BAYOU RIGOLETTE AND IATT LAKE TMDL FOR DISSOLVED OXYGEN

SUBSEGMENTS 101301 AND 101302

MARCH 25, 2008

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SUBSEGMENTS 101301 and 101302

Prepared for

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily loads (TMDLs) for pollutants for those waterbodies. A TMDL is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) for Iatt Lake (Subsegment 101302) and Bayou Rigolette (Subsegment 101301), in the Red River basin in northern Louisiana.

The Iatt Lake and Bayou Rigolette subsegments extend approximately 56 kilometers (35 miles) from the Iatt Lake headwaters in Winn Parish to the confluence of Bayou Rigolette and the Red River north of Pineville, Louisiana. Subsegments 101301 and 101302 cover approximately 413 square miles. Subsegment 101301 is approximately 48% forested and 28% agricultural. Subsegment 101302 is approximately 76% forested.

Subsegments 101301 and 101302 were listed as impaired on the final 2004 303(d) List for Louisiana dated August 17, 2005 (Louisiana Department of Environmental Quality (LDEQ) 2005) on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority No. 7 for TMDL development. The causes for impairment cited in the 303(d) List included organic enrichment and low DO. The water quality standard for DO in these subsegments is 5 mg/L year-round.

A water quality model (LA-QUAL) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in these subsegments. The model was set up and calibrated using observations from a synoptic survey conducted by FTN Associates, Ltd. (FTN) during August through September 2005, and other various information obtained from LDEQ and the United States Geological Survey (USGS). The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing nonpoint source loads were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

A TMDL for oxygen-demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) was calculated using the results of the summer and winter projection simulations for Subsegments 101301 (Tables ES.1 and ES.2, respectively) and 101302 (Tables ES.3 and ES.4, respectively). Both implicit and explicit margins of safety (MOS) were included in the TMDL calculations, along with a 10% future growth (FG) component. Seven point sources were identified in Subsegment 101301, and none were found in Subsegment 101302. Therefore, the TMDL for Subsegment 101301 included wasteload allocations (WLAs) for the point sources (Tables ES.5 and ES.6).

In order to maintain the DO standard of 5.0 mg/L throughout Subsegment 101301, nonpoint source oxygen demand loads will need to be reduced by 36% in the summer and 24% in the winter. In order to maintain the DO standard of 5.0 mg/L throughout Subsegment 101302, nonpoint source oxygen demand loads will need to be reduced by 53% both in the summer and winter. No changes to National Pollutant Discharge Elimination System point source permit limits are necessary.

Table ES.1. Bayou Rigolette (Subsegment 101301) summer TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	35	27	16	78	NA	77	59	35	172	0
MOS	NA	4.4	3.4	2	9.8	NA	9.7	7.5	4.4	22	NA
FG	NA	4.4	3.4	2	9.8	NA	9.7	7.5	4.4	22	NA
Nonpoint Sources											
LA	1,397	398	54	1.24	1,851	3,073	876	119	2.7	4,072	36%
MOS	175	50	6.8	0.16	232	385	109	15	0.4	510	NA
FG	175	50	6.8	0.16	232	385	109	15	0.4	510	NA
TMDL	1,746	542	101	22	2,413	3,841	1,192	222	48	5,308	NA

Table ES.2. Bayou Rigolette (Subsegment 101301) winter TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	50.6	27.0	15.8	93.5	NA	111	59.4	34.8	206	0
MOS	NA	6.3	3.4	2.0	11.7	NA	13.9	7.5	4.4	25.7	NA
FG	NA	6.3	3.4	2.0	11.7	NA	13.9	7.5	4.4	25.7	NA
Nonpoint Sources											
LA	1,650	480	84.1	8.4	2,223	3,630	1,056	185	18.5	4,891	24%
MOS	206	60	10.5	1.0	278	453	132	23	2.2	611	NA
FG	206	60	10.5	1.0	278	453	132	23	2.2	611	NA
TMDL	2,063	663	139	30.2	2,896	4,539	1,459	306	66.4	6,371	NA

Table ES.3. Iatt Lake (Subsegment 101302) summer TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	0	0	0	0	NA	0	0	0	0	0
MOS	NA	0	0	0	0	NA	0	0	0	0	NA
FG	NA	0	0	0	0	NA	0	0	0	0	NA
Nonpoint Sources											
LA	31,209	10,510	1,286	1.15	43,006	68,660	23,122	2,829	3	94,614	53%
MOS	3,901	1,314	161	0.14	5,376	8,582	2,891	354	0	11,828	NA
FG	3,901	1,314	161	0.14	5,376	8,582	2,891	354	0	11,828	NA
TMDL	39,011	13,138	1,608	1	53,758	85,824	28,904	3,538	3	118,269	NA

Table ES.4. Iatt Lake (Subsegment 101302) winter TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	0	0	0	0	NA	0	0	0	0	0
MOS	NA	0	0	0	0	NA	0	0	0	0	NA
FG	NA	0	0	0	0	NA	0	0	0	0	NA
Nonpoint Sources											
LA	31,209	10,514	1,300	1.79	43,025	68,660	23,131	2,860	4	94,655	53%
MOS	3,901	1,314	162	0.23	5,377	8,582	2,891	356	1	11,830	NA
FG	3,901	1,314	162	0.23	5,377	8,582	2,891	356	1	11,830	NA
TMDL	39,011	13,142	1,624	2	53,779	85,824	28,912	3,573	5	118,314	NA

Table ES.5. Flows, concentrations, and loads for point sources included in summer DO TMDL.

Subseg. Number	NPDES Number	Name of Discharger	Flow Rate (gpd)	Concentrations			Loads*		
				BOD_5 or $CBOD_5$ (mg/L)	Ammonia Nitrogen (mg/L)	Organic Nitrogen (mg/L)	BOD_5 or $CBOD_5$ (lbs/day)	Ammonia Nitrogen (lbs/day)	Organic Nitrogen (lbs/day)
101301	LA0033456	Town of Colfax Sewage Treatment Plant	300,000	10	1.7	3.3	24.9	4.24	8.24
101301	LAG560232	Aurora Park Subdivision	29,000	20	10	20	4.84	2.42	4.82
101301	LAG530502	Bellsouth Tioga Main K4472	40	45	5	10	0.02	0.00	0.00
101301	LAG530785	Hyams Trailer Park	20	45	10	20	0.01	0.00	0.00
101301	LAG540490	Tioga Manor Nursing Home	16,400	30	5	10	4.10	0.68	1.37
101301 Total Point Source Loads:							33.9	7.34	14.4

*Loads of organic nitrogen and ammonia nitrogen in this table represent loads of nitrogen, not oxygen demand.

Table ES.6. Flows, concentrations, and loads for point sources included in winter DO TMDL.

Subseg. Number	NPDES Number	Name of Discharger	Flow rate (gpd)	Concentrations			Loads*		
				BOD_5 or $CBOD_5$ (mg/L)	Ammonia Nitrogen (mg/L)	Organic Nitrogen (mg/L)	BOD_5 or $CBOD_5$ (lbs/day)	Ammonia Nitrogen (lbs/day)	Organic Nitrogen (lbs/day)
101301	LA0033456	Town of Colfax Sewage Treatment Plant	300,000	15	1.7	3.3	37.4	4.24	8.24
101301	LAG560232	Aurora Park Subdivision	29,000	20	10	20	4.84	2.42	4.82
101301	LAG530502	Bellsouth Tioga Main K4472	40	45	5	10	0.02	0.00	0.00
101301	LAG530785	Hyams Trailer Park	20	45	10	20	0.01	0.00	0.00
101301	LAG540490	Tioga Manor Nursing Home	16,400	45	5	10	6.19	0.68	1.37
101301 Total Point Source Loads:							48.5	7.34	14.4

*Loads of organic nitrogen and ammonia nitrogen in this table represent loads of nitrogen, not oxygen demand.

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1.0 INTRODUCTION

This report presents a total maximum daily load (TMDL) for dissolved oxygen (DO) for Subsegments 101301 (Bayou Rigolette headwaters to Red River) and 101302 (Iatt Lake). These subsegments were listed as impaired on the final 2004 303(d) List for Louisiana dated August 17, 2005 (Louisiana Department of Environmental Quality (LDEQ) 2005). Table 1.1 shows the suspected sources and suspected causes for impairment in the 303(d) List, as well as the priority ranking. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (USEPA) regulations at Title 40 Code of Federal Regulations (CFR) Part 130.7. The 303(d) listings for other pollutants in these subsegments are being addressed by USEPA and LDEQ in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources, including natural background. The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

Table 1.1. Summary of 303(d) listing for Subsegments 101301 and 101302 (LDEQ 2005, USEPA 2005).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
101301	Bayou Rigolette	Unknown source	Organic enrichment / low DO	7*
101302	Iatt Lake	Unknown source	Organic enrichment / low DO	7*

*Priority ranking is 7 because this waterbody-impairment combination was not included on the April 2002 consent decree between USEPA and plaintiffs of the Louisiana TMDL lawsuit.

2.0 STUDY AREA DESCRIPTION

2.1 General Information

The study area for this TMDL consists of Subsegments 101301 (Bayou Rigolette) and 101302 (Iatt Lake). Iatt Lake and Bayou Rigolette are located in central Louisiana in the Red River Basin (see Figure A.1 in Appendix A). Iatt Lake is located in northern Grant Parish, east of Montgomery, Louisiana, with its headwaters extending north into Winn Parish. Bayou Rigolette extends approximately 26 kilometers (16 miles) from Iatt Lake in a southeasterly direction, roughly parallel to the Red River channel until it joins the Red River north of Pineville. The study area for these TMDLs covers 413 square miles.

2.2 Land Use

Land use characteristics for the study area were compiled from the United States Geological Survey (USGS) National Land Cover Dataset (USGS 2006). Although these data were based on satellite imagery from the early 1990s, there are no land use data for this area that are more recent. The spatial distribution of these land uses is shown on Figure A.2 (located in Appendix A), and land use percentages are shown in Table 2.1. These data indicate that forest is the predominant land cover in the study area.

Table 2.1. Land use percentages for the study area.

Land Use Type	% of Total Area	
	Subsegment 101301	**Subsegment 101302**
Water	1.2%	4.5%
Urban/Transportation	2.6%	0.2%
Barren	0.5%	2.6%
Forest	47.6%	75.5%
Shrubland/grassland	0.2%	0.0%
Pasture/hay	7.2%	1.6%
Row crops	26.6%	1.1%
Small grains	1.1%	0.0%
Wetlands	13.0%	14.5%
TOTAL	**100.0%**	**100.0%**

2.3 Water Quality Standards

Water quality standards for Louisiana are listed in Title 33 Environmental Regulatory Code (LDEQ 2007). The designated uses for Subsegments 101301 and 101302 are primary contact recreation, secondary contact recreation, propagation of fish and wildlife, and agriculture. The primary numeric criteria for the DO TMDL presented in this report are the DO criterion of 5 mg/L (year-round) and the temperature criterion of 32°C.

The Louisiana water quality standards also include an antidegradation policy (LAC 33: IX.1109.A). This policy states that waters exhibiting high water quality should be maintained at that high level of water quality. If this is not possible, water quality of a level that supports designated uses of the waterbody should be maintained. Changing the designated uses of a waterbody to allow a lower level of water quality can only be achieved through a use attainability study.

2.4 Point Sources

A list of all point source discharges in the study area was prepared by LDEQ using their internal databases. For each permit, FTN Associates, Ltd. (FTN) personnel reviewed permit applications, permits, and other documents in LDEQ's Electronic Document Management System to obtain information such as location, type of discharge, flow rate, and relevant permit limits. Seven point sources were identified within Subsegment 101301; none were identified in Subsegment 101302. A summary of the permit information for the point sources in Subsegment 101301 is included in Table 2.2. The majority of the point sources do have permit limits for 5-day biochemical oxygen demand (BOD_5); however, only the Town of Colfax wastewater treatment plant and those point sources with oxygen demand permit limits that discharge directly to Bayou Rigolette were included in the model. The other point sources with oxygen demand permits have small flows and, since they discharge to tributaries, were judged to have little impact on DO concentrations in Bayou Rigolette. Approximate locations of the point sources are shown on Figure A.3 (in Appendix A).

Table 2.2. Summary of information for point sources.

NPDES	Facility Name	Company name	Receiving Stream	SIC Code	Flow (gpd)	CBOD	NH3	Included in model?	Included in TMDL?
LA0033456	Colfax Sewage Treatment Plant	Town of Colfax	Sugarhouse Bayou – Bayou Rigolette	Municipal oxidation ditch	300,000	10, 15	NA	Yes	Yes
LAG560232	Aurora Park Subdivision	Rapides Par Sew District No.2	Creek – Bayou Rigolette – Red River	Residential oxidation pond	29,000	20	NA	No	Yes
LA0099457	Dresser Valve & Control Division	Dresser Equip Group	Bayou Rigolette	Valve manufacturer				No	No
LAG530502	Tioga Main K4472	Bellsouth Telecommunications Inc.	Bayou Rigolette – Red River	Telephone/service/ repairs	40	45	NA	Yes	Yes
LAG530785		Hyams Trailer Park	Hudson Creek	Trailer park	20	45	NA	No	Yes
LAG540490	Tioga Manor Nursing Home	Magnolia Management Service of Louisiana, Inc.	Ditch – Bayou Rigolette	Nursing home	16,400	30, 45	NA	Yes	Yes
LAG750306	Fuel Plus	Pineville, 8322 Hwy 71N	Hudson Creek	Store; car/truck wash	variable	NA	NA	No	No

2.5 Nonpoint Sources

In the final 2004 303(d) List, no specific nonpoint sources were cited as suspected sources for the organic enrichment/low DO impairment (Table 1.1). Urban runoff and agricultural activities may contribute some nonpoint source pollution to Iatt Lake and Bayou Rigolette.

2.6 Historical Water Quality Data Summary

There are four LDEQ routine water quality monitoring stations in the study area: Station 556 (Cress Creek west of Oak Grove, Louisiana), Station 570 (Beaver Creek west of Faircloth, Louisiana), Station 1221 (Iatt Lake southwest of Fairfield, Louisiana), and Station 1220 (Bayou Rigolette northwest of Pineville, Louisiana). The DO and nutrient data from these monitoring stations are summarized in Table 2.3 and the individual data are listed in Appendix B. One-third of the DO measurements in Iatt Lake are less than the DO criterion. Less than 10% of the DO measurements from Bayou Rigolette are less than the DO criterion. The station locations are shown on Figure A.1 in Appendix A.

Table 2.3. Summary of LDEQ routine water quality monitoring DO data from study area.

Station No.	Station Description	Period of Record	No. of Values	Min.	Avg.	Median	Max.	No. of Values Below Standard	% of Values Below Standard
556	Cress Creek west of Oak Grove, LA	Nov 1996 – Mar 2001	13	3.68	7.89	7.74	12.71	3	23.1%
570	Beaver Creek west of Faircloth, LA	Sep 1997 – Mar 2001	12	3.41	7.68	7.44	12.23	1	8.3%
1221	Iatt Lake southwest of Fairfield, LA	Jan 2002 – Dec 2002	12	4.3	7.09	6.16	15.42	4	33.3%
1220	Bayou Rigolette northwest of Pineville, LA	Jan 2002 – Dec 2002	13	4.60	7.33		10.75	1	7.6%

2.7 Previous Studies

No previous studies of the subsegments in the study area were identified.

3.0 FTN FIELD DATA

FTN conducted a field survey for 14 subsegments in the Red River and Sabine River basins during August 31 through September 9, 2005. Low flow conditions existed throughout the survey area during this time. The survey was conducted after Hurricane Katrina and before Hurricane Rita. Hurricane Katrina did not cause any noticeable impacts on water quality in the survey area. Field data were collected in the Iatt Lake and Bayou Rigolette subsegments on September 8, 2005.

The field survey included water quality sampling and corresponding in situ measurements at various locations; measurements of flow, depth, and width at several locations; and continuous in situ monitoring at several locations. The water quality samples were analyzed for 20-day time series for carbonaceous biochemical oxygen demand (CBOD), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH3-N), nitrate+nitrite nitrogen, total phosphorus, chlorophyll *a*, total organic carbon (TOC), and total suspended solids (TSS). A list of the survey sites and the type of data collected at each site is presented in Table C.1 (in Appendix C). The in situ measurements and water quality sampling results are summarized in Tables C.2 and C.3, respectively. The calculations of CBOD decay rates and ultimate CBOD (CBODu) concentrations from the time series data are shown in Table C.4.

In the study area for this TMDL, field data were collected at LDEQ Stations 556, 570, 1220, and 1221, and at Stations 101301-A and 101302-A (locations shown on Figure A.1 in Appendix A). The field data collected at the sites in Subsegments 101301 and 101302 are listed in Table C.2, and the water quality data for the sites in Subsegments 101301 and 101302 are listed in Tables C.3 and C.4. The DO concentration measured in Iatt Lake was 3.2 mg/L. The DO concentrations measured in Bayou Rigolette were 5.0 mg/L and 4.3 mg/L.

4.0 CALIBRATION OF WATER QUALITY MODEL

4.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (Version 8.11), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, CBODu, and DO.

Figure D.1 in Appendix D shows the model reach/element design and the location of the modeled inflows. Iatt Lake was divided into three reaches and Bayou Rigolette was divided into seven reaches to represent varying depths and widths along the stream.

4.2 Calibration Period and Calibration Targets

Routine water quality monitoring has been conducted at two LDEQ sampling stations: Station 1221 (Iatt Lake southwest of Fairfield, Louisiana), and Station 1220 (Bayou Rigolette northwest of Pineville, Louisiana). A field survey of the subsegments addressed in this TMDL was performed by FTN on September 6 through 9, 2005. The water quality data collected by LDEQ are summarized in Section 2.6, and the FTN field survey data are summarized in Section 3.0.

The two conditions that usually characterize critical periods for DO are high temperatures and low flows. High temperatures decrease DO saturation values and increase rates for oxygen demanding processes (BOD decay, nitrification, and sediment oxygen demand (SOD)). In most systems, low flows cause reaeration rates to be lower. The purpose of selecting a critical period for calibration is so that the model will be calibrated as accurately as possible for making projection simulations for critical conditions.

The model was calibrated to the FTN intensive survey. This period represented the most critical period for DO. The calibration target (i.e., the concentration to which the model was calibrated) for each parameter was set equal to the concentrations measured during the survey. Organic nitrogen was estimated as TKN minus the ammonia nitrogen value.

4.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (LTP; Aguillard and Deurr 2006). These correction factors were:

1. Correction for BOD decay: 1.047 (value in LTP is same as model default).
2. Correction for SOD: 1.065 (value in LTP is same as model default).
3. Correction for ammonia N decay: 1.070 (specified in Data Group 4).
4. Correction for organic N decay: 1.020 (not specified in LTP; model default used).
5. Correction for reaeration: Automatically calculated by the model.

4.4 Hydraulics (Data Type 9)

The hydraulics were specified in the input for the LA-QUAL model using the power functions (width = $a * Q^b + c$ and depth = $d * Q^e + f$). For Iatt Lake, average widths were estimated by dividing the surface area of the lake in each reach by the reach length. Depths in Iatt Lake were assumed to increase gradually between the upper and lower ends. Average depth in Iatt Lake is 4.5 ft (Louisiana Department of Wildlife and Fisheries 2006). The depth for the middle reach in the lake (Reach 2) was set to the average depth of 4.5 ft. Depths in the upper and lower reaches (Reach 1 and Reach 3, respectively) were set to 3 ft and 6 ft, respectively, to represent gradual changes in depth. The typical width and depth of the reaches of the Bayou Rigolette portion of the model were based on cross-section and flow data collected by FTN during its intensive survey (Table 4.1). Relationships were developed between flow and width, and flow and depth (shown in Appendix E). These relationships were used to estimate widths and depths for reaches where cross-sections were not measured during the FTN intensive survey.

Table 4.1. Iatt Creek and Bayou Rigolette width and depth measurements from FTN intensive survey.

Survey Section	Width (ft)	Mean Depth (ft)	Flow (cfs)
101301-A	46.3	0.61	3.0
1220	198	3.8	0

4.5 Initial Conditions (Data Type 11)

Because temperature is not being simulated in the model, the temperature for the reach was specified in the initial conditions for LA-QUAL. The input data and sources for initial temperature and DO concentrations are shown in Appendix F.

For constituents not being simulated, the initial concentrations were set to zero. Otherwise the model would have assumed a fixed concentration of those constituents, and the model would have included effects of the unmodeled constituents on the modeled constituents.

4.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, CBOD decay rates, nitrification rate, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix F.

For reaeration in the Iatt Lake reaches, the equation $K_2 = a/D$ (Option 20) was specified in the model. For reaeration in the rest of the model reaches, the Louisiana Equation (Option 15) was specified in the model because it was developed specifically for streams in Louisiana, and it has been used successfully in the past for other TMDLs in Louisiana.

The rates for CBOD decay were based on the values of laboratory decay rates from the FTN intensive survey. The nitrification rate was based on analyzing NBOD decay rates measured by LDEQ for agricultural subsegments in the Ouachita and Calcesiu river basins. The median of the measured rates from all of the subsegments was used for Bayou Rigolette and Sugarhouse Bayou model reaches (Appendix G). The median of the measured rates from primarily forested subsegments was used for the Iatt Lake model reaches (Appendix G).

The mineralization rates (organic nitrogen decay) in the model were set to 0.02 per day for all reaches. This value was similar to the values shown in Table 5.3 of the “Rates, Constants, and Kinetics” publication (USEPA 1985) for dissolved organic nitrogen being transformed to ammonia nitrogen. The literature values for mineralization rates are shown in Appendix G.

4.7 Nonpoint Source Loads (Data Type 19)

The nonpoint source loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBOD loads, and organic nitrogen loads. The SOD (specified in Data Type 12), the benthic ammonia source rates (specified in Data Type 13), and the mass loads of organic nitrogen and CBODu (specified in Data Type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix F.

Typically, these four calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables will affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBODu loads were adjusted until the predicted CBODu concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted DO concentrations were similar to the observed concentrations. The SOD rate was not adjusted below 0.5 g/m^2/day. The DO was calibrated last because all of the other state variables affect DO.

4.8 Headwater, Tributary, and Point Source Flow (Data Types 16 and 24)

Headwater inflow for Iatt Lake (Iatt Creek) was not measured during the FTN field survey. Using flows measured by LDEQ for the Iatt Creek TMDL on July 14, 2004 (LDEQ 2006), a ratio between the flow in Iatt Creek at Iatt Lake and Big Creek at Pollock, Louisiana (USGS Station 07373000) was calculated. This ratio was used to estimate flow in Iatt Creek during the FTN field survey based on flow in Big Creek at Pollock, Louisiana, during the same time period. These calculations are shown in Appendix K.

To estimate headwater flow for the Iatt Lake tributaries (Dartigo Creek and Black Creek), a flow per unit area was calculated based on the estimated flow and drainage area of Iatt Creek at Iatt Lake. Using this flow per unit area, a flow at the Iatt Lake Dam was estimated. The difference between the estimated flows at the Iatt Lake Dam and Iatt Creek at Iatt Lake was assigned to the Iatt Lake tributaries in relative proportion to their respective drainage areas.

Flows for the Bayou Rigolette tributaries (Sugarhouse Bayou, Gray Creek, Bayou Marteau, and Hudson Creek) were estimated in similar fashion to the Iatt Lake tributaries. A flow per unit area was calculated using the difference in flow and drainage area between the Iatt Lake Dam and FTN Station 101301-A. Flows for the tributaries were then calculated using the flow per unit area and their respective drainage areas. Any remaining incremental flow was divided between the tributaries in relative proportion to their respective drainage areas.

Point source flows used in the calibration were based on monthly average flows reported on discharge monitoring reports (DMRs) for September 2005.

4.9 Headwater, Tributary, and Point Source Water Quality (Data Types 16, 17, 24, and 25)

Concentrations of DO, CBODu, organic nitrogen, and ammonia nitrogen were specified in the model for the headwater and tributary flows. Water quality for the Iatt Lake headwater was set to the average of the concentrations measured at Station 101302-A. Water quality for the Sugarhouse Bayou headwaters was set to the concentrations measured at Station 101301-A. Water quality for Iatt Lake tributaries was set to the concentrations measured at Station 570. Water quality for Bayou Rigolette tributaries was set to the concentrations measured at Station 556. Point source concentrations of DO, organic nitrogen, and ammonia nitrogen were set based on the LTP guidance (Aguillard and Deurr 2006). Point source CBODu concentrations were set to 2.3 times the BOD_5 values reported on DMRs for September 2005.

4.10 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix H and a printout of the LA-QUAL output file is included as Appendix I. The calibration was considered to be acceptable based on the amount of data that were available.

5.0 WATER QUALITY MODEL PROJECTION

USEPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

5.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and USEPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of an MOS in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for Louisiana waterbodies in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow, and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or re-suspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP (Aguillard and Deurr 2006), critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cubic feet per second (cfs) (whichever is higher) for all headwaters, and 90th percentile temperature for the summer season. Model loading is from perennial tributaries, point sources, SOD, and resuspension of sediments.

In reality, the highest temperatures occur in July through August and the lowest stream flows occur in October through November. The combination of these conditions, plus the impact of other conservative assumptions regarding rates and loadings, yields an implicit MOS that is not quantified. Over and above this implicit MOS, explicit MOS of 10% for nonpoint sources and 20% for point sources were incorporated into the TMDLs in this report to account for model uncertainty.

5.2 Temperature Inputs

The LTP (Aguillard and Deurr 2006) specifies that the critical temperatures should be determined by calculating the 90th percentile seasonal temperatures for the waterbody being modeled. Water temperature data were collected in Iatt Lake (Station 1221) and Bayou Rigolette (Station 1220) for only one year, which is not enough data to calculate 90th percentile temperatures. Therefore, data from nearby waterbodies were used to estimate 90th percentile temperatures for Iatt Lake and Bayou Rigolette.

Data from Flat River were used to estimate 90th percentile temperatures for Bayou Rigolette. Flat River is located about 90 miles northwest of Bayou Rigolette and has similar morphometry and flow characteristics to Bayou Rigolette. Long-term water temperature data were collected by LDEQ at Station 272 on Flat River. These data are summarized in Table J.1 in Appendix J. Calculations for the 90th percentile temperatures for Flat River were developed for both summer and winter. These calculations are shown in Table J.1. There was an overlapping period of record during which temperature data were collected in both Bayou Rigolette and Flat River (2002). Average summer and winter temperatures were calculated using 2002 temperature data from Bayou Rigolette and Flat River (Table J.2). The difference between the seasonal averages for the two streams was used to adjust the 90th percentile temperatures calculated from the long-term data from Flat River (Table J.2). This resulted in a summer 90th percentile temperature of 29.2ºC and a winter 90th percentile temperature of 22.9ºC for Bayou Rigolette.

Data from Lake Bistineau were used to estimate 90th percentile temperatures for Iatt Lake. Lake Bistineau is located about 80 miles northwest of Iatt Lake and has similar morphometry and flow characteristics to Iatt Lake. Long-term water temperature data were collected by LDEQ at Station 275 in Lake Bistineau. These data are summarized in Table J.3 in Appendix J. Calculations for the 90th percentile temperatures for Lake Bistineau were developed for both summer and winter. These calculations are shown in Table J.3. There was an overlapping period of record during which temperature data were collected in both Iatt Lake and Lake Bistineau (2002). Average summer and winter temperatures were calculated using 2002 temperature data from Iatt Lake and Lake Bistineau (Table J.4). The difference between the seasonal averages for the two lakes was used to adjust the 90th percentile temperatures calculated from the long-term data from Lake Bistineau (Table J.4). This resulted in a summer 90th percentile temperature of 33.24ºC and a winter 90th percentile temperature of 23.5ºC for Iatt Lake.

5.3 Headwater and Tributary Inputs

The headwater flow rates for the projection simulations were based on guidance in the LTP (Aguillard and Deurr 2006), which states that headwater flows should be set equal to either the 7Q10 flow or 0.1 cfs for summer and 1.0 cfs for winter, whichever is greater. The flow ratio between Iatt Creek and Big Creek at Pollock, Louisiana (see Section 4.8) was used to estimate 7Q10 flows for Iatt Lake headwater (Iatt Creek). For the summer projection, an estimated 7Q10 of 0.019 cubic meters per second (cms) (0.69 cfs) was used for Iatt Creek based on the published lowest annual average 7Q10 flow for Big Creek of 0.23 cms (8.1 cfs). For the winter projection, an estimated 7Q10 of 0.036 cms (1.27 cfs) was used for Iatt Creek based on the published 7Q10 flow for Big Creek of 0.42 cms (15 cfs) (USGS 2003). These calculations are included as

Appendix K. Sugarhouse Bayou and all tributaries were assumed to have 7Q10 flows less than 0.1 cfs during summer and 1.0 cfs during winter.

Iatt Lake headwater concentrations for DO, CBODu, and organic nitrogen in the projection simulations were set equal to the projected tailwater concentrations for the corresponding simulation in LDEQ's TMDL for Iatt Creek (LDEQ 2006). No reductions to the Iatt Creek loads were made in the projection simulations since reductions were already considered as part of the TMDL for Iatt Creek.

It was assumed that the water quality of Sugarhouse Bayou and the tributaries within the subsegments would improve with reductions of nonpoint source loads in the watershed. For the projection simulations, the concentrations of CBODu, organic nitrogen, and ammonia nitrogen for these inputs were reduced from the calibration simulation values by the same percentages as the reductions of nonpoint source loads (see Section 5.5 for reductions applied to nonpoint source loads). The values used as model inputs for Sugarhouse Bayou and the tributaries are summarized in Table 5.1.

Table 5.1. Tributary water quality concentrations used in projection simulations for Iatt Lake and Bayou Rigolette.

	Reduction		CBODu (mg/L)		Organic Nitrogen (mg/L)		Ammonia Nitrogen (mg/L)		DO (mg/L)	
	Lake	Bayou	Lake	Bayou	Lake	Bayou	Lake	Bayou	Lake	Bayou
Calibration	--	--	2	2	0.5	0.3	0.1	0.2	8.30	7.50
Summer projection	53%	36%	0.94	1.28	0.24	0.19	0.05	0.13	7.54*	7.10*
Winter projection	53%	24%	0.94	1.52	0.24	0.23	0.05	0.15	8.76*	8.09*

*See Appendix K for calculations.

The headwater and tributary DO concentrations for the projection simulations were estimated using the 90th percentile seasonal temperatures (explained in Section 5.2), and estimated critical condition percent DO saturation values. Critical condition percent DO saturation values were calculated for each modeled headwater and tributary. The value was calculated using linear interpolation assuming that 0% reduction of nonpoint source loads corresponded to the calibration percent DO saturation, and 100% reduction of nonpoint source loads corresponded to 100% DO saturation. The interpolated DO saturation value associated with the nonpoint source load reduction used in the projection simulation was used as the critical condition percent DO saturation (Table 5.1). These calculations are included in Appendix K.

5.4 Point Source Inputs

Flows for the NPDES-permitted point sources included in the projection simulations were set to 1.25 times the design flows to allow for an MOS. Point source CBODu was set to 2.3 times the BOD_5 permit limits. Point source ammonia and organic nitrogen concentrations for the projection simulations were set based on the BOD_5 permit limits, using guidance in the LTP (Aguillard and Deurr 2006). Point source DO concentrations were set to 5 mg/L, based on guidance in the LTP and information about the treatment systems. Point source temperatures were set to the Bayou Rigolette critical temperature (see Section 5.2). The values used as projection model inputs for the point sources are summarized in Table 5.2.

Table 5.2. Values used for point source inputs in projection models.

NPDES Number	Name of Discharger	Flow Rate (gpd)	BOD_5 or $CBOD_5$ (mg/L)	Ammonia Nitrogen (mg/L)	Organic Nitrogen (mg/L)
LA0033456	Town of Colfax Sewage Treatment Plant	375,000	10/15	1.7	3.3
LAG530502	Bellsouth Tioga Main K4472	50	45	10	5
LAG540490	Tioga Manor Nursing Home	20,500	30/45	10	5

5.5 Nonpoint Source Loads

Because the initial projection simulation showed low DO values, the nonpoint source loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. Given the differences in characteristics between a lake and a stream, different reduction rates were used for the Iatt Lake and Bayou Rigolette subsegments. Within each subsegment, the same percent reduction was applied to the SOD and nonpoint source mass loads of CBODu and organic nitrogen. SOD was not reduced below 0.5 g/m^2/day. The values used as model input in the projection simulation are shown in Appendix L.

5.6 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 5.2 through 5.5. Other model inputs (e.g., hydraulic coefficients, decay rates, reaeration equations, etc.) were unchanged from the calibration simulation.

5.7 Model Results for Projections

Plots of predicted water quality for the projections are presented in Appendix M and a printout of the LA-QUAL output file is included as Appendix N.

Oxygen-demanding load reductions were required to meet the DO standard. For the summer projection, nonpoint source load reductions of approximately 53% in Iatt Lake (Subsegment 101302) and 36% in Bayou Rigolette (Subsegment 101301) were required to bring the predicted DO values to at least 5.0 mg/L. For the winter projection, nonpoint source load reductions of approximately 53% in Iatt Lake and 24% in Bayou Rigolette were required to bring the predicted DO values to at least 5.0 mg/L. This percentage reduction for nonpoint source loads represents a percentage of the entire nonpoint source loading, not a percentage of the manmade nonpoint source loading. The nonpoint source loads in this report were not divided between natural and manmade because it would be difficult to estimate natural nonpoint source loads for the study area. No reduction in point source loads was needed.

6.0 DO TMDL CALCULATIONS

6.1 DO TMDL

A TMDL for oxygen-demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) was calculated using the results of the summer and winter projection simulations for Subsegments 101301 (Tables 6.1 and 6.2, respectively) and 101302 (Tables 6.3 and 6.4, respectively). The TMDL calculations were performed using a program developed by FTN. The source code is included in Appendix P, and the inputs and outputs used with the program are included in Appendix O. Both implicit and explicit MOS were included in the TMDL calculations, along with a 10% FG component.

In order to maintain the DO standard of 5.0 mg/L throughout Subsegment 101301, nonpoint source oxygen demand loads needed to be reduced by 36% in the summer and 24% in the winter. In order to maintain the DO standard of 5.0 mg/L throughout Subsegment 101302, nonpoint source oxygen demand loads needed to be reduced by 53% both in the summer and winter. Reductions from point source discharges are not required as a result of this TMDL.

Table 6.1. Bayou Rigolette (Subsegment 101301) summer TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	35	27	16	78	NA	77	59	35	172	0
MOS	NA	4.4	3.4	2	9.8	NA	9.7	7.5	4.4	22	NA
FG	NA	4.4	3.4	2	9.8	NA	9.7	7.5	4.4	22	NA
Nonpoint Sources											
LA	1,397	398	54	1.24	1,851	3,073	876	119	2.7	4,072	36%
MOS	175	50	6.8	0.16	232	385	109	15	0.4	510	NA
FG	175	50	6.8	0.16	232	385	109	15	0.4	510	NA
TMDL	1,746	542	101	22	2,413	3,841	1,192	222	48	5,308	NA

Table 6.2. Bayou Rigolette (Subsegment 101301) winter TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	50.6	27.0	15.8	93.5	NA	111	59.4	34.8	206	0
MOS	NA	6.3	3.4	2.0	11.7	NA	13.9	7.5	4.4	25.7	NA
FG	NA	6.3	3.4	2.0	11.7	NA	13.9	7.5	4.4	25.7	NA
Nonpoint Sources											
LA	1,650	480	84.1	8.4	2,223	3,630	1,056	185	18.5	4,891	24%
MOS	206	60	10.5	1.0	278	453	132	23	2.2	611	NA
FG	206	60	10.5	1.0	278	453	132	23	2.2	611	NA
TMDL	2,063	663	139	30.2	2,896	4,539	1,459	306	66.4	6,371	NA

Table 6.3. Iatt Lake (Subsegment 101302) summer TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	0	0	0	0	NA	0	0	0	0	0
MOS	NA	0	0	0	0	NA	0	0	0	0	NA
FG	NA	0	0	0	0	NA	0	0	0	0	NA
Nonpoint Sources											
LA	31,209	10,510	1,286	1.15	43,006	68,660	23,122	2,829	3	94,614	53%
MOS	3,901	1,314	161	0.14	5,376	8,582	2,891	354	0	11,828	NA
FG	3,901	1,314	161	0.14	5,376	8,582	2,891	354	0	11,828	NA
TMDL	39,011	13,138	1,608	1	53,758	85,824	28,904	3,538	3	118,269	NA

Table 6.4. Iatt Lake (Subsegment 101302) winter TMDL.

	Oxygen Demand (kg/day) from:					Oxygen Demand (lbs/day) from:					Percent Reduction Needed
	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	SOD	CBODu	Organic Nitrogen	Ammonia Nitrogen	Total	
Point Sources											
WLA	NA	0	0	0	0	NA	0	0	0	0	0
MOS	NA	0	0	0	0	NA	0	0	0	0	NA
FG	NA	0	0	0	0	NA	0	0	0	0	NA
Nonpoint Sources											
LA	31,209	10,514	1,300	1.79	43,025	68,660	23,131	2,860	4	94,655	53%
MOS	3,901	1,314	162	0.23	5,377	8,582	2,891	356	1	11,830	NA
FG	3,901	1,314	162	0.23	5,377	8,582	2,891	356	1	11,830	NA
TMDL	39,011	13,142	1,624	2	53,779	85,824	28,912	3,573	5	118,314	NA

Table 6.5. Flows, concentrations, and loads for point sources included in summer DO TMDL.

Subseg. Number	NPDES Number	Name of Discharger	Flow Rate (gpd)	Concentrations			Loads*		
				BOD_5 or $CBOD_5$ (mg/L)	Ammonia Nitrogen (mg/L)	Organic Nitrogen (mg/L)	BOD_5 or $CBOD_5$ (lbs/day)	Ammonia Nitrogen (lbs/day)	Organic Nitrogen (lbs/day)
101301	LA0033456	Town of Colfax Sewage Treatment Plant	300,000	10	1.7	3.3	24.9	4.24	8.24
101301	LAG560232	Aurora Park Subdivision	29,000	20	10	20	4.84	2.42	4.82
101301	LAG530502	Bellsouth Tioga Main K4472	40	45	5	10	0.02	0.00	0.00
101301	LAG530785	Hyams Trailer Park	20	45	10	20	0.01	0.00	0.00
101301	LAG540490	Tioga Manor Nursing Home	16,400	30	5	10	4.10	0.68	1.37
101301 Total Point Source Loads:							33.9	7.34	14.4

*Loads of organic nitrogen and ammonia nitrogen in this table represent loads of nitrogen, not oxygen demand.

Table 6.6. Flows, concentrations, and loads for point sources included in winter DO TMDL.

Subseg. Number	NPDES Number	Name of Discharger	Flow Rate (gpd)	Concentrations			Loads*		
				BOD_5 or $CBOD_5$ (mg/L)	Ammonia Nitrogen (mg/L)	Organic Nitrogen (mg/L)	BOD_5 or $CBOD_5$ (lbs/day)	Ammonia Nitrogen (lbs/day)	Organic Nitrogen (lbs/day)
101301	LA0033456	Town of Colfax Sewage Treatment Plant	300,000	15	1.7	3.3	37.4	4.24	8.24
101301	LAG560232	Aurora Park Subdivision	29,000	20	10	20	4.84	2.42	4.82
101301	LAG530502	Bellsouth Tioga Main K4472	40	45	5	10	0.02	0.00	0.00
101301	LAG530785	Hyams Trailer Park	20	45	10	20	0.01	0.00	0.00
101301	LAG540490	Tioga Manor Nursing Home	16,400	45	5	10	6.19	0.68	1.37
101301 Total Point Source Loads:							48.5	11.3	14.4

*Loads of organic nitrogen and ammonia nitrogen in this table represent loads of nitrogen, not oxygen demand.

6.2 Ammonia Toxicity Calculations

Although Subsegments 101301 and 101302 are not on a 303(d) list for ammonia, the ammonia concentrations predicted by the DO projection model were checked to make sure that they did not exceed USEPA criteria for ammonia toxicity (USEPA 1999). The USEPA criteria are dependent on temperature and pH. The water temperatures used to calculate the ammonia toxicity criterion for Iatt Lake and Bayou Rigolette were the same as the critical temperatures used in the projection simulations. For pH, seasonal averages of the values measured at the LDEQ monitoring stations within Subsegments 101301 and 101302 were used. The resulting criteria were 2.13 mg/L of ammonia nitrogen for the summer, and 3.34 mg/L for the winter. None of the instream ammonia nitrogen concentrations predicted by the projection models for Iatt Lake and Bayou Rigolette were above the criteria. This indicates that the ammonia nitrogen loadings that will maintain the DO standard are low enough that the USEPA ammonia toxicity criteria will not be exceeded under critical conditions. These results do not indicate a need to add ammonia and/or organic nitrogen limits to the NPDES-permitted discharges included in the TMDL calculations. The ammonia toxicity calculations are shown in Appendix Q.

6.3 Summary of Nonpoint Source Reductions

In summary, the projection modeling used to develop the DO TMDL showed that nonpoint source loads needed to be reduced by approximately 53% in Iatt Lake (Subsegment 101302) and 36% in Bayou Rigolette (Subsegment 101301) to maintain the DO standard of 5.0 mg/L in both subsegments during the summer. Nonpoint source load reductions of approximately 53% in Iatt Lake and 24% in Bayou Rigolette are needed to maintain the DO standard in both subsegments during the winter.

6.4 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 5.1, the highest temperatures occur in July through August, and the lowest stream flows occur in October through November. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS, which is not quantified. In addition to the implicit MOS, the TMDL in this report includes an explicit MOS of 10% for nonpoint source loads.

7.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. Therefore, it is of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The calibration simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 7.1. Each parameter was varied by ±30%, except for temperature, which was varied ±2ºC.

Values reported in Table 7.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration, SOD, and initial temperature were the parameters to which DO was most sensitive.

Table 7.1. Summary of results of sensitivity analyses.

Parameter	Change in Parameter	Minimum DO (mg/L)	Change in DO
Baseline	--	5.03	N/A
Stream Reaeration	-30	3.59	-28.6
Benthal Demand	30	4.04	-19.7
Initial Temperature	2	4.42	-12.1
Benthal Demand	-30	5.28	5
Initial Temperature	-2	5.28	5
Stream Reaeration	30	5.28	5
Nonpoint Source CBOD	30	4.88	-3
Headwater Flow	-30	4.93	-2
Stream Depth	30	4.93	-2
Stream Depth	-30	5.08	1
Headwater Flow	30	5.06	0.7
Wasteload Flow	-30	5	-0.6
Wasteload Flow	30	5.06	0.6
Non-Point Source CBOD	-30	5.04	0.3
CBOD Aerobic Decay Rate	-30	5.03	0.1
Nonpoint Source Organic N	-30	5.03	0.1
Nonpoint Source Organic N	30	5.02	-0.1
Ammonia Decay Rate	-30	5.03	0
Organic Nitrogen Decay Rate	-30	5.03	0
Headwater DO	-30	5.03	0
Headwater CBOD	-30	5.03	0
Headwater Ammonia	-30	5.03	0
Headwater Organic Nitrogen	-30	5.03	0
Wasteload DO	-30	5.03	0
Wasteload CBOD	-30	5.03	0
Wasteload Ammonia Nitrogen	-30	5.03	0
Wasteload Organic Nitrogen	-30	5.03	0
CBOD Aerobic Decay Rate	30	5.02	0
Ammonia Decay Rate	30	5.03	0
Organic Nitrogen Decay Rate	30	5.03	0
Headwater DO	30	5.03	0
Headwater CBOD	30	5.03	0
Headwater Ammonia	30	5.03	0
Headwater Organic Nitrogen	30	5.03	0
Wasteload DO	30	5.03	0
Wasteload CBOD	30	5.03	0
Wasteload Ammonia Nitrogen	30	5.03	0
Wasteload Organic Nitrogen	30	5.03	0

8.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the state anti-degradation policy (LAC 33:IX.1109.A).

This TMDL report does not include an implementation plan. Implementation plans are not required for TMDLs under current federal regulations. Implementation plans can be developed most effectively and efficiently on the state and local level.

LDEQ will work with other agencies such as local Soil Conservation Districts to implement nonpoint source best management practices in the watershed through the Section 319 programs. LDEQ will also continue to monitor the waters to determine whether standards are being attained.

In accordance with Section 106 of the Federal Clean Water Act, and under the authority of the Louisiana Environmental Quality Act, LDEQ has established a comprehensive program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a 4-year cycle. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the 4-year cycle. Sampling is conducted on a monthly basis to yield approximately 12 samples per site each year the site is monitored. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, approximately one half of the state's waters are newly assessed for each 305(b) and 303(d) listing biennial cycle, with sampling occurring statewide each year. The 4-year cycle follows an initial 5-year rotation that covered all basins in the state according to the TMDL priorities. This will allow LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

9.0 PUBLIC PARTICIPATION

Federal regulations require USEPA to notify the public and seek comment concerning TMDLs it prepares. The TMDL in this report was developed under contract to USEPA, and USEPA held a public review period seeking comments, information, and data from the public and any other interested parties. The notice for the public review period was published in the Federal Register on October 25, 2007, and the review period closed on November 26, 2007.

Comments were received from LDEQ. These comments were used to revise this TMDL report. The comments and responses to these TMDLs are included in a separate document that includes comments on similar TMDLs with the same public review period.

USEPA will submit the final version of these TMDLs to LDEQ for implementation and incorporation into LDEQ’s current water quality management plan.

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