Big Creek
Subsegment 080903

Watershed Implementation Plan For:
Biochemical Oxygen Demand And Nutrients

Nonpoint Source Unit

Implementation Plan for the
Big Creek Watershed, Subsegment 080903, Site 0069 and 0328

Executive Summary

Louisiana has extensive surface water resources including miles of freshwater swamps, streams, bayous, rivers, and lakes. Water has always been important to the history and development of Louisiana. Surface water resources in Louisiana are used for a wide variety of purposes including human consumption, agricultural irrigation, transportation, industrial processes, recreation, seafood production, wildlife, and so much more. A great portion of the Louisiana economy and cultural heritage is directly linked to the surface water resources that exist today.

The Big Creek watershed is subsegment 080903 of the Ouachita River Basin (Basin 08). Subsegment 080903 is comprised of Big Creek, Big Colewa, and all their tributaries, including Bee Bayou, Turkey Creek, and Little Colewa. Big Creek's land uses are comprised of 79.67% agriculture, 12.71% forestry, 0.12% urban, 5.27% water, 1.83% shrub/scrub, and 0.39% marsh. The urban areas have had a diminutive population growth in the last 10 years and a large percentage of the land use is utilized for agriculture and forestry. Because of these facts, the estimated nonpoint explicit margin of safety for this watershed was reduced from the standard 20% to 10%. The explicit point source margin of safety used in the TMDL load calculations was 20%.

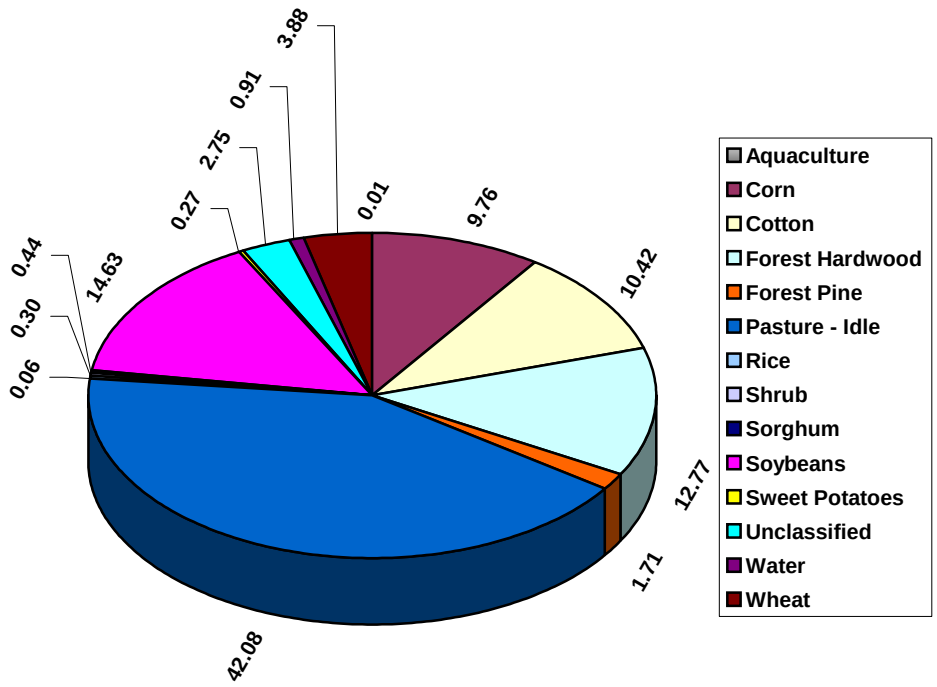

***Figure 1*. Big Creek's Land Uses (%)**

Designated uses for Big Creek (080903) from the headwaters to its confluence with Boeuf River, include primary contact recreation, secondary contact recreation, and propagation of fish and wildlife. Big Creek is listed on the 2004 303(d) list as not meeting its designated use of Fish and Wildlife Propagation, however, preliminary results for the 2006 303 (d) report indicate that the Big Creek is meeting its designated uses. The suspected causes of impairment include organic enrichment/low DO, nitrogen, phosphorus, pesticides, suspended solids, turbidity, salinity/TDS/chlorides/sulfates, and pathogens. The suspected sources of impairment include agriculture, non-irrigated crop production, pastureland, land disposal, and onsite wastewater (septic tanks).

This document describes best management practices (BMPs) that are recommended to manage nonpoint source (NPS) pollution for the Big Creek Watershed. A consolidated list of recommended BMPs can be found in the State of Louisiana Water Quality Management Plan, Volume 6, *Louisiana's Nonpoint Source Management*, 2000.

***Figure 2*. Big Creek, Richland Parish, LA**

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1.0 Introduction

Nonpoint source pollution is a diffuse source of water pollution that flows across land transporting contaminants to a waterbody. Common land-use categories that contribute to water quality impairments from nonpoint sources of pollution include agriculture, forestry, urban runoff, construction, home sewerage systems, resource extraction, and hydromodification. Detailed explanations of each category can be found in the State of Louisiana Water Quality Management Plan, Volume 6, *Louisiana's Nonpoint Source Management*, 2000.

Section 319 of the Clean Water Act authorizes The Environmental Protection Agency (EPA) to issue grants to states to assist in implementing management programs to control nonpoint sources of water pollution. Highest priority is to be given to waterbodies included in the 303(d) list of Impaired Waters. A waterbody is entered into the 303(d) list when it surpasses the water quality standard 10% of the time during an assessment period.

Water quality has been one of the major environmental issues across the country for over 30 years (Adams et al. 2000). Many of the water bodies across the state have become impaired. Negative impacts caused by the activities of man have resulted in many Louisiana water bodies not meeting standards set by the Louisiana Department of Environmental Quality (LDEQ). The Clean Water Act of 1972 requires that water bodies in all states meet minimum surface water quality standards. Pollutants from both point sources (ex. factories, sewage facilities) and nonpoint sources (ex. yards, pastures, field runoff) play a role in poor water quality. Louisiana has over 285 stream segments listed on the EPA 303(d) list of impaired steams.

Major efforts are now underway in Louisiana to improve the quality of surface waters. State and federal agencies, universities, industry, business and citizen groups have formed a wide variety of partnerships to move forward in solving water quality problems in the state. Water quality solutions are often complicated and require cooperation of all stakeholders.

Surface water quality management is approached by many state and federal agencies on a watershed basis. A watershed is an area of land drained by a particular set of

streams and rivers. Louisiana has 12 major watersheds, i.e. river basins, composed of smaller sub-watersheds. Watersheds often cross political boundaries. Several watersheds in Louisiana are shared with the neighboring states of Arkansas, Mississippi, and Texas.

Much of the cleanup effort is being focused first on those watersheds in the state with the most serious water quality challenges. The Louisiana Department of Environmental Quality (LDEQ) Nonpoint Source Program is responsible for determining water quality problems in each watershed. Total Maximum Daily Loads (TMDLs) are now being established for all watersheds in the state that do not meet their designated uses. Both the USEPA and LDEQ work to establish TMDLs in Louisiana. The amount of pollutants allowed to enter an impaired waterbody (a waterbody on the 303-d list) will be limited under the TMDL program. Municipalities, homeowners, farmers, business, and industry will all be expected to minimize pollutant runoff in watersheds that contain impaired water bodies.

Helpful programs designed to promote good surface water quality in agricultural areas are managed by the Natural Resource Conservation Service (NRCS) in Louisiana. Many farmers and landowners participate in the Environment Quality Incentive Program (EQIP), Wetlands Reserve Program (WRP), and Conservation Reserve Program (CRP). These and other USDA conservation program provide cost-share and technical assistance to help improve environmental quality.

The purpose of this report is to outline a plan, which can be implemented to reduce the amount of nonpoint source pollution entering the Big Creek watershed and thereby increase water quality to a level where the watershed fully meets its designated uses.

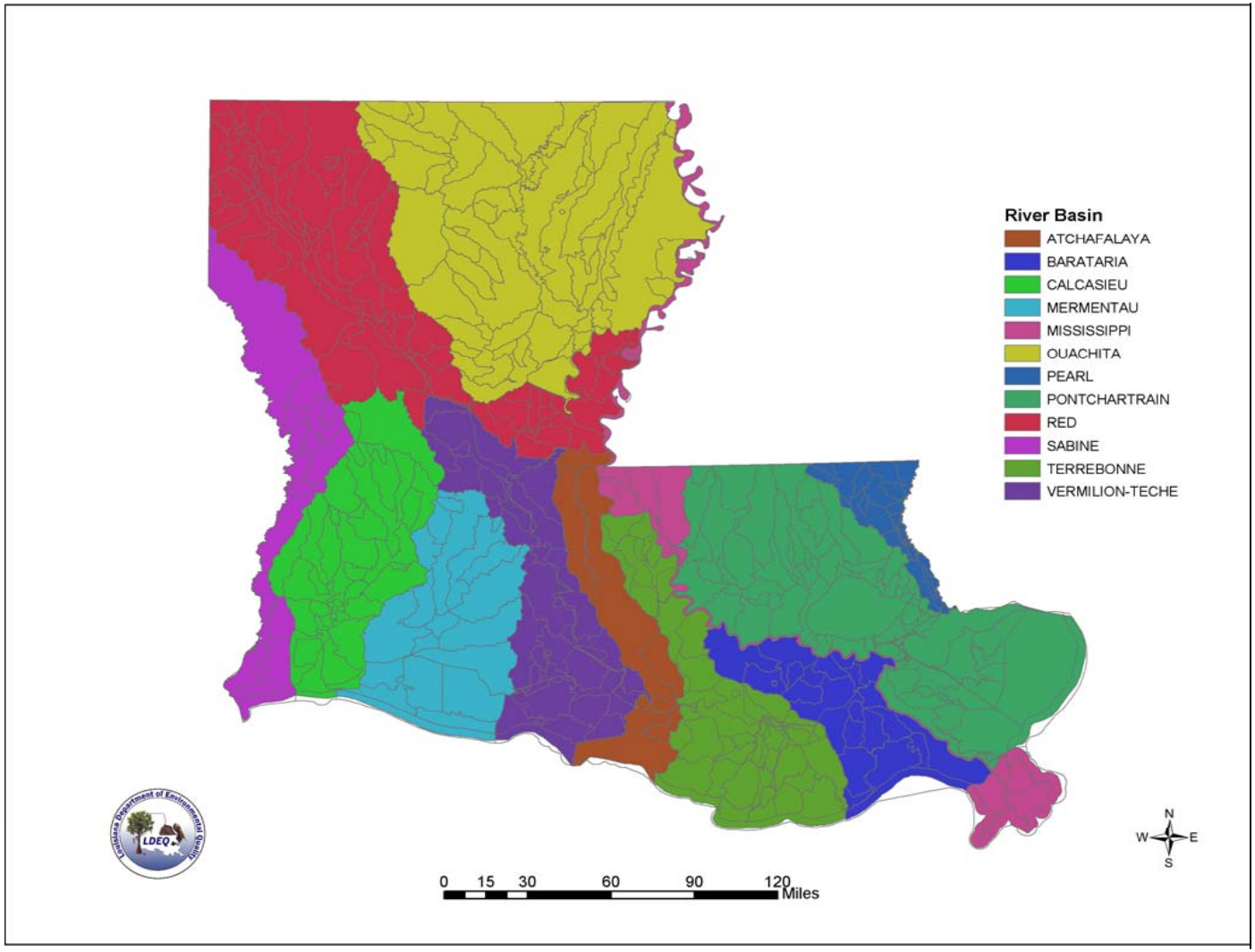

Figure 3. **Louisiana's River Basins**

1.1 Ouachita River Basin Description

The Ouachita River's source is found in the Ouachita Mountains of west-central Arkansas near the Oklahoma border. The Ouachita River flows south through northeastern Louisiana and joins with the Tensas River to form the Black River, which empties into the Red River. The Ouachita River Basin covers more than 9,884 square miles of drainage area. Most of the basin consists of rich, alluvial plains cultivated in cotton, corn, and soybeans. Most of the basin is forested in pine, which is commercially harvested (LDEQ,2000).

The area of the thirteen subsegments being considered in the Ouachita River Basin is 3,868 square miles. The land use in the ten non-scenic subsegments is largely agriculture at 67% with 23% forest (USEPA, 2001). The land use in the three scenic subsegments is largely forest at 86% with 4% agriculture. The average annual rainfall is approximately 55.24 inches. Urban land use comprises only 1.3% of the geographic area with Monroe/West Monroe being the largest urban area in the basin. Land uses for the thirteen subsegments covered by the TMDL in the Ouachita River Basin are summarized in Table 1, the three scenic subsegments are shown in Table 2 and the ten non-scenic subsegments are shown in Table 3.

Table 1. Land use (mi^2) in the 13 Subsegments of the Ouachita River Basin

Coverage Type	*Area mi^2*	*% of Watershed*
Row Crops	2037.97	53.53
Forested Wetlands	599.25	15.49
Small Grains	277.05	7.16
Pasture	231.49	5.98
Mixed Forest	229.36	5.93
Evergreen Forest	198.67	5.14
Deciduous Forest	115.48	2.99
Water	68.93	1.78
Urban	52.20	1.35
Other	14.69	0.38
Non Forested Wetlands	12.22	.032
TOTAL	3837.31	100.00

Table 2. Land use (mi^2) in the 3 Scenic Subsegments of the Ouachita River Basin

Coverage Type	*Area mi^2*	*% of Watershed*
Evergreen Forest	154.27	38.56
Mixed Forest	71.08	17.77
Forested Wetlands	54.41	13.60
Deciduous Forest	51.86	12.96
Pasture	25.95	6.49
Row Crops	15.30	3.83
Other	12.06	3.06
Water	7.81	1.98
Urban	4.53	1.15
Small Grains	2.10	0.54
Non Forested Wetlands	0.25	0.06
TOTAL	399.62	100.00

Table 3. Land use (mi^2) in the 10 Non-Scenic Subsegments of the Ouachita River Basin

Coverage Type	*Area mi^2*	*% of Watershed*
Row Crops	2022.90	59.27
Forested Wetlands	536.23	15.71
Small Grains	270.56	7.93
Pasture	202.28	5.93
Mixed Forest	155.77	4.56
Deciduous Forest	62.62	1.83
Water	60.03	1.76
Urban	46.85	1.37
Evergreen Forest	43.70	1.28
Non Forested Wetlands	11.77	0.34
Other	2.40	0.07
TOTAL	3415.11	100.00

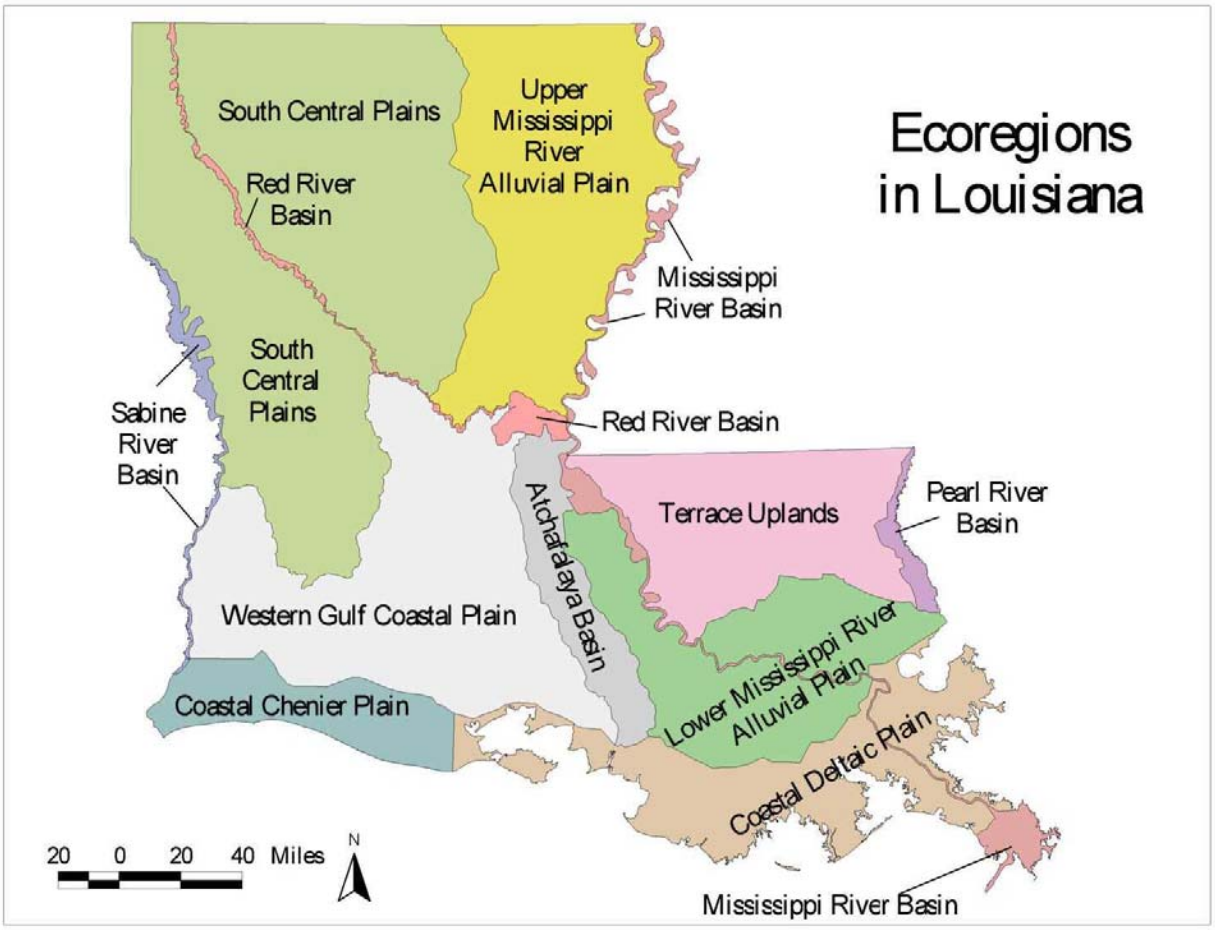

***Figure 4*. Louisiana's Ecoregions**

1.2 Big Creek Watershed Description

The Big Creek watershed is located in the Upper Mississippi River Alluvial Plains ecoregion of the Coastal Plain in central Louisiana. The 50-mi^2 watershed ranges in elevation from 73.6 to 256 ft and drains a landscape dissected by numerous small streams with narrow, gently sloping ridgetops, and steep-sided hillslopes. The main channel is perennial, and the mean monthly discharge varies from a minimum of 25ft^3/s in August to a maximum of 109 ft^3/s in February. Average annual runoff from the basin was 25 in from 1943 through 1995 (Garrison and others, 1996). High infiltration rates and substantial groundwater storage result in well-sustained, constant base flows during dry months of the year.

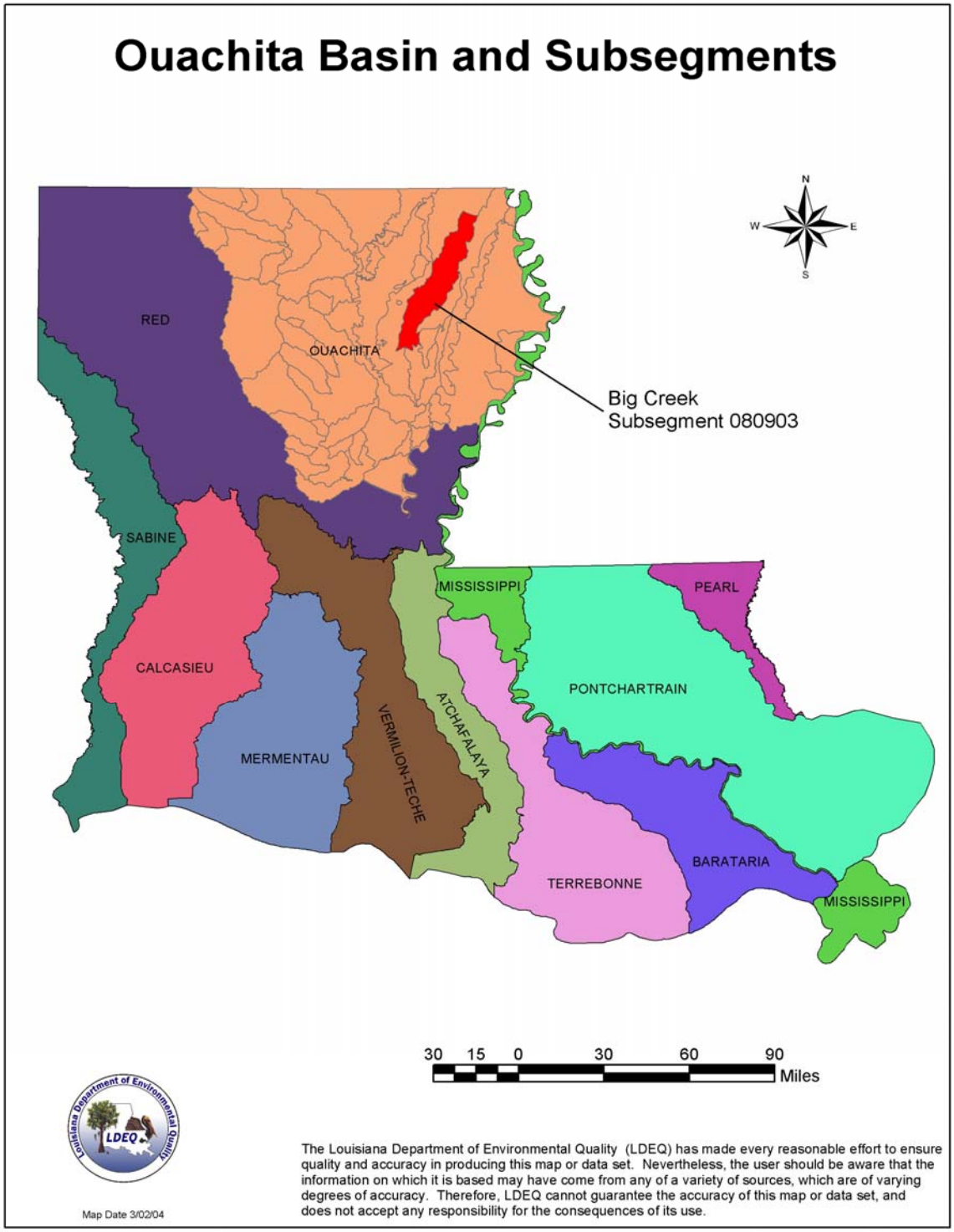

***Figure 5*. Big Creek Watershed**

The climate is subtropical and is characterized by frequent and sometimes abrupt changes in weather. Average daily air temperatures range from 46.76^{0}F in January to 82.04^{0}F in July (Kilpatrick and others, 1986). Precipitation averages 58.27 inches annually and is slightly greater in the winter and the spring than in the summer and the fall (Kilpatrick and others, 1986). Average annual snowfall is less than 1.18 inch and only rarely are there days in winter when the air temperature does not rise above freezing.

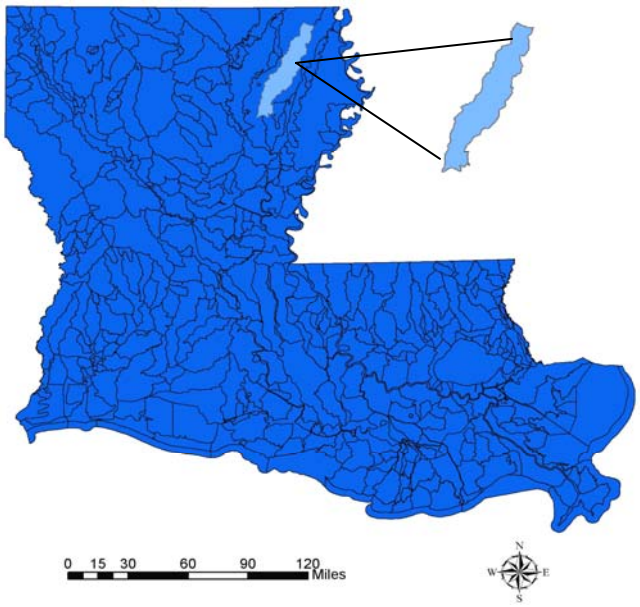

Figure 6. **Big Creek Watershed**

The Big Creek watershed is in the Upper Mississippi River Alluvial Plain ecoregion and is covered by a subclimax pine forest, which has an understory of grasses and sedges (Bailey and others, 1994). This area is typical of the basin and is primarily used for agriculture as documented in Table 4 (LADEQ, 2000). Subsegment 080903 is comprised of Big Colewa, which is renamed Big Creek at or near the Hwy 80 bridge. Big Creek flows in a general north to south direction from its headwaters to its confluence with the Boeuf River. The modeled portion of Big Creek receives flow from the following perennial tributaries: Little Colewa Creek 1, Little Colewa Creek 2, Cypress Creek, Cow Bayou, Bee Bayou, Turkey Creek, Little Creek and several unnamed intermittent

tributaries. The modeled reach is 83 miles in length, and has a total of six weirs/dams, which have an average fall height of 3-4 feet during low flow conditions.
The reservoirs created behind these dams are used for agricultural purposes as well as some recreational ones.

Location of the Big Creek Watershed: c.75 miles long, NE LA; rises in West Carroll Parish; flows SW to Boeuf R. 10 miles W of Winnsboro; 31^{0}19'N 92^{0}05'W.

Table 4. Big Creek, Louisiana (LA), United States

Facts & Statistics	
Place Name	Big Creek
Place Status (Type)	Creek
Location	West Carroll parish, Louisiana (LA), United States, North America
Latitude	31°19'N
Longitude	92°05'W

Figure 7. **Waterbodies that encompass the Big Creek Watershed**

Average annual precipitation in the segment, based on 30-years of record (1961-1990) for the Northeastern weather region, is 55 inches (SRCC, 2000). Land use in the Ouachita is largely agriculture.

1.3 Watershed Land use

Land use data from Landsat 5 land cover classifications in the Big Creek Watershed are summarized in Figure 8. The primary land use of the Big Creek Watershed is pasture idle (42.08%). There are several small towns in the watershed, primarily in the lower portion of the watershed, but population growth in the past ten years has been minimal. The dominant land use is agriculture if all the crop types are combined in Table 5.

Table 5. Land uses in Subsegment 080903 of the Ouachita Basin

Land use	Acres	Percent (%)
Aquaculture	34.12	0.01
Corn	27044.20	9.76
Cotton	28872.68	10.42
Forest Hardwood	35367.69	12.77
Forest Pine	4742.20	1.71
Pasture Idle	116569.34	42.08
Rice	162.78	0.06
Shrub	834.96	0.30
Sorghum	1227.95	0.44
Soybeans	40523.95	14.63
Sweet Potatoes	745.24	0.27
Unclassified	7614.17	2.75
Water	2522.54	0.91
Wheat	10742.25	3.88
Total	**277004.06**	**100.00**

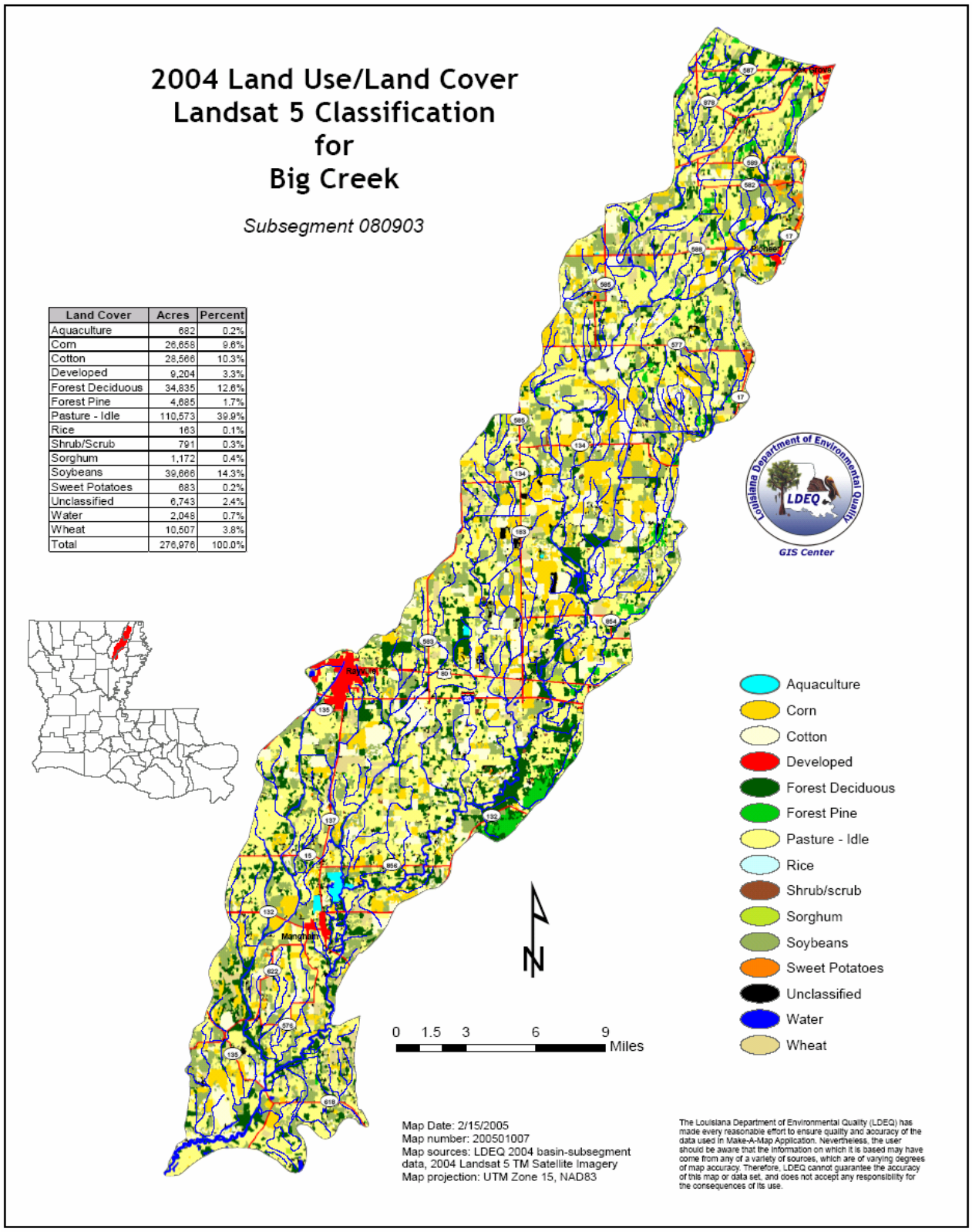

Figure 8. **2004 Land Use/Land Cover Landsat 5 Classification for Big Creek Watershed.**

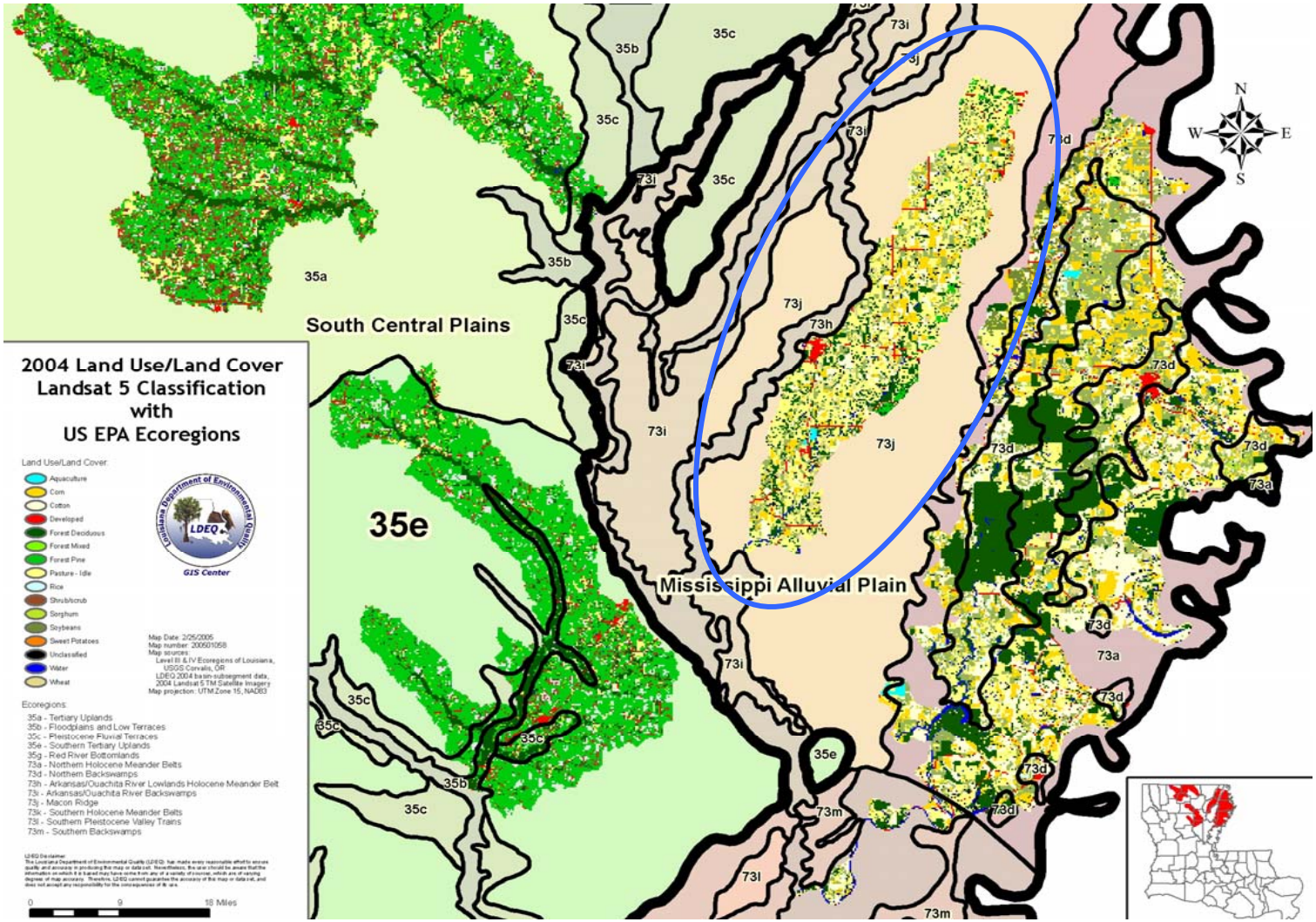

***Figure 9*. 2004 Land Use/Land Cover Landsat 5 Classification with US EPA Ecoregions. The figure shows the strong aerial correlation of the predominant land cover classes within selected subsegments with the Level III and Level IV Ecoregions of Louisiana. EPA Ecoregions are from Griffith et al. (2005).**

1.4 Big Creek Water Quality Standards

Water quality standards for the State of Louisiana have been defined (LA DEQ, 2000). The standards are defined according to designated uses of the waterbodies. Designated uses for Big Creek from the headwaters to its confluence with Boeuf River, waterbody subsegment 080903, include primary contact recreation, secondary contact recreation, propagation of fish and wildlife.

2.0 Historical Water Quality Data

The ambient monitoring samples for Big Creek were obtained between 1995 and 1999 with several dissolved oxygen samples falling below the dissolved oxygen criteria for this waterbody. The majority of the samples below criteria were taken at the upper water quality station, located on Highway 80. The water quality survey conducted in September 1999, during a period of extreme drought conditions, revealed dissolved oxygen levels below criteria in the upper reaches of the creek.

Big Creek was modeled from its headwaters, at Highway 879, to its confluence with the Boeuf River. The Big Creek watershed is subsegment 080903 of the Ouachita River Basin (Basin 08). Subsegment 080903 is comprised of Big Creek, Big Colewa and all their tributaries, including Bee Bayou, Turkey Creek, and Little Colewa.

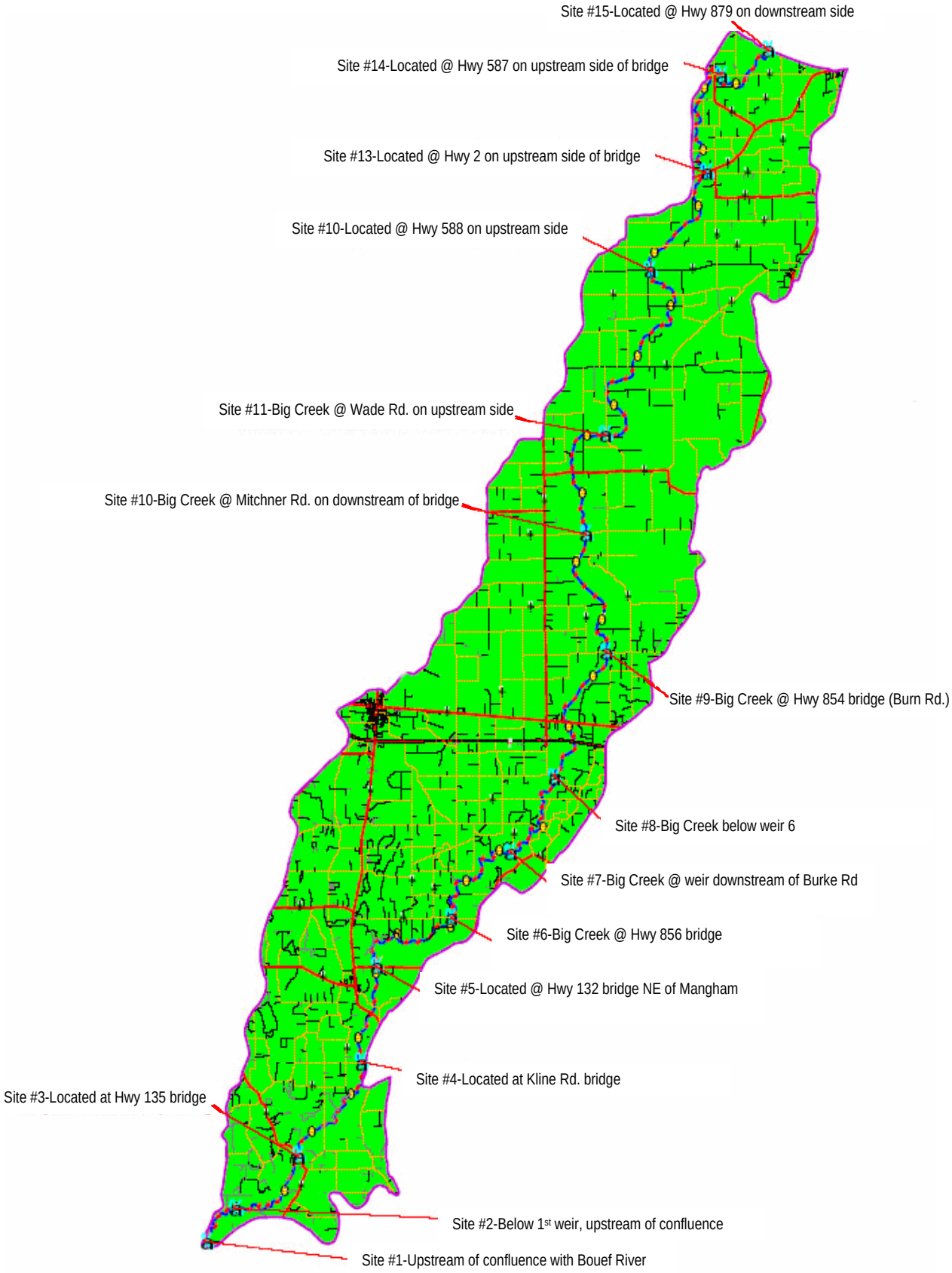

***Figure 10*. Big Creek Survey Sites**

Several point sources fall within the subsegment. Many of these facilities were deemed either intermittent stormwater or small industrial dischargers without oxygen demand limits. Other municipal and industrial point sources discharging to tributaries of Big Creek were considered to be minor and not significantly contributing to the current problems in Big Creek (080903).

These facilities' current state permit BOD and nitrogen limits were compiled and added to the TMDL Waste Load Allocation and point source components. The perennial tributaries were included in the model only as a boundary condition to the mainstem of Big Creek. One municipal discharger, Village of Mangham, which discharges directly to Big Creek, was included in the water quality model. Its current permit limits were confirmed by the model and were added to the TMDL WLA. The nonpoint source loads included benthic nonpoint loading, which was not associated with flow, as well as headwater and tributary loads.

A survey was conducted (September 20-21, 1999) during a period of severe drought. The Big Creek watershed was in a low flow condition. There were only two tributaries that had velocities that could be measured with typical survey equipment, Bee Bayou and Turkey Creek.

The waterbody was also listed as impaired due to nutrients. This TMDL establishes load limitations for oxygen-demanding substances and goals for reduction of those pollutants.

Land use in the Big Creek watershed is fairly homogeneous with agriculture as the primary use. TMDLs have been calculated for Big Creek and are presented in the following tables.

Table 6. **Components used in TMDL calculations**

Current Standard: 5.0 mg/l	Critical summer season (May - Oct)	
TMDL component loads	BOD Loading (lbs/day)	% of TMDL
Headwater/Tributary Loads	33	0.13
Benthic Loads	22,317	89.73
Point Source Loads	891	3.60
Margin of Safety	1,634	6.54
Reduction of man-made nonpoint	35% - 75%	
Total maximum daily load (TMDL)	24,875	100.00

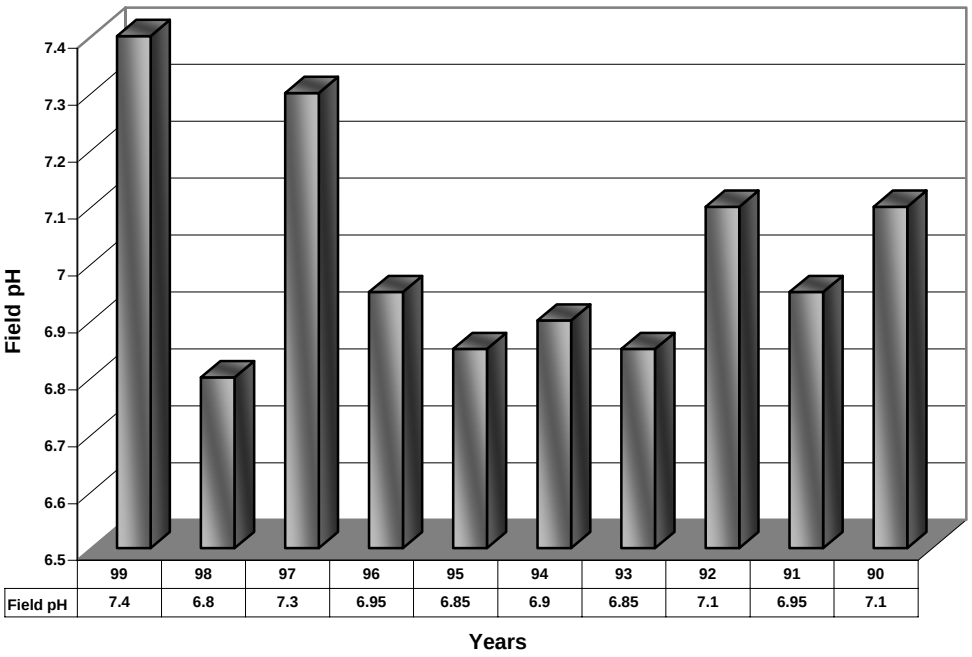

***Figure 11*. Median Field pH for Big Creek, Site 0069**

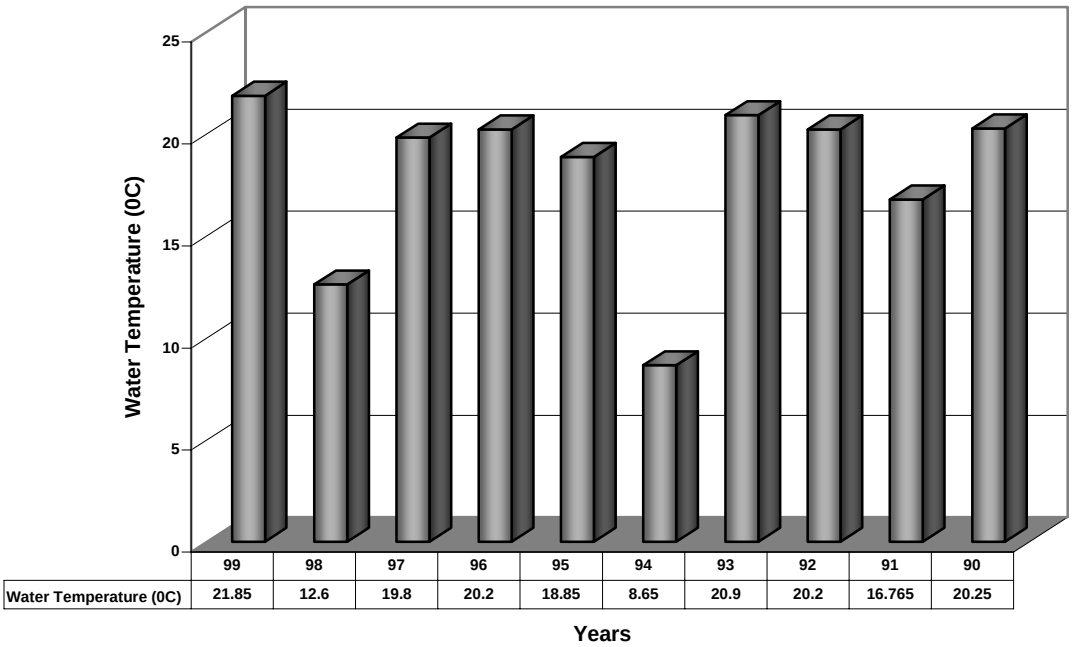

***Figure 12*. Median Water Temperature for Big Creek, Site 0069**

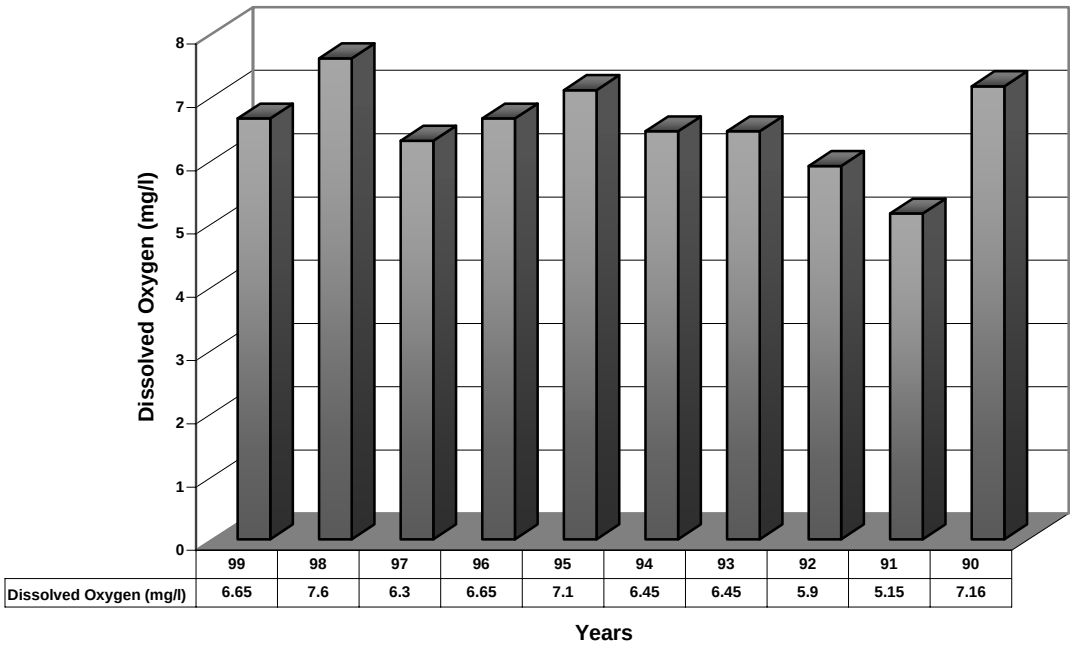

***Figure 13*. Median Dissolved Oxygen for Big Creek, Site 0069**

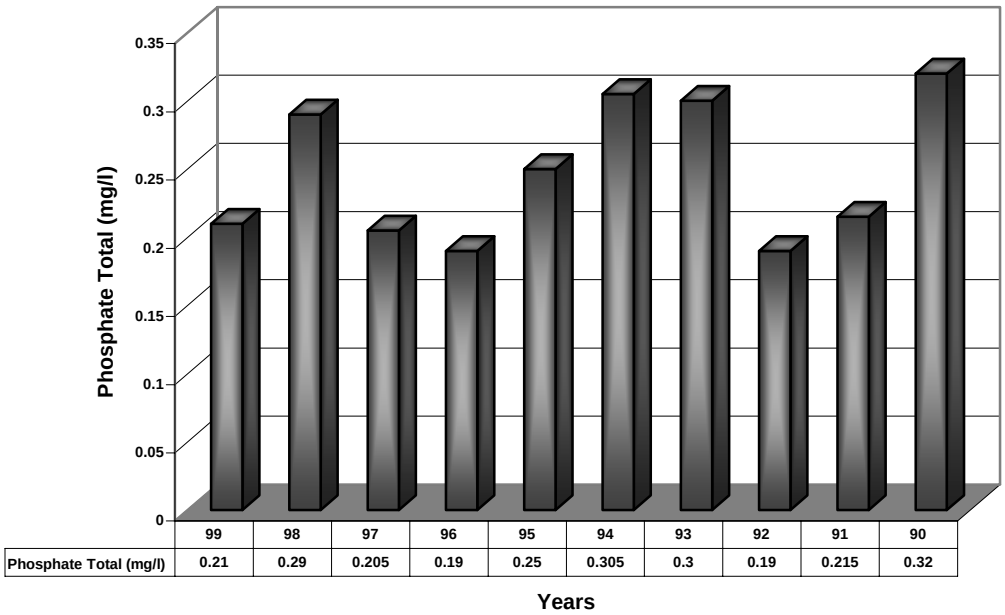

***Figure 14*. Median Phosphate Total for Big Creek, Site 0069**

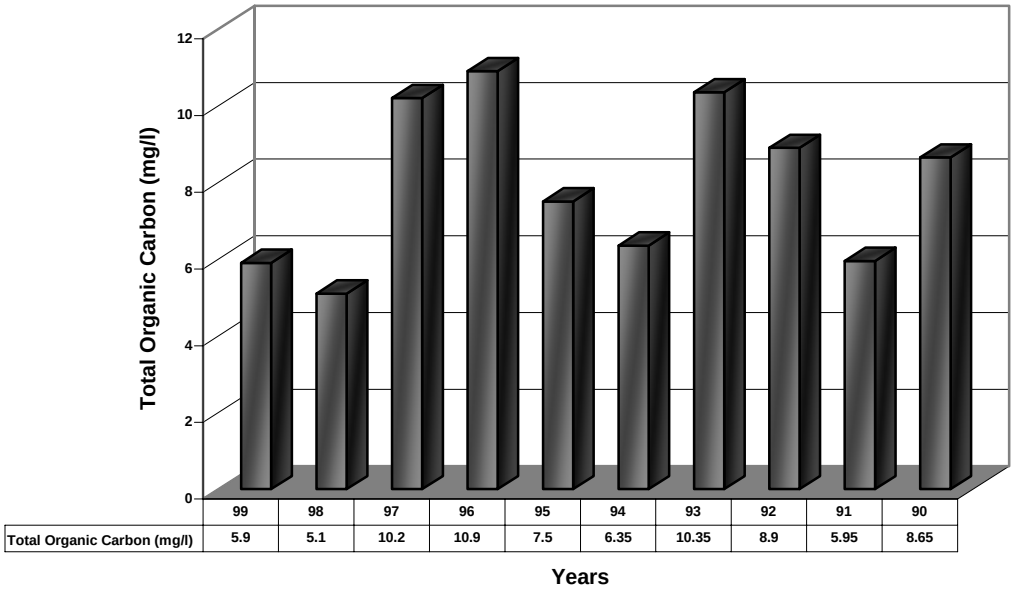

***Figure 15*. Median Total Organic Carbon for Big Creek, Site 0069**

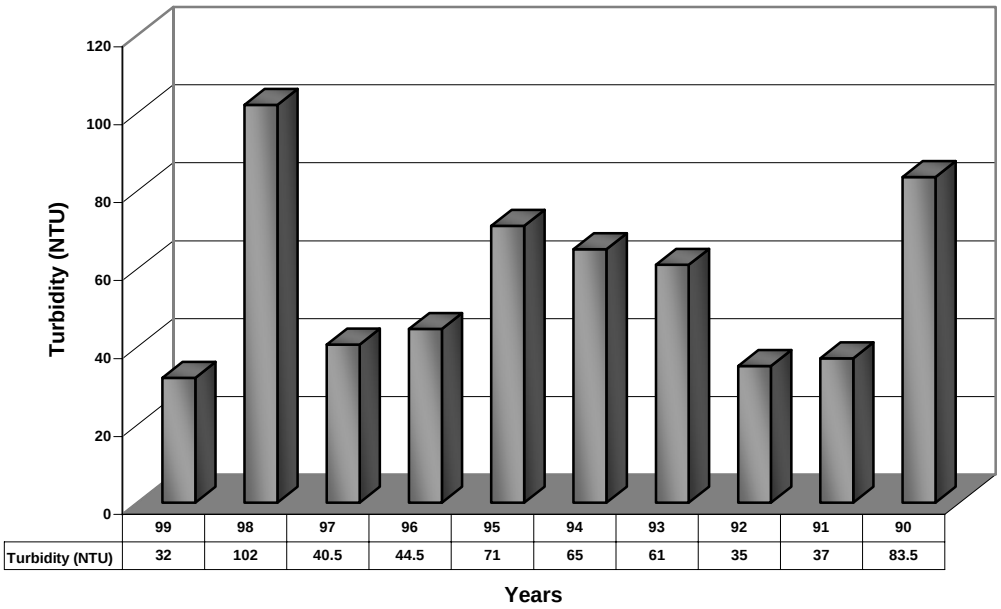

***Figure 16*. Median Turbidity for Big Creek, Site 0069**

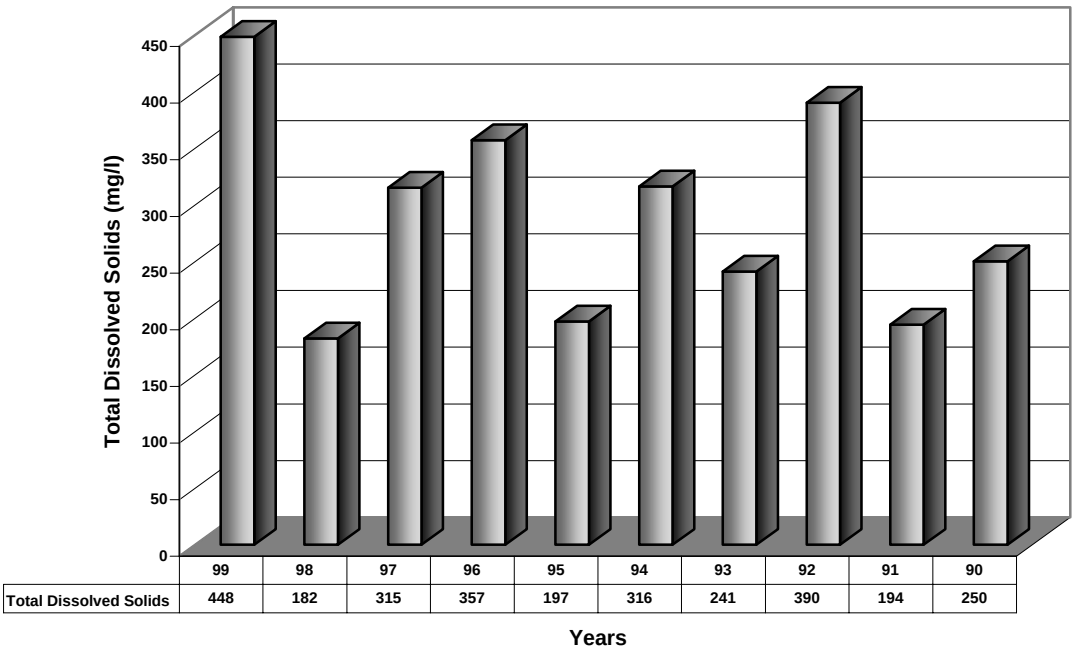

***Figure 17*. Median Total Dissolved Solids for Big Creek, Site 0069**

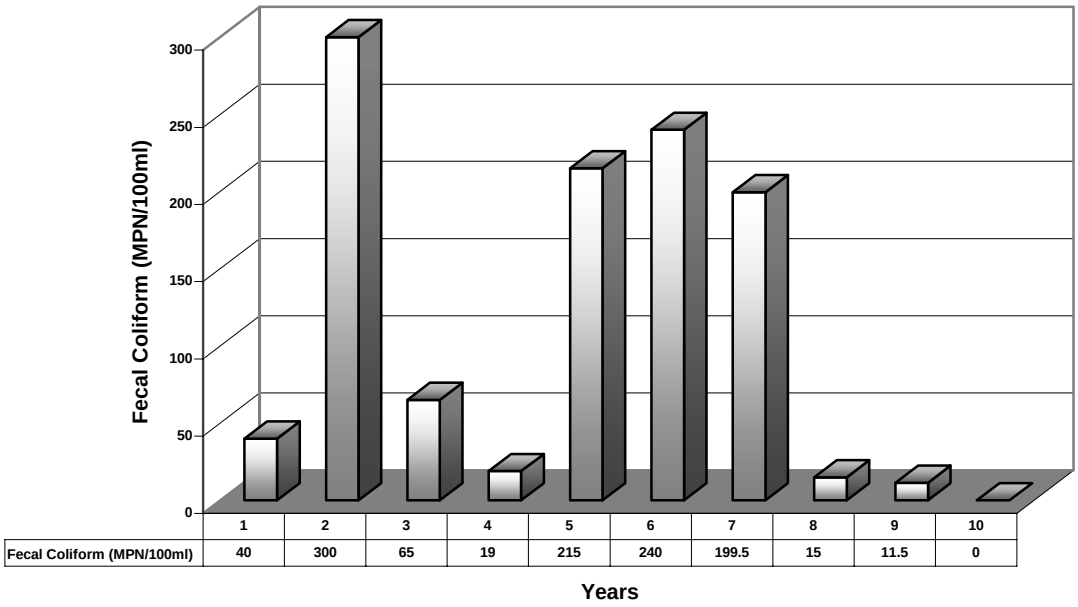

***Figure 18*. Median Fecal Coliform for Big Creek, Site 0069**

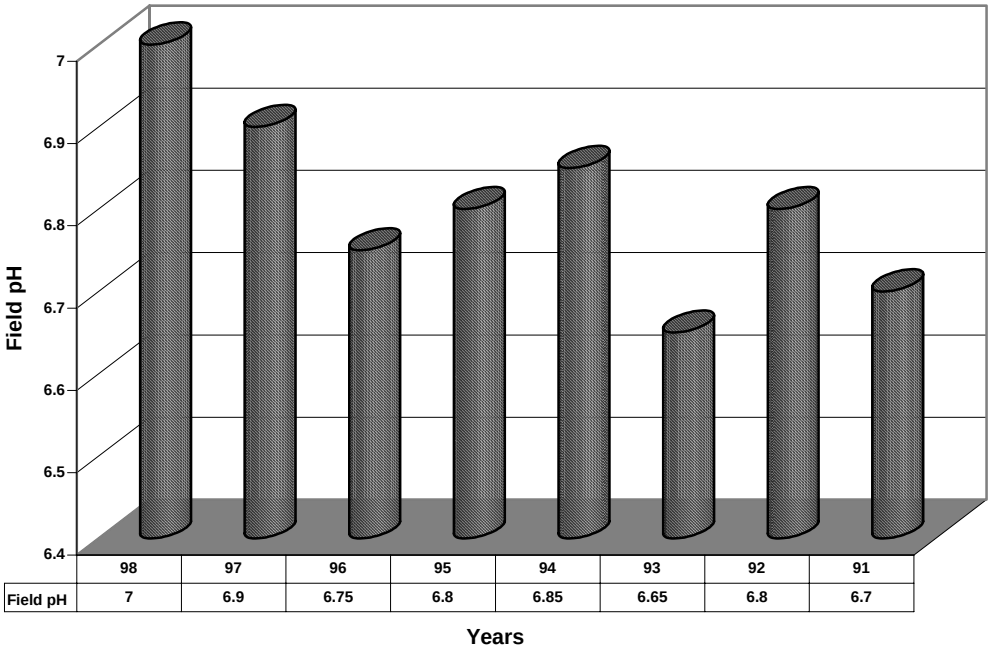

***Figure 19*. Median Field pH for Big Creek, Site 0328**

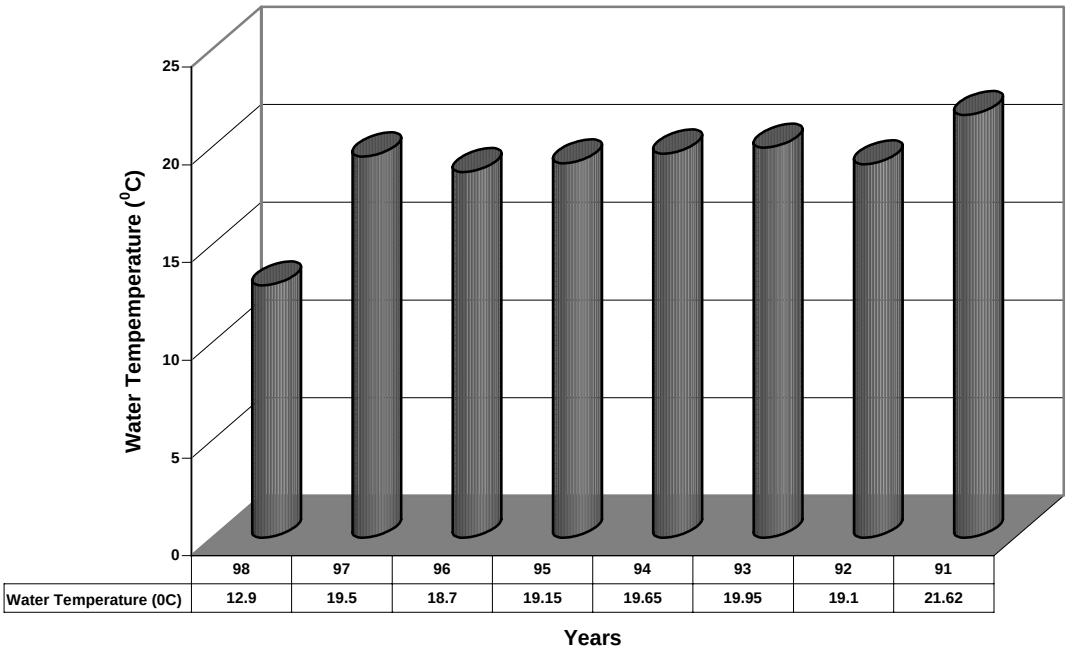

***Figure 20*. Median Water Temperature for Big Creek, Site 0328**

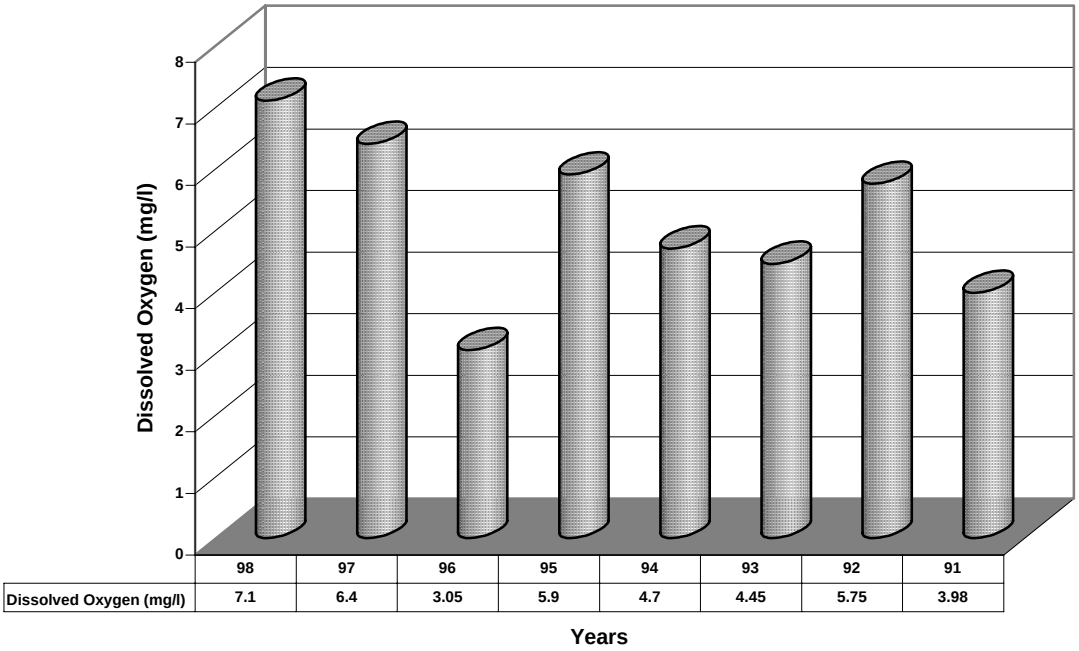

***Figure 21*. Median Dissolved Oxygen for Big Creek, Site 0328**

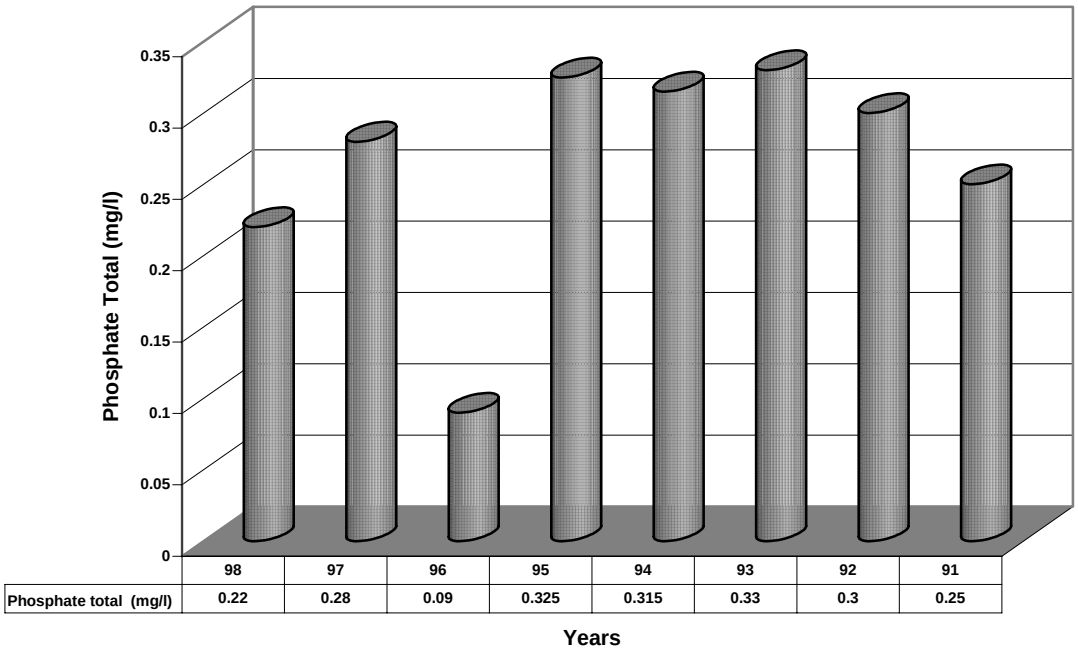

***Figure 22*. Median Phosphate Total for Big Creek, Site 0328**

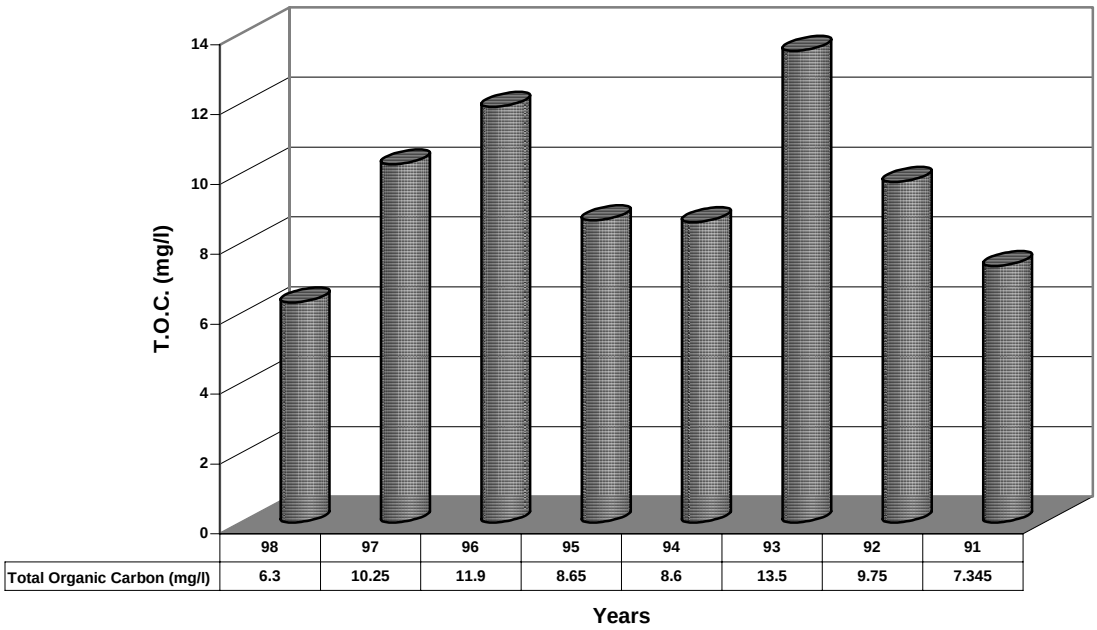

***Figure 23*. Median Total Organic Carbon for Big Creek, Site 0328**

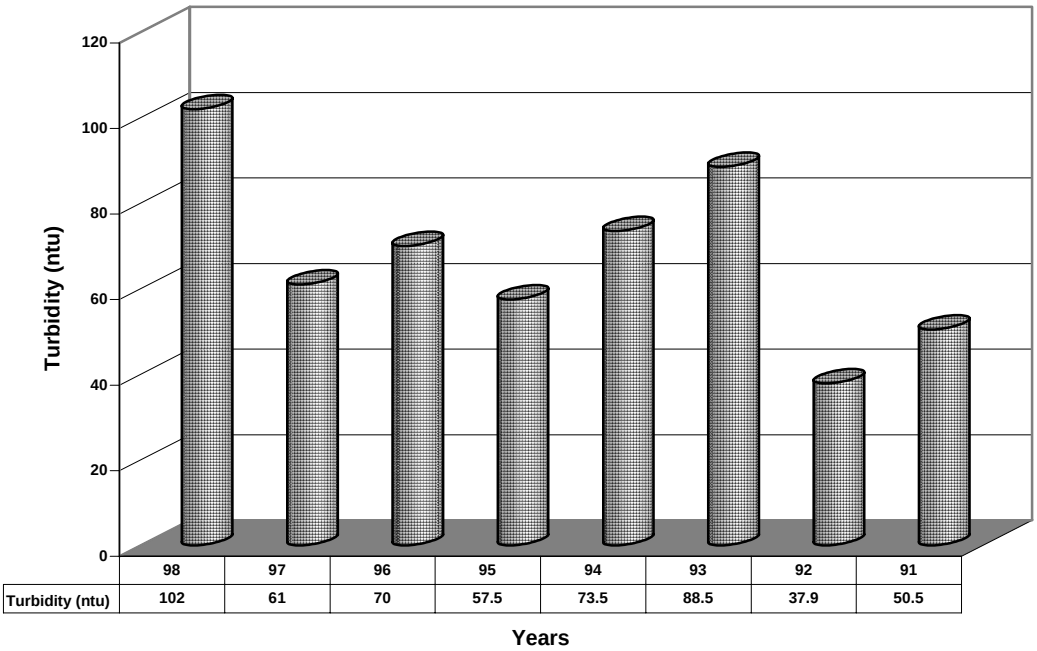

***Figure 24*. Median Turbidity for Big Creek, Site 0328**

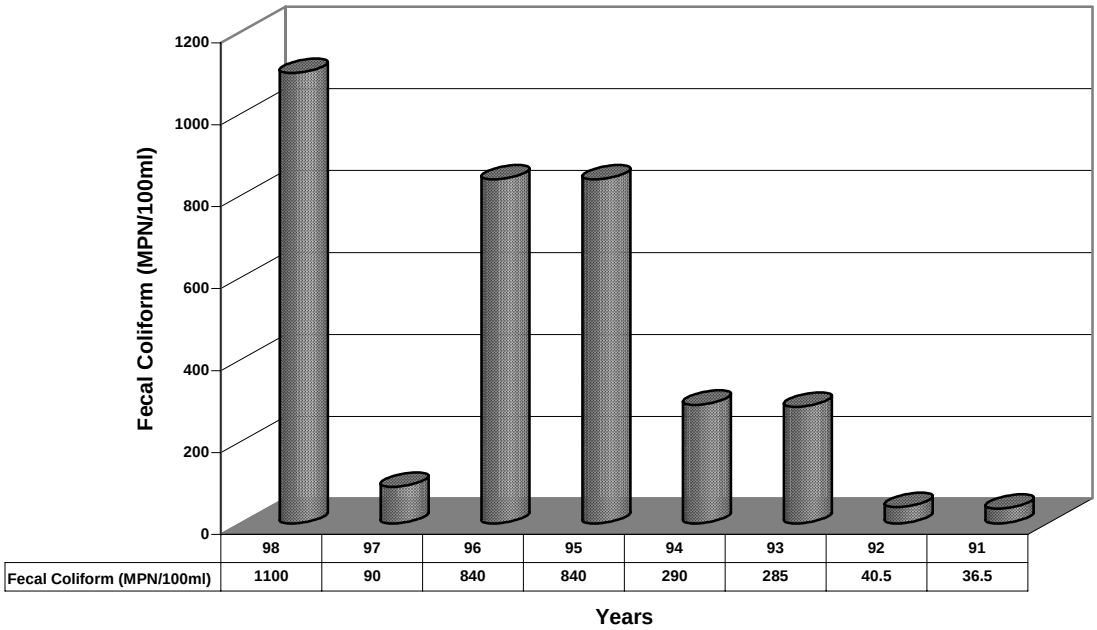

***Figure 25*. Median Fecal Coliform for Big Creek, Site 0328**

Based on the winter and summer projection model outputs and a review of the historical records, the summer season was determined to be the critical conditions for this watershed and the basis of the TMDL calculations. The results of the summer critical projections show that the current water quality standard for dissolved oxygen for Big Creek (WQ Subsegment 080903) of 5.0 mg/L can be maintained during the summer critical season, (May – October).

This can be accomplished with the imposition of a 35-75% reduction of seasonal man-made nonpoint source loads depending upon the reach and a 10% MOS. The results of the winter projection model show that the water quality criterion for dissolved oxygen for Big Creek of 5.0 mg/L will be maintained and exceeded during the winter season, (December – February).

2.1 Water Quality Data

Water quality problems have been identified in the Big Creek Watershed for a period of 8 years (shown in the graphs above). After reviewing the historical data, the establishment of the Best Management Practices (BMPs) for the pollutants contributing to water quality problems is focused on reducing nutrient loadings.

The main water quality problem associated with Big Creek is Dissolved Oxygen (DO). This results from excessive oxygen-demanding substances and nutrients entering the waterbody. Low DO levels result from an imbalance between oxygen production input and use by physical, chemical and biological processes. As organic substances decompose, oxygen in the system decreases.

Elevated levels of plant nutrients can cause algae (phytoplankton and filamentous algae) blooms which can severely deplete DO levels. This can cause problems for fish populations and other aquatic organisms (stress and/or death). A bloom creates a situation where plankton population numbers exceed the capacity of the system. During plankton blooms, DO levels during daylight hours can be very high, often greater than 10 milligrams per liter (mg/L or parts per million; ppm). However, during the night when oxygen production (photosynthesis) ceases and respiration (consumption) begins, the DO can drop to low levels.

The suspected causes of impairment include organic enrichment/low DO, nitrogen, phosphorus, pesticides, suspended solids, turbidity, salinity/TDS/chlorides/sulfates and pathogens. The suspected sources of impairment include agriculture, non-irrigated crop production, pastureland, land disposal and onsite wastewater (septic tanks).

The review of historical data supports the development of the TMDL for bacteria and dissolved oxygen. Implementation of BMPs, especially for agriculture, which is described in the following chapters, should be prioritized for the reduction of the pollutant loading to the Big Creek watershed.

***Figure 26*. Big Creek weir**

3.0 TMDL Results and Recommendations

Over the years, pollutants from a variety of sources have impaired the quality of some of Louisiana's lakes, rivers, and streams. However, since the signing of the federal Clean Water Act (CWA) in 1972, water quality has improved greatly, primarily through regulation of point source discharges. Although great strides have been made in restoring our state waters, there are still degraded lakes, streams, and rivers that need

attention. Restoring their quality is crucial in maintaining a healthy environment and ensuring the sustainability of these waters for all to use and enjoy. Restoration can be done using TMDL's to monitor and regulate the amount of pollutants entering the waterbody. TMDL's are as follows:

- TMDL is an acronym for Total Maximum Daily Load. It determines the greatest amount of a given pollutant that a water body can receive without violating water quality standards and designated uses.
- TMDLs set pollution reduction goals that are necessary to improve the quality of impaired waters.
- A TMDL utilizes a watershed approach in determining the pollutant load that can be allowed in a given lake or stream. By taking a watershed approach, a TMDL considers all potential sources of pollutants, both point and non-point sources. It also takes into account a margin of safety, which reflects scientific uncertainty and future growth. The effects of seasonal variation are also included.
- A TMDL is calculated using the following equation:

$$TMDL = WLA + LA + MOS + SV$$

Where: WLA= Waste Load Allocation (point sources)
LA= Load Allocation (non-point sources)
MOS= Margin of Safety
SV= Seasonal Variation

Section 303(d) of the Clean Water Act does not require the inclusion of an Implementation Plan as part of a TMDL. However, Louisiana Department of Environmental Quality (LDEQ) has taken the initiative to develop Implementation Plans for TMDLs that have been developed for the Big Creek Watershed.

3.1 TMDL for Big Creek

Big Creek was ranked as high priority (priority 1) on the list for development of a total maximum daily load (TMDL). A TMDL for biochemical oxygen-demand pollutants and nutrients has been developed for the Big Creek Watershed based on hydrologic and water quality data available as of February, 2000. Big Creek is listed on both the 1998 303(d) and 2000 305(b) list as not meeting its designated use of Fish and Wildlife

Propagation. The suspected causes of impairment include organic enrichment/low DO, nitrogen, phosphorus, pesticides, suspended solids, turbidity, salinity/TDS/chlorides/sulfates and pathogens. The suspected sources of impairment include agriculture, non-irrigated crop production, pastureland, land disposal and onsite wastewater (septic tanks). The TMDL addresses the organic enrichment/low DO as well as the nitrogen and phosphorus (nutrients) suspected causes.

The current annual dissolved oxygen criterion for the 080903 subsegment is 5.0 mg/l. Model projections were performed for the summer and winter critical seasons using the current DO criterion. Projections show that compliance with the current dissolved oxygen criterion will require a 35% to 75% reduction of man-made nonpoint loading, with the higher percent reductions being applied to the upper reaches of the watershed.

4.0 Identification of High Priority Areas in the Big Creek Watershed

Watersheds are not homogeneous with regards to their potential for soil erosion. Soil type, the slope of the land, and land use are each important factors in determining the risk to water quality from a given area. Therefore, when determining priority for conservation measures within a watershed both location and activity must be considered. Soils data, sediment loading models, and land use data, are valuable tools that can provide clues as to where potential sources of water pollution may be and which problems can most easily be corrected.

LDEQ is utilizing a model called Annualized Agriculture Non-Point-Source (AnnAGNPS), a Natural Resources Conservation Service (NRCS) sponsored model, to evaluate current sediment loadings in watersheds. The model produces results on sediment, phosphorus, nitrogen, and organics as the constituents travel overland, through the reaches and out the watershed outlet. Cells (land area representations) of a watershed are used to provide landscape spatial variability. Each cell represents the landscape within its respective land area boundary as one homogeneous unit. The physical or chemical constituents are routed from their origin within the land area and are either deposited within the stream channel system or transported out of the watershed.

Pollutant loadings can then be identified at their source and tracked as they move through the watershed system.

5.0 AnnAGNPS Model Outputs for Big Creek

5.1 Water Run-Off

Water runoff is influenced by a number of factors including soil chemical and physical properties, presence of impermeable surfaces, slope of the land, climate, type of vegetative cover, and root mass. Some of the physical factors affecting rainfall are:

- Land use
- Vegetation
- Soil type
- Drainage area
- Basin shape
- Elevation
- Slope
- Topography
- Direction of orientation
- Drainage network patterns
- Ponds, lakes, reservoirs, sinks, etc. in the basin, which prevent or alter runoff from continuing downstream.

Runoff from agricultural land can carry excess nutrients, such as nitrogen and phosphorus into streams, lakes, and ground-water supplies. These excess nutrients have the potential to degrade water quality.

Based on many of these factors (figure 27), AnnAGNPS estimates the average annual amount of water (in/ac/yr) running off of the cells.

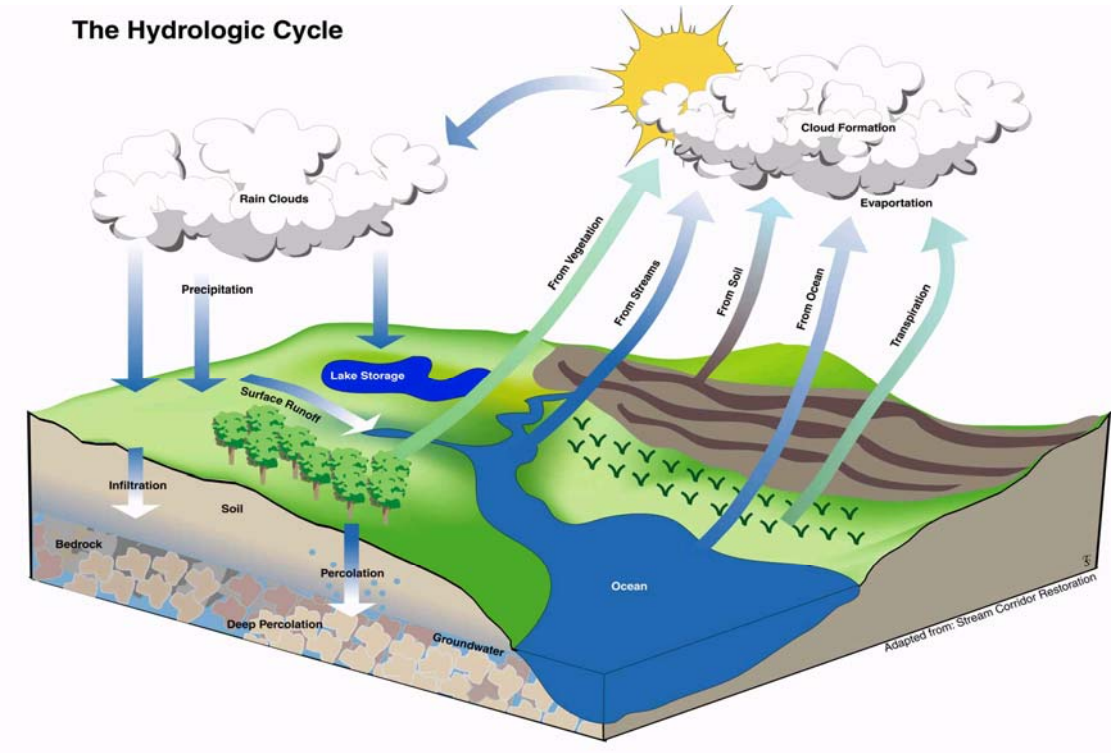

Figure 27. *The figure above illustrates the hydrologic cycle.* When rainfall falls on land, the water can follow several pathways. Some of the water will remain attached to vegetation and soil and soon evaporate after rainfall. Some of it is taken up by the roots of the plants and is evaporated through the leaves, a process called transpiration. Some of the rainfall will infiltrate into the soil where it migrates laterally toward a stream, a process called interflow. The water will also infiltrate into a permanent groundwater system. During heavy rainfall event, water will migrate overland to local waterbodies. Illustration adapted from Stream Corridor Restoration.

The model estimates that some cells are experiencing runoff amounts in excess of 14 in/ac/yr (figure 28). The stream reaches in these areas may be experiencing bed and bank erosion along the stream network. In watersheds with large areas of impervious surfaces, upward of 50% of the sediment load can be attributed to stream erosion. In this case, water rushes overland and scours existing streambeds. Hydraulic modifications to bayous and rivers can also create an unstable system.

5.2 Sediment Run-Off

Sediment run off is principally related to land use, slope (LS Factor), soil erodibility (K-Factor), and rainfall intensity. These variables are the most significant factors affecting agricultural NPS pollution. AnnAGNPS estimates three general types of soil erosion:

sheet, rill, and gully. In AnnAGNPS, sheet erosion is considered to be removed uniformly from every part of the cell. Rill and gully erosion create small or large ravines by undermining and downward cutting of soils. Gully erosion is larger and more pronounced rill erosion. Gullies eventually produce ditches or ravines exposing subsoils to erosion. AnnAGNPS estimates sheet, rill, and gully erosion for each cell. The results for sediment erosion (figure 32), sediment yield (figure 33) and sediment load (figure 34), indicate where these activities are most likely to occur.

The AnnAGNPS model produces sediment loss by particle size class and source of erosion and divides the runoff into 3 categories: Sediment Erosion, Sediment Yield, and Sediment Load. Sediment Erosion is the amount of sediment that travels overland to the edge of the cell. Sediment Yield is the amount of sediment that is deposited into the stream network. Sediment Load is the amount of sediment that travels through the stream network and out the outlet. The results are rendered in standard tons/acre/year. Similarly, the model produces runoff and loading for nitrogen, phosphorus, and organic carbon. The nutrient and organic results are rendered in lbs/acre/yr (table 7). In addition, the model predicts how much water runs off a watershed cell (table 7).

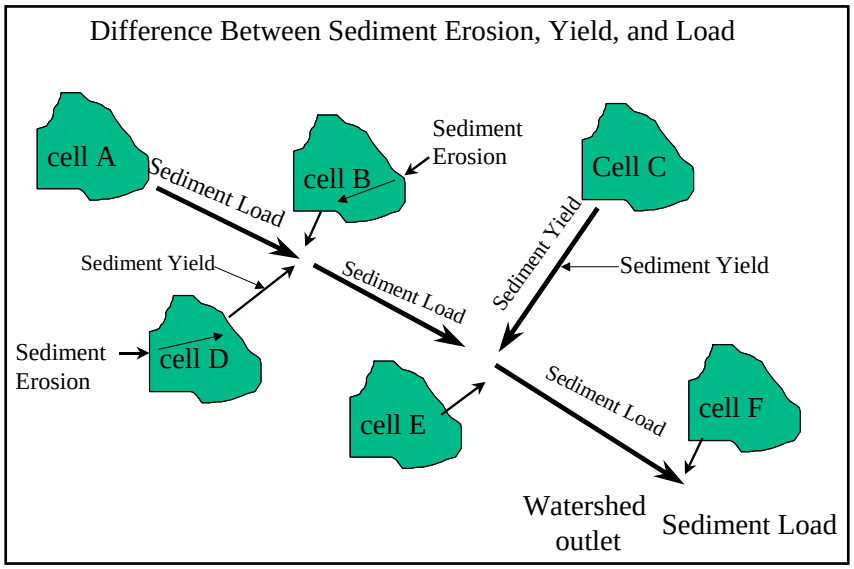

Figure 28. *AnnAGNPS cells.* AnnAGNPS describes soil run-off in 3 basic categories: 1) Sediment Erosion is soils moving across the cells; 2) Sediment Yield is the soils of the cell depositing into the stream; 3)Sediment Load is the soil moving through the stream from reach to reach.

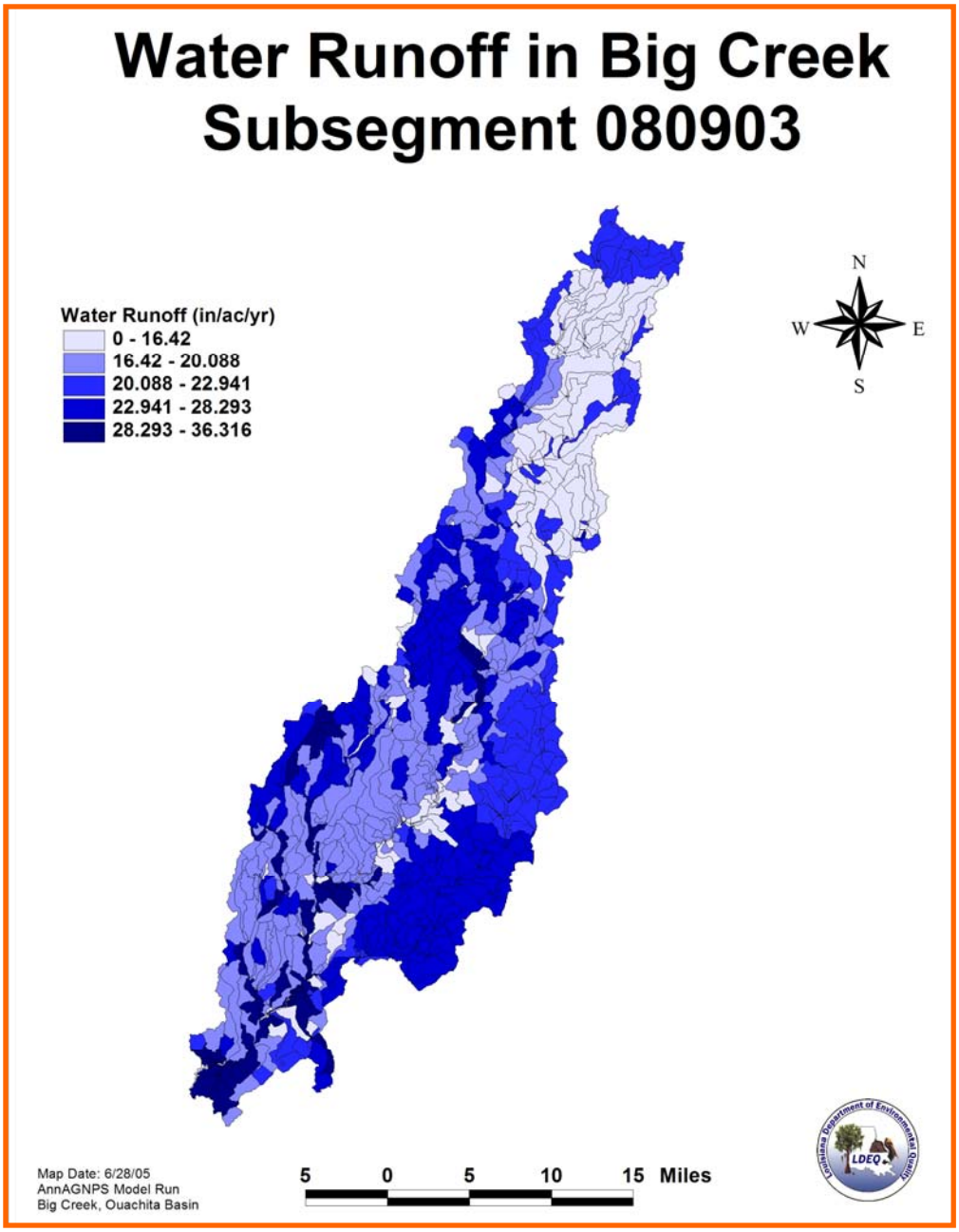

Figure 29. **AnnAGNPS Model Output for Water Runoff**

5.3 Soils

Erosion of soil and transportation to waterbodies can cause a plethora of water quality problems. The addition of soil to surface water can decrease the amount of light reaching submerged vegetation. This decreases photosynthesis and therefore the amount of oxygen being released into the water. Furthermore, when the vegetation dies, bacteria will consume additional oxygen from the water as they degrade the plant material. Chemicals such as pesticides, fertilizers, and metals can attach to soil particles and be transported to waterbodies. These chemicals have the potential to directly harm aquatic species or may result in decreased DO as bacteria degrade the compounds.

The inherent soil erodibility may be critical in determining loading rates. It is possible that two different stream reaches with the same land use patterns may have different loading rates, because one area has underlying soils, which are more susceptible to erosion. For this reason, this section of the plan examines the different soils in the the Big Creek Watershed and their inherent erodibility. Erodibility of soils is a function of the properties of the soil and the slope.

5.4 Soil Erodibility K-Factor

When planning for soil conservation and water management, it is important to understand that all soils are not the same and that some are more susceptible to erosion than others. The Revised Universal Soil Loss Equation (RUSLE) can be used to predict soil loss and the effectiveness of management practices. One of the factors used in the RUSLE is the K factor. The K factor is a numeric value attributed to the susceptibility of a soil to sheet and rill erosion. The K value for specific soils can be found in parish soil survey books published by the United States Department of Agriculture (USDA). Values for K range from 0.02 to 0.64 with soils having higher values being more susceptible to sheet and rill erosion. In the Big Creek Watershed, K values range from 0.32 to 0.49 (figure 30).

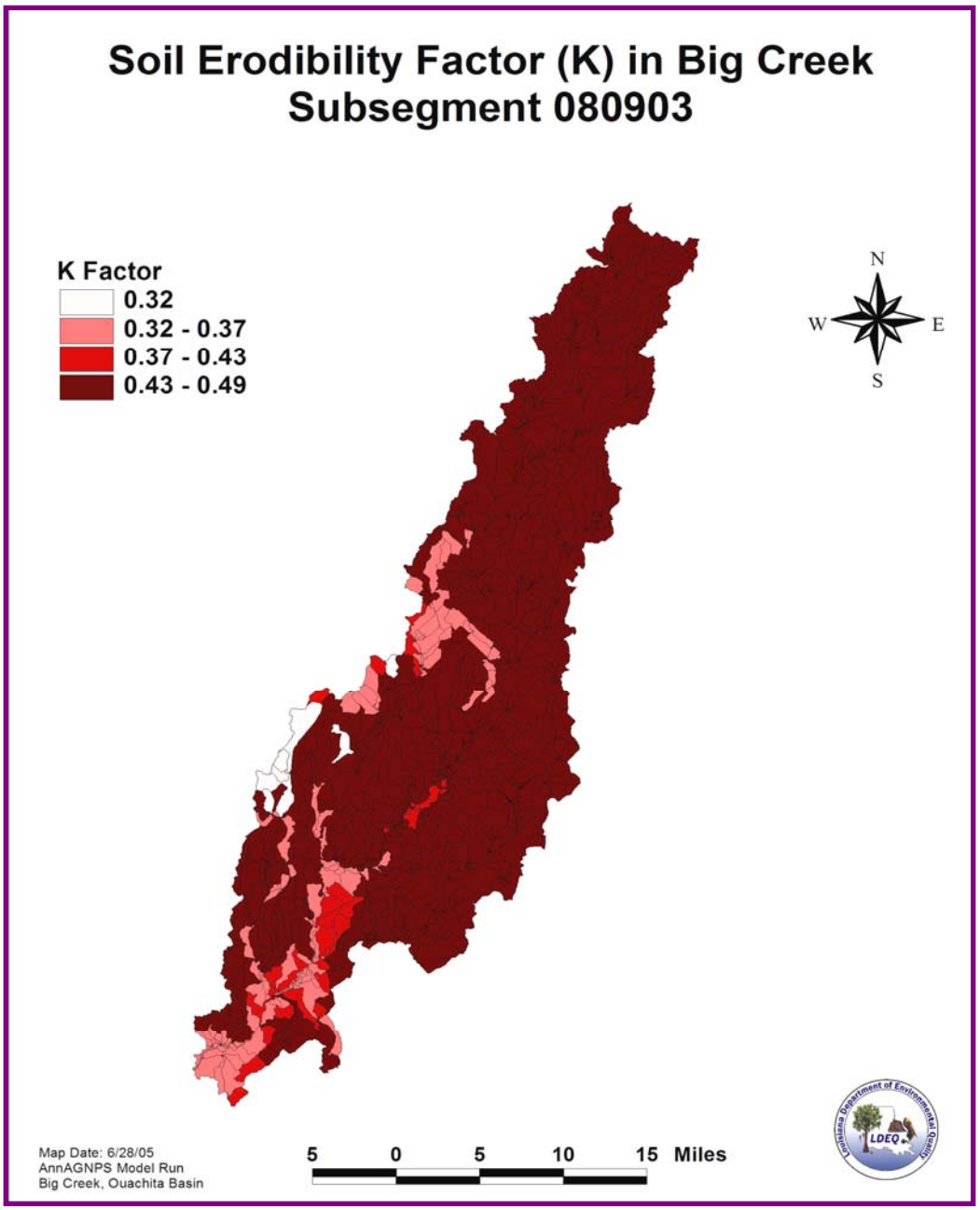

***Figure 30*. AnnAGNPS Model Output for Soil Erodibility Factor (k)**

5.5 Slope Length and Steepness Factor (LS-Factor)

An important tool for determining the effect of topography on soil loss is the slope length and steepness factor (LS factor). LS values are not absolute values, but represent the ratio of soil loss in a specific area to a value of 1.0 that is given to a slope with 9% steepness and is 72.6 ft long. LS factors are utilized as part of the RUSLE soil erosion equation and can be generated by AnnAGNPS for each cell to determine areas that have high potential for soil erosion. LS values in the Big Creek watershed range from 0.031 to 5.845 (figure 31) with the highest values tending to be near the big creek.

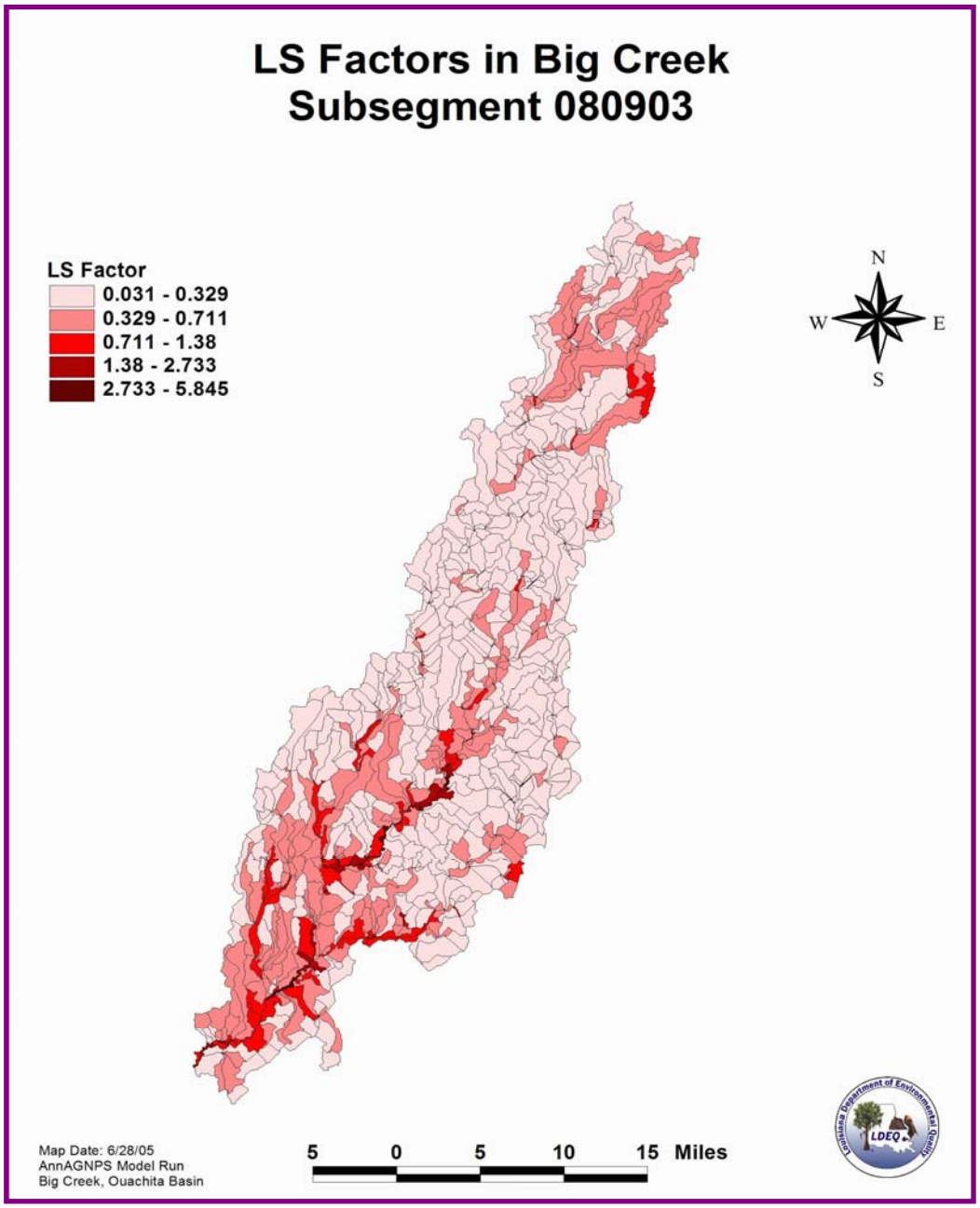

***Figure 31*. AnnAGNPS Model Output for the LS Factors**

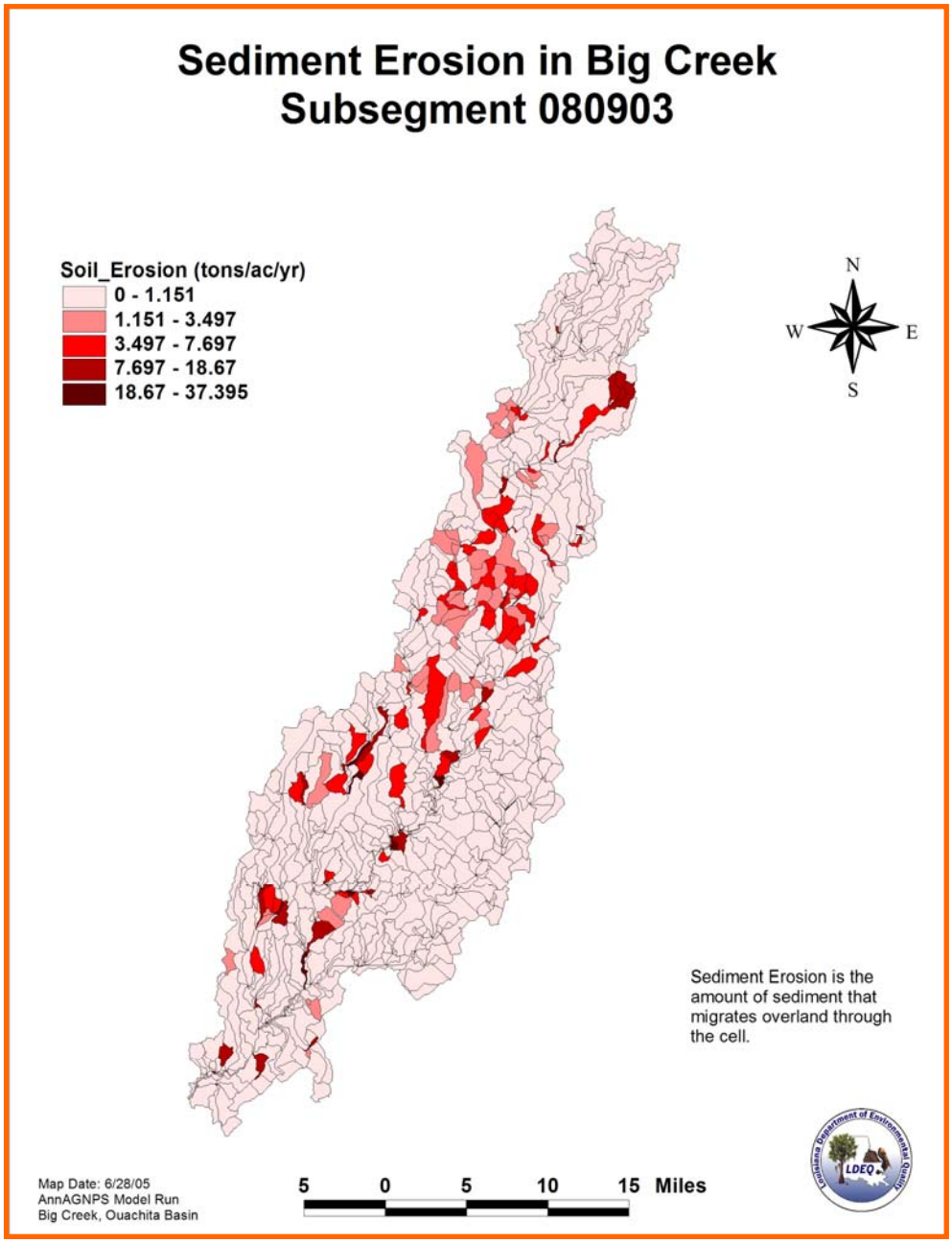

***Figure 32*. AnnAGNPS Model Output for Sediment Erosion**

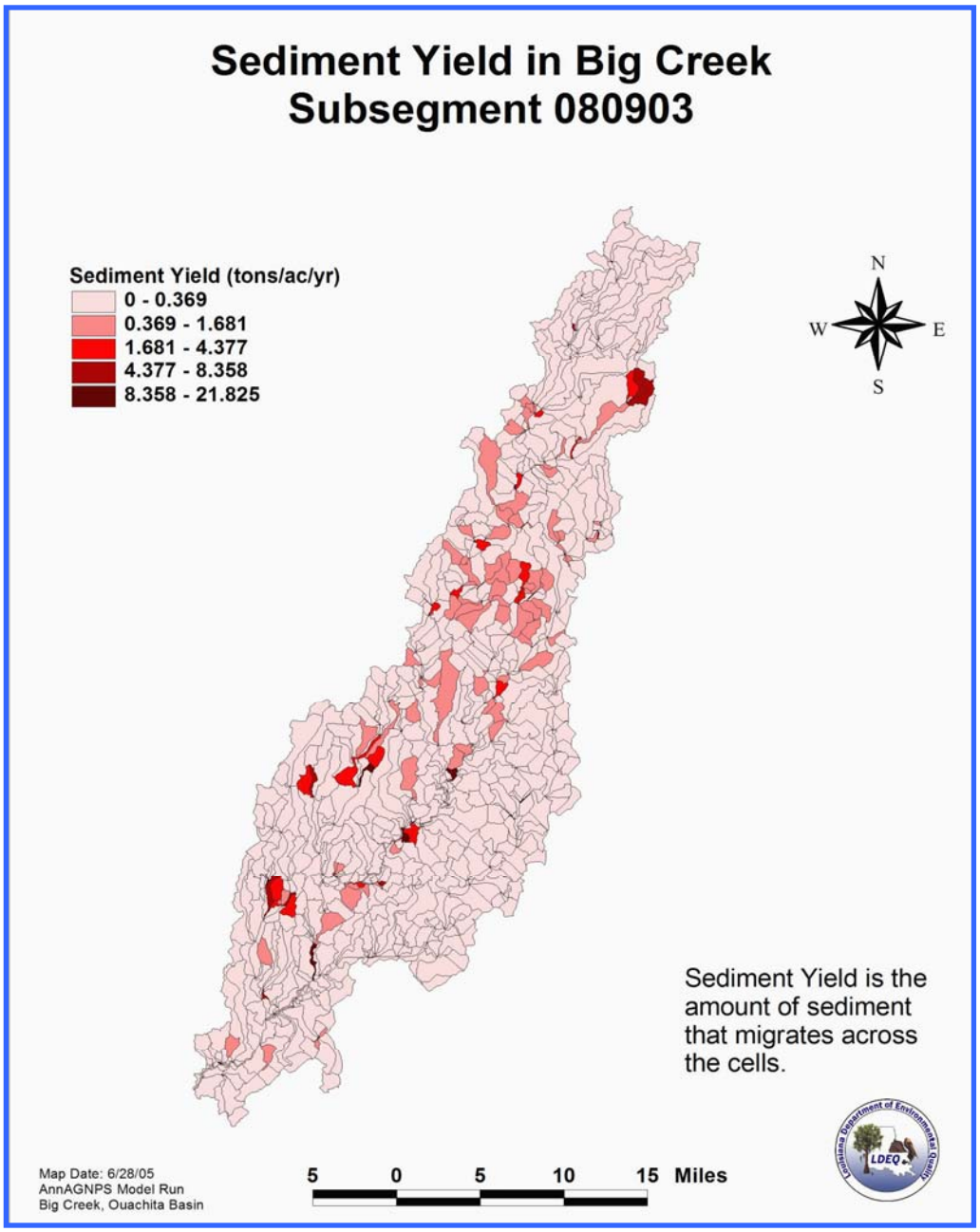

Figure 33. **AnnAGNPS Model Output for Sediment Yield**

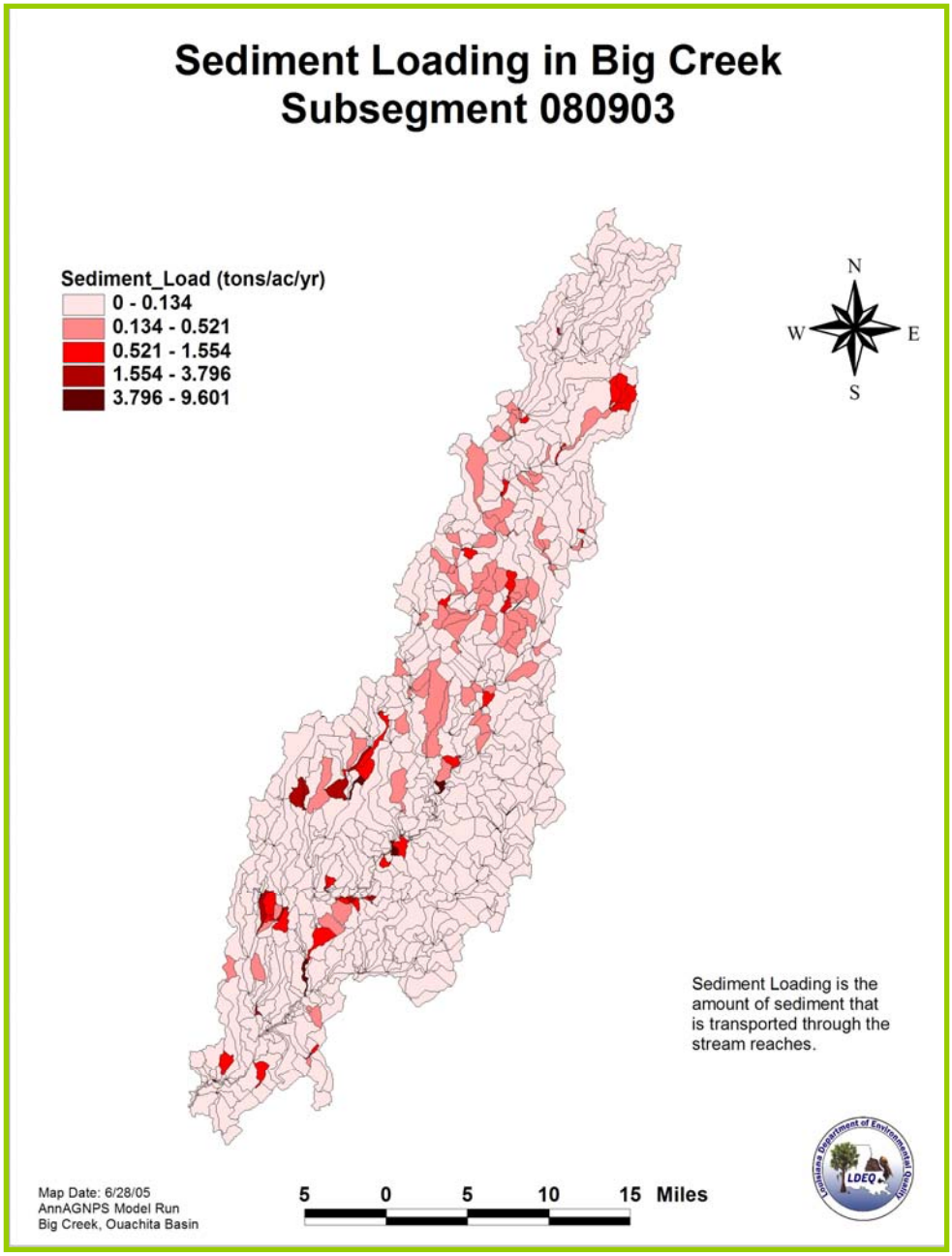

Figure 34. **AnnAGNPS Model Output for Sediment Loading**

5.6 Nutrients and Organic Carbon

Although nutrients are necessary to plant growth in a water body, over-enrichment leads to excessive algae growth, an imbalance in natural nutrient cycles, changes in water quality and a decline in the number of desirable fish species. Nutrients may reach surface water when soil particles they are adsorbed to are eroded or when the nutrients are dissolved in runoff water. Factors influencing nutrient losses are precipitation, temperature, soil type, land use, and soil chemical and biochemical reactions. Chronic symptoms of over-enrichment include low dissolved oxygen, fish kills, murky water, and depletion of desirable flora and fauna. Excessive amounts of nutrients can also stimulate the activity of microbes, such as pfisteria, which may be harmful to human health.

Although AnnAGNPS has the capability to calculate runoff and loading for nitrogen, phosphorus, and organic carbon, these parameters are not reported because sufficient data pertaining to nutrient levels in the soil was not available. It should be noted, however, that some of the practices which reduce the amount of sediment that enters the waterbody typically reduce the nutrient load as well.

5.7 Nitrogen

Organic nitrogen is the nitrogen incorporated into organic compounds, primarily unassimilated proteins. Bacterial action on such organic matter results in its degradation and the release of ammonia (NH_3). The NH_3 may then be further oxidized to nitrite(NO_2^-) by bacteria such as *Nitrosomonas,* and the NO_2^- produced from this reaction can be oxidized to nitrate (NO_3^-) by other bacteria such as *Nitrobacter.* These biologically mediated reactions are collectively referred to as *nitrification.* In areas subject to reasonably fast currents, the dilution of nitrogen occurs down current and oxidation of ammonia to nitrate prevents accumulation of soluble nitrogenous wastes in the water column.

In aquatic systems excessive concentrations of nitrogen compounds result in both direct and indirect problems. The primary adverse effects are as follows: 1. Organic nitrogen compounds can be mineralized in aquatic systems which results in a loss of dissolved

oxygen from the water. 2. In instances where nitrogen is limiting to growth in a particular aquatic ecosystem, discharge of nitrogen compounds can promote the growth of nuisance plankton and algae. 3. When ingested, NO_3^- can be transformed to NO_2^- and result in Methemoglobinemia (Blue Baby Syndrome). 4. Both NH_3 and NO_2^- are toxic to some aquatic species.

Nitrogen loading in the Big Creek Watershed is generally the highest in the northern portion of the watershed, which is near the headwaters of the Big Creek. Nitrogen loading ranges from 0 to 7.565 lbs/ac/yr in the Big Creek Watershed (figure 35).

5.8 Nitrogen Biochemical Oxygen Demand

Nitrogen is important in water quality assessments for reasons other than its role as a nutrient. For example, the oxidation of NH_3 to NO_3^- during the nitrification process consumes oxygen and may represent a significant portion of the total BOD. Stoichiometrically, 3.43 g of oxygen are consumed for each gram of ammonium-nitrogen oxidized to nitrite-nitrogen. During the second stage of nitrification, the nitrobacter bacteria oxidize nitrite to nitrate and 1.14 g of oxygen are consumed per gram of nitrite-nitrogen oxidized. If the two reactions are combined, the complete oxidation of ammonia can be represented by:

$$NH_4^+ + 2\ O_2 \rightarrow N_O^3- + H_2O + 2H^+$$
$$(14\ g)\ (64\ g)$$

As seen, 64/14 or 4.57 g of oxygen are required for the complete oxidation of one gram of ammonia. In the reactions above, the organic-nitrogen form does not appear, since organic-nitrogen is hydrolyzed to ammonia, and does not consume oxygen in the process.

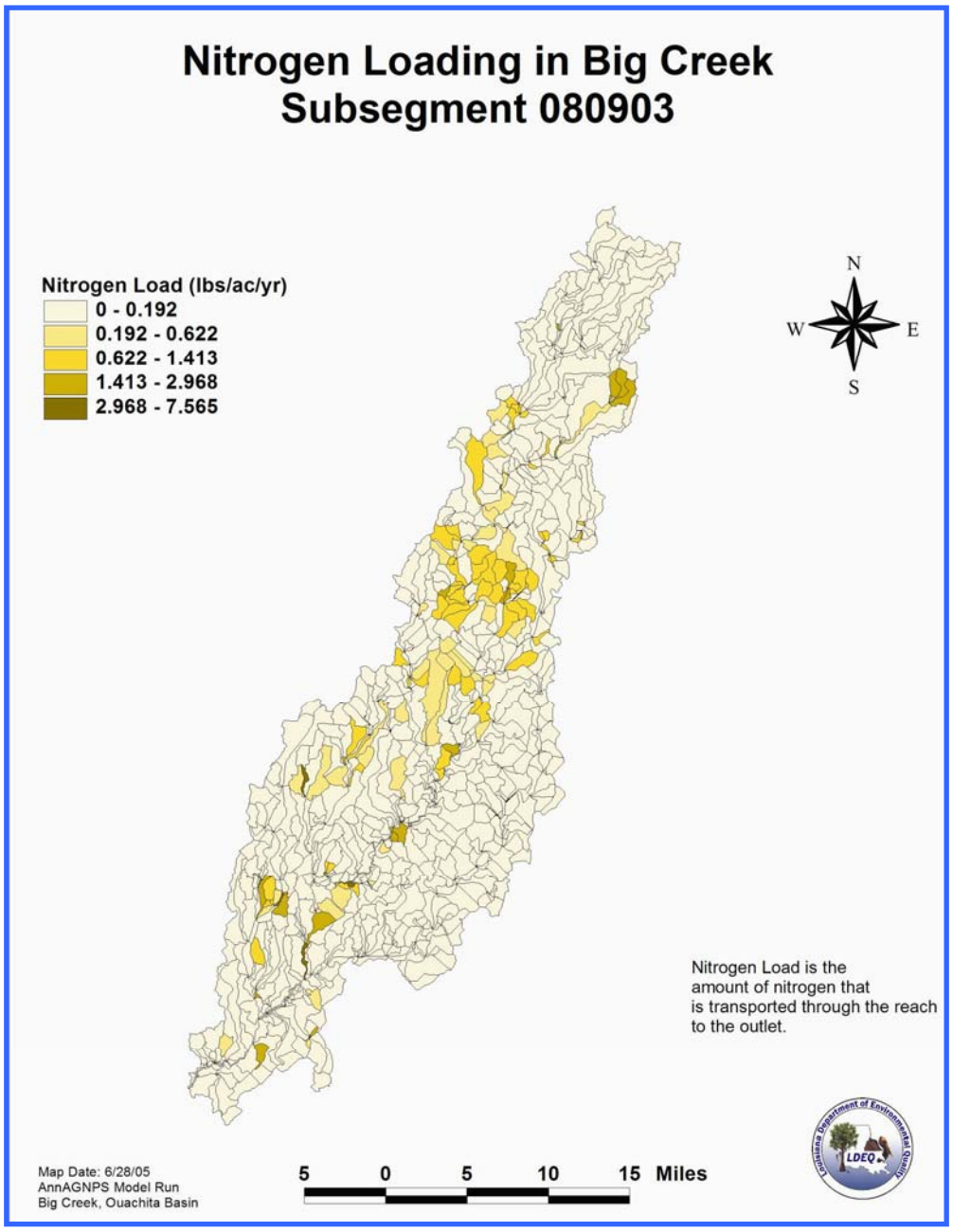

***Figure 35*. AnnAGNPS Model Output for Nitrogen Loading**

5.9 Organic Carbon

BOD in Louisiana waterways and sediments is largely composed of Carbonaceous BOD (CBOD). Animal waste, crop debris, oil and grease from roadways and boats, sewage, lawn clippings, and natural sources of plant and animal material all have the potential to enter water bodies and place an oxygen demand on them upon decomposition. If dissolved oxygen levels decrease to low levels and remain low, fish and other aquatic species can die. Often this occurs on a seasonal basis in Louisiana, during periods of low flow and warm water.

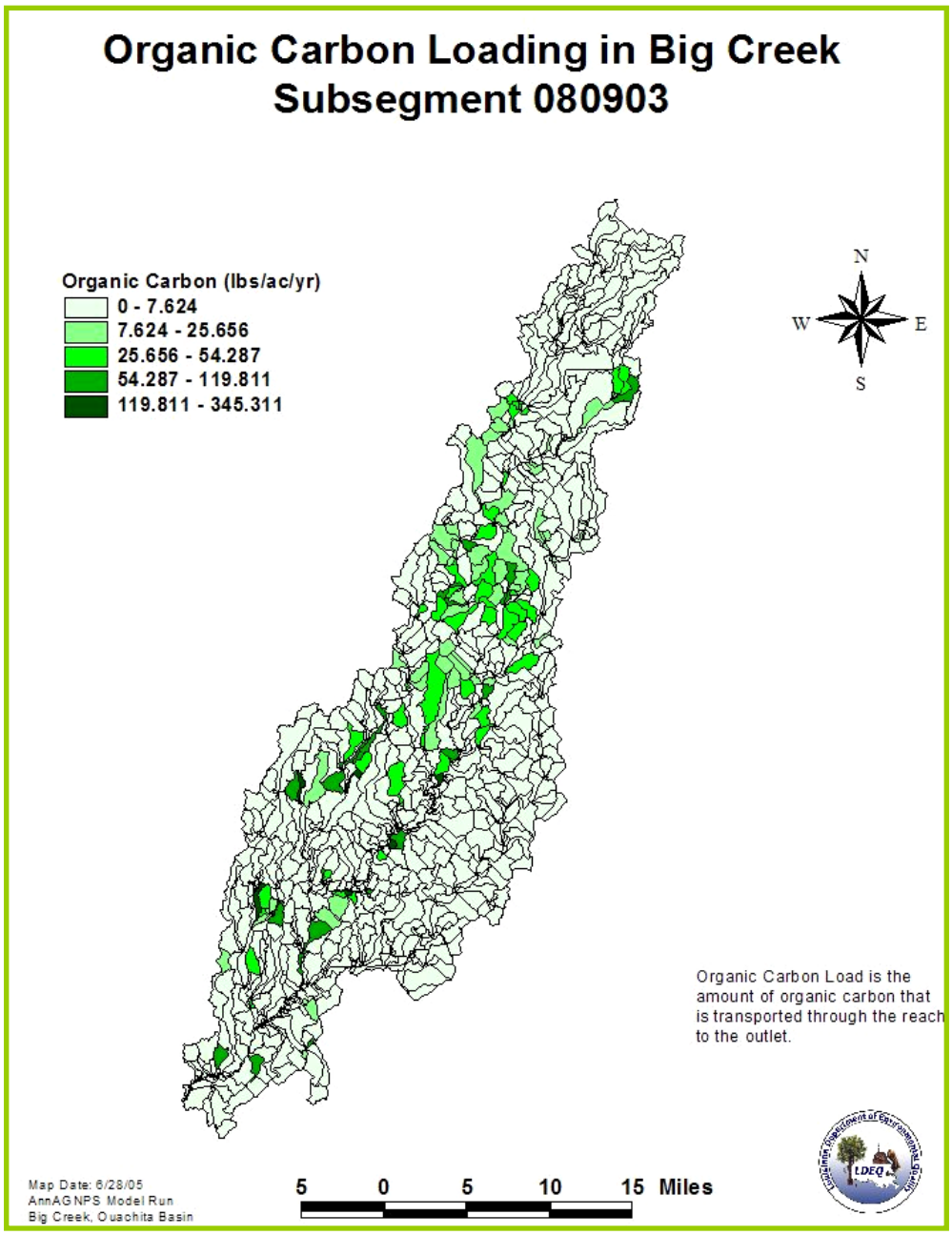

Figure 36. **AnnAGNPS Model Output for Organic Carbon Loading**

5.10 Phosphorus

Phosphorus is typically the most limited nutrient in freshwater systems for plant growth. Therefore, when it is introduced to phosphorus limited water, algal blooms can occur. Algae consume dissolved inorganic phosphorus and convert it to the organic form. When the algae die and decompose, dissolved oxygen in the water can decrease and result in fish kills.

Natural sources of P in water include leaching from phosphate-bearing rocks, and organic matter decomposition. Runoff and erosion can carry additional phosphorus to water bodies in the form of manmade fertilizers, domestic sewage, animal manure, and detergents. Numerous Phosphorus compounds exist in soil, but most are insoluble. Dissolved inorganic phosphorus (orthophosphate) is the major form of P directly available to algae. Phosphorus in forms that have very low solubilities that get washed into water bodies may later be released and become available to algae if the water chemical properties, such as pH, change.

Total P levels in unpolluted waters are usually less than 0.1mg per liter and inorganic (orthophosphate) soluble P is often less than 0.01 mg per liter (Lind, 1979). Phosphorus is rarely found in concentrations that are toxic to higher organisms.

Phosphorus loading in the Big Creek Watershed has the highest amounts of loading in the southeastern portion of the watershed (figure 37).

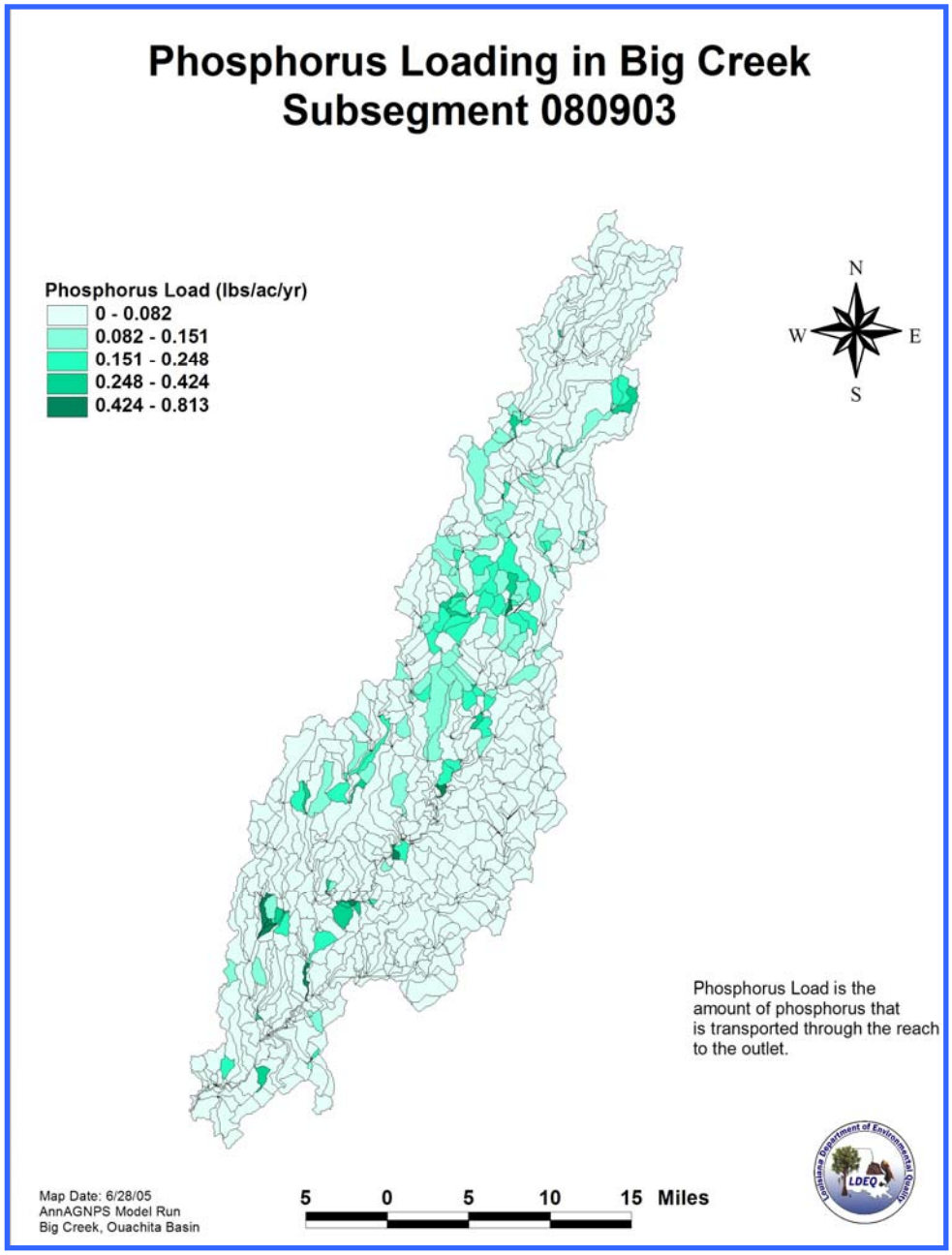

***Figure 37*. AnnAGNPS Model Output for Phosphorus Loading**

6.0 AnnAGNPS Results Summary

The AnnAGNPS model summary (table 7) indicates that on average, 0.810 tons/ac/yr of sediment is eroded from the Big Creek Watershed per year and even less ends up as part of the waterbody load. However, the cells that are reported in the AnnAGNPS model results as having increased sediment erosion, yield, and load are primarily along the Big Creek and the major tributaries. From the output of the modeling results, the watershed has an increased risk of soil loss in the southern part of the watershed. Therefore, implementing conservation measures and BMPs in these areas should be a priority.

Table 7. AnnAGNPS Model Results for the Big Creek Watershed

Type of Model Results	Results	Units	Description
Sediment Erosion	0.810	tons/ac/yr	Overland erosion
Sediment Yield	0.209	tons/ac/yr	Sediment deposited in streams
Sediment Load	0.0878	tons/ac/yr	Sediment that moves through stream reaches
Water Load	21.302	in/ac/yr	Amount of water running of cells into the stream reaches

7.0 LDEQ's Monitoring Plan

LDEQ has implemented a watershed approach to ambient water quality monitoring. Beginning in 2004 LDEQ changed from a five-year rotating monitoring cycle to a four-year cycle. This change allows for the same level of water quality monitoring over a shorter period of time. At the same time, it allows regional field staffs responsible for the sampling to more evenly distribute their monitoring workload. The four-year cycle will also permit a more balanced schedule of water quality assessments for Integrated Reporting (305(b) and 303(d)) purposes.

Within each basin, all monitored subsegments will be sampled over the year or years specified under each cycle period. Water quality assessments for the Integrated Report will be conducted for each basin following the last year of its monitoring period.

Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second four-year cycle. This will allow LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the four-year cycle is shown below:

Table 8. LDEQ's 4-year water sampling cycle

Basin	*First 4-Year Cycle*	*Second 4-Year Cycle*
Mermentau	2004, 2005, 2006, 2007	2008, 2009, 2010, 2011
Vermilion-Teche	2004, 2005, 2006, 2007	2008, 2009, 2010, 2011
Calcasieu River	2004,2005	2008,2009
Ouachita River	2004,2005	2008,2009
Barataria	2004,2005	2008,2009
Terrebonne	2004,2005	2008,2009
Mississippi River	2004,2005	2008,2009
Lake Pontchartrain	2006,2007	2010,2011
Pearl River	2006	2010
Red River	2004,2005,2006,2007	2008,2009,2010,2011
Sabine River	2006,2007	2010,2011
Atchafalaya River	2004,2005	2008,2009

8.0 REGULATORY AUTHORITY

8.1 Federal Authority

Section 319 of the Clean Water Act (PL 100-4, February 4, 1987) was enacted to specifically address problems attributed to nonpoint sources of pollution. Its objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Sec. 101; PL 100-4), instructed the Governor of each State to prepare and submit a Nonpoint Source Management Program for reduction and control of pollution from nonpoint sources to navigable waters within the State by implementation of a four-year plan (submitted within 18 months of the day of enactment).

8.2 State Authority

In response to the federal law, the State of Louisiana passed Revised Statute 30:2011, signed by the Governor in 1987 as Act 272. Act 272 designated the Louisiana Department of Environmental Quality as the "Lead Agency" for development and implementation of the State's Nonpoint Source Management Plan. The Louisiana Revised Statutes R.S. 30:2011.D (20) includes the following provision as the authority for LDEQ to implement the State's NPS Program.

To develop and implement a nonpoint source management and ground water quality protection program and a conservation and management plan for estuaries, to receive federal funds for this purpose and provide matching state funds when required, and to comply with terms and conditions necessary to receive federal grants. The nonpoint source conservation and management plan, the groundwater protection plan, and the plan for estuaries shall be developed in coordination with, and with the concurrence of the appropriate state agencies, including but not limited to, the Department of Natural Resources, the Department of Wildlife and Fisheries, the Department of Agriculture and Forestry and the State Soil and Water Conservation Committee in those areas pertaining to their respective jurisdictions.

9.0 Best Management Practices for Big Creek Watershed

9.1 Best Management Practices (BMPs)

An essential step in achieving effective local stormwater runoff water-quality management programs is developing technically valid approaches for assessing the water-quality significance of chemical constituents and pathogens in urban runoff. Best management practices (BMPs) are effective practices that act to reduce the nonpoint pollution load in water systems and decrease the velocity of runoff after storm events. These practices are usually created and maintained for long-term use and coincide with the local water quality standards for a particular area. Selection and suitability of a BMP

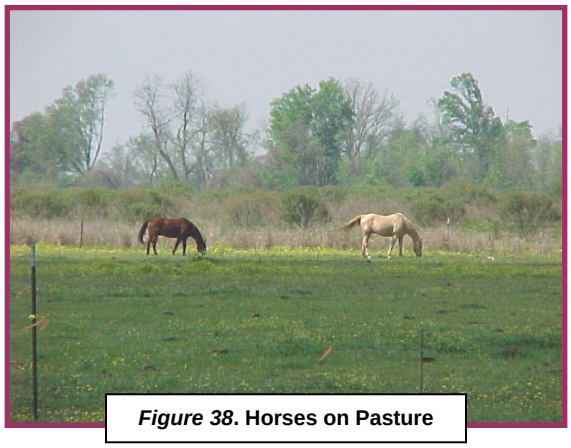

***Figure 38*. Horses on Pasture**

should be based on: site specific conditions, type of land use activity, the physical makeup of the watershed, and consideration of the pollutant(s) involved.

BMPs are recommended methods, structures, and practices designed to prevent or reduce water pollution while maintaining economic returns. The BMP concept deals specifically with nonpoint source pollution, such as runoff from agricultural fields. Implicit within the BMPs concept is a voluntary, site-specific approach to water quality problems. Many of these methods are already standard practices, known to be both environmentally and economically sustainable.

BMPs are practices, which may be applied to agriculture and urban development, to control the generation of pollutants and their delivery of pollutants to the watershed. Although a wide variety of BMPs are available which may be applied to the Big Creek Watershed, specific BMPs designed to address the problems in Big Creek are recommended in this document.

The goal of BMPs is to protect Louisiana's water resources from degradation, while maintaining the economic viability of Louisiana's agriculture and related industries. Ideally, these practices will improve producer profitability.

9.2 Agricultural BMPs

Conservation Tillage

Figure 39. **Conservation Tillage**

Conservation tillage is an agricultural BMP that provides long-term crop residues and vegetation on croplands. This practice greatly reduces erosion and surface runoff of heavy metals and pesticides, which may reside in higher concentrations in the surrounding soil. No-till is a similar practice that minimizes the spring influx of sediment into nearby waters by anchoring the soil to the plant root systems. Either way, by retaining crop residue and vegetative cover, this practice reduces time and energy on the farmer; it delays the warming and drying of the soil, and overall maintains a higher quality of soil.

Animal Husbandry

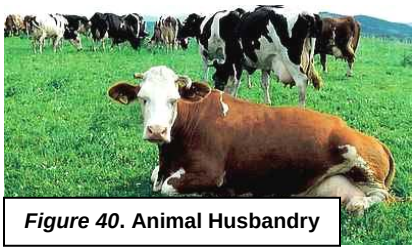

***Figure 40*. Animal Husbandry**

Simple practices can be implemented to offset livestock impacts on nearby streams and rivers. By providing an alternative water source, for example, livestock would not be forced to wade in the streams and therefore would not be as likely to contribute to excess nutrient input from wastes. Large concentrations of wastes can speed up eutrophication of a stream, which will eventually decrease the effectiveness of the watershed's sustainability. Another effect of livestock in waterways is the increased potential for erosion by streambank deterioration from trampling and compaction. An alternative to better manage the watershed could include creating a bridge to connect pastures where the animals can easily cross the stream without directly interacting with the water system.

9.3 Urban and Suburban BMPs

- **Vegetative Buffers**

Filter Strips

Filter strips are wide areas of vegetation that act to intercept runoff. They can consist of any type of dense vegetation from woodlands to grass and can remove various pollutants, such as heavy metals, sediment loads, and excess organic materials.

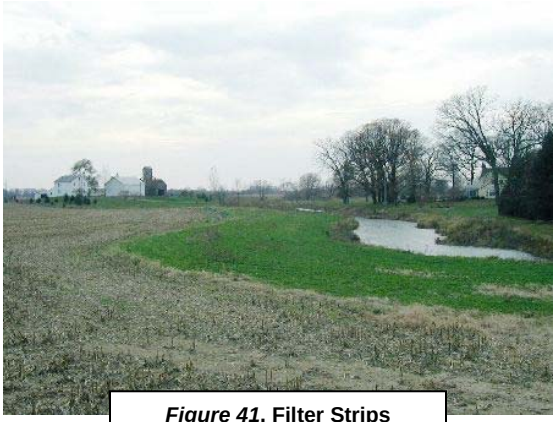

***Figure 41*. Filter Strips**

Swales

Swales are shallow channel depressions where runoff flows. These swales slow the flow of the runoff water and allow particulates to settle out and water to infiltrate into the soil. These swales can effectively remove small amounts of excess nutrients and heavy metals.

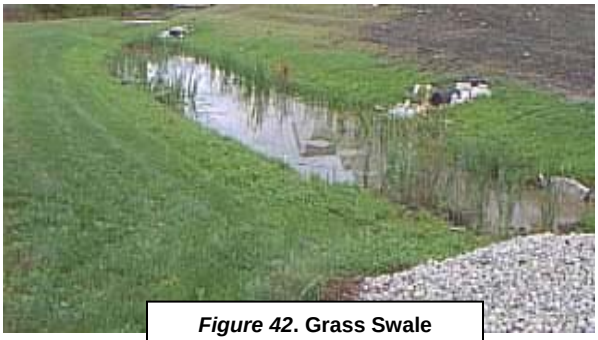

***Figure 42*. Grass Swale**

Constructed Wetlands

Constructed wetlands are often used in mitigation of other areas that lost wetlands due to development. Both natural and constructed wetland areas are saturated for sufficient time periods and are able to support unique vegetation adapted for life in such conditions. Wetlands are extremely efficient in filtering sediment, nutrients, and some heavy metals from storm water runoff and overflow of nearby water systems.

***Figure 43*. Constructed Wetland**

Detention Ponds

Structures are often built in residential areas to alleviate stormwater runoff and retain or detain precipitation from storm events. Detention ponds are basins that temporarily store runoff from a site and release it at a controlled rate to minimize downstream flooding. These ponds are quite effective for pollutant removal, especially suspended sediments, if well designed.

***Figure 44*. Detention Ponds**

Infiltration Trenches

These trenches are shallow, usually three to eight feet deep, and backfilled with gravel to create underground reservoirs. Runoff, therefore, is diverted to the trenches and percolates into the subsoil. Such a practice effectively removes sediments and similar particles from stormwater runoff. This practice is commonly used in both commercial and residential areas.

***Figure 45*. Infiltration Trenches**

Construction Sites

Construction sites, while under development, can implement many BMPs to reduce runoff, decrease pollutant loads to nearby water systems, and decrease the amount of soil washed from the site. Simple practices, such as setting up straw bales, silt fences, or even filter fabrics can act to slow runoff and retain sediment during storm events.

Other practices, such as sediment basins to detain runoff or stabilizing entrances of construction, further decrease sediment and pollutant runoff.

***Figure 46*. Short-term Construction**

10.0 Maintenance Practices

Citizens, commercial businesses, and even local and state agencies can implement and maintain efficient BMPs by taking the conservative approach to many everyday landscaping events. For example, fertilizing and sufficiently seeding grass to promote long-term stabilization of soil surfaces and planting wildflower cover (a practice used by many highway departments to provide aesthetically pleasing vegetation along roadways) greatly reduces the potential for erosion by securing the surfaces with plant roots. Other practices such as sodding and mulching can also be applied and have similar effective results.

11.0 TMDL Timeline for the NPS Implementation Plan

The NPS Implementation Plan for the Big Creek Watershed outlines a 5-year management plan to reduce NPS pollutants reaching the waterway. LDEQ intensively samples each watershed in the state once every 5 years to see if the waterbodies are meeting water quality standards. The 5-year cyclic sampling began during 1999 for the Ouachita Basin, including Big Creek, and will occur again in 2004, 2009, and 2014 (Table 9). The data from 1999 will be used as a baseline to measure the rate of water quality improvement in samples taken in subsequent years. If no improvement in water

quality is witnessed by the 2009 sampling, LDEQ will revise the NPS Implementation Plan to include additional corrective actions to bring the waterway into compliance. Additional BMPs and or other options will be employed, if necessary, until water quality standards are achieved and Big Creek is restored to its designated uses.

Table 9. Revised Timeline for Watershed Planning and Implementation

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mermentau																			
Vermilion																			
Calcasieu																			
Ouachita																			
Barataria																			
Terrebonne																			
Pontchartrain																			
Pearl																			
Red																			
Sabine																			
Mississippi																			
Atchafalaya																			

1. Black Stripes = Collect Water Quality Data to Develop Total Maximum Daily Loads (TMDLs) and to Track Water Quality Improvement at the Watershed Level **[Objective 1**]
2. Light Blue = Develop Total Maximum Daily Loads for the Watersheds on the 303(d) List [**Objective 2]**
3. Green = Develop Watershed Management Plans to Implement the NPS Component of the TMDL **[Objective 3]**
4. Yellow = Implement the Watershed Management Plans **[Objectives 4-8]**
5. Dark Blue = Develop and Implement Additional Corrective Actions Necessary to Restore the Designated Uses to the Water Bodies **[Objective 9-10]**

12.0 Making the Implementation Plan Work

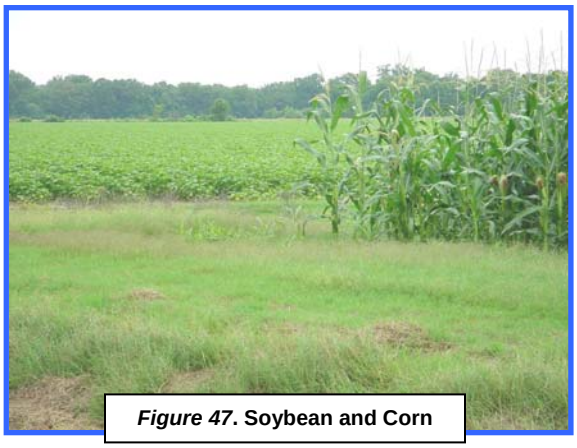

***Figure 47*. Soybean and Corn**

To implement BMPs and/or other conservation practices in order to reduce the NPS load in the Big Creek Watershed so that it meets its designated uses and is no longer listed on the 303(d) list, will require programs that provide technical assistance, funding, incentives, as well as foster a sense of stewardship. Many of these programs that are designed to assist the landowner are already in place. Louisiana's Nonpoint Source Unit provides monies distributed through the USEPA under Section 319 of the CWA. The funds are utilized to implement BMPs for all types of land uses within the watershed in order to reduce and/or prevent the NPS pollutants and achieve the river's designated uses. The USDA and NRCS are federal government agencies that have several such programs made available by way of the Farm Security and Rural Investment Act of 2002. These programs are made available through the local Soil and Conservation District (SWCD). The NRCS has a list of BMPs for almost all types of agriculture and programs to facilitate their use.

"Parish-wide" cooperation and coordination will be necessary in order to protect the water quality within the watershed. The Ouachita Basin Watershed is especially challenging since it encompasses four different parishes. Though challenging, it is an opportunity and reason for leaders, officials, and local citizens to come together for a common interest. As a result, people develop new relationships. The watershed approach helps build new levels of cooperation and coordination, which is necessary to successfully control NPS loading.

13.0 Timeline to Achieve TMDL Goals

The NPS Management Plan (LDEQ, 2000) outlines an eighteen-year schedule for watershed implementation of all TMDLs in Louisiana (Table 5). This schedule was based on the TMDL timeline for all of the waterbodies listed on the 303(d) list. The Big

Creek watershed, located in the Ouachita Basin will follow the schedule for the entire basin, which is represented in the table. In 2003, intensive monitoring of the Ouachita Basin was done for the 1st time since the TMDL was completed (the 5-year cycle of water quality sampling began in 1999 for the Ouachita Basin). In 2003, LDEQ sampled Big Creek to see if there had been any improvement since 1999. In 2008, LDEQ will sample again in the watershed to see if there has been improvement as the result of BMPs. If there has not been sufficient improvement, LDEQ will revise the implementation plan to include additional corrective actions to bring the waterway into compliance. Additional BMPs will be employed, if necessary, beginning in 2009 and increased until water quality standards are achieved by 2013. The long-term goal for restoring the waterway is 2015.

14.0 Long-term Nonpoint Source Management Goals

LDEQ has four broad goals for nonpoint source management in the Ouachita River Basin Region:

1. Monitor and assess ambient water quality and beneficial uses to determine the need for and performance of nonpoint source management measures throughout the region.
2. Ensure effective implementation of land-use specific nonpoint source pollution management measures throughout the region.
3. Facilitate implementation of watershed management plans for prevention and control of nonpoint source pollution throughout the region.
4. Provide technical assistance and education to the public, public agencies, and private landowners and other interested parties about prevention and correction of nonpoint source pollution problems.

15.0 Actions being implemented by other agencies

Figure 48. **Conservation Tillage**

The U.S. Department of Agriculture (USDA) and Natural Resource Conservation Service (NRCS) offers landowners financial, technical, and educational assistance to implement conservation practices and/or BMPs on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. The new "Farm Security and Rural Investment Act of 2002", known as the 2002 Farm Bill provides funding to various conservation programs for each state by way of the NRCS and the State's local Soil and Water Conservation Districts (SWCD). Although most of these programs are designed to assist agriculture, there may be cases where the may be utilized for conservation practices for other land uses. A complete list of agriculture BMPs is provided by the NRCS in their "Technical Guide Handbook". The handbook includes a description of each BMP and their recommended uses. Each BMP is listed by a "code", i.e. Field Border (386).

The Louisiana Department of Agriculture and Forestry now receives USEPA §319(h) funds from USEPA specifically for the implementation of BMPs in impaired watersheds. For more information regarding these funds, please contact LDAF Office of Soil and Water Conservation.

The 2003 Farm Bill provides funding to various conservation programs for each state by way of the NRCS and local Soil and Water Conservation Districts (SWCD). The following includes a brief summary of the programs available through the local SWCD under the oversight of USDA and NRCS. The descriptions of the programs are general and are subject to change.

2003 Farm Bill Conservations Programs and Potential Funding Sources

Environmental Quality Incentive Program (EQIP) provides 75% - 90% cost share for environmentally beneficial structural and management alterations, primarily 60% to

livestock operations. Applications prioritized for benefits. Considered the "Working Lands" program.

Wildlife Habitat Incentive Program (WHIP) provides 75% - 90% cost share for the costs of wildlife habitat restoration and enhancement on private lands. Eligible to private property owners and lessees for installing riparian buffers, native pine & hardwoods, wildlife corridors, and other wildlife enhancing measures, 5 – 10 year contracts.

Wetland Reserve Program (WRP) is a voluntary program for wetland restoration, enhancement, and protection on private lands. WRP provides annual payments and restoration costs for 10 year, 30 year, or perpetual easements on prior converted wetlands. Louisiana leads the US in WRP participation. 2002 Farm Bill total funding allocation is 1.5 billion and expanded the program to purchase long-term easements and cost sharing to agriculture producers.

Conservation Reserve Program (CRP)

The 1985 Farm Bill established CRP as a voluntary program to protect highly erodible and environmentally sensitive lands. CRP places a positive value on rural environment by improving soil, water, and wildlife, and extends a pilot sub-program called the Conservation Reserve Enhancement program

Conservation Security Program (CSP) is a new national incentive payment program for maintaining and increasing farm and ranch stewardship practices. The CSP is designed to correct a policy disincentive in which independently conducted resource stewardship has disqualified many farmers from receiving conservation program assistance. CSP features an optional "tiered" level of farmer participation where higher tiers receive greater funding for greater conservation practices.

Farmland Protection Program (FPP) provides funding to states, tribes, or local governments and to nonprofit organizations to help purchase development rights and protect farmlands with prime, unique, or productive soil; historical or archaeological significance; or farmlands threatened by urban sprawl. Louisiana does not currently have any FPP contracts.

Grassland Reserve Program (GRP) is a new program to enroll up to 2 million acres of virgin and improved pastureland. GRP easements would be divided 40/60 between agreements of 10, 15, or 20-years and agreements and easements for 30-years and permanent easements to restore grassland, rangeland, and pasture through annual rental payments.

Small Watershed Rehabilitation Program (SWRP) provides essential funding for the rehabilitation of aging small watershed impoundments and dams that have been constructed over the past 50 years.

Although information is not currently available for conservation treatments specifically in The Big Creek Watershed, they are available for Jackson, Caldwell, LaSalle, and Winn parishes where the watershed is located. It is reported that 4,895 acres in these parishes were engaged in conservation treatments through programs, such as EQIP, WHIP, CRP, and WRP, during fiscal year 2003 (NRCS PRMS Report). This includes total conservation buffers, erosion reduction, irrigation water management, nutrient management, pest management, prescribed grazing, residue management, tree and shrub establishment, and wildlife habitat.

In addition to the programs mentioned, the following organizations have signed an MOU with LDEQ within the state's NPS Management Plan that each will aid LDEQ in achieving the goals of the management plan:

- Louisiana Department of Agriculture and Forestry
- Louisiana Department of Health and Hospitals
- Louisiana Department of Wildlife and Fisheries
- Louisiana Department of Transportation and Development
- Louisiana Department of Natural Resources
- Louisiana State University Agricultural Center
- Natural Resources Conservation Service
- USDA – Farm Services Agency
- Louisiana Forestry Association
- US Fish and Wildlife Service
- USDA Forest Service

- US Army Corps of Engineers
- US Geological Survey
- Federal Emergency Management Agency
- Louisiana Farm Bureau Federation

Master Farmer Program

The Master Farmer Program (developed by Louisiana State University Agricultural Center) is to encourage on-the-ground BMP implementation with a focus on environmental stewardship. The 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.

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 environmental education and implementation of crop-specific BMPs. Phase II of the environmental component includes in-the-field viewing of implemented BMPs on Model Farms. 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 and receive the distinction of being considered a master farmer.

This program can help to initiate and distribute the use of BMPs throughout the Big Creek Watershed. Participants will set an example for the rest of the agricultural community and will work closely with NRCS staff and other Master Farmers to identify potential problem areas in the watershed. They will receive information on new and innovative ways to reduce soil and nutrient loss from their fields. They will be kept informed of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements.

Master Logger Program

The master logger program served as a model for development of the master farmer program, and has been very successful at educating foresters as to BMP implementation. This program was developed by the Louisiana Forestry Association, which is a private organization, along with the Louisiana Department of Agriculture and Forestry Office of Forestry.

16.0 Tracking and Evaluation

As Stated in the Louisiana Nonpoint Management Plan, program tracking will be done at several levels to determine if the watershed approach is an effective method to reduce nonpoint source pollution and improve water quality:

1. Tracking of actions outlined with the Watershed Restoration Action Strategy (short-term)
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share ant technical assistance within the watershed (short term);
3. Tracking progress in reducing nonpoint source pollutants, such as solids, nutrients, and organic carbon from the various land uses (rice, soybeans, crawfish farms) within the watershed (short-term);
4. Tracking water quality improvement in the bayou (i.e. decreases in total organic carbon, total dissolved oxygen) (short and long term)
5. Documenting results of the tracking to the Nonpoint Source Interagency Committee, residents within the watershed, and EPA (short and long term);
6. Submitting semi-annual and annual reports to EPA which summarize results of the watershed restoration actions (short and long term)
7. Revising LDEQ's web-site to include information on the progress made in watershed restoration actions, nonpoint source pollutant load reductions, and water quality improvement in the bayou (short and long term).

17.0 Summary

In order to restore the water quality and designated uses of "Fish and Wildlife Propagation" in Subsegment 080903 in the Big Creek Watershed, it will require a

concerted effort from all of the stakeholders within it, including government (local, state, and federal), private and public groups and local citizens. Persons who live there and/or own property in the watershed are "stakeholders" and stand to benefit from their contribution toward protecting it. Public education is the first critical element for accomplishing goals and objectives, because it is necessary that they understand and support efforts to implement BMPs. Successful outcomes are more likely, when citizens understand what is occurring and why. When stakeholders volunteer to demonstrate conservation practices on their land, they should receive positive recognition and other incentives. Soon, there will be even greater participation.

The dominant land use in the watershed is agriculture followed closely by forestry, rural residential, and natural areas. Each type of land use that has been identified within subsegment 080903 has BMPs that are known for reducing NPS pollutants loads. Prevention of sediment runoff and runoff containing excess nutrients from land use activities occurring within the Big Creek Watershed will make significant water quality improvements in Big Creek. Improved water quality will help to achieve and to sustain the bayou's designated uses, which in turn benefits other natural resources and future generations to come. For the lands in the watershed used for forestry production, sediment and erosion control practices should be implemented and always practiced. Planning is likely the greatest strategy for controlling NPS loading from forestry sites. Use of maps for identifying streams, land topography, and drainage patterns can effectively increase a forester's strategy when developing a plan for preventing NPS loading by implementing BMPs. Preservation of the riparian areas along tributaries is another BMP that can function to prevent NPS loading from forestry activities as well as other agricultural activities and land use types. Any type of land use activity that disturbs the soil and/or leaves an area of barren earth for a period of time should plan to utilize existing plants as filters or establish new vegetation around the perimeter of the disturbed site. Additionally, vegetation could be established on the down slope of the site. These type

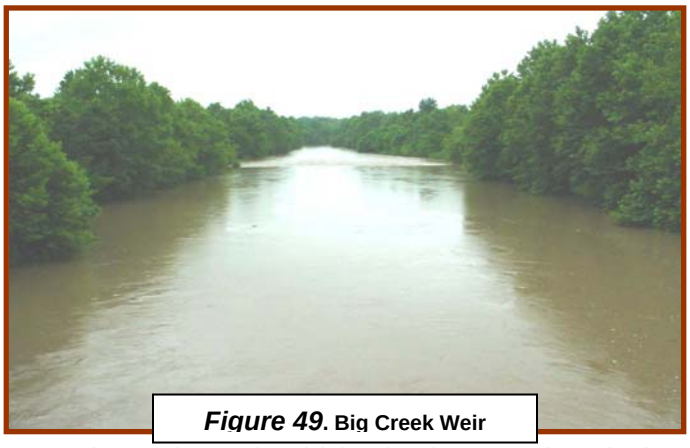

Figure 49. **Big Creek Weir**

BMPs are very simple and very cost-effective, although there may be others types, which may or may not be more effective at preventing NPS loading.

Although, some of the BMPs and the recommended course of actions were described within this plan, a consolidated list of BMPs recommended for each of these land uses can be viewed in the State of Louisiana Water Quality Management Plan, Volume 6, *Louisiana's Nonpoint Source Management,* 2000.

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GLOSSARY OF TERMS

aquatic ecosystem *- An aquatic community, including all the component organisms, together with the aquatic environment, forming an interacting system.*

artificial recharge *- The process by which water is added to the zone of saturation, as recharge of an aquifer.*

benefit/risk *- A comparison between the advantages and disadvantages of a project expressed in terms of economic, social and environmental impacts.*

best management practice (BMP) *- A land management system which improves water quality.*

biochemical oxygen demand (BOD) *- A measure of the quantity of oxygen used by aerobic microorganisms in meeting their metabolic needs in water rich in organic matter.*

biomagnification *- The increasing concentration of substances along succeeding steps in a food chain.*

construction erosion *- Loss of soil as a result of construction activities; normally the rate is greatest when the soil is being manipulated and decreases when surface becomes fully stabilized.*

critical land *- Land that because of slope and soil property requires special management to stabilize soil conditions. Usually this land requires permanent vegetation to keep soil losses within tolerance.*

dissolved oxygen (DO) *- The amount of gaseous oxygen dissolved in water.*

dredging *- The removal of sediment and/or obstructions from existing channels or bodies of water such as ponds or lakes.*

effluent *- The discharge or outflow of liquids into the environment as a by-product of man-oriented processes.*

field drainage tiles *- A subsurface method of removing excess water from the soil by means of buried short lengths of burnt clay, concrete or similar material with open joints or perforated plastic pipe at specified depth and grade.*

gross erosion *- The total amount of soil loss expressed in tons per acre per year as calculated using the Universal Soil Loss Equation. Does not equate to the amount of soil delivered to waterways, streams or rivers.*

groundwater *- Phreatic water or subsurface water in the zone of saturation.*

heavy metals *- Metals present in municipal and industrial wastes that pose long-term environmental hazards; they include cadmium, cobalt, chromium, copper, mercury, nickel, lead and zinc.*

herbicides *- Any chemical agent used for the control of unwanted plants.*

holding pond *- A pond or reservoir usually made of earth, built to store polluted runoff.*

hydrographic modifications *- Activities which alter the geometry and physical characteristics of stream channels in such a way that flow patterns are changed.*

inflow/infiltration *- The water discharged into a sewer system either by direct connection or indirect, such as storm flow and water entering the sewer system by defective pipes or connections.*

insecticides *- Any chemical agent used for the control insects.*

livestock waste *- The excreta of animals, with or without the admixture of bedding or litter, in varying degrees of decomposition.*

livestock waste management *- The handling and management of livestock wastes in a non-polluting manner.*

nonpoint source (pollution) *- Pollution whose sources cannot be pinpointed or easily identified, such as soil erosion or acid mine drainage.*

pesticides *- Any chemical agent used for control of specific organisms, such as insecticides, herbicides, fungicides, etc.*

plant nutrients *- Those chemical elements necessary for good plant growth, usually thought of as nitrogen, phosphorus and potassium.*

point source (pollution) *- A source of pollution coming from an easily identified opening, such as a discharge pipe.*

river conservancy district *- A governmental unit under which local residents may control water resource management activities, including water pollution control, within the district's boundaries.*

resource management plan *- A plan or system used to manage a farm unit in such a manner that soil losses are within soil loss tolerances.*

rill erosion *- An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently cultivated soils.*

sedimentation *- The process of depositing sediment.*

sheet erosion *- The removal of a fairly uniform layer of soil from the land surface by runoff water.*

soil erosion *- The detachment and movement of soil by water, wind, ice or gravity.*

soil loss tolerance *- The maximum average annual soil loss in tons per acre per year that does not reduce the land's productivity for a given soil.*

soil percolation *- The rate that water moves downward through the soil mass, usually measured in minutes per inch. Used by sanitarians in designing soil absorption fields for on-site sewage systems.*

soil productivity *- The capacity of soil in its normal environment for producing a specified plant or sequence of plants under a specified system of management.*

stormwater detention/retention *- Managing of stormwater runoff through temporary holding and controlled release of flow.*

suspended solids *- Any solid substance present in water in an undissolved state, usually contributing directly to turbidity.*

toxic materials *- Chemicals and classes of chemicals which are designated by the U.S. Environmental Protection Agency which cause adverse effects upon human health or the environment.*

urban runoff *- Storm water from city streets and gutters that usually contains a great deal of litter, organic matter and bacterial wastes.*

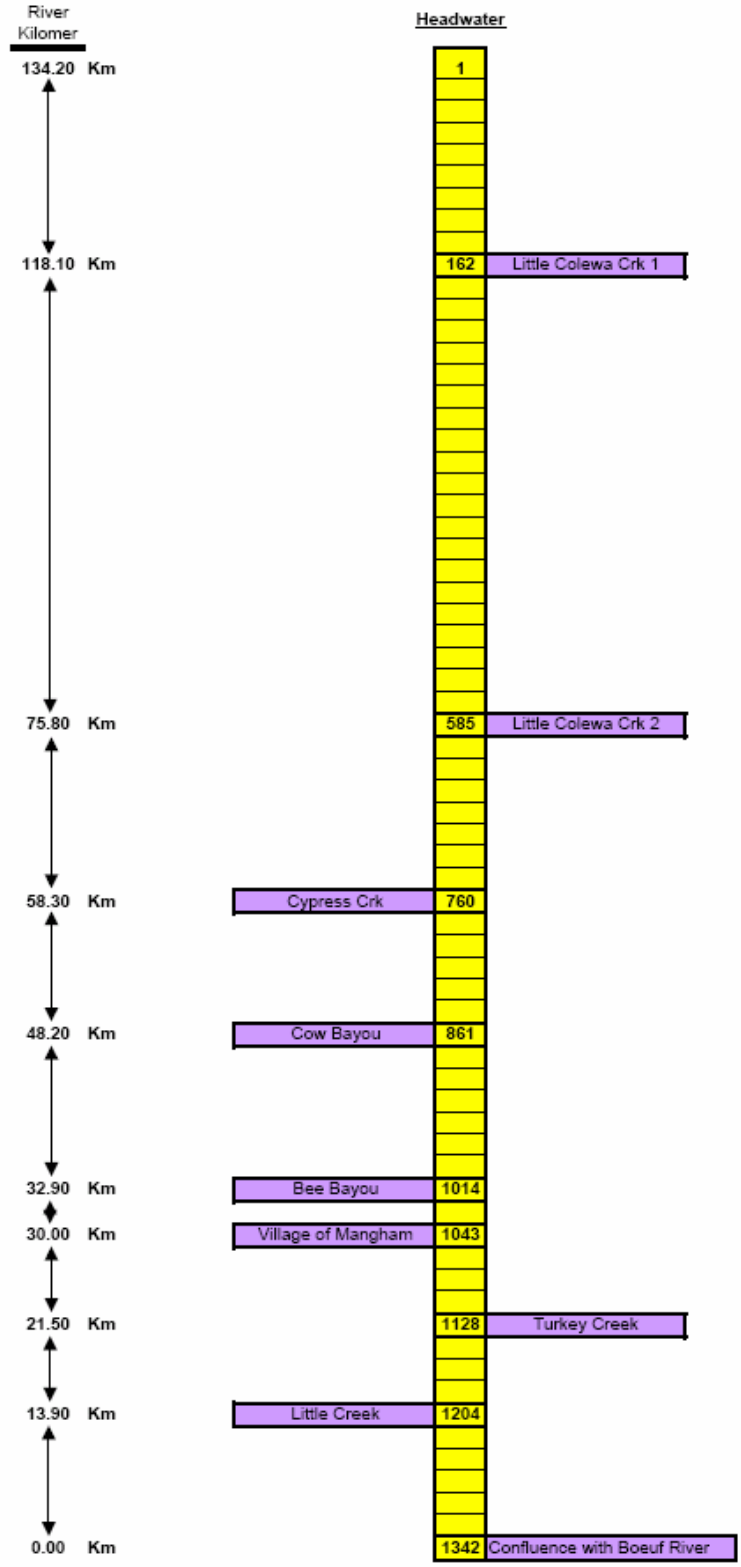
vegetative filter system *- A designed vegetative channel to filter organic wastes from a livestock holding area.*

water quality standards *- Minimum requirements of quality to support designated uses.*

Appendix A

Model element and tributary layout

Big Creek - 080903, TMDL model layout
Ouachita Basin



Model reach descriptions and element determinations:

Big Creek in the Ouachita Basin ***:Stream Model Description***

Reach #	Reach description	Reach start (km)	Reach end (km)	Reach increm. (km)	Reach start element	Reach end element
1	BIG CREEK, Rkm 120 TO Hwy 2	134.2	118	0.1	1	162
2	BIG CREEK, HWY 2 TO MITCHER RD	118	82.1	0.1	163	521
3	BIG CREEK, MITCHNER RD TO 67.4	82.1	67.4	0.1	522	668
4	BIG CREEK, RKM 67.4 TO WEIR #6	67.4	60.2	0.1	669	740
5	WEIR #6	60.2	60.1	0.1	741	741
6	BIG CREEK, WEIR #6 TO WEIR #5	60.1	50.9	0.1	742	833
7	WEIR #5	50.9	50.8	0.1	834	834
8	BIG CREEK, WEIR #5 TO WEIR #4	50.8	37.5	0.1	835	967
9	WEIR #4	37.5	37.4	0.1	968	968
10	BIG CREEK, WEIR #4 TO WEIR #3	37.4	31.3	0.1	969	1029
11	WEIR #3	31.3	31.2	0.1	1030	1030
12	BIG CREEK, WEIR #3 TO WEIR #2	31.2	22.1	0.1	1031	1121
13	WEIR #2	22.1	22	0.1	1122	1122
14	BIG CREEK, WEIR #2 TO WEIR #1	22	5	0.1	1123	1292
15	WEIR #1	5	4.9	0.1	1293	1293
16	BIG CREEK,WEIR#1 TO BOEUF RVR	4.9	0	0.1	1294	1342

Facility / Tributary Description and Element # determinations:

Stream Model Name: *Big Creek in the Ouachita Basin*

Facility/tributary description	Reach #	Reach start (km)	Reach end (km)	Reach increm. (km)	Fac./Trib. Location (km)	Reach start element	Fac./Trib. Location (element)
Tributary, Little Colewa Creek 1	1	134.2	118	0.1	118.1	1	162
Tributary, Little Colewa Creek 2	3	82.1	67.4	0.1	75.8	522	585
Tributary, Cypress Creek	6	60.1	50.9	0.1	58.25	742	760
Tributary, Cow Bayou	8	50.8	37.5	0.1	48.15	835	861
Tributary, Bee Bayou	10	37.4	31.3	0.1	32.9	969	1014
Town of Mangham	12	31.2	22.1	0.1	30	1031	1043
Tributary, Turkey Creek	14	22	5	0.1	21.45	1123	1128
Tributary, Little Creek	14	22	5	0.1	13.86	1123	1204

Input data into the Yellow highlighted areas

Appendix B

Survey Data Measurements and Analysis Results

Water quality insitu and lab data from the September, 1999 survey on Big Creek:

Site #	Site Description	River Kilometer	Waterbody description	Collection date	Collection Time	Sample Depth (m)	Field pH	Field Temp. (C)	Field DO (mg/l)	Field Conductivity (umhos)	TSS (mg/l)	TDS (mg/l)	Hardness (mg/l)	Specific Conductance (umhos)	Color (PCU)	Chloride (mg/l)	Sulfate (mg/l)	NOx (mg/l)	Total Phosphorus (mg/l)
1	Upstream of confluence with Boeuf River	0.5	Mainstem	9/20/1999	15:50	1	8.01	26.97	8.06	702	32	643.9	256	1092	12	207	18.9	0.04	0.17
2	Below 1st weir, upstream of confluence	5	Mainstem	9/20/1999	14:00	0.5	7.45	26.19	7.24	1152	37	699.8	264	1147	12	222	19.3	0.03	0.18
3	Located at Hwy 135 bridge	12.7	Mainstem	9/21/1999	8:10	1	7.75	25.6	7.75	1214	35	1400.2	277	1207	11	236	62	0.04	0.17
4	Located at Kline Road bridge	22.8	Mainstem	9/21/1999	9:00	1	7.62	24.74	8.75	834	11	494.1	242	826	12	118	23.3	0.04	0.15
5	Located at Hwy 132 bridge NE of Mangham	30.2	Mainstem	9/21/1999	9:30	1	7.59	24.66	7.69	854	20	504	241	850	12	123	42.5	0.04	0.15
6	Big Creek at Hwy 856 bridge	40	Mainstem	9/21/1999	8:35	1	7.64	25.23	7.18	689	27	404.1	226	684	15	80.4	33.7	0.04	0.12
7	Big Creek @ weir downstream of Burke Road	49.9	Mainstem	9/21/1999	9:20	1	7.93	24.94	6.97	590	35	370	213	581	14	52.8	35.9	0.04	0.15
8	Big Creek below weir 6	58.9	Mainstem	9/20/1999	15:45	1	7.72	25.28	7.32	658	37	414	221	687	20	88.2	32	0.04	0.19
9	Big Creek at Hwy 854 bridge (Burn Rd.)	70.7	Mainstem	9/21/1999	12:35	1	7.34	24.06	7.47	401	48	262	157	403	12	31.4	25.4	0.03	0.16
10	Big Creek @ Mitchner Rd. downstream of b	80.5	Mainstem	9/21/1999	11:01	1	8.05	22.65	5.56	310	44	202	96.8	571	30	38.6	15.7	0.04	0.27
11	Big Creek @ Wade Road on upstream side	89.7	Mainstem	9/21/1999	10:00	1	8	23.61	3.5	318	84	192.1	101	318	27	38.6	15.8	0.04	0.26
12	Located at Hwy 588 on upstream side	106.8	Mainstem	9/21/1999	10:10	1	9.52	21.16	4.49	646	6	410	173	663	22	125	21.6	0.05	0.15
13	Located at Hwy 2 on upstream side of bridge	116	Mainstem	9/20/1999	17:10	1	7.79	24.18	6.08	892	30	342.1	268	872	20	145	10.5	0.03	0.13
14	Located at Hwy 587 on upstream side of bridge	126	Mainstem	9/21/1999	9:30	surface	7.63	19.74	3.61	1093	12	616.7	336	1106	25	190	21.5	0.09	0.14
15	Located at Hwy 879 on downstream side	132	Mainstem	9/21/1999	8:55	1	7.99	22.35	5.24	913	168	383	324	899	25	128	14.7	0.04	0.23
16	Boeuf River, upstream of the confluence	0	Boeuf R.	9/20/1999	15:20	1	8.27	30.05	9.82	519	164	336	118	499	25	91.9	5.5	0.03	0.19
18	Located on Big Creek Road downstream	21.2	Trib	9/21/1999	12:00	mid	7.44	20.8	9.43	948	12	493.1	300	951	12	127	7.2	0.08	0.15
19	Town of Mangham Sewage Pond	30.8	Discharge	9/20/1999	15:30	near	7.7	26.51	5.05	609	8	402	175	604	45	44.6	11.2	0.85	1.79
20	Bee Bayou at Minnow Farm Road off of Hwy	32.2	Trib	9/21/1999	13:00	0.5	7.8	21.52	11	487	4	256	202	480	12	29.4	12.3	0.06	0.14
Average for sites 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15							7.87	24.1	6.46	751.07	41.73	489.20	226.39	793.73	17.93	121.60	26.19	0.04	0.17

Mainstem - Big Creek
Tributaries or discharger

Water quality insitu and lab data from the

Site #	Site Description	TKN (mg/l)	Est. UNBOD (mg/l)	Est. NBOD decay rate (1/day)	TKN, duplicate (mg/l)	TOC (mg/l)	Est. UCBOD (mg/l)	Est. CBOD decay rate (1/day)	NH3-N (mg/l)	Sodium (mg/l)	Corrected Chlorophyll a (ug/l)
1	Upstream of confluence with Bouef River	0.25	0.43	0.14	0.34	3.1	6.95	0.08	0.1	138.6	22.03
2	Below 1st weir, upstream of confluence	0.43	0.74	0.17		2.9	6.85	0.08	0.1	144.3	19.15
3	Located at Hwy 135 bridge	0.35	0.60	0.15		3	6.90	0.08	0.1	85.2	16.47
4	Located at Kline Road bridge	0.2	0.34	0.13		3.9	7.39	0.07	0.1	85.2	13.13
5	Located at Hwy 132 bridge NE of Mangham	0.22	0.38	0.13		3.8	7.33	0.07	0.1	79.6	19.14
6	Big Creek at Hwy 856 bridge	0.42	0.72	0.16		4.6	7.79	0.07	0.1	50.7	17.01
7	Big Creek @ weir downstream of Burke Road	0.37	0.64	0.16		4.3	7.62	0.07	0.1	36	10.57
8	Big Creek below weir 6	0.57	0.98	0.19		3.8	7.33	0.07	0.1	50.8	34.12
9	Big Creek at Hwy 854 bridge (Burn Rd.)	0.66	1.14	0.21		4.5	7.73	0.07	0.1	19.6	11.94
10	Big Creek @ Mitchner Rd. downstream of b	0.92	1.58	0.27		6.3	8.87	0.06	0.1	20.2	8.16
11	Big Creek @ Wade Road on upstream side	1.39	2.39	0.43		5.9	8.60	0.06	0.11	20.6	28.48
12	Located at Hwy 588 on upstream side	0.68	1.17	0.21		7.5	9.71	0.05	0.11	60	4.97
13	Located at Hwy 2 on upstream side of bridge	0.81	1.39	0.24		6	8.67	0.06	0.12	70.3	20.69
14	Located at Hwy 587 on upstream side of bridge	0.86	1.48	0.25	0.86	2.1	6.44	0.10	0.11	93.7	12.16
15	Located at Hwy 879 on downstream side	1.98	3.41	0.78		6.3	8.87	0.06	0.12	65.5	53.69
16	Boeuf River, upstream of the confluence	1.44	2.48	0.45		8.3	10.32	0.05	0.1	51.7	46.41
18	Located on Big Creek Road downstream	0.27	0.46	0.14		2	6.40	0.10	0.1	85.4	2.15
19	Town of Mangham Sewage Pond	6.79	11.69	95.60		15.7	18.12	0.04	5.4	48.2	58.05
20	Bee Bayou at Minnow Farm Road off of Hwy	0.04	0.07	0.11		2.7	6.74	0.09	0.1	24.5	2.3
Average for sites 1,2,3,4,5,6,7,8,9,10,11,12,13,		0.67	1.16	0.24	0.60	4.53	7.80	0.07	0.10	68.02	19.45

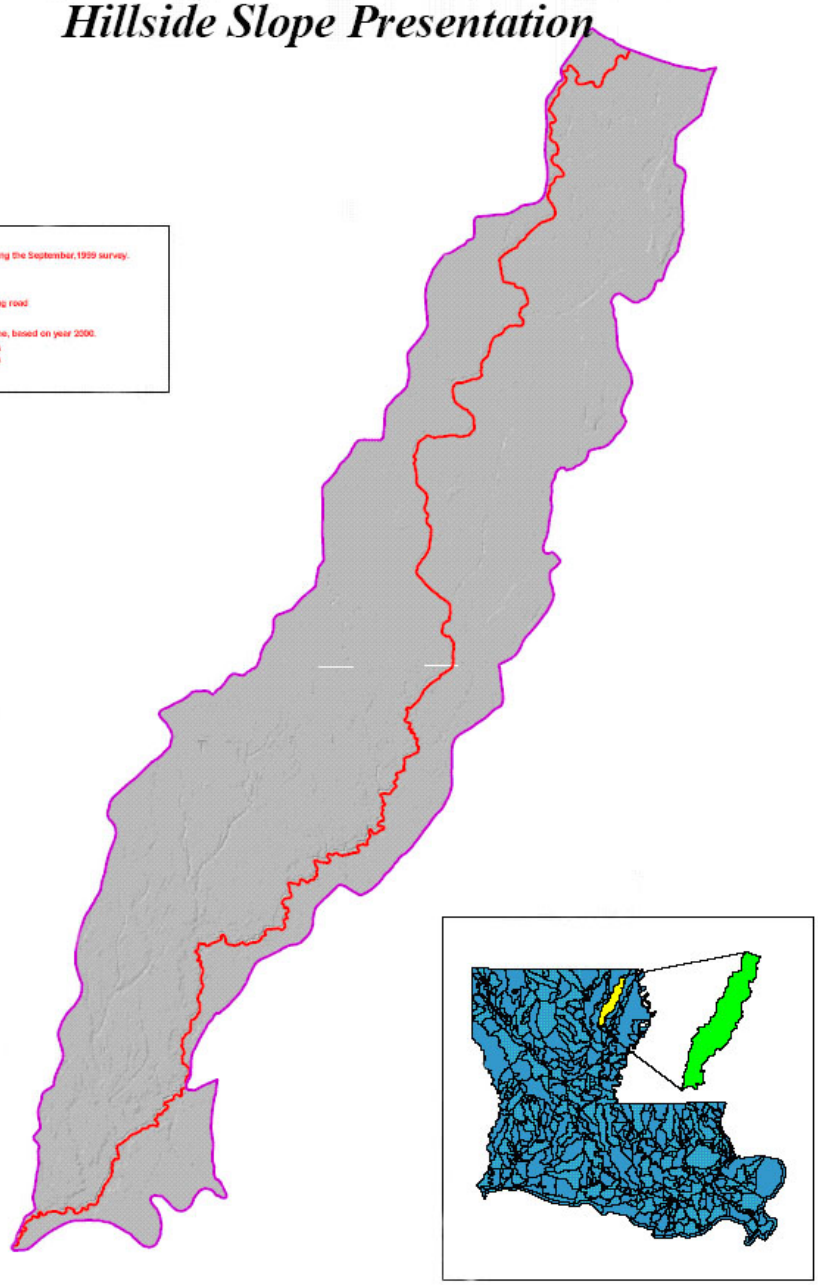
Mainstem - Big Creek
Tributaries or discharger

0.28	:Average of sites 10-14
0.16	:Average of sites 1-9

Appendix C

Maps and Diagrams

Big Creek, Subsegment 080903, Ouachita Basin
Hillside Slope Presentation



Environmental Technology Division
Map No. 200103007, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations
Hillside view generated from the National Elevation Dataset.
Projection: UTM Zone 15 NAD 1983

LDEQ Disclaimer:
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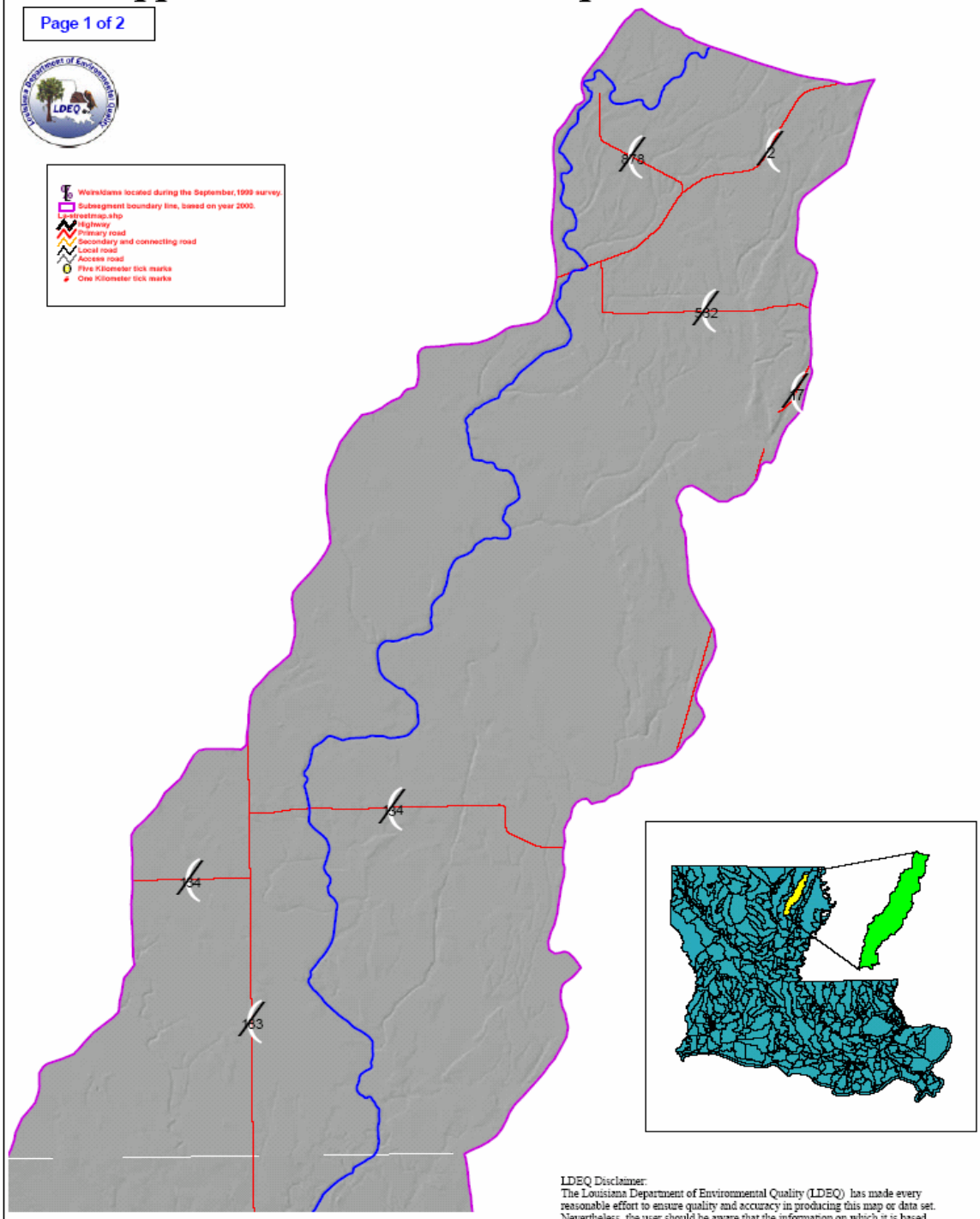
10 0 10 20 Miles

N W E S

Big Creek, Subsegment 080903, Ouachita Basin, Upper section, Hillside Slope Presentation



Environmental Technology Division
Map No. 200103007, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations
Hillside view generated from the National Elevation Dataset.
Projection: UTM Zone 15 NAD 1983

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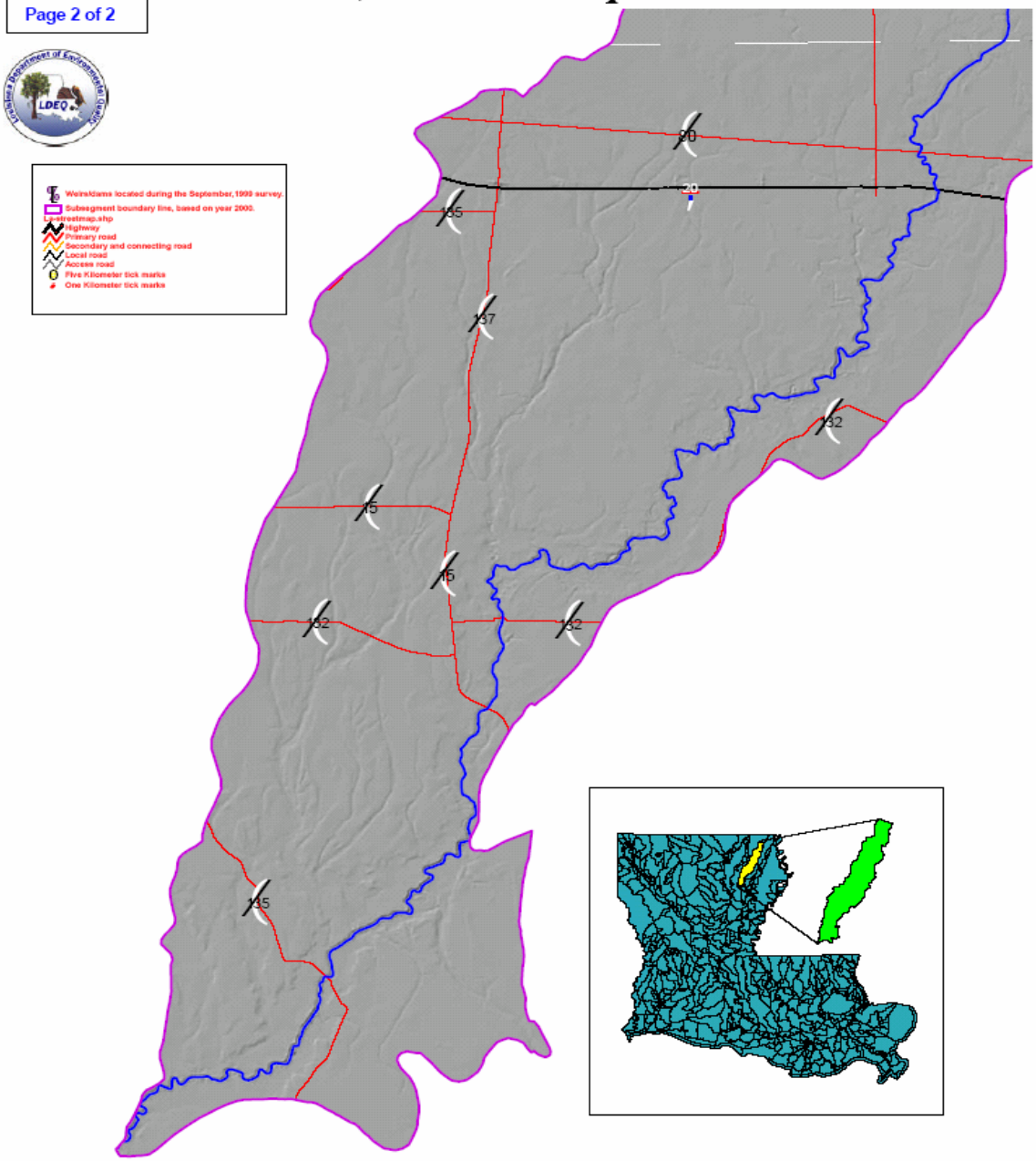
2 0 2 4 6 8 10 12 Miles

N W E S

Big Creek, Subsegment 080903, Ouachita Basin, Lower sections, Hillside Slope Presentation



Environmental Technology Division
Map No. 200103008, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations
Hillside view generated from the National Elevation Dataset.
Projection: UTM Zone 15 NAD 1983

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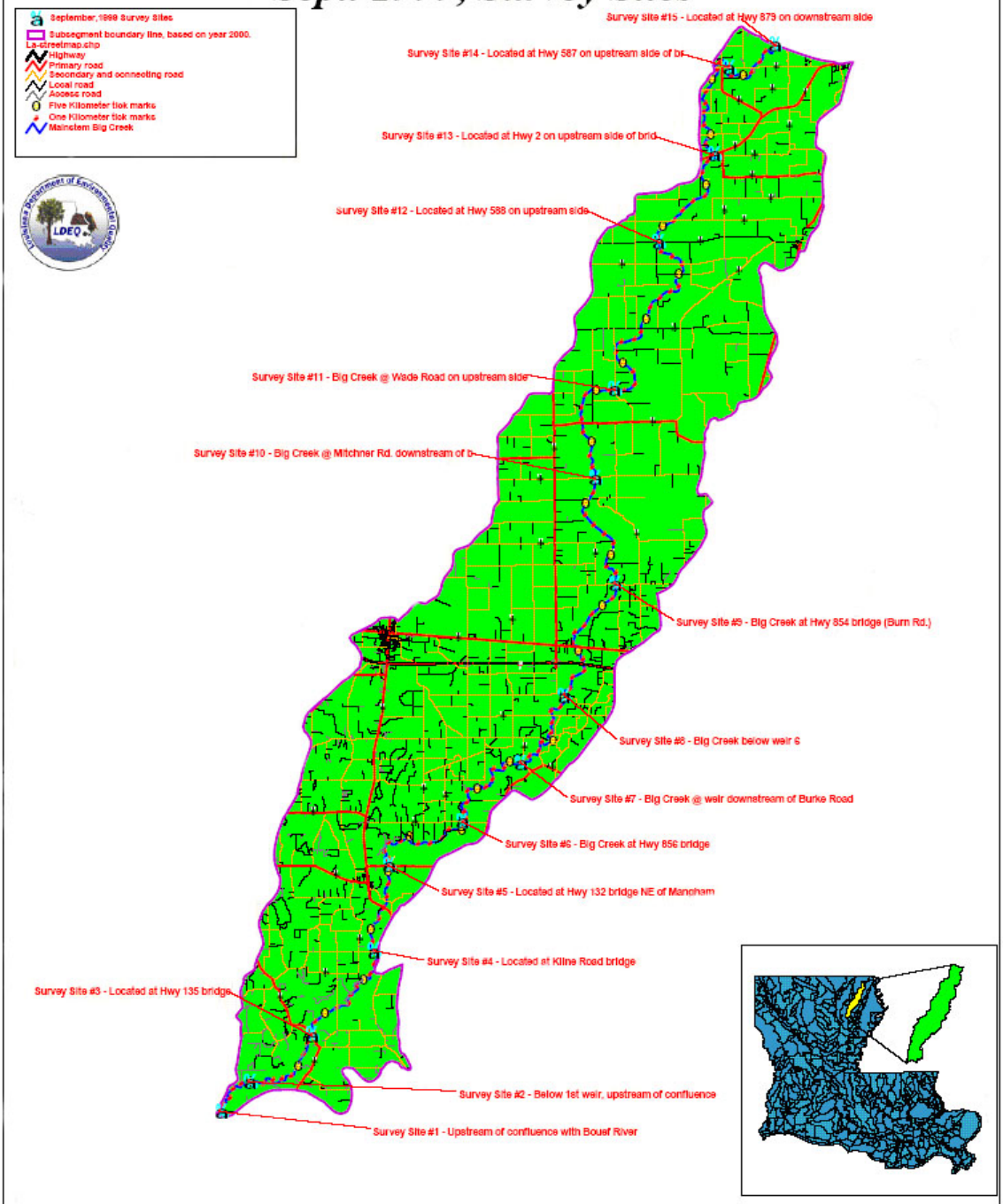
2 0 2 4 6 8 10 12 Miles

N W E S

Big Creek, Subsegment 080903, Ouachita Basin
Sept. 1999, Survey Sites



Environmental Technology Division
Map No. 200103005, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations.
Roads based on ESRI's Streetmap software.
Sites determined by LDEQ personnel with GPS.
Projection: UTM Zone 15 NAD 1927

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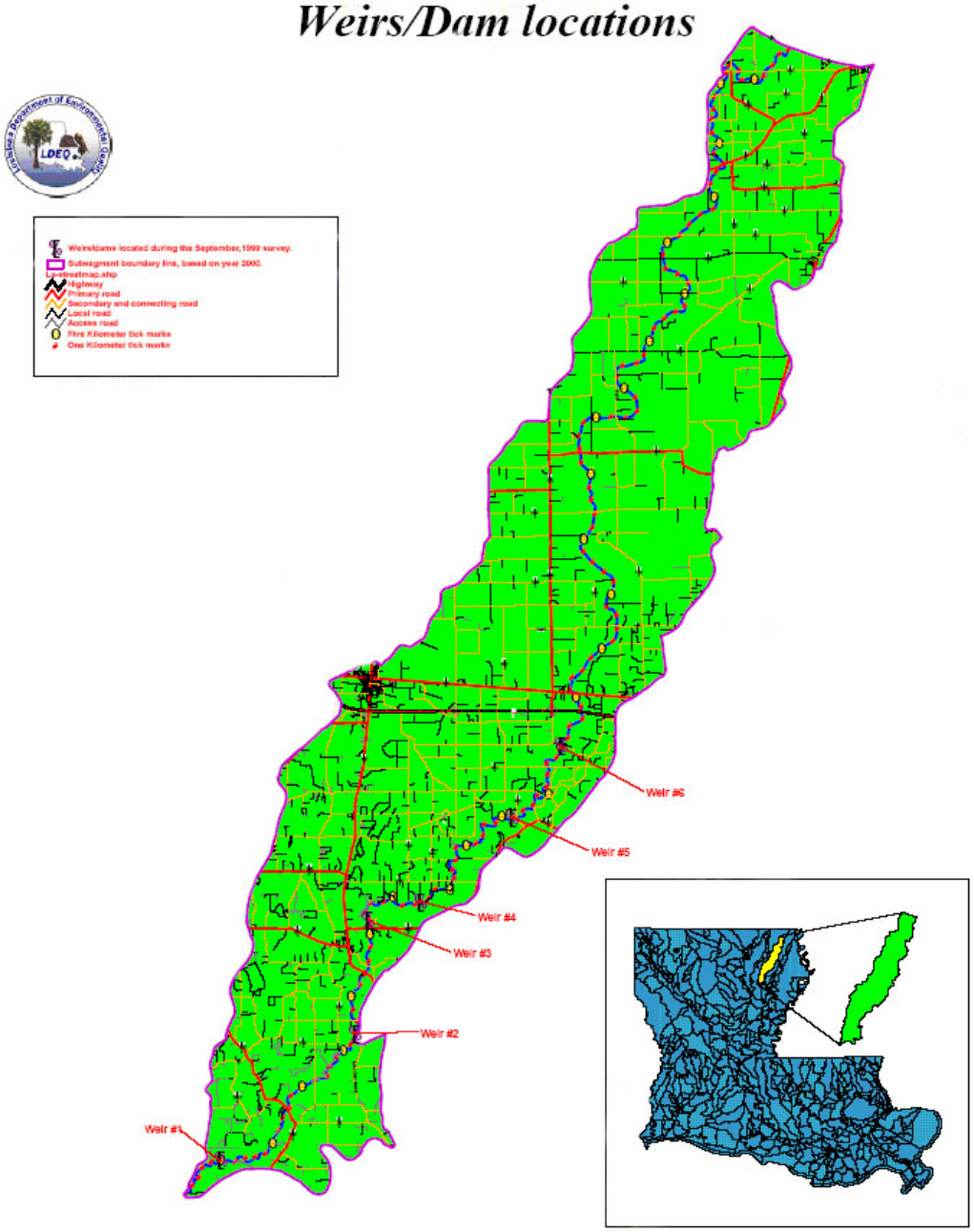
10 0 10 20 Miles

N W E S

Big Creek, Subsegment 080903, Ouachita Basin
Weirs/Dam locations



Environmental Technology Division
Map No. 200103004, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations
Roads based on ESRI's streetmap software.
Weir locations determined by LDEQ personnel.
Projection: UTM Zone 15 NAD 1927

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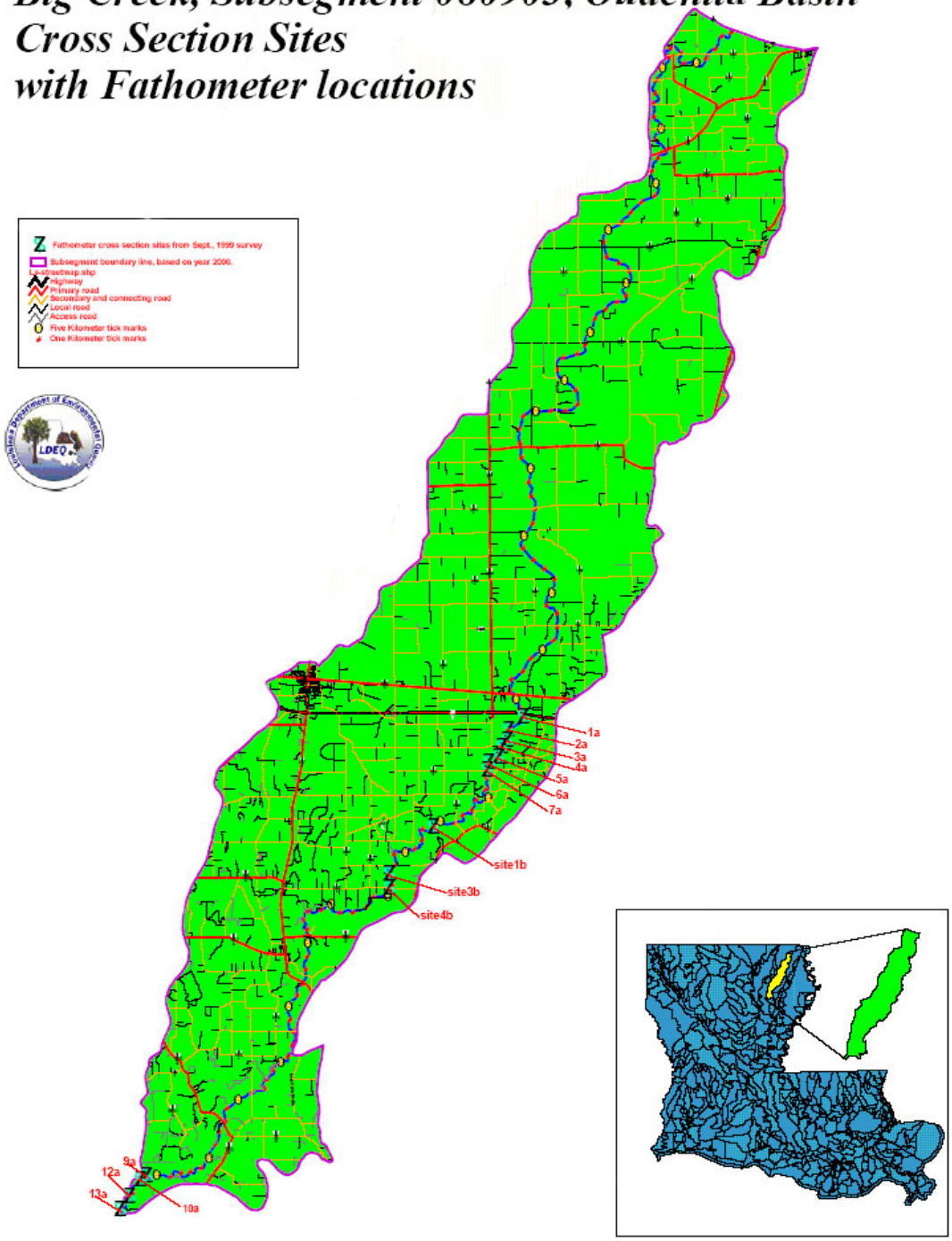
10 0 10 20 Miles

N W E S

Big Creek, Subsegment 080903, Ouachita Basin
Cross Section Sites
with Fathometer locations



Environmental Technology Division
Map No. 200103006, April 2001
Base Map: Basin Subsegment lines are from LDEQ's 2000 determinations
Roads based on ESRI's Streetmap software.
Cross Section locations determined by LDEQ personnel with GPS equipment.
Projection: UTM Zone 15 NAD 1927

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10 0 10 20 Miles

N W E S