FINAL REPORT
January 2003
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Phase One
Fecal Coliform TMDL
for Little Tallahatchie River

Yazoo River Basin

Panola County, Mississippi

Prepared By

Mississippi Department of Environmental Quality
Office of Pollution Control
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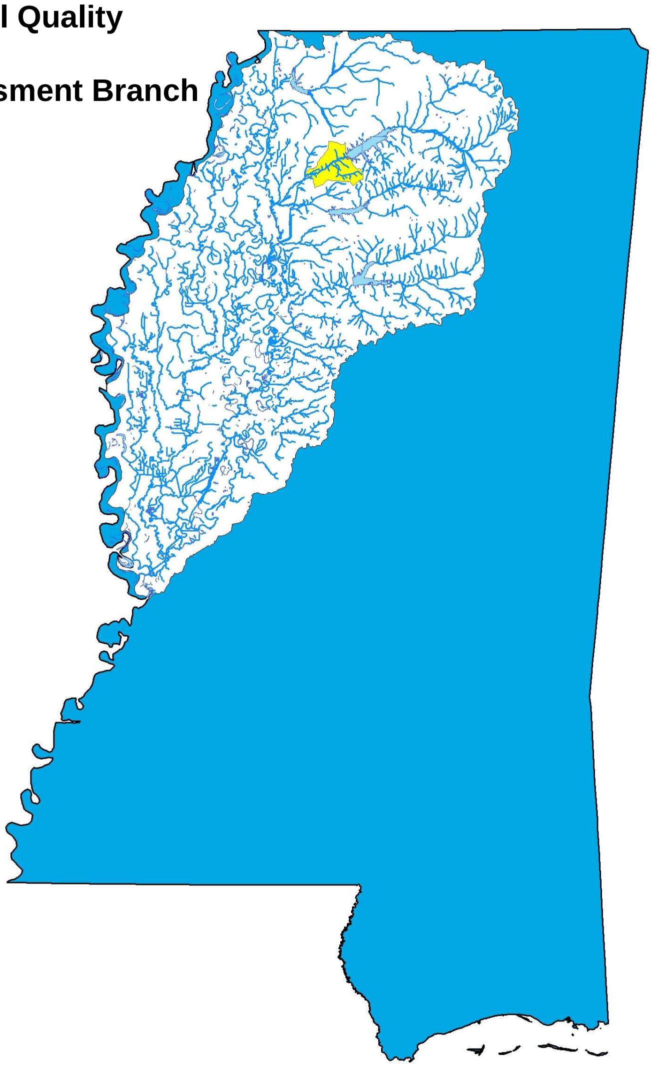

MISSISSIPPI DEPARTMENT OF
ENVIRONMENTAL QUALITY

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
Little Tallahatchie River	MS261M	Panola	08030201	Pathogens	Evaluated
Near Sardis from Lower Sardis Lake to confluence with McIver Canal					
Portion of Lower Tallahatchie – DA	MS261E	Panola	08030201	Pathogens	Evaluated
Near Sardis from Lower Sardis Lake to confluence with McIver Canal					
Hotophia Creek – DA	MS262E	Panola	08030201	Pathogens	Evaluated
Near Terza from Headwaters to the Little Tallahatchie River					

Table ii. Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Fecal Coliform	Contact Recreation	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.
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

NPDES ID	Facility Name	Subwatershed	Receiving Water
MS0024627	Batesville POTW	8030201001	Little Tallahatchie
MS0046710	Sardis POTW	8030201001	Little Tallahatchie
MS0045969	Smith Mobile Home Park	8030201002	Deer Creek
MS0030520	John Kyle State Park	8030201003	Clarendon Creek
MS0048852	Brewer Mobile Home Park	8030201003	Little Tallahatchie
MS0043737	USACOE Sardis Lower Lake Recreation	8030201003	Little Tallahatchie

Table iv. MS261M Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	6.76E+11	counts/30 day critical period	
LA	3.72E+14	counts/30 day critical period	
MOS	4.14E+13	counts/30 day critical period	Explicit
TMDL	4.14E+14	counts/30 day critical period	

Table v. MS261E Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	6.76E+11	counts/30 day critical period	
LA	3.83E+14	counts/30 day critical period	
MOS	4.26E+13	counts/30 day critical period	Explicit
TMDL	4.26E+14	counts/30 day critical period	

Table vi. MS262E Total Maximum Daily Load

Type	Number	Unit	MOS Type
WLA	3.40E+08	counts/30 day critical period	
LA	1.26E+13	counts/30 day critical period	
MOS	1.40E+12	counts/30 day critical period	Explicit
TMDL	1.40E+13	counts/30 day critical period	

EXECUTIVE SUMMARY

Two segments of the Little Tallahatchie River and one segment of Hotophia Creek have been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as evaluated waterbody segments, due to fecal coliform bacteria. The applicable state standard specifies for segments MS261E and MS262E, 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. The applicable state standard specifies for segment MS261M, that 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.

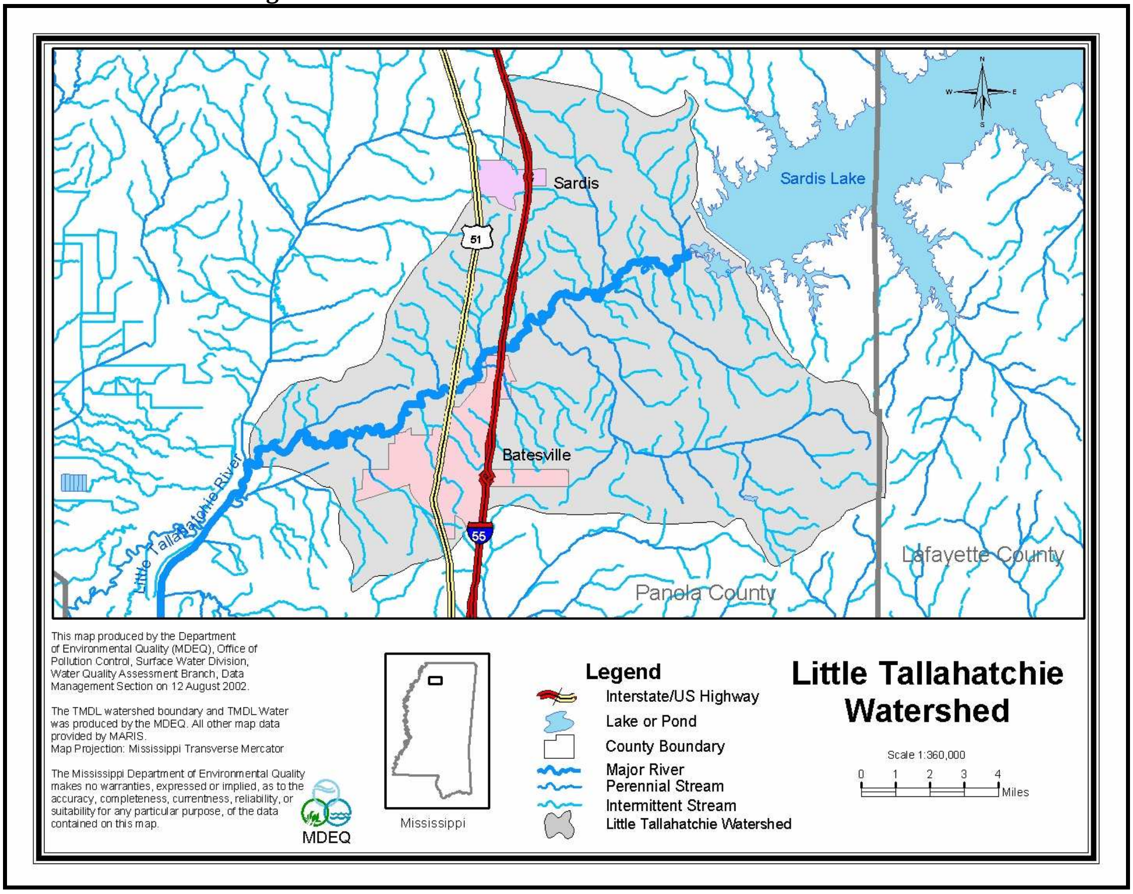
Photo 1. Little Tallahatchie River

The Little Tallahatchie River, photo 1, flows in a southwestern direction from its headwaters near Dumas, Mississippi to Sardis Lake. From Sardis Lake Dam the Little Tallahatchie flows in a southwestern direction to the Panola-Quitman Floodway. This TMDL has been developed for three listed sections of the Little Tallahatchie River and Hotophia Creek that are below Sardis Lake, Figure 2. A mass balance approach was used to calculate this Phase One TMDL. This method of analysis was due to the absence of water quality data during the possible modeling time frame. After using this approach, a TMDL was determined to be 4.26E+14 counts per 30 days.

The limited data available for Little Tallahatchie River indicate violation of the geometric mean fecal coliform standards. The existing condition load was based on the highest instantaneous exeedance and resulted in a 95% reduction in sources of fecal coliform to the waterbody.

The 6 permitted facilities in the watershed currently have requirements in their NPDES Permits that require disinfection to meet standards, therefore, no changes are required to the existing NPDES permit. However, a reduction in the WLA is required due to previous violations of permit limits. Monitoring of the permitted facility in the Little Tallahatchie River Watershed should continue to ensure that compliance with permit limits is consistently attained.

Figure 1. Location of Little Tallahatchie River Watershed



INTRODUCTION

1.1 Background

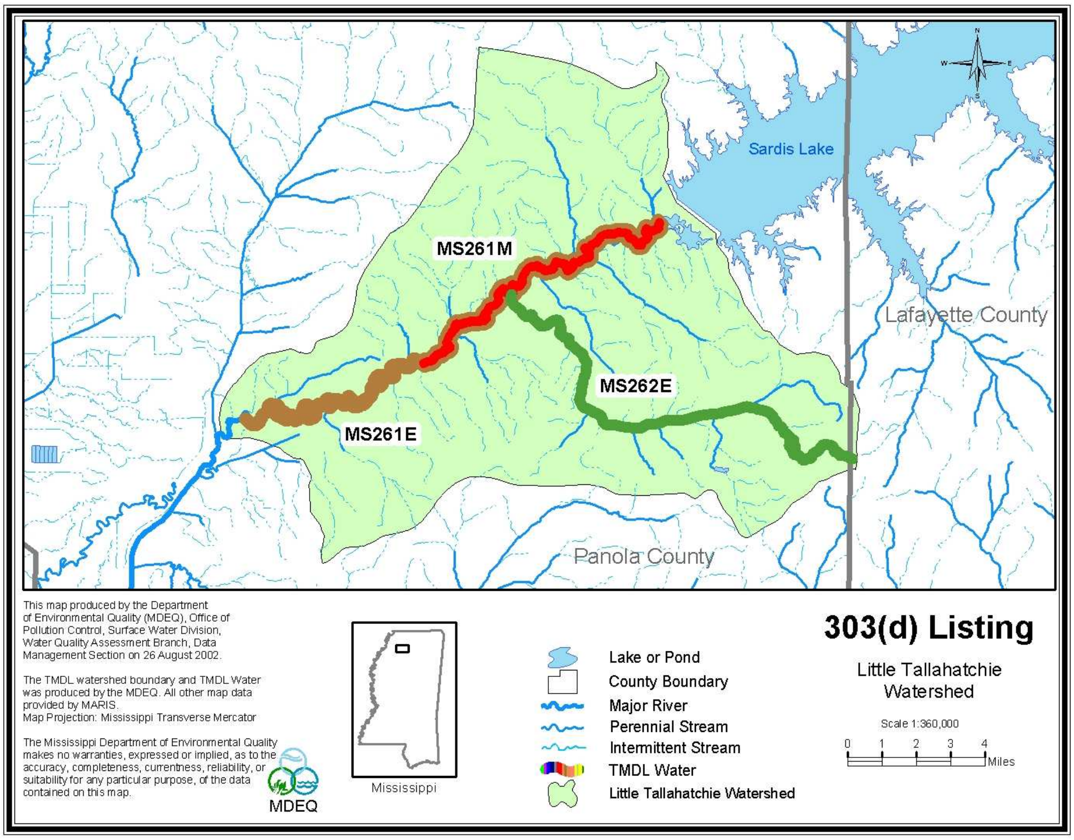
The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 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 Mississippi Department of Environmental Quality (MDEQ) has placed the Little Tallahatchie River on the Mississippi 1998 Section 303(d) List of Waterbodies. The 303(d) listed sections are shown in Figure 2. The Little Tallahatchie River is in the Yazoo River Basin Hydrologic Unit Code (HUC) 08030201 in northwest Mississippi. The Little Tallahatchie River watershed is approximately 93,739 acres; and lies within Panola County. The watershed is rural. Forest, pasture, and cropland are the dominant landuses within the watershed. The landuse distribution is shown below in Table 1.

Table 1. Landuse Distribution for the Little Tallahatchie River Watershed

	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
Area (acres)	3,313	19,305	16,953	52,809	0	238	0	1,121	93,739
% Area	4%	21%	18%	56%	0%	0%	0%	1%	100%

Figure 2. Little Tallahatchie River 303(d) Listed Segments



1.2 Applicable Waterbody Segment Use

As established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, the water use classification for the listed segment of the Little Tallahatchie River (MS261M) is Recreation, and the water use classification for Hotophia Creek (MS262E) and the Portion of the Lower Tallahatchie – DA (MS261E) is Fish and Wildlife Support. The designated beneficial uses for the Little Tallahatchie River, MS261M, are Contact Recreation and Aquatic Life Support. The designated beneficial uses for Hotophia Creek, MS262E, and the Portion of the Lower Tallahatchie – DA, MS261E, 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 Secondary Contact 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 Contact Recreation standard states that the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than ten percent of the samples examined during any month exceed a colony count of 400 per 100 ml regardless of the season. 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

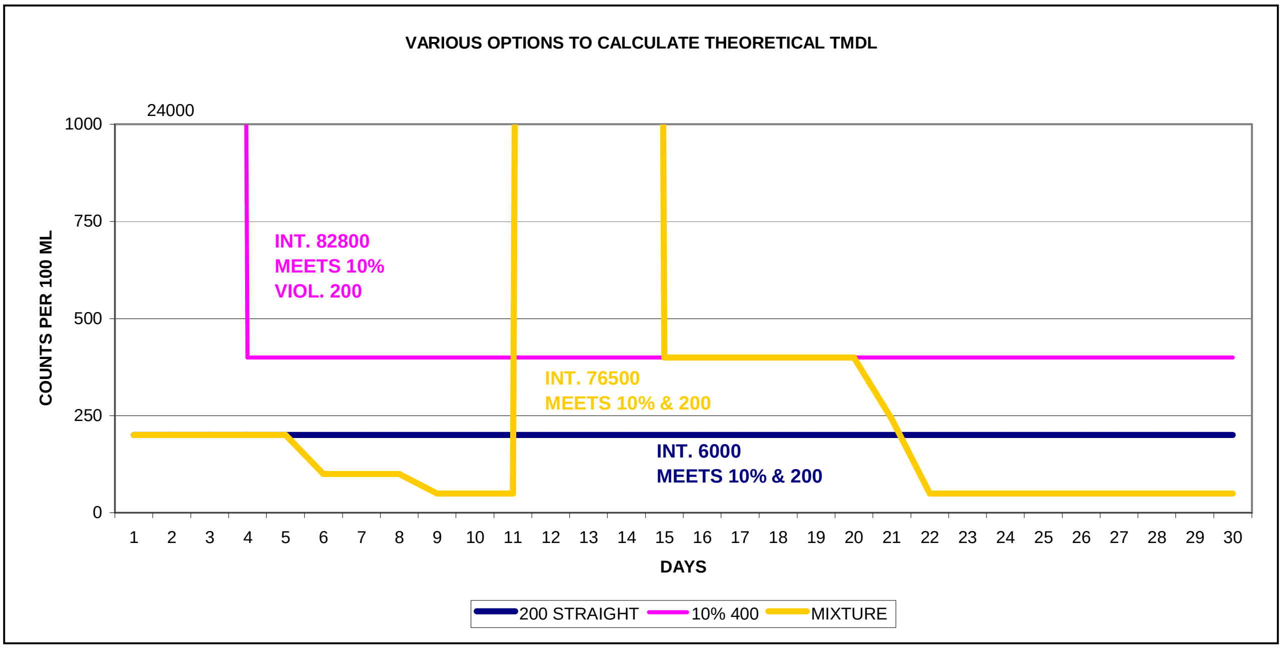
One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions 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.

MDEQ calculated the TMDL using the more appropriate of the sections of the fecal coliform standard. It is important to remember that this mass-balance method for calculating the total maximum 30-day load is theoretical and is not supported by data. If data were available, MDEQ would have modeled the stream to calculate the TMDL and compare the model results to the standard. Also, the flow used for these calculations is the annual average flow. Therefore, there is no variance in the flow figure for the 30-day calculation. If flow data were available for the stream, this method could be modified to account for variance in flow.

The fecal coliform standard says the counts shall not exceed a 30-day geometric mean of 200 per 100 ml nor shall more than 10% of the samples examined during any month exceed 400 counts per 100 ml. To calculate the TMDL for the Little Tallahatchie River, the average annual flow was multiplied by the 30-day geometric mean of 200 counts per 100 ml standard. MDEQ believes this to be the most protective calculation using the mass-balance method. MDEQ developed the following chart to illustrate this. All three lines meet the 10% section of the standard. The blue line represents a constant 200 count for 30 days. The integral of the area below the curve is 6000. The geometric mean is 200. The purple line represents 3 days reading 24,000 counts and 27 days reading 400. The purple line represents the maximum load possible that meets the 10% section of the standard. The integral of the area below the curve is 82,800. However, the geometric mean is 602. While these data meet the 10% section of the standard, it does not meet the 200 geometric mean section. The yellow line represents a data set with the same 3-day readings of 24,000 counts and 27 days below 400. This data set meets the 10% section of the standard as well as the geometric mean section. The integral of the area below the curve is 76,500. Therefore when comparing all three sample data sets, MDEQ believes the selection of calculating the load by multiplying 30 days by the 200 count is the more appropriate of the approaches. Additionally when the margin of safety is added, this value is reduced by an additional 10%.

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 periods of low-flow, low-dilution conditions.

Figure 3: Theoretical TMDL Calculations



2.2 Discussion of Instream Water Quality

Historical fecal coliform bacteria data were available for station 7273000, located near Sardis on Belmont Road. Fecal coliform bacteria data were collected at this station on approximately a monthly basis between August 1975 and May 1977.

MDEQ no longer collects monthly fecal monitoring data at this station. In order to gather fecal coliform data, MDEQ now goes to monitoring stations six times within a 30-day period. Data collected in this manner can be used to calculate the geometric mean for the waterbody. Little Tallahatchie River and Hotophia Creek, a tributary of the Little Tallahatchie River, were 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 7273000 from August 1975 to May 1977 are included in Table 2. Data collected from the geometric mean study from 2001 are shown in Table 3 and Table 4.

Table 2. Fecal Coliform Data reported in the Little Tallahatchie River, Station 7273000

Date	Fecal Coliform (counts/100ml)
6-Aug-75	480
4-Sep-75	1
8-Oct-75	10
4-Nov-75	2509
2-Dec-75	60
6-Jan-76	100
3-Feb-76	40
2-Mar-76	1
6-Apr-76	50
18-May-76	1
1-Jun-76	1
29-Jun-76	10
3-Aug-76	43
5-Sep-76	23
5-Oct-76	23
2-Nov-76	63
8-Dec-76	420
25-Jan-77	10
9-Feb-77	10
2-Mar-77	13
4-Apr-77	5200
2-May-77	10
30-May-77	50
6-Aug-75	480

Table 3. Fecal Coliform Data reported in the Little Tallahatchie River, Station 2, Old Panola Road
September 2001 to December 2001

Date	Fecal Coliform (counts/100ml)	Geometric Mean
9/26/2001 11:49	150	113
10/2/2001 11:50	180	
10/8/2001 13:15	18	
10/16/2001 12:50	128	
10/18/2001 13:20	470	
10/23/2001 11:01	72	
11/14/2001 12:05	42	220
11/19/2001 12:48	44	
11/26/2001 13:50	76	
11/29/2001 11:40	4000	
12/4/2001 13:30	116	
12/10/2001 12:20	66	

Table 4. Fecal Coliform Data reported in Hotophia Creek, Station 40, Highway 35
September 2001 to December 2001

Date	Fecal Coliform (counts/100ml)	Geometric Mean
9/27/2001 12:10	28	106
10/2/2001 10:30	210	
10/8/2001 11:15	136	
10/10/2001 10:35	224	
10/17/2001 9:55	70	
10/23/2001 10:15	114	
11/13/2001 10:10	34	104
11/19/2001 10:25	40	
11/26/2001 9:05	184	
11/28/2001 10:08	420	
12/5/2001 10:15	76	
12/10/2001 10:40	156	

2.2.2 Analysis of Instream Water Quality Monitoring Data

Historically, MDEQ only had data appropriate to compare all of the samples to the instantaneous portion of the standard, which is 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 for segment MS261E and MS262E. For segment MS261M, the instantaneous portion of the standard states that no more than 10% of the samples shall be more that 400 counts per 100 ml, regardless of the season. The geometric mean portion of the current fecal coliform standard was not used in assessment due to lack of appropriate data at that time. MDEQ's new method of collecting data six times during a 30-day period must be assessed for both parts of the standard. Tables 5, 6, and 7 show the statistical summary of the recent monitoring data, which is part of an ongoing project. The data are provisional data and verify impairment in the Little Tallahatchie River, indicated by previous assessments.

Table 5. Summer Statistical Summaries of Water Quality Data for Station 40

Station	Number of Samples	Geometric Mean	Standard Violation (200 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (400 counts/100 ml)
40	6	106	No	0%	No

Table 6. Winter Statistical Summaries of Water Quality Data for Station 40

Station	Number of Samples	Geometric Mean	Standard Violation (2000 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (4000 counts/100 ml)
40	6	104	No	0%	No

Table 7. Statistical Summaries of Water Quality Data for Station 2

Season	Number of Samples	Geometric Mean	Standard Violation (200 counts/100 ml)	Percent Instantaneous Exceedance	Standard Violation (400 counts/100 ml)
Summer	6	113	No	16%	Yes
Winter	6	220	Yes	16%	Yes

SOURCE ASSESSMENT

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

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. The facilities are shown below in Table 7.

Table 7. Inventory of Point Source Dischargers

NPDES ID	Facility Name	Subwatershed	Receiving Water	Design Flow (MGD)
MS0024627	Batesville POTW	8030201001	Little Tallahatchie	2.100
MS0046710	Sardis POTW	8030201001	Little Tallahatchie	0.8500
MS0045969	Smith Mobile Home Park	8030201002	Deer Creek	0.0015
MS0030520	John Kyle State Park	8030201003	Clarendon Creek	0.0135
MS0048852	Brewer Mobile Home Park	8030201003	Little Tallahatchie	0.0076
MS0043737	USACOE Sardis Lower Lake Recreation	8030201003	Little Tallahatchie	0.0750

3.2 Assessment of Nonpoint Sources

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

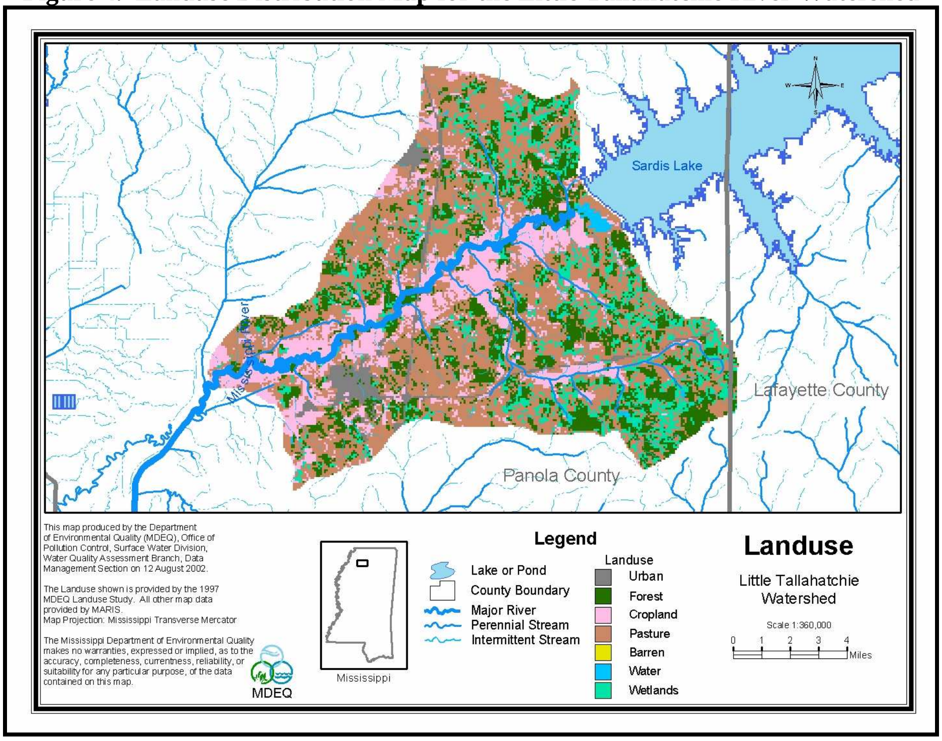
- Failing septic systems
- Wildlife
- Land application of hog and cattle manure
- Grazing animals
- Land application of poultry litter
- Other Direct Inputs
- Urban development

The 93,739 acre drainage area of the Little Tallahatchie River contains many different landuse types, including urban, forest, cropland, pasture, and wetlands. The landuse distribution for the each subwatershed is provided in Table 8 and displayed in 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.

Table 8. Landuse Distribution for Each Subwatershed (acres)

Subwatershed	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Total
08030201001	2,352	5,873	8,976	18,884	0	163	0	319	36,567
08030201002	430	6,530	2,784	13,693	0	16	0	134	23,587
08030201003	532	6,902	5,192	20,232	0	60	0	667	33,584
Total	3,313	19,305	16,953	52,809	0	238	0	1,121	93,739
Percent	4%	21%	18%	56%	0%	0%	0%	1%	100%

Figure 4. Landuse Distribution Map for the Little Tallahatchie River Watershed



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 Little Tallahatchie 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.

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 Little Tallahatchie River Watershed contributes to fecal coliform bacteria on the land surface. 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 pastureland 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 lactating cattle for a limited time during the day. During all other times and for the dry cattle, dairy cattle are assumed to graze on pasturelands. Beef cattle have access to pastureland for grazing all of the time. Manure produced by grazing beef and dairy cows is directly deposited onto pastureland and is available for wash off.

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 Little Tallahatchie 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 Little Tallahatchie River Watershed, it was assumed that all land slopes in the watershed are such that unconfined animals are generally unable to access the intermittent streams in all pastures. 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 Little Tallahatchie 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.

MASS BALANCE PROCEDURE

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

A mass balance approach was used to calculate this Phase One TMDL. This method of analysis was selected due to a lack of water quality data during the possible modeling time frame. It was not considered appropriate to model the watershed for a time period in which the data from the 1970's could be utilized for calibration. Also, it was not possible to model the time period during which the 2001 data was collected due to a lack of weather data for that time period. The landuse for the watershed had changed significantly from the 1970's to 2001, so it was not considered appropriate to model a time period between these two data collection events. The mass balance approach is suitable for a Phase One TMDL

4.2 Calculation of Load

The mass balance approach utilizes the conservation of mass principle. Loads can be calculated by multiplying the fecal coliform concentration versus the flow. The principle of the conservation of mass allows for the addition and subtraction of those loads to determine the appropriate numbers necessary for the TMDL. The loads can be calculated using the following relationship:

Load (counts/30days) = [**Concentration** (counts/ 100 ml)] * [**Flow** (cfs)] * (Conversion Factor)

where (Conversion Factor) = [(28316.8 ml/1 ft^3)*(1 (100 ml)/100 (1 ml))*(60 s/1 min)*
(60 min/1 hour)*(24 hour/1 day)*(30 days/1 (30 days)]
= 7.34 E+08 ((100 ml * s)/(ft^3 *30 days))

For the calculation of this TMDL the appropriate concentration used was the geometric mean standard. While MDEQ realizes it would be most appropriate to use the geometric mean flow corresponding to the period of violation, the only flow information available was sporadic stage data collected at Belmont Bridge on the Little Tallahatchie River near Sardis. This stage was converted to flow using a rating curve. There were no stage measurements available when the measured violation in the waterbody occurred, so the average annual flow through the waterbody was used to calculate the TMDL.

4.3 Stream Characteristics

The stream characteristics given below describe the reaches that make up the impaired segment of the Little Tallahatchie River. The channel geometry and lengths for the Little Tallahatchie River are based on data available within the BASINS modeling system. The 7Q10 flow given is based on USGS station 07273000 located on Old Highway 51, 4 miles southwest of Sardis. The flow in the

Little Tallahatchie River has been regulated by the Sardis Reservoir since 1939; however, the 7Q10 flow given for this station is based on unregulated conditions. The characteristics of the Little Tallahatchie River are as follows.

♦ Length	3.95 miles
♦ Average Depth	1.06ft
♦ Average Width	70.45 ft
♦ Average Flow	914.0 cubic ft per second
♦ Mean Velocity	1.53 ft per second
♦ 7Q10 Flow	274 cubic ft per second
♦ Slope	0.0040 ft per ft

ALLOCATION

The allocation for this Phase One TMDL could include a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources, and a margin of safety (MOS). This Phase One TMDL is comprised of the WLA, LA and MOS.

5.1 Wasteload Allocations

The contribution of the point source was considered on a subwatershed basis. Typically, within each subwatershed, the 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 assumed existing load, allocated load, and percent reduction are shown below. There are 6 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 9 below.

Table 9. Wasteload Allocations

Subwatershed	Existing Load (counts/30 days)	Allocated Load (counts/30 days)	Percent Reduction
08030201001	2.51E+12	6.69E+11	73.3%
08030201002	3.40E+08	3.40E+08	0%
08030201003	9.94E+09	6.51E+09	34.5%
Total	**2.52E+12**	**6.76E+11**	**73.1%**

5.2 Load Allocations

The LA for Little Tallahatchie River is calculated using the water quality criterion and the average annual flow. In calculating the LA component, the water quality is reduced by a 10 percent MOS. For this Phase One TMDL, the load is based on a fecal coliform concentration of 180 counts per 100 ml and the average annual flow of the entire watershed, MS261E, of 2901 cfs. The resulting load is estimated to be 3.83E+14 counts for 30 days. The WLA is then subtracted from this load to calculate the LA.

LA = 180 (counts/100 ml) * 2901 (cfs) * 7.34E+08 ((100 ml * s)/(ft^3 *30 days))
– 6.76E+11(counts for 30 days)

LA = 3.83E+14 counts for 30 days

The existing load of fecal coliform bacteria counts per 30 days entering the Little Tallahatchie River for each listed segment was estimated based on the highest measured violation and the average annual flow through the waterbody. The scenario resulted in a 95% reduction in fecal coliform bacteria to the waterbody.

5.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. For this study, reducing the instream target concentration by 10 percent from 200 counts per 100 ml to 180 counts per 100 ml explicitly specifies the MOS. Using the average annual flow and 10 percent of the target, which is 20 counts per 100 ml, the load attributed to the MOS is 4.26E+13 counts for 30 days.

MOS = 20 (counts/100ml) * 2901 (cfs) * 7.34E+08 ((100 ml * s)/(ft^3 *30 days))

MOS = 4.26E+13 counts for 30 days

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 Facilities

LA = Surface Runoff + Other Direct Inputs

MOS = Explicit

The TMDL was calculated based on the average annual flow of the entire watershed, MS261E, and the target, which is 200 counts per 100 ml. Table 10 gives the Phase One TMDL for the listed segments of Little Tallahatchie River.

TMDL = 200 (counts/100ml) * 2901 (cfs) * 7.34E+08 ((100 ml * s)/(ft^3 *30 days))

TMDL = 4.26E+14 counts for 30 days

Table 10. Summary for Listed Segments (counts/30 days)

	MS261M	MS261E	MS262E
WLA	**6.76E+11**	**6.76E+11**	**3.40E+08**
LA	**3.72E+14**	**3.83E+14**	**1.26E+13**
MOS	**4.14E+13**	**4.26E+13**	**1.40E+12**
TMDL = WLA + LA + MOS	**4.14E+14**	**4.26E+14**	**1.40E+13**

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. The Little Tallahatchie River, MS261M, is designated for the use of contact recreation. For this use, the pollutant standard is constant. Hotophia Creek, MS262E, and the Portion of the Lower Tallahatchie – DA, MS261E, are designated for the use of secondary contact. For this use, the pollutant standard is seasonal. The TMDL was developed to meet the applicable fecal coliform standard for Recreation, which limits do not vary according to seasons. Therefore, the TMDL is determined to be protective during all seasons of the year for the listed segment of Little Tallahatchie River (MS261M), the Portion of the Lower Tallahatchie-DA (MS261E), and Hotophia Creek (MS262E).

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 existing load from NPDES dischargers of fecal coliform by 73.1% by requiring all NPDES Permitted dischargers of fecal coliform to meet water standards for disinfection, along with reducing the assumed fecal load by 95%.

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 Little Tallahatchie 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 30th root of the product of 30 numbers.

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

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

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant. The load allocation is the value assigned to the summation of all 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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