FINAL

Total Maximum Daily Load (TMDL)

Organic Enrichment/Dissolved Oxygen

Threemile Creek	AL03160204-0504-101
Threemile Creek	AL03160204-0504-102
Threemile Creek	AL03160204-0504-103

Alabama Department of Environmental Management
Water Quality Branch
Water Division

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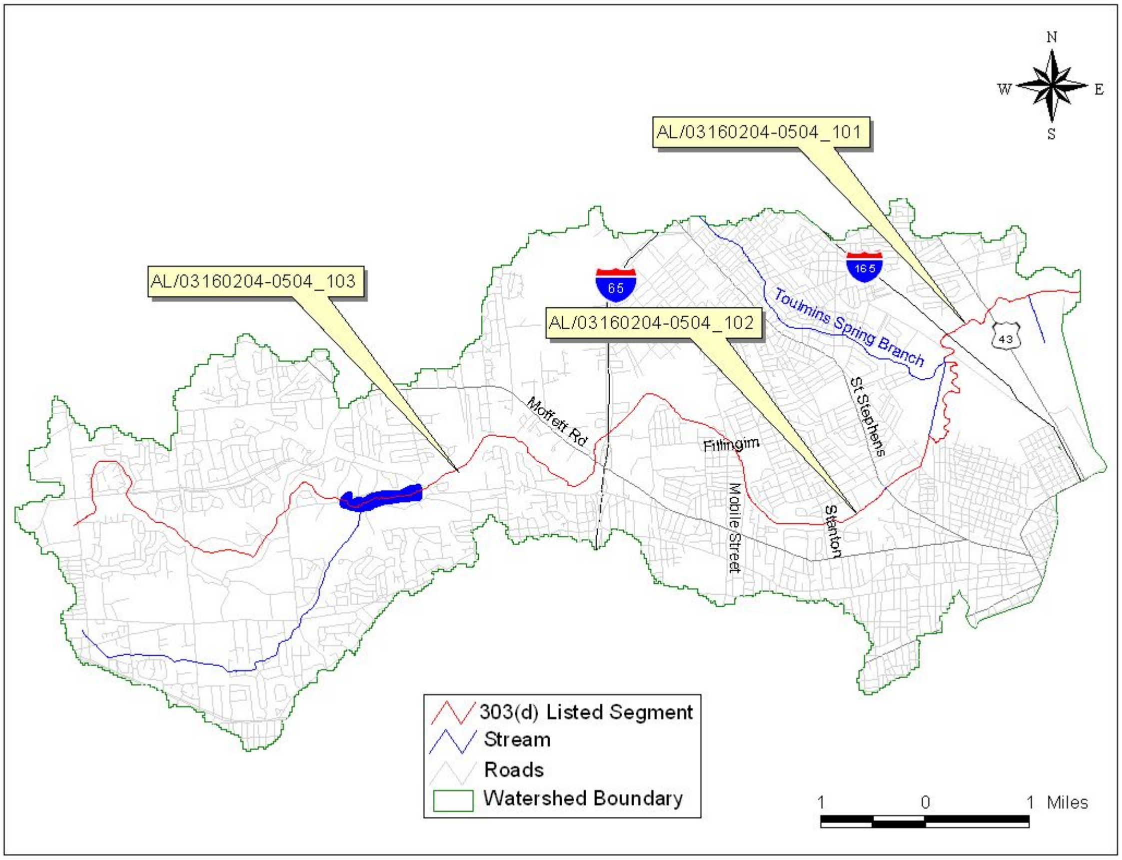

Figure I **Location of Listed Segments in the Threemile Creek Watershed**

List of Abbreviations

ADEM	Alabama Department of Environmental Management
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
CFS	Cubic Feet per Second
CWP	Clean Water Partnership
DEM	Digital Elevation Model
DO	Dissolved Oxygen
FSA	Farm Services Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOA	Memorandums of Agreements
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Stormwater Sewer System
NBOD	Nitrogenous Biochemical Oxygen Demand
NCDC	National Climatic Data Center
NHD	National Hydrography Database
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
OE	Organic Enrichment
OEO	ADEM Office of Education and Outreach
RF3	Reach File 3
SOD	Sediment Oxygen Demand
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCS	Watershed Characterization System
WLA	Waste Load Allocation

1.0 Executive Summary

This report presents the Total Maximum Daily Load (TMDL) for waterbody segments in Threemile Creek that are impaired by organic enrichment/dissolved oxygen and listed on Alabama's Section 303(d) list of impaired waterbodies.

Threemile Creek is a tidally influenced, brackish tributary to Mobile River. The majority of the 30 square mile Threemile Creek watershed lies within the city of Mobile (pop. 198,915). Threemile Creek was originally identified on the 303(d) list due to impairment by organic enrichment/dissolved oxygen (OE/DO) in 1996. Table 1-1 summarizes the listing information related to TMDL development. The first point in the Impaired Segments column represents the downstream location while the second point is the upstream location (of the impaired segment).

Table 1-1 § 303(d) Listed Segments in the Threemile Creek Watershed

Impaired Segments (ID)	Uses	Length (mi)	Causes	Sources
USGS Catalog Unit 03160204 – Mobile-Tensaw River Basin				
Threemile Creek (AL03160204-0504-101) From Mobile River to Toulmins Spring Branch	Agricultural & Industrial Water Supply	2.0	OE/DO	Municipal; Collection system failure; Urban runoff/storm sewers.
Threemile Creek (AL03160204-0504-102) From Toulmins Spring Branch to Mobile Street	Agricultural & Industrial Water Supply	3.4	OE/DO	Municipal; Collection system failure; Urban runoff/storm sewers.
Threemile Creek (AL03160204-0504-103) From Mobile Street to its Source	Agricultural & Industrial Water Supply	9.5	OE/DO	Municipal; Collection system failure; Urban runoff/storm sewers.

Threemile Creek has a use classification of Agricultural and Industrial Water Supply (A&I). In accordance with ADEM water quality standards, the minimum dissolved oxygen (DO) concentration allowed in a stream classified as A&I is 3.0 mg/L. For the purpose of this TMDL, a minimum dissolved oxygen concentration of 3.0 mg/L must be maintained on a year round basis. TMDL regulations require that seasonal variations be considered. Two seasons were modeled for this TMDL: winter (December through April) and summer (May through November). Regardless of the season, water quality standards must always be protected.

A summary of the OE/DO TMDL for Threemile Creek is provided in Tables 1-2 and 1-3. The pollutants shown in these tables are ultimate nitrogenous biochemical oxygen demand ($NBOD_U$) and ultimate carbonaceous biochemical oxygen demand ($CBOD_U$). Based upon analysis of available data, it has been identified that low DO measurements within Threemile Creek are associated with salinity intrusion during low flows, stratification of DO, temperature and salinity during neap tides, and the heating of surface waters. Data analysis does not indicate that low DO waters enter Threemile Creek from Mobile River. The demand upon oxygen within the water column comes from biochemical oxygen demand (BOD). Oxygen consuming wastes come from point source discharges and storm water runoff from adjacent land uses. For the purpose of this TMDL, the source material has been identified as nitrogenous and carbonaceous oxygen demand ($NBOD_U$, $CBOD_U$). Because organic nitrogen can be converted to ammonia, its potential oxygen demand is included in the $NBOD_U$ component of the TMDL. Tables 1-2 and 1-3 list allowable daily average pollutant loadings by source (point and nonpoint sources) for both the summer and winter seasons. Seasonal percent reductions are required to achieve Alabama's water quality criterion of 3.0 mg/L for DO. The wasteload capacity is dependent on seasonal flows. Therefore, Threemile Creek will have seasonal TMDLs for a critical low flow summer period (May through November), as measured in 2000, and a higher flow winter period (December through April). Loads will be based on average daily values for each season.

The wasteload allocations (WLA) within the system represent the contributions from point source discharges and Municipal Separate Storm Sewer System (MS4) Phase I stormwater permits. Two facilities with flows greater than 1 million gallons per day (MGD) are permitted to discharge oxygen consuming wastes within the Threemile Creek watershed, the City of Prichard's Carlos Morris Wastewater Treatment Plant (WWTP) (AL0023205) and the City of Mobile's Wright Smith WWTP (AL0023094). The WLA to National Pollutant Discharge Elimination System (NPDES) point sources represents reductions necessary to reduce BOD_U to meet the applicable water quality criterion for dissolved oxygen. There are four other NPDES permits in the watershed but these are not presented in the TMDL tables because they do not discharge oxygen consuming wastes that are regulated under the NPDES program.

The entirety of the watershed is also within the Phase I stormwater permit area for the Greater Mobile Area Municipal Separate Storm Sewer System (MS4). The WLA will reflect reductions in the watershed that enter Threemile Creek via storm water sewers as MS4 allocations.

The load allocation to the nonpoint sources (LA) is associated with background sources of oxygen consuming wastes entering the system through forested wetlands.

Table 1-2 Maximum Allowable Loads for Threemile Creek from December through April with Municipal Point Source Discharges

Constituent	Existing WLA (lb/day)		Existing LA (lb/day)	TMDL WLA (lb/day)		TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction NPDES	WLA Reduction MS4	LA Reduction
	NPDES	MS4		NPDES	MS4					
$NBOD_U$	3217	65	65.4	116.7	84.3	84.9	201.6	96%	0%	0%
$CBOD_U$	11540	262.5	274.9	881.8	637.3	649.7	1531.4	92%	0%	0%

Table 1-3 Maximum Allowable Loads for Threemile Creek from May through November with Municipal Point Source Discharges

Constituent	Existing WLA (lb/day)		Existing LA (lb/day)	TMDL WLA (lb/day)		TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction NPDES	WLA Reduction MS4	LA Reduction
	NPDES	MS4		NPDES	MS4					
$NBOD_U$	3217	70.6	71.2	140.7	63	63.6	204.3	96%	11%	11%
$CBOD_U$	11540	248.5	260.9	1104.3	494.6	507	1611.4	90%	0%	0%

Tables 1-4 and 1-5 present the existing loads, TMDLs, and the required load reductions of $NBOD_U$ and $CBOD_U$, on a seasonal basis, for Threemile Creek if municipal point source discharges are removed from the system.

Table 1-4 Maximum Allowable Loads for Threemile Creek from December through April with Municipal Point Source Discharges Removed

Constituent	Existing WLA (lb/day) MS4	Existing LA (lb/day)	TMDL WLA (lb/day) MS4	TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction MS4	LA Reduction
$NBOD_U$	65	65.4	51	51.6	51.6	21%	21%
$CBOD_U$	262.5	274.9	203.5	215.9	215.9	22%	22%

Table 1-5 Maximum Allowable Loads for Threemile Creek from May through November with Municipal Point Source Discharges Removed

Constituent	Existing WLA (lb/day) MS4	Existing LA (lb/day)	TMDL WLA (lb/day) MS4	TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction MS4	LA Reduction
$NBOD_U$	70.6	71.2	31.7	32.3	32.3	55%	55%
$CBOD_U$	248.5	260.9	126.1	138.5	138.5	49%	49%

These two scenarios, Tables 1-2 through 1-5, are representative of two allocation scenarios that are both expected to result in the achievement of applicable water quality standards. Only one of the allocation scenarios presented will be implemented.

1.1 Endangered or Threatened Species

Three species have been identified in the Threemile Creek watershed as endangered or threatened. The Alabama Natural Heritage Program identified the *Macroclemys temminckii*, alligator snapping turtle, with good to fair established variability and no signs of decline, and the *Pseudemys alabamensis*, Alabama red-belly turtle, with fair established variability. The U.S. Fish and Wildlife Service (USFWS), in addition to the endangered Alabama red-belly turtle, has identified the *Acipenser Oxyrinchus Desotoi*, gulf sturgeon, as a threatened fish.

The alligator snapping turtle has not been identified under the Endangered or Threatened Species Act but has been identified by the World Wildlife Federation as the sixth most endangered species in the world due to increased shipments to international world markets in Asia (Extravalue, 2003). The gulf sturgeon is threatened under the Endangered or Threatened Species Act due to habitat destruction and degradation. Dredging and other navigation maintenance, possibly including lowering of river elevations and elimination of deep holes and altered rock substrates, may have adversely affected gulf sturgeon habitats (Wooley and Crateau 1985)(USFWS, 2003). The primary threat of the Alabama red-belly turtle is from human activities on the turtle's only known nesting site, a 20-acre wooded swamp. Consistent disturbances to nesting habitat, and predation, have apparently reduced reproductive success and recruitment since 1970. A final factor of undetermined impact on the Alabama red-belly turtle relates to an apparent reduction in the amount of aquatic vegetation in the marshes and bays utilized by the turtle in the lower part of the Mobile Bay System (USFWS, 2003).

2.0 Basis for the §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987 and USEPA's Water Quality Planning and Management Regulations [(Title 40 of the Code of Federal Regulations (CFR), Part 130)] require states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. Total Maximum Daily Loads (TMDLs) for all pollutants causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Alabama has identified three segments of the Threemile Creek watershed as being impaired by organic enrichment/dissolved oxygen (OE/DO). The listings are reported on the Alabama's §303(d) list of impaired waters as shown in Table 1-1. The TMDLs developed for the Threemile Creek watershed are consistent with a phased-approach: estimates are made of needed pollutant reductions, load reduction controls will be implemented, and water quality will be monitored for plan effectiveness. Flexibility is built into the plan so that load reduction targets and control actions can be reviewed and updated if monitoring indicates continuing water quality problems.

2.2 Problem Definition

Hydrologic conditions that affect surface water quality in Threemile Creek include salinity intrusion during low flows, stratification of DO, temperature and salinity during neap tides, and the heating of surface waters. Oxygen consuming waste from both natural and anthropogenic sources is retained in tidal areas during periods of low freshwater inflow and exerts high biochemical oxygen demand (BOD) on the water column.

The purpose of these TMDLs is to establish the acceptable loading of oxygen consuming material from all sources, such that the State of Alabama water quality criteria for dissolved oxygen are not violated.

Pollutant of Concern: Organic Enrichment/Dissolved Oxygen

Water Use Classification: Agricultural and Industrial Water Supply

Usage of waters in the Agricultural and Industrial Water Supply classification is described in ADEM Admin. Code R. 335-6-10-.09(7)(a), (b), and (c).

(a) Best usage of waters:

Agricultural irrigation, livestock watering, industrial cooling and process water supplies, and any other usage, except fishing, bathing, recreational activities, including water-contact sports or as a source of water supply for drinking or food processing purposes.

(b) Conditions related to best usage:

(i) The waters, except for natural impurities which may be present therein, will be suitable for agricultural irrigation, livestock watering, industrial cooling waters, and fish survival. The waters will be usable after special treatment, as may be needed under each particular circumstance, for industrial process water supplies. The waters will be suitable for other uses for which waters of lower quality will be satisfactory.

(ii) This category includes watercourses in which natural flow is intermittent and non-existent during droughts and which may, of necessity, receive treated wastes from existing municipalities and industries, both now and in the future. In such instances, recognition must be given to the lack of opportunity for mixture of the treated wastes with the receiving stream for purposes of compliance. It is also understood in considering waters for this classification that urban runoff or natural conditions may impact any waters so classified.

(c) Specific criteria:

4. Dissolved oxygen: sewage, industrial wastes, or other wastes shall not cause the dissolved oxygen to be less then 3.0 mg/L. In the application of dissolved oxygen criteria referred to above, dissolved oxygen shall be measured at a depth of 5 feet in waters 10 feet or greater in depth; and for those waters less than 10 feet in depth, dissolved oxygen criteria will be applied at mid-depth.

ADEM Admin. Code R. 335-6-10-.05(4) also states: "*Natural waters may, on occasion, have characteristics outside of the limits established by these criteria. The criteria contained herein relate to the condition of waters as affected by the discharge of sewage, industrial wastes or other wastes, not to conditions resulting from natural forces.*"

3.0 Technical Basis for TMDL Development

3.1 Applicable Water Quality Criterion

The minimum DO concentration in a stream classified as Agricultural and Industrial Water Supply (A&I) is 3.0 mg/L except where natural conditions cause DO to fall below 3.0 mg/L. The target is established at a depth of 5 feet in waters 10 feet or greater in depth; for those waters less than 10 feet in depth, dissolved oxygen criteria are applied at mid-depth. This TMDL specifies the $NBOD_U$ and $CBOD_U$ loads necessary to meet the DO criterion.

3.2 Source Assessment

Threemile Creek extends approximately 14 miles upstream from its confluence with Mobile River in Mobile, Alabama. The watershed drains 30 square miles of the city of Mobile. Much of the lower watershed is defined by high intensity, urban land use activities. Low intensity residential areas and forested areas in the upper watershed comprise 33 and 25 percent of the total watershed area respectively.

Threemile Creek has undergone a number of restructuring projects from its headwaters to Mobile River. After leaving Municipal Lake, the creek flows freely through a forested residential area. Nearly one mile downstream, a series of drop structures have been installed to decrease the impacts of flooding on residential and commercial buildings. In addition to drop structures, gabion baskets and rip-rap have been used to stabilize the creek banks at several locations. Threemile Creek is not influenced by the tidal cycle of Mobile Bay upstream of these drop structures. The last drop structure is located near Redmond Road, just downstream of the USGS Fillingim Station (024710145), shown in Figure 3-4. At St. Stephens Road, approximately 1.8 miles downstream of the final drop structure, Threemile Creek flows down a straight channel through forested wetlands. The original creek remains meandering through the forested wetlands and discharges into the constructed channel at Conception Street. Water levels in this portion of the creek are influenced by tidal fluctuations. Threemile Creek, once again, meanders freely for 1.8 miles to its mouth at the Mobile River, the end of the listed segment.

Threemile Creek at its mouth is a wide tidally influenced channel with daily water level fluctuations of two feet. Salinity concentrations range from 28 parts per thousand during dry periods to near zero after large rain events. The dissolved oxygen levels also fluctuate greatly depending on the contribution of freshwater and solar radiation.

3.2.1 General Sources

Both point and nonpoint sources may contribute NBODu and CBODu to a given waterbody. Potential sources of oxygen consuming waste loads are numerous and often occur in combination. Nationwide, poorly treated municipal sewage comprises a major source of organic compounds that decay and create additional organic loading. Urban storm water runoff and sanitary sewer overflows can also be significant sources. Forested wetland environments are also known sources of organic loading (Tufford, 2003). These organic loads are comprised of carbon. As carbon decays, oxygen is consumed. The rate of oxygen consumption can be measured and modeled as BOD.

All potential sources of organic loading in the watershed were identified based on an evaluation of current land use/cover information on watershed activities (e.g., urban high density or forested wetland). The source assessment was used as the basis of development of the model and analysis of the TMDL allocations. Organic and nutrient loading within the watershed included both point and nonpoint sources.

Watershed Sources

A Multi Resolution Land use Coverage (MRLC) map of the Threemile Creek watershed is presented in Figure 3-1 and listed in Table 3-1. Much of the lower watershed is defined by high intensity, urban land use activities. Low intensity residential areas and forested areas in the upper watershed, respectively, comprise 33 and 25 percent of the total watershed area. Each land use type has the potential to contribute to the organic loading in the watershed due to organic material on the land surface that potentially can be washed off into the receiving waters. The entirety of Threemile Creek lies within a Phase I storm water permitted area, therefore, contributions from storm water runoff are allocated as MS4 WLAs in the TMDL.

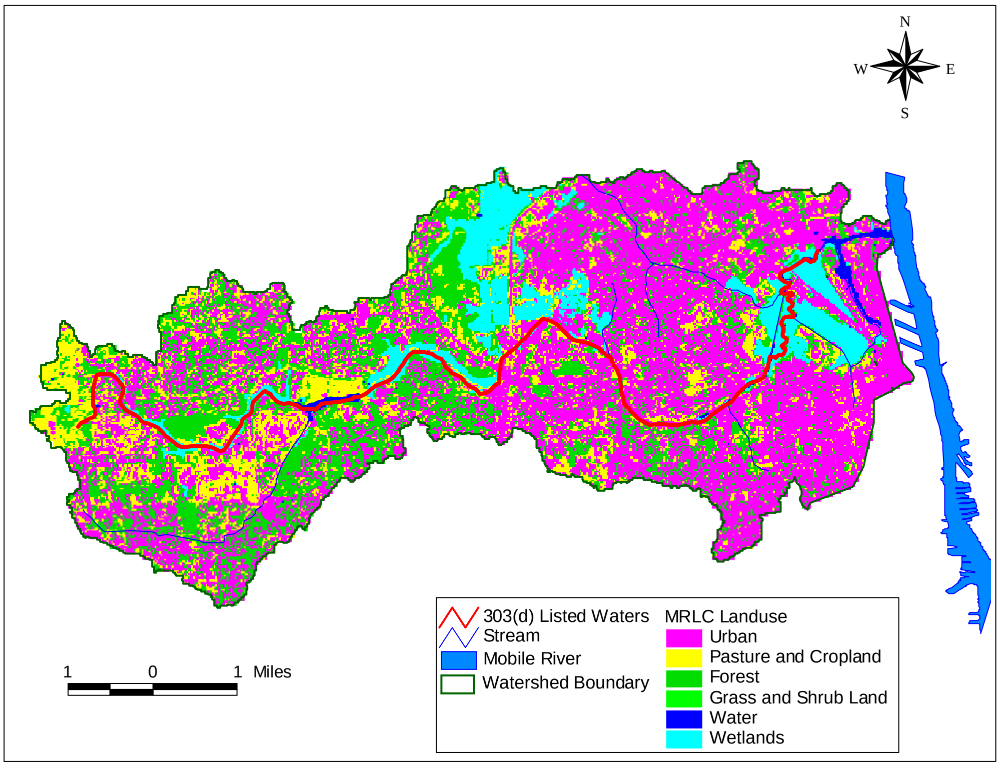

Figure 3-1 Land Use Distribution in the Threemile Creek Watershed

Table 3-1 Land Use Distribution in the Threemile Creek Watershed

High Intensity Residential	17%
Low Intensity Residential	33%
Cropland, Pasture, Grasses and Open Space	16%
Forested	25%
Wetlands	8%
Water	1%

Anthropogenic activities in the watershed may be direct or indirect sources of nutrients and organic enrichment via ground and surface waters. The forested wetlands, eight percent of the total area, in the watershed may also be a significant nonpoint source of nutrient enrichment in the watershed. The influence of organics from these areas was determined using land use modeling and rates of nutrient export from previous studies. Loadings from the forested wetlands were considered in the LA portion of the TMDL.

NPDES Point Sources

ADEM maintains a database of current NPDES permits and GIS files that locate each permitted outfall. This database includes municipal, semi-public/private, industrial, mining, industrial storm water, and concentrated animal feeding operations (CAFOs) permits.

Although there are various NPDES construction and industrial permits located in the basin, only two NPDES permitted facilities discharge oxygen-consuming wastes, Wright Smith WWTP and Carlos Morris WWTP. The Stormwater Phase I Municipal Separate Storm Sewer System (MS4) permit is also regulated by the NPDES program and is therefore considered a point source discharge. During rain events sediment and other compounds, including oxygen consuming waste, from urban areas are transported to the creek by road drainage systems and storm drains. The Greater Mobile Area Storm Sewer System is regulated under ADEM's NPDES Program as a stormwater source and is defined as a wasteload allocation (WLA). Therefore, the Mobile Area MS4 permit (ALS000002) is considered in the TMDL as a WLA.

Table 3-2 NPDES Permitted Discharges of Oxygen Consuming Wastes in the Threemile Creek Watershed

NPDES Number	Facility	Permitted Values			
		Flow (MGD)	BOD Monthly Avg (mg/L)	NH3 Monthly Avg (mg/L)	TSS Monthly Avg (mg/L)
AL0023094	Wright Smith Jr. WWTP	12.8	20	5	30
AL0023205	Carlos Morris WWTP	4.08	15	5	30

3.3 Data Availability and Analysis

A wide range of data and information were used to characterize the watershed and the instream conditions. The categories of data used include physiographic data that describe the physical conditions of the watershed, environmental monitoring data that identify potential pollutant sources and their contribution, and instream water quality monitoring data.

The data available throughout the Threemile Creek watershed include intensive physical and chemical samples, which are necessary to characterize loading inputs from tributary streams in the watershed. The following presents a brief discussion of the data sources and their use within the TMDL development. More extensive explanation of data sources can be found in the Threemile Creek Data Summary and Modeling Reports in Appendices A and B.

3.3.1 Meteorological Data

Meteorological data are a critical component of the watershed model and the instream model. The following meteorological parameters are necessary for the watershed and instream water quality model:

- Rainfall
- Air temperature
- Solar radiation
- Wind speed and direction
- Relative humidity
- Cloud cover

Long-term hourly data of these parameters is available at a National Climatic Data Center (NCDC) weather station located at the Mobile Regional Airport (Figure 3-2). Precipitation data collected at various sites throughout the watershed was also utilized to provide meteorological inputs to the watershed model. Solar radiation measured in Fairhope, Alabama, was also used in model development.

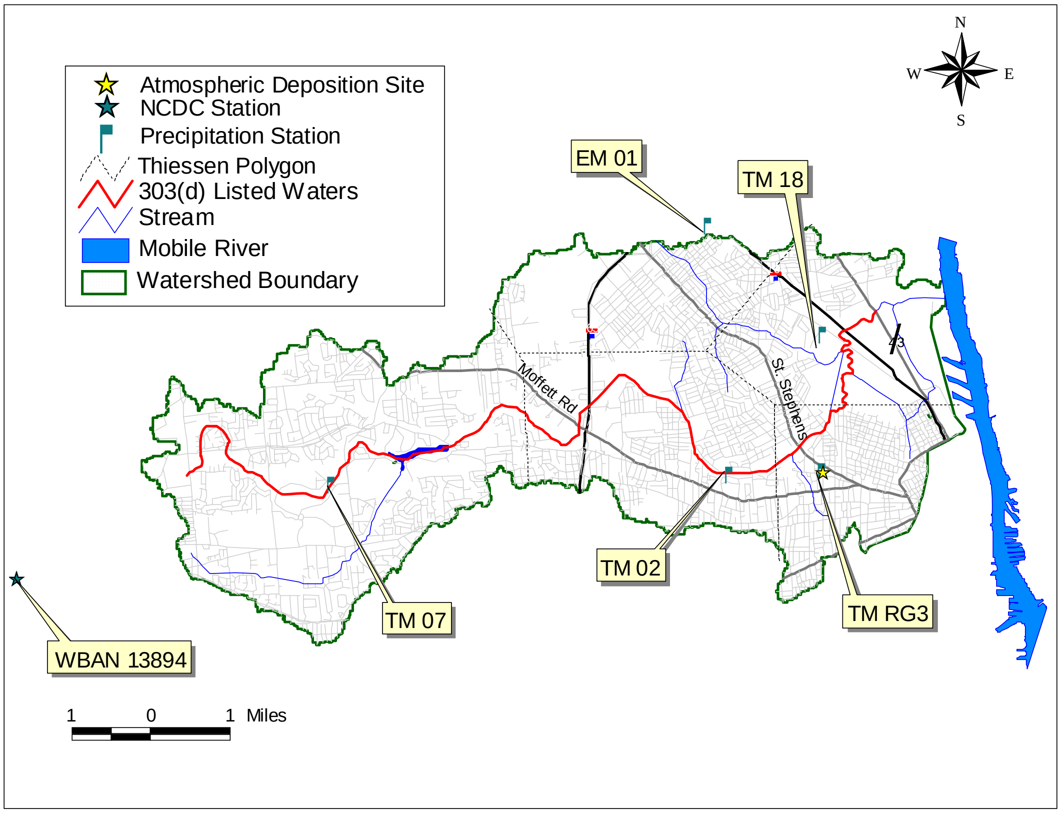

Figure 3-2 Meteorological Stations

3.3.2 Watershed Data

Three types of spatial watershed information are utilized in the TMDLs:

- National Elevation Dataset (NED),
- Multi Resolution Land use Coverage (MRLC), and
- National Hydrography Database Reach Network (NHD).

Figure 3-3 presents a spatial contour plot of the NED data outlining the gradients seen in the system and highlights the change in slope and grade of the land surface. Figure 3-3 also presents the NHD stream network within the watershed. The NED and NHD provide the general connectivity and routing within the system for both the watershed and instream receiving water model.

The MRLC was presented and discussed in Section 3.2.2. These data provided the land use distribution utilized within the watershed model to develop the relative loads from urban, forested, agricultural, residential, and wetland uses.

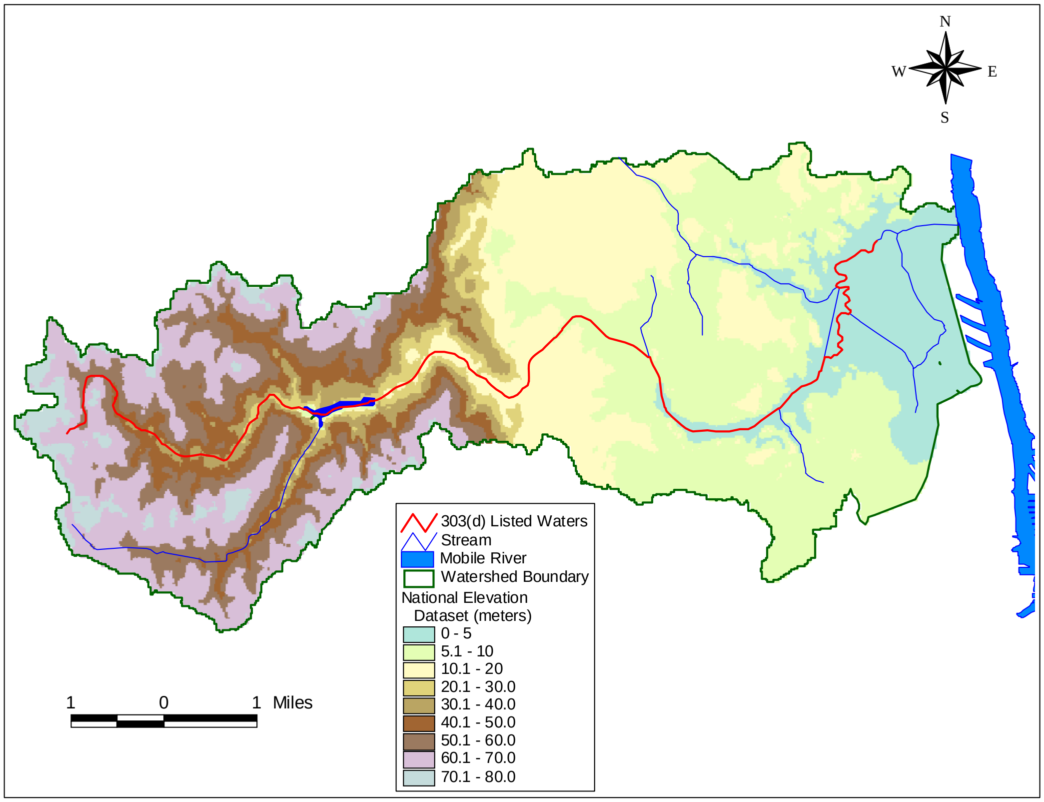

Figure 3-3 NED with the NHD Stream Network

Instream Flow and Water Surface Elevation Data

Although there have been continuous flow and water level stations in operation on Threemile Creek since 1999, a more extensive flow record in a neighboring watershed provided an index to hydrologic conditions necessary for the calibration of watershed simulations. Continuous flows collected on Threemile Creek were used to validate the watershed model calibrated on Eightmile Creek, an adjacent watershed. This station was the only nearby monitoring site with sufficient data to characterize the stream flow in the watershed. Calibrated parameters were then validated to data collected on Threemile Creek at Ziegler Boulevard (USGS 02471013) in 2000 and 2001.

In addition to flows, water surface elevations were imperative in the development of this TMDL. The USGS collects water level information at three stations along Threemile Creek and in Mobile River downstream of its confluence with Threemile Creek. Table 3-3 shows the USGS stations used in this study and the corresponding period of record. Figure 3-4 shows the location of the USGS stations used in TMDL development.

Table 3-3 USGS Flow Stations Employed in TMDL Development

Longitude	Latitude	USGS ID	Station Description	Period of Record
88.1511	30.7060	02471013	Threemile Creek at Ziegler Blvd.	12/3/1999-9/30/2001
88.0900	30.7000	0247101490	Threemile Creek at Stanton Rd.	10/1/1999-9/30/2001
88.0589	30.7240	02471016	Threemile Creek at US-43	10/1/1999-9/30/2001
88.0400	30.7100	02471017	Mobile River at Alabama State Docks	1/1/1999-9/30/2001
88.2150	30.7416	0247100550	Eightmile Creek at Highpoint Blvd.	10/1/1996-9/30/2000

Water Quality Data

The most recent data utilized for the development of the OE/DO TMDL were collected by ADEM, the USGS and USEPA for several special studies:

- USGS Threemile Creek Water Quality Study (July 1999 through September 2003)
- USEPA Mobile Bay Water Quality Intensive Surveys (July 2000/May 2001)
- ADEM Long-Term Trend Monitoring Program

Each study is identified individually below to outline the type and distribution of data collected. Some data analyses are presented to identify key processes that influence the DO conditions in the receiving waters. Further data analyses and explanation can be found in Appendix A.

USGS Threemile Creek Water Quality Study (July 1999 through September 2003)
In July 1999, the USGS was contracted by the Mobile Area Water and Sewer System (MAWSS) to characterize Threemile Creek's hydrologic and water quality condition under various flow regimes. Three stations were constructed to measure continuous stage, temperature, specific conductivity, dissolved oxygen, and turbidity. During high and low flow periods grab samples were collected and measured for ammonia, nitrate, phosphorus, chlorophyll a, total suspended solids (TSS), biochemical oxygen demand (BOD), fecal bacteria and other chemical constituents not pertinent to this TMDL.

The continuous records collected at USGS 02471016 – US-43/Telegraph Road, and USGS 024710190 - Stanton Road, were used to establish the cause of low DO at both stations. In most cases there is a clear correlation with salinity and flooding tides as saline water enters Threemile Creek from Mobile River. As the more dense saline water enters Threemile Creek, stratification in the water column causes DO concentrations to drop.

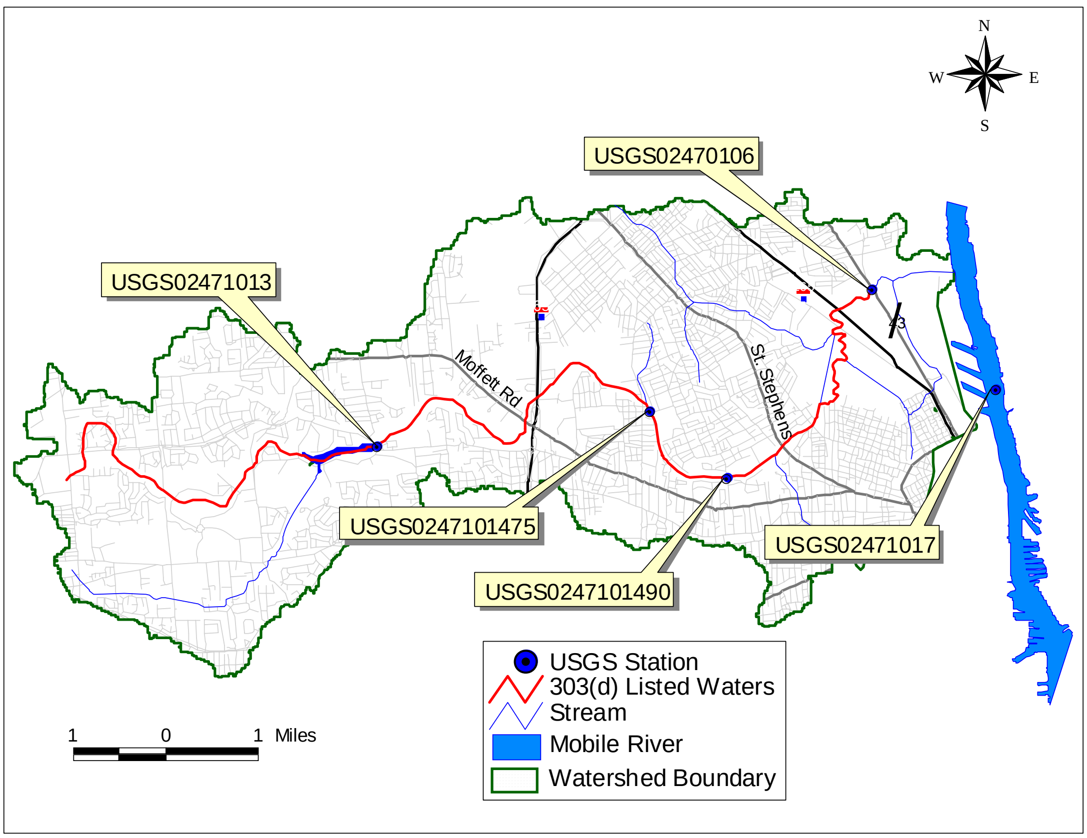

Figure 3-4 USGS Sampling Station Locations

Three days of continuously sampled DO, water level (or stream stage), and salinity are shown in Figures 3-5 and 3-6. These figures represent dry weather conditions. In the time periods illustrated, with the exception of November 2000, water temperatures were greater than 25°C. Figures were simplified and do not display water temperature but understanding water temperature helps to understand the system. Figure 3-5 shows that in November 2000 salinity levels dropped and dissolved oxygen increased, when water temperatures dropped nearly 5 degrees to less than 15°C. As salinity increased on November 19, 2000, water temperatures also increased. Appendix A contains the more extensive continuous data record at USGS 02471016.

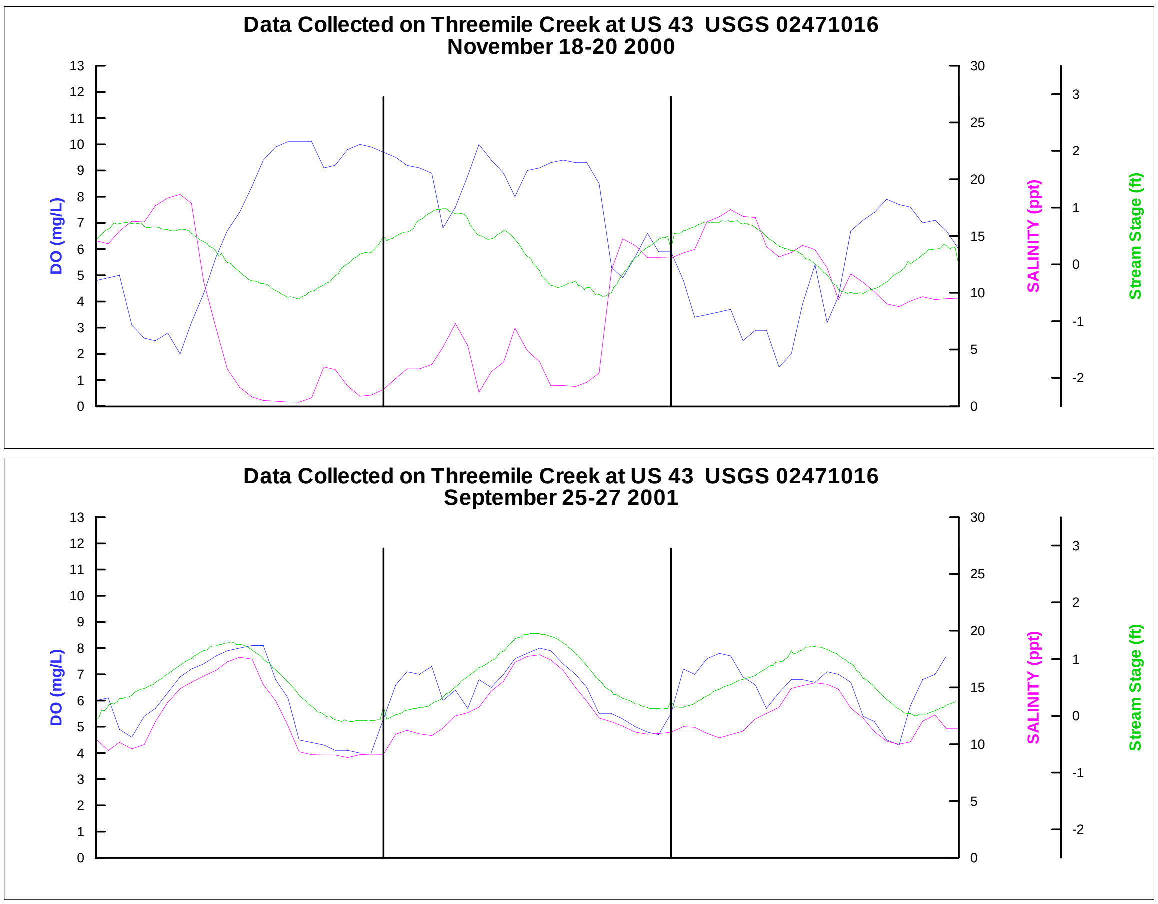

Figure 3-5 Three Days of Continuous Data Recorded on Threemile Creek at US-43 (USGS 02471016) in November 2000 and September 2001

Figure 3-6 Three Days of Continuous Data Recorded on Threemile Creek at US-43 (USGS 02471016) in May 2000 and 2001

USEPA Mobile Bay Water Quality Intensive Surveys (July 2000/May 2001)

In July of 2000 (7/11/00-7/15/00) and May of 2001 (5/14/01-5/18/01), USEPA conducted intensive water quality surveys of Mobile Bay and its surrounding receiving waters. These two measurement periods reflect distinctly different hydrologic conditions. In 2000, flows were very low and near critical 7Q10 conditions, while in 2001 flows were higher. Under these studies three sampling stations were established inside the mouth of Threemile Creek at the confluence with Mobile River. At these stations, vertical profiles of dissolved oxygen, conductivity, salinity, temperature, pH, and turbidity and chlorophyll a were collected.

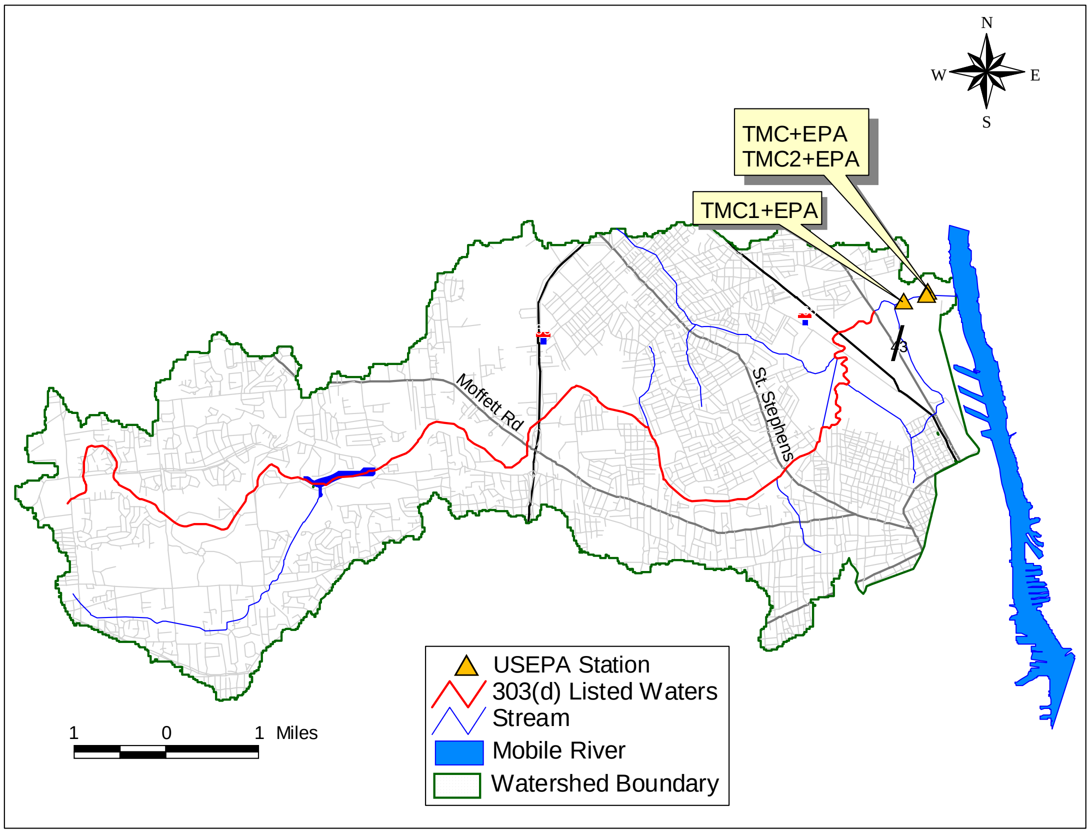

Figure 3-7 USEPA Sampling Station Locations

The USEPA study also collected water quality samples from point sources discharging into Threemile Creek. These data were used to establish boundary conditions for water quality modeling. BOD samples collected during this study in Dog River, an adjacent watershed, the Carlos Morris WWTP, and Wright Smith WWTP were also used in developing water quality model boundaries. These data are critical in defining the influence of point and nonpoint sources on water quality conditions in Threemile Creek.

ADEM Long-Term Trend Monitoring Stations

Two long-term trend monitoring stations were used in TMDL development, a station in Threemile Creek at US-43 (TM1) and in Mobile River at Alabama State Docks (MO2), Figure 3-8. At these stations, monthly samples of DO, temperature, salinity, ammonia, BOD_5, and chlorophyll *a* are collected. The data collection spans from 1985 to the present. Data collected since 1990 at TM1 and MO2 was compared to determine concentrations of DO and other constituents entering Threemile Creek from Mobile River. The DO data collected at Mobile River shows fewer violations of the criteria than data collected on Threemile Creek. Ammonia levels in Mobile River range from 0.01 mg/L to 0.20 mg/L with a mean value of 0.06 mg/L. Threemile Creek data ranges from 0.01 mg/L to 0.94 mg/L with a mean of 0.30 mg/L. BOD_5 levels on Threemile Creek range from 1.0mg/L to 11.0 mg/L with a mean value around 4.0 mg/L. Levels typical of estuarine systems are found in Mobile River at Alabama State Docks. These data range from 1.0 mg/L to 3.6 mg/L, with a mean of 1.45 mg/L. In general nutrients are greater in Threemile Creek at US-43/Telegraph Road than data collected in Mobile River.

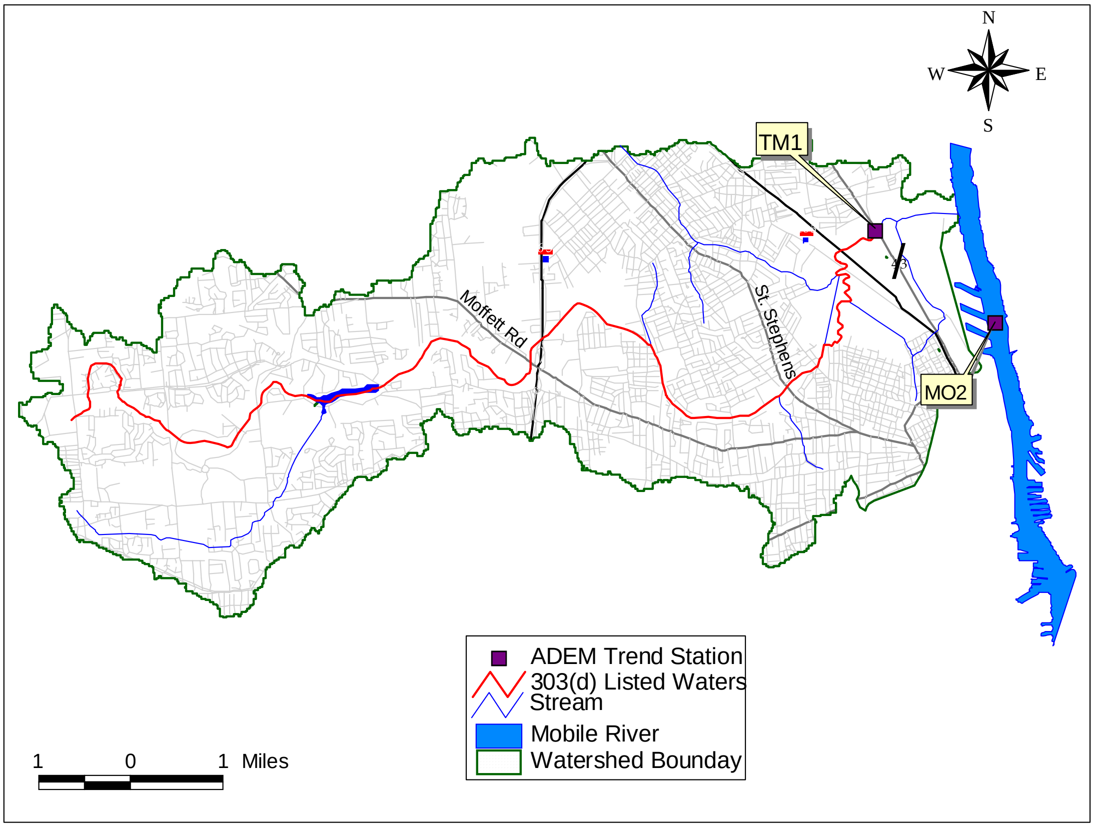

Figure 3-8 ADEM Trend Station Locations

NDPES Point Source Discharge Data

Two municipal facilities and four industrial facilities are permitted to discharge to Threemile Creek. Daily discharge monitoring data was received from the municipal facilities and loadings were considered in the instream model. Discharge monitoring data submitted to ADEM for the industrial facilities was included in the watershed model. The location of NPDES permitted discharges are shown in Figure 3-9. Details on the discharges are presented in Table 3-4 and Appendix A.

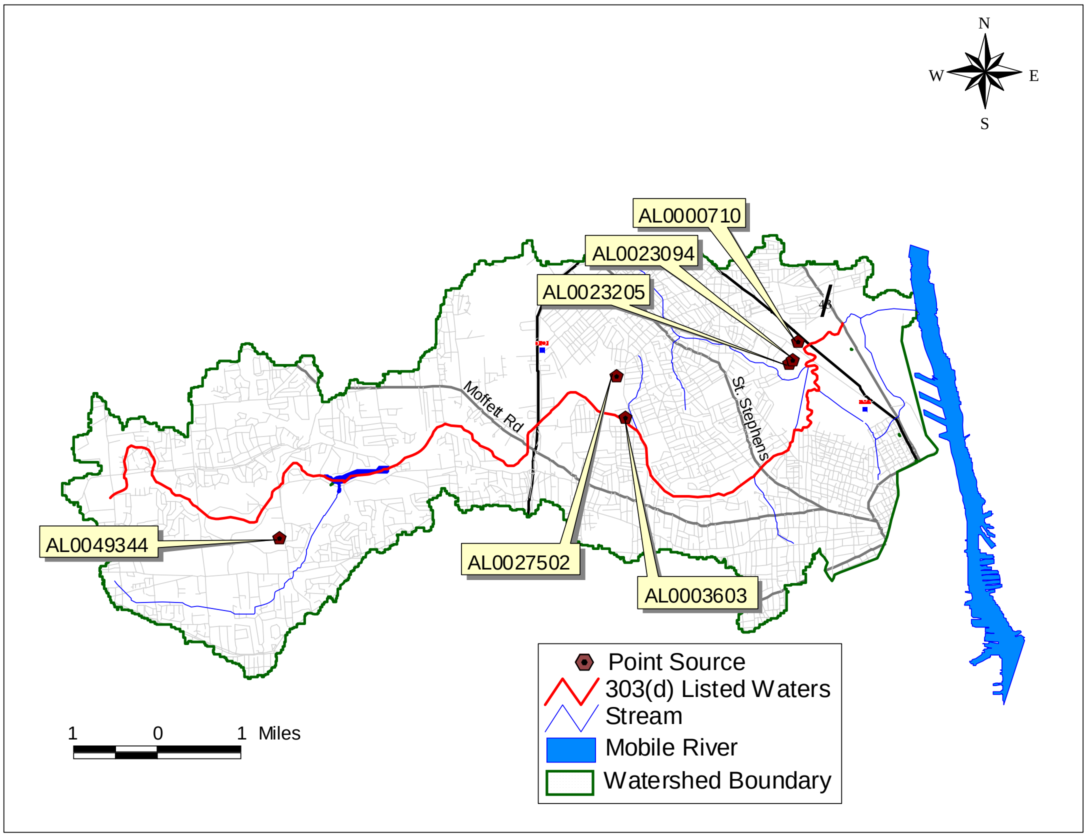

Figure 3-9 NPDES Point Sources Discharging to Threemile Creek

Table 3-4 Point Sources Discharging to Threemile Creek

NPDES Number	Facility	Permitted Values									
		Flow		BOD Monthly Avg	NH3 Monthly Avg	TSS Monthly Avg	TDS Daily Max	pH		Temp Daily Max	Total Phosphorus
		(MGD)	(gpd)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Daily Min	Daily Max		(mg/L as P)
AL0000710	Gulf Lumber Company		<5000				500	6	8.5	95	1
AL0003603	Mobile Paperboard*	0.002								90	
AL0023094	Wright Smith Jr. WWTP	12.8		20	5	30					
AL0023205	Carlos Morris WWTP	4.08		15	5	30					
AL0027502	Mobile Rosin Oil*										
ALG250033	University of South AL	0.01						6	8.5	90	

* Facilities Permitted For Oil and Grease Daily Max of 15 mg/L

4.0 Model Development

Establishing the relationship between instream water quality and source loading is an important component of TMDL development. It allows the determination of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options. This relationship can be developed using a variety of techniques ranging from qualitative assumptions based on scientific principles to numerical computer modeling. In this section, the numerical modeling techniques developed to simulate the loading of organic material and nutrients, and the resulting instream response of DO, are presented. For this TMDL, a system of models was developed to allow the determination of the watershed loads to the listed reaches, the instream flow and transport within the listed reaches, and the instream response of critical water quality parameters. The system of models includes the following:

- Loading Simulation Program in C++ (LSPC) – to quantify the watershed loads of BOD_5 and nutrients to the listed reaches,
- Environmental Fluid Dynamics Code (EFDC) – to simulate the flow and transport of material within the listed reaches, and
- Water Quality Analysis and Simulation Program (WASP) – to simulate the instream response of critical water quality parameters to the watershed loads.

The following presents general descriptions of each of the models along with brief descriptions of the model calibrations and applications. Further explanation of modeling for TMDL development can be found in the Threemile Creek Modeling Report in Appendix B.

Watershed Modeling –LSPC

Hydrologic response and pollutant loading model calibrations must occur to determine the watershed loads to the receiving waters. First, the model is calibrated for the hydrologic response of the watershed to rainfall and background source flows. During periods of precipitation, the rainfall will govern hydrology and subsequent loads of oxygen consuming waste. During dry periods, past events and their associated deposition within the system, and background inflows will govern the system hydrology. In each case there is a subsequent load to the listed waters that must be carried forward to the instream model. Loads washed into the system will pass through and/or react during dry periods if the loads still remain in the water column. In addition, build up of organic material in the listed reaches from past high flow events can create increased sediment oxygen demand that exerts itself during low flow periods. In each case, the development of a TMDL that accounts for the storm water impacts upon the system requires the quantification of the total load and its distribution.

Hydrology Model Set Up and Calibration

Based on the considerations described above, analysis of the monitoring data, review of the literature, and past modeling experience, the Loading Simulation Program C++ (LSPC) was used to represent the source-response linkage in the Threemile Creek watershed. LSPC is a comprehensive data management and modeling system that is capable of representing loading from nonpoint and point sources and simulating instream processes.

LSPC is a system designed to support TMDL development for areas impacted by nonpoint and point sources. The most critical component of LSPC to TMDL development is the dynamic watershed model, because it provides the linkage between source contributions, instream response during routing of flows, and delivery of loads to receiving streams. The comprehensive watershed model is used to simulate watershed hydrology and pollutant transport as well as stream hydraulics and instream water quality. It is capable of simulating flow, sediment, metals, nutrients, pesticides, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and waterbodies. LSPC was configured for Threemile Creek to simulate the watershed as a series of hydrologically connected subwatersheds that contribute loads to various lengths of the listed reaches. Configuration of the model involved subdivision of the watershed into modeling units and continuous simulation of flow and water quality for these units using meteorological, land use, and stream data. The pollutants simulated are nutrients and biochemical oxygen demand. Appendix B describes the configuration process and key components of the model in greater detail.

The watershed was divided into 19 subwatersheds to represent watershed loadings and resulting concentrations of nutrients and BOD_5 to the stream segments. Figure 4-1 presents the subwatershed breakdown in LSPC. These subwatersheds represent hydrologic boundaries. The division was based on elevation data from the 30m resolution, National Elevation Dataset (NED) from USGS, stream connectivity from the National Hydrography Dataset (NHD) stream coverage, and the locations of monitoring stations.

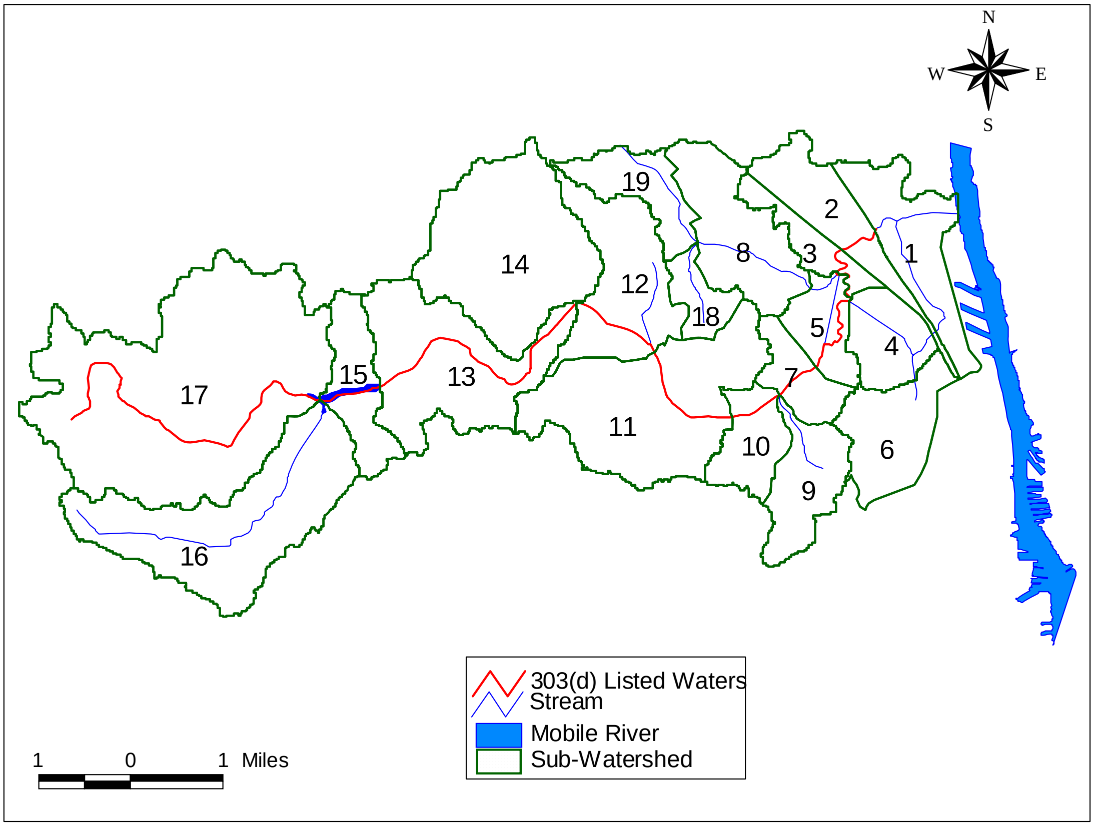

Figure 4-1 Subwatershed Delineation of Threemile Creek

The hydrology of the LSPC model was calibrated for the period of record 10/1/1996-9/30/2000 at USGS station 0247100550 on Eightmile Creek. The hydrology calibration was performed prior to water quality calibration and involved adjustment of the model parameters used to represent the hydrologic cycle until acceptable agreement was achieved between simulated flows and historic stream flow data measured at USGS station 0247100550 for the same period of time. Model parameters adjusted included: evapotranspiration, infiltration, upper and lower zone storage, groundwater storage, recession, losses to the deep groundwater system, and interflow discharge. Modeled flow was compared to the continuous flow record collected at USGS station 02471013 on Threemile Creek at Ziegler Boulevard. The hydrological calibration plots are presented in Appendix B.

4.1.2 Water Quality Model Set Up and Calibration

A dynamic computer model was selected for nutrients and BOD_5 analysis in order to: a) simulate the time varying nature of deposition on land surfaces and transport to receiving waters; and b) incorporate seasonal effects on the production and fate of BOD_5.

For modeling purposes, the BOD_5 sources are represented by the following components:

- Runoff loads from land uses (build-up and washoff due to runoff), and
- Point source discharges.

Typically, watershed sources are characterized by buildup and washoff processes; they contribute material to the land surface, where they accumulate and are available for runoff during storm events. These sources can be represented in the model as land-based runoff from the land use categories to account for their contribution to form loading within the watersheds. Accumulation rates (mass per acre per day) can be calculated for each land use based on all sources contributing nutrients, $NBOD_U$ and $CBOD_U$ to the surface of the land use.

Literature values for typical $CBOD_U$ and $NBOD_U$ accumulation rates were used for the urban land uses. The literature value used for urban land uses is the median default value for commercial land (Horner, 1992). The value used for barren and strip-mining land uses was half of the urban value. The value used for $CBOD_U$ and $NBOD_U$ accumulation rates on the harvested woodland use was the same value as forest.

The LSPC model is a build-up and washoff model that represents the pollutant by accumulating the pollutant over time, storing the pollutant to some maximum limit, and then transporting the pollutant through overland flow to the stream. The model represents these processes with an accumulation rate (ACQOP) and the storage limit (SQOLIM). WSQOP is defined as the rate of surface runoff (inches per hour) that results in 90 percent washoff in one hour. The lower the value, the more easily washoff occurs. This parameter is user-defined and was determined for each land use by USEPA recommended ranges. The ACQOP and SQOLIM can be varied monthly or be a constant through the simulation. For the Threemile Creek watershed model, the rates were input as constant values.

Following hydrology calibration, the water quality constituents were calibrated. Modeled versus observed instream concentrations for nutrient species along with BOD_5 were directly compared during model calibration. The water quality calibration consisted of executing the watershed model, comparing water quality time series output to available water quality observation data, and adjusting water quality parameters within a reasonable range. The parameters that were adjusted to obtain a calibrated model were the build-up and washoff of nutrients and BOD_5 from the land use and the direct loads such as sanitary sewer overflows and industrial point source discharges.

The approach taken to calibrate water quality focused on matching trends identified during the water quality analysis. Daily average instream concentrations from the model were compared directly to observed data. Observed nutrient and BOD_5 data were obtained from ADEM and the USGS. The objective was to best simulate low flow, mean flow, and storm peaks at representative water quality monitoring stations. The model was calibrated at all water quality stations with observation data during the chosen calibration period. These stations were typically USGS and ADEM monitoring stations (Figures 3-8 and 3-9).

The time period of the model simulation was from 2000 to 2001. This time period was selected based on the availability and relevance of the observed data to the current conditions in the watershed. The model was calibrated for the year 2000, which represented both high and low flow periods. For each water quality station, model results were plotted against the respective observed data to assess the model's response to spatial variation of loading sources.

Receiving Water Models – EFDC and WASP

Section 4.1 presented the watershed model utilized to develop the time dependent overland flows and pollutant concentrations to be input to the receiving water models. The receiving water models take the pollutant loads from the watershed model along with available information on the point source loads to the system, and provide for the transport and transformation of the material as it moves through the system. In the case of oxygen consuming material the models provide for the oxidation, nitrification, uptake through photosynthesis, and other processes that simulate the instream DO concentrations. Additionally, the instream models provide for the balance in the water column between oxygen depletion due to the processes described above, sediment oxygen demand, and reaeration across the water surface. These processes act on the water as it moves through the system under the simulated flow and transport.

Hydrodynamic Model Selection, Set Up and Calibration (EFDC)

A hydrodynamic model was developed to simulate the flow, velocity, temperature and transport in the listed reaches. The EFDC model was applied with 59 grid cells, each with four vertical layers. Figure 4-2 presents the grid utilized for the instream model. The grid coverage extends from the mouth of Threemile Creek at Mobile River upstream to the most downstream drop structure installed by the City of Mobile and the U.S. Army Corps of Engineers (USACE), where the extent of salinity intrusion and tidal influence is negligible.

The Environmental Fluid Dynamics Code (EFDC) is a general purpose modeling package for simulating 1-D, 2-D, and 3-D flow and transport in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software. The EFDC code has been extensively tested and documented.

Within the EFDC modeling package, solutions for flow and transport can be made on multiple scales i.e. 1-D or 2-D. These models solve the 1-D/2-D continuity, momentum, and transport equations. The models use the efficient numerical solution routines within the more general 2-D/3-D EFDC hydrodynamic model, as well as the transport and meteorological forcing functions. In addition, it allows for specification of time variable water surface elevation at the downstream boundary, i.e. allowing time-dependent water surface elevations collected at Alabama State Docks in Mobile River by the USGS as the downstream boundary. Specific details on the model equations, solution techniques and assumptions may be found in Hamrick (1996). Further explanation of model development setup and calibration can be found in Appendix B.

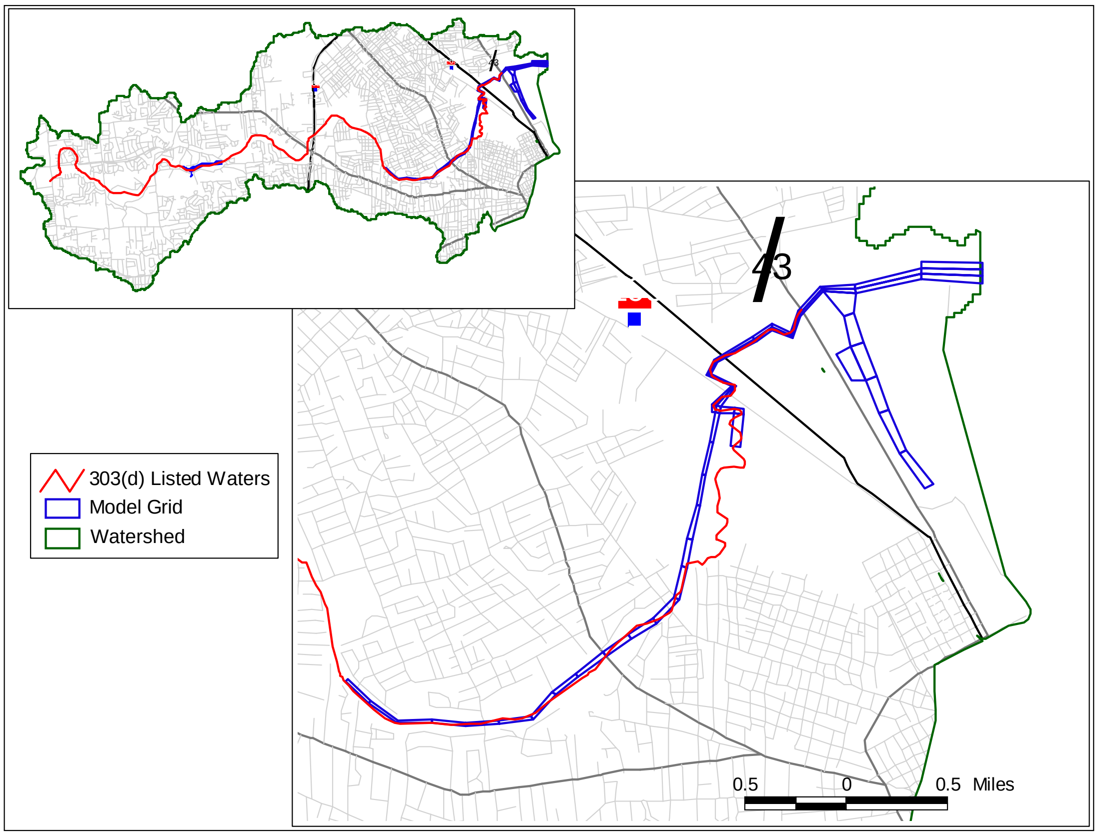

Figure 4-2 Extent of Instream Model Grid for Threemile Creek

4.2.2 Water Quality Model Selection, Set Up and Calibration (WASP)

In order to simulate the temporal and spatial DO concentrations, a water quality model was utilized to simulate the full eutrophication kinetics including phosphorus and nitrogen cycling, oxidation of organic material, sediment oxygen demand, and reaeration across the water surface. The WASP model was utilized with a four-layer grid identical to the EFDC grid, with the exception of one boundary cell at the inlet from Mobile River.

For simulation of water quality within Threemile Creek, the EFDC model was externally linked to the Water Quality Analysis Simulation Program (WASP) through a hydrodynamic forcing file that contains the flows, volumes, and exchange coefficients between adjacent cells.

Water quality processes are represented in special kinetic subroutines that are either chosen from a library or written by the user. WASP is structured to permit easy substitution of kinetic subroutines into the overall package to form problem-specific models. WASP permits the modeler to structure one, two, and three-dimensional models; allows the specification of time-variable exchange coefficients, advective flows, waste loads and water quality boundary conditions; and permits tailored structuring of the kinetic processes, all within the larger modeling framework without having to write or rewrite large sections of computer code.

For the Threemile Creek watershed simulations, the WASP model was run under full eutrophication kinetics with the following state variables simulated:

- Dissolved oxygen (DO)
- Ultimate Carbonaceous Biochemical Oxygen Demand (CBODU)
- Ammonia as Nitrogen (NH_3-N)
- Nitrate/Nitrite as Nitrogen (NO_3-NO_2-N)
- Organic Nitrogen (ON)
- Organic Phosphorus (OP)
- Ortho-Phosphorus (PO_4)
- Chlorophyll a

In order to perform the full eutrophication simulations the following general input conditions were required.

- Boundary flows and concentrations for all eight state variables where flow enters the model,
- Meteorological forcings, and
- Model input coefficients.

Boundary flows and concentrations came from the LSPC simulations described in Section 4.1.1 and 4.1.2. Sediment oxygen demand measurements were taken from data collected by the USEPA during a special study of Mobile Bay. These values were utilized to develop the sediment oxygen demand with an average value used throughout the creek in the model.

Meteorological data used in the WASP model came from the Mobile Regional Airport weather station data described in Section 3.3.1. For the WASP model, hourly weather data was utilized for the inputs to establish diurnal fluctuations in the system.

The WASP model input coefficients reflect the best available literature values, and where available (i.e. CBOD decay rate) site-specific values were utilized. The best fit between the WASP model simulations and the measured data was obtained by variation of critical parameters within the range of acceptable literature values. Where site-specific measured values were used, no adjustment of those coefficients was made. Appendix B provides the Modeling Report describing the model set up and calibration along with model inputs and critical parameters.

5.0 Development of Total Maximum Daily Load

5.1 Numeric Targets for TMDL

Four modeling scenarios were run to establish an achievable DO target for Threemile Creek. These scenarios are as follows:

NPDES municipal point sources at 2003 permit limits and MS4 at existing conditions (WWTP permits and MS4 existing conditions simulation),
Natural conditions with NPDES point sources removed and MS4 contributions at reference (or background) concentrations (natural conditions simulation),
NPDES municipal point source reductions and MS4 point source reductions to meet water quality criteria (TMDL with point sources), and
NPDES municipal point sources removed and MS4 point source reductions to meet water quality criteria (TMDL without point sources).

The DO concentrations from these scenarios were analyzed to determine compliance with water quality criteria. The natural conditions scenario demonstrates that under natural conditions in Threemile Creek, DO does drop below 3.0 mg/L. ADEM Admin. Code R. 335-6-10-.05(4) states: "*Natural waters may, on occasion, have characteristics outside of the limits established by these criteria. The criteria contained herein relate to the condition of waters as affected by the discharge of sewage, industrial wastes or other wastes, not to conditions resulting from natural forces.*" The model was simulated from May 2000 through April 2001 to account for both summer (May through November) and winter (December through April) conditions. Further explanation of modeled scenarios, including natural conditions, and their results can be found in Appendix B. Results from the TMDL scenarios can be found in Table 5.1.

5.2 Critical Conditions

Data analysis shows that dissolved oxygen levels in Threemile Creek naturally drops below 3.0 mg/L during certain periods. These periods when natural conditions dip below 3.0 mg/L have been identified as critical conditions in Threemile Creek. In the natural conditions model, two critical periods were selected to establish seasonal TMDLs. A period during June 2000 was simulated under natural conditions which resulted in a minimum DO concentration of 1.91 mg/L at a 5 ft depth at US-43/Telegraph Road. This June event defines critical conditions in Threemile Creek during the summer season. A period during April of 2001, the model simulated natural condition is 2.26 mg/L at a 5 ft depth at US-43/Telegraph Road and thus defines the winter critical period. For the purpose of this TMDL, a low flow period with high temperatures for both summer and winter seasons was utilized to represent the worst-case conditions. The simulations were performed with time-dependent daily fluctuations of the Mobile River tidal boundary of water surface elevation, simulated inflows from the LSPC model with simulated concentrations of total phosphorus, total nitrogen, and BOD_5, measured meteorological conditions, measured and averaged DO, averaged sediment oxygen demand and literature value loads from forested wetlands.

5.3 Margin of Safety (MOS)

There are two methods for incorporating a margin of safety (MOS) in the analysis: a) by implicitly incorporating the MOS using conservative model assumptions to develop allocations; or b) by explicitly specifying a portion of the TMDLs as the MOS and using the remainder for allocations. An implicit MOS was incorporated in this TMDL. This TMDL used the worst-case conditions. Also this implicit MOS included conservative modeling assumptions and a continuous simulation that incorporates a range of meteorological events. Conservative modeling assumptions used include: setting point sources discharges at permitted design flows, conservative estimates of instream decay, and all land areas considered to be connected directly to streams. Organic material loss on the land surface is not computed in the model. Therefore, the loads delivered to the model do not account for decay and are conservative.

5.4 Seasonal Variation

Seasonal variation is considered in the development of the TMDLs by use of two periods from December through April (winter) and May through November (summer). Allocation runs were performed under seasonal conditions to simulate the response of DO under various hydrologic, meteorological, and loading conditions, thus fully evaluating the potential seasonal variations.

5.5 Wasteload Allocations

Within the Threemile Creek watershed, two facilities are permitted to discharge oxygen consuming wastes. The watershed also lies within a MS4 Phase I permitted area; therefore, the wasteload allocation (WLA) to this system is based on the systems capacity to receive these loads and maintain water quality standards. Currently, the WWTPs in Threemile Creek are permitted to discharge BOD_5 of 20.0 mg/L and 15.0 mg/L and NH_3-N of 5.0 mg/L, as shown in Table 5-1. Modeled results of the WWTP at current permit limits simulate DO levels less than 3.0 mg/L nearly half the summer period. By reducing each facility's permitted $CBOD_5$ & NH_3-N concentrations during the summer period to a $CBOD_5$ of 1.75 mg/L and NH_3-N of 0.22 mg/L, the subject WWTP's will not cause dissolved oxygen levels to drop below natural conditions in Threemile Creek. In addition, to meet water quality criteria during winter months (December – April) the permitted discharges must be reduced to a BOD_5 and NH_3-N of 6.26 mg/L and 0.18 mg/L, respectively, to achieve the instream DO criterion. These concentrations are also applied to the MS4 for flows corresponding to the critical period and therefore, may cause an increase in the MS4 wasteload (Appendix B, Section 7.1). Table 5-1 presents the allowable concentrations for point sources as $CBOD_5$. In the summer of 2004, the ADEM's Field Operations office in Mobile conducted a comprehensive Bay study where f-ratios were determined for WWTPs. The f-ratio for the Wright Smith WWTP was determined to be 4.48 and the Carlos Morris WWTPs f-ratio equal to 3.87. The f-ratio is the ratio of ultimate BOD to 5-day BOD. 5-day BOD is permitted for municipal wastewater treatment plants and therefore, is sampled and available in discharge monitoring reports (DMRs). The f-ratio is used to convert measured data to a form that can be used in the water quality model, ultimate BOD. Table 5-2 presents existing and allowable MS4 concentrations.

Table 5-1 WWTP Existing and Allowable Loads for Permitted Discharges

NPDES Permitted WWTPs	Current Permitted BOD_5 (mg/L)	Current Permitted NH_3-N (mg/L)	Summer/Winter TMDL $CBOD_5$ (mg/L)	Summer/Winter TMDL NH_3-N (mg/L)
MAWSS Wright Smith WWTP (AL0023094)	20	5	1.75/1.4	0.22/0.18
City of Prichard's Carlos Morris WWTP (AL0023205)	15	5	2.03/1.62	0.22/0.18

Table 5-2 Existing and Allowable MS4 Concentrations with Municipal Point Sources in Threemile Creek

NPDES Permitted MS4	Summer/Winter Existing $CBOD_U$ (mg/L)	Summer/Winter Existing NH_3-N (mg/L)	Summer/Winter TMDL $CBOD_U$ (mg/L)	Summer/Winter TMDL NH_3-N (mg/L)
ALS000002	3.94/2.58	0.25/0.14	7.84/6.26	0.22/0.18

MS4 wasteloads were also simulated with the municipal discharges removed from the system to determine the allowable load during the critical time at US-43/Telegraph Road. The entire Threemile Creek watershed is within the MS4 permitted area and therefore, the allowable concentrations for critical low flow conditions are equal to natural condition concentrations. The modeled existing watershed concentrations during the critical time in June of 2000 are 3.94 mg/L $CBOD_u$ and 0.25 mg/L ammonia, requiring a reduction of 49% and 55% respectively to meet natural conditions. The modeled existing watershed concentrations during the critical time in April of 2001 are 2.58 mg/L CBODu and 0.14 mg/L ammonia, and the allowable $CBOD_u$ and NH_3-N concentrations are 2.0 mg/L and .11 mg/L respectively. Therefore, a $CBOD_u$ and NH_3-N reduction of 21% and 22% respectively is required from the MS4 regulated area to meet natural conditions.

Table 5-3 Existing and Allowable MS4 Concentrations with Municipal Point Sources Removed from Threemile Creek

NPDES Permitted MS4	Summer/Winter Existing $CBOD_U$ (mg/L)	Summer/Winter Existing NH_3-N (mg/L)	Summer/Winter TMDL $CBOD_U$ (mg/L)	Summer/Winter TMDL NH_3-N (mg/L)
ALS000002	3.94/2.58	0.25/0.14	2	0.11

5.6 Load Allocations

The entire Threemile Creek watershed is within the MS4 permitted area. Therefore the nonpoint source loads, or load allocations (LA), in Threemile Creek are for the forested wetlands and other areas that are not directly regulated under the Mobile Area MS4 permit. The load contribution from these forested wetland areas is already considered to be at background conditions, therefore the nonpoint source reductions would theoretically come from non-forested wetland areas within the Threemile Creek watershed that are not directly regulated under the MS4 permit.

5.7 TMDL Results

These two scenarios, Tables 5-4 through 5-7, are representative of two allocation scenarios that are both expected to result in the achievement of applicable water quality standards. Only one of the allocation scenarios presented will be implemented. The allocations proposed in the TMDL ensure that dissolved oxygen levels during critical conditions are not less than natural conditions. The dissolved oxygen levels of 1.91 mg/L and 2.26 mg/L referenced in Section 5.2 are expected to be maintained during critical conditions as a result of the allocations proposed in the TMDL.

Tables 5-4 and 5-5 present the existing loads, TMDLs, and the required load reductions of $NBOD_U$ and $CBOD_U$, on a seasonal basis, for Threemile Creek with municipal point source discharges.

Table 5-4 Maximum Allowable Loads for Threemile Creek from December through April with Municipal Point Source Discharges

Constituent	Existing WLA (lb/day)		Existing LA (lb/day)	TMDL WLA (lb/day)		TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction NPDES	WLA Reduction MS4	LA Reduction
	NPDES	MS4		NPDES	MS4					
$NBOD_U$	3217	65	65.4	116.7	84.3	84.9	201.6	96%	0%	0%
$CBOD_U$	11540	262.5	274.9	881.8	637.3	649.7	1531.4	92%	0%	0%

Table 5-5 Maximum Allowable Loads for Threemile Creek from May through November with Municipal Point Source Discharges

Constituent	Existing WLA (lb/day)		Existing LA (lb/day)	TMDL WLA (lb/day)		TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction NPDES	WLA Reduction MS4	LA Reduction
	NPDES	MS4		NPDES	MS4					
$NBOD_U$	3217	70.6	71.2	140.7	63	63.6	204.3	96%	11%	11%
$CBOD_U$	11540	248.5	260.9	1104.3	494.6	507	1611.4	90%	0%	0%

Tables 5-6 and 5-7 present the existing loads, TMDLs, and the required load reductions of $NBOD_U$ and $CBOD_U$, on a seasonal basis, for Threemile Creek if municipal point source discharges are removed from the system.

Table 5-6 Maximum Allowable Loads for Threemile Creek from December through April with Municipal Point Source Discharges Removed

Constituent	Existing WLA (lb/day) MS4	Existing LA (lb/day)	TMDL WLA (lb/day) MS4	TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction MS4	LA Reduction
$NBOD_U$	65	65.4	51	51.6	51.6	21%	21%
$CBOD_U$	262.5	274.9	203.5	215.9	215.9	22%	22%

Table 5-7 Maximum Allowable Loads for Threemile Creek from May through November with Municipal Point Source Discharges Removed

Constituent	Existing WLA (lb/day) MS4	Existing LA (lb/day)	TMDL WLA (lb/day) MS4	TMDL LA (lb/day)	TMDL (lb/day)	WLA Reduction MS4	LA Reduction
$NBOD_U$	70.6	71.2	31.7	32.3	32.3	55%	55%
$CBOD_U$	248.5	260.9	126.1	138.5	138.5	49%	49%

6.0 Follow-up Monitoring

ADEM has adopted a basin approach to water quality management; an approach that divides Alabama's fourteen major river basins into five groups. Each year, the ADEM water quality resources are concentrated in one of the five basin groups. One goal is to continue to routinely monitor §303(d) listed waters until such waters are meeting their designated uses. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed. This monitoring will occur in each basin according to the schedule shown in Table 6-1 below. The Threemile Creek watershed is located in the Mobile Basin.

Table 6-1. ADEM's Monitoring Schedule for Alabama's Major River Basins

River Basin Group	Year to be Monitored
Escatawpa / Mobile / Lower Tombigbee / Upper Tombigbee	2006
Black Warrior / Cahaba	2007
Tennessee	2008
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2009
Alabama / Coosa / Tallapoosa	2010

7.0 Public Participation

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or clj@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

8.0 References

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