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TMDL for Dissolved Oxygen for New Orleans East Leveed Waterbodies (Subsegment 041401) in Lake Pontchartrain Basin, Louisiana

Prepared for:

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Executive Summary

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] section 130.7) require TMDLs for waterbody-pollutant pairs on the approved 303(d) impaired waters list, even if pollutant sources have implemented technology-based controls. A total maximum daily load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can assimilate while still meeting the water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality to, and it may include a future growth (FG) component. The components of the TMDL calculations are illustrated using the following equation:

$$TMDL = \Sigma\, WLAs + \Sigma\, LAs + MOS + FG$$

The area for this TMDL includes New Orleans east leveed waterbodies. New Orleans east leveed waterbodies is entirely within Orleans Parish and has an area of 54.47 square miles (141.08 square kilometers). The subsegment is bounded on the north by Lake Pontchartrain, on the south by the Intracoastal Waterway, on the west by the Inner Harbor Navigational Canal, and on the east by the Bayou Sauvage National Wildlife Refuge. The eastern portion of the subsegment includes portions of the Bayou Sauvage National Wildlife Refuge. The predominant land use in the impaired subsegment is wetlands (47.1 percent), followed by urban development (39.9 percent), and open water (11.0 percent).

The Louisiana Department of Environmental Quality (LDEQ) has included New Orleans east leveed waterbodies (subsegment 041401) on the state's 2010 section 303(d) list of impaired waterbodies (*Draft 2010 Integrated Report*) (Table ES-1). The subsegment is listed for low dissolved oxygen (DO) and fecal coliform. The impaired designated uses for the subsegment are primary contact recreation, secondary contact recreation, and fish and wildlife propagation.

Table ES-1. Excerpt from *Draft 2010 Integrated Report*

Subsegment	Subsegment name	Designated uses		
		Primary contact recreation	Secondary contact recreation	Fish and wildlife propagation
041401	New Orleans east leveed waterbodies	Not supporting	Not supporting	Not supporting

Source: LDEQ 2010a

A water quality spreadsheet model was set up to predict DO, ammonia nitrogen, phosphorus, and phytoplankton for the entire segment under stagnant conditions of water. The model was calibrated using data from fieldwork conducted in July 2009. The projection simulation was conducted at no-flow condition and the same high water temperatures. Reductions of benthic nutrient fluxes were required for the projection simulation to meet the DO standard of 4 milligrams per liter (mg/L). In general, the modeling for this TMDL was consistent with guidance in the Louisiana TMDL technical procedures manual (LDEQ 2010b).

TMDLs for, ammonia, inorganic phosphorus, and sediment oxygen demand (SOD) were calculated using the projection simulation. In developing the TMDL, allowable loads from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls. WLAs were assigned to permitted point source discharges, including regulated stormwater. An explicit MOS of 10 percent and an FG component of 10 percent were also included.

This TMDL establishes load limitations for oxygen-demanding substances and nutrients. The numeric DO water quality criterion for subsegment 041401 is 4 mg/L and was used to calculate the total allowable oxygen-demanding pollutant load. Table ES-2 presents a summary of the DO TMDLs. The ammonia, inorganic phosphorus, and SOD fluxes were taken from the spreadsheet model and multiplied by the canal bottom surface area in square meters of the canal system, including Charles Canal, West Morris Canal, and East Morris Canal. The LDEQ assessment point for the subsegment is included in the western canal system in the developed area of subsegment 041401. No data exist for the eastern portion of the subsegment, which is dominated by wetlands and the Bayou Sauvage National Wildlife Refuge and, thus, is not represented by the assessment point in the western portion of the subsegment. The TMDLs presented in Table ES-2 cover those areas only. To calculate the loadings for other areas, multiply the reduced fluxes in grams per square meters per day ($g/m^2\ d^{-1}$) for SOD (13.99 for summer/9.00 for winter), ammonia (0.1686 for summer/0.1354 for winter), and inorganic phosphorus (0.0112 for summer/0.0090 for winter) by the canal bottom surface area (908,188 m^2) in square meters.

Table ES-2. Summary of DO TMDLs, WLAs, LAs, MOSs, and FGs for the western urban canal area of subsegment 041401

Season	Loadings (lb/d)					
	SOD		Ammonia as N		Inorganic phosphorus as P	
Summer	Baseline	TMDL	Baseline	TMDL	Baseline	TMDL
WLA	38,194	22,409	472.5	270.1	31.39	17.94
LA	0	0	0.0	0.0	0.00	0.00
MOS	4,774	2,801	59.1	33.8	3.92	2.24
FG	4,774	2,801	59.1	33.8	3.92	2.24
TMDL	47,743	28,011	590.7	337.6	39.24	22.42
Percent reduction	41%		43%		43%	
Season	Loadings (lb/d)					
	SOD		Ammonia as N		Inorganic phosphorus as P	
Winter	Baseline	TMDL	Baseline	TMDL	Baseline	TMDL
WLA	17,528	14,416	216.9	216.9	14.41	14.41
LA	0	0	0.0	0.0	0.00	0.00
MOS	2,191	1,802	27.1	27.1	1.80	1.80
FG	2,191	1,802	27.1	27.1	1.80	1.80
TMDL	21,911	18,020	271.1	271.1	18.01	18.01
Percent reduction	18%		0%		0%	

Implementing the DO TMDL through future wastewater discharge permits, if required, and implementing best management practices to control and reduce runoff of soil and oxygen-demanding pollutants from nonpoint sources in the watershed, should reduce the nutrient loading from those sources.

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1. Introduction

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] section 130.7) require TMDLs for waterbody-pollutant pairs apply to the approved 303(d) impaired waters list even if pollutant sources have implemented technology-based controls. A total maximum daily load (TMDL) is a calculation of the maximum allowable load (in mass per unit time) of a pollutant that a waterbody is able to assimilate while still supporting its designated uses. The maximum allowable load is determined on the basis of the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

The text of 40 CFR 130.7 has been affected by several Federal District Court suits, appeals rulings, and a Supreme Court ruling mandating that a TMDL must be described in terms of mass per day. According to 40 CFR 130.7, if EPA does not approve a TMDL submitted by a state, EPA is responsible for developing a TMDL. In a District Court case regarding the TMDL program in Louisiana (*Sierra Club and Louisiana Environmental Action Network, Inc. v. EPA*, Civil Action Number: 96-0527), EPA was listed as the sole defendant. That case resulted in the April 1, 2002, consent decree approved by the judge. A consent decree is a negotiated set of actions to satisfy the plaintiff. In many situations, the actions are more stringent than the established regulation. For example, most consent decrees require an annual report to the plaintiff summarizing the work done in the year; that is not required by any regulation and will cease when the consent decree is closed.

The 2002 consent decree between EPA and the plaintiffs establishes a fixed set of waterbody-pollutant pairs for which TMDLs are to be established or approved, and it establishes a timeline for each set of TMDLs. Each set is determined to be complete when every waterbody-pollutant pair either has a TMDL established or approved, or a subsequent approved 303(d) list has removed the waterbody-pollutant pair. The TMDLs in this report are part of that consent decree. Because the original court suit was initiated because of a lack of progress in establishing TMDLs, the date when a TMDL is established or approved is not easy to extend, and an extension would require another agreement with the plaintiffs.

In most circumstances, a variety of scientifically acceptable methods can be used for developing a TMDL, wasteload allocation (WLA), and load allocation (LA). For these TMDLs, the simplified spreadsheet model model was used. Note that because some acceptable TMDL calculation methods appear simple, that does not imply that its results are not valid. Models vary in the amount of necessary resources (e.g., training, setup/computational time, personnel, expense), required input and background data, questions answered, and output capability (e.g., charts, tables, data files). The final result of these TMDLs (and any TMDL) is a plan adopted into the Water Quality Management Plan (WQMP) to achieve the TMDL. Stakeholder involvement and additional information, such as monitoring data, might lead to an update of the WQMP and, in turn, a proposal for a different plan to meet water quality objectives. Such a WQMP update receives the same public participation as the original TMDL and WQMP review and approval.

For the TMDL discussed in this report, monitoring data collected by the Louisiana Department of Environmental Quality (LDEQ) indicate that observed dissolved oxygen (DO) levels sometimes do not meet the state's water quality criteria for New Orleans east leveed waterbodies (subsegment 041401) in Lake Pontchartrain Basin. The impaired designated uses for the subsegment are primary and secondary contact recreation and fish and wildlife propagation. The subsegment is listed as not supporting the designated uses in Louisiana's 2010 section 303(d) list (as included in the *Draft 2010 Integrated Report*). Subsegment 041401 has suspected causes for the DO impairment of *municipal (urbanized high density area)* and *sanitary sewer overflows (collection system failures)*.

Oxygen concentrations in bodies of water fluctuate naturally; however, depletion of DO can be caused by human activities or natural sources. Temperature and salinity also have an effect on DO. For example, during extended hot weather, the subsequent warmer water can result in fish kills from lower DO in the water column because of decreased gas solubility compared to cooler water (Scorecard 2005). Chemical reactions can generate a chemical oxygen demand on receiving waters and further lower DO. Human activities, such as lawn mowing and fertilizing, can contribute large amounts of biodegradable organic matter or nutrients through stormwater and, over time, lead to eutrophication (Scorecard 2005). Natural sources can also add organic material to a waterbody. Forests add leaves and woody debris, whereas wetlands have large algal masses that can be carried over into the waterbody. In streams with significant amounts of organic matter, bacterial degradation can result in a net reduction of oxygen in the water column.

Other factors that affect DO concentrations include the following (Murphy 2005):

- Volume and velocity of water flowing in the waterbody
- Climate and season
- The type and number of organisms in the waterbody
- Altitude
- Dissolved or suspended solids
- Amount of nutrients in the water
- Organic waste
- Riparian vegetation
- Groundwater inflow

2. Background Information

2.1 General Description

Lake Pontchartrain Basin is in southeastern Louisiana and is primarily composed of the rivers and bayous that drain into Lake Pontchartrain. The basin is bordered by the Pearl River Basin to the east, by Breton and Chandeleur Sound to the southeast, and by the Mississippi River Levee to the south and west. The northern portion of Lake Pontchartrain Basin consists of forests, pines and hardwoods, pastures, and dairies. The southern portion consists of cypress-tupelo swamps and lowlands, and brackish and saline marshes. Elevations in the basin range from minus 5 feet at New Orleans to greater than 200 feet near the Mississippi River (LDEQ 2010c). Subsegment 041401 (New Orleans east leveed waterbodies) is entirely in Orleans Parish and has an area of 54.47 square miles (141.08 square kilometers). The subsegment is bounded on the north by Lake Pontchartrain, on the south by the Intracoastal Waterway, on the west by the Inner Harbor Navigational Canal, and on the east by the Bayou Sauvage National Wildlife Refuge (Figure 2-1). The eastern portion of the subsegment includes portions of the Bayou Sauvage National Wildlife Refuge.

2.2 Land Use

Land use data were obtained from the 2006 U.S. Geological Survey (USGS) National Land Cover Dataset (NLCD) (Table 2-1 and Figure 2-2). The predominant land use in subsegment 041401 is wetlands (47.1 percent), followed by urban development (39.9 percent), and open water (11.0 percent). There are very little other land uses in the subsegment.

Table 2-1. Land uses percentages for subsegment 041401

Land use	Percent of total area
Water	11.0%
Developed	39.9%
Barren	0.6%
Forest	0.1%
Grassland/shrub	0.2%
Pasture/hay	0.2%
Cultivated crops	0.9%
Wetlands	47.1%
TOTAL	100.00%

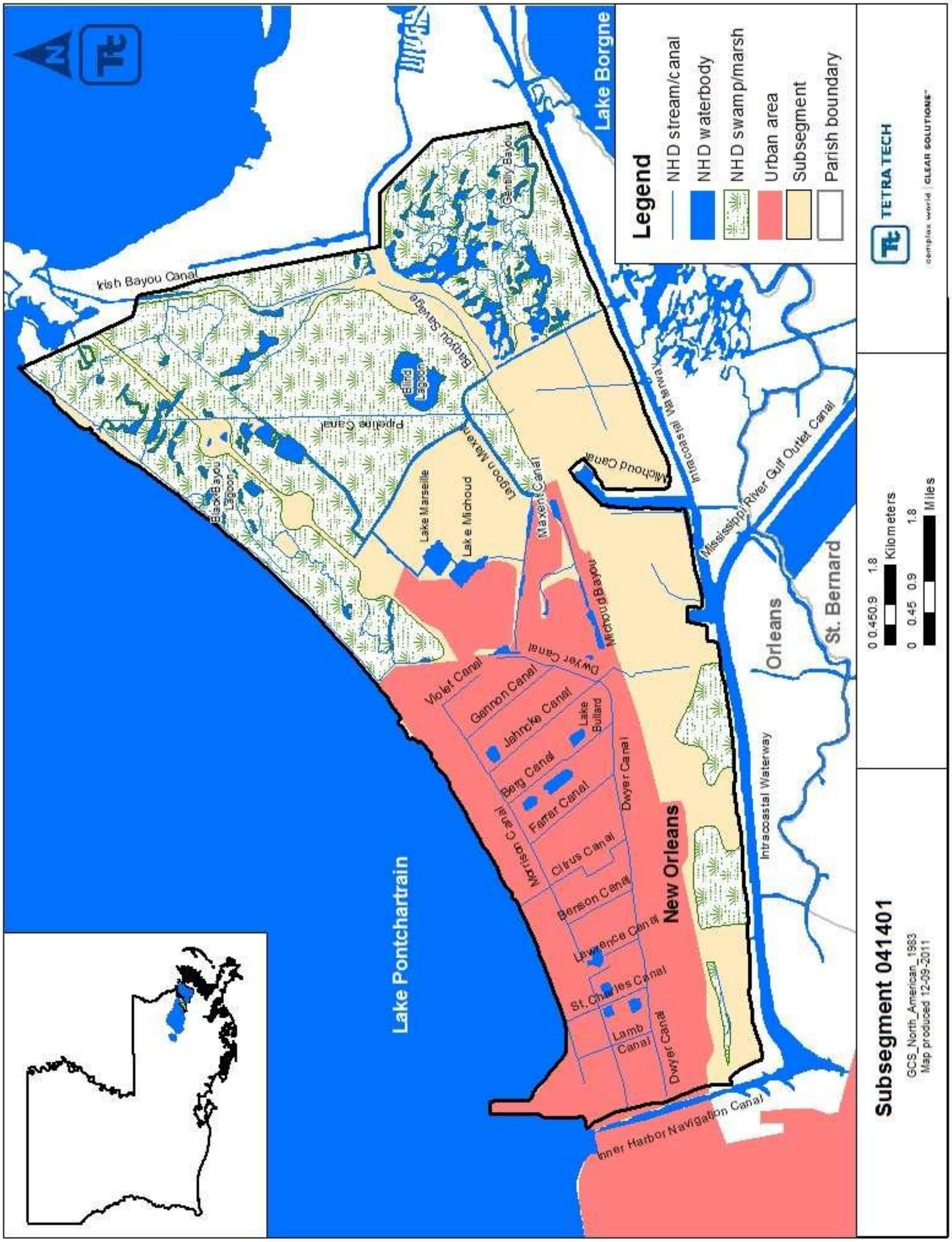

Figure 2-1. Location of subsegment 041401.

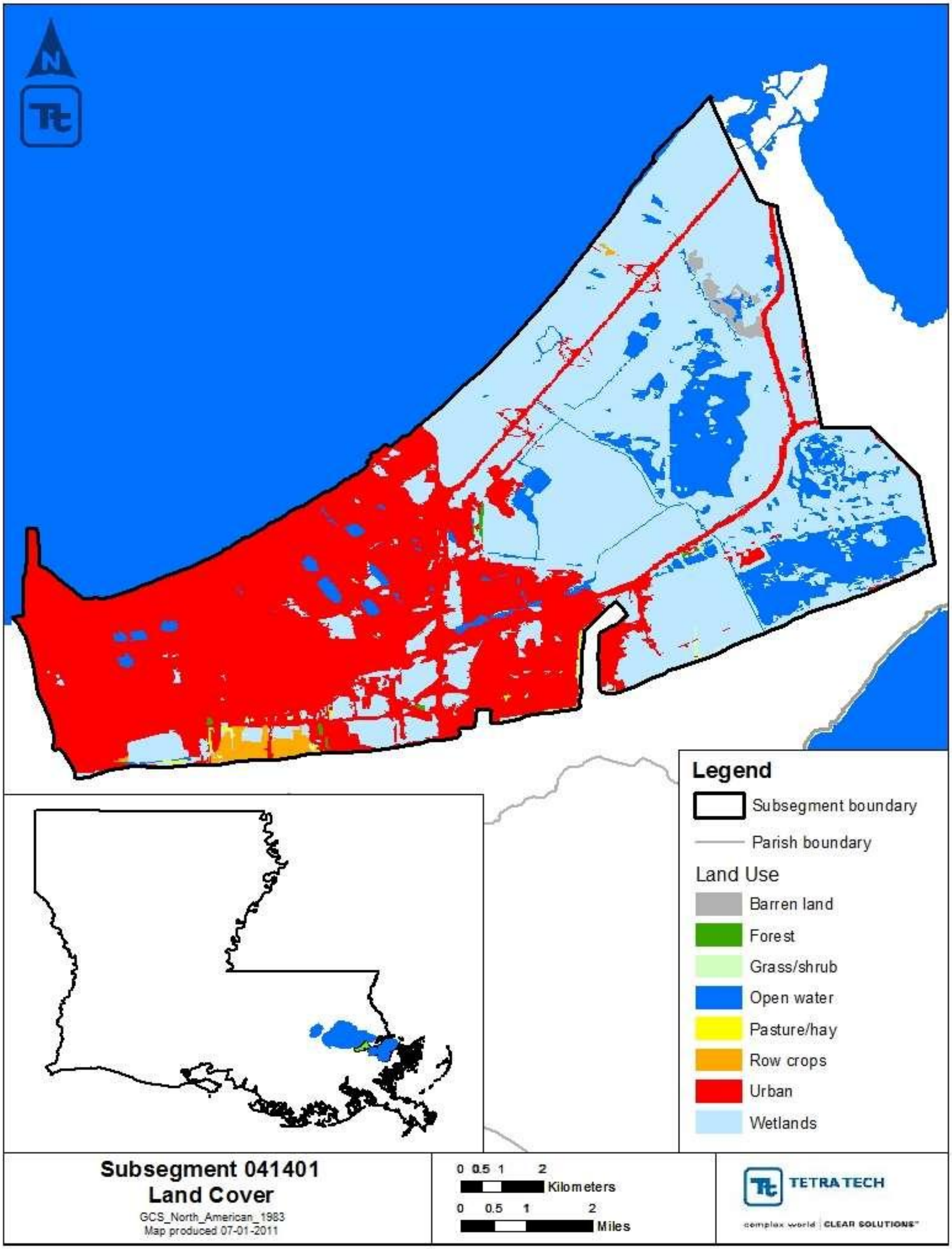

Figure 2-2. Land use in subsegment 041401.

2.3 Hydrologic Setting

The USGS online hydrology database (NWISWeb) does not contain any stations with flow data for the listed subsegment that is impaired for DO. Lake Pontchartrain drainage canal area is leveed, and rainfall runoff is the only source of water. The canals pump when a specified water level is reached within the leveed area (Max Forbes, Retired USGS, personal communication, May 31, 2011).

2.4 Designated Uses and Water Quality Criteria

Louisiana's 2010 section 303(d) list (as included in the *Draft 2010 Integrated Report*) indicates that designated uses of the subsegment are primary and secondary contact recreation and fish and wildlife propagation. Primary contact recreation includes any recreational or other water contact involving full-body exposure to water and a considerable probability of ingesting water. Examples of that use are swimming and water skiing. Secondary contact recreation involves activities like fishing, wading, or boating, where water contact is accidental or incidental and there is a minimal chance of ingesting appreciable amounts of water. Fish and wildlife propagation includes the use of water for aquatic habitat, food, resting, reproduction, cover, or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment.

The assessment methodology presented in LDEQ's 305(b) report (LDEQ 2010a) specifies that primary contact recreation, secondary contact recreation, and fish and wildlife propagation uses are to be fully supported. Subsegment 041401 is an estuarine system. The DO criterion for the subsegment is 4 milligrams per liter (mg/L) year-round.

The Louisiana water quality standards also include an antidegradation policy (*Louisiana Administrative Code* Title 33, Part IX, Section 1109.A), which states that state waters exhibiting high water quality should be maintained at that high level of water quality. If that is not possible, water quality of a level that supports the designated uses of the waterbody should be maintained. The designated uses of a waterbody may be changed to allow a lower level of water quality only through a use attainability study.

2.5 Identification of Sources

2.5.1 Point Sources

LDEQ stores permit information using internal databases. LDEQ generated a list of point source discharges in the subsegment by using the TEMPO database. Information on point source discharges to the listed subsegments was obtained from the Integrated Compliance Information System - National Pollutant Discharge Elimination System (ICIS-NPDES) and Louisiana's Electronic Document Management System (EDMS). Data were pulled from ICIS for the list of permits generated by LDEQ, and data were confirmed through EDMS. Subsegment 041401 contains 49 permitted and 5 unpermitted point source discharges in subsegment 041401 (Figure 2-3), many of which are physically in the subsegment but discharge outside the subsegment. Because of the large number of permits, they are listed in Appendix A. Each facility was evaluated on the basis of its discharges and permit limits to determine whether the facility should be used in developing the TMDLs (Section 5.1.1).

Phase I and II stormwater systems are additional possible point source contributors in Lake Pontchartrain Basin. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. Those discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Most stormwater discharges are considered point sources and require coverage by an NPDES permit.

Under the NPDES stormwater program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more.

Phase II requires a select subset of small MS4s to obtain an NPDES stormwater permit. A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II rule automatically covers all small MS4s in urbanized areas (UAs), as defined by the Bureau of the Census, and also includes small MS4s outside an UA that are so designated by NPDES permitting authorities, case by case (USEPA 2000).

In Louisiana, there are two ways that an MS4 can be identified as a regulated, small MS4. The category includes all cities within UAs and any small MS4 area outside UAs with a population of at least 10,000 and a population density of at least 1,000 people per square mile (LDEQ 2002). Subsegment 041401 has one regulated Phase I MS4 and one regulated Phase II MS4. Table 2-2 presents MS4 discharge information for this impaired subsegment in Lake Pontchartrain Basin.

Table 2-2. MS4 information for subsegment 041401

NPDES permit number	Authority	Discharge subsegments	Waterbody names
LAS000301	New Orleans City of - MS4	041001, 041302, 041401	
	Orleans Levee District - MS4	041001, 041302, 041401	Lake Pontchartrain, Lake Pontchartrain Drainage Canals, Bayou St. John, Inner Harbor Navigational Canal, Mississippi River
	LADOTD District 02 - MS4	041001, 041302, 041401	Lake Pontchartrain, Lake Pontchartrain Drainage Canals
	Sewerage & Water Board of New Orleans - MS4	041001, 041302, 041401	Lake Pontchartrain, Lake Pontchartrain Drainage Canals, Bayou St. John, Inner Harbor Navigational Canal
LAR043001	LADOTD - Statewide MS4 coverage	various	Including: Lake Pontchartrain, Lake Pontchartrain Drainage Canals, Bayou St. John, Inner Harbor Navigational Canal

2.5.2 Nonpoint Sources

Louisiana's section 303(d) list identifies the suspected causes of the DO impairment in subsegment 041401 of Lake Pontchartrain Basin as *municipal (urbanized high density area)* and *sanitary sewer overflows (collection system failures)*.

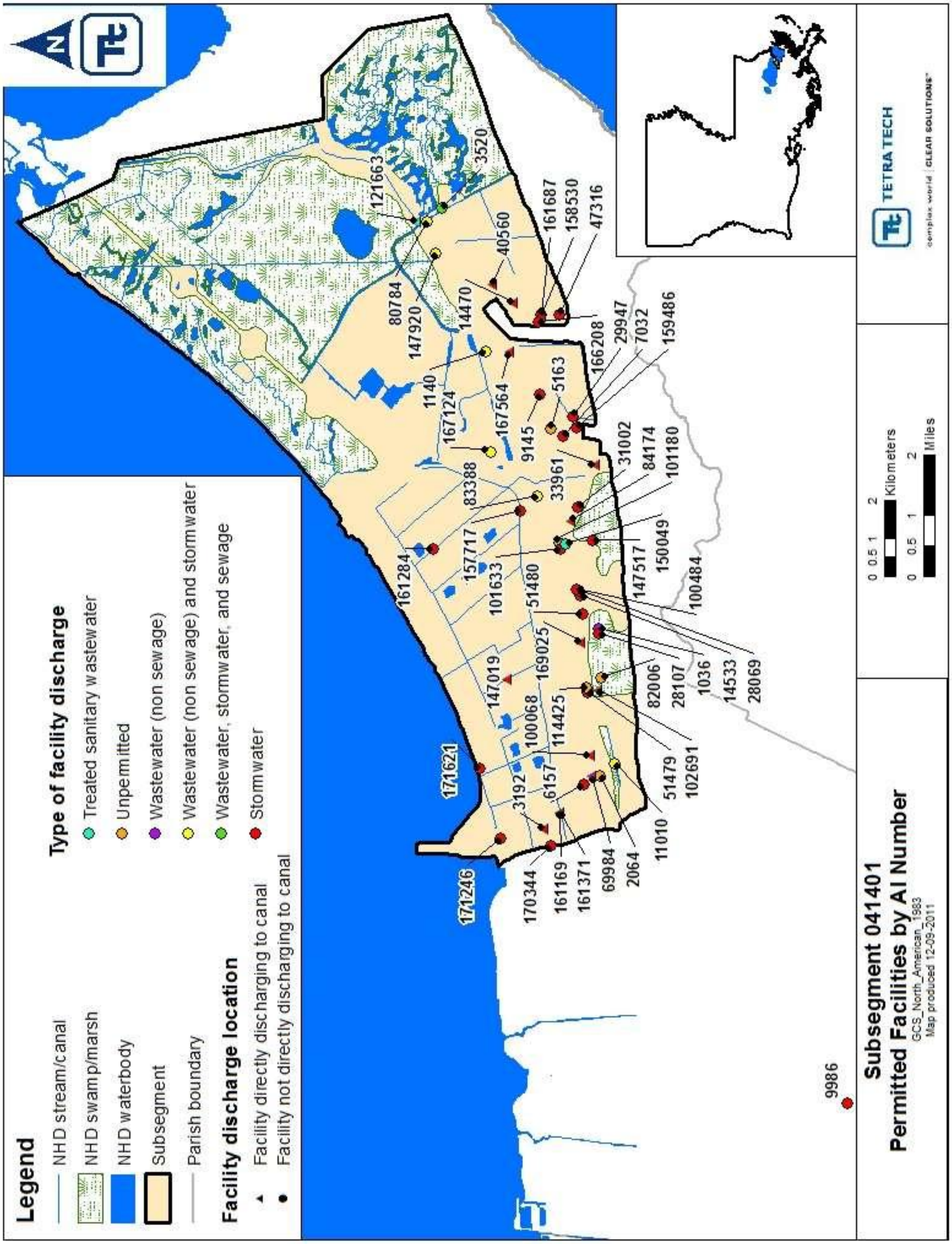

Figure 2-3. Permitted facilities in subsegment 041401 in Lake Pontchartrain Basin.

3. Characterization of Existing Water Quality

3.1 Water Quality Data

Water quality data were obtained from LDEQ's routine ambient water quality monitoring program. Additional environmental data were obtained from a monitoring event conducted by FTN Associates (FTN) on July 10–11, 2009. Figure 3-1 shows the locations of the LDEQ and FTN sampling sites. Data collected during the 2009 field study included in situ measurements of temperature, DO, pH, specific conductivity, and Secchi depth in addition to sampling data for total phosphorus, ortho-phosphorus, chlorophyll *a*, total suspended solids, ammonia nitrogen, total Kjeldahl nitrogen, nitrate plus nitrite nitrogen (NO_3+NO_2), total organic carbon, and carbonaceous biochemical oxygen demand (CBOD) time series, which used a nitrogen suppressant. The CBOD time-series data were collected on days 2, 5, 9, 14, 20, and 27 of the analysis. Tables B-1 through B-7 in Appendix B present summaries of the water quality data for the section 303(d)-listed constituents, along with additional constituents used in the TMDL development process. Appendix B contains summaries of the DO and nutrient data. Appendix C presents the Field Survey Notes. For most stations, field notes indicate the canals were turbid and contained trash and algae and sometimes other organic material like grass clippings.

3.2 Comparison of Observed Data to Criteria

Table B-1 in Appendix B provides a summary of the July 2009 DO data for nine stations (plus one duplicate station) in subsegment 041401. Each station has one observation taken on July 10, 2009. Three of the nine stations had DO observations below the water quality criterion of 4 mg/L. Figures B-1 through B-4 in Appendix B show the LDEQ DO and other continuous monitoring data observations at stations STCH-2 (St. Charles Canal) over time.

Table B-4 summarizes 23 observations at the LDEQ DO data at station 1051 (St. Charles Canal at Morrison Rd., New Orleans, Louisiana). Six (26 percent) of the DO observations are below the 4 mg/L water quality criterion. Figures 3-2 and 3-3 show the DO data collected at station 1051 plotted over time and season. No strong seasonal or temporal DO trends are apparent, although the lowest DO concentrations were observed in the summer and fall. As expected, DO levels are lower in the hotter summer months.

Louisiana does not have numeric nutrient criteria. The original nutrient impairment for this waterbody was not based on a quantitative assessment of historical nutrient data. The impairment was based on an evaluative assessment that might have included DO. LDEQ and EPA plan to reevaluate the previous nutrient impairments for this waterbody. As a result, both EPA and LDEQ expect the nutrient impairment to change from category 5 (impairment exists; TMDL required) to category 3 (insufficient data) for the 2010 Integrated Report. A TMDL for DO should adequately address any potential nutrient impairment, in the absence of numeric nutrient criteria and a quantitative assessment.

LDEQ is developing numeric nutrient criteria for waterbody types on the basis of ecoregions in accordance with LDEQ's plan *Developing Nutrient Criteria for Louisiana 2006.*[1] Waterbody types for nutrient criteria development in Louisiana are (1) inland rivers and streams; (2) freshwater wetlands; (3) freshwater lakes and reservoirs; (4) big rivers and floodplains/boundary rivers and associated water bodies; and 5() estuarine and coastal waters, including up to Louisiana's 3-mile boundary in the Gulf of Mexico. Proposed approaches for nutrient criteria development are under review by LDEQ and EPA. Nutrient criteria can be implemented upon state promulgation and EPA approval per 40 CFR 131.21.

[1] http://www.deq.louisiana.gov/portal/Portals/0/planning/LA%20Nutrient%20Strategy%20Plan%20Final%20FOR%20WEB.pdf. Accessed January 11, 2011.

After nutrient criteria have been developed, a subsequent quantitative assessment of the waterbodies, and the development of full nutrient models, nutrient limits may be established for all facilities discharging to impaired waterbodies in Lake Pontchartrain Basin. LDEQ recommends that all facilities discharging to this subsegment take a proactive approach and prepare to receive nutrient limitations in the near future. Such a proactive approach should include nutrient monitoring and documentation through facility Discharge Monitoring Reports (DMRs) to assess their nutrient loads and the need to modify their treatment processes for nutrient removal.

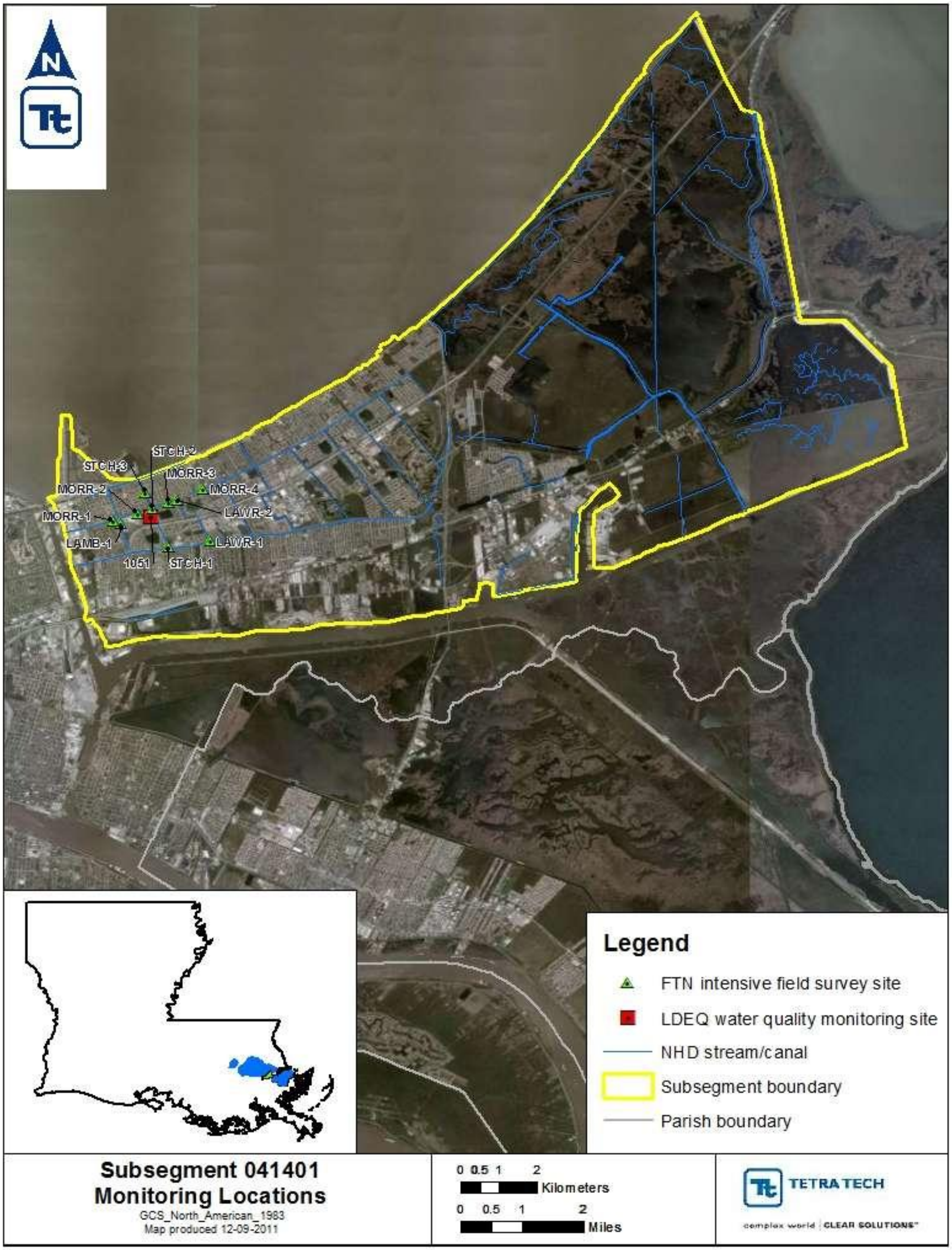

Figure 3-1. Monitoring locations in subsegment 041401 in Lake Pontchartrain Basin.

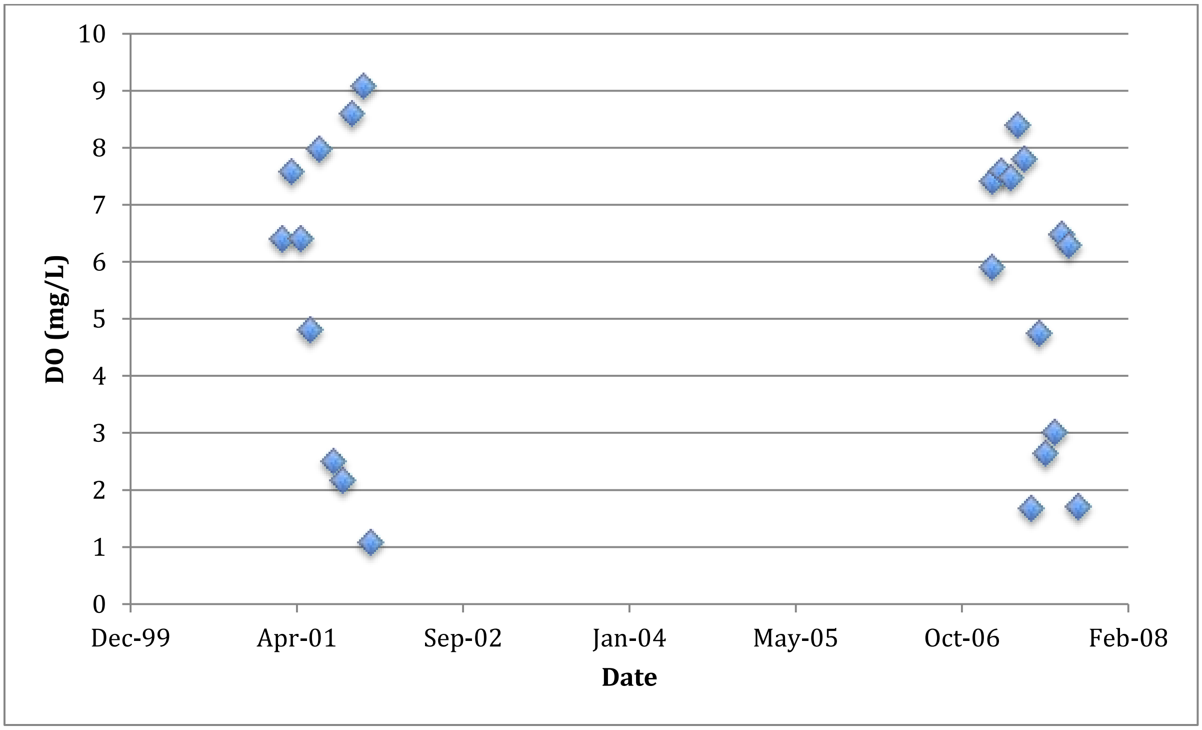

Figure 3-2. DO concentrations over time at station 1051.

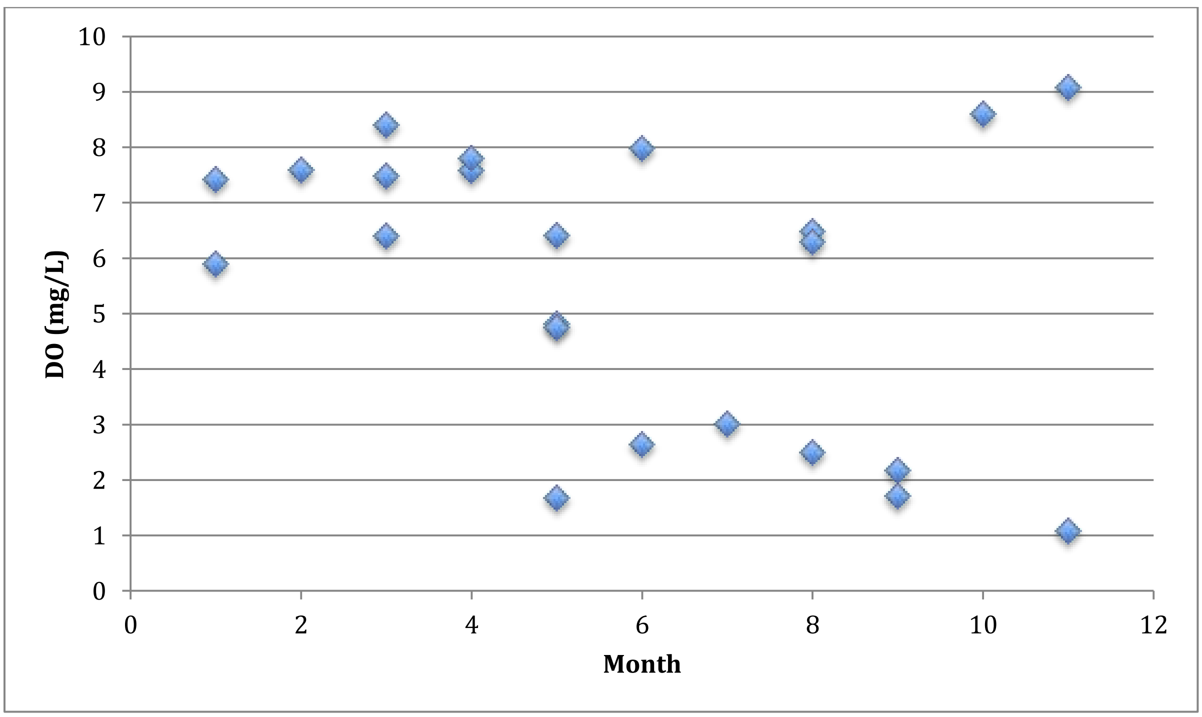

Figure 3-3. Seasonal DO concentrations at station 1051.

4. TMDL Approach

Because of subsegment 041401's unique flow system, traditional models would not produce adequate results. For example, LA-QUAL calculates the transport of materials when there is stream flow and does not work in systems without flow. For subsegment 041401, the channel receives most inflow from stormwater during rainfall events. Pump stations release water to Lake Pontchartrain if the leveed waterbodies reach a certain water elevation. Therefore, flow usually occurs during rain events and periods when the pumps are in operation, and the water is stagnant at other times. The model uses data that were observed on July 10, 2009. For this TMDL, subsegment 041401 is considered as a well-mixed system without inflow and outflow during the critical periods. Nutrients and organic material are carried in by stormwater during rainfall events. Nutrients are released by the decomposition of dead phytoplankton on the channel bottom. No data exist of stormwater flow rate or the concentrations of nutrients or amount of organic material.

On the basis of the available chlorophyll *a* and DO data, low DO readings are primarily caused by excessive levels of phytoplankton. In this TMDL, it is assumed that the nutrients support the growth of phytoplankton during dry days. Nutrients, phytoplankton, and sediment oxygen demand (SOD) will eventually reach a steady state.

4.1 Governing Equations

The TMDL calculation approach for segment 041401 is based on the governing equations for QUAL2E kinetics that are found in Chapra (1997). These governing equations are fundamental and are used in LA-QUAL. LA-QUAL includes more options than the QUAL2E model. The original governing equations for QUAL2E kinetics are as below:

Phytoplankton

$$\frac{dA}{\partial t} = \mu A - \rho A - \frac{\sigma_1}{H} A$$

A: chlorophyll *a*
μ: phytoplankton growth rate
ρ: phytoplankton respiration rate
σ_1: phytoplankton settling rate
H: water depth
t: time

Organic nitrogen

$$\frac{dN_4}{\partial t} = \alpha_1 \rho A - \beta_3 N_4 - \sigma_4 N_4$$

N_4: organic nitrogen
α_1: chlorophyll *a* to nitrogen ratio
β_3: organic nitrogen hydrolysis rate
σ_4: organic nitrogen settling rate

Ammonia nitrogen

$$\frac{dN_1}{\partial t} = \beta_3 N_4 - \beta_1 N_1 + \frac{\sigma_3}{H} - F \alpha_1 \mu A$$

N_1: ammonia nitrogen
β_1: ammonia nitrification rate
σ_3: benthic ammonia flux
F: phytoplankton nitrogen preference constant

Nitrite nitrogen

$$\frac{dN_2}{\partial t} = \beta_1 N_1 - \beta_2 N_2$$

N_2: nitrite nitrogen
β_2: nitrite nitrification rate

Nitrate nitrogen

$$\frac{dN_3}{\partial t} = \beta_2 N_2 - (1 - F)\alpha_1 \mu A$$

N_3: Nitrate nitrogen

Organic phosphorus

$$\frac{dP_1}{\partial t} = \alpha_2 \rho A - \beta_4 P_1 - \sigma_5 P_1$$

P_1: organic phosphorus
α_2: chlorophyll *a* to phosphorus ratio
β_4: organic phosphorus hydrolysis rate
σ_5: organic phosphorus settling rate

Inorganic phosphorus

$$\frac{dP_2}{\partial t} = \beta_4 P_1 + \frac{\sigma_2}{H} - \alpha_2 \mu A$$

P_2: inorganic phosphorus
σ_2: benthic flux of inorganic phosphorus

CBOD

$$\frac{dL}{\partial t} = -K_1 L - K_3 L$$

L : CBOD
K_1: CBOD decay rate
K_3: CBOD settling rate

DO

$$\frac{dO}{\partial t} = K_2 \;\; O_s - O \;\; - K_1 L - \frac{K_4}{H} + \;\; \alpha_3 \mu - \alpha_4 \rho \;\; A - \alpha_5 \beta_1 N_1 - \alpha_6 \beta_2 N_2$$

O: DO
O_s: DO saturation
K_1: CBOD decay rate
K_4: SOD
α_3: phytoplankton oxygen production constant
α_4: phytoplankton oxygen consumption constant
α_5: ammonia nitrogen to DO constant
α_5: nitrite nitrogen to DO constant

The original QUAL2E simulates nine state variables. For segment 041401, the governing equations can be further reduced with the following assumptions:

- For subsegment 041401, the water is stagnant during dry periods. There is no inflow and outflow. Therefore, the transport mechanisms including advection and diffusion are not considered.

- The state variables reach steady-state status. The left side of the original QUAL2E governing equations become 0, meaning that there is no changes in concentrations with time.
- Phytoplankton nitrogen preference is ammonia nitrogen, and F equals 1.
- Organic nitrogen and organic phosphorus are all dissolved. That assumption eliminates the organic nitrogen and organic phosphorus equations under steady-state conditions. The terms for converting dead phytoplankton to organic nitrogen and phosphorus are directly merged into ammonia nitrogen and inorganic phosphorus equations. It is acceptable because the model does not track the deposition of organic matter.
- CBOD is neglected because the non-phytoplankton related CBOD are carried in by stormwater runoff only during rainfall events. The CBOD continues to decay and eventually becomes 0 when there are no constant sources. If any settled CBOD remains on the sediment bottom with lower decaying rate, it is lumped with the SOD.
- The unit phytoplankton photosynthesis and respiration generates and consumes the same amount of DO so that $\alpha_3$and $\alpha_4$are equal. The respiration lumped all the mechanisms for loss of phytoplankton biomass from the water column except settling.

With those assumptions, the governing equations of kinetics under steady-state conditions are reduced to the following:

Phytoplankton

$$\mu - \rho = \frac{\sigma_1}{H}$$

Ammonia nitrogen

$$\beta_1 N_1 + \alpha_1(\mu - \rho)A = \frac{\sigma_3}{H}$$

Inorganic phosphorus

$$\alpha_2(\mu - \rho)A = \frac{\sigma_2}{H}$$

DO

$$K_2 \;\; O_s - O \;\; + \alpha_3 \;\; \mu - \rho \;\; A - \alpha_5 \beta_1 N_1 = \frac{K_4}{H}$$

The simplified governing equations show that the DO in the system is under the influence of ammonia nitrogen nitrification, reaeration, phytoplankton photosynthesis and respiration, and SOD. Phytoplankton is not changing because photosynthesis, respiration, and settling loss are balanced under steady-state condition. The growth (photosynthesis) rate is determined by a maximum growth rate and adjustments based on available ammonia nitrogen and inorganic phosphorus as the equation below.

$$\mu = \mu_{max}\min(\frac{N_1}{N_{1+}H_N}, \frac{P_2}{P_{2+}H_P})$$

H_N: nitrogen half-saturation concentration
H_P: phosphorus half-saturation concentration

Figure 4-1 shows the diagram of the interactions of the simplified governing equations for subsegment 041401.

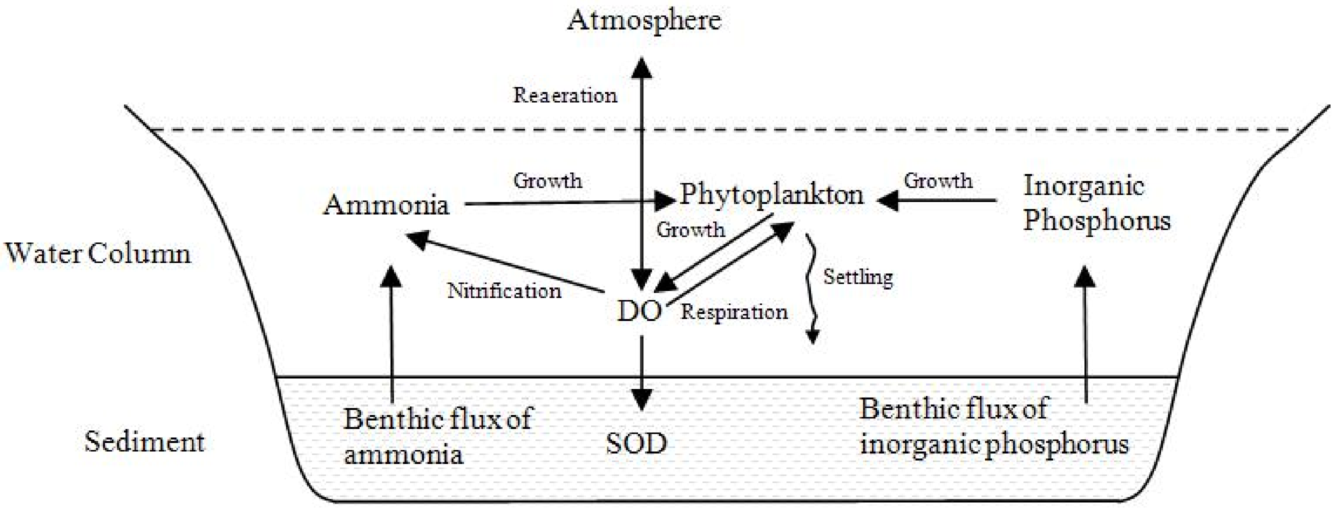

Figure 4-1. Diagram for the simplified steady-state model for subsegment 041401.

4.2 Existing and TMDL Input and Results

A Microsoft Excel spreadsheet was prepared to input the variables in the simplified equations. Available data for the summer simulation included chlorophyll *a*, ammonia nitrogen, inorganic phosphorus, and DO (Table 4-1). The highest observed chlorophyll *a* value at the three monitoring stations was used because it corresponds to the strongest DO fluctuation. For nutrients, average concentrations were used. Growth rate and settling rate were considered as calibration parameters. Respiration rate is calculated directly from the governing equation once growth rate and settling rate are determined. DO saturation level is calculated using the average water temperature as follows:

$$O_s = 468/(31.5 + ℃)$$

Table 4-1. Observed concentrations used in the TMDL calculations

Parameter	Unit	STCH-2[a]	STCH-3[b]	MORR-1[c]	Maximum	Average	Minimum
Temperature	°C	31.7	30.9	29	31.7	30.53	29
DO	mg/L	16.3	10.3	2	16.3	9.53	2
Ammonia nitrogen	mg/L	0.1	0.1	0.1	0.1	0.10	0.1
Inorganic phosphorus	mg/L	0.235	0.183	0.151	0.235	0.19	0.151
Chlorophyll *a*	µg/L	98		42	98	70.00	42

Notes:
a. St. Charles Canal on the south side of Morrison Rd.
b. St. Charles Canal 0.09 miles upstream of pump station
c. Morrison Canal at Morrison Rd. and I-10 ramps

Nitrification rate, reaeration rate, and half-saturation rates for nitrogen and phosphorus were adjusted. The benthic fluxes of nitrogen and phosphorus were determined after all the other rate constants were calibrated. The daily maximum and minimum DO were computed using the averaged DO and the DO swing range from the delta method. DO swing was calculated using the delta method as shown below (Lung 2001), and the parameter values are presented in Table 4-2.

$$\Delta = P_{av} \frac{1 - e^{-K_a f T} \ (1 - e^{-K_a T(1-f)})}{f K_a (1 - e^{-K_a f T})}$$

where

Δ = range of diurnal DO (mg/L)
K_a = reaeration coefficient (1/day)
f = photoperiod (0–1.0). For this subsegment, 0.56 was used according to the location and date.
T = 1 day
$P_{av} = a \times Chl\ a$, daily average photosynthetic DO production (mg/L/day)
$Chl\ a$ = chlorophyll a concentration (micrograms per liter [μg/L])
a = coefficient to convert chlorophyll a concentration to daily DO production.

Table 4-2. Delta method calculations

Parameter	Value-baseline summer	Value-TMDL summer	Value-baseline winter	Value-TMDL winter	Notes
K_a (1/d)	1.000	1.000	1.000	1.000	Re-aeration coefficient.
Latitude	30.04228	30.04228	30.04228	30.04228	
Longitude	-90.36624	-90.36624	-90.36624	-90.36624	
Year	2009	2009	2009	2009	
Month	7	7	1	1	
Day	10	10	10	10	
Time zone	-6	-6	-6	-6	time zone in hours relative to GMT/UTC
Sunrise	6:08 AM	6:08 AM	7:58 AM	7:58 AM	Calculated from latitude, longitude, & date
Sunset	8:05 PM	8:05 PM	6:19 PM	6:19 PM	Calculated from latitude, longitude, & date
Photo period (hours)	14.0	14.0	10.4	10.4	f = photoperiod
Daily average photosynthetic DO production (mg/L/day)	23.23	13.27	5.62	5.62	P_{av} = daily average photosynthetic DO production
Time (day)	1	1	1	1	T
Target chlorophyll *a*	98	56	45.0	45.0	Chl *a*
Delta	**9.52**	**5.44**	**3.13**	**3.13**	Range of diurnal DO
Average DO	**6.76**	**6.76**	**3.62**	**5.57**	
Minimum DO	2.00	4.04	2.05	4.00	

In Table 4-2, for the winter scenario, the chlorophyll *a* was calculated to be 44.97 μg/L using a temperature of 20 °C. In addition, the average DO was determined to be only 3.62 mg/L with a minimum DO of 2.05 mg/L because of the SOD.

For the summer, the measured DO varied greatly from 2.0 to 16 mg/L. With the minimum DO 2 mg/L and the computed DO fluctuation; the average DO was determined to be 6.76 mg/L. Table 4-3 presents the spreadsheet baseline values and calculated results. The SOD rate is very high for the summer. However, it is considered acceptable because it is a lumped term and includes all the organic matter, and dead phytoplankton are trapped in the channel. In addition, literature values show that SOD can even reach 36 grams per square meter per day ($g/m^2\ d^{-1}$) (Hickey 1985). It is assumed that this material is present in the summer and winter. Phytoplankton settling rates can vary significantly from 0.08 to 6.8 meter per day (m/d) depending on the actual type of phytoplankton (Chapra 1997). For subsegment 041401, 1 m/d is used. The respiration rate equals the difference between the growth rate and the settling loss rate. Under existing conditions, the respiration rate reaches 0.7391 d^{-1} for summer and 0.0987 d^{-1} for winter. The summer value exceeds the normal range of the respiration rate, which is between 0.05 d^{-1} and 0.25 d^{-1} according to Chapra (1997). However, the respiration term in the simplified approach lumps all the loss terms except settling loss. Therefore, this value is still acceptable.

Table 4-3. Baseline parameters and results

Parameter	Variable	Unit	Summer value	Winter value
Channel depth	H	m	1	1
Water temperature	Wtem	°C	30	20
Algae base growth rate	K_g	1/d	2	1.2635
Algae respiration rate	K_{ra}	1/d	0.7391	0.0987
Algae settling velocity	V_a	m/d	1	1
Phosphorus to algae ratio	A_{pa}	p to chla (mg/L / µg /L)	0.0002	0.0002
Nitrogen to algae ratio	A_{na}	n to chla (mg/L / µg /L)	0.0025	0.0025
Benthic phosphorus release	S_p	$g/m^2\ d^{-1}$	0.0196	0.0090
Benthic ammonia release	S_{na}	$g/m^2\ d^{-1}$	0.295	0.1354
Nitrification rate	K_n	1/d	0.5	0.3159
Phosphorus half-saturation concentration	H_p	mg/L	0.002	0.002
Ammonia half-saturation concentration	H_{na}	mg/L	0.015	0.015
Adjusted algae growth rate	K_g	1/d	1.7391	1.099
Algae (chlorophyll *a* concentration)	a	µg/L	98.00	44.97
Phosphorus concentration	p	mg/L	0.19	0.151
Ammonia concentration	n_a	mg/L	0.10	0.1
Nitrogen to oxygen ratio	R_{on}	*unitless*	4.33	4.33
Algae to oxygen ratio at 20 °C	R_{oa20}	*unitless*	0.125	0.125
Algae to oxygen ratio	R_{oa}	*unitless*	0.23685	0.125
Reaeration rate	K_a	1/d	1	1
Saturation DO	O_s	mg/L	7.61	9.09
SOD at 30 °C	S_o	$g/m^2\ d^{-1}$	23.845	--
SOD at 20 °C	S_{o20}	$g/m^2\ d^{-1}$	10.94	10.94
DO concentration	O	mg/L	6.76	3.63

After the rates and constants are determined, reductions of nutrients are calculated until phytoplankton values are reduced to a level that decreases the DO fluctuation. It was assumed that the average DO in summer is controlled by both phytoplankton and SOD, and the average DO in winter is mainly controlled by SOD. Therefore, it was assumed that the average concentration of DO does not change for the summer. By controlling phytoplankton, the fluctuation of DO is reduced, and the minimum DO can meet the 4 mg/L criterion. It was determined that chlorophyll *a* be controlled to a concentration of 56 µg/L to achieve DO goals (Table 4-4). To control chlorophyll *a*, the benthic fluxes of nitrogen and phosphorus require reduction for the summer. It is assumed that once those fluxes are reduced, the water column ammonia and inorganic phosphorus concentrations would also be reduced. The growth rate is reduced with the decreased nutrients. Accordingly, the respiration rate also reduces because the respiration rate has to equal the difference between the growth rate and the settling rate. The settling rate does not change because the type of phytoplankton after nutrient reduction does not change. In addition, SOD needs to be reduced for the summer to achieve the same daily average DO concentration of 6.76 mg/L and minimum concentration of 4.03 mg/L

During winter, water temperature is low, and the oxygen generated and consumed by phytoplankton is low. SOD is the main factor that governs the average DO. Only SOD needed to be reduced in the winter. The final SO fluxes are 13.99 $g/m^2\ d^{-1}$ for the summer and 9.00 $g/m^2\ d^{-1}$ in the winter. The final fluxes are 0.0112 $g/m^2\ d^{-1}$ for phosphorus and 0.169 $g/m^2\ d^{-1}$ for ammonia for the summer and for the winter, they are 0.009 $g/m^2\ d^{-1}$ for phosphorus and 0.1354 $g/m^2\ d^{-1}$ for ammonia. The fluxes of phosphorus and ammonia were based on the summer values and were adjusted using typical temperature-adjustment coefficients. Loads can be calculated from the fluxes by knowing the channel bottom area.

Table 4-4. TMDL reduction parameters and results

Parameter	Variable	Unit	Summer value	Winter value
Channel depth	H	m	1	1
Water temperature	Wtem	°C	30	20
Algae base growth rate	K_g	1/d	2	1.2635
Algae respiration rate	K_{ra}	1/d	0.5845	0.0987
Algae settling velocity	V_a	m/d	1	1
Phosphorus to algae ratio	A_{pa}	p to chla (mg/L / µg /L)	0.0002	0.0002
Nitrogen to algae ratio	A_{na}	n to chla (mg/L / µg /L)	0.0025	0.0025
Benthic phosphorus release	S_p	$g/m^2\ d^{-1}$	0.0112	0.0090
Benthic ammonia release	S_{na}	$g/m^2\ d^{-1}$	0.169	0.1354
Nitrification rate	K_n	1/d	0.5	0.3159
Phosphorus half-saturation concentration	H_p	mg/L	0.002	0.002
Ammonia half-saturation concentration	H_{na}	mg/L	0.015	0.015
Adjusted algae growth rate	K_g	1/d	1.5845	1.099
Algae (chlorophyll *a* concentration)	a	µg/L	56.00	44.97
Phosphorus concentration	p	mg/L	0.11	0.151
Ammonia concentration	n_a	mg/L	0.06	0.1
Nitrogen to oxygen ratio	R_{on}	*unitless*	4.33	4.33
Algae to oxygen ratio at 20 °C	R_{oa20}	*unitless*	0.125	0.125
Algae to oxygen ratio	R_{oa}	*unitless*	0.2369	0.125
Reaeration rate	K_a	1/d	1	1
Saturation DO	O_s	mg/L	7.61	9.09
SOD at 30 °C	S_o	$g/m^2\ d^{-1}$	13.99	--
SOD at 20 °C	S_{o20}	$g/m^2\ d^{-1}$	4.38	9.00
DO concentration	O	mg/L	6.76	5.57

5. Dissolved Oxygen TMDL Development

A TMDL is the total amount of a pollutant that a receiving waterbody can assimilate while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls.

A TMDL for a given pollutant and waterbody is calculated using the sum of individual WLAs for point sources and LAs for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody, and it may include a future growth (FG) component. The components of the TMDL are illustrated using the following equation:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS + FG$$

This TMDL establishes load limitations for oxygen-demanding substances and goals for reduction of those pollutants. LDEQ's position is that when oxygen-demanding loads are reduced to ensure that the DO criterion is supported, nutrients are also reduced. Implementation of this TMDL through discharge permits, along with application of best management practices (BMPs) to control and reduce runoff of oxygen-demanding pollutants from nonpoint sources in the watershed, will also reduce nutrient loading from those sources.

5.1 TMDLs, WLAs, and LAs

A summary of the TMDLs is presented in Table 5-1. The DO TMDL is presented as ammonia, inorganic phosphorous, and SOD, and they were derived using the spreadsheet model. The ammonia, inorganic phosphorus, and SOD fluxes were taken from the spreadsheet model and multiplied by the canal bottom surface area in square meters. The area covered in this TMDL includes the urban area canals in the western portion of the subsegment. The LDEQ assessment point for the subsegment is included in the western canal system in a developed area. No data exist for the eastern portion of the subsegment, which is dominated by wetlands and the Bayou Sauvage National Wildlife Refuge and, thus, is not represented by the assessment point in the western portion of the subsegment. To calculate the loadings for other areas, multiply the reduced fluxes in $g/m^2\ d^{-1}$ for SOD (13.99 for summer/9.00 for winter), ammonia (0.1686 for summer/0.1354 for winter), and inorganic phosphorus (0.0112 for summer/0.0090 for winter) by the canal bottom surface area (908,188) in square meters.

Table 5-1. Summary of DO TMDLs, WLAs, LAs, MOSs, and FGs for the western urban canal area of subsegment 041401

Season	Loadings (lb/d)					
	SOD		Ammonia as N		Inorganic phosphorus as P	
Summer	Baseline	TMDL	Baseline	TMDL	Baseline	TMDL
WLA	38,194	22,409	472.5	270.1	31.39	17.94
LA	0	0	0.0	0.0	0.00	0.00
MOS	4,774	2,801	59.1	33.8	3.92	2.24
FG	4,774	2,801	59.1	33.8	3.92	2.24
TMDL	47,743	28,011	590.7	337.6	39.24	22.42
Percent reduction	41%		43%		43%	
Season	Loadings (lb/d)					
	SOD		Ammonia as N		Inorganic phosphorus as P	
Winter	Baseline	TMDL	Baseline	TMDL	Baseline	TMDL
WLA	17,528	14,416	216.9	216.9	14.41	14.41
LA	0	0	0.0	0.0	0.00	0.00
MOS	2,191	1,802	27.1	27.1	1.80	1.80
FG	2,191	1,802	27.1	27.1	1.80	1.80
TMDL	21,911	18,020	271.1	271.1	18.01	18.01
Percent reduction	18%		0%		0%	

5.1.1 Wasteload Allocation

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources that include the MS4 permits in the subsegment. Because the portion of the subsegment covered by this TMDL is completely within the MS4 area, the entire TMDL is considered a WLA.

The majority of the point sources identified in Appendix A are for stormwater with a lesser degree to non-sanitary discharges. Almost all permits or discharge monitoring reports lack flow information. In addition, the stormwater permits do not have readily available information regarding the drainage area, so WLAs cannot be calculated for stormwater permits. Only the two sanitary discharge permits have permit limits for BOD_5 and those facilities do not discharge to the canal system covered in this TMDL.

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. Table 5-2 lists the individual WLAs for the MS4s identified in Section 2.5. The MS4 loads presented reflect only that portion of the MS4 in the subsegment. The subsegment drains areas that are regulated by MS4 permit LAS000301, which covers the city of New Orleans, the New Orleans Levee District, Louisiana DOT district 02, and the Sewerage & Water Board of New Orleans. The WLAs provided for those MS4s do not represent stormwater. The WLAs represent the nonpoint load present with the area regulated by the MS4s under critical, low-flow conditions. The WLAs should not be used as permit limits or targets. The areas covered by the MS4 permit might include many permitted and unpermitted facilities. While LDEQ assumes responsibility for the facilities, partial responsibility belongs to the MS4 permittees to ensure that water draining from the MS4 coverage area does not affect the named waterbodies. Reductions in the nonpoint source loading presented in this report also apply to MS4 regulated areas.

The impact of stormwater loading on the waterbody under critical conditions is difficult to determine. Frequent monitoring at many sites could be monetarily and logistically prohibitive. Therefore, it is impractical to set MS4 permit limits. EPA and LDEQ expect that the MS4 WLAs will be achieved through BMPs and adaptive management. Appropriate BMP measures will be incorporated into the MS4 permits to minimize the impacts of loads from stormwater on water quality. All facilities discharging into the MS4 permit area should have appropriate limits that ensure the protection of the water quality. Such BMP measures should include the location of all wastewater discharges, the elimination of illicit wastewater discharges, rehabilitating and upgrading sewer collection system lines, and other appropriate activities. Stormwater permits may also include a monitoring component, provided it is cost effective.

Table 5-2. Summary of WLAs for MS4s subsegment 041401 in Lake Pontchartrain Basin

NPDES permit number	Authority	Loadings (lb/d)		
		SOD	Ammonia	Inorganic phosphorus
Summer				
LAS000301	New Orleans City of - MS4	22,409	270.1	17.94
	Orleans Levee District - MS4			
	LADOTD District 02 - MS4			
	Sewerage & Water Board of New Orleans - MS4			
Winter				
LAS000301	New Orleans City of - MS4	14,416	216.9	14.41
	Orleans Levee District - MS4			
	LADOTD District 02 - MS4			
	Sewerage & Water Board of New Orleans - MS4			

The estimated annual runoff from the MS4 can be calculated with the following equation.

$$R = P \times Pj \times Rv$$

where

R = Annual runoff (inches)
P = Annual rainfall (inches)
Pj = Fraction of annual rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient

Because watershed imperviousness is a reasonable predictor of the runoff coefficient, the runoff coefficient was substituted using the following equation.

$$Rv = 0.05 + 0.9Ia$$

where

Ia = Impervious fraction

The estimated annual runoff from the MS4 was calculated to be 23.66 inches per year. For that calculation, the average annual rainfall (58 inches) was calculated using the past 14 years of complete data collected by the National Climatic Data Center at New Orleans International Airport. The impervious fraction of the MS4 was estimated to be 45 percent using USGS impervious cover information. Once the runoff in inches was calculated, it was multiplied by the area to obtain the runoff is 7.188 billion gallons per year (19.7 million gallons per day).

5.1.2 Load Allocation

The LA is the portion of the TMDL assigned to nonpoint sources such as natural background loadings or upstream loading. For this TMDL, the LA is zero because this TMDL covers only the leveed waterbodies, which are entirely within MS4 areas, and not the wetlands (Bayou Sauvage National Wildlife Refuge) to the east.

5.2 Seasonality and Critical Condition

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations and take into account critical conditions for stream flow, loading, and water quality parameters. The sampling results for all pollutants were plotted over time and reviewed for any seasonal patterns (see Section 3). The water quality criteria for DO apply all year, accounting for seasonal variations.

Critical conditions for DO have been determined to be the following: negligible nonpoint runoff and low system flow combined with high water temperatures. Oxygen-demanding substances can enter a water system during higher flows and settle to the bottom, where they exert a large oxygen demand during the high-temperature/low-flow seasons. Water temperature is one of the leading factors that affect DO in the segment. High water temperatures lower the DO saturation concentration, decreasing the amount of DO that the stream can contain. In addition, high temperature increases SOD. Therefore, it is most important to develop a TMDL to address the high water-temperature conditions. Ambient water quality data from LDEQ show that low DO concentrations occur during the summer. Summer should have the highest algae growth, and it is the worst time for DO. In winter, saturation DO will be high because of the cool water, and algae growth is limited by relatively low temperature. So summer was considered the most critical condition for this TMDL. However, winter DO can still violate the criteria when an excessive level of SOD is present. This TMDL was developed under summer critical conditions and winter conditions, providing a year-round TMDL.

5.3 Margin of Safety

Section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly using conservative assumptions in establishing the TMDL. In addition to the MOS, an FG component may be added to account specifically for FG in the TMDL area.

The MOS can be incorporated in two ways (USEPA 1991). One way is to implicitly incorporate it by using conservative model assumptions to develop allocations, including using the DO water quality criteria for model inflows. DO was set to the water quality criterion, which is lower than the 90 percent saturation level of DO at 30 ºC.

The other way to incorporate the MOS is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this analysis, the MOS is explicit: 10 percent of each targeted TMDL was reserved as the MOS. Using 10 percent of the TMDL load provides an additional level of protection to the designated uses of the subsegments of concern.

5.4 Future Growth

The FG is an allocation for growth. Ten percent of the load was allocated for FG within the area covered by the TMDL. That growth includes future urban development, including point sources, MS4 areas, agriculture, and other nonpoint sources. The FG could also be used for unaccounted or unknown sources not included in the TMDL.

6. FUTURE ACTIVITIES

This section discusses TMDL implementation strategies, environmental monitoring activities, and stormwater permitting requirements and presumptive BMPs approach for the TMDL conducted for the subsegment.

6.1 TMDL Implementation Strategies

Current TMDL requirements do not require implementation plans to be included in TMDL reports. Louisiana is responsible for developing and implementing the TMDL implementation plans. Section 303(d) of the Clean Water Act and the implementing regulations at 40 CFR 130.7 state that EPA has no authority to approve or disapprove TMDL implementation plans.

WLAs will be implemented through LPDES permit procedures. LDEQ was delegated to manage the NPDES program in August 1996, and LDEQ is responsible for all permits covered by the delegation package. As part of that designation, a Memorandum of Agreement (MOA) was established between LDEQ and EPA. The designation and memorandum were revised in April 2004. In accordance with section 1.C of the NPDES MOA between LDEQ and EPA (Revision 1, April 28, 2004), EPA has the responsibility of providing continued technical and other assistance, including interpreting and implementing federal regulations, policies, and guidelines on permitting and enforcement matters. The MOA further states that LDEQ has primary responsibilities for implementing the LPDES program in Louisiana, including applicable sections of the federal Clean Water Act, applicable state legal authority, the applicable requirements of 40 CFR Parts 122–125, and any other applicable federal regulations establishing LPDES program priorities with consideration of EPA Region 6 and national NPDES goals and objectives. For details on the designation and agreement, see the EPA Region 6 website at http://www.epa.gov/region6/water/lpdes/.[2] LDEQ's position is that, if any unresolved LDEQ comments to this TMDL become the basis for an EPA Region 6 objection of an LDEQ-drafted permit or permittee objection/appeal of an LDEQ drafted permit, LDEQ may relinquish permitting authority to EPA Region 6.

The TMDL analysis illustrate that only a small amount of CBOD and other substances that create oxygen demand are entering the canals through watershed loading. The sediment at the bottom of the canals can be considered a source of oxygen-demanding substances such as ammonia and phosphorus. In addition, a large source of internal oxygen demand is a layer of organic material that is decaying on the bottom of the canal, which is represented by SOD. SOD is a parameter that measures the total organic materials that consumes oxygen on the canal bottom, which is similar to CBOD, which measures the total organic materials in the water column.

The organic material carried into the canals by the stormwater system along with the nutrients with stimulate algal growth have contributed to a canal bottom load of decaying material. The low flow of the canals makes an efficient recycler of nutrients. The algae die and fall to the bottom where the organic material is broken down into the building blocks of carbon, nitrogen, and phosphorus while consuming oxygen. The nitrogen and phosphorus return to the water column where they are used by algae to reproduce more algae, starting the cycle over again.

Eliminating all discharge into the canals might not change the DO in the lake in a short time frame; however, the MS4s should limit its present discharge to prevent conditions from degrading. Innovative water quality improvement solutions should be reviewed and considered to improve water quality in the canals rather than strict daily load limits. Some of those solutions could focus on limiting the amount of new organic materials, such as grass clippings and leaves, entering the lake.

[2] Accessed January 11, 2011.

6.2 LDEQ Phased TMDL Approach

LDEQ is using a phased approach to TMDL implementation, as shown in Table 6-1. The approach provides LDEQ with the opportunity to revise the DO criteria for a subsegment by developing a meaningful and implementable DO TMDL on the basis of DO criteria that are appropriate for a specific waterbody and in accordance with the consent decree deadlines. In addition, it will lead to improved water quality while providing entities the opportunity to prepare for potential new permit requirements as a result of the TMDL developed in Phases I and II (LDEQ 2010d).

Table 6-1. Phased TMDL approach

Stage/Phase	DO criteria (mg/L)
Phase I: Phase I implementation required upon EPA approval of the TMDL and subsequent update of Louisiana's Water Quality Management Plan	4.0
Primary Activities: Ecoregion-based UAA developed and DO criteria revised and promulgated	
Phase II: Phase II implementation required upon EPA approval of Phase II of the TMDL and subsequent update of Louisiana's Water Quality Management Plan	Appropriate DO criteria based on UAA

UAA = use attainability analysis

6.2.1 Phase I – Permit Implementation

All TMDL, permitting, and enforcement activities will be conducted in accordance with the Clean Water Act, the Louisiana Environmental Regulatory Code, and applicable state laws.

1. **New discharges of oxygen-demanding loads:** In general, LDEQ might not be able to permit additional discharges of oxygen-demanding loads because of the impaired status of New Orleans east leveed waterbodies. However, LDEQ may permit the new discharges case by case after evaluating relevant information (i.e., environmental impact statement). The typical permit limits will be 5 mg/L for BOD_5, 2 mg/L for ammonia, and 5 mg/L for DO. Such new facilities could be required to submit an environmental impact assessment to LDEQ's permitting staff, which will conduct a thorough evaluation of the proposed facility on the basis of environmental impacts, economic benefits, an analysis of alternatives, and other pertinent factors. Example scenarios where a new discharge may be permitted are as follows.

   a. The facility demonstrates that it will provide a significant load reduction of man-made, oxygen-demanding constituents to the impaired watershed(s) serviced by the facility. The facility must also contribute to a reduction in the number of facilities discharging to the watershed(s). Facilities that might be considered for permits under this provision include the following:

      i. A facility that will provide improved sewage treatment to multiple subdivisions previously serviced by wastewater treatment plants that are incapable of treating to tertiary limits.

      ii. A facility that will provide sewage collection and treatment to previously unsewered areas in which many of the sanitary discharges from permitted facilities and individual home treatment units were entering an impaired watershed. As a result, the facility would be expected to provide more efficient treatment to the wastewater and reduce the net loading of oxygen-demanding substances in the watershed.

   b. The facility demonstrates that its wastewater will not leave the facility or its property. Significant stormwater events do not apply to this provision. For the purpose of this provision, a significant stormwater event is defined as the 25-year, 24-hour rainfall event or its numerical equivalent, as defined by the Southern Regional Climate Center.

      i. Facilities that might be considered under this provision include the following:

         a. Effluent reduction systems that have been approved by the Louisiana Department of Health and Hospitals.

         b. Wastewater treatment plants equipped with overland flow systems in which the effluent will not leave the facility.

c. Wastewater treatment plants equipped with holding ponds that will retain the effluent such that the effluent will not leave the facility.

ii. LDEQ recognizes that some local governments are in the process of building or expanding regional sewage collection and treatment systems. In such areas, LDEQ may, on a limited basis, grant permits of limited durations to facilities that agree to tie into a regional collection and treatment system when it becomes available. LDEQ must have assurance that the regional collection system will be available to the facility, and the facility will connect to the regional collection system on or before the expiration date of the permit. Such assurance could include a formal agreement among the facility, the owner and operator of the regional wastewater treatment system, and LDEQ. The regional system must have the capacity to treat the additional wastewater. Such a permit could have a duration of less than 5 years, or it could have a 5-year duration with interim permit limits. The permit will be written on the basis of projected completion dates for the construction of the collection and treatment system. The facility will be required to cease all wastewater discharges to the New Orleans east leveed waterbodies watershed and transfer the discharge to the regional collection system once the permit or interim limits expire or the collection system is available to the facility, whichever comes first. If the permit or interim limits expire, but, because of unforeseen circumstances, the availability of the collection system has been temporarily delayed, the duration of the permit or interim limits could be extended. If the availability of the collection system has been indefinitely delayed, the facility might be required to cease all discharges to the New Orleans east leveed waterbodies. Such facilities could resort to options covered in item 1.b.i. above.

a. LDEQ reassesses subsegment 041401 (New Orleans east leveed waterbodies). LDEQ determines that subsegment 041401 is meeting the appropriate DO criteria and designated uses.

2. **Existing discharges of oxygen demanding loads:** Existing facilities discovered to be discharging oxygen-demanding loads without LPDES permits as of the TMDL approval date are to be permitted in accordance with the limits established for existing facilities with permits. Unpermitted facilities that are newly activated or reactivated and discharging after the TMDL approval date could be subject to enforcement actions and will be required to tie into regional collection and treatment systems, once those systems are available. Once the TMDL is approved, existing facilities could have up to 3 years from their next permit renewal to meet the interim limits.

3. **Nutrient monitoring:** Nutrient monitoring (i.e., reporting for total nitrogen and total phosphorus) might be required for individual permits. Nutrient monitoring will be added to the general permit series (LAG530000, LAG540000, LAG560000, and LAG570000) on the next scheduled renewal of each series.

6.2.2 Phase II – Use Attainability Analysis Implementation

Phase II permit implementation will be developed on the basis of an ecoregion-based use attainability analysis (UAA) being developed. Using existing data, the UAA is expected to propose new DO criteria for many of the Lake Pontchartrain Basin TMDLs that are being developed. These TMDLs have an EPA backstop date of March 31, 2012. The new DO criterion is expected to be developed in the next several years (LDEQ 2010d).

If new criteria are not developed and applied within 5 years from approval date of this TMDL, LDEQ will take one of the following actions:

- **Case 1:** If the UAA study indicates that the current DO criterion is appropriate, the TMDL will be implemented using the existing criterion.
- **Case 2:** If the UAA is not likely to be completed or approved, the TMDL will be implemented using the existing DO criterion.
- **Case 3:** If the UAA is still being developed but is expected to be approved, Phase II of this TMDL will be postponed for up to 2 years. If by then the UAA has not been completed, the UAA status will be reviewed again according to Cases 1–3.

6.3 Environmental Monitoring Activities

LDEQ uses funds provided under Clean Water Act section 106 and under the authority of the Louisiana Environmental Quality Act to run a program for monitoring the quality of Louisiana's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations using appropriate sampling methods and procedures to ensure 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 are used to develop the state's biennial section 305(b) report (*Water Quality Inventory*) and section 303(d) list of impaired waters (*Draft 2010 Integrated Report*).

LDEQ has implemented a rotating approach to surface water quality monitoring. Through the rotating approach, the entire state is sampled on 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 monthly during a water year (October through September) to yield approximately 12 samples per site during each year the site is monitored. Sampling locations are selected where they are considered representative of the waterbody. Under the current monitoring schedule, approximately one-half of the state's waters are newly assessed for section 305(b) and section 303(d) listing purposes for each biennial cycle. Monitoring allows LDEQ to determine whether any improvement in water quality occurred after the TMDLs had been implemented. LDEQ evaluates the monitoring results to generate the Integrated Report submitted by April 1 on even-numbered years. More information can be found in *Louisiana's Water Quality Assessment Method and Integrated Report Rationale: 2010 Water Quality Integrated Report* (LDEQ 2010a). Monitoring will allow LDEQ to determine whether there has been any improvement in water quality following TMDL implementation. As the monitoring results are evaluated at the end of each year, waterbodies might be added to or removed from the section 303(d) list of impaired waterbodies.

Two watershed coordinators have been hired to work with the Lake Pontchartrain Basin Foundation (LPBF) on stakeholder involvement for watershed plans. LDEQ's nonpoint source staff is also working with LPBF to implement those plans and will be assigned additional watersheds to work on through the planning and implementation process. To address some of the known problems that exist within this basin, LDEQ has been implementing programs that address fecal coliform, DO, and mercury, which are the primary water quality problems that have been identified in the waterbodies. LPBF has implemented many programs to restore water quality and will be an important partner for LDEQ as TMDLs are implemented in the basin. Because much of the basin is included within the Coastal Zone Boundary, Louisiana Department of Natural Resources – Coastal Management Division will be working with LDEQ and LPBF on implementing management measures required through the Coastal Nonpoint Source Pollution Control Program (LDEQ 2010c).

6.4 Stormwater Permitting Requirements and Presumptive BMPs Approach

6.4.1 Background

The NPDES permitting program for stormwater discharges was established under the Clean Water Act as the result of a 1987 amendment. The act specifies the level of control to be incorporated into the NPDES stormwater permitting program depending on the source (industrial versus municipal stormwater). Those programs contain specific requirements for the regulated communities/facilities to establish a comprehensive stormwater management program (SWMP) or stormwater pollution prevention plan (SWPPP) to implement any requirements of the TMDL allocation (see 40 CFR Part130).

Stormwater discharges are highly variable, both in terms of flow and pollutant concentration, and the relationships between discharges and water quality can be complex. For municipal stormwater discharges in particular, the use of system-wide permits and a variety of jurisdiction-wide BMPs, including educational and programmatic BMPs, does not easily lend itself to the existing methodologies for deriving numeric water quality-based effluent limitations. Those methodologies were designed primarily for process wastewater discharges, which occur at predictable rates with predictable pollutant loadings under low-flow conditions in receiving waters. EPA has recognized such problems and developed permitting guidance for stormwater permits (USEPA 1996).

Because of the nature of stormwater discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA recommends an interim permitting approach for NPDES stormwater permits that is based on BMPs. EPA permitting guidance states that, "[t]he interim permitting approach uses BMPs in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards" (USEPA 1996).

A monitoring component is also included in the recommended BMP approach. According to EPA permitting guidance, "each storm water permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations for subsequent permits" (USEPA 1996). That approach was further elaborated on in a guidance memo issued in 2002. "The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and nonstructural BMPs) that address stormwater discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. … If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the stormwater component of the TMDL, EPA recommends that the TMDL reflect this" (Wayland and Hanlon 2002). The BMP-based approach to stormwater sources in TMDLs is also recognized and described in the most recent EPA guidance (USEPA 2008).

This TMDL adopts the EPA-recommended approach and relies on appropriate BMPs for implementation. No numeric effluent limitations are required or anticipated for municipal stormwater discharge permits.

6.4.2 Specific SWMP/SWPPP Requirements

As discussed in the Louisiana Small MS4 NPDES permit, if a TMDL assigns an individual WLA specifically to a MS4's stormwater discharge, LDEQ's permit specifies that the WLA must be included as a measurable goal for the SWMP.

Examples of activities that the MS4 can conduct to be consistent with the WLA include the following:

- Monitoring to evaluate program compliance, the appropriateness of identified BMPs, and progress toward achieving identified measurable goals
- Developing a schedule for implementing additional controls and/or BMPs, if necessary, on the basis of monitoring results, to ensure compliance with applicable TMDLs

7. PUBLIC PARTICIPATION

Federal regulations require EPA to notify the public and seek comments concerning the TMDLs it prepares. This TMDL were developed under contract to EPA, and EPA 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 is tentatively scheduled to be published in the *Federal Register* on approximately December 19, 2011, and the review period tentatively set to close on January 31, 2012. Any comments will be reviewed, and this TMDL may be revised if appropriate. If any comments are submitted they, will be included in a new appendix in the final TMDL along with EPA responses.

EPA will submit the final TMDL to LDEQ for implementation and incorporation into LDEQ's current WQMP.

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APPENDIX A: Point Source Discharge Information

Table A-1. Active point source discharge permit information

AI	Permit #	Outfall	Outfall Type	Facility name	Facility type	Expir. Date	Receiving waterbody
1036	LA0122530	001	wastewater associated with the operation of a construction/demolition debris landfill	New Orleans City of Sanitation Dept - Gentilly Landfill	electric, gas, and sanitary services	06/30/12	unnamed ditch along Almonaster Blvd to Intracoastal Waterway
1036	LA0122530	002	wastewater associated with the operation of a construction/demolition debris landfill	New Orleans City of Sanitation Dept - Gentilly Landfill	electric, gas, and sanitary services	06/30/12	unnamed ditch along Almonaster Blvd to Intracoastal Waterway
1036	LA0122530	003	landfill wastewater	New Orleans City of Sanitation Dept - Gentilly Landfill	electric, gas, and sanitary services	06/30/12	unnamed ditch along Almonaster Blvd to Intracoastal Waterway
1140	LAG480244	001	cooling tower overflow and stormwater runoff	Folger Coffee Co - Gentilly Plant	food and kindred products	07/31/06	drainage ditch to Lake Michoud
2064	LAU004057			Air Liquide	general agency interest		
3192	LAR05M840		MSGP stormwater	US Gypsum Co	stone, clay, glass, and concrete products	04/30/11	Morrison Canal to Lake Pontchartrain
3520	LAR05N595		treated leachate, sewage and stormwater from municipal landfill	Recovery 1 Landfill	electric, gas, and sanitary services	04/30/11	Lagoon Maxent to Intracoastal Waterway to Lake Borgne
5163	LAU009199			Hamps Michoud Yard	electronic & electr. equip., exc. comp. equip		
6157	LAR05M563		MSGP stormwater	United Parcel Service Inc (UPS)	motor freight transportation and warehousing	04/30/11	LAKE PONTCHARTRAIN
7032	LAG110086	001	process wastewater from external washing of trucks and equipment, stormwater runoff from process area and product storage		stone, clay, glass, and concrete products	03/14/14	Intracoastal Waterway
7032	LAG110086	002	process wastewater from plant and equipment wash down, stormwater runoff from the process area and product storage area		stone, clay, glass, and concrete products	03/14/14	Intracoastal Waterway
7032	LAR05M010		stormwater	Hanson Pipe & Products Inc - Michoud Plant	stone, clay, glass, and concrete products	04/30/11	Intracoastal Waterway
9145	LA0052256	002	stormwater	NASA Michoud Assembly Facility	transportation equipment	12/31/15	New Orleans stormwater drain system
9145	LA0052256	003	stormwater	NASA Michoud Assembly Facility	transportation equipment	12/31/15	New Orleans stormwater drain system
9886	LAR05M298		stormwater	UPS Freight (NOR)	motor freight transportation and warehousing	04/30/11	Lake Pontchartrain
11010	LA0065307	001	process wastewater from equipment maintenance washdown, treated petroleum contaminated groundwater, and stormwater	CSX Transportation	railroad transportation	11/30/13	internal ditch to Almonaster Avenue roadside ditch to Inner Harbor Navigational Canal

AI	Permit #	Outfall	Outfall Type	Facility name	Facility type	Expir. Date	Receiving waterbody
11010	LA0065307	003	intermittent process wastewater from equipment maintenance and washdown, treated petroleum contaminated groundwater, and stormwater as overflow from the equalization basin	CSX Transportation	railroad transportation	11/30/13	internal ditch to Almonaster Avenue roadside ditch to Inner Harbor Navigational Canal
14470	LAR05M754		MSGP stormwater	Stolt Offshore Inc	general agency interest	04/30/11	Michoud Canal to Intracoastal Waterway
14533	LAR05N830		MSGP stormwater	Area Auto & Truck Parts	wholesale trade-durable goods		ditches along Old Gentilly and Almonaster Road
28069	LAR05N448		MSGP stormwater	Acme Auto Wreckers	automotive repair, services, and parking	05/28/11	
28107	LAR05P201		MSGP stormwater	9130 Almonaster Site - Hamp Enterprises LLC	nonclassifiable establishments	04/30/11	Intracoastal Waterway
29947	LA0091201	001	stormwater runoff	Delgado Community College Fire School	educational services	09/30/14	Effluent pipe-Old Gentilly Road ditch-Michoud Boulevard ditch-Bayou Michoud
31002	LAR05M767		stormwater runoff	Whitney's Industrial Auto Wreckers Inc	not classified	05/03/16	Lake Pontchartrain
33961	LAR05N220		stormwater	Almonaster Salvage Yard	business corporation	05/03/16	Industrial Canal
40560	LAR05M515		stormwater	American Freightways Inc	motor freight transportation and warehousing	04/30/11	intracoastal canal
47316	LAG679102		hydrostatic test wastewater	FCC Environmental LLC	business services	01/31/13	Intracoastal Waterway
47316	LAR05N249		stormwater	FCC Environmental LLC	business services	04/30/11	Intracoastal Waterway
51479	LAR05M802		MSGP stormwater	Coleman's Auto Salvage	wholesale trade-durable goods	04/30/11	
51480	LAR05N930		MSGP stormwater	Raisinman Towing & Gulf South Automotive	automotive repair, services, and parking	12/31/12	Intracoastal Waterway
69984	LA0098272	001	carwash	Texaco 44-398-0112	auto dealers and gasoline service stations	No permit	Morrison Canal
80784	LA0123528	001	landfill wastewater and non-contact stormwater	Chef Menteur C & D Landfill	closed construction demolition debris & woodwaste landfill	08/27/13	Maxent Lagoon to Intracoastal Waterway to Lake Borgne
82006	LAU003967			Temple Auto Wreckers	electric, gas, and sanitary services		
83388	LAG110208	001	process wastewater and process area storm water from cement and concrete facilities	Lafarge North America Inc - New Orleans East Plant	stone, clay, glass, and concrete products	05/14/14	LAKE PONTCHARTRAIN
84174	LAR05N943		MSGP stormwater	The Real Industrial Auto Wreckers Inc	wholesale trade-durable goods	04/30/11	Intracoastal Canal
100068	LAR10G001		construction stormwater	St Mary's Academy - JLG Structures	educational services	10/14/14	Duyer Canal

AI	Permit #	Outfall	Outfall Type	Facility name	Facility type	Expir. Date	Receiving waterbody
100484	LAR05N621		MSGP stormwater	City Auto Wreckers Inc	automotive repair, services, and parking	04/30/11	LAKE PONTCHARTRAIN
101180	LAU003791			BAC of New Orleans	nonclassifiable establishments		
101633	LAR05N925		MSGP stormwater	B Automotive	auto dealers and gasoline service stations	12/13/12	parish ditch into Intracoastal Waterway Mississippi
102691	LAR05N347		MSGP stormwater	Magee & Son	nonclassifiable establishments	04/30/11	canal to Mississippi River
114425	LAU004961			Coleman's Wrecker Service	automotive repair, services, and parking		
121663	LAG532008	001	treated sanitary wastewater	USFWS - Bayou Sauvage National Wildlife Refuge	federal agency	11/30/12	Maxent Canal - Intracoastal Waterway
147019	LAR10G052		construction stormwater	Gaslight Apartments - Walton Construction Co LLC Southern	nonclassifiable establishments	09/30/14	Benson Canal
147517	LAR05N908		stormwater	SCC1 - SC Crushing LLC	nonclassifiable establishments	04/30/11	New Orleans MS4
147920	LAG490062	002	process wastewater and process area stormwater discharges into waterbodies designated for primary contact recreation	Chapel Hill LLC - Little Pine Island Dirt Pit	min. & quarrying of nonmet. min., exc. fuels	03/13/15	Settlement pond-unnamed ditch-LaGoon Maxent-Lake Borgne
150049	LAG533150	001	treated sanitary wastewater	JWA Trucking LLC	nonclassifiable establishments	11/30/12	Local drainage-parish pumping station-Mississippi River Gulf Outlet
157717	LAR10H378		construction stormwater	Fannie C. Williams School	educational services	10/09/16	Storm sewer to Lake Pontchartrain
158530	LAR10F184		construction stormwater	IHNC Field Management Office/Vulcan Yard - Shaw Environmental & Infrastructure	nonclassifiable establishments	02/13/15	Michoud Canal - Gulf Intracoastal Waterway
159486	LAR10F258		construction stormwater	US Coast Guard Integrated Support Command Facility - NASA Michoud Assembly Facility	nonclassifiable establishments	09/30/14	Intercoastal Waterway
161169	LAR10F385		construction stormwater	Southeast LA Urban Flood Control Project - USArmy Corps of Engineers PM-RP	nonclassifiable establishments	09/30/14	Dwyer canal into the Inner Harbor Navigation Canal
161284	LAR10F416		construction stormwater	Xperts Gulf LLC - Earthen Channel Within Levee - Ray Alexis Miranda	nonclassifiable establishments	09/30/14	LAKE PONTCHARTRAIN
161371	LAR10F398		construction stormwater	SE LA Urban Flood Control Project Dwyer Rd Intake Canal - Hill Brothers Construction Co Inc	nonclassifiable establishments	02/13/15	Dwyer Canal - Inner Harbor Navigational Canal
161687	LAR10F426		construction stormwater	Inner Harbor Navigation Canal Hurrican Protection System - Shaw Environmental & Infrastructure	nonclassifiable establishments	09/30/14	Bayou Bienvenue to Gulf Intracoastal Waterway to Mississippi Gulf Outlet

AI	Permit #	Outfall	Outfall Type	Facility name	Facility type	Expir. Date	Receiving waterbody
166208	LAR05P173		stormwater	Lafarge North America - Hagan Plant	stone, clay, glass, and concrete products	04/30/11	Intracoastal Waterway
167124	LAG490106	002	process wastewater and process area storm water	Delta Mining Co LLC - East Over Lake	min. & quarrying of nonmet. min., exc. fuels	01/31/15	pipe to noname ditch to Connon Canal to Dwyer Canal/Inner Hagor to Lake Pontchartrain
167564	LAR10G024		construction stormwater	USACE - New Orleans District - Contract # W912P8-08-D-0037,000	nonclassifiable establishments	09/30/14	Michoud Canal/MRGO GIWW
169025	LAR05P239		MSGP stormwater	K M Construction Inc	wholesale trade-durable goods	04/30/11	Industrial Canal
170344	LAG119045	001	stormwater	Metro # 2 Con-E-Co - Metro Materials Inc	nonclassifiable establishments	03/14/14	
171246	LAR10G512		construction stormwater	Lakefront Airport T-Walls LVP 105.01 West NO East - RCG Enterprises Inc	nonclassifiable establishments	09/30/14	City drainage system-Lake Pontchartrain
171621	LAR10G568		construction stormwater	LPV-105.02 East Reach Lakefront Airport T-Walls - David Boland Inc	nonclassifiable establishments	09/30/14	Lake Pontchartrain

Table A-2. Terminated point source discharge permits

AI	Permit #	Facility name	Facility type	Expiration date
2291	LAG470055	Banner Chevrolet Inc	Auto dealers and gasoline service stations	Terminated 1/29/2003
5351	LAR05M114	Former Louisiana Army National Guard - AASF #1	State agency	Terminated 03/09/2009
9886	LAR05M298	UPS Freight (NOR)	Motor Freight Transportation and Warehousing	Cancelled 2/6/07
24326	LA0108111	Triple E Transport Inc	General agency interest	Terminated
24545	LAR05M339	Chemical Express	General agency interest	Terminated 8/21/06
40519	LAR05M196	Air Reldan Inc	General agency interest	Terminated 1/4/06
40658	LAR05M115	Aviation Bus Jet Center	General agency interest	Terminated
40905	LAR05M311	Cal Hingle Auto & Truck Inc	Automotive Repair, Services, and Parking	Terminated 06/15/2006
41607	LAR05M117	General Aviation of No Inc	General agency interest	Terminated 12/12/07
42517	LAR05M118	Million Air New Orleans	General agency interest	Terminated 03/14/2008
42893	LAR05M334	Praxair Inc CO2 - Dry Ice	General agency interest	Terminated
43494	LAR05M197	Taylor Energy Co LLC	General agency interest	Terminated 09/11/2006
80784	LAR10D485	Chef Menteur C&D Disposal Facility	Electric, Gas, and Sanitary Services	Terminated 02/26/2010
86751	LAG480059	Global Lime Calciner of LA LLC	Stone, Clay, Glass, and Concrete Products	Terminated 9/18/2006
107401	LAR10C119	Crescent Crown Distribution Center	Nonclassifiable establishments	Terminated 02/17/2010
119266	LA0119652	Crescent City Power LLC - Crescent City Power	Electric, gas, and sanitary services	Request for termination 10/30/2006
151017	LAR10E243	Lowes of New Orleans East - Donahue Favret Contractors Inc -	Nonclassifiable establishments	Terminated
162692	LAR10F558	Maynard Borrow Pit - Hamps Construction LLC	Nonclassifiable establishments	Terminated
162746	LAR10F568	Lawrence Canal New Orleans LA - American Contractor & Technology Inc - Sediment Removal	Nonclassifiable establishments	Terminated 2/3/10

APPENDIX B: Monitoring Data Tables and Plots

Tables

Figures

Table B-1. In situ data collected during the July 2009 intensive survey

Site ID	Site name	Date	Time	Depth (m)	Temp. (°C)	DO (mg/L)	Specific conductivity (µmhos/cm)	pH (su)	Secchi depth (m)
LAWR-1	Lamb Canal at Lamb Rd. and I-10 ramps	7/10/09	19:11	0.38	31.3	1.9	619	7.6	
LAWR-2	Morrison Canal at Morrison Rd. and I-10 ramps	7/10/09	17:51	0.1	34.0	18.3	1934	9.0	
LAMB-1	Morrison Canal at Martin Dr.	7/10/09	11:00	0.46	29.1	1.6	1333	7.2	0.76
LAMB-1-D	Morrison Canal at Mayo Blvd.	7/10/09	11:15	0.46					
MORR-1	Morrison Canal on west side of Crowder Blvd.	7/10/09	9:54	0.38	29.0	2.0	1664	7.1	
MORR-2	Lawrence Canal on north side of Dwyer Rd.	7/10/09	14:05	0.1	34.0	15.8	2000	9.3	0.37
MORR-3	Lawrence Canal on south side of Morrison Rd.	7/10/09	16:20	0.46	35.3	18.0	1845	9.3	
MORR-4	St. Charles Canal on north side of Dwyer Rd.	7/10/09	17:45	0.37	33.6	19.1	1957	9.1	
STCH-2	St. Charles Canal on south side of Morrison Rd.	7/10/09	20:00	0.53	31.7	16.3	1884	8.8	
STCH-3	St. Charles Canal 0.09 mi upstream of pump station	7/10/09	15:20	1.0	30.9	10.3	1935	8.2	0.24

Table B-2. Water quality data from July 2009 intensive survey

Site ID	Site name	Date	Time	TKN (mg/L)	NH3 (mg/L)	NO2+ NO3 (mg/L)	Total Phos. (mg/L)	Ortho Phos. (mg/L)	Chloro-phyll a (µg/L)	TSS (mg/L)	TOC (mg/L)
LAWR-1	Lamb Canal at Lamb Rd. and I-10 ramps	7/10/09	19:11	3.75	1.55	0.63	0.594	0.349	4	15	5.1
LAMB-1	Morrison Canal at Martin Dr.	7/10/09	11:00	1.87	0.93	0.409	0.358	0.225	4	8	4.3
LAMB-1-D	Morrison Canal at Mayo Blvd.	7/10/09	11:15	2.03	0.96	0.383	0.371	0.232	3	7	4.4
MORR-1	Morrison Canal on west side of Crowder Blvd.	7/10/09	9:54	2.02	1.03	0.379	0.327	0.186	5	7	3.6
MORR-3	Lawrence Canal on south side of Morrison Rd.	7/10/09	16:20	2.08	<0.10	<0.040	0.498	0.151	42	38	6.1
MORR-4	St. Charles Canal on north side of Dwyer Rd.	7/10/09	17:45	2.07	<0.10	<0.040	0.579	0.235		34	6.4
STCH-2	St. Charles Canal on south side of Morrison Rd.	7/10/09	20:00	3.36	<0.10	0.059	0.522	0.146	98	27	5.9
STCH-3	St. Charles Canal 0.09 mi upstream of pump station	7/10/09	15:20	3.91	<0.10	0.051	0.524	0.183		33	5.0

Table B-3. CBOD monitoring results from July 2009 intensive survey

Site ID	Site name	Date	Time	CBOD Day 2 (mg/L)	CBOD Day 5 (mg/L)	CBOD Day 9 (mg/L)	CBOD Day 14 (mg/L)	CBOD Day 20 (mg/L)	CBOD Day 27 (mg/L)
LAWR-1	Lamb Canal at Lamb Rd. and I-10 ramps	7/10/09	19:11	5	7	8	11	16	28
LAWR-2	Morrison Canal at Morrison Rd. and I-10 ramps	7/10/09	17:51						
LAMB-1	Morrison Canal at Martin Dr.	7/10/09	11:00	<2	2	3	4	7	16
LAMB-1-D	Morrison Canal at Mayo Blvd.	7/10/09	11:15	<2	<2	2	3	7	12
MORR-1	Morrison Canal on west side of Crowder Blvd.	7/10/09	9:54	<2	2	3	3	4	15
MORR-2	Lawrence Canal on north side of Dwyer Rd.	7/10/09	14:05						
MORR-3	Lawrence Canal on south side of Morrison Rd.	7/10/09	16:20	8	16	21	32	35	42
MORR-4	St. Charles Canal on north side of Dwyer Rd.	7/10/09	17:45	7	15	21	37	46	53
STCH-2	St. Charles Canal on south side of Morrison Rd.	7/10/09	20:00	5	9	12	16	28	41
STCH-3	St. Charles Canal 0.09 mi upstream of pump station	7/10/09	15:20	6	13	17	21	30	40

Table B-4. Available data for station 1051 (St. Charles Canal at Morrison Rd., New Orleans, Louisiana)

Parameter	Period of record	No. of Obs.	Minimum	Maximum	Average
dissolved oxygen (mg/L)	3/6/01–9/24/07	23	1.08	9.08	5.55
nitrite+nitrate (mg/L)	3/6/01–9/24/07	23	0.14	1.07	0.46
total Kejldahl nitrogen (mg/L)	3/6/01–9/24/07	23	0.37	2.93	1.67
total phosphorus (mg/L)	3/6/01–9/24/07	23	0.17	0.61	0.34
water temperature (°C)	3/6/01–9/24/07	23	11.4	31.0	22.8

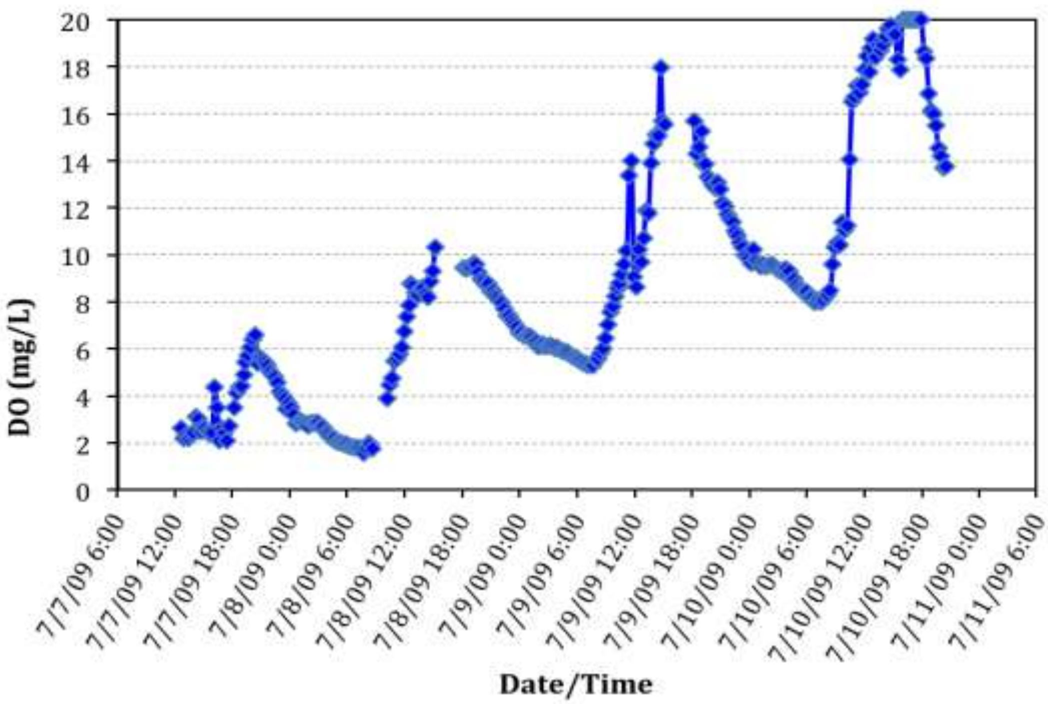

Figure B-1. Continuous dissolved oxygen data observed at STCH-2 (St. Charles Canal).

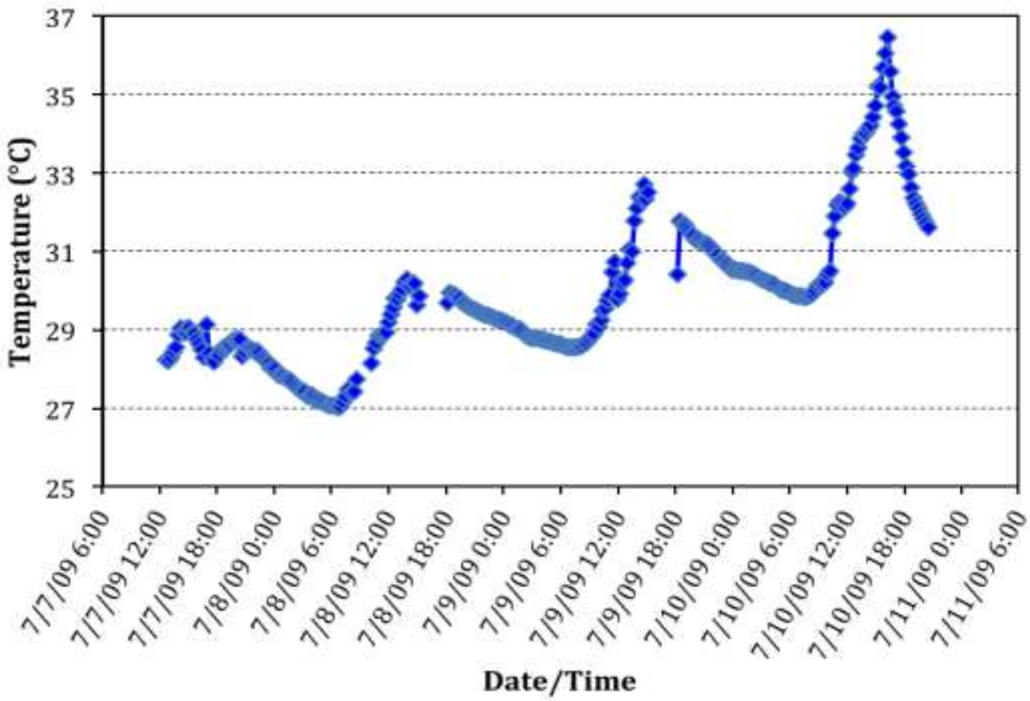

Figure B-2. Continuous temperature data observed at STCH-2 (St. Charles Canal).

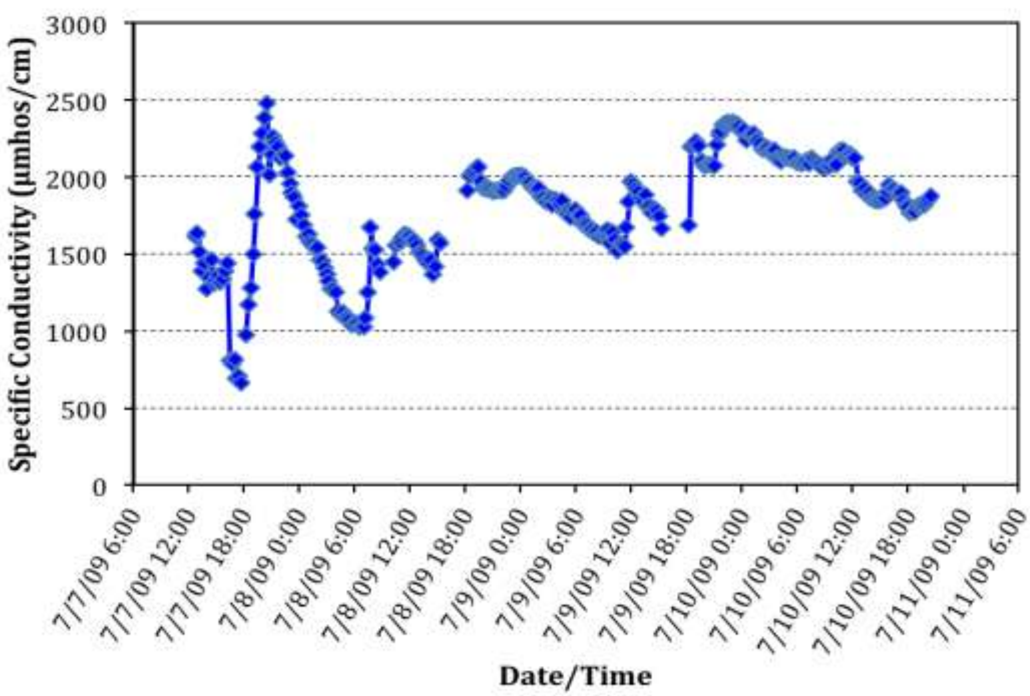

Figure B-3. Continuous specific conductivity data observed at STCH-2 (St. Charles Canal).

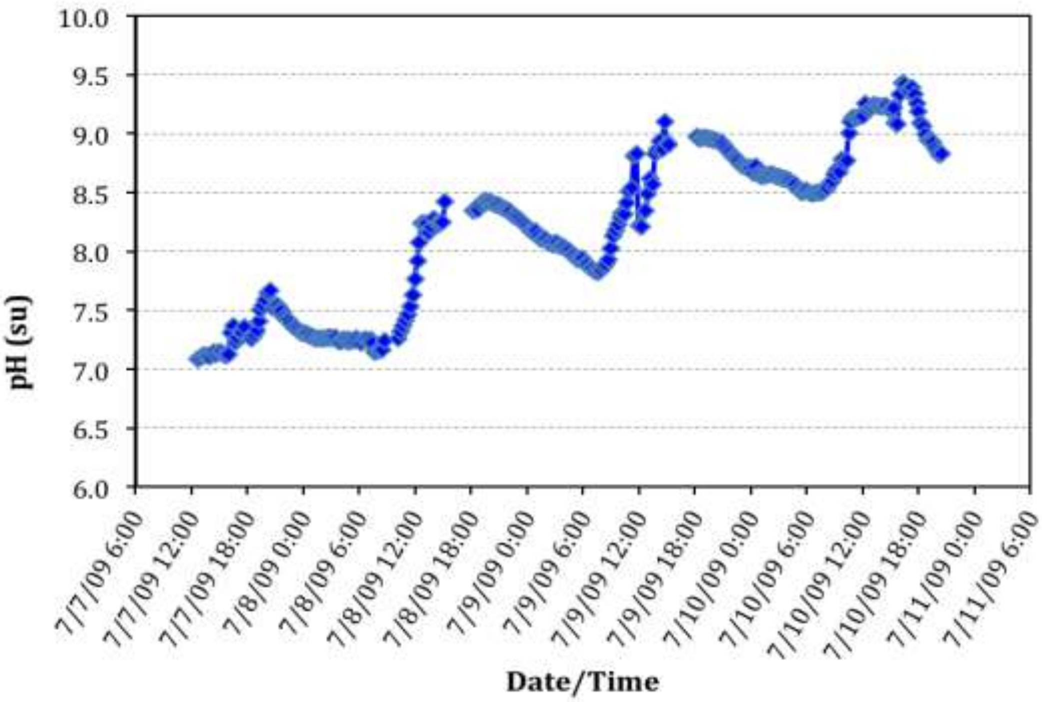

Figure B-4. Continuous pH data observed at STCH-2 (St. Charles Canal).

APPENDIX C:
Field Survey Notes
(CD-ROM)

This appendix contains large files, which are provided only on a CD-ROM. To obtain a copy of this appendix, please contact EPA.