Bayou Plaquemine Brule Watershed Implementation Plan

Watershed Sub-segment 050201

Louisiana Department of Environmental Quality
Water Quality Assessment Division
2008

EXECUTIVE SUMMARY

The Bayou Plaquemine Brule flows through the Mermentau River Basin and is classified by the state as water quality sub-segment 050201. The water body has been included on the state's 303(d) list of impaired waters because it does not meet the fish and wildlife propagation (FWP) or the contact recreational uses. This means that the nonpoint source pollutant (NPS) load entering the bayou is too high and will need to be reduced in order to meet water quality standards for dissolved oxygen, fecal coliform bacteria and nutrients. In order to determine how much of this nonpoint load needs to be reduced, the Louisiana Department of Environmental Quality (LDEQ) and the U.S. Environmental Protection Agency (USEPA) Region 6 developed total maximum daily loads (TMDLs) for the bayou.

The TMDL indicated that in order to meet water quality standards for dissolved oxygen (DO) of 5 mg/l in the winter and 3mg/l in the summer, there will need to be a 50% reduction of man-made NPS in the upper reaches of the watershed and 30% in the main channel. In order to understand how that load reduction can be reduced and water quality standards met, LDEQ worked with many partners on a watershed implementation plan for Bayou Plaquemine Brule. This plan was originally written in 1999-2000 but has been revised in 2008 to meet the 9 key elements of USEPA's Guidelines for Watershed Plans. There has been substantial work done in the Bayou Plaquemine Brule watershed by the agricultural agencies to assist the farmers with implementation of more than 70,000 acres of best management practices (BMPs). There has also been a substantial effort made by the farmers and landowners that live in the watershed who have participated in the project by implementing the practices and allowing edge of field data collection to be gathered on the effectiveness of the BMPs. Louisiana State University (LSU) and University of Louisiana at Lafayette (UL) have gathered in-stream and edge of field water quality data to determine if BMP implementation has been effective and if the load reductions that were calculated in the TMDL process can be achieved.

The results of water quality data collected from two sub-watersheds, Bayou Wickoff and Cole Gully, indicated that the BMPs could reduce nonpoint source loading sufficiently to meet water quality standards. The monitoring from Cole Gully indicated that approximately 80% of the farmers were implementing BMPs for soybean and rice practices, which would result in a 40% reduction in nonpoint source loads. The monitoring from Cole Gully indicated that suspended solids and turbidity could be reduced by 65% and 58%, respectively when rotational grazing was used instead of continuous grazing. The runoff from rotationally grazed sites was consistent with reference sites, indicating that this BMP was effective. Total phosphorus and dissolved phosphorus were also reduced by 49% and 40%, respectively, with rotational grazing. The monitoring of sugarcane sites indicated that leaving mulch residue on the fields after harvest resulted in a 34% reduction in total solids, a 26% reduction in suspended solids, a 60% reduction in turbidity and an 8% reduction in phosphorus when compared to fields where the residue was burned.

These watersheds in the Mermentau River Basin are primarily utilized for rice and crawfish production, both of which utilize a large amount of water. Therefore, it is a challenge to find the right combination of management practices that can be utilized on these fields to reduce

the pollutant loads to the bayous. Based on the work that has been done on evaluating the effectiveness of best management practices (BMPs) and on watershed modeling, LDEQ recommends dry land or clear field planting for rice, more efficient water management methods for crawfish production, conservation tillage for soybeans, and retaining mulch on sugarcane fields during the fallow season and rotational grazing for cattle. If these BMPs are implemented throughout the watershed with special attention given to the areas of highest loading, the models indicated that the pollutant reduction goals estimated in the TMDL could be reached by 2012-2013. The map that has been included on page 28 illustrates the parts of the watershed that contribute the largest loads to Bayou Plaquemine Brule. The map that has been included on page 33 illustrates how those high loading areas can be reduced with soybean and rice BMPs. Therefore, these areas should be prioritized for BMP implementation through the Farm Bill programs such as Environmental Quality Incentive Program (EQIP), the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). When incremental Section 319 funds are utilized for BMP implementation, they should also be applied in these targeted areas and tracked by LDEQ, LDAF and USDA to see if load reductions are occurring and water quality is improving as a result of expenditure of federal funds. LDEQ collected data in 2008 and will utilize those data to determine whether progress has been made in improving water quality. Data will be collected again in 2012 in order to determine if the water quality standards have been met and designated uses restored. The NPS Management Plan indicated that this was a realistic schedule to measure in-stream water quality improvement in this part of the state. LDEQ and its partnering agencies will be working with local stakeholders in the watershed during the next four years in order to meet the water quality goals that have been outlined within this watershed plan.

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1.0 IMPLEMENTATION PLAN FOR BAYOU PLAQUEMINE BRULE WATERSHED

1.1 INTRODUCTION

The purpose of the watershed implementation plan for Bayou Plaquemine Brule is to describe the water quality problems that exist and to outline a management strategy to reduce those problems in order to restore the bayou to its designated uses by 2012-13. Bayou Plaquemine Brule is not currently meeting its designated uses for contact recreation or fish and wildlife propagation. Therefore, the bayou was included on the state's 303(d) list of impaired waters which required that a total maximum daily (TMDL) be developed. In 1999, the Louisiana Department of Environmental Quality (LDEQ) and the Environmental Protection Agency (EPA) developed Total Maximum Daily Loads (TMDLs) for DO, nutrients, and fecal coliform bacteria. A TMDL report measures the pollutant load within a water body and determines how far it exceeds water quality standards. The report discriminates between point source loads and nonpoint source (NPS) loads. The TMDL for Bayou Plaquemine Brule required lower LPDES permit limits (point source loads) for the large dischargers in the watershed and the Watershed Implementation Plan describes how to reduce NPS loading. These plans are the basis for outlining how and where NPS programs should focus their effort and resources within the watershed in order to achieve use attainment by the year 2012-13. In agricultural watersheds, such as Plaquemine Brule, LDEQ recommends implementation of clear field rice, conservation tillage for soybeans, rotational grazing for pastures and mulch on sugarcane fields during the fallow season for reducing pollutant runoff from agricultural lands. Water quality modeling and edge of field data collection has indicated that these practices would reduce the nonpoint source pollutant load by 50-60%. These reductions should result in water body standards being met and the designated uses restored. Hydromodification, home sewerage, and urban runoff also contribute to low DO conditions and high fecal coliform counts. Therefore, BMPs for these NPS pollutant sources are presented in this plan as well.

In addition to the TMDL for D.O., EPA developed a TMDL for fecal coliform bacteria. The load reduction needed to meet water quality standards for primary contact recreation was 83% during the recreational period (May 1 to October 31). The load reduction needed to meet water quality standards for secondary contact recreation was 73% during the non-recreational period (November 1 – April 30). Best management practices to reduce fecal coliform bacteria from agriculture, urban and individual home sewage systems are included in this watershed management plan.

1.2 DO AND NUTRIENT TMDL FINDINGS

The DO TMDL reported that NPS pollution accounts for 90.9% of the man-made pollutant load in the summer and 86.9% in the winter. As mentioned previously in this report, the TMDL estimated that compliance with the criteria 5 mg/l (winter) and 3mg/l (summer) will require a 50 % reduction of man-made NPS in the upper reaches of the watershed and 30% in the main channel. Agricultural activities account for 89% of the total landmass in the watershed. More stringent effluent limitations will be applied to the larger point source dischargers in the watershed.

1.3 FECAL COLIFORM TMDL FINDINGS

The Bayou Plaquemine Brule and its tributaries do not meet the primary or the secondary contact recreation uses because of high concentrations of fecal coliform, however, the bayou meets criteria for drinking water supply. As mentioned previously, the load reduction needed to meet the water quality standard for primary contact recreation in the watershed during the recreational period (May 1 – October 31) is 83% reduction. For secondary contact during the non-recreational period (November 1 – April 30), the load reduction needed is 73%. More stringent limitations on point sources of fecal coliform will not be required. LDEQ regulations already require that point discharges of sanitary waste must maintain a fecal coliform count in effluents of 200 cfu/100 mL. In other words, point sources already meet criteria at the end-of-pipe. Reductions in NPS loadings, once they are identified, will need to be reduced in order to meet the primary and secondary contact recreation criteria.

1.4 TIMELINE FOR IMPLEMENTATION PLAN

This document outlines a watershed implementation plan to reduce NPS pollutants from reaching the waterways by 30% in the lower reaches and 50% in the upper reaches. LDEQ samples each watershed in the state once every 4 years to see if the water bodies are meeting water quality standards. Watershed sampling began in 1978 in the Bayou Plaquemine Brule, but the basis for this work is the court ordered list from 1998-99. Water quality sampling was done in 1998 as a baseline from which to implement this watershed implementation strategy. Data was collected again in 2003 to determine if water quality had improved; data will be collected again in 2008, and in 2012 to track water quality improvements. Additional BMPs will need to be implemented, as necessary, beginning in 2009 until water quality standards are achieved. The data from 1998 was considered baseline from which to measure the rate of the water quality improvement in samples taken in subsequent years. During the years 2002-2005, LDEQ and University of Lafayette (ULL) and Louisiana State University (LSU) targeted drainage areas to install BMPs. These targeted drainage areas were sampled to determine the effectiveness of BMPs (see figure 1.1). The data collected in 2008 will be used to determine if the implementation of management measures in the Watershed Implementation Plan has been effective.

USEPA has issued several guidance documents to assist the states and local watershed groups on key components of a watershed implementation plan. Their FY 2004 Section 319 Guidelines included nine key elements that the states should include in all watershed plans that request Section 319 funds for their implementation. These nine key elements are summarized here:

1. Identify the causes and sources of the of pollutants that will need to be controlled within the watershed;
2. An estimate of the pollutant load reduction that is expected from the BMPs or management measures for each of the sources or causes identified within the watershed;
3. A description of the nonpoint source management measures or BMPs that will need to implemented for each source and cause of NPS pollution within the watershed;

4. An estimate of the technical and financial assistance needed to implement the BMPs within the watershed;
5. An information/education component that will be needed to enhance public understanding of the problems and BMPs that need to be implemented;
6. A schedule for implementing the NPS management measures or practices;
7. A description of interim, measureable milestones for determining whether BMPs or management measures are being implemented;
8. A set of criteria that can be utilized to determine whether load reductions are being achieved;
9. A monitoring component to evaluate the effectiveness of implementation efforts over time.

One of the nine key elements in USEPA's Guidelines for Watershed Plans is to include a schedule for implementing the nonpoint source management measures or BMPs that have been recommended through this watershed plan. LDEQ described the timeline for watershed implement in the NPS Management Plan, but has included this description as the timeline that LDEQ hopes to see water quality improvement in this part of the state as a result of watershed implementation. In order to track progress made in BMP implementation, LDEQ has provided annual summaries of BMPs implemented through Farm Bill Programs and Section 319 Programs in the NPS Annual Report. This annual tracking and reporting are the interim milestones that LDEQ utilizes to comply with what USEPA has requested in the nine key elements for successful watershed planning. LDEQ has utilized the water quality data from their watershed based ambient monitoring program to determine if nonpoint source pollutant loadings have occurred as a result of watershed implementation. The criteria for measuring progress are water quality standards for fecal coliform bacteria and dissolved oxygen. Once the water body meets these criteria, it can be delisted and removed from the water quality impairment list. These water quality criteria are included in Table 1.1.

Table 1.1 The Attainable and Designated Uses of the Bayou Plaquemine Brule are the numerical criteria to insure Louisiana's waterways maintain safe levels for human health, propagation of fish and wildlife, and maintenance of recreational uses. As you can see from the table below, the bayou Plaquemine Brule is not meeting criteria for primary and secondary recreation and the criteria for the propagation of fish and wildlife (DO standards).

Use Attainability and Designated uses of the Bayou Plaquemine Brule

Water body	NPS related parameters for which numerical standards have been developed	Standard (From LDEQ Environmental Regulatory Code)	Does water body meet standard? (From 2000 305(b) Report)	Constituents for which TMDLs will be developed (From 1998 Court Ordered 303(d) list) [3]
Bayou Plaquemine Brule	Primary Contact Recreation	[1]	Not	Lead, Mercury, Phosphorus, Nitrogen, Organic Enrichment/Low D.O., Pathogen Indicators, Turbidity, Suspended Solids, Salinity/TDS/Chlorides/Sulfates, Oil and Grease, Ammonia, Siltation
	Secondary Contact Recreation	[2]	Not	
	Dissolved Oxygen	5 mg/l	Not	
	Total Dissolved Solids	500 mg/l	Partially	
	Chloride	45 mg/l	Fully	
	Sulfate	30 mg/l	Fully	
	pH	6.0-8.5	Fully	
	Temperature ºC	32	Fully	
	Turbidity	150	Insufficient Data	

[1] Based on a minimum of not less than five samples taken over not more than a 30-day period. Fecal coliform count should be less than 200 /100ml over a 30-day period, and less than 10 % of samples during any 30-day period or 25 % of total samples collected annually can exceed 400/100ml. Applies only May 1 – Oct. 31, otherwise, criteria for secondary contact recreation applies.

[2] Based on a minimum of not less than five samples taken over not more than a 30-day period Fecal coliform count should be less than 1000 /100ml in at least 5 samples taken over a 30-day period, and less than 10 % of samples during any 30-day period or 25 % of total samples collected annually can exceed 400/100ml.

[3] It should be noted that TMDL listings were based on information dating back to 1992. A water body may meet standards for a particular constituent in the 2000 305(b) Report, but may require a TMDL due to failure to meet standards in a previous year. In addition, a water body may be listed due to its failure to meet certain narrative criteria.

1.5 DESCRIPTION OF BAYOU PLAQUEMINE BRULE WATERSHED

The Bayou Plaquemine Brule watershed is a 372 sq mile area located in South Louisiana. Historically, the watershed encompassed a prairie region peppered with small clusters of hardwood forest. Currently, rice, sugarcane, soybean and crawfish production are the major agricultural activities in the watershed. Pastureland that supports livestock production, primarily beef cattle, is also common in the watershed. Silt loams, formed on Pleistocene terraces, with very slowly permeable sub-soils, are the dominant soil types in the watershed. The watershed is comprised of Bayou Plaquemine Brule as the main stem with several tributaries. These tributaries include Hazelwood Gully, Cole Gully, Long Point Gully, Bayou Wikoff, Bayou Blanc and North Coulee Trief. The average annual precipitation in the watershed, based on a 30-year record at the nearest Louisiana Climatic Station in Crowley, is 57 inches (LSU State Office of Climatology). The main urban areas in the watershed include Crowley, Rayne, Esterwood, Lawtell and Church Point. All of these population centers have less than 50,000 citizens. In the watershed, agriculture accounts for 81% of land-uses, and remaining land-use types include urban (7%), forest land (10%), wetlands (2.0%), others (1%) (LDEQ, 1990). Elevations range from mean sea level in the flood plain near the watershed outlet to 70 ft above mean sea level in the northernmost part. The Bayou Plaquemine Brule is 55 miles long and the flow conditions change in a downstream direction from ephemeral to intermittent, then perennial.

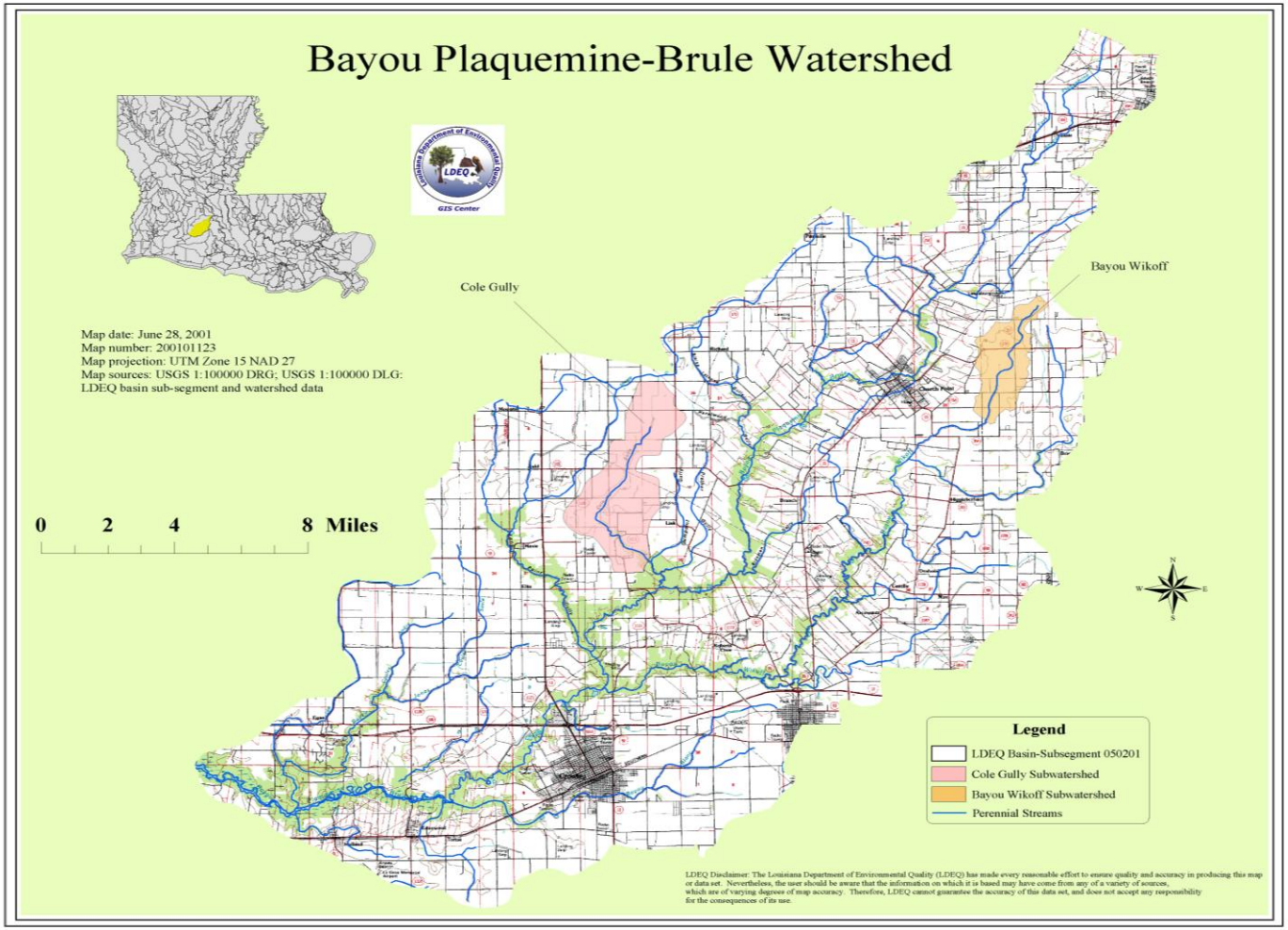


FIGURE 1.1 Bayou Plaquemine Brule watershed is located in Southern Louisiana and is primarily comprised of agricultural lands of which rice, soybeans, crawfish, and pasturelands constitute the majority of crops raised in the area. The two highlighted areas above, Cole Gully and Bayou Wikoff, are currently being monitored for NPS agricultural runoff.

Figure 1.2 This picture was taken about midway down the 55 miles long Bayou Plaquemine Brule. As can be seen there is very little slope and flow, and the water is quite turbid.

1.6 DESCRIPTION OF LOUISIANA ECO-REGIONS

The Bayou Plaquemine Brule watershed is located in the Western Gulf Coastal Plain Eco-region (WGCPE). The WGCPE lies between the southern boundary of the South Central Plains Eco-region (SCPE) and the Coastal Chenier Plain Eco-region to the south (Figure 1.3). The WGCPE consists of several vegetation types including, at its transition with the SCPE, longleaf pine flatwoods. Historically, 60-70% of the WGCPE has been a seasonally wet prairie. The prairie was maintained as a mosaic of treeless plains and treed river corridors by the presence of an impermeable, calcareous clay layer that prevented percolation downward or capillary action of water upward into the shallow soils. Disjunction of this clay layer at stream margins allows trees to grow for a few hundred feet on either side of the stream. The clay allows water to stand during wet seasons, permitting the dominant land-use of the area, rice culture.

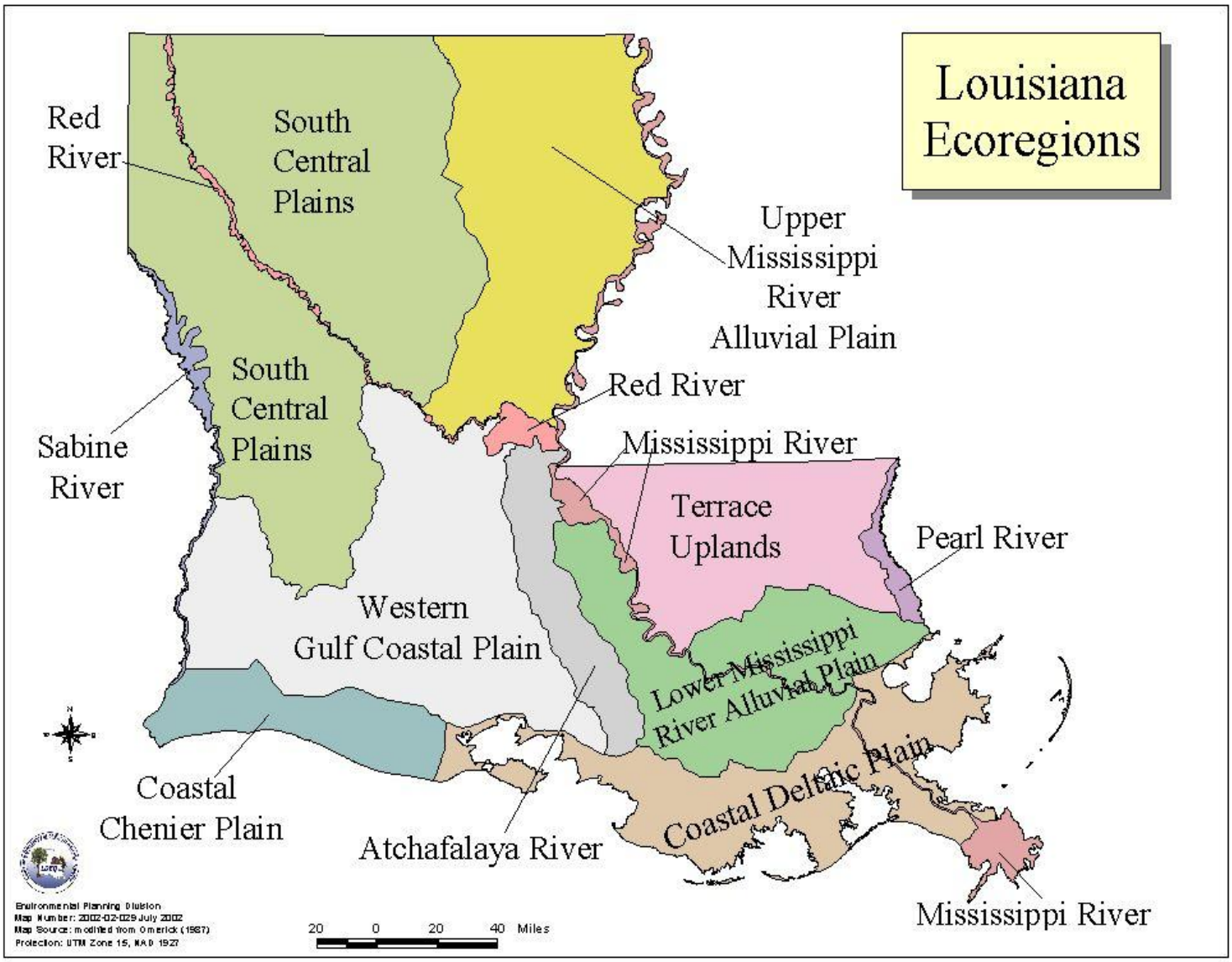


Figure 1.3 The State of Louisiana is divided into 12 Eco-Regions characterized by unique soils, fauna, and agricultural crops. The Bayou Plaquemine Brule is located in the Western Gulf Coastal Plains.

1.7. Identification of Causes of Impairment That Need to Be Controlled to Achieve Needed Load Reduction and Restore Designated Uses for Contact Recreation and Fish and Wildlife Propagation

The first element in EPA's 9 key elements for Watershed Planning is to describe the sources or groups of sources that need to be controlled in order to restore the water body to its designated uses. In order to meet this first element, LDEQ worked with the Local Soil and Water Conservation Districts and the Natural Resource Conservation Service on a detailed crop-level mapping system for Bayou Plaquemine Brule. The purpose of this mapping system was to gain a better understanding of the diversity of agricultural crops that exist within the watershed. This information can be layered into a watershed model such as AnnAGNPS or SWAT in order to target which parts of the watershed need the highest level of treatment with BMPs to reach the water quality goals for fish and wildlife propagation. The maps and

charts included in this plan were based on field work and satellite imagery classification from 1999 to coincide with the date of the TMDL Bayou Plaquemine Brule. These data indicated that rice, crawfish, soybeans and pastures were the primary crops in the middle and lower portion of the watershed and pastures and small grain crops dominate the upper portion of the watershed. Table 1.2 indicates acreage of each crop type. These cropping patterns have changed since 1999 and will be sampled again in 2008 to update the land-use data to reflect current conditions.

Table 1.2
Types of Crops and Acreage for Bayou Plaquemine Brule in 1998-99*

Crops	**Acreage**
Corn	2394 acres
Forest	23,936 acres
Pasture/Idle	64,627 acres
Rice/Crawfish	62,234 acres
Soybeans	62,234 acres
Sugarcane	2394 acres
Urban	16,755 acres
Water	4786 acres
Total	**239,360**

*These data will be revised in 2008-2009

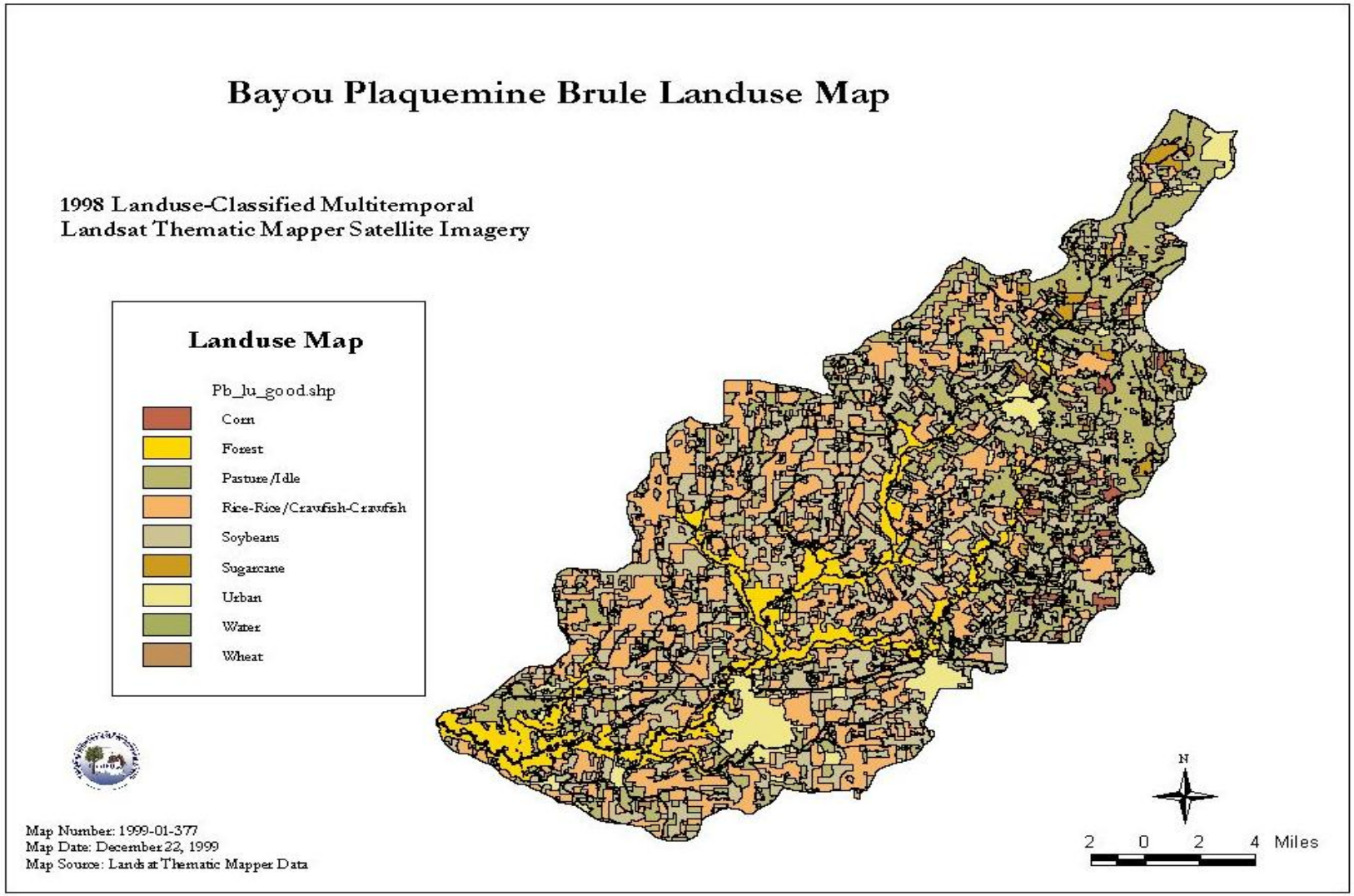


Figure 1.4 Land-use map of Bayou Plaquemine Brule. Pasture is the predominant landuse in the NE sector of the watershed and rice and soybeans are the predominate crops in the lower SW sector of the watershed.

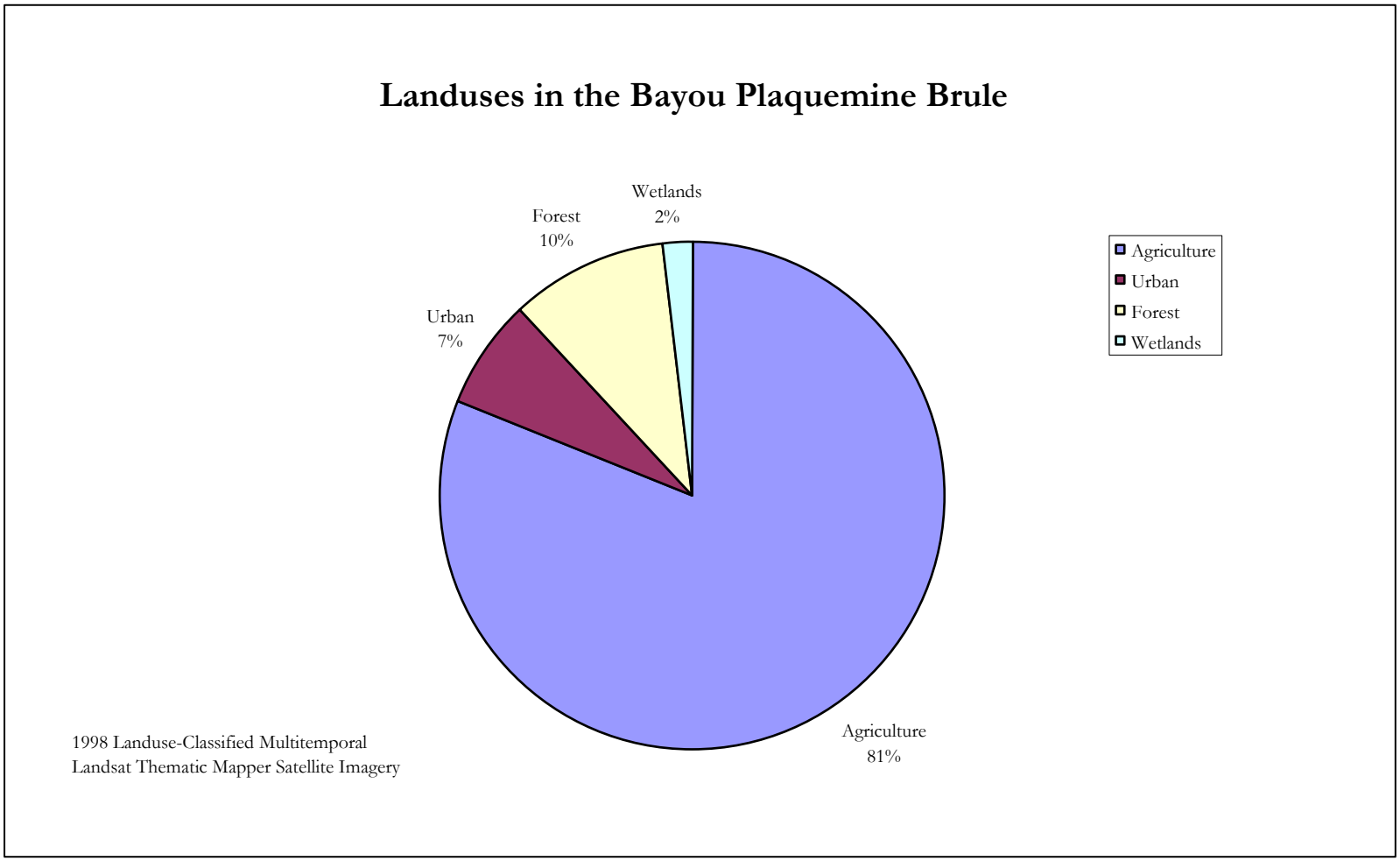


Figure 1.5 Agricultural practices compose 81% of the land-uses in the Bayou Plaquemine Brule watershed.

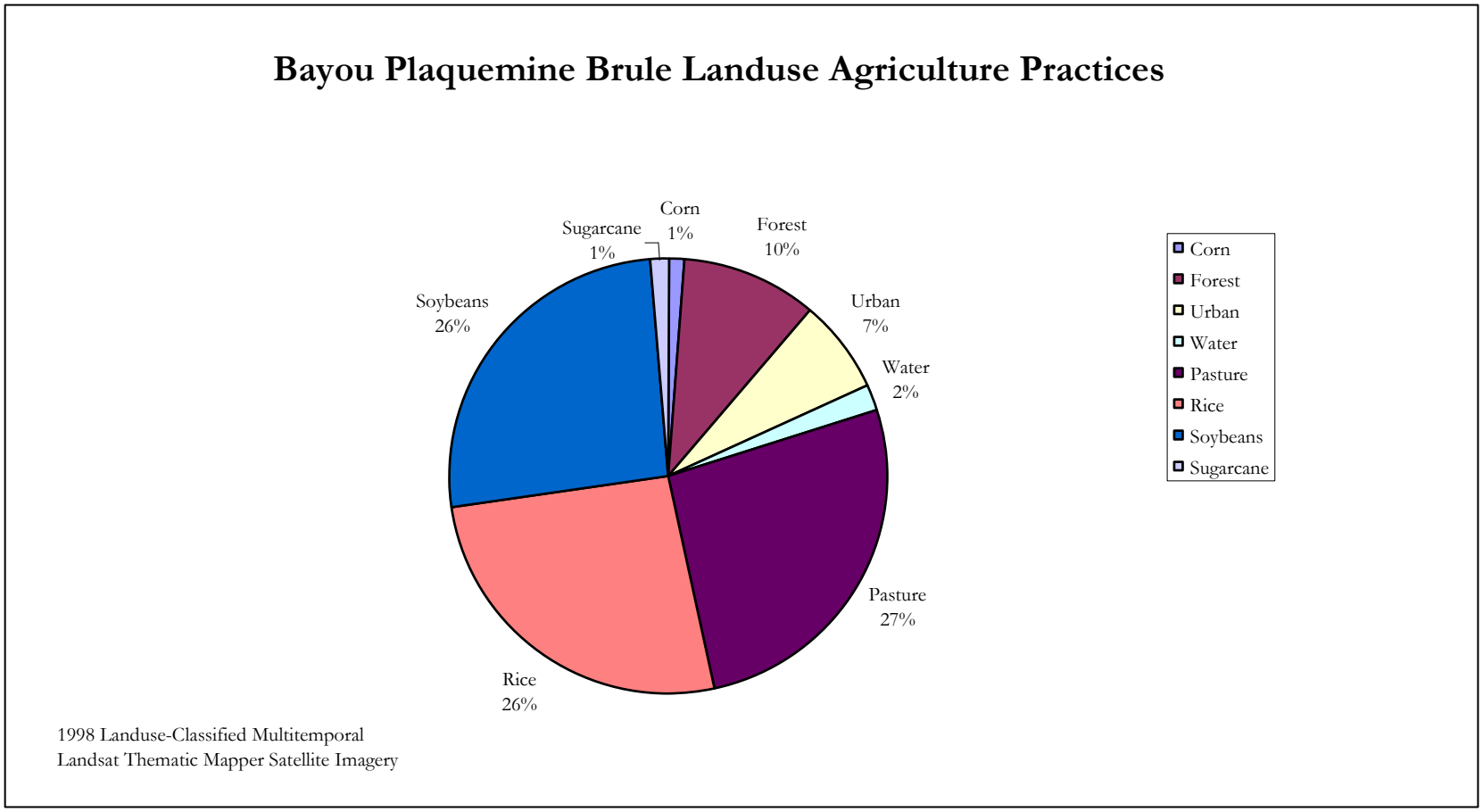


Figure 1.6 Agricultural practices are almost equally divided between rice, soybeans, and pasture. Rice and soybeans are commonly rotated with each other in the fields in the lower SE sector of the watershed.

1.8 NONPOINT SOURCE (NPS) LOADINGS INTO THE PLAQUEMINE BRULE WATERWAYS

In addition to identifying the types of land-uses that exist within the watershed, LDEQ utilized the AnnAGNPS watershed model to estimate the level of nonpoint source loads that are associated with each type of land-use. The Bayou Plaquemine Brule is comprised of agricultural lands, forested riparian areas along the stream banks, urban and rural residential areas and pastures. When the land-use was classified in 1998, agricultural rice fields rotated with soybeans were the dominant crops grown, primarily in the southern portions of the watershed. The AnnAGNPS Watershed model indicated that 91% of the nonpoint source pollutant load was associated with these crops. Pastures represented 27% of the land area within the watershed and 4% of the pollutant load. The urban communities represented 7% of the land area and 4% of the pollutant load and the forested riparian areas represented 10% of the land area and 1% of the pollutant load. Therefore, it is apparent that implementing agricultural BMPs will be the basis for nonpoint source pollutant reduction within the Bayou Plaquemine Brule Watershed. These lands will be classified and mapped again during 2008-2009 to coincide with the ambient water quality monitoring cycle.

1.8.1 AGRICULTURE

The primary agricultural crops in the Bayou Plaquemine Brule watershed consist of rice which is often grown in rotations with either crawfish or soybeans, a few fields of sugarcane, and grazing pasture. Rain events suspend sediments, fertilizers, and pesticides and transport the agriculture runoff to the reaches of the bayou. During the late winter and early spring, large volumes of very turbid water have been observed flowing downstream in the waterways, and this has been associated with planting activities in adjacent rice fields. The cumulative effect of agricultural nonpoint pollutants result in higher concentrations of nitrogen, phosphorus, sediments, turbidity, and pesticide residue in the water bodies. The primary mechanism to reduce the amount of sediment and nutrients entering the water body is for the farmers to adopt Best Management Practices (BMPs) in order to meet TMDL objectives for the watershed. LDEQ and NRCS composed a list of BMPs that can be utilized to reduce agricultural NPS loading. There has been extensive work in this watershed during the past 5-7 years to implement these types of BMPs on agricultural lands.

1.8.2 URBAN RUNOFF

Water quality monitoring studies in urban areas have shown that the highest pollutant loading usually occurs during rainfall events in the first runoff of rain, commonly referred to as the "first flush." In urbanizing an area, impervious surface area such as streets, parking lots, and rooftops, is increased. These smooth, impenetrable surfaces allow little or no detention or infiltration of storm water. Pollutants that are present between rainfall events in the atmosphere prior to a storm and which accumulate on impervious surfaces are generally carried away in the first 0 to 1 inch of rainfall in moderate to heavy urbanized areas. As precipitation falls on urban areas, it picks up contaminants from the air, littered and dirtied streets and sidewalks; petroleum residues from automobiles, exhaust products, heavy metals

Figure 1.7 Urban construction sites are significant sources of NPS pollution. The result is an increase of impervious areas and reduction of the assimilative capacity of the vegetative cover.

and tar residuals from the roads; chemicals applied for fertilization, weed and insect control; and sediments from construction sites. The dumping of chemicals such as used motor oil and antifreeze into storm sewers is another source of urban NPS pollution. Illegal hookups of storm drains to sanitary sewers can result in increased volumes of flow to waste water treatment plants causing more frequent overflows of sewerage into receiving waters.

Urbanization has an impact not only on water quality, but on the hydrologic characteristics of watersheds as well. In undeveloped natural drainage areas, the volume and rate of storm water runoff from a particular rainfall event is primarily determined by the natural detention and infiltration characteristics of the land, and is related to topography, soil types, and vegetative cover. With less detention and infiltration due to impervious surfaces, runoff volume increases, as well as, the rate of storm water runoff. Flooding and stream channel degradation in urbanizing watersheds has obvious adverse impacts upon public convenience, safety, and aesthetics, but there are some significant adverse impacts on water quality as well. When streams overflow their banks, there is an increased opportunity for pollutants including trash and debris to enter the flow of water. Erosion of the stream channel represents a significant source of sediment pollution, and the loss of vegetation along stream banks reduces the pollutant assimilation capacity of a stream.

1.8.3 HYDROMODIFICATION

Hydrologic modifications are defined as those activities, which are designed to affect natural stream flow. These types of modifications include bank stabilization, channel alignments, high-flow cutoff devices, in-stream construction, dredging, locks and dams, levees, spillways, and impoundments. Dredging, channel modifications, and impoundments are the most serious contributors to the nonpoint source pollution problem. Currently, all of these activities are being pursued in Louisiana waters, mainly for purposes of navigation and flood protection in coastal areas.

The Plaquemine Brule watershed receives approximately 57 inches of rainfall annually and has very low elevations and almost no slope. In order to prevent agricultural fields and homes from flooding, maintenance dredging and riparian zone removal has become a "fact of life." Many of the reaches along the bayou and its tributaries lack adequate riparian zones. Landowners and municipal authorities find it necessary to cut down trees and spray herbicides along the riparian zones in the watershed. The lack of riparian zones reduces the amount of shade over the waterway and the temperature of the water increase without the benefit of canopy cover from trees and bushes. Root matter from riparian zones also has the added benefit of retaining soils along the stream perimeter and prevents the banks from sheet and rill erosion. Dredging can cause scouring in some areas of the streambed and then deposit the sediments over larger areas. The process disturbs the benthic organisms by blanketing the streambed. Dredging will also suspend sediments in the water column, increasing turbidity and affecting water organisms.

1.8.4 HOME SEWERAGE

A significant portion of Louisiana's NPS pollution can be attributed to sewerage runoff from homes, camps, and businesses that are not connected to municipal sewerage treatment facilities. It is estimated that 1,323,600 people in Louisiana treat and dispose of their sewerage with individual waste disposal systems, and that over 50% of these systems are malfunctioning because of incompatible soil types or lack of maintenance. These failing systems are a major cause for water quality degradation in Louisiana's scenic streams and fresh water aquifers. Septic tank systems normally consist of two components, a treatment unit and a disposal unit. The septic tank and soil absorption system is the most common individual waste disposal system used in Louisiana. The purpose of the septic tank is to condition household wastes so that the discharge will readily percolate into the soil. This conditioning is done in a septic tank by the removal of solids by settling and also by decomposition of the soluble organics. The soil then provides additional treatment by the removal of bacteria, organics, and nutrients. One of the main problems with using conventional septic tank soil absorption systems in Louisiana is that 87 percent of the soil associations in Louisiana are considered inadequate for conventional septic tank systems as determined from the Soil Limitation Ratings for Sanitary Facilities. Another major component to the pollution caused by septic tank systems is inadequate enforcement of the State Sanitary Code. Within the Bayou Plaquemine Brule Watershed, individual home sewage systems may account for a significant part of the bacterial problems that are causing the bayou to not meet water quality standards.

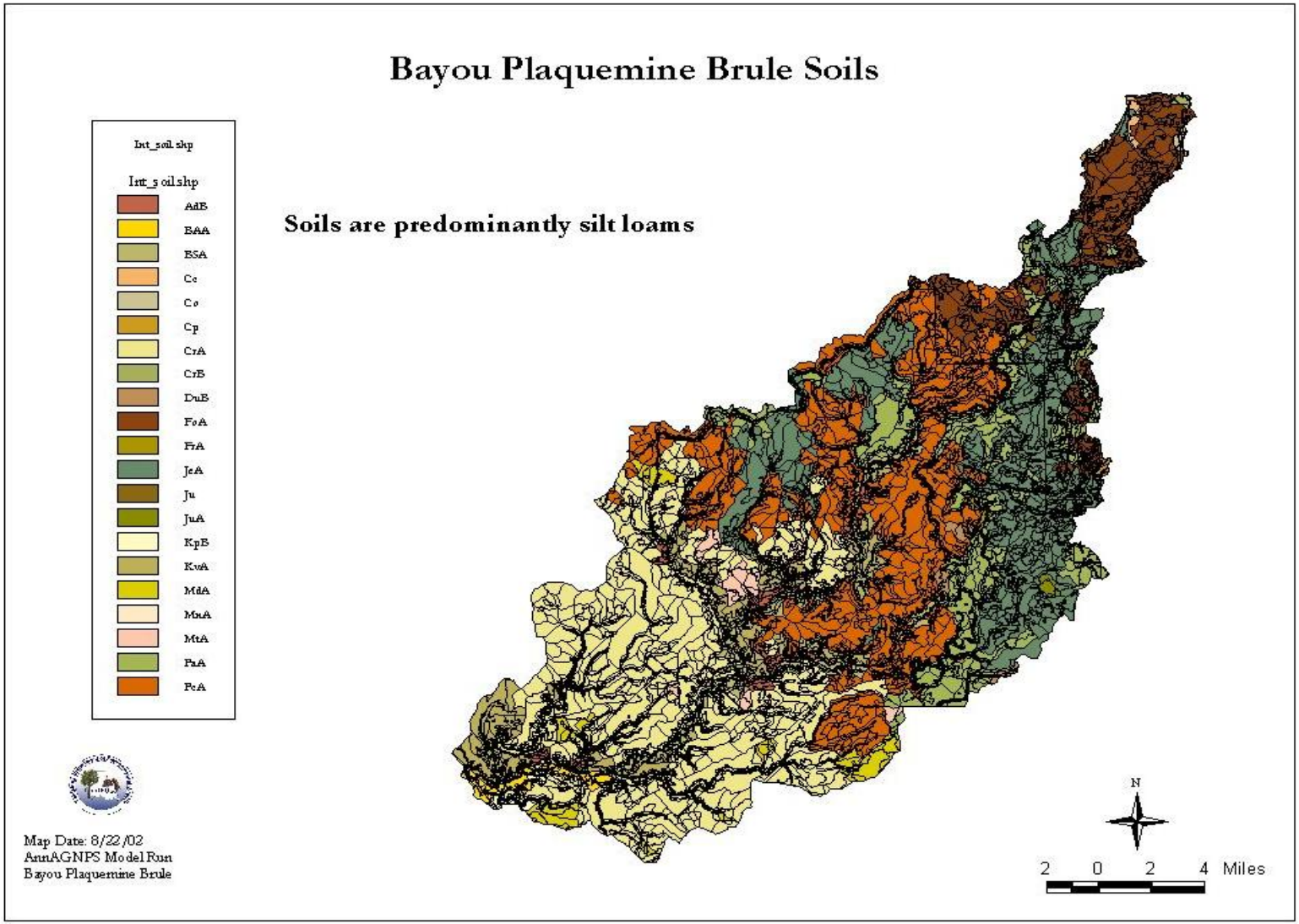


Figure 1.8 SURRGO soils map. There are 21 different soils in the Bayou Plaquemine Brule watershed that are predominantly silt loams.

1.9 PHYSICAL, CHEMICAL, AND BIOLOGICAL CAUSES FOR OXYGEN DEPLETION

1.9.1 SEDIMENT OXYGEN DEMAND AND REAERATION

The slope of the Plaquemine Brule is very gradual and the potential for reaeration is low. The bayou is slow moving and depositional in nature, resulting in continued sedimentation within the streambed. The watershed rests on an alluvial plain where soils are composed of silty loams and clays (see soils map). Organic matter attaches to the clay and silts and creates an oxygen demand as the particles decompose within the waterway. After time, this process results in a layer of muck along the streambed. This layer of muck creates what is commonly referred to as sediment oxygen demand (SOD). Agriculture is the largest contributor to the accumulation of sediments and nutrients to the waterway. Rain events suspend exposed soils and fertilizers, transport them overland, and deposit them in the bayou. Nutrients encourage the growth of aquatic plants and nitrifying bacteria. Sediment oxygen demand is the amount of oxygen consumed by the bacteria as they attack the organic material that has settled or been captured to form a sediment or sludge deposit. Composed largely of particles of organics attached to sediments, feces, dead algae, and decaying plant matter, the accumulated sediments can dominate oxygen dynamics. Both winter and summer fish-kills in natural systems, caused by oxygen depletion, can be attributed to oxygen consumption by the sediments.

1.9.2 HIGH TEMPERATURES AND LOW FLOW

July and August are the hottest months in Louisiana, while October and November are the months with lowest stream flows. The TMDL analysis concluded that critical conditions for stream DO concentrations were those of negligible nonpoint run-off and low stream flow combined with high stream temperature. When the rainfall and stream flow are high, turbulence is higher due to higher flow and the temperature is lowered due to rainfall run-off. This accumulated loading (SOD) has its greatest impact on the stream during periods of higher temperature and lower flow. NPS pollutant loadings, primarily agriculture, are the major source of this SOD in the Plaquemine Brule watershed.

2.0 WASTE LOAD ALLOCATION

2.1 POINT SOURCE DISCHARGES IN BAYOU PLAQUEMINE BRULE

There are 66 known dischargers in the watershed, the majority of which are too small to have a significant impact on water quality in the watershed. Limits for the small discharges are generally set by state policy. Only eight of the point sources are considered to have a potential impact on the Plaquemine Brule. Only three of the point sources will require more stringent effluent limitation to meet dissolved oxygen criteria. Reductions from point sources will be addressed in revisions to discharge permits. In the following pages, a pie chart is presented that compares the point source, headwaters and tributaries, incremental, and NPS discharges in the Bayou Plaquemine Brule watershed.

2.2 TMDL BOD LOAD IN BAYOU PLAQUEMINE BRULE

LDEQ collects water quality samples along the waterway to establish a BOD load and to calibrate the model. Once the total BOD load is determined, it is partitioned into point sources and NPS sources, plus a margin of safety is factored in to accommodate any potential errors. Point sources require a LPDES discharge permit, which identifies its location and sets a limit on the amount of BOD load that can be discharged out the end of the pipe. The modelers are able to subtract the point source load from the measured and modeled total BOD load. The rest of the BOD load is either assigned to natural or manmade NPS pollution. In the Bayou Plaquemine Brule, 7% of the total BOD load was assigned to point sources.

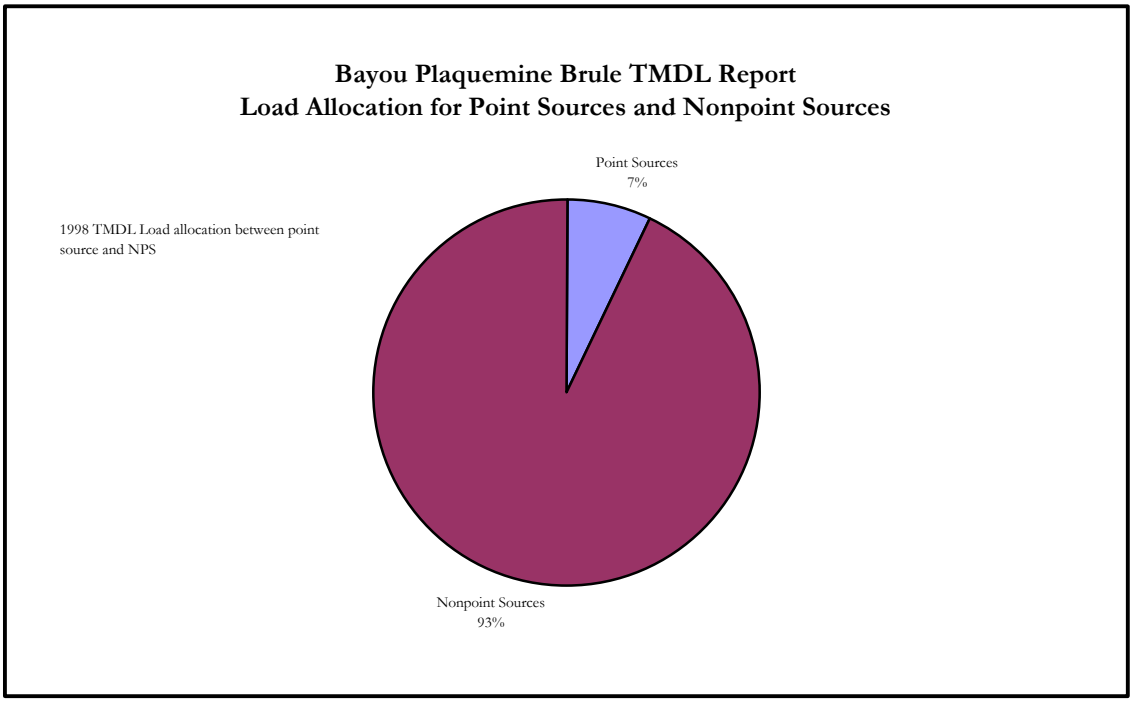


Figure 2.1 Point sources are known and subtracted from the total BOD load. The remaining load is designated as natural and manmade NPS pollutants.

2.3 LA QUAL MODELING RESULTS

In the following table, the partitioned BOD loads are distributed by reach, beginning at the top of the watershed. The values are the results of calibrated data during 7Q10 periods, which represents the amount of suspended and benthic materials present in the bayou at the time of sampling. It should be noted that since samples were collected during low flow conditions, they represent only a portion of the pollutant load delivered to the bayou. It is what remained in the bayou during the lowest flow conditions. The sediment oxygen demand (SOD) portion of the total load (11%) is defined as the oxygen demand exerted by the bottom sediments.

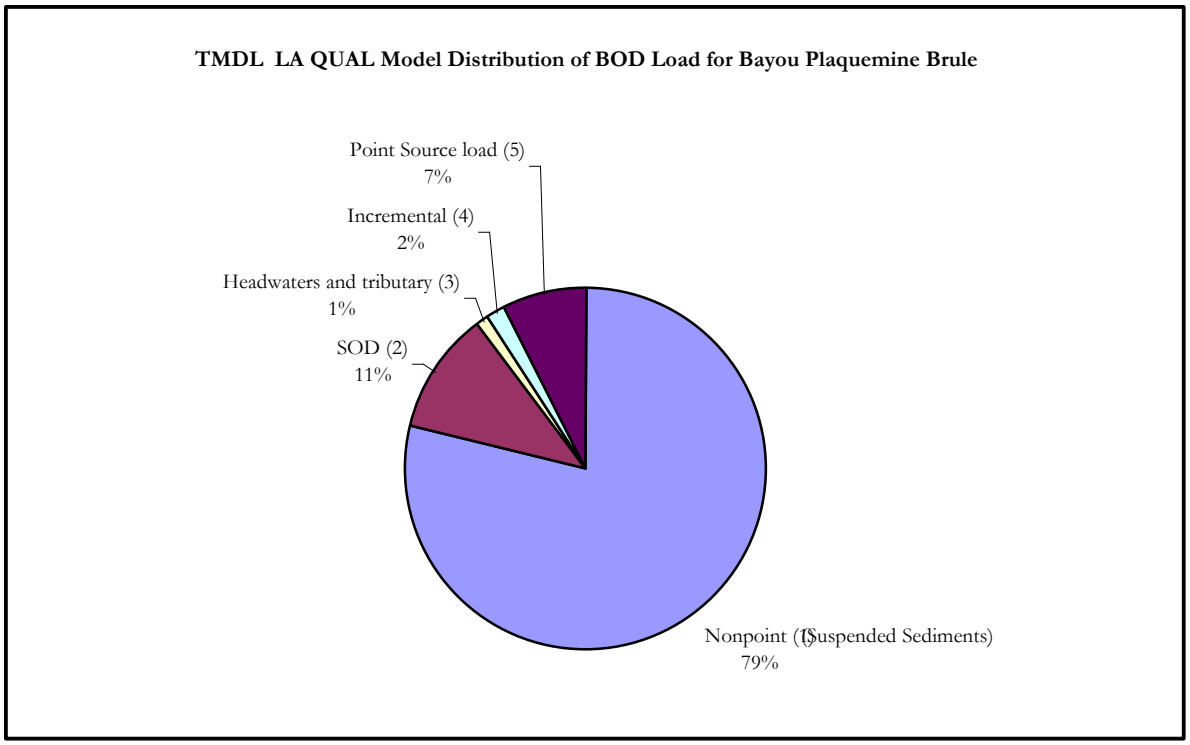
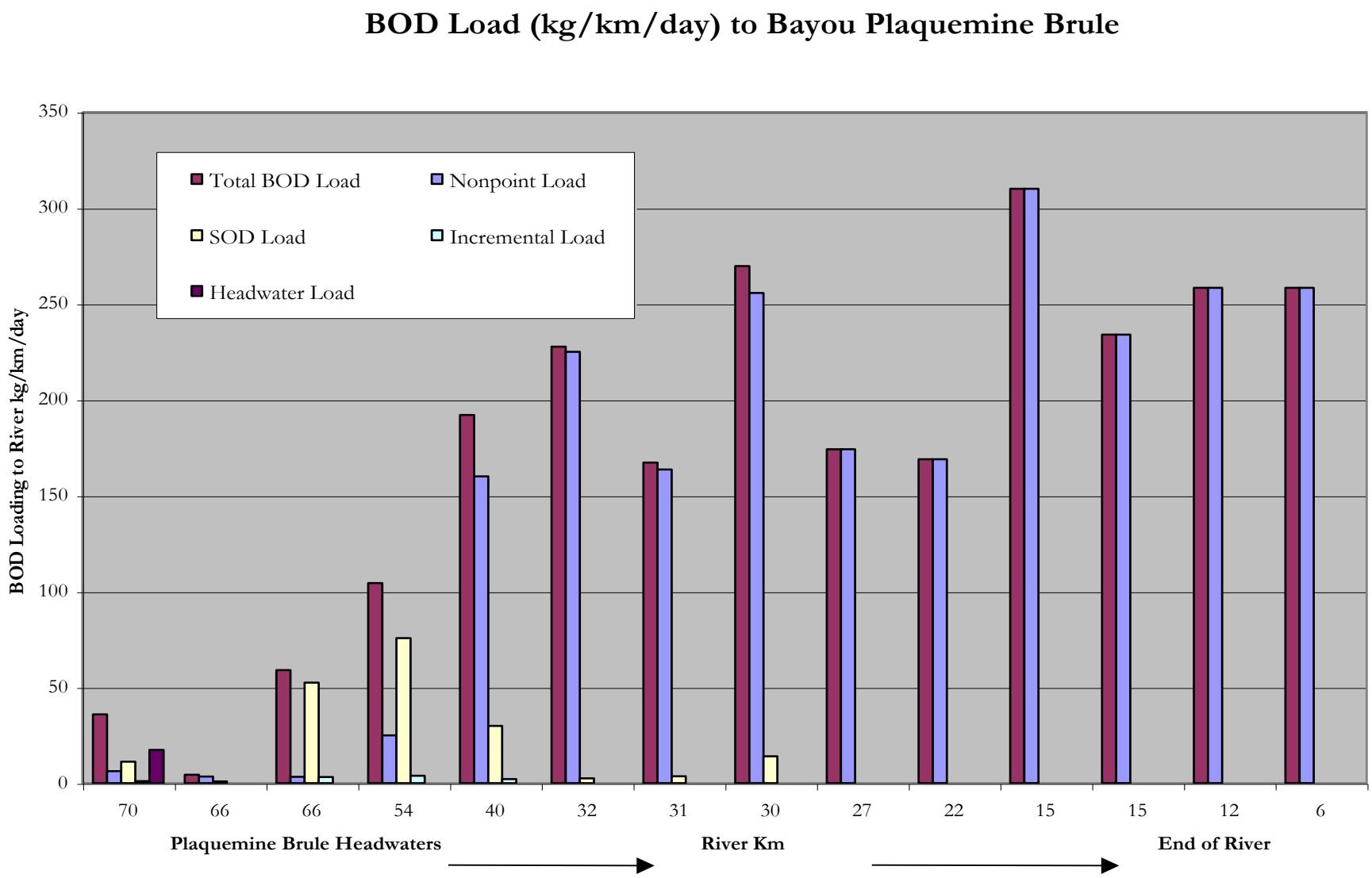


Figure 2.2 (1) Nonpoint load is defined as the portion of the BOD (both NBOD and CBOD) that is suspended in the water column. (2) Sediment oxygen demand (SOD) is defined as the benthic load that resides on the stream bottom. (3) Headwaters and tributaries are the BOD loads associated with tributaries and headwaters. (4) Incremental load includes ground water, NPS from rain events, and tributaries. (5) Waste loads are the share of pollutants discharged from industrial and municipal point sources in the waterway.

The chart indicates where the BOD load resides within the bayou. As you can see, the BOD load tends to increase towards the bottom of the watershed. One reason that BOD materials collect and reside toward the lower end of the watershed is because of the channel slope. The elevation in the upper portion of the watershed is 76 ft and the elevation near the bottom of the bayou is at sea level. The sediments and the BOD load will collect where the bayou levels out until a large rain event produces enough hydraulic head to push the material down stream eventually into the Gulf of Mexico. Secondly, the lower end of the watershed is a region cultivated mainly with rice. Rice constitutes a major portion of the NPS pollutant load in the watershed. In conclusion, the BOD increases towards the bottom of the bayou due to lack of elevation and its proximity to the largest contributor of NPS pollutants. **The Annualized Agricultural Nonpoint Source** (AnnAGNPS) watershed pollutant model was utilized to determine more precisely where within the watershed the sediments, nutrients and carbon-based substances originate, thereby prioritizing where BMPs should be applied to reduce the amount of sediment and BOD entering the bayou.


BOD Load (kg/km/day) to Bayou Plaquemine Brule
Total BOD Load
Nonpoint Load
SOD Load
Incremental Load
Headwater Load
BOD Loading to River kg/km/day
350
300
250
200
150
100
50
0
70
66
66
54
40
32
31
30
27
22
15
15
12
6
Plaquemine Brule Headwaters
River Km
End of River

3.0 BEST MANAGEMENT PRACTICES IMPLEMENTATION PLAN: ACHIEVING GOALS IN THE WATERSHED

FIGURE 3.1 The scene above depicts the SW region of Bayou Plaquemine Brule and shows turbid rice fields just after mudding in and rice ponds that are clear as the result of a controlled release. Farmers will retain the water in the fields up to 2 week to allow silt and clay to settle out of the water. The rice is rotated with soybeans and the vegetated fields in the picture are growing soybeans this season.

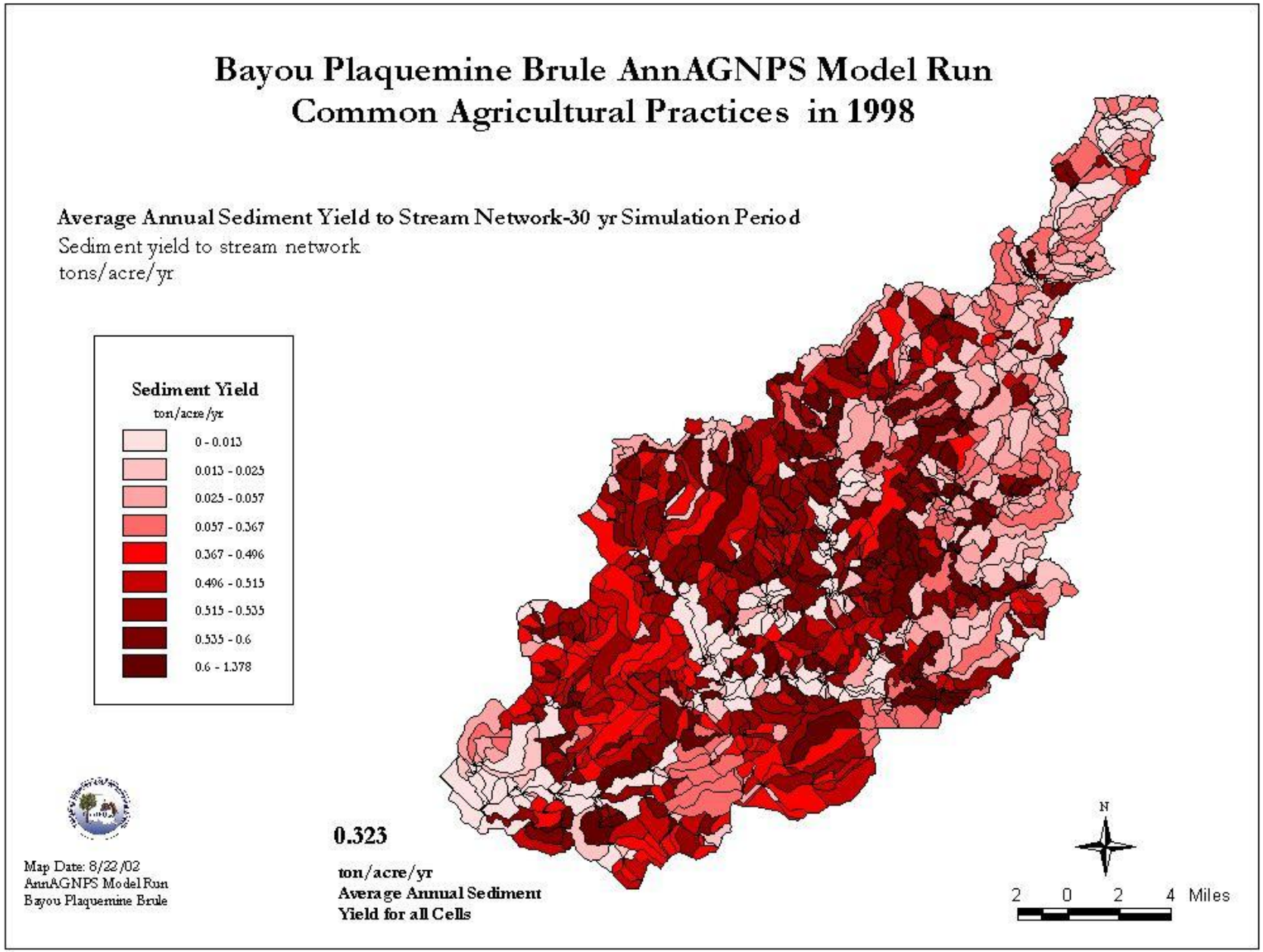
3.1 DESCRIPTION OF NPS BEST MANAGEMENT PRACTICES NECESSARY TO ACHIEVE NPS LOAD REDUCTION

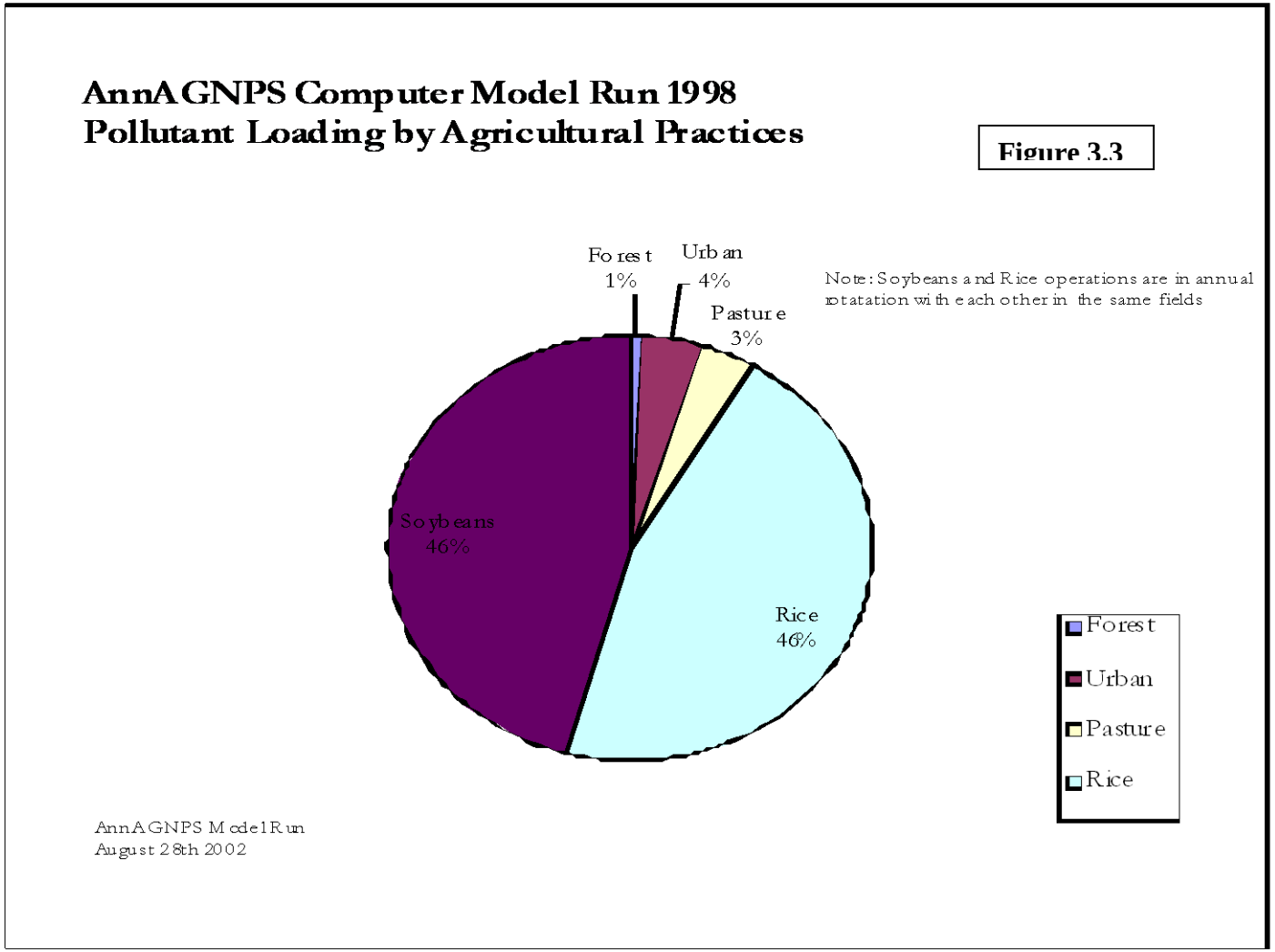
Another key element from EPA's guidelines for watershed plans is to describe the types of BMPs that will need to be implemented for these source areas that contribute the largest nonpont source pollutant loads. The TMDL goal is to reduce NPS loading of oxygen demanding substances by 50% in the upper reaches and 30% in the lower reaches. The AnnAGNPS Watershed Model was utilized to estimate the types of BMPs that would be needed and the possible load reduction that could be achieved when these BMPs were implemented. It indicated that fields with a rice and soybean rotation comprised the majority of the pollutant load in the watershed. A 50% reduction in sediments could be achieved with

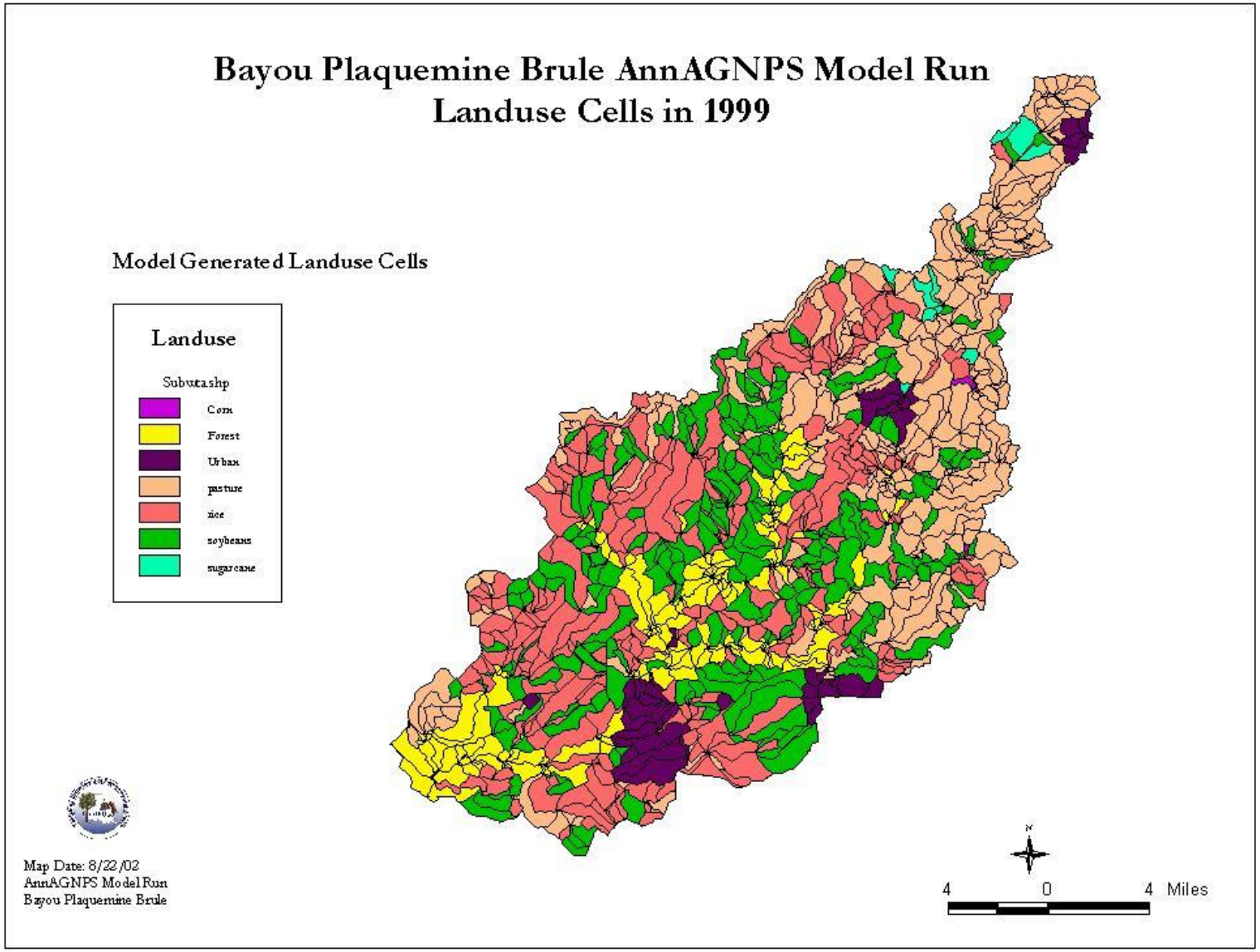
a BMP for rice called "clear field planting." Also, "precision leveling" dramatically reduces the amount of sediments that runs off into the waterways. Many farmers are embracing these new BMPs, however, it will still be necessary to continue to work on BMP implementation and to set measurable goals and milestones, and monitor to sample any improvement in the watershed as the result of BMP implementation. Stakeholder participation is a necessary component of any successful watershed implementation plan and the local community has been encouraged to get involved in the effort to reduce the NPS pollutant loads in the watershed. A schedule to meet goals outlined in the TMDL will be presented after this section and methods to monitor progress in the watershed and sources to finance BMP implementation will be discussed.

3.2 MODELING: ANNAGNPS AND BMP IMPLEMENTATION

Another one of USEPA's 9 key elements is to estimate the load reductions expected from management measures or best management practices. LDEQ utilized the AnnAGNPS Watershed Model to estimate the load reductions that would be achieved if the BMPs for soybeans and rice were implemented within the watershed. Results from AnnAGNPS are presented below. The first model run shown below is of standard agricultural operations commonly practiced in 1998 when the watershed was sampled for pollutants that resulted in a failure to meet water quality standards and in which it was listed for a high priority for TMDLs. The local Soil and Water Conservation District (SWCD) representatives from Acadia and St. Landry Parish were consulted to depict common operational practices. Secondly, the model was run utilizing BMPs for rice and soybeans. In 1998 and earlier, high concentrations of sediments reach the waterways after the farmers released large quantities of water from rice fields after mud leveling fields and again after planting during the spring. Numerous fish kills have been reported during these spring water releasing events. The spring release of rice field discharges represents the majority of sediment load to the waterways. The BMPs for rice such as precision leveling and clear field planting reduce or eliminate the spring discharges i.e. the majority of the sediment load to the bayous. The remainder of the year, the water is fairly clean because of the abundance of plant and root material that retains the sediments in the impounded fields. Over the winter, the levies and the pipe drops remain closed so there is very little discharged from the rice fields-except during large rain events when there is an excess of water.


Bayou Plaquemine Brule AnnAGNPS Model Run
Common Agricultural Practices in 1998
Average Annual Sediment Yield to Stream Network-30 yr Simulation Period
Sediment yield to stream network
tons/acre/yr
Sediment Yield
ton/acre/yr
0 - 0.013
0.013 - 0.025
0.025 - 0.057
0.057 - 0.367
0.367 - 0.496
0.496 - 0.515
0.515 - 0.535
0.535 - 0.6
0.6 - 1.378
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
0.323
ton/acre/yr
Average Annual Sediment
Yield for all Cells
N
2 0 2 4 Miles


AnnAGNPS Computer Model Run 1998
Pollutant Loading by Agricultural Practices
Figure 3.3
Forest 1%
Urban 4%
Pasture 3%
Soybeans 46%
Rice 46%
Note: Soybeans and Rice operations are in annual rotatation with each other in the same fields
Forest
Urban
Pasture
Rice
AnnAGNPS Model Run
August 28th 2002


Bayou Plaquemine Brule AnnAGNPS Model Run
Landuse Cells in 1999
Model Generated Landuse Cells
Landuse
Subwtaship
Corn
Forest
Urban
pasture
rice
soybeans
sugarcane
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
N
4
0
4
Miles

3.3 ANNAGNPS MODEL RUN FOR 1998 AGRICULTURAL PRACTICES

Standard agricultural operations for 1998 were entered into the AnnAGNPS model to reconstruct conditions that occurred the year Bayou Plaquemine Brule was included on the 303 (d) TMDL list. The TMDL, NPS reductions of 30-50% were based on this data. In this section of the watershed, rice is rotated with soybeans so there is not really any difference between the cells labeled as rice or soybeans-simply because they rotate with each other. The results are rendered in standard tons/acre/year and range from 0.01 tn/acre/yr to 1.38 tn/acre/yr. Sediment Yield is the amount of sediment that runs off the digital land cells and into the stream network. In other words, sediment yield is the loading of sediments into the stream reaches. The average sediment yield for the whole watershed is 0.323 tn/acre/yr in the 1998 AnnAGNPS model run.

3.3.1 FORESTED AREAS/RIPARIAN AREAS

Riparian or forest cell areas along the bayou had the lowest loading rates. The light color cells running up through the center of the watershed are forested areas. These cells also have the greatest slopes and would have greater sediment yields if they were not colonized with hardwood wetland forest. This evidence supports previous findings that riparian areas are effective management measures for reducing agricultural NPS pollutant loadings. Forested areas constitute over 10% of the land mass yet the sediment yield coming off these areas is lees than 1% of the NPS pollutant loadings.

3.3.2 PASTURE

As can be seen from the ArcView representation of model results, the cells in the NE section of the watershed have lower loading rates. This is largely due to the fact that pasture is grown in this area and the soil is not tilled and exposed to rain events. The presence of dense root matter and foliage coverage prevents the soils from moving off the field and into the stream reaches. Pasture only represents 4% of the pollutant load yet it represents 27% of the land area in the watershed.

3.3.3 URBAN AREAS

Urban areas are a moderate source of NPS pollution. Urban land uses constitute 4% of the pollutant loading and 7% of the area in the watershed. Its actual loading of oxygen demanding materials may be greater than what the model predicts. The AnnAGNPS model is primarily for describing soil losses in agricultural areas. The results are rendered in sediment yields. Urban areas use default settings and constituents such as oil and grease, lawn fertilizer, and pet waste are not considered in the model. Urban may compose a greater pollutant load than what is depicted in the model.

3.3.4 RICE AND SOYBEANS

Soybean and Rice field rotation almost exclusively dominate the agricultural land use in the SW section of the Bayou Plaquemine Brule watershed. They represent about 91% of the pollutant loading in the watershed. Of the two, rice produces the greatest annual sediment load to the stream reaches. An estimated 85% of the pollutant loading from rice fields originates from the spring discharges after land leveling (mudding in) and seeding. Mudding in a rice field involves flooding the field and running disks through the mud and water. Presumably, the disk leveling evens out the high spots and the suspended solids fill in the low spots. Discharges of suspended solids are magnitudes greater during this spring discharge event over the drainages for pesticide/fertilizer applications and harvest that occur during the summer and fall seasons. Root matter anchor sediments in the field and foliage rising through the impounded water provide surface area for microbial decomposition of organic materials and nitrogenous compounds. The summer and fall discharges are relatively clean outflows with very little of the sediments leaving the field.

3.4 BMP IMPLEMENTATION TO ACHIEVE TMDL GOALS

This section discusses the modifications to the standard operational practices in 1998 (year watershed was included on the 303 (d) TMDL list) to incorporate BMPs that may achieve the prescribed reduction of 30%-50%. The standard practices were discussed above and plugged into the AnnAGNPS model. The results of the AnnAGNPS run can be seen above. Conversely, LDEQ ran the model again with new BMP operational practices. The outcome was a reduction of sediment loads of 62% (see figure below). The BMPs applied to the adjusted run are discussed below.

3.5 RICE AND SOYBEAN BMPS FOR ANNAGNPS

The key to reducing NPS runoff in the Bayou Plaquemine Brule watershed to the levels prescribed in the TMDL is to eliminate or reduce the spring discharge of muddy water from the rice fields. The application of rice BMPs will allow farmers to circumvent the muddy discharges that occur during planting season. Instead of "mudding in," the rice farmers can utilize precision leveling techniques. Instead of aerial seeding into flooded fields, farmers can knife in rice seed into a dry seedbed. "Clear field" planting is a BMP that also allows farmers to plant onto a dry seedbed. These measures will supply methods to eliminate the spring discharge and prevent the discharge of turbid waters that represent the majority of NPS loading occurring into the waterways.

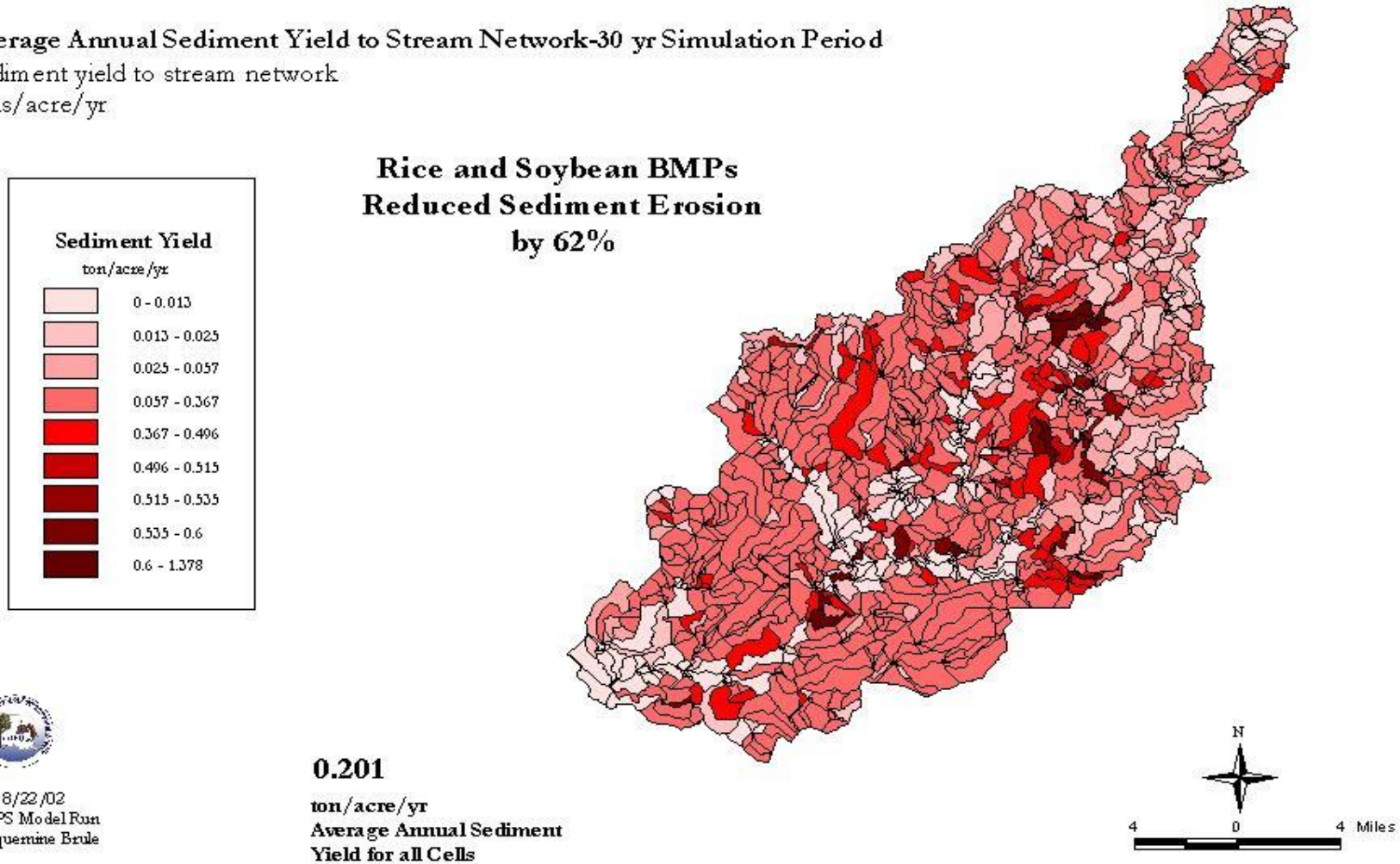
Soybean conservation tillage practices help retain soils during the years of soybean rotation. In 1998, farmers in the watershed tilled the fields 4 times, twice during the spring and twice again during the fall after harvest. By simply eliminating the fall tillage operations and leaving the crop residue on the field, a significant amount of soil is retained on the fields over the winter months when the region experiences heavy and frequent rain events.

Bayou Plaquemine Brule AnnAGNPS Model Run
Best Management Practices (BMPs)

Average Annual Sediment Yield to Stream Network-30 yr Simulation Period

Sediment yield to stream network
tons/acre/yr

Rice and Soybean BMPs
Reduced Sediment Erosion
by 62%

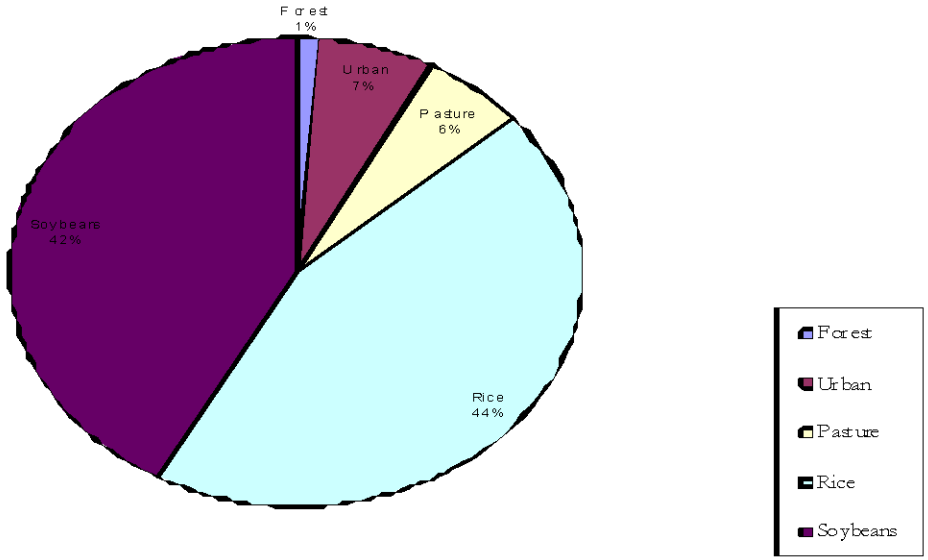


Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule

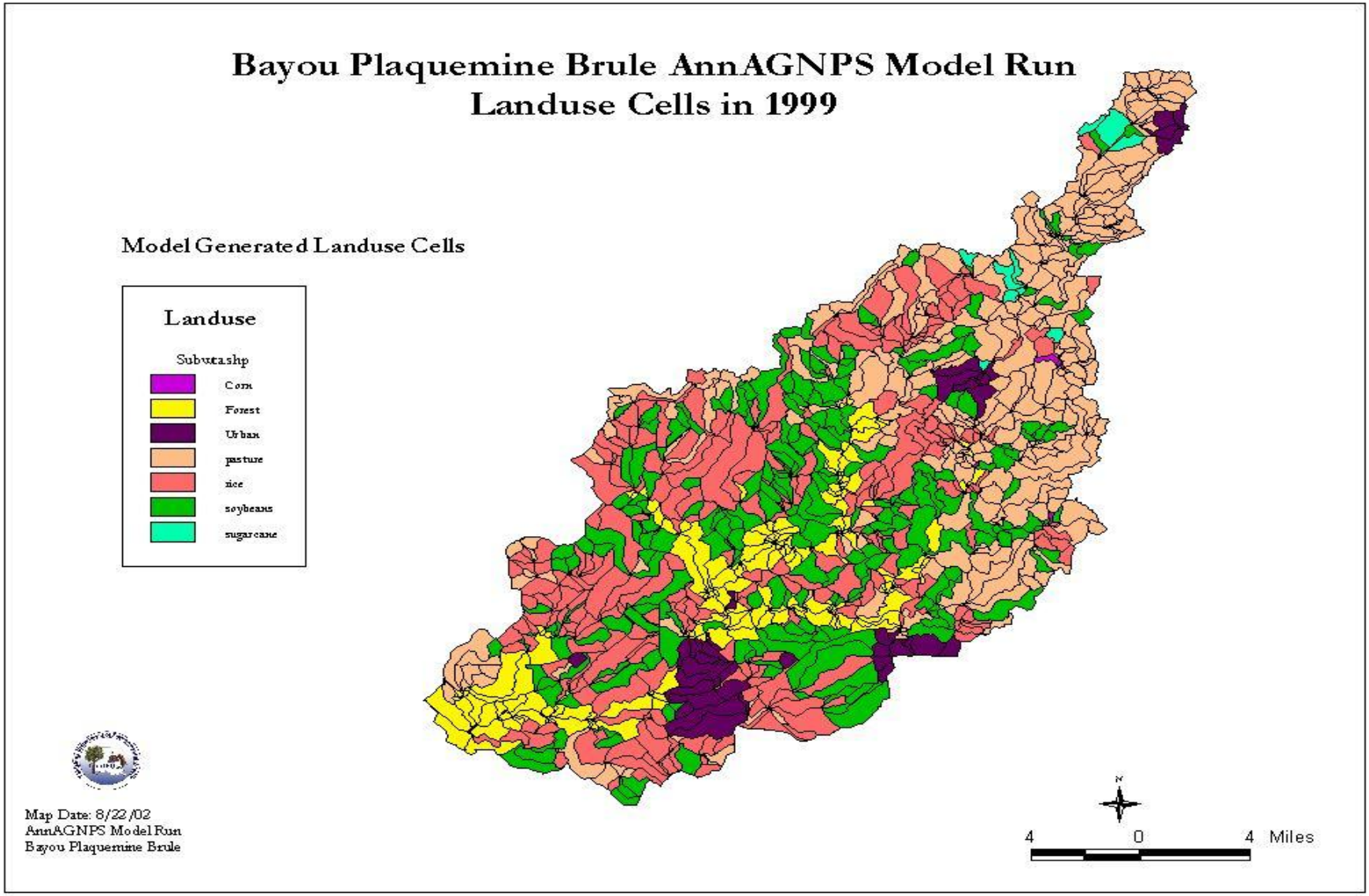
0.201
ton/acre/yr
Average Annual Sediment Yield for all Cells

AnnAGNPS Computer Model Run
Pollutant Loading by Agricultural Practices
Best Management Practices (BMPs)

Note: Soybeans and Rice operations are in annual rotatation with each other in the same fields



AnnAGNPS Model Run
August 28th 2002


Bayou Plaquemine Brule AnnAGNPS Model Run
Landuse Cells in 1999
Model Generated Landuse Cells
Landuse
Subwtashp
Corn
Forest
Urban
pasture
rice
soybeans
sugarcane
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
N
4
0
4
Miles

3.6 ACHIEVING GOALS IN THE WATERSHED

A 62% reduction was achieved with the recommended BMPs programmed into the operational input parameters for rice and soybeans. This indicates that a 50% reduction is achievable with a 20% allowable margin of error. As discussed above, the recommended agricultural BMPs include precision leveling and dry seed bedding for rice fields and conservation tillage practices during the soybean growing rotation. Funding for and implementation of precision farming is outlined later in this document.

3.7 RIPARIAN BMPS

Looking closely at both the 1998 and BMP model runs; one can see that forested riparian areas result in the lowest sediment yield. If you check the land-use map, one can see that forested areas supply riparian zones along much of the bayou. However, there are still many miles of river where agriculture lands run up right against the bayou-particularly in the upper reaches of the watershed. Riparian zones are proven methods from many sources and a section later in the text is designed to address implementation of riparian zones in the upper reaches of the bayou.

3.8 REVISION OF ANNAGNPS MODEL RUN

If the recommended BMPs are not achievable, the model accommodates numerous scenarios that can be modified with relative ease. Through the model, all parties involved can review and concur in the operational data being fed in the model and the output from the model. It will benefit the local farmers; state and federal agencies and regional universities to reach agreements on what actions need to be taken to achieve TMDL goals and objectives. If farmers disagree with a certain management plan, then an alternative plan can be tested in the digital representation of the watershed. If the new scenario achieves management goals and all parties agree, then a BMP implementation plan can be revised that can achieve the goals outlined in the TMDLs. The model helps facilitate an open planning process and encourages public involvement. When this happens, the watershed is more likely to be moving toward an environmentally sustainable state.

3.9 LAND-SLOPE FACTOR (LS-FACTOR)

AnnAGNPS generates LS factors for each cell. LS factors are the slope of the land and are utilized as part of the RUSLE soil erosion equation. The LS factors were generated by the model to determine areas that have the greatest potential for soil erosion. As you can see, the slopes are greatest near the bayou and tributaries. LDEQ is recommending that these areas maintain riparian zones to 50-100 ft on both sides of the streams and bayou to make sure that the soils do not runoff into the waterways. Also, DO levels are inversely proportional to temperature, and the shade trees provide over the streams helps keep water temperatures down and DO from dissipating out of the water.

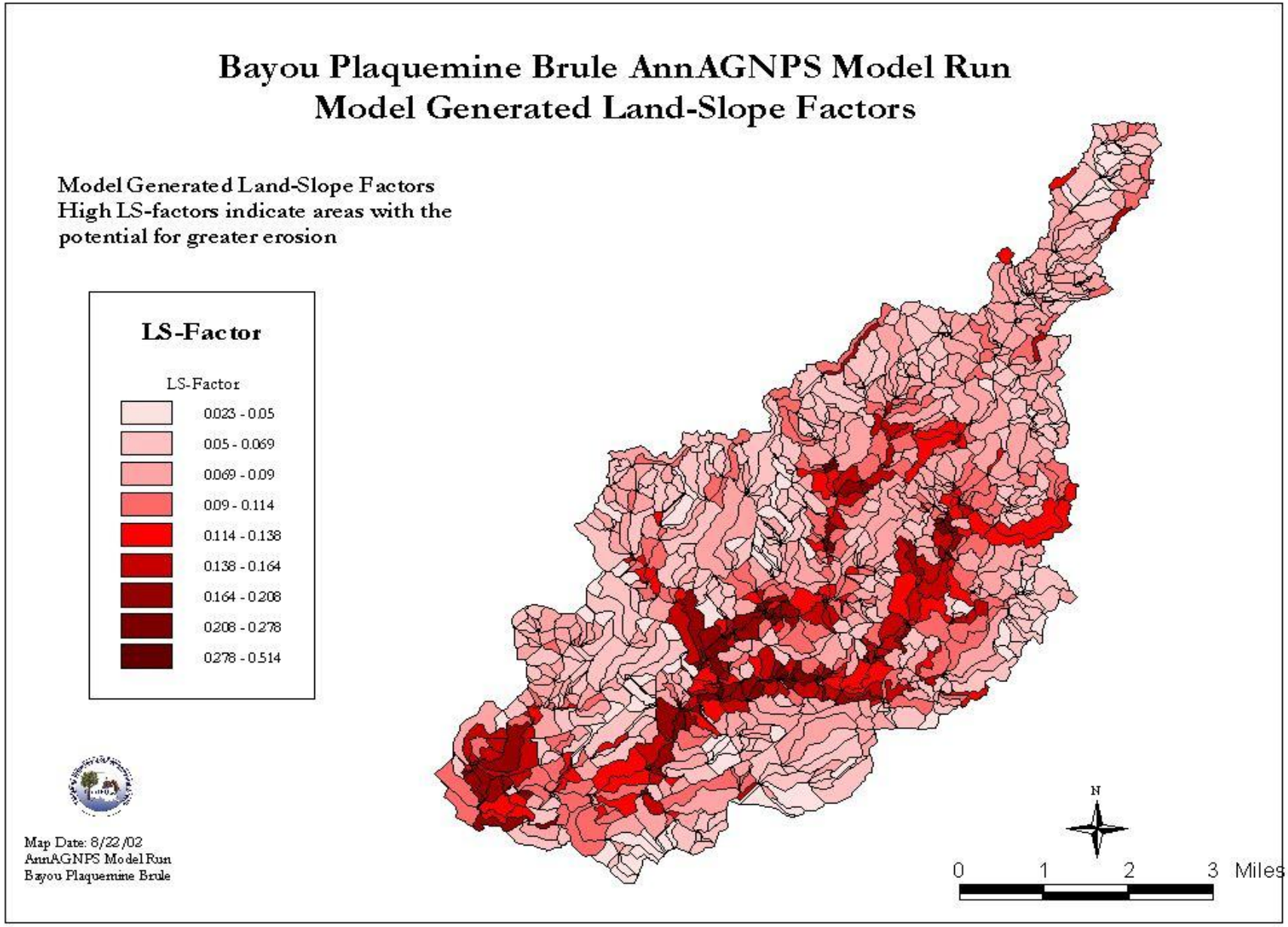
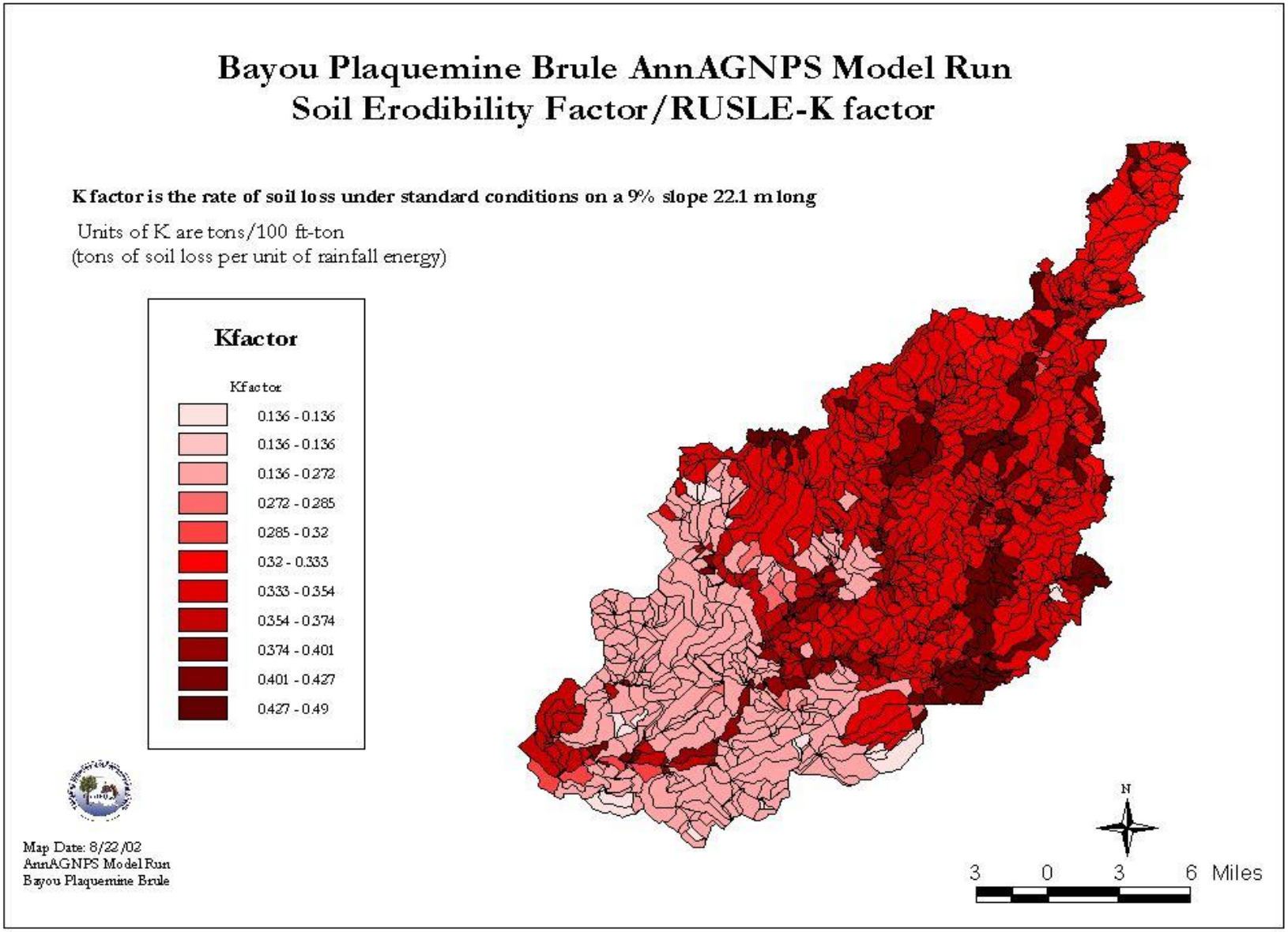

Bayou Plaquemine Brule AnnAGNPS Model Run
Model Generated Land-Slope Factors
Model Generated Land-Slope Factors
High LS-factors indicate areas with the potential for greater erosion
LS-Factor
LS-Factor
0.023 - 0.05
0.05 - 0.069
0.069 - 0.09
0.09 - 0.114
0.114 - 0.138
0.138 - 0.164
0.164 - 0.208
0.208 - 0.278
0.278 - 0.514
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
N
0
1
2
3
Miles

Figure 3.9 In the Plaquemine Brule watershed, the most erodible soils are in close proximity to the stream network. As you can see, the stream bank is completely lacking in riparian habitat and is losing large amounts of soil during rain events.

3.10 SOIL ERODIBILITY K-FACTOR

Soil Erodibility is a soil property that is defined as the ease with which soil is detached by a splash of rainfall or by surface flow or both. Physically, soil erodibility is the change in the soil per unit of applied external force or energy, namely rainfall or overland flow. The soil-erodibility factor (K) in the RUSLE soil loss equation accounts for the loss of soil from the external energies mentioned above. As can be seen in Figure 3.10, the more erodible soils are located along the bayou and tributaries and in the upper NE section of the watershed. Fortunately, much of the upper portion of the watershed is pastureland and is not tilled nearly as much as conventional row crops. The most erodible soils are along the bayou and tributaries and the most effective management plan for retaining soils in these areas is the implementation and maintenance of riparian zones.


Bayou Plaquemine Brule AnnAGNPS Model Run
Soil Erodibility Factor/RUSLE-K factor
K factor is the rate of soil loss under standard conditions on a 9% slope 22.1 m long
Units of K are tons/100 ft-ton
(tons of soil loss per unit of rainfall energy)
Kfactor
Kfactor
0.136 - 0.136
0.136 - 0.136
0.136 - 0.272
0.272 - 0.285
0.285 - 0.32
0.32 - 0.333
0.333 - 0.354
0.354 - 0.374
0.374 - 0.401
0.401 - 0.427
0.427 - 0.49
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
N
3 0 3 6 Miles

3.12 ACHIEVING GOALS: BMP IMPLEMENTATION AND COST SHARE

Cost share funding for BMPs is a key element in a successful Implementation Plan. A number of Federal and State funding sources exist for BMP implementation, riparian zones, and land conservation. The LDEQ and LDAF provide the USEPA §319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed on the §303(d) list. LDAF provides cost-share funds to implement BMPs in watersheds where TMDLs have been completed and watershed implementation plans developed.

3.12.1 COST SHARE: FUNDING CURRENTLY ACTIVE

Another one of the 9 key elements that USEPA included within their Guidelines for Watershed Plans was to estimate the amount of technical and financial assistance needed associated costs, and/or the sources and authorities that will be relied upon to implement this plan. Based on information from the Local Soil and Water Conservation District, there are approximately 330 farms in the Bayou Plaquemine Brule Watershed, 255 in Acadia Parish and 75 in St. Landry Parish. Of these farms, 260 are used for crop production and 70 for livestock. On the 239,360 acres of land in the Bayou Plaquemine Brule Watershed, USDA has implemented more than 70,656 acres of BMPs between 2004-2008. The types of BMPs have included:

Conservation Crop Rotation……..13,065 acres
Grade Stabilization Structures…..….400
Heavy Use Protection Area……11 acres
Irrigation Land Leveling……...13,136 acres
Irr. Water Conveyance……120,801 ft.
Irr. Water Management……..8,827 acres
Pipeline……8,743 ft.
Nutrient Management……6,581 acres
Pest Management…….....6,581 acres
Residue Management……...19,146 acres
Wetland Wildlife……8,934 acres
Prescribed Grazing……787 acres
Fencing……..18,671 feet
Pasture and Hayland Planting……...169 acres

In addition to the work that USDA has done in this watershed, LDEQ directed 319(b) funds to St. Landry and Acadia Soil and Water Conservation Districts (SWCD) to implement BMPs in Cole Gully and Bayou Wickoff sub-watersheds of the Bayou Plaquemine Brule Watershed. The government funds helped to offset the costs accrued by the farmers for the management practices. One of these sub-watersheds was approximately 6,000 acres and the other was approximately 3,000 acres. The amount of technical support and cost sharing per cooperating farmer varied with the field-specific management plan and acreage. Agricultural practices in Cole Gully were almost exclusively rice and soybean rotation with a small amount of grazing pastureland. Bayou Wikoff had a more diverse range of crops that include sugarcane, grazing pasture, and a little soybean and rice. The major objective of this cost sharing was to demonstrate that agricultural NPS loadings in Bayou Plaquemine Brule could

be reduced to prescribed levels by implementing BMPs. The Bayou Wikoff and Cole Gully sub-watersheds were monitored at the edge of field level and at the in-stream/watershed level.

Within the Cole Gully Sub-watershed, 40 farmers participated in the watershed project which resulted in BMPs being implemented on 4,438 acres through a Section 319 cost-share program that utilized $234,979 in federal funds. The two most common practices that were implemented through this project were irrigation water management drill planting of rice. Other BMPs included:

- Residue management, seasonal
- Nutrient management
- Pest management
- Conservation Crop Rotation
- Wildlife Wetland Habitat Management
- Record Keeping

In addition to the Section 319 funds, USDA provided funds through the Environmental Quality Incentive Program (EQIP) to assist the same producers with structural practices, such as underground irrigation pipelines, grade stabilization structures, well decommissioning, and irrigation land-leveling. The EQIP provided an additional $235,815 for cost-share of these practices.

Within the Bayou Wickoff sub-watershed project, 23 tracts of lands were included in a Section 319 project where BMPs were implemented on 883 acres of land with cost-share assistance of $193,906 of federal funds provided for BMP implementation. The BMPs that were implemented included:

- Conservation Crop Rotation
- Residue Management, Seasonal
- Nutrient Management
- Pest Management
- Record Keeping
- Prescribed Grazing

In addition to the federal funds provided for cost-share of BMPs, the technicians from the NRCS worked with each of these producers on their farm plans and on implementation of the BMPs. This work was above and beyond what they had provided through their own programs.

3.11.2 OTHER FEDERAL AND STATE FUNDS

The U.S. Department of Agriculture (USDA) offers landowners financial, technical and educational assistance to implement conservation practices on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. One of these programs is the Conservation Reserve Program (CRP). It is designed to encourage farmers to convert highly erosive cropland to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive annual rental payment for the term of the multi-year contract. The Conservation Reserve Enhancement Program (CREP) combines the resources of the CRP

program with that of the State government. This program focuses on NPS pollution and water and habitat restoration. The Environmental Quality Incentives Program (EQIP) is another source of funding available to the farmers for conservation practices. These are a few of the State and Federal funding sources available to agricultural landowners that will help with the cost of reducing NPS run-off from their fields.

LDEQ 319 PROJECTS IN THE BAYOU PLAQUEMINE BRULE

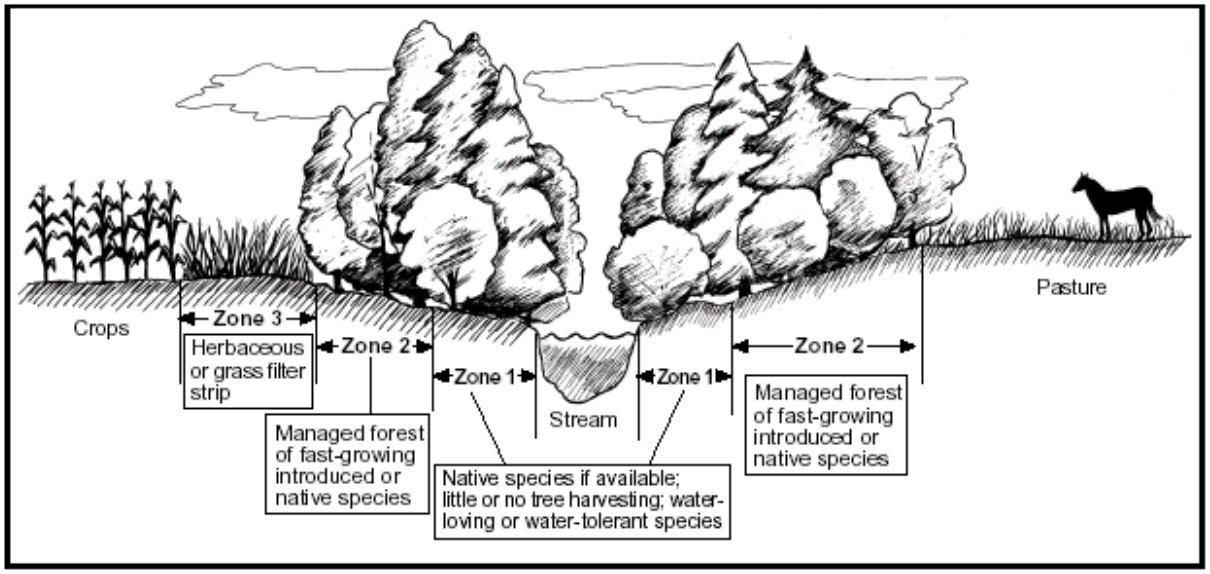
Contractor	Location of the Project	Federal	Matching Funds	Total
University of Louisiana Lafayette	Bayou Plaquemine Brule-main channel monitoring	$ 249,563	$ 180,617	$ 430,180
Louisiana State University	Bayou Plaquemine Brule-BayouWikoff monitoring	$ 332,250	$ 299,605	$ 631,855
Louisiana State University	Bayou Plaquemine Brule-Cole Gully monitoring	$ 229,450	$ 153,149	$ 382,599
SoilandWater Conservation District-Acadia	Bayou Plaquemine Brule-Cole Gully BMP cost share	$ 290,860	$ 248,800	$ 539,660
SoilandWater Conservation District-Acadia	Bayou Plaquemine Brule-Wikoff BMP cost share	$193,906	$ 165,867	$ 359,773
NRCS	Bayou Plaquemine Brule-technical support	$136,270		$ 136,270
Total		$1,432,099	$1,048,038	$2,480,337

Table 3.1 The table above is a list of 319 grants in the Bayou Plaquemine Brule and a brief description of the projects and the contractors performing the tasks.

3.12 ACHIEVING GOALS: RIPARIAN ZONES

Riparian areas can be defined in numerous ways. The USDA – Forest Service defines it as "the aquatic ecosystem and the portions of the adjacent terrestrial ecosystem that directly affect or are affected by the aquatic environment. This includes streams, rivers, lakes, and bays and their adjacent side channels, flood plain, and wetlands. In specific cases, the riparian area may also include a portion of the hill-slope that directly serves as streamside habitat for wildlife." Because of landscape position, the riparian zone is ultimately linked to the stream channel and its aquatic ecosystems as well as the upland ecosystems. As a result they play a critical role in the hydrology of watersheds. Their typically long and narrow nature, along with their unique physical and biological processes, allows riparian zones to act

as strategic buffers between upland and aquatic ecosystems. Although riparian zones may occupy as little as 1% of the land area of a watershed, these ecosystems are among the most productive in the landscape. Some of their most important functions are filtering and retaining sediment; immobilizing , storing, and transforming chemical inputs from uplands; controlling stream environments and morphology; controlling aquatic and terrestrial habitats; providing water storage and recharge of subsurface aquifers; and, reducing floods.



A riparian forest buffer includes zone 1, the area closest to the waterbody or course, and zone 2, the area adjacent to and up gradient of zone 1. Trees and shrubs in zone 1 provide important wildlife habitat, litter fall for aquatic organisms, and shading to lower water temperature. This zone helps stabilize streambanks and shorelines. Trees and shrubs in zone 2 (along with zone 1) intercept sediment, nutrients, pesticides, and other pollutants in surface and subsurface water flows. Zone 2 can be managed to provide timber, wood fiber, and horticultural products. A third zone, zone 3, is established if periodic and excessive water flows, erosion, and sediment from upslope fields or tracts are anticipated. Zone 3 is generally of herbaceous plants or grass and a diversion or terrace, if needed. This zone provides a "first defense" to assure proper functioning of zones 1 and 2.

Figure 3.11 Above is an illustration of the 3 riparian zones

3.12.1 RIPARIAN FOREST BUFFERS HAVE THREE DISTINCT ZONES

Zone 1 is a 5m wide strip of undisturbed mature trees that begins at the edge of the stream bank and provides the final filter for materials moving through the buffer. The purpose of this zone is to create an undisturbed, stable ecosystem that provides bank stability, an environment for dissolved soil water nutrients to interact with the "living filter" including plants that shade the stream stabilizing water temperatures and provide both fine particulate organic matter and large woody debris to the stream. Over mature trees are valued as they provide large woody debris for the stream. Logging equipment is excluded except at designated stream crossings. Likewise, grazing is excluded for this zone.

Zone 2 is adjacent to Zone 1 and is a zone of trees at least 18m wide and managed to provide maximum infiltration of surface runoff and nutrient uptake and storage while also providing organic matter for microbial processing of agrochemicals. The purpose of this zone is to provide the necessary contact time for biological processes associated with microbial activity and to provide plant uptake to remove NPS pollutants from the soil water column. Multiple-use management for timber and wildlife can be compatible with NPS removal.

Zone 3 is a zone of grazed or ungrazed grass, a minimum of 6m wide, which converts concentrated flow from the upland to sheet flow, either naturally or by the use of structures. This zone filters sediment from the sheet flow and causes the water and agrochemicals to infiltrate into the biologically active rooting zone where nutrient uptake and microbial processing occurs. The zone is comprised of grasses and forbs that must be removed to provide effective nutrient sequestering. Grazing is allowed when earthen control structures are not damaged. Occasional reshaping of structures and removed of accumulated sediment may be necessary to maintain proper function

3.12.2 CONSERVATION RESERVE PROGRAM (CRP)

The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation (CCC). CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, Environmental Benefit Index Scoring, and conservation planning.

The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices. Currently, CRP is financially the most lucrative program the USDA offers to eligible farmers and ranchers with a 50% cost-share, an additional 40% practice incentive payment, a $10/acre X length of contract signing bonus, as well as an annual rental rate of approximately $30/acre.

3.12.3 ENVIRONMENTAL QUALITY INCENTIVES PROGRAM (EQIP)

The Environmental Quality Incentives Program (EQIP) was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. Nationally, it provides educational assistance primarily in designated priority areas. About half of the program is targeted towards livestock related natural resource concerns and the remainder goes to other significant conservation concerns.

EQIP offers 5-to 10-year contracts that provide incentive payments and cost-sharing for conservation practices called for in the site-specific conservation plan. All EQIP activities must be carried out according to a conservation plan that is site specific for each farm or ranch. Producers can develop these plans with help from the NRCS or other service providers.

Cost-sharing may pay up to 75% of the costs of certain conservation practices such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices important to improving and maintaining the health of natural resources in the area. Incentive payments may be made to encourage a producer to perform land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. Total cost-share and incentive payments are limited to $10,000 per person/year and $50,000 for the length of the contract. These payments may be provided for up to three years.

3.12.4 WILDLIFE HABITAT INCENTIVES PROGRAM (WHIP)

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

The objectives of WHIP are to implement parts of the eligible participant's conservation plan that create and enhance wildlife habitat, provide program participants informational and educational support regarding wildlife habitat needs, and foster a positive public attitude towards wildlife, wildlife habitat, and land stewardship. This will be accomplished by participants entering into a WHIP agreement to provide financial assistance in the form of cost-share payments to enhance habitat on eligible land.

Cost-share assistance is provided in 5-to 10-year agreements provided the landowner agrees to install and maintain the WHIP practices and allow the NRCS or its agent access to monitor the effectiveness of the practices. In return, the USDA agrees to provide technical assistance and pay up to 75% of the cost of installing the wildlife habitat practices.

3.13 PROGRAM TRACKING AND EVALUATION: WATERSHED MONITORING

In addition to BMP implementation, there needs to be a monitoring component for the watershed strategy to evaluate whether the nonpoint source pollutant loads will be reduced as BMPs are implemented. Another key element of USEPA's Watershed Plan is to include a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established to determine whether load reductions are being achieved. As part of LDEQ's efforts to understand NPS pollution in the Bayou Plaquemine Brule watershed, the NRCS and the Soil and Water Districts from St. Landry and Acadia parishes implemented BMPs in the Bayou Wikoff and Cole Gully sub-watersheds. In conjunction with these efforts, four monitoring projects were implemented by scientists

from University of Louisiana Lafayette (ULL) and Louisiana State University (LSU) monitored the effectiveness of the BMP implementation. The objective of the monitoring projects were to accurately measure the difference between a BMP site and a control site and to see if the NPS pollution load could be reduced by 50% in the two sub-watersheds. Monitoring occurred over a three year period and resulted in edge of field and in-stream data on the effectiveness of the project in reducing nonpoint source pollutants. The map depicted on the following page indicates where LSU implemented the two sub-watershed projects, one for Cole Gully and one for Bayou Wickoff.

The LSU monitoring projects measured overland flow in the two sub-watersheds where the BMPs were implemented. Sampling occurred in drainage ditches and small runoff streams at the edge of fields to quantify runoff from fields with BMPs and those without. LSU also sampled the smaller streams of Bayou Wikoff and Cole Gully. The ULL effort focused on the larger main channel of the Bayou Plaquemine Brule watershed. The combination of the efforts provided a good analysis of the effectiveness of BMPs.

The monitoring plan included a series of six automated water samplers along the course of the Bayou Wickoff sub-watershed and twelve in the Cole Gully sub-watershed. Another eight automated samplers were placed in the main channel of Plaquemine Brule for a total of 26 automated samplers in the watershed.

Sampling involved "first flush" or stage/discharge sampling and also included ambient sampling, field measurements with an analytical probe, and soil sampling. Meteorological data and land-use/operational data were also needed for watershed analysis. Sampling was designed to measure the effectiveness of agriculture BMP management to reduce the run-off of oxygen demanding substances. Sampling included automated sampling at "edge of field" sites and "in-stream" sites. Ambient grab samples and field monitoring with electronic probes was also a part of the sampling plan. The focus of the sampling compared BMP sites to control sites. Control sites were areas where standard agriculture practices occurred and BMP sites were areas where management practices are installed to reduce the runoff of NPS pollution related to agriculture.

The monitoring project was a three-year effort and resulted in information that indicated that Cole Gully Sub-watershed was able to maintain the water quality standard for dissolved oxygen during the three years of data collection. The monitoring also indicated that BMPs on rice and soybeans resulted in a 40% in nonpoint source loading to the watershed. The inventory of practices within the watershed also indicated that approximately 80% of the farmers were utilizing BMPs.

The monitoring component of the watershed project in Bayou Wickoff provided information on the effectiveness of BMPs for pastures and sugarcane. The data from edge of field monitoring on pastures indicated that total solids could be reduced by 40% with rotational grazing. The suspended solids could be reduced by 65% and turbidity by 58% when rotational grazing is utilized instead of continuous grazing. When compared to a site that was selected as a pristine or reference site, rotational grazing did not produce runoff significantly higher than this reference condition. In addition to reduction in solids, the phosphorus loading was also reduced significantly with rotational grazing, with a 49% reduction in total phosphorus and a 40% reduction in dissolved phosphorus.

On the sugarcane sites, it was found that mulch residue left on the field after harvest resulted in a 34% reduction in total solids, a 26% reduction in suspended solids, a 60% reduction in turbidity and an 8% reduction in phosphorus when compared to the sugarcane field where the residue was burned.

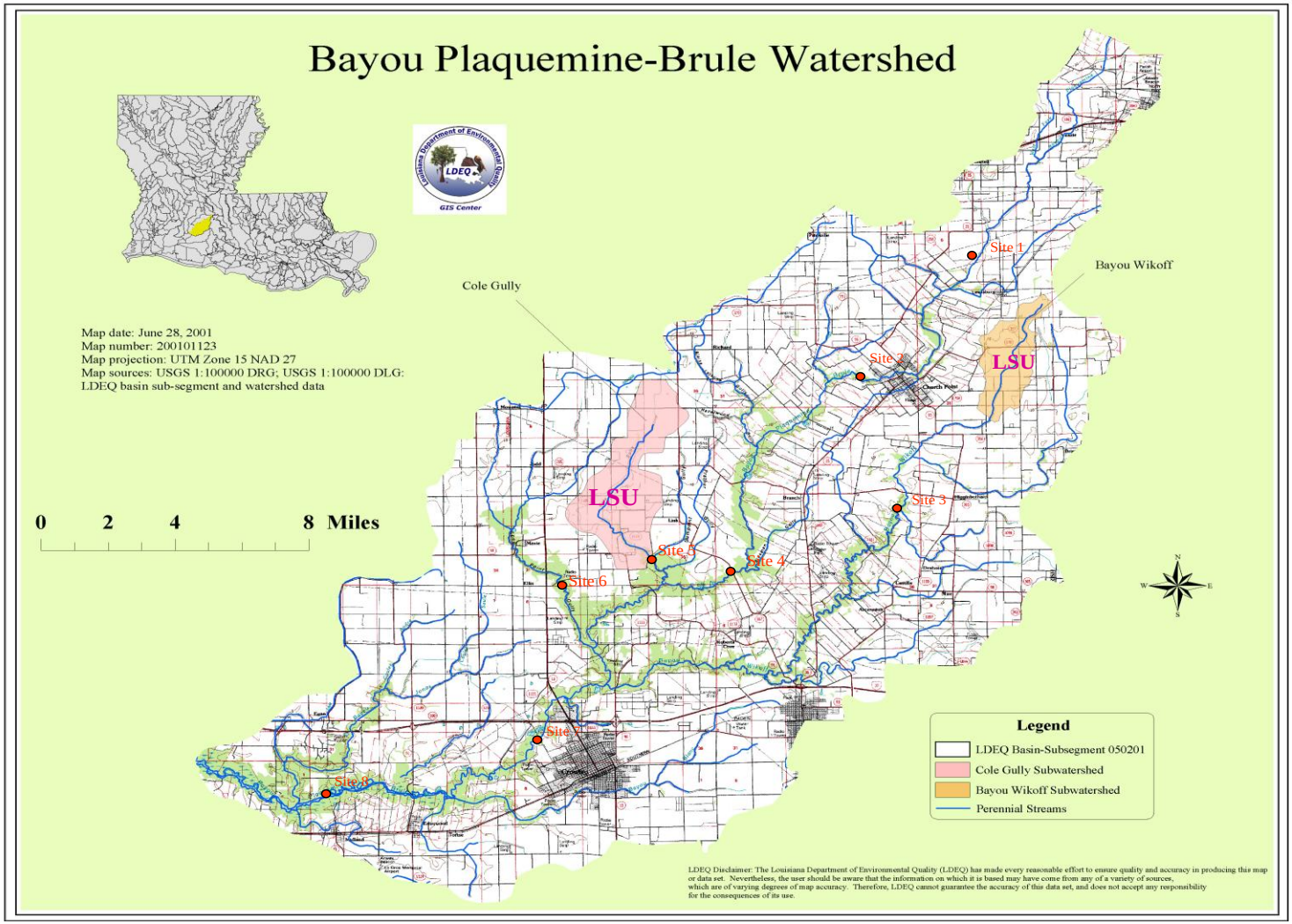


Figure 3.12 The 8 sampling sites marked above are locations that will be sampled by ULL and are part of a larger watershed analysis. The 2 highlighted sub-watersheds will be monitored by LSU at the "edge of field" and sub-watershed level. These 2 sub-watersheds are the areas where the local Soil and Water Conservation Districts (SWCD implemented agricultural BMPs.

3.14 TMDL MONITORING SCHEDULE

In order to determine if the watershed implementation plan is resulting in in-stream water quality improvement, LDEQ will continue to monitor at their ambient site which is located at the base of the watershed. As LDEQ continues to monitor this water body on the 4-year basin cyclic program, annual progress made in BMP implementation will be documented and reported to EPA, the NPS Interagency Committee and the general public through LDEQ's website. The first cycle of water quality monitoring data was utilized along with intensive stream surveys to develop the TMDL and devise the watershed restoration action strategy. The second cycle provided a baseline from which to measure the effectiveness of the TMDL Implementation Plan and the third cycle will determine whether the Implementation Plan has been effective in reducing nonpoint source pollutants and improving water quality within the water body. If this third cycle of water quality monitoring does not indicate a significant improvement in the implementation of agricultural best management practices within the watersheds on the 1998 303(d) list, then LDEQ and the cooperating federal and state agencies will determine what additional steps are necessary to achieve the BMP implementation required to reduce nonpoint sources of pollution and improve water quality. This ambient monitoring at the base of the watershed has been augmented with additional sampling sites up into the watershed closer to where the BMP implementation is occurring. ULL is conducting this targeted watershed monitoring program at 7 sites along the Bayou Plaquemine Brule in order to gain a better understanding of where the largest pollutant loads are coming from. Their results, to date, indicate that dissolved oxygen levels meet water quality standards in the upstream and also in the middle portions of the watershed, but drops to 3.65 mg/L at the downstream sampling site. There is also relatively greater turbidity at the middle to the downstream sites.

3.15 FUTURE OBJECTIVES AND MILESTONES: THE MASTER FARMER PROGRAM

The objective is to get as many of the landowners in the Bayou Plaquemine Brule watershed to implement BMPs as possible and to restore the designated uses back to the bayou by 2012-2013. As outlined in the TMDL, it will require a 50% reduction in NPS pollution. Restoration will require the implementation of BMPs, not only in the two sub-watersheds mentioned above, but throughout the watershed. LSU AgCenter is promoting the Master Farmer Program to help farmers address environmental stewardship through voluntary, effective, and economically achievable BMPs. The program will be implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ, and agricultural producers. This educational program combined with the watershed specific program that was implemented to inform the landowners in Bayou Wickoff and Cole Gully has formed the basis of the educational and outreach portion of the Bayou Plaquemine Brule Watershed Program. One of EPA's 9 key elements in the Watershed Plan Guidelines is to include an information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing and implementing the nonpoint source management measures or BMPs that will be

implemented. The continued work of the Local Soil and Water Conservation Districts, the Local Work Groups of USDA and the LSU AgCenter forms the core of these educational efforts on a daily basis.

The Master Farmer Program has three components: environmental stewardship, agricultural production, and farm management. The environmental stewardship component has three phases. Phase I focuses on the environmental education and crop-specific BMPs and their implementation. Phase II of the environmental component includes in-the-field viewing of implemented BMPs on "Model Farms." Farmers are able to see farms that document BMP effectiveness in reducing sediment runoff. Phase III involves the development and implementation of farm-specific, comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status.

This program can help to distribute the use of BMPs throughout the Plaquemine Brule watershed. The members set an example for the rest of the agricultural community. They work closely with scientists and other Master Farmers to identify potential problem areas in the watershed. They receive information on new and innovative ways to reduce soil and nutrient loss from their fields. They will be kept abreast of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements. The Master Farmer Program will allow regulators to observe the acceptance of BMPs throughout the watershed and they will help LDEQ observers track the implementation of soil management plans.

The solutions to controlling runoff will require the joint efforts of agriculture producers, landowners, government, private citizens and private organizations working together. The Louisiana Cooperative Extension Service (LCES) and Louisiana State University (LSU) AgCenter conducted a commodity-specific BMP review. These reviews were conducted through a multi-agency/organization partnership made up of research and extension scientists, the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the LDEQ, USDA-Agriculture Research Service (ARS), and agriculture producers.

4.0 URBAN BEST MANAGEMENT PRACTICES

Figure 4.1 Silt fences are one of the BMPs for construction sites in urban areas.

4.1 INTRODUCTION

Since the urban communities within the Bayou Plaquemine Brule Watershed have populations smaller than 50,000, they will not fall within the requirements for storm water regulations. However, urban areas represented over 16,000 acres of land and 7% of the watershed, so urban best management practices will need to be implemented in order to restore the designated uses of fishing and swimming. Water quality goals in urban areas of the watershed are virtually the same as in other types of land-use categories, but they are often more difficult to reach. The types of pollutants associated with the low dissolved oxygen concentration were sediments, nutrients, and organic enrichment. These pollutants come from construction sites, lawns and golf courses, and industrial parks. Oil and grease and metals also continue to be included in the array of pollutants associated with urban nonpoint source pollution. Oil and grease comes from streets and parking lots and also from people who change the oil in the family automobile and dispose of the used oil down the storm drain. In order to address the long-term water quality goals of restoring the designated uses for urban stream, the types of pollutants defined will need to be reduced.

4.2 BMPS TO REDUCE URBAN NPS RUNOFF

Citizens and city planners have a wide variety of urban BMPs to choose from to address the many different sources of NPS pollution in urban settings. A list of storm water BMPs are available that are effective methods for construction sites, parking lots and other impervious surfaces, industrial parks, residential homes and lawns, and automobile service centers. LDEQ has worked with a landscape architect to design storm water BMPs that can be incorporated into landscape codes, with more information available on these types of BMPs at: http://www.greenlaws.lsu.edu/Homepage.htm

4.2.1 STORM DRAIN STENCILING AND MARKER PROGRAM

Louisiana's NPS Program has had a storm drain marking program, which provides storm drain markers that are basically a plastic decal that can be glued to the storm drain. It has the message, "Dump No Waste. Drains to Stream", and should be a more permanent way to mark the storm drain with a water quality message. The Louisiana Department of Environmental Quality can provide these storm drain markers to the cities in the Bayou Plaquemine Brule Watershed along with educational materials on urban BMPs.

4.2.2 OIL AND GREASE

Oil and grease from parking lots and streets can be controlled with infiltration trenches, grassed swales or wetlands and filters in storm drains. Storm drain stenciling or marking programs can be one method to reduce the amount of used oil down storm drains. These types of programs combined with a better understanding of how and where used oil and antifreeze should be disposed of can reduce the amount of these chemicals in urban streams. There are many publications available on urban BMPs for parking lots available on EPA's website:http://www.epa.gov/owow/nps/toolbox/and
http://www.epa.gov/owow/nps/toolbox/.

4.2.3 URBAN EDUCATIONAL MATERIALS

Educational materials such as brochures, fact cards and pamphlets are an important component to any watershed or statewide educational program. People need to clearly understand what the water quality issue is and how their activities contribute to the pollution problem. The educational materials that LDEQ has designed have been very popular with both adults and children and have been widely distributed through many workshops, schools, conferences, and other public events across the state. The messages are simple, but clearly stated so that each individual can understand which type of actions he can take to reduce nonpoint source pollution from his home, lawn, or neighborhood. Examples of the message on some of these materials have been included here and copies can be obtained by contacting the Louisiana Department of Environmental Quality (LDEQ).

4.2.4 URBAN EDUCATIONAL VIDEO

LDEQ developed an educational video on urban nonpoint source pollution that could be distributed to the townships in the watershed. The objective of the video is to highlight actions that some of the cities and communities across the state have taken to address their urban nonpoint source pollution. In order for these management measures to be sufficiently implemented to reduce and control urban nonpoint source pollutants, federal, state and local authorities will need to be utilized.

4.3 FUTURE OBJECTIVES AND MILESTONES

The future objectives and milestones for the urban nonpoint source program are to continue to educate city officials, engineers, planners, developers, and the general public about urban nonpoint source pollution. This educational program will rely on materials and information already developed, but will continue to build on new information that has been successfully utilized in other states and cities. Information on home lawn chemicals, urban forestry, sustainable and cluster development, urban wetland detention areas, and many other technologies will continue to be provided to the cities across the state. In addition to providing educational materials, LDEQ will work with other state and local governments to form local nonpoint source working groups or coalitions where the specific nonpoint source problems can be identified and best management practices (BMPs) implemented to reduce and control them.

4.4 ACHIEVING GOALS

Addressing urban nonpoint source pollution is difficult since there is not a federal or state infrastructure for urban areas like there is for agricultural and forested areas of the state. However, there are many things that can be done to address urban nonpoint pollution issues. These activities include: storm drain stenciling and marking programs that can be disseminated into the local community; urban nonpoint source educational materials that can be distributed through parish and city offices; an urban educational video that highlights the pollution problems and pollution control methods that can be implemented to reduce these pollutants; an urban educational program developed and implemented through statewide organizations such as the LSU AgCenter, the Office of Soil and Water Conservation, Louisiana Department of Natural Resources/Coastal Management Division, Natural Resources Conservation Service, Resource Conservation and Development Districts, Urban Forestry Council, Municipal Associations, etc. develop and/or implement local ordinances that require implementation of urban best management practices; and encourage and track the use of checklists such as Pesticide Application Checklist, Auto Repair Checklist, and the Construction Site checklist as a method to track BMP implementation.

4.5 URBAN PROGRAM TRACKING AND EVALUATION

In order for progress to be monitored and evaluated, it is important to track the level and also the pace of implementation of the goals and objectives outlined within this document. LDEQ reports on progress made in all of the areas of the NPS Management Program to the

NPS Interagency Committee. This is done through meetings and also through LDEQ's website. Progress is reported on all of the goals and milestones outlined within the NPS Management Plan to EPA Region 6 on an annual basis. Semi-annual reporting through GRTs highlights project activities and progress made in specific areas of the program.

5.0 HYDROMODIFICATION BEST MANAGEMENT PRACTICES

FIGURE 5.1 AS you can see, this stream reach has a multitude of problems resulting from hydromodification. It has been straightened to accommodate increased flow, the stream bank vegetation has been destroyed, and the system has been dredged to accommodate temporary transportation needs.

5.1 INTRODUCTION

Hydromodification can cause a multitude of problems to a river ecosystem. Dredging typically increases the turbidity in the water body by disturbing the bottom sediments, which have accumulated over an extended period of time. Dredging causes a re-suspension, re-dissolution, or leaching of these materials. The concern that arises is that toxic substances or heavy metals may be reintroduced to the water column where they can adversely affect plant and animal life and other beneficial uses of the water body. Within Louisiana, the re-suspension of the benthic sediments often results in the organic material attached or stored with the sediments also being suspended within the water column, adding to the oxygen depletion of the bayou or stream.

There are a number of methods used to perform channel modifications. These include clearing and snagging, modifications of existing channels, and new channel excavation. Channel excavation is used to increase the hydraulic conveyance. This can be done by widening and deepening the channel or by eliminating meanders. The types of water quality problems associated with these activities include vegetative and soil cover disturbance during construction, increased scour due to increased water velocities, and increased water temperature if overhanging vegetation is removed. Further increasing velocities increase the reach over which organic pollutants can exert an oxygen demand.

When stream bank vegetation, such as trees is removed from the edge of the stream, it can have several affects on the water quality. If the trees provided shading to the stream, then their removal can result in increased stream temperature and decreased dissolved oxygen concentrations. If the trees were providing organic input to the stream by leaf material and woody debris, then removing the trees can result in a decreased food source for macro-invertebrates and woody debris for fish habitat. This woody debris is an important component of fish habitat in bayous and streams of Louisiana, since bayous often do not have pools and riffles in them. Pools and riffles develop around the woody debris that falls into the stream or bayou and provide good habitat for fish and macro-invertebrates. Removing trees from the stream bank can also result in increased soil erosion from steep banks if proper stabilization methods are not utilized. This increased erosion can result in higher concentrations of suspended solids in the stream as sediment is washed from the bank during storm water events. The increased sediment in the stream can lead to turbidity or murky water that has the potential to affect the designated use for fish and wildlife propagation.

When a water body is straightened, the hydrologic characteristics are altered which can affect its ability to re-aerate itself. In the Mermentau River Basin, hydromodification has created areas called "stretch lakes" in many of its bayous. These long, wide segments of the bayou begin to function more like a lake than a flowing stream. Bayous are naturally slow-moving water bodies that transport large amounts of sediment and organic material. As the bayou is channelized and a stretch lake is formed, the pollutants settle out and are deposited on the bottom similar to a detention basin. Once these stretch lakes are formed, it is very difficult to flush the pollutants out of the system because the flow has been reduced to such an extent that the pollutants are no longer transported but are deposited in this wide, deep portion of the bayou. These segments of the bayou typically exhibit almost no flow and have very low dissolved oxygen concentrations.

Therefore through hydromodifcation, often both the stream bank and the stream channel are altered. These alterations affect the dynamics of the stream or bayou in many ways, primarily changing the energy of the stream, which affects its flow and its ability to transport pollutants and re-oxygenate itself. Urban streams are often channelized so that they can transport the water more quickly, thereby reducing flooding. Through this process the energy of the stream typically increases and transports the water and the associated pollutant load downstream where it is deposited in a lake, estuary or wetland. If the stream is converted to a channel that has a homogenous substrate, this can also affect fishery populations by decreasing habitat diversity. The combined effect of stream channel alteration and removal of riparian vegetation along the stream bank often lead to lower

dissolved oxygen concentration and reduced species diversity of fish and macro-invertebrates.

5.2 ACHIEVING GOALS

The water quality goals related to hydromodification are to reduce the impact that physical alteration of the water body has on the temperature and the dissolved oxygen. These two water quality parameters are utilized to determine if the fish and wildlife propagation use is being met or protected. The programmatic goal is to either reduce the frequency and extensiveness of hydromodification in Louisiana's water bodies or to implement the types of best management practices included within this document in order to reduce the impacts that hydromodification has on the fish and wildlife habitat. If steps are taken to implement best management practices (BMPs) on agricultural land and at construction sites, then less sediment should get into the water. If urban planning for new developments includes detention basins and vegetated wetlands to trap sediments and organic material, then fewer pollutants will be delivered to the water body. If the water body has a lower concentration of sediment, nutrients, and organic matter to transport, then it should be able to retain its carrying capacity for water more efficiently. This should result in more effective drainage and less frequent dredging. Less frequent dredging should result in improved aquatic habitat for fish and macro-invertebrate populations and improve the designated use for fish and wildlife propagation.

Through the reduction of sediment and other pollutants associated with these three land-use categories, the need for channelization of streams, bayous and rivers should be reduced. There also needs to be an extensive educational program for police juries, city engineers and parish drainage boards on innovative ways to manage streams and drainage systems at the local level. Most of them spend a great deal of their time planning projects and hearing complaints to alleviate drainage problems. The most effective way to address these problems is through a watershed focus instead of working on the water body in a piece-meal fashion that never examines it as a total system. Through work in Tangipahoa Parish, the Louisiana Department of Environmental Quality (LDEQ) worked with the Parish Drainage District and University of Southeastern Louisiana on a stream bank vegetation management project. This project has resulted in a manual that instructs parish drainage boards and police juries on the steps that can be taken to manage vegetation with less pesticides and disturbance of the steam bank. This manual will be made available to each of the 64 parishes across the state as one educational tool to illustrate the importance of stream banks in maintaining and improving water quality.

The goals of the Statewide Hydromodification Education Program are to incorporate nonpoint source water quality goals and objectives into state, federal and local programs that manage stream channels and stream banks. Louisiana Department of Environmental Quality has committed to the previous goals and objectives in order to improve the quality of the streambank and aquatic habitats along the state's water bodies. Since all of the water bodies on the state's 1998 303(d) list will have TMDLs developed within the next five years, the hydromodification issues will be included within the watershed restoration action strategies and implementation plans. These steps are consistent with the goals and objectives of the section of the NPS Management Program and are expected to result in water quality improvement by 2013.

5.4 PROGRAM TRACKING AND EVALUATION

Tracking of the changes that are made in the methods used to manage streams at the local level will need to be done at the local and the state level. The parish drainage boards and police juries often have the authorities for these types of projects. The NRCS and the Local SWCD are also local entities that can assist with tracking the changes that result from these restoration techniques being utilized more frequently. LDEQ will work with these local entities to determine a method that can effectively track improvements made as a result of the activities outlined here.

Tracking the water quality improvements that result from increased implementation of hydromodification management practices is the responsibility of LDEQ. Through the basin cyclic water quality monitoring program, watersheds will be sampled every four years for stream chemistry. This program can report on the long-term changes that result in the stream from improved methods of stream bank protection and watershed management. LDNR/CMD will assist in tracking and evaluation by providing data from the permit/mitigation database on hydromodification/restoration activities that require Coastal Use Permits in the coastal zone.

6.0 HOME SEWAGE BEST MANAGEMENT PRACTICES

6.1 INTRODUCTION

Ground and surface water pollution are major considerations when on-site systems are used. Sewerage treatment and disposal systems should be designed and operated in a manner, which prevents the degradation of ground and surface water quality. Septic tank systems used in undersized lots or where soils are unsuitable for proper treatment of wastewater are subject to undesirable conditions such as widespread saturation of the soil and malfunction of the treatment system. Malfunctioning systems result in sewerage leaching into ground water and into roadside ditches, contaminating surface water.

Septic tank systems must be designed so that they are compatible with the geological attributes of the area. If the ground water level is high (less than 4 feet below the surface) or if the soil is extremely permeable, the soil will not be effective in removing pollutants and the ground water may become contaminated, resulting in a public health hazard. Many diseases, including infectious hepatitis, typhoid fever, dysentery, and some forms of diarrhea are caused by water and food contaminated with sewerage and can easily be spread by flies.

One of the main problems with using conventional septic tank soil absorption systems in Louisiana is that 87 percent of the soil associations in Louisiana are considered inadequate

for conventional septic tank systems as determined from the Soil Limitation Ratings for Sanitary Facilities (LDOTD, 1981). Another major component to the pollution caused by septic tank systems is inadequate enforcement of the State Sanitary Code. The State of Louisiana currently has regulations concerning private sewerage disposal systems under the State Sanitary Code (LHHRA, 1974) and the Department of Health and Hospitals (DHH) (LR, 1980). A majority of the sanitarians expressed concern that there is control over new septic tank systems being installed, but there are extensive problems with monitoring the maintenance of existing systems.

6.2 ACHIEVING GOALS: EDUCATIONAL PROGRAMS

There are several issues or program activities that need to be addressed to reduce the water quality problems that are associated with home sewerage systems. One of the most important steps is continued education of the homeowner about how his/her home sewerage systems works. Most homeowners have no idea how to maintain their home sewerage system for maximum efficiency. A second aspect of the statewide program that needs to be addressed is the lack of inspection of home sewerage systems. The local parish sanitarian office typically does not have sufficient staff to inspect all of the systems across the parish. Even if the system was inspected, it is often difficult to force an action to correct the problem. LDEQ and LDHH are working together to ensure that more education about the problems that these systems cause to water quality across the state will result in more stringent regulations on maintenance of new and existing home sewerage systems.

LDEQ has worked with the Louisiana Department of Health and Hospitals on statewide educational programs aimed at reducing fecal coliform bacteria and nutrients from home sewerage systems. An educational brochure and video were produced that focused on the various types of home sewerage systems that are approved for use in Louisiana. Each type of system was explained along with maintenance requirements recommended to keep the system functioning properly. A maintenance checklist was also included so that the homeowner could keep a record of the steps that had been taken to clean the system out or to have it repaired.

The educational video has been reproduced and distributed across the state in parish offices of the Department of Health and Hospitals and the Louisiana Cooperative Extension Service. These materials are important components for the statewide educational program on home sewerage systems.

The primary goals of the Home Sewerage Statewide Educational Program are to continue to work with the Department of Health and Hospitals and parish governments on more effective inspection programs to ensure that the regulations, which require home sewerage systems to function properly, are enforced. Implementation of the short term and long term objectives described above should result in an increased level of compliance across the state and a > 50% reduction of fecal coliform problems from home sewerage systems during the next 5-10 years.

6.3 HOME SEWERAGE SYSTEMS APPROVED FOR USE IN LOUISIANA

6.3.1 SEPTIC SYSTEMS

A septic tank is a watertight tank constructed of steel, concrete or other approved materials in which the suspended solids of sewerage settle out and are largely changed into liquids or gases by microbial degradation. The remaining residue in the tank is a black semi-liquid sludge that must be removed periodically from the tank. Although relatively few disease organisms should be present in the sludge material, precautions should be taken in cleaning the tank and the sludge material safely disposed. Cleaning and disposal of sludge material from septic tanks can be provided by commercial services. These services are controlled by a permit system, required by local parish health units in accordance with Chapter 13 of the State Sanitary Code.

A series of single compartment septic tank systems or a multiple compartment septic tank system has proven to be more effective than the individual septic tank system, but the individual septic tank system is still acceptable. Information on the velocities of flow through the system and the types of tees and baffles required for the inlet and outlet valves are included within the description of septic tank systems. Estimates of capacities and size for a system are also included, with recommendations for the types of materials that should be utilized in their construction. Recommendations are also made for inspection and cleaning of the systems with the optimum time period being every two to five years, although the average period between cleaning was estimated to be between eight and ten years.

6.3.2 SEPTIC TANK EFFLUENT

Although many people believe that discharge waters from a septic tank system are clean and pure, this is not the case. The effluent of the liquid discharged from a septic tank system is classified as primary treatment, usually being foul and potentially dangerous, often containing disease-causing bacteria. Therefore discharge of septic tank effluent is not allowed in street gutters, surface ditches, or streams, according to regulations in the Louisiana State Sanitary Code. The method recommended for treatment of septic tank effluent is a soil absorption trench system. If the absorption trench is not possible due to poor soil or drainage conditions, then a small oxidation pond or a sand filter bed can also be utilized for secondary treatment of septic tank effluent.

6.3.3 ABSORPTION TRENCH FIELDS

The recommended method of treatment for septic tank effluent is an absorption trench or "subsurface irrigation" field, when suitable soil conditions exist. The absorption trench consists of a system of covered, gravel-filled trenches into which the septic tank effluent is applied, allowing for seepage of the liquid into the soil. Within the soil, the microbial populations degrade the organic matter in suspension or in solution to the mineral compounds, similar to the process involved in decomposition of animal waste manure in a plowed field. Basically three conditions must be met in order for absorption trenches to be a suitable method of secondary treatment:

1. The soil percolation rate should be within the acceptable range, dependant on soil porosity or permeability,

2. The maximum elevation of the ground-water table should be at least two feet below the bottom of the proposed trench,
3. Clay formations or other impervious strata should be at a depth greater than four feet below the bottom of the trenches.

If these three conditions are not met, then an alternative method of treatment should be utilized. In order for a determination to be made on the suitability of the soil for an absorption trench field, a percolation test should be done. The procedure for conducting this test is given within the sanitary code. The code also describes specifications required for adsorption trenches associated with individual residences (Chapter 13: A: 3.5-3.18) Absorption trenches shall not be located:

1. beneath driveways, parking or other paved areas;
2. in areas that may be subjected to passage or parking of heavy equipment or vehicles, or storage of materials;
3. Beneath buildings or other structures.

6.3.4 OXIDATION PONDS

An oxidation pond may be utilized in conjunction with the septic tank to treat sewerage effluent. The oxidation pond is a shallow pond that is designed specifically to treat sewerage by natural purification processes under the influence of air and sunlight. The stabilization process consists primarily of interactions of bacteria and algae. The bacteria digest and oxidize the constituents of sewerage and render it harmless and odor free. Algae utilize carbon dioxide and other substances resulting from bacterial action and through photosynthesis produce the oxygen needed to sustain the bacteria in the treatment process. During the detention period, the objectionable characteristics of the sewerage largely disappear. Specifications for construction of the oxidation ponds are given in Chapter 13: Section IV of the State Sanitary Code.

6.3.5 SAND FILTER BEDS

A second method for treatment of septic tank effluent is a deep-type sand filter bed. In this method, treatment is accomplished by microbial action in the sand filter bed, where suspended solids of the septic tank effluent are trapped by filtration. It is important for the sand bed to remain aerobic if degradative processes are to occur, therefore the sand surface needs to remain in contact with the air for as long as possible. This can best be accomplished by no cover being allowed on the sand bed system, but that is not usually acceptable to the landowner so a course gravel cover of not more than six inches in depth is permitted. No other cover is acceptable. Recommendations on the size and construction specifications for the sand filter bed are included in Chapter 13:5.2-5.11 of the State Sanitary Code.

6.3.6 MECHANICAL WASTEWATER TREATMENT

In the cases where septic tank systems can not be expected to function properly due to unsuitability of soils (based on results of the percolation tests), a mechanical waste water treatment plant is allowed. Mechanical waste water treatment plants are small plants capable of providing primary and secondary sewerage treatment. They are considered aerobic treatment systems that do not require previous treatment in septic tanks. Mechanical treatment plants must strictly comply with National Sanitation Foundation International Standard, NSF 40-1996 for Residential Wastewater Treatment Systems (Class I Systems). Determination of compliance with NSF Standard Number 40 requirements shall be the responsibility and sole authority of the State Health Officer acting through the Office of Public Health.

6.3.7 PUMPING STATION

A pumping station is often required when a sand filter bed and/or an oxidation pond is utilized as a means of secondary treatment for a septic tank system, especially in areas with flat terrain. Due to the corrosive nature of septic tank effluent, pumps or pumping stations built especially for these effluents are required. Construction specifications for the pumping stations are included in Chapter 13: Part VIII of the State Sanitary Code. These specifications include the dimensions and type of materials that should be used for the culvert pipe, the type of pump and the pump housing that is required and the type of cover that should be used for the top of the pump station, allowing for maintenance of the pump.

6.3.8 SANITARY PIT PRIVY

When a dwelling is not served by water under pressure, water carriage waste systems, as have been previously covered, can not be used. In these cases, a pit privy is required for waste disposal. The pit privy system must be located so that they will not pollute domestic, private, or public water supplies. Therefore, they must be located downgrade and at least fifty feet away from water wells and water supply lines. Pit privies must also be located at least four feet from any fence, ditch, or building to give room for a proper earth mound. They must be housed as separate units and located at least ten feet from the property line. Specifications for construction and maintenance of an approved privy system are included within a pamphlet entitled, "Louisiana Type Sanitary Pit Privy, which can be obtained through the Division of Environmental Services within the Office of Health Services and Environmental Quality.

6.3.9 MICROBIAL ROCK FILTER

One alternative type of individual waste water treatment system that the Department of Health and Hospitals has investigated and that Region 6 EPA supports is the microbial rock plant filter. Dr. W. C. Wolverton, a research scientist at the Stennis Space Center, originally designed the system to be used for recycling wastes in a space station on the moon. The technology has been evaluated and implemented during the past 10 years for use in individual and community waste water treatment systems within the United States. Thirty-seven of these systems are presently functioning or are being planned for construction in Louisiana. The design utilizes the concept of synergistic effects of naturally occurring plant and rock microbial populations to reduce biochemical oxygen demand (BOD) in septic tanks and oxidation lagoon effluent. The systems have been shown to reduce BOD from 110-50 mg/L to 10-2 mg/L in 24 to 48 hours.

Toxic organic and metals have also been reduced through the use of these systems, with measurable reductions in fecal coliform levels.

The scientific basis for the microbial rock plant system for waste water treatment is growth of plants and microbial populations living on and around plant root systems and the rock filter. Once the microbial populations are established on the aquatic plant roots and the rocks in the filter, a symbiotic relationship is formed with the higher plants, resulting in increased degradation rates and removal of organic chemicals from the waste water effluent surrounding the plant roots and the rock system. The degradative products of the organic are absorbed by the plants and utilized along with nitrogen, phosphorus, and other minerals as a food source. Microorganisms also use some or all of the metabolites released through the plant roots as a food. Each ecological system, using the other's waste products, provides for a biogenerative habitat to be sustained for accelerated removal of organic from waste water. Charges associated with the plant root hairs attract the colloidal particles, such as suspended solids, with opposite charges causing them to adhere to the plants where the solids are being removed by the rocks, then digested and assimilated by microorganisms. This system increases the density of the microorganisms and accelerates the biological activity. The species of plants recommended for these microbial rock plant systems include:

6.3.10 AQUATIC PLANTS

Southern bulrush (Scirpus californicus)
Pickerel weed (Pontederia cordata)
Arrowhead (Sagitaris spp.)
Torpedo grass (Panicum Repens)
Calla Lily (Zantedeschia aethiopical)
Canna Lily (Canna Flaccida)
Reed (Phragmited communis)
Cattail (Typhas spp.)
Soft Rush (Juncus effusus)
Water Iris (Iris pseudacorus)
Ginger Lily (Hedychium spp.)

The use of the aquatic plants allows for introduction of oxygen through translocation from the upper leaf areas into the roots, producing an aerobic zone around the roots, increasing biological activity.

6.4 PROGRAM TRACKING AND EVALUATION

Tracking installation and maintenance of home sewerage systems is a labor intensive job that requires sufficient staff to conduct inspections. The Nonpoint Source Unit will work with the Parish Sanitarian Office in watersheds across the state where home sewerage systems have been identified as contributing to use impairment. Through this partnership, LDEQ could provide federal funds to expand their present staff capabilities for home sewerage system inspection for a three-year period. These staff would inspect existing home sewerage systems to determine if they function properly and work with the homeowner to correct any problems that are identified. These staff would also assist in establishing a parish-wide database to record the inspections and track progress in correcting problems that have been identified through the inspections. LDEQ will report on the results of this project through semi-annual and annual reports that are submitted to EPA.

- Implement the home sewer inspection and tracking program (short-term);
- Work with the Parish Health Sanitarian Office to determine the extensiveness of the inspections and a timeline to complete them (short-term);
- Assist the parish office in establishing a computer tracking system that identifies where inspections have been made, problems identified, actions taken and timeline to correct the problems (short-term);
- Utilize federal funds to support this pilot project through additional staff for conducting the inspections, establishing the computer tracking system and working with the homeowner on correcting the problems that were identified through the inspection process (short-term);
- Link results of parish-wide sewer inspection and tracking program with in-stream water quality improvements (short and long-term);
- Report results of the pilot project to EPA on a semi-annual and annual basis (short-term);
- Submit a final report that summarizes the results of the project to EPA (short-term);
- Determine if the project was successful and transfer to other priority watersheds if it proves to be an effective mechanism to reduce the fecal coliform problems associated with home sewerage systems (long-term);
- Work with LDHH to determine if this program can become established as a statewide program that is supported through a combination of federal and state funds (long-term).

7.0 FECAL COLIFORM IN THE BAYOU PLAQUEMINE BRULE

7.1 INTRODUCTION

Fecal coliform bacteria live in large numbers the intestines of warm-blooded animals. They aid in the digestion of food and the presence of them in an aquatic environment indicates that the water has been contaminated with the fecal material of man or other animals. If high numbers are found in a waterbody, the system may be contaminated with pathogens or disease producing bacteria or viruses, which can exist in fecal materials. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

The Louisiana fecal coliform standards for primary contact are below:

"…the fecal coliform content shall not exceed a log mean of 200/100mL, nor shall more than 10% of the total samples during any 30-day period or 25% of the total samples collected annually shall exceed 400/100mL. These primary contact recreation criteria shall apply only during the defined recreational period of May 1st through October 31st. During the non-recreational period of November 1st through April 30th, the criteria for secondary contact recreation shall apply"

The standard for secondary contact reads similarly:

"Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1000/100 mL, nor shall more than 10% if the total samples during any 30-day period or 25% of the total samples collected annually exceed 2,000/100ML".

And the standard for drinking water supply is written as follows:

"The monthly arithmetic mean of total coliform most probable number shall not exceed 10,000/100 mL, nor shall monthly arithmetic mean of fecal coliforms exceed 2,000/100 mL."

7.2 TMDL FINDINGS:

The Bayou Plaquemine Brule and its tributaries do not meet either the primary or secondary contact recreation for fecal coliform; however, the bayou meets criteria for drinking water supply. The load reduction needed to meet the water quality standard for primary contact recreation in the watershed during the recreational period (May 1 – October 31) is 83% reduction. For secondary contact during the non-recreational period (November 1 – April 30), the load reduction needed is 73% reduction.

Table 7.1 Fecal coliform counts, criteria, loading, and flow in the Bayou Plaquemine Brule during winter and summer seasons.

MEASUREMENT	MAY TO OCTOBER	NOVEMBER TO APRIL
Flow at Esterwood	504 ft^3/sec	878 ft^3/sec
Average fecal coliform count	1,162 cfu/100ml	3,719 cfu/100ml
TMDL fecal coliform criteria	200/100mL	1,000/100mL
TMDL % reduction required	83%	73 %
Point source loading per day for all dischargers	4.00 E10 cfu/day	4.00 E10 cfu/day
Average loading per day	1.43 E13 cfu/day	7.98 E13 cfu/day

7.3 POINT SOURCES

There are 17 known sanitary waste facilities discharging into the Bayou Plaquemine Brule and its tributaries. The combined flow for all these discharges is 5,277,000 gpd. More stringent limitations on point sources of fecal coliforms will not be required. LDEQ regulations already require that point discharges of sanitary waste must maintain a fecal coliform count on the effluents of 200 cfu/100 mL. In other words, point sources already

meet criteria at the end-of-pipe. At 200 cfu/100mL, the contribution of all point sources to the Bayou Plaquemine Brule is 4.00 E10 cfu/day.

7.4 NPS SOURCES OF FECAL COLIFORM

Fecal coliform bacteria are everywhere and can be found in high numbers in surface waters after major rain events. Sources of fecal coliform include faulty septic systems, sewer overflow, municipal trash, urban areas, bovine grazing pasture, animal feedlots, and wildlife such as waterfowl, mammals, and even cold-blooded animals discharge fecal coliforms. Precipitation can transport fecal materials as they can attach to soil particles and organic debris and run into waterways. Associating coliform levels with rainfall, rainfall intensity, or turbidity may be misleading, however, other watershed variables such as population density or presence of animal husbandry operations such as animal feedlots may be better indicators to predict of coliform levels in a watershed (Glenne, 1984) (Chang, 1999) page 76.

Fecal counts drop sharply during the winter months, as much as 90% (Schueler et al. 2000), in many of the surface waters around the country; however, the rice/crawfish ponds and flooded fields in the Bayou Plaquemine Brule watershed are frequented by a multitude of migratory birds during the winter months. Fecal coliform levels rise during the winter months as the migratory birds settle in the region during the winter months or as they pass on through to destinations further south. Upon return many of the migratory birds will again utilize the flooded fields in the Bayou Plaquemine Brule watershed on their trip back up to the northern latitudes.

7.5 WASTE LOAD ALLOCATION

LDEQ does not know the relative contribution of the various NPS sources of fecal coliforms in the Bayou Plaquemine Brule. LDEQ does know that the point sources are contributing 4.00 E10 cfu/day. If LDEQ is going to be able to remediate the high levels of coliforms and bring the bayou within criteria limits, we will have to perform extensive studies to identify the sources. The table below represents our knowledge of the sources and the management practices available to mitigate the problem.

TABLE 7.2 FECAL COLIFORM REQUIRE A 83% REDUCTION DURING THE SUMMER RECREATIONAL PERIOD AND A 73% REDUCTION DURING THE WINTER NON-RECREATIONAL PERIOD

Source	Present in watershed	Percent of total load	Transport and pathway to water system	Can LDEQ implement meditative actions?	Remediation techniques	BMP effectiveness
Faulty septic systems	> 50%of the septic systems are not operating properly	Unknown	Faulty septic tanks drain into ditches	Educate public and coordinate efforts w/the Department of Health and Hospitals to monitor and correct home sewerage problems	Install effective septic tank systems	95%
Sewer overflow	Unknown	Unknown	Drains right into Bayou	Unknown	Increase treatment capacity of sewerage system	Sewerage plant will meet criteria at all times
Grazing pasture	Yes 27% of the watershed contains pasture grazing land	Unknown	Rain events transport fecals overland into waterways	Yes, implement BMPs to prevent bovine discharges from migrating into waterways	Filter strips, livestock drinking wells located in away from waterways	Unknown
Rice and soybean crops	Yes, >50% of the watershed contains agriculture row crops	Unknown	Rain events transport sediments and fecals overland into waterways	Yes, implement BMPs to prevent sediments and organics, which fecal coliforms attach to.	Conservation tillage, filter strips, and other BMPs which reduce sediment runoff	BMPs for rice can reduce sediment load by 60%. Fecal reduction unknown
Animal husbandry feedlots	No	NA	NA	NA	NA	NA
Wildlife/migratory waterfowl	Yes, migratory birds double and sometimes triple coliform counts during the winter when they are utilizing the flooded fields in the watershed	Unknown	Waterfowl discharge fecals directly into water or very close to shore	No	None	NA
Urban areas-pets and trash	Yes, > 7% of the land areas are urban	Unknown	Rain events transport coliforms	Yes, cities may apply for section 319 funds for BMP implementation	Neighborhood retention ponds, artificial wetlands, and buffer zones	Retaining urban runoff in retention ponds and artificial wetlands can result in a 95% reduction of fecal coliforms. The greater the residence time before the runoff reaches the stream system the greater the remediation of coliforms

APPENDIX A

TMDL AND HISTORICAL WATER QUALITY DATA

SUMMARY

The most obvious conclusion in analyzing the data sets is the pronounced spike in pollutants in the bayou during the month of April. This seasonal spike in pollutants coincides with the spring discharge of impounded water from rice field operations. Also, increases of fecal coliforms correlate with the increased precipitation. DO is inversely proportional to temperature.

DATA SETS

Data used for the TMDL was obtained from 5 separate sites which are listed below. All monitoring sites and events clearly indicate that Bayou Plaquemine Brule is in violation of DO and fecal coliform standards. Monitoring site 5801004 at Estherwood, Louisiana contains the most comprehensive collection of data. Sampling occurred at the same location over a 20 year period following the same protocol. A number of oxygen demanding substances (noted below) and fecal coliforms were analyzed from the water samples. This data set (5801004) is presented for analysis since LDEQ is examining the results for any historical trends.

DISSOLVED OXYGEN

Average Annual DO levels at Bayou Plaquemine Brule site (5801004) fluctuated between 7 mg/L and near 2 mg/L between 1978 and 1998. As expected, the winter months showed higher monthly averages of DO levels while the lowest DO levels occurred in September and May. Periodically, DO levels fell below 2 mg/L during the course of all seasons. Between 1998 and 2008, the median and maximum values of DO have improved and the minimum DO values were substantially higher in 2003 and 2008 compared to 1998. Organic carbon, nitrogen, and phosphorus are the major constituents of nutrient pollution in the water bodies. The median, maximum and minimum values of total phosphorus, TKN, TOC and nitrate/nitrite have all increased since 1998. The concentration of total suspended solids increased since 1998, especially in 2003 and the beginning of 2008.

FECAL COLIFORM

Monthly medians for fecal coliforms indicate that May and September have significantly lower coliform populations in the waterway while the months February is the highest which coincides with the annual visitation of migratory birds. The yearly chart on the following pages suggests that coliform numbers increase with the levels of precipitation. More information is needed to determine the sources of fecal coliform in the watershed. Average annual levels sharply rose in 1990 and then they were the lowest in 1998. There was a large peak in fecal coliform bacteria concentrations in February and March of 2004, but the concentrations have declined since then remaining below the water quality standard for most

of the year. Precipitation in 1990 was 54 inches, slightly below the average of 57 inches a year. The data clearly indicates that Bayou Plaquemine Brule exceeds fecal coliform standards during both the primary and secondary contact seasons, but more recent data indicates that the concentration of fecal coliform bacteria has improved since 1998.

Location of monitoring	Time and duration of sampling	Type of sampling event
Bayou Plaquemine Brule at Estherwood Site 5801004	1978-1998	Ambient sampling
Bayou Plaquemine Brule at Church Point	October 2-5, 1989	Intensive survey
Bayou Plaquemine Brule at Crowley	August 29th-September 2nd 1989	Intensive survey
Bayou Blanc at Rayne	July 18th –23rd 1993	Intensive survey
Bayou Plaquemine Brule at Egan Site 0650	1 yr 1998	Ambient sampling

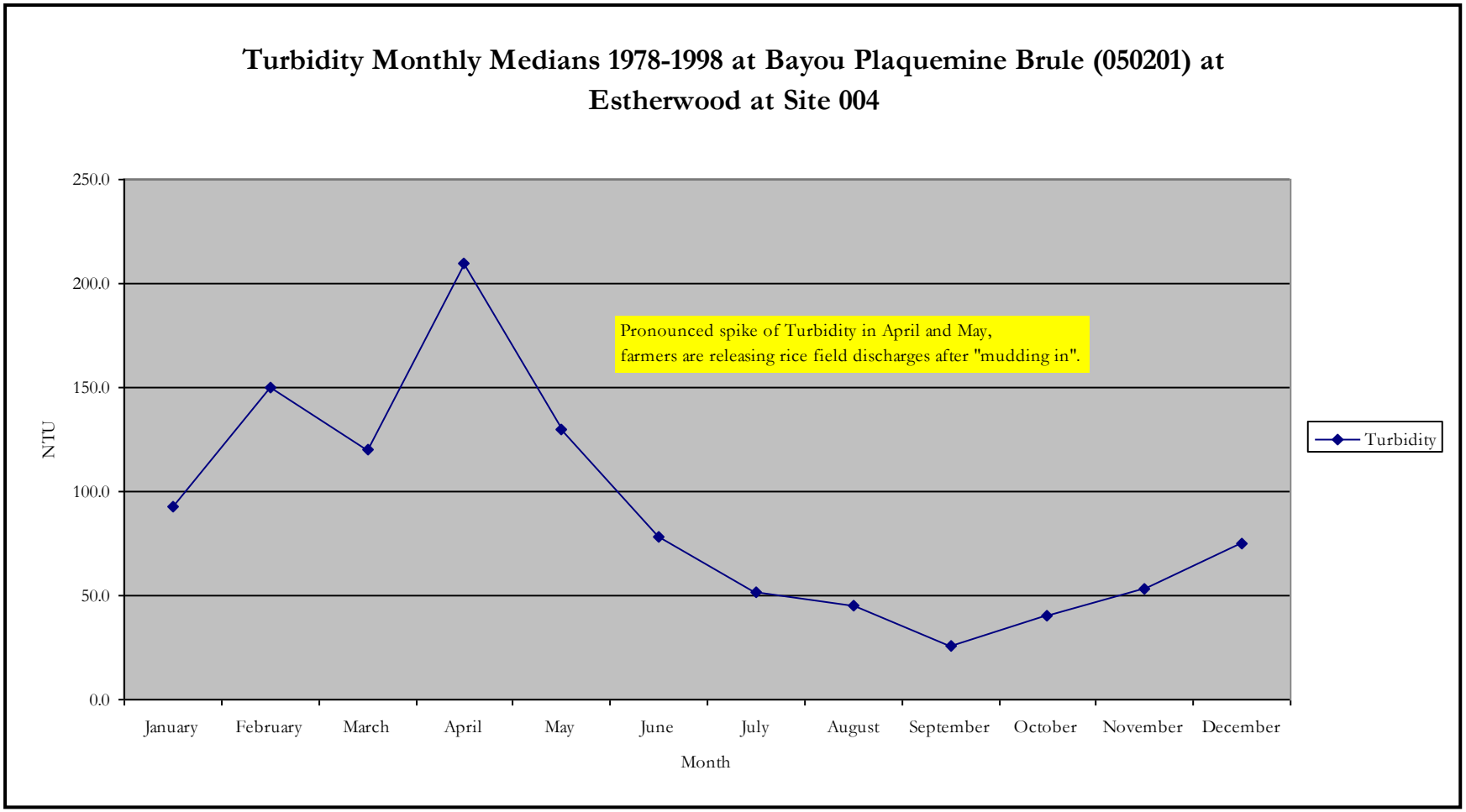
Note: Water quality data for the Bayou Plaquemine Brule TMDL were from LDEQ water quality sites listed in the table above. The method for sampling at all sites was a standard "grab sample." Bayou Plaquemine Brule (5801004) near Estherwood contained a multi-year record of water-quality data, including field pH, temperature, DO, conductivity, alkalinity, heavy metals (As, Cd, Cr, Cu, Hg, Pb, Ni), nutrients (N, P, TOC), suspended solids, turbidity, and coliform. Bayou Plaquemine Brule (0650) site contained only one year (1998) of water quality data.

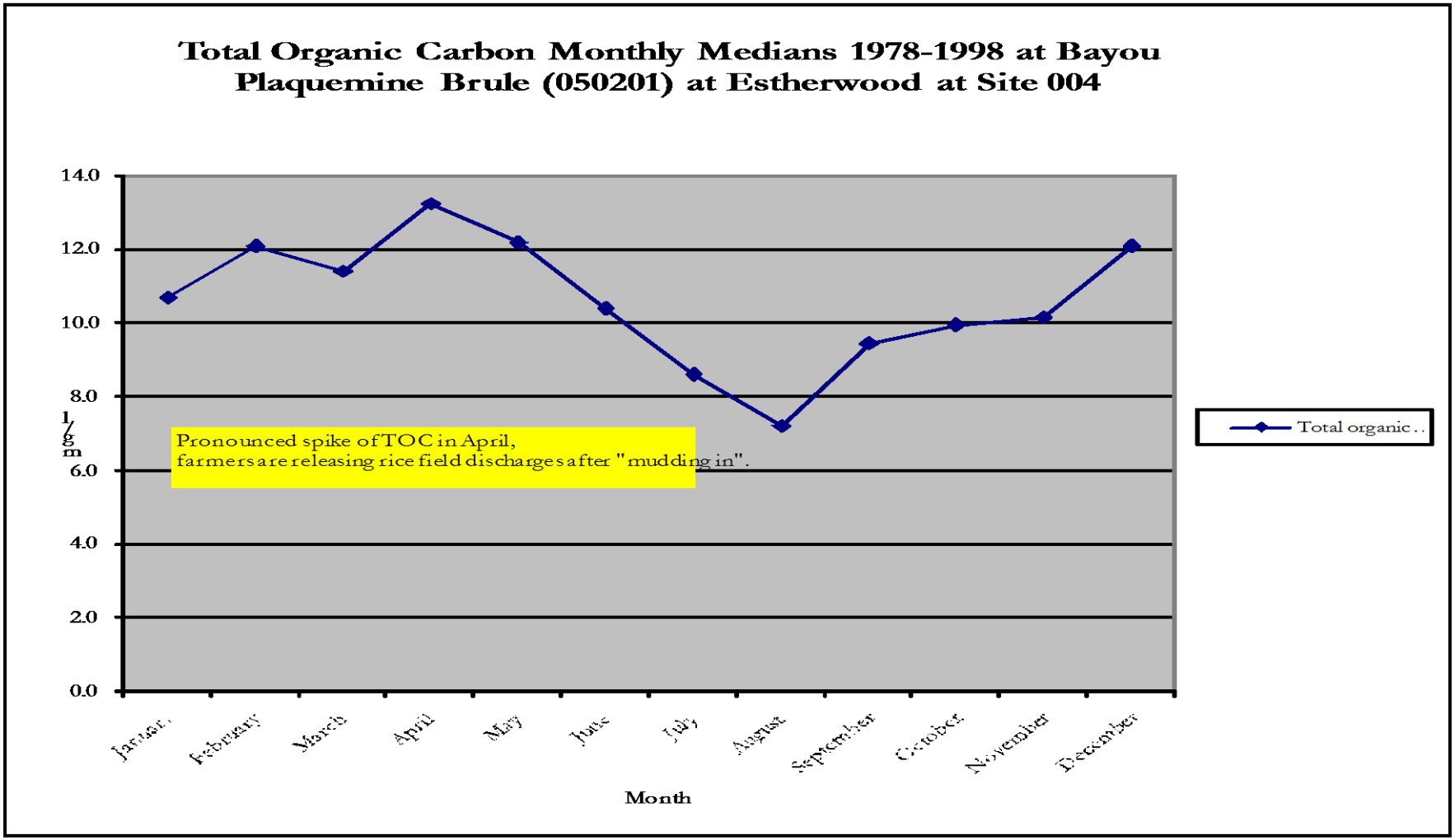
DISCUSSION

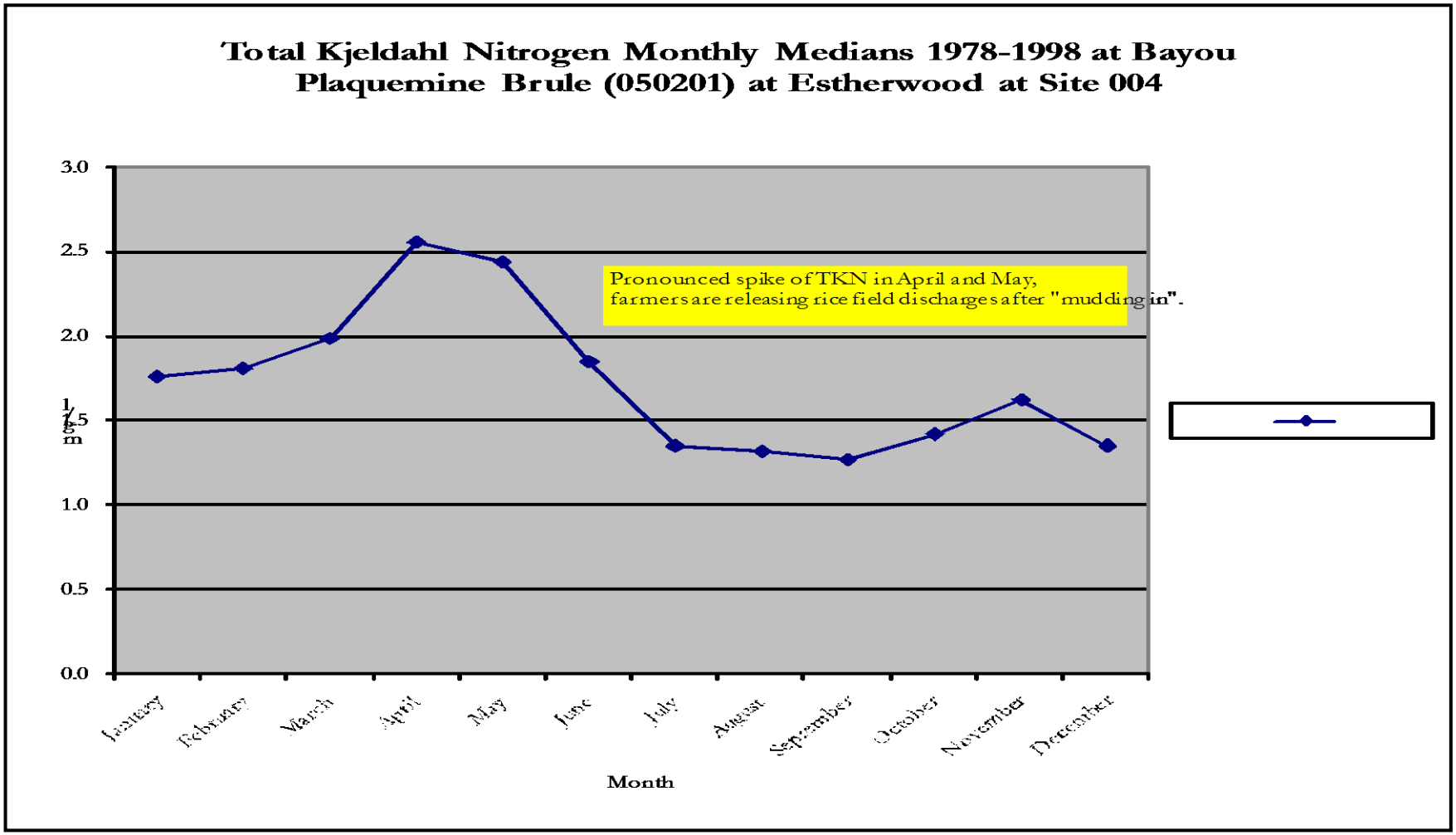
The water quality data clearly demonstrates that runoff of the majority of oxygen demanding substances coincide with the spring release of impounded water from rice fields. Rice farmers flood the fields in the spring to level the field "mudding in" and plant the rice seed. Once the field is leveled and planted, the impounded water is release from the field and after a couple of weeks, the field refilled again. Mudding in a rice field involves flooding the field and running disks through the mud and water. Presumably, the disk leveling evens out the high spots and the suspended solids fill in the low spots. Discharges of suspended solids are magnitudes greater during this spring discharge event over the drainages for pesticide/fertilizer applications and harvest that occur during the summer and fall seasons. Root matter anchor sediments in the field and foliage rising through the impounded water provide surface area for microbial decomposition of organic materials and nitrogenous compounds. The summer and fall discharges are relatively clean outflows with very little of the sediments leaving the field.

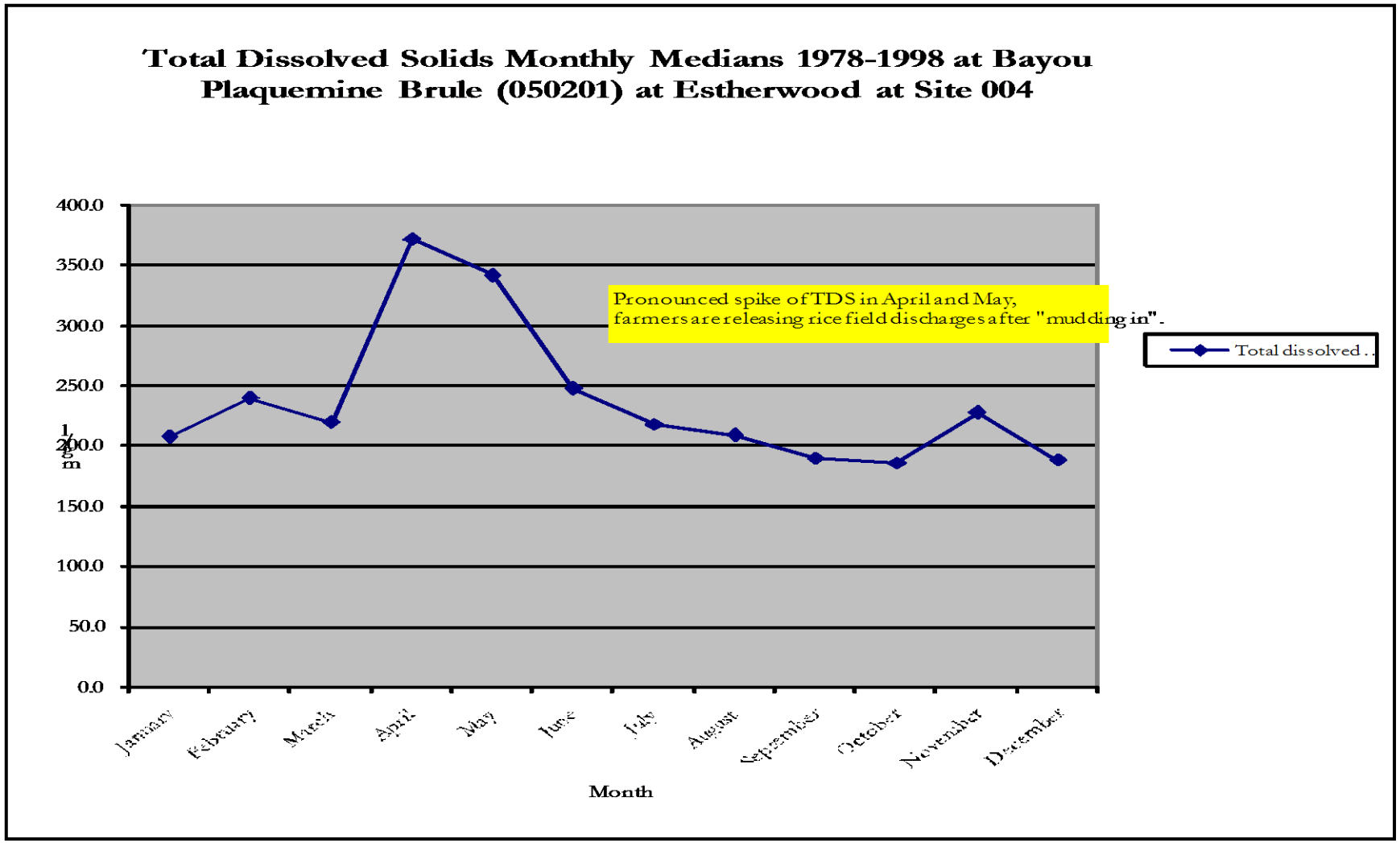
NPS pollutants such as sediments, nutrients and total organic carbon are linked to DO standards, and sufficient considerations should be given to minimize these parameters to maintain higher DO levels in the water body. Dissolved oxygen levels were recorded at 2 mg/L or below at least once or twice during almost every year over the 20 year period. Based on the USGS annual discharge data, the average annual discharge rate for Bayou Plaquemine

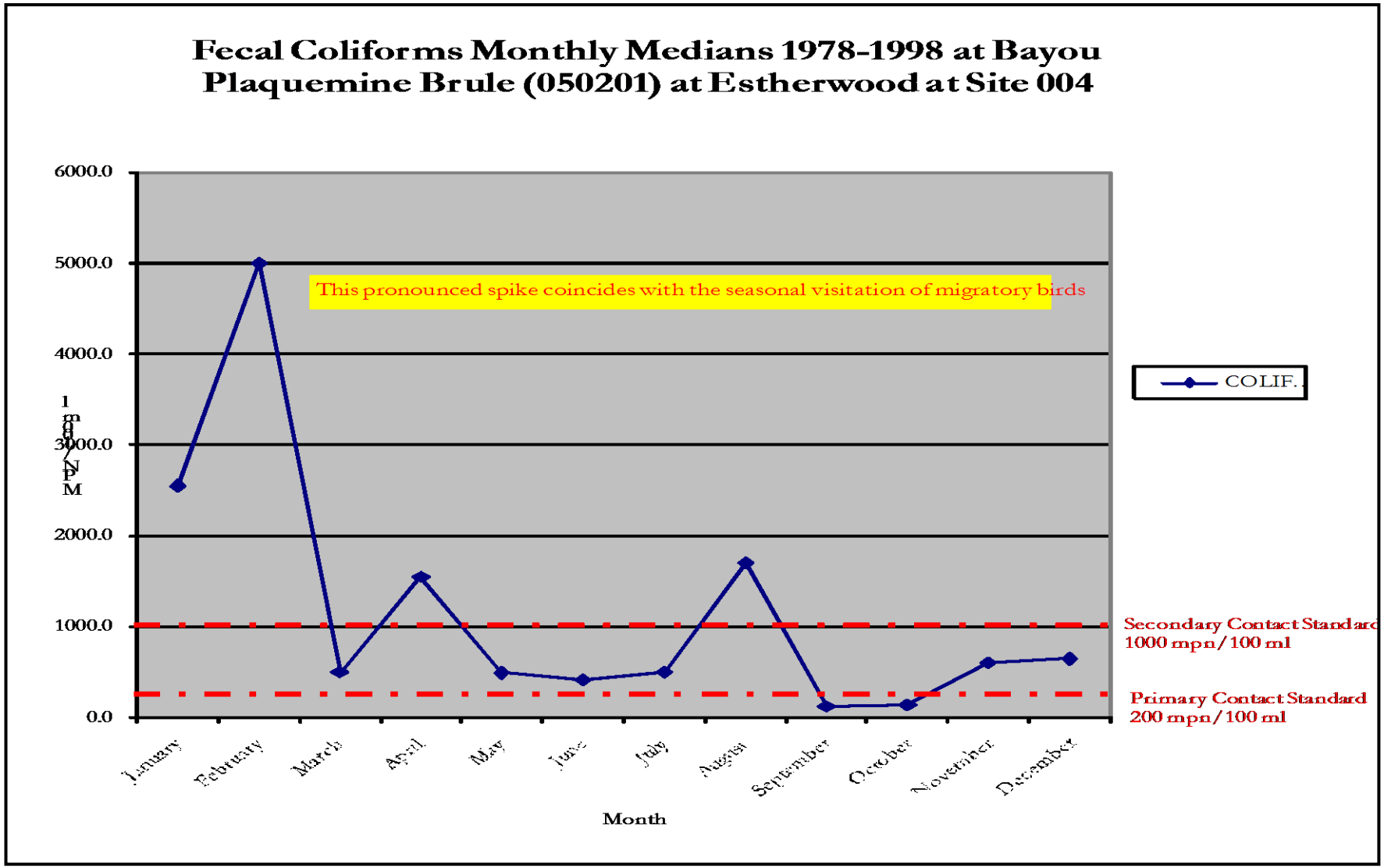
Brule near Crowley was 15.68 cubic feet/ second, while the annual average discharge rate for Bayou Plaquemine Brule near Estherwood was 9.4 cubic feet/second, which means that discharge rates of the Bayou Plaquemine Brule decrease downstream compared to upstream. The total amount of annual rainfall varied across the watershed. Total annual rainfall for Rayne varied mostly between 40 and 70 inches with a total annual average of 57.6 inch, while for Crowley total annual rainfall varied mostly between 40 and 80 inches, with the total annual average rainfall of 58.9 inches.

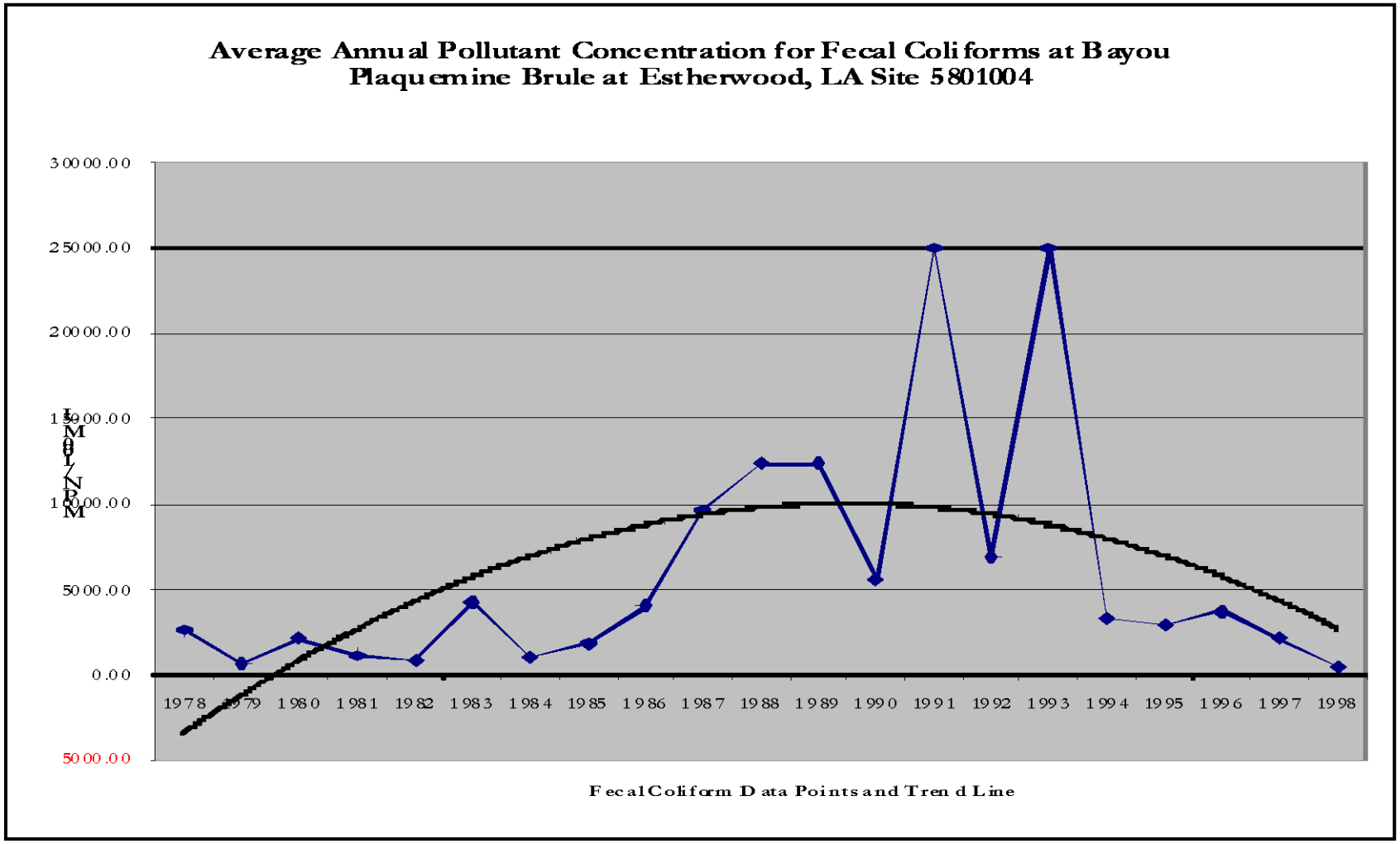

Turbidity Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
250.0
200.0
150.0
100.0
50.0
0.0
NTU
Pronounced spike of Turbidity in April and May,
farmers are releasing rice field discharges after "mudding in".
Turbidity
January
February
March
April
May
June
July
August
September
October
November
December
Month

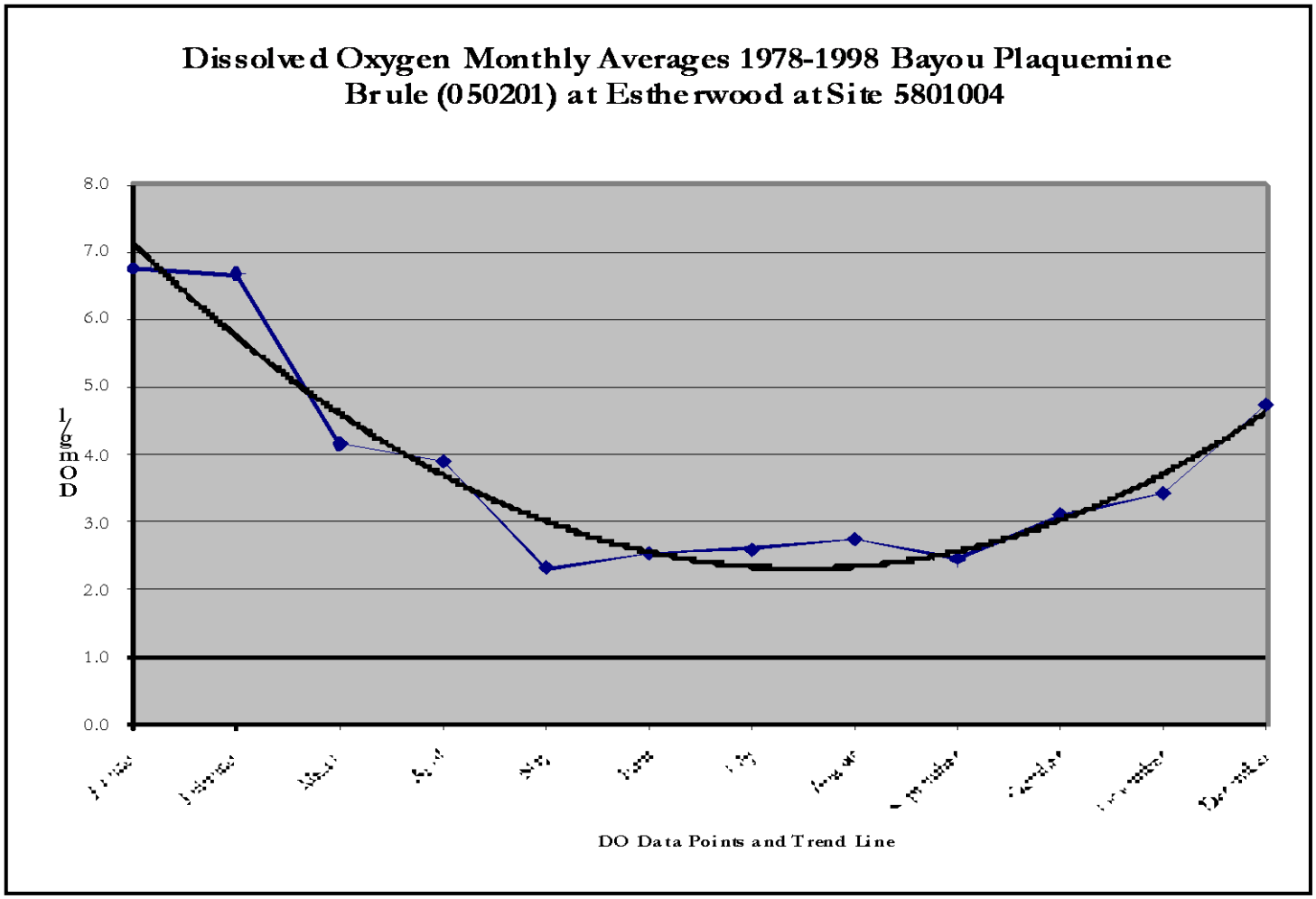

Total Organic Carbon Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
mg/l
Pronounced spike of TOC in April, farmers are releasing rice field discharges after "mudding in".
January
February
March
April
May
June
July
August
September
October
November
December
Month
Total organic..

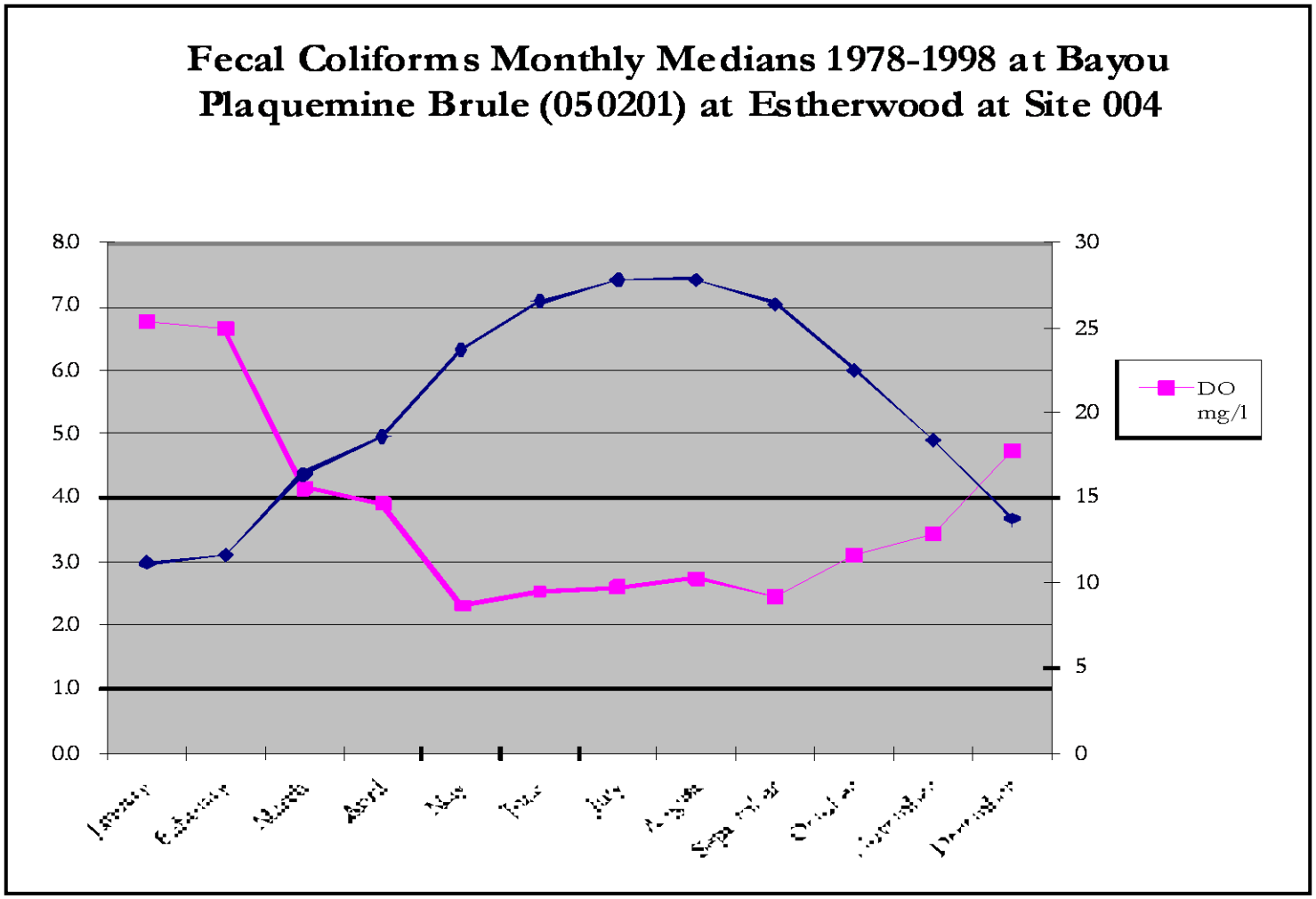

Total Kjeldahl Nitrogen Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Pronounced spike of TKN in April and May, farmers are releasing rice field discharges after "mudding in".
January
February
March
April
May
June
July
August
September
October
November
December
Month

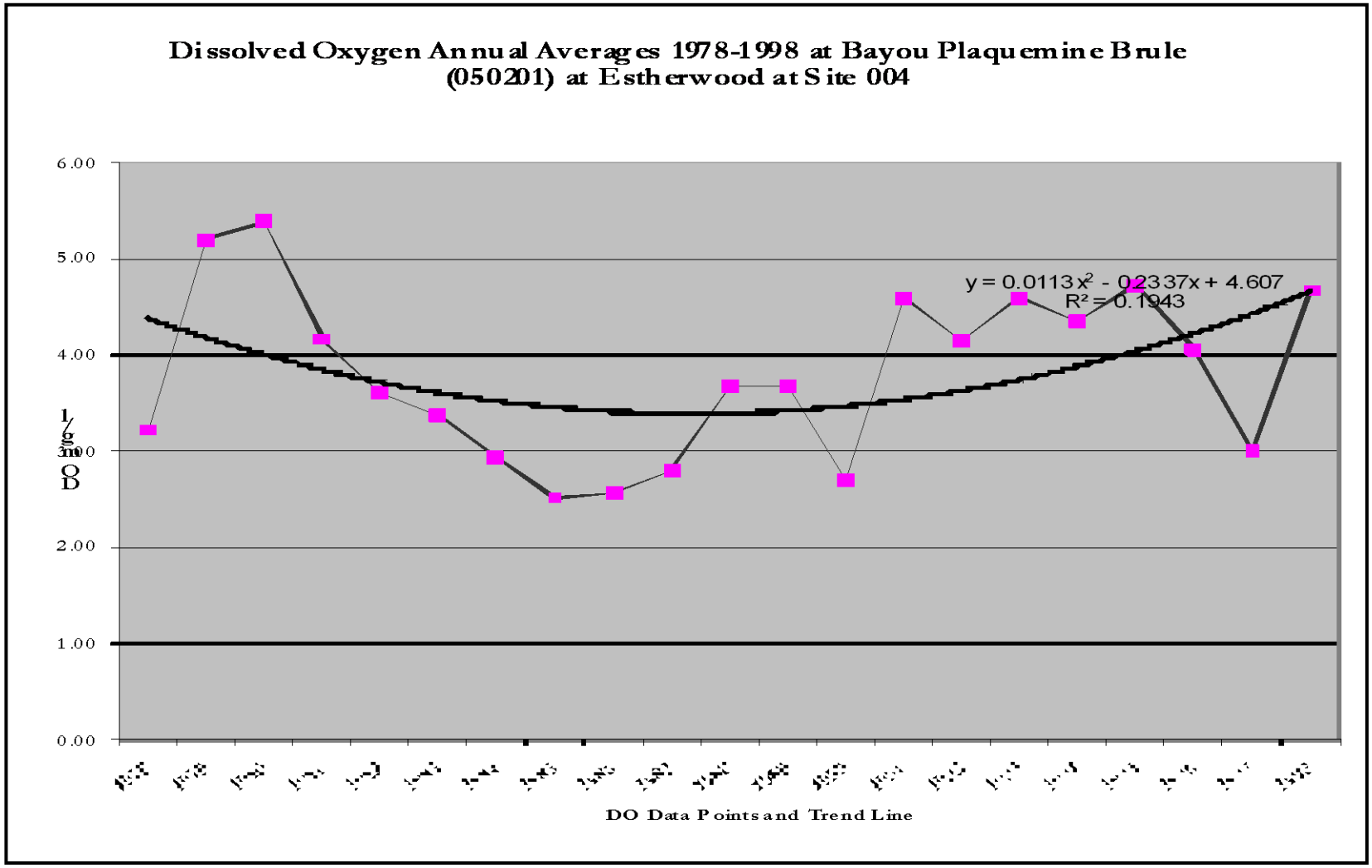

Total Dissolved Solids Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
mg/l
Pronounced spike of TDS in April and May, farmers are releasing rice field discharges after "mudding in".
Total dissolved . .
January
February
March
April
May
June
July
August
September
October
November
December
Month


Fecal Coliforms Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
This pronounced spike coincides with the seasonal visitation of migratory birds
COLIF.
Secondary Contact Standard
1000 mpn/100 ml
Primary Contact Standard
200 mpn/100 ml
January
February
March
April
May
June
July
August
September
October
November
December
Month


Average Annual Pollutant Concentration for Fecal Coliforms at Bayou Plaquemine Brule at Estherwood, LA Site 5801004
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
-5000.00
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Fecal Coliform Data Points and Trend Line


Dissolved Oxygen Monthly Averages 1978-1998 Bayou Plaquemine Brule (050201) at Estherwood at Site 5801004
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
DO Data Points and Trend Line


Fecal Coliforms Monthly Medians 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
30
25
20
15
10
5
0
DO mg/l


Dissolved Oxygen Annual Averages 1978-1998 at Bayou Plaquemine Brule (050201) at Estherwood at Site 004
6.00
5.00
4.00
3.00
2.00
1.00
0.00
mg/l DO
y = 0.0113x² - 0.2337x + 4.607
R² = 0.1943
DO Data Points and Trend Line

Monthly Medians from 1978-1998 for Oxygen Demanding Substances and Fecal Coliforms in Bayou Plaquemine Brule at Estherwood Site 004

Month	Dissolved oxygen (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)	NO2 Nitrate (mg/L)	Total Kjeldahl nitrogen (mg/L)	Total Phosphorus (mg/L)	Total organic carbon (mg/L)	Turbidity NTU	COLIFORM MPN/100 ML
January	6.8	208.0	61.0	0.3	1.8	0.5	10.7	92.5	2550.0
February	6.7	240.0	94.0	0.3	1.8	0.5	12.1	150.0	5000.0
March	4.2	220.0	56.0	0.3	2.0	0.4	11.4	120.0	495.0
April	3.9	372.0	84.0	0.4	2.6	0.5	13.3	210.0	1550.0
May	2.3	342.0	56.0	0.6	2.4	0.4	12.2	130.0	490.0
June	2.5	248.0	52.0	0.4	1.9	0.4	10.4	78.0	410.0
July	2.6	218.0	39.5	0.3	1.4	0.3	8.6	51.3	500.0
August	2.7	209.0	40.0	0.3	1.3	0.3	7.2	45.0	1700.0
September	2.5	190.0	22.0	0.1	1.3	0.4	9.5	26.0	120.0
October	3.1	186.0	37.0	0.2	1.4	0.4	10.0	40.0	140.0
November	3.4	228.0	40.0	0.3	1.6	0.5	10.2	53.0	600.0
December	4.7	188.0	60.0	0.3	1.4	0.4	12.1	75.0	645.0
Criteria	3mg/l summer 5mg/l winter	260 mg/l	NA	Naturally occurring range [1]			NA	150 NTU	200 cfu primary 1000 cfu secondary

[1] The naturally occurring range of nitrogen-phosphorus ratios shall be maintained. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated uses shall not be added to any surface waters. LAC 33:IX.1113.8

Average Annual Pollutant Concentration for Oxygen Demanding Substances and Fecal Coliform at Bayou Plaquemine Brule at Estherwood, LA Site 5801004

YEAR	Dissolved oxygen (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)	NO2 Nitrate (mg/L)	Total Kjeldahl nitrogen (mg/L)	Total Phosphorus (mg/L)	Total organic carbon (mg/L)	Turbidity NTU	Fecal Coliform MPN/100 ML
1978	3.22	314.44	118.89	0.35	2.08	0.56	12.50	99.11	2656.00
1979	5.21	230.50	119.75	0.38	1.75	0.54	15.39	119.90	683.00
1980	5.39	214.75	150.67	0.35	2.44	0.65	6.08	112.25	2139.75
1981	4.17	213.45	104.00	0.36	2.03	0.50	8.01	74.71	1173.64
1982	3.62	274.33	69.33	0.38	1.96	0.96	12.02	79.42	868.18
1983	3.38	218.50	68.83	0.24	1.78	0.47	7.83	112.75	4268.00
1984	2.94	268.33	58.50	0.32	1.62	0.43	11.48	129.55	1028.58
1985	2.52	237.83	91.00	0.41	2.15	0.54	12.03	173.42	1887.50
1986	2.57	231.00	40.67	0.24	2.97	0.48	12.23	75.78	4033.33
1987	2.81	202.92	77.83	0.23	2.92	0.62	11.23	80.25	9652.50
1988	3.68	216.91	49.67	0.31	1.74	0.51	12.48	77.42	12358.33
1989	3.68	216.91	49.67	0.31	1.74	0.51	12.48	77.42	12358.33
1990	2.69	315.25	45.25	0.47	2.05	0.49	11.76	126.79	5648.18
1991	4.60	273.08	42.75	0.40	1.53	0.42	10.27	65.17	25010.00
1992	4.15	208.83	76.83	0.34	1.48	0.42	10.89	96.50	6945.00
1993	4.60	273.08	42.75	0.40	1.53	0.42	10.27	65.17	25010.00
1994	4.35	254.00	58.00	0.32	1.49	0.39	11.76	95.50	3313.33
1995	4.73	290.83	83.42	0.37	1.47	0.29	9.63	120.04	2975.67
1996	4.06	258.00	171.83	0.30	1.83	0.36	12.61	93.17	3751.50
1997	3.00	308.08	56.83	0.29	1.89	0.35	11.15	101.50	2134.17
1998	4.67	340.80	66.80	0.29	2.11	0.40	11.60	199.60	482.00
20 yr avg	**3.81**	**255.33**	**78.25**	**0.34**	**1.93**	**0.49**	**11.13**	**103.59**	**6113**
Criteria	3mg/l summer 5mg/l winter	260 mg/l	NA		Naturally occurring range [1]		NA	150 NTU	200 cfu primary 1000 cfu secondary

[1] The naturally occurring range of nitrogen-phosphorus ratios shall be maintained. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated uses shall not be added to any surface waters. LAC 33:IX.1113.8

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