EPA FINALIZED TMDL

South Carolina
Department of Health and Environmental Control

Total Maximum Daily Load Development for the Little River Watershed (Hydrological Unit Code: 03050109-160); Stations: S-034, S-038, S-099, S-297, S-305, and S-135 Fecal Coliform Bacteria

September 29, 2004

Bureau of Water

D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

2600 Bull Street
Columbia, SC 29201

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for fecal coliform bacteria in the Little River Basin. Subsequent actions must be consistent with this TMDL.

James D. Giattina, Director   Date
Water Management Division

Abstract

The Little River watershed (11-digit HUC 03050109-160) is located in Laurens and Newberry Counties occupying 230 square miles (Figure 1-1). The watershed drains from north of the City of Laurens toward the southeast and the town of Silverstreet in the Piedmont region of South Carolina. Six water quality-monitoring stations in the watershed have been placed on the South Carolina §303(d) list of impaired waters for violations of the fecal coliform bacteria standard, as shown in Table 1-1. The Little River watershed is composed of mostly forested land (72%) with some pastureland (11%) and cropland (9%). There is one active continuous point source discharging fecal coliform bacteria in the Little River watershed of South Carolina.

The load-duration curve methodology was used to establish allowable fecal coliform loads in the watershed. The existing load was determined using measured data from the impaired water quality monitoring stations. Loads were established from measured concentrations and a power trend line was fit to samples violating the instantaneous standard. The existing load and allowable total maximum daily load for impaired stations is presented in Table I. To achieve the TMDL target, reductions of fecal coliform loads will be necessary, as shown in Table I.

Table I Total Maximum Daily Loads for Impaired Water Quality Stations in the Little River Watershed (03050109)

Station ID	Existing Waste Load Continuous (counts/day)	TMDL WLA Continuous[1] (counts/day)	Existing Load (counts/day)	TMDL LA (counts/day)	MOS (counts/day)	TMDL[2] (counts/day)	Percent Reduction
S-034	NA	NA	7.52E+11	1.84E+11	1.02E+10	1.95E+11	74%
S-038	3.33E+09	3.33E+09	2.74E+12	5.60E+11	3.13E+10	5.95E+11	78%
S-099	3.33E+09	3.33E+09	1.49E+12	6.76E+11	3.78E+10	7.18E+11	52%
S-135	NA	NA	2.99E+10	8.37E+09	4.65E+08	8.83E+09	70%
S-297	3.33E+09	3.33E+09	1.01E+12	2.24E+11	1.26E+10	2.40E+11	76%
S-305	3.33E+09	3.33E+09	1.80E+12	1.04E+12	5.80E+10	1.10E+12	39%

Table Notes:
1. Total monthly wasteload cannot exceed 5E+10 #/30 days.
2. TMDLs expressed as monthly load (#/30 days) by station are listed in Table B-1.

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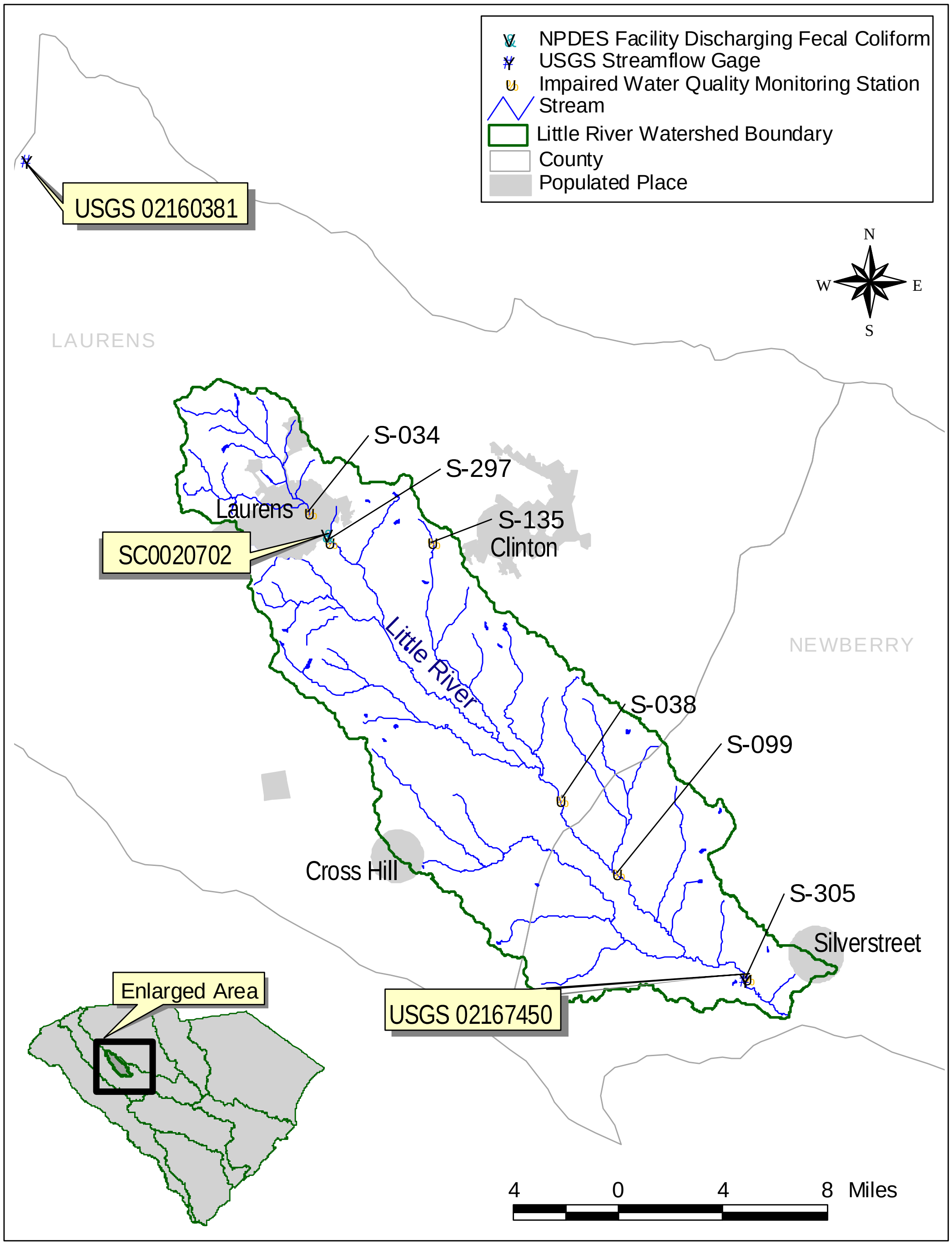

Figure 1-1 Little River Watershed (03050109-160)

1.0 INTRODUCTION

1.1 Background

Levels of fecal coliform bacteria can be elevated in waterbodies as the result of both point and nonpoint sources of pollution. Section §303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for waterbodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and instream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA, 1991).

The State of South Carolina has placed six monitoring stations in the Little River watershed (11-digit HUC 03050109-160) on South Carolina's 2002 Section §303(d) list for impairment due to fecal coliform bacteria. These stations are identified in Table 1-1.

Table 1-1 Water Quality Monitoring Stations Impaired by Fecal Coliform in the Little River Watershed (03050109-160)

Waterbody Name	Waterbody ID	Waterbody Location
Little River	S-034	Little River at US 76 Business Route, in Laurens above the STP
Little River	S-038	Little River at SC 560
Little River	S-099	Little River at S-36-22 8.3 miles Northwest of Silverstreet, SC
Little River	S-297	Little River at SC ROUTE 127
Little River	S-305	Little River at SC 34
North Creek	S-135	North Creek at Junction with US 76 2.8 miles West of Clinton, SC

1.2 Watershed Description

The Little River watershed (11-digit HUC 03050109-160) (Figure 1-1) is located in the Saluda River basin. The 230 square mile watershed occupies the Piedmont region in Laurens and Newberry Counties from the City of Laurens south to Silverstreet. The Little River watershed consists primary of the Little River and its tributaries with a total of 190 stream miles.

Based on 1996 USGS Multi-Resolution Land Characteristic (MRLC) land use data, 72 percent of the watershed is forested. The remaining 28 percent is composed of pastureland (11%), cropland (9%), and a mix of urban area, water and barren land uses (8%). Urban areas in the watershed are concentrated in the upper watershed between the Cities of Laurens and Clinton. Downstream of state highway SC-560 and of impaired water quality monitoring station S-038, a larger percentage of the land is either barren or in transition.

Table 1-2 presents the percentage of total watershed area for each aggregated land use. The percentage of land use area in each monitoring station drainage area is presented in Appendix A (Table A-1). The actual areas in square miles are presented in Table A-2. Figure 1-2 illustrates land use activities in the basin.

Table 1-2 MRLC Aggregated Land Use for the Little River Watershed (03050109)

Aggregated Land Use	Percent of Total Area
Urban	3.2%
Barren	4.4%
Row Crops	9.2%
Pasture	11.4%
Forest	71.6%
Water	0.2%

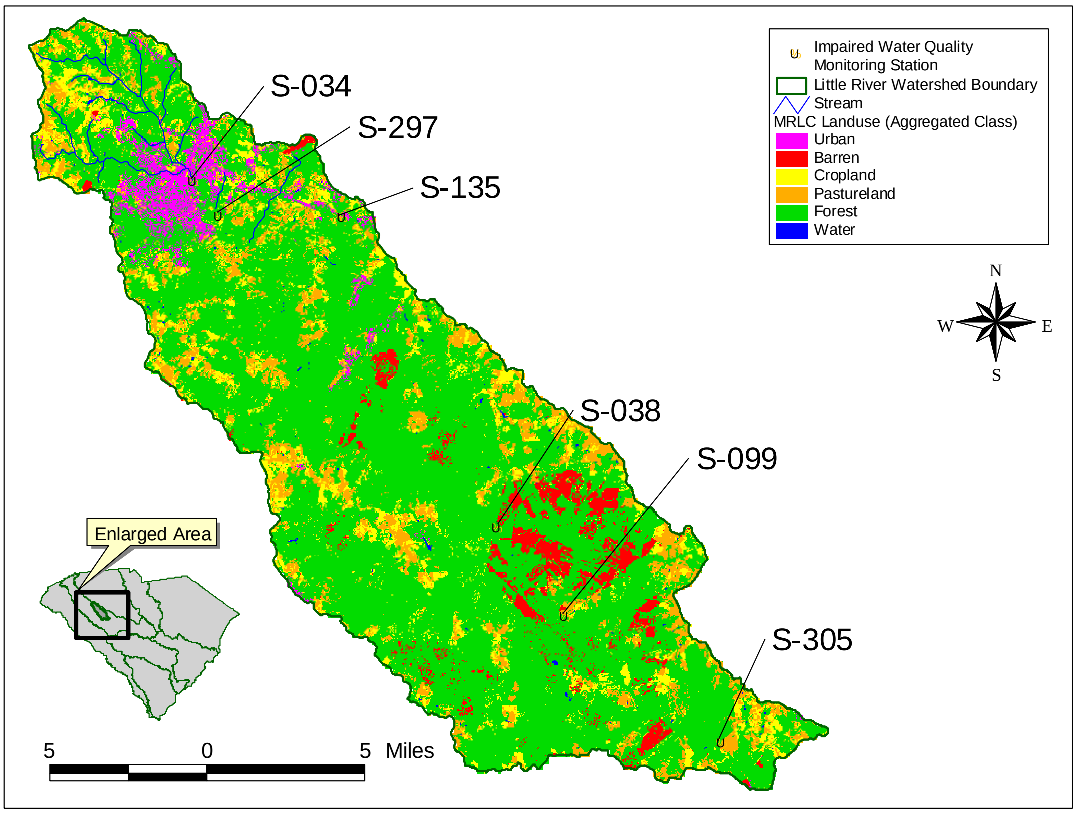

Figure 1-2 Little River Watershed Land Use

1.3 Water Quality Standard

The impaired stream segments of the Little River watershed are designated as Class Freshwater. Waters of this class are described as:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

South Carolina's standard for fecal coliform bacteria in freshwater is:

> "Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30 day period; nor shall more than 10 percent of the total samples during any 30 day period exceed 400/100 mL." (R.61-68).

2.0 WATER QUALITY ASSESSMENT

Fecal coliform bacteria data collected in the Little River watershed from 1996 through 2000 were assessed to determine impairment of standards for recreational use. The State of South Carolina monitors fecal coliform bacteria at six stations in the watershed. Figure 1-1 shows the location of water quality monitoring stations in the watershed.

Six water quality monitoring stations in the basin have been identified on the State of South Carolina's Section §303(d) list for 2002 as impaired (Table 1-1). Table 2-1 presents the statistical information supporting the listing of impaired water quality monitoring sites in the watershed. Waters in which no more than 10 percent of the samples collected over the five-year period are greater than 400 fecal coliform counts per 100 mL are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 counts per 100 mL are considered impaired and were listed for fecal coliform bacteria on the State of South Carolina's Section §303(d) list. The fecal coliform bacteria data collected since 1990 at impaired water quality monitoring stations are presented in Appendix A (Table A-2).

Table 2-1 Statistical Assessment of Observed Fecal Coliform Bacteria Collected from 1996 through 2000

Station	Total Number of Samples	Total Number of Samples >400 #/100 mL	Percent of Samples >400 #/100 mL
S-034	59	34	58%
S-038	15	3	20%
S-099	30	5	17%
S-135	29	20	69%
S-297	28	14	50%
S-305	12	3	25%

The timeframe, both annually and seasonally, of water quality monitoring at each station varies greatly. The statistical assessment presented in Table 2-1 was based on data collected over the five-year period from 1996 through 2000.

After determining compliance with water quality standards, observed violations were assessed to determine conditions critical to impairment. Data were compared with estimated streamflows to establish a relationship between instream concentrations and hydrologic conditions. Due to limited streamflow data in the watershed, observed data were plotted with the load-duration curves generated based on area-weighted flows. The development of load-duration curves is discussed further in Section 4.0 of this report. Load-duration curves plotted for each station in Figures B-1 through B-5, and in Figure 2-1 (for S-034) are equal to the TMDL target based on the criteria for instantaneous events. The observed fecal coliform bacteria data were also converted from counts per 100 mL to loads in counts per day to assess hydrologic conditions when the standard is not attained.

The percent of flow exceeded in Figure 2-1 and Figures B-1 through B-5 represent flow conditions at each monitoring station. Hydrologic conditions for very dry events, likely to be exceeded in 99.99 percent of measured events, are represented as 99.99 percent. Extremely wet events that occur rarely are represented as 0.01 percent. Data collected at all impaired stations in the basin have violations during all flow conditions, except S-038. Water quality monitoring station S-038 has violations during above average flow events but not during either high or low flow extreme events. Violations during various flow events, including extreme events, suggest both overland, instream, and continuous sources, such as groundwater, of fecal coliform bacteria. Violations occurring within the range of the 10 to 60 percent of flow exceeded, as in S-038, suggest that overland flow contributions are the most likely source of fecal coliform bacteria.

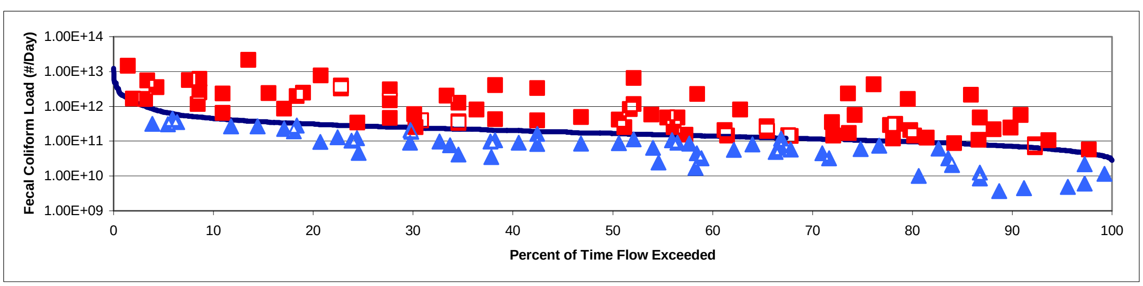

Figure 2-1 Fecal Coliform Bacteria Load-Duration Curve for Station S-034 Illustrating Observed Fecal Coliform Bacteria Loads Over Various Hydrologic Conditions

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria enter surface waters of the Little River watershed from both point and nonpoint sources. Point sources are facilities that discharge at a specific location through pipes, outfalls, and/or conveyance channels. All point sources must have a National Pollutant Discharge Elimination System (NPDES) permit and are often municipal wastewater treatment plants or industrial waste treatment facilities. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters. Some nonpoint sources are related to land use activities that accumulate fecal coliform bacteria on the land surface (i.e. pastureland) and runoff during storm events.

3.1 Point Sources

There is one active continuous point source discharging fecal coliform bacteria in the Little River watershed, SC0020702 the Laurens Sewage Treatment Plant (STP). In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL).

The Laurens STP (SC0020702) actively discharges to the Little River south of Laurens, as shown in Figure 1-1. The facility has a specified allowable flow limit of 0.22 MGD (million gallons per day). Table 3-1 lists permit information pertinent to fecal coliform bacteria TMDL development.

Table 3-1 Permitted Facilities Actively Discharging Fecal Coliform Bacteria into the Little River Watershed

Facility Name	NPDES No.	Flow Limits * (MGD)	Receiving Stream
Laurens STP	SC0020702	0.22	Little River

* Note: Flow limits are either permit limits or design limits.

Table 3-2 Impaired Water Quality Monitoring Stations Draining NPDES Facilities in the Little River Watershed

SC0020702
S-038
S-099
S-297
S-305

The TMDLs presented in this report were developed using permitted flow and permitted concentrations for fecal coliform bacteria. Limited information was available to determine the survival rate of fecal coliform bacteria discharging from permitted facilities to establish the impact downstream. Therefore, for the purpose of fecal coliform bacteria TMDL development in the Little River watershed, the wasteload for SC0020702 is cumulative for a given drainage area. The estimated existing load and the permitted geometric mean concentration of 200 counts per 100 mL and instantaneous concentration of 400 counts per 100 mL are listed in Table 3-3.

Sewage collection systems typically are placed adjacent to waterways. At these locations, there is a potential for collection system leaks which could result in elevated instream concentrations of fecal coliform bacteria. Sanitary sewer overflows (SSOs) are also a potential source, particularly after periods of intense rainfall. This source is associated with infrequent events, limited in duration and likely to have an insignificant long-term impact instream. Identified collection system and/or SSO problems are addressed by SCDHEC through compliance and enforcement mechanisms. Streams and monitoring sites that have significant collection systems present (based on a GIS analysis) are listed in Table 3-4.

Table 3-3 Estimated Existing Fecal Coliform Bacteria Load for the Laurens STP in the Little River Watershed

NPDES Facility	Flow (MGD)	Existing Loading (counts/days)	Existing Loading (counts/30days)
SC0020702	0.22	3.33E+09	5.00E+10

Table 3-4 Waterbodies and impaired sites with the presence of collection systems.

Waterbody	Impaired Stations
Little River	S-034, S-297
North Creek	S-135

3.2 Nonpoint Sources

The land use distribution of the Little River watershed provides insight into determining nonpoint sources of fecal coliform bacteria (Figure 1-2). In the watershed, 72 percent of the land area is classified forested land, 11 percent is pastureland, and 9 percent of the area is cropland. Key nonpoint sources identified in the watershed include livestock, manure application, failing septic systems, illicit discharges (including leaking and overflowing sewers), over land contributions from impervious surfaces, and natural sources.

3.2.1 Wildlife

Fecal coliform bacteria are found in forested areas, pastureland, and cropland due to the presence of wild animal sources such as deer, raccoons, wild turkeys and waterfowl. The Department of Natural Resources in South Carolina estimates the deer habitat in the basin at a density of more than 45 deer per square mile (SC Deer Density 2000 map). Deer habitat was assumed to include forests, cropland, and pastures. Wildlife waste is transported over land surfaces during rainfall events or may be directly deposited by animals into streams. The high percentage of permeable surfaces in forested areas increases the infiltration rate over the watershed area. This process ultimately reduces the runoff reaching streams by overland flow and reduces the significance of fecal coliform contributions transported over land.

3.2.2 Agricultural Activities and Grazing Animals

Agricultural land can be a source of fecal coliform bacteria. Runoff from grazing pastures, improper land application of animal wastes, livestock operations, and livestock with access to waterbodies are all agricultural sources of fecal coliform bacteria. Agricultural best management practices (BMPs) such as buffer strips, alternative watering sources, limiting livestock access to streams, and the proper land application of animal wastes reduce fecal coliform bacteria loading to waterbodies.

The number of grazing animals in the watershed, shown in Table 3-5, was estimated by area-weighting the 1997 USDA census data over the watershed area aggregated to pastureland for Laurens and Newberry Counties. Livestock, except for dairy cattle, are not usually confined and are typically grazing in pastures where deposited manure is a source of nonpoint pollution. The time that cattle spend in streams is assumed to be 0.15 percent of their total gazing time. Hogs are usually confined. However the number of permitted animals is smaller than indicated by the agricultural census (Table A-4 Appendix A). Horses and ponies are expected to spend the majority of spring, summer, and fall months grazing in pastureland where manure is a source of nonpoint pollution. SC DHEC also permits in the Little River watershed a number of animal feeding operations, which include in addition to swine and dairy cattle, broilers, layers, and turkeys (Table A-4 in Appendix A). The facilities that are in the watershed are permitted to have at any time about 1.7 million birds. Several facilities are outside of the watershed but have one or more fields within the watershed. While not all of the litter produced by these birds is applied to land in this watershed, there are 167 fields permitted for application of litter.

Table 3-5 1997 USDA Agricultural Census Data Animal Estimates

Animal	1997 Census Estimate
Beef Cow	4055
Dairy Cow	943
Hog	1077
Sheep	27
Horses and Ponies	232

3.2.3 Failing Septic Systems and Illicit Discharges

Failing septic systems and illegal discharges represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface, subsurface malfunctions or direct discharges. Based on 1990 census information, population change from 1990 to 2000, and assuming an average of 2.5 people per household (U.S. Census, 2000), some 9,500 people in the Little River watershed use septic systems. Though the precise failure rate is unknown, Schueler (1999) suggests an average septic failure rate of 20 percent. Many of these areas are also on sewer systems that may leak and/or overflow during rain events contributing significant loads of fecal coliform bacteria directly to streams.

3.2.4 Urban and Impervious Runoff

Runoff from urban areas may be a significant source of fecal coliform bacteria in the Little River watershed. Water quality data collected from streams draining the city of Laurens and the developed area within the watershed near Clinton show existing instream loads of fecal coliform bacteria violating the State's instantaneous standards in greater than 50 percent of samples. Best management practices such as buffer strips and the proper disposal of domestic animal wastes reduce fecal coliform bacteria loading to these water bodies.

4.0 TECHNICAL APPROACH – LOAD-DURATION METHOD

Load-duration curves were developed for impaired water quality monitoring stations in the Little River watershed to establish allowable fecal coliform bacteria loads under various hydrologic conditions. The load-duration methodology uses the cumulative frequency distribution of streamflow and pollutant concentration (fecal coliform bacteria) data to estimate the allowable loads for a waterbody. Allowable load-duration curves were established in the basin using the instantaneous concentration of fecal coliform bacteria, minus a five percent margin of safety (MOS), and streamflow measured at various USGS stations in the Little River watershed and surrounding watersheds, as shown in Figure 1-1 and listed in Table 4-1.

Table 4-1 USGS Stations Used to Establish Area-Weighted Flows

Site Number	Site Name	From	To	Drainage Area (mile^2)
02160381	Durbin Creek above Fountain Inn, SC	1994-07-06	1999-09-30	14.5
02160700	Enoree River at Whitmire, SC	1973-10-01	2001-09-30	444
02167450	Little River near Silverstreet, SC	1990-03-30	2001-09-30	223.8

Streamflow data was not available at each impaired water quality monitoring station to develop load-duration curves. Therefore, flows were determined by area-weighted data collected at USGS stations listed in Table 4-1. Data collected at these stations through 2001 were used to develop loading curves. For USGS station 02160381, Durbin Creek above Fountain Inn, South Carolina, where data were not collected from 1990 through 1994 and 1999 through 2001, the program MOVE.1 was used to interpolate streamflow by comparing overlapping records with USGS station 02160700, Enoree River at Whitmire, South Carolina. Statistical analysis from matched stations and technical clarification of the MOVE.1 methods can be found in Appendix D.

Watershed characteristics (including the distribution of land use activities, ecoregions, and topography) for the USGS stations and impaired water quality monitoring sites were compared to associate stations to develop load-duration curves. Ideally streamflow available in the watershed would be used to establish loads for TMDLs but for some stations in the Little River watershed that was not appropriate and an USGS gage outside the watershed was used. The selection of USGS station 02160381 for use in the development of load-duration curves for S-034, S-135, and S-297 was made based on several factors. USGS 02160381 is located on Durbin Creek above Fountain in the Enoree River basin and drains a 14.5 square mile area. The small drainage area, distribution of landuse activates, and ecoregion made USGS 02160381 the most appropriate streamflow station to use in developing load-duration curves the stations listed above. Table 4-2 lists the impaired water quality monitoring stations and associated streamflow stations used to develop area-weighted flow relationships. The location of both USGS and water quality monitoring stations are identified in Figure 1-1.

Table 4-2 USGS Stations and Associated Water Quality Stations

Monitoring Station ID	Station
S-034	USGS 02160381
S-038	USGS 02167450
S-099	USGS 02167450
S-135	USGS 02160381
S-297	USGS 02160381
S-305	USGS 02167450

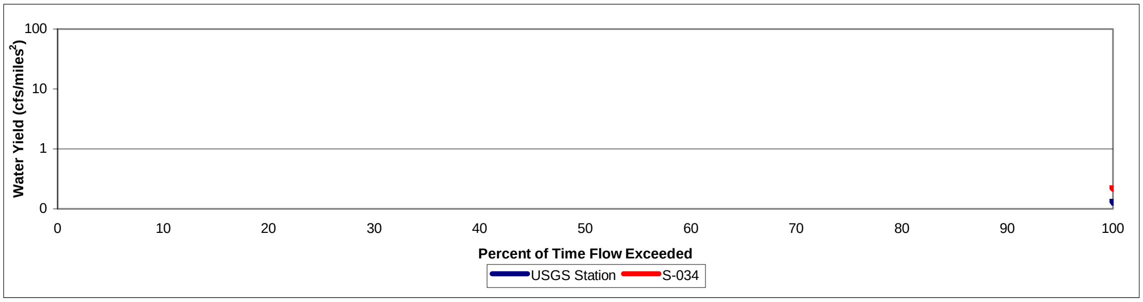

Figure 4-1 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS station 02160381

After calculating streamflow for each impaired monitoring station the data were ranked to determine the percent of time streamflow was exceeded. The streamflow was then multiplied by a concentration of 380 counts/100 mL (based on the instantaneous concentration and a five percent MOS) to generate a load-duration curve for each impaired station, shown in Figures B-6 through B-7 of Appendix B. The result of the load-duration curve is the TMDL target.

To define the TMDL for each station, an average of the load-duration curve was calculated. The average was calculated using loads at five percent intervals from the 10th percentile of flow exceeded to the 90th percentile of flow exceeded. Loads occurring at less than the 10th percentile of flow exceeded are extreme high flow events and the data collected at greater than the 90th percentile of flow exceeded are extreme low flow events and therefore were not considered in developing theses TMDLs. Loads established at intervals and the mean load for each station can be found in Appendix B, Table B-1.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and waterbody is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the equation:

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

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls. For some pollutants, TMDLs are expressed on a mass-loading basis (e.g., pounds per day). For bacteria, however, TMDLs can be expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

Critical conditions for fecal coliform bacteria in the Little River watershed occur at various flow regimes. The load-duration curve methodology used to establish TMDLs in the watershed considers various hydrologic conditions critical in maintaining water quality standards.

5.2 Existing Load

The existing load for each impaired station was established using observed fecal coliform bacteria data and area-weighted streamflow. The measured data occurring at less than the 10th percentile of flow exceeded is an extreme high flow event and the data collected at greater than the 90th percentile of flow exceeded is an extreme low flow event and therefore not considered as critical conditions for these TMDLs.

The data violating the instantaneous concentration were isolated and a best-fit trendline was fit to violating data. The power trendline was determined using a best-fit relationship that was most representative of the violating data. The equation representing the trendline was then used to calculate the average violating load that occurred between the 10th and 90th percentiles, at every fifth percentile. This average load is equal to the existing instream fecal coliform bacteria load at the associated station. The existing nonpoint source load is equal to the existing instream load minus the wasteload from point sources.

Figure 5-1 presents the power best-fit trendline for station S-034, the impaired station on Little River at US-76 Business Route, in Laurens above the STP. Interval loads calculated for existing instream conditions are presented in Table B-2. Power trendlines are presented in Figures B-1 through B-5 of Appendix B. Existing nonpoint loads calculated for each station are listed in Table 5-1.

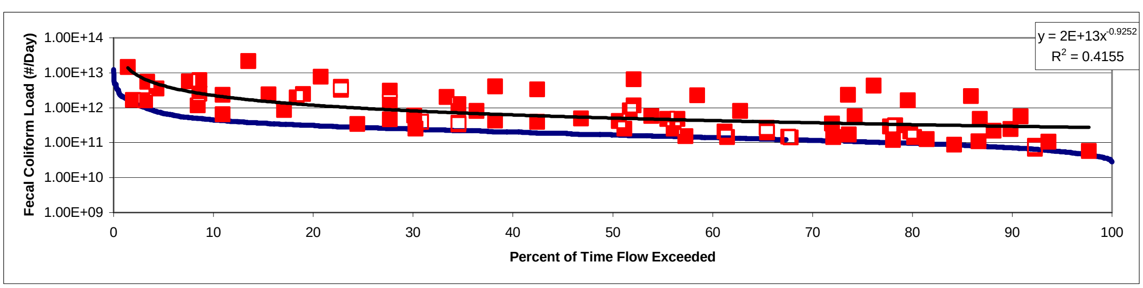

Figure 5-1 Power Trendline Generated from Violating Fecal Coliform Bacteria at S-034

Table 5-1 Existing Loads for Impaired Water Quality Stations in the Little River Watershed (03050109-160)

Station ID	Existing Load (counts/day)
S-034	7.52E+11
S-038	2.74E+12
S-099	1.49E+12
S-135	2.99E+10
S-297	1.01E+12
S-305	1.80E+12

5.3 Existing Wasteload

The existing wasteload was calculated for the NPDES permitted continuous discharge. The facility is assumed to discharge at a permitted flow of 0.22 MGD and permitted limits of fecal coliform bacteria equal to the State criteria for both instantaneous and geometric mean loads. In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State's criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL). Under these permitted concentrations facilities should not be in exceedance of the fecal coliform bacteria water quality criteria, and therefore, not considered to be a major contributing source. If facilities are discharging at greater than permitted concentrations this is an illicit discharge and regulated through the NPDES program. Allowable TMDL wasteloads for impaired stations, as shown in Table 5-2, are equal to load calculated for the facility, if it is within the station's drainage area.

Table 5-2 Wasteloads from the NPDES Continuous Discharge to Impaired Water Quality Stations in the Little River Watershed (03050109-160)

Station ID	Existing Waste Load Continuous (counts/day)
S-038	3.33E+09
S-099	3.33E+09
S-297	3.33E+09
S-305	3.33E+09

5.4 Margin of Safety

There are two methods for incorporating a margin of safety (MOS) in the analysis: a) by implicitly incorporating the MOS using conservative assumptions to develop allocations; or b) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations. For the Little River watershed TMDLs, both methods were applied to incorporate a MOS. An implicit MOS was incorporated through the use of conservative assumptions in developing the TMDL, such as the use of the design or permitted flow for NPDES facilities and the use of a trendline to establish a total instream load. A five percent explicit MOS was reserved from the water quality criteria in developing the load-duration curves. Specifically, the water quality target was set at 190 counts per 100 mL for the geometric mean 30-day period and 380 counts per 100 mL for the instantaneous criterion, which is five percent lower than the water quality criteria of 200 and 400 counts per 100 mL, respectively.

5.5 Total Maximum Daily Load

The TMDL represents the maximum fecal coliform bacteria load the stream may carry and still meet water quality standards. The TMDL is presented in fecal coliform counts to be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria. Table 5-3 defines the fecal coliform bacteria total maximum daily load for protection of water quality standards for impaired stations in the Little River watershed.

Table 5-3 Total Maximum Daily Loads for Impaired Water Quality Stations in the Little River Watershed (03050109-160)

Station ID	Existing Waste Load Continuous (counts/day)	TMDL WLA Continuous[1] (counts/day)	Existing Load (counts/day)	TMDL LA (counts/day)	MOS (counts/day)	TMDL[2] (counts/day)	Percent Reduction
S-034	NA	NA	7.52E+11	1.84E+11	1.02E+10	1.95E+11	74%
S-038	3.33E+09	3.33E+09	2.74E+12	5.60E+11	3.13E+10	5.95E+11	78%
S-099	3.33E+09	3.33E+09	1.49E+12	6.76E+11	3.78E+10	7.18E+11	52%
S-135	NA	NA	2.99E+10	8.37E+09	4.65E+08	8.83E+09	70%
S-297	3.33E+09	3.33E+09	1.01E+12	2.24E+11	1.26E+10	2.40E+11	76%
S-305	3.33E+09	3.33E+09	1.80E+12	1.04E+12	5.80E+10	1.10E+12	39%

Table Notes:

1. Total monthly wasteload cannot exceed 5E+10 #/30 days.
2. TMDLs expressed as monthly load (#/30 days) by station are listed in Table B-1.

6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Little River watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Laurens and Newberry Counties Soil and Water Conservation Services, and the South Carolina Department of Natural Resources. Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. NRCS can provide cost share money to land owners installing BMPs.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions which threaten the quality of waters of the state.
In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Little River and North Creek. TMDL implementation projects are given highest priority for 319 funding.

In addition to the resources cited above for the implementation of this TMDL in the Little River watershed, Clemson Extension has developed a Home-A-Syst handbook that can help urban or rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in the Little River watershed in order to bring about the necessary reductions in fecal coliform bacteria loading to Little River and North Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

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APPENDIX A Data

Table A-1 Percent of Watershed Area Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations in the Little River Watershed

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren
S-034	0.4%	11.7%	16.3%	14.6%	56.4%	0.5%
S-038	0.2%	6.0%	9.9%	11.5%	70.9%	1.5%
S-099	0.2%	5.0%	9.3%	11.6%	69.3%	4.6%
S-135	0.3%	14.4%	26.9%	15.7%	42.6%	0.1%
S-297	0.4%	15.8%	15.6%	12.9%	54.9%	0.4%
S-305/USGS 02167450	0.2%	3.3%	8.9%	11.2%	71.9%	4.4%
USGS 02160381	0.1%	14.4%	17.2%	16.7%	51.5%	0.1%

Table A-2 Watershed Area in Square Miles Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations in the Little River Watershed

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren	Total
S-034	0.1	2.9	4.0	3.6	14	0.1	25
S-038	0.3	7.2	12	14	86	1.8	121
S-099	0.4	7.2	14	17	101	6.7	146
S-135	0.0	0.2	0.3	0.2	0.5	0.0	1.1
S-297	0.1	4.8	4.7	3.9	17	0.1	30
S-305/USGS 02167450	0.5	7.4	20	25	161	10	224
USGS 02160381	0.0	2.1	2.5	2.4	7.5	0.0	15

Table A-3 Fecal Coliform Data Collected between 1990 and 2001 at Water Quality Monitoring Stations in the Little River Watershed

S-034	
Date	Value
1/2/1990	230
2/15/1990	220
3/15/1990	470
4/19/1990	1400
5/1/1990	490
6/4/1990	410
7/5/1990	1300
8/1/1990	680
9/4/1990	6500
10/2/1990	480
11/1/1990	130
12/3/1990	1200
1/3/1991	180
2/6/1991	320
3/1/1991	400
4/5/1991	2300
5/2/1991	330
6/5/1991	160
7/18/1991	1400
8/7/1991	2300
9/19/1991	960
10/21/1991	90
11/15/1991	110
12/4/1991	590
1/10/1992	470
2/6/1992	150
3/3/1992	140
4/7/1992	170
5/26/1992	160
6/4/1992	230
7/10/1992	40
8/4/1992	25
9/2/1992	8300
10/5/1992	1700
11/5/1992	900
12/4/1992	170
1/26/1993	180
2/26/1993	280
3/25/1993	3200
4/20/1993	2600
5/26/1993	3400
6/15/1993	2000
7/14/1993	1100
8/3/1993	390

S-034	
Date	Value
9/9/1993	19
10/6/1993	35
11/5/1993	1200
12/9/1993	45
1/19/1994	120
2/1/1994	290
3/9/1994	64
4/21/1994	65
5/27/1994	1200
6/21/1994	120
7/6/1994	580
8/2/1994	87
9/6/1994	7600
10/12/1994	9800
11/9/1994	640
12/7/1994	2200
1/26/1995	5300
2/28/1995	22000
3/17/1995	4400
4/13/1995	800
5/3/1995	190
6/26/1995	2300
7/28/1995	3100
8/9/1995	820
9/7/1995	600
10/12/1995	180
11/7/1995	2200
12/8/1995	270
1/11/1996	630
2/6/1996	250
3/21/1996	580
4/30/1996	4200
5/10/1996	630
6/25/1996	1100
7/24/1996	2800
8/13/1996	2000
9/10/1996	520
10/8/1996	6700
11/25/1996	16000
12/4/1996	16000
1/10/1997	4800
2/3/1997	4700
3/7/1997	2100
4/10/1997	170

S-034	
Date	Value
5/16/1997	370
6/26/1997	1200
7/8/1997	600
8/19/1997	640
9/4/1997	500
10/20/1997	440
11/13/1997	1000
1/15/98	600
3/5/98	260
4/23/98	140
5/7/98	270
6/30/98	390
7/20/98	6000
8/5/98	520
9/1/98	390
10/29/98	160
11/23/98	240
1/11/1999	330
2/16/1999	200
3/18/1999	71
4/15/1999	800
5/20/1999	150
6/14/1999	140
7/7/1999	700
8/12/1999	120
9/9/1999	580
10/12/1999	470
11/2/1999	2000
12/14/1999	800
1/19/2000	220
2/17/2000	170
3/15/2000	60
4/18/2000	140
5/2/2000	200
6/22/2000	570
7/31/2000	*Present >QL
8/28/2000	480
9/6/2000	450
10/23/2000	50
11/1/2000	180
12/27/2000	260

Table A-3 (Continued)

S-034	
Date	Value
1/24/2001	270
2/21/2001	210
3/15/2001	3000
4/5/2001	*Present <QL
6/11/2001	280
9/25/2001	940
10/10/2001	60
11/5/2001	40
12/18/2001	2300

S-038	
Date	Value
5/26/1992	210
6/4/1992	560
7/10/1992	250
8/4/1992	240
9/2/1992	280
10/5/1992	9200
12/4/1996	590
2/3/1997	150
3/7/1997	260
4/10/1997	100
5/16/1997	150
6/30/1997	230
7/9/1997	200
8/19/1997	350
9/4/1997	280
10/2/1997	190
11/13/1997	600
01/15/98	170
02/19/98	390
4/25/2000	*Present >QL
1/16/2001	83
2/14/2001	140
3/6/2001	220
4/2/2001	130
5/2/2001	280
6/5/2001	140
6/5/2001	140
7/9/2001	230
7/9/2001	230
8/23/2001	130
9/12/2001	190
10/16/2001	160
11/15/2001	180
12/10/2001	80

Table A-3 (Continued)

S-099	
Date	Value
5/10/1990	2600
6/18/1990	150
7/27/1990	120
8/24/1990	4900
9/14/1990	510
10/4/1990	520
5/16/1991	420
6/26/1991	180
7/19/1991	640
8/23/1991	350
9/19/1991	190
10/3/1991	450
5/7/1992	420
6/4/1992	480
7/21/1992	230
8/6/1992	100
9/24/1992	1500
10/22/1992	70
6/22/1993	160
7/27/1993	190
8/17/1993	110
9/8/1993	220
10/20/1993	250
5/17/1994	150
6/29/1994	3600
7/12/1994	180
8/9/1994	180
9/26/1994	400
10/18/1994	320
5/5/1995	250
6/26/1995	450
7/18/1995	500
8/10/1995	230
9/26/1995	240
10/10/1995	410
5/23/1996	110
6/12/1996	470
7/18/1996	230
8/12/1996	700
9/23/1996	280

S-099	
Date	Value
10/15/1996	250
5/14/1997	230
6/17/1997	530
7/9/1997	180
8/20/1997	310
9/16/1997	260
10/15/1997	320
05/20/98	170
06/02/98	570
07/08/98	150
08/05/98	190
09/01/98	300
10/29/98	91
5/4/1999	80
6/9/1999	190
7/19/1999	210
8/19/1999	130
9/16/1999	230
10/4/1999	2200
5/1/2000	120
6/27/2000	220
7/11/2000	100
8/2/2000	40
9/6/2000	130
10/18/2000	100
1/16/2001	160
2/14/2001	130
3/6/2001	220
4/2/2001	100
5/2/2001	110
6/5/2001	170
6/5/2001	170
7/9/2001	170
7/9/2001	170
8/23/2001	270
9/12/2001	130
10/16/2001	99
11/27/2001	270
12/10/2001	65

Table A-3 (Continued)

S-135	
Date	Value
5/1/1990	270
6/4/1990	740
7/5/1990	360
8/1/1990	540
9/4/1990	3600
10/2/1990	380
5/2/1991	75
6/5/1991	2200
7/18/1991	340
8/7/1991	1100
9/19/1991	2100
10/21/1991	310
5/26/1992	210
6/4/1992	310
7/10/1992	3500
8/4/1992	1200
9/2/1992	2400
10/5/1992	1500
5/26/1993	730
6/15/1993	39
7/14/1993	980
8/3/1993	1100
9/9/1993	190
10/6/1993	380
5/27/1994	290
6/21/1994	360
7/6/1994	420
8/2/1994	130
9/6/1994	790
10/12/1994	900
5/3/1995	180
6/26/1995	620
7/28/1995	790
8/9/1995	1400
9/7/1995	1000
10/12/1995	250
5/10/1996	900
6/25/1996	950

S-135	
Date	Value
7/24/1996	860
9/10/1996	420
10/8/1996	800
5/16/1997	150
6/26/1997	350
7/8/1997	500
8/19/1997	1000
9/4/1997	51000
10/20/1997	160
05/07/98	170
06/30/98	180
07/20/98	340
08/05/98	450
09/01/98	2300
10/29/98	350
5/20/1999	430
6/14/1999	150
7/7/1999	820
8/12/1999	1500
9/9/1999	3700
10/12/1999	1500
5/2/2000	530
6/22/2000	940
7/31/2000	*Present >QL
8/28/2000	870
9/6/2000	350
10/23/2000	2300
1/24/2001	1800
2/23/2001	1100
3/15/2001	2400
4/5/2001	*Present <QL
6/11/2001	200
7/11/2001	360
8/23/2001	500
9/25/2001	1900
10/10/2001	1500
11/5/2001	820
12/18/2001	12000

Table A-3 (Continued)

S-297	
Date	Value
7/5/1990	5000
8/1/1990	1300
9/4/1990	5400
10/2/1990	1200
5/2/1991	760
6/5/1991	24000
7/18/1991	23000
8/7/1991	2400
9/19/1991	420
10/21/1991	160
5/26/1992	100
6/4/1992	360
7/10/1992	210
8/4/1992	75
9/2/1992	360
10/5/1992	3500
5/26/1993	1000
6/15/1993	2500
7/14/1993	310
8/3/1993	15000
9/9/1993	280
10/6/1993	160
5/27/1994	700
6/21/1994	140
7/6/1994	1100
8/2/1994	80
9/6/1994	5600
10/12/1994	2100
5/3/1995	240
6/27/1995	1800
7/28/1995	1100
8/9/1995	740
9/7/1995	440
10/12/1995	220
5/10/1996	160
6/25/1996	680
7/24/1996	1300

S-297	
Date	Value
8/13/1996	1600
9/10/1996	440
10/8/1996	8100
5/16/1997	540
6/26/1997	380
7/8/1997	220
8/19/1997	310
9/4/1997	520
10/20/1997	520
06/30/98	270
07/20/98	10000
08/05/98	280
09/01/98	180
10/29/98	81
5/20/1999	100
6/14/1999	270
7/7/1999	490
8/12/1999	45
9/9/1999	160
10/12/1999	480
5/2/2000	70
6/22/2000	950
7/31/2000	4200
8/28/2000	590
10/23/2000	310
1/24/2001	180
2/21/2001	250
3/15/2001	7600
4/5/2001	100
6/11/2001	700
7/11/2001	200
8/23/2001	370
9/25/2001	1100
10/10/2001	600
11/5/2001	130
12/18/2001	1700

Table A-3 (Continued)

S-305	
Date	Value
5/7/1992	580
6/4/1992	490
7/21/1992	300
8/6/1992	380
9/24/1992	1700
10/22/1992	110
11/14/1996	180
12/4/1996	700
1/6/1997	430
2/25/1997	210
3/17/1997	230
4/2/1997	130
5/14/1997	170
6/18/1997	480
7/8/1997	190
8/20/1997	370
9/17/1997	300
10/15/1997	390
1/10/2001	140
2/20/2001	140
3/27/2001	100
4/16/2001	91
5/22/2001	100
6/5/2001	250
6/5/2001	250
7/9/2001	130
7/9/2001	130
8/23/2001	100
9/17/2001	240
10/17/2001	120
11/15/2001	86
12/10/2001	74

Table A-4 Currently DHEC permitted animal feeding operations in the Little River watershed.

Permit #	Type of Livestock	Animal Counts	# of Fields
ND0003387	Broilers	65000	0
ND0006246	Dairy	275	0
ND0006491	Layers	220000*	2
ND0008681	Broilers	61000	0
ND0014214	Dairy	400*	1
ND0014991	Swine	300	3
ND0015105	Dairy	200	0
ND0015750	Dairy	400	0
ND0016683	Broilers	115000*	1
ND0064173	Layers	896000	19
ND0073156	Dairy	40	0
ND0077909	Broilers	121000	0
ND0078981	Broilers	16000	11
ND0079502	Turkey	16000	7
ND0079511	Broilers	16000	10
ND0079685	Broilers	16000	10
ND0079707	Broilers	60000	12
ND0081469	Broilers	92000*	5
ND0081663	Broilers	93000*	14
ND0081825	Broilers	93000	20
ND0081914	Broilers	168000	21
ND0082465	Broilers	56000	0
ND0082473	Broilers	114800	0

Note: * Animal buildings not in Little River watershed.

APPENDIX B Calculations

Table B-1 TMDL Loads

Station	S-034	Station	S-038	Station	S-099
Instantaneous Conc. (#/100 ml)	**380**	**Instantaneous Conc. (#/100 ml)**	**380**	**Instantaneous Conc. (#/100 ml)**	**380**
Geo. Mean Conc. (#/100 ml)	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**

Mean	1.95E+11	**Mean**	5.95E+11	**Mean**	7.18E+11
Allowable Load (#/day)	1.95E+11	**Allowable Load (#/day)**	5.95E+11	**Allowable Load (#/day)**	7.18E+11
Geometric Mean Load (#/30days)	2.92E+12	**Geometric Mean Load (#/30days)**	8.93E+12	**Geometric Mean Load (#/30days)**	1.08E+13

Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)
10	4.45E+11	10	1.67E+12	10	2.02E+12
15	3.61E+11	15	1.22E+12	15	1.48E+12
20	3.13E+11	20	1.01E+12	20	1.22E+12
25	2.67E+11	25	8.69E+11	25	1.05E+12
30	2.44E+11	30	7.58E+11	30	9.14E+11
35	2.20E+11	35	6.68E+11	35	8.05E+11
40	2.04E+11	40	5.92E+11	40	7.14E+11
45	1.86E+11	45	5.32E+11	45	6.42E+11
50	1.68E+11	50	4.77E+11	50	5.75E+11
55	1.54E+11	55	4.27E+11	55	5.15E+11
60	1.41E+11	60	3.82E+11	60	4.60E+11
65	1.27E+11	65	3.41E+11	65	4.12E+11
70	1.16E+11	70	3.01E+11	70	3.63E+11
75	1.06E+11	75	2.66E+11	75	3.21E+11
80	9.59E+10	80	2.36E+11	80	2.85E+11
85	8.49E+10	85	1.96E+11	85	2.36E+11
90	7.11E+10	90	1.61E+11	90	1.94E+11

Table B-1 (Continued)

Station	S-135	Station	S-297	Station	S-305
Instantaneous Conc. (#/100 ml)	**380**	**Instantaneous Conc. (#/100 ml)**	**380**	**Instantaneous Conc. (#/100 ml)**	**380**
Geo. Mean Conc. (#/100 ml)	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**	**Geo. Mean Conc. (#/100 ml)**	**190**

Mean	8.83E+09	**Mean**	2.40E+11	**Mean**	1.10E+12
Allowable Load (#/day)	8.83E+09	**Allowable Load (#/day)**	2.40E+11	**Allowable Load (#/day)**	1.10E+12
Geometric Mean Load (#/30days)	1.33E+11	**Geometric Mean Load (#/30days)**	3.60E+12	**Geometric Mean Load (#/30days)**	1.65E+13

Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)	Percent Exceedance (%)	Load(#/Day)
10	2.02E+10	10	5.49E+11	10	3.10E+12
15	1.64E+10	15	4.46E+11	15	2.27E+12
20	1.42E+10	20	3.86E+11	20	1.88E+12
25	1.21E+10	25	3.29E+11	25	1.61E+12
30	1.11E+10	30	3.01E+11	30	1.40E+12
35	9.99E+09	35	2.71E+11	35	1.24E+12
40	9.28E+09	40	2.52E+11	40	1.10E+12
45	8.45E+09	45	2.30E+11	45	9.85E+11
50	7.64E+09	50	2.08E+11	50	8.83E+11
55	6.99E+09	55	1.90E+11	55	7.90E+11
60	6.41E+09	60	1.74E+11	60	7.07E+11
65	5.78E+09	65	1.57E+11	65	6.32E+11
70	5.28E+09	70	1.43E+11	70	5.58E+11
75	4.83E+09	75	1.31E+11	75	4.93E+11
80	4.35E+09	80	1.18E+11	80	4.37E+11
85	3.85E+09	85	1.05E+11	85	3.63E+11
90	3.23E+09	90	8.77E+10	90	2.97E+11

Table B-2 Existing Loads

Station	S-034
Trend Line:	Power
Equation: y=2E+13*x^(-0.9252)	

Existing Load (#/Day):	7.52E+11
Average (#/Day):	7.52E+11

Percent Exceedance(%)	Load(#/Day)
10	2.38E+12
15	1.63E+12
20	1.25E+12
25	1.02E+12
30	8.60E+11
35	7.46E+11
40	6.59E+11
45	5.91E+11
50	5.36E+11
55	4.91E+11
60	4.53E+11
65	4.20E+11
70	3.93E+11
75	3.68E+11
80	3.47E+11
85	3.28E+11
90	3.11E+11

Station	S-038
Trend Line:	Power
Equation: y=8E+12*x^(-0.2907)	

Existing Load (#/Day):	2.74E+12
Average (#/Day):	2.74E+12

Percent Exceedance(%)	Load(#/Day)
10	4.10E+12
15	3.64E+12
20	3.35E+12
25	3.14E+12
30	2.98E+12
35	2.85E+12
40	2.74E+12
45	2.65E+12
50	2.57E+12
55	2.50E+12
60	2.43E+12
65	2.38E+12
70	2.33E+12
75	2.28E+12
80	2.24E+12
85	2.20E+12
90	2.16E+12

Station	S-099
Trend Line:	Power
Equation: y=2E+14*x^(-1.4307)	

Existing Load (#/Day):	1.49E+12
Average (#/Day):	1.49E+12

Percent Exceedance(%)	Load(#/Day)
10	7.42E+12
15	4.15E+12
20	2.75E+12
25	2.00E+12
30	1.54E+12
35	1.24E+12
40	1.02E+12
45	8.63E+11
50	7.42E+11
55	6.47E+11
60	5.72E+11
65	5.10E+11
70	4.58E+11
75	4.15E+11
80	3.79E+11
85	3.47E+11
90	3.20E+11

Table B-2 (Continued)

Station	S-135
Trend Line:	Power
Equation: y=6E+11*x^(-0.8405)	

Existing Load (#/Day):	2.99E+10
Average (#/Day):	2.99E+10

Percent Exceedance(%)	Load(#/Day)
10	8.66E+10
15	6.16E+10
20	4.84E+10
25	4.01E+10
30	3.44E+10
35	3.02E+10
40	2.70E+10
45	2.45E+10
50	2.24E+10
55	2.07E+10
60	1.92E+10
65	1.80E+10
70	1.69E+10
75	1.59E+10
80	1.51E+10
85	1.43E+10
90	1.37E+10

Station	S-297
Trend Line:	Power
Equation: y=2E+13*x^(-0.8367)	

Existing Load (#/Day):	1.01E+12
Average (#/Day):	1.01E+12

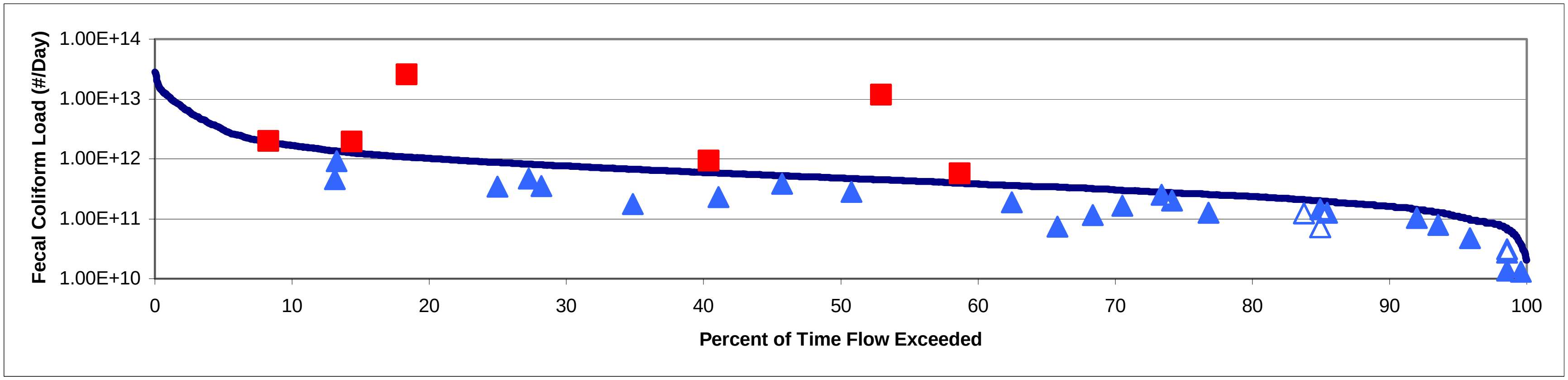
Percent Exceedance(%)	Load(#/Day)
10	2.91E+12
15	2.07E+12
20	1.63E+12
25	1.35E+12
30	1.16E+12
35	1.02E+12
40	9.13E+11
45	8.28E+11
50	7.58E+11
55	7.00E+11
60	6.51E+11
65	6.08E+11
70	5.72E+11
75	5.40E+11
80	5.11E+11
85	4.86E+11
90	4.63E+11

Station	S-305
Trend Line:	Power
Equation: y=4E+13*x^(-0.8718)	

Existing Load (#/Day):	1.80E+12
Average (#/Day):	1.80E+12

Percent Exceedance(%)	Load(#/Day)
10	5.37E+12
15	3.77E+12
20	2.94E+12
25	2.42E+12
30	2.06E+12
35	1.80E+12
40	1.60E+12
45	1.45E+12
50	1.32E+12
55	1.22E+12
60	1.13E+12
65	1.05E+12
70	9.85E+11
75	9.28E+11
80	8.77E+11
85	8.32E+11
90	7.91E+11

Figure B-1 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-038



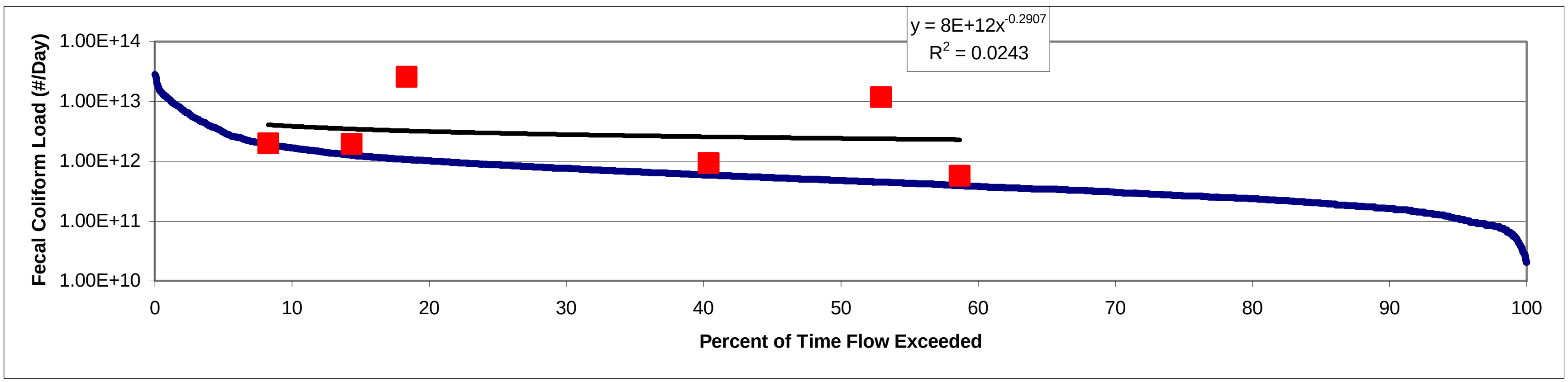
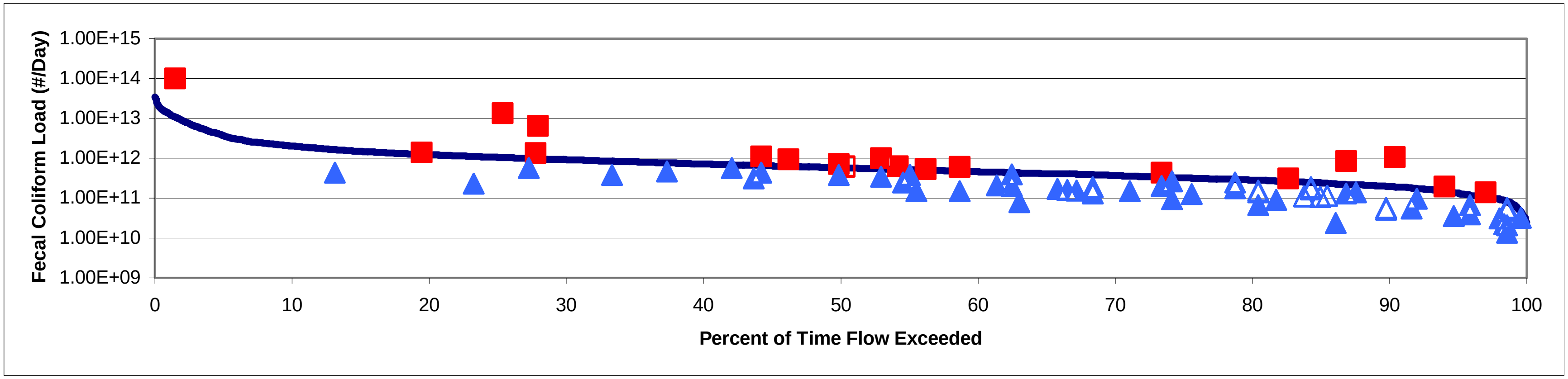


Figure B-2 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-099



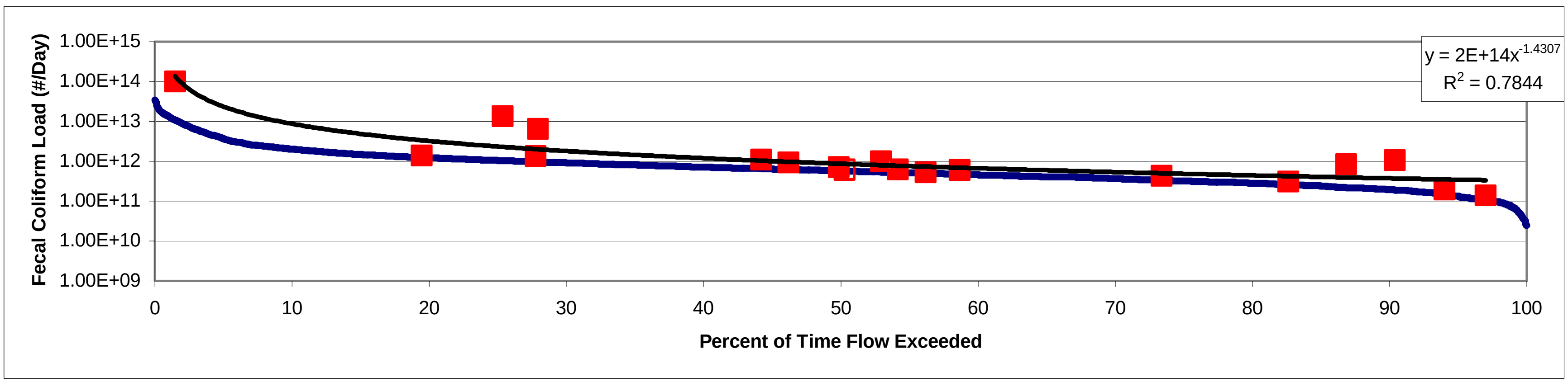
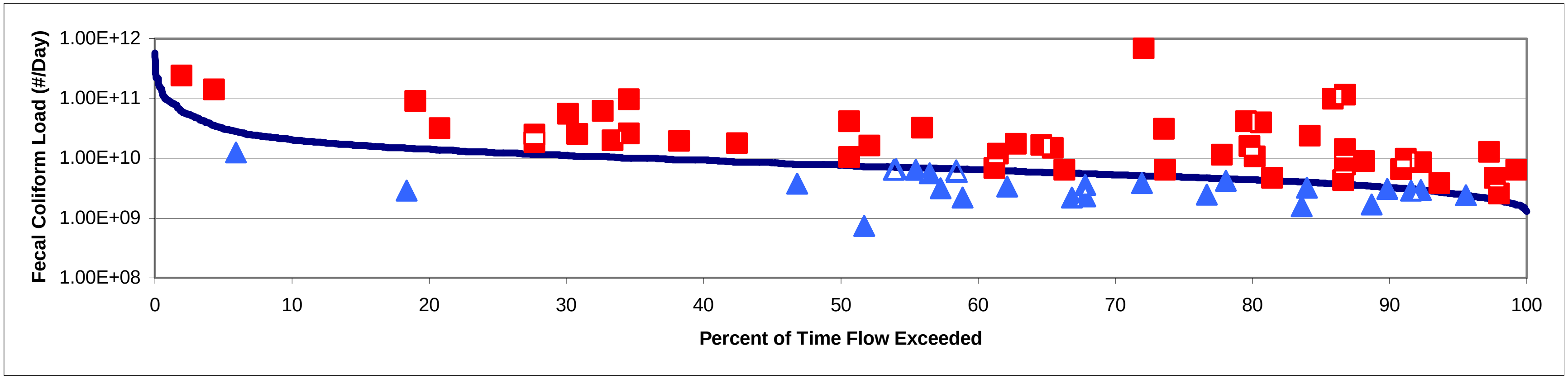


Figure B-3 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-135



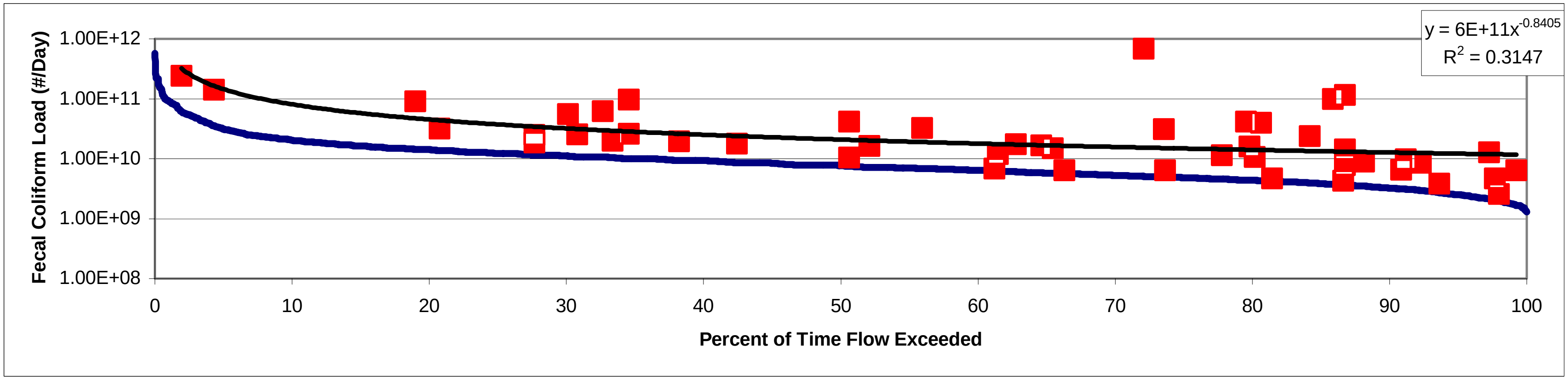
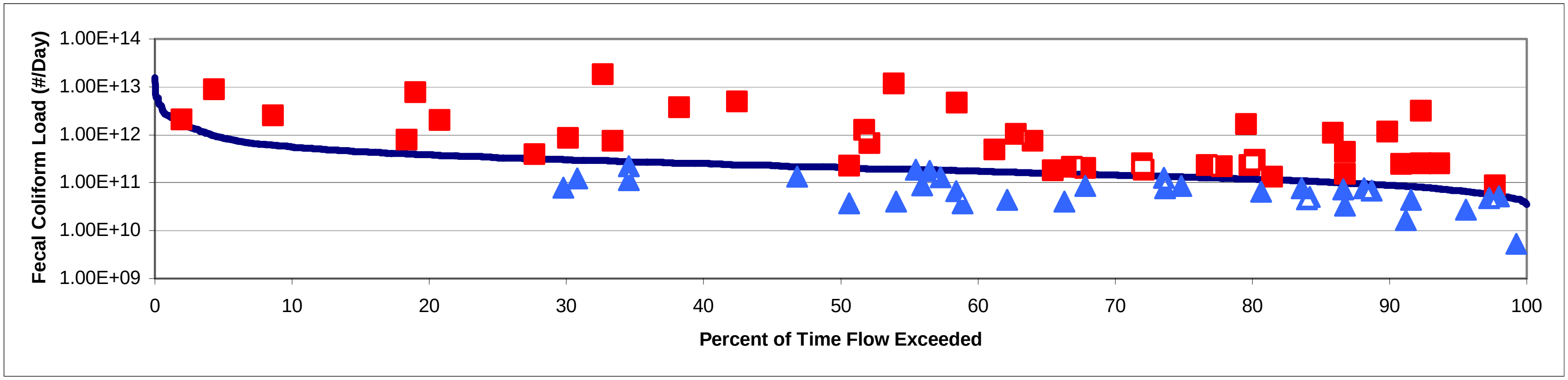


Figure B-4 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-297



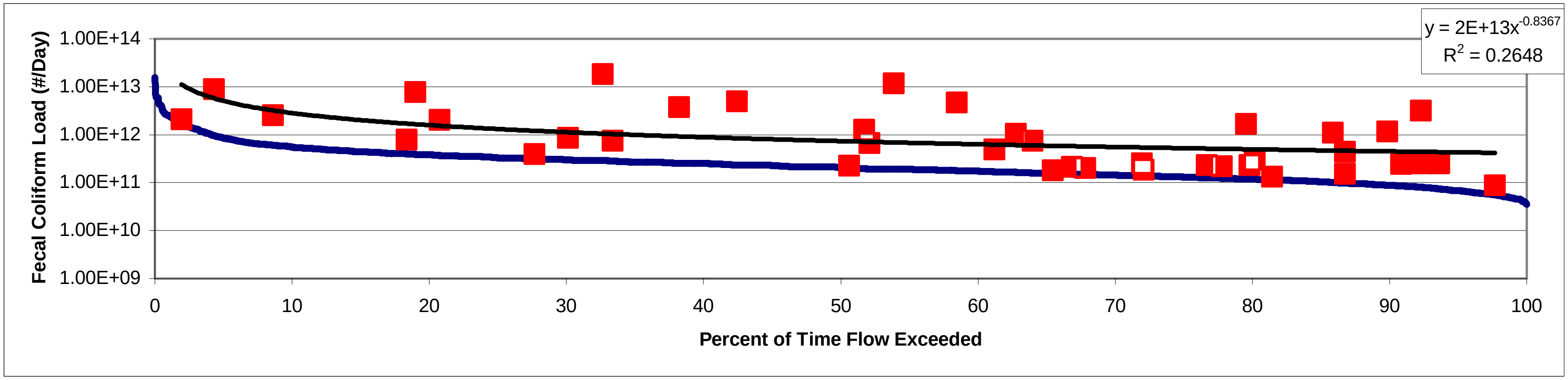
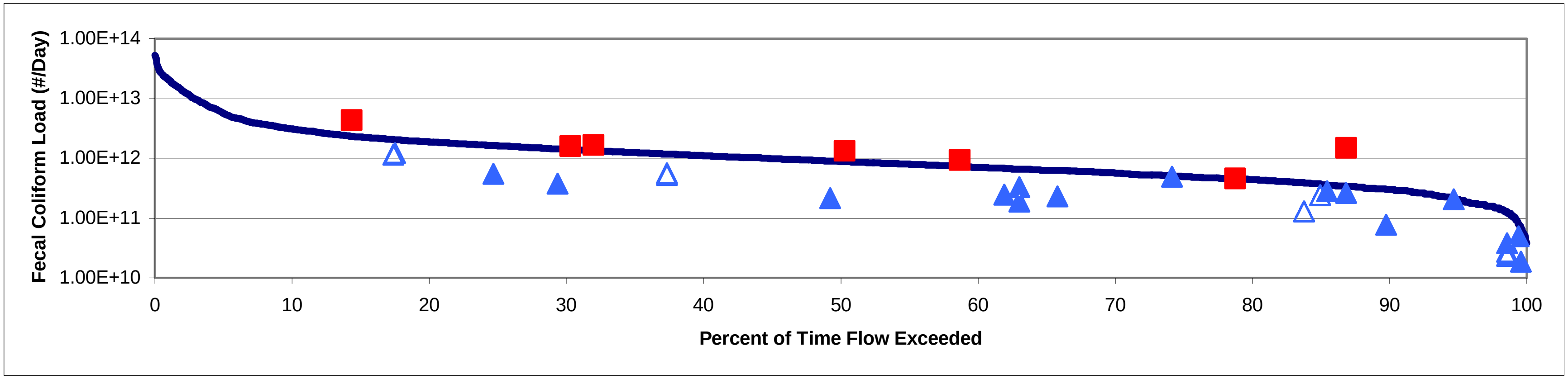


Figure B-5 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at S-305



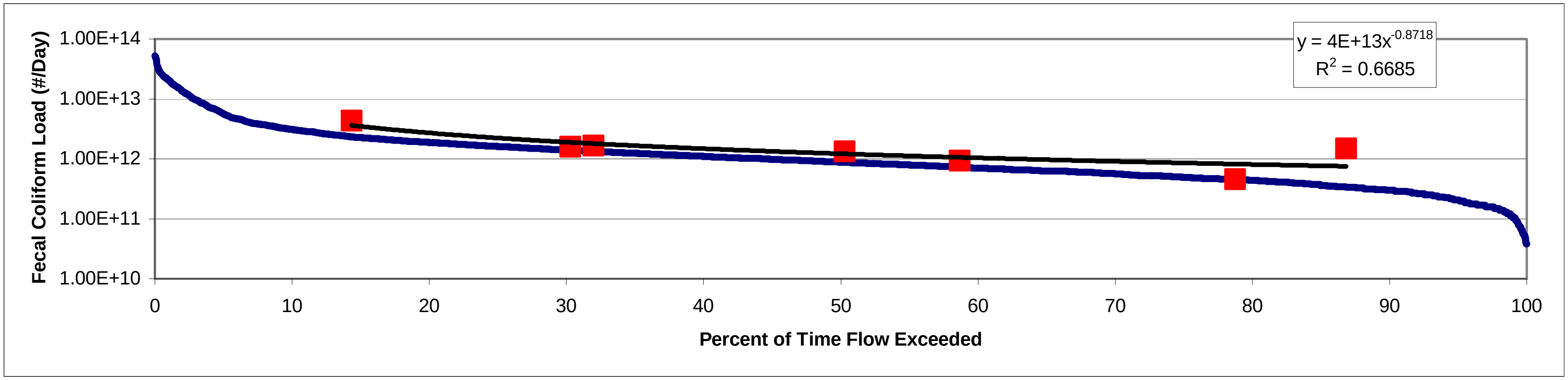
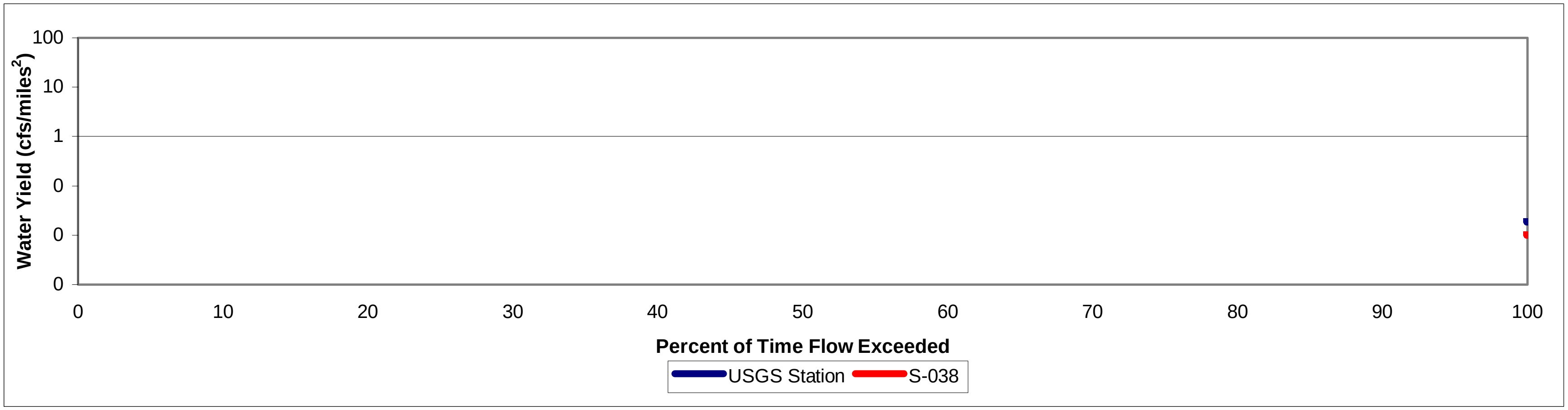


Figure B-6 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS Station 02167450



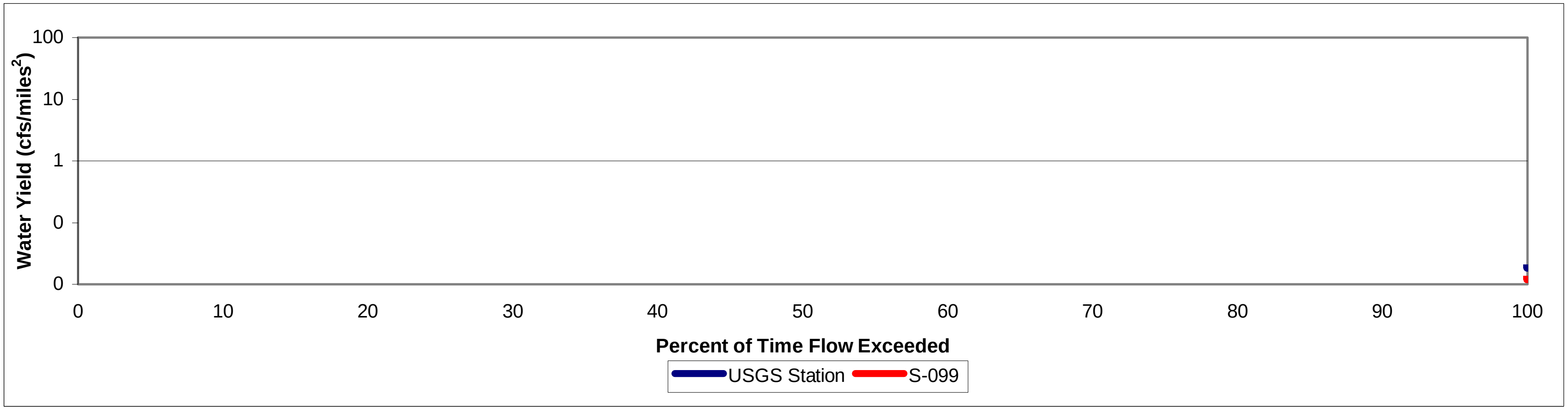


Figure B-6 Continued

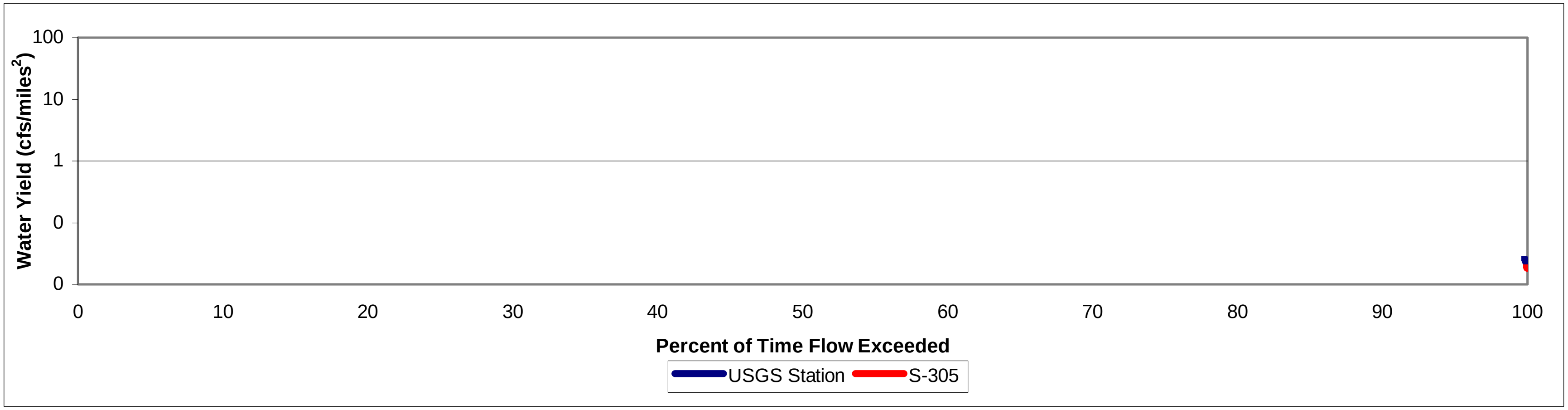
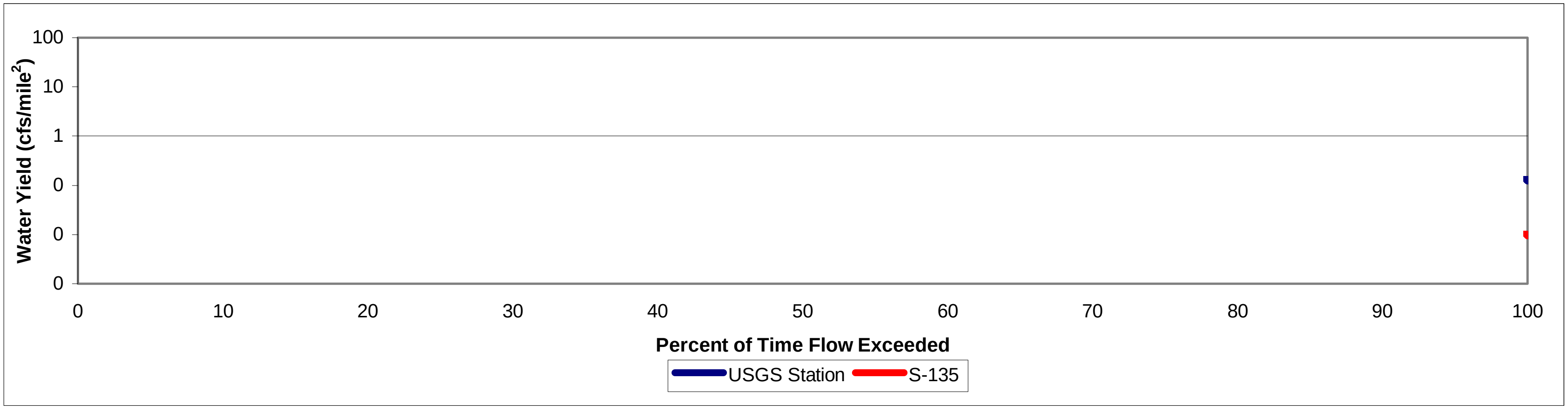
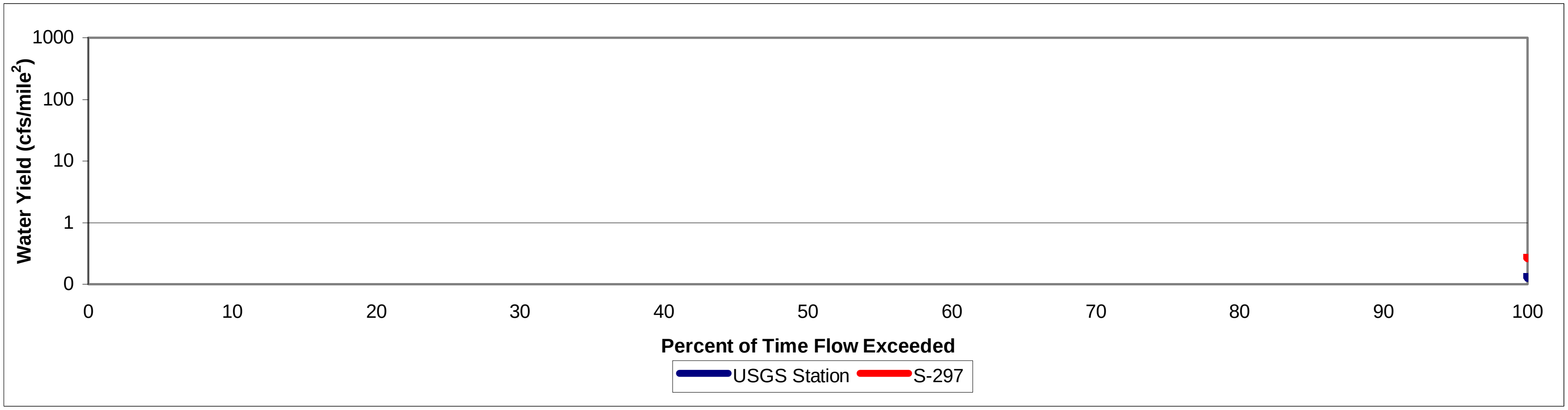


Figure B-7 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS Station 02160381





APPENDIX C Public Notification

PUBLIC NOTICE

U.S. Environmental Protection Agency, Region 4
Water Management Division
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

NOTICE OF AVAILABILITY
TOTAL MAXIMUM DAILY LOADS (TMDLS)
FOR WATERS AND POLLUTANTS IN THE STATE OF SOUTH CAROLINA

Section 303(d)(1)(C) of the Clean Water Act (CWA), 33 U.S.C. §1313(d)(1)(C), and the U.S. Environmental Protection Agency's implementing regulation, 40 CFR §130.7(c)(1), require the establishment of Total Maximum Daily Loads (TMDLs) for waters identified by states as not meeting water quality standards under authority of §303(d)(1)(A) of the CWA. These TMDLs are to be established at levels necessary to implement applicable water quality standards with seasonal variations and a margin of safety, accounting for lack of knowledge concerning the relationship between pollutant loading and water quality.

The waterbody impairments on South Carolina's 303(d) list that will be addressed by the TMDLs are listed below. These impaired waterbodies are located in the Saluda Basin in Laurens and Newberry Counties.

Waterbody Name	Station ID	§303(d) List Pollutants
Little River at US 76 Business Route, in Laurens above the STP	S-034	Fecal Coliform Bacteria
Little River at SC 560	S-038	Fecal Coliform Bacteria
Little River at S-36-22 8.8 mi NW of Silverstreet, SC	S-099	Fecal Coliform Bacteria
Little River at SC Rt 126	S-297	Fecal Coliform Bacteria
Little River at SC 34	S-305	Fecal Coliform Bacteria
North Creek at Jct w/ US 76 2.8 mi W of Clinton, SC	S-135	Fecal Coliform Bacteria

Persons wishing to comment on the proposed TMDLs or to offer new data or information regarding the proposed TMDLs are invited to submit the same in writing no later than

August 16, 2004 to the U.S. Environmental Protection Agency, Region 4, Water Management Division, 61 Forsyth Street, S.W., Atlanta, Georgia 30303-8960, ATTENTION: Ms. Sibyl Cole, Standards, Monitoring, and TMDL Branch.

A copy of the proposed TMDLs can be obtained through the Internet or by contacting Ms. Cole at (404) 562-9437 or via electronic mail at cole.sibyl@epa.gov. The URL address for the proposed TMDLs is:
http://www.epa.gov/region4/water/tmdl/tennessee/index.htm#sc.
The proposed TMDLs and supporting documents, including technical information, data, and analyses, may be reviewed at 61 Forsyth Street, S.W., Atlanta, Georgia, between the hours of 8 AM and 4:30 PM, Monday through Friday. Persons wishing to review this information should contact Ms. Cole to schedule a time for that review.

http://www.epa.gov/region

/s/

James D. Giattina, Director Date
Water Management Division
Region 4
U.S. Environmental Protection Agency

NO COMMENT RECEIVED

APPENDIX D MOVE.1

Constructing Flow Curves Using MOVE.1

The concept of record extension is to transfer the characteristics of distribution shape, serial correlation, and seasonality from the base station to the short-record station with adjustments of location and scale appropriate to the short-record station. MOVE.1 is a statistical technique developed by the USGS (Hirsch, 1982) for extending discharge records at partial or discontinued gages using continuous records at a base station having a common period of record as the partial station. Record extension is based on the following equation:

$$Y(i) = m(y_1) + (S(y_1)/S(x_1))(x(i) - m(x_1)) \qquad \text{Equation 1}$$

Where: Y = discharge at partial record station on particular date
$m(y_1)$ = mean value at partial record station
$S(y_1)$ = standard deviation of discharge record at partial station
$S(x_1)$ = standard deviation of discharge record at continuous station
X(i) = discharge at continuous gage on a particular date
$m(x_1)$ = mean value at continuous record station

Application of the MOVE.1 technique is explained below; however, for more information on the derivation of the equations used in the analysis, please refer to Hirsch (1982).

The record extension procedure can be easily performed in a spreadsheet, such as Excel, having the “analysis toolpak” feature loaded as an add-in program. In Excel, the “descriptive statistic” feature in the “analysis toolpak” is used to compute the complex statistical parameters described in Equation 1. The first step in utilizing MOVE.1 is to compute the logarithms of the discharges at each gage during the concurrent time period. By selecting the “descriptive statistic” feature from the data analysis menu (in Excel, this is located under the “tools” menu bar), and highlighting the cells containing the logarithms of the discharges at both the partial and continuous record stations, the summary statistics used in Equation 1 can be calculated. Flows at other time periods at the partial record station can be estimated by using Equation 1, the summary statistics from the analysis toolpak, and flow at the continuous record station.

A partial flow record is available for Durbin Creek above Fountain Inn, SC at USGS station 02160381. MOVE.1 was used to establish the missing period of record between 1990 and 1994, 1999 and 2001 for the purpose of developing loads for water quality samples. The partial station was matched with a USGS station with complete records. The USGS station 02160700 on the Enoree River at Whitmire was used to extend the record at USGS station 02160381. The concurrent time period for each pair was used in the MOVE.1 analysis. Statistical parameters derived from the MOVE.1 analysis are shown in Table D-1. The resulting flow duration curve is presented in Figure D-1.

Table D-1 Statistical Parameters Derived from the MOVE.1 Analysis Comparing USGS 02160700 and USGS 02160381

log 02160700		*log 02160381*	
Mean	2.629557732	Mean	1.089851515
Standard Error	0.007203046	Standard Error	0.007492697
Median	2.597695186	Median	1.079181246
Mode	2.519827994	Mode	1.041392685
Standard Deviation	0.315045783	Standard Deviation	0.3277145
Sample Variance	0.099253845	Sample Variance	0.107396793
Kurtosis	2.03035589	Kurtosis	3.07531938
Skewness	0.933766112	Skewness	0.945977257
Range	2.447540838	Range	2.647817482
Minimum	1.908485019	Minimum	0.255272505
Maximum	4.356025857	Maximum	2.903089987
Sum	5030.343942	Sum	2084.885948
Count	1913	Count	1913
Standard Deviation Y / Standard Deviation X = 1.04			

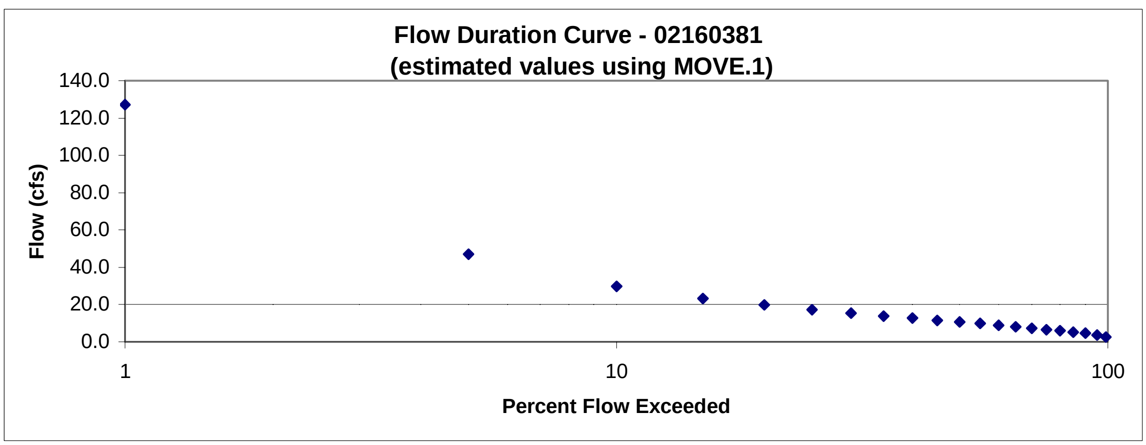


Figure D-1 Flow Duration Curve for the Durbin Creek above Fountain Inn, SC USGS 02160381 (Estimated Using MOVE.1)