FINAL REPORT
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Fecal Coliform TMDL for Yalobusha River

Yazoo River Basin

Grenada County, Mississippi

Prepared By

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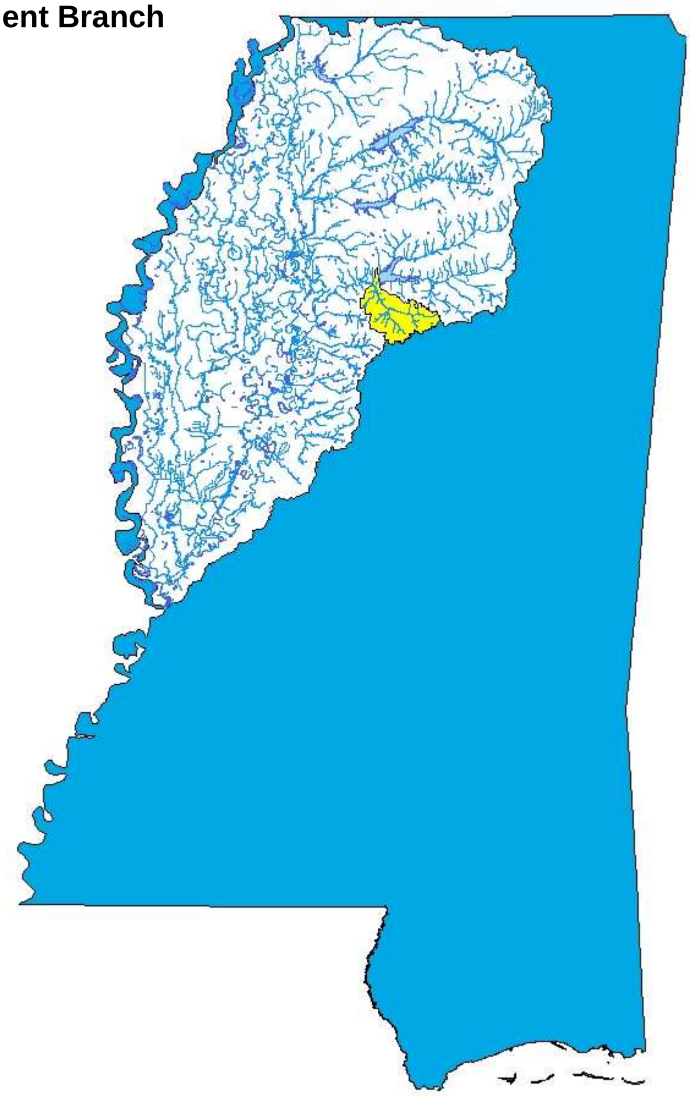

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Prefixes for fractions and multiples of SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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Table i. Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Yalobusha River segment 2	MS339M2	Grenada	08030205	Pathogens	Monitored
At Grenada: From confluence of Batupan Bogue to the Newsprint South outfall					

Table ii. Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Fecal Coliform	Secondary Contact	**May - October**: Fecal coliform colony counts not to exceed a geometric mean of 200 per 100ml, nor shall more than 10 percent of samples examined during any month exceed a colony count of 400 per 100ml. **November – April**: Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than 10 percent of the samples examined during any month exceed a colony count of 4000 per 100 ml.

Table iii. NPDES Facilities

Facility Name	NPDES ID	Subwatershed	Receiving Water
Duck Hill POTW	MS0020133	08030205012	Big Bogue Creek
Camp McCain	MS0029564	08030205013	Crowder Creek

Table iv. Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	9.50E+12	counts/30 day critical period	
LA	1.59E+14	counts/30 day critical period	
MOS	---	counts/30 day critical period	Implicit
TMDL	1.69E+14	counts/30 day critical period	

EXECUTIVE SUMMARY

A segment of the Yalobusha River has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as a monitored waterbody segment, due to fecal coliform bacteria. 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. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies 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.

Photo 1. Yalobusha River

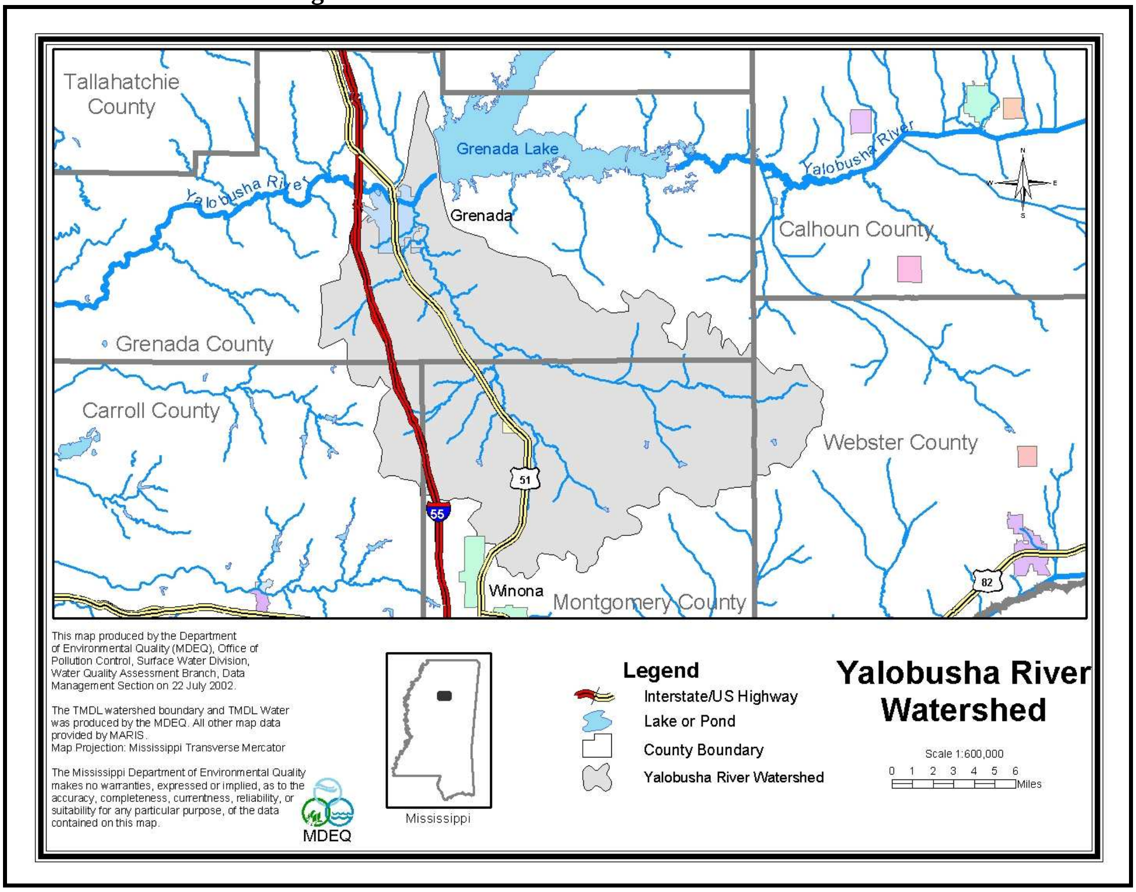
The Yalobusha River, photo 1, flows in a western direction from its headwaters near Thelma, Mississippi into Grenada Lake. The Yalobusha River then flows from Grenada Lake to the Yazoo River. This TMDL has been developed for one listed section of the Yalobusha River below Grenada Lake. The BASINS Nonpoint 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 Calhoun City, MS. The representative hydrologic period used for this TMDL was January 1985, through December 1998.

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 Yazoo River Basin; and urban development. The model was then calibrated against the limited fecal coliform data available. 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 other direct inputs to tributaries of the Yalobusha River. There are two NPDES Permitted discharge included as point sources in the model. Under the existing loading conditions, output from the model indicates violation of the fecal coliform standard in the waterbody. After applying a loading scenario with the model, there were no violations of the standard according to the model.

The permitted facilities currently have requirements in their NPDES Permits that require disinfection to meet standards, therefore, no changes are required to the existing NPDES permit. Monitoring of the permitted facilities in the Yalobusha River Watershed should continue to ensure that compliance with permit limits is consistently attained. The model assumed there is a 75% failure rate of septic tanks in the drainage area.

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. The location of the Yalabusha River Watershed is shown below.

Figure 1. Location of Yalobusha River Watershed



INTRODUCTION

1.1 Background

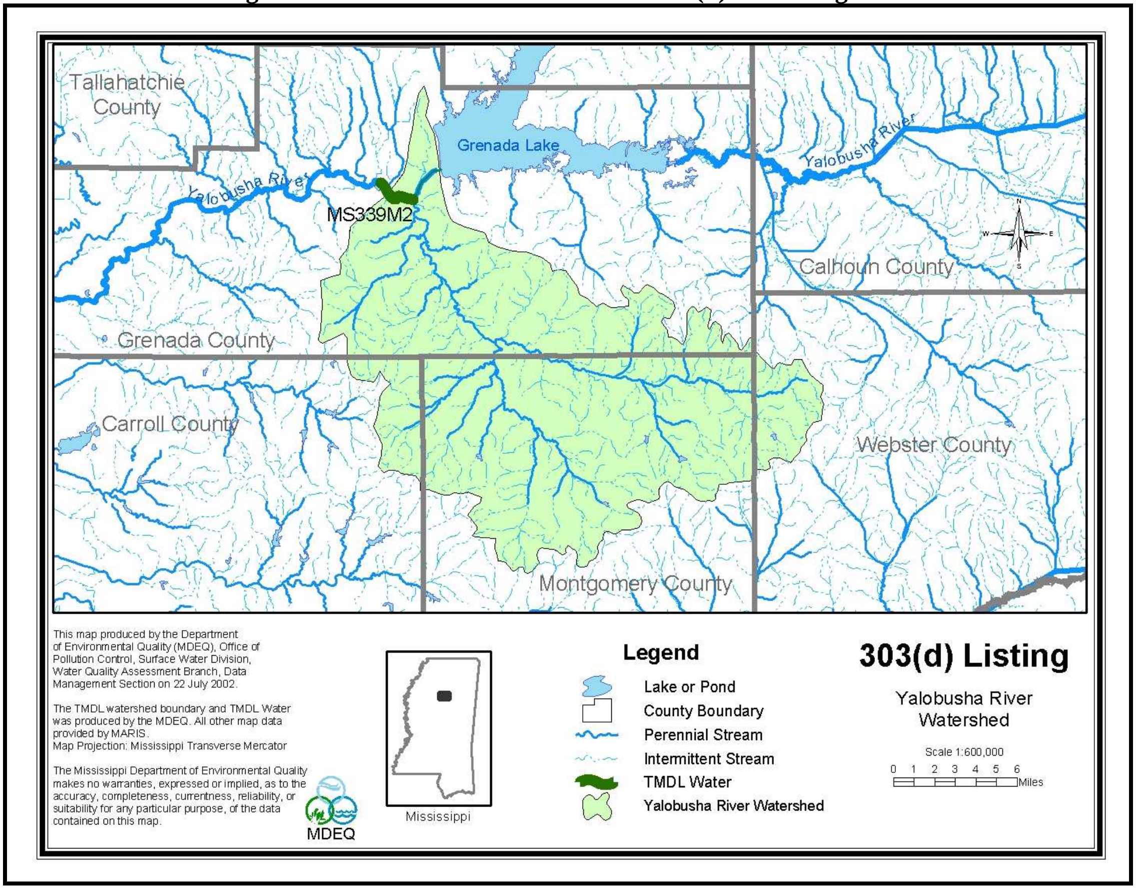
The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 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 nonpoint sources, maintain permit requirements for point sources, and restore and maintain the quality of water resources. The 303d listed section is shown in Figure 2.

The Yalobusha River Drainage Area is in the Yazoo River Basin Hydrologic Unit Code (HUC) 08030205 in northwest Mississippi. The drainage area is approximately 163,249 acres; and lies within portions of Grenada, Carroll, Montgomery, and Webster Counties. The watershed is rural. Forest and Pasture are the dominant landuses within the watershed. The landuse distribution is shown in Table 1.

Table 1. Landuse Distribution for the Yalobusha River Watershed

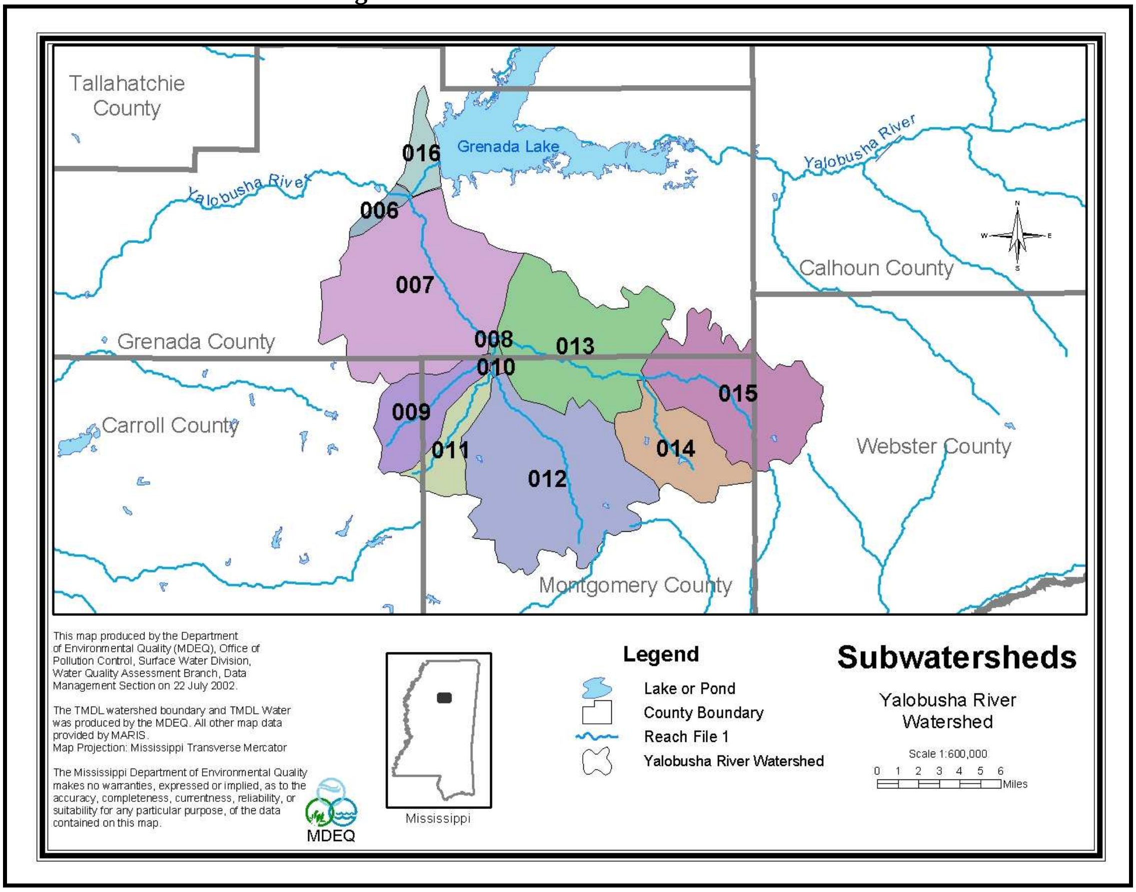
	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
Area (acres)	4,004	65,976	12,227	76,969	156	3,392	0	526	163,249
% Area	2%	40%	7%	47%	0%	2%	0%	0%	100%

Figure 2. Yalobusha River Watershed 303(d) Listed Segments



The drainage area, or watershed, has been divided into 11 subwatersheds based on the major tributaries and topography. Figure 3 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 consists of (using HUC and Reach File 1 identification numbers) segment 08030205006.

Figure 3. Yalobusha River Subwatersheds



1.2 Applicable Waterbody Segment Use

The water use classification for the listed segment of the Yalobusha River, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Fish and Wildlife Support. The designated beneficial uses for the Yalobusha River are Secondary Contact and Aquatic Life Support.

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 for the summer months 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. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies 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. The water quality standard will be used to assess the data to determine impairment in the waterbody. The geometric mean portion of this water quality standard will be used as the targeted endpoint to establish this TMDL.

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.

While the endpoint of a TMDL calculation is similar to a standard for a pollutant, the endpoint is not the standard. Currently MDEQ's standard for fecal coliform states that for the summer months 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. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies 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. For this TMDL, MDEQ considered the 10% portion of the standard when looking at the data for assessment of impairment, however, when setting the target, modeling the waterbody, and calculating the TMDL, MDEQ will use the geometric mean portion of the standard exclusively.

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 derived within 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 1985-1998 period represents both low-flow conditions as well as wet-weather conditions and encompasses a range of wet and dry seasons. Therefore, the 14-year period was used to find the critical conditions associated with all potential sources of fecal coliform bacteria within the watershed.

2.2 Discussion of Instream Water Quality

There is one ambient station on the listed segment operated by USGS in which fecal coliform monitoring data were collected during the 14-year modeling period. Monitoring for flow and fecal coliform was performed on a routine basis at station 07285500 at the Highway 51 bridge crossing near Grenada. Water quality data collected in Grenada Reservoir, at Corps of Engineers station 327GRE1 was also used to set up the model. This station was located near the dam on Grenada Lake.

MDEQ no longer gathers monthly fecal monitoring data at this station. In order to gather fecal coliform data, MDEQ now goes to the station six times within a 30-day period. These data are used to calculate the geometric mean for the waterbody. This stream was recently included in this type of monitoring. These data were used to confirm impairment in this waterbody for fecal coliform.

2.2.1 Inventory of Available Water Quality Monitoring Data

Data collected at station 07285500 from January 1998 to September 1995 are included in Table 2. Flows were not available for all sampling dates. Data collected from the geometric mean study from 2001 are also shown below in Table 3.

Table 2. Fecal Coliform Data reported in the Yalobusha River, Station 07285500
January 1998 to September 1995

Date	Flow (cfs)	Fecal Coliform (counts/100ml)
01/05/88	-	190
03/08/88	-	580
05/02/88	-	350
07/05/88	-	170
09/06/88	-	285
11/07/88	-	7
09/05/89	-	920
11/06/89	-	2400
01/09/90	-	64
05/01/90	-	460
07/09/90	-	540
09/04/90	-	2
11/06/90	-	20
01/11/94	-	23
03/07/94	5480	20
05/03/94	537	2400
06/20/94	223	79
08/22/94	684	1070
11/07/94	742	2400
01/10/95	2600	33
03/07/95	7000	2400
07/11/95	1340	46
09/12/95	3370	11

Table 3. Fecal Coliform Data reported in Yalobusha River, Station 12, Main Street North of Grenada September 2001 to December 2001

Date and Time	Tape Down Measurement	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/2001 13:08	28.30	2	7.8
10/3/2001 13:20	28.57	16	
10/9/2001 11:17	29.05	6	
10/18/2001 11:52	29.25	16	
10/22/2001 11:25	29.53	12	
10/24/2001 11:41	29.72	6	
11/15/2001 12:07	28.31	14	202.6
11/20/2001 12:12	28.30	12	
11/27/2001 10:20	28.94	6000	
11/30/2001 11:33	18.88	4900	
12/5/2001 11:23	30.40	250	
12/11/2001 12:15	26.46	56	

2.2.2 Analysis of Instream Water Quality Monitoring Data

Historically, MDEQ compared all of the samples to no more than 10% greater than the instantaneous maximum standard of 400 counts per 100 ml for the summer months and 4000 counts per 100 ml for the winter months. This is not technically in line with the current fecal coliform standard. The data were used to list this waterbody. The new data recently collected have been assessed by calculating the geometric mean of a minimum of five samples within a 30-day period. Also, the data are compared to no more than 10% greater than 400 counts per 100 ml for the summer months and 4000 counts per 100 ml for the winter. The recent data indicate the waterbody is impaired as shown in Tables 4 and 5 below.

Table 4. Summer Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Geometric Mean	Standard Violation (200 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (400 counts/100 ml)
12	6	7.8	No	0%	No

Table 5. Winter Statistical Summaries of Water Quality Data

Station Number	Number of Samples	Geometric Mean	Standard Violation (2000 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (4000 counts/100 ml)
12	6	202.6	No	33%	Yes

SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Yalobusha River Watershed. The source assessment was used as the basis of development for the model and ultimate analysis of the TMDL allocation options. The sources were analyzed according to the 11 separate subwatersheds. The subwatershed delineations were based primarily on an analysis of the Reach File 3 (RF3) stream network and the digital elevation model of the watershed. 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.

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.

Once the permitted discharger was located, the effluent 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. DMRs from 1994 through 2001 were analyzed and no violations were found. The facilities' permit limits were used as input in the model. The facilities are shown below in Table 6.

Table 6. Inventory of Point Source Dischargers

Facility Name	Subwatershed	NPDES Permit	Receiving Waterbody
Duck Hill POTW	08030205012	MS0020133	Big Bogue Creek
Camp McCain	08030205013	MS0029564	Crowder Creek

3.2 Assessment of Nonpoint Sources

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

- Failing septic systems
- Wildlife
- Land application of hog and cattle manure
- Grazing animals
- Land application of poultry litter
- Other Direct Inputs
- Urban development

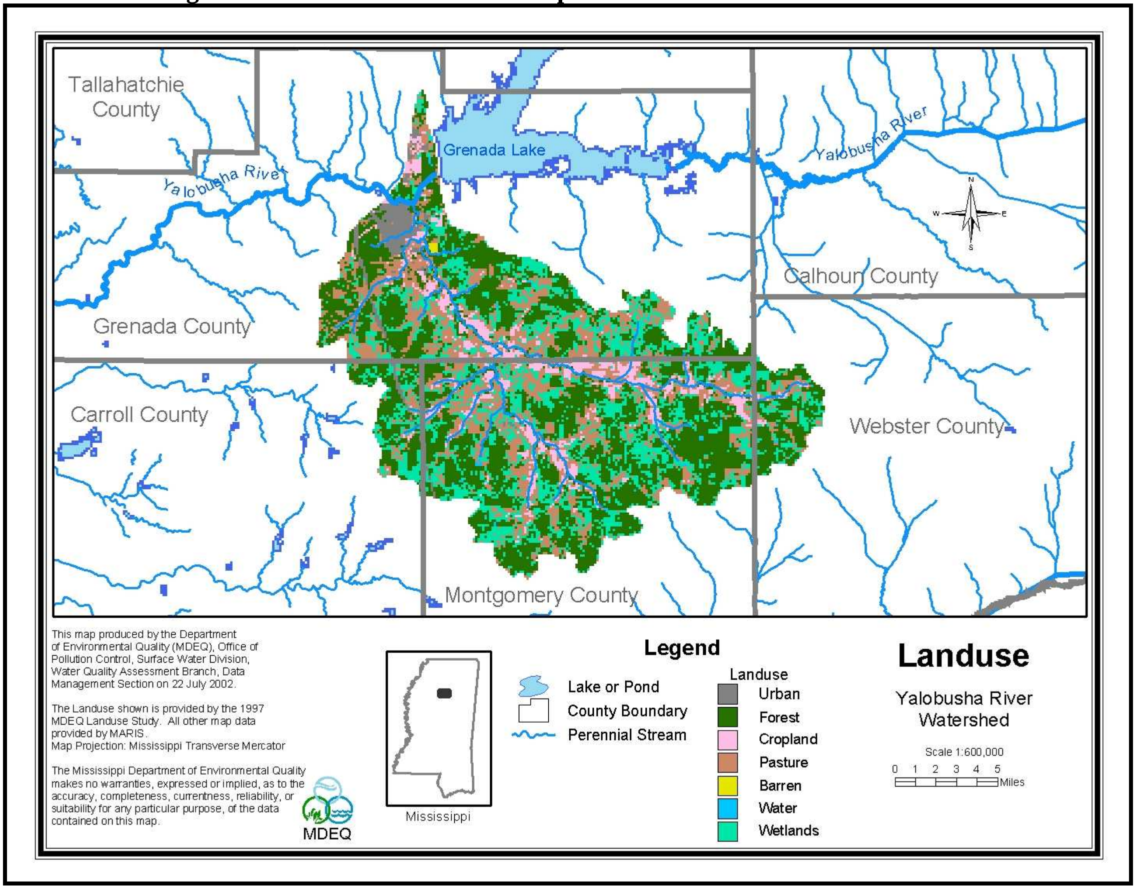
The 163,249 acre drainage area of the Yalobusha River contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands, shown in Table 7 and Figure 4. The modeled landuse information for the watershed is based on the State of Mississippi's Automated Resource Information System (MARIS), 1997. This data set is based Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS data are classified on a modified Anderson level one and two system with additional level two wetland classifications. For modeling purposes the landuse categories were grouped into the landuses of urban, forest, cropland, pasture, barren, and wetlands.

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, and agriculture census data. 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 Yalobusha 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 information on manure application practices and loading rates for hog farms and cattle operations. The Natural Resources Conservation Service gave MDEQ information on manure treatment practices and land application of manure. Additionally, the USDA ARS Sediment Lab in Oxford has been assisting MDEQ in developing TMDL targets and application figures for best management practices.

Table 7. Landuse Distribution for Each Subwatershed (acres)

Subwatershed	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
08030205006	572	459	112	91	0	360	0	1	1,595
08030205007	2,706	15,908	2,581	16,368	156	1,087	0	50	38,857
08030205008	0	0	152	112	0	43	0	2	310
08030205009	245	4,093	595	5,127	0	189	0	0	10,250
08030205010	0	26	60	195	0	68	0	0	349
08030205011	112	2,333	496	3,292	0	25	0	18	6,275
08030205012	55	16,068	2,481	17,910	0	369	0	112	36,995
08030205013	0	7,964	2,843	16,581	0	462	0	82	27,932
08030205014	0	6,756	517	5,328	0	17	0	63	12,681
08030205015	0	11,328	1,722	10,722	0	375	0	93	24,239
08030205016	314	1,042	667	1,244	0	396	0	105	3,768
Total	4,004	65,976	12,227	76,969	156	3,392	0	526	163,249
Percent	2%	40%	7%	47%	0%	2%	0%	0%	100%

Figure 4. Landuse Distribution Map for the Yalobusha River Watershed



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 may not 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. Septic systems have the greatest impact on nonpoint source fecal coliform impairment in the Yazoo Basin. The best management practices needed to reduce this pollutant load need to prioritize elimination of septic tank loads from failures and improper use of individual onsite treatment systems.

3.2.2 Wildlife

Wildlife present in the Yalobusha River Watershed contributes to fecal coliform bacteria on the land surface. In the Yalobusha River model, all wildlife were accounted for by establishing a constant load of 3.52E+07 per acre. It was assumed that the wildlife population remained constant throughout the year, and that wildlife were present on all land classified as pastureland, cropland, and forest. It was also assumed that the manure produced by the wildlife was evenly distributed throughout these land types.

3.2.3 Land Application of Hog and Cattle Manure

In the Yazoo River Basin processed manure from confined hog and dairy 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 Yazoo River Basin operate by either keeping the animals confined or by 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 Yazoo River Basin 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. 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 land where it is available for wash-off and delivery to receiving waterbodies. The dairy farms that are currently operating in the Yazoo River Basin confine the wet cattle for a limited time during the day. The model assumes a confinement time of four hours per day for one third of the herd. During all other times, and for the dry cattle, dairy cattle are assumed to graze on pasturelands. There are no dairy cattle operations within the Yalobusha River watershed.

Beef cattle have access to pastureland for grazing all of the time. In addition, according to local NRCS offices, some beef cattle within the Yazoo River Basin also graze on forested land. Changes were made to the fecal spreadsheets to represent these cattle. Manure produced by grazing beef and dairy cows is directly deposited onto pastureland or forested land and is available for wash off and is subject to a die off rate in the model.

3.2.5 Land Application of Poultry Litter

There are no chickens sold in this area. There are very few layers and no broilers produced in the Yalobusha River Watershed. The loading contribution from these few layers was considered insignificant.

3.2.6 Other Direct Inputs

Due to the general topography in the Yalobusha River watershed, it was assumed that most land slopes in the watershed are such that unconfined animals are generally unable to access the streams in all pastures. Yalobusha River and its tributaries have incised stream banks up to eight feet in height. In most cases, unconfined animals are unable to enter the streams. Therefore, this source of fecal coliform has been reduced in our estimated loading for this watershed.

The manure that is deposited in the streams by grazing animals is included in the water quality model as a point source having constant flow and concentration. Due to the incised streams, MDEQ reduced this loading rate by 90 percent. To estimate the amount of bacteria introduced into streams by all animals, it is assumed that, for the winter months, cattle deposit 0.0026 percent of their bacteria load in the stream; and that for the summer months, cattle deposit 0.0052 percent of their bacteria load in the stream. This direct input of cattle manure represents all animal access to streams (domestic and wild), illicit discharges of fecal coliform bacteria, and leaking sewer collection lines.

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 Yalobusha River was considered. Fecal coliform contributions from urban areas may come from storm water runoff, failing sewer pipes, and runoff contribution from improper disposal of materials such as litter.

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. 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 Yalobusha 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 Yalobusha River TMDL model includes the listed section of the river. The watershed was divided into 11 subwatersheds in an effort to isolate the major stream reaches in the Yalobusha River Watershed. This subdivision allowed the relative contribution of point and nonpoint sources to be addressed within each subwatershed. The flow and pollutant contribution from Grenada Lake was input to the model as a time varying point source with an hourly varying flow and pollutant load.

4.3 Source Representation

Both point and nonpoint sources were represented in the model. A spreadsheet was developed for quantifying point and nonpoint sources of bacteria for the Yalobusha 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 the point source was added as a direct input into the appropriate reach of the waterbody. There are two 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 Yalobusha River. Other sources are represented as an application rate to the land in the Yalobusha 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 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

The number of failing septic systems used in the model was derived from the watershed area normalized county populations. The percentage of the population on septic systems was determined from 1990 United States Census Data. The total number of septic tanks in the watershed was estimated to be 2477. A failure rate of 75% was assumed based on discussions with the local NRCS office and the MS Department of Health. This information was used to calculate the estimated number of failing septic tanks. Therefore, of these 2477 septic tanks it was assumed that 1858 were not operating properly. This number of failing septic tanks also incorporates an estimate for the failing individual onsite wastewater treatment systems in the area. In reality, septic tank failures are both point and nonpoint sources. Therefore, the load from failing septic tanks has been considered to contribute equally to the wasteload allocation component and load allocation component of the TMDL calculation

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 70 gallons per person per day, and a septic system effluent fecal coliform concentration of 10^6 counts per 100 ml (Horsley and Whitten, Inc., 1996).

4.3.2 Wildlife

The per acre loading rate applied to the landuses is 3.52E+07 counts per acre per day. This number is based on an average assumption to the number of wildlife species present in the watershed. The calculation used for the model is an estimate of the wildlife contribution of fecal coliform available for wash off during a rain event. For contributions of fecal coliform directly into the stream, we are using a percentage of the cattle manure available to cover the direct wildlife source as well.

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 and the 1997 USDA Livestock County Estimates. 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 on pastureland 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.

Table 8. Agricultural Animal Counts by Subwatershed

Subwatershed	Beef Cattle	Dairy Cattle	Swine (Hogs)
08030205006	0	0	0
08030205007	35	0	1
08030205008	4	0	0
08030205009	156	0	3
08030205010	10	0	0
08030205011	166	0	0
08030205012	864	0	0
08030205013	305	0	0
08030205014	205	0	0
08030205015	402	0	0
08030205016	0	0	0
Total	**2147**	**0**	**4**

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 1.06E+11 counts per day per animal (NCSU, 1994). The resulting fecal coliform loads are in the units of counts per acre per day.

4.3.5 Other Direct Inputs

In the water quality model, a point source of constant flow and concentration was added in each subwatershed. This direct input represented animals having direct access to the stream, illicit discharges of fecal coliform bacteria, and leaking sewer collection lines. To estimate the amount of bacteria introduced into streams by all animals, it is assumed that, for the winter months, cattle deposit 0.026 percent of their bacteria load in the stream; and that for the summer months, cattle deposit 0.052 percent of their bacteria load in the stream. The fecal coliform concentration is calculated using the number of cows in the stream and a bacteria production rate of 1.06E+11 counts per animal per day (NCSU, 1994).

4.4 Stream Characteristics

The stream characteristics given below describe the most downstream reach of the listed drainage area of the Yalobusha River. The channel geometry and lengths for the Yalobusha River are based on data available within the BASINS modeling system. The 7Q10 flow is based on the USGS gaging station 07285510 at the NSI intake at Grenada, MS. The 7Q10 calculated for this station is based on flow data collected prior to the construction of the Grenada Reservior in 1953. Thus, this 7Q10 represents the pre-regulated conditions. Though there are flow data available from 1989 to the present for station 072885510, a 7Q10 cannot be calculated from these data. This is because the flow is now controlled by the flow from the dam of Grenada Reservior. The mean flow, however, was calculated from the flow data from the active USGS station. Thus, it represents post-regulated conditions. The characteristics of the modeled section of the Yalobusha River are as follows.

- Length 3.6 miles
- Average Depth 1.23 ft
- Average Width 87.7 ft
- Mean Flow 2,442 cubic ft per second (post-regulated conditions)
- Mean Velocity 1.97 ft per second
- 7Q10 Flow 40.0 cubic ft per second (pre-regulated conditions)
- Slope 0.00275 ft per ft

4.5 Selection of Representative Modeling Period

The model was run for a 15 year time period, from January 1, 1984, through December 31, 1998. Results from the model were evaluated for the time period from January 1, 1985, until December 31, 1995. 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 14-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

For the time period 1985 through 1998, flow data were available from the USGS gage 07285510 near Grenada, MS. Hydraulic calibration was performed for the time period 1991-1998. In Appendix A, Graphs A-1, A-2, and A-3 show the modeled flow and the USGS data for 1994, 1996, and 1997.

Water quality was calibrated by comparing the limited ambient monitoring program data to the output from the model. A computer spreadsheet was developed to compare the daily fecal coliform load calculated in the model with the actual fecal coliform samples taken in monitoring. The monitoring values are instantaneous values of individual samples and the modeled values are daily averages. The modeled values and field data values are plotted together with rainfall data to evaluate the relationship between the model and recorded events. This allows the model parameters to be modified as appropriate to calibrate the model. The model parameters that may be adjusted to achieve calibration include land loading rates, failing septic tank discharges, and other direct inputs. In Appendix A, Graph A-4 shows the calibrated model output, ambient fecal coliform data, and the rainfall data.

4.7 Existing Loading

Appendix A includes graphs of the model results showing the instream fecal coliform concentrations for reach 08030205006 of the Yalobusha River. The graph shows a 30-day geometric mean of the data. The straight line at 200 counts per 100 ml indicates the water quality standard for the stream.

ALLOCATION

The allocation for this TMDL involves a wasteload allocation for point sources, a load allocation for nonpoint sources, and a margin of safety. 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. Failing septic tanks and other direct inputs were modeled as direct inputs to the stream. 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.

5.1 Wasteload Allocations

The contribution of the point source was considered on a subwatershed basis for the model. Typically, 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 some cases, this information indicated violations of permit limits that resulted in reductions in the assumed existing load. The point source contribution, on a subwatershed basis, along with its existing load, allocated load, and percent reduction are shown below. There are two point sources within the watershed. All of these facilities currently disinfect so no changes to their permits are required at this time, however, the assumed existing load for the NPDES permitted facilities needs to be reduced in the watersheds as indicated in Table 8 below. The final wasteload allocation on the summary page also accounts for the load from 50% of the failing septic tanks.

Table 9. Wasteload Allocations

Facility Name	NPDES ID	Existing Load (counts/30 days)	Allocated Load (counts/30 days)	Percent Reduction
Duck Hill POTW	MS0020133	4.40E+10	4.40E+10	0%
Camp McCain	MS0029564	4.99E+10	4.99E+09	90%
Total		**9.39E+10**	**4.90E+10**	**48%**

5.2 Load Allocations

The TMDL scenario for the load allocation for this TMDL involves two different types of nonpoint sources: septic tanks and other direct inputs. 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. The nonpoint source contributions due to other direct inputs, on a subwatershed basis, along with their existing load, allocated load, and percent reduction are shown below. The same parameters for contributions due to septic tank failures are also shown. Septic tank failures in reality are both point and nonpoint contributions and have been calculated as equal contributors to the wasteload allocation component and load allocation component of the TMDL calculation.

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 Yalobusha River to achieve water quality standards.

Table 10. Fecal Coliform Loading Rates for Nonpoint Source Contribution of Other Direct Inputs

Subwatershed	Existing Flow (cfs)	Existing Load (counts/30 days)	Allocated Flow (cfs)	Allocated Load (counts/30 days)	Percent Reduction
08030205006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0%
08030205007	1.11E-08	4.11E+09	8.32E-09	3.08E+09	25%
08030205008	1.27E-09	4.70E+08	9.51E-10	3.52E+08	25%
08030205009	4.95E-08	1.83E+10	3.71E-08	1.38E+10	25%
08030205010	3.17E-09	1.17E+09	2.38E-09	8.78E+08	25%
08030205011	5.26E-08	1.95E+10	3.95E-08	1.46E+10	25%
08030205012	2.74E-07	1.02E+11	2.05E-07	7.63E+10	25%
08030205013	9.67E-08	3.59E+10	7.25E-08	2.69E+10	25%
08030205014	6.50E-08	2.40E+10	4.87E-08	1.81E+10	25%
08030205015	1.27E-07	4.72E+10	9.56E-08	3.54E+10	25%
08030205016	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0%
Total	**6.80E-07**	**2.52E+11**	**5.10E-07**	**1.89E+11**	**25%**

Table 11. Fecal Coliform Loading Rates for Contribution of Failing Septic Tanks (50% WLA and 50% LA)

Subwatershed	Existing Flow (cfs)	Existing Load (counts/30 days)	Allocated Flow (cfs)	Allocated Load (counts/30 days)	Percent Reduction
08030205006	4.15E-04	3.04E+11	2.24E-04	1.64E+11	46%
08030205007	1.13E-02	8.28E+12	6.12E-03	4.49E+12	46%
08030205008	9.77E-05	7.16E+10	5.27E-05	3.87E+10	46%
08030205009	2.33E-03	1.71E+12	1.26E-03	9.22E+11	46%
08030205010	1.06E-04	7.78E+10	5.71E-05	4.18E+10	46%
08030205011	1.81E-03	1.32E+12	9.76E-04	7.15E+11	46%
08030205012	1.11E-02	8.14E+12	6.02E-03	4.41E+12	46%
08030205013	8.43E-03	6.18E+12	4.55E-03	3.33E+12	46%
08030205014	3.74E-03	2.74E+12	2.02E-03	1.48E+12	46%
08030205015	7.23E-03	5.30E+12	3.91E-03	2.86E+12	46%
08030205016	1.14E-03	8.35E+11	6.15E-04	4.51E+11	46%
Total	**4.77E-02**	**3.49E+13**	**2.58E-02**	**1.89E+13**	**46%**

The model estimated the fecal coliform bacteria count per 30 days entering the Yalobusha River for each listed segment due to runoff during the 30-day critical period. These values are given in section 5.4. The scenario used in this analysis for the load allocation in the Yalobusha River Watershed assumes a 46% reduction in contributions from failing septic tanks and a 25% reduction in contributions from other direct inputs is required to meet standards.

5.3 Incorporation of a Margin of Safety (MOS)

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. For this study, the MOS is incorporated into the modeling process by utilizing a conservative fecal coliform decay rate, conservative loading and environmental conditions, and running a dynamic simulation for a period of 14 years.

In addition, running the model for a 14 year time period with no violations of the water quality standard provides a component of the implicit MOS. The average 30-day geometric mean value during the 14-year model period is 52 counts per 100 ml. By setting the reduction needed in the TMDL on the maximum critical instance of 238 counts per 100 ml. instead of the average of 63 counts per 100 ml., the implicit MOS can be quantified as a 73.5% conservative assumption. Another conservative assumption contained in the implicit MOS is modeling the flow from septic tanks directly into the stream. While it is likely that some septic tanks reach the stream directly, the majority of failures only discharge a portion of the bacteria load due to filtration and die off during transport to the stream.

5.4 Calculation of the TMDL

This TMDL is calculated based on the following equation where WLA is the wasteload allocation (the load from the point sources), the LA is the load allocation (the load from nonpoint sources), and MOS is the margin of safety:

TMDL = WLA + LA + MOS

WLA = NPDES Permitted Facilites + ½ of the Septic Tank Failures

LA = Surface Runoff + Other Direct Inputs + ½ of the Septic Tank Failures

MOS = implicit

The TMDL was calculated based on the 30-day critical period for the Yalobusha River Watershed according to the model. Each of the loading rates has been converted to the 30-day equivalent. The wasteload allocation incorporates the fecal coliform contribution from the identified NPDES Permitted facilities and 50% of the contribution from failing septic tanks. The load allocation includes the fecal coliform contributions from surface runoff, other direct inputs, and 50% of the contribution from failing septic tanks. The margin of safety for this TMDL is derived from the conservative loading assumptions used in setting up the model and is implicit. Table 11 gives the TMDL for the listed segment.

Table 12. Summary for Listed Segment (counts/30 days)

	MS339M2
NPDES Permits	4.90E+10
½ Failing Septic Tanks	9.45E+12
WLA	**9.50E+12**
Surface Runoff	1.49E+14
Other Direct Inputs	1.89E+11
½ Failing Septic Tanks	9.45E+12
LA	**1.59E+14**
TMDL = WLA + LA	**1.69E+14**

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. This stream is designated for the use of secondary contact. For this use, the pollutant standard is seasonal. Because the model was established for a 14-year time span, it took into account all of the seasons within the calendar years from 1985 to 1998. 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.

5.6 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There are no point sources (WLA) requesting a reduction based on promised Load Allocation components and reductions. The point sources are required to discharge effluent treated and disinfected that will be below the 200 colony counts per 100-ml. target at the end of the pipe.

CONCLUSION

The fecal coliform reduction scenario used in this TMDL included reducing the assumed fecal load from NPDES Permitted dischargers by 48%, requiring all NPDES Permitted dischargers of fecal coliform to meet water standards for disinfection, along with reducing the assumed fecal load from 46% of the failing septic tanks and the assumed fecal load from 25% of the other direct inputs in the watershed.

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for pathogens. MDEQ will not approve 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.

6.1 Future 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 Yazoo River Basin, the Yalobusha River may receive additional monitoring to identify any change in water quality. MDEQ produced guidance for future Section 319 project funding will encourage NPS restoration projects that attempt to address TMDL related issues within Section 303(d)/TMDL watersheds in Mississippi.

MDEQ assembled a team of scientists and engineers to develop a monitoring plan for the Delta ecoregion. This approach will allow MDEQ to assess the Delta based on biology that is appropriate for the Delta.

6.2 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. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to be included on the TMDL mailing list should contact Linda Burrell at (601) 961-5062 or Linda_Burrell@deq.state.ms.us. 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 meeting.

All written comments received during the public notice period and at any public meeting become a part of the record of this TMDL. All comments will be considered in the ultimate completion of this TMDL for submission of this TMDL to EPA Region 4 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 direct sources 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.

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.

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.

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, pon ds, 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

RF3.. Reach File 3

USGS .... United States Geological Survey

WLA ....Waste Load Allocation

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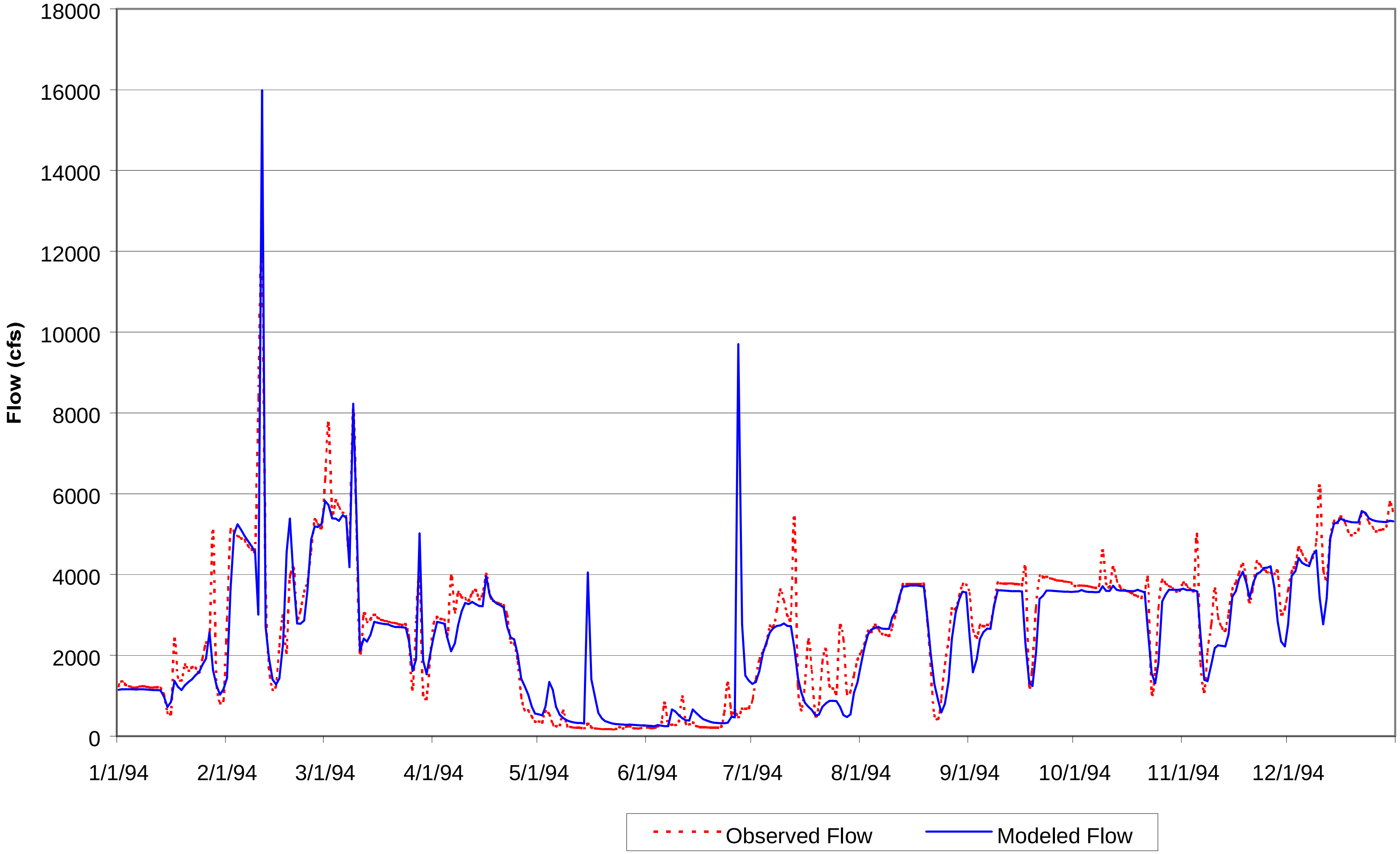
APPENDIX A

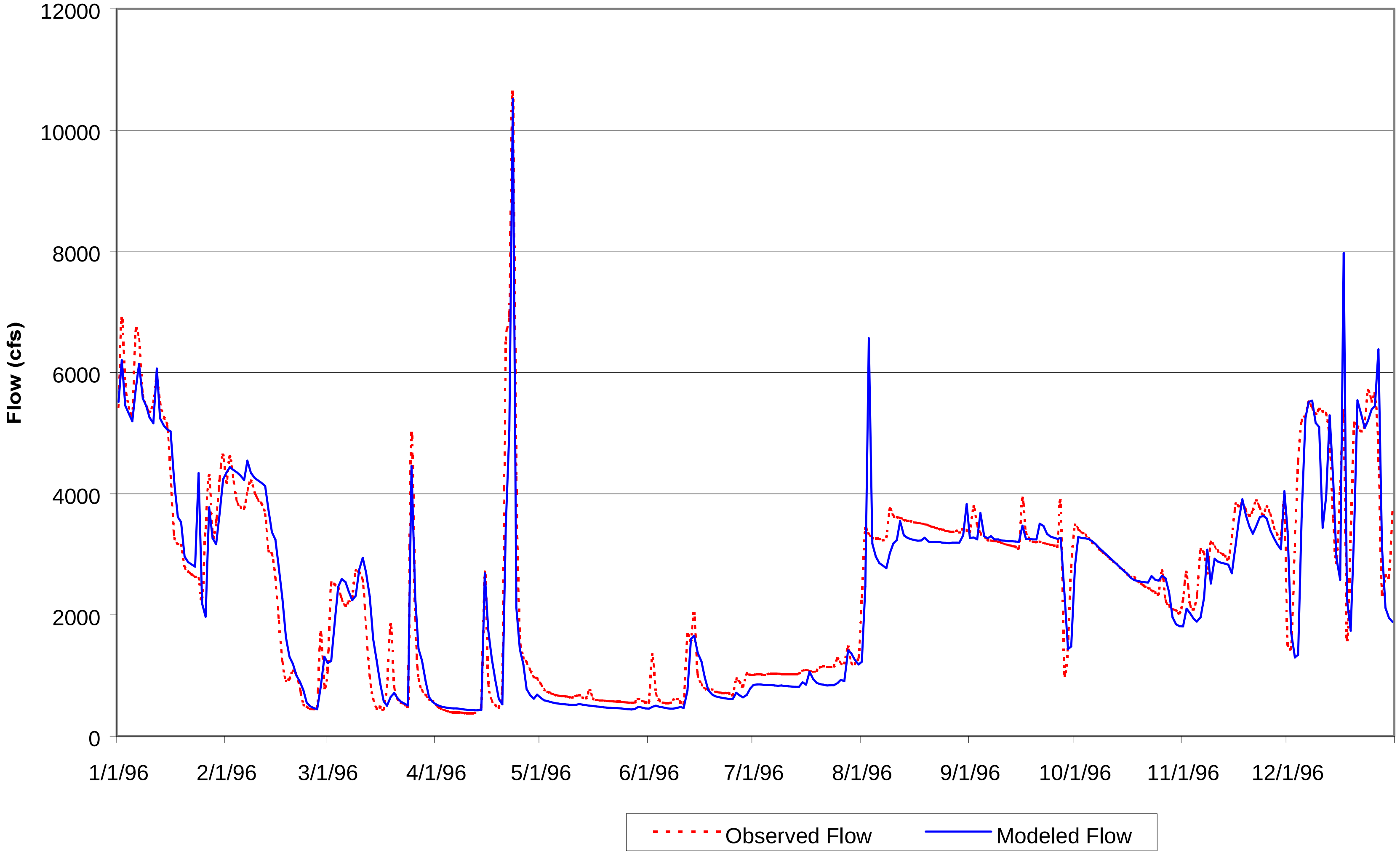
This appendix contains printouts of the various model run results. Graphs A-1, A-2, and A-3 show the modeled flow, in cubic feet per second, through reach 08030205006 compared to the USGS Station 07285510 flow data. Graph A-4 shows the calibrated model output, ambient fecal coliform data, and rainfall data. The following graphs show the 30-day geometric mean for fecal coliform concentrations in counts per 100 ml in the listed segment of the Yalobusha River. The graphs contain a reference line at 200 counts per 100 ml. Graph A-5 shows the fecal coliform levels in the most impaired reach (08030205006) during the 14-year modeling period. Graph A-6 shows the modeled fecal coliform levels in reach 08030205006 after the reduction scenario has been applied.

The TMDL calculated in this report represents the fecal coliform load that is estimated in the waterbody segment during the critical 30-day period. 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 loading scenario for the most downstream reach 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.

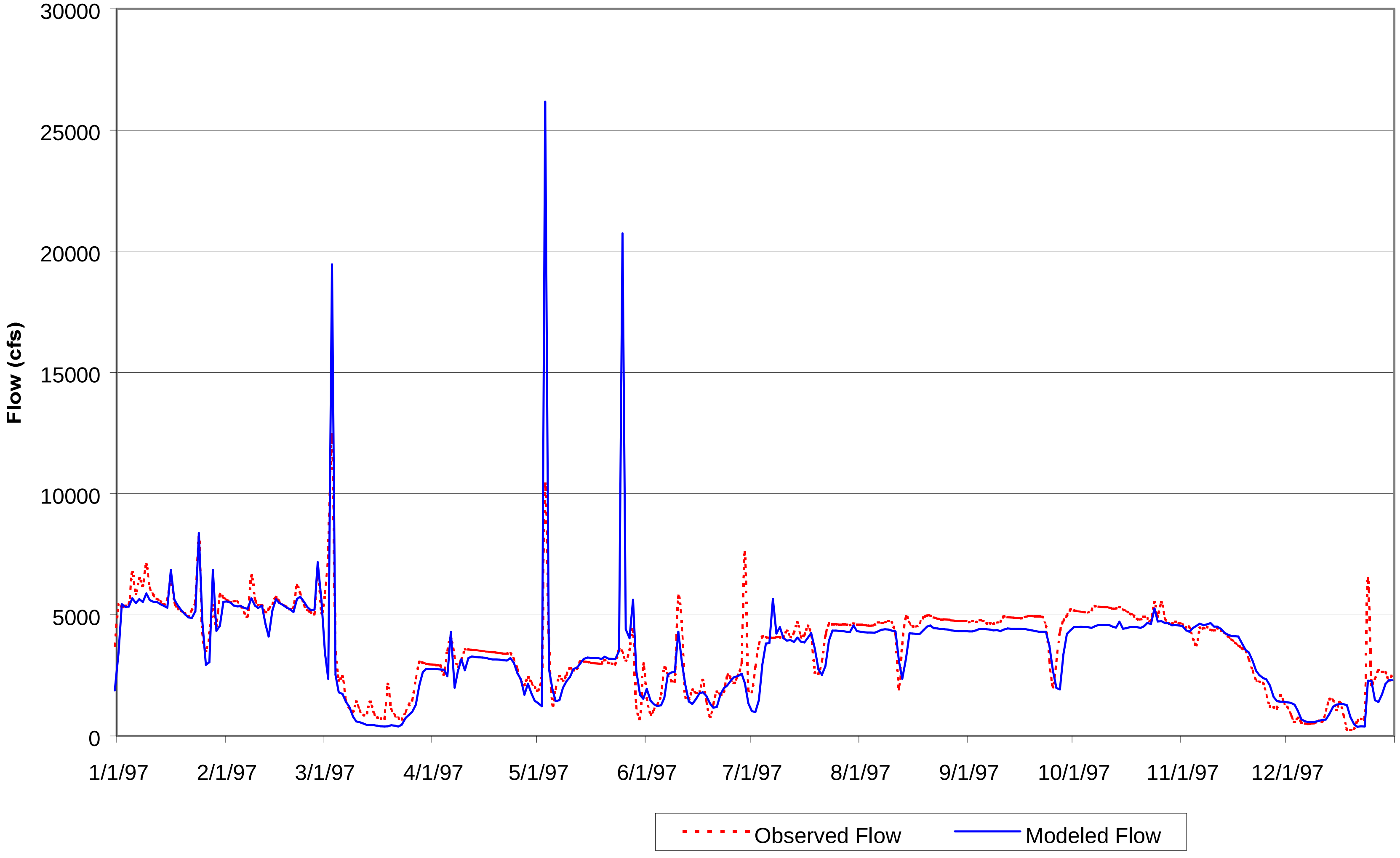
Graph A-1 Daily Flow Comparison between USGS Gage Station 07285510 and Reach 08030205006 for 01/01/1994 - 12/31/1994



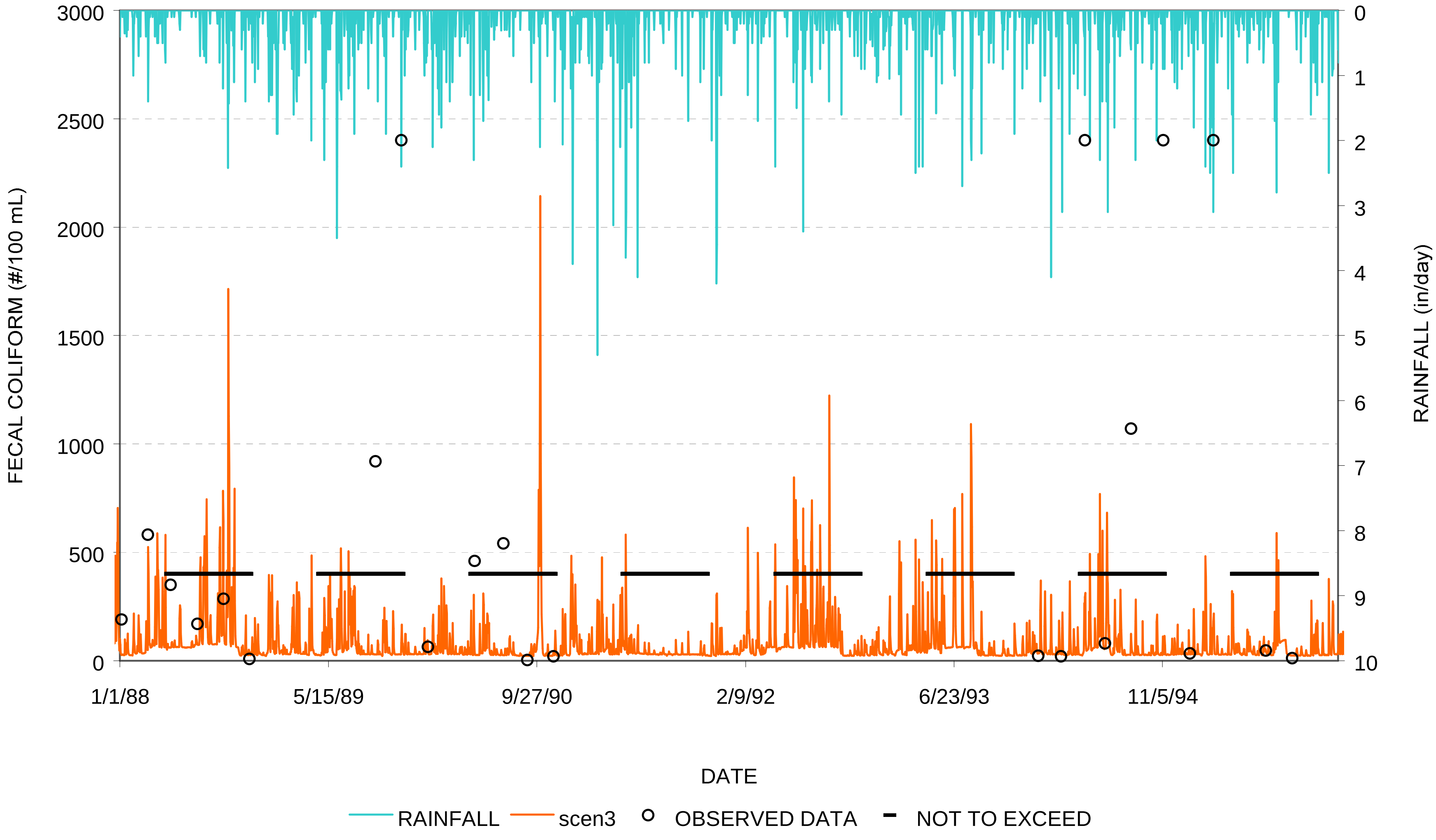
Graph A-2 Daily Flow Comparison between USGS Gage Station 07285510 and Reach 08030205006 for 01/01/1996 - 12/31/1996



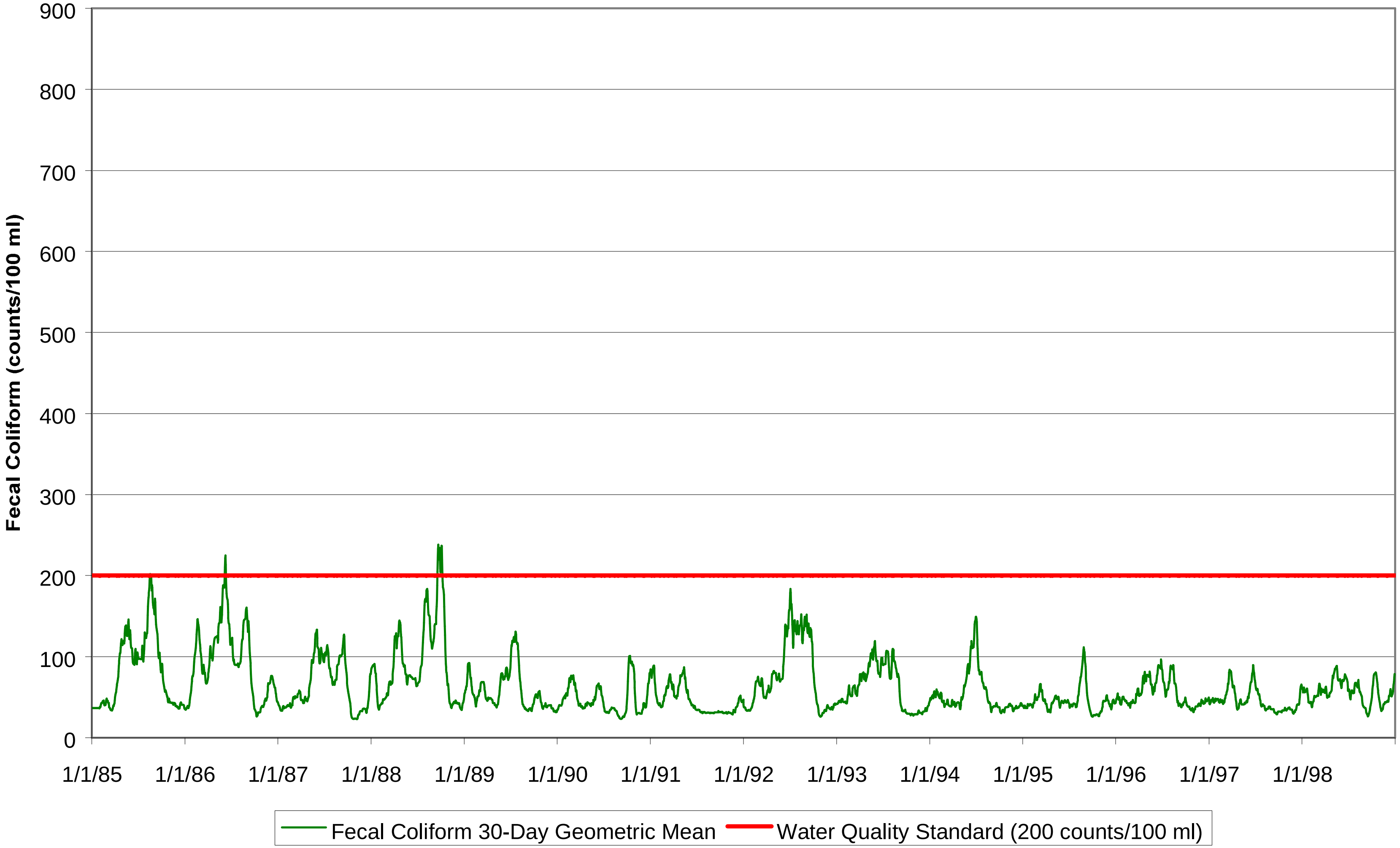
Graph A-3 Daily Flow Comparison between USGS Gage Station 07285510 and Reach 08030205006 for 01/01/1997 - 12/31/1997



Graph A-4 Water Quality Calibration Plot for Reach 08030205006 and DEQ Ambient Monitoring Station 07285500



Graph A-5 Modeled Fecal Coliform Concentrations Under Existing Conditions for Reach 08030205006



Graph A-6 Modeled Fecal Coliform Concentrations After Application of TMDL Scenario for Reach 08030205006