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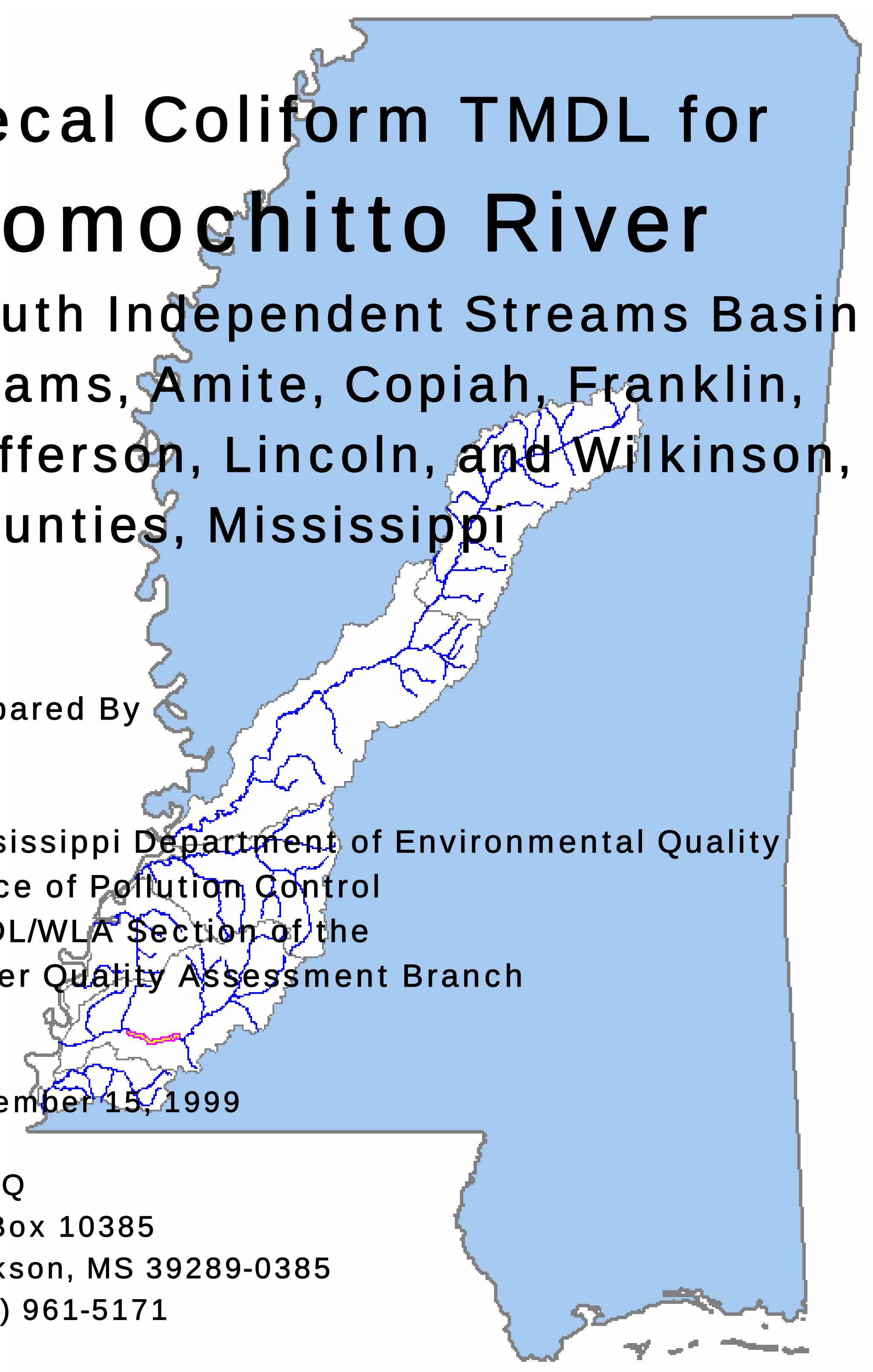

Fecal Coliform TMDL for

Homochitto River

South Independent Streams Basin Adams, Amite, Copiah, Franklin, Jefferson, Lincoln, and Wilkinson, Counties, Mississippi

Prepared By

Mississippi Department of Environmental Quality
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TMDL/WLA Section of the
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CONTENTS

MONITORED SEGMENT IDENTIFICATION

Name:	Homochitto River
Waterbody ID:	MSHMCHTRM
Location:	At Rosetta: from confluence with Richardson's Creek to confluence with Pretty Creek
County:	Franklin County, Mississippi
USGS HUC Code:	08060205
NRCS Watershed:	Border between 060 and 090
Length:	16 miles
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	112
NPDES Permits:	8 fecal coliform dischargers in the watershed (Table 3.1).
Pollutant Standard:	May through October - 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. November through April - Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.
Waste Load Allocation:	1.31E+ 12 counts/30 days (All dischargers must meet water quality standards for disinfection.)
Load Allocation:	6.16E+12 counts/30 days
Margin of Safety:	Implicit in conservative modeling assumptions
Total Maximum Daily Load (TMDL):	7.47E +12 counts/30 days (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 necessary to meet the fecal coliform standard)

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Richardson Creek Drainage Area
Waterbody ID:	MS465RE
Location:	Drainage Area near Freewoods
County:	Franklin County, Mississippi
USGS HUC Code:	08060205
NRCS Watershed:	060
Size:	14,000 Acres
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low Priority
Pollutant Standard:	May through October - 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. November through April - Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.
Waste Load Allocation:	2.98E+10 counts/30 days (All dischargers must meet water quality standards for disinfection.)
Load Allocation:	7.75E+10 counts/30 days
Margin of Safety:	Implicit in conservative modeling assumptions
Total Maximum Daily Load (TMDL):	10.7E+10 counts/ 30 days (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 necessary to meet the fecal coliform standard.

EVALUATED DRAINAGE AREA IDENTIFICATION

Name:	Dry Creek Drainage Area
Waterbody ID:	MS466E
Location:	Drainage Area near Garden City
County:	Franklin County, Mississippi
USGS HUC Code:	08060205
NRCS Watershed:	070
Size:	12,000 acres
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low Priority
Pollutant Standard:	May through October - 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. November through April - Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.
Waste Load Allocation:	2.55E+10 counts/30 days (All dischargers must meet water quality standards for disinfection.)
Load Allocation:	6.64E+10 counts/30 days
Margin of Safety:	Implicit in conservative modeling assumptions
Total Maximum Daily Load (TMDL):	9.19E+10 counts/30 days (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 necessary to meet the fecal coliform standard

EVALUATED SEGMENT IDENTIFICATION

Name:	Zeigler Creek Drainage Area
Waterbody ID:	MS013LPE
Location:	Drainage Area near Rosetta
County:	Franklin County, Mississippi
USGS HUC Code:	08060205
NRCS Watershed:	060
Size:	5,300 Acres
Use Impairment:	Secondary Contact Recreation
Cause Noted:	Fecal Coliform, an indicator for the presence of pathogenic organisms
Priority Rank:	Low Priority
Pollutant Standard:	May through October - 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. November through April - Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.
Waste Load Allocation:	1.13E+ 10 counts/30 days (All dischargers must meet water quality standards for disinfection.)
Load Allocation:	2.93E+10 counts/30 days
Margin of Safety:	Implicit in conservative modeling assumptions
Total Maximum Daily Load (TMDL):	4.06E+10 counts/30 days 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 necessary to meet the fecal coliform standard

EXECUTIVE SUMMARY

A segment of the Homochitto River has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as an impaired waterbody, due to fecal coliform bacteria. Three drainage areas of the Homochitto River have also been placed on the list as evaluated areas, due to fecal coliform bacteria. 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 counts per 100 ml, nor shall more than 10% 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 Homochitto River is a major waterbody in the South Independent Streams Basin. It flows east for approximately 85 miles in a southwestern direction from its headwaters to its confluence with the Mississipp River. This TMDL, however, has been developed for the monitored segment as well as the three evaluated drainage areas mentioned above. The BASINS Nonpoint Source Model (NPSM) was selected as the modeling framework for performing the TMDL allocations for this study. Daily flow values from the USGS gage 07292500 on the Homochitto River at Rosetta were used to calibrate the hydrologic flow for the watershed. The meteorological data used for this model were collected in Ruth, MS and Winsboro, LA. The representative hydrologic period used for this TMDL was January 1, 1985 through December 31, 1995.

Fecal coliform loading from nonpoint sources in the watershed were calculated based upon wildlife populations; numbers of cattle and hogs; information on livestock and manure management practices for the South Independent Streams 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 creeks. There are eight NPDES Permitted discharges that are located in the watershed and included as point sources in the model. Under existing conditions, output from the model indicates that there are frequent violations 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 Homochitto 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. Monitoring of all permitted facilities in the watersheds should be continued to ensure that compliance with permit limits is consistently attained. Second is the removal of 90% 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 60% 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 Homochitto River as being impaired by fecal coliform bacteria for a length of 16 miles as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. The impaired segment begins near Rosetta with the confluence of Richardson's Creek and ends with the confluence of Pretty Creek. This segment is listed as impaired because sufficient monitoring data is available to show that there are impairments in the segment. The location of the impaired segment is shown below.

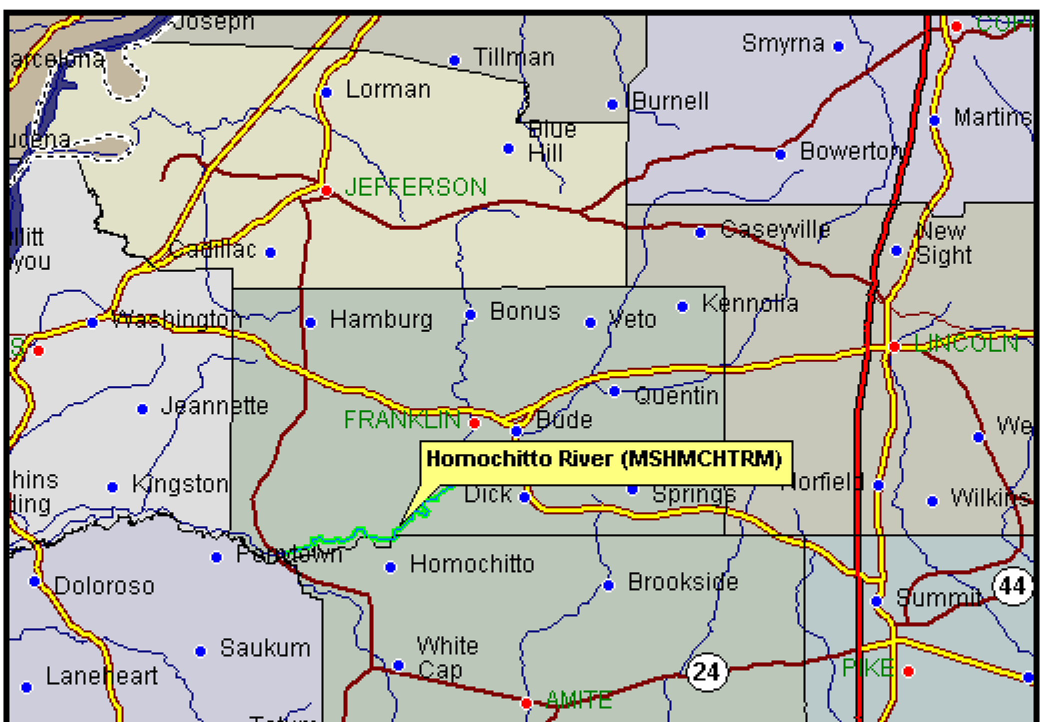

Figure 1.1 Location of the Impaired Segment of the Homochitto River

In order to analyze the sources of fecal coliform bacteria in the drainage areas of Richardson's Creek, Dry Creek, and Zeigler Creek, the areas were divided into separate subwatersheds. The subwatershed delineations were based primarily on an analysis of the Reach File 3 (RF3) stream network in the basin as well as a topographic analysis of the watershed. Figure 1.2 shows a map of the evaluated drainage areas.

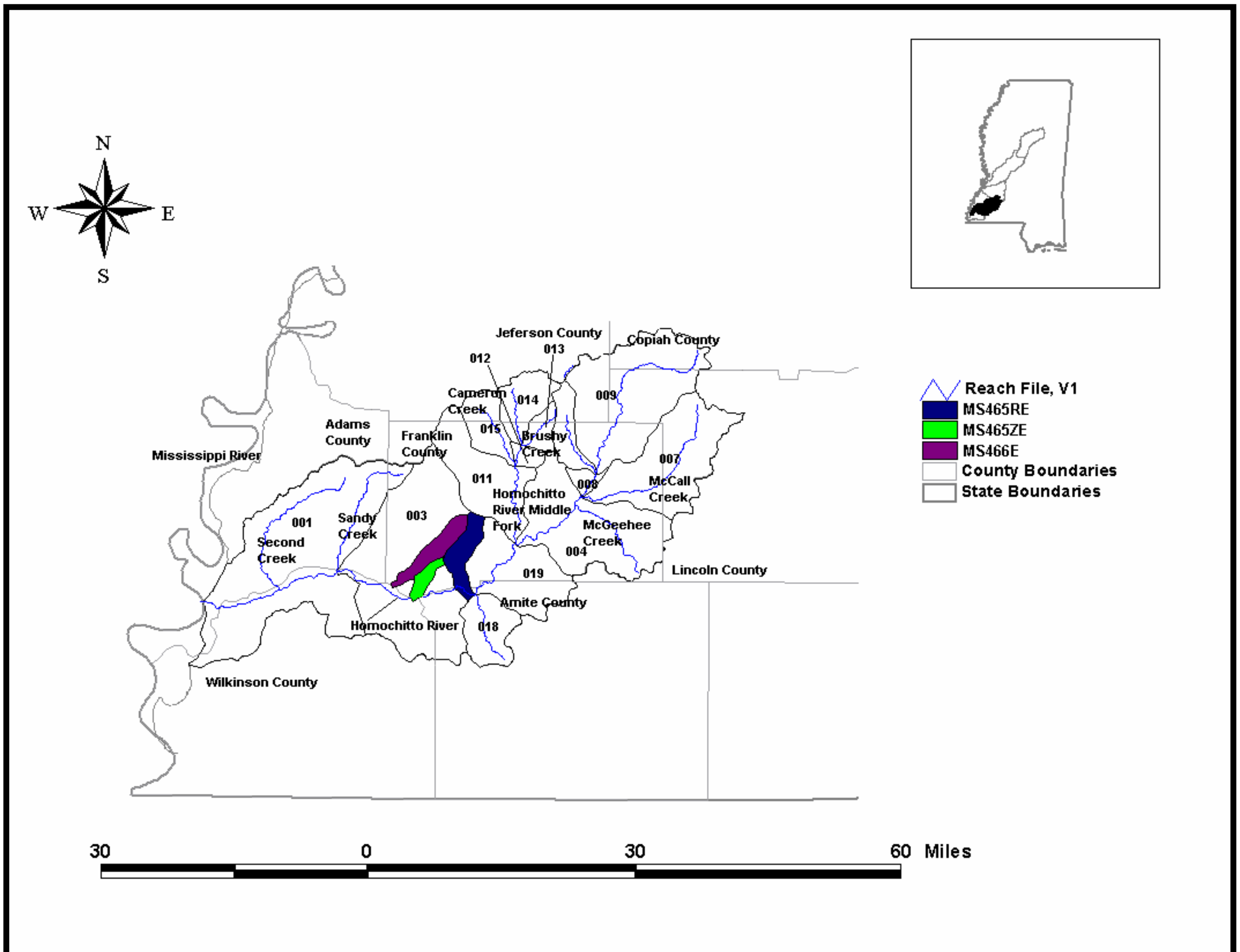

Figure 1.2 Evaluated waterbodies in Homochitto River Watershed

Evaluated Area ID	Evaluated Area Name	Area (Acres)	Use Listed
MS465RE	Richardson's Creek-DA	14,000	Secondary Contact Recreation
MS466E	Dry Creek-DA	12,000	Secondary Contact Recreation
MS465ZE	Zeigler Creek-DA	5,300	Secondary Contact Recreation

The impaired segment and evaluated waterbodies of the Homochitto River lie within the South Independent Streams Basin Hydrologic Unit Code (HUC) 08060205 in southwestern Mississippi. The Homochitto River Watershed included in the model totals approximately 609,000 acres; and lies within portions of Adam, Amite, Copiah, Wilkinson, Franklin, Jefferson, and Lincoln Counties Forest is the dominant landuse within this watershed. The landuse distribution for the watershed is given below in Figure 1.3.

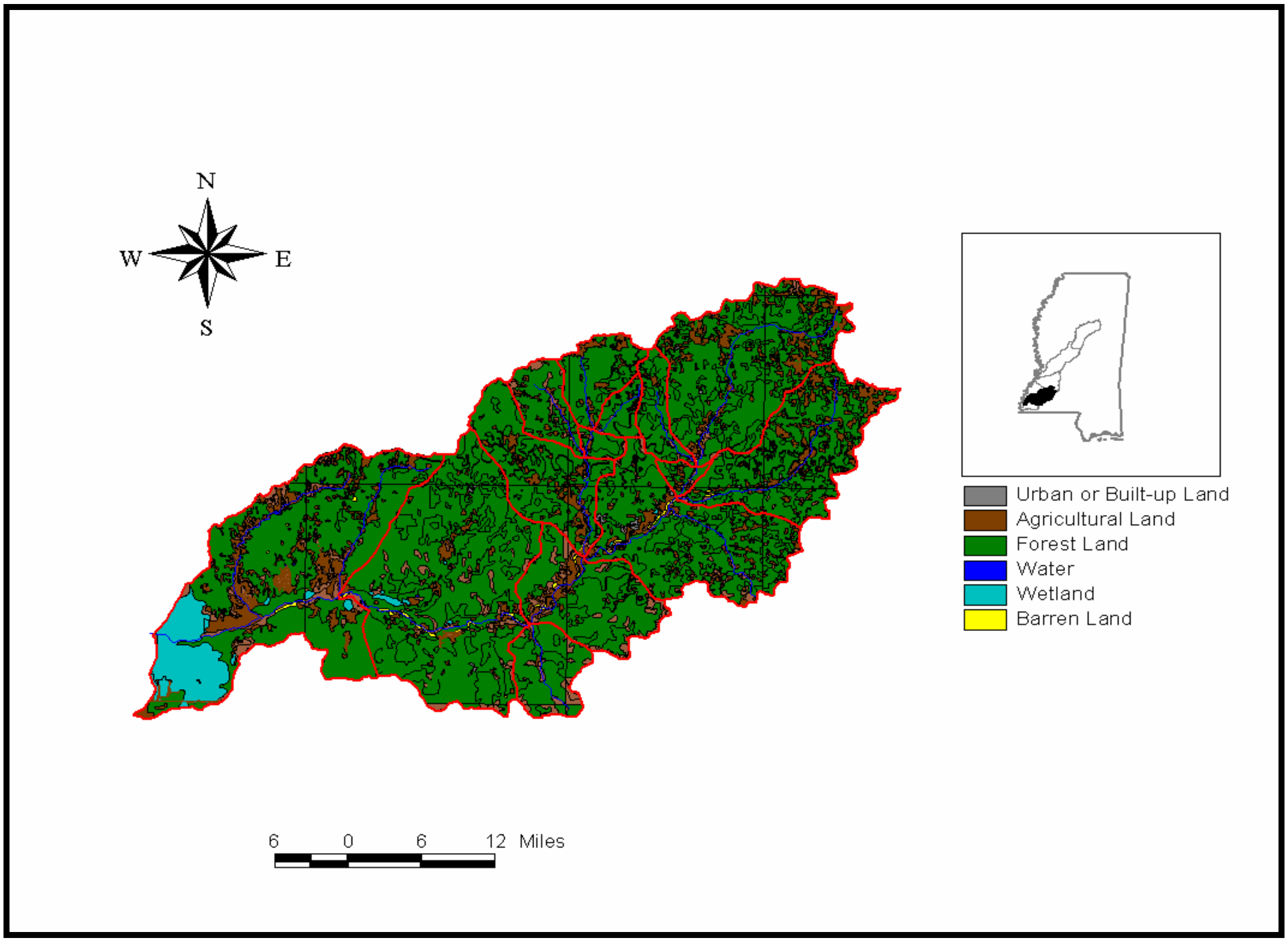

Figure 1.3 Homochitto River Landuse Distribution

The monitored section as well as the evaluated drainage areas are contained entirely within the watershed, 08060205003.

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 use for the Homochitto River, Richardson's Creek-DA, Dry Creek-DA, and Zeigler Creek-DA as defined by the regulations is Secondary Contact Recreation. Secondary Contact Recreation is defined as incidental contact with the water, including wading and occasional swimming.

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 from May through October 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, and that from November through April the fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 4000 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 wasteload 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 based upon the more stringent water quality criteria, a 30-day geometric mean of 200 colony counts per 100 ml during the months of May through October.

Because fecal coliform bacteria 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 Homochitto River show that high levels of fecal coliform bacteria impair the stream. There was one ambient station (07292500) operated by MDEQ where fecal coliform monitoring data were collected during the 11-year modeling period. 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 Homochitto River is partially supporting the use of secondary contact recreation due to the presence of fecal coliform bacteria. These conclusions were based on instantaneous data collected at station 07292500. Data collected at this station are listed below in Table 2.2.1

Table 2.2.1 Fecal Coliform Data reported in the Homochitto River, Station 07292500

Date	Flow (cfs)	Fecal Coliform (counts/100 ml)
10/08/91	276	***740***
01/29/92	2400	1900
04/09/92	936	180
07/15/92	438	300
10/09/92	347	53
01/19/93	531	150
04/06/93	1660	1300
07/21/93	460	***500***
11/10/93	460	120
01/25/94	743	33
04/21/94	942	180
07/07/94	934	190

Bold Italics indicate violations

2.2.2 Analysis of Instream Water Quality Monitoring Data

Statistical summaries of the water quality data discussed above are presented in Tables 2.2.2 and 2.2.3. Samples collected during May through October were compared to the recreational season instantaneous maximum standard of 400 counts per 100 ml in Table 2.2.2. Table 2.2.3 shows a comparison of the samples collected during November through April with the non-recreational season instantaneous maximum standard of 4000 counts per 100 ml. The percent exceedance was calculated by dividing the number of exceedances by the total number of samples. Because the samples are instantaneous, the percent exceedance does not represent the amount of time that the water quality is in violation.

Table 2.2.2 Recreational Season Statistical Summaries

Station Number	Number of Samples	Minimum Violation (count/100 ml)	Maximum Violation (count/100 ml)	Mean Violation (count/100 ml)	Number of Exceedances	Percent Instantaneous Exceedance
07292500	5	500	740	620	2	40%

Table 2.2.3 Non-Recreational Season Statistical Summaries

Station Number	Number of Samples	Minimum Violation (count/100 ml)	Maximum Violation (count/100 ml)	Mean Violation (count/100 ml)	Number of Exceedances	Percent Instantaneous Exceedance
07292500	7	-	-	-	0	0%

3.0 SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Homochitto 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.

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. Table 3.1. lists all of the fecal coliform dischargers according to the subwatershed in which the discharger is located, along with the NPDES Permit number and the receiving waterbody.

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. 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 permit limits of each facility included in the model are given in Table 3.1.

Table 3.1 Inventory of Identified Point Source Dischargers

Facility Name	Subwatershed	NPDES Permit	Receiving Waterbody
Bude POTW	08060205004	MS0024651	Homochitto River
Clear Springs REC Area Dump	08060205003	MS0048232	Richardson Creek
Meadville POTW	08060205004	MS0026956	Homochitto River
Roxie POTW	08060205003	MS0024830	Wells Creek
Crosby POTW	08060205003	MS0020877	Redding Creek
Broadmoor Utilities	08060205004	MS0048046	St. Catherine Creek
Foresite Subdivision	08060205001	MS0029611	St. Catherine Creek
Highland North Subdivision	08060205001	MS0029629	St. Catherine Creek

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for the Homochitto River Watershed including:

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

The 608,727-acre Homochitto River watershed contains many different landuse types, including urban, forests, cropland, pasture, and wetlands. The landuse information is based on data collected by the State of Mississippi's Automated 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 Homochitto River was considered on a subwatershed basis. Table 3.2 shows the landuse distribution within each subwatershed in number of acres.

Table 3.2 Landuse Distribution in Number of Acres

Subwatershed	Cropland	Forest*	Urban**	Pasture	Total
08060205003	1,127	140,172	2,064	9,522	**152,885**
08060205004	757	28,310	750	4,938	**34,756**
08060205005	554	36,161	379	8664	**45,758**
08060205006	27	4,113	137	888	**5,165**
08060205007	1,802	5,7403	323	14,481	**74,008**
08060205008	65	2892	181	1006	**4,145**
08060205009	1,353	74,141	240	20,628	**96,362**
08060205010	54	13,351	342	1,722	**15,469**
08060205011	372	40,866	414	7,004	**48,656**
08060205012	40	4,169	0	314	**4,523**
08060205013	5	7,545	498	1,101	**9,150**
08060205014	103	17,747	0	4,367	**22,217**
08060205015	55	16,209	6	2,580	**18,851**
08060205018	130	23,481	1,155	1,267	**26,033**
08060205019	520	43,849	311	6,071	**50,751**
Total	**6,965**	**510,407**	**6,802**	**84,553**	**608,727**

*** Includes Wetlands ** Includes Barren**

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 Homochitto River Watershed. 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, which may be represented as a point source.

The use of individual onsite wastewater treatment plants was also considered. 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 Homochitto River watershed contributes to fecal coliform bacteria on the land surface. In the watershed 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 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 South Independent Streams Basin processed manure from confined hog and dairy cattle operations is collected in lagoons and routinely applied to pastureland in the months of March through May, October, and November. This manure is a potential contributor of bacteria to receiving waterbodies due to runoff produced during a rain event. Hog farms in the South Independent Streams 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 Homochitto 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.

3.2.6 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 the 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 Homochitto 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 cattle are deposited directly in the stream.

3.2.7 Urban Development

Urban areas include land classified as urban and barren. Even though only a small percentage of the watershed is classified as urban, the contribution of the urban areas to fecal coliform loading in the Homochitto River was considered. 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 based on sound scientific principles 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 Homochitto 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 Homochitto River TMDL model includes the listed sections of the creek as well as all the drainage areas that are upstream of the segments. Thus, all upstream contributors of bacteria are accounted for in the model. To obtain a spatial variation of the concentration of bacteria in the watershed, it was divided into 15 subwatersheds in an effort to isolate the major stream reaches in the watershed. This 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 this model. There are 8 NPDES Permitted facilities in the watershed which discharge fecal coliform bacteria. The discharge was added as a direct input into the appropriate reach of the waterbody. 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 waterbodies. Other sources are represented as an application rate to the land in the 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 at the same time, and all forest and wetland fecal coliform accumulations were combined for model input. The model inputs for fecal coliform loading due to point and nonpoint sources are calculated using assumptions about land management, septic systems, farming practices, and permitted point source contributions.

4.3.1 Failing Septic Systems

The number of failing septic systems used in the model was derived from the watershed area normalized population of Wilkinson, Adams, Amite, Copiah, Franklin, Lincoln, and Jefferson Counties. The percentage of the population on septic systems was determined from 1990 United States Census Data. Based on the best available information, a septic tank failure rate of 40% was assumed. This information was used to calculate the estimated number of failing septic tanks per watershed. The number of failing septic tanks also incorporates an estimate for the failing individual onsite wastewater treatment systems in the area.

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.

County	Wilkinson	Adams	Copiah	Lincoln	Amite	Franklin	Jefferson
Percent On Septic Systems	54%	30%	53%	59%	80%	71%	65%

4.3.2 Wildlife

Based on information provided by the Mississippi Department of Wildlife, Fisheries, and Parks, the deer population throughout the Homochitto River watershed was estimated to be 45 deer per square mile. The estimate 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.

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 fecal coliform spreadsheet estimates the concentration of bacteria that accumulates in the dry litter where poultry waste is collected. This is done by multiplying the daily number of chickens on farms by a fecal coliform production rate of 6.75E+07 counts/day/chicken (ASAE, 1998). 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 bacteria from cattle wading in streams 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.

4.3.7 Urban Development

The MARIS landuse data divide urban land into several categories. For the Homochitto 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. The literature values for each urban landuse category are given in Tables 4.2. Table 4.3. shows the urban landuse distribution within each subwatershed. In the model, fecal coliform loading rates on urban land are input as counts per acre per day.

Table 4.2 Urban Loading Rates, by Landuse (counts per acre per day)

High Density Area	Low Density Area	Transportation Area
1.54E+07	1.03E+07	2.00E+05

Table 4.3 Urban Landuse Distribution

Subwatershed	High Density Area (acres)	Low Density Area (acres)	Transportation (acres)	Total
08060205003	146	298	1666	**2110**
08060205004	120	338	293	**751**
08060205005	61	171	148	**380**
08060205006	22	62	54	**138**
08060205007	52	145	126	**323**
08060205008	29	81	71	**181**
08060205009	38	108	93	**239**
08060205010	55	154	134	**343**
08060205011	66	186	162	**414**
08060205012	0	0	0	**0**
08060205013	80	224	194	**498**
08060205014	0	0	0	**0**
08060205015	1	3	2	**6**
08060205018	185	520	450	**1155**
08060205019	50	140	121	**311**
Total	**905**	**2430**	**3514**	**6849**

4.4 Stream Characteristics

The stream characteristics given below in Table 4.4 describe the modeled impaired segment of the Homochitto River. The channel geometry and lengths for the segments are based on data available within the BASINS modeling system. The 7Q10 flow was determined from USGS data.

- Length 85 miles
- Average Depth 0.784 ft
- Average Width 58 ft
- Mean Flow 908 cfs
- Mean Velocity 0.94 f/s
- 7Q10 Flow 152 cfs
- Slope 0.000801 ft per ft

4.5 Selection of Representative Modeling Period

The model was run for 11 years, from January 1, 1984, through December 31, 1995. The first year of data were used to stabilize the model. 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

Several assumptions were made to determine the fecal coliform loading rates from the nonpoint source contributors. Many of these assumptions were incorporated into the fecal coliform spreadsheet. An effort was made to contact researchers and agricultural experts to give as much validity as possible to the assumptions made within the BASINS model. Model outputs were also compared to water quality monitoring data from the same time period in order to calibrate the fecal coliform loadings in the model. The loadings were adjusted so that modeled fecal coliform concentrations closely matched the monitoring data.

A set of input values for hydrologic parameters was established for the South Independent Streams Basin. This data set was applied to one gage (07292500) in the basin as a means of hydrologic calibration and validation. The hydrology calibration was performed by adjusting model parameters representing evapotranspiration, surface runoff, interflow, and groundwater flows. The weather data used for this model were collected in Ruth, MS except for reaches 08060205004-08060205010, which were collected in Winsboro, LA. The representative hydrologic period used for the TMDL was January 1, 1985, through December 31, 1995.

4.7 Existing Loading

Appendix A includes two graphs of the model results showing the instream fecal coliform concentrations for the impaired reach of the Homochitto River, 08060205003. Graph AB-1 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 25 standards violations in 11 years according to the model. The straight line at 200 counts per 100 mL is an indication of the standards limits for the stream.

Graph AB-2 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 two violations of the water quality standard.

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 in segments MSHMCHTRM, MS466E, MS465RE, and MS465ZE. Point source contributions enter the stream directly in the appropriate reach. Cows in the stream and failing septic tanks were modeled as direct inputs to the stream. Cows in the stream are nonpoint sources while failing septic tanks are both point and nonpoint sources. The other nonpoint source contributions were applied to land area on a count per day per acre basis. The fecal coliform bacteria applied to land are subject to a die-off rate and an absorption rate before entering 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 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. As part of this TMDL, these 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 lists the point source contributions, on a subwatershed basis, along with their existing load, allocated load, and percent reduction. The final WLA on the summary page also accounts for the portion of the failing septic tanks which have direct bypass to the stream.

Table 5.1 NPDES Fecal Coliform Contribution, by Subwatershed

Subwatershed	Existing Flow cfs	Existing Load counts/hr	Allocated Flow cfs	Allocated Load counts/hr	Reduction %
08060205003	0.313	1.07E+07	0.313	6.36E+06	**41**
08060205004	0.580	1.75E+07	0.580	1.18E+07	**32**
08060205005	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205006	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205007	0.015	3.15E+05	0.015	3.15E+05	**0**
08060205008	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205009	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205010	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205011	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205012	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205013	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205014	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205015	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205018	0.000	0.00E+00	0.000	0.00E+00	**0**
08060205019	0.000	0.00E+00	0.000	0.00E+00	**0**
Total	**0.909**	**2.85E+07**	**0.909**	**1.85E+07**	**35**

5.2 Load Allocations

Nonpoint sources that contribute to fecal coliform accumulation within Homochitto 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 failing septic tanks. Contributions from both of these sources are input into the model in a manner similar to point source input, with a flow in cubic feet per second and fecal coliform concentration in counts per hour. Table 5.2 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 5.3 gives the same parameters for contributions due to septic tank failure.

Table 5.2 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	Reduction %
08060205003	0.0002	7.27E+09	0.0000	7.27E+08	**90**
08060205004	0.0002	8.25E+09	0.0000	8.25E+08	**90**
08060205005	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205006	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205007	0.0004	1.55E+10	0.0000	1.55E+09	**90**
08060205008	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205009	0.0008	3.18E+10	0.0001	3.18E+09	**90**
08060205010	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205011	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205012	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205013	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205014	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205015	0.0000	0.00E+00	0.0000	0.00E+00	**0**
08060205018	0.0000	1.17E+09	0.0000	1.17E+08	**90**
08060205019	0.0001	3.32E+09	0.0000	3.32E+08	**90**
Total	**0.0018**	**6.73E+10**	**0.0002**	**6.73E+09**	**90**

Table 5.3 Fecal Coliform Loading Rates for Nonpoint Source and Point Contribution of Failing Septic Tanks

Subwatershed	Existing Flow cfs	Existing Load counts/hr	Allocated Flow cfs	Allocated Load counts/hr	Reduction %
08060205003	0.2191	2.23E+09	0.0876	8.92E+08	**60**
08060205004	0.0358	3.64E+08	0.0143	1.46E+08	**60**
08060205005	0.0500	5.08E+08	0.0200	2.03E+08	**60**
08060205006	0.0053	5.36E+07	0.0021	2.14E+07	**60**
08060205007	0.1707	1.74E+09	0.0683	6.95E+08	**60**
08060205008	0.0042	4.23E+07	0.0017	1.69E+07	**60**
08060205009	0.1861	1.89E+09	0.0744	7.58E+08	**60**
08060205010	0.0154	1.57E+08	0.0062	6.28E+07	**60**
08060205011	0.0498	5.07E+08	0.0199	2.03E+08	**60**
08060205012	0.0045	4.61E+07	0.0018	1.84E+07	**60**
08060205013	0.0087	8.89E+07	0.0035	3.56E+07	**60**
08060205014	0.0224	2.28E+08	0.0090	9.13E+07	**60**
08060205015	0.0191	1.94E+08	0.0076	7.77E+07	**60**
08060205018	0.0349	3.55E+08	0.0140	1.42E+08	**60**
08060205019	0.0598	6.09E+08	0.0239	2.44E+08	**60**
Total	**0.8859**	**9.01E+09**	**0.3544**	**3.61E+09**	**60**

Nonpoint fecal coliform loading due to cattle grazing; land application of manure produced by confined dairy cattle and hogs; wildlife; and urban development are also included in the load allocation. Currently, no reduction is required for these contributors in order for the Homochitto River to achieve water quality standards. Daily fecal coliform loading rates for each landuse are given in Table 5.4. 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 three 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 rate is based on an average of the monthly accumulation rates. The estimated loads shown in Table 5.4 are those applied to the land, while the total LA shown on he summary page is the load which enters the stream due to runoff.

Table 5.4 Daily Fecal Coliform Loading Rates by Subwatershed and Landuse Type in Counts per Day

Subwatershed	Urban **	Forest *	Cropland	Pastureland	Total
08060205003	2.04E+10	5.00E+12	4.02E+10	9.42E+12	**1.45E+13**
08060205004	5.38E+09	1.01E+12	2.70E+10	1.04E+13	**1.14E+13**
08060205005	2.72E+09	1.29E+12	1.98E+10	3.05E+11	**1.62E+12**
08060205006	9.83E+08	1.47E+11	9.64E+08	3.12E+10	**1.80E+11**
08060205007	2.32E+09	2.05E+12	6.43E+10	2.37E+13	**2.58E+13**
08060205008	1.30E+09	1.03E+11	2.32E+09	3.54E+10	**1.42E+11**
08060205009	1.72E+09	2.65E+12	4.83E+10	5.09E+13	**5.36E+13**
08060205010	2.45E+09	4.77E+11	1.93E+09	1.37E+11	**6.18E+11**
08060205011	2.97E+09	1.46E+12	1.33E+10	2.46E+11	**1.72E+12**
08060205012	0.00E+00	1.49E+11	1.43E+09	1.10E+10	**1.61E+11**
08060205013	3.57E+09	2.69E+11	1.79E+08	8.01E+10	**3.53E+11**
08060205014	0.00E+00	6.34E+11	3.68E+09	3.72E+11	**1.01E+12**
08060205015	4.31E+07	5.79E+11	1.96E+09	1.98E+11	**7.79E+11**
08060205018	8.29E+09	8.38E+11	4.64E+09	1.93E+12	**2.78E+12**
08060205019	2.23E+09	1.57E+12	1.86E+10	4.69E+12	**6.28E+12**
Total	**5.44E+10**	**1.82E+13**	**2.49E+11**	**1.02E+14**	**1.21E+14**

* Includes Wetland ** Includes Barren

The scenario chosen for the load allocation in the Homochitto River Watershed is a 90% reduction in contributions from cows in the stream, and a 60% 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 TMDL 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

Because the model was established for an eleven-year time span, it took into account all of the seasons within the calendar years from 1985 to 1995 for the monitored segment as well as the evaluated drainage area. 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 one-year cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the South Independent Streams Basin, the Homochitto 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 90% of the cattle access to streams and 60% 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 include plans 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 Natchez. 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 30^{th} 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: $2.7X10^{4}$ = 2.7E+4 =27000 and $2.7X10^{-4}$ = 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 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

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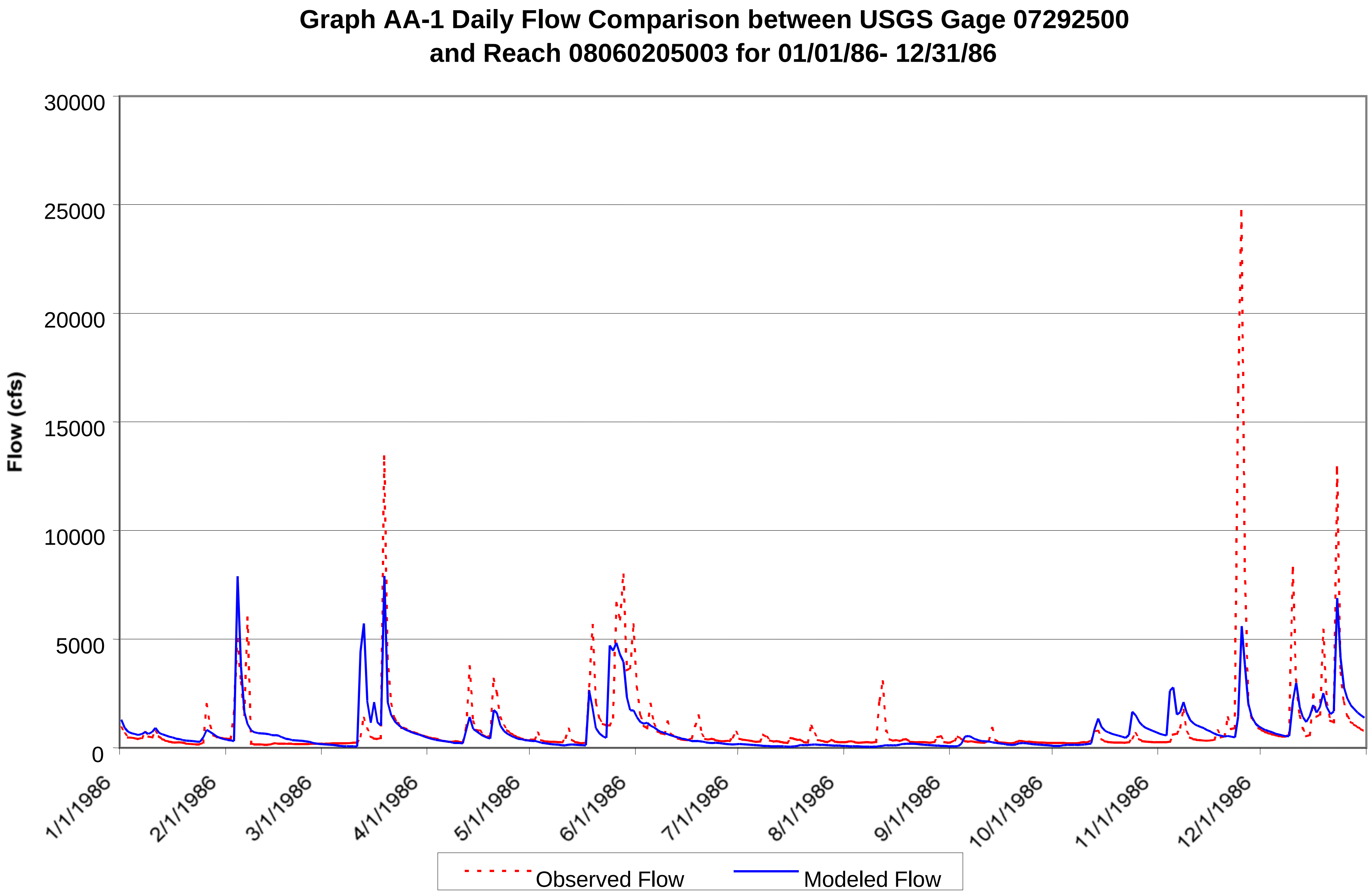
APPENDIX A

This appendix contains printouts of the various model run results. Graphs AA-1, AA-2, and AA-3 show the modeled flow, in cfs, through reach 08060205003 compared to the actual USGS gage readings from The Homochitto River at Rosetta, station 07292500. The graphs show data from selected years of the modeled period, 1986, 1989, and 1990.

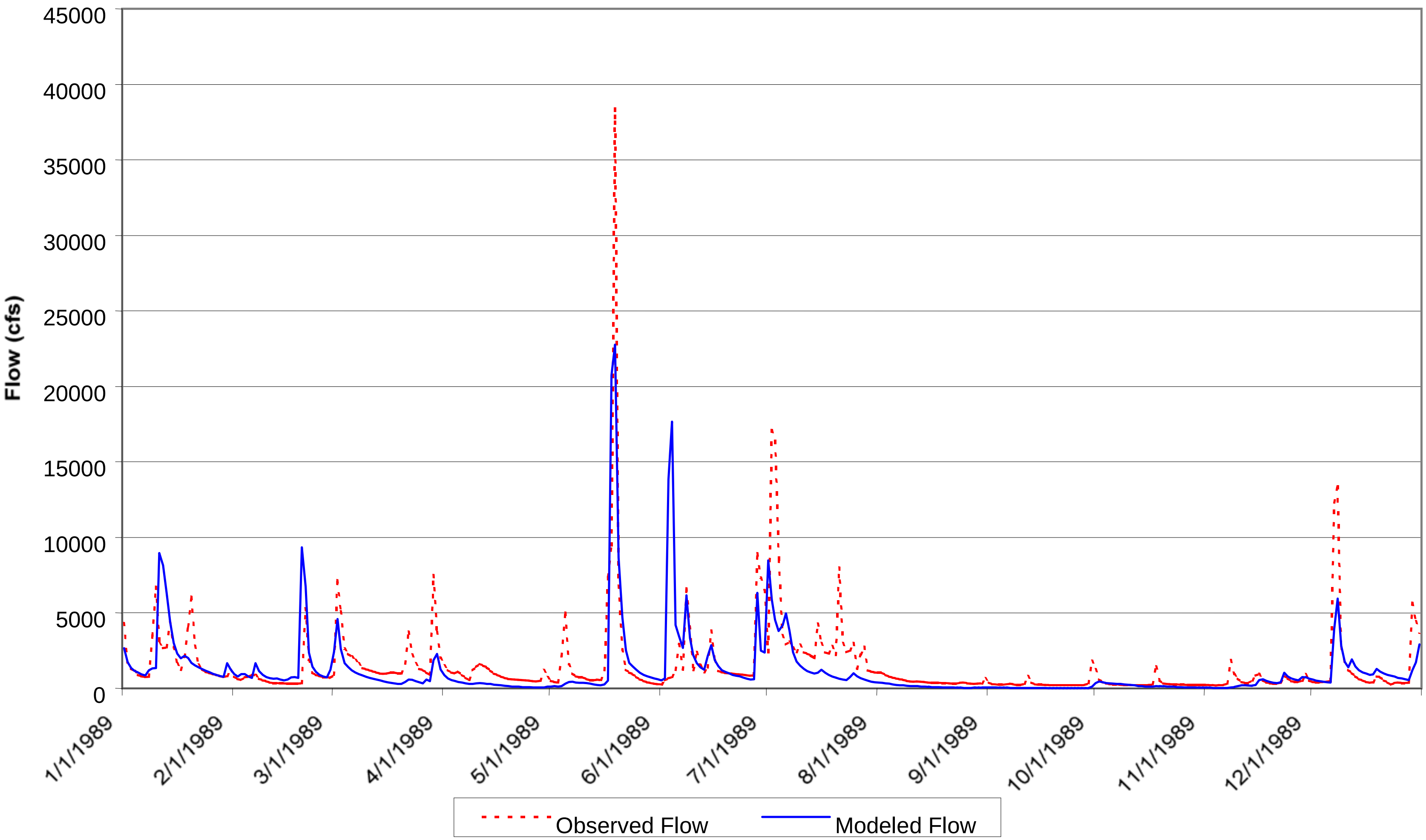
The second set of graphs show the 30-day geometric mean for fecal coliform concentrations in counts per 100 ml in the impaired section of the Homochitto River. These graphs represent an 11-year time period, from 1985 to 1995. The graphs contain a reference line at 200 counts per 100 ml. Graph AB-1 represents the existing conditions in the Homochitto River. There are 25 violations of the fecal coliform standard on this graph. Graph AB-2 represents the conditions in Homochitto River after the reduction scenario has been applied. Graphs AB-1 and AB-2 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 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.

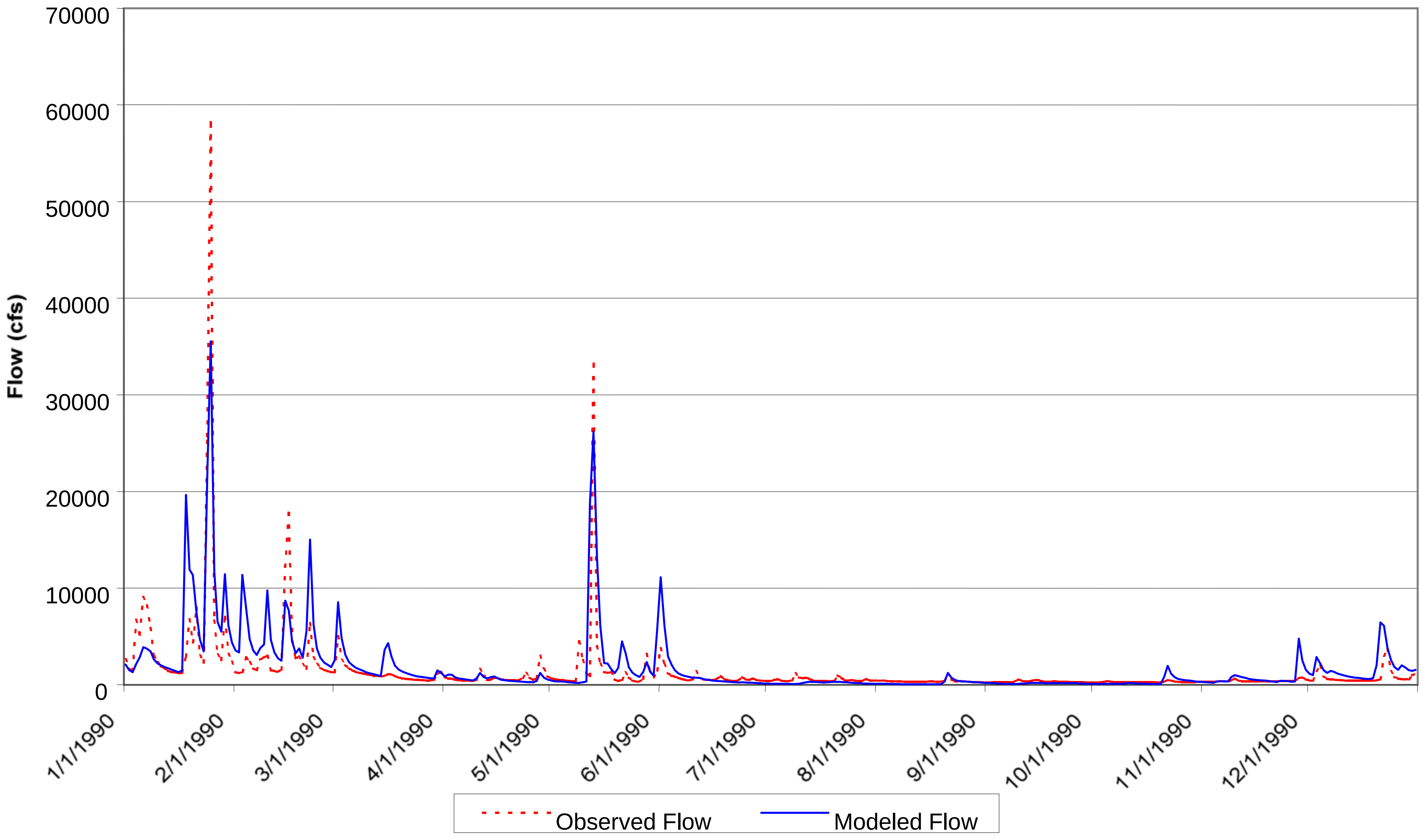
An individual TMDL calculation was prepared for each waterbody segment and drainage area included in this report. The numerical values for the wasteload allocation (point sources) and load allocation (nonpoint sources) for each waterbody segment or drainage area can be found on the waterbody segment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


Graph AA-1 Daily Flow Comparison between USGS Gage 07292500
and Reach 08060205003 for 01/01/86- 12/31/86
Flow (cfs)
30000
25000
20000
15000
10000
5000
0
1/1/1986
2/1/1986
3/1/1986
4/1/1986
5/1/1986
6/1/1986
7/1/1986
8/1/1986
9/1/1986
10/1/1986
11/1/1986
12/1/1986
Observed Flow
Modeled Flow

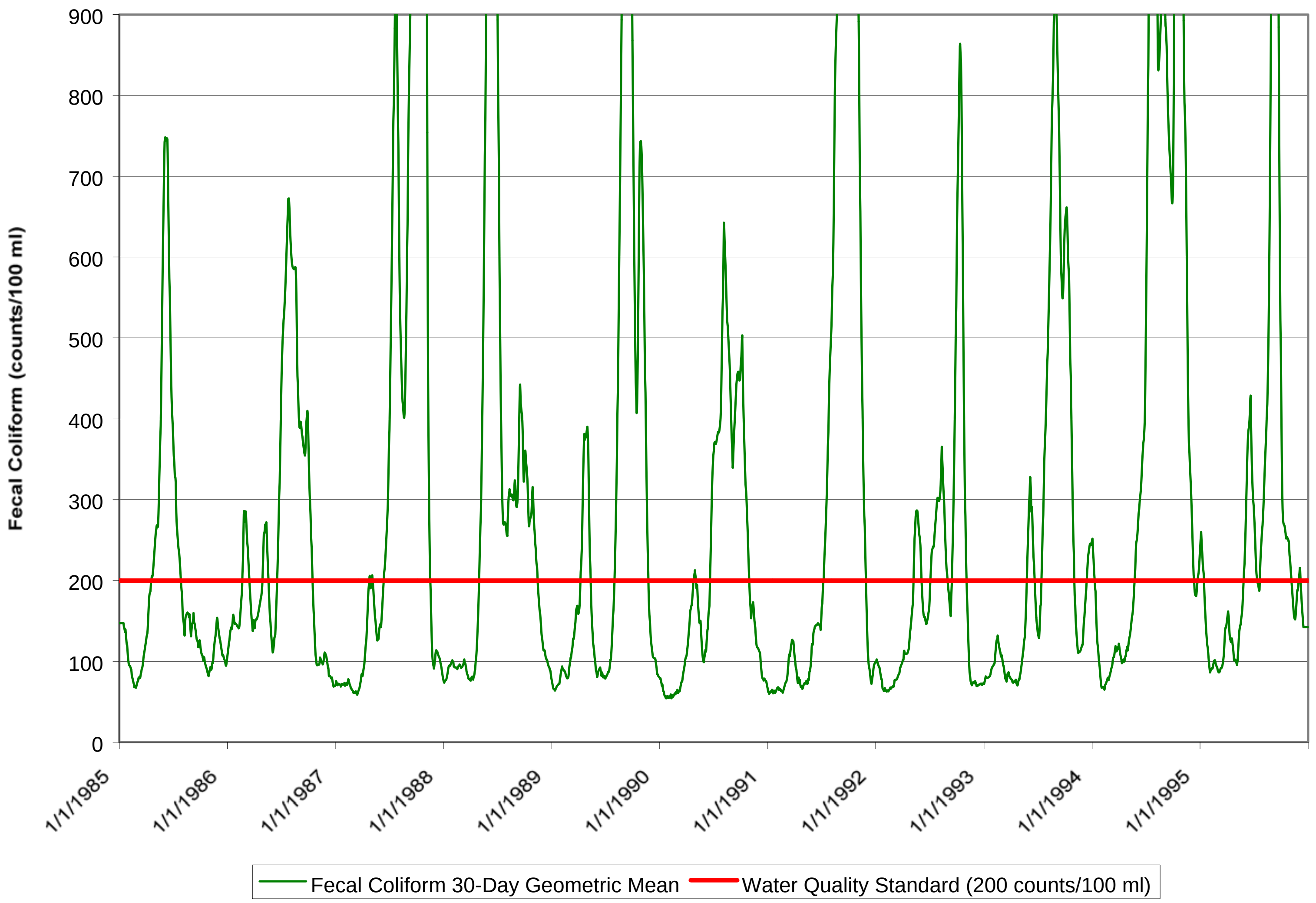
Graph AA-2 Daily Flow Comparison between USGS Gage 07292500 and Reach 08060205003 for 01/01/89- 12/31/89



Graph AA-3 Daily Flow Comparison between USGS Gage 07292500 and Reach 08060205003 for 01/01/90- 12/31/90



Graph AB-1 Modeled Fecal Coliform Concentrations Under Existing Conditions for Reach 08060205003



Graph AB-2 Modeled Fecal Coliform Concentrations After Application of Reduction Scenario for Reach 08060205003