

Total Maximum Daily Load
Evaluation
for
Five Stream Segments
in the
Tennessee River Basin
for
Fecal Coliform

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Submitted by:
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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of two categories with respect to designated uses: supporting or not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (Draft, GA EPD, 2006 – 2007).

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

The State of Georgia has identified five stream segments located in the Tennessee River Basin as water quality limited due to fecal coliform bacteria. A stream is placed on the not support list if more than 10% of the samples exceed the fecal coliform criteria. Water quality samples collected within a 30-day period that have a fecal coliform geometric mean in excess of 200 counts per 100 milliliters during the period May through October, or in excess of 1,000 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 (4,000 counts per 100 milliliters) for the months of November through April. The water use classification of the impacted streams is Fishing.

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

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

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

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

Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/ 30 days)	TMDL Components					Percent Reduction
		WLA (counts/ 30 days) ¹	WLA _{sw} (counts/ 30 days)	LA (counts/ 30 days)	MOS (counts/ 30 days)	TMDL (counts/ 30 days)	
Cooper Creek	9.25E+12			6.64E+12	7.38E+11	7.38E+12	20
Dry Creek	4.89E+12			6.08E+11	6.75E+10	6.75E+11	86
Hiawassee River	3.11E+13			6.11E+12	6.79E+11	6.79E+12	78
Little Chickamauga Creek	1.40E+13		5.78E+09	2.97E+12	3.30E+11	3.30E+12	76
Toccoa River	6.77E+13			3.64E+13	4.04E+12	4.04E+13	40

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

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

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

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

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of two categories with respect to designated uses: supporting or not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that addresses the assessment process, and are published in *Water Quality in Georgia* (Draft, GA EPD, 2006 – 2007). This document is available on the Georgia Environmental Protection Division (GA EPD) website.

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

The list identifies the waterbodies that are not supporting their designated use classifications, due to exceedances of water quality standards for fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. Table 1 presents the five streams of the Tennessee River Basin included on the 2008 303(d) list for exceedances of the fecal coliform standard criteria. These five stream segments were listed as not supporting their designated use on the 2008 303(d) list.

1.2 Watershed Description

The Tennessee River originates in southwest Virginia and flows southwest across Tennessee and through Chattanooga, just north of the Georgia-Tennessee state line. It then continues into Alabama. Major tributaries of the Tennessee River are located in north Georgia. Lookout Creek, West Chickamauga Creek and Little Chickamauga Creek originate in the northwest corner of Georgia. Lookout Creek flows north into Tennessee and joins the Tennessee River in southwest Chattanooga. West Chickamauga Creek and Little Chickamauga Creek merge near the Georgia-Tennessee border, forming Chickamauga Creek, which continues north and flows into the Tennessee River in Chattanooga. Further east, the Toccoa River flows north from Georgia into Tennessee, where it's name changes to the Ocoee River, and continues north to the Tennessee River. The Nottely River and Brasstown Creek originate in Georgia and also flow north to the Tennessee River. The headwaters of the Little Tennessee River originate in the northeast corner of Georgia. The Little Tennessee flows north, then northwest where it joins the Tennessee River. The Tennessee River Basin contains parts of the Cumberland Plateau, Ridge and Valley, and Blue Ridge physiographic provinces that extend throughout the southeastern United States.

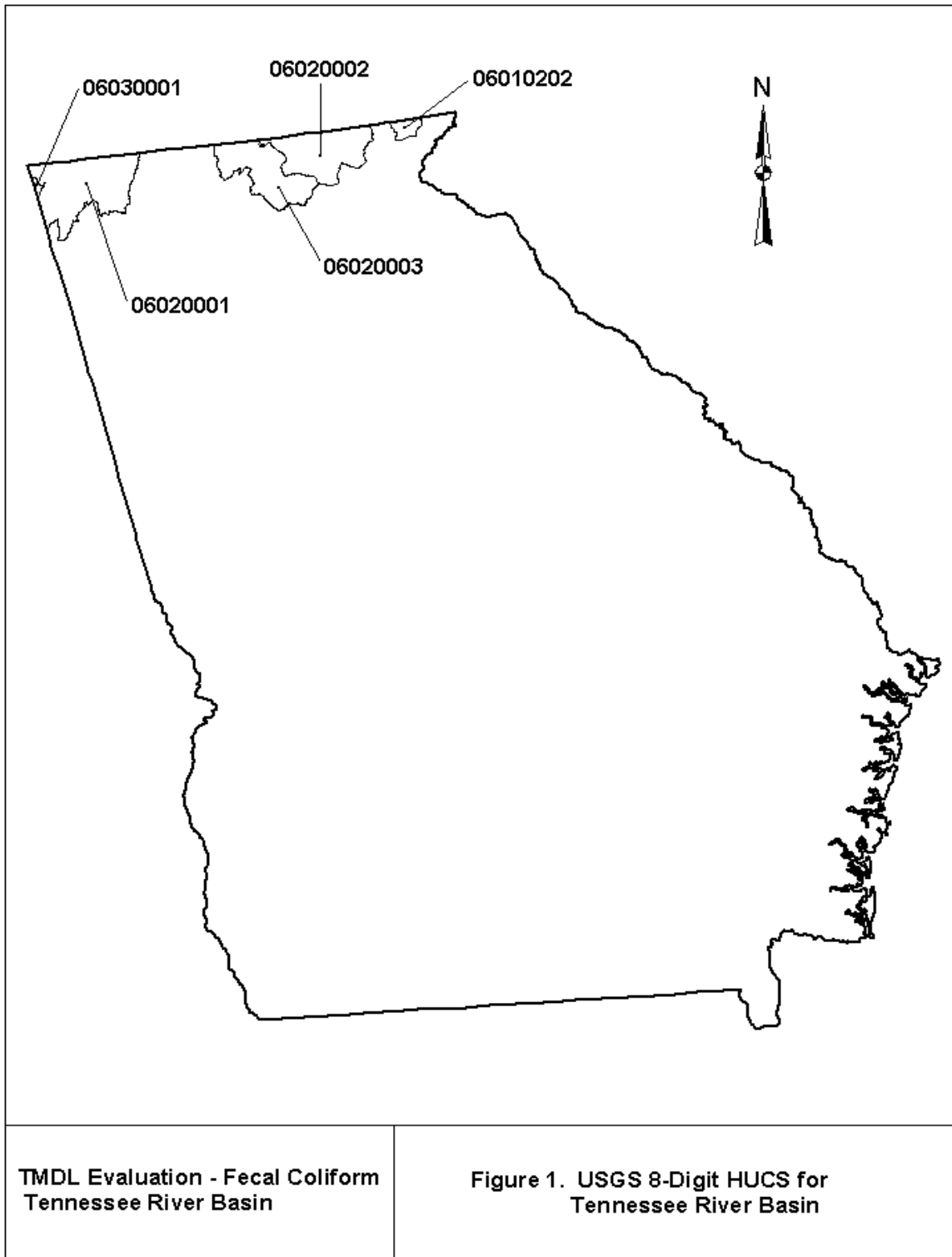
The United States Geologic Survey (USGS) has divided the Georgia portion of the Tennessee basin into four sub-basins, or Hydrologic Unit Codes (HUCs). Figure 1 shows the locations of these sub-basins. Figure 2 shows the impaired segments in HUCs 06020001 and 06030001,

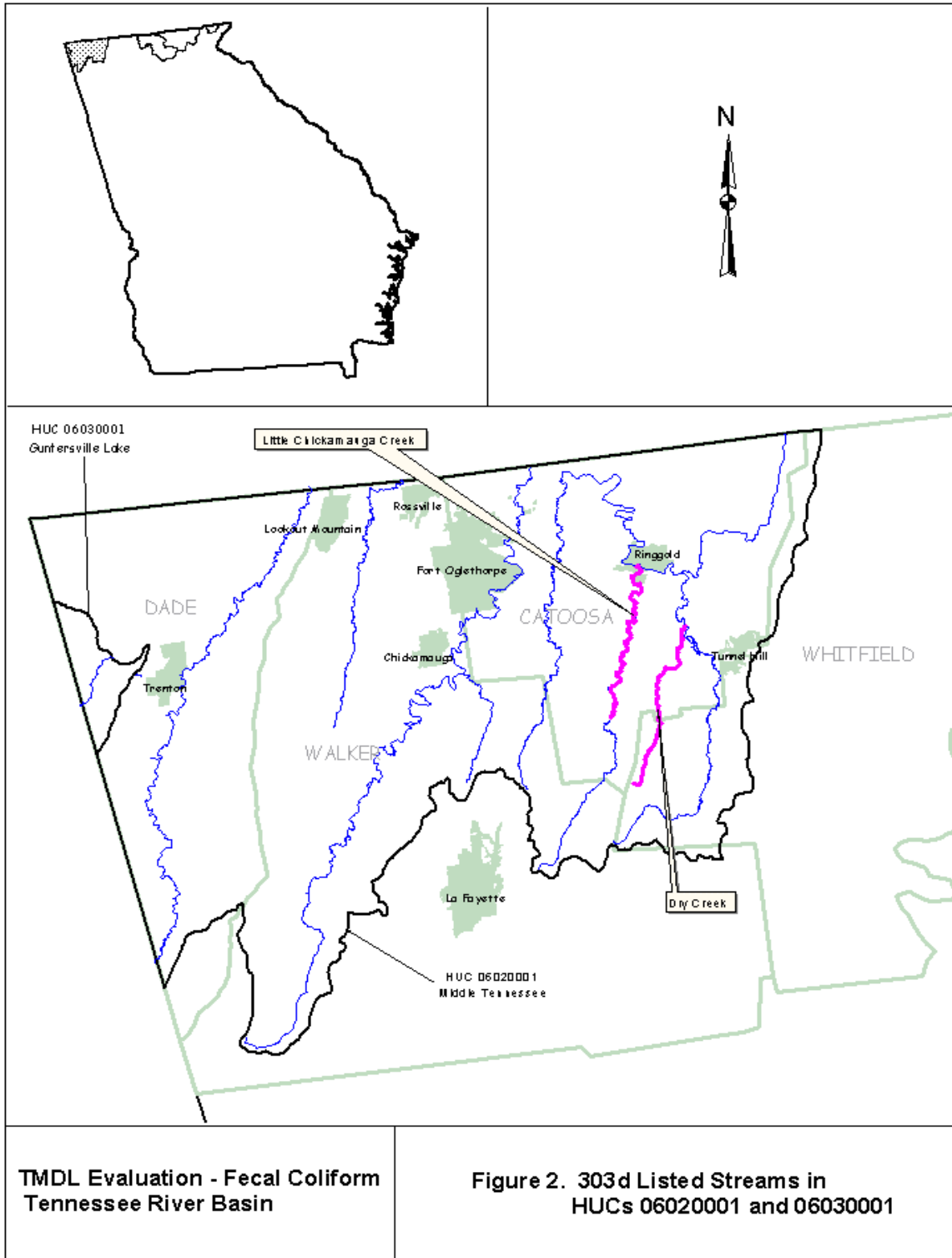
Table 1. Water Bodies Listed on the 2008 303(d) List for Fecal Coliform Bacteria in the Tennessee River Basin

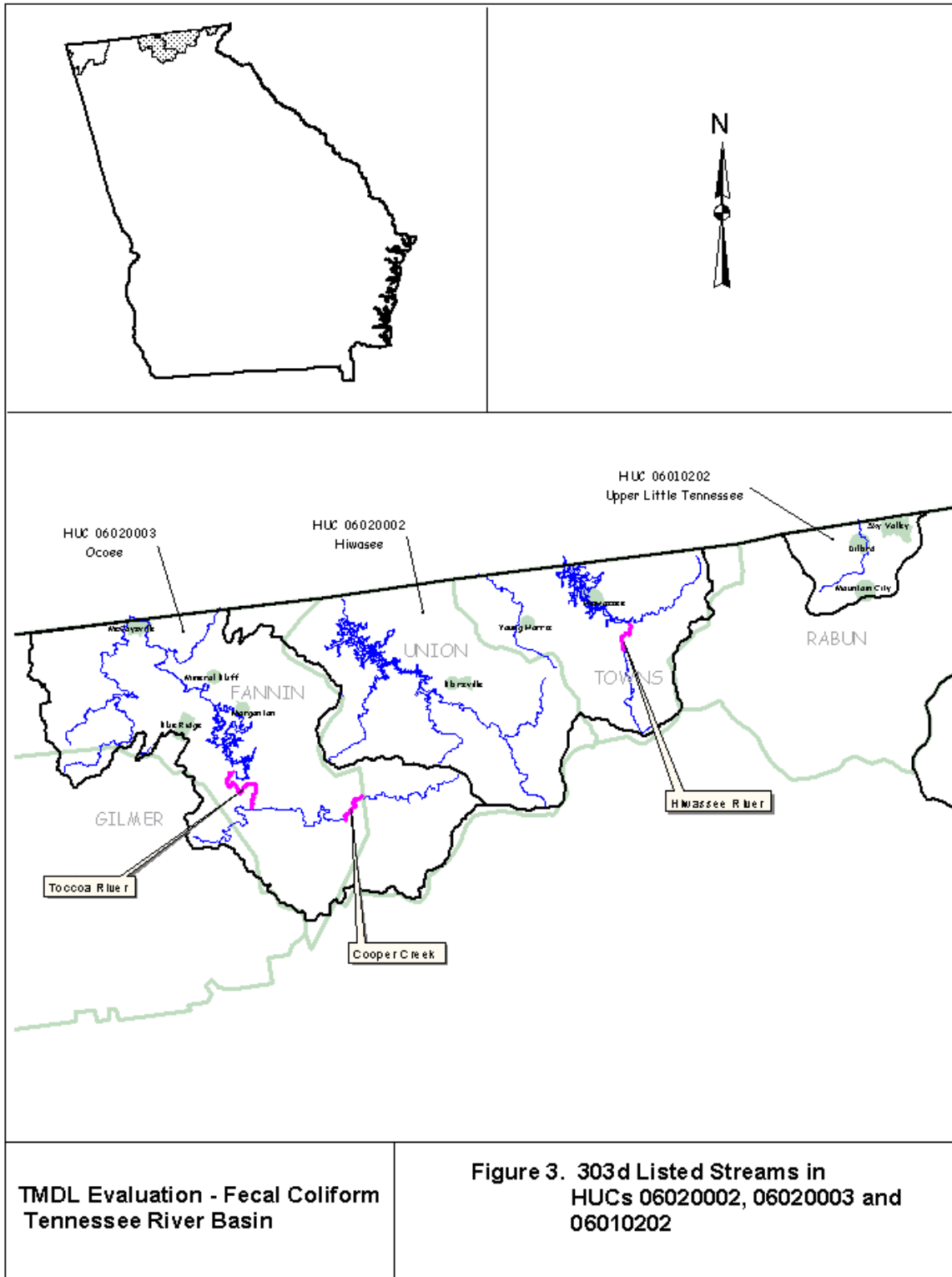
Stream Segment	Location	Segment Length (miles)	Designated Use
Cooper Creek	Tributary to Toccoa River (Fannin County)	3	Fishing
Dry Creek	Headwaters to East Chickamauga Creek (Whitfield and Catoosa Counties)	10	Fishing
Hiawassee River	Upstream Lake Chatuge (Towns County)	10	Fishing
Little Chickamauga Creek	Coulter Creek to S. Chickamauga Creek (Catoosa County)	11	Fishing
Toccoa River	Big Creek to Lake Blue Ridge (Fannin County)	10	Recreation

and Figure 3 shows the locations the impaired watersheds in HUCs 06020002, 06020003, and 06010202.

The land use characteristics of the Tennessee River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage was produced from Landsat Thematic Mapper digital images developed in 2001. Land use classification is based on a modified Anderson level one and two system. Table 2 lists the watershed land coverage distribution of the five stream segments.







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**Figure 3. 303d Listed Streams in
HUCs 06020002, 06020003 and
06010202**

Table 2. Tennessee 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	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total
Cooper Creek	6.89 (0.03)	2.89 (0.01)				24.91 (0.1)	24326.47 (96.7)	290.66 (1.2)	0.89 (0.001)	488.14 (1.9)	24.24 (0.1)		25165.09 (100.0)
Dry Creek	16.90 (0.2)	7.56 (0.1)	6.00 (0.1)		2.22 (0.03)		6169.90 (80.8)	1080.36 (14.2)	123.42 (1.6)	195.70 (2.6)	31.13 (0.4)		7633.21 (100.0)
Hiawasse River	2.00 (0.01)	15.12 (0.1)	3.11 (0.01)	0.44 (0.00)	2.22 (0.01)	19.57 (0.1)	26959.75 (91.4)	1159.97 (3.9)	28.24 (0.1)	1282.06 (4.3)	18.90 (0.1)		29491.40 (100.0)
Little Chickamauga Creek	276.65 (0.3)	1693.92 (1.6)	529.06 (0.5)	177.24 (0.2)	77.39 (0.1)	49.15 (0.05)	61483.77 (58.7)	29696.66 (28.4)	2641.51 (2.5)	7466.42 (7.1)	562.64 (0.5)	7.12 (0.01)	104661.53 (100.0)
Toccoa River	52.71 (0.04)	34.69 (0.03)			11.12 (0.01)	50.04 (0.04)	113946.63 (94.5)	3092.96 (2.6)	58.27 (0.05)	3243.07 (2.7)	110.08 (0.1)		120599.56 (100.0)

1.3 Water Quality Standard

The water use classification for the listed stream segments in the Tennessee River Basin is Fishing. The criterion violated is listed as fecal coliform. The potential cause(s) listed include urban runoff, nonpoint sources, and municipal facilities. The use classification water quality standards for fecal coliform bacteria, as stated in the *State of Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (GA EPD, 2007), are:

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

2.0 WATER QUALITY ASSESSMENT

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

Fecal coliform data used for TMDLs developed in this document were collected during calendar year 2001 by the Georgia Environmental Protection Division (GA EPD) as part of the trend monitoring program. The data used for these TMDLs are presented in Appendix A.

3.0 SOURCE ASSESSMENT

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

3.1 Point Source Assessment

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

3.1.1 Wastewater Treatment Facilities

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

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

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

Discharges from municipal and industrial wastewater treatment facilities can contribute fecal coliform to receiving waters. There are no NPDES permitted discharges with flows greater than 0.1 MGD identified in the Tennessee River Basin that discharge treated municipal wastewater and that potentially impact streams on the 2008 303(d) list for fecal coliform bacteria.

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 Tennessee River Basin.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls “to the maximum extent practicable” (MEP). Currently, regulated storm water discharges that may contain fecal coliform bacteria consist of those associated with industrial activities including construction sites disturbing one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more.

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

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

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

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Thirty counties and 56 communities are permitted under the Phase II regulations in Georgia. There are nine counties or communities located in the Tennessee River Basin that are covered by the Phase II General Storm Water Permit (Table 3).

Table 3. Phase II Permitted MS4s in the Tennessee River Basin

Name	Watershed
Catoosa County	Tennessee
Chickamauga	Tennessee
Fort Oglethorpe	Tennessee
Lookout Mountain	Tennessee
Ringgold	Tennessee
Rossville	Tennessee
Tunnel Hill	Tennessee
Walker County	Coosa, Tennessee
Whitfield County	Coosa, Tennessee

Source: Nonpoint Source Permitting Program, GA DNR, 2007

Those watersheds located within Phase I or Phase II MS4 city or county urbanized areas are listed in Table 4. The table provides the total area of each of these watersheds, and the percentage of the watersheds that is MS4 city or county urbanized area.

Table 4. Percentage of Watersheds in the Tennessee River Basin Located in MS4 City or County Urbanized Areas

Stream Segment	Location	Total Area (square miles)	% in MS4 area
Little Chickamauga Creek	Coulter Creek to South Chickamauga Creek	4.3	2.7

3.1.3 Confined Animal Feeding Operations

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

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs using liquid manure handling systems were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). There are no registered or permitted liquid manure CAFOs located in the Tennessee River Basin.

Georgia is consistently among the top three states in the U.S. in terms of poultry operations. The majority of poultry farms are dry manure operations where the manure is land applied. This can be a nonpoint source for fecal coliform bacteria. Current federal regulations require that large poultry farms operate under an NPDES permit. Table 5 presents the dry manure poultry operations in the Tennessee River Basin that have submitted an application for the General NPDES Permit GAG930000. Of these, none have been issued a permit, 3 will be issued a permit in the near future, and 2 are submitting additional information to complete the application process.

Table 5. Registered Dry Manure Poultry Operations in the Tennessee River Basin

Name	County	Number of Animals (thousands)	Permit Number
DP Phillips Farm	Catoosa	188.8	NAI
R.H. Stephens Poultry	Dade	135	NAI
Lewis Poultry Farm	Fannin	159	P
Barnes Poultry Farm, Inc.	Walker	280	P
Fricks Cove Farm	Walker	192.8	P

Source: GA Dept. of Agriculture, 2008

Notes: P = permit pending

NAI = needs additional information for application

3.2 Nonpoint Source Assessment

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

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

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

3.2.1 Wildlife

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

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

3.2.2 Agricultural Livestock

Agricultural livestock are a potential source of fecal coliform to streams in the Tennessee 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 6 provides the estimated number of beef cattle, dairy cattle, goats, horse, swine, sheep, and chickens by category reported by county. These data were provided by the Natural Resources Conservation Service (NRCS).

Table 6. Estimated Agricultural Livestock Populations in the Tennessee River Basin

County	Livestock							
	Beef Cattle	Dairy Cattle	Swine	Sheep	Horses	Goats	Chickens Layers	Chickens-Broilers Sold
Catoosa	3,000	-	-	25	300	40	60,000	15,158,000
Dade	3,800	-	-	50	350	450	140,000	5,863,000
Fannin	1,900	-	-	15	695	100	160,000	6,476,800
Gilmer	5,500	800	-	-	510	100	400,000	72,192,000
Lumpkin	3,300	200	-	80	390	329	140,000	12,531,200
Rabun	2,200	-	-	125	250	200	-	3,097,600
Towns	5,000	-	13,350	30	1,025	300	-	288,000
Union	3,500	200	-	-	1,150	500	150,000	3,000,000
Walker	9,700	630	-	150	1,100	800	30,000	19,305,000
Whitfield	7,500	180	-	10	2,000	300	60,000	15,730,000

Source: NRCS, 2008

3.2.3 Urban Development

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

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

In addition to urban animal sources of fecal coliform, there may be illicit connections to the storm sewer system. As part of the MS4 permitting program, municipalities are required to conduct dry-weather monitoring to identify and then eliminate these illicit discharges. Fecal coliform bacteria may also enter streams from leaky sewer pipes, or during storm events when combined sewer overflows discharge.

3.2.3.1 Leaking Septic Systems

A portion of the fecal coliform contributions in the Tennessee River Basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Table 7 presents the number of septic systems in each county of the Tennessee River Basin existing in 2001 and the number existing in 2006, based on the Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems installed and repaired during the five year period from 2001 through 2006 is given. These data show that a substantial increase in the number of septic systems has occurred in some counties. Often, this is 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.

Table 7. Number of Septic Systems in the Tennessee River Basin

County	Existing Septic Systems (2001)	Existing Septic Systems (2006)	Number of Septic Systems Installed (2001 to 2006)	Number of Septic Systems Repaired (2001 to 2006)
Catoosa	16,375	17,571	1196	598
Dade	5,342	5,714	372	124
Fannin	11,999	14,476	2477	178
Gilmer	12,538	15,242	2704	123
Lumpkin	8,525	10,061	1536	78
Rabun	10,713	11,730	1017	172
Towns	6,817	7,941	1124	42
Union	10,737	12,720	1983	229
Walker	19,097	20,425	1328	662
Whitfield	23,385	24,718	1333	698

Source: The Georgia Dept. of Human Resources, Division of Public Health, 2007

3.2.3.2 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewaters. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non-discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing fecal coliform bacteria to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying the wastewater, resulting in surface runoff from the field. If not properly bermed, this runoff, which probably contains fecal coliform bacteria, may discharge to nearby surface waters. There is one permitted LAS system with a flow of 0.1 MGD or greater located in the Tennessee River Basin (Table 8).

Table 8. Permitted Land Application Systems in the Tennessee River Basin

LAS Name	County	Permit No.	Type	Flow (MGD)
National Textiles LLC	Rabun	GA01-429	Industrial	0.15

Source: Permitting Compliance and Enforcement Program, GA EPD, Atlanta, Georgia, 2008

3.2.3.3 Landfills

Leachate from landfills may contain fecal coliform bacteria that may at some point discharge into surface waters. Sanitary (or municipal) landfills are the most likely to serve as a source of fecal coliform bacteria. These types of landfills receive household wastes, animal manure, offal, hatchery and poultry processing plant wastes, dead animals, and other types of wastes. Older sanitary landfills were not lined and most have been closed. Those that remain active and have not been lined operate as construction/demolition landfills. Currently active sanitary landfills are lined and have leachate collection systems. All landfills, excluding inert landfills, are now required to install environmental monitoring systems for groundwater and methane sampling. There are 26 known landfills in the Tennessee River Basin (Table 9). Of these, 1 is an active landfill, 3 are in the process of being closed and 22 are inactive or closed. As shown in Table 9, many of the older, inactive landfills were never permitted.

Table 9. Landfills in the Tennessee River Basin

Name	County	Permit No.	Type	Status
Catoosa Co - SR 151 W Exp.	Catoosa	023-005D(SL)	Sanitary Landfill	Closed
Catoosa Co - SR 151, Site No. 2	Catoosa	023-007D(MSWL)	Municipal Solid Waste Landfill	In-Closure
Catoosa Co - SR 151 - S	Catoosa	023-002D(SL)	Sanitary Landfill	Inactive
Charlie Page	Dade		NA	Inactive
Dada Co - Back Valley Rd.	Dade	041-004D(SL)	Sanitary Landfill	Closed
Dalton - Rocky Face (WS) Ph 2	Whitfield	155-033D(SL)	Sanitary Landfill	Closed
E.R. Anderson	Catoosa		NA	Inactive
Ed Winters	Catoosa		NA	Inactive
Fannin Co - SR 5 Ph 2	Fannin	055-007D(SL)	Sanitary Landfill	Closed
Fannin Co - Barnes Chapel	Fannin		NA	Inactive
Fannin Co - Mercier Apple Rd.	Fannin	055-005D(SL)	Sanitary Landfill	Inactive
Ft. Oglethorpe	Catoosa		NA	Inactive
Mathis Brothers - Chickamauga Rd.	Walker	146-006D(L)	Dry Trash Landfill	Inactive
Mathis Brothers - S. Marbletop Rd.	Walker	146-005D(SL)	Sanitary Landfill	Inactive
Oscar Reardon - Hwy 146	Catoosa		NA	Inactive
Ringgold	Catoosa		NA	Inactive
Rising Fawn	Dade		NA	Inactive
Standard Brands Chemical Ind. Inc.	Walker	146-004D(SL)	Sanitary Landfill	Closed
Steele Brothers - SR 341	Walker	146-011D(L)	Industrial Landfill	In-Closure
Towns Co - SR 288 Ph 1	Towns	139-002D(SL)	Sanitary Landfill	In-Closure
Towns Co - Hwy 288	Towns	139-001D(SL)	Sanitary Landfill	Inactive
Union Co - Haralson Memorial Dr.	Union	144-001D(SL)	Sanitary Landfill	Closed
Walker Co - Marble Top Rd. Areas 1-5	Walker	146-003D(SL)	Sanitary Landfill	Closed
Walker Co - Marble Top Rd. Site 2	Walker	146-015D(MSWL)	Construction and Demolition Landfill	Operating
West Side, Rocky Face, Ph. 2	Whitfield	155-015D(SL)	Sanitary Landfill	Inactive
West Side, Rocky Face, Ph. 2	Whitfield	155-024D(SL)	Sanitary Landfill	Inactive

Source: Land Protection Branch, GA DNR, 2008

4.0 ANALYTICAL APPROACH

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

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

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

4.1 Loading Curve Approach

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

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

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

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

Where:

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

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

The maximum fecal coliform load at which the instream fecal coliform criteria will be met can be determined using a variation of the equation above. By setting C equal to the seasonal,

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

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

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

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

$$\text{TMDL}_{\text{critical}} = C_{\text{standard}} \times Q_{\text{mean}}$$

Where:

$\text{TMDL}_{\text{critical}}$ = critical fecal coliform TMDL load

C_{standard} = seasonal fecal coliform standard (as a 30-day geometric mean)
summer - 200 counts/100 mL
winter - 1,000 counts/ 100 mL

Q_{mean} = stream flow as an arithmetic mean (same as used for L_{critical})

A 30-day geometric mean load that plots above the respective seasonal TMDL curve represents an exceedance of the instream fecal coliform standard. The difference between the current critical load and the TMDL curve represents the load reduction required for the stream segment to meet the appropriate instream fecal coliform standard. There is also a single sample maximum criterion (4,000 counts per 100 milliliters) for the months of November through April. If a single sample exceeds the maximum criterion, and the seasonal geometric mean criteria is also exceeded, then the TMDL is based on the criteria exceedance requiring the largest load reduction. The load reduction can be expressed as follows:

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

5.0 TOTAL MAXIMUM DAILY LOADS

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

A TMDL is expressed as follows:

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

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

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

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

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

5.1 Waste Load Allocations

The waste load allocation is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits. There are no active

NPDES permitted facilities that have flows greater than 0.1 MGD with fecal coliform permit limits in the Tennessee River Basin watershed that discharge into listed segments or have permit violations upstream of a listed segment.

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

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

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

Dry manure poultry CAFOs are located within the Tallapoosa River Basin (see Section 3.1.3). These facilities have applied for an NPDES General Permit. Because these facilities do not discharge wastewater, they were not provided a WLA.

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

5.2 Load Allocations

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

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

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

$$\sum LA = TMDL - (\sum WLA + \sum WLA_{sw} + \sum MOS)$$

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 10 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 Tennessee 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 10 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_0) versus fecal coliform are shown in Appendix B. The plots do not show a consistent relationship between fecal coliform concentrations and flow. The summer and winter plots show that the fecal coliform violations occur during both high (wet weather) and low (dry weather) flow conditions.

5.4 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative modeling assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, an explicit MOS of 10 percent of the TMDL was used. The MOS values are presented in Table 10.

5.5 Total Fecal Coliform Load

The fecal coliform TMDL for the listed stream segment is dependent on the time of year, the stream flow, and the applicable state water quality standard.

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

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

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

$$\text{TMDL}_{\text{winter}} = 4,000 \text{ counts (instantaneous)}/100 \text{ mL} \times Q$$

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 the product of the fecal coliform permitted limit and the average monthly discharge at the time of the critical load. The current critical loads and corresponding TMDLs, WLAs (WLA and WLA_{sw}), LAs, MOSs, and percent load reductions for the Tennessee River Basin listed stream segments are presented in Table 10.

The relationships of the current critical loads to the TMDLs are shown graphically in Appendix A. The vertical distance between the two values represents the load reductions necessary to achieve the TMDLs. If no TMDL or Critical Load is given on the graphs in Appendix A, the TMDL given in Table 10 is based on the instantaneous maximum standard. As a consequence of the localized nature of the load evaluations, the calculated fecal coliform load reductions pertain to point and nonpoint sources occurring within the immediate drainage area of the listed segment. These current critical values represent a worst-case scenario for the limited set of data. Thus, the load reductions required are conservative estimates, and should be sufficient to prevent exceedances of the instream fecal coliform standard for a wide range of conditions.

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

Table 10. Fecal Coliform Loads and Required Fecal Coliform Load Reductions

Stream Segment	Current Load (counts/30 days)	TMDL Components					Percent Reduction
		WLA (counts/30 days) ¹	WLASw (counts/30 days)	LA (counts/30 days)	MOS (counts/30 days)	TMDL (counts/30 days)	
Cooper Creek	9.25E+12			6.64E+12	7.38E+11	7.38E+12	20
Dry Creek	4.89E+12			6.08E+11	6.75E+10	6.75E+11	86
Hiawassee River	3.11E+13			6.11E+12	6.79E+11	6.79E+12	78
Little Chickamauga Creek	1.40E+13		5.78E+09	2.97E+12	3.30E+11	3.30E+12	76
Toccoa River	6.77E+13			3.64E+13	4.04E+12	4.04E+13	40

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

6.0 RECOMMENDATIONS

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

This TMDL represents part of a long-term process to reduce fecal coliform loading to meet water quality standards in the Tennessee 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 Tennessee, Coosa, and Tallapoosa River Basins will again receive focused monitoring in 2011.

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

6.2 Fecal Coliform Management Practices

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

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

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

6.2.1 Point Source Approaches

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

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

6.2.2 Nonpoint Source Approaches

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia is working with local governments, agricultural and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of BMPs to address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality. The following sections describe, in more detail, recommendations to reduce nonpoint source loads of fecal coliform bacteria in Georgia's surface waters.

6.2.2.1 Agricultural Sources

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

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

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

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

The GA EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the State. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses.

The NRCS works with federal, state, and local governments to provide financial and technical assistance to farmers. The NRCS develops standards and specifications for BMPs that are to be used to improve, protect, and/or maintain our state's natural resources. In addition, every five years, the NRCS conducts the National Resources Inventory (NRI). The NRI is a statistically based sample of land use and natural resource conditions and trends that covers non-federal land in the United States.

The NRCS is also providing technical assistance to the GSWCC and the GA EPD with the Georgia River Basin Planning Program. Planning activities associated with this program will describe conditions of the agricultural natural resource base once every five years. It is recommended that the GSWCC and the NRCS continue to encourage BMP implementation, education efforts, and river basin surveys with regard to river basin planning.

6.2.2.2 Urban Sources

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

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

6.4 Public Participation

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

7.0 INITIAL TMDL IMPLEMENTATION PLAN

The GA EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. The GA EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. The 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. The 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. The GA EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major pollutant categories of concern for the respective River Basin as identified in the TMDLs. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the GA EPD Contractor and approved by GA EPD. Other such measures may include those found in EPA's "*Best Management Practices Handbook*," the "*NRCS National Handbook of Conservation Practices*," or any similar reference, or measures that the volunteers, etc., devise that GA EPD approves. If for any reason the GA EPD Contractor does not complete the BMP demonstration project, GA EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan, the GA EPD brochure entitled "*Watershed Wisdom -- Georgia's TMDL Program*" will be distributed by GA EPD to the GA EPD Contractor for use with appropriate stakeholders for this TMDL. Also, a copy of the video of that same title will be provided to the GA EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL implementation plan development.
4. If for any reason the GA EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, GA EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.
5. The deadline for development of a Revised TMDL Implementation Plan is the end of December 2011.
6. The GA EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with GA EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:
 - A. Generally characterize the watershed;
 - B. Identify stakeholders;
 - C. Verify the present problem to the extent feasible and appropriate (e.g., local monitoring);
 - D. Identify probable sources of pollutant(s);
 - E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
 - F. Determine measurable milestones of progress;
 - G. Develop a monitoring plan, taking into account available resources, to measure effectiveness; and
 - H. Complete and submit to GA EPD the Revised TMDL Implementation Plan.
7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.
8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan once GA EPD accepts 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	—	—			—			—	

REFERENCES

- Carter, R.F., 1982. *Storage Requirements for Georgia Streams*, USGS, Water Resources Investigations, Open File Report 82-557.
- Federal Register, 1990. *Federal Register, Part II: Environmental Protection Agency*, Vol. 55, No. 222, November 16, 1990.
- GA EPD, 2006 – 2007. *Water Quality in Georgia, 2006 – 2007* (draft), Georgia Department of Natural Resources, Environmental Protection Division.
- GA EPD, 2001. *Coosa River Basin Management Plan 2001*, State of Georgia, Department of Natural Resources, Environmental Protection Division, Water Protection Branch.
- GA EPD, 2000. *Combined Databases Of Landfills In Georgia; Historic And Current Through 1999*, State of Georgia, Department of Natural Resources, Environmental Protection Division, Land Protection Branch.
- GA EPD, 2008. Personal Communications with Ms. Mindy Crean, State of Georgia, Department of Natural Resources, Environmental Protection Division, Land Protection Branch. February-May 2008.
- GA EPD, 2007. *State of Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6, Revised October 2007*, State of Georgia, Department of Natural Resources, Environmental Protection Division, Water Protection Branch.
- GA WRD, 2007. Personal Communications with Mr. Charlie Killmaster, Region IV Office, Wildlife Resources Division, Georgia Department of Natural Resources, Thomson, GA, February-May 2007.
- USDA, 2008. Personal Communications with Mr. Jimmy Bramblett, Water Resources Specialist, U.S. Department of Agriculture, NRCS, 355 East Hancock Ave., Athens, GA, February 2008.
- USEPA, 1991. *Guidance for Water Quality Based Decisions: The TMDL Process*, EPA 440/4-91-001, U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.

Appendix A

30-day Geometric Mean Fecal Coliform Monitoring Data

2001 Monitoring Water Quality Stations

Stream Segment	Location	USGS Monitoring Station No.	Monitoring Station Description
Cooper Creek	Tributary to Toccoa River (Fannin County)	03557842	Cooper Creek at State Road 60 near Suches, Georgia
Dry Creek	Headwaters to East Chickamauga Creek (Whitfield and Catoosa Counties)	035666419	Dry Creek at Houston Valley Road near Ringgold, Georgia
Hiwassee River	Upstream Lake Chatuge (Towns County)	03545005	Hiwassee River at Streak Hill Road (CR87) near Presley, Georgia
Little Chickamauga Creek	Coulter Creek to S. Chickamauga Creek (Catoosa County)	03566688	Little Chickamauga Creek at Hackett Mill Road near Ringgold, Georgia
Toccoa River	Big Creek to Lake Blue Ridge (Fannin County)	03558000	Toccoa River - Near Dial

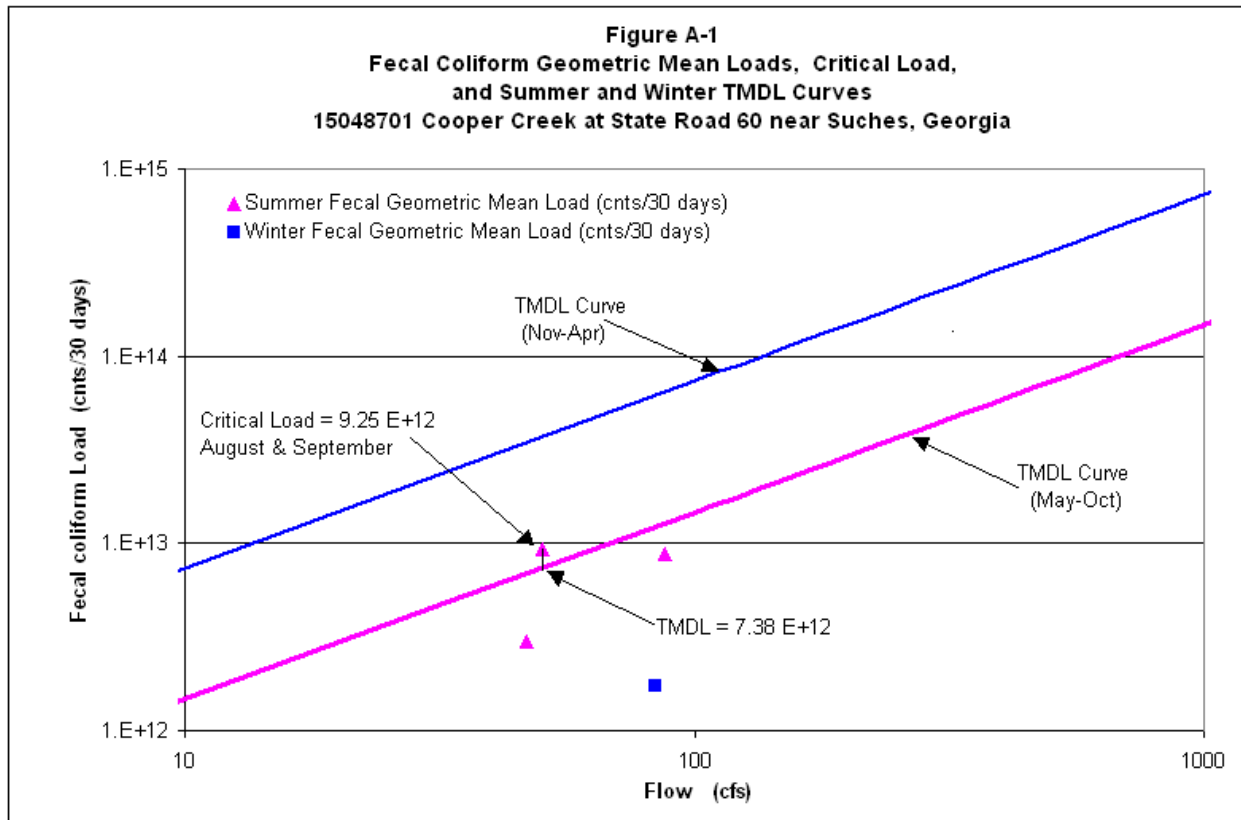


Table A-1. Data for Figure A-1

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
1/16/2001	20	40.0				
1/23/2001	40	79.0				
1/30/2001	40	159.0				
2/6/2001	20	57.0	28.3	83.8	1.74E+12	6.15E+13
5/7/2001	790	124.0				
5/14/2001	50	44.0				
5/21/2001	130	57.0				
6/4/2001	70	124.0	137.7	87.3	8.82E+12	1.28E+13
8/26/2001	790	50.0				
9/10/2001	170	54.0				
9/18/2001	210	47.0				
9/27/2001	140	50.0	250.7	50.3	9.25E+12	7.38E+12
10/2/2001	20	43.0				
10/9/2001	140	43.0				
10/15/2001	490	55.0				
10/23/2001	40	47.0	86.1	47.0	2.97E+12	6.90E+12

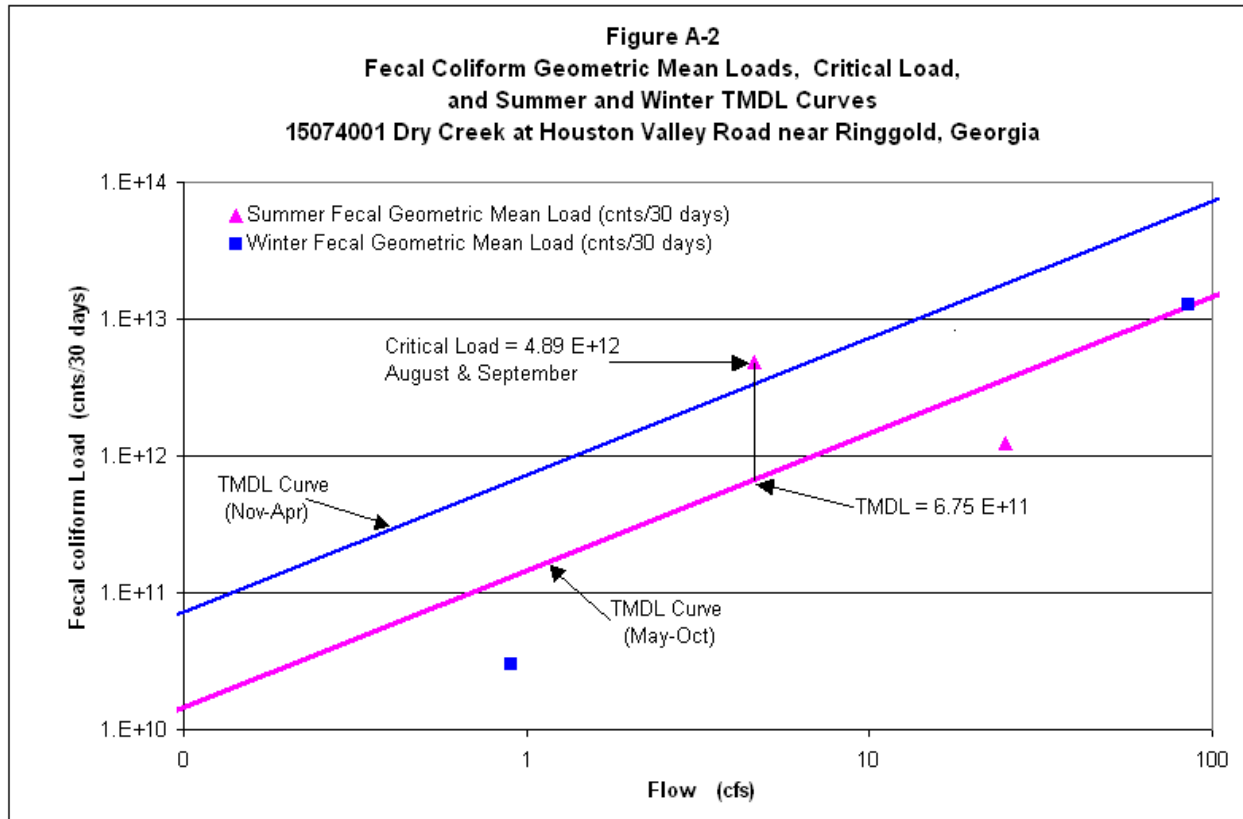


Table A-2. Data for Figure A-2

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
2/22/2001	400	139.0				
2/28/2001	170	38.0				
3/7/2001	20	20.0				
3/15/2001	1300	145.0	205.1	85.5	1.29E+13	6.28E+13
5/15/2001	20	65.0				
5/23/2001	60	20.0				
5/31/2001	130	13.0				
6/13/2001	130	1.9	67.1	25.0	1.23E+12	3.67E+12
8/20/2001	3300	0.6				
8/29/2001	1700	16.0				
9/4/2001	1700	0.9				
9/13/2001	460	0.9	1447.2	4.6	4.89E+12	6.75E+11
11/8/2001	220	0.9				
11/15/2001	20	0.9				
11/27/2001	20	0.9				
12/3/2001	50	0.9	45.8	0.9	3.03E+10	6.61E+11

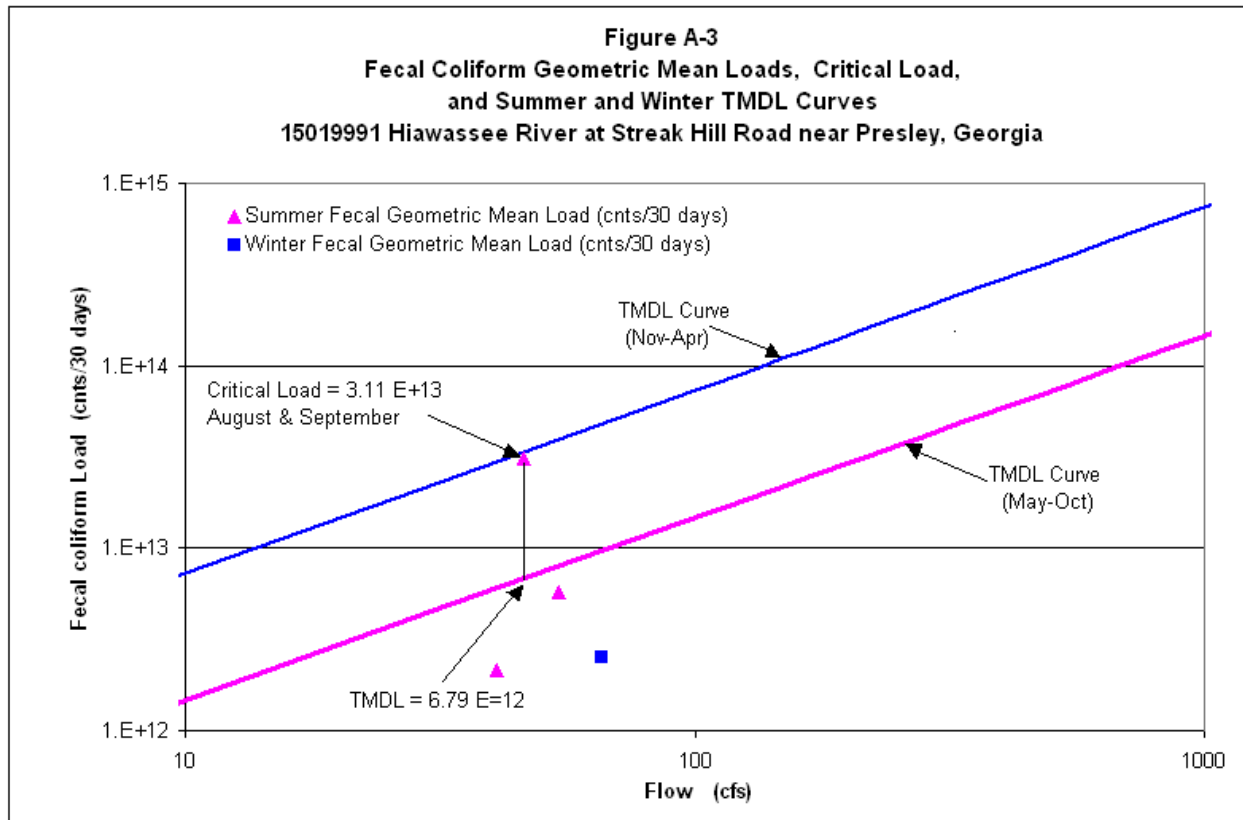


Table A-3. Data for Figure A-3

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
1/18/2001	80	53.0				
1/25/2001	230	80.0				
2/1/2001	20	72.0				
2/8/2001	20	58.0	52.1	65.8	2.51E+12	4.83E+13
5/9/2001	70	58.0				
5/16/2001	220	46.0				
5/23/2001	170	46.0				
6/6/2001	170	66.0	145.2	54.0	5.76E+12	7.93E+12
8/30/2001	1300	37.0				
9/12/2001	490	37.0				
9/20/2001	2400	58.0				
9/26/2001	460	53.0	915.8	46.3	3.11E+13	6.79E+12
10/4/2001	80	32.0				
10/11/2001	310	32.0				
10/18/2001	50	54.0				
10/25/2001	20	46.0	70.6	41.0	2.12E+12	6.02E+12

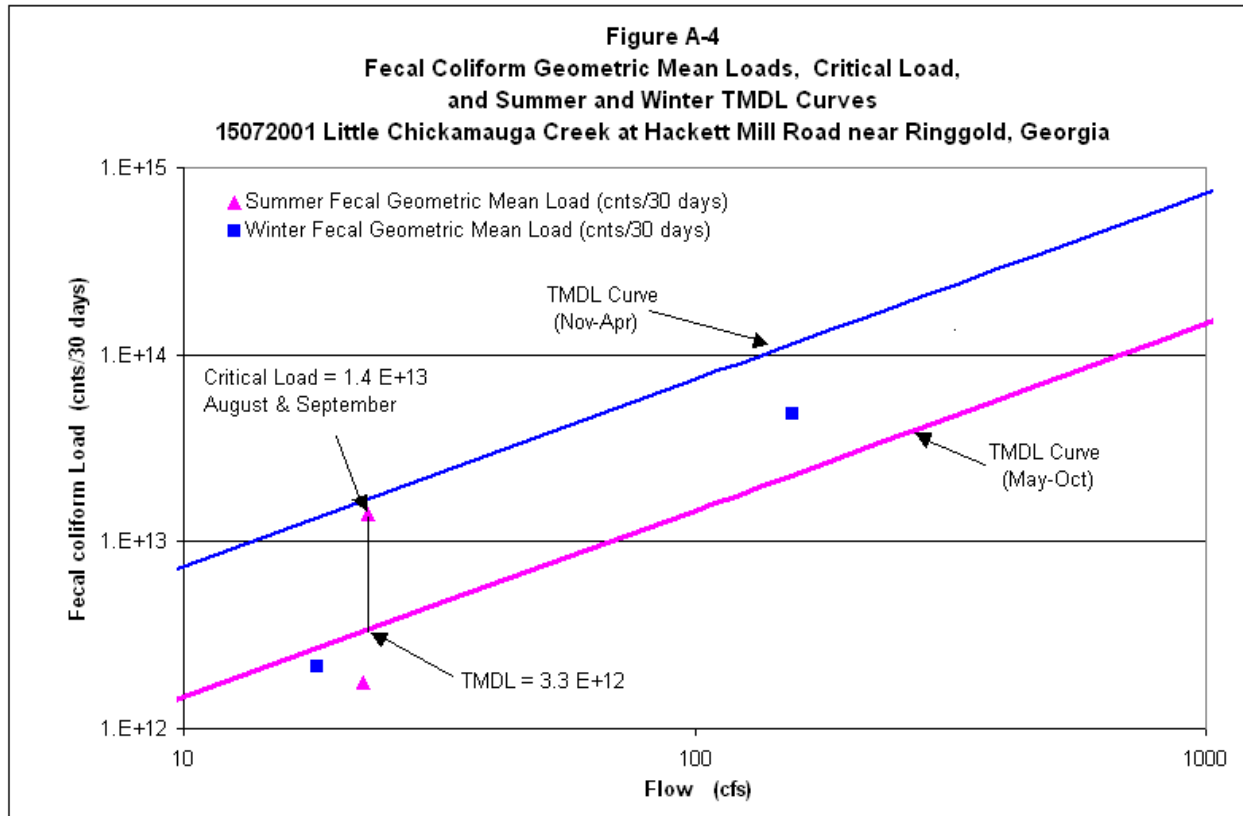


Table A-4. Data for Figure A-4

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
2/22/2001	5400	339.0				
2/28/2001	220	99.0				
3/7/2001	80	49.0				
3/14/2001	330	134.0	420.8	155.3	4.80E+13	1.14E+14
5/15/2001	20	19.0				
5/23/2001	170	20.0				
5/30/2001	210	28.0				
6/13/2001	170	25.0	105.0	23.0	1.77E+12	3.38E+12
8/20/2001	24000	18.0				
8/29/2001	340	19.0				
9/4/2001	700	36.0				
9/12/2001	90	17.0	846.8	22.5	1.40E+13	3.30E+12
11/7/2001	170	19.0				
11/14/2001	20	19.0				
11/27/2001	1100	17.0				
12/3/2001	170	18.0	158.8	18.3	2.13E+12	1.34E+13
2/22/2001	5400	339.0	5400.0	339.0	1.34E+15	9.95E+14

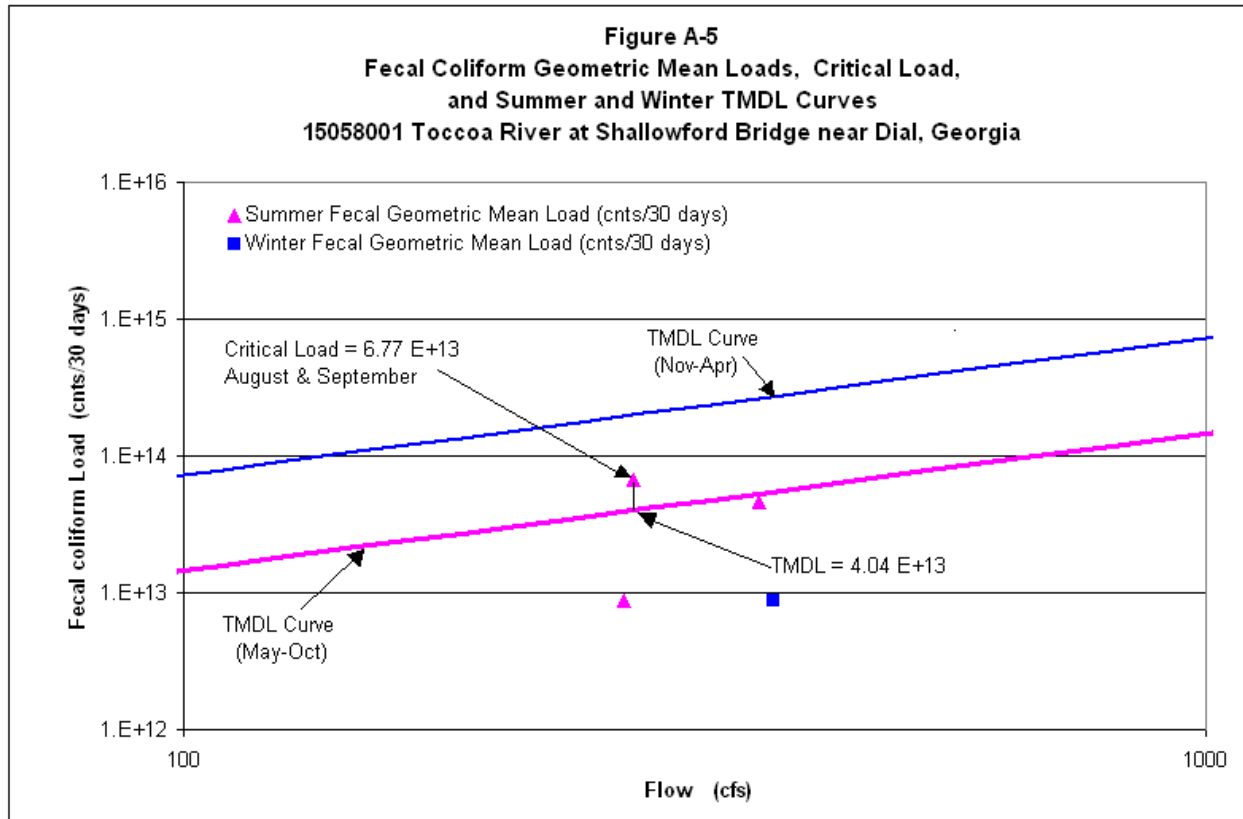


Table A-5. Data for Figure A-5

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
1/16/2001	20	254.0				
1/23/2001	20	406.0				
1/30/2001	130	514.0				
2/6/2001	20	336.0	31.9	377.5	8.85E+12	2.77E+14
5/7/2001	1700	418.0				
5/14/2001	50	275.0				
5/21/2001	20	304.0				
6/4/2001	490	467.0	169.9	366.0	4.56E+13	5.37E+13
8/26/2001	490	291.0				
9/10/2001	330	288.0				
9/18/2001	460	234.0				
9/27/2001	170	288.0	335.3	275.3	6.77E+13	4.04E+13
10/2/2001	20	260.0				
10/9/2001	20	260.0				
10/15/2001	490	320.0				
10/23/2001	20	239.0	44.5	269.8	8.81E+12	3.96E+13

Appendix B

Normalized Flows Versus Fecal Coliform Plots

