

# Total Maximum Daily Load For Total Toxics

Bayou La Croix and  
Bayou Caddy  
**Coastal Basin**

**Hancock County, Mississippi**

Prepared By

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## FOREWORD

This 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.

### Prefixes for fractions and multiples of SI units

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

### Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.00156	Days	Seconds	86400
Cubic feet	Cu. Meter	0.02832	Feet	Meters	0.3048
Cubic feet	Gallons	7.48052	Gallons	Cu feet	0.1337
Cubic feet	Liters	28.3168	Hectares	Acres	2.4711
cfs	Gal/min	448.831	Miles	Meters	1609.3
cfs	MGD	.646317	mg/l	ppm	1
Cubic meters	Gallons	264.172	μg/l * cfs	Gm/day	2.45

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## TMDL INFORMATION PAGE

**Table 1. Listing Information**

Name	ID	County	HUC	Cause	Mon/Eval
Bayou La Croix	MS115BLCE	Hancock	03170009	Total Toxics	Evaluated
Near Waveland from Headwaters to mouth at Jourdan River					
Bayou Caddy	MS115BCE	Hancock	03170009	Total Toxics	Evaluated
Near Lakeshore from Headwaters to mouth at Mississippi Sound					

**Table 2. Water Quality Standard**

Parameter	Beneficial use	Water Quality Criteria
Total Toxics	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

**Table 3. Total Maximum Daily Load**

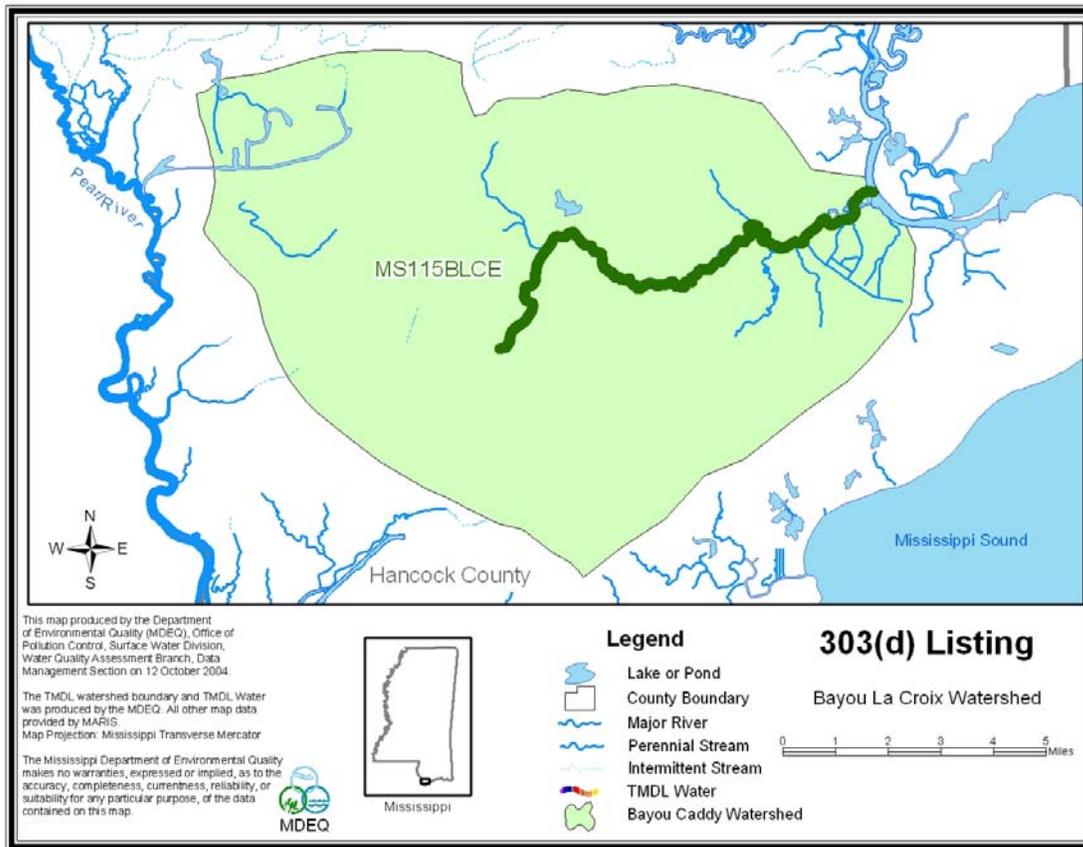
Pollutant of Concern	WLA	LA	MOS	TMDL
Toxicity Unit, Chronic	1 TUc	1 TUc	Implicit	1 TUc*
Toxicity Unit, Acute	1 TUa	1 TUa	Implicit	1 TUa*

\*This expression of toxicity in the receiving water is applicable to each discharger and runoff area separately.

## INTRODUCTION

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 2004 §303(d) listed segments shown in the figures 1 and 2 below.

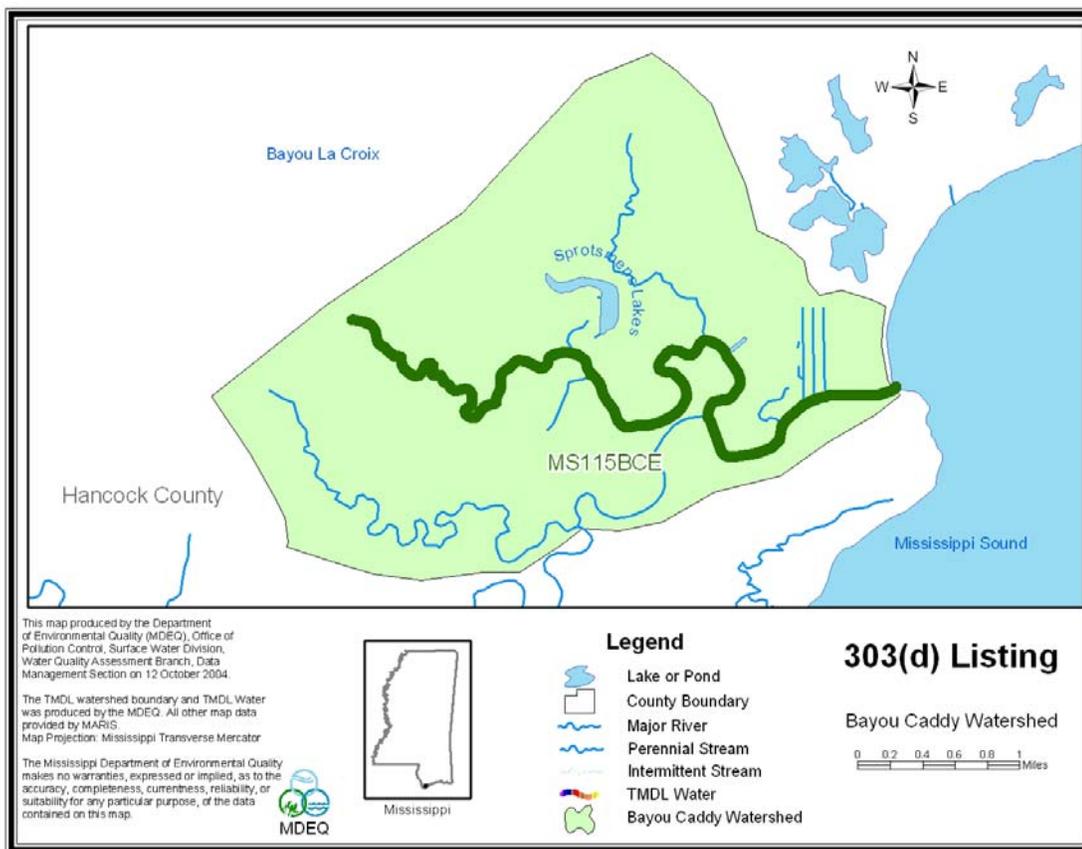
**Figure 1. Bayou LaCroix 303(d) Segment**



### Note on Toxic Units

The load (LA) and wasteload (WLA) allocations are set to zero chronic and zero acute toxicity, which is equivalent to one chronic toxic unit from each source or one acute toxic unit, with any future potential LA or WLA also being set at 1 chronic or 1 acute toxic unit. (These units are not additive.) The LA includes the contributions from surface runoff, also set at 1 chronic toxic unit.

Figure 2. Bayou Caddy 303(d) Segment



Toxicity (see EPA 1991) involves an inverse relation to the Effective Concentration (EC), which is the lowest percentage (greatest dilution) of effluent or runoff that would still cause the minimum specified effect upon a given fraction of the test organisms, (e.g. EC10 or EC50). The lower the EC is, the higher the toxicity. The number of toxicity units in an effluent is defined as 100 divided by the EC (expressed as a percentage):

$$TU_a = 100/LC_{50}$$

$$TU_c = 100/NOEC$$

Where:

TU<sub>a</sub> = toxic unit acute

TU<sub>c</sub> = toxic unit chronic

LC<sub>50</sub> = the concentration that is lethal to 50% of the test organisms

NOEC = No Observed Effect Concentration = the highest tested concentration (%) of an effluent or a toxicant (or of runoff) at which no adverse effects are observed on the aquatic test organisms at a specific time of observation

A chronic or acute toxic unit of 1 means that a 100% concentration of the runoff produces no more than the specified effect on the organisms tested (NOEC or LC<sub>50</sub>, respectively).

## Problem Definition

The Consent Decree between the Environmental Protection Agency (EPA) and the Sierra Club in the Mississippi Total Maximum Daily Load (TMDL) Lawsuit requires development of TMDLs for waters included on Mississippi's 1996 303(d) List of Impaired Water Bodies, according to a prescribed schedule. The 1996 Section 303(d) List includes all waters determined to be impaired based on monitored or evaluated assessments, and shows cause(s) of impairment for each listed water body. The more recent 2004 Section 303(d) List differentiated monitored causes from evaluated causes. Causes are identified as evaluated because there are little or no data available to verify the actual causes of impairment. Bayou La Croix and Bayou Caddy were placed on the Mississippi 2004 Section 303(d) List of Impaired Water Bodies as evaluated segments due to Total Toxics.

## Applicable Water Body Segment Use

The water use classification for Bayou La Croix and Bayou Caddy, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* (MDEQ, 2003) regulation, is Fish and Wildlife Support. Waters with this classification are intended for fishing and propagation of fish, aquatic life, and wildlife. Waters that meet the Fish and Wildlife Support criteria should also be suitable for secondary contact recreation, which are defined as incidental contact with water including wading and occasional swimming.

## 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). The standard states the following.

“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.”

## Water Body Location

The listed segments of Bayou La Croix and Bayou Caddy are in the Coastal Basin Hydrologic Unit Code (HUC) 03170009 in south Mississippi. The drainage area of the listed segments is approximately 62,075 acres; and lies within Hancock County.

The drainage area of Bayou La Croix and Bayou Caddy contains many different landuse types, including urban, forest, cropland, pasture, barren, and wetlands. The landuse information is based on the State of Mississippi's Automated Resource Information System (MARIS 1997). This data set is based on Landsat Thematic Mapper digital images taken between 1992 and 1993. Figure 3 and Table 2 show the landuse distribution for the watershed. Forest and wetland areas represent the largest percentage of landuses within the watershed. The watershed includes the urban area of Waveland and Bay St. Louis and the exclusion zone around Stennis Space Center.

**Table 4. Landuse Distribution in Acres for the Bayou La Croix and Bayou Caddy Watershed**

	Urban	Forest	Cropland	Pasture	Barren	Water	Wetland	Total
<b>Bayou Caddy</b>	116.0	1029.5	24.4	164.5	1280.2	120.3	2251.7	4986.6
<b>Bayou LaCroix</b>	4799.2	24038.2	397.5	897.2	13739.9	831.0	12386.1	57089.1
<b>Total</b>	4915.2	25067.7	421.9	1061.7	15020.1	951.3	14637.8	62075.7

## Point Source Assessment

There are no point sources in these water bodies.

## Other Potential Sources

Atmospheric deposition may be a concern, however, data collected in oyster samples after Hurricane Katrina do not support a toxicity listings. No toxic pollutants were found in the oyster flesh that exceeded FDA or EPA levels for action.

## TMDL Pollutants of Concern

Based on the TMDL source assessment no specific pollutants could be identified with toxicity problems, therefore this TMDL will not address specific pollutants but will address the general problem of toxicity through the development of a TMDL for Total Toxics.

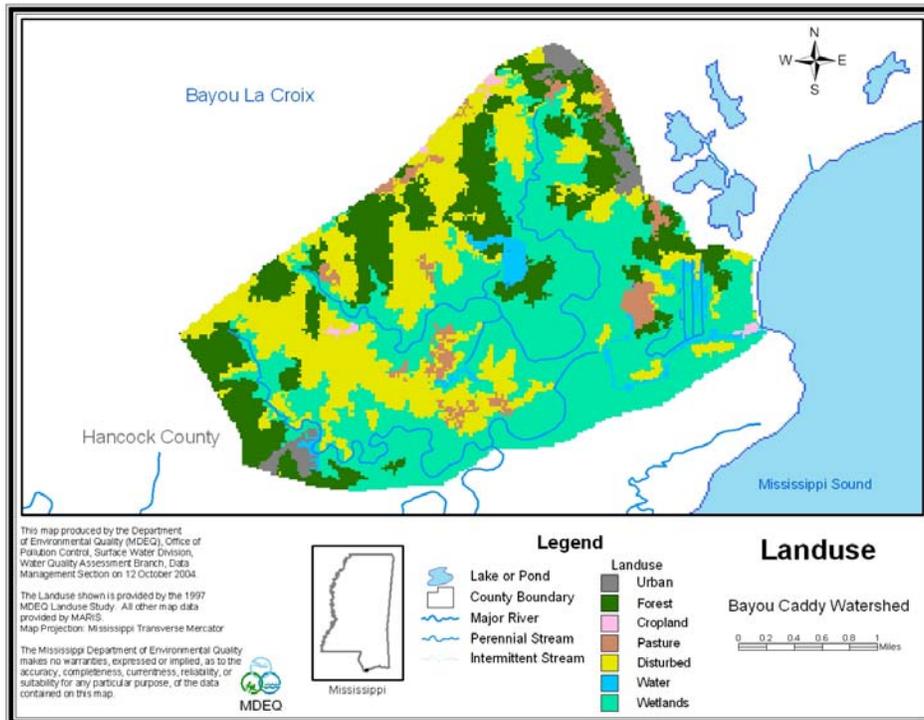
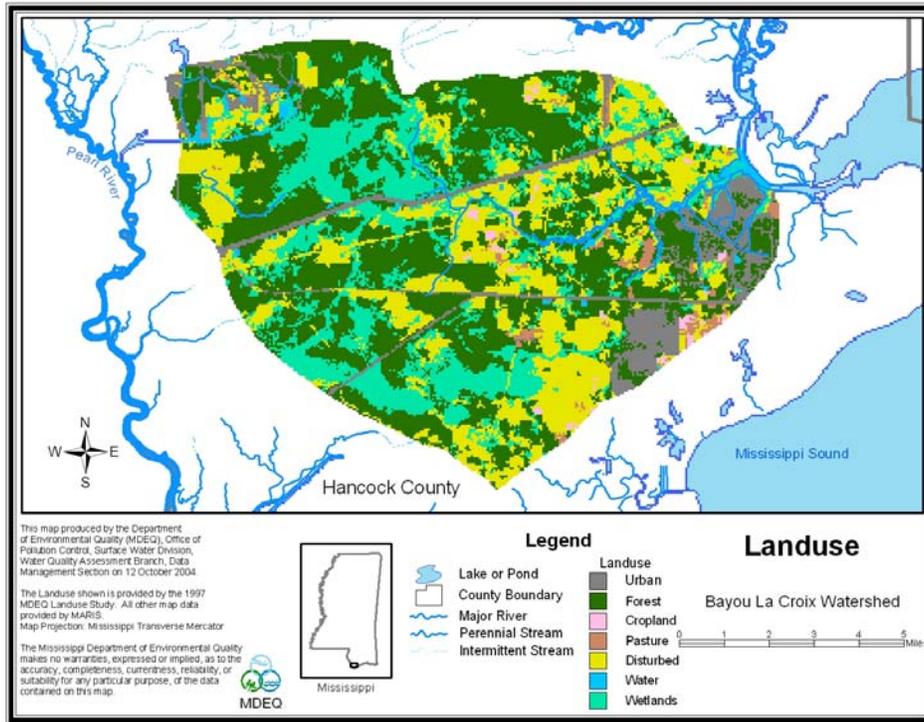
## Seasonality and Critical Condition

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

## Data Collection Results

Oysters (*Crassostrea virginica*), hooked mussels (*Ischadium recurvum*), and Rangia clams (*Rangia cuneata*), were collected from twelve sites along the Mississippi Gulf Coast in the summer of 2005. Shellfish collections were performed by personnel from the Mississippi Department of Environmental Quality and the Mississippi Department of Marine Resources. Sampling procedures in the field and laboratory were performed in accordance with the Standard Operating Procedures established by the Mississippi Department of Environmental Quality. Shellfish tissue was analyzed for a suite of metals by Battelle Marine Sciences Laboratory in Sequim, Washington, and were reported to the Mississippi Department of Environmental Quality. Metal concentrations were compared to the Food and Drug Administration’s action levels for the metals to evaluate human health risks from shellfish consumption. No shellfish from any of the twelve study sites sampled in this investigation showed elevated levels of the metals for which an analysis was done. None of the Food and Drug Administration’s action levels were exceeded by any shellfish species at any site examined.

Figure 3 and 4: Bayou La Croix (MS118BBM3) and Bayou Caddy (MS118BBM5) Land Use Maps



2B18B17B16B15B14B13B27B12B11B10B9B8B24B7B6B5B4B26B3B25  
B1B23B22B21B0B20B19B

## Total Toxics TMDL

The target for the Total Toxics TMDL is that waters shall be free from substances attributable to municipal, industrial, agricultural, or other discharges in concentrations, which are toxic or harmful to humans, animals, or aquatic life. Specific requirements for toxicity are found in Section II.10, *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* –(MDEQ, 2003).

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while maintaining water quality standards. For some pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). In accordance with 40 CFR Part 130.2(i), “TMDLs can be expressed in terms of ... mass per time, toxicity, or other appropriate measure.” In addition, NPDES permitting regulations in 40 CFR 122.45(f) state that, “All pollutants limited in permits shall have limitations...expressed in terms of mass except ... pollutants which cannot appropriately be expressed by mass.” For the toxicity TMDL for waters in the Coastal Basin, the Total Maximum Daily Load is expressed in terms of chronic and acute toxicity units (TU<sub>c,s</sub> and TU<sub>a,s</sub>).

## Toxic Units (Chronic and Acute)

Chronic and acute toxic units are not additive, and they both must be met separately. Toxicity (see EPA 1991) involves an inverse relation to the Effective Concentration (EC), which is the lowest percentage (greatest dilution) of effluent or runoff that would still cause the minimum specified effect upon a given fraction of the test organisms, (e.g. EC<sub>10</sub> or EC<sub>50</sub>). The lower the EC is, the higher the toxicity. The number of toxic units in an effluent (or runoff) is defined as 100 divided by the EC (expressed as a percentage):

$$\begin{aligned} \text{TU}_a &= 100/\text{LC}_{50} \\ \text{TU}_c &= 100/\text{NOEC} \end{aligned}$$

Where:

TU<sub>a</sub> = toxic unit acute

TU<sub>c</sub> = toxic unit chronic

LC<sub>50</sub> = the concentration that is lethal to 50% of the test organisms

NOEC = No Observed Effect Concentration = the highest tested concentration (%) of an effluent or a toxicant (or of runoff) at which no adverse effects are observed on the aquatic test organisms at a specific time of observation

Note: The terms TU<sub>a</sub> and TU<sub>c</sub> are indicated as the plural simply by adding an “s” as in TU<sub>a,s</sub> and TU<sub>c,s</sub>.

## Chronic Toxicity

Based on MDEQ’s mixing zone policy, the dilution in the tidal system has been established at a ratio of six to one (6:1). The chronic toxicity wasteload allocation (WLA) for any discharger to this segment of Bayou La Croix and Bayou Caddy will be determined as follows:

Toxicity from each point source =  $6 \text{ TU}_{\text{cS}} (\text{max}) / 6 = 1 \text{ TU}_{\text{c}}$  in the receiving water

Based on the previously described surface water toxicity testing, nonpoint toxicity, which includes surface runoff, is believed to be absent and therefore the LA for Total Toxics is zero or 1 TU<sub>c</sub>.

The load (LA) and wasteload (WLA) allocations are set to zero chronic toxicity (1 chronic toxic unit) in the receiving water, which is equivalent to six chronic toxic units at the end-of-the-pipe from each point source, with any future potential LA or WLA also being set at 1 chronic toxic unit in the receiving water. The TMDL expression, in terms of chronic toxicity at the end of the mixing zone, then becomes:

TMDL = 1 TU<sub>c</sub>: WLA = 1 TU<sub>c</sub>: LA = 1 TU<sub>c</sub>: MOS is implicit

## **Acute Toxicity**

MDEQ regulations require a case-by-case evaluation for establishing NPDES permit limits related to acute toxicity in the zone of initial dilution. For this TMDL the acute toxicity load (LA) and wasteload (WLA) allocations are set to zero acute toxicity (1 acute toxic unit). The TMDL expression, in terms of acute toxicity, then becomes:

TMDL = 1 TU<sub>a</sub>: WLA = 1 TU<sub>a</sub>: LA = 1 TU<sub>a</sub>: MOS is implicit

## **Margin of Safety and Seasonality**

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 model is implicit.

## **Conclusion**

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 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 become a member of the TMDL mailing list should contact Greg Jackson at (601) 961-5098 or [Greg\\_Jackson@deq.state.ms.us](mailto:Greg_Jackson@deq.state.ms.us).

All comments received during the public notice period and at any public hearings become a part of the record of this TMDL. All comments will be considered in the submission of this TMDL to EPA Region 4 for final approval.

## REFERENCES

- MDEQ. 2003. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. Office of Pollution Control.*
- USEPA. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA/440/4-91-001, April 1991.*
- Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater), EPA440/5-86-003, April 1986.*
- Lytle, Thomas F. and Julia S. "Pollutant Transport in Mississippi Sound". Gulf Coast Research Laboratory- Mississippi-Alabama Sea Grant Consortium Publication No. MASGP-82-038. July 1985.*