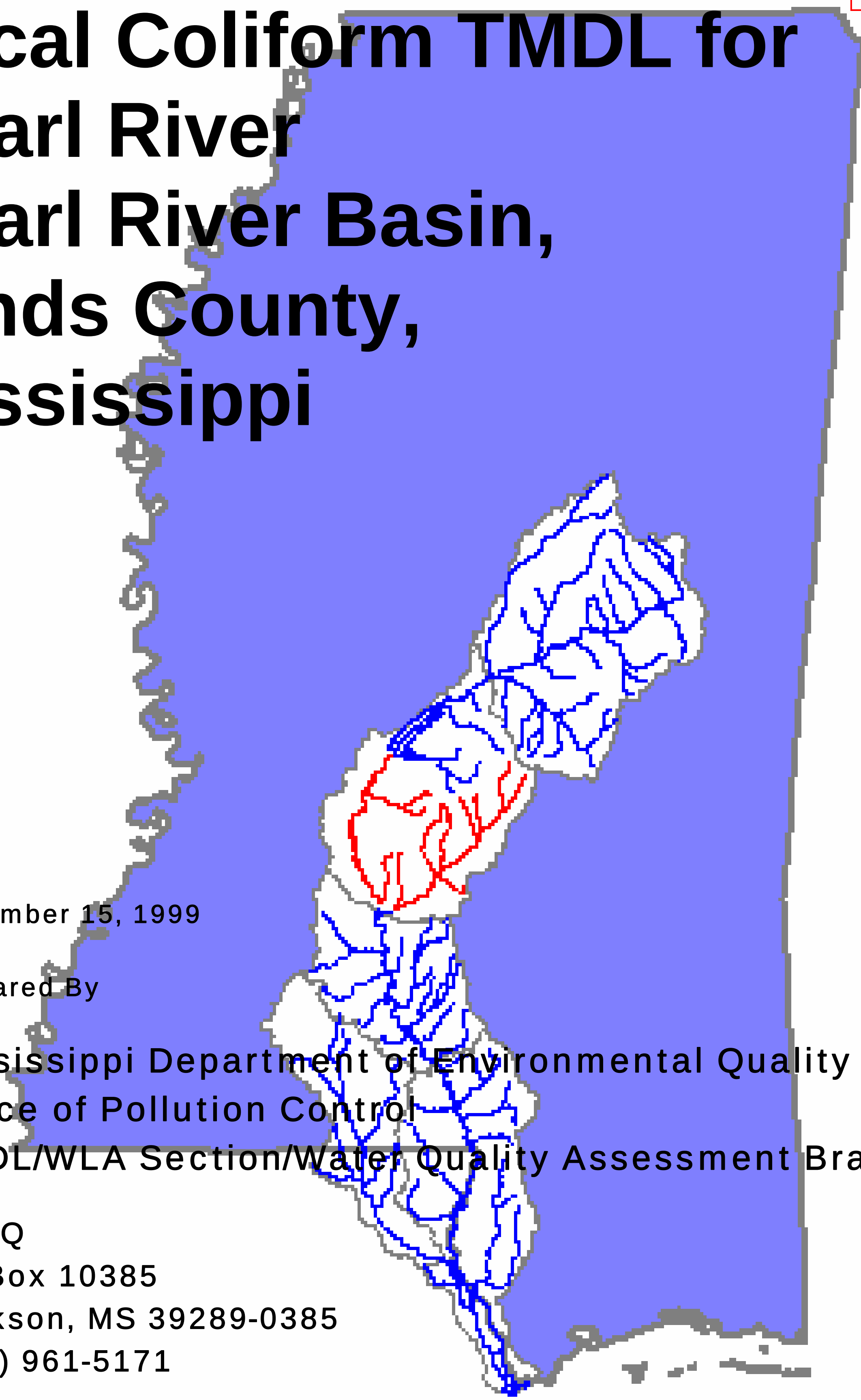
FINAL REPORT
December 1999
ID: 599121502

Fecal Coliform TMDL for Pearl River Pearl River Basin, Hinds County, Mississippi



December 15, 1999

Prepared By

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MONITORED SEGMENT IDENTIFICATION

Name:	Pearl River segment 2
Waterbody ID:	MSUMPRLR1M2
Location:	Near Byram: from the Jackson POTW outfall to the confluence with Big Creek
County:	Hinds County, Mississippi
USGS HUC Code:	03180002
Length:	12 miles
Use Impairment:	Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	22
NPDES Permits:	There are 36 NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Standards Variance:	None
Pollutant Standard:	Fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml.
Waste Load Allocation:	1.28E+13 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	1.98E+13 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	3.26E+13 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates.

EVALUATED SEGMENT IDENTIFICATION

Name:	Caney Creek
Waterbody ID:	MS164CE
Location:	Near Trenton: from Headwaters to confluence with Strong River
County:	Scott and Smith Counties, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	160
Length:	12 miles
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are no NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Standards Variance:	None
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	9.97E+10 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	1.38E+12 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	1.48E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Big Creek - DA
Waterbody ID:	MS159E
Location:	Drainage Area near Byram
County:	Hinds County, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	110
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are 6 NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	1.37E+12 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	1.90E+12 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	2.10E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Brushy Creek - DA
Waterbody ID:	MS162E
Location:	Drainage Area near Georgetown
County:	Copiah County, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	140
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are 3 NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	3.11E+11 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	2.72E+12 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	3.01E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Campbell Creek - DA
Waterbody ID:	MS165CE
Location:	Drainage Area near D'Lo
County:	Rankin and Simpson Counties, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	170
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are no NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	3.10E+11 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	1.80E+12 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	2.11E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates. Due to die-off rates and transport considerations, the load allocation is represented as two separate numbers, which vary by multiple orders of magnitude.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Rhodes Creek - DA
Waterbody ID:	MS161E
Location:	Drainage Area near Rosemary
County:	Hinds County, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	130
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are 4 NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	3.12E+11 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	2.64E+12 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	2.91E+12 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Rials Creek - DA
Waterbody ID:	MS166RE
Location:	Drainage Area near Merit
County:	Simpson County, Mississippi
USGS HUC Code:	03180002
NRCS Watershed:	180
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low
NPDES Permits:	There are no NPDES Permits issued for facilities that discharge fecal coliform in the watershed (Table 3.1.1).
Pollutant Standard:	May through October - Geometric mean of 200 per 100 ml, Less than 10% of the samples may exceed 400 per 100 ml. November through April - Geometric mean of 2000 per 100 ml, Less than 10% of the samples may exceed 4000 per 100 ml.
Waste Load Allocation:	8.80E+10 counts per 30 day critical period (The TMDL requires all dischargers to meet water quality standards for disinfection.)
Load Allocation:	8.48E+11 counts per 30 day critical period
Margin of Safety:	Implicit modeling assumptions - The model was run for a time span of 11 years.
Total Maximum Daily Load (TMDL):	9.36E+11 counts per 30 day critical period The TMDL is a combination of the direct input of fecal coliform from NPDES Permitted dischargers and nonpoint sources due to cows with access to streams, failing septic tanks, and land surface fecal coliform application rates. Due to die-off rates and transport considerations, the load allocation is represented as two separate numbers, which vary by multiple orders of magnitude.

EXECUTIVE SUMMARY

A segment of the Pearl River has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as impaired due to fecal coliform bacteria. Five drainage areas and one waterbody segment within this Pearl River subwatershed have been placed on the list as evaluated, due to fecal coliform bacteria impairment. For these waterbody segments, the applicable state standard specifies that for the summer months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 colonies per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. A review of the available monitoring data for the watershed indicates that there is a violation of the standard for the impaired waterbody.

The Pearl River is a major waterbody in Mississippi, flowing in a southerly direction from its headwaters in Winston County to its mouth in the Mississippi Sound. This TMDL has been developed for one impaired section of the Pearl River, one evaluated segment, and five evaluated drainage areas within the Pearl River Watershed. The BASINS Nonpoint Source Model (NPSM) was selected as the modeling framework for performing the TMDL allocations for this study. The weather data used for this model were collected at Jackson, MS. The representative hydrologic period used for this TMDL was January 1, 1985, through December 31, 1995.

Fecal coliform loadings from nonpoint sources in the watershed were calculated based upon wildlife populations; livestock populations; information on livestock and manure management practices for the Pearl River Basin; and urban development. The estimated fecal coliform production and accumulation rates due to nonpoint sources for the watershed were incorporated into the model. Also represented in the model were the nonpoint sources such as failing septic systems and cattle that have direct access to tributaries of the Pearl River. There are 54 NPDES Permitted discharges located in the watershed and included as point sources in the model. Under existing conditions, output from the model indicates violation of the fecal coliform standard in the stream. After applying a load reduction scenario, there were no violations of the standard according to the model.

The scenario used to reduce the fecal coliform load involves a cooperative effort between all fecal coliform contributors in the Pearl River Watershed. First, all NPDES facilities will be required to treat their discharge so that the fecal coliform concentrations do not exceed water quality standards. Careful monitoring of all permitted facilities in the Pearl River Watershed should be continued to ensure that compliance with permit limits is consistently attained. Second is the removal of 75% of the cattle♣s direct access to tributaries. This could be accomplished by fencing streams in cattle pastures. Education on best management practices is a vital part of achieving this goal. Finally, a 50% reduction in the fecal coliform contribution from failing septic tanks is required. The model assumed there is a 40% failure rate of septic tanks in the drainage area. A reduction could be accomplished by education on best management practices for septic tank owners. Additionally, users of individual onsite wastewater treatment plants could be educated on the importance of disinfection of the effluent from their treatment plant.

The model accounted for seasonal variations in hydrology, climatic conditions, and watershed activities. The use of the continuous simulation model allowed for consideration of the seasonal aspects of rainfall and temperature patterns within the watershed. Calculation of the fecal coliform accumulation parameters and source contributions on a monthly basis accounted for seasonal variations in watershed activities such as livestock grazing and land application of manure.

1.0 INTRODUCTION

1.1 Background

The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of water resources.

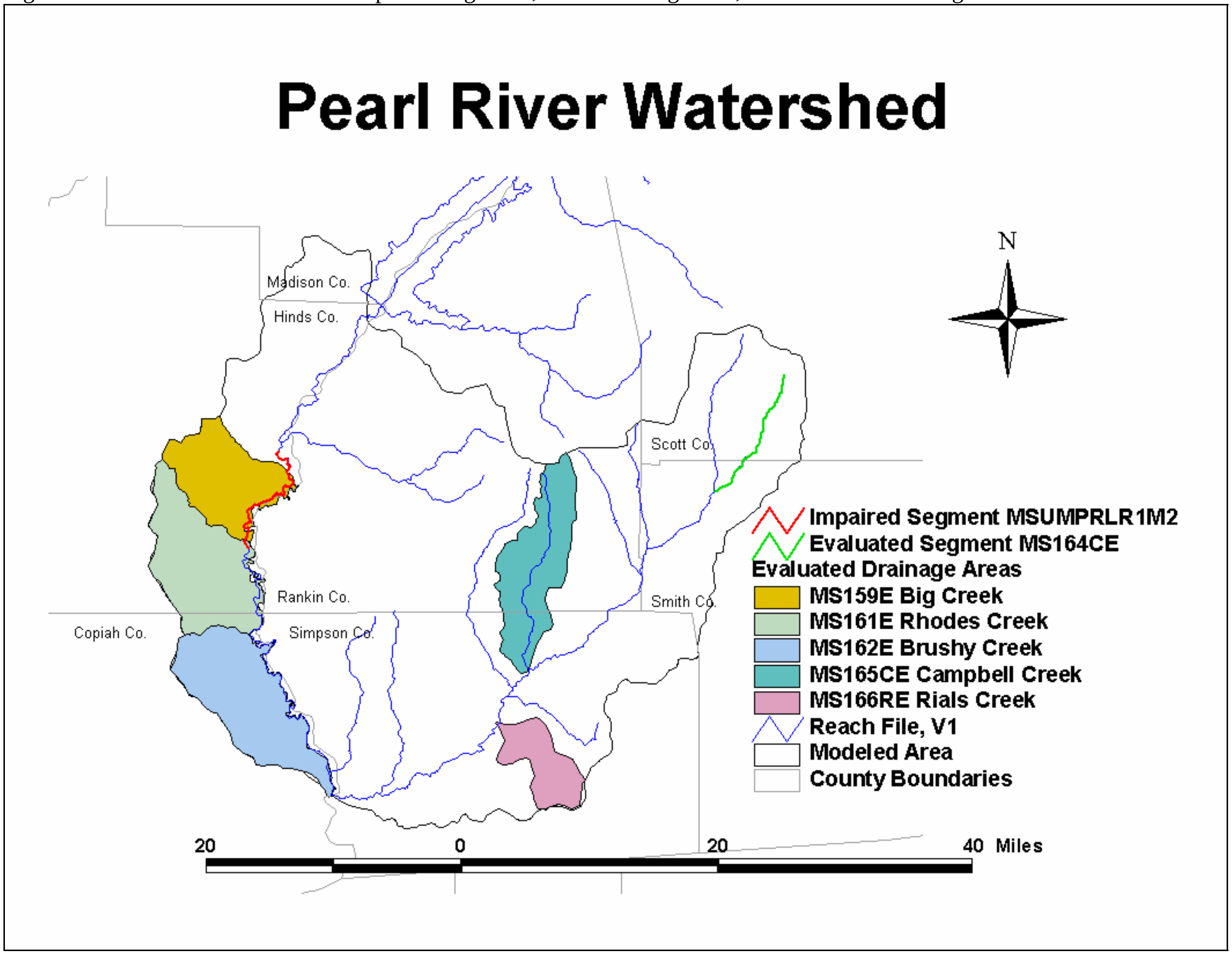
The Mississippi Department of Environmental Quality (MDEQ) has identified a segment of the Pearl River as being impaired by fecal coliform bacteria for a length of 12 miles as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. This segment is listed as impaired because sufficient monitoring data is available to show that there is an impairment in this segment. The impaired segment is near Byram, from the Jackson POTW outfall to the confluence with Big Creek. MDEQ has identified Caney Creek, another segment within the Pearl River Watershed, as being evaluated for the presence of fecal coliform bacteria as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. The evaluated segment is near Trenton, from the headwaters to the confluence with Strong River. There are also five drainage areas within the Pearl River Watershed that are reported as being evaluated for the presence of fecal coliform bacteria. This segment and these drainage areas are listed as evaluated because the data available is insufficient to show a definite impairment caused by fecal coliform bacteria. However, there is anecdotal evidence of a possible water quality problem. Both the monitored and evaluated sections are shown in Figure 1.1.1.

The impaired segment of the Pearl River is in the Pearl River Basin Hydrologic Unit Code (HUC) 03180002 in central Mississippi. The drainage area of the monitored segment, the evaluated segment, and the evaluated drainage areas, is approximately 870,000 acres; and lies within portions of Copiah, Hinds, Madison, Rankin, Scott, Simpson, and Smith Counties. The Ross Barnett Reservoir is considered the upper boundary of the drainage area of the impaired segment. The watershed is rural with urban and suburban elements and includes the major urban area of Jackson. Forest and pasture are the dominant landuses within the watershed. The land distribution is shown in Table 1.1.1.

Table 1.1.1 Land Distribution in Acres for the Pearl River Watershed

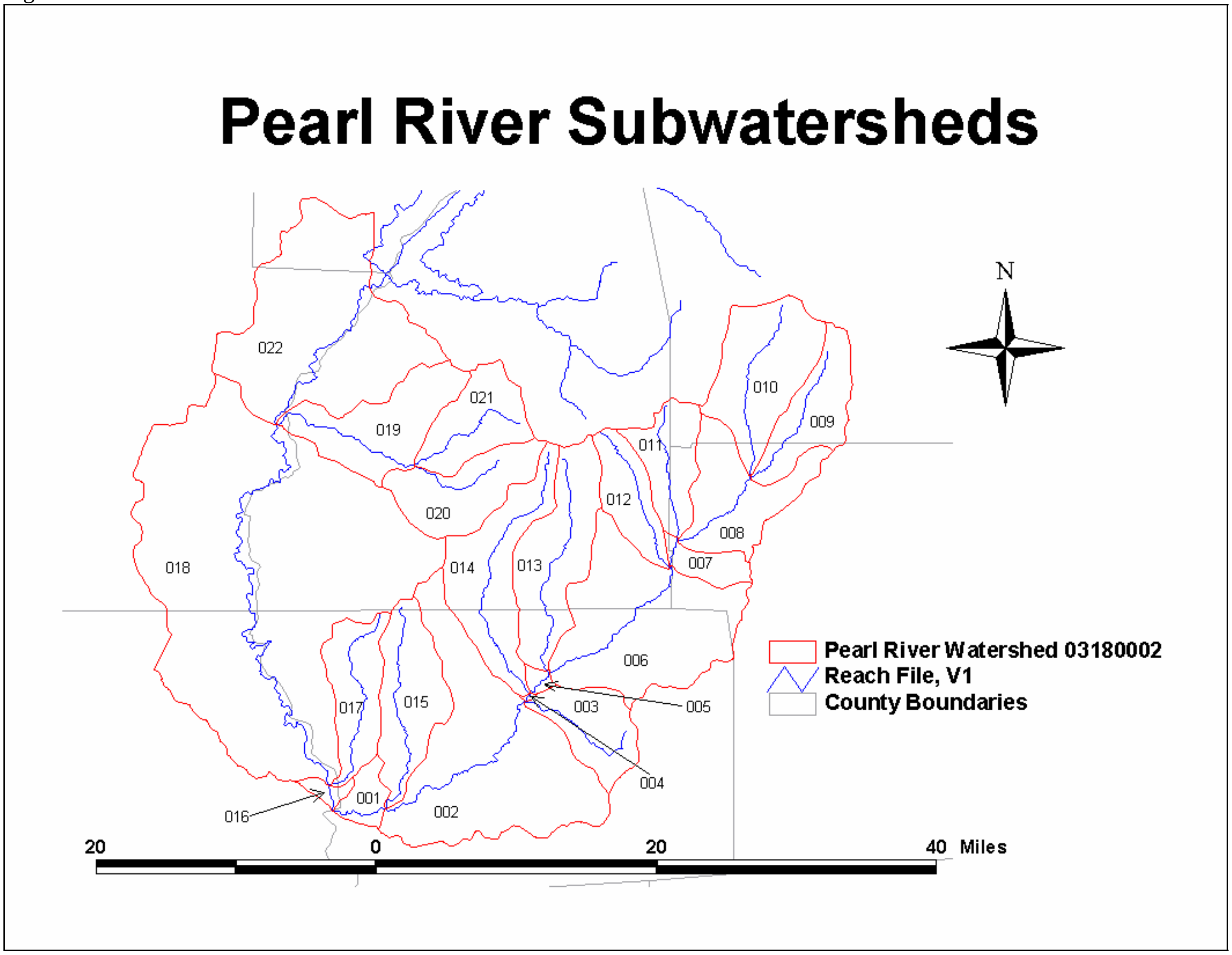
	Urban	Forest	Cropland	Pasture	Barren	Wetland	Total
Area (Acres)	43,118	394,605	27,816	339,941	5,155	63,570	874,203
% Area	5%	45%	3%	39%	1%	7%	

Figure 1.1.1 Pearl River Watershed Impaired Segments, Evaluated Segments, and Evaluated Drainage Areas



The drainage area, or watershed, has been divided into 22 subwatersheds based on the major tributaries and topography. Figure 1.1.2 shows the subwatersheds with a three-digit Reach File 1 segment identification number. Each subwatershed is assigned a corresponding identification number, which is a combination of the eight-digit HUC and the three-digit Reach File 1 segment identification number. The impaired segment is contained in, using HUC and Reach File 1 identification numbers, 03180002018.

Figure 1.1.2 Pearl River Subwatersheds



1.2 Applicable Waterbody Segment Use

Designated beneficial uses and water quality standards are established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations. The designated uses for the Pearl River as defined by the regulations are Public Water Supply (from the Ross Barnett Reservoir to the City of Jackson water intake), Contact Recreation (from Byram bridge to the Mississippi Sound), and Fish and Wildlife Support. The monitored section of Pearl River has the designated use of Contact Recreation.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standard states that the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml. This water quality standard will be used as targeted endpoints to evaluate impairments and establish this TMDL.

2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions specified in the TMDL. The endpoints allow for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The instream fecal coliform target for this TMDL is a 30-day geometric mean of 200 colony counts per 100 ml.

Because fecal coliform may be attributed to both nonpoint and point sources, the critical condition used for the modeling and evaluation of stream response was represented by a multi-year period. Critical conditions for waters impaired by nonpoint sources generally occur during periods of wet-weather and high surface runoff. But, critical conditions for point source dominated systems generally occur during low flow, low dilution conditions. The 1985-1995 period represents both low flow conditions as well as wet-weather conditions and encompasses a range of wet and dry seasons. Therefore, the 11-year period was selected as representing critical conditions associated with all potential sources of fecal coliform bacteria within the watershed.

2.2 Discussion of Instream Water Quality

Water quality data available for the monitored segment of the Pearl River show that high levels of fecal coliform bacteria frequently impair the stream. There is one ambient station on the impaired segment operated by MDEQ that collected fecal coliform monitoring data during the 11-year modeling period. Data from this station was used to determine the impaired status of the segment. Monitoring for flow and fecal coliform was performed on a bimonthly (six per year) basis at station 02486500 at the Pearl River near Byram, beginning in November 1991 and ending in September 1996. The data indicate that high instream fecal coliform concentrations occurred during both periods of high flow and dry, low flow conditions.

2.2.1 Inventory of Available Water Quality Monitoring Data

The State's 1998 Section 305(b) Water Quality Assessment Report was reviewed to assess water quality conditions and data available for the watershed. According to the report, the Pearl River is not supporting the use of contact recreation and threatened for the use of aquatic life support. These conclusions were based on instantaneous data collected at stations 02486500. Data collected at the station are listed below in Tables 2.2.1.

Table 2.2.1 Fecal Coliform Data reported in the Pearl River, Station 02486500

Date	Flow (cfs)	Fecal Coliform (counts/100ml)
11/4/1991	750	400
1/6/1992	528	**2800**
3/2/1992	5820	230
5/4/1992	301	210
7/13/1992	160	**920**
9/14/1992	218	180
11/2/1992	1150	50
1/11/1993	5730	**1100**
3/8/1993	4050	20
5/3/1993	5580	240
7/12/1993	4070	**2400**
9/13/1993	327	50
11/2/1993	317	**9200**
1/10/1994	6000	**2400**
3/8/1994	9090	**790**
5/2/1994	570	330
6/20/1994	460	**920**
8/23/1994	490	**630**
11/7/1994	1570	**9200**
1/9/1995	5000	**540**
3/6/1995	8600	330
4/18/1995	1200	110
7/10/1995	600	**2400**
9/12/1995	400	110
11/6/1995	430	180
1/11/1996	7040	79
3/4/1996	160	79
5/14/1996	625	110
7/11/1996	400	**2400**
9/9/1996	400	14

2.2.2 Analysis of Instream Water Quality Monitoring Data

A statistical summary of the water quality data discussed above is presented in Table 2.2.2. Samples are compared to the instantaneous maximum standard of 400 counts per 100 ml. The percent exceedance was calculated by dividing the number of exceedances by the total number of samples and does not represent the amount of time that the water quality is in violation.

Table 2.2.2 Statistical Summaries

Station Number	Number of Samples	Minimum Value (counts/100ml)	Maximum Value (counts/100ml)	Number of Exceedances	Percent Instantaneous Exceedance
02486500	30	14	9200	13	43%

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Pearl River watershed. The source assessment was used as the basis of development for the model and ultimate analysis of the TMDL allocation options. In evaluation of the sources, loads were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis. The representation of the following sources in the model is discussed in Section 4.0, Modeling Procedure: Linking the Sources to the Endpoint.

3.1 Assessment of Point Sources

Point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. Thus, a careful evaluation of point sources that discharge fecal coliform bacteria was necessary in order to quantify the degree of impairment present during the low flow, critical condition period. The 54 wastewater treatment plants in the Pearl River watershed serve a variety of activities including residential subdivisions, schools, recreational areas, and other businesses. The majority of the 54 wastewater treatment plants serve residential subdivisions.

Once the permitted dischargers were located, the effluent from each source was characterized based on all available monitoring data including permit limits, discharge monitoring reports, and information on treatment types. Discharge monitoring reports (DMRs) were the best data source for characterizing effluent because they report measurements of flow and fecal coliform present in effluent samples. Of the facilities for which they were available, the DMRs for the past five years, 1993 through 1998, were analyzed. When data were available, the fecal coliform concentrations used in the model were calculated by taking an average of fecal coliform concentrations reported in the discharge monitoring reports. If evidence of insufficient treatment existed, best professional judgement was used to estimate a fecal coliform loading rate in the model. The facilities included in the model are given in Table 3.1.1.

Table 3.1.1 Inventory of Point Source Dischargers

Facility Name	Subwatershed	NPDES Permit	Receiving Waterbody
Pineywoods Country Life School	03180002002	MS0037541	Sanders Creek
Pinola Head Start Center	03180002002	MS0053848	Strong River
Pinola Laundromat	03180002002	MS0047112	Westville Creek
Williamson Poultry Farms, Inc.	03180002002	MS0052175	Strong River
Magnetek Incorporated	03180002003	MS0024554	Little Creek
MDOT Hwy 49 Rest Area – Simpson	03180002003	MS0030287	Sellers Creek
Mendenhall POTW	03180002003	MS0021539	Sellers Creek
Simpson Central Elementary	03180002003	MS0033626	Strong River
Camp Lancaster	03180002006	MS0038971	Rocky Creek
Puckett POTW	03180002006	MS0043397	Strong River
Morton POTW	03180002010	MS0036234	Strong River
D'Lo POTW	03180002014	MS0024821	Dabbs Creek
E & S Country Store & Kitchen	03180002014	MS0051365	Dabbs Creek

Table 3.1.1 Inventory of Point Source Dischargers cont.

Facility Name	Subwatershed	NPDES Permit	Receiving Waterbody
E & S Country Store & Kitchen	03180002014	MS0051365	Dabbs Creek
Rock Hill Baptist Church	03180002014	MS0052744	Dabbs Creek
Boswell Regional Center	03180002015	MS0038849	Big Creek
Byram Attendance Center	03180002015	MS0023469	Big Creek
Child Care Management Group	03180002015	MS0045837	Big Creek
Gary Road Elementary	03180002015	MS0042099	Big Creek Tributary
Alpine Cove Trailer Park	03180002018	MS0039900	Pearl River
Arkansas Best Motor Freight	03180002018	MS0029122	Cany Creek
Briar Hill Rest Home, Inc.	03180002018	MS0029726	Indian Creek
Brookwood Subdivision	03180002018	MS0031194	Trahon Creek
Cleary Heights POTW	03180002018	MS0036307	French Branch
Florence POTW	03180002018	MS0025275	Steen Creek
Forest Woods Utility Company	03180002018	MS0042978	Trahon Creek
Gary Road Children's Center	03180002018	MS0045161	Big Creek Tributary
Georgetown POTW	03180002018	MS0020605	Un. Wetland thence Pearl River
Ivy's Trailer Park	03180002018	MS0047856	Howard Creek
Jackson POTW - Trahon/Big Creek	03180002018	MS0044059	Big Creek
McLaurin Attendance Center	03180002018	MS0038466	Dry Creek
Owens Road S/D (aka Indian Hills)	03180002018	MS0051781	Rhodes Creek
Peggy's Trailer Park	03180002018	MS0053821	Indian Creek
Perryman Elementary - Hinds	03180002018	MS0023493	Vaughn Creek
Poole Subdivision	03180002018	MS0039845	Harris Creek
Ridge Park Subdivision	03180002018	MS0044792	Big Creek
Rolling Hills Wastewater Inc	03180002018	MS0040134	Steen Creek
Siwell Meadows Subdivision	03180002018	MS0043541	Big Creek
Southern Style Mobile Home Park	03180002018	MS0050482	Howard Creek
Sugar's Fitness Center	03180002018	MS0042579	Steen Creek
Terry POTW	03180002018	MS0025224	Rhodes Creek
Wilson Slaughterhouse	03180002018	MS0037338	Turkey Creek
Woodland Acres Treatment Plant	03180002018	MS0030252	Indian Creek
K's Kids Learning Center	03180002019	MS0048488	Richland Creek
M & S Trailer Park	03180002019	MS0045527	Richland Creek
Mill Creek Place Subdivision	03180002019	MS0033731	Terrapin Skin Creek
Willow Creek Golf/Country Club	03180002020	MS0033006	Tumbaloo Creek
Flora POTW	03180002022	MS0025119	Town Creek
Hi-Ridge Trailer Park	03180002022	MS0036404	Hog's Creek
Jackson POTW - Savannah Street	03180002022	MS0024295	Pearl River
Magnolia RV Park	03180002022	MS0035297	Pearl River
MS/Utica Jr College POTW	03180002022	MS0039306	White Oak Creek
PRVWSD/Lake Harbor	03180002022	MS0025003	Cane Creek
Robie's Quick Stop	03180002022	MS0044946	White Oak Creek Tributary
Utica POTW - South	03180002022	MS0020613	White Oak Creek Tributary

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for the Pearl River, including:

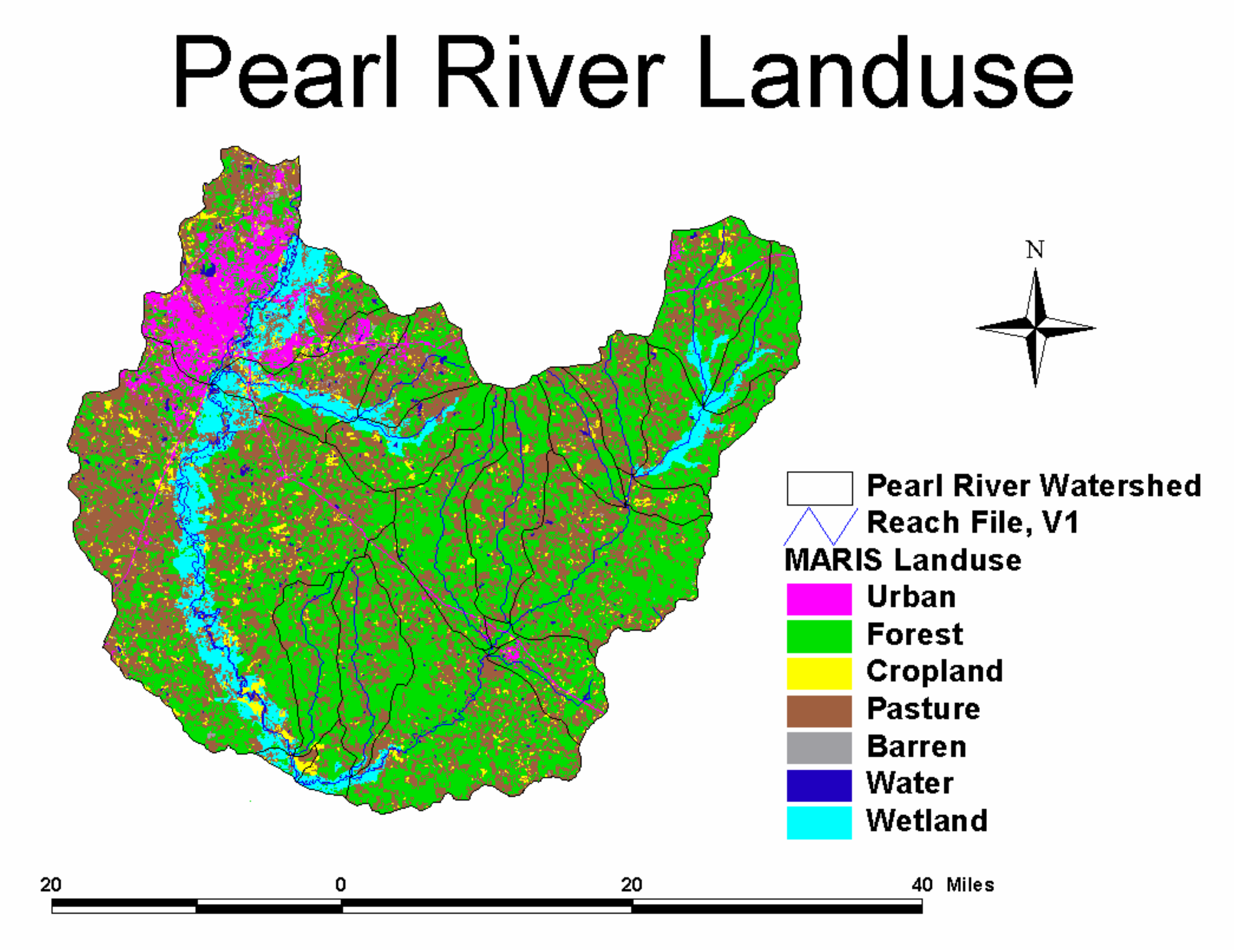
- Failing septic systems
- Wildlife
- Land application of hog and cattle manure
- Grazing animals
- Land application of poultry litter
- Cattle contributions directly deposited instream
- Urban development

The 870,000-acre drainage area of the Pearl River contains many different landuse types. The landuse information is based on data collected by the Mississippi Automated Resources Information System (MARIS), 1997. This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. This classification is based on a modified Anderson level one and two system with additional level two wetland classifications. The contribution of each of these land types to the fecal coliform loading of the Pearl River was considered on a subwatershed basis. Table 3.2.1 and Figure 3.2.1 show the landuse distribution for the watershed.

Table 3.2.1 Landuse Distribution in Number of Acres

Subwatershed	Urban	Forest	Cropland	Pasture	Barren	Wetland	Total
03180002001	0	3,056	547	1,546	1	1,977	7,126
03180002002	218	52,567	2,153	32,199	132	1,543	88,814
03180002003	1,011	11,738	788	7,269	67	0	20,874
03180002004	4	227	0	32	0	0	263
03180002005	192	1,225	52	443	0	0	1,912
03180002006	47	39,642	1,184	28,678	138	6	69,694
03180002007	0	4,777	543	2,997	6	0	8,323
03180002008	0	17,371	398	9,057	19	4,436	31,279
03180002009	115	15,295	52	5,583	0	2,412	23,457
03180002010	880	20,435	1,285	14,341	63	2,540	39,543
03180002011	0	10,040	327	9,666	5	78	20,116
03180002012	0	8,049	558	9,245	64	0	17,916
03180002013	0	21,360	721	16,091	17	0	38,189
03180002014	433	26,091	470	12,315	48	20	39,377
03180002015	0	19,478	247	11,764	21	373	31,884
03180002016	8	331	488	762	0	1,159	2,748
03180002017	0	17,762	301	6,016	7	97	24,183
03180002018	6,022	77,709	10,436	110,096	1,004	26,710	231,976
03180002019	2,483	9,222	1,947	12,623	708	6,582	33,564
03180002020	0	12,435	810	10,694	48	3,274	27,261
03180002021	711	9,996	548	10,915	204	1,395	23,767
03180002022	30,995	15,800	3,962	27,609	2,602	10,968	91,936
All Watersheds	**43,118**	**394,605**	**27,816**	**339,941**	**5,155**	**63,570**	**874,203**

Figure 3.2.1 Landuse Distribution



The nonpoint fecal coliform contribution from each landuse was estimated using the latest information available. The MARIS landuse data for Mississippi was utilized by the BASINS model to extract landuse sizes, populations, agriculture census data, and other information. MDEQ contacted several agencies to refine the assumptions made in determining the fecal coliform loading. The Mississippi Department of Wildlife, Fisheries, and Parks provided information of wildlife density in the Pearl River Watershed. The Mississippi State Department of Health was contacted regarding the failure rate of septic tank systems in this portion of the state. Mississippi State University researchers provided valuable information on manure application practices and loading rates for hog farms and cattle operations. The Natural Resources Conservation Service also gave MDEQ information on manure treatment practices and land application of manure

3.2.1 Failing Septic Systems

Septic systems have a potential to deliver fecal coliform bacteria loads to surface waters due to malfunctions, failures, and direct pipe discharges. Properly operating septic systems treat wastewater and dispose of the water through a series of underground field lines. The water is applied through these lines into a rock substrate, thence into underground absorption. The systems can fail when the field lines are broken, or when the underground substrate is clogged or flooded. A failing septic system's discharge can reach the surface, where it becomes available for wash-off into the stream. Another potential problem is a direct bypass from the system to a stream. In an effort to keep the water off the land, pipes are occasionally placed from the septic tank or the field lines directly to the creek.

Another consideration is the use of individual onsite wastewater treatment plants. These treatment systems are in wide use in Mississippi. They can adequately treat wastewater when properly maintained. However, these systems do not typically receive the maintenance needed for proper, long-term operation. These systems require some sort of disinfection to properly operate. When this expense is ignored, the water does not receive adequate disinfection prior to release.

3.2.2 Wildlife

Wildlife present in the Pearl River watershed contributes to fecal coliform bacteria on the land surface. In the Pearl River model, all wildlife was accounted for by considering contributions from deer. Estimates of deer population were designed to account for the deer combined with all of the other wildlife and domestic pets contributing to the area. An upper limit of 45 deer per square mile was used as the estimate. It was assumed that the wildlife population remained constant throughout the year, and that wildlife was present on all land classified as pastureland, cropland, and forest. It was also assumed that the wildlife and the manure produced by the wildlife were evenly distributed throughout these land types.

3.2.3 Land Application of Hog and Cattle Manure

In the Pearl River Basin processed manure from confined hog and dairy cattle operations is collected in lagoons and routinely applied to pastureland during April through October. This manure is a potential contributor of bacteria to receiving waterbodies due to runoff produced during a rain event. Hog farms in the Pearl River Basin operate by either keeping the animals confined by or allowing hogs to graze in a small pasture or pen. For this model, it was assumed that all of the hog manure produced by either farming method was applied evenly to the available pastureland. Application rates of hog manure to pastureland from confined operations varied monthly according to management practices currently used in this area.

The dairy farms that are currently operating in the Pearl River Watershed only confine the animals for a limited time during the day. The model assumed a confinement time of four hours per day, during which time the cattle are milked and fed. During all other times, dairy cattle are allowed to graze on pasturelands. The manure collected during confinement is applied to the available pastureland in the watershed. Like the hog farms, application rates of dairy cow manure to pastureland vary monthly according to management practices currently used in this area.

3.2.4 Grazing Beef and Dairy Cattle

Grazing cattle deposit manure on pastureland where it is available for wash-off and delivery to receiving waterbodies. Beef cattle have access to pastureland for grazing all of the time. However, dairy cattle can spend four hours per day confined in milking barns, and the remainder of their time grazing on pastureland. Manure produced by grazing beef and dairy cows is directly deposited onto pastureland.

3.2.5 Land Application of Poultry Litter

There are a considerable number of chickens produced in the Pearl River Watershed each year. In this area, poultry farming operations use houses in which chickens are confined all of the time. The litter produced by the chickens is collected and is routinely applied as a fertilizer to pastureland in the watershed. Application rates of the litter vary monthly.

Predominantly, two kinds of chickens are raised on farms in the Pearl River Basin, broilers and layers. For the broiler chickens, the amount of growth time from when the chicken is born to when it is sold off the farm is approximately 48 days or 1.6 months. Layer chickens remain on farms for ten months or longer. More than 93% of the chickens raised in this area are broilers. For the model, a weighted average of growth time was determined to account for both types of chickens. An average growth time of 52 days, or 1/7 of a year, was used. To determine the number of chickens on farms on any given day, the yearly population of chickens sold was divided by seven.

3.2.6 Cattle Contributions Directly Deposited Instream

Cattle often have direct access to flowing and intermittent streams that run through pastureland. These small streams are tributaries of larger streams. Fecal coliform bacteria deposited in these streams by grazing cattle are modeled as a direct input of bacteria to the stream. Due to the general topography in the Pearl River Watershed, it was assumed that all land slopes in the watershed are such that cattle are able to access the intermittent streams in all pastures. In order to determine the amount of bacteria introduced into streams from cattle, it was assumed that all grazing cattle spent two percent of their time standing in the streams. Thus, the model assumes that two percent of the manure produced by grazing beef and dairy cows are deposited directly in the stream.

3.2.7 Urban Development

Urban areas include land classified as urban and barren. Even though only five percent of the watershed is classified as urban, the contribution of the urban areas to fecal coliform loading in the Pearl River was considered. Municipalities within the Pearl River Watershed include Jackson, Terry, Utica, Puckett, and Morton. Fecal coliform contributions from urban areas may come from storm water runoff, runoff from construction sites, and runoff contribution from improper disposal of materials such as household toxic materials and litter.

4.0 MODELING PROCEDURE: LINKING THE SOURCES TO THE ENDPOINT

Establishing the relationship between the instream water quality target and the source loading is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established though a range of techniques, from qualitative assumptions to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. In this section, the selection of the modeling tools, setup, and model application are discussed.

4.1 Modeling Framework Selection

The BASINS model platform and the NPSM model were used to predict the significance of fecal coliform sources to fecal coliform levels in the Pearl River Watershed. BASINS is a multipurpose environmental analysis system for use in performing watershed and water quality-based studies. A geographic information system (GIS) provides the integrating framework for BASINS and allows for the display and analysis of a wide variety of landscape information such as landuses, monitoring stations, point source discharges, and stream descriptions. The NPSM model simulates nonpoint source runoff from selected watersheds, as well as the transport and flow of the pollutants through stream reaches. A key reason for using BASINS as the modeling framework is its ability to integrate both point and nonpoint sources in the simulation, as well as its ability to assess instream water quality response.

4.2 Model Setup

The Pearl River TMDL model includes the listed sections of the creek as well as all the drainage areas within HUC 03180002. The flow and fecal loading from the Ross Barnett Reservoir were input into the model as a point source. Thus, all upstream contributors of bacteria are accounted for in the model. The portion of the watershed downstream of the Reservoir and the remaining portion of HUC 03180002 was divided into 22 subwatersheds in an effort to isolate the major stream reaches is the Pearl River Watershed. This subdivision allowed the relative contribution of point and nonpoint sources to be addressed within each subwatershed.

4.3 Source Representation

Both point and nonpoint sources were represented in the model. A fecal coliform spreadsheet was developed for quantifying point and nonpoint sources of bacteria for the Pearl River model. This spreadsheet calculates the model inputs for fecal coliform loading due to point and nonpoint sources using assumptions about land management, septic systems, farming practices, and permitted point source contributions. Each of the potential bacteria sources is covered in the fecal coliform spreadsheet.

The discharge from point sources was added as a direct input into the appropriate reach of the waterbody. There are 54 NPDES permitted facilities in the watershed which discharge fecal coliform bacteria. Fecal coliform loading rates for point sources are input to the model as flow in cubic feet per second and fecal coliform contribution in counts per hour.

The nonpoint sources are represented in the model with two different methods. The first of these methods is a direct fecal coliform loading to the Pearl River. Other sources are represented as an application rate to the land in the Pearl River Watershed. For these sources, fecal coliform accumulation rates in counts per acre per day were calculated for each subwatershed on a monthly basis and input to the model for each landuse. Fecal coliform contributions from forests and wetlands were considered to be equal. Urban and barren areas were also considered to produce equal loads. The fecal coliform accumulation rate for pastureland is the sum of accumulation rates due to litter application, wildlife, processed manure, and grazing animals. For cropland, the accumulation rate is only due to wildlife. Accumulation rates for pastureland are calculated on a monthly basis to account for seasonal variations in manure and litter application.

4.3.1 Failing Septic Systems

Discharges from failing septic systems were quantified based on several factors including the estimated population served by the septic systems, an average daily discharge of 100 gallons per person per day, and a septic system effluent fecal coliform concentration of 10^4 counts per 100 ml.

4.3.2 Wildlife

Based on information provided by the Mississippi Department of Wildlife, Fisheries, and Parks, the deer population throughout the Pearl River Watershed was estimated to be 30 to 45 animals per square mile. For the model, the upper limit of 45 deer per square mile was used to account for the deer and all other wildlife contributing to fecal coliform accumulation in the area. The wildlife contribution in counts per acre per day is calculated by multiplying a loading rate by the number of animals. The loading rate used in the model was estimated to be 5.00E+08 counts per day per animal. The per acre loading rate applied to the landuses is 3.52E+07 counts/acre/day.

4.3.3 Land Application of Hog and Cattle Manure

The fecal coliform spreadsheet was used to estimate the amount of waste and the concentration of fecal coliform bacteria contained in hog and dairy cattle manure produced by confined animal feeding operations. The livestock count per county is based upon the 1997 Census of Agriculture data. The county livestock count is used to estimate the number of livestock on a subwatershed scale. This is calculated by multiplying the county livestock figures with the area of the county within the subwatershed boundaries. This estimate is made with the assumption that the livestock are uniformly distributed throughout the county. A fecal coliform production rate in counts per day per animals was multiplied by the number of confined animals to quantify the amount of bacteria produced. The manure produced by these operations is collected in lagoons and applied evenly to all pastureland. Manure application rates to pastureland vary on a monthly basis. This monthly variation is incorporated into the model by using monthly loading rates.

4.3.4 Grazing Beef and Dairy Cattle

The model assumes that the manure produced by grazing beef and dairy cattle is evenly spread on pastureland throughout the year. The fecal coliform content of manure produced by grazing cattle is estimated by multiplying the number of grazing cattle by a fecal coliform production of 5.40E+09 counts per day per animal (Metcalf and Eddy, 1991). The resulting fecal coliform loads are in the units of counts per acre per day.

4.3.5 Land Application of Poultry Litter

The concentration of bacteria, which accumulates in the dry litter where poultry waste is collected, is estimated with the fecal coliform spreadsheet. This is done by multiplying the daily number of chickens on farms by a fecal coliform production rate in counts per day per animal given in Metcalf & Eddy, 1991. The model assumed a watershed area normalized chicken population. The chicken population was determined from the 1997 Census of Agriculture Data for the number of chickens sold from each county per year. Litter application to pastureland varies monthly, and is modeled with a monthly loading rate.

4.3.6 Cattle Contributions Deposited Directly Instream

The contribution of fecal coliform from cattle to a stream is represented as a direct input into the stream by the model. In order to estimate the point source loading produced by grazing beef and dairy cattle with access to streams, it is assumed that two percent of the number of grazing cattle in each subwatershed are standing in a stream at any given time. When cattle are standing in a stream, their fecal coliform production is estimated as flow in cubic feet per second and a concentration in counts per hour. The fecal coliform concentration is calculated using the number of cows in the stream and a bacteria production rate of 5.40E+09 counts per animal per day (Metcalf and Eddy, 1991).

4.3.7 Urban Development

The MARIS landuse data divide urban land into several categories. For the Pearl River Watershed, the urban land is divided into three different categories: high density, low density, and transportation. For the model, fecal coliform buildup rates for each category were determined by using literature values from Horner, 1992. The literature value accounts for all of the potential fecal coliform sources in each urban category. Table 4.3.1 shows the break up of urban land into high density, low density, and transportation on a subwatershed basis. The fecal coliform production rate for each of these subdivisions of urban land is 1.54E+07 for high density, 1.03E+07 for low density, and 2.00E+05 for transportation. In the model, fecal coliform loading rates on urban land are input as counts per acre per day.

Table 4.3.1 Urban Landuse Distribution

Subwatershed	High Density Urban	Low Density Urban	Transportation	Total
03180002001	0	0	0	0
03180002002	2	40	161	203
03180002003	139	401	464	1,005
03180002004	0	4	0	4
03180002005	5	56	131	192
03180002006	35	11	0	47
03180002007	0	0	0	0
03180002008	0	0	0	0
03180002009	0	0	105	105
03180002010	81	327	472	880
03180002011	0	0	0	0
03180002012	0	0	0	0
03180002013	0	0	0	0
03180002014	14	112	307	433
03180002015	0	0	0	0
03180002016	0	1	0	1
03180002017	0	0	0	0
03180002018	530	3,424	1,887	5,841
03180002019	264	1,175	875	2,314
03180002020	0	0	0	0
03180002021	80	370	260	711
03180002022	7,688	18,479	4,536	30,703
All Watersheds	**8,838**	**24,401**	**9,200**	**42,439**

4.4 Stream Characteristics

The stream characteristics given below describe the entire modeled section of the Pearl River. This section begins at the Jackson POTW outfall and ends at the end of the monitored reach, with the confluence of Big Creek. The channel geometry and lengths for the Pearl River are based on data available within the BASINS modeling system. The 7Q10 flow was determined from USGS data. The characteristics of the modeled section of the Pearl River are as follows.

- Length 12 miles
- Average Depth 1.93 ft
- Average Width 212.87 ft
- Mean Flow 4702.55 cubic ft per second
- Mean Velocity 2.29 ft per second
- 7Q10 Flow 165.64 cubic ft per second
- Slope 0.00018 ft per ft

4.5 Selection of Representative Modeling Period

The model was run for 11 years, from January 1, 1985, through December 31, 1995. Results from the model were evaluated for the time period from January 1, 1985, until December 31, 1995. Because this 11-year time span is used, a margin of safety is implicitly applied. Seasonality and critical conditions are accounted for during the extended time frame of the simulation.

The critical condition for fecal coliform impairment from nonpoint source contributors occurs after a heavy rainfall that is preceded by several days of dry weather. The dry weather allows a build up of fecal coliform bacteria, which is then washed off the ground by a heavy rainfall. By using the 11-year time period, many such occurrences are captured in the model results. Critical conditions for point sources, which occur during low flow and low dilution conditions, are simulated as well.

4.6 Model Calibration Process

First, the model was calibrated for hydraulics. The data from USGS gage 02486000 was used to calibrate the model hydraulically. The data from this gage was compared to the hydraulic output from the corresponding waterbody segment within the model. A sample of these results is included in Appendix A, Graphs A-1 through A-3.

The water quality data available are such that water quality calibration was difficult. As described in section 2.2 the water quality data available are instantaneous samples collected approximately every two months. The data available are not sufficient for calibration purposes. Instead, MDEQ contacted researchers and agricultural experts to quantify representative pathogen loads entering the stream.

4.7 Existing Loading

Appendix A includes two graphs of the model results showing the instream fecal coliform concentrations for reach 03180002018 of the Pearl River. Graph A-4 shows the fecal coliform levels in the stream during the 11-year modeling period. The graph shows a 30-day geometric mean of the data. There have been 17 standards violations in 11 years according to the model. The straight line at 200 counts per 100 ml indicates the water quality standard for the stream.

Graph A-5 shows the 30-day geometric mean of the fecal coliform levels after the reduction scenario has been modeled. The scale matches the previous graph for comparison purposes. The graph indicates that there are no violations of the water quality standard for the monitored segment after the reduction scenario is applied.

5.0 ALLOCATION

The allocation for this TMDL involves a wasteload allocation for point sources and a load allocation for nonpoint sources necessary for attainment of water quality standards. Point source contributions enter the stream directly in the appropriate reach. The nonpoint fecal coliform sources used in the model have two different transportation methods. Cows in the stream and failing septic tanks were modeled as direct inputs to the stream. The other nonpoint source contributions were applied to land area on a counts per day per acre basis. The fecal coliform bacteria applied to land are subject to a die-off rate and an absorption rate before it enters the stream. The TMDL was calculated based on modeling estimates which are referenced in Appendix A.

5.1 Wasteload Allocations

Point sources within the watershed discharging at their current level are subject to some reduction from their current level of fecal coliform contribution. The contribution of point sources was considered on a subwatershed basis for the model. Within each subwatershed, the modeled contribution of each discharger was based on the facility's discharge monitoring data and other records of past performance. In several cases, the fecal coliform contribution from a facility is much greater than the permitted limit of 200 counts per 100 ml. As part of this TMDL, all wastewater treatment facilities will be required to meet water quality standards at the end of their pipe. All wastewater treatment facilities with current NPDES Permits that meet water quality standards should take steps to comply with their current permits. Table 5.1.1 lists the point source contributions, on a subwatershed basis, along with their existing load, allocated load, and percent reduction.

Table 5.1.1 Wasteload Allocations

Subwatershed	Existing Flow (cfs)	Existing Load (counts/hr)	Allocated Flow (cfs)	Allocated Load (counts/hr)	Percent Reduction
03180002002	0.13	2.74E+07	0.13	2.74E+07	0%
03180002003	1.08	1.04E+09	1.08	2.20E+08	79%
03180002006	0.21	3.84E+09	0.21	4.25E+07	99%
03180002010	4.60	9.35E+09	4.60	9.35E+08	90%
03180002014	0.26	5.06E+08	0.26	5.24E+07	90%
03180002015	0.20	8.25E+07	0.20	4.00E+07	52%
03180002018	9.60	1.73E+10	9.60	1.95E+09	89%
03180002019	0.78	1.59E+08	0.78	1.59E+08	0%
03180002020	0.02	4.41E+06	0.02	4.41E+06	0%
03180002022	58.22	1.35E+10	58.22	1.18E+10	12%

5.2 Load Allocations

Nonpoint sources that contribute to fecal coliform accumulation within the Pearl River Watershed are subject to reduction from their current level of contribution. Reductions in the load allocation for this TMDL involve two different types of nonpoint sources: cattle access to streams and septic tanks. Contributions from both of these sources are input into the model in a manner similar to point source input, with a flow and fecal coliform concentration in counts per hour. Table 5.2.1 lists the nonpoint source contributions due to cattle access to streams, on a subwatershed basis, along with their existing load, allocated load, and percent reduction. Table 5.2.2 gives the same parameters for contributions due to septic tank failure.

Table 5.2.1 Fecal Coliform Loading Rates for Nonpoint Source Contribution of Cattle Access to Streams

Subwatershed	Existing Flow (cfs)	Existing Load (counts/hr)	Allocated Flow (cfs)	Allocated Load (counts/hr)	Percent Reduction
03180002001	4.70E-05	1.80E+09	1.17E-05	4.49E+08	75%
03180002002	5.67E-04	2.17E+10	1.42E-04	5.42E+09	75%
03180002003	1.35E-04	5.16E+09	3.38E-05	1.29E+09	75%
03180002004	1.65E-06	6.30E+07	4.12E-07	1.58E+07	75%
03180002005	1.24E-05	4.73E+08	3.09E-06	1.18E+08	75%
03180002006	4.26E-04	1.63E+10	1.06E-04	4.06E+09	75%
03180002007	5.46E-05	2.09E+09	1.36E-05	5.22E+08	75%
03180002008	2.12E-04	8.09E+09	5.30E-05	2.02E+09	75%
03180002009	1.81E-04	6.93E+09	4.53E-05	1.73E+09	75%
03180002010	3.16E-04	1.21E+10	7.90E-05	3.02E+09	75%
03180002011	1.26E-04	4.82E+09	3.15E-05	1.21E+09	75%
03180002012	9.33E-05	3.56E+09	2.33E-05	8.91E+08	75%
03180002013	2.08E-04	7.96E+09	5.21E-05	1.99E+09	75%
03180002014	2.18E-04	8.34E+09	5.46E-05	2.09E+09	75%
03180002015	2.03E-04	7.74E+09	5.07E-05	1.94E+09	75%
03180002016	1.57E-05	6.00E+08	3.92E-06	1.50E+08	75%
03180002017	1.55E-04	5.94E+09	3.88E-05	1.48E+09	75%
03180002018	1.74E-03	6.67E+10	4.36E-04	1.67E+10	75%
03180002019	1.72E-04	6.58E+09	4.30E-05	1.64E+09	75%
03180002020	1.09E-04	4.15E+09	2.72E-05	1.04E+09	75%
03180002021	1.26E-04	4.81E+09	3.15E-05	1.20E+09	75%
03180002022	2.50E-04	9.56E+09	6.25E-05	2.39E+09	75%
Total	**5.37E-03**	**2.05E+11**	**1.34E-03**	**5.13E+10**	**75%**

Table 5.2.2 Fecal Coliform Loading Rates for Failing Septic Tanks (50% WLA and 50% LA)

Subwatershed	Existing Flow (cfs)	Existing Load (counts/hr)	Allocated Flow (cfs)	Allocated Load (counts/hr)	Percent Reduction
03180002001	2.04E-02	2.07E+08	1.02E-02	1.04E+08	50%
03180002002	2.56E-01	2.60E+09	1.28E-01	1.30E+09	50%
03180002003	5.87E-02	5.97E+08	2.93E-02	2.99E+08	50%
03180002004	7.27E-04	7.40E+06	3.64E-04	3.70E+06	50%
03180002005	5.35E-03	5.44E+07	2.67E-03	2.72E+07	50%
03180002006	2.28E-01	2.32E+09	1.14E-01	1.16E+09	50%
03180002007	1.45E-02	1.47E+08	7.23E-03	7.36E+07	50%
03180002008	5.88E-02	5.98E+08	2.94E-02	2.99E+08	50%
03180002009	5.44E-02	5.54E+08	2.72E-02	2.77E+08	50%
03180002010	9.65E-02	9.82E+08	4.83E-02	4.91E+08	50%
03180002011	6.69E-02	6.81E+08	3.35E-02	3.40E+08	50%
03180002012	8.74E-02	8.90E+08	4.37E-02	4.45E+08	50%
03180002013	1.69E-01	1.72E+09	8.47E-02	8.62E+08	50%
03180002014	1.68E-01	1.71E+09	8.40E-02	8.55E+08	50%
03180002015	9.10E-02	9.26E+08	4.55E-02	4.63E+08	50%
03180002016	3.21E-02	3.27E+08	1.60E-02	1.63E+08	50%
03180002017	6.75E-02	6.87E+08	3.37E-02	3.43E+08	50%
03180002018	7.58E-01	7.71E+09	3.79E-01	3.85E+09	50%
03180002019	1.64E-01	1.67E+09	8.22E-02	8.36E+08	50%
03180002020	1.34E-01	1.36E+09	6.68E-02	6.80E+08	50%
03180002021	1.17E-01	1.19E+09	5.84E-02	5.94E+08	50%
03180002022	3.13E-01	3.19E+09	1.57E-01	1.59E+09	50%
Total	**2.96E+00**	**3.01E+10**	**1.48E+00**	**1.51E+10**	**50%**

Nonpoint fecal coliform loading due to cattle grazing; land application of manure produced by confined dairy cattle, hogs, and poultry; wildlife; and urban development are also included in the load allocation. Currently, no reduction is required for these contributors in order for the Pearl River to achieve water quality standards. Daily fecal coliform loading rates for each landuse are given in Table 5.2.3. The total accumulation for each landuse type was determined by combining the contributions from each subwatershed. For example, the loading rate for forests was determined by combining all of the forest contributions from each of the five subwatersheds. The loading rates are constant throughout the year for forest, cropland, and urban land. The loading rates for pastureland vary for each month. However, in the table, the given pastureland rate is based on an average of the monthly accumulation rates.

Table 5.2.3 Number of Bacteria Applied to Land, Available for Surface Runoff, in Counts per Day

Subwatershed	Urban & Barren	Forest & Wetland	Cropland	Pastureland	Total
03180002001	7.96E+06	1.77E+11	1.92E+10	5.13E+12	5.33E+12
03180002002	2.15E+09	1.90E+12	7.57E+10	6.24E+13	6.44E+13
03180002003	7.20E+09	4.13E+11	2.77E+10	1.49E+13	1.54E+13
03180002004	3.90E+07	7.97E+09	0.00E+00	1.83E+11	1.91E+11
03180002005	6.82E+08	4.30E+10	1.81E+09	1.35E+12	1.40E+12
03180002006	2.22E+09	1.39E+12	4.16E+10	4.55E+13	4.70E+13
03180002007	6.80E+07	1.68E+11	1.91E+10	7.34E+12	7.53E+12
03180002008	2.12E+08	7.67E+11	1.40E+10	2.89E+13	2.97E+13
03180002009	1.39E+08	6.23E+11	1.82E+09	2.52E+13	2.58E+13
03180002010	5.42E+09	8.08E+11	4.52E+10	4.43E+13	4.52E+13
03180002011	5.79E+07	3.56E+11	1.15E+10	1.48E+13	1.51E+13
03180002012	7.25E+08	2.83E+11	1.96E+10	7.55E+12	7.85E+12
03180002013	1.96E+08	7.51E+11	2.53E+10	1.83E+13	1.91E+13
03180002014	1.98E+09	9.18E+11	1.65E+10	1.96E+13	2.06E+13
03180002015	2.39E+08	6.98E+11	8.69E+09	2.24E+13	2.31E+13
03180002016	8.68E+07	5.24E+10	1.72E+10	1.18E+12	1.25E+12
03180002017	8.06E+07	6.28E+11	1.06E+10	1.70E+13	1.77E+13
03180002018	5.72E+10	3.67E+12	3.67E+11	1.08E+14	1.12E+14
03180002019	2.63E+10	5.56E+11	6.84E+10	1.38E+13	1.44E+13
03180002020	5.42E+08	5.52E+11	2.85E+10	8.79E+12	9.38E+12
03180002021	7.41E+09	4.00E+11	1.93E+10	1.01E+13	1.06E+13
03180002022	3.42E+11	9.41E+11	1.39E+11	1.46E+13	1.61E+13
Total	**4.55E+11**	**1.61E+13**	**9.78E+11**	**4.92E+14**	**5.09E+14**

The scenario chosen for the load allocation in the Pearl River Watershed is a 75% reduction in contributions from cows in the stream, and a 50% reduction from failing septic tanks. The scenario also requires all permitted dischargers to meet water quality standards for disinfection. This scenario could be achieved by supporting BMP projects that promote fencing around streams in pastures, and by supporting education projects that encourage homeowners to properly maintain their septic tanks by routinely pumping them out, repairing broken field lines, and disinfecting the effluent from small individual onsite wastewater treatment plants.

5.3 Incorporation of a Margin of Safety

The two types of MOS development are to implicitly incorporate the MOS using conservative model assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS selected for this model is implicit. Running the model for 11 years with no violations of the water quality standard provides the primary component of the MOS. Ensuring compliance with the standard throughout all of the critical condition periods represented during the 11 years is a conservative practice. Another component of the MOS is the conservative assumption that in the model all of the fecal coliform bacteria discharged from failing septic tanks reaches the stream, while it is likely that only a portion of the bacteria will reach the stream due to filtration and die off during transport.

5.4 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. This stream, however, is designated for the use of contact recreation. For this use, the pollutant standard is constant throughout the year.

Because the model was established for an 11-year time span, it took into account all of the seasons within the calendar years from 1985 to 1995. The extended time period allowed the simulation of many different atmospheric conditions such as rainy and dry periods and high and low temperatures. It also allowed seasonal critical conditions to be simulated.

6.0 IMPLEMENTATION

6.1 Follow-Up Monitoring

MDEQ has adopted the Basin Approach to Water Quality Management, a plan that divides Mississippi's major drainage basins into five groups. During each yearlong cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Pearl River Basin, the Pearl River may receive follow-up monitoring to identify the improvement in water quality from the implementation of the strategies in this TMDL.

6.2 Reasonable Assurance

The fecal coliform reduction scenario used by this TMDL includes requiring all NPDES Permitted dischargers of fecal coliform to meet water standards for disinfection, along with reducing 75% of the cattle access to streams and 50% of the failing septic tanks in the watershed. Reasonable assurance for the implementation of the TMDL has been considered for both point and nonpoint source contributors.

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for fecal coliform bacteria. MDEQ will reject any NPDES Permit application that does not plan to meet water quality standards for disinfection. Education projects that teach best management practices should be used as a tool for reducing nonpoint source contributions. These projects may be funded by CWA Section 319 Nonpoint Source (NPS) Grants.

6.3 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper and a newspaper in the area of the watershed. The public will be given an opportunity to review the TMDL and submit comments. At the end of the 30-day period, MDEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public hearing.

If a public hearing is deemed appropriate, the public will be given a 30-day notice of the hearing to be held at a location near the watershed. That public hearing would be an official hearing of the Mississippi Commission on Environmental Quality, and would be transcribed.

All comments received during the public notice period and at any public hearings become a part of the record of this TMDL. All comments will be considered in the ultimate approval of this TMDL by the Commission on Environmental Quality and for submission of this TMDL to EPA Region IV for final approval.

DEFINITIONS

Ambient stations: a network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.

Assimilative capacity: the capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered waterbody may be based upon a similar, unaltered or least impaired, waterbody or on historical pre-alteration data.

Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody have their greatest potential for adverse effects.

Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.

Designated Use: use specified in water quality standards for each waterbody or segment regardless of actual attainment.

Discharge monitoring report: report of effluent characteristics submitted by a NPDES Permitted facility.

Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent: treated wastewater flowing out of the treatment facilities.

Fecal coliform bacteria: a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

Geometric mean: the *n*th root of the product of *n* numbers. A 30-day geometric mean is the 30th root of the product of 30 numbers.

Impaired Waterbody: any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Land Surface Runoff: water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for nonpoint source pollution from the land surface to the receiving stream.

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant. The load allocation is the value assigned to the summation of all cattle and land applied fecal coliform that enter a receiving waterbody. It also contains a portion of the contribution from septic tanks.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Nonpoint Source: pollution that is in runoff from the land. Rainfall, snowmelt, and other water that does not evaporate become surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come from land use activities such as agriculture; construction; silviculture;

surface mining; disposal of wastewater; hydrologic modifications; and urban development.

NPDES permit: an individual or general permit issued by the Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Point Source: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW): a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Scientific Notation (Exponential Notation): mathematical method in which very large numbers or very small numbers are expressed in a more concise form. The notation is based on powers of ten. Numbers in scientific notation are expressed as the following: *4.16 x 10^(+b)* and *4.16 x 10^(-b) [same as 4.16E4 or4.16E-4]*. In this case, *b* is always a positive, real number. The *10^(+b)* tells us that the decimal point is *b* places to the right of where it is shown. The *10^(-b)* tells us that the decimal point is *b* places to the left of where it is shown.
For example: $2.7\text{X}10^4$ = 2.7E+4 =27000 and $2.7\text{X}10^{-4}$ = 2.7E-4=0.00027.

Sigma (Σ): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, ($\mathbf{d}_1$, $\mathbf{d}_2$, $\mathbf{d}_3$) respectively could be shown as:

$$\sum_{i=1}^{3} d_i = d_1+d_2+d_3 = 24 + 123 + 16 = 163$$

Total Maximum Daily Load or TMDL: the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant. It also contains a portion of the contribution from septic tanks

Water Quality Standards: the criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality criteria: elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean

Water Act (33 U.S.C.1251 et seq.).

Watershed: the area of land draining into a stream at a given location.

ABBREVIATIONS

7Q10 .... Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period

BASINS .... Better Assessment Science Integrating Point and Nonpoint Sources

BMP .... Best Management Practice

CWA .... Clean Water Act

DMR .... Discharge Monitoring Report

EPA .... Environmental Protection Agency

GIS .... Geographic Information System

HUC .... Hydrologic Unit Code

LA .... Load Allocation

MARIS .... State of Mississippi Automated Resources Information System

MDEQ .... Mississippi Department of Environmental Quality

MOS .... Margin of Safety

NRCS .... National Resource Conservation Service

NPDES .... National Pollution Discharge Elimination System

NPSM .... Nonpoint Source Model

USGS .... United States Geological Survey

WLA .... Waste Load Allocation

REFERENCES

Horner, 1992. Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation. In R.W. Beck and Associates. Covington Master Drainage Plan. King County Surface Water Management Division, Seattle, WA.

Horsley & Whitten, Inc. 1996. Identification and Evaluation of Nutrient Bacterial Loadings to Maquoit Bay, Brunswick, and Freeport, Maine. Casco Bay Estuary Project.

Metccalf and Eddy. 1991. *Wastewater Engineering: Treatment, Disposal, Reuse*. 3rd Edition. McGraw-Hill, Inc., New York.

MDEQ. 1994. *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification.* Office of Pollution Control.

MDEQ. 1995. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Costal Waters*. Office of Pollution Control.

MDEQ. 1998. *Mississippi List of Waterbodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

MDEQ. 1998. *Mississippi 1998 Water Quality Assessment, Pursuant to Section 305(b) of the Clean Water Act*. Office of Pollution Control.

USEPA. 1998. *Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, Version 2.0 User's Manual*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

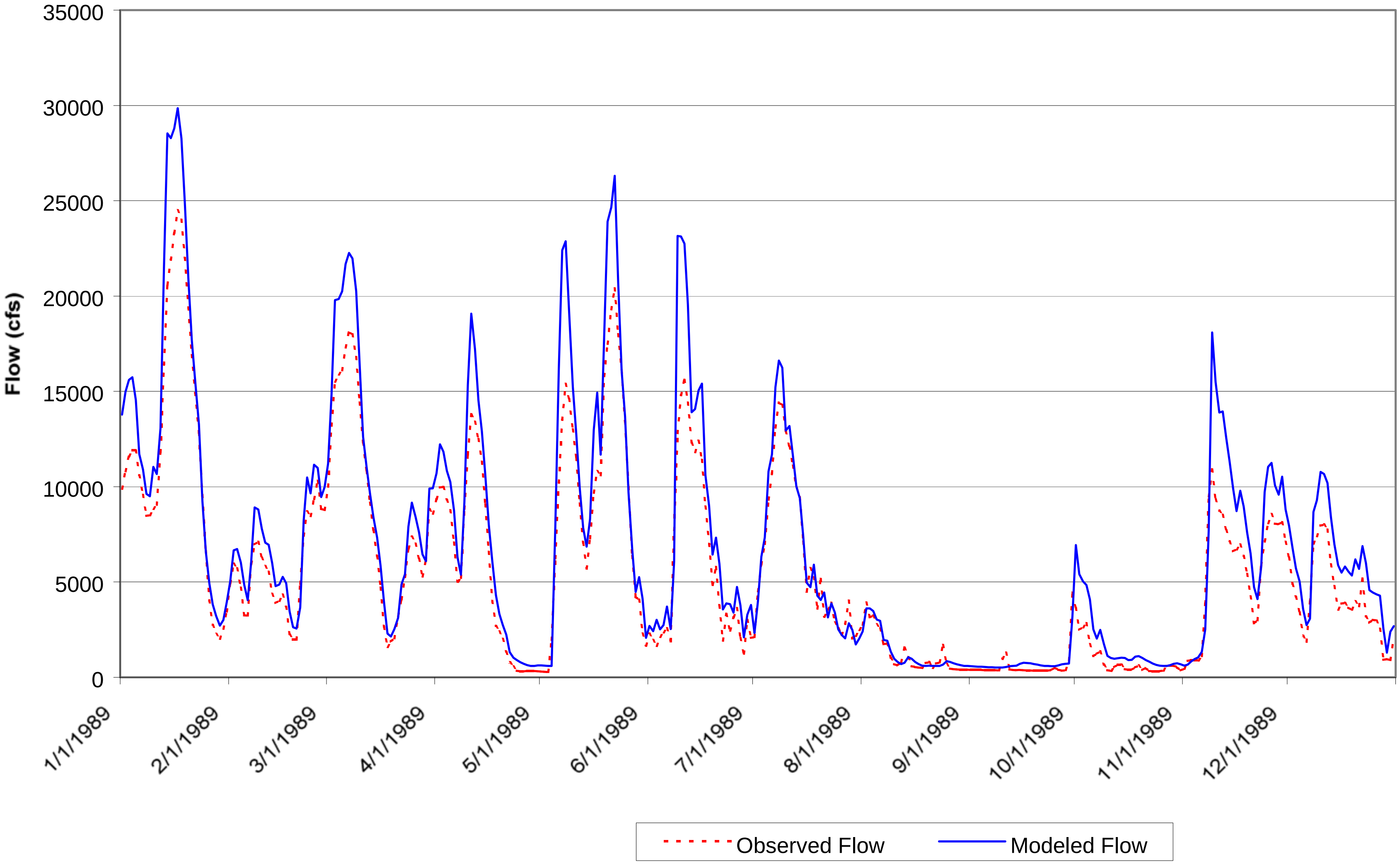
APPENDIX A

This appendix contains printouts of the various model run results. All graphs represent an 11-year time period, from January 1, 1985, to December 31, 1995. Graphs A-1 through A-3 show the modeled flow, in cubic feet per second, through reach 03180002018 compared to the actual USGS gage readings from the Pearl River near Byram. The second set of graphs show the 30-day geometric mean for fecal coliform concentrations in counts per 100 ml in the impaired section of the Pearl River, reach 03180002018. The graphs contain a reference line at 200 counts per 100 ml. Graph A-4 represents the existing conditions in the Pearl River. There are 17 violations of the fecal coliform standard on this graph. Graph A-5 represents the conditions in the Pearl River after the reduction scenario has been applied. Graphs A-4 and A-5 are shown with the same scale for comparison purposes.

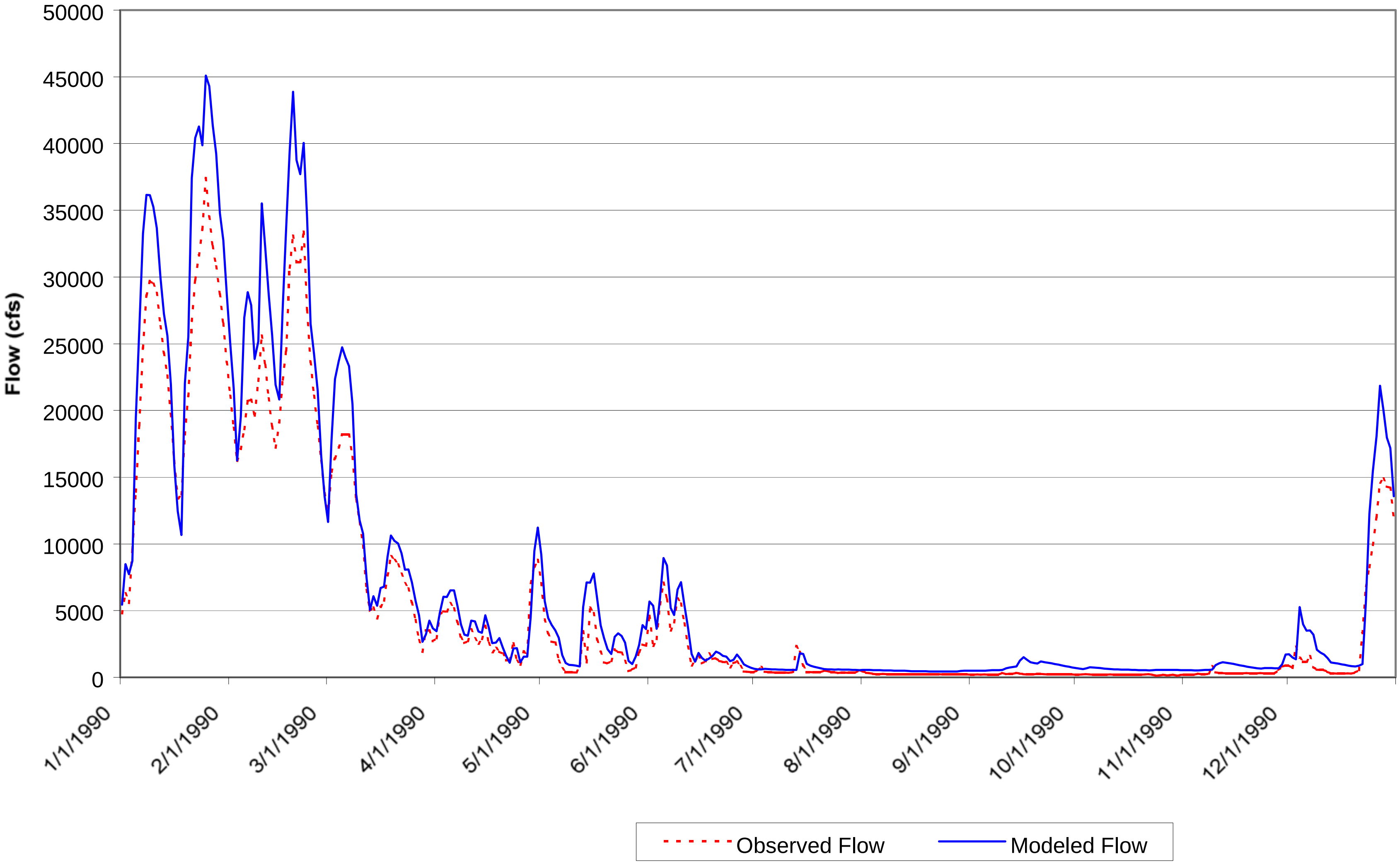
The TMDL calculated in this report represents the maximum fecal coliform load that can be assimilated by the waterbody segment during the critical 30-day period that will maintain water quality standards. The calculation of this TMDL is based on the critical hydrologic flow condition that occurred during the modeled time span. The graph showing the 30-day geometric mean of instream fecal coliform concentrations representing the allocated loading scenario (Graph A-5) was used to identify the critical condition. The TMDL calculation includes the sum of the loads from all identified point and nonpoint sources applied or discharged within the modeled watershed.

An individual TMDL calculation was prepared for each waterbody segment and drainage area included in this report. The numerical values for the wasteload allocation (point sources) and load allocation (nonpoint sources) for each waterbody segment or drainage area can be found on the waterbody segment identification pages at the beginning of this report.

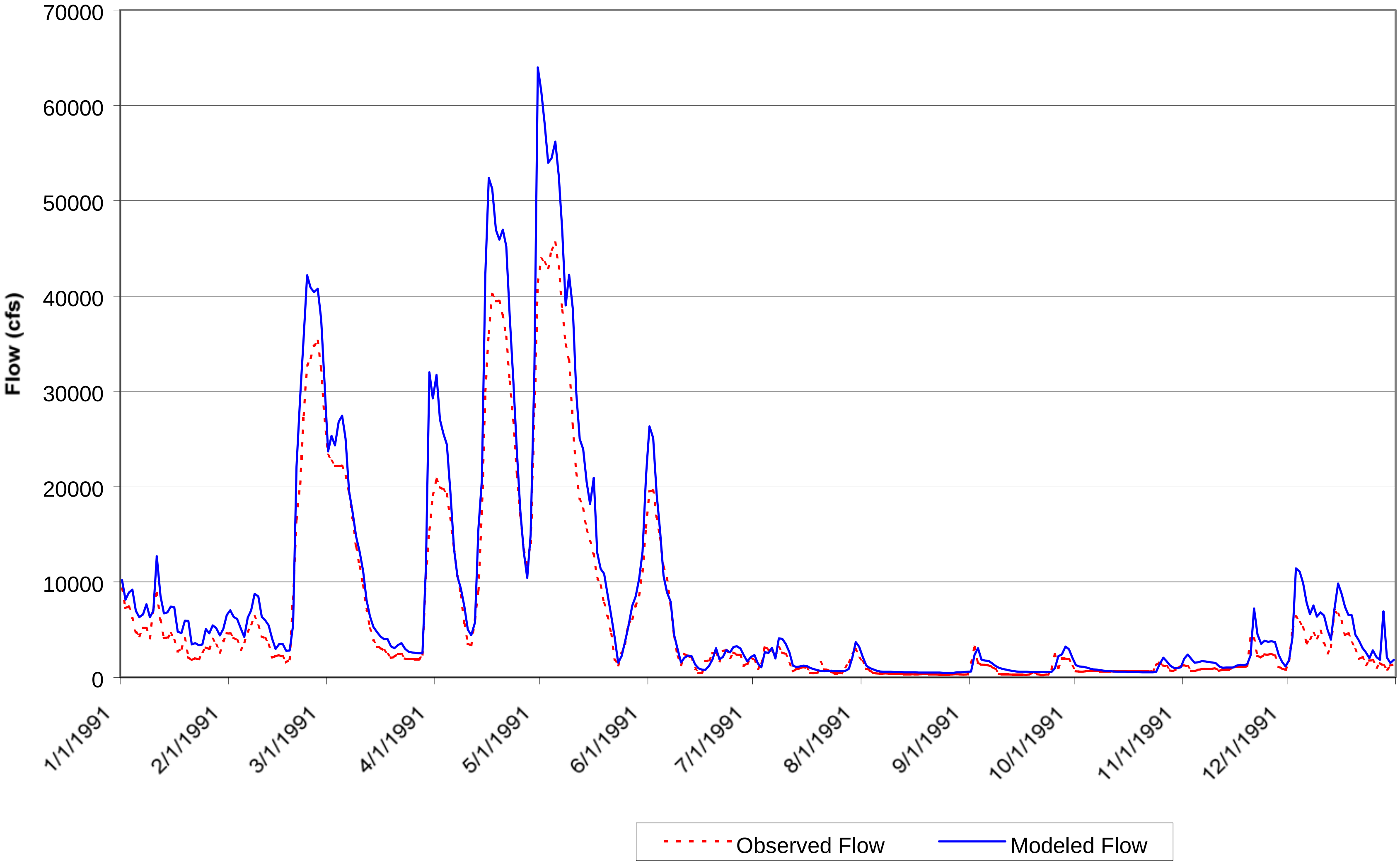
Graph A-1 Daily Flow Comparison between USGS Gage 02486000 and Reach 03180002018 for 1/1/1989 - 12/31/1989



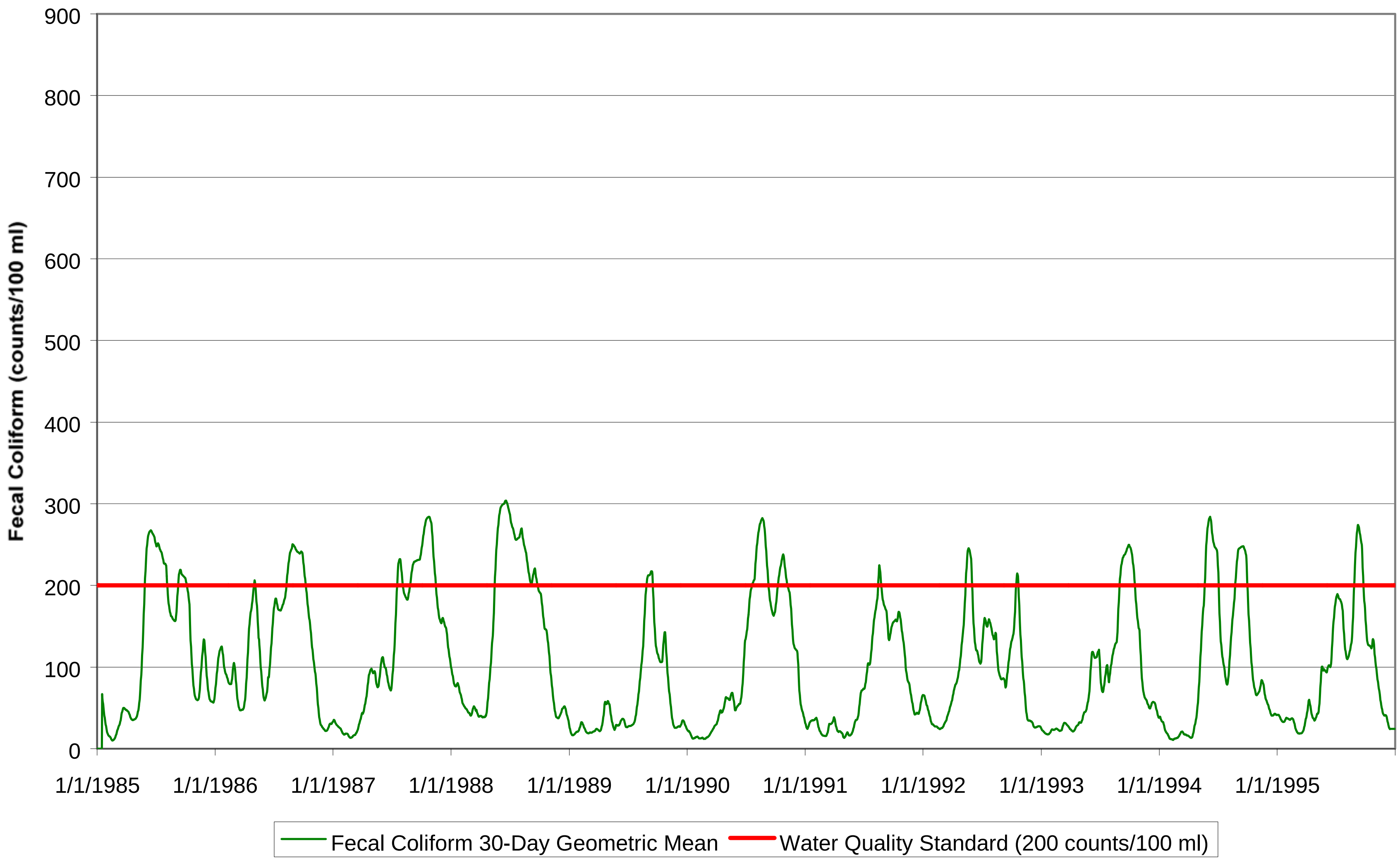
Graph A-2 Daily Flow Comparison between USGS Gage 02486000 and Reach 03180002018 for 1/1/1990 - 12/31/1990



Graph A-3 Daily Flow Comparison between USGS Gage 02486000 and Reach 03180002018 for 1/1/1991 - 12/31/1991



Graph A-4 Modeled Fecal Coliform Concentrations Under Existing Conditions for Reach 03180002018



Graph A-5 Modeled Fecal Coliform Concentrations After Application of Reduction Scenario for Reach 03180002018