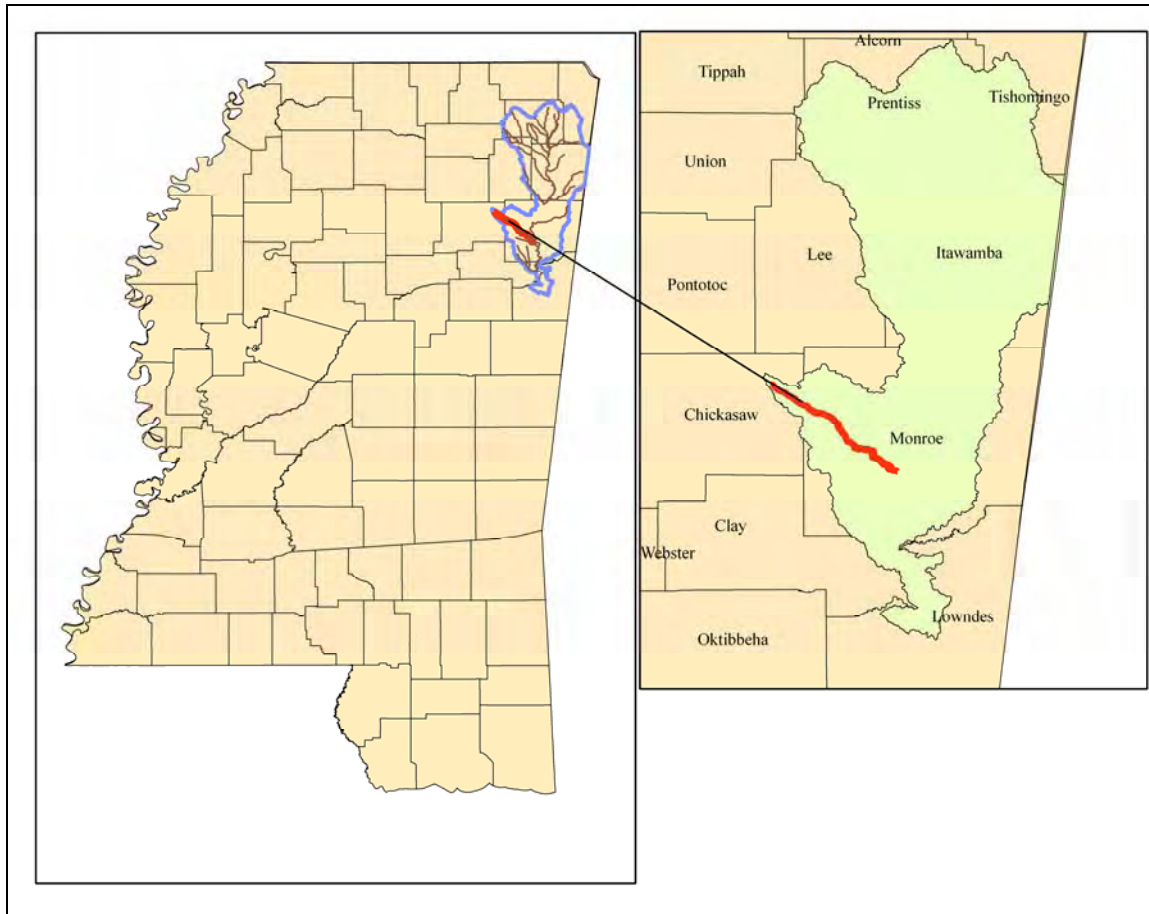


**DRAFT Total Maximum Daily Load (TMDL)
For
Mattubby Creek Watershed
In the Tombigbee River Basin of Mississippi
To address Biological Impairment due to Nutrients,
Organic Enrichment/Low Dissolved Oxygen**



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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.

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	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

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TMDL Information Page

Table 1. Listing Information

ID	Name	County	Cause	Stressors	HUC	Mon/Eval
MS009ME	Mattubby Creek	Chickasaw, Monroe	Biological Impairment	Nutrients and Organic Enrichment/Low Dissolved Oxygen	03160101	Evaluated
Location: Near Aberdeen from headwaters to the Ten-Tom Waterway						

Table 2. Applicable Mississippi Water Quality Standards

Parameter	Beneficial use	Narrative Water Quality Criteria
Nutrients	Aquatic Life Support	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)."
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 in the Watershed

NPDES ID	Facility Name	Permitted Discharge (MGD)	Receiving Water
MS0058122	Monroe County Board of Supervisors, Wren Industrial Park Sewer System	0.015	Cowpen Creek
MS0025631	Okolona POTW, South	0.66	Mattubby Creek

Table 4. Total Maximum Daily Loads

Nutrient	WLA (lbs/day)	LA (lbs/day)	MOS	TMDL (lbs/day)
TP	6.15	57.57 – 99.99	implicit	63.63 – 106.05
TN	17.95	618.32 – 724.37	implicit	636.28 – 724.37
TBOD _u	135.9	0	implicit	135.9

EXECUTIVE SUMMARY

The State of Mississippi placed Mattubby Creek 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 (low DO), and pathogens. The Mississippi Department of Environmental Quality (MDEQ) completed biological monitoring on Mattubby Creek, which indicated biological impairment. MDEQ determined that nutrients and organic enrichment/low dissolved oxygen are probable primary stressors. This TMDL addresses biological impairment due to nutrients and organic enrichment/low DO in Mattubby Creek. This TMDL provides an estimate of the total nitrogen (TN), total phosphorus (TP), and ultimate Total Biochemical Oxygen Demand (TBODu) loads to address the impairment by nutrients and organic enrichment/low DO.

The applicable state water quality standard for DO specifies that 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. Mississippi does not have numeric water quality standards for allowable nutrient concentrations; however MDEQ is currently working on the development of numeric nutrient criteria to be adopted in State water quality standards. A Nutrient Task Force (NTF) has been established to assist the State in this effort, and MDEQ is progressing in accordance with the State's Nutrient Criteria Development Plan, which has been mutually agreed upon with EPA. Based on MDEQ's field studies and consistent with the State's current TMDL methodology, MDEQ has determined that an annual average instream concentration range of 0.6 to 0.7 mg/l is an appropriate target for TN and 0.06 to 0.10 mg/l is an appropriate target for TP for wadable streams located in Ecoregion 65. As part of the TMDL development process for the Mattubby Creek TMDL, EPA is proposing a numeric translation of Mississippi's narrative nutrient criteria within the range of that used by MDEQ in its TMDL development process. Specifically, EPA is proposing a TP concentration target of 0.06 mg/L and a TN concentration target of 0.6 mg/l as representing levels of protection which are sufficient to fully support designated uses for aquatic life for the waters subject to the TMDL. In recognition of the absence of numeric nutrient criteria for these waters, EPA is also accepting comments on an alternative TP concentration target of 0.10 mg/L and a TN concentration target of 0.7 mg/l as representing levels of protection which are sufficient to fully support designated uses. These TMDLs are being proposed with recognition that appropriate nutrient targets may be further evaluated when more data are available.

Based on the available data and information, including the conclusions of a Stressor Identification study conducted by MDEQ, EPA expects that potential excursions of the DO criteria will not occur as long as TP and TN loads are sufficiently reduced. In order to ensure that the TBODu loads do not increase to a level that would cause excursions of the DO criteria, allocations are provided to TBODu which ensure that such loads do not increase above existing levels.

Two facilities regulated by the National Pollutant Discharge Elimination System (NPDES) program discharge to the Mattubby Creek watershed; i.e., the Okolona Publicly Owned Treatment Works (POTW) and the Wren Industrial Park Sewer System. The proposed TMDL provides wasteload allocations (WLAs) of TN, TP, and TBODu for both facilities. The proposed

TP and TN WLA for the Okolona POTW would require significant reductions to this facility, in consideration of its significant contributions of nutrient loads to Mattubby Creek. The proposed load allocation (LA) also identifies significant reductions needed for TN and TP from nonpoint sources in the watershed. As part of EPA's solicitation for public review and comment on the proposed TMDL for Mattubby Creek, EPA is requesting comment with respect to the allocation between the point sources and nonpoint sources.

1. 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 U.S. 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 1.

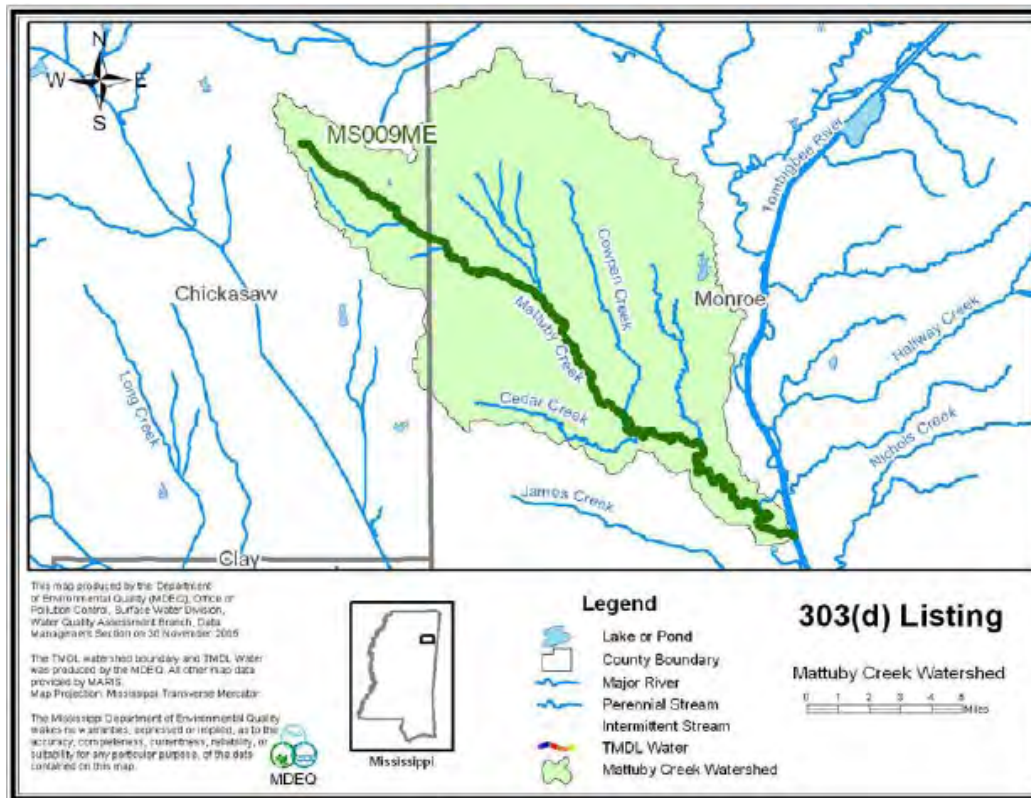


Figure 1. Map of the Listed Segment, Mattubby Creek (map provided by MDEQ)

Mattubby Creek was originally listed on the State of Mississippi's 1996 303(d) list. At that time, there were no ambient monitoring data so the stream was listed based on evaluated causes (anecdotal information). The Mississippi Department of Environmental Quality (MDEQ) began a biological monitoring program, the Mississippi Benthic Index of Stream Quality (M-BISQ), to monitor this and other evaluated streams to confirm the water quality condition based on the health of the biology in the stream.

Mattubby Creek was confirmed as impaired based on the biology. Mattubby Creek is located in Hydrologic Unit Code (HUC) 03160101 in the Tombigbee River Basin in east-central Mississippi. Mattubby Creek is located in the Black Belt Bioregion of Ecoregion 65. The

impaired segment begins at its headwaters near Okolona and flows in a southeastern direction until it reaches the Tennessee-Tombigbee Waterway near Aberdeen, Mississippi in Chickasaw and Monroe Counties. The impaired segment is approximately 25 miles in length and is a fairly large stream, which is fed by several tributaries, including Cedar Creek, Cowpen Creek, and Wolf Creek. The watershed drainage area is approximately 124 square miles. The watershed contains two towns, Aberdeen and Okolona. The remaining area in the watershed is rural and is dominated by pasture and cropland. A photo of Mattubby Creek is provided in Figure 2.



Figure 2. Photo of Mattubby Creek (taken by MDEQ, 2006)

Flow in Mattubby Creek is not measured; however, MDEQ estimates the 7-day flow with a return period of 10 years (i.e., 7Q10 flow) as zero. The nutrient targets EPA is proposing for Mattubby Creek are annual average concentrations and it is not appropriate to assume these concentrations will necessarily be achieved at the 7Q10 flow. MDEQ estimates flow in ungaged streams using a weighted drainage area approach and a nearby continuous flow gage. EPA used this method to estimate an annual average flow value for calculating the nutrient TMDLs. The water quality standard for DO is required to be met at all times, and achieving the criteria at the 7Q10 flow ensures that it will be met at all other times.

1.2 Stressor Identification

The impaired segment was listed due to failure to meet minimum water quality criteria for aquatic use support based on biological sampling (MDEQ, 2003). Because of these results, a detailed assessment of the watershed and potential pollutant sources, called a stressor identification report, was developed for the stream. The purpose of the stressor identification process is to identify the stressors and the sources most likely causing degradation of in-stream biological conditions. The results indicate that nutrients and organic enrichment were probable primary stressors for Mattubby Creek (MDEQ, 2006). Based on the data and information presented in the report, EPA expects that potential excursions of the DO criteria will not occur as long as nutrient loads (i.e., total phosphorus and total nitrogen) are sufficiently reduced.

1.3 Applicable Designated 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.

1.4 Applicable Water Quality Standard

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

Mississippi's current standards contain a narrative criteria applicable to nutrients which states that "[w]aters 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 offish, aesthetic quality, or impair the waters for any designated use (MDEQ, 2002)."

1.5 Nutrient Target Development

Since there are no specific numeric criteria for nutrients in Mississippi, the State's narrative water quality standard must be translated to quantify a level of nutrients that is protective of aquatic life. Numeric criteria for TN and TP are currently being developed by the Mississippi Nutrient Task Force (NTF) in coordination with EPA Region 4. MDEQ has a State nutrient criteria development plan that has been mutually agreed upon with EPA and is on schedule according to that plan in development of numeric nutrient criteria (MDEQ, 2004). MDEQ has collected data for wadeable streams to calculate nutrient criteria.

In the 1999 *Protocol for Developing Nutrient TMDLs*, EPA suggests several methods for the development TMDL targets for nutrients (USEPA, 1999). According to this document, "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." Mississippi's method is based on a comparison between similar but unimpaired waters within the same region. This method is dependent on adequate data and utilizes data collected in support of nutrient criteria development, as per the plan mutually agreed upon with EPA. The initial phase of the data collection process for wadeable streams in Mississippi is complete.

Nutrient data were collected quarterly at 99 discrete sampling stations statewide 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 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 Mississippi Benthic Index of Stream Quality (M-BISQ) process or stations that resulted in a biological impairment rating of “fully attaining” were used to evaluate natural variability of the data set (MDEQ, 2003). The M-BISQ, a regionally calibrated benthic index of biotic integrity, was developed through a partnership between MDEQ and Tetra Tech, Inc. in 2001 from 434 wadeable (perennial, 1st to 4th order streams) in the State excluding the Yazoo Delta. This index defined five bioregions for the State, and established the 25th percentile of the least disturbed condition for each bioregion as the threshold of impairment of the state of Mississippi’s wadeable streams.

The impairment threshold for the Black Belt Bioregion, defined as the 25th percentile value of the range of M-BISQ scores from least disturbed (LD) sites in the bioregion, is 82.27. Scores above this threshold are assessed as non-impaired. The M-BISQ Phase 1 score for Mattubby Creek (IBI station #151) is 64.33 in the Black Belt Bioregion. Each of the two groups - “least disturbed sites” and “fully attaining sites” - was evaluated separately. 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 four 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.

For the preliminary target concentration range, the means of the data at each of the nutrient sites were taken. The 75th and 90th percentiles of the means of the nutrient sites in that ecoregion fully supporting aquatic life support according to the M-BISQ scores were used. For the estimate of the existing concentrations, the median of the data from the sites with nutrient concentrations greater than the target were used. For nutrient TMDLs developed by MDEQ for impaired within Ecoregion 65, the State has identified 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 is an applicable target for TP.

As part of the TMDL development process for the Mattubby Creek TMDL, EPA is proposing a numeric translation of Mississippi’s narrative nutrient criteria within the range of that used by MDEQ in its TMDL development process. Specifically, EPA is proposing a TP concentration target of 0.06 mg/L and a TN concentration target of 0.6 mg/l as representing levels of protection which are sufficient to fully support designated uses for aquatic life for the waters subject to the TMDL. In recognition of the absence of numeric nutrient criteria for these waters, EPA is also accepting comments on an alternative TP concentration target of 0.10 mg/L and a TN

concentration target of 0.7 mg/l as representing levels of protection which are sufficient to fully support designated uses. These TMDLs are being proposed with recognition that appropriate nutrient targets may be further evaluated when more data are available.

1.6 Pollutants of Concern: Total Nitrogen and Total Phosphorus

The following is an adaptation of the State of Washington Department of Ecology's *Citizen's Guide to Understanding and Monitoring in Streams and Lakes* and provides a brief description and basic understanding of the pollutants of concern for this TMDL report.

The two primary nutrients of concern are nitrogen and phosphorus. Both elements commonly are measured in several forms. Phosphorus can be reported as TP, which includes a particulate form and a dissolved form. The dissolved form is measured and reported as soluble reactive phosphate (SRP), phosphate (PO_4^{-3}), or orthophosphate (ortho-P); all different terms used to describe the fraction of TP that is soluble, and therefore more immediately available to organisms for growth.

Nitrogen can be reported as TN, either measured directly or calculated from its constituents, which are organic-N, ammonia-N (unionized or ionized), nitrite-N, and nitrate-N. Of these, organic-N and ammonia-N are measured as total Kjeldahl nitrogen (TKN), while nitrite-nitrogen (NO_2^-), and nitrate-nitrogen (NO_3^-), are usually measured as nitrate+nitrite-nitrogen ($\text{NO}_3^- + \text{NO}_2^-$). As is the case with TP, there are fractions of TN that are more bioavailable. TKN includes the organic form of TN, which is less immediately bioavailable for growth versus the more readily available component of TKN, which is NH_3 or NH_4^+ . Together, the fractions of NH_3 or NH_4^+ and $\text{NO}_3^- + \text{NO}_2^-$ represent forms of nitrogen that are most immediately available for growth.

Organically bound TP and TN, while not immediately available, can be converted to bioavailable forms at predictable rates; and may be significant drivers of primary productivity. One chemical form of an element can be converted into another, and the conditions under which the conversion occurs are influenced by many factors; such as pH, temperature, oxygen concentration, and biological activity. The original form of the nutrient and the prevailing physical conditions will determine if an increase in total nutrient concentrations will result in higher available nutrient concentrations and therefore, a corresponding immediate increase in growth or productivity. If nutrients enter the stream as organic matter, that has to be decomposed before the nutrients can be utilized for additional growth. This process consumes oxygen and temperature becomes important due to its effect on the rate of decomposition. During warmer months, nutrients entering the system, as intact organic matter would decompose relatively quickly as compared to cold, wet-weather months when decomposition is slow. These dynamics are further complicated by the fact that increased growth leads to greater numbers of organisms that need even more nutrients. So, as nutrients become available they are often immediately utilized.

Increases in anthropogenic nutrient concentrations and their impacts are considered nutrient pollution. Municipal and industrial discharges usually contain nutrients, and overland flow from developed watersheds contains nutrients from lawn and garden fertilizers as well as the additional organic debris so easily washed from urban surfaces. Agricultural areas also

significantly contribute to nutrient increases through poor manure management, fertilizing practices, and increased erosion of nutrient-bearing soil from plowed surfaces.

Increased nutrient loading typically results in increased algal growth, when and where sufficient conditions of light, temperature, substrate and flow (residence time) are met. And, the resulting enhanced growth in algal biomass will occur locally and/or downstream. In flowing stream segments where conditions are right, attached forms of algae tend to dominate, i.e., periphyton attached to rocks, logs, aquatic macrophytes, and other substrate. In slower flowing streams, algae suspended in the water column, i.e., phytoplankton, may tend to dominate. Excessive growths of algae, both periphyton and phytoplankton, can adversely affect other aquatic life through habitat/life cycle disruption and exaggerated fluctuations of normal dissolved oxygen cycles; eventually resulting in a DO crash. In addition, unsightly conditions, odors and poor habitat conditions for aquatic organisms can also be attributed to excessive algae (WDOE, 1994).

2. WATER BODY ASSESSMENT

2.1 Mattubby Creek Water Quality Data

Nutrient data collected in the Mattubby Creek watershed are presented in Table 5. Data for the §303(d)-listed segment of Mattubby Creek were collected during the §303(d)/M-BISQ monitoring project at site #151 and as part of MDEQ's ambient monitoring program. The location of the MBISQ Station is shown in Figure 3. Ambient station TB055 is at the same location as MBISQ Station #151. MDEQ does not conduct ambient monitoring for DO in Mattubby Creek. The Stressor Identification Report for Mattubby Creek indicates the organic enrichment/low DO impairment was based on anecdotal information and no monitoring data.

Table 5. Mattubby Creek In-Stream Nutrient Data

Station	Date	Time	TN (mg/l)	TP (mg/l)
TB055	06/16/1999	16:00	0.86	0.13
TB055	10/06/1999	14:00	0.23	0.01
TB055	01/11/2000	13:30	3.30	0.12
TB055	04/11/2000	11:00	1.42	0.15
IBI #151	02/22/2001	08:45	1.23	0.12

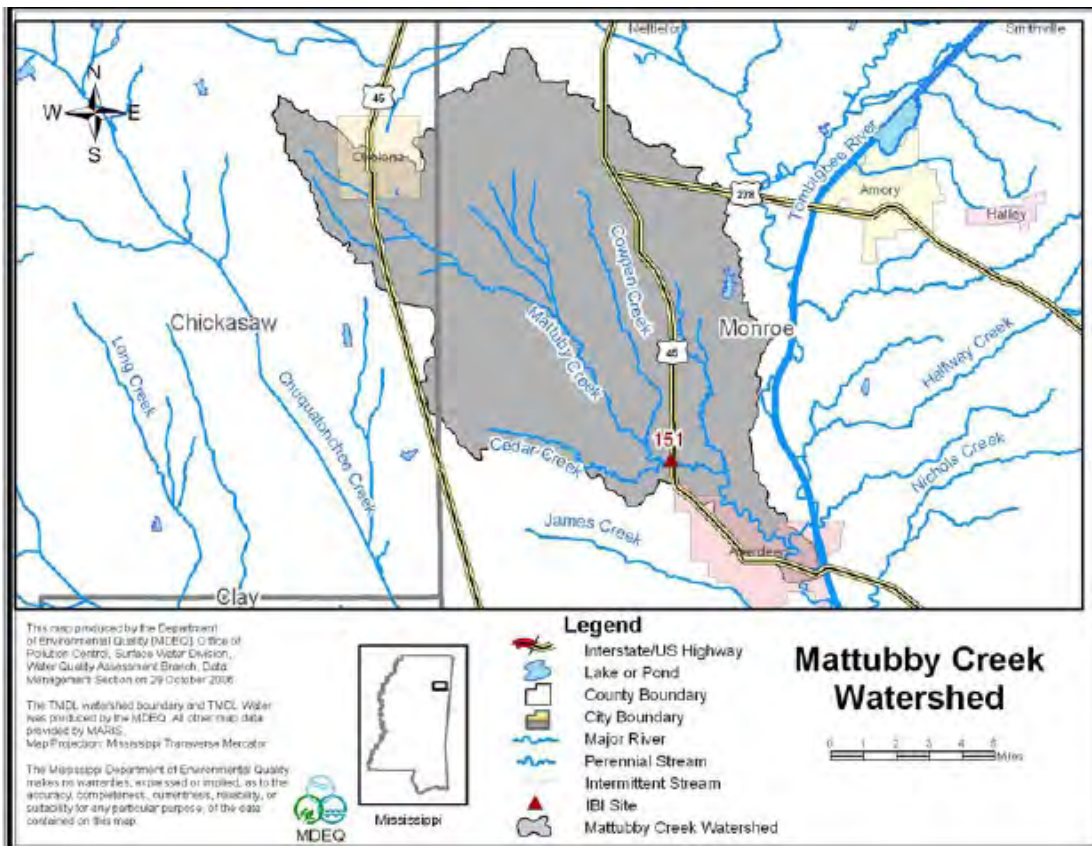


Figure 3. Mattubby Creek Water Quality Monitoring Station

2.2 Assessment of Point Sources

An important step in assessing pollutant sources in the Mattubby Creek watershed is locating the NPDES facilities. There are two facilities permitted to discharge into the Mattubby Creek watershed. The facilities and their permitted discharges are presented in Table 6. The locations of the facilities are shown in Figure 4. One of the facilities, Okolona POTW South, will require changes to their existing NPDES permit to include a limit of 2 mg/l for ammonia nitrogen (NH₃-N), in accordance with MDEQ’s *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*.

Table 6. NPDES Permitted Facilities and Treatment Types

Name	NPDES Permit	Treatment Type	Discharge (MGD)	BOD ₅ (mg/l)	NH ₃ -N (mg/l)
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	MS0058122	Conventional Lagoon w/ constructed wetlands	0.015	10	2
Okolona POTW, South	MS0025631	Conventional Lagoon with sand filter	0.66	10	2* (proposed permit limit)

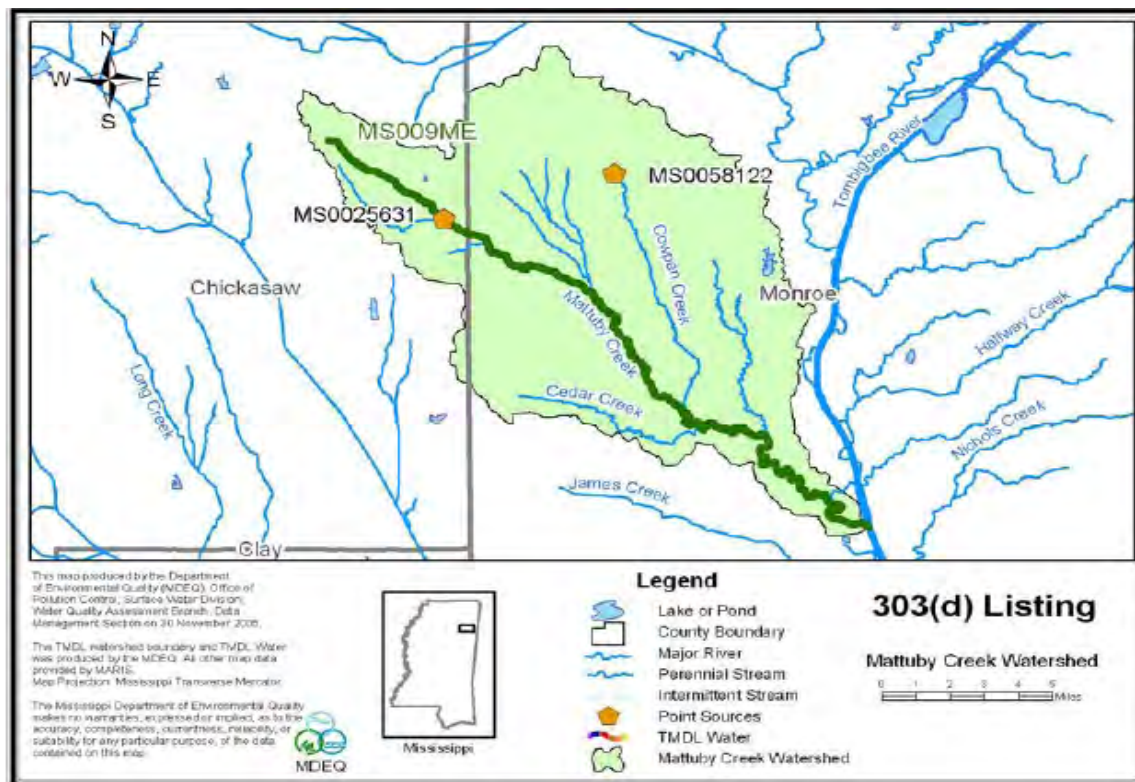


Figure 4. Mattubby Creek Point Sources

2.3 Assessment of Non-Point Sources

The two primary nutrients of concern are nitrogen and phosphorus. TN 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. In agricultural areas, studies have indicated that human activities have increased nitrate concentrations in ground water. In urban areas, it is likely that nitrogen sources are relatively localized when compared with the generally more intensive and widespread use of fertilizers on cropland. The greater the percentage of impervious surfaces in a watershed (usually more predominant in urban areas) generally results in surface runoff of nutrient-laden water, rather than seepage to ground water (USGS, 1999). 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 may be a limiting nutrient in 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). Table 7 presents an estimate of typical nutrient loading ranges associated with various land uses.

Table 7. Nutrient Loadings for Various Land Uses

Landuse	Total Phosphorus (lb/acre-yr)			Total Nitrogen (lb/acre-yr)		
	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

The drainage area of Mattubby Creek is approximately 124.4 square miles. The watershed contains many different landuse types, including urban, forest, cropland, pasture, water, and wetlands. 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 on 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 land use categories were grouped into the land uses of urban, forest, cropland, pasture, disturbed, wetlands, and water. The area directly surrounding the impaired segment, MS009ME, is predominantly cropland and pasture. The landuse distribution for Mattubby Creek is shown in Table 8 and Figure 5.

Table 8. Landuse Distribution for Mattubby Creek Watershed (acres)

	Urban	Forest	Cropland	Pasture	Scrub/Barren	Water	Wetlands
Mattubby	1,532	13,938	17,853	32,312	13,504	330	139
Percentage	1.9	17.5	22.4	40.6	17.0	0.4	0.2

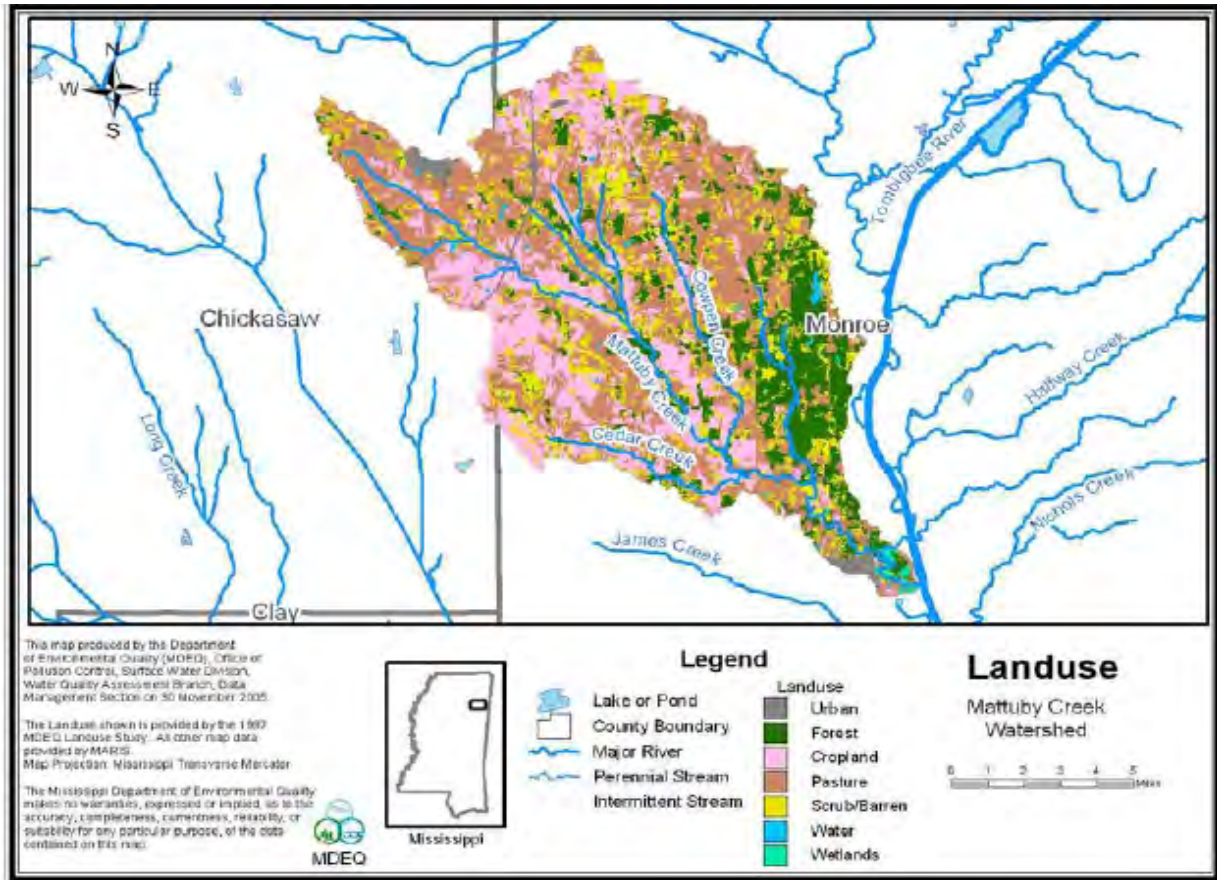


Figure 5. Landuse in Mattubby Creek Watershed

3. ANALYTICAL APPROACH

3.1 Introduction

Mattubby Creek was listed for biological impairment due to nutrients and organic enrichment/low dissolved oxygen (low DO). Since DO is not a pollutant, the TMDL needs to allocate limitations for pollutants that cause low DO and nutrient enrichment. Therefore, in order to address the DO impairment, the TMDL will target BOD₅, TP, and TN. The TMDL allocations proposed for Mattubby Creek are based on achieving average annual in-stream concentrations for TN and TP in the range of values recommended by the NTF for Ecoregion 65.

3.2 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. CBOD is the carbonaceous portion of that demand that occurs in the first stage of decomposition as organic matter is converted to carbon dioxide. TBODu is equal to the sum of NBODu and CBODu (see Equation 1).

$$\text{TBODu} = \text{CBODu} + \text{NBODu} \quad (\text{Equation 1})$$

Organic material discharged to a stream from an NPDES facility is typically quantified as 5-day biochemical oxygen demand (BOD₅). BOD₅ 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, BOD₅ is generally considered equal to CBOD₅.

Because permits for point source facilities are written in terms of BOD₅ while TMDLs are typically developed using CBODu, a ratio between the two terms is needed (see Equation 2).

$$\text{CBODu} = \text{CBOD5} * \text{Ratio} \quad (\text{Equation 2})$$

The CBODu to CBOD₅ 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. A CBODu to CBOD₅ ratio of 1.5 is appropriate for the smaller facilities located in the Mattubby Creek watershed. A ratio 2.3 is appropriate for the wastewater treatment facility (WWTF).

In order to determine the NBODu, the ammonia nitrogen (NH₃-N) loads were converted to an oxygen demand using a factor of 4.57 pounds of oxygen per pound of ammonia

nitrogen (NH₃-N) oxidized to nitrate nitrogen (NO₃-N). First, the NH₃-N concentration is converted into pounds per day. Equation 3 was used to calculate the ammonia nitrogen load from the ammonia nitrogen concentration. Once the load was calculated, it was multiplied by a factor of 4.57 to obtain the NBODu values. Using this factor is a conservative assumption because it assumes that all of the ammonia is converted to nitrate through nitrification.

$$\text{NH}_3\text{-N lbs/day} = \text{NH}_3\text{-N (mg/l)} * \text{Flow} * 8.34 \text{ (conversion factor)} \quad \text{(Equation 3)}$$

The sum of CBODu and NBODu is equal to the point source load of TBODu. For facilities that do not have a permit limit for NH₃-N, an assumed value of 2.0 mg/L was used to calculate the NBODu load for the facility. The maximum permitted loads of TBODu from the existing point sources are given in Table 9.

Table 9. Point Sources, Maximum Permitted Loads

Facility name	Flow (MGD)	CBOD5 (mg/l)	NH ₃ -N (mg/L)	CBODu to CBOD5 Ratio	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	0.015	10	2	1.5	1.88	1.14	3.02
Okolona POTW, South	0.66	10	2* (proposed permit limit)	1.5	82.57	50.31	132.88

Based on the available data and information, including the conclusions of the State's Stressor Identification report, EPA expects that potential excursions of the DO criteria will not occur as long as TP and TN loads are sufficiently reduced. In order to ensure that the BOD loads do not increase to a level that would cause excursions of the DO criteria, allocations should be provided to BOD which ensure that such loads do not increase above existing permitted levels.

3.3. Evaluation of Existing Loads of Total Nitrogen

The average TN concentration found in Mattubby Creek is 1.41 mg/l. This concentration is similar to the median TN concentration of 1.38 mg/l measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients. To convert the estimated existing TN concentration to a load, average annual flow in Mattubby Creek was estimated based on flow data from the U.S. Geological Survey (USGS) gage located on the Chuquatonchee Creek near West Point, Mississippi (02440500). The average annual flow for this gage is 797 cfs. To estimate the amount of flow in Mattubby Creek, a drainage area ratio was calculated (797 cfs/505 square miles = 1.58 cfs/square miles). The ratio was then multiplied by the drainage area of the impaired segment. The existing TN load was then calculated using Equation 3.

$$\text{Load (lb/day)} = \text{Flow (cfs)} * 5.394 \text{ (conversion factor)} * \text{Concentration (mg/l)} \text{ (Eq. 3)}$$

Table 10. Estimated Existing Total Nitrogen Load for Mattubby Creek

Stream	Area (sq. miles)	Average Annual Flow (cfs)	TN (mg/l)	TN (lbs/day)
Mattubby Creek	124.4	196.6	1.41	1495

3.4 Evaluation of Existing Loads of Total Phosphorus

The average TP concentration measured in Mattubby Creek is 0.11 mg/L. This concentration is less than the median TP concentration of 0.18 mg/l measured in wadeable streams in Ecoregion 65 with impaired biology and elevated nutrients. To convert the estimated existing TP concentration to a load, the average instream concentration was multiplied by the average annual flow.

Table 11. Estimated Existing Total Phosphorus Load for Mattubby Creek

Stream	Area (sq miles)	Average Annual Flow (cfs)	TP (mg/l)	TP (lbs/day)
Mattubby Creek	124.4	196.6	0.11	117

3.5 Evaluation of Existing Point Source Loads

The existing TN and TP loads consist of both point and non-point components. Since many treatment facilities in Mississippi do not have permit limits for nutrients, nor do they have reporting requirements for effluent nutrient concentrations, EPA used an estimated effluent concentration based on literature values for different wastewater treatment types. Table 12 shows the median effluent TN and TP concentrations for four conventional wastewater treatment processes. The appropriate concentration for each of the facilities was then used in Equation 3 to estimate nutrient loads from point sources (see Table 13 and Table 14).

Table 12. Median Nutrient Concentrations in Wastewater Effluents

	Treatment Type			
	Primary	Trickling Filter	Activated Sludge	Stabilization Pond
Number of plants sampled	55	244	244	149
TN (mg/l)	22.4 ± 1.30	16.4 ± 0.54	13.54 ± 0.62	11.5 ± 0.84
TP (mg/l)	6.6 ± 0.66	6.9 ± 0.28	5.8 ± 0.29	5.2 ± 0.45

Source: After Ketchum, 1982 in EPA 823-397-002 (USEPA, 1997)

Table 13. NPDES Permitted Facilities Treatment Types with Nitrogen Estimates

Facility Name	NPDES	Treatment Type	Flow (MGD)	TN (mg/l)	TN Load estimate (lbs/day)
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	MS0058122	Conventional lagoon with constructed wetlands	0.015	11.5	1.4
Okolona POTW, South	MS0025631	Conventional lagoon with sand filter	0.66	11.5	63.3

The average TN point source load is estimated to be 64.7 lbs/day. The annual average total load based on the estimated TN concentration of 1.41 mg/l and an annual average flow of 196.6 cfs is 1,495 lbs/day. The existing TN point source load is approximately 4 percent of the total load.

Table 14. NPDES Permitted Facilities Treatment Types with Phosphorus Estimates

Facility Name	NPDES	Treatment Type	Flow (MGD)	TP concentration (mg/l)	TP Load estimate (lbs/day)
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	MS0058122	Conventional lagoon with constructed wetlands	0.015	5.2	0.7
Okolona POTW, South	MS0025631	Conventional lagoon with sand filter	0.66	5.2	28.6

The average TP point source load is estimated to be 29.3 lbs/day. The annual average total load based on the estimated total phosphorous concentration of 0.11 mg/L and an annual average flow of 196.6 cfs is 117 lbs/day. The point source load is approximately 25% of the total load.

3.6 Evaluation of Existing Non-Point Source Loads

The non-point source load for existing conditions was calculated by subtracting the existing point source load from the total load (see Equation 4).

$$\text{Non-point Source Load} = \text{Total Load} - \text{Point Source Load} \quad (\text{Equation 4})$$

Based on Equation 4, the existing TN non-point source load for Mattubby Creek is estimated to be 1430 lbs/day. The existing non-point source load of TP in Mattubby Creek is estimated to be 88 lbs/day. Table 15 and Table 16 provide a summary of the TN and TP loads, respectively.

Table 15. Existing Point Source and Non-point Source TN Loads for Mattubby Creek

Waterbody	Estimated Total Load (lbs/day)	Estimated Point Source Load (lbs/day)	Estimated Non-point Source Load (lbs/day)	Percent of non-point source load contribution relative to total load
Mattubby Creek	1495	64.74	1430.26	96%

Table 16. Existing Point Source and Non-point Source TP Loads for Mattubby Creek

Waterbody	Estimated Total Load (lbs/day)	Estimated Total Point Source Load (lbs/day)	Estimated Non-point Source Load (lbs/day)	Percent of non-point source load contribution relative to total load
Mattubby Creek	117	29.27	87.73	75%

4. ALLOCATION

4.1 TMDL Allocation

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody without exceeding the applicable water quality standard. It identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL is expressed as the sum of all point source loads (WLA), non-point source loads (LA), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS} \quad (\text{Equation 5})$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures. The TMDLs for Mattubby Creek are expressed as daily load values given in pounds per day.

4.2 Wasteload Allocation

There are two point sources in the Mattubby Creek watershed—Wren Industrial Park Sewer System and Okolona POTW South. The wastewater discharged from Wren Industrial Park is small relative to the effluent discharged from the Okolona POTW. Effluent from the Okolona POTW represents approximately 98% of the combined load from these two facilities.

4.2.1 Wasteload Allocation for TBODu

MDEQ's permitting regulations, *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*, specify that for streams with a 7Q10 flow of zero, permit limits for dischargers should be set at 10-2-6 (10.0 mg/l-BOD₅, 2.0 mg/l-NH₃-N, and 6.0 mg/l-DO). Based on the available data and information, including the conclusions of the State's Stressor Identification report, EPA expects that potential excursions of the DO criteria will not occur as long as loads from TN and TP are sufficiently reduced. In order to ensure that the TBOD loads do not increase to a level that would cause excursions of the DO criteria, allocations should be provided to TBOD which ensure that such loads do not cause or contribute to water quality standards violations. Therefore, the TBOD loads are provided equal to the existing permitted TBOD loads (see Table 17).

Table 17. TBODu Wasteload Allocations

Facility Name	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	1.88	1.14	3.02
Okolona POTW, South	82.57	50.31	132.88
Total	84.45	51.45	135.90

4.2.2 Wasteload Allocation for TN and TP

Prior to determining the specific wasteload allocations (WLAs), EPA determined the total allowable load for TN and TP from point sources and nonpoint sources (i.e., the TMDL) necessary to attain the applicable water quality standards. As described earlier, EPA is proposing TP and TN concentration targets of 0.06 mg/L and 0.6 mg/l respectively, as representing ambient concentrations of nutrients that are sufficient to fully support designated uses for aquatic life for the waters subject to the TMDL. In recognition of the absence of numeric nutrient criteria for these waters, EPA is also accepting comments on an alternative ambient TP concentration target of 0.10 mg/L and an ambient TN concentration target of 0.7 mg/l as representing concentrations of nutrients that are sufficient to fully support designated uses. Based on these nutrient targets, the TMDLs were calculated using Equation 3 and are presented in Table 18.

Table 18. TMDL Values for Nutrients in Mattubby Creek

Flow (cfs)	TP Targets (mg/l)	Total TP Based on Ecoregion 65 Targets (lbs/day)	TN Targets (mg/l)	Total TN based on Ecoregion 65 Targets (lbs/day)
196.60	0.06	63.63	0.6	636.28
	* 0.10	* 106.05	* 0.7	* 742.32

* EPA is accepting comments on alternate allocations based on an alternate TP and TN target.

The Okolona POTW comprises the vast majority of wasteloads from point sources and is assigned a proposed allocation which requires effluent concentrations for TN and TP, respectively, of 3.0 mg/l and 1.0 mg/l. In consideration of the relatively insignificant contribution of wasteloads from the Wren Industrial Park Sewer System point source, the proposed allocation for that facility is set equal to the estimated existing loads from this facility (see Section 3.5). The proposed WLA for the point sources are presented in Table 19 and Table 20, and coupled with the proposed load allocation (LA) described in Section 4.3 of this report, is expected to provide full protection of the designated uses in Mattubby Creek.

Table 19. TN WLAs for Dischargers to Mattubby Creek

Facility	Permitted discharge (MGD)	WLA TN effluent concentration (mg/l)	WLA TN effluent load (lb/day)	% Reduction from Existing Load to Target
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	0.02	11.50	1.44	0.00
Okolona POTW, South	0.66	3.00	16.51	74%
TOTAL TN LOAD FROM POINT SOURCES: 17.95				

Table 20. TP WLAs for Dischargers to Mattubby Creek

Facility	Permitted discharge (MGD)	WLA TP effluent concentration (mg/l)	WLA TP effluent load (lb/day)	% Reduction from Existing Load to Target
Monroe County Board of Supervisors, Wren Industrial Park Sewer System	0.02	5.20	0.65	0.00
Okolona POTW, South	0.66	1.00	5.50	81%
TOTAL TP LOAD FROM POINT SOURCES: 6.15				

4.3 Load Allocation

The non-point source load allocation was calculated by subtracting the WLA from the TMDL load. The load allocation for TBODu is zero because the critical time for DO impairment is during low flow or 7Q10 conditions. MDEQ estimates the 7Q10 flow in Mattubby Creek is zero; therefore, there are no non-point source flows entering the water body at the critical 7Q10 condition.

The LA for non-point sources of TN and TP are calculated using Equation 4 and are presented in Table 21 and Table 22. As shown in these Tables, the level of reductions required from the nonpoint sources is dependent on the TMDL target for TN and TP. As part of EPA solicitation for public review and comment on the proposed TMDL for Mattubby Creek, EPA is requesting comment with respect to the allocation between the point sources and nonpoint sources.

Table 21. TN Load Allocations for Mattubby Creek

TMDL (lbs/day)	Point Source Load (lbs/day)	Non-point Source LA (lbs/day)	Non-point Source Reductions (from existing to Ecoregion 65 targets)
636.28 (based on a target of 0.6 mg/l)	17.95	618.32	58%
* 742.32 (based on an alternate target of 0.7 mg/l)	17.95	* 724.37	* 50%

* EPA is accepting comments on alternate allocations based on an alternate TP and TN target.

Table 22. TP Load Allocations for Mattubby Creek

TMDL (lbs/day)	Point Source Load (lbs/day)	Non-point Source LA (lbs/day)	Non-point source Reductions (from existing to Ecoregion 65 targets)
63.6 (based on a target of 0.06 mg/l)	6.15	57.57	70%
* 106.05 (based on an alternate target of 0.1 mg/l)	6.15	* 99.99	* 47%

* EPA is accepting comments on alternate allocations based on an alternate TP and TN target.

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 other nutrient reduction BMPs. For land disturbing activities related to silviculture, construction, and agriculture, it is recommended that the practices outlined in the following manuals be followed: *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).

4.4 Margin of Safety

The margin of safety (MOS) 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 TP and TN allocations in this TMDL incorporate an implicit margin of safety based on the conservative approach used in the nutrient target development. The TMDL targets represents the 75th percentile of TP and TN concentrations in a dataset comprised solely of waters in Ecoregion 65 within the State of Mississippi that have been determined by the State to fully support designated uses as confirmed by the State's rigorous biological assessment methodology. The MOS is further enhanced by using a TP and TN values that corresponds to the 75th percentile of a distribution of streams fully supporting their uses based on their IBI scores. Thus, 25 percent of the fully supporting streams within this Ecoregion could have TP and TN values above these target values.

4.5 TMDL Components

TMDL components for TN, TP and TBODu are provided in Table 23. The Table includes the proposed TMDL, based on instream TN and TP targets of 0.6 mg/l and 0.06 mg/l, as well as an alternate allocations based on an alternate set of TN and TP targets of 0.7 mg/l and 0.1 mg/l.

Table 23. TMDL Summary for Mattubby Creek

Parameter	WLA (lbs/day)	LA (lbs/day)	MOS	TMDL (lbs/day)
TN	17.95	618.32 * 724.37	Implicit	636.28 * 742.32
TP	6.15	57.57 * 99.99	implicit	63.63 * 106.05
TBODu	135.9	0	implicit	135.9

* EPA is accepting comments on alternate allocations based on an alternate TP and TN targets of 0.1 mg/l and 0.7 mg/l, respectively.

4.6 Seasonality and Critical Conditions

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions. In addition, the targets for TP and TN that were used to calculate the necessary percent reductions were developed based on the average annual TP and TN concentrations determined to be typical of non-impaired Wadeable streams in the bioregion for all seasons of the calendar year. Due to these reasons, the TMDL is protective of the waterbody during all seasons.

5. CONCLUSIONS

EPA proposes that the allocations described in this TMDL report will ensure protection of the applicable water quality standards in Mattubby Creek. EPA is soliciting public review and comment on this proposal and will fully consider all comments, including any data and information, received from the public. As part of this proposal, EPA is requesting comments on an alternate set of allocations based on an alternate instream target for nutrients. In addition, EPA is requesting comment with respect to the allocation of the TMDL between the point sources and nonpoint sources.

The State is strongly encouraged to continue proceeding with the development of numeric nutrient criteria for all waters of the State, including Mattubby Creek. As part of this process, EPA recommends that the State consider conducting effluent discharge studies in order to verify the targets proposed in the TMDL. This TMDL assigns wasteload allocations to the two NPDES facilities in the watershed, including an allocation for the Okolona POTW that proposes reductions of nutrients from the treated effluent. It is recommended that the Mattubby Creek watershed be considered a priority for riparian buffer zone restoration and other 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.

5.1 Public Participation

This draft TMDL is being proposed for public review and comment for a 30-day period. The EPA is notifying the public by publishing a notice of the TMDL through a legal ad in the statewide newspaper, the *Clarion-Ledger*. EPA is also providing an e-mail notice to members of the public who have requested that MDEQ include them on a TMDL mailing list. The TMDL is also available for review and comment on EPA Region 4's website:

(<http://www.epa.gov/Region4/water/tmdl/mississippi/>).

The public may request a copy of the TMDL report by mail from:

Attention: Ms Sibyl Cole,
U.S. EPA Region 4, Water Management Division
61 Forsyth Street, S.W.
Atlanta, Georgia 30303

The public may also submit comments by mail at the address listed above or by email at cole.sibyl@epa.gov or by phone at 404-562-9437. All comments received during the public notice period will become a part of the public record for this TMDL.

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