Castor Creek Watershed
Segment 081501

Louisiana Department of Environmental Quality

Watershed Implementation Plan

Dissolved Oxygen
and
Chlorides and Salinity/Total Dissolved Solids

Nonpoint Source Unit

EXECUTIVE SUMMARY

Castor Creek Watershed (sub-segment 081501), located in the Ouachita River Basin, was listed on the Court Ordered 303(d) List as not supporting the designated use for propagation of fish and wildlife as a result of elevated levels of chlorides and total dissolved solids (TDS) and low dissolved oxygen.

The total maximum daily load (TMDL) for Castor Creek indicated that there would need to be a 75% reduction in oxygen demanding substances in order to meet the water quality standard for dissolved oxygen. There would also need to be a 38.6% reduction of total chlorides, and a 47.1% reduction of TDS. These reductions will require a concerted effort by residents, foresters, the oil industry, and all levels of government.

The oil industry was listed in the TDS/chlorides TMDL as being a likely contributor to high levels of TDS and chlorides in Castor Creek. However, it was noted that "little information is available which can be used to quantify a cause and effect relationship between observed saline flows and the identified sources." The amount of chloride and TDS that is entering Castor Creek from improperly plugged wells, abandoned brine pits, rainfall runoff transporting pollutants to surface waters, and groundwater migration through abandoned or improperly cased oil wells needs to be quantified. Once the primary sources are identified, actions should be taken to reduce the contribution from those sources, if possible.

Forestry is the primary land use in Castor Creek Watershed. Since improper forestry techniques and practices have the potential to contribute nonpoint source water pollution to Castor Creek, ensuring that forestry BMPs are utilized is essential to improving water quality. Additionally, evaluating and minimizing the effects of both private and parish roads on water quality could likely help reduce pollutant loading in Castor Creek Watershed.

The areas along Castor Creek and some of the larger tributaries within sub-segment 081501, such as Beech Creek, Big Chickasaw Creek, and Black Bayou, have elevated erosion rates based on AnnAGNPS model results; therefore, BMP implementation in these areas should be a priority. With the proximity of the elevated soil erosion areas to the water bodies, maintaining a riparian zone along these areas could be crucial to restoring water quality in Castor Creek to levels that support its designated uses.

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*.

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1.0 INTRODUCTION

Nonpoint source pollution is a diffuse source of water pollution that flows across land, often 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*.

Section 319 of the Clean Water Act authorizes the United States Environmental Protection Agency (USEPA) 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 water bodies included in the 303(d) List of Impaired Waters. A water body is entered into the 303(d) list when it fails to meet the water quality standard 10% of the time during an assessment period. Castor Creek Watershed (sub-segment 081501) was found to not be meeting its designated use of Fish and Wildlife Propagation due to elevated levels of chlorides and total dissolved solids (TDS) and low dissolved oxygen (ambient sampling data). Total Maximum Daily Loads (TMDL) for both TDS and oxygen-demand pollutants have been developed. The purpose of this report is to outline a plan, which can be implemented to reduce the amount of nonpoint source pollution entering Castor Creek and thereby increase water quality to a level where the waterbody fully meets its designated uses.

1.1 ECOREGION DESCRIPTION

Ecoregions, which are areas of distinct biological and physical characteristics, separate different patterns of human stresses on the environment and different patterns in the existing and attainable quality of environmental resources. Ecoregions have proven to be an effective aid for inventorying and assessing national and regional environmental resources, for setting regional resource management goals, and for developing biological criteria and water quality standards.

Castor Creek Watershed is in the South Central Plains Ecoregion (Figure 1). This ecoregion, located in northwestern Louisiana, is bisected by the Red River Alluvial Ecoregion. The South Central Plains ecoregion also overlaps eastern Texas and southwest Arkansas. The easternmost boundary of this ecoregion extends to the boundary of the Coastal Plain and Red River Alluvium soil associations near the Ouachita River. The southern extent of this ecoregion, located west of the Red River Alluvial Plain Ecoregion, is formed by the boundary between the Coastal Plain and Gulf Coast Flatwoods soil associations. The South Central Plains ecoregion is characterized by maximum elevations and relief and longleaf and shortleaf vegetation types.

Castor Creek Watershed is also a part of the Hills Natural Region as designated by Kniffen and Hilliard (1988). The Hills Natural Region includes longleaf pine forests, maximum elevations and relief, dendritic and trellis drainage, interior salt domes, wolds

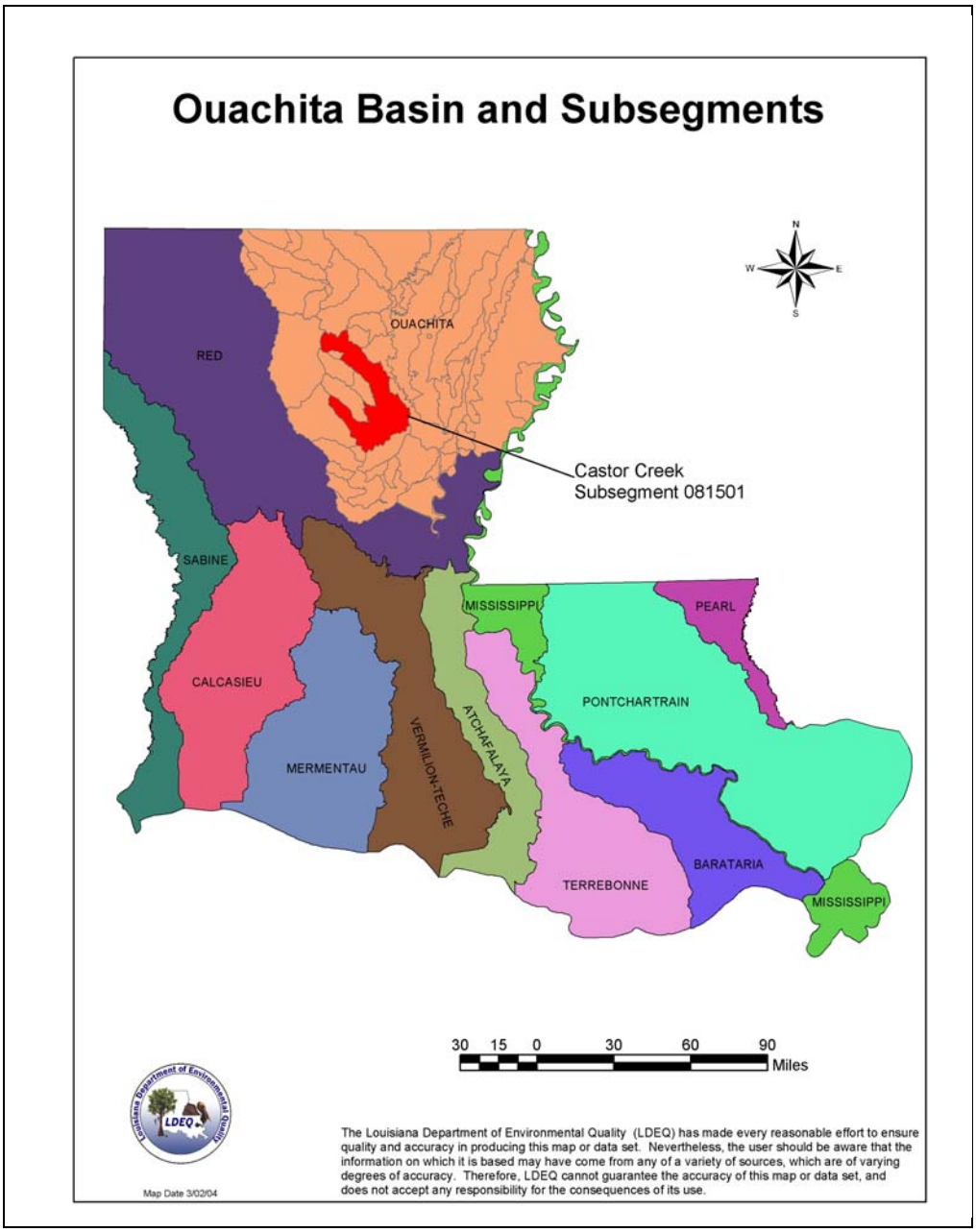
or cuestas (hard sedimentary rock), ironstone, excellent surface and groundwater resources, mature soils, and the oldest rocks in the state. The soil types consist of coastal plain soils and flatwoods soils. Vegetation exists as longleaf pine forests (longleaf pines, slash pines, some hardwoods) and bottomland hardwoods (cottonwood, sycamore, willow, water oaks, gum, maple, and loblolly pine) (Kniffen and Hilliard, 1988).

Figure 1. Map of Louisiana Ecoregions

1.2 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 Basin covers over 10,000 square miles of drainage area (Figure 2). Most of the basin consists of rich, alluvial plains cultivated in cotton and soybeans. The northwest corner of the basin is forested in pine, which is commercially harvested (LDEQ, 1996).

Figure 2. Location of Louisiana River Basins and Castor Creek Watershed



1.3 CASTOR CREEK WATERSHED, SUB-SEGMENT 081501

Image 1. Castor Creek between LA Highway 126 and US Highway 84

The headwaters of Castor Creek Watershed, Sub-segment 081501 of the Ouachita River Basin, originate in north Jackson Parish, Louisiana, west of Highway 146 (Figure 3). Sub-segment 081501 is comprised of the Castor Creek main stem from its headwaters to its confluence with the Dugdemona River and the Little River. There are more than thirty-six tributaries in Castor Creek Watershed. The two major tributaries, Flat Creek (Sub-segment 081504) and Beaucoup Creek (Sub-segment 081503), were included in the TMDL for chlorides and salinity/total dissolved solids (TDS), but not for oxygen-demand substances.

Figure 3. Digital Orthophoto Quarter Quadrangle map of Castor Creek Watershed

1.4 FIELD SURVEY OF THE CASTOR CREEK WATERSHED

Image 2. Castor Creek near 7 Runs Crossing

A site visit to Castor Creek Watershed was conducted in March of 2004 in an attempt to identify primary sources of nonpoint source pollution. At the time of the site visit, Castor Creek appeared to be at a normal flow level. Beaver dams and log jams below bridges appeared to be restricting the flow of water in the headwaters and upper reaches of Castor Creek. The most extreme example was found at a highway crossing near Chatham where pooling was observed on one side of the road (image 3), while the other side looked like a relatively dry marsh with only the stream channel still holding water (image 4).

A large drainage structure was also found that passes water beneath Highway 124 (image 5). Upstream of this structure, Castor Creek resembles a lake. After passing through this structure, Castor Creek flows on towards the confluence with the Dugdemona River. The effects of this structure on water quality are unknown.

Image 3. A pool of water caused by a beaver dam at a highway crossing

Image 4. Across the road and downstream of the pool in image 3

Image 5. Large drainage structure on Castor Creek passing water under Highway 124

2.0 WATER QUALITY ANALYSIS

A water quality standard is a definite numerical criterion value, general criterion statement, or policy statement promulgated to enhance or maintain water quality and to provide for, and fully protect, the designated uses of a waterbody (LDEQ, 2003). The designated uses for Castor Creek include Primary Contact Recreation, Secondary Contact Recreation, and Propagation of Fish and Wildlife. Numeric Criteria for Castor Creek are listed in Table 1.

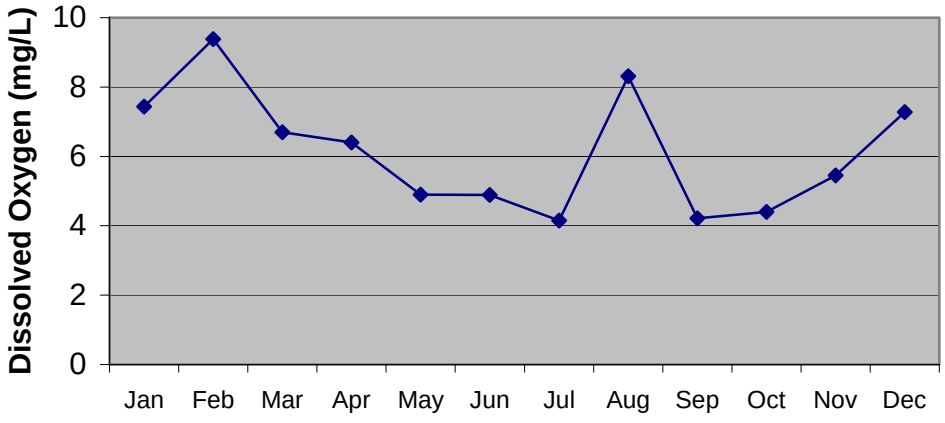
Table 1. Numerical Criteria for Castor Creek (LDEQ, 2003)

Water Quality Parameter	Numerical Criteria
Chlorides, mg/L	25
Sulfates, mg/L	25
pH	6.0 - 8.5
Bacteria concentration (log mean/100 ml)	200 May 1 – Oct. 31 1,000 Nov. 1 - April 30
Temperature, deg Centigrade	32
TDS, mg/L	100
Dissolved Oxygen, mg/L	5.0

2.1 WATER QUALITY TEST RESULTS FROM CASTOR CREEK

Water quality samples were collected and analyzed from LDEQ's statewide ambient water quality monitoring site number 0079 on Castor Creek near Tullos, LA in 1999. The water quality data indicated that dissolved oxygen (DO) levels were below the 5 mg/L standard five out of the twelve months in 1999 (Figure 4). Lower DO levels during the summer months can be expected as water temperature and DO levels tend to be inversely correlated. The DO spike in August was not consistent with the historical data and may have been the result of a rainfall event.

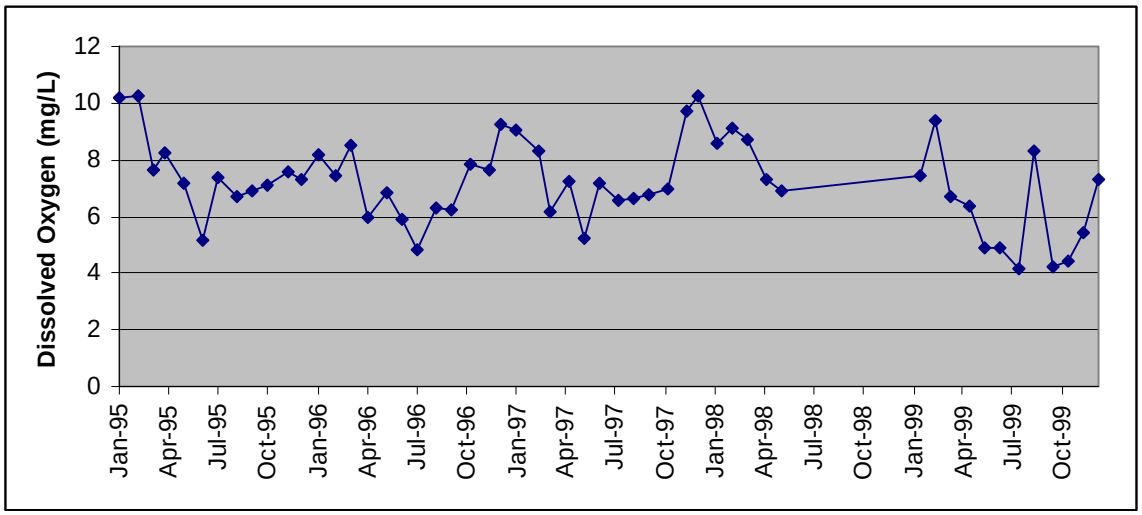
Figure 4. Seasonal Variations of DO in Castor Creek Watershed for the year 1999



The drought conditions during 1999 may have contributed to uncharacteristically low DO levels for Castor Creek. With the exception of one missed data point in November of 1994, dissolved oxygen measurements were taken monthly at site 0079 in Castor Creek from January of 1991 through May of 1998. During that time period, DO levels were below 5.0 mg/L only three times. The DO level dropped below the 5.0 mg/L standard

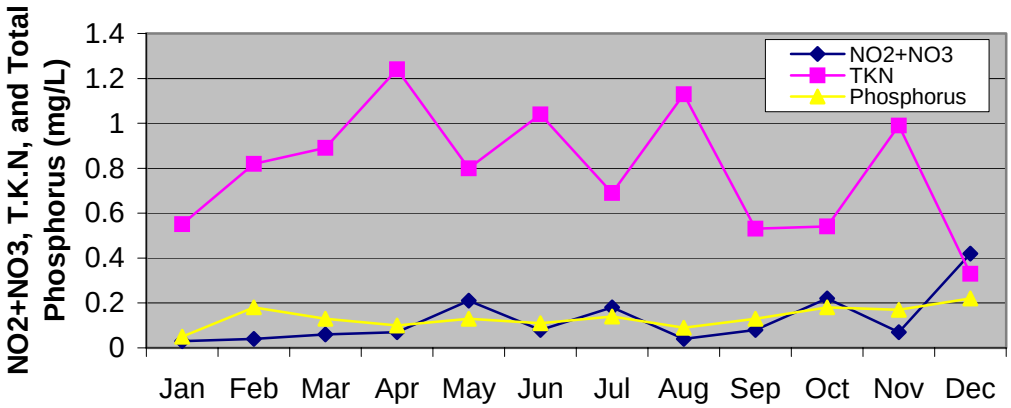
only one time between January of 1995 and May of 1998. In 1999, the standard was not met five times (Figure 5).

Figure 5. Seasonal variations of DO in Castor Creek Watershed from 1995-1999



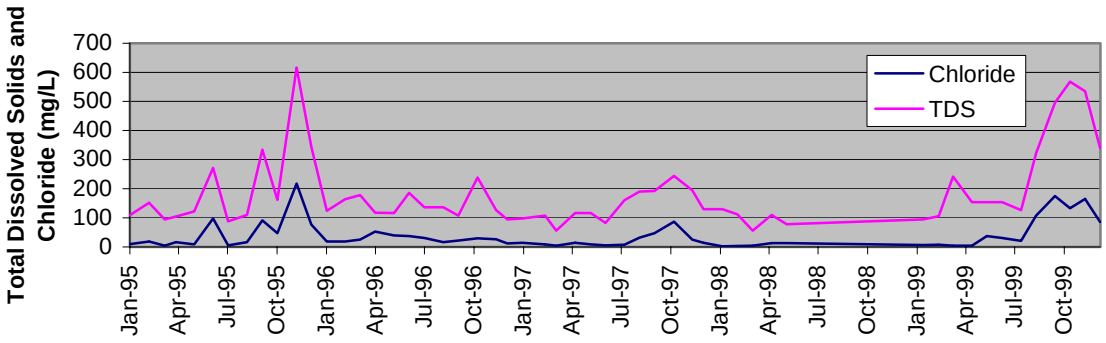
Although nutrient levels do not presently have numeric criteria, nutrient level trends can provide clues as to potential sources of pollution. However, no discernable trends were determined in Castor Creek Watershed (Figure 6).

Figure 6. Seasonal Variations of Nutrients in Castor Creek Watershed for the year 1999



Total Dissolved Solids in Castor Creek Watershed surpassed the 100 mg/L standard in every month of 1999 except January (Figure 7). When looking at the 5 year period from 1995 through 1999, the average TDS concentration was 189 mg/L and the average chloride concentration was 40.70 mg/L. Peaks in both TDS and chloride appear to correspond with low flow periods that tend to occur during October in Castor Creek.

Figure 7. Seasonal Variations of Total Dissolved Solids and Turbidity in Castor Creek Watershed from January 1995 – December 1999



3.0 TMDL FINDINGS AND RECOMMENDATIONS

Total Maximum Daily Loads (TMDLs), are the maximum amount of a pollutant that can be discharged into a waterbody without causing the waterbody to become impaired and/or violate state water quality standards. TMDLs are the sum of the individual Waste load Allocations (WLAs) for point sources, Load Allocations (LAs) for nonpoint and natural background sources, and a Margin of Safety (MOS). The margin of safety is 20% for point sources and 10% for nonpoint sources.

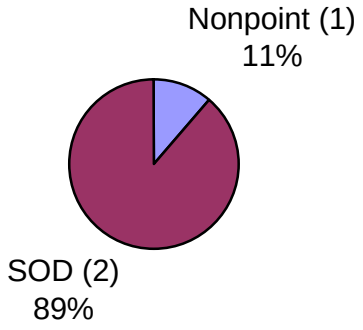
$$\text{TMDL Allocation} = \text{WLA} + \text{LA} + \text{MOS}$$

Castor Creek was scheduled for TMDL development because it didn't meet water quality criteria for fish and wildlife propagation. The suspected causes of impairment in sub-segment 081501 were organic enrichment/low DO and salinity/TDS/chlorides. High salinity, TDS, and chloride levels are suspected to be the result of historic discharges of oilfield produced water. The suspected source of organic enrichment/low DO is listed as unknown.

3.1 TMDL FOR BIOLOGICAL OXYGEN-DEMAND SUBSTANCES

The DO standard for sub-segment 081501 is 5.0 mg/L. LA-QUAL model runs have determined that the TMDL required to maintain the DO standard is 6,026 lbs/day of BOD loading during the summer months (May-Oct.) and 3,098 lbs/day of BOD loading in the winter months (Nov.–April). To meet the TMDL requirements, a 75% reduction of both naturally occurring and man made loading from sources other than point source dischargers is required.

Figure 8. TMDL Load Distribution of Oxygen Demanding Substances for Castor Creek Watershed. (1) Nonpoint load is the material suspended in the water column. (2) Sediment oxygen demand (SOD) is the benthic load that resides on the stream bottom.



The largest percentage of the load in Castor Creek is the sediment oxygen demand (SOD). The nonpoint load represents the second largest percentage of the load (Figure 8). Together, the SOD and nonpoint loads represent the benthic load portion of the TMDL. The loading from headwaters and tributaries, incremental loads, and waste loads are each less than 1% of the total load as calculated for the *Castor Creek Watershed TMDL for Biological Oxygen-Demand Substances.*

A reduction in nonpoint source water pollution entering Castor Creek and its headwaters and tributaries will reduce both the SOD and nonpoint loads as required by the TMDL. Sediment oxygen demand is comprised of oxygen demanding substances, such as organic matter and chemicals attached to soil particles, which enter the main channel of Castor Creek and settle to the bottom of the stream bed. The nonpoint load, as described in the TMDL, only refers to the portion of the oxygen demanding substances that enter the main stem of Castor Creek and are suspended, or resuspended, in the water column. The nonpoint load represents only a portion of the nonpoint source pollution that enters Castor Creek and its tributaries. Reducing the amount of oxygen demanding substances that enter Castor Creek by 75% will result in a decreased nonpoint load in the water column and a decreased SOD load in the stream bed that should allow for the standard to be maintained.

For modeling purposes, Castor Creek Watershed was divided into 36 reaches (Table 2). The load distribution by reach (Figure 9) does not indicate that any particular reach contributed a disproportionate amount of the total load. The partitioned BOD load (Figure 10) does indicate that some reaches have a higher SOD load per river kilometer than other reaches. This does not necessarily indicate these reaches contribute more of the load, but may indicate where it is settling or accumulating.

Figure 9. Calibration Model Total Benthic Load by Reach

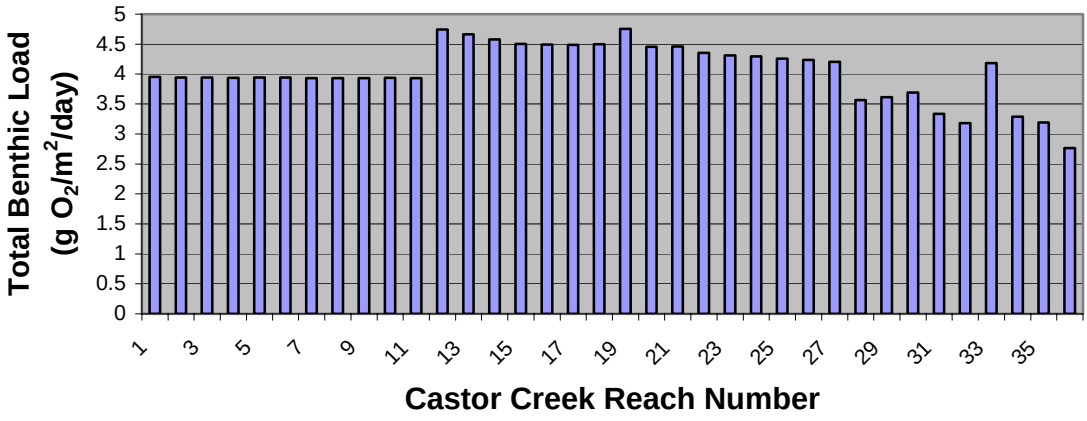
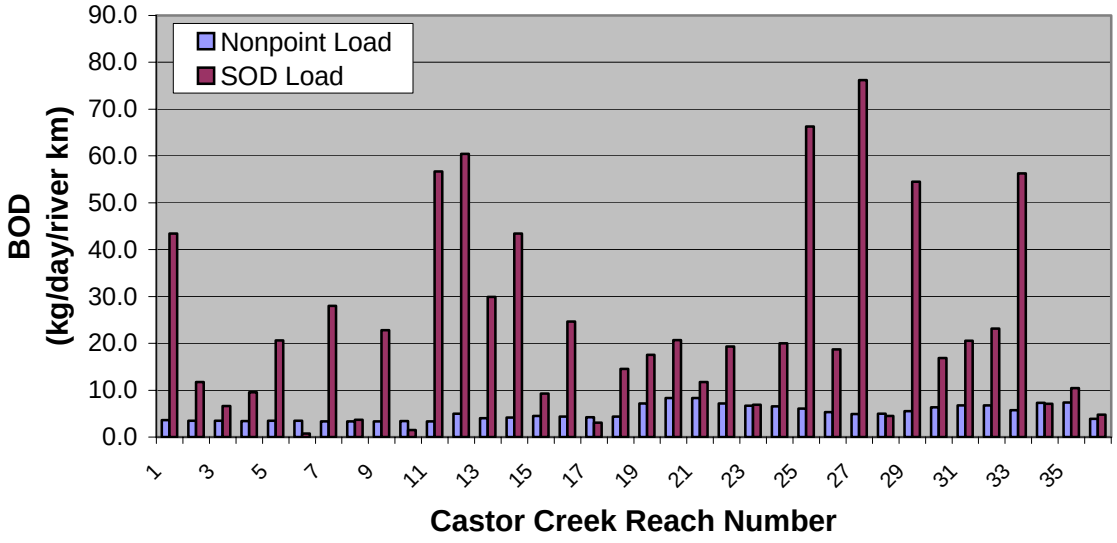


Table 2. Calibration model reach descriptions.

Reach Number	Description	Calibration Model Reach Length (km)	Calibration Model Average Reach Width (meters)	Ending River Kilometer of the Reach
1	Headwater to McDowell Branch	5.90	11.90	147.100
2	McDowell Branch to Horse Creek	1.6	11.9	145.500
3	Horse Creek to Guice Branch	0.9	11.9	144.600
4	Guice Branch to Curr Creek	1.3	11.9	143.300
5	Curr Creek to Poplar Branch	2.8	11.9	140.500
6	Poplar Branch to White Branch	0.1	11.9	140.400
7	White Branch to Colston Creek	3.8	11.9	136.600
8	Colston Creek to Fourmile Creek	0.5	11.9	136.100
9	Fourmile Creek to Pool Branch	3.1	11.9	133.000
10	Pool Branch to Ginney Branch	0.2	11.9	132.800
11	Ginney Branch to Edwards Branch	7.7	11.9	125.100
12	Edwards Branch to Little Flat Creek	7.4	11.2	117.700
13	Little Flat Creek to Glade Creek	3.7	11.1	114.000
14	Glade Creek to Cub Creek	5.5	11.1	108.500
15	Cub Creek to Cow Creek	1.2	11.1	107.300
16	Cow Creek to Bear Creek Branch	3.2	11.1	104.100
17	Bear Creek Branch to Biles Branch	0.4	11	103.700
18	Biles Branch to Hurricane Creek	1.9	11	101.800
19	Hurricane Creek to Indian Branch	2.3	11	99.500
20	Indian Branch to Moody Creek	3	11	96.500
21	Moody Creek to Bull Creek	1.7	11	94.800
22	Bull Creek to Sweetwater Creek	2.8	11	92.000
23	Sweetwater Creek to Brushy Creek	1	11	91.000
24	Brushy Creek to White Oak Creek	2.9	11	88.100
25	White Oak Creek to Bills Creek	9.7	10.9	78.400
26	Bills Creek to Lost Creek	2.7	10.9	75.700
27	Lost Creek to Messer Creek	11.1	10.8	64.600
28	Messer Creek to Richland Creek	0.8	10.8	63.800
29	Richland Creek to Piney Creek	9.6	10.8	54.200
30	Piney Creek to Beaucoup Creek	3	10.7	51.200
31	Beaucoup Creek to Banister Creek	4.2	10.7	47.000
32	Banister Creek to Brushy Creek2	5	10.7	42.000
33	Brushy Creek2 to McClellen BR	8.5	10.7	33.500
34	McClellen BR to Flat Creek	1.5	10.7	32.000
35	Flat Creek to Sandy Creek	2.3	10.7	29.700
36	Sandy Creek to HWY 124	1.1	10.7	28.600

Figure 10. Partitioned BOD load per river kilometer (kg/day/km) by reach in Castor Creek Watershed



3.2 TMDL FOR CHLORIDES AND SALINITY/TOTAL DISSOLVED SOLIDS

The TMDL for chloride and TDS in Castor Creek Watershed (sub-segment 081501) was prepared by PARSONS for the U.S. EPA. Since Flat Creek (sub-segment 081504) and Beaucoup Creek (sub-segment 081503) are major tributaries to Castor Creek, they were included in the TMDL assessment.

Nonpoint sources are estimated to contribute 99.4% and 97.9% of the chloride and TDS concentration at station 0079, respectively. The current loads for chloride and TDS are calculated at 13,055 and 60,623 lb/day, respectively at 59 cfs. The load reduction needed to meet the water quality standard for propagation of fish and wildlife in sub-segment 081501 at 59.51 cfs is 5,036 and 28,547 lb/day for chlorides and TDS respectively (38.6% and 47.1% reductions, respectively).

4.0 IDENTIFICATION OF HIGH PRIORITY AREAS

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 Nonpoint 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.

4.1 SOILS

Erosion of soil and transportation to water bodies 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 reduces 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 water bodies. 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 that are more susceptible to erosion. For this reason, this section of the plan examines the different soils in the Castor Creek Watershed (Figure 11) and their inherent erodibility. Erodibility of soils is a function of the properties of the soil and the slope.

4.2 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. K values in Castor Creek Watershed 0.17 to 0.49 (Figure 12).

Figure 11. Soils in Castor Creek Watershed

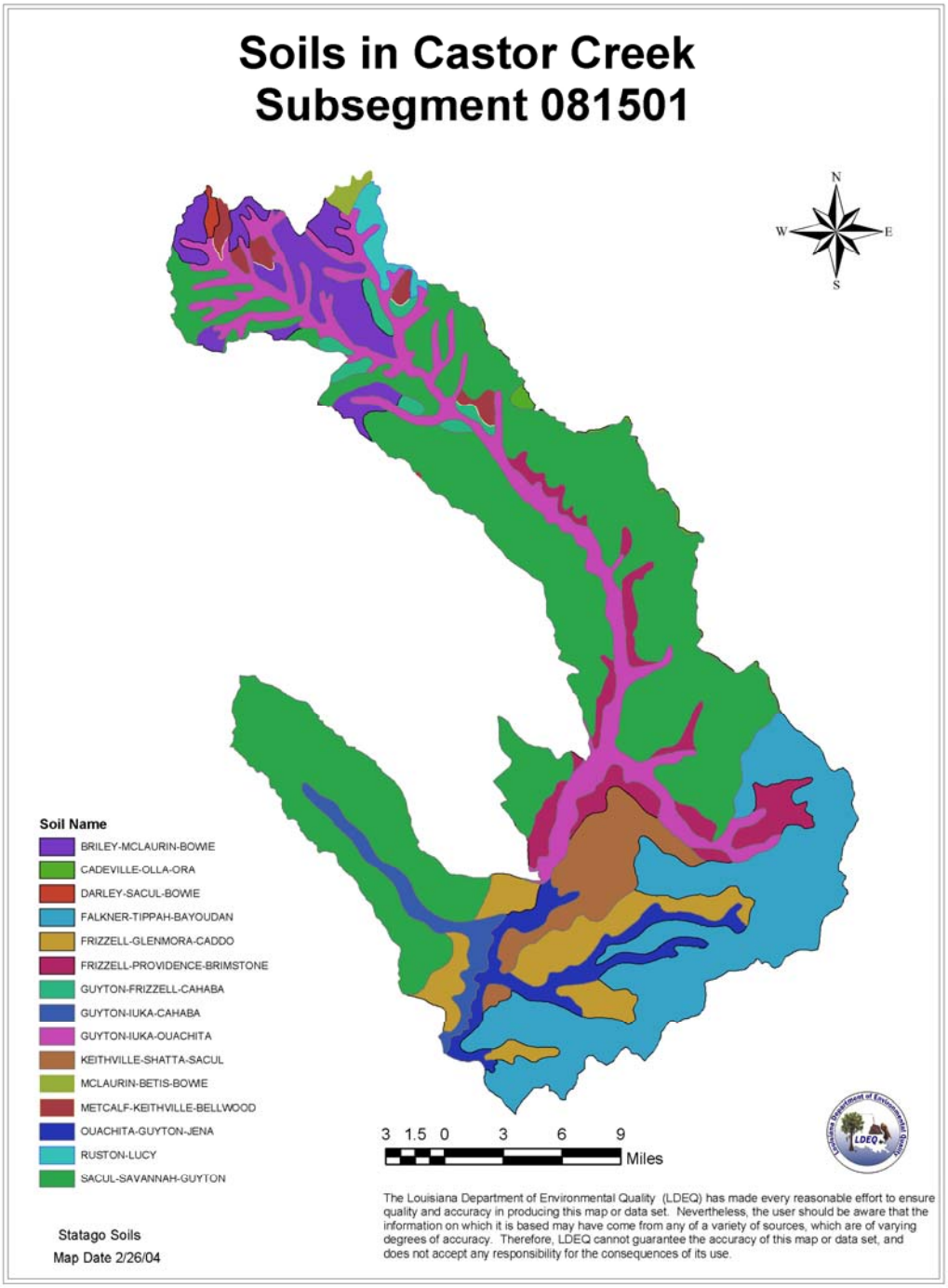
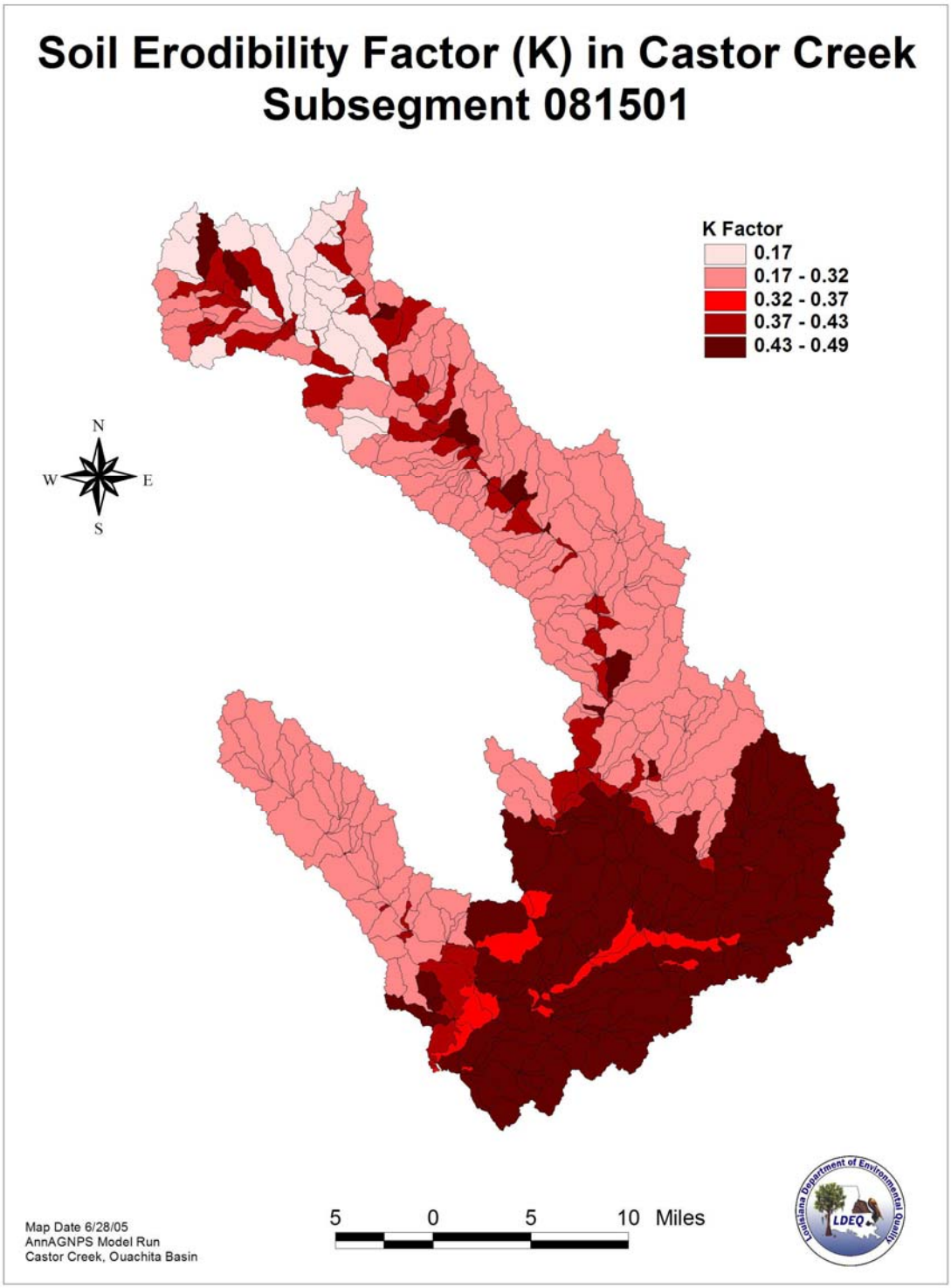


Figure 12. K factors in Castor Creek Watershed



4.3 LAND 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 factors in Castor Creek Watershed range from 0.027 to 6.314 (Figure 13).

4.4 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 than 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, sediment load, and sediment yield indicate where these activities are most likely to occur. AnnAGNPS defines sediment erosion as the amount of sediment that travels overland to the edge of the cell, sediment yield as the amount of sediment that is deposited into the stream network, and sediment load as the amount of sediment that travels through the stream network and out the outlet (Figure 14). Sediment erosion (Figure 15), sediment yield (Figure 16), and sediment load (Figure 17) are reported in tons of sediment/acre/year.

Figure 13. LS Factors in Castor Creek Watershed

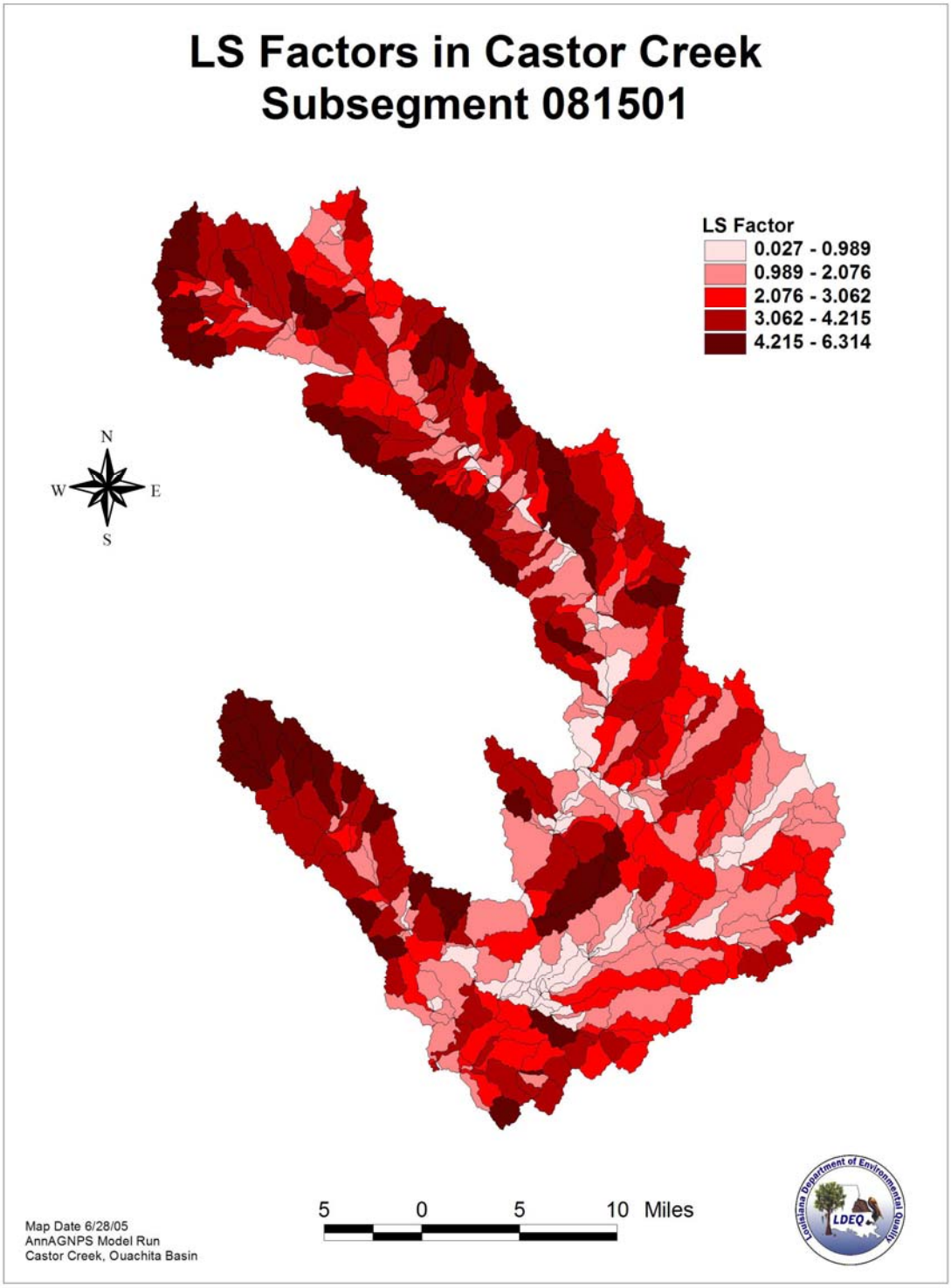


Figure 14. AnnAGNPS Illustration of Sediment Erosion, Sediment Yield, and Sediment Loading in Castor Creek Watershed

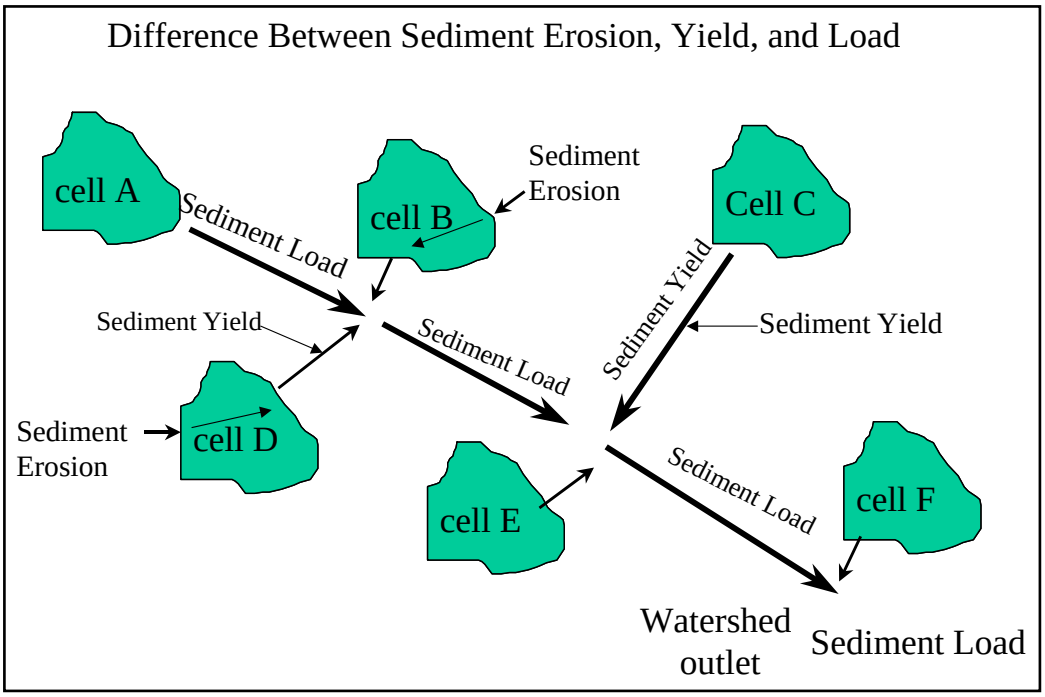


Figure 15. Sediment Erosion in Castor Creek Watershed

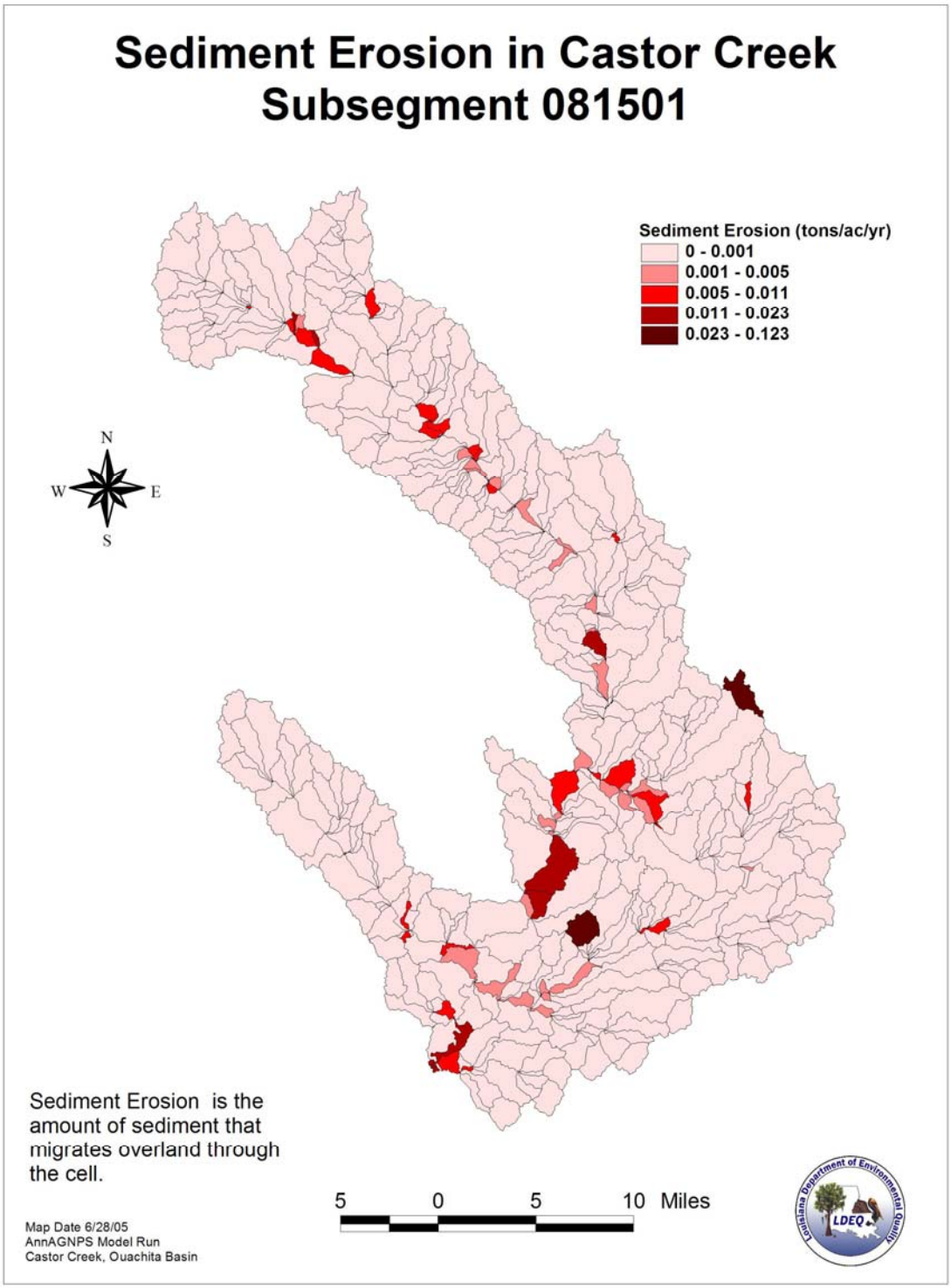


Figure 16. Sediment Yield in Castor Creek Watershed

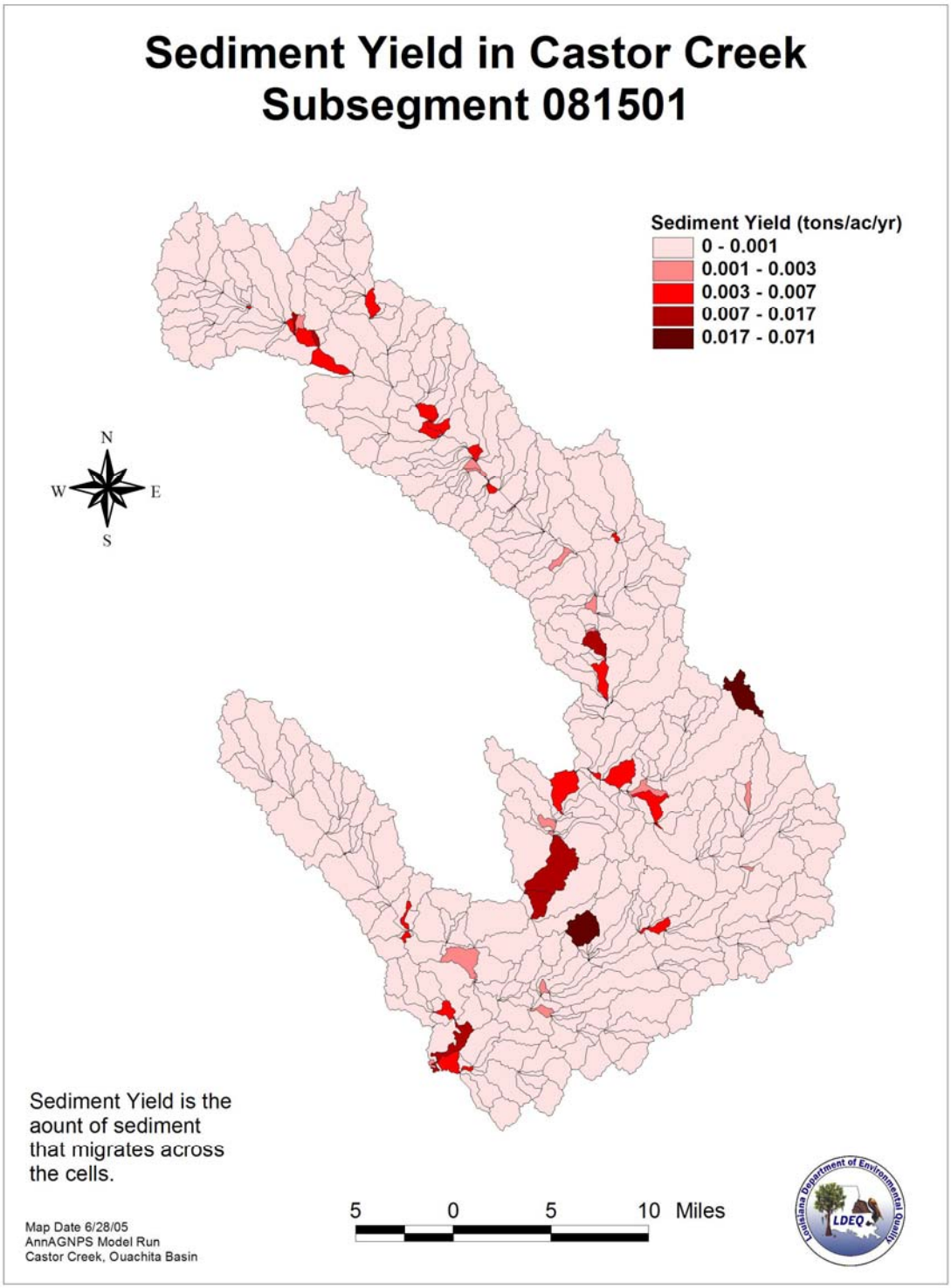
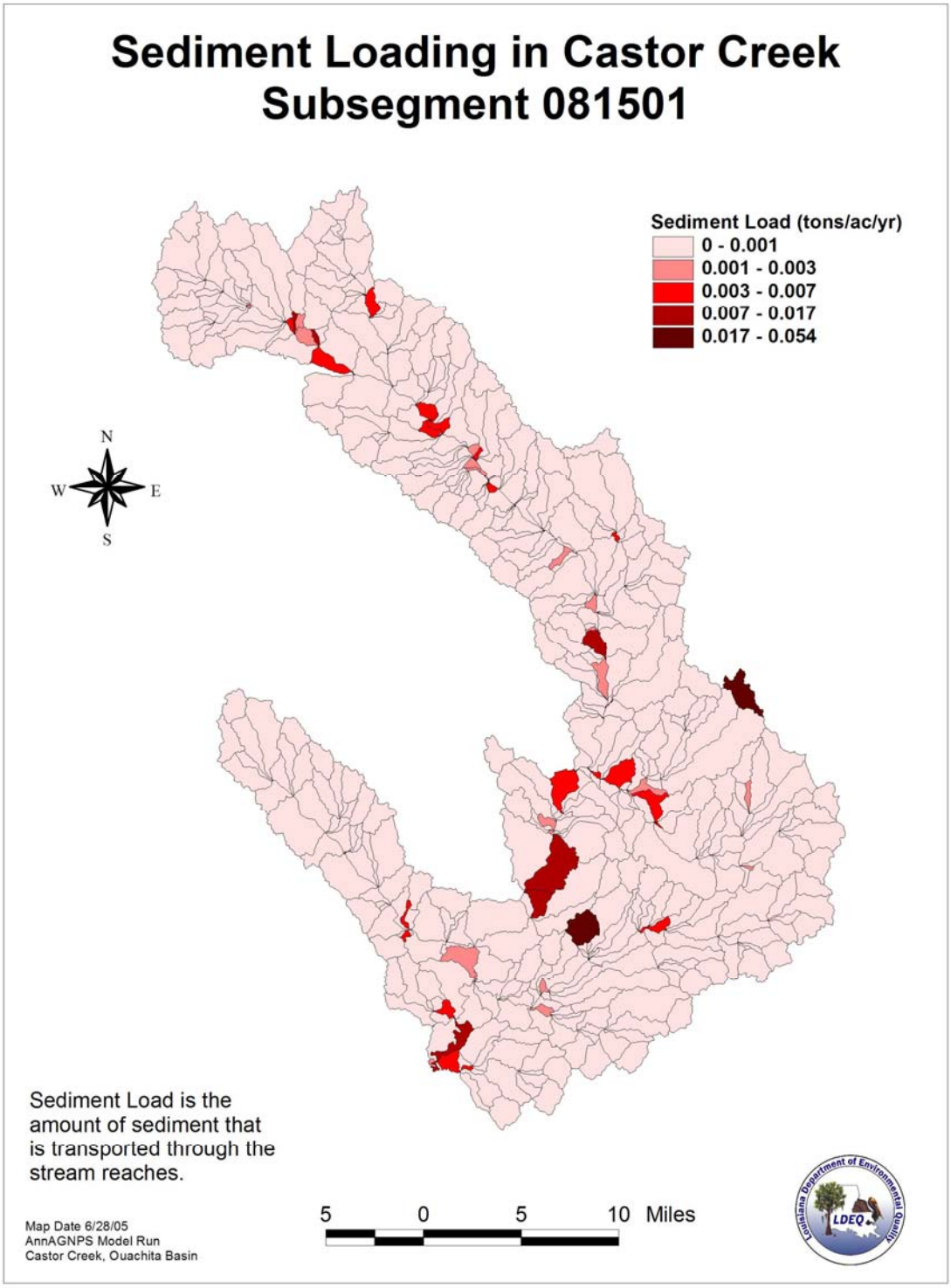


Figure 17. Sediment Load in Castor Creek Watershed

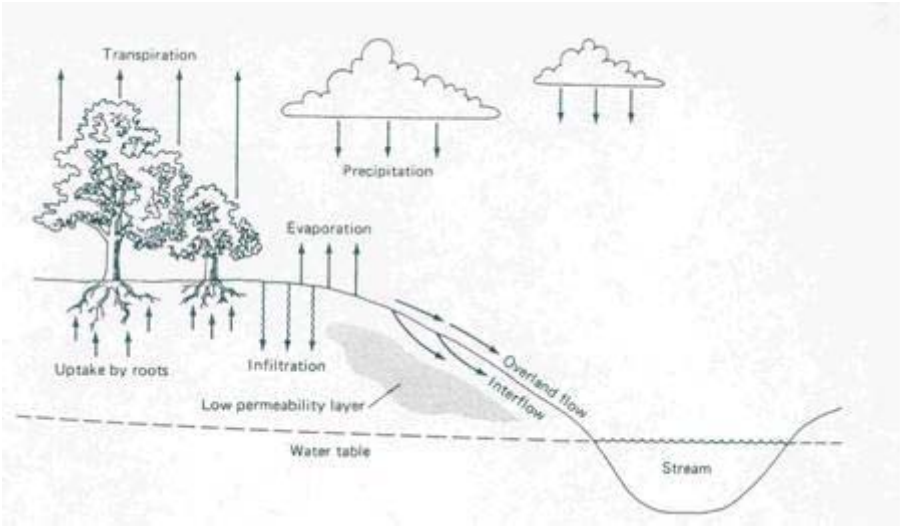


4.5 WATER RUN-OFF

Based on a 30-year record from the nearest Louisiana Climatic Station, average annual precipitation in Castor Creek Watershed is 54 inches (Louisiana State University 2000). 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. Based on many of these factors (Figure 18), AnnAGNPS estimates the average annual amount of water (in/ac/yr) running off of the cells (Figure 19).

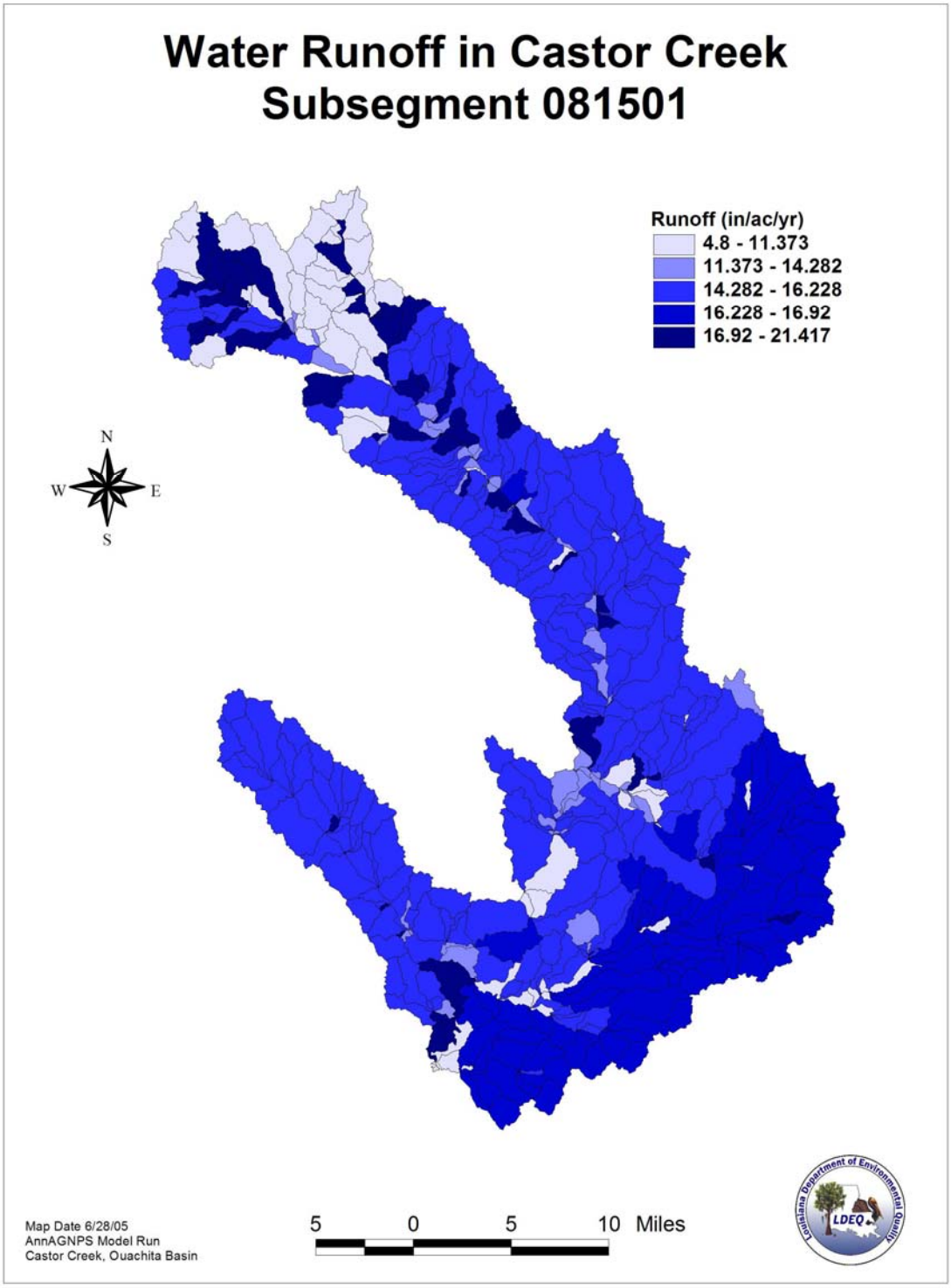
The stream reaches in areas with high water run-off may be experiencing bed and bank erosion along the stream network. In watersheds with large areas of impervious surfaces, upward of 50% of the sediment load can be attributed to stream erosion. In this case, water rushes overland and scours existing streambeds. Hydraulic modifications to bayous and rivers can also create an unstable system.

Figure 18. Illustration of the Hydrologic Cycle (Drever, 1997)



When rain 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 events, water will migrate overland to local water bodies. Illustration and text provided by Drever, 1997.

Figure 19. Water Runoff from Castor Creek Watershed



4.6 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 loss include 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 fertilizer inputs and nutrient levels in the soil were not readily 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.

4.7 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 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 result 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.

4.8 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.

4.9 PHOSPHORUS

Phosphorus is typically the most limited nutrient in freshwater systems for plant growth. Therefore, when it is introduced water with a limited amount of phosphorus, 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. Forms of phosphorus with very low solubilities that are 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 0.1 mg/L 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.

4.10 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.

4.11 AnnAGNPS Results Summary

The AnnAGNPS model summary (Table 3) indicates that on average, only 0.001 tons/ac/yr of sediment is eroded from Castor 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 Castor Creek and the major tributaries such as Beech Creek, Big Chickasaw Creek, and Black Bayou. The area in and around the towns of Columbia and Olla are also reported in the modeling results as having an increased risk of soil loss. Therefore, implementing conservation measures and BMPs in these areas should be a priority.

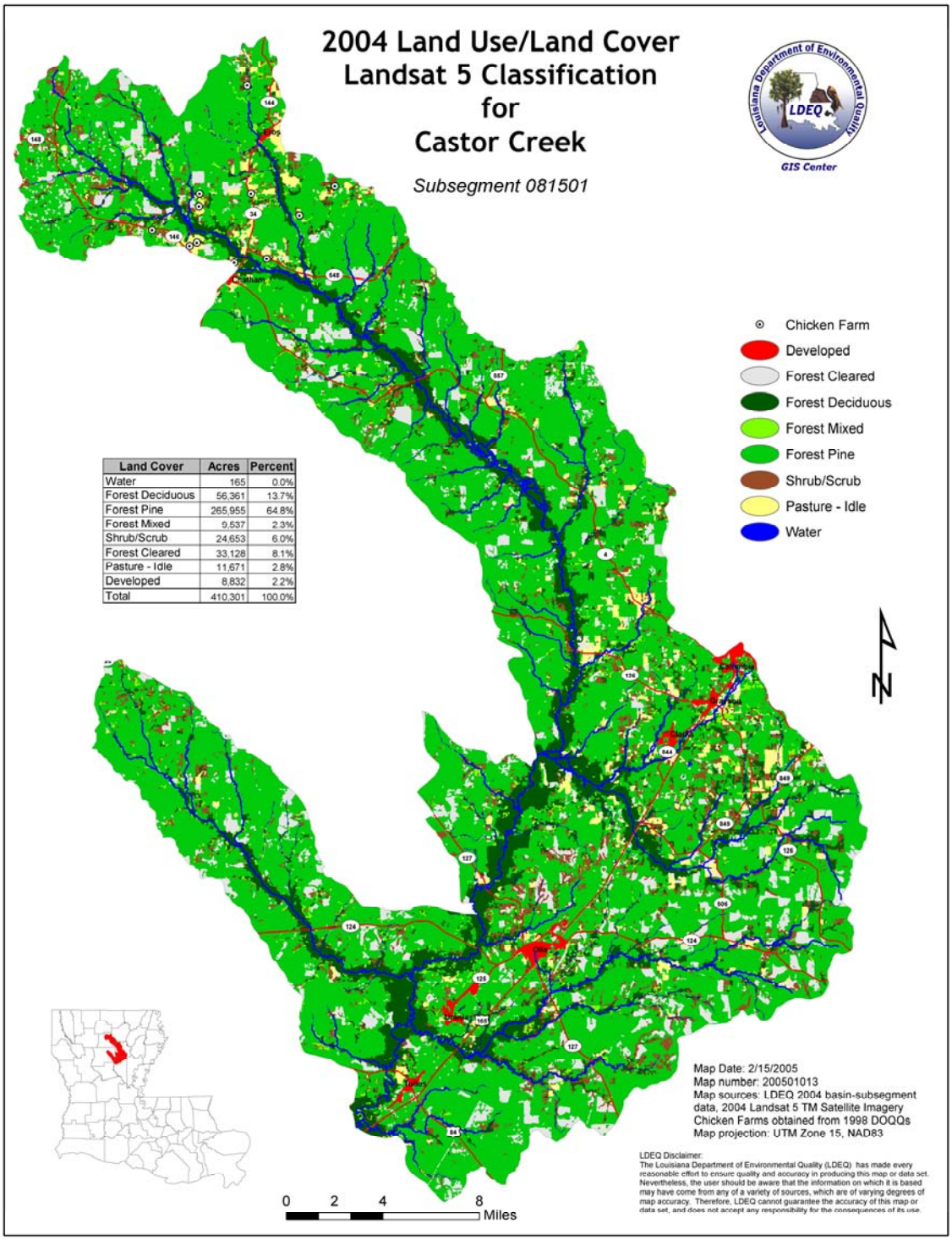
Table 3. AnnAGNPS modeling results for Castor Creek Watershed reported as average annual runoff of materials over a thirty year simulation period.

Type of Model Results	**Results**	**Units**	**Description**
Sediment Erosion	0.001	tons/ac/yr	Overland erosion
Sediment Yield	0.001	tons/ac/yr	Sediment deposited in streams
Sediment Load	0.0006	tons/ac/yr	Sediment that moves through stream reaches
Water Load	15.604	in/ac/yr	Amount of water running off cells into the stream reaches

5.0 WATERSHED LAND USE

The primary land use in Castor Creek Watershed is forest (94.9%), and a small amount of pasture is also present (2.8%) (Figure 20). There are also several small towns in the watershed, but population growth in the past ten years has been minimal.

Figure 20. Land uses in Sub-segment 081501 of the Ouachita Basin



Land Cover	Acres	Percent
Water	165	0.0%
Forest Deciduous	56,361	13.7%
Forest Pine	265,955	64.8%
Forest Mixed	9,537	2.3%
Shrub/Scrub	24,653	6.0%
Forest Cleared	33,128	8.1%
Pasture - Idle	11,671	2.8%
Developed	8,832	2.2%
Total	410,301	100.0%

6.0 SOURCES OF NONPOINT SOURCE POLLUTION LOADING

Nonpoint source pollution comes from various sources within a watershed including agriculture, forestry, urban runoff, construction, hydromodification, home sewage, and resource extraction. Practices resulting in the exposure of bare soil to precipitation events lead to greater runoff than land that has a healthy root system and dense canopy cover. Forested and pasture areas generally have lower loading rates than bare or tilled ground. Nutrient loading from forestry and agriculture can be mitigated by the use of Best Management Practices (BMPs).

6.1 OIL AND GAS WELLS

Image 6. An oil well near Saline Creek

Scattered throughout the entire Castor Creek Watershed (including Flat and Beaucoup Creek watersheds) are 5,478 active or abandoned oil and gas wells (Figure 21). Oil and gas production has occurred for decades throughout the watershed. The historical practice of discharging produced water from active wells has resulted in elevated concentrations of chlorides and TDS at the surface layer. This practice is no longer allowed, but is possibly still occurring on a smaller scale. Furthermore, groundwater is naturally high in TDS. Improperly plugged wells, abandoned brine pits, rainfall runoff

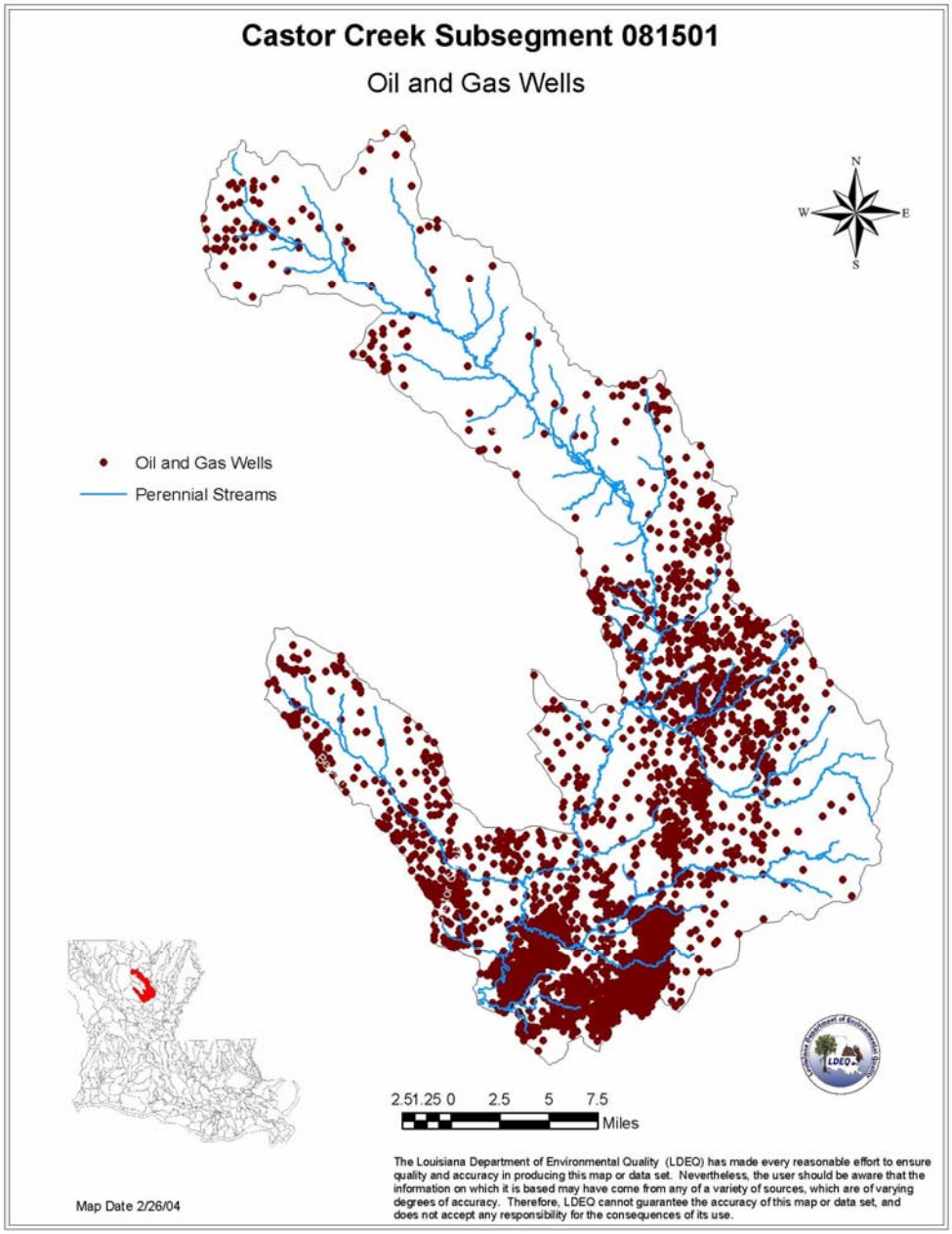
transporting pollutants to surface waters, and groundwater migration through abandoned or improperly cased oil wells may all be contributing to the chloride and TDS pollutant load in Castor Creek.

In addition to having an effect on TDS and chlorides, oil wells have the potential to contribute oxygen-demand substances to the waterbody. Salt water and oil spillage from or near the wells can result in areas around the wells being void of vegetation (Image 7). The exposed soil is more easily transported to streams. The spilled oil can also enter water bodies and result in decreased dissolved oxygen.

Image 7. Unvegetated ground with oil on it in Castor Creek Watershed

When drilling new oil wells, roads often need to be constructed to access the sites. In many cases, areas of land are also cleared of vegetation and leveled to support the pumping units and tanks. Alterations of the landscape, such as road construction and leveling, have the possibility to effect drainage patterns and clearing the land makes it more susceptible to erosion. Both altered drainage patterns and increasing the potential for erosion can increase nonpoint loading in the watershed.

Figure 21. Oil and Gas Wells in Sub-segment 081501 of the Ouachita Basin



6.2 PASTURELAND GRAZING

Image 8. Pastureland near Castor Creek on Highway 126

Grazing cattle on pastureland is a common practice in Castor Creek Watershed (Image 8). Livestock often seek the shade offered in the riparian zone around streams and use the stream itself as a water source. When livestock are not fenced out of riparian zones, water quality has the potential to decrease.

When allowed inside the riparian zone, livestock can directly degrade water quality in multiple ways. Fecal matter can be deposited into the water adding nutrients and bacteria directly to the stream. The undigested organic material associated with fecal matter also has the potential to decrease DO as bacteria degrade it. Furthermore, the trampling by hooves can collapse stream banks and increase turbidity by churning up the streambed.

Riparian buffers in pastures, which are not always present in Castor Creek (Image 9), can help stabilize banks and shade water. When water is shaded, water temperatures are kept cooler. Since dissolved oxygen appears to be related to temperature, as water temperatures increase dissolved oxygen decreases, maintaining a riparian buffer that consists of trees may help Castor Creek meet the standard for dissolved oxygen. Livestock allowed in riparian zones also have the potential to indirectly degrade water quality if not managed properly. Groundcover within the riparian zone can be decreased

as a result of overgrazing and trampling by hooves. Groundcover loss can result in unstable banks that are easily eroded and allow streambeds to be filled in with sediment. The loss of groundcover also decreases the filtering capabilities of the riparian zone. Maintaining quality riparian zones in pasturelands is especially important for filtering sediment, fertilizers, and pesticides out of runoff.

Reducing livestock access to Castor Creek and riparian zones should help improve water quality.

Image 9. A collapsing bank along a pasture without a riparian buffer in the headwaters of Castor Creek

6.3 FORESTRY

Image 10. A replanted clear cut in Castor Creek Watershed

Undisturbed forestland can benefit water quality in many ways. Trees along stream banks can not only shade the water and decrease water temperature, but they can also help trap sediment runoff and stabilize stream banks. Trees also decrease the total amount of runoff volume through the uptake of water and evapotranspiration. Although healthy riparian areas were noticed along most of Castor Creek and its tributaries, an area where all timber was harvested adjacent to the creek and treetops were deposited in the water was noticed and has since been remediated.

The forestry practice of clear cutting (Image 10) not only negates the positive effects of trees, but also leaves soil exposed and more susceptible to erosion. Additionally, when forests are harvested or planted using improper techniques, water quality can suffer. Increased amounts of sediment and nutrients may be transported to the streams and altered flow patterns may occur due to debris in the streams and improper water crossings when forestry practices, such as skidding, fire management, site preparation, and road construction and placement, are designed without concern for BMPs. It should be noted that "forest roads that are improperly located, poorly constructed and/or not maintained are the largest contributor of nonpoint source pollution from forest activities" (Louisiana BMP Guide).

6.4 HIGHWAYS AND ROADS/URBAN DEVELOPMENT

Image 11. A stream crossing on Seven Runs Road

In addition to runoff from forestry roads, local, state, and federal roads also have the potential to negatively impact water quality in various ways. Although little new public road construction was seen in Castor Creek Watershed, exposed soil and machinery in streambeds during bridge construction or repair can potentially degrade water quality. When culverts are too small (Image 11), natural water flow patterns can be altered and sedimentation can increase. Accumulations of debris beneath bridges (Image 12) can also redirect flow in the channel, increasing bank cutting and resulting in sedimentation.

Changes in hydrology are also caused by impervious paved surfaces, such as roads and parking lots. Impervious surfaces increase the amount of water runoff as they do not allow water to pass through into the soil. Oil and grease buildup on roadways can also be washed into water-bodies during rainfall events increasing the NPS loading. Although there are only a few small communities and no large urban areas in Castor Creek Watershed (Table 4), NPS loading from urban areas should not be ignored.

Table 4. Populations of towns in Castor Creek Watershed (2000 Census)

Town Name	Population
Eros	202
Grayson	531
Clarks	1,071
Olla	1,417
Urania	700
Tullos	419

Image 12. Debris accumulated beneath a bridge in Castor Creek Watershed

6.5 CONCENTRATED ANIMAL FEEDING OPERATIONS

Image 13. Chicken houses in Castor Creek Watershed

When the large quantities of manure produced from concentrated animal feeding operations (CAFOs) are managed incorrectly, or added to soil at rates above what is indicated by soil tests, the potential to increase nutrient levels in nearby water bodies is increased. A final rule that revises and clarifies the Environmental Protection Agency's (EPA) regulatory requirements for CAFOs under the Clean Water Act was passed April 14, 2003. The new rule ensures that CAFOs take appropriate actions to manage manure effectively in order to protect the nation's water quality. The rule establishes a mandatory duty for all CAFOs to apply for a National Pollutant Discharge Elimination System (NPDES) permit and to develop and implement a nutrient management plan. The nutrient management plan is a site specific outline of the steps to be taken to ensure proper manure and wastewater management. Full implementation of the requirements of the rule was scheduled for December 31, 2006, with several steps required before the final deadline (Code of Federal Regulations, 2003). Please refer to 40 CFR Parts 9, 122, 123, and 412 for specific requirements of the rule.

6.6 ROW CROP AGRICULTURE

Although minimal row crop agriculture is present in Castor Creek Watershed, common agricultural practices, such as tillage and chemical applications, can both directly and indirectly affect water quality. Tillage can cause the soil to be void of vegetation which holds soil particles in place. When the vegetation is removed, it is more susceptible to being washed away by rainfall and carried into water bodies. Soil tillage can also affect soil bulk density and reduce soil moisture content, each of which can affect the microorganisms needed to convert nutrients into plant available forms. Furthermore, tillage can delay infection of arbuscular mycorrhiza, which has been shown to transfer phosphorus, nitrogen, zinc, carbon, and sulphur to plants. Plants grown with reduced arbuscular mycorrhiza infection due to tillage have been shown to have lower P uptake and lower yields relative to no till (Paul and Clark, 1989). Reduced P uptake is of importance because excess soil P is readily transported in runoff as dissolved P or attached to soil particles. Therefore, soil practices that help keep soil particles from washing away, such as no till, are beneficial in both improving crop production and in reducing nonpoint pollution.

7.0 NONPOINT SOURCE POLLUTION SOLUTIONS

Image 14. An example of a forestry BMP, a wing ditch, near Beech Creek

Best management practices (BMPs) are “schedules of activities, prohibitions of practices, maintenance procedures, and other management practices designed to prevent or reduce the pollution of the waters of the state, including treatment requirements, operating

procedures, and practices to control plant site runoff, spillage or leaks, sludge, or waste disposal, or drainage from raw material storage" (LDEQ 2003). BMPs are one of the most important methods for controlling nonpoint source pollution where runoff occurs from diffuse sources, making regulations in the form of discharge permits unpractical.

Many entities have been involved in recommending the most effective and up-to-date BMP practices possible. These BMP practices are often the culmination of years of research and demonstrations conducted by agricultural research scientists and soil engineers (LSU Agricultural Center, 2000). A summary of the effectiveness of favorable BMPs is provided in Louisiana's Nonpoint Source Management Plan (LDEQ, 2000).

For Castor Creek, BMPs need to be implemented to reduce the total oxygen demand load by 75% and increase the DO to levels that comply with the standards and allow it to support its designated uses. As previously indicated, reducing NPS loading from oil wells and associated operations is a primary concern in Castor Creek Watershed. Water quality regulations governing disposal of waste oil, oil field brine, and all other materials resulting from the drilling for, production of, or transportation of oil, gas, or sulfur can be found within Louisiana's Administrative Code (Title 33:Volume 14:Chapter 17). These regulations require disposal of crude oil, oil sludge, oil-water emulsion, or oil-bearing mixtures of any kind in a manner that results in no pollution hazard. No oil fluids should be discharged into surface or ground waters, and all barges should be equipped with devices to drain all oil or oily fluids into a catch tank. No oil field brine should be discharged into any stream, lake or water body, or into any ditch or surface drainage leading to any stream, lake or body of water (33:IX.1701). Additional federal regulations for spill prevention control can be found in the 1990 Title 40 of the Code of Federal Regulations (40 CFR) Part 110: the Spill Prevention Control and Countermeasure Plan (SPCC Plan). State regulation can be found in Title 33, Part IX, Water Quality Regulations entitled, Spill Prevention and Control.

LSU AgCenter has produced BMP manuals for agronomic crops, rice, poultry, sugar cane, dairy, sweet potato, swine, beef, and aquaculture which are available on their website (http://www.lsuagcenter.com/Subjects/bmp/index.asp). For all entities involved in silvicultural operations, the "Recommended Forestry Best Management Practices for Louisiana" manual has been and will continue to be an invaluable source of information and recommendations (Louisiana Department of Environmental Quality, 2000). Appendix 1 contains a list of BMP sources.

8.0 MAKING THE IMPLEMENTATION PLAN WORK

Although reducing the oxygen demanding pollutant load in Castor Creek Watershed will most likely require financial and technical assistance from federal, state, and local entities, the residence and landowners in the watershed are the most important group for improving the water quality in Castor Creek. Presently, the only requirement for public participation is that there be a 30–day comment period after the TMDL is issued. Therefore, stakeholders are informed by mailed public notices and notices in newspapers.

Ultimately, the public needs to be the most important part of the implementation of TMDLs, especially in the arena of nonpoint source pollution where there are few regulations. Foresters, agricultural producers, and local residence need to be made aware of the impacts their actions can cause on water quality, ways they can reduce the amount of pollution they are contributing, and financial assistance programs available to help them implement BMPs. Educational programs such as Master Logger and Master Farmer can be valuable tools in spreading this information.

8.1 REGULATORY AUTHORITY

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). This section instructs 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 eighteen months of the day of enactment).

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) include the following provision as the authority for LDEQ to implement the State's NPS Program: To develop and implement a nonpoint source management and groundwater 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.

LAC 33:IX.1101.D.

The water quality standards described within this chapter are applicable to surface waters of the state and are utilized through the waste load allocation and permit process to develop effluent limitations for point source discharges to surface waters of the State. These also form the basis for implementing the best management practices for control of nonpoint sources of water pollution.

LAC 33:IX.1109.A.2 Antidegradation Policy

Chapter 11 also states that the administrative authority will not approve any wastewater discharge or certify any activity for federal permit that would impair

water quality or use of state waters. Waste discharges must comply with applicable state and federal laws for the attainment of water quality goals. Any new, existing, or expanded point source or nonpoint source discharging into state waters, including land clearing which is the subject of a federal permit application, will be required to provide the necessary level of waste treatment to protect state waters as determined by the administrative authority. Further, the highest statutory and regulatory requirements shall be achieved for all existing point sources and best management practices (BMPs) for nonpoint sources. Additionally, no degradation shall be allowed in high-quality waters that constitute outstanding natural resources, such as waters of ecological significance as designated by the office. Those water bodies presently designated as outstanding resources are listed in LAC 33:IX.1123.

8.2 ACTIONS BEING IMPLEMENTED BY LDEQ

LDEQ is presently designated the lead agency for implementation of the Louisiana Nonpoint Source Program. LDEQ Nonpoint Source Unit provides USEPA §319(h) funds to assist in implementation of BMPs and to address water quality problems on sub-segments listed on the §303(d) list. USEPA §319(h) funds are utilized to sponsor cost sharing, monitoring, and education projects. These monies are available to all private, for profit, and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including cities, counties, tribal entities, federal agencies, or agencies of the State. Presently, LDEQ is cooperating with such entities on over forty nonpoint source projects that are active throughout the state. Two of the nonpoint projects LDEQ is cooperating on are in the Flat Creek Watershed, which is a tributary to Castor Creek. Both of these projects, one with LSU and the other with LA Tech, are evaluating the effectiveness of forestry BMPs.

8.3 ACTIONS BEING IMPLEMENTED BY OTHER AGENCIES

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 U.S. Department of Agriculture (USDA) and Natural Resource Conservation Service (NRCS) offer 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 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.

Wildlife Habitat Incentive Program (WHIP) provides 75% - 90% cost share for the costs of wildlife habitat restoration and enhancement on private lands. WHIP is 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 Castor 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 Castor 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.

8.4 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:

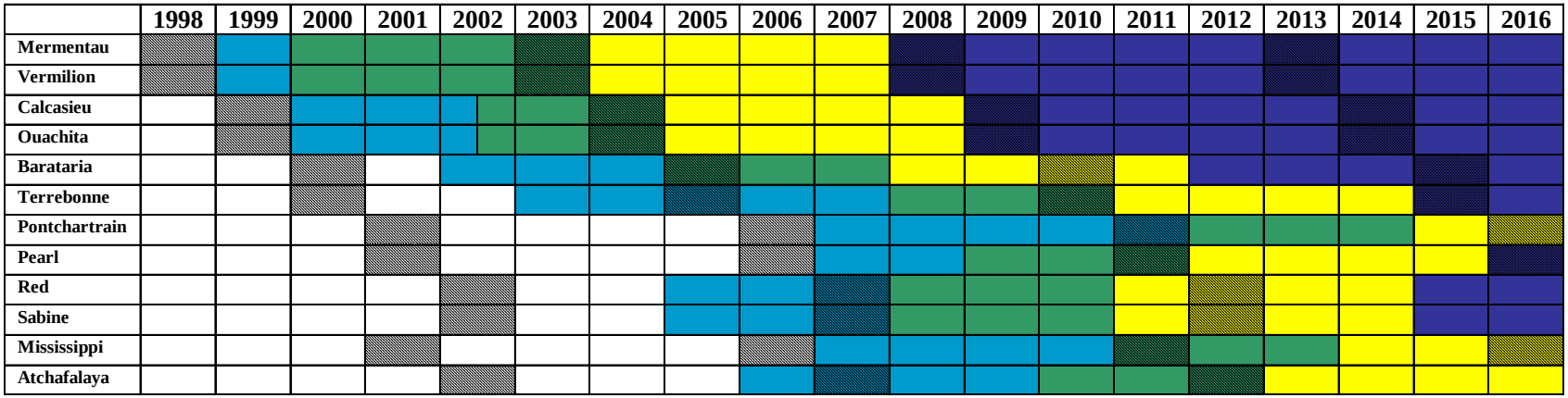
1. Tracking of actions outlined with the Watershed Restoration Action Strategy (short-term);
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share and technical assistance within the watershed (short term);
3. Tracking progress in reducing nonpoint source pollutants, 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 website 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).

9.0 TIMELINE FOR IMPLEMENTATION

The NPS Implementation Plan for Castor Creek Watershed outlines a multiple year management plan to reduce NPS pollutants reaching the waterway. LDEQ intensively samples each watershed in the state once every 4 years to see if the water bodies are meeting water quality standards. Statewide sampling began using a 5-year schedule (Table 5), but was changed to a 4-year schedule in 2004 (Table 6). Castor Creek was first included in the statewide ambient samples in 1999, and will be sampled again in 2005 and either 2008 or 2009. 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, 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 Castor Creek is restored to its designated uses.

Table 5.

Revised Timeline for Watershed Planning and Implementation



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]**

Table 6. Louisiana 4-Year Ambient Water Quality Sampling Schedule

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

10.0 CASTOR CREEK WATERSHED IMPLEMENTATION PLAN SUMMARY

Image 15. Little River below the confluence of Castor Creek, the Dugdemona River, and Cochran Creek below Castor Creek Watershed

Castor Creek Watershed does not meet the water quality standards for dissolved oxygen or chlorides and TDS. In order to restore the water quality and designated use of Fish and Wildlife Propagation in Sub-segment 081501 in the Castor Creek Watershed, a 75% reduction of total nonpoint loading, a 38.6% reduction in total chlorides, and a 47.1% reduction in TDS are required. To meet these load reduction goals, a concerted effort from all of the stakeholders within the watershed, including government (local, state, and federal), special interest groups, and local citizens, is needed. This could be challenging due to the number of parishes that the watershed is in. Everyone who lives in Castor Creek Watershed and/or owns property in the watershed is a “stakeholder” and stands to benefit from their contribution toward protecting water quality. 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.

Any type of land use activity that disturbs the soil and/or leaves an area of barren earth for a period of time without implementation of BMPs has an increased probability of contributing to NPS loading. The dominant land uses in the watershed are forestry and rangeland with a small amount of agriculture and urban land also present. Oil and gas production is also a large industry in Castor Creek Watershed and is the primary suspected contributor to high TDS and chloride levels in the watershed. BMPs and regulations are available for reducing NPS pollutant loads from these land uses and, if implemented and followed properly, should reduce sediment and nutrient runoff into Castor Creek.

Although some of the BMPs and the recommended courses of action 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* and in LSU and LDEQ BMP publications as indicated in section 7.0.

11.0 REFERENCES

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APPENDIX 1

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