trion to Henry Branch	4.45E+13	3.07E+11		1.74E+13	1.97E+12	1.97E+13	56
Chattooga River - Henry Branch to Lyerly	4.98E+13	8.99E+11		2.14E+13	2.48E+12	2.48E+13	50
Coahula Creek	4.08E+16		7.60E+14	3.44E+15	4.67E+14	4.67E+15	89
Conasauga River - Hwy. 286 to Holly Creek	2.31E+16		2.37E+14	4.65E+15	5.43E+14	5.43E+15	76
Conasauga River - Holly Creek to Oostanaula River	1.37E+14		3.57E+12	5.87E+13	6.92E+12	6.92E+13	50
Coosa River	1.28E+16	4.60E+12	1.50E+14	5.69E+15	6.49E+14	6.49E+15	49
Coosawattee River	2.18E+14	5.10E+11		5.02E+13	5.64E+12	5.64E+13	74
Ellijay River	6.01E+13			1.00E+13	1.11E+12	1.11E+13	82
Etowah River - Clear Creek to Forsyth Co. Line	7.59E+13			2.29E+13	2.54E+12	2.54E+13	67
Etowah River - Settingdown Creek to Long Swamp Creek	1.51E+14		8.71E+12	6.33E+13	8.00E+12	8.00E+13	47
Etowah River - Lake Allatoona to Richland Creek	4.54E+14	2.09E+12	1.98E+12	2.11E+14	2.39E+13	2.39E+14	47
Etowah River - Euharlee Creek to US Hwy 411	1.28E+14		3.21E+12	1.10E+14	1.25E+13	1.25E+14	2
Etowah River - Hwy. 411 to Coosa River	4.14E+16		6.04E+14	1.56E+16	1.80E+15	1.80E+16	57
Euharlee Creek	5.46E+13	2.23E+11		1.11E+13	1.26E+12	1.26E+13	77
Flat Creek	9.90E+12			3.82E+12	4.25E+11	4.25E+12	57
Holly Creek	1.25E+13			4.00E+12	4.44E+11	4.44E+12	65
Lake Acworth	7.14E+12		6.92E+11	2.20E+12	3.21E+11	3.21E+12	55
Lake Allatoona - Little River Embayment	4600				4.00E+02	4000	13
Lake Allatoona - Carter's Creek Embayment	Improperly listed	-	-	-	-	-	0
Lake Allatoona - Tanyard Creek Embayment	Improperly listed	-	-	-	-	-	0

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)	
Little Allatoona Creek	1.30E+12		5.23E+11	3.32E+11	9.50E+10	9.50E+11	27
Little Noonday Creek	3.27E+12		6.54E+11	3.43E+11	1.11E+11	1.11E+12	66
Long Swamp Creek	8.94E+13	9.90E+08		1.70E+13	1.89E+12	1.89E+13	79
Mountaintown Creek	2.72E+13			8.92E+12	9.91E+11	9.91E+12	64
Oostanaula River - Oothkalooga Creek to Hwy 156	2.19E+14	1.66E+12	4.70E+12	1.39E+14	1.61E+13	1.61E+14	26
Oostanaula River - Hwy 156 to Hwy. 140	3.83E+14		6.92E+12	2.24E+14	2.56E+13	2.56E+14	33
Oostanaula River - Hwy 140 to Coosa River	3.83E+14		7.93E+12	2.23E+14	2.56E+13	2.56E+14	33
Owl Creek	7.16E+11		1.51E+11	1.33E+11	3.17E+10	3.17E+11	56
Pine Log Creek	5.85E+13			1.02E+13	1.14E+12	1.14E+13	81
Proctor Creek	3.32E+12		5.81E+11	5.59E+11	1.27E+11	1.27E+12	62
Pumpkinvine Creek	4.50E+14	1.32E+11	3.98E+12	4.12E+13	5.04E+12	5.04E+13	89
Raccoon Creek - U/S Chattooga River, Berryton	1.21E+13			2.01E+12	2.24E+11	2.24E+12	81
Raccoon Creek - Pegamore Lake to Etowah River	2.36E+13			3.98E+12	4.42E+11	4.42E+12	81
Rocky Creek	2.27E+12		6.17E+11	5.22E+11	1.27E+11	1.27E+12	44
Rubes Creek	4.78E+12	1.03E+11	1.10E+12	9.30E+11	2.37E+11	2.37E+12	50
Sharp Mountain Creek	1.02E+14	9.72E+10		1.72E+13	1.92E+12	1.92E+13	81
Silver Creek	1.21E+13		6.26E+11	2.94E+12	3.96E+11	3.96E+12	67
Spring Creek - Walker/Chattooga County	1.88E+13			3.20E+12	3.56E+11	3.56E+12	81
Spring Creek - Etowah River Tributary	1.26E+15			2.06E+14	2.29E+13	2.29E+14	82
Tails Creek	2.65E+13			1.37E+13	1.52E+12	1.52E+13	43
Talking Rock Creek	2.78E+13			1.17E+13	1.30E+12	1.30E+13	53
Tanyard Creek	5.04E+11		1.05E+11	9.28E+10	2.20E+10	2.20E+11	56
Tributary to Allatoona Creek	4.74E+11		1.22E+11	1.63E+11	3.17E+10	3.17E+11	33
Tributary to Oothkalooga Creek	1.69E+12			2.89E+11	3.21E+10	3.21E+11	81
Tributary to Pettit Creek	2.30E+12			1.32E+11	1.47E+10	1.47E+11	94
Two Run Creek	2.18E+14	2.07E+10		4.09E+13	4.55E+12	4.55E+13	79
Webb Creek	3.27E+12			3.37E+11	3.74E+10	3.74E+11	89
Woodward Creek	3.23E+14			5.28E+13	5.87E+12	5.87E+13	82

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.
[2] Units are in counts/100 mL.

6.0 RECOMMENDATIONS

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

This TMDL represents the first phase of a long-term process to reduce fecal coliform loading to meet water quality standards in the Coosa 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 Coosa, Tallapoosa, and Tennessee River Basins were the subjects of focused monitoring in 2001 and will again receive focused monitoring in 2006.

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

6.2 Fecal Coliform Management Practices

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

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

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

6.2.1 Point Source Approaches

Point sources are defined as discharges of treated wastewater or storm water into rivers and streams at discrete locations. The NPDES permit program provides a basis for municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GA EPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times. In the future, all municipal and industrial wastewater treatment facilities with the potential for the occurrence of fecal coliform in their discharge will be given end-of-pipe limits equivalent to the water quality standard of 200 counts/100 ml or less.

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:

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

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

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

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

- Sustained compliance with storm water NPDES permit requirements; and

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

6.3 Reasonable Assurance

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

6.4 Public Participation

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

7.0 INITIAL TMDL IMPLEMENTATION PLAN

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

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

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table" shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations for wastewater treatment plant facilities will be implemented in the form of water-quality based effluent limitations in NPDES permits. Any wasteload allocations for regulated storm water will be implemented in the form of best management practices in the NPDES permits. NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

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

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

Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

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

5. The deadline for development of a Revised TMDL Implementation Plan, is the end of December 2005.

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

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

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

Management Measure Selector Table

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

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

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Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

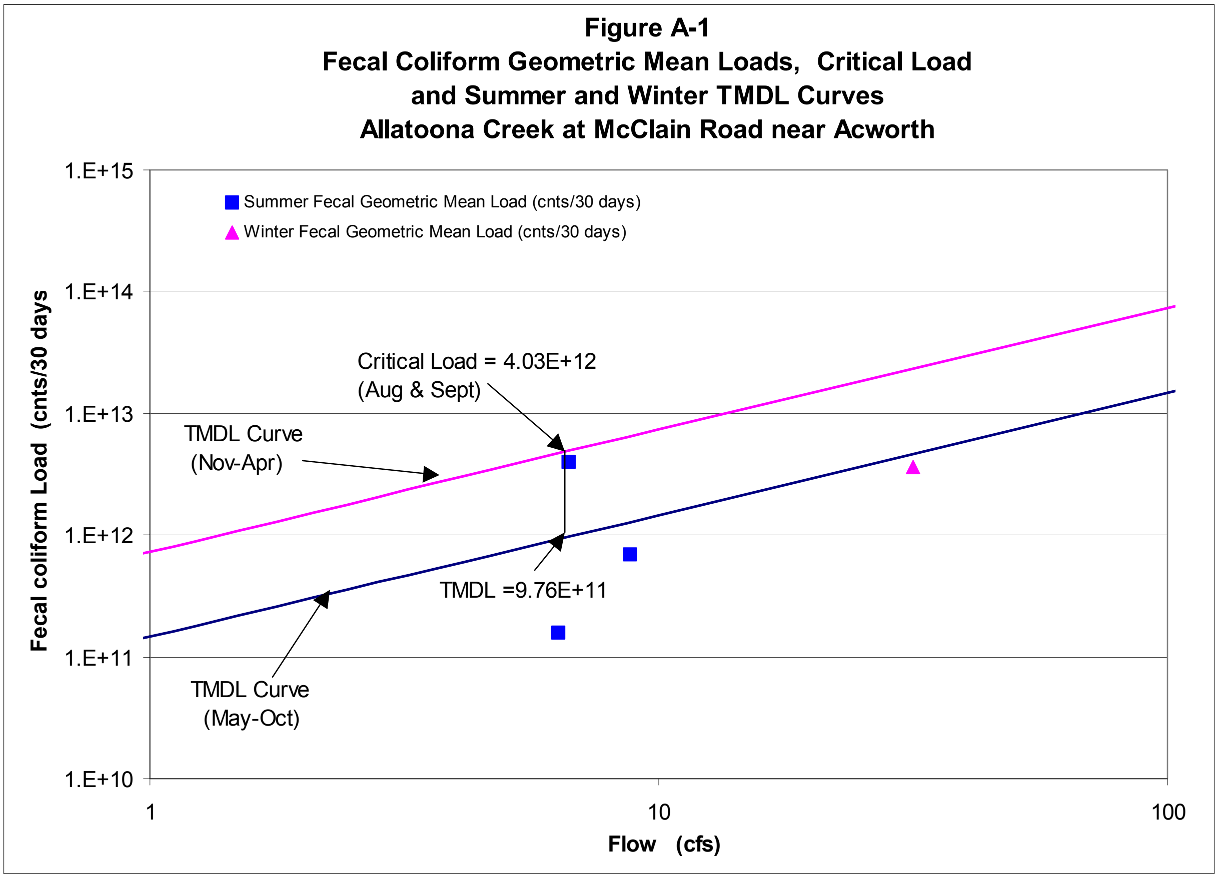

Table A-1. Data for Figure A-1, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
21-Feb-01	130	96				
7-Mar-01	110	9				
14-Mar-01	130	10				
21-Mar-01	330	12	157	32	3.65E+12	2.32E+13
31-May-01	270	8				
6-Jun-01	110	10				
21-Jun-01	230	9				
25-Jun-01	20	9	108	9	6.96E+11	1.29E+12
14-Aug-01	490	8				
22-Aug-01	360	6				
28-Aug-01	1100	6				
4-Sep-01	2400	7	826	7	4.03E+12	9.76E+11
4-Oct-01	80	6				
24-Oct-01	40	7				
29-Oct-01	20	7				
31-Oct-01	20	6	34	6	1.57E+11	9.32E+11

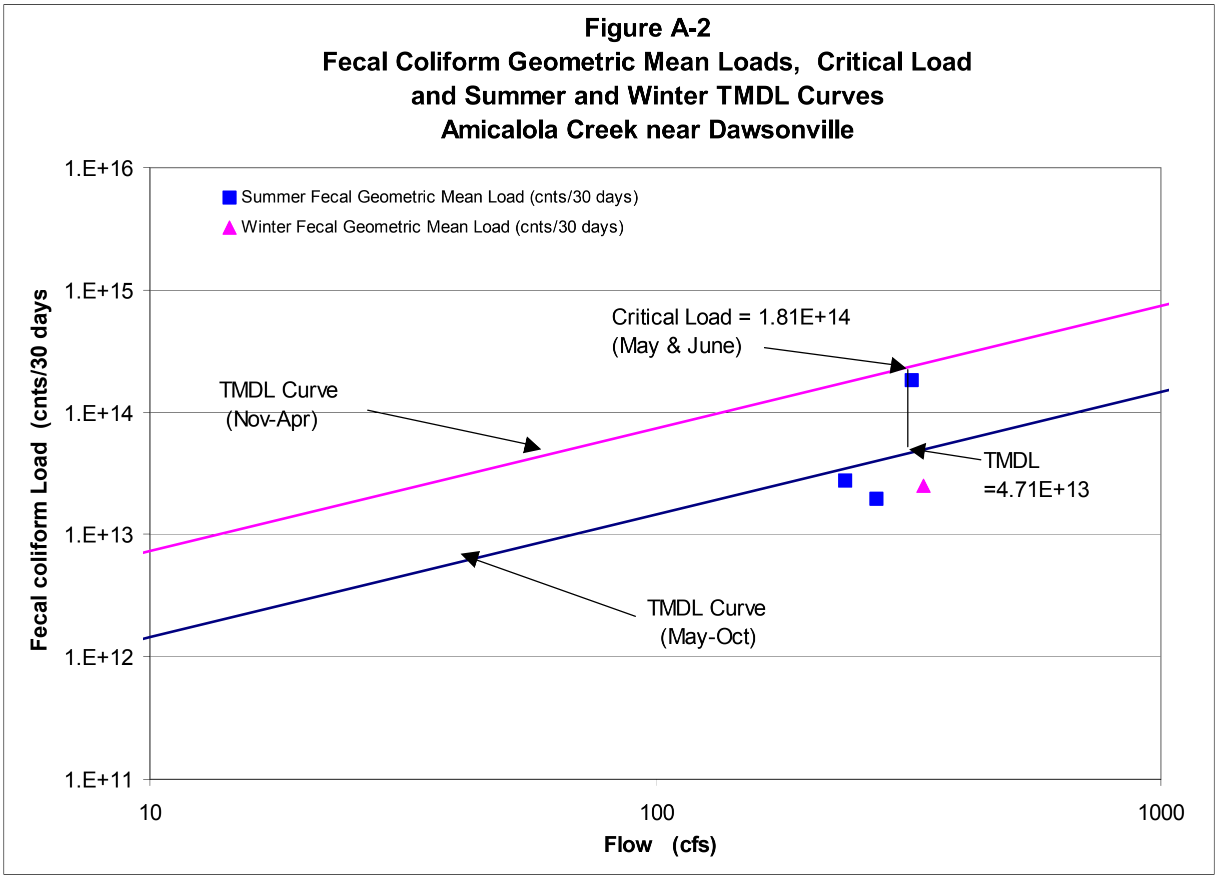

Table A-2. Data for Figure A-2, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	50	317				
22-Feb-01	490	382				
1-Mar-01	80	328				
8-Mar-01	50	330	99	339	2.48E+13	2.49E+14
8-May-01	130	293				
21-May-01	1100	311				
23-May-01	7900	315				
5-Jun-01	310	364	769	321	1.81E+14	4.71E+13
21-Aug-01	130	117				
4-Sep-01	1100	321				
10-Sep-01	220	257				
12-Sep-01	20	256	158	238	2.76E+13	3.49E+13
1-Oct-01	80	268				
15-Oct-01	1100	298				
22-Oct-02	50	271				
30-Oct-01	20	261	97	275	1.95E+13	4.03E+13

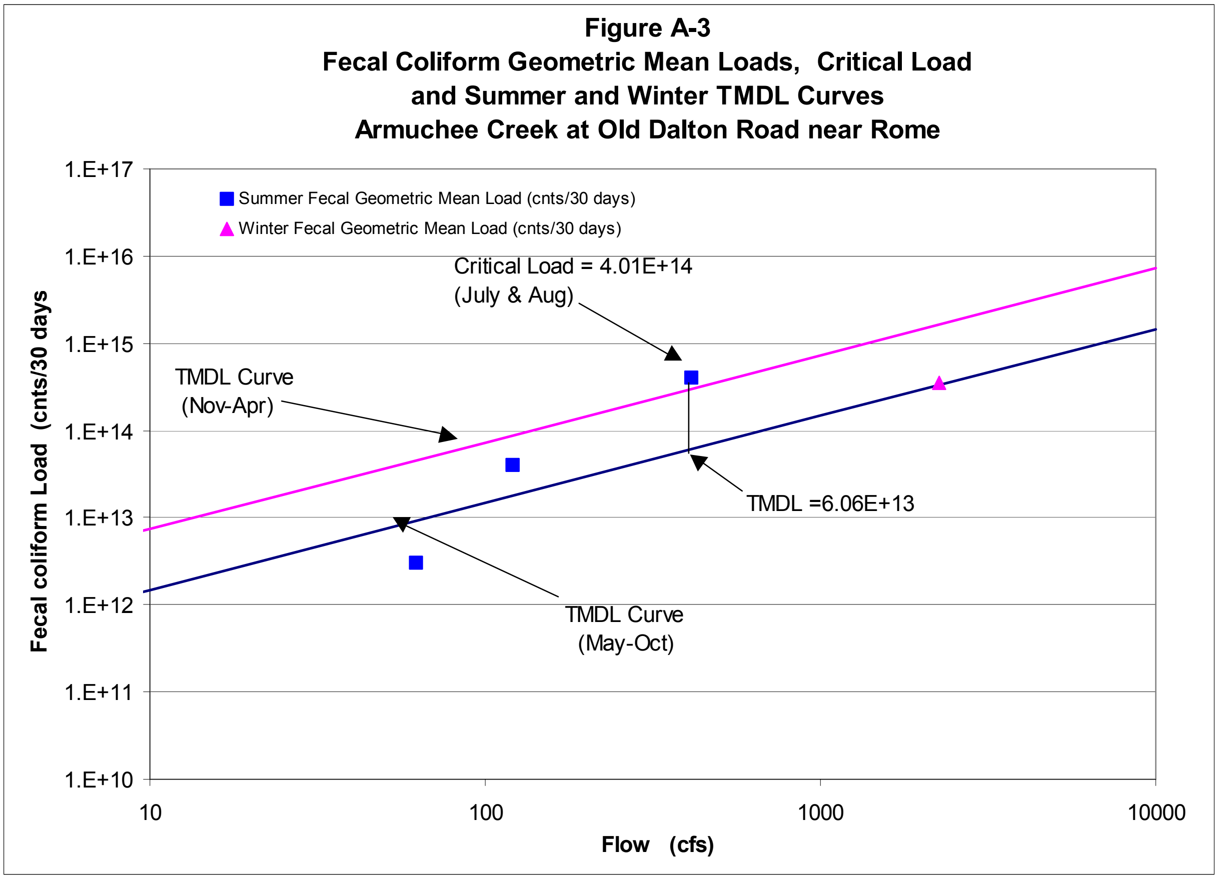

Table A-3. Data for Figure A-3, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	220	2930				
12-Mar-01	20	219				
15-Mar-01	3500	5310				
19-Mar-01	130	577	212	2259	3.51E+14	1.66E+15
24-May-01	110	77				
4-Jun-01	1300	221				
13-Jun-01	130	102				
24-Jun-01	2210	82	450	121	3.98E+13	1.77E+13
30-Jul-01	790	90				
7-Aug-01	490	94				
14-Aug-01	24000	1370				
21-Aug-01	330	97	1323	413	4.01E+14	6.06E+13
3-Oct-01	170	68				
11-Oct-01	110	71				
25-Oct-02	20	55				
31-Oct-01	50	54	66	62	2.99E+12	9.10E+12

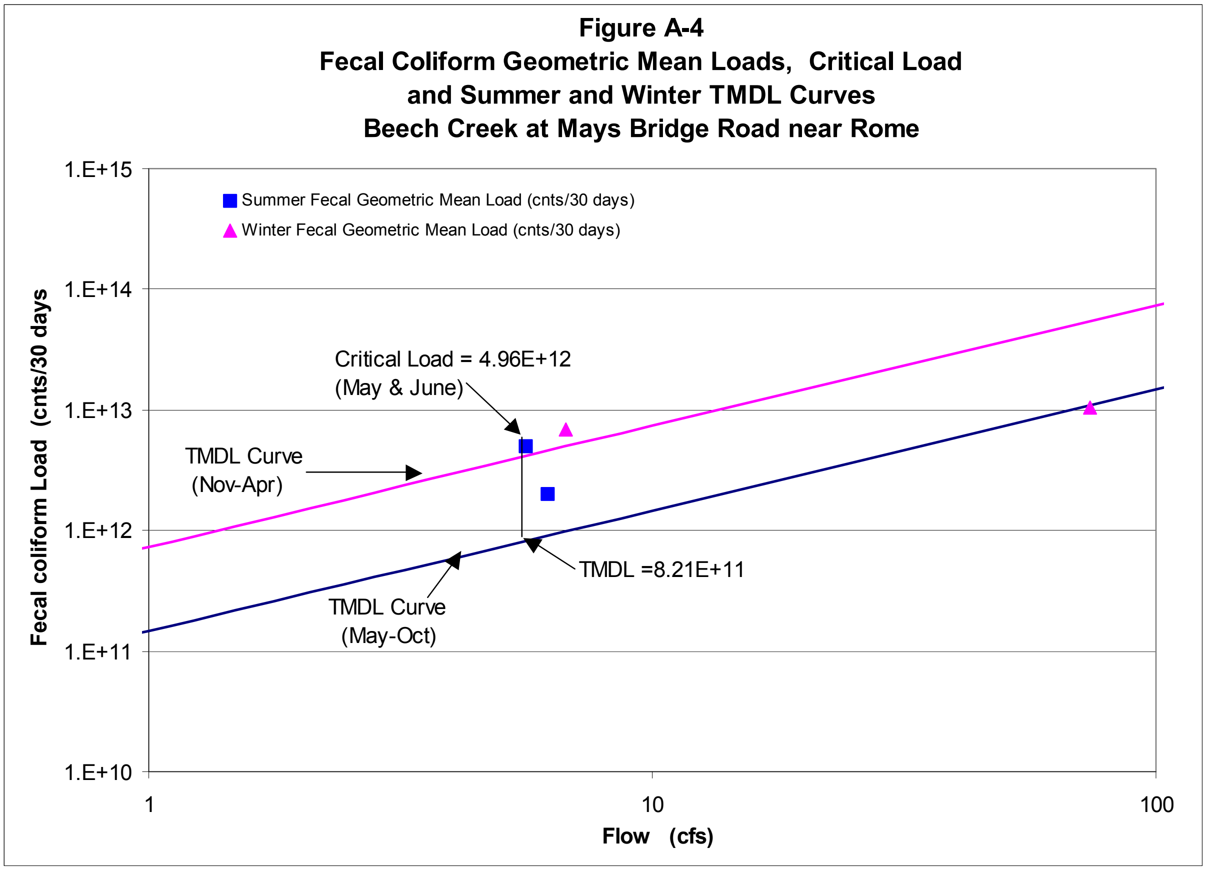

Table A-4. Data for Figure A-4, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	80	13				
8-Mar-01	210	17				
22-Mar-01	460	224				
26-Mar-01	170	43	190	74.1	1.04E+13	5.44E+13
24-May-01	14000	5				
7-Jun-01	170	12				
20-Jun-01	3300	3				
21-Jun-01	270	2	1207	5.6	4.96E+12	8.21E+11
12-Jul-01	340	17				
18-Jul-01	170	3				
30-Jul-01	2800	3				
2-Aug-01	230	2	439	6.2	2.00E+12	9.10E+11
5-Nov-01	170	2				
26-Nov-01	1400	15				
4-Dec-01	490	2				
17-Dec-01	790	5				
18-Dec-01	7000	5	1396	6.7	6.91E+12	4.95E+12

Figure A-5
Fecal Coliform Geometric Mean Loads, Critical Load and Summer and Winter TMDL Curves (Big Cedar) Cedar Creek near Cedartown

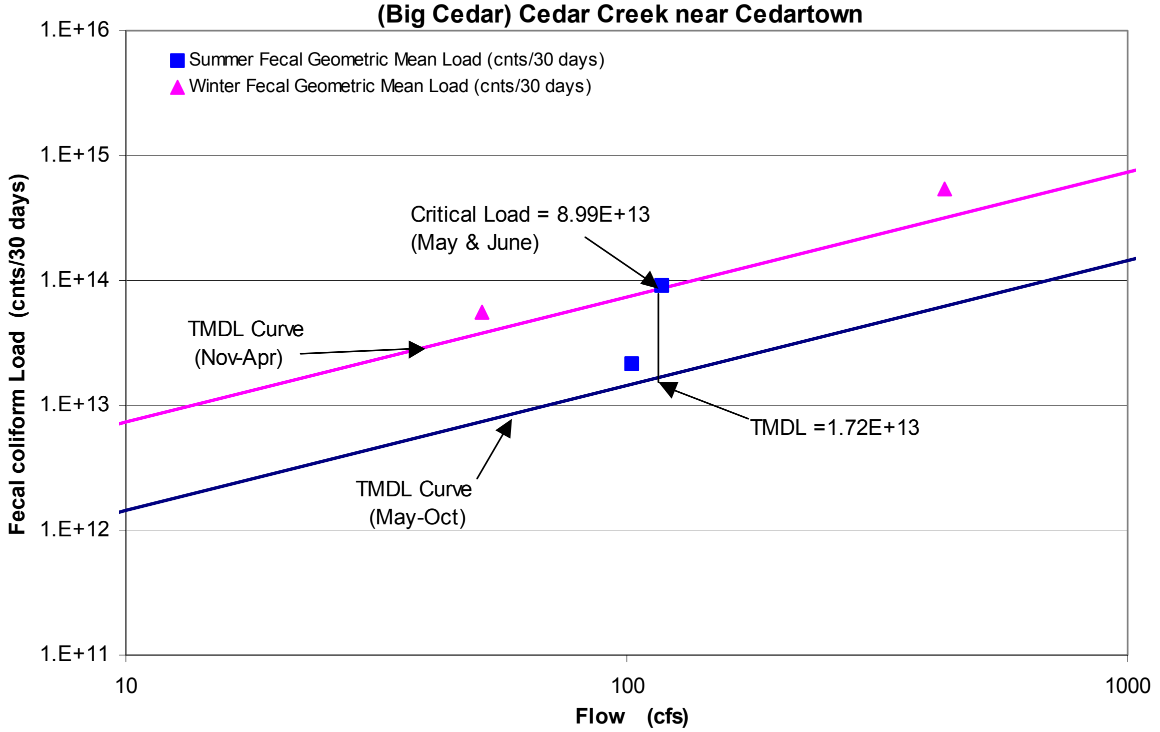

Table A-5. Data for Figure A-5, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	4900	372				
8-Mar-01	700	263				
22-Mar-01	3300	792				
26-Mar-01	790	294	1729	430	5.46E+14	3.16E+14
24-May-01	490	60				
7-Jun-01	2200	213				
20-Jun-01	1400	99				
21-Jun-01	790	97	1045	117	8.99E+13	1.72E+13
12-Jul-01	580	132				
18-Jul-01	20	97				
30-Jul-01	1300	99				
2-Aug-01	430	82	284	103	2.13E+13	1.50E+13
5-Nov-01	130	30				
26-Nov-01	1100	50				
4-Dec-01	170	34				
17-Dec-01	7900	61				
18-Dec-01	3300	61	1486	52	5.62E+13	3.78E+13

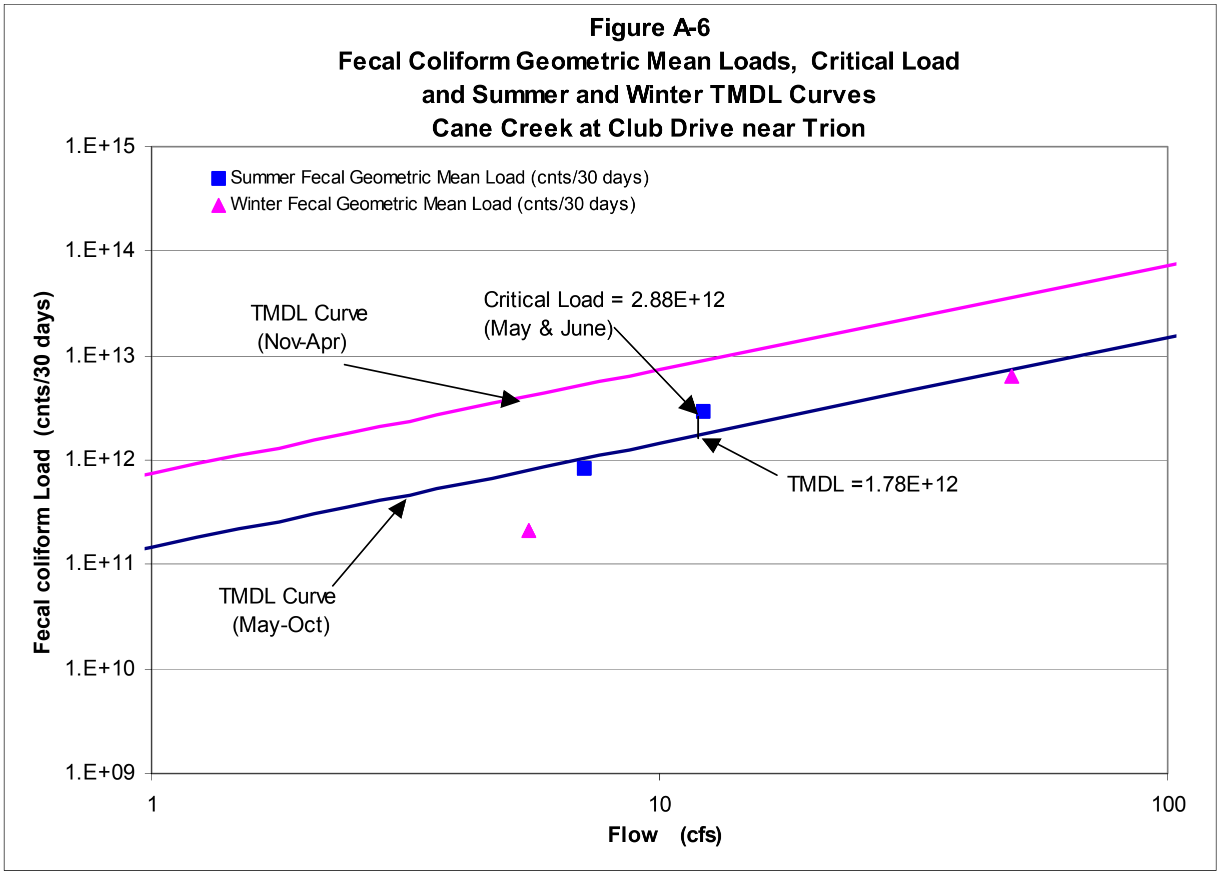

Table A-6. Data for Figure A-6, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
20-Feb-01	110	48				
26-Feb-01	210	79				
5-Mar-01	230	43				
12-Mar-01	170	28	173	50	6.30E+12	3.63E+13
14-May-01	220	8				
21-May-01	170	7				
29-May-01	1700	24				
14-Jun-01	170	9	322	12	2.88E+12	1.78E+12
22-Aug-01	70	7				
28-Aug-01	130	7				
5-Sep-01	230	8				
10-Sep-01	310	7	160	7	8.35E+11	1.05E+12
5-Nov-01	20	5				
13-Nov-01	20	6				
28-Nov-01	80	6				
5-Dec-01	220	6	52	6	2.09E+11	4.06E+12

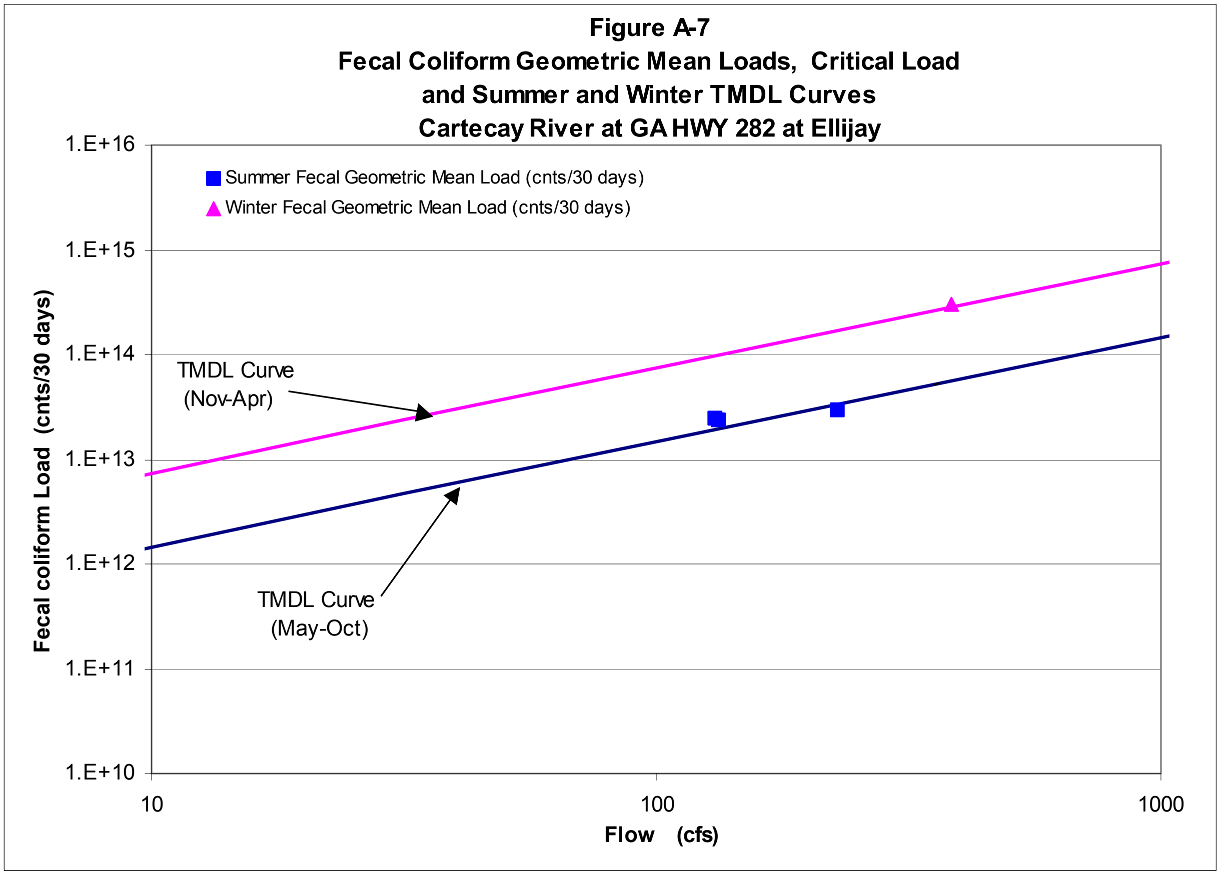

Table A-7. Data for Figure A-7, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	630	341				
5-Mar-01	330	296				
22-Mar-01	790	287				
29-Mar-01	7900	619	1067	386	3.02E+14	2.83E+14
15-May-01	130	165				
22-May-01	80	156				
29-May-01	400	376				
12-Jun-01	230	214	176	228	2.94E+13	3.34E+13
28-Aug-01	490	117				
5-Sep-01	240	167				
10-Sep-01	90	121				
18-Sep-01	310	127	239	133	2.34E+13	1.95E+13
2-Oct-01	90	127				
4-Oct-01	260	132				
9-Oct-02	170	132				
16-Oct-01	1100	132	257	131	2.47E+13	1.92E+13

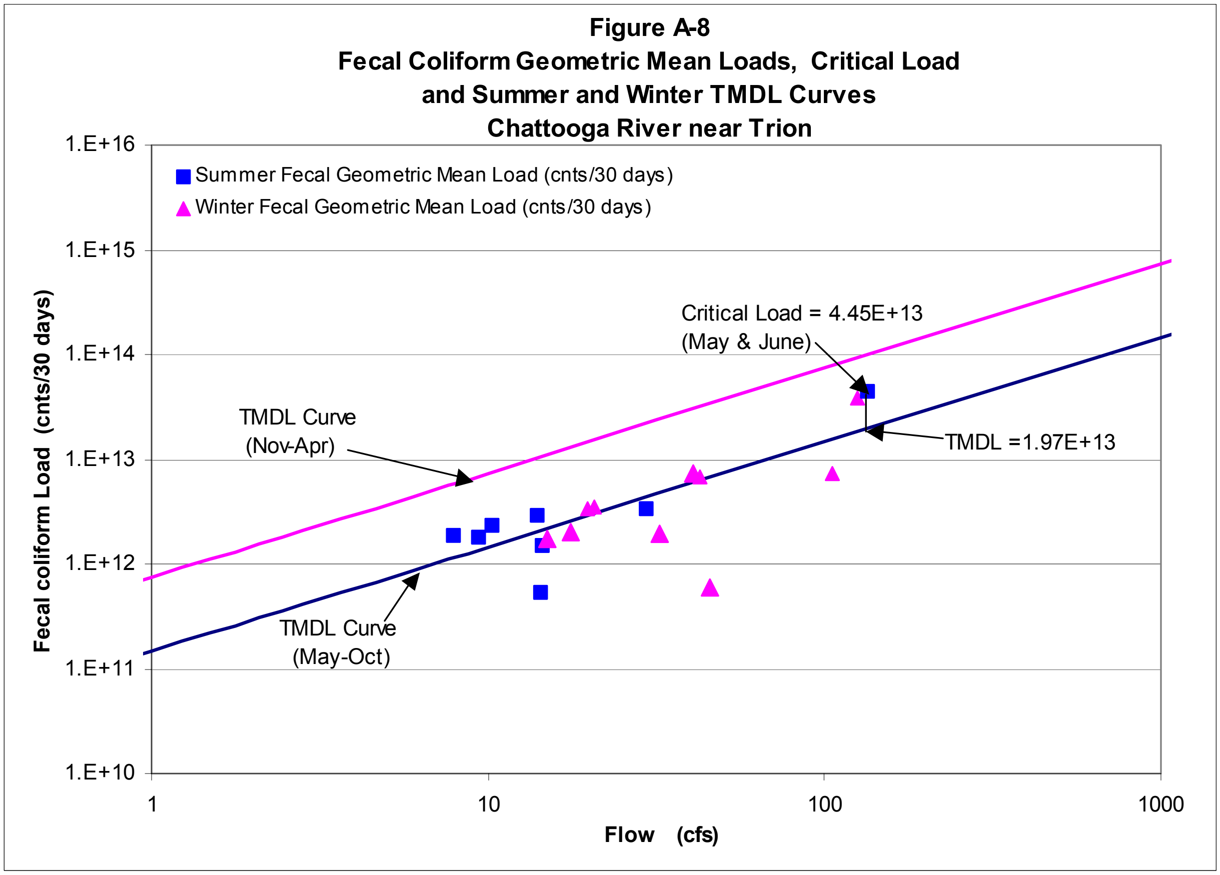
Figure A-8
Fecal Coliform Geometric Mean Loads, Critical Load
and Summer and Winter TMDL Curves
Chattooga River near Trion
Summer Fecal Geometric Mean Load (cnts/30 days)
Winter Fecal Geometric Mean Load (cnts/30 days)
Critical Load = 4.45E+13
(May & June)
TMDL Curve
(Nov-Apr)
TMDL =1.97E+13
TMDL Curve
(May-Oct)
Fecal coliform Load (cnts/30 days)
1.E+16
1.E+15
1.E+14
1.E+13
1.E+12
1.E+11
1.E+10
1
10
100
1000
Flow (cfs)

Table A-8. Data for Figure A-8, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
4-Jan-00	200	12				
11-Jan-00	500	28				
18-Jan-00	33	14				
25-Jan-00	866	25	231	20	3.37E+12	1.46E+13
1-Feb-00	100	16				
8-Feb-00	33	13				
15-Feb-00	3596	37				
22-Feb-00	67	19				
29-Feb-00	866	18	233	21	3.53E+12	1.51E+13
7-Mar-00	67	14				
14-Mar-00	200	29				
21-Mar-00	999	94				
28-Mar-00	166	34	217	43	6.82E+12	3.14E+13
4-Apr-00	666	409				
11-Apr-00	266	38				
18-Apr-00	266	27				
25-Apr-00	666	26	421	125	3.86E+13	9.18E+13
1-May-00	150	20				
8-May-00	100	15				
14-May-00	1	12				
15-May-00	1	11				
16-May-00	1	14				
17-May-00	50	14				
18-May-00	50	15				
19-May-00	30	14				
20-May-00	65	14				
21-May-00	80	17				
22-May-00	120	18				
23-May-00	100	16				
24-May-00	250	15				
25-May-00	200	12				
26-May-00	175	12				
27-May-00	725	11				
28-May-00	250	11	51	14	5.35E+11	2.09E+12
6-Jun-00	1600	10				
13-Jun-00	500	10				
20-Jun-00	250	11				
27-Jun-00	50	11	316	10	2.38E+12	1.50E+12
4-Jul-00	399	8				
11-Jul-00	166	9				
18-Jul-00	100	12				
25-Jul-00	733	8	264	9	1.82E+12	1.38E+12
1-Aug-00	166	9				
8-Aug-00	466	7				
15-Aug-00	250	7				
22-Aug-00	250	8				
29-Aug-00	666	9	317	8	1.85E+12	1.16E+12
4-Sep-00	850	15				
12-Sep-00	233	7				
19-Sep-00	100	11				
26-Sep-00	300	24	278	14	2.86E+12	2.06E+12
2-Oct-00	150	13				
9-Oct-00	50	13				
16-Oct-00	200	13				
23-Oct-00	50	16				
30-Oct-00	700	17	139	14	1.47E+12	2.12E+12
7-Nov-00	100	16				
14-Nov-00	190	16				
21-Nov-00	80	20				

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Nov-00	400	18	157	18	2.03E+12	1.29E+13
4-Dec-00	140	17				
12-Dec-00	170	11				
20-Dec-00	260	16				
26-Dec-00	100	16	158	15	1.73E+12	1.10E+13
2-Jan-01	100	12				
9-Jan-01	240	16				
16-Jan-01	20	14				
23-Jan-01	200	60				
30-Jan-01	40	60	83	32	1.97E+12	2.38E+13
6-Feb-01	40	24				
13-Feb-01	1	29				
20-Feb-01	60	41				
27-Feb-01	40	88	18	46	5.90E+11	3.35E+13
6-Mar-01	50	59				
13-Mar-01	2270	182				
22-Mar-01	750	131				
28-Mar-01	1	49	96	105	7.42E+12	7.72E+13
5-Apr-01	610	62				
9-Apr-01	100	45				
17-Apr-01	550	34				
24-Apr-00	100	21	241	41	7.20E+12	2.99E+13
1-May-01	90	17				
8-May-01	247	15				
15-May-01	25	15				
22-May-01	257	15				
29-May-01	633	87	155	30	3.38E+12	4.35E+12
5-Jun-01	1260	456				
12-Jun-01	222	40				
21-Jun-01	282	20				
26-Jun-01	533	20	453	134	4.45E+13	1.97E+13

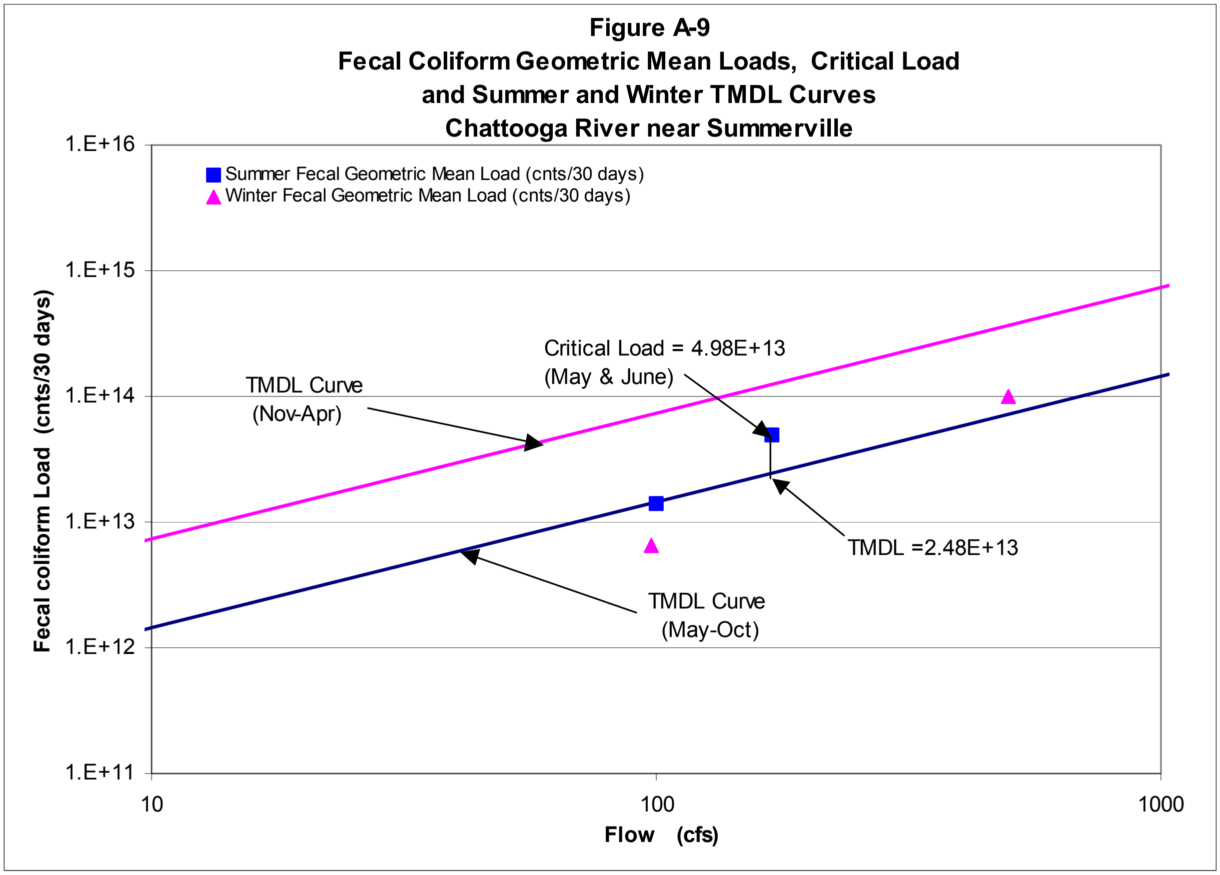

Table A-9. Data for Figure A-9, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
20-Feb-01	460	490				
26-Feb-01	4900	826				
5-Mar-01	130	435				
12-Mar-01	20	240	277	498	1.01E+14	3.65E+14
14-May-01	140	105				
21-May-01	330	95				
29-May-01	1700	287				
14-Jun-01	330	189	401	169	4.98E+13	2.48E+13
22-Aug-01	330	102				
28-Aug-01	50	88				
5-Sep-01	490	119				
10-Sep-01	170	91	193	100	1.41E+13	1.47E+13
5-Nov-01	50	69				
13-Nov-01	130	69				
28-Nov-01	80	129				
5-Dec-01	130	124	91	98	6.51E+12	7.17E+13

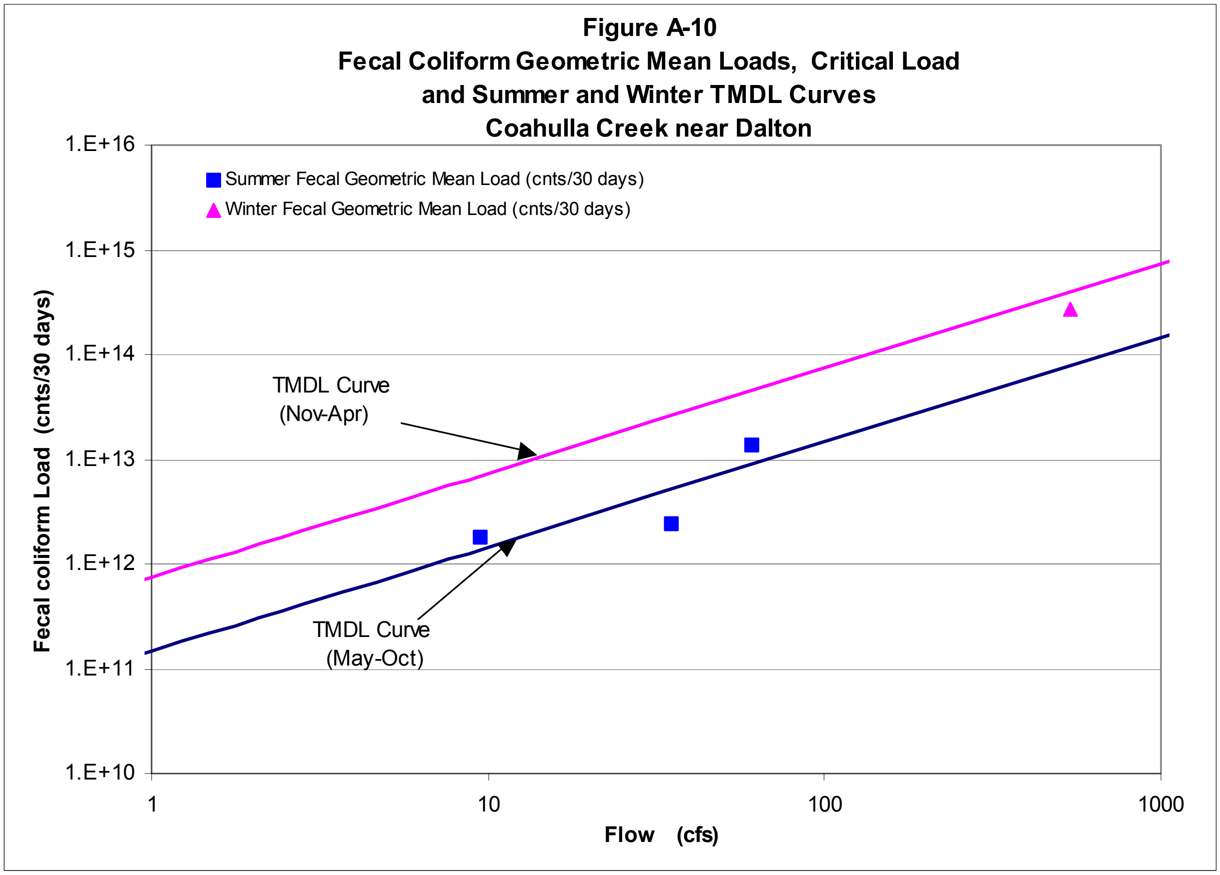

Table A-10. Data for Figure A-10, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	130	217				
6-Mar-01	230	196				
13-Mar-01	35000	1590				
19-Mar-01	210	158	685	540	2.72E+14	3.97E+14
16-May-01	490	39				
21-May-01	130	35				
30-May-01	430	74				
12-Jun-01	330	96	308	61	1.38E+13	8.95E+12
30-Aug-01	220	4				
5-Sep-01	330	10				
11-Sep-01	470	3				
20-Sep-01	130	21	258	10	1.80E+12	1.39E+12
1-Oct-01	790	31				
3-Oct-01	60	28				
10-Oct-01	20	29				
15-Oct-01	80	53	93	35	2.41E+12	5.17E+12

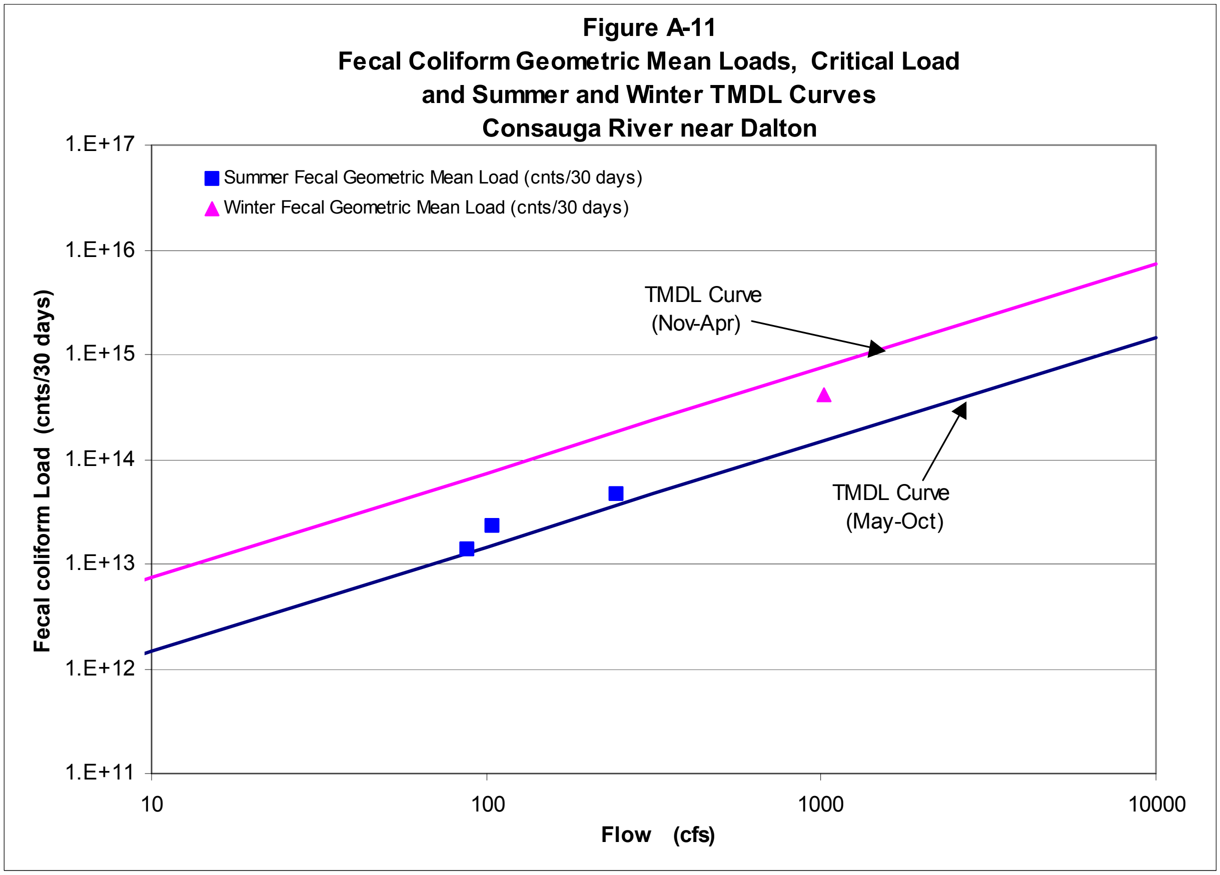

Table A-11. Data for Figure A-11, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	330	824				
6-Mar-01	330	811				
13-Mar-01	17000	1850				
19-Mar-01	50	571	552	1014	4.11E+14	7.44E+14
16-May-01	170	124				
21-May-01	170	80				
30-May-01	330	403				
12-Jun-01	490	369	261	244	4.68E+13	3.58E+13
30-Aug-01	1700	60				
5-Sep-01	220	232				
11-Sep-01	130	73				
20-Sep-01	170	53	302	105	2.31E+13	1.53E+13
1-Oct-01	1100	101				
3-Oct-01	490	86				
10-Oct-01	50	69				
15-Oct-01	80	93	215	87	1.38E+13	1.28E+13

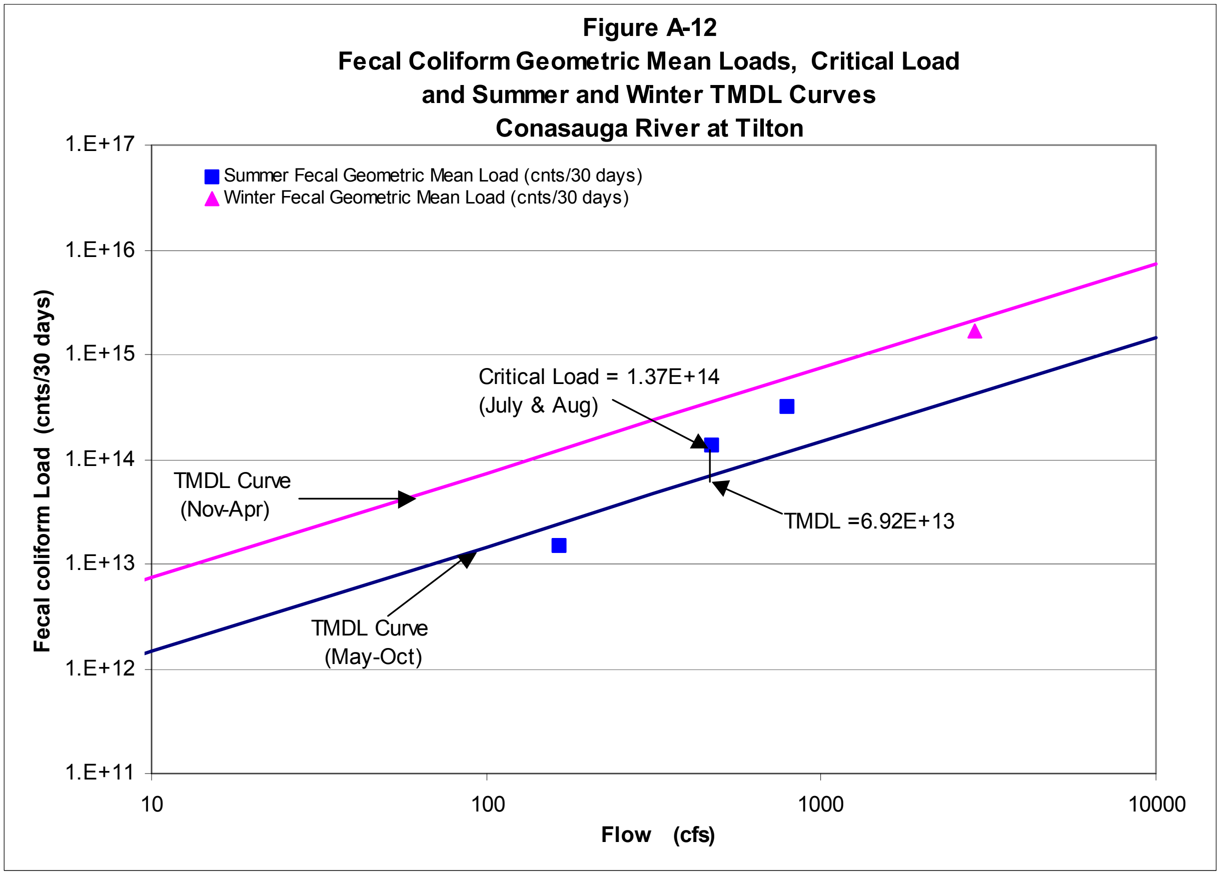

Table A-12. Data for Figure A-12, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	130	1220				
26-Feb-01	7900	5370				
27-Feb-01	490	2970				
6-Mar-01	790	1960	794	2880	1.68E+15	2.11E+15
17-Apr-01	2400	1310				
19-Apr-01	330	825				
24-Apr-01	220	543				
26-Apr-01	490	503	541	795	3.16E+14	5.84E+14
16-Jul-01	340	281				
23-Jul-01	170	415				
30-Jul-01	1300	592				
7-Aug-01	330	597	397	471	1.37E+14	6.92E+13
1-Oct-01	1300	212				
9-Oct-01	20	135				
17-Oct-01	440	195				
23-Oct-01	20	120	123	166	1.49E+13	2.43E+13

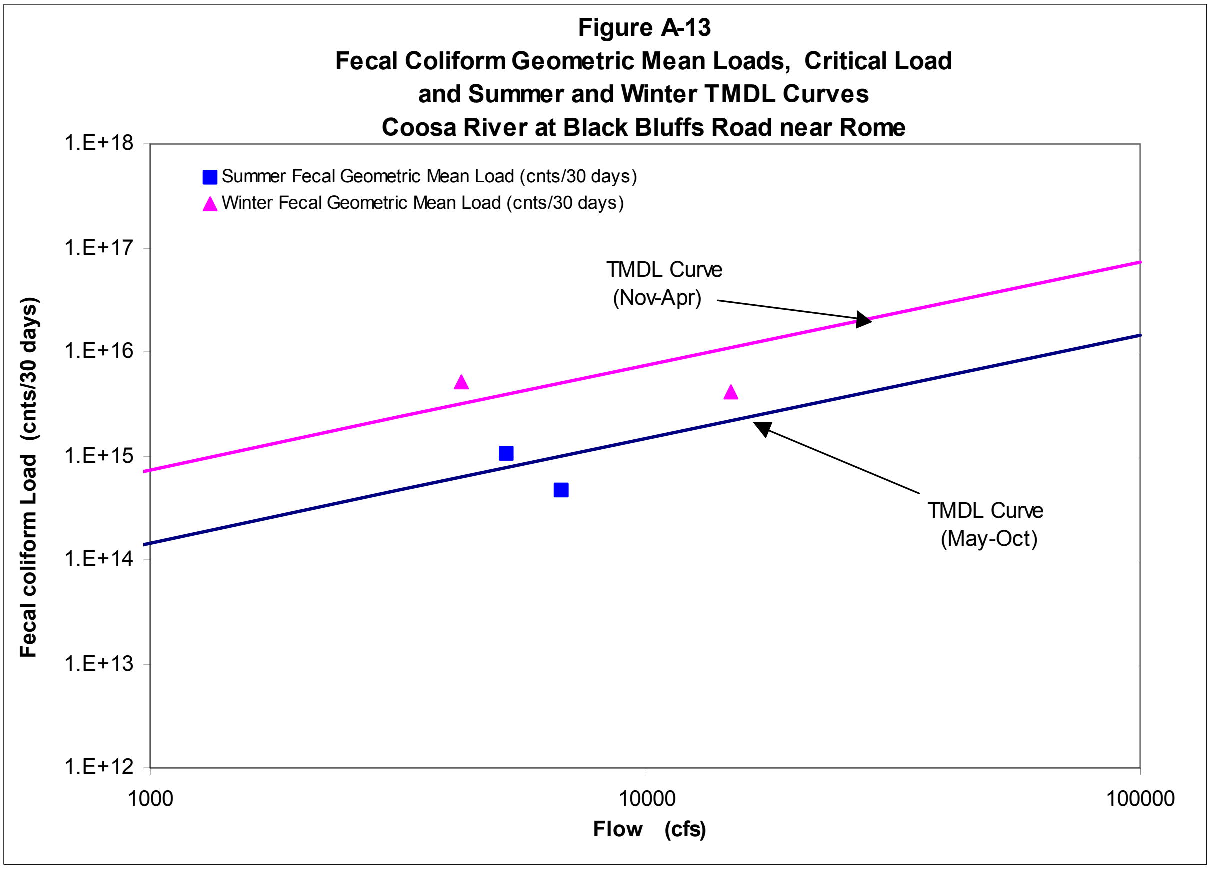

Table A-13. Data for Figure A-13, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	790	11600				
8-Mar-01	50	8360				
22-Mar-01	1100	31400				
26-Mar-01	490	8260	382	14905	4.18E+15	1.09E+16
24-May-01	20	5120				
7-Jun-01	330	13700				
20-Jun-01	110	4590				
21-Jun-01	110	3740	95	6788	4.71E+14	9.96E+14
12-Jul-01	270	5760				
18-Jul-01	20	2800				
30-Jul-01	7900	5490				
2-Aug-01	130	6970	273	5255	1.05E+15	7.71E+14
5-Nov-01	20	1070				
26-Nov-01	7900	2210				
4-Dec-01	170	3880				
17-Dec-01	2400	4470				
18-Dec-01	2400	6450	1668	4253	5.21E+15	3.12E+15

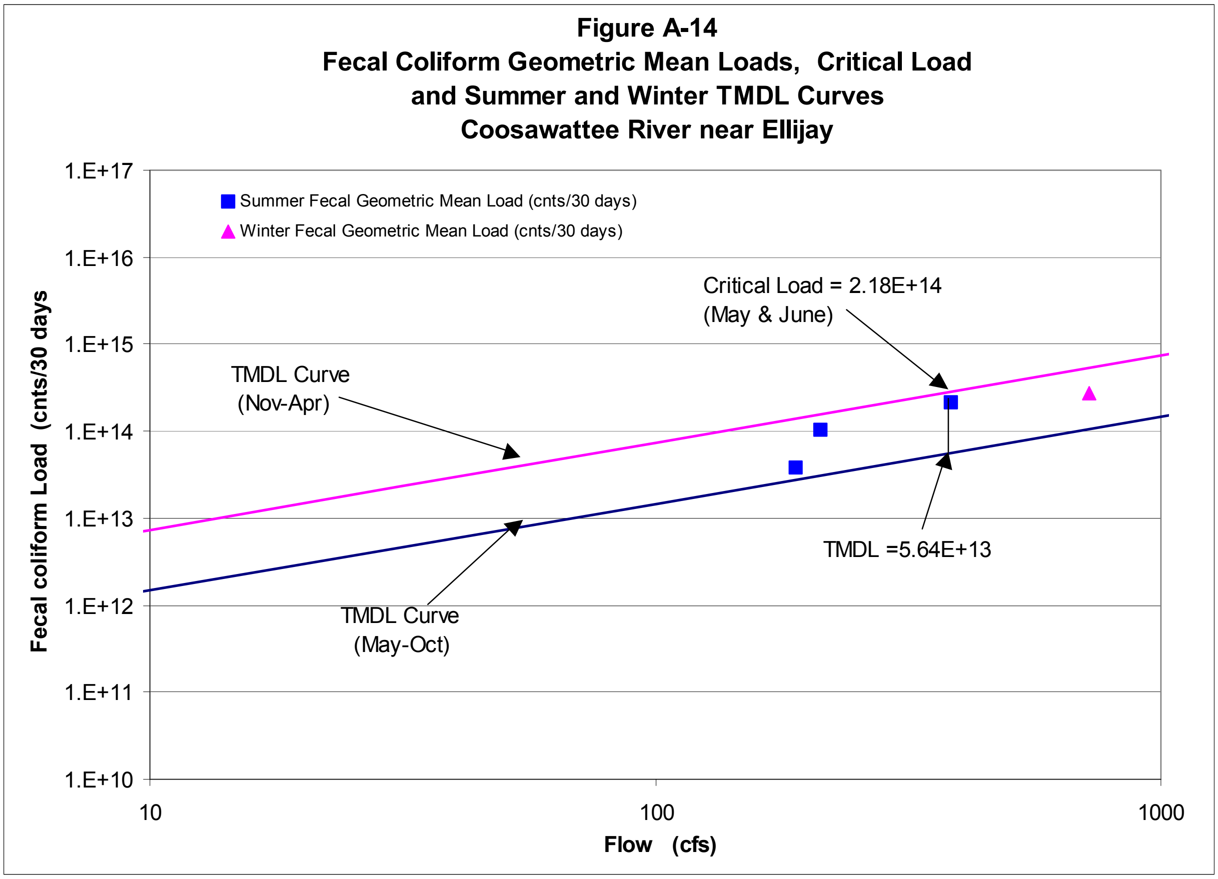

Table A-14. Data for Figure A-14, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	310	642				
5-Mar-01	210	512				
14-Mar-01	230	453				
20-Mar-01	4900	1280	520	722	2.76E+14	5.30E+14
15-May-01	1700	267				
22-May-01	490	247				
29-May-01	3300	649				
12-Jun-01	130	373	773	384	2.18E+14	5.64E+13
28-Aug-01	130	206				
5-Sep-01	2400	267				
10-Sep-01	1300	202				
18-Sep-01	490	175	668	213	1.04E+14	3.12E+13
2-Oct-01	170	172				
4-Oct-01	110	166				
9-Oct-02	170	172				
15-Oct-01	1700	247	271	189	3.77E+13	2.78E+13

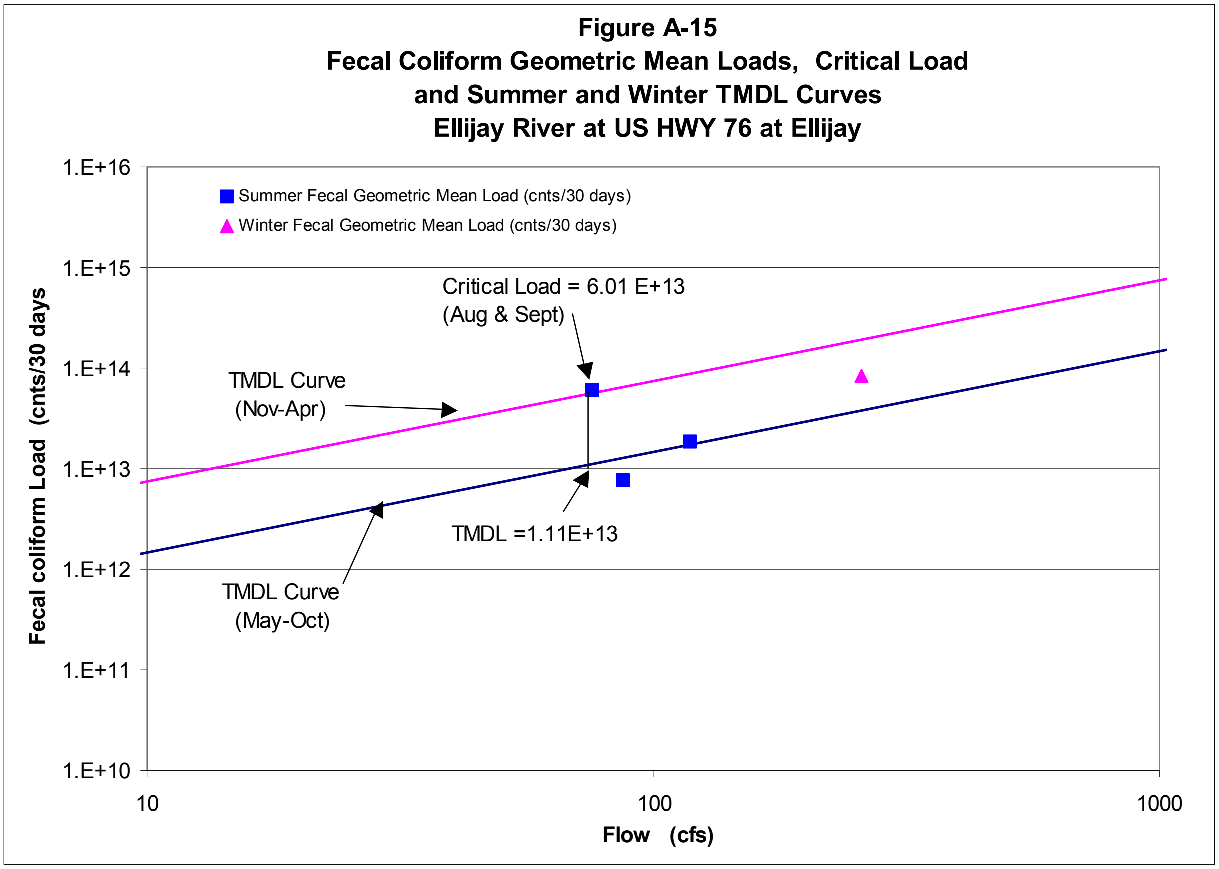

Table A-15. Data for Figure A-15, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	330	150				
5-Mar-01	330	135				
22-Mar-01	70	135				
29-Mar-01	4900	610	440	258	8.31E+13	1.89E+14
15-May-01	20	105				
22-May-01	170	105				
29-May-01	2800	150				
12-Jun-01	220	112	214	118	1.85E+13	1.73E+13
28-Aug-01	40	75				
5-Sep-01	13000	76				
10-Sep-01	2800	76				
18-Sep-01	940	76	1082	76	6.01E+13	1.11E+13
2-Oct-01	110	76				
4-Oct-01	140	88				
9-Oct-02	130	88				
16-Oct-01	110	96	122	87	7.78E+12	1.28E+13

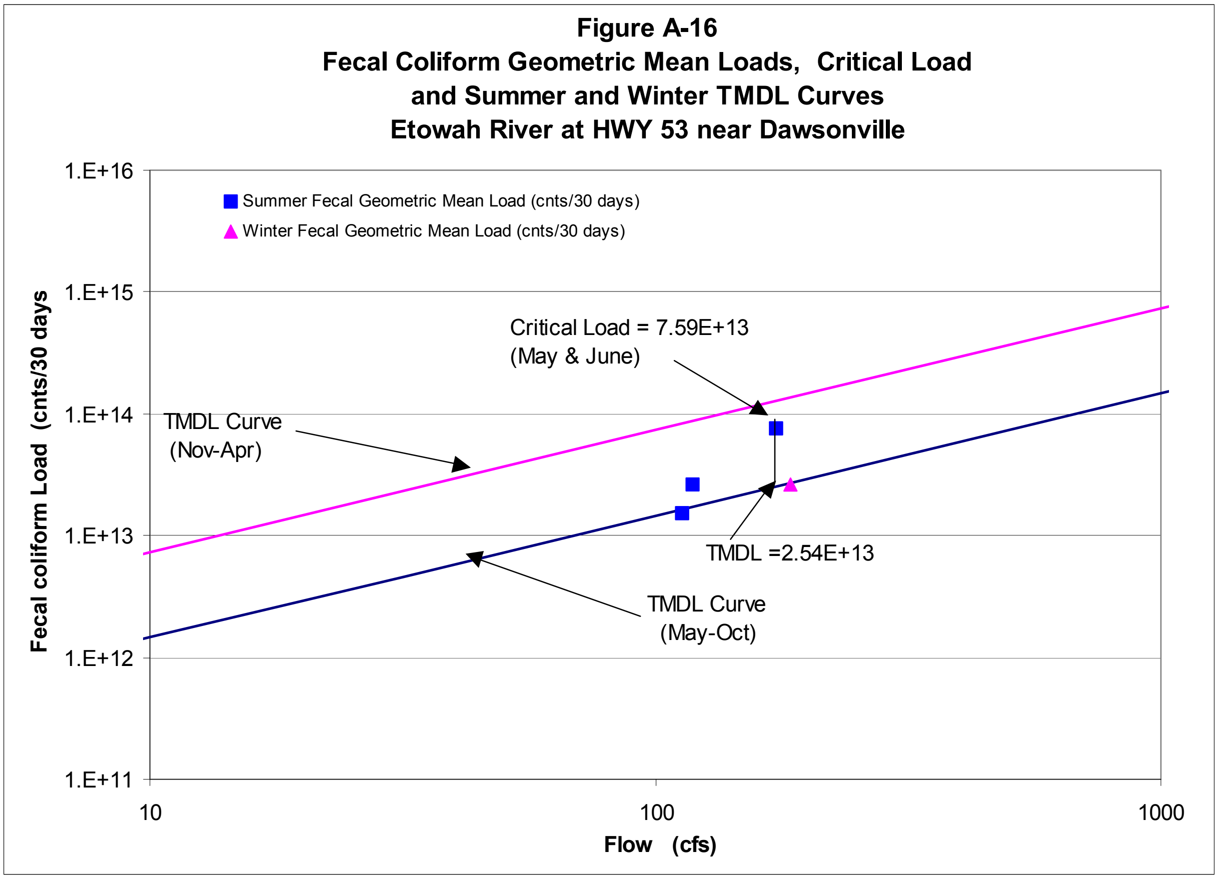

Table A-16. Data for Figure A-16, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	80	146				
22-Feb-01	11000	224				
1-Mar-01	80	202				
8-Mar-01	20	170	194	186	2.64E+13	1.36E+14
8-May-01	330	151				
21-May-01	230	150				
23-May-01	700	173				
5-Jun-01	2400	218	598	173	7.59E+13	2.54E+13
21-Aug-01	20	117				
4-Sep-01	1100	165				
10-Sep-01	490	85				
12-Sep-01	110	84	186	113	1.54E+13	1.66E+13
1-Oct-01	270	101				
15-Oct-01	1700	163				
22-Oct-02	80	108				
30-Oct-01	220	101	300	118	2.60E+13	1.74E+13

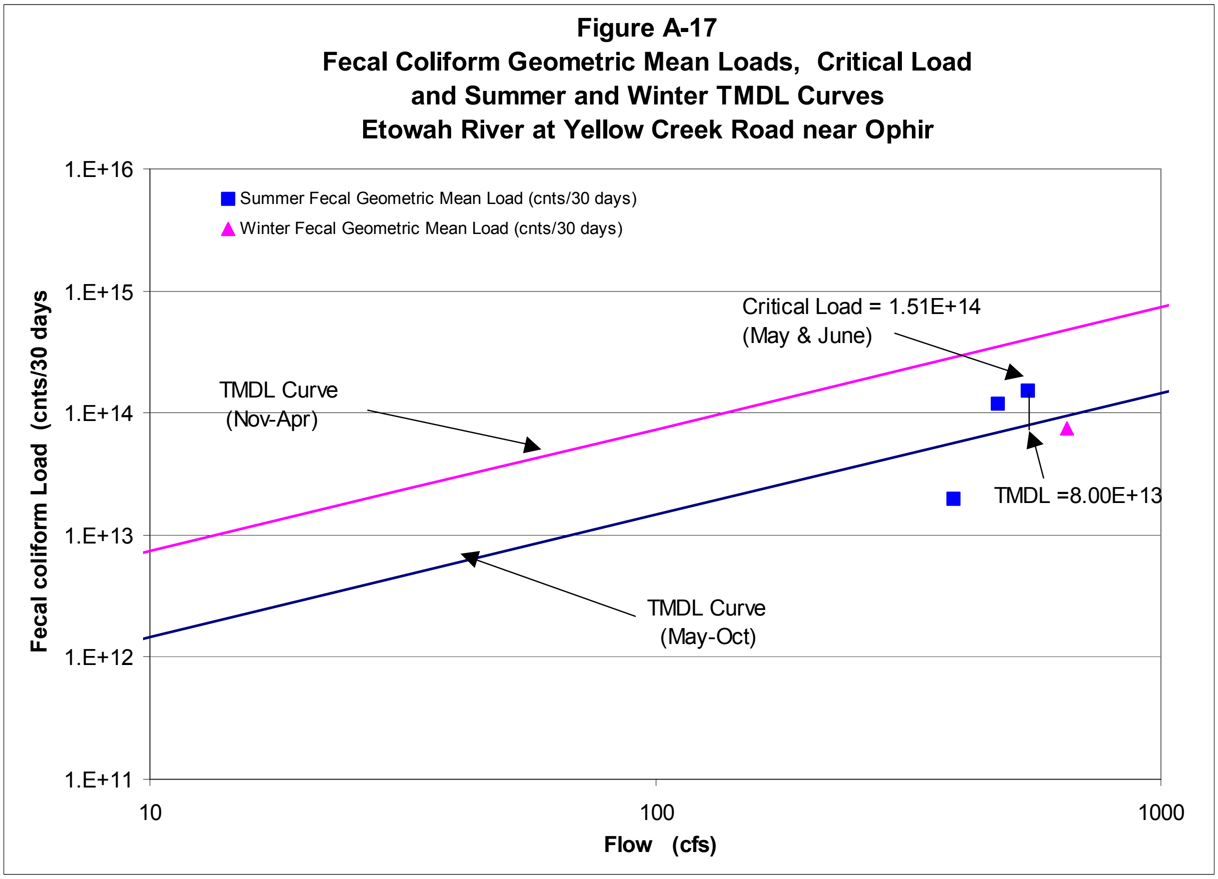

Table A-17. Data for Figure A-17, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	80	544				
22-Feb-01	2400	658				
1-Mar-01	50	733				
8-Mar-01	60	680	155	654	7.43E+13	4.80E+14
8-May-01	110	518				
21-May-01	170	504				
23-May-01	330	589				
5-Jun-01	3300	568	378	545	1.51E+14	8.00E+13
21-Aug-01	220	407				
4-Sep-01	2200	730				
10-Sep-01	170	381				
12-Sep-01	170	387	344	476	1.20E+14	6.99E+13
1-Oct-01	170	355				
15-Oct-01	170	504				
22-Oct-02	40	370				
30-Oct-01	20	328	69	389	1.98E+13	5.71E+13

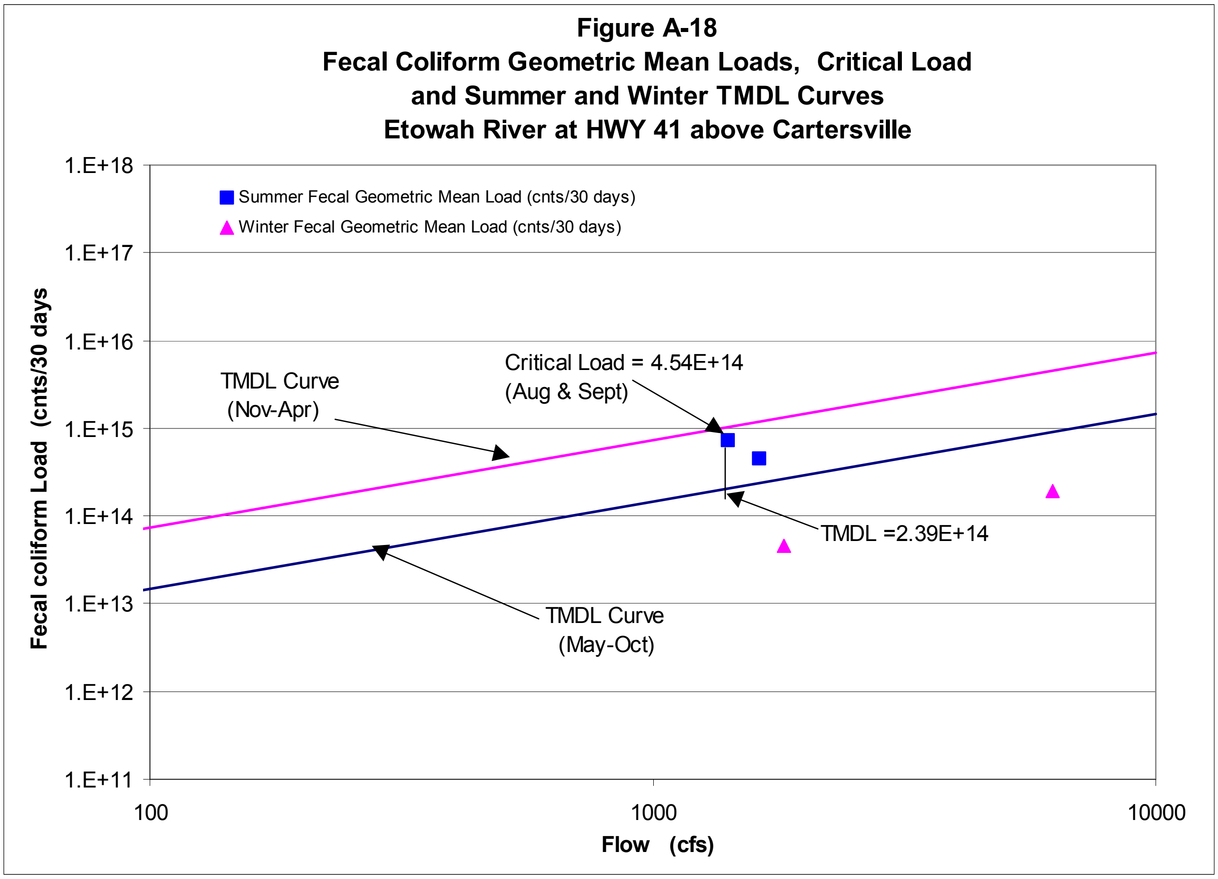

Table A-18. Data for Figure A-18, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	40	5900				
15-Feb-01	80	4350				
20-Feb-01	50	7600				
6-Mar-01	20	7150	42	6250	1.94E+14	4.59E+15
7-May-01	330	1930				
9-May-01	20	1700				
29-May-01	3500	400				
4-Jun-01	11000	1600	710	1408	7.33E+14	2.07E+14
16-Aug-01	570	2800				
20-Aug-01	490	2750				
23-Aug-01	570	480				
11-Sep-01	130	490	379	1630	4.54E+14	2.39E+14
7-Nov-01	20	4350				
14-Nov-01	20	460				
26-Nov-01	170	1850				
6-Dec-01	20	630	34	1823	4.57E+13	2.68E+14

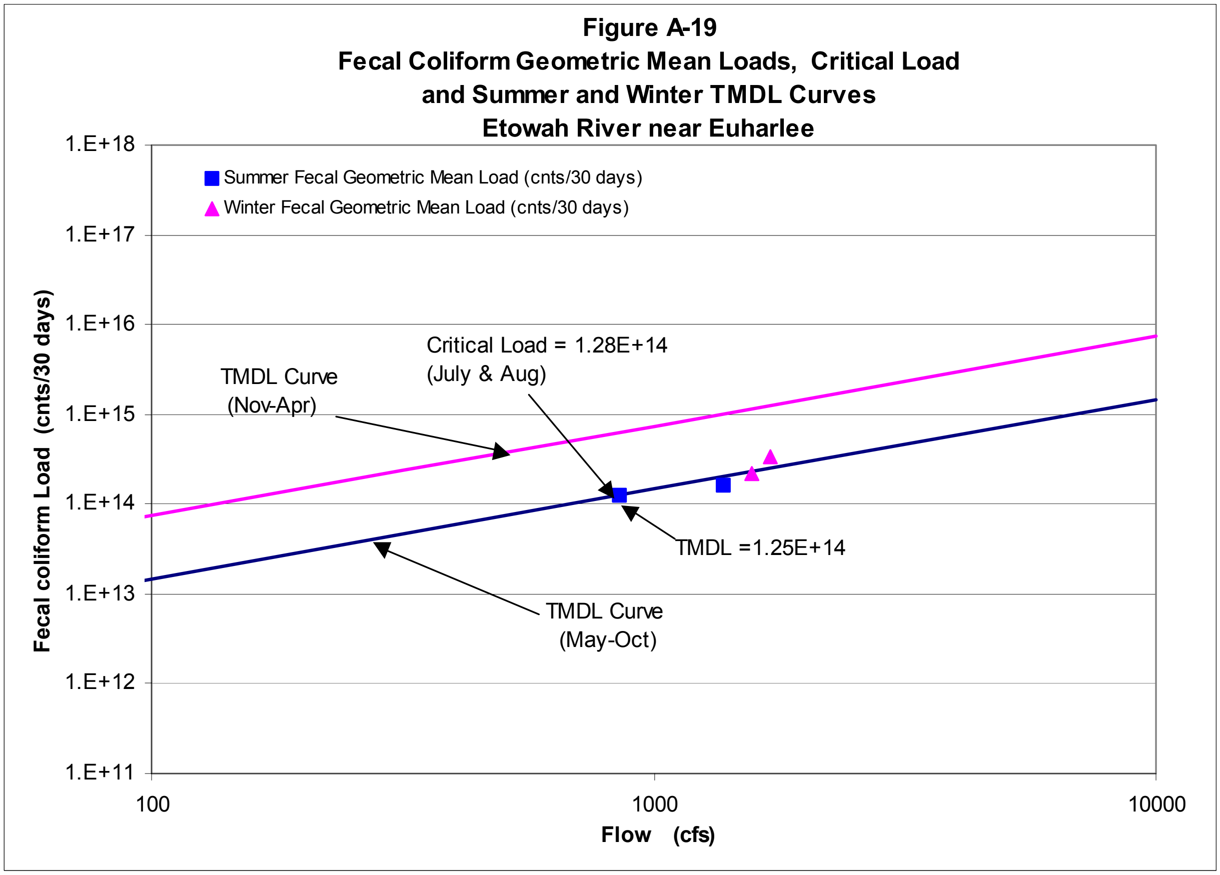

Table A-19. Data for Figure A-19, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	170	935				
21-Feb-01	50	2290				
28-Feb-01	170	1400				
5-Mar-01	3500	2190	267	1704	3.33E+14	1.25E+15
5-Apr-01	330	2620				
19-Apr-01	70	1250				
25-Apr-01	140	889				
30-Apr-01	220	749	163	1377	1.65E+14	1.01E+15
11-Jul-01	40	1010				
17-Jul-01	70	772				
24-Jul-01	2400	726				
1-Aug-01	260	909	204	854	1.28E+14	1.25E+14
26-Nov-01	310	NA				
29-Nov-01	80	743				
4-Dec-01	230	2990				
13-Dec-01	220	988	188	1574	2.17E+14	1.16E+15

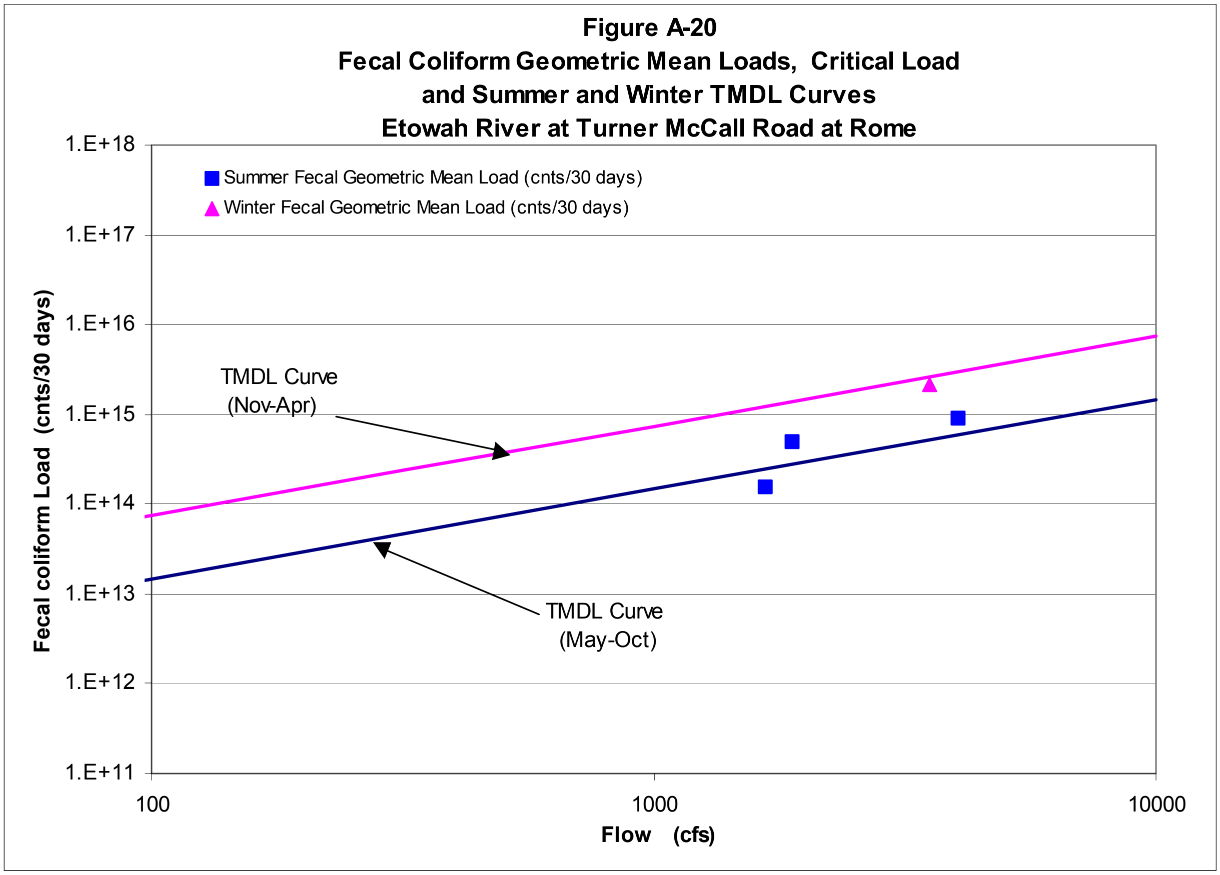

Table A-20. Data for Figure A-20, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	1300	5110				
12-Mar-01	230	1110				
15-Mar-01	9200	6130				
19-Mar-01	170	1840	827	3548	2.15E+15	2.60E+15
24-May-01	270	3490				
4-Jun-01	490	5040				
13-Jun-01	230	4370				
19-Jun-01	310	3270	312	4043	9.25E+14	5.93E+14
30-Jul-01	330	1740				
7-Aug-01	330	2410				
14-Aug-01	1100	2030				
21-Aug-01	130	1390	353	1893	4.91E+14	2.78E+14
3-Oct-01	220	2620				
11-Oct-01	490	837				
25-Oct-01	20	2660				
31-Oct-01	130	562	129	1670	1.59E+14	2.45E+14

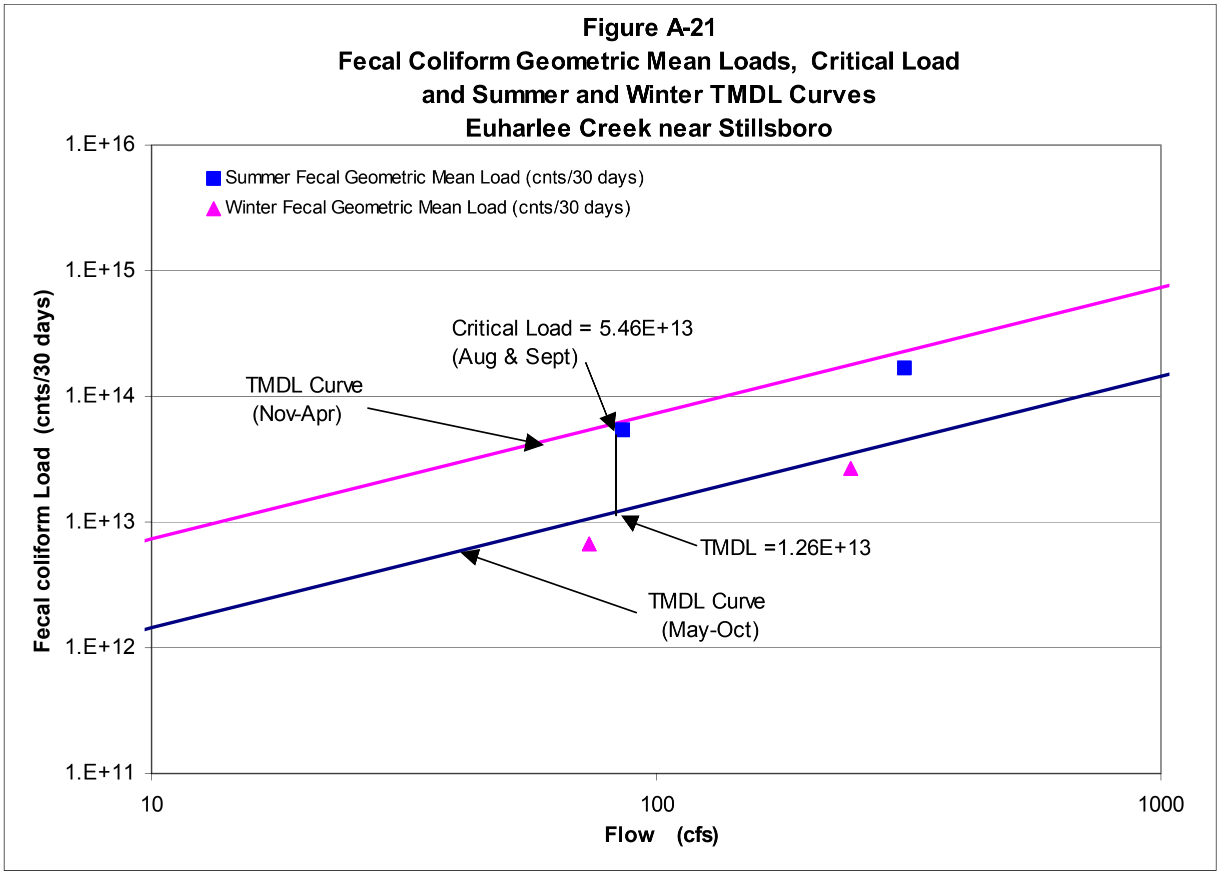

Table A-21. Data for Figure A-21, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	130	186				
15-Feb-01	330	192				
20-Feb-01	140	212				
6-Mar-01	80	379	148	242	2.63E+13	1.78E+14
7-May-01	490	135				
9-May-01	230	135				
29-May-01	3500	662				
4-Jun-01	760	308	740	310	1.68E+14	4.55E+13
16-Aug-01	790	99				
20-Aug-01	790	88				
23-Aug-01	1300	68				
11-Sep-01	700	88	868	86	5.46E+13	1.26E+13
7-Nov-01	110	67				
14-Nov-01	20	68				
26-Nov-01	310	90				
6-Dec-01	330	69	122	74	6.61E+12	5.39E+13

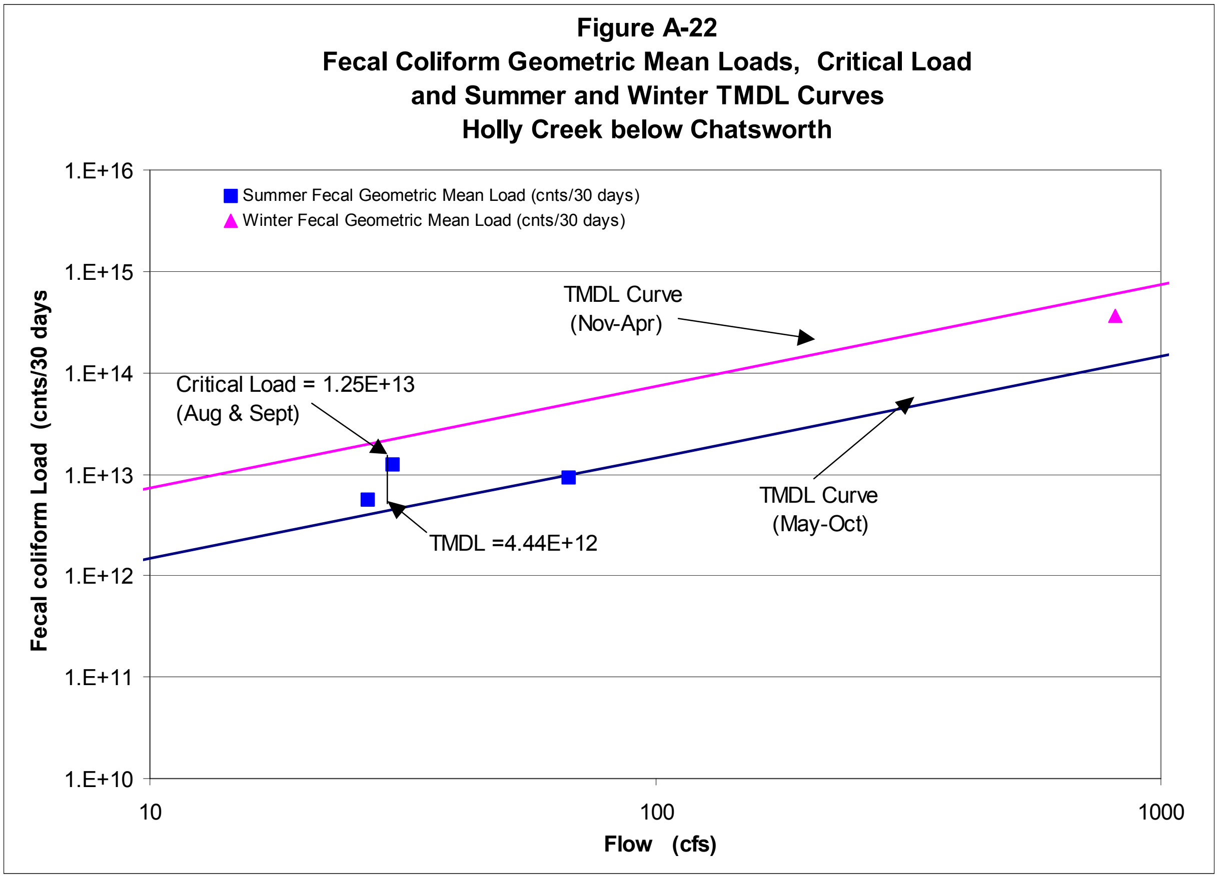

Table A-22. Data for Figure A-22, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
26-Feb-01	790	1240				
6-Mar-01	220	484				
13-Mar-01	5400	1260				
19-Mar-01	140	264	602	812	3.59E+14	5.96E+14
14-May-01	700	44				
21-May-01	110	40				
31-May-01	130	114				
13-Jun-01	130	72	190	68	9.41E+12	9.91E+12
29-Aug-01	330	24				
6-Sep-01	490	55				
11-Sep-01	790	25				
19-Sep-01	790	17	564	30	1.25E+13	4.44E+12
1-Oct-01	490	17				
3-Oct-01	130	17				
10-Oct-01	130	14				
15-Oct-01	790	60	284	27	5.64E+12	3.96E+12

Table A-23. Observed fecal coliform, fecal colifrom geometric mean, TMDL and Percent Reduction

Lake Allatoona Carter's Creek Embayment

			Drainage	**950**	acres
Date		Fecal	Geomean	TMDL	% Reduction
2/20/2001	<	20			
2/23/2001		140			
2/26/2001		945			
3/1/2001		205	153	1000	-555
6/4/2001	<	20			
6/12/2001	<	20			
6/20/2001	<	20			
6/28/2001		20	20	200	-900

Table A-24. Observed fecal coliform, fecal colifrom geometric mean, TMDL and Percent Reduction

Lake Allatoona Little River Embayment

			Drainage	**950**	acres
Date		Fecal	Geomean	TMDL	Reduction
2/20/2001		200			
2/23/2001		4600			
2/26/2001		490			
3/1/2001		110	472	1000	-112
6/4/2001		80			
6/12/2001	<	20			
6/20/2001	<	20			
6/28/2001	<	20	28	200	-607
2/23/2001		4600		4000	13

Table A-25. Observed fecal coliform, fecal colifrom geometric mean, TMDL and Percent Reduction

Lake Allatoona Tanyard's Creek Embayment

			Drainage	**950**	acres
Date		Fecal	Geomean	TMDL	% Reduction
2/20/2001		270			
2/23/2001		170			
2/26/2001		510			
3/1/2001	<	20	147	1000	-580
6/4/2001		40			
6/12/2001	<	20			
6/20/2001	<	20			
6/28/2001		50	30	200	-569

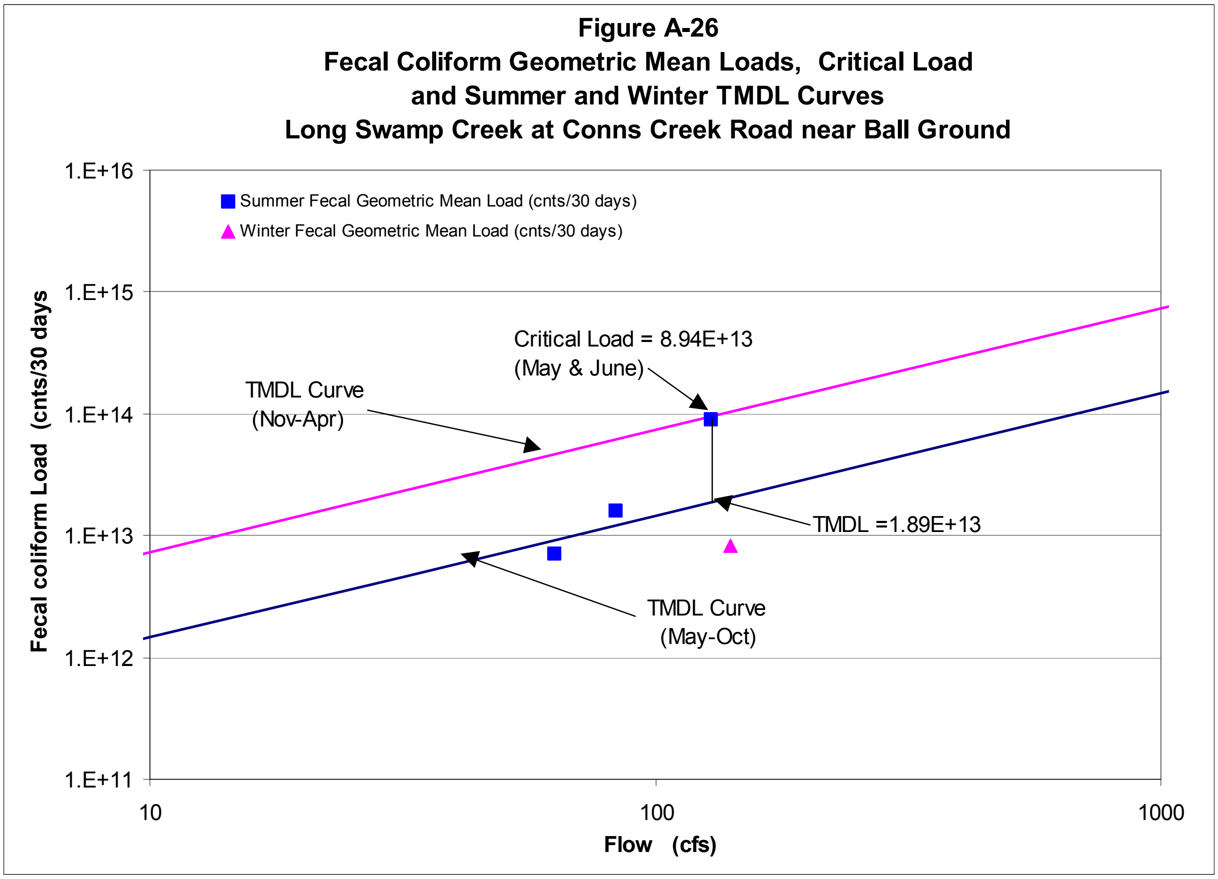

Table A-26. Data for Figure A-26, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	20	110				
22-Feb-01	790	165				
1-Mar-01	50	147				
8-Mar-01	50	140	79	141	8.18E+12	1.03E+14
8-May-01	140	99				
21-May-01	340	92				
23-May-01	700	111				
5-Jun-01	24000	213	946	129	8.94E+13	1.89E+13
21-Aug-01	80	67				
4-Sep-01	4900	159				
10-Sep-01	170	51				
12-Sep-01	70	57	261	84	1.60E+13	1.23E+13
1-Oct-01	50	56				
15-Oct-01	1300	76				
22-Oct-02	80	62				
30-Oct-01	110	59	155	63	7.18E+12	9.29E+12

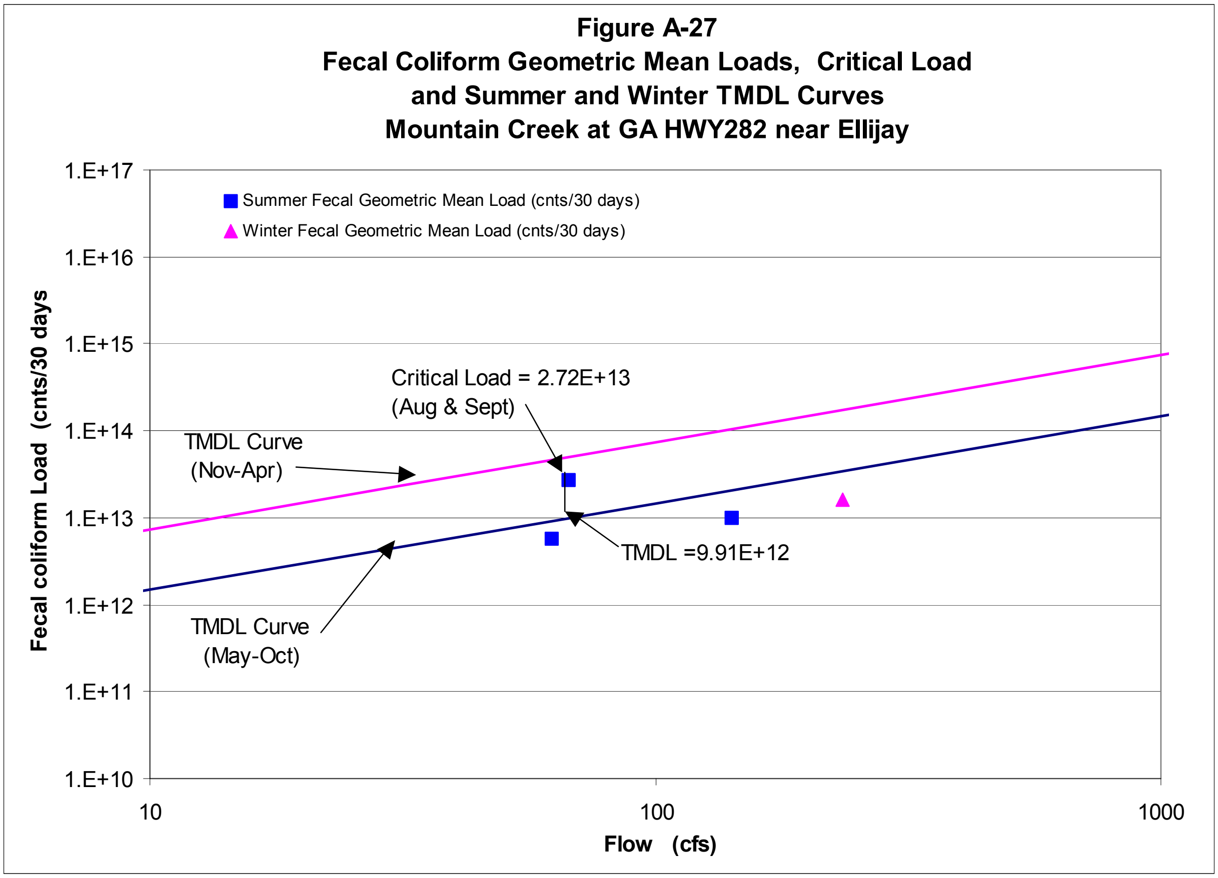

Table A-27. Data for Figure A-27, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	80	209				
5-Mar-01	20	196				
14-Mar-01	20	181				
20-Mar-01	2300	352	93	235	1.59E+13	1.72E+14
15-May-01	40	118				
22-May-01	110	112				
29-May-01	460	200				
12-Jun-01	40	137	95	142	9.87E+12	2.08E+13
28-Aug-01	170	53				
5-Sep-01	490	73				
10-Sep-01	330	58				
18-Sep-01	3300	86	549	68	2.72E+13	9.91E+12
2-Oct-01	270	60				
4-Oct-01	50	79				
9-Oct-02	140	81				
15-Oct-01	130	29	125	62	5.72E+12	9.14E+12

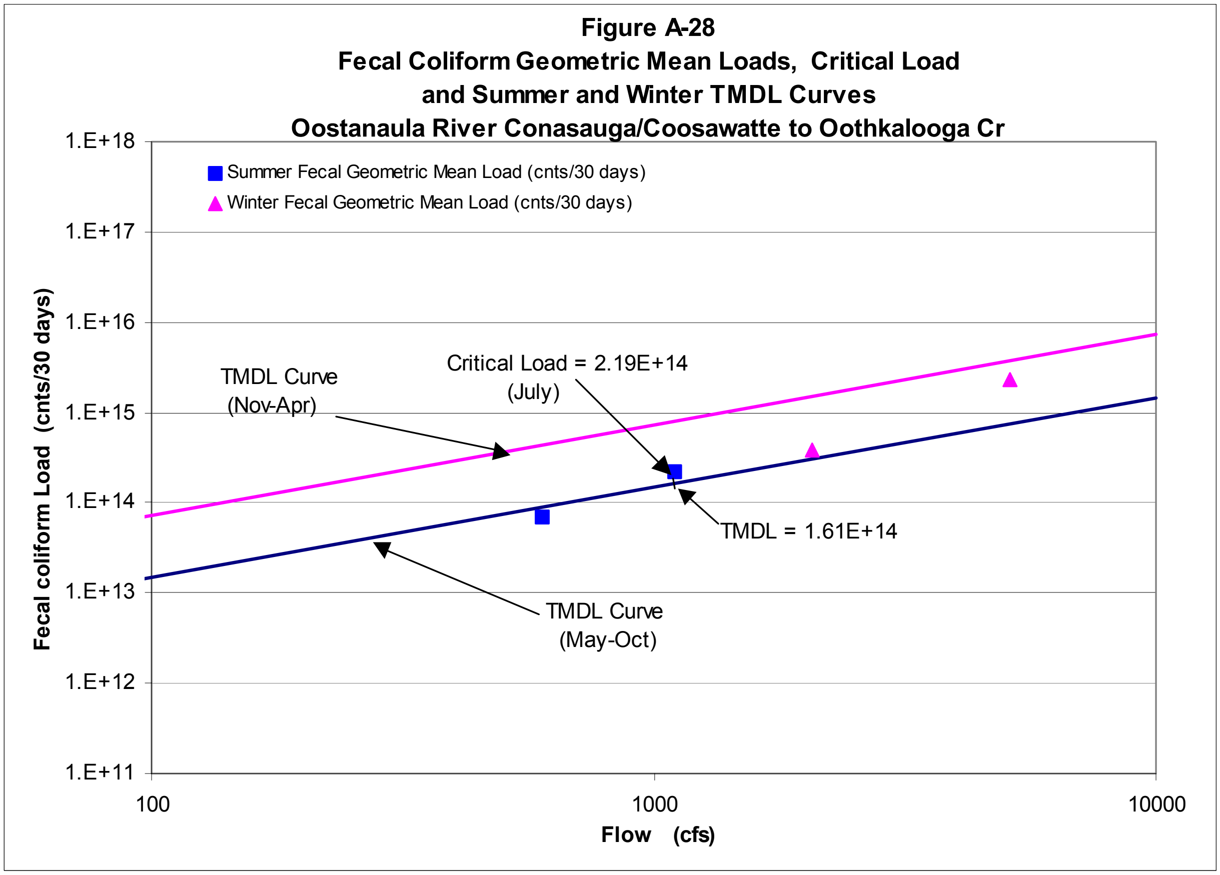

Table A-28. Data for Figure A-28, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	80	2460				
26-Feb-01	2300	7510				
27-Feb-01	2400	6380				
6-Mar-01	330	4100	618	5113	2.32E+15	3.75E+15
17-Apr-02	1300	2850				
19-Apr-01	490	2060				
24-Apr-01	80	1690				
26-Apr-01	80	1670	253	2068	3.83E+14	3.04E+14
16-Jul-01	940	784				
23-Jul-01	20	983				
30-Jul-01	1700	1370				
7-Aug-01	170	1260	271	1099	2.19E+14	1.61E+14
1-Oct-01	330	670				
9-Oct-02	110	520				
17-Oct-01	330	737				
23-Oct-01	50	472	156	600	6.89E+13	8.80E+13

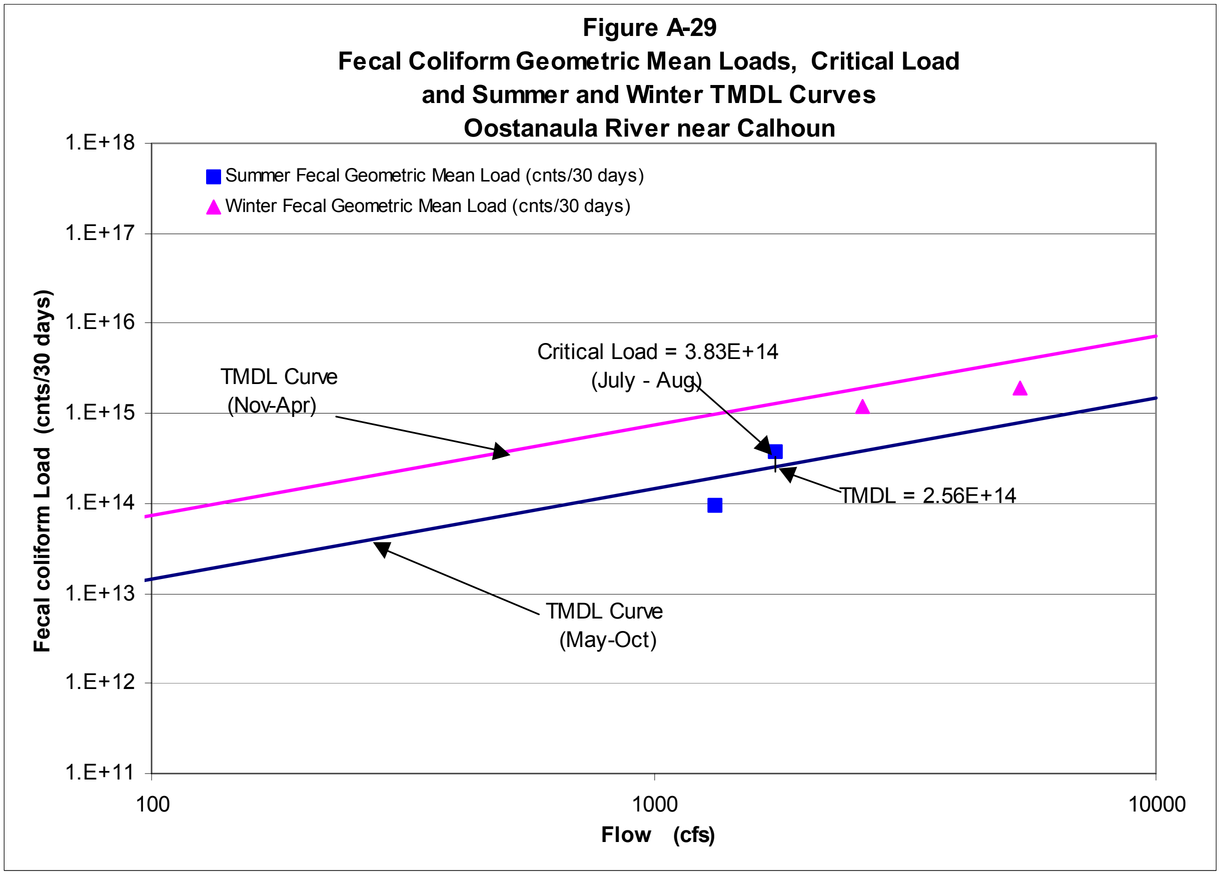

Table A-29. Data for Figure A-29, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
12-Feb-01	210	2690				
26-Feb-01	4900	7370				
27-Feb-01	1100	7400				
7-Mar-01	50	4080	488	5385	1.93E+15	3.95E+15
16-Apr-02	490	3340				
18-Apr-01	790	2770				
23-Apr-01	490	2200				
26-Apr-01	790	2110	622	2605	1.19E+15	1.91E+15
17-Jul-01	170	1550				
24-Jul-01	40	1670				
6-Aug-01	2400	1960				
8-Aug-01	490	1800	299	1745	3.83E+14	2.56E+14
2-Oct-01	110	1430				
10-Oct-02	140	1270				
18-Oct-01	130	1270				
22-Oct-01	50	1330	100	1325	9.73E+13	1.95E+14

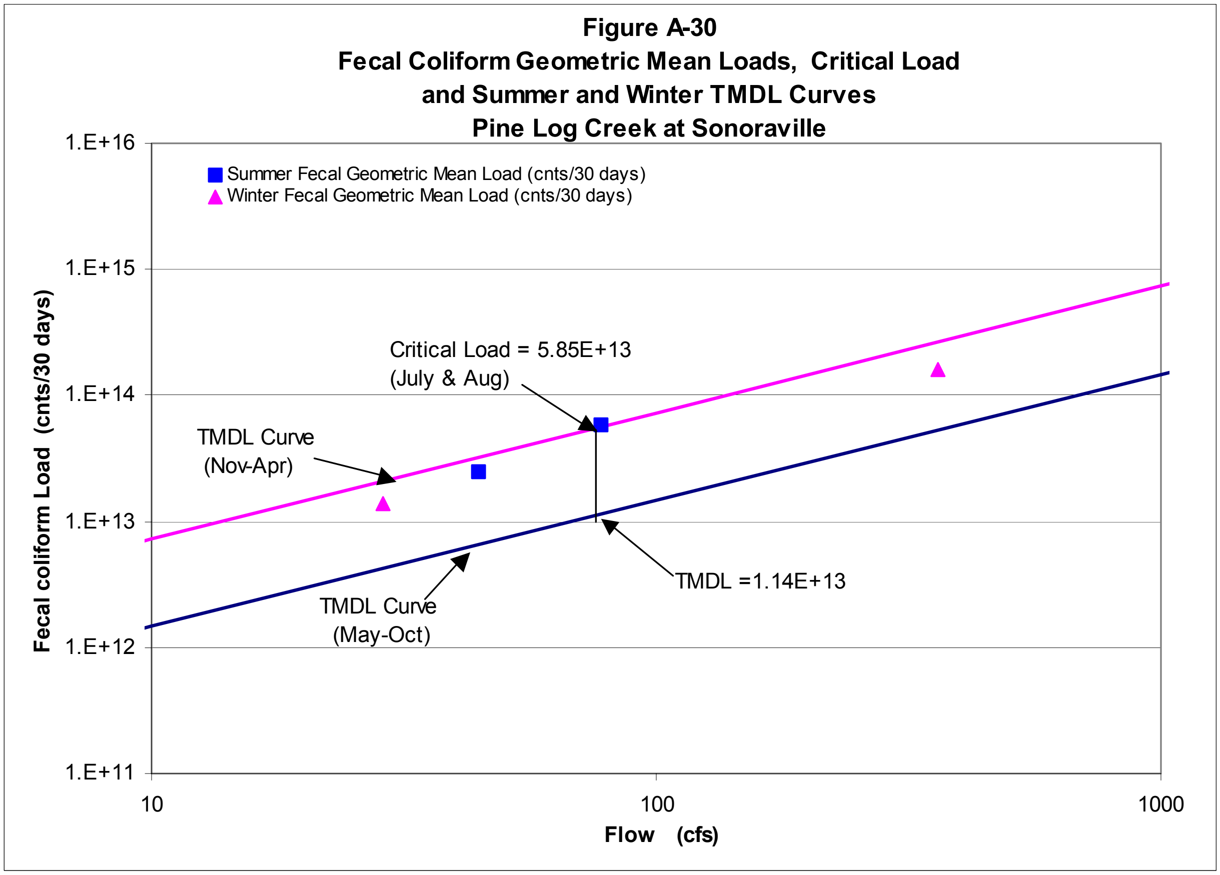

Table A-30. Data for Figure A-30, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	310	53				
26-Feb-01	1700	920				
27-Feb-01	790	300				
6-Mar-01	330	175	609	362	1.62E+14	2.66E+14
17-Apr-01	1700	55				
19-Apr-01	490	48				
24-Apr-01	490	38				
26-Apr-01	790	37	754	45	2.46E+13	3.27E+13
16-Jul-01	2200	32				
23-Jul-01	1400	28				
30-Jul-01	1100	210				
7-Aug-01	330	40	1028	78	5.85E+13	1.14E+13
1-Oct-01	700	24				
9-Oct-01	1700	28				
17-Oct-01	330	29				
23-Oct-01	460	34	652	29	1.38E+13	4.22E+12

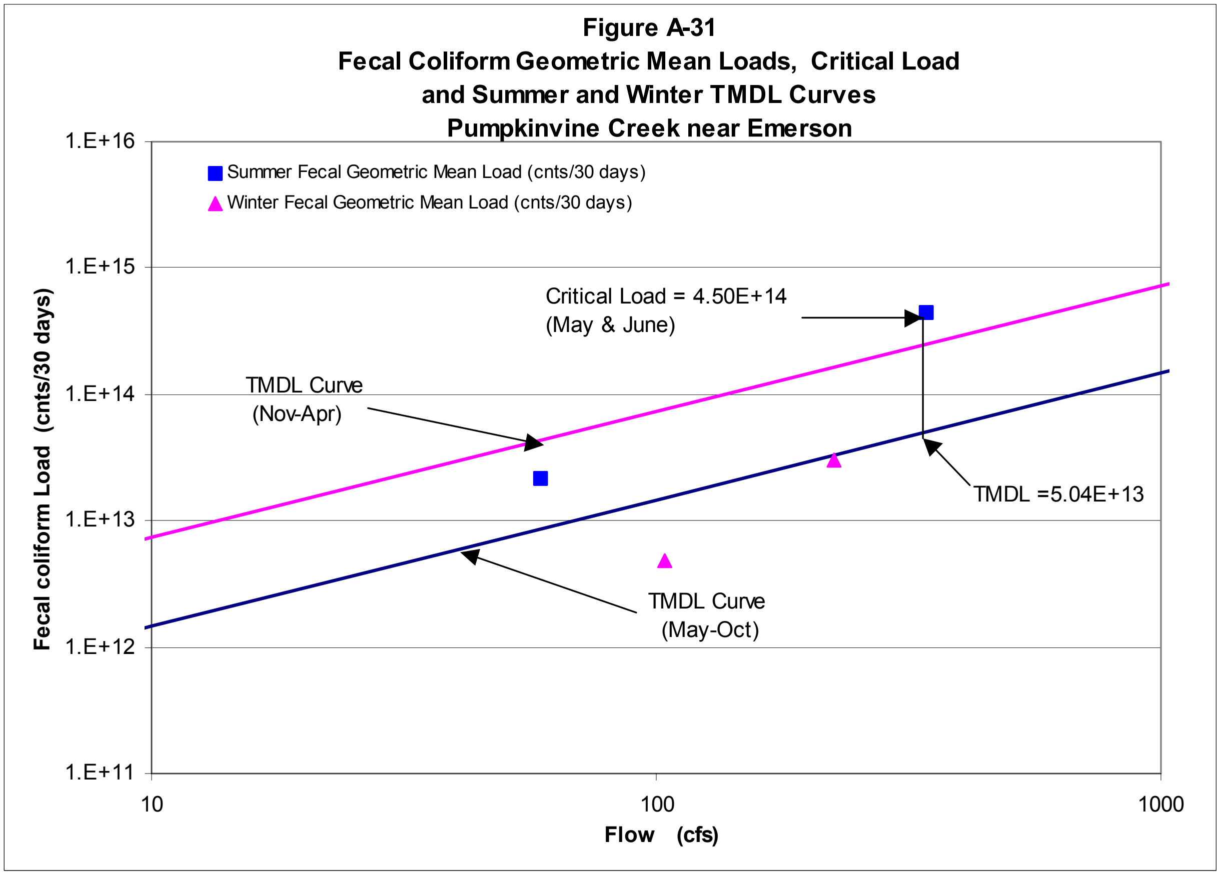

Table A-31. Data for Figure A-31, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	210	138				
15-Feb-01	50	122				
20-Feb-01	460	148				
6-Mar-01	220	494	181	226	2.99E+13	1.66E+14
7-May-01	1400	102				
9-May-01	330	88				
29-May-01	1700	690				
4-Jun-01	13000	492	1788	343	4.50E+14	5.04E+13
16-Aug-01	1300	72				
20-Aug-01	210	55				
23-Aug-01	170	43				
11-Sep-01	1400	66	505	59	2.19E+13	8.66E+12
7-Nov-01	50	259				
14-Nov-01	20	44				
26-Nov-01	120	66				
6-Dec-01	130	48	63	104	4.81E+12	7.65E+13

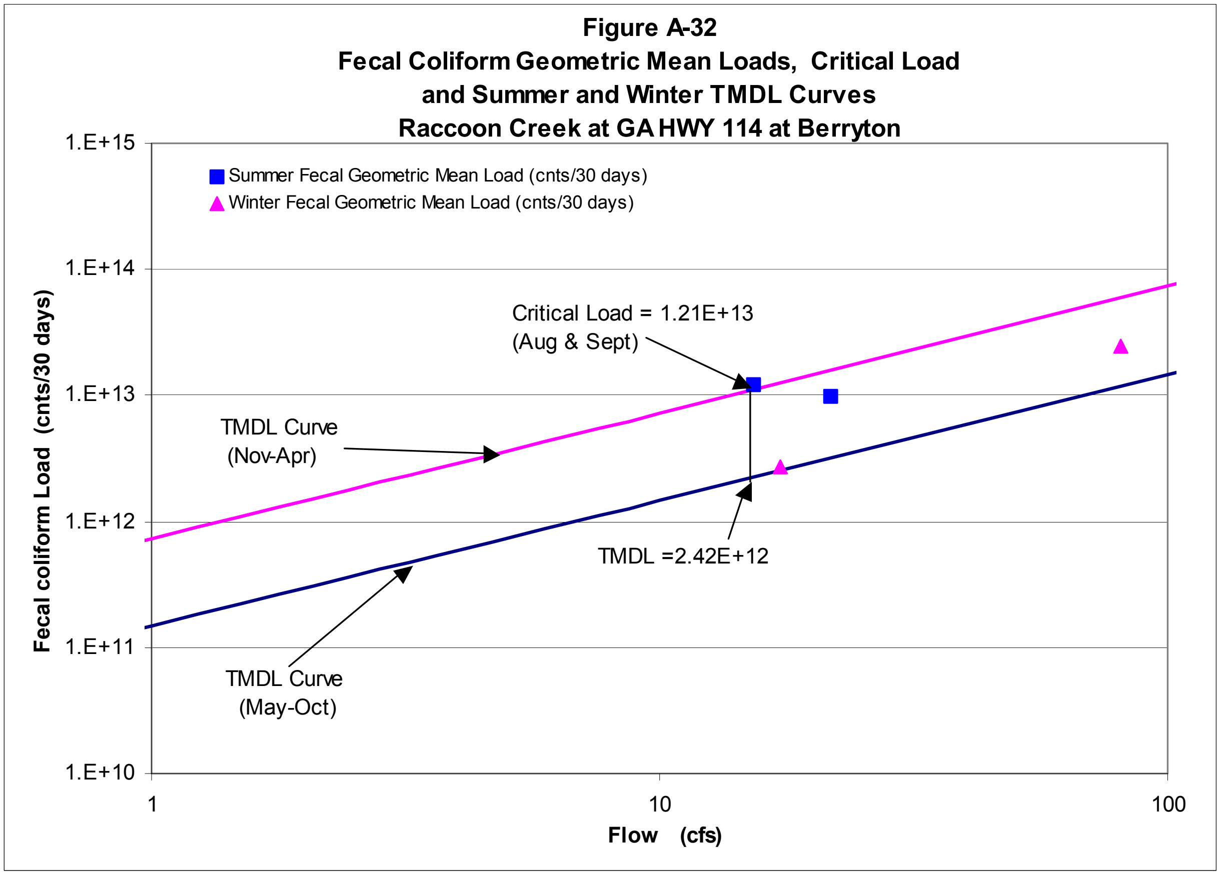

Table A-32. Data for Figure A-32, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
20-Feb-01	80	66				
26-Feb-01	3300	160				
5-Mar-01	790	68				
12-Mar-01	140	29	413	81	2.45E+13	5.93E+13
14-May-01	490	16				
21-May-01	330	16				
29-May-01	1100	38				
11-Jun-01	790	17	612	22	9.77E+12	3.19E+12
22-Aug-01	3300	8				
28-Aug-01	3500	21				
5-Sep-01	90	19				
10-Sep-01	1300	13	1078	15	1.21E+13	2.24E+12
5-Nov-01	230	16				
13-Nov-01	330	25				
28-Nov-01	330	13				
5-Dec-01	80	15	212	17	2.68E+12	1.27E+13

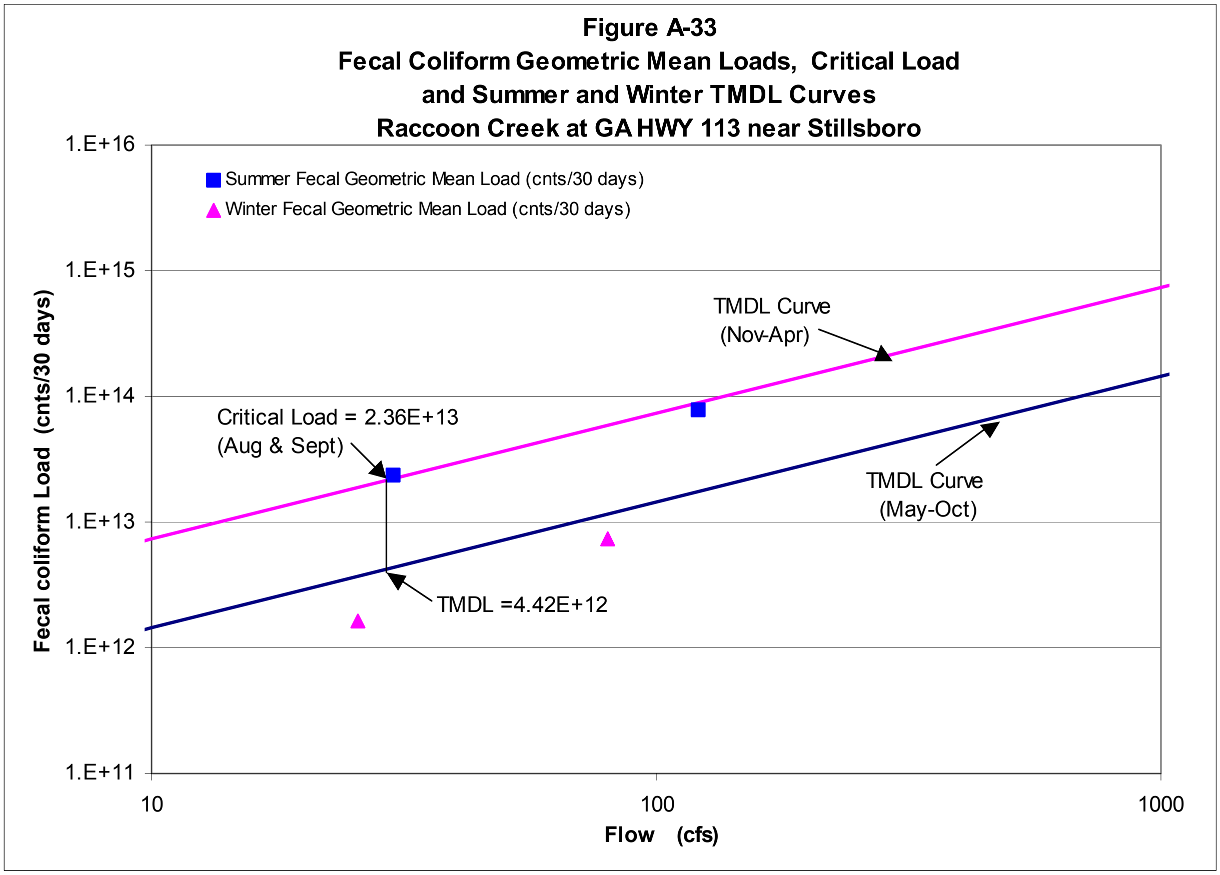

Table A-33. Data for Figure A-33, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	700	60				
15-Feb-01	50	55				
20-Feb-01	140	84				
6-Mar-01	50	121	125	80	7.34E+12	5.87E+13
7-May-01	490	28				
9-May-01	50	30				
29-May-01	7000	177				
4-Jun-01	3300	249	867	121	7.73E+13	1.78E+13
16-Aug-01	490	35				
20-Aug-01	790	32				
23-Aug-01	2400	32				
11-Sep-01	1400	22	1068	30	2.36E+13	4.42E+12
7-Nov-01	80	24				
14-Nov-01	20	23				
26-Nov-01	490	35				
6-Dec-01	70	21	86	26	1.62E+12	1.91E+14

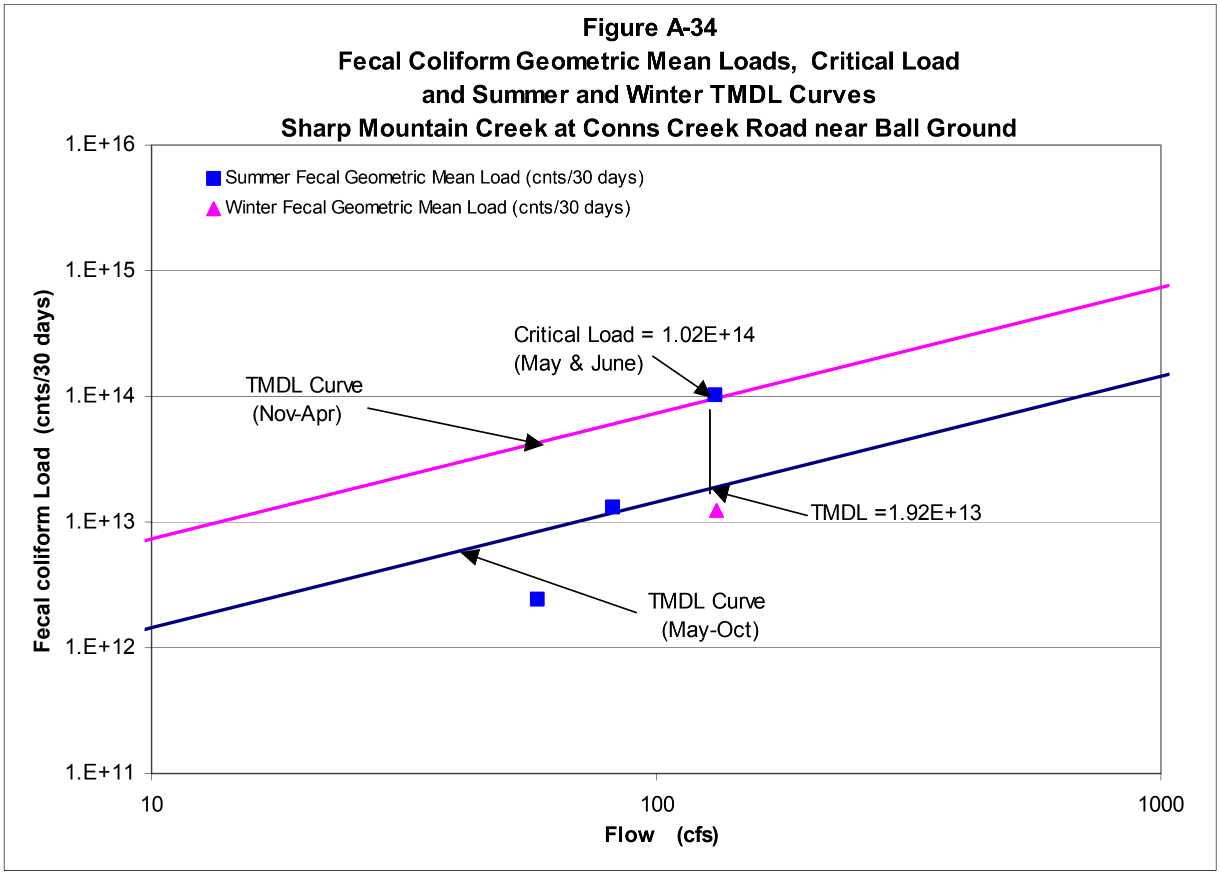

Table A-34. Data for Figure A-34, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
14-Feb-01	40	100				
22-Feb-01	2400	188				
1-Mar-01	20	126				
8-Mar-01	140	114	128	132	1.24E+13	9.69E+13
8-May-01	330	78				
21-May-01	330	77				
23-May-01	490	85				
5-Jun-01	24000	284	1064	131	1.02E+14	1.92E+13
21-Aug-01	50	59				
4-Sep-01	13000	159				
10-Sep-01	170	54				
12-Sep-01	20	57	217	82	1.31E+13	1.21E+13
1-Oct-01	60	52				
15-Oct-01	130	72				
22-Oct-02	20	55				
30-Oct-01	70	54	57	58	2.46E+12	8.55E+12

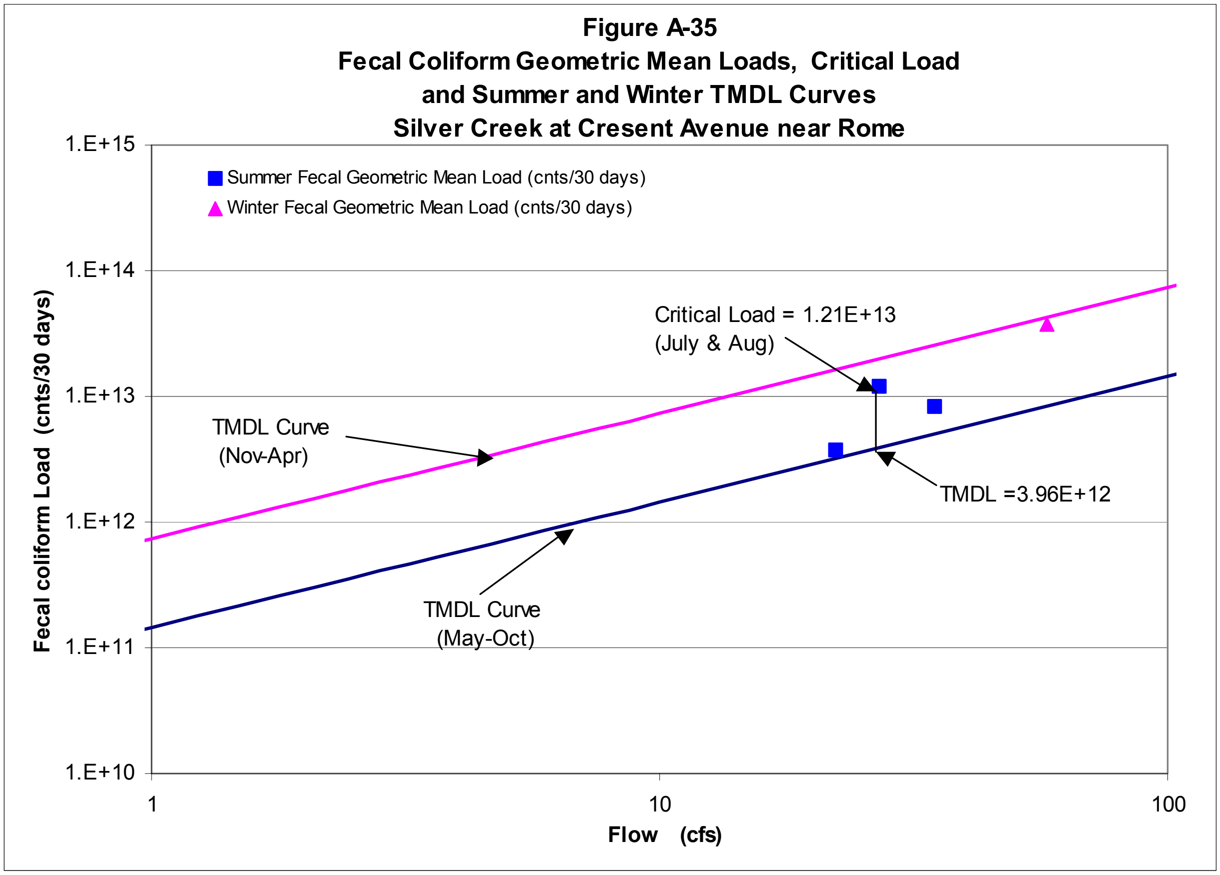

Table A-35. Data for Figure A-35, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	330	57				
12-Mar-01	260	30				
15-Mar-01	9200	100				
19-Mar-01	790	45	889	58	3.78E+13	4.26E+13
24-May-01	130	25				
4-Jun-01	490	51				
13-Jun-01	130	34				
19-Jun-01	1300	29	322	35	8.22E+12	5.10E+12
30-Jul-01	130	27				
7-Aug-01	1100	26				
14-Aug-01	400	30				
21-Aug-01	2400	25	609	27	1.21E+13	3.96E+12
3-Oct-01	1300	21				
11-Oct-01	330	20				
25-Oct-01	20	27				
31-Oct-01	330	21	231	22	3.77E+12	3.27E+12

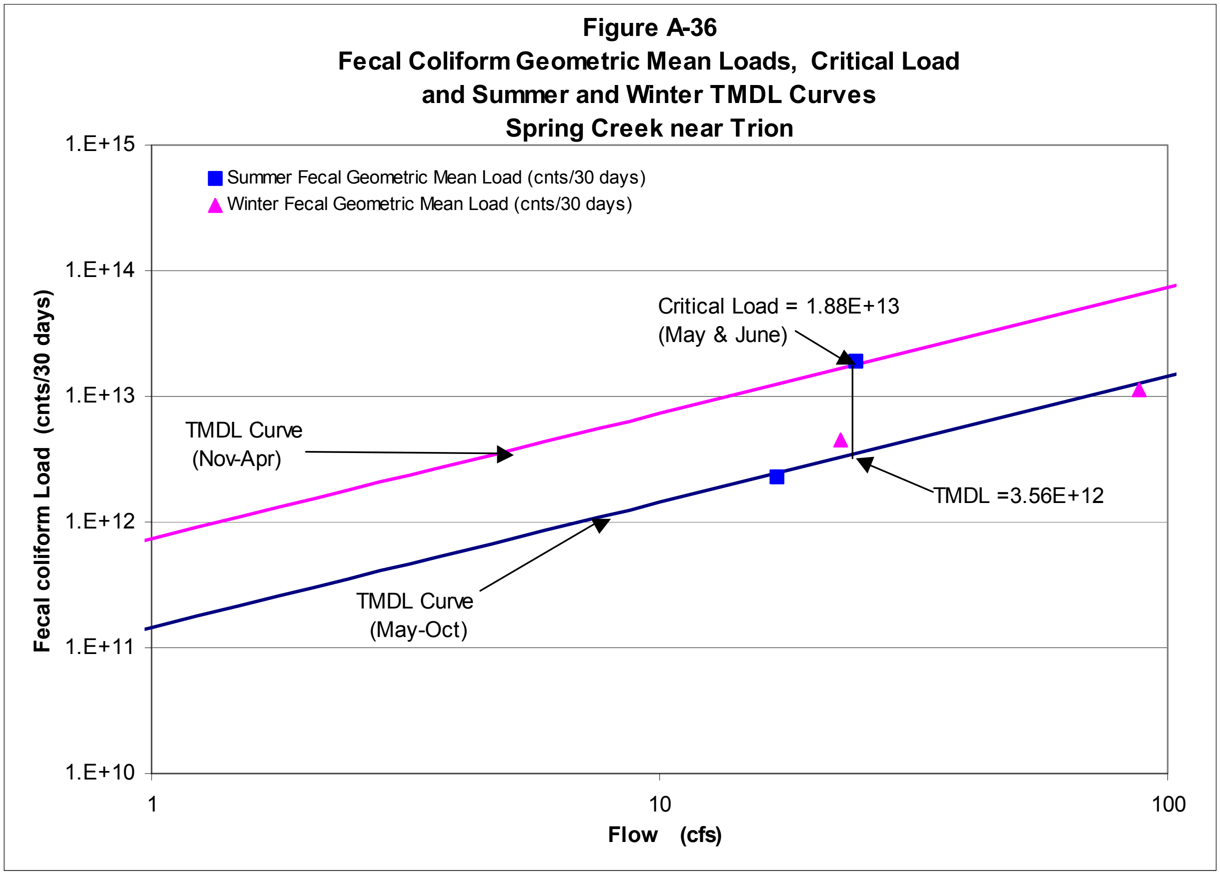

Table A-36. Data for Figure A-36, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
20-Feb-01	110	96				
26-Feb-01	230	134				
5-Mar-01	50	75				
12-Mar-01	790	46	178	88	1.15E+13	6.44E+13
14-May-01	330	19				
21-May-01	4900	18				
29-May-01	1100	33				
14-Jun-01	700	27	1056	24	1.88E+13	3.56E+12
22-Aug-01	70	16				
28-Aug-01	80	15				
5-Sep-01	490	21				
10-Sep-01	430	16	185	17	2.31E+12	2.50E+12
5-Nov-01	330	13				
13-Nov-01	330	12				
28-Nov-01	110	35				
5-Dec-01	460	31	272	23	4.55E+12	1.67E+13

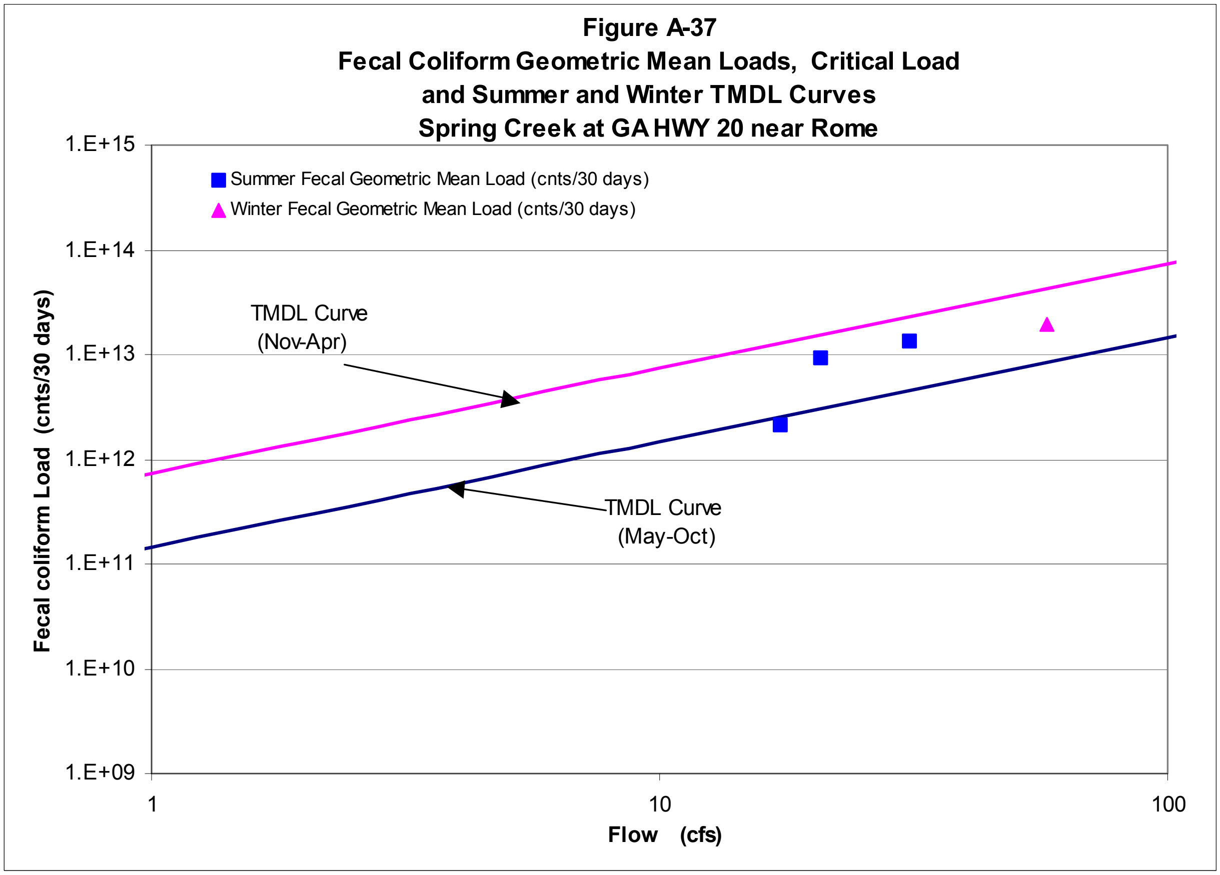

Table A-37. Data for Figure A-37, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	330	78				
12-Mar-01	80	26				
15-Mar-01	22000	78				
19-Mar-01	80	50	464	58	1.98E+13	4.26E+13
24-May-01	2400	20				
4-Jun-01	330	37				
13-Jun-01	170	44				
19-Jun-01	940	23	596	31	1.36E+13	4.55E+12
30-Jul-01	1700	22				
7-Aug-01	330	21				
14-Aug-01	1100	21				
21-Aug-01	220	19	607	21	9.25E+12	3.05E+12
3-Oct-01	310	18				
11-Oct-01	790	18				
25-Oct-01	20	18				
31-Oct-01	170	15	170	17	2.15E+12	2.53E+12

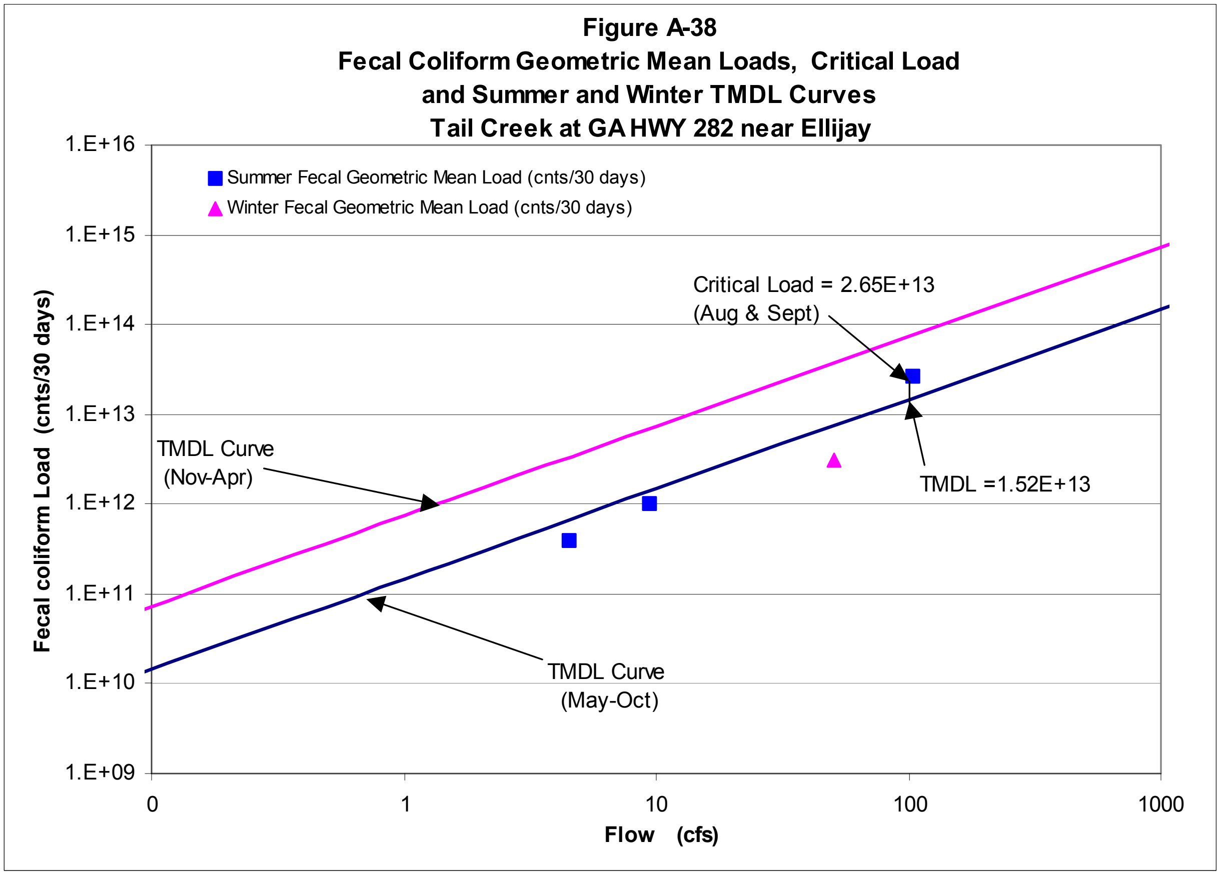

Table A-38. Data for Figure A-38, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	20	29				
5-Mar-01	50	32				
14-Mar-01	20	16				
20-Mar-01	2300	125	82	51	3.05E+12	3.71E+13
15-May-01	130	7				
22-May-01	490	7				
29-May-01	80	14				
12-Jun-01	90	10	146	9	1.02E+12	1.39E+12
28-Aug-01	40	5				
5-Sep-01	570	147				
10-Sep-01	460	257				
18-Sep-01	1400	6	348	104	2.65E+13	1.52E+13
2-Oct-01	81	5				
4-Oct-01	110	5				
9-Oct-02	170	4				
15-Oct-01	130	4	118	5	3.91E+11	6.61E+11

Figure A-39
Fecal Coliform Geometric Mean Loads, Critical Load and Summer and Winter TMDL Curves Talking Rock Creek near Blaine

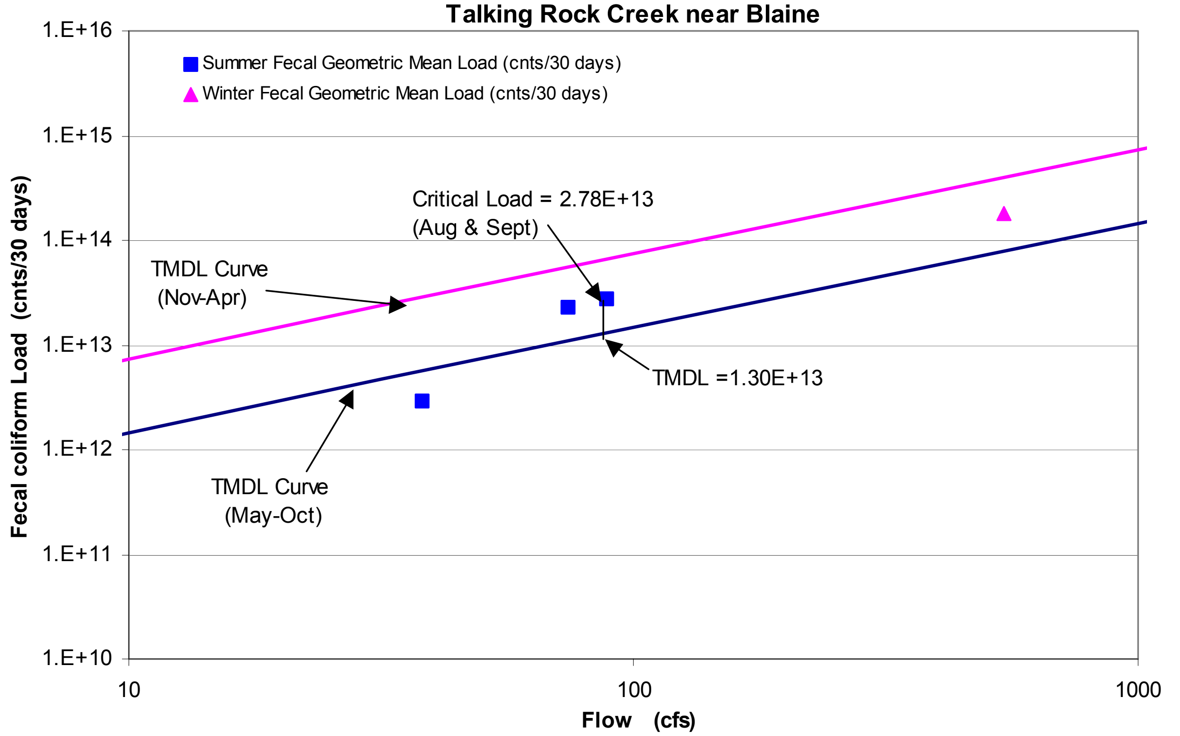

Table A-39. Data for Figure A-39, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	130	172				
5-Mar-01	130	152				
14-Mar-01	330	155				
20-Mar-01	7900	1690	458	542	1.82E+14	3.98E+14
15-May-01	110	58				
22-May-01	1300	76				
29-May-01	170	76				
12-Jun-01	1300	87	422	74	2.30E+13	1.09E+13
28-Aug-01	80	27				
5-Sep-01	4900	54				
10-Sep-01	330	238				
18-Sep-01	260	35	428	89	2.78E+13	1.30E+13
2-Oct-01	80	35				
4-Oct-01	80	30				
9-Oct-02	130	39				
15-Oct-01	130	49	102	38	2.86E+12	5.62E+12

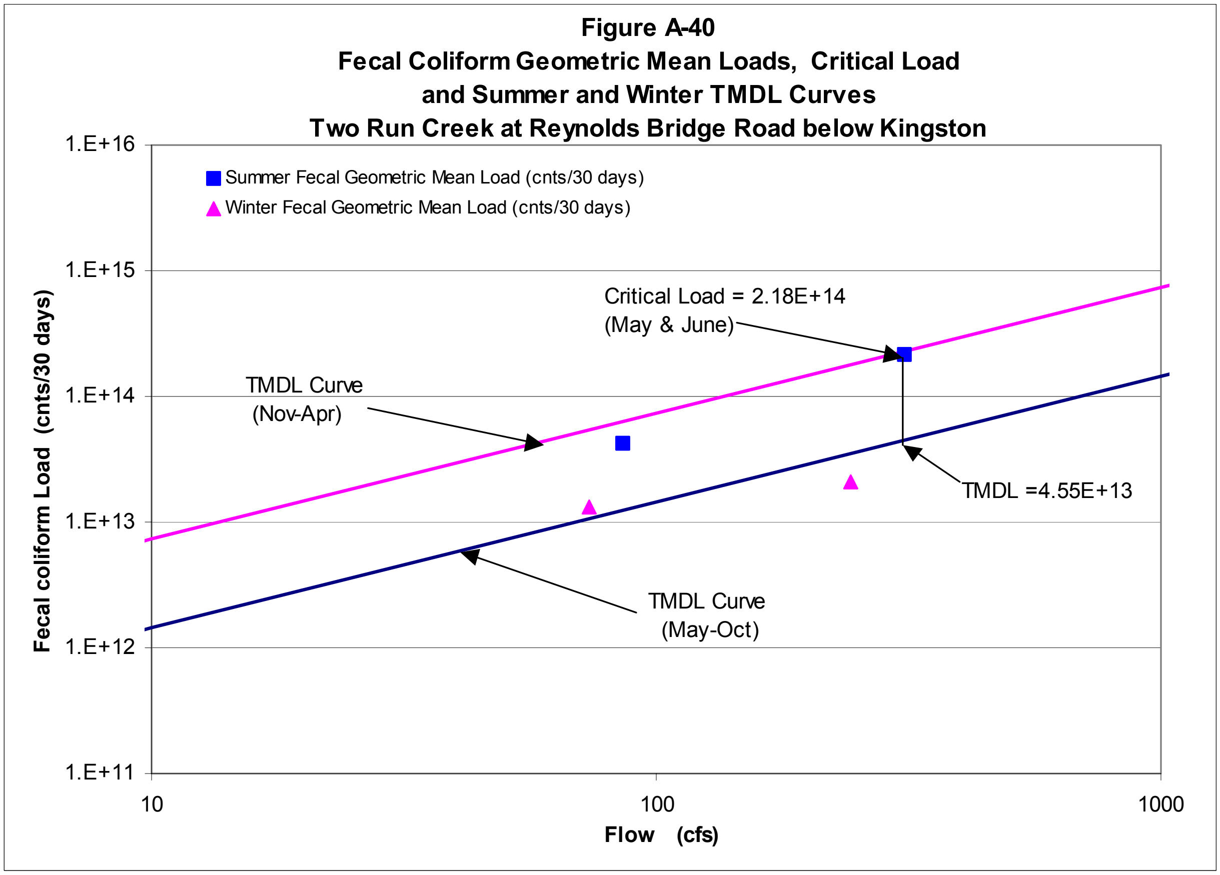

Table A-40. Data for Figure A-40, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
13-Feb-01	80	186				
15-Feb-01	80	192				
20-Feb-01	170	212				
6-Mar-01	170	379	117	242	2.07E+13	1.78E+14
7-May-01	330	135				
9-May-01	220	135				
29-May-01	3500	662				
4-Jun-01	3300	308	957	310	2.18E+14	4.55E+13
16-Aug-01	490	99				
20-Aug-01	790	88				
23-Aug-01	490	68				
11-Sep-01	1100	88	676	86	4.25E+13	1.26E+13
7-Nov-01	80	67				
14-Nov-01	20	68				
26-Nov-01	17000	90				
6-Dec-01	130	69	244	74	1.32E+13	5.39E+13

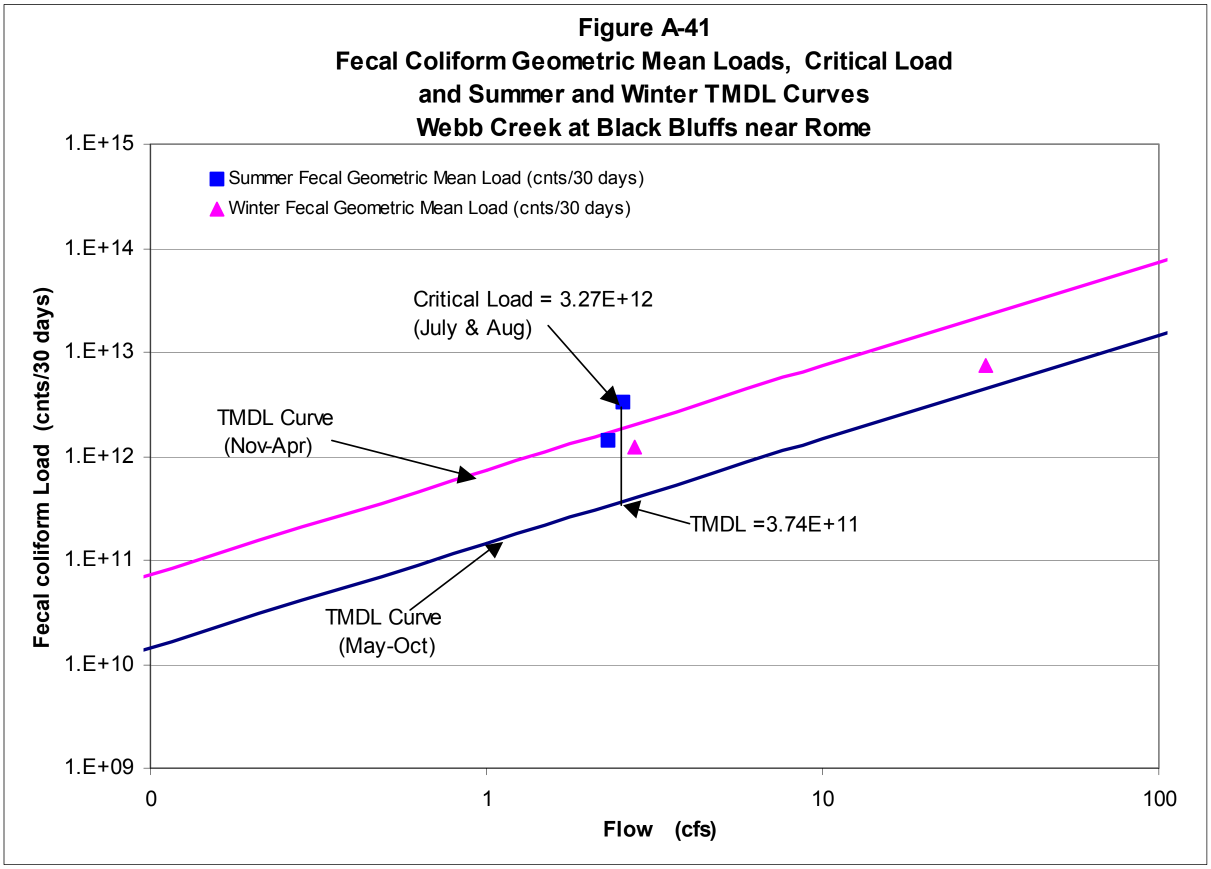

Table A-41. Data for Figure A-41, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
28-Feb-01	130	5				
8-Mar-01	70	7				
22-Mar-01	1100	92				
26-Mar-01	1300	18	338	30.5	7.55E+12	2.24E+13
24-May-01	330	2				
7-Jun-01	1300	5				
20-Jun-01	2400	1				
21-Jun-01	490	1	843	2.3	1.42E+12	3.37E+11
12-Jul-01	1300	7				
18-Jul-01	570	1				
30-Jul-01	18000	1				
2-Aug-01	700	1	1748	2.5	3.27E+12	3.74E+11
5-Nov-01	140	1				
26-Nov-01	2200	6				
4-Dec-01	140	1				
17-Dec-01	330	2				
18-Dec-01	1400	2	614	2.8	1.25E+12	2.03E+12

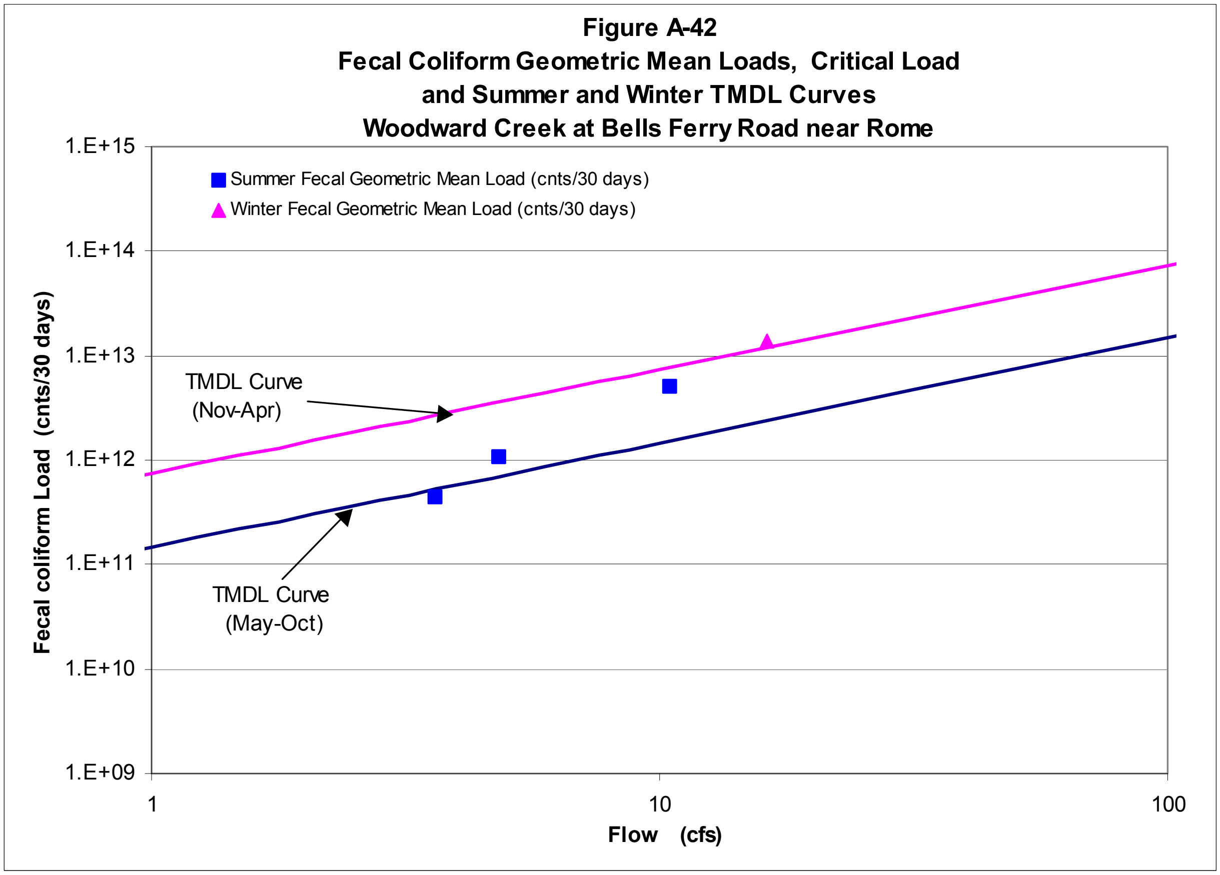

Table A-42. Data for Figure A-42, including: observed fecal coliform, instantaneous flow fecal coliform load, fecal coliform geometric mean, mean flow, fecal coliform geometric mean load.

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (cnts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (cnts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (cnts/30 days)
27-Feb-01	2400	20				
12-Mar-01	490	10				
15-Mar-01	22000	20				
19-Mar-01	70	15	1160	16	1.38E+13	1.19E+13
24-May-01	3500	7				
4-Jun-01	700	19				
13-Jun-01	170	10				
24-Jun-01	490	6	672	10	5.17E+12	1.54E+12
30-Jul-01	24000	6				
7-Aug-01	20	4				
14-Aug-01	210	6				
21-Aug-01	80	4	300	5	1.06E+12	7.08E+11
3-Oct-01	790	4				
11-Oct-01	490	5				
25-Oct-02	40	3				
31-Oct-01	50	4	167	4	4.41E+11	5.28E+11

Appendix B

Summary of Limited Fecal Coliform Monitoring Data

Summary of Limited Fecal Coliform Monitoring Data

Listed Segment	Number of Observations	Long-Term Geometric Mean (counts/100 mL)	Data Source
Acworth Creek	38	705	Lake Acworth-96/97, Kennesaw State College Study-94
Big Dry Creek	30	1127	Rome WPCP Monitoring
Butler Creek	81	387	Cobb County-95/97
Flat Creek	17	528	Carter's Lake WPMP-96
Lake Acworth	488	161	Lake Acworth-96/97, Kennesaw State College Study - 94
Little Allatoona Creek	36	172	Cobb County-95/97
Little Noonday Creek	37	293	Cobb County-95/97
Owl Creek	27	1555	Lake Allatoona Clean Lakes Study, Cherokee County Monitoring
Proctor Creek	95	291	Cobb County-95/97
Rocky Creek	13	261	Rocky Creek Fulton County-94/95
Rubes Creek	65	341	Cobb County-95/97
Tanyard Creek	39	306	Cobb County-95/97
Trib to Allatoona Creek	13	120	Cobb County -95/97
Trib. to Oothkalooga Creek	4	76	Calhoun - Oothkalooga Creek Spill Data 1996
Trib to Pettit Creek	53	771	Cartersville - Pettit Creek Spill Data 1997

Appendix C

Technical Details for Estimating TMDLs for Limited-Data Sites

Georgia Environmental Protection Division
Atlanta, Georgia

Conceptual Approach

The approach to estimating fecal coliform bacteria TMDLs for the waterbodies lacking 30-day geometric mean data relies on a relationship to other similar or “equivalent” waterbodies that do have 30-day geometric mean data. This provides an estimated TMDL that can be refined in the future as additional site-specific data are collected.

Development of the TMDLs via an “equivalent” site approach needed to address three important issues:

1. Any site-specific monitoring data for a waterbody should also be incorporated, even if it is not sufficient for direct estimation of 30-day geometric means.

2. Differences in land use will result in different fecal coliform bacteria concentrations. An equivalent waterbody that provides a perfect match in landuse to a subject site is unlikely to be available.

3. The selection of an equivalent waterbody is likely to have a strong impact on the resulting TMDL estimates for a subject waterbody

Consideration of these three issues led to a corresponding set of objectives for the approach:

1. Site-specific and equivalent site data should be combined in a weighted approach that reflects the relative accuracy of information provided by each data source.

2. Differences in land use among watersheds should be addressed through use of a regionalization model that identifies the extent to which changes in geometric mean fecal coliform concentrations can be explained by changes in land use.

3. The influence of equivalent waterbody selection should be minimized through the use of multiple equivalent waterbodies for each subject waterbody.

These three objectives may be met through use of an Empirical Bayes regionalization analysis. This method combines two important concepts: Bayesian maximum likelihood techniques for combining sources of data (local and regional), and hierarchical regionalization techniques. The data combination step assumes that both the regional or equivalent site information and the available site-specific data provide information on the true, local geometric mean. The two sources of data should be combined or weighted in accordance with the degree of precision or accuracy in each source. The regionalization step assumes that the true mean at any site is a result of random variability and a regression model on land use. Empirical Bayes techniques provide statistically optimal methods for computing both the data combination and regionalization steps from observed data.

Technical Basis

In the TMDL Curve method, the needed reductions for a given waterbody, and thus the allocations, are determined by the ratio

$$\text{Reduction} = \frac{\text{TMDL Curve Point}}{\text{Critical Load}} \tag{1}$$

where the critical load is the estimated 30-day fecal coliform load most exceeding the TMDL curve, and the TMDL curve point is calculated as the geometric mean water quality standard for fecal coliform bacteria times the 30-day average flow corresponding to the critical load estimate. Both the numerator and denominator of this equation can be written in terms of a critical geometric mean, G_{cri} and a corresponding critical flow, $Q_{crit:}$

$$\begin{aligned} \text{TMDL Curve Point} &= WQS \cdot Q_{crit} \\ \text{Critical Load} &= G_{crit} \cdot Q_{crit} \end{aligned} \tag{2}$$

Sites for which sufficient 30-day geometric means have not been collected, an estimate of G_{crit} is not available. For many waterbodies, some to many scattered observations are available, even though 30-day geometric means cannot be estimated. For other waterbodies, no site-specific data are available. In most cases, site-specific flow gaging is also not available. The approach estimates the TMDL for the sites without geometric mean data by adjusting the critical load, and thus the reduction estimate, from one or more equivalent sites that do have data. In this way, appropriate 30-day geometric mean data are “translated” to the limited-data sites to provide an estimate of load reduction needed to achieve the TMDL.

In translating from an equivalent site to a subject site, it is important to account for changes in runoff concentrations associated with differences in land use, and for changes in flow associated with different basin size. The critical load at limited-data site *i* can be estimated in relation to calculated critical loads at *n* other sites*j* through

$$\text{Critical Load}_{\text{i}} = \frac{1}{n} \sum_{j=1}^{n} \left[A_{ij} \cdot G_{crit,j} \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j} \right] \tag{3}$$

in which A_{ij} is a factor (based on land use) that relates the expected fecal coliform concentration at site *i* to that at site *j*, expressed in log space since a geometric mean is used to determine compliance), and *DA* represents the drainage area above the sample site.

The ratio DA_i/DA_j adjusts the estimated critical flow from site *j* to site *i*. In the case where gage data are available, actual mean flows rather than drainage areas can be used for the ratio. Equation (3) thus translates both the critical geometric mean concentration and the associated critical flow to provide a new estimate of critical load at site *i*. Averaging over estimates obtained from *n* equivalent sites, the estimated reduction needed at site *i* is then, from (1):

$$\text{Reduction}_{\text{i}} = \sum_{\text{j=1}}^{\text{n}} \frac{\left[WQS \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j} \right]}{\left[A_{ij} \; G_j \cdot Q_{crit,j} \cdot \frac{DA_i}{DA_j} \right]} \tag{4}$$

The key task for completing this effort is determining the translation factor, A_{ij}, which relates the expected concentrations at site *i* to those at site *j*. It is assumed that the critical 30-day geometric mean concentration at site *i* is related to that at site *j* by the same proportionality observed between the long-term geometric means of the full data at sites *i* and *j*. The factor A_{ij} can reasonably be assumed to vary with land use, but also to exhibit strong site-specific characteristics. For instance, a given site might tend to exhibit higher concentrations relative to an equivalent site than are expected from consideration of land use differences alone.

So, what is needed is a method that provides an appropriate weighting between limited site-specific data and a landuse-based regression on equivalent sites. This situation is ideally suited for an empirical Bayes analysis (Berger, 1985; Morris, 1983). This is a technique for Bayesian updating that is based entirely on observed data (thus, "empirical").

It is assumed that the long-term geometric mean fecal coliform concentration at a given site (expressed in log space) is a function of underlying properties of land use in the watershed plus site-specific factors that are represented by random noise. A sample realization of the (log space) long-term geometric mean at site *i*, x_i is assumed to be normally distributed about a true mean, 2_i, with standard error of the estimate given by Φ_i. In statistical notation this may be written as:

$$x_i \sim \mathrm{N}\left(\theta_i, \sigma_i^2\right) \tag{5}$$

The desired translation factor for use in Equations (3) and (4) above is then

$$A_{ij} = e^{\theta_i} \Big/ e^{\theta_j} \tag{6}$$

In a regional context, we assume that each of the true (but unknown) local site long-term geometric means arises from a regional regression on land characteristics, such that

$$\theta_i = \boldsymbol{y}_i^t \cdot \beta + \varepsilon_i \tag{7}$$

where $\boldsymbol{y}$ is a vector of land use characteristics, **ß** is a vector of regression coefficients, and γ_i is a normally-distributed error term, such that

$$\varepsilon_i \sim \mathrm{N}\left(0, \sigma_\pi^2\right) \tag{8}$$

Equations (7) and (8) constitute a standard linear regression model, written in vector notation. (Note that the vector **ß** includes an intercept value, in addition to coefficients on the regressors, and the first item in the vector $\boldsymbol{y}$ is a 1 corresponding to the intercept value.) The regionalization is accomplished by estimating **ß** and Φ_B from the data, i.e., across multiple sites. To simplify the mathematics, it is assumed that the Φ_i are known from the sample data, and uncertainty in the estimation of the Φ_i is ignored (Berger, 1985).

The desired maximum likelihood estimate of a geometric mean associated with a given site should range between the regression estimate, $\boldsymbol{y}_i^t$ **ß**, and the at-site observed long-term geometric mean, x_i. If there are no monitoring data at a given site, the best estimator is simply the regression estimator; on the other hand, if there are sufficient data at a given site, it is appropriate to use the observed geometric mean without regionalization. Weighting between these two end-members depends on the relative magnitudes of Φ_i and Φ_B, which express, respectively, the degree of uncertainty associated with the local and regional estimators. In a Bayesian sense, the best estimate is provided by the posterior distribution, incorporating the regional regression (as a prior distribution estimated *prior* to incorporating the site data) and the likelihood function of observed site data.

In a standard Bayes approach, the prior distribution should be independent of the data used to form the likelihood function. Morris (1983) developed Empirical Bayes approximations to the posterior means and variances that take into account the errors introduced by estimating **ß** and Φ_B from the data. The maximum likelihood Empirical Bayes estimator of 2 is given by $:_i^{EB}$, with variance V_i^{EB}. These are estimated through the equations

$$E(\theta_i) \;=\; \mu_i^{EB} = \; x_i - \hat{B}_i \cdot \left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right) \tag{9}$$

and

$$V_i^{EB} = \sigma_i^2 \cdot \left[1 - \frac{\left(p - \hat{l}_i\right)}{p}\hat{B}_i\right] + \frac{2}{p-l-2}\hat{B}_i^2 \left(\frac{\hat{\sigma}_p^2 + \hat{\sigma}_\pi^2}{\sigma_i^2 + \hat{\sigma}_\pi^2}\right)\left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right)^2 \tag{10}$$

In these equations, the parameter B_i is a Bayes factor that weights between the regional and local estimates. The x_I and Φ_i are, as noted above, the observed mean and variance of the logarithms of fecal coliform concentration data at site *i*. When no observations are available at a site, Φ_I^2 is assumed to be equal to the mean variance across all sites with data.

The vector of regression parameters, **ß**, is estimated by the standard least squares regression equation, written in matrix notation as

$$\hat{\beta} = \left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{y}\right)^{-1}\left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{x}\right) \tag{11}$$

where $\boldsymbol{y}$, representing the observed land characteristics, is a (p x l) matrix of l regressors at p sites, $\boldsymbol{x}$ is the (p x 1) vector of observed means at the p sites, and $\boldsymbol{V}$ is a (p x p) diagonal matrix with diagonal elements $V_{ii} = \Phi_i^2 + \Phi_B^2$. The regional variance is in turn estimated as

$$\hat{\sigma}_\pi^2 = \frac{\sum_{i=1}^{p}\left\{\left[\left(p/(p-l)\right)\left(x_i - \boldsymbol{y}_i^t \hat{\beta}\right)^2 - \sigma_i^2\right] / \left[\sigma_i^2 + \hat{\sigma}_\pi^2\right]^2\right\}}{\sum_{i=1}^{p}\left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)^{-2}} \tag{12}$$

and the remaining factors are

$$\hat{B}_i = \frac{(p-l-2)}{(p-l)} \cdot \frac{\sigma_i^2}{\sigma_i^2 + \hat{\sigma}_\pi^2} \tag{13}$$

$$\hat{l}_i = p\left[\boldsymbol{y}\left(\boldsymbol{y}^t \boldsymbol{V}^{-1} \boldsymbol{y}\right)^{-1} \boldsymbol{y}^t\right]_{ii} / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right) \tag{14}$$

and

$$\hat{\sigma}_p^2 = \frac{\sum_{i=1}^{p} \sigma_i^2 / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)}{\sum_{i=1}^{p} 1 / \left(\sigma_i^2 + \hat{\sigma}_\pi^2\right)} \tag{15}$$

These equations do not provide a closed form solution, as **ß** is involved in the equation for Φ_B, while Φ_B is required in the equation for **ß**. The equations must thus be solved by iteration: Start with a guess for Φ_B and use it to calculate **ß**, then use the estimate of **ß** to recalculate Φ_B. Convergence is usually rapid, with the proviso that, if Φ_B converges to a negative number, it is replaced by zero. All the necessary calculations have been incorporated into a spreadsheet.

Development of Regionalization Format

The technical approach can be applied to any type of linear regional regression model. Some experimentation was needed to determine the appropriate independent variables for use in the regression equation. Results of Atlanta-area studies such as the Atlanta Regional Stormwater Characterization Study (Quasenbarth, 1993; CDM, 1996; CH2M HILL, 1999) suggested that the most relevant information for urban areas is likely to be percent of the watershed area in residential and commercial/industrial/office land uses.

Data to support the regionalization were obtained from GA EPD via the Water Resources Database (WRDB) and supplemented by local (county and municipal) data. Though some of the data sources extend back as far as 1968, the regionalization was restricted to data from the last ten years (1992-2002). Land use data were aggregated to the scale of 12-digit hydrologic unit codes with some further delineation based on reach monitoring locations such that only upstream land use is tabulated for the regionalization. The smaller sub-watersheds were assigned 13 digit alphanumeric codes. These 12 or 13 digit watersheds will be referred to simply as watersheds in the following discussion.

This approach was previously applied to the Chattahoochee and Flint River basins. Particularly in the Chattahoochee basin the availability of data is much more extensive, largely as a result of monitoring conducted as part of the Chattahoochee River Modeling Project. In addition, observations are available from a wider range of land use fractions in these basins than are available for the Coosa and Tennessee basin sites. As a result, the regionalization data were pooled for the Coosa, Tennessee, Chattahoochee, and Flint basins to improve estimation.

For each watershed the mean and variance of the long-term fecal coliform data were calculated in log space. The log-space means were then plotted against the fraction of the local watershed in agricultural, rural, urban, or single family residential land use. Single independent variable regressions on fractions in individual land uses had poor explanatory power and high standard errors; however, there was a positive correlation between coliform concentration and urban land uses. Correlation against the total agricultural land use fraction was weakly negative. Multiple regressions provided better results, and the final exploratory model used fraction of land in single family residential and urban land uses. This model has an adjusted R^2 of 40 percent for the Coosa and Tennessee basin sites, as shown in Figure 1, with both coefficients statistically significant. (The adjusted R^2 is an unbiased estimate of the explanatory power of the model after correcting for potential correlation among multiple regression coefficients that can lead to an over-estimate of the un-adjusted R^2.)

In sum, the exploratory regression indicates a statistically significant relationship between the long-term geometric mean of observed fecal coliform data and land use. This model then provides the format for the empirical Bayes regional regression. As expected, the regional regression information provides some useful information, but is not in itself sufficient to provide an accurate estimate of observations. For this reason the weighting of regional and local data based on relative precision, as is done in the Bayes approach, is particularly important.

It should be noted that the long-term geometric mean data from sites is used only in the estimation of the parameters for the regional regression. These estimates are not used for assessing compliance with the 30-day geometric mean criterion, which would be inappropriate.

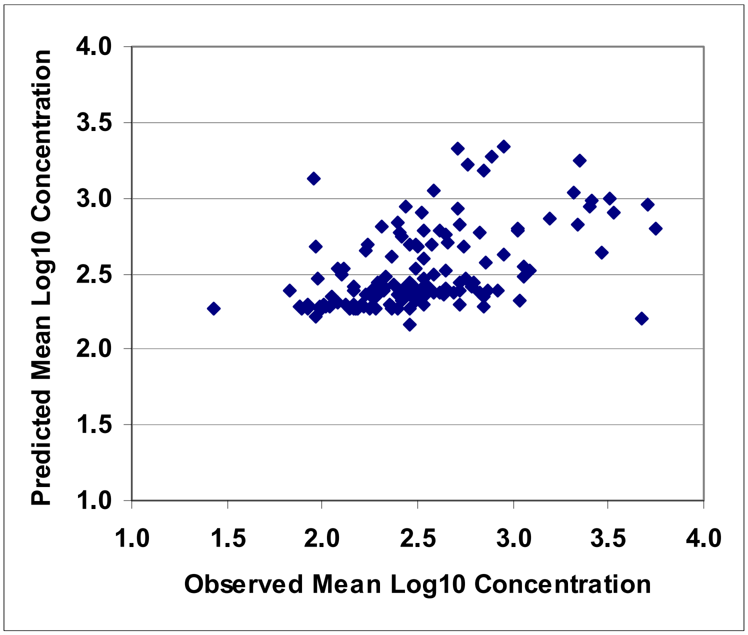

Figure 1. Predicted versus Observed Geometric Mean Fecal Coliform Bacteria Concentrations based on Land Use, Coosa and Tennessee Sites

Method Implementation

The methods described above were implemented in Excel spreadsheets, using built-in matrix/array functions. The process consists of two general steps: determination of the regionalization parameters, and combination of site and regional data to estimate individual-site results.

The regionalization problem was broken into two sets. One set included the data from the Atlanta metropolitan area, the other set included sites outside the Atlanta metropolitan area. There are two reasons for taking this approach. First, there are likely to be systematic differences in the sources of bacterial pollution in this highly developed area. Second, the land use coverage for the Atlanta metropolitan area is obtained from the Atlanta Regional Commission (ARC) ESDIS system, which combines a variety of sources of high-accuracy information, including aerial photography interpretation, and is likely to differ in quality from the satellite imagery-derived National Land Cover Database (NLCD) data available for the remainder of the state.

Within both the ARC and NLCD areas the regional regression used fraction urban area and fraction single family residential area as independent variables. In both cases, only the local land use within the 12+-digit HUC watershed corresponding to the listed segment was used in the regression, and not the entire upstream area land use, as concentrations are believed to be most strongly associated with local inputs. In three cases where the listed segment includes two or more 12+-digit HUCs, the land use distribution in the HUCs associated with the listed segment was combined for the purposes of the regression. The land use fractions associated with each site are shown in Table 1a (ARC area) and Table 1b (NLCD area). Site fecal coliform data used in the regionalization consisted of the post-1992 data collected for the "limited-data" TMDL sites, plus data provided by GA EPD for the sites at which TMDLs were estimated from valid 30-day geometric means using the TMDL Curve method.

Selection of Equivalent Sites

Selection of equivalent sites proceeded with the following rules:

1. In the case where valid 30-day geometric mean data are available for a downstream segment within the same watershed, this site (or sites) would be used as the equivalent site (this case does not occur among the Coosa/Tennessee basin sites).

2. The total pool of equivalent sites available consisted of all the sites with completed TMDL estimates provided by GA EPD. Potential equivalent sites for segments within the Atlanta Metropolitan area were selected from other sites in the metropolitan area; the pool for sites outside the metropolitan area was composed of other sites outside the metro area (NLCD sites).

3. Where an equivalent site was not already present in a downstream segment, up to 5 equivalent sites were selected from within an approximately 10 mile radius, depending on availability. If the subject site is a headwater basin, preference was given to selection of equivalent sites that were also headwater basins, as these should have similar flow regimes.

4. Sites known to be influenced by local point source discharges were omitted from the pool of potential equivalent sites for limited-data sites impacted by nonpoint sources only.

5. If no equivalent sites were present within a 10 mile radius of the subject site, 1 or 2 equivalent sites were picked from the general pool of sites that had similar land use and drainage area size.

Selected equivalent sites for each limited-data site are identified in Table 2. This table also shows the estimated TMDL reduction percentages calculated by GA EPD for each of the equivalent sites.

Table 1a. Data for Sites used for Empirical Bayes Regionalization, ARC Landuse Area

Site	Location	Watershed ID	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Anneewakee Creek	House Creek to Lake Monroe (Douglas Co.)	031300020304A	Chattahoochee	0.0037	0.3000	73	170	CRMP(1992-1996)
Arrow Creek	Atlanta (Fulton Co.)	031300011201B	Chattahoochee	0.6500	0.3000	21	1096	Dekalb County-94/95
Ball Mill Creek	Fulton/DeKalb Counties	031300010907B	Chattahoochee	0.0700	0.8500	23	513	Dekalb County-94/95, CRMP-92/96
Big Creek	Hwy 400 to Chattahoochee River (Fulton Co.)	031300011004A	Chattahoochee	0.5600	0.2900	141	1047	CRMP(1992-1996)
Bubbling Creek	Dekalb County	031300011203B	Chattahoochee	0.6600	0.2900	23	708	Dekalb County-94/95, ARC stormwater data
Burnt Fork Creek	DeKalb County	031300011202D	Chattahoochee	0.3600	0.5700	23	891	Dekalb County-94/95
Buttermilk Creek	Cobb County	031300020208C	Chattahoochee	0.2000	0.5900	103	380	Cobb County-90/05
Camp Creek	Fulton County	031300020302	Chattahoochee	0.0800	0.2900	53	525	CRMP(1992-1996)
Chattahoochee River	Morgan Falls Dam to Peachtree Creek (Fulton/Cobb Co.)	031300011101A	Chattahoochee	0.1800	0.6100	16	91	WRDB(1998-2000)
Chattahoochee River	Headwaters to Chattahoochee River (Cobb Co.)	031300011103A	Chattahoochee	0.0900	0.8000	54	1047	WRDB(1998-2000)
Chattahoochee River	Utoy Creek to Pea Creek (Fulton/Douglas Co.)	031300020301	Chattahoochee	0.0400	0.1400	16	417	WRDB(1998-2000)
Chattahoochee River	Pea Creek to Wahoo Creek (Fulton Co.)	031300020307	Chattahoochee	0.0200	0.0800	17	110	WRDB(1998-2000)
Johns Creek	Headwaters to Chattahoochee River (Fulton Co.)	031300010906	Chattahoochee	0.1000	0.6600	56	891	CRMP(1992-1996)
Level Creek	Headwaters to Chattahoochee River (Gwinnett Co.)	031300010902B	Chattahoochee	0.0500	0.4900	36	457	CRMP(1992-1996)
Level Creek	Tributary to Chattahoochee River (Gwinnett Co.)	031300010907C	Chattahoochee	0.6000	0.2600	72	1230	CRMP(1992-1996)
Long Island Creek	Headwaters to Chattahoochee River (Fulton Co.)	031300011105B	Chattahoochee	0.1700	0.7900	53	575	CRMP(1992-1996)

Site	Location	Watershed ID	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Lullwater Creek	DeKalb County	031300011202C	Chattahoochee	0.1500	0.6700	23	3388	Dekalb County-94/95
March Creek	Fulton County	031300011101B	Chattahoochee	0.2700	0.6100	38	5623	CRMP(1992-1996)
Mud Creek	Ga.Hwy 120 to Noses Creek (Cobb Co.)	031300020206C	Chattahoochee	0.0200	0.5900	94	275	Cobb County-90/02
Nancy Creek	Headwaters to Peachtree Creek, Atlanta (DeKalb/Fulton Co.)	031300011203A	Chattahoochee	0.2500	0.6500	55	1148	CRMP(1992-1996)
Nickajack Creek	Headwaters to Chattahoochee River (Cobb Co.)	031300020102	Chattahoochee	0.1500	0.6100	57	513	CRMP(1992-1996)
Olley Creek	Cobb County	031300020207	Chattahoochee	0.2300	0.5400	140	447	Cobb County-90/02
Pea Creek	Fulton County	031300020305	Chattahoochee	0.0013	0.1100	12	245	CRMP(1992-1996)
Peachtree Creek	I-85 to Chattahoochee River Atlanta (Fulton Co.)	031300011204A	Chattahoochee	0.2700	0.6700	124	4786	CRMP(1992-1996)
Peavine Creek	DeKalb County	031300011202B	Chattahoochee	0.2200	0.7500	46	2570	Dekalb County-94/95
Proctor Creek	Headwaters to Chattahoochee River, Atlanta (Fulton Co.)	031300020101C	Chattahoochee	0.4100	0.4300	72	5129	CRMP(1992-1996)
Rottenwood Creek	Headwaters to Chattahoochee River (Cobb Co.)	031300011104A	Chattahoochee	0.6700	0.1400	88	2089	CRMP(1992-1996)
S Fk Peachtree Creek	Atlanta (Fulton Co.)	031300011202A	Chattahoochee	0.2600	0.6400	52	2239	Dekalb County-94/95, ARC stormwater data, NAWQUA
S Fk Peachtree Creek	Atlanta (Fulton Co.)	031300011202E	Chattahoochee	0.3600	0.4900	33	2512	Dekalb County-94/95, ARC stormwater data, NAWQUA
Sandy Creek	I-285 to Chattahoochee River (Fulton Co.)	031300020101B	Chattahoochee	0.1800	0.6300	56	3236	CRMP(1992-1996)
Sewill Mill Creek	Cobb County	031300011103D	Chattahoochee	0.0500	0.8800	96	204	Sanitary survey (93), Cobb County-90/02, NAWQUA

Site	Location	Watershed ID	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Sweetwater Creek	U/S Pine Valley Rd. to Noses Creek (Paulding/Cobb Co.)	031300020208A	Chattahoochee	0.1300	0.4400	125	257	CRMP(1992-1996)
Sweetwater Creek	U/S Pine Valley Rd. to Noses Creek (Paulding/Cobb Co.)	031300020208B	Chattahoochee	0.2000	0.3100	17	229	WRDB(1998-2000)
Utoy Creek	Atlanta (Fulton Co.)	031300020103A	Chattahoochee	0.1800	0.4200	92	2884	CRMP(1992-1996)
Ward Creek	Cobb County	031300020205B	Chattahoochee	0.1300	0.7100	90	550	Cobb County-90/01
White Oak Creek	Fulton County	031300020312B	Chattahoochee	0.0000	0.0600	55	339	CRMP(1992-1996)
Willeo Creek	Cobb/Fulton Counties	031300011102	Chattahoochee	0.0500	0.8600	54	288	CRMP(1992-1996)
Butler Creek	Cobb County	031501040902B	Coosa	0.1125	0.6125	81	387	Cobb County-95/97
Little Allatoona Creek	Cobb County	031501040901A	Coosa	0.0377	0.3774	36	172	Cobb County-95/97
Little Noonday Creek	Cobb County	031501040808A	Coosa	0.1598	0.7539	37	293	Cobb County-95/97
Owl Creek	Lake Allatoona Tributary (Cherokee Co.)	031501041004A	Coosa	0.0952	0.6191	27	1555	Lake Allatoona Clean Lakes Study, Cherokee County Monitoring
Proctor Creek	Cobb County	031501040902C	Coosa	0.2273	0.4091	95	291	Cobb County-95/97
Pumpkinvine Creek	Little Pumpkinvine Creek to Etowah River (Paulding/Bartow Co.)	031501041105	Coosa	0.0309	0.1536	16	318	GA EPD
Rocky Creek	Fulton County	031501040804A	Coosa	0.0429	0.6286	13	261	Rocky Creek Fulton County-94/95
Rubes Creek	Cobb/Cherokee Counties	031501040806	Coosa	0.0720	0.6400	65	341	Cobb County-95/97
Trib. to Allatoona Creek	Cobb County	031501040901C	Coosa	0.0500	0.4500	13	120	Cobb County
Camp Creek	Headwaters to Flint River (Clayton Co.)	031300050102	Flint	0.1100	0.5800	16	195	WRDB(1998-2000)
Flint River	Hwy 138 to N. Hampton Road	031300050101A	Flint	0.1400	0.4300	29	91	WRDB(1998-2000)

Table 1b. Data for Sites used for Empirical Bayes Regionalization, NLCD Landuse Area

Site	Location	HUC	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Chattahoochee River	Ga. Hwy 17, Helen to SR255 (White/ Habersham Co.)	031300010102	Chattahoochee	0.0029	0.0012	16	76	WRDB(1998-2000)
Chattahoochee River	SR255 to Soquee River (White/Habersham Co.)	031300010106	Chattahoochee	0.0015	0.0017	16	151	WRDB(1998-2000)
Soquee River	Goshen Creek to SR 17, Clarkesville (Habersham Co.)	031300010202	Chattahoochee	0.0004	0.0005	16	102	WRDB(1998-2000)
Tesnatee Creek	Cleveland (White Co.)	031300010504	Chattahoochee	0.0137	0.0080	16	166	WRDB(1998-2000)
Amicalola Creek	Headwaters near Hwy 52 to Etowah River (Dawson Co.)	031501040204	Coosa	0.0487	0.0019	16	185	GA EPD
Armuchee Creek	Oostanaula River Tributary (Floyd Co.)	031501030507	Coosa	0.0412	0.0051	16	302	GA EPD
Big Dry Creek	Rome (Floyd Co.)	031501030604A	Coosa	0.1097	0.0583	30	1127	Rome WPCP Monitoring
Cane Creek	Dry Creek to Chattooga River (Walker/Chattooga Co.)	031501050407	Coosa	0.0611	0.0200	16	146	GA EPD
Cartecay River	Owltown Creek to Coosawattee River (Gilmer Co.)	031501020106	Coosa	0.0590	0.0275	33	254	GA EPD, Carter's Lake WPMP-96
Cedar Creek	Polk County	031501050203	Coosa	0.0583	0.0257	17	832	GA EPD
Chattooga River 1	Cane Creek, Trion to Henry Branch (Chattooga Co.)	031501050501A	Coosa	0.0713	0.0269	16	210	GA EPD
Chattooga River 2	Henry Branch to Lyerly (Chattooga Co.)	031501050504A	Coosa	0.0666	0.0253	16	293	GA EPD
Coahulla Creek	Below 728 Road to Mill Creek (Whitfield Co.)	031501010307	Coosa	0.0351	0.0299	16	267	GA EPD
Conasauga River 1	Hwy 286 to Holly Creek (Whitfield/Murray Co.)	031501010207	Coosa	0.0289	0.0074	16	311	GA EPD
Conasauga River 2	Holly Creek to Oostanaula River (Murray/Gordon Co.)	031501010501	Coosa	0.0581	0.0293	16	380	GA EPD
Coosa River	Rome to Hwy 100 (Floyd Co.)	031501041607	Coosa	0.0658	0.0301	17	302	GA EPD
Coosawattee River	Confluence with Ellijay River to Mountaintown Creek (Gilmer Co.)	031501020401	Coosa	0.0622	0.0291	16	520	GA EPD
Ellijay River	Upstream Coosawattee River (Gilmer Co.)	031501020205	Coosa	0.0669	0.0315	33	440	GA EPD, Carter's Lake WPMP-96

Site	Location	HUC	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Etowah River 1	Clear Creek to Forsyth County Line (Dawson Co.)	031501040105	Coosa	0.0450	0.0020	16	283	GA EPD
Etowah River 2	Clear Creek to Forsyth County Line (Dawson Co.)	031501040306A	Coosa	0.0515	0.0308	16	193	GA EPD
Etowah River 4	Lake Allatoona to Richland Creek (Bartow Co.)	031501041304	Coosa	0.0670	0.0604	16	202	GA EPD
Etowah River 5	Rome to Hwy 100 (Floyd Co.)	031501041607	Coosa	0.0705	0.0486	16	329	GA EPD
Euharlee Creek	Hills Creek to upstream Plant Bowen	031501041407A	Coosa	0.0647	0.0161	16	329	GA EPD
Flat Creek	Upstream Coosawattee River (Gilmer Co.)	031501020402A	Coosa	0.0895	0.0755	17	528	Carter's Lake WPMP-96
Holly Creek	Rock Creek to Conasauga River (Murray Co.)	031501010406A	Coosa	0.0604	0.0210	16	368	GA EPD
Long Swamp Creek	Hwy 53 to Etowah River, near Ball Ground (Pickens/ Cherokee Co.)	031501040404	Coosa	0.0822	0.0619	16	235	GA EPD
Mountain Town Creek	Hwy 282 to Coosawattee River (Gilmer Co.)	031501020305A	Coosa	0.0360	0.0098	33	186	GA EPD, Carter's Lake WPMP-96
Oostanaula River	Hwy 140 to Coosa River (Floyd Co.)	031501030103	Coosa	0.0649	0.0241	16	309	GA EPD
Pine Log Creek	Cedar Creek to Salacoa Creek (Gordon Co.)	031501020706	Coosa	0.0601	0.0049	16	745	GA EPD
Raccoon Creek 502	U/S Chattooga River, Berryton (Chattooga Co.)	031501050502	Coosa	0.0579	0.0194	16	490	GA EPD
Sharp Mtn Creek	Rock Creek to Etowah River (Cherokee Co.)	031501040506	Coosa	0.0858	0.0529	16	203	GA EPD
Silver Creek	Rome (Floyd Co.)	031501041606	Coosa	0.1354	0.0620	16	448	GA EPD
Spring Creek 1603	Etowah River Tributary (Floyd Co.)	031501041603	Coosa	0.0519	0.0207	16	411	GA EPD
Spring Creek 0403	Walker/Chattooga County	031501050403	Coosa	0.0415	0.0012	16	312	GA EPD
Tails Creek	Hwy 282 to Carters Lake (Gilmer Co.)	031501020403A	Coosa	0.0446	0.0113	33	170	GA EPD, Carter's Lake WPMP-96
Talking Rock Creek1	GA Hwy 136 to Pickens/Gilmer Co. Line (Pickens Co.)	031501020505	Coosa	0.0625	0.0189	16	303	GA EPD
Tanyard Creek	White Lake to Lake Allatoona (Cobb Co.)	031501040903A	Coosa	0.2323	0.2707	39	306	Cobb County-95/97

Site	Location	HUC	Basin	Fraction Urban	Fraction Single Family Residential	Sample Count	Long-term Geometric Mean (cts/100 ml)	Data Source
Trib. to Oothkalooga Creek	Peters Street to Oothkalooga Creek, Calhoun (Gordon County)	031501030203C	Coosa	0.2923	0.1925	42	330	Calhoun - Oothkalooga Creek Spill Data 1996
Trib to Pettit Creek	Cartersville (Bartow Co.)	031501041303C	Coosa	0.2640	0.0658	53	771	Cartersville - Pettit Creek Spill Data 1997
Two Run Creek	Clear Creek to Etowah River (Bartow Co.)	031501041504	Coosa	0.0655	0.0149	16	368	GA EPD
Woodward Creek	Oostanaula River Tributary (Floyd Co.)	031501030602	Coosa	0.0655	0.0121	16	444	GA EPD
Butternut Creek	Blairsville (Union Co.)	060200020804A	Tennessee	0.1234	0.0895	15	127	TVA
Fightingtown Creek	CR 159 to Stateline (Fannin Co.)	060200030206	Tennessee	0.0418	0.0129	16	193	GA EPD
Hemptown Creek	Mitchell Branch to Young Stone Creek (Fannin Co.)	060200030203A	Tennessee	0.0691	0.0111	16	289	GA EPD
Nottley Creek 1	Right/Left Forks to US Hwy 19 (Union Co.)	060200020801	Tennessee	0.0425	0.0001	16	112	GA EPD
Nottley Creek 2	US Hwy 19 to Lake Nottely (Union Co.)	060200020803	Tennessee	0.0501	0.0084	16	193	GA EPD
Youngcane Creek	Little Youngcane Creek to Nottely Lake (Union Co.)	060200020807A	Tennessee	0.0595	0.0136	16	343	GA EPD

Table 2. Equivalent Sites Selected for Each Limited-Data TMDL Site.

Limited-Data Site	Equivalent Site	Watershed ID	Drainage Area (mi^2)	30-Day Critical Geometric Mean (cts/100 ml)	Percent Reduction for TMDL
Acworth Creek		031501040902A	0.16		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Big Dry Creek		031501030604A	17.00		
	Armuchee Creek at Old Dalton Road near Rome	031501030507	224.00	1323.2	84.9
	Woodward Creek at Bells Ferry Road near Rome	031501030602	26.20	672.1	70.2
	Silver Creek at Cresent Avenue near Rome	031501041606	37.40	608.7	67.1
	Spring Creek at GA Hwy 20 near Rome	031501041603	37.40	607.0	67.1
Butler Creek		031501040902B	9.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Flat Creek		031501020402A	7.00		
	Talking Rock Creek near Blaine	031501020505	78.10	428.2	53.3
	Tails Creek at GA Hwy 282 near Ellijay	031501020403A	7.70	348.1	42.5
	Ellijay River at US Hwy 76 at Ellijay	031501020205	87.70	1081.6	81.5
	Mountaintown Creek at GA Hwy282 near Ellijay	031501020305A	61.60	548.8	63.6
Lake Acworth		031501040902D	20.30		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Little Allatoona Creek		031501040901A	6.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Little Noonday Creek		031501040808A	7.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Owl Creek		031501041004A	2.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Proctor Creek		031501040902C	8.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1

Limited-Data Site	Equivalent Site	Watershed ID	Drainage Area (mi^2)	30-Day Critical Geometric Mean (cts/100 ml)	Percent Reduction for TMDL
Rocky Creek		031501040804A	8.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Rubes Creek		031501040806	15.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Tanyard Creek		031501040903A	3.00		
	Euharlee Creek near Stillsboro	031501041407A	158.00	868.1	77.0
	Spring Creek at GA Hwy 20 near Rome	031501041603	37.40	607.0	67.1
	Woodward Creek at Bells Ferry Road near Rome	031501030602	26.20	672.1	70.2
Trib to Allatoona		031501040901C	2.00		
	Allatoona Creek at McClain Road near Acworth	031501040901B	18.60	826.1	75.8
	Level Creek	031300010902B	8.83	1392.9	85.6
	Willeo Creek	031300011102	16.67	255.3	21.7
	Kelly Mill Branch	031300011001D	3.85	205.4	2.6
	Mobley Creek	031300020309B	16.38	426.8	53.1
Trib to Oothkalooga Creek		031501030203C	3.00		
	Oostanaula River near Calhoun	031501030103	1734.00	299.0	33.1
	Woodward Creek at Bells Ferry Road near Rome	031501030602	26.20	672.1	70.2
	Pine Log Creek at Sonoraville	031501020706	99.10	1028.3	80.6
Trib to Pettit Creek		031501041303C	2.00		
	Euharlee Creek near Stillsboro	031501041407A	158.00	868.1	77.0
	Spring Creek at GA Hwy 20 near Rome	031501041603	37.40	607.0	67.1
	Woodward Creek at Bells Ferry Road near Rome	031501030602	26.20	672.1	70.2
Butternut Creek		060200020804A	11.00		
	Youngcane Creek near Youngcane	060200020807A	22.40	740.8	73.0
	Nottley River at Hwy 180	060200020801	27.00	1156.4	82.7
	Nottley River near Blairsville	060200020803	74.80	674.4	70.3
	Chattahoochee River at Nacoochee	031300010102	50.93	303.7	51.9

The empirical Bayes implementation yields the regionalization parameters shown in Table 3. These parameters are then used in Equation 9 to maximum likelihood estimates of 2 for each site. This in turn allows calculation of the translation factors using Equation 6. The resulting TMDL estimates are provided in the main document.

Table 3. Regional Regression Parameter Estimates to Predict Long-Term Average Log base-10 Fecal Coliform Bacteria Concentration

Landuse Source	Intercept	Coefficient on fraction urban area	Coefficient on fraction single family residential
ARC	2.16	1.44	0.43
NLCD	2.31	4.15	-3.54

For both areas, the estimate of Φ_B is zero. This is a common occurrence in the method, and does not interfere with application. The implications are discussed by Berger (1985, p. 177) who states that the presence of a zero estimate of the regional or prior variance does not mean that there is no uncertainty in the estimate of the regional parameters. Rather, it implies a *lack* of information about Φ_B due to the fact that the likelihood function for Φ_B is quite flat.

The resulting empirical Bayes estimates of the individual limited-data site statistics are provided in Table 4.

Table 4. Empirical Bayes Sufficient Statistics for Limited Data Sites (Expressed as log base 10 of the long-term geometric mean concentration, cts/100 ml)

Site Name	Watershed ID	μ EB (Equation 9)	V EB (Equation 10)
Atlanta Metro Area (ARC) Sites			
Acworth Creek	031501040902A	3.007	0.063
Butler Creek	031501040902B	2.593	0.039
Lake Acworth	031501040902D	2.589	0.032
Little Allatoona Creek	031501040901A	2.377	0.014
Little Noonday Creek	031501040808A	2.712	0.021
Owl Creek	031501041004A	2.597	0.033
Proctor Creek	031501040902C	2.661	0.042
Rocky Creek	031501040804A	2.496	0.015
Rubes Creek	031501040806	2.546	0.020
Trib. to Allatoona	031501040901C	2.418	0.018
Non-ARC (NLCD) Sites			
Big Dry Creek	031501030604A	2.580	0.044
Flat Creek	031501020402A	2.426	0.017
Tanyard Creek	031501040903A	2.322	0.039
Trib. to Oothkalooga Creek	031501030203C	2.825	0.024
Trib. to Pettit Creek	031501041303C	3.158	0.078
Butternut Creek	060200020804A	2.485	0.032

Translating Results to TMDLs

If a single equivalent site is used, estimation of the TMDL is straightforward. The procedure is the same as is used for the sites with valid geometric mean data, except that the estimates of critical load and associated flow would be obtained from the equivalent site using the methods described in this appendix. This situation (requiring a valid 30-day geometric mean estimate from a downstream segment) does not occur among the Coosa/Tennessee basin limited-data sites.

When multiple equivalent sites are used, the situation is somewhat more complicated, as each equivalent site may produce a different estimate of critical load and flow. The Bayes procedure described in this appendix is based, of necessity, on determining the relationship of long-term geometric means between sites. As a result, the primary output of this procedure is an estimate of the needed percent reduction, while the estimates of critical loads are less reliable because the regionalization reflects mean loads rather than critical loads. For this reason, the TMDL table entry for a limited-data site with multiple equivalent sites is filled in starting with the estimated percent reduction as the primary output and working backward to fill in the other entries. The estimate of the TMDL is set at the average of the TMDL curve points determined in relationship to each of the equivalent sites. The estimate of current critical load is then set to a value such that current load times percent reduction equals the TMDL. When more than one equivalent site is used, this procedure results in an estimate of current critical load that may differ somewhat from the average of the critical load estimates obtained from the equivalent sites, but is within the range of the critical load estimates from the equivalent sites.

The TMDL estimates calculated by this method are based on compliance with the seasonal geometric mean criteria. It is also necessary to check for compliance against the winter maximum concentration criterion of 4000 counts per 100 ml. Of the limited data sites addressed in this study, none had winter observations in excess of this criterion reported in recent data (1998-2002). Older data are not appropriate for comparison to the maximum concentration criterion as situations that lead to maxima in urban streams such as spills are modified over time. As a result, it is not necessary to do an alternate calculation of reductions based on this criterion.

The final TMDL estimates are reported in Table 15 in the main text.

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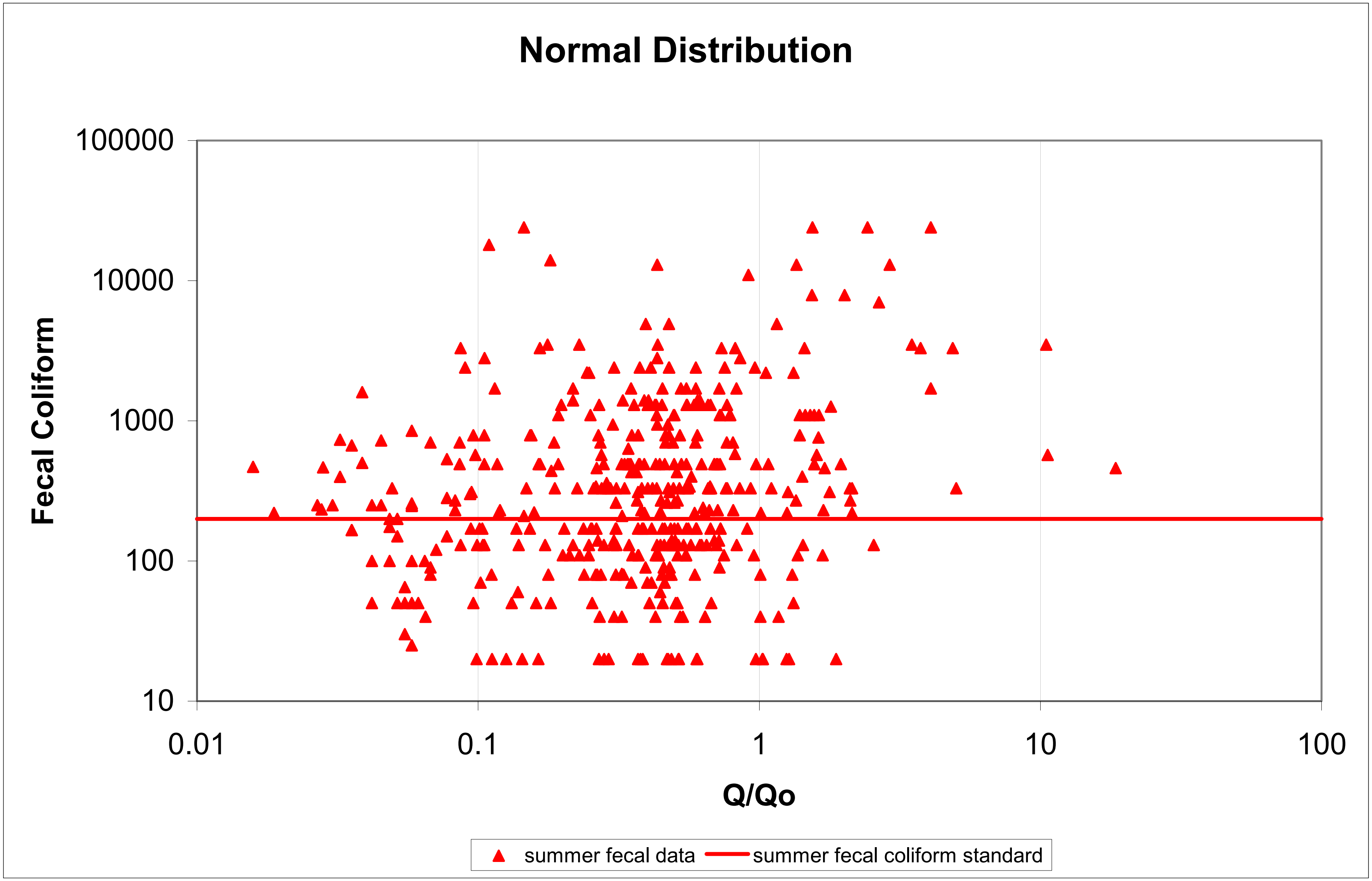
Appendix D

Normalized Flows Versus Fecal Coliform Plots


Normal Distribution
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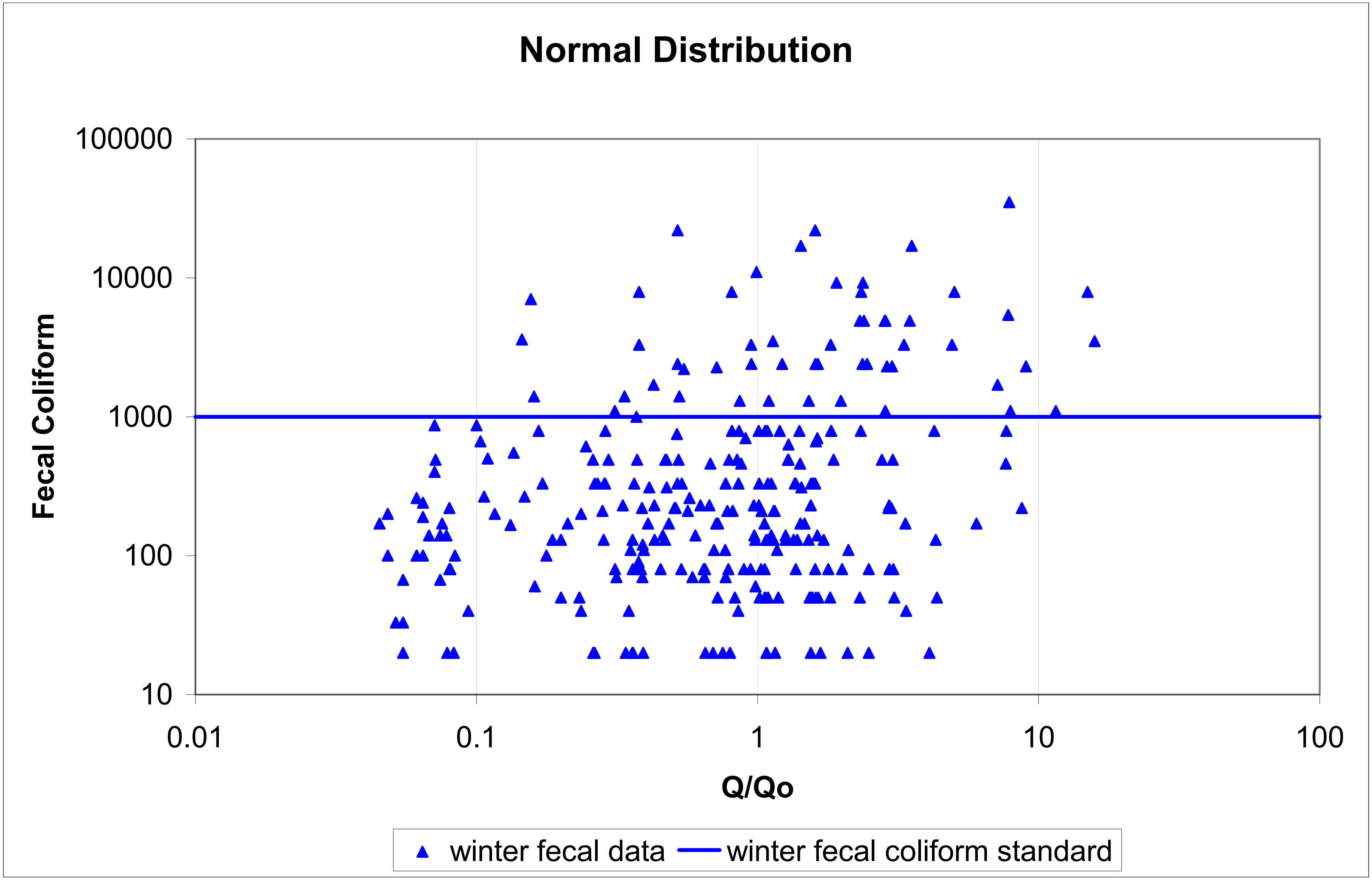
10000
1000
100
10
Fecal Coliform
0.01
0.1
1
10
100
Q/Qo
summer fecal data
summer fecal coliform standard


Normal Distribution
100000
10000
1000
100
10
Fecal Coliform
0.01
0.1
1
10
100
Q/Qo
winter fecal data
winter fecal coliform standard