FINAL REPORT
June 2008
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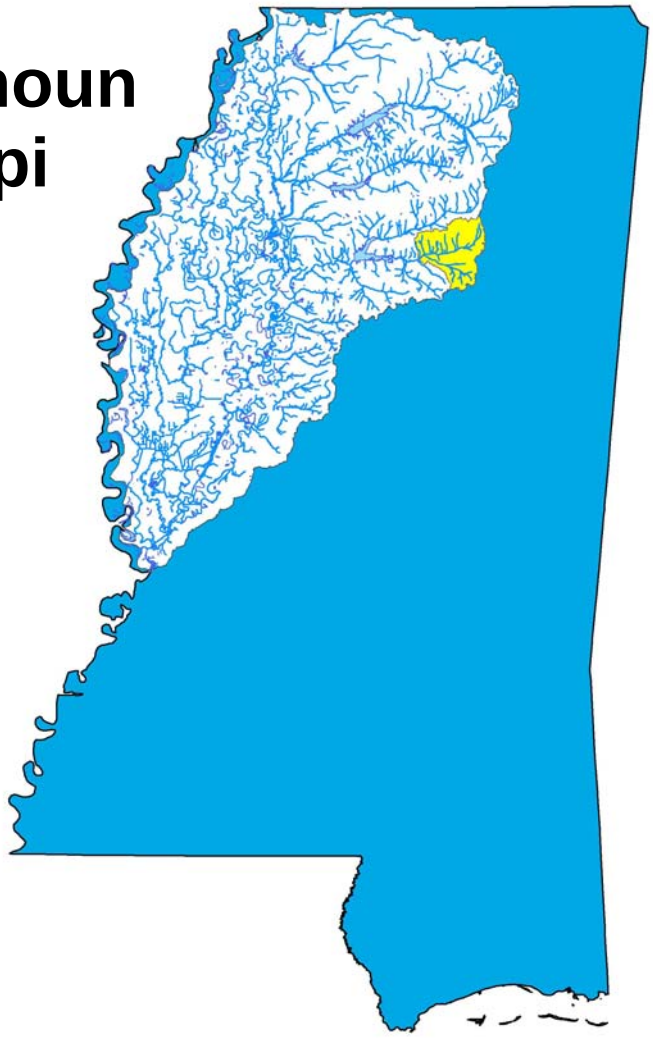
Total Maximum Daily Load
For
Nutrients and Organic Enrichment / Low Dissolved Oxygen
For the
Yalobusha River

Yazoo River Basin

Chickasaw and Calhoun Counties, Mississippi



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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 water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Water bodies. 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.

Conversion Factors

To convert from	To	Multiply by	To convert from	To	Multiply by
$mile^2$	acre	640	acre	ft^2	43560
km^2	acre	247.1	days	seconds	86400
m^3	ft^3	35.3	meters	feet	3.28
ft^3	gallons	7.48	ft^3	gallons	7.48
ft^3	liters	28.3	hectares	acres	2.47
cfs	gal/min	448.8	miles	meters	1609.3
cfs	MGD	0.646	tonnes	tons	1.1
m^3	gallons	264.2	µg/l * cfs	gm/day	2.45
m^3	liters	1000	µg/l * MGD	gm/day	3.79

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	:	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

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TMDL INFORMATION PAGE

Table 1. Listing Information

Name	ID	County	HUC	Impaired Use	Causes
Yalobusha River	MS325YE	Chickasaw, Calhoun	08030205	Aquatic Life Support	Nutrients and Organic Enrichment / Low Dissolved Oxygen
Location: Near Calhoun City from headwaters at confluence with Four Mile Creek to confluence with Lickup Creek					

Table 2. Water Quality Standards

Parameter	Beneficial use	Water Quality Criteria
Nutrients	Aquatic Life Support	Waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses.
Dissolved Oxygen	Aquatic Life Support	DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l

Table 3. NPDES Facilities

Facility Name	NPDES ID	Permitted Discharge (MGD)	Receiving Water
Vardaman POTW	MS0025097	0.34	Yalobusha River
Calhoun City POTW	MS0028134	0.32	Yalobusha River
Calhoun County Courthouse	MS0032174	0.004	Hurricane Creek/Yalobusha River
Derma POTW	MS0034975	0.21	Yalobusha River
Calhoun County Jail	MS0047813	0.01	Hurricane Creek

Table 4. Total Maximum Daily Load

Pollutant	WLA (lbs/day)	LA (lbs/day)	MOS	TMDL (lbs/day)
TN	**85**	**1207.2 – 1408.4**	Implicit	**1292.2 –1493.4**
TP	**38.4**	**120.7 – 201.2**	Implicit	**159.1 – 239.6**
TBODu	**342.6**	**0**	Implicit	**342.6**

EXECUTIVE SUMMARY

This TMDL has been developed for the Yalobusha River which was placed on the Mississippi 1996 Section 303(d) List of Impaired Water Bodies due to evaluated causes of pesticides, siltation, nutrients, organic enrichment/low dissolved oxygen, and pathogens. Separate TMDLs will be done for the pesticides and siltation causes. This TMDL addresses organic enrichment/low DO and nutrients and will provide an estimate of the total nitrogen (TN) and total phosphorus (TP) in the stream.

Mississippi does not have numeric criteria in its water quality standards for allowable nutrient concentrations. MDEQ currently has a Nutrient Task Force (NTF) working on the development of criteria for nutrients. An annual concentration range of 0.6 to 0.7 mg/l is an applicable target for TN and 0.06 to 0.10 mg/l for TP for water bodies located in Ecoregion 65. MDEQ is presenting these ranges as preliminary target values for TMDL development which is subject to revision after the development of numeric nutrient criteria

The Yalobusha River Watershed is located in HUC 08030205. The Yalobusha River begins near Calhoun City and flows in a southwestern direction from its headwaters to its mouth at Grenada Lake in Grenada County. The 303(d)-listed segment ends in at the confluence of Four Mile Creek and Lickup Creek in Calhoun County. The location of the watershed for the listed segment is shown in Figure 1.

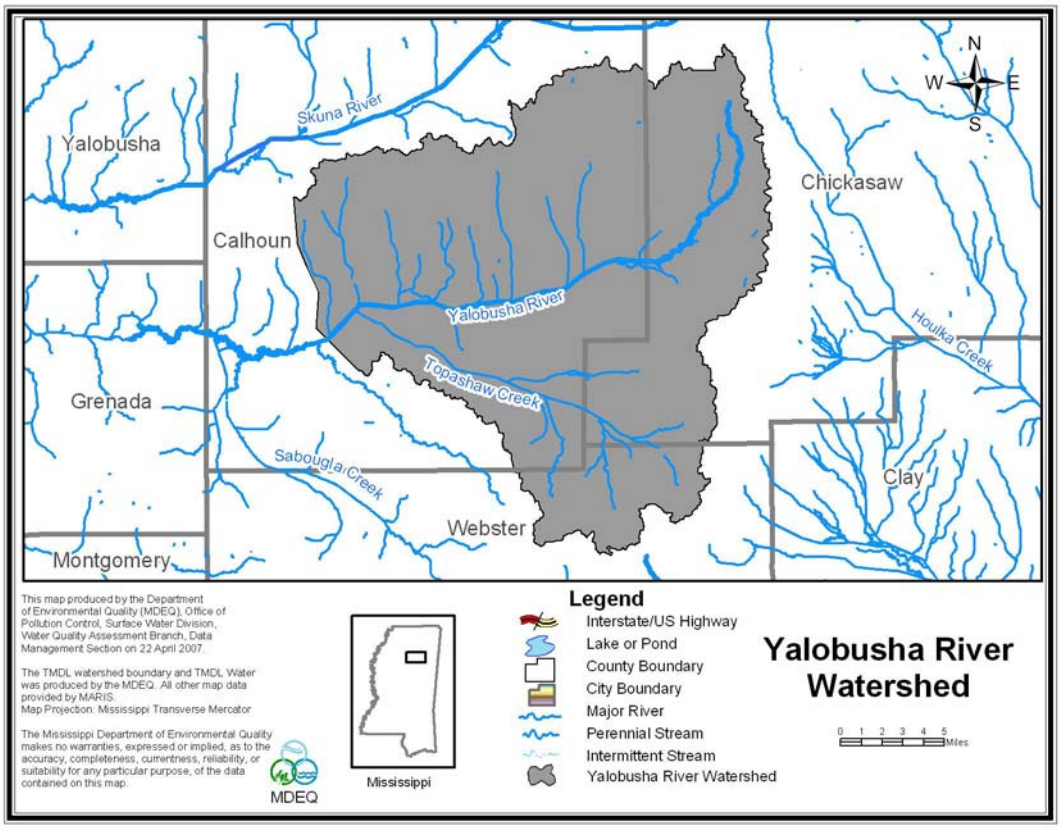

Figure 1. The Yalobusha River

Because the critical 7Q10 flow for the Yalobusha River is zero, a predictive model was not applicable. However, the limited total nutrient data and estimated ecoregion concentrations indicate reductions of nutrients are needed.

INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies 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 water bodies through the establishment of pollutant specific allowable loads. This TMDL has been developed for the 2006 §303(d) listed segment shown in Figure 2.

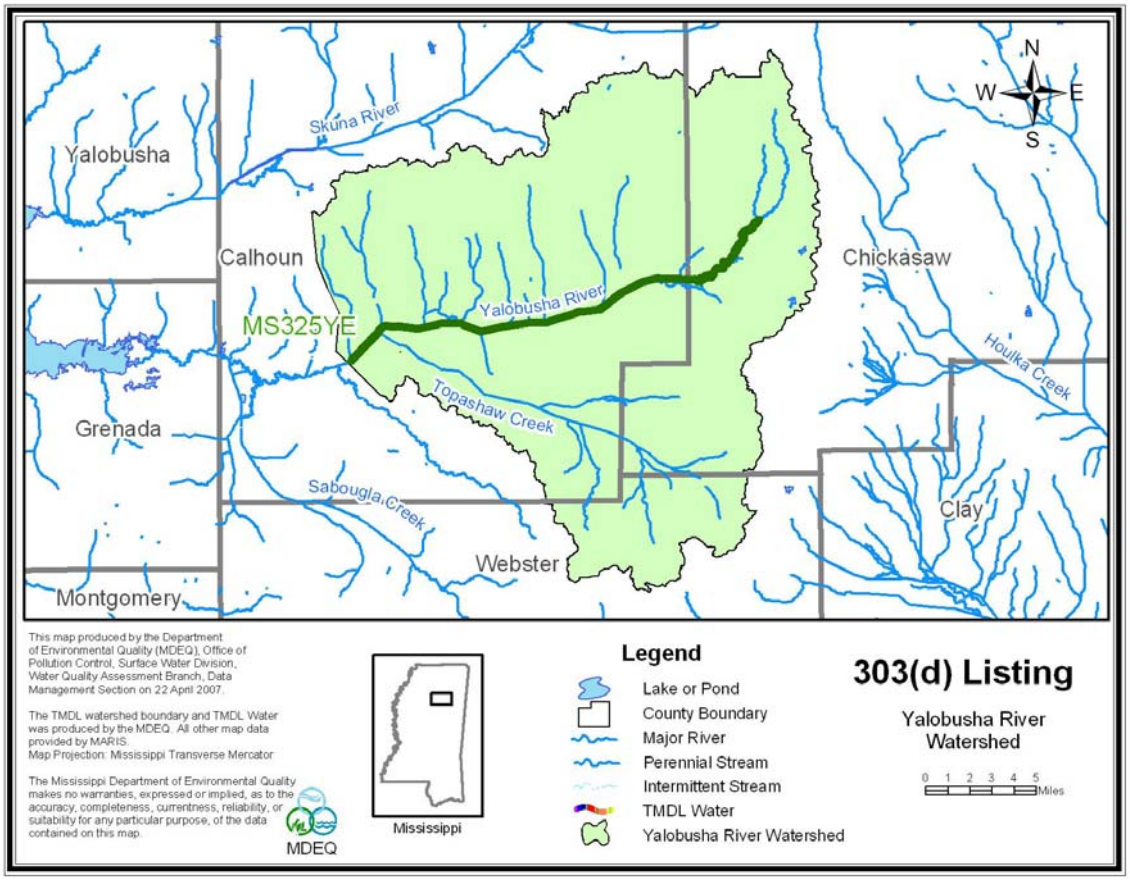

Figure 2. The Yalobusha River §303(d) Segment

1.2 Applicable Water Body Segment Use

The water use classifications are established by the State of Mississippi in the document *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003). The designated beneficial use for the listed segment is fish and wildlife.

1.3 Applicable Water Body Segment Standard

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2003).

Mississippi's current standards contain a narrative criteria that can be applied to nutrients which states "*Waters shall be free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use* (MDEQ, 2002)." In the 1999 Protocol for Developing Nutrient TMDLs, EPA suggests several methods for the development of numeric criteria for nutrients (USEPA, 1999). In accordance with the 1999 Protocol, "The target value for the chosen indicator can be based on: comparison to similar but unimpaired waters; user surveys; empirical data summarized in classification systems; literature values; or professional judgment." MDEQ believes the most economical and scientifically defensible method for use in Mississippi is a comparison between similar but unimpaired waters within the same region. This method is dependent on adequate data which are being collected in accordance with the EPA approved plan. The initial phase of the data collection process for wadeable streams is complete.

1.4 Nutrient Target Development

Nutrient data were collected quarterly at 99 discrete sampling stations state wide where biological data already existed. These stations were identified and used to represent a range of stream reaches according to biological health status, geographic location (selected to account for ecoregion, bioregion, basin and geologic variability) and streams that potentially receive non-point source pollution from urban, agricultural, and silviculture lands as well as point source pollution from NPDES permitted facilities.

Nutrient concentration data were not normally distributed; therefore, data were log transformed for statistical analyses. Data were evaluated for distinct patterns of various data groupings (stratification) according to natural variability. Only stations that were characterized as "least disturbed" through a defined process in the M-BISQ process (M-BISQ 2003) or stations that resulted in a biological impairment rating of "fully attaining" were used to evaluate natural variability of the data set. Each of these two groups was evaluated separately ("least disturbed sites" and "fully attaining sites). Some stations were used in both sets, in other words, they were considered "least disturbed" and "fully attaining". The number of stations considered "least disturbed" was 30 of 99, and the number of stations considered "fully attaining" was 53 of 99.

Several analysis techniques were used to evaluate nutrient data. Graphical analyses were used as the primary evaluation tool. Specific analyses used included; scatter plots, box plots, Pearson's correlation, and general descriptive statistics.

In general, natural nutrient variability was not apparent based on box plot analyses according to the 4 stratification scenarios. Bioregions were selected as the stratification scheme to use for TMDLs in the Pascagoula Basin. However, this was not appropriate for some water bodies in

smaller bioregions. Therefore, MDEQ now uses ecoregions as a stratification scheme for the water bodies in the remainder of the state.

In order to use the data set to determine possible nutrient thresholds, nutrient concentrations were evaluated as to their correlation with biological metrics. That thorough evaluation was completed prior to the Pascagoula River Basin TMDLs. The methodology and approach were verified. The same methodology was applied to the subsequent bioregions and ecoregions.

For the preliminary target concentration range per each ecoregion, the 75th and 90th percentiles were derived for station mean values of nutrient sites found to be fully supporting of aquatic life support according to the M-BISQ scores. For the estimate of the existing concentrations the 50th percentile (median) was derived for station mean values of sites that were not attaining and had nutrient concentrations greater than the target.

WATER BODY ASSESSMENT

2.1 The Yalobusha River Water Quality Data

Nutrient data for the Yalobusha River Watershed were gathered and reviewed. Data exist for the §303(d)-listed segment of the Yalobusha River based on MDEQ's ambient monitoring at station 07282000 and nutrient monitoring at station 1007. The locations of the stations are shown in Figure 3. The data are given in Table 5.

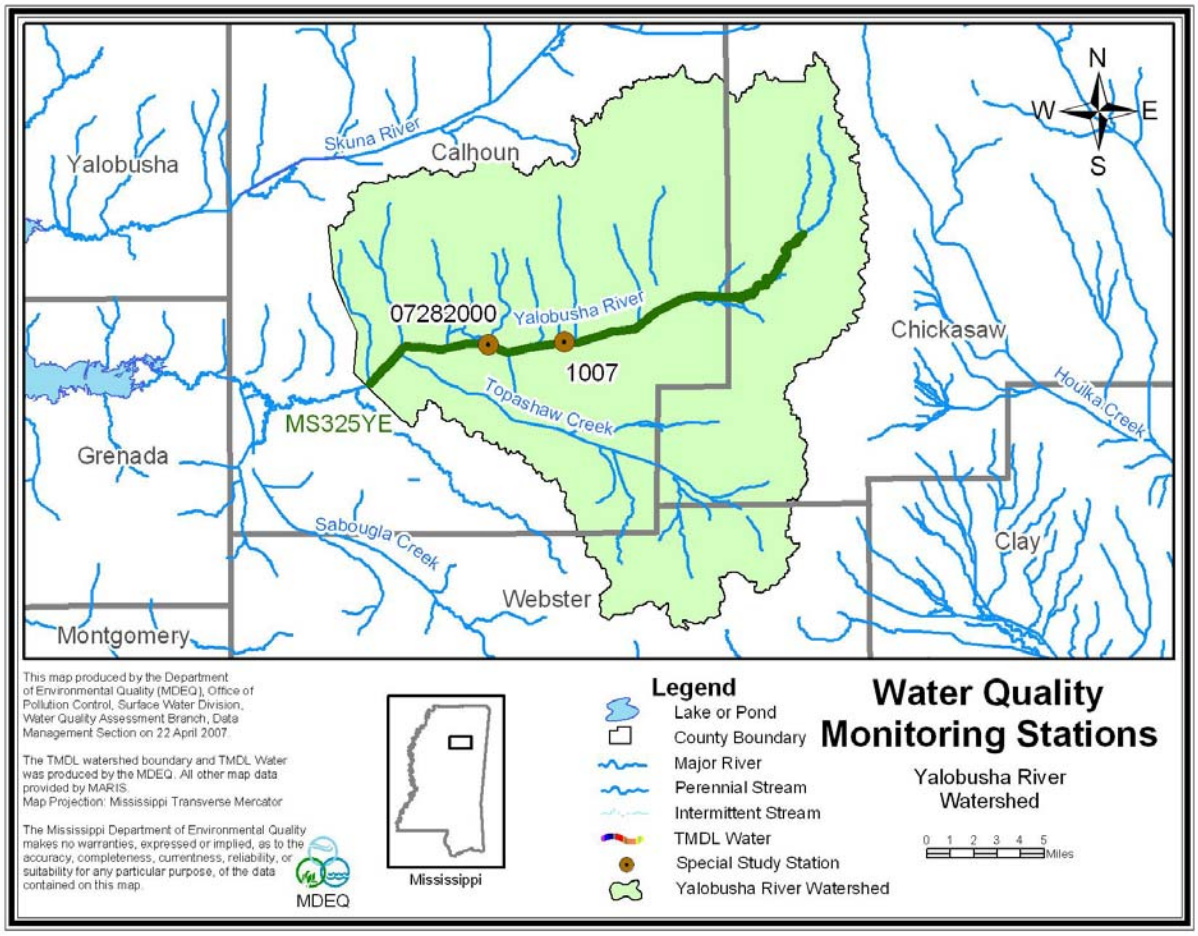

Figure 3. The Yalobusha River Water Quality Monitoring Station

Table 5. The Yalobusha River Nutrient Data

Station	Date	Time	TN (mg/l)	TP (mg/l)
1007	3/24/2004	11:53	0.49	0.15
1007	6/23/2004	10:30	1.74	0.26
1007	9/22/2004	12:45	0.35	0.05
7282000	12/02/96	10:00	1.01	0.32
7282000	01/07/97	10:20	1.19	0.32
7282000	02/24/97	14:00	0.42	0.03
7282000	03/05/97	12:40	1.19	0.18
7282000	04/03/97	13:15	0.42	0.21
7282000	06/10/97	13:15	1.22	0.18
7282000	11/18/97	13:00	0.53	0.03
7282000	12/09/97	13:10	0.36	0.08
7282000	06/09/98	12:35	0.62	0.10
7282000	07/14/98	13:30	1.76	0.38
7282000	08/13/98	13:30	1.54	0.20
7282000	01/11/99	13:00	0.45	0.06
7282000	02/16/99	13:12	0.48	0.03
7282000	03/02/99	13:51	0.38	0.08
7282000	03/30/99	13:00	0.38	0.06
7282000	05/05/99	12:40	0.61	0.10
7282000	06/03/99	13:15	1.06	0.14
7282000	07/01/99	14:00	1.35	0.24
7282000	08/11/99	13:00	0.73	0.91
7282000	09/16/99	14:45	1.22	0.14
7282000	10/27/99	13:15	0.65	0.09
7282000	11/08/99	14:30	0.43	0.03
7282000	12/14/99	9:45	1.80	0.32
7282000	01/19/00	9:45	0.93	0.12
7282000	04/10/00	9:00	0.68	0.09
7282000	05/17/00	12:45	0.95	1.00
7282000	06/01/00	13:00	1.53	0.14
7282000	11/20/00	12:50	1.56	0.13
7282000	12/06/00	13:45	1.36	0.01
7282000	04/03/01	10:30	0.70	0.05
7282000	05/02/01	9:45	0.46	0.03
7282000	06/28/01	9:18	3.56	0.82
7282000	07/12/01	12:05	0.57	0.06
7282000	09/13/01	11:00	0.55	0.05
7282000	10/10/01	9:30	0.22	0.05
7282000	11/08/01	9:35	0.82	0.07
7282000	12/05/01	9:05	0.72	0.06
Average			**0.92**	**0.18**

2.2 Assessment of Point Sources

An important step in assessing pollutant sources in the Yalobusha River watershed is locating the NPDES permitted sources. There are 5 facilities permitted to discharge into this watershed, Table 6. The locations of the facilities are shown in Figure 4.

Table 6. NPDES Permitted Facilities Treatment Types

Name	NPDES Permit	Treatment Type	Discharge (MGD)	BOD_5 (mg/l)
Vardaman POTW	MS0025097	Hydrograph Controlled Release	0.34	30
Calhoun City POTW	MS0028134	Hydrograph Controlled Release	0.32	30
Calhoun County Courthouse	MS0032174	Activated Sludge	0.004	30
Derma POTW	MS0034975	Conventional Lagoon	0.21	30
Calhoun County Jail	MS0047813	Activated Sludge	0.01	30

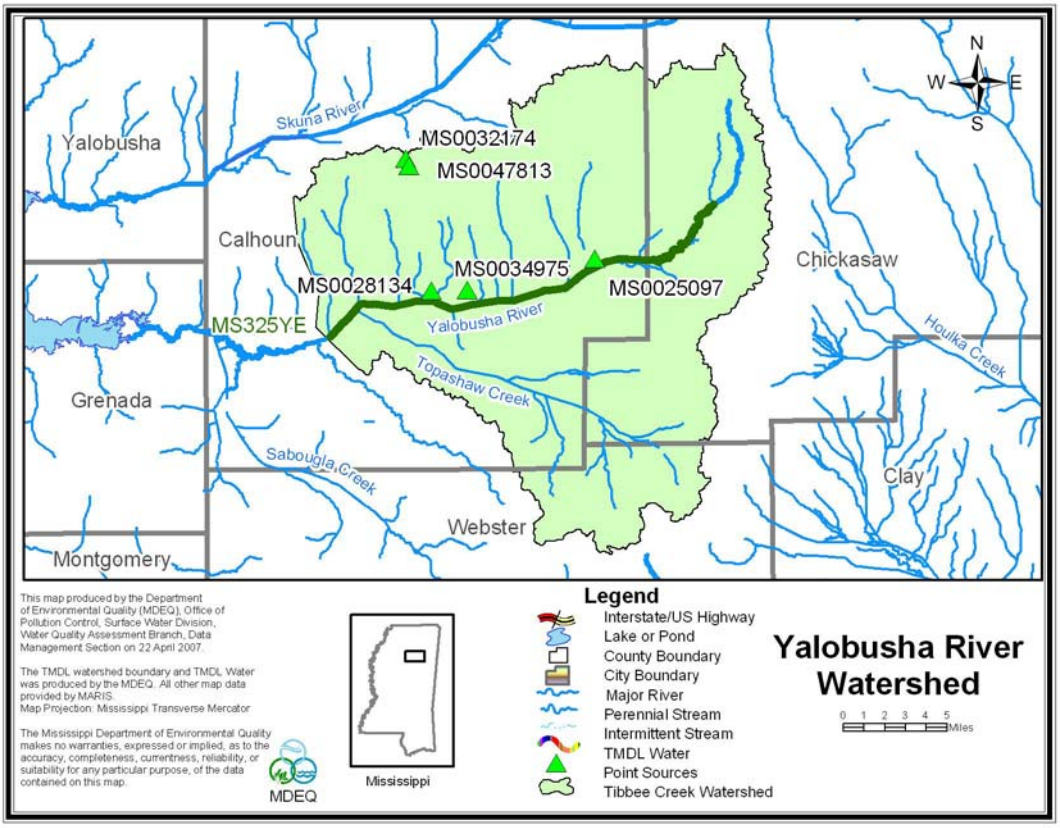

Figure 4. The Yalobusha River Point Sources

2.3 Assessment of Non-Point Sources

Non-point loading of nutrients and organic material in a water body results from the transport of the pollutants into receiving waters by overland surface runoff, groundwater infiltration, and atmospheric deposition. The two primary nutrients of concern are nitrogen and phosphorus. Total nitrogen is a combination of many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can be transported in groundwater and may enter a stream from groundwater infiltration. Finally, atmospheric gaseous nitrogen may enter a stream from atmospheric deposition.

Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been sorbed by eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (USEPA, 1999). However, phosphorus is typically not readily available from the atmosphere or the natural water supply (Davis and Cornwell, 1988). As a result, phosphorus is typically the limiting nutrient in most non-point source dominated rivers and streams, with the exception of watersheds which are dominated by agriculture and have high concentrations of phosphorus contained in the surface runoff due to fertilizers and animal excrement or watersheds with naturally occurring soils which are rich in phosphorus (Thomann and Mueller, 1987).

Watersheds with a large number of failing septic tanks may also deliver significant loadings of phosphorus to a stream. All domestic wastewater contains phosphorus which comes from humans and the use of phosphate containing detergents. Table 7 presents typical nutrient loading ranges for various land uses.

Table 7. Nutrient Loadings for Various Land Uses

Landuse	Total Phosphorus [lb/acre-y]			Total Nitrogen [lb/acre-y]		
	Minimum	Maximum	Median	Minimum	Maximum	Median
Roadway	0.53	1.34	0.98	1.2	3.1	2.1
Commercial	0.61	0.81	0.71	1.4	7.8	4.6
Single Family-Low Density	0.41	0.57	0.49	2.9	4.2	3.6
Single Family-High Density	0.48	0.68	0.58	3.6	5.0	5.2
Multifamily Residential	0.53	0.72	0.62	4.2	5.9	5.0
Forest	0.09	0.12	0.10	1.0	2.5	1.8
Grass	0.01	0.22	0.12	1.1	6.3	3.7
Pasture	0.01	0.22	0.12	1.1	6.3	3.7

Source: Horner et al., 1994 in Protocol for Developing Nutrient TMDLs (USEPA 1999)

The drainage area of the Yalobusha River is approximately 218,996 acres (342.2 square miles). The watershed contains many different landuse types, including urban, forest, cropland, pasture, water, wetlands and clouds. The land use 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. The area directly surrounding the impaired segment, MS325YE, is predominantly cropland and wetland. The landuse distribution for the Yalobusha River is shown in Table 8 and Figure 5.

Table 8. Landuse Distribution for the Yalobusha River Watershed

In Acres	Urban	Forest	Cropland	Pasture	Scrub/Barren	Water	Wetlands	Clouds
Yalobusha	830	74255	41927	55533	34175	734	11502	40
Percentage	0.4	33.9	19.1	25.4	15.6	0.3	5.3	0.0

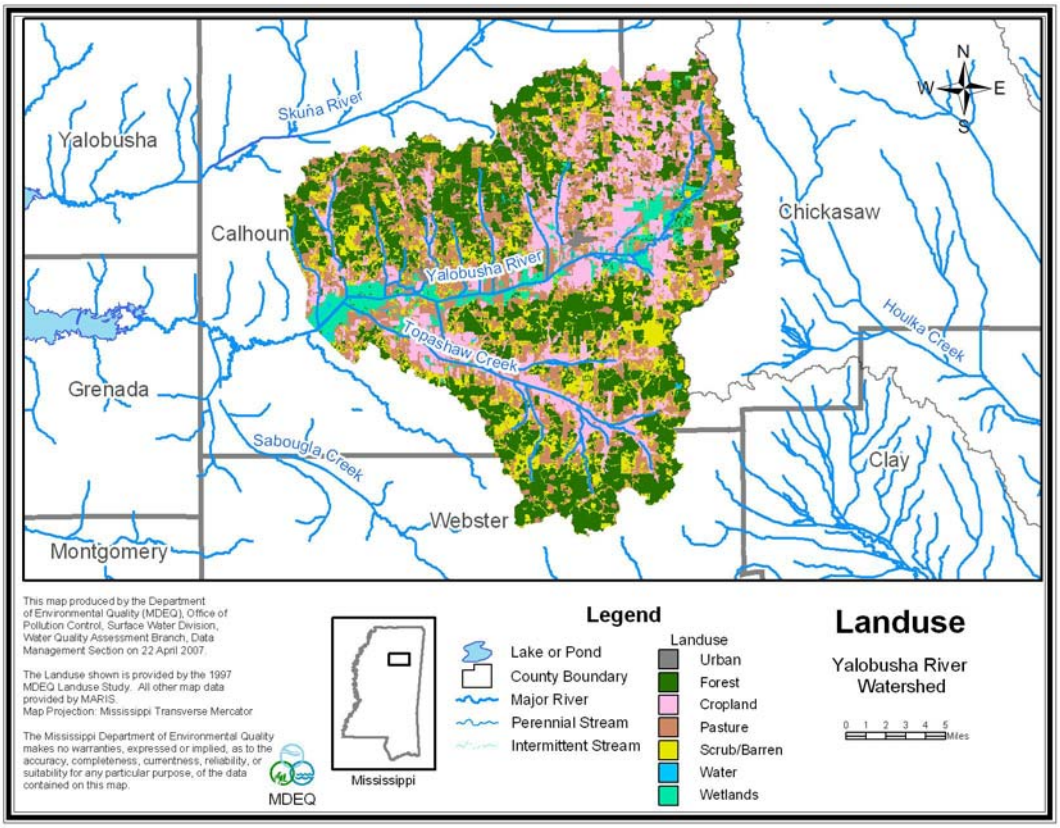

Figure 5. Landuse in the Yalobusha River Watershed

2.4 Evaluation of TBODu

The TMDL for DO will be quantified in terms of organic enrichment. Organic enrichment is measured in terms of total ultimate biochemical oxygen demand (TBODu). TBODu represents the oxygen consumed by microorganisms while stabilizing or degrading carbonaceous and nitrogenous compounds under aerobic conditions over an extended time period. The carbonaceous compounds are referred to as CBODu, and the nitrogenous compounds are referred to as NBODu. TBODu is equal to the sum of NBODu and CBODu, Equation 1.

$$\mathbf{TBODu = CBODu + NBODu} \qquad \mathbf{(Equation\ 1)}$$

Organic material discharged to a stream from an NPDES permitted point source is typically quantified as 5-day biochemical oxygen demand (BOD_5). BOD_5 is a measure of the oxidation of carbonaceous and nitrogenous material over a 5-day incubation period. However, oxidation of nitrogenous material, called nitrification, usually does not take place within the 5-day period because the bacteria that are responsible for nitrification are normally not present in large numbers and have slow reproduction rates (Metcalf and Eddy, 1991). Thus, BOD_5 is generally

considered equal to $CBOD_5$. Because permits for point source facilities are written in terms of BOD_5 while TMDLs are typically developed using CBODu, a ratio between the two terms is needed, Equation 2.

$$\textbf{CBODu} = \textbf{CBOD}_5 * \textbf{Ratio} \qquad \textbf{(Equation 2)}$$

The CBODu to $CBOD_5$ ratios are given in *Empirical Stream Model Assumptions for Conventional Pollutants and Conventional Water Quality Models* (MDEQ, 2001). These values are recommended for use by MDEQ regulations when actual field data are not available. The value of the ratio depends on the treatment type of wastewater. A CBODu to $CBOD_5$ ratio of 1.5 is appropriate for all of the facilities (conventional lagoon and HCR) except for the Calhoun County Courthouse and the Calhoun County Jail that use an activated sludge plant for treatment. This type of treatment requires a CBODu to $CBOD_5$ ratio of 2.3.

In order to determine the NBODu, the ammonia nitrogen (NH_3-N) loads were converted to an oxygen demand using a factor of 4.57 pounds of oxygen per pound of ammonia nitrogen (NH_3-N) oxidized to nitrate nitrogen (NO_3-N). Using this factor is a conservative modeling assumption because it assumes that all of the ammonia is converted to nitrate through nitrification. The sum of CBODu and NBODu is equal to the point source load of TBODu. The maximum permitted load of TBODu from the existing point sources are given in Table 9.

Table 9. Point Sources, Maximum Permitted Loads

Facility Name	Flow (MGD)	$CBOD_5$ (mg/l)	NH_3-N (mg/L)	$CBOD_u$: $CBOD_5$ Ratio	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Vardaman POTW	0.34	30	2	1.5	127.6	3.11	130.7
Calhoun City POTW	0.32	30	2	1.5	120.1	2.92	123.0
Calhoun County Courthouse	0.004	30	2	2.3	2.30	0.04	2.34
Derma POTW	0.21	30	2	1.5	78.8	1.92	80.7
Calhoun County Jail	0.01	30	2	2.3	5.75	0.09	5.84
Total	**0.88**				**333.85**	**8.08**	**342.58**

2.5 Estimated Existing Load for Total Nitrogen

The estimated existing total nitrogen concentration is based on the median total nitrogen concentrations measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients, which is 1.38 mg/l. The target concentration for TN for Ecoregion 65 is 0.6 to 0.7 mg/l. The average concentration found in this stream is 0.92 mg/L. However, due to the limited amount of data, the targeted reductions will be based on the estimated total nitrogen level for impaired streams in Ecoregion 65.

To convert the estimated existing total nitrogen concentration to a total nitrogen load, the average annual flow was estimated based on flow data from the USGS gage located on the Yalobusha River and Toposhaw Creek near Calhoun City, Mississippi (07282000). The average

annual flow for this gage is 321.5 cfs. To estimate the amount of flow in the lower section of the Yalobusha River, a drainage area ratio was calculated (321.5 cfs/295 square miles = 1.09 cfs/square miles). The ratio was then multiplied by the drainage area of the impaired segment.

Nutrient Load (lb/day) = Flow (cfs) * 5.394 (conversion factor)* Nutrient Concentration (mg/L) (Equation 3)

Table 10. Estimated Existing Total Nitrogen Load for The Yalobusha River

Water body	Area (sq miles)	Average Annual Flow (cfs)	TN (mg/l)	TN (lbs/day)
Yalobusha River	342.2	373.0	1.38	2,776.5

The existing TN load consists of both point and non-point components. Since many treatment facilities in Mississippi do not have permit limits for nitrogen, nor are they currently required to report effluent nitrogen concentrations, MDEQ used an estimated effluent concentration based on literature values for different treatment types. Table 11 shows the median effluent nitrogen concentrations for four conventional treatment processes. The appropriate concentration for each of the facilities was then used in Equation 3 to estimate the TN load from point sources, Table 12.

Table 11. Median Phosphorous Concentrations in Wastewater Effluents

	Treatment Type			
	Primary	Trickling Filter	Activated Sludge	Stabilization Pond
No. of plants sampled	55	244	244	149
Total P (mg/L)	22.4 ± 1.30	16.4± 0.54	13.6 ±0 .62	11.5 ± 0.84

Source: After Ketchum, 1982 in EPA 823-B-97-002 (USEPA, 1997)

Table 12. NPDES Permitted Facilities Treatment Types with Nitrogen Estimates

Facility Name	Treatment Type	Permitted Discharge (MGD)	TN concentration estimate (mg/l)	TN Load estimate (lbs/day)
Vardaman POTW	Hydrograph Controlled Release	0.34	11.5	32.6
Calhoun City POTW	Hydrograph Controlled Release	0.32	11.5	30.7
Calhoun County Courthouse	Activated Sludge	0.004	13.6	0.50
Derma POTW	Conventional Lagoon	0.21	11.5	20.1
Calhoun County Jail	Activated Sludge	0.01	13.6	1.10
	Total	**0.88**		**85.0**

The TN point source load is estimated to be 85 lbs/day, Table 12. The annual average total load based on the estimated total nitrogen concentration of 1.38 mg/l and an annual average flow of 373.0 cfs is 2776.5 lbs/day. The point source load is 3% of the total load. Therefore, 97% of the estimated existing TN load is from non-point sources

2.6 Estimated Existing Load for Total Phosphorus

The estimated existing total phosphorous concentration is based on the median total phosphorous concentrations measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients, which is 0.18 mg/l. The target concentration for TP for Ecoregion 65 is 0.06 to 0.10 mg/l. The average concentration found in this stream is 0.18 mg/L.

To convert the estimated existing total phosphorous concentration to a total phosphorous load, the average annual flow was estimated based on flow data as shown above. The existing TP load was then calculated using Equation 3 and summarized in Table 13.

Table 13. Estimated Existing Total Phosphorus Load for The Yalobusha River

Stream	Area (sq miles)	Average Annual Flow (cfs)	TP (mg/l)	TP (lbs/day)
Yalobusha River	342.2	373.0	0.18	362.2

The existing TP load consists of both point and non-point components. Since many treatment facilities in Mississippi do not have permit limits for phosphorous, nor are they currently required to report effluent phosphorous concentrations, MDEQ used an estimated effluent concentration based on literature values for different treatment types. Table 14 shows the median effluent phosphorous concentrations for four conventional treatment processes. The appropriate concentration for each of the facilities was then used in Equation 3 to estimate the TP load from point sources, Table 15.

Table 14. Median Phosphorous Concentrations in Wastewater Effluents

	Treatment Type			
	Primary	Trickling Filter	Activated Sludge	Stabilization Pond
No. of plants sampled	55	244	244	149
Total P (mg/L)	6.6 ± 0.66	6.9 ± 0.28	5.8 ± 0.29	5.2 ± 0.45

Source: After Ketchum, 1982 in EPA 823-B-97-002 (USEPA, 1997)

Table 15. NPDES Permitted Facilities Treatment Types with Phosphorous Estimates

Facility Name	Treatment Type	Permitted Discharge (MGD)	TP concentration estimate (mg/l)	TP Load estimate (lbs/day)
Vardaman POTW	Hydrograph Controlled Release	0.34	5.2	14.7
Calhoun City POTW	Hydrograph Controlled Release	0.32	5.2	13.9
Calhoun County Courthouse	Activated Sludge	0.004	5.8	0.2
Derma POTW	Conventional Lagoon	0.21	5.2	9.1
Calhoun County Jail	Activated Sludge	0.01	5.8	0.5
	Total	**0.88**		**38.4**

The average TP point source load is estimated to be 38.4 lbs/day. The annual average total load based 373.0 cfs is 362.2 lbs/day. The point source load is 10.6% of the total load. Therefore, 89.4% of the estimated existing total load is from non-point sources.

ALLOCATION

The allocation for this TMDL involves a wasteload allocation for point sources and a load allocation for non-point sources necessary for attainment of water quality standards in the The Yalobusha River. The nutrient portion of this TMDL is addressed through initial estimates of the existing and target TN and TP concentrations.

3.1 Wasteload Allocation

There are 5 point sources in the Yalobusha River watershed. The critical 7Q10 flow for the Yalobusha River is zero. As a result, a predictive model was not used.

The NPDES permitted facilities included in the wasteload allocation for the Yalobusha River are given in Tables 16-18. Table 16 gives the wasteload allocation for TBODu. Table 17 gives the estimated load of TN from the point sources which are 3.0% of the total existing load as described in Section 2.5. Table 18 gives the estimated load of TP from the point sources which are 10.6% of the total existing load as described in Section 2.6.

Table 16. TBODu Wasteload Allocation

Facility Name	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Vardaman POTW	127.6	3.1	130.7
Calhoun City POTW	120.1	2.9	123.0
Calhoun County Courthouse	2.3	0.0	2.3
Derma POTW	78.8	1.9	80.7
Calhoun County Jail	5.8	0.1	5.8
Total	**333.9**	**8.08**	**342.6**

Table 17. TN Wasteload Allocation

Facility Name	TN concentration estimate (mg/l)	Permitted Discharge (MGD)	TN Load estimate (lbs/day)	TN Load allocated (lbs/day)	Percent Reduction
Vardaman POTW	11.5	0.34	32.6	32.6	0
Calhoun City POTW	11.5	0.32	30.7	30.7	0
Calhoun County Courthouse	13.6	0.004	0.5	0.5	0
Derma POTW	11.5	0.21	20.1	20.1	0
Calhoun County Jail	13.6	0.01	1.1	1.1	0
Total		**0.88**	**85.0**	**85.0**	**0**

Table 18. TP Wasteload Allocation

Facility Name	TP concentration estimate (mg/l)	Permitted Discharge (MGD)	TP Load estimate (lbs/day)	TP Load allocated (lbs/day)	Percent Reduction
Vardaman POTW	5.2	0.34	14.7	14.7	0
Calhoun City POTW	5.2	0.32	13.9	13.9	0
Calhoun County Courthouse	5.8	0.004	0.2	0.2	0
Derma POTW	5.2	0.21	9.1	9.1	0
Calhoun County Jail	5.8	0.01	0.5	0.5	0
Total		**0.88**	**38.4**	**38.4**	**0**

It is noted that due to the lack of nutrient water quality criteria these TMDL allocations are estimates based on literature assumptions and projected targets. The State of Mississippi is in the

process of developing numeric nutrient criteria in accordance with an EPA approved work plan for nutrient criteria development. This TMDL recommends quarterly monitoring of nutrients for the NPDES facilities. MDEQ's calculations of the annual average load indicate that the majority of the estimated nutrient load is from non-point sources. Therefore, the State will focus on striving to attain the goal set by the LA portion of the TMDL.

3.2 Load Allocation

The non-point source load for TBODu in the Yalobusha River is given in Table 19. The load allocation for the TBODu TMDL is has been set to zero because there are no non-point source flows entering the water body at the critical 7Q10 condition which is used for DO modeling.

Based on initial estimates in Sections 2.5 and 2.6, most of the TN and TP loads in this watershed come from non-point sources. Therefore, best management practices (BMPs) should be encouraged in the watershed to reduce potential nutrient loads from non-point sources The watershed should be considered a priority for riparian buffer zone restoration and any nutrient reduction BMPs. For land disturbing activities related to silviculture, construction, and agriculture, it is recommended that practices, as outlined in "Mississippi's BMPs: Best Management Practices for Forestry in Mississippi" (MFC, 2000), "Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater" (MDEQ, et. al, 1994), and "Field Office Technical Guide" (NRCS, 2000), be followed, respectively. Table 20 shows the load allocation for TN and TP.

Table 19. Load Allocation for TBODu

Water Body	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Yalobusha River	0	0	0

Table 20. Load Allocation for TN and TP

Nutrient	Estimated Nutrient Non-point Source Load (lbs/day)	Allocated Nutrient Non-point Source Load (lbs/day)
TN	2691.5	1207.2 – 1408.4
TP	323.8	120.7 – 201.2

3.3 Incorporation of a Margin of Safety

The margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving water body. The two types of MOS development are to implicitly incorporate the MOS using conservative model assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS selected for this TMDL is implicit.

3.4 Calculation of the TMDL

The TMDLs were calculated based on Equation 4.

$$\mathbf{TMDL = WLA + LA + MOS} \qquad \mathbf{(Equation\ 4)}$$

In this equation, WLA is the wasteload allocation, LA is the load allocation, and MOS is the margin of safety. A predictive model was not used to calculate the dissolved oxygen TMDL due to the 7Q10 flow being zero. The TBODu allocated for the stream is shown in Table 21. Equation 3 was used to calculate the TMDL for TN and TP. The TMDLs needed for nutrients are shown in Table 22. The target concentration was used with the average flow for the watershed to determine the TMDL. The TMDL was then compared to the estimated existing load previously calculated. The estimated existing total nitrogen concentration indicates needed reductions of 46% to 53.4%. The TMDL for TN is 1292.2– 1493.4 lbs/day. The estimated existing total phosphorous concentration indicates needed reductions of 33.8% to 56.1%. The TMDL for TP is 159.1-239.6 lbs/day.

Table 21. TMDL for TBODu in the Yalobusha River

	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
CBODu	333.85	0	Implicit	**333.85**
NBODu	8.08	0	Implicit	**8.08**
TBODu	**342.58**	**0**		**342.58**

Table 22. TMDL for TN and TP in the Yalobusha River

	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
TN	**85**	**1207.2 – 1408.4**	Implicit	**1292.2 –1493.4**
TP	**38.4**	**120.7 – 201.2**	Implicit	**159.1 – 239.6**

3.5 Seasonality and Critical Condition

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions.

CONCLUSION

Nutrients were addressed through an estimate of a preliminary total phosphorous concentration target range and a preliminary total nitrogen concentration target range. Based on the estimated existing and target total nitrogen concentrations, this TMDL recommends a 46.0% to 53.4% reduction of the nitrogen loads entering this stream to meet the preliminary target range of 0.6 to 0.7 mg/l. Based on the estimated existing and target total phosphorous concentrations, this TMDL recommends a 33.8% to 56.1% reduction of the phosphorous loads entering this stream to meet the preliminary target range of 0.06 to 0.10 mg/l. Because only 3.0% of the existing TN load and 10.6% of the TP load are estimated to be due to point sources, this TMDL does not recommend percent reductions from the NPDES permits. However, this TMDL recommends quarterly monitoring of nutrients for the NPDES facilities.

It is recommended that the Yalobusha River watershed be considered as a priority watershed for riparian buffer zone restoration and any nutrient reduction BMPs. The implementation of these BMP activities should reduce the nutrient load entering the creek. This will provide improved water quality for the support of aquatic life in the water bodies and will result in the attainment of the applicable water quality standards.

4.1 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. The public will be given an opportunity to review the TMDLs 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. Anyone wishing to become a member of the TMDL mailing list should contact Kay Whittington at Kay_Whittington@deq.state.ms.us.

All comments should be directed to Kay Whittington at Kay_Whittington@deq.state.ms.us or Kay Whittington, MDEQ, PO Box 10385, Jackson, MS 39289. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL and will be considered in the submission of this TMDL to EPA Region 4 for final approval.

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