LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Water Quality Management Plan: Volume 4

Basin and Subsegment Boundaries

Office of Environmental Services
Water Permits Division

September 9, 2014

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INTRODUCTION

Section 208 of the Clean Water Act (1972) requires states to establish and implement area-wide waste treatment management plans. In response to the federal mandates, Louisiana's Water Pollution Control Division supervised the development of river basin management plans which resulted in the formation of twelve water quality management basins within the state. By 1980, twelve plans were completed for Louisiana's river basins and constituted the state's Water Quality Management Plan (WQMP). Each basin plan divided the twelve river basins into management segments (watersheds) identified by a 4-digit code. Field observations, hydrology, dams, levees, weirs and other recommendations presented in the basin plans were considered in the formation of the management segments. Over the next decade the watersheds were further subdivided into 6-digit subsegments to describe them hydrologically, and to manage and prioritize efforts to improve water quality.

In 1985, the WQMP was expanded beyond the basin plans to include multiple volumes. Each volume addressed or represented the management plan components as required in federal regulations (40 CFR 130.6). The 12 basin plans contained a great deal of duplicated information on features that were similar throughout much of Louisiana, such as climatology and geology. Volume 4 of the WQMP, as published in 1987, was extracted from the basin plans to condense this repetitive information for the reader while preserving information on characteristics unique to each basin. Volume 4 described each water quality management basin and all subsegments within each basin. It also gave broad descriptions of the geology, geography, climatology, and hydrology of the basins.

Since Volume 4 of the WQMP was published in 1987, subsegment delineations and descriptions have evolved tremendously. Subsegment delineations are primarily based on natural watershed boundaries, but also take into account site-specific conditions, such as dams, levees, weirs, etc., that require unique water quality standards and criteria. Ecoregion boundaries are also considered. As of the August, 2008 update, Volume 4 of the WQMP exists in two parts: basin descriptions, and subsegment delineations by basin. The text description is presented in this document and includes the original (as published in 1987) broad descriptions of the geology, geography, and hydrology of the basins, as well as subsegment descriptions and the primary water body types of those subsegments. The GIS coverage is available on the department's web site as part of the Louisiana Interactive Mapping Application (LIMA). The Office of Environmental Services, Water Permits Division, Water Quality Section maintains this document.

APPLICABILITY OF SUBSEGMENTS TO WATER QUALITY STANDARDS

LDEQ reports on water quality in the state by basin subsegment. This subsegment approach divides the state's waters into discrete hydrologic units and provides a workable framework to evaluate the state's waters. This approach, originally presented in the 1978 Water Quality Management Plan, increases hydrologic consistency within each named subsegment. Water quality standards that apply to Louisiana waters are described in LAC 33:IX.Chapter 11 of the Louisiana Administrative Code. Designated uses and water quality criteria are applied on a subsegment by subsegment basis. Table 3 in LAC 33:IX.1123 describes the designated uses and criteria that are applied to each subsegment. Although the subsegments, as presented in this document and in Table 3 of the water quality standards, generally describe the primary water body within the watershed, standards and criteria apply to all tributaries and connected water bodies within the boundaries of a subsegment unless specifically exempted elsewhere in the regulations (LAC 33:IX.1123.C).

Subsegment delineations and descriptions are reviewed periodically to ensure that subsegments are distinct and consistent representations of the state's hydrology. Coastal erosion, man-made hydrologic modifications, and reevaluations of the physical and chemical water quality properties often prompt subsegment revisions. High resolution geographic coverage, which is continuously improving, also allows refinement of subsegment delineations which were based on older topography. Reviews of subsegment delineations include an analysis of the most recent geospatial data, including, satellite imagery, and Geographic Names Information System (GNIS). Subsegment descriptions and water body types are revised accordingly. Subsegments are periodically added or merged into other subsegments as water quality standards related to a subsegment or group of subsegments are revised.

Primary water bodies, which are the named water body or water bodies in the subsegment description, are classified into one of five primary types: rivers/streams, canals, lakes, bays, and wetlands. These five types generally have distinct physical, chemical, and biological factors that may require unique water quality standards. LDEQ has recognized that standards and criteria within ecoregions or basins may need to be developed with regard to water body type. The Nutrient Criteria Development Plan (LDEQ, 2006) and the document, *Development of Dissolved Oxygen (DO) Criteria and Assessment Protocols to Support Fish and Wildlife Propagation in Louisiana Waters Based on Ecological Regions (Ecoregions) and Water Body Types* (LDEQ, 2008) discuss the development of criteria based upon water body type, as well as other factors. Appendix A of this document is a complete list of subsegments, their descriptions and water body types, by basin.

Rivers and streams are described as a body of water with a regular or intermittent current that is confined by a bed and banks. Synonyms may include, but are not limited to, bayou, brook, creek, slough, and fork. Although rivers and streams are normally thought of as flowing water bodies, many Louisiana water bodies have little or no gradient and often have a zero rate of flow. LDEQ has not formally adopted size classifications for rivers and streams; however, LDEQ does consider the stream size in the development of standards and criteria. Canals are considered flowing (regular or intermittent) water bodies with little or no sinuosity, and are usually man-made or man-modified. Synonyms may include ditch, gut, channel, and strait. Lakes are generally described as large, lotic (i.e., standing water) systems that are entirely or almost entirely surrounded by land. Bays are large expanses of water that are near the shoreline and are usually directly connected to ocean waters. Synonyms may include bight, cove, inlet and sound. Wetlands are specifically defined in LAC 33:IX.1105. Various wetland subtypes have also been recognized and defined in the water quality standards. Subtypes for the remaining four water body types may be defined in future revisions of Volume 4 and/or the water quality standards.

BASIN DESCRIPTIONS

Atchafalaya River Basin (01)

1.0 Physical Description

The Atchafalaya River Basin is located in the south-central part of Louisiana. The Atchafalaya River is a distributary of the Red, Black, and Mississippi Rivers, presently carrying about 30 percent of the Mississippi's flow. The basin is well defined by a system of levees which surround it on the north, east and west. The entire basin serves as a major floodway for the region, and it encompasses approximately 1840 square miles. The Atchafalaya Basin is predominantly wooded lowland and swamp with some freshwater marshes in the lower distributary area. It constitutes one of the largest contiguous freshwater swamps in the United States. The Atchafalaya River is the largest distributary of the Mississippi River. The Atchafalaya Basin includes portions of Avoyelles, St. Landry, Pointe Coupee, Iberville, St. Martin, Iberia and St. Mary Parishes.

2.0 Physiography and Geology

2.1 Development of the Atchafalaya Basin

The Atchafalaya Basin was formed when the low central portion of the Lower Mississippi Alluvial Valley became completely surrounded by the alluvial ridges built by various Mississippi River courses. During the Teche stage (100 A.D.) the Mississippi River built the Teche ridge which forms the western and southern boundaries of the Atchafalaya Basin. Also, during the Teche stage, the Yazoo River flowed along the eastern wall of the Mississippi Alluvial Valley and began the basic forming of the eastern boundary of the Atchafalaya Basin. The northern boundary was formed as alluvial ridges along Bayou des Glaises developed during the Lafourche Stage. As already mentioned, the Mississippi River traversed the Atchafalaya Basin several times before it occupied its present course. Each of these courses had significant effects on the boundaries and characteristics of the basin.

Teche Stage

The earliest of the Mississippi River courses in the basin which can be easily traced is that of the Teche-Mississippi. While in this position, the river built the Teche ridge which forms the western and southern boundaries of the Atchafalaya Basin. The Teche-Mississippi (approximately 100 A.D.) followed closely the western wall of the alluvial valley for much of its length. South of Franklin this valley wall was buried beneath the coastal lowlands, and the valley wall undoubtedly controlled the Teche-Mississippi course beyond Franklin, where the river flowed eastward and built an extensive delta south and east of Houma.

Lafourche Stage

The Mississippi River abandoned the Teche course on the western side of the alluvial valley in favor of a new course (Lafourche-Mississippi 900 A.D.) adjacent to its eastern valley wall. Alluvial ridges built along a path now occupied by Bayou des Glaises formed the northern boundary of the Atchafalaya Basin. South of Angola, the Mississippi occupied its present course to Donaldsonville; it flowed in a channel partially used by Bayou Lafourche and established a delta in Lafourche and Terrebonne Parishes. When the Lafourche-Mississippi delta was built out to join parts of the Teche-Mississippi delta, the Atchafalaya Basin was surrounded by alluvial ridges and isolated from the rest of the Mississippi Valley. Subsidence and the lack of sediment deposited in the area caused the basin to remain a lowland.

Modern Mississippi Stage

The Mississippi River abandoned its Lafourche course at Donaldsonville, occupying its present course, and becoming well established in its new course by the year 1400. This new course did not have any effects on the delta within the basin. During this stage the Red River had abandoned the old Teche-Mississippi channel and now entered the Mississippi at the meander loop just south of Old River. The whole of the basin was a very low-lying part of the alluvial valley, and the entire southern basin area as far north as the latitude of Baton Rouge was one large lake. The basin surface remained low and the lake area became extensive because no large stream contributed the sediment necessary to build it up.

Atchafalaya River Stage

The Atchafalaya River was introduced into the basin about the year 1500 as the last step in the basin development. The Atchafalaya Basin is presently being alleviated at an ever-increasing rate by the Atchafalaya River. The lake areas in the southern portion of the basin are being rapidly reduced as the Atchafalaya delta continues to enlarge.

2.2 Geology

Geomorphic Units

There are four geomorphic units located within the Alluvial Plains of the Atchafalaya Basin, namely, riverines, natural levees, coastal flatlands and basins, and point bars. Riverines, flatlands and basins occupy most of the area of the basin. This land is generally level or nearly level topography of low and poorly drained areas. The riverine areas of the Atchafalaya Basin are in some cases below adjacent river levels and/or below sea level; however, they are bounded by natural or man-made levees.

Natural levees are the second most abundant geomorphic unit within the basin. These levees are broad asymmetric ridges which flank channels of main and certain tributary and distributary streams of the alluvial plain. These natural levees are as high as twenty-five feet immediately adjacent to river channels and slope gently toward adjacent lower flatlands and depressions, being in some places more than three miles wide.

Coastal (fresh to brackish wetlands) flatlands and basins are extensive marsh areas located in the southern part of the Atchafalaya Basin near the Gulf of Mexico. These marsh areas are mostly grass and reed covered, with many round lakes. The water table is at the surface most of the year, and these marshes increase and decrease in size seasonally when flooded with overflow and rain runoff from levees, with the marshes gradually becoming more saline southward.

Point bars are the final geomorphic unit to be described which exist in the Basin. Point bars are series of alternating arch ridges and swales which lie concentrically on the inner sides of meanders of stream courses. These ridges are generally low and rounded, rise 2 to 16 feet above intervening swales with the highest ridges nearest streams and more than 50 feet wide.

Soil Characteristics

Soil associations vary widely throughout the Atchafalaya Basin. Associations within each geomorphic unit will be discussed describing the texture, along with the uses as cropland, forestry, wildlife management and construction capacity. Two soil associations exist in the natural levee category. Commerce series is a dark grayish-brown silt loam. It is a very fertile soil with a wide variety of plant choices. The soil is moderately well drained with the forest areas consisting of nuttall oak, water oak, green ash, and cottonwood. Due to high fertility, a wide variety of vegetation exists which may support deer, turkey, squirrels, quail, doves and rabbits.

Sharkey association, a very dark grayish-brown clay, comprises the remaining area of the natural 'levee unit. Sharkey soils are also very fertile; however the soils usually need drainage which makes it difficult to farm. Green ash, nuttall oak, water oak and sweet gum are the major tree species with deer, ducks, squirrel, turkey, crayfish and rabbits abundant in these areas due to supportive vegetation. These soils have a low bearing strength due to the severe wetness of the soil.

The Riverine is comprised of Sharkey soils and swamp. In the Riverine the Sharkey soil is a dark gray clay which is nearly level. It is subject to flooding and poorly drained, thus it is poorly suited for cropland. Green ash, nuttall oak, water oak and sweet gum are the major trees, while the vegetation in the Riverine supports deer, duck, dove, squirrel, crayfish, rabbit and turkey. The swamps in this unit are composed of organic matter. Since this area is flooded most of the time the land is not suitable for cropland, and only a few southern hardwoods are found in the swamp. Vegetation in the swamp supports deer, duck, crayfish, rabbit and squirrel. Since the land in the Riverine is flooded most of the time the soils are subject to shrinking and swelling, thus having a low bearing strength when considering the use of the soil as a base for construction.

The fresh and brackish marsh soils are comprised of organic matter with a permanently high water table. Due to the high water table the land is not suitable for cropland or forestry. The marshes may support alligator, duck, deer, geese, muskrat, nutria, rabbit, rail and snipe. Since the water table is at or above the surface most of the time, the soil has a very low bearing capacity, thus construction on marsh soils is minimal.

The swales of point bars are comprised of Sharkey soils of a dark grayish brown clay. It is a poorly drained soil but very fertile. The swales are seldom used for farming and the forested areas are comprised of green ash, nuttall oak, water oak and sweet gum. Deer, dove, duck, turkey, squirrel, crayfish and rabbit are found in this area. The point bar areas are subject to flooding while the soils are subject to shrinking and swelling with a low bearing strength. The ridges of point bars are comprised of a dark grayish-brown clay (loamy and fine sandy materials common at depths greater than 25 inches) called Tunica. Tunica is a fertile soil but seldom used as agricultural land. Green ash and sweet gum are the major tree species. The ridges are subject to occasional flooding and may support deer, squirrel, turkey, rabbit, crayfish, duck and dove. These soils are subject to very high shrinkage and swelling, sometimes of more than 25 inches, thus a low bearing strength exists.

3.0 Hydrology

3.1 Surface Water

The Atchafalaya River main channel is the largest distributary of the Mississippi River. The Atchafalaya River's length is 135 miles from its junction with Old River to the Atchafalaya Bay, an inlet to the Gulf of Mexico. At its northern origin, the Atchafalaya River is designed to carry 680,000 ft^3/sec.. The West Atchafalaya Floodway, near Simmesport, is designed to carry 250,000 ft^3/sec. Near Morganza, thirty-five miles downstream from the Old River Control Structure, an additional 600,000 ft^3/sec. can be diverted from the Mississippi River into the Morganza Floodway. The Atchafalaya Basin Floodway, the southern extension of these floodways, is approximately 15 miles wide and extends from just below Krotz Springs to Morgan City. Most of the water is discharged from this floodway through the lower Atchafalaya River at Morgan City, and Wax Lake Outlet near Calumet.

The Atchafalaya Basin surface slopes gently seaward. At its northern limits, the elevation is approximately 45 feet mean sea level (m.s.l.), decreasing to an average elevation of 15 feet m.s.l. at the latitude of Krotz Springs. South of Krotz Springs the basin surface gradually slopes to sea level and is underwater for a portion of the year.

The Atchafalaya River does not drain the northern portion of the basin. Streams in the inner ridge areas are not integrated into an efficient system but wander freely in complex drainage networks over the area, eventually emptying into lakes in the southern part of the basin. Natural drainage has been altered by: (1) railroad and highway embankments across the Atchafalaya Basin at the latitudes of Simmesport, Melville, Krotz Springs, and Atchafalaya; (2) the erection of the west Atchafalaya and Morganza Floodways guide levees; and (3) the artificial river levees. Normal drainage into the Atchafalaya River has been interrupted, and water has been channeled into the lake system in the southern portion of the basin through openings in the transbasin railroad and highway embankments built between the artificial river levees and the floodway guide levees. South of the leveed portion of the Atchafalaya River, where the Morganza and West Atchafalaya Floodways merge during flood stages into a single floodway, a sheet of water approximately 15 miles wide flows seaward during flood stages.

The lower southern part of the Atchafalaya Basin contains a system of shallow lakes covering approximately 150 square miles. These lakes are the centrally located Grand Lake, Six Mile Lake, Duck Lake, and Flat Lake. Drainage between the newer separate, smaller lakes of the Basin is accomplished either by direct connection or by a network of swampy streams.

Since 1964 the average load of suspended sediment transported past Simmesport has been 260,000 tons per day. The maximum and minimum suspended sediment loads were 2,120,000 and 3,000 tons per day, respectively. Approximately 25 percent of the suspended sediment load was sand and 75 percent was silt and clay (Wells and Demas, 1977). The Atchafalaya River Basin has been divided into 12 water quality management subsegments. These stream subsegments are described in Table 1-2.

Barataria Basin (02)

1.0 Physical Description

The Barataria Basin lies in the eastern coastal region of the state. This basin is bounded on the north and east by the lower Mississippi River, on the west by Bayou Lafourche, and on the south by the Gulf of Mexico. The major receiving waterbody in this basin is Barataria Bay. The Barataria Basin consists largely of wooded lowlands and fresh to brackish marshes, having some saline marsh on the fringes of Barataria Bay. Elevations in this basin range from minus two feet to four feet above sea level. The Barataria Basin drains an area of approximately 2,260 square miles.

There are no parishes that lie entirely within the basin boundaries. The basin is comprised of land areas from Plaquemines, Jefferson, St. Charles, Orleans, St. John the Baptist, St. James, Ascension, Assumption and Lafourche Parishes.

2.0 Physiography and Geology

2.1 Land Resource Areas

Barataria Basin is in the southeastern portion of the state of Louisiana known as the Delta Region. The geomorphology and ecology of the Delta Region have been and continue to be dominated by the Mississippi River. Historically the Mississippi River has repeatedly changed its course, as evidenced by topographic features observable today. Previous routes of the Mississippi have covered most of south Louisiana. Only 600 years ago the Mississippi River began to follow its present course to the Gulf of Mexico.

Except for the northwest portion of St. James Parish near Donaldsonville and northern Lafourche Parish, much of the Barataria Basin is marshland. The non-marsh areas of the Barataria Basin are considered to be in the Bottomland Hardwoods and Cypress Region. Numerous low islands in the Barataria Bay area are covered with black mangrove.

The marshland in Barataria Basin can be broken down into four general types: saline marsh, brackish marsh, intermediate marsh and fresh marsh. The major factors influencing the vegetation types in a marsh are edaphic factors such as soil salinity, soil type, drainage characteristics and elevation. These and other factors are interrelated but soil salinity, usually higher than surrounding water salinity, probably has the greatest influence on the frequency and distribution of marsh plant species. In the northern part of the basin, Lakes Des Allemands, Cataouatche and Salvador are surrounded by freshwater marsh. There is an intervening band of brackish marsh and the large area around Barataria and Caminada Bays is covered with vegetation typical of a saline marsh.

The Barataria estuarine area is a highly productive source of commercially important species of shrimp, oysters and crabs. Approximately one-third of Louisiana's annual blue crab catch is from these estuarine waters, and the juveniles of the species migrate as far up the estuary as Lac Des Allemands and mature there. The common American oyster is a species that is also commercially important. This species never leaves estuaries during its entire life cycle.

2.2 Geology

Geological sediments underlying Barataria Basin accumulated in the modern Mississippi River Delta. Sediment types span the textural spectrum from sand to mud. Organic debris including peat is a lesser constituent. Surface and near surface sediments in the basin were deposited in geologically recent times by the Mississippi Delta System. These sediments accumulated in abandoned delta distributary channels, natural levees and crevasse splays, and on the adjacent delta plain. Processes of

sedimentation and subsidence occur continuously in the delta. Subsidence is defined as the relative lowering of the land surface with respect to sea level and typically occurs along the sides of old river channels creating delta-flank depressions. Sedimentation allows marsh and swamp vegetation to thrive. Soils in Barataria Basin range from relatively compact clay to 80 percent organic material.

3.0 Hydrology

3.1 Surface Water Hydrology

The dominant bodies of water in the basin are Lac Des Allemands, Lakes Cataouatche and Salvador, and Barataria and Caminada Bays. A majority of the basin is traversed by numerous bayous, canals and channels. The hydrology of the basin is greatly affected by the fact that the elevation of most of the land in this basin is at, just below or just above sea level. The tidal influence from the Gulf of Mexico is evident as far north as Bayou Des Allemands at the town of Des Allemands.

Lac Des Allemands is a large lake of about 23 square miles surface area located in the northern part of the basin. A large area of swamp land is drained by several bayous including Grand Bayou and Bayou Chevreuil that flow into this lake. Lac Des Allemands is drained to the southeast by Bayou Des Allemands which runs to Lake Salvador. Lac Des Allemands is shallow throughout, averaging about five feet.

Lakes Cataouatche and Salvador are located about 10 miles southwest of New Orleans. The lakes are, for all practical purposes, one body of water being separated only by Couba Island. The lakes are fed by numerous bayous, including the large Bayou Des Allemands which enters the northwest corner of Lake Salvador, and drain into the Gulf of Mexico through Little Lake and Barataria Bay. The surface area of Lakes Cataouatche and Salvador is 84.5 square miles. Both are shallow, averaging about five feet. Water quality is quite variable due to the influx of brackish water from the Gulf of Mexico during high tides and freshwater during periods of high runoff. Both lakes are brackish at times, and the water sometimes exceeds the chloride concentration recommended for domestic usage. Due to the shallowness and industrial boat traffic connected with oilfields in Lake Salvador, the lakes are unusually muddy.

The Intracoastal Waterway crosses Barataria Basin just south of Lake Salvador. It is connected to the Mississippi River on the east by Algiers and the Harvey locks and to Bayou Lafourche on the west by the lock at Larose. A significant amount of freshwater enters the basins through these locks since both the Mississippi River and Bayou Lafourche have higher water surface elevations than the Intracoastal Canal.

The waters south of the Intracoastal Canal are estuarine in nature. Barataria Bay is connected to the Gulf of Mexico by Barataria Pass, Quatre Bayoux Pass and Abel Pass, and Caminada Bay is connected to the Gulf by Caminada Pass. These bays are connected to Little Lake and the Intracoastal Canal by several waterways including Bayou Perot and Bayou Barataria.

Calcasieu River Basin (03)

1.0 Physical Description

The Calcasieu River Basin is located in southwestern Louisiana and is positioned in a north-south direction. The drainage area of the Calcasieu Basin comprises approximately 4,105 square miles. Headwaters of the Calcasieu River are in the hills west of Alexandria. The river flows south for about 215 miles to the Gulf of Mexico; the mouth of the river is about 30 miles east of the Texas-Louisiana state line. The landscape in this basin varies from pine forested hills in the upper end to brackish and salt marshes in the lower reach around Calcasieu Lake. The Calcasieu River Basin includes portions of Natchitoches, Rapides, Vernon, Beauregard, Allen, Jefferson Davis, Calcasieu and Cameron Parishes.

2.0 Physiography and Geology

2.1 Land Resource Areas

The basin contains four principal physiographic areas. These are the Benthy Terrace in the upland areas, the Montgomery Terrace in the rolling hill area between the uplands and the prairie, the Prairie Terrace between the rolling hills and coastal marsh area, and the Deltaic Plain in the coastal area. Land use in the Calcasieu Basin is extremely varied due to the natural resources of the basin. The basin contains one large urban industrial area (Lake Charles, located in Calcasieu Parish). Sulphur and oil deposits, timber and port facilities have encouraged industrialization of the community. The majority of the rest of the area is rural. The following general descriptions of the remaining basin parishes reflect the variability of land use within the Calcasieu Basin.

Allen Parish, once important as a great lumber producing region, is undergoing a large reforestation project. A major portion of parish revenues are still derived from the timber industry. In Beauregard Parish, timber production plays a major role in the economy. Considerable sheep and cattle raising occurs in the parish, and the principal agricultural crops are sweet potatoes and vegetables. The southernmost parish in the basin is Cameron Parish, which borders the Gulf of Mexico. Much of the parish is covered with marshland which serves as a wintering ground for migratory birds. Fur trapping is extensive, and the fish and shrimp industry is important. There are also rich farmlands which give big yields of corn, rice, figs, and oranges. Jefferson Davis Parish is a farming parish with rice being the most important crop. Other major crops are potatoes, cotton and truck crops. Over 2,000 farms are found in the parish, which is also among the largest oil producing parishes of the State. Rapides Parish is in the midst of a rich agricultural section. Cotton is the mainstay of the parish, though there is much diversified farming, with crops including sugar cane, corn, forage, and vegetables. Cotton is also the principal crop in Vernon Parish. Timber has been of decreasing importance. Part of the parish has been converted into the Kisatchie National Forest, a conservation and reforestation project.

2.2 Geology

The Calcasieu River flows from the upland hills with elevations generally being around 260 feet above mean sea level (a maximum of 400 feet above mean sea level). The river flows through the coastal prairie and coastal marshes, which have an elevation ranging from 1-2 feet above mean sea level. The flood plains are extremely flat with little relief and average 2-3 feet above mean sea level. Lakes traversed include Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake. Dominant features include oxbow lakes, natural levees and the surrounding Pleistocene Uplands.

General soil areas in the Calcasieu River Basin are the Flatwoods, the Coastal Prairies and the Coastal Marsh soil series groups. The-Flatwoods group is a poorly drained forested soil developed from Pleistocene sediments. Coastal Marsh soils are organic clays and sandy beaches derived from stream sediments and marine deposits.

3.0 Hydrology

The Calcasieu River varies from a small, fast stream in the headwaters to a broad, sluggish estuary from the latitude of Lake Charles to its entrance to the Gulf of Mexico. Flows in the upper basin may range from a high of 180,000 cfs in the winter and spring to zero during the summer and fall. Precipitation is generally greatest during December through April and usually very sparse during May through October. Average annual rainfall in the basin ranges from 55 inches in the western portion to 61 inches in the eastern portion of the basin. The 50 percent duration flow in the Calcasieu and its major tributaries ranges from 0.35 to 0.73 cfs/mi^2 of drainage area.

The Calcasieu River is tidally influenced for the lower 50 miles, from St. John's Pass to the saltwater barrier above the City of Lake Charles. The barrier divides the river into the riverine freshwater portion above and the estuarine, saltwater portion below. By preventing saltwater intrusion, the barrier protects the upper Calcasieu from degradation and thus preserves the major source of irrigation water for rice production. The lower portion of the river from the City of Lake Charles to the Gulf is subject to tidal variation. A semi-diurnal tide extends 65 miles upstream and has mean tidal ranges of 1.7 feet at the river mouth and 0.7 foot at Lake Charles. Navigation improvements have modified the Calcasieu from its mouth approximately 52.6 river miles inland.

The Calcasieu Basin is located in a water-rich area of the United States. The area not only receives abundant rainfall, but also has vast sources of untapped groundwater. Aquifers containing fresh groundwater underlie most of the basin except for the coastal area. The aquifers are generally of fairly high quality and yield large volumes of fresh water. The Chicot Aquifer underlies most of the Calcasieu River Basin. The Calcasieu River Basin is dotted with numerous lakes and reservoirs. Major waterbodies within the basin include: Calcasieu Lake, Bundick Lake, Lake Charles, Prien Lake, Moss Lake, Sweet Lake, Black Lake, and Mud Lake.

The Intracoastal Waterway (E-W) crosses the Calcasieu River just above Calcasieu Lake. In addition to the Intracoastal Waterway both the Calcasieu River and Houston River are navigable with 71 and 20 miles navigable length respectively.

Lake Pontchartrain Basin (04)

1.0 Physical Description

The Lake Pontchartrain Basin, located in southeastern Louisiana, consists of the tributaries and distributaries of Lake Pontchartrain, a large estuarine lake. The basin is bounded on the north by the Mississippi state line, on the west and south by the east bank Mississippi River levee, on the east by the Pearl River Basin, and on the southeast by Breton and Chandeleur Sounds. This basin includes Lake Borgne, Breton and Chandeleur Sounds, and the Chandeleur Islands. The Lake Pontchartrain Basin encompasses approximately 5,960 square miles within Louisiana. The northern part of the basin consists of wooded uplands, both pine and hardwood forests. The southern portions of the basin consist of cypress-tupelo swamps and lowlands and brackish and saline marshes. The marshes of the southeastern part of the basin constitute the most-rapidly eroding area along the Louisiana coast. Elevations in this basin range from minus five feet at New Orleans to over two hundred feet near the Mississippi border.

2.0 Physiography and Geology

2.1 Geology

The Lake Pontchartrain Basin lies entirely in what is known as the Quaternary Lowlands. In the basin, these lowlands are composed of the Bentley Terrace, Red River Alluvial Cane, Mississippi Alluvial Plain, Prairie Terrace, and Deltaic Plain. The East Gulf Coastal Plain is the major physiographic province in the basin.

The soils in the basin belong to three major groupings: Coastal Plain, Mississippi Terrace Hills, and Loessial. The soils of the Coastal Plain are believed to be developed from unconsolidated sand, clays, and sandy clays of early geologic periods. The Mississippi Terrace Hills and Loessial soils are wind blown on alluvial silts and flatwoods which are forested soils developed from pleistocene and tertiary materials. Mississippi alluvial and coastal marsh soils are also present in the basin.

3.0 Hydrology

The Lake Pontchartrain Basin consists of the tributaries and distributaries of Lake Pontchartrain. Lake Pontchartrain is a brackish natural lake in southeast Louisiana with a surface area of 632 square miles and a tributary drainage area of approximately 4,900 square miles. Major tributaries draining into Lake Pontchartrain are the Tangipahoa and Tchefuncte Rivers, Lake Maurepas, and Bayous Lacombe and Bonfouca. Lesser tributaries include Bayous Chinchuba, Castine, and Cane. The Bonnet Carre Spillway serves as an intermittent source of inflow when used for flood control on the Mississippi River. The drainage systems of Jefferson and Orleans Parishes discharge storm flows into the lake on the south shore. Tributaries discharging into Lake Maurepas include the Blind, Amite, and Tickfaw Rivers. Pass Manchac links Lake Maurepas to Lake Pontchartrain. Rigolets and Chef Mentuer Pass are natural distributaries or outlets of Lake Pontchartrain which discharge to Lake Borgne. The Inner Harbor Navigation Channel, the Intracoastal Waterway, and the Mississippi River Gulf Outlet are man made navigable waterways that inter-link the Mississippi River, the Gulf of Mexico and Lake Pontchartrain for commercial shipping operations.

Mermentau River Basin (05) and Vermilion - Teche River Basin (06)

1.0 Physical Description

The physiography, geology, hydrology, and climate of the Mermentau River Basin and Vermilion-Teche River Basin will be discussed jointly because the basins are adjacent and share common characteristics.

The Mermentau River Basin is located in southwestern Louisiana, and it encompasses the prairie region of the state and a section of the coastal zone. The Mermentau River Basin is bounded on the north and east by the Vermilion-Teche River Basin, on the west by the Calcasieu River Basin, and on the south by the Gulf of Mexico. The Mermentau River Basin is approximately 3,710 square miles in area, excluding the gulf waters segment.

The Vermilion-Teche River Basin lies in south-central Louisiana. The upper end of the basin lies in the central part of the state near Alexandria, and the basin extends southward to the Gulf of Mexico. The basin is bordered on the north and northeast by a low escarpment and the lower end of the Red River Basin. The Atchafalaya River Basin is to the east, and the Mermentau River Basin is to the west. The Vermilion-Teche River Basin has an area of approximately 4,000 square miles.

2.0 Physiography and Geology

2.1 Land Resource Areas

These basins are composed of three different and distinctive land forms which are arranged in broad bands from north to south. The northern part of the basins is a flatwoods area which gives way to an undulating landscape extending northward into the drainage basins of the Calcasieu and Red Rivers. To the south of the flatwoods area lies a broad prairie which extends from the Bayou Teche on the east into the Calcasieu Basin to the west. The prairie is characterized by large expanses of flat grassland dissected by the numerous tributaries of these basins and with scattered areas of oak trees and other mixed hardwoods. The prairie, which is extensively cultivated, gives way to a band of marshland which extends from east to west along Louisiana's entire coastline. The marsh is further subdivided into a fresh water marsh which borders the prairie to the north and a salt water marsh which forms the coastline adjacent to the Gulf of Mexico and its bays. The flatwoods and the prairie are generally considered upland areas while the marshland is considered a coastal area.

2.2 Geology

Geological sediments underlying the Mermentau River Basin and Vermilion-Teche River Basin accumulated in the modern Mississippi River Delta, in the flanking Chenier Plain, and in older Pleistocene Age fluvial and deltaic depositional systems. Sediment types span the textural spectrum from sand to mud. Shell and organic debris including peat are lesser constituents. Surface and near surface sediments in the eastern portion of the Vermilion-Teche Basin were deposited in geologically recent times by the Mississippi Delta System. These sediments accumulated in abandoned delta distributary channels, natural levees and crevasse splays, and on the adjacent delta plain. Consolidation of these sediments allows marsh and swamp vegetation to thrive as the land subsides.

The older Pleistocene fluvial deltaic deposits were accumulated in a manner similar to the Mississippi Delta. These deposits have a consolidation rate less than the Mississippi Delta deposits since they are older than the Mississippi Delta deposits. Geological deposits within the southern portion of these basins accumulated predominantly in the modern Chenier Plain adjacent to the Mississippi River Delta. The Chenier Plain is characterized by alternating bands of sand and mud. Westward littoral drift distributed muddy sediment from the mouth of the Mississippi along the Louisiana coast. Periodic

reductions in sediment supply because of shifts in the river mouth allowed waves to build sandy beach ridges called cheniers.

3.0 Hydrology

The slope of the land is generally from north to south with the highest elevation being in excess of 300 feet. The three major streams are the Mermentau River, the Vermilion River and Bayou Teche. Each of these streams flows south toward the Gulf of Mexico. Tables 5-2 and 6-2 provide descriptions of the stream segments in the two basins. Tables 5-3 and 6-3 list the lakes found in the Mermentau Basin and the Vermilion-Teche Basin. Because of its relatively low relief, especially in the prairie and marsh areas, this region is characterized by annual backwater flooding of agricultural lands, poor drainage, and salt water intrusion along the Gulf of Mexico. The variations in the monthly rates of precipitation are reflected in corresponding variations in the stream flows of the streams within these basins as indicated by USGS flow records. The critical, low stream flows generally occur during warm weather in September and October. The low flow, combined with a tidal influence in the coastal zone and low relief, contributes to a low natural reaeration rate and oxygen depletion.

The Mermentau River is the westernmost of the streams in the basins. It provides drainage for more than half of the area. The Mermentau River is formed by the confluence of Bayou des Cannes, Bayou Nezpique, and Bayou Plaquemine Brule. Other major tributaries to the river are Bayou Queue de Tortue and Bayou Lacassine. The Mermentau River is a vital and valuable water resource for irrigation. To prevent salt water intrusion, and to aid navigation, the Catfish Point Control Structure was installed below Grand Lake. The Mermentau River empties into the Gulf of Mexico and is subject to tidal action below the Catfish Point Control Structure.

Relief along the Mermentau and its tributaries is low and is a contributing factor to annual backwater flooding of agricultural lands. In addition, the slope of the river and its tributaries is very low and, as a result, flow is sluggish.

The Vermilion River has a well defined watershed, draining the 652 square mile area lying between the Mermentau watershed on the west and the Bayou Teche ridge on the east. The elevation of the watershed ranges from 1 foot above msl near the mouth, to 15 feet above msl at Abbeville, to 40 feet above msl at Lafayette, to 75 feet above msl at Opelousas.

The Vermilion River can be separated into two distinct sections: Upper Vermilion River and Lower Vermilion River. The Upper Vermilion River, about 12.4 miles long, runs south to the city of Lafayette, having a broad valley. Its banks are only slightly higher than the adjacent lands, and it receives drainage waters from the adjacent watershed at several points where tributary streams enter the river. The Lower Vermilion River begins at Lafayette and ends at Vermilion Bay. It has high banks and a well defined stream valley. The Intracoastal Canal intersects the Vermilion River just as it flows into Vermilion Bay. Below Abbeville, Louisiana, the Vermilion River is tidal. The mean range of normal tides at the mouth is 10 inches. The maximum variation of water level in the lower reaches during hurricanes is 8 to 10 feet.

The Vermilion River also functions as a distributary of Bayou Teche. Bayou Fusilier, a small alluvial stream about 6 miles in length, connects the Vermilion River at its head with Bayou Teche at Arnaudville. An average of about 25 percent of the flow of Bayou Teche is normally diverted through this channel into the Vermilion, although a small earth dam prevents flow at stages below about 10 feet msl. Runoff from heavy local storms in the upper Vermilion watershed occasionally causes a reversal of flow in Bayou Fusilier toward Bayou Teche.

The Ruth Canal is about 4 miles long and connects Bayou Teche with the Vermilion River. It was built by private interests for diverting a portion of the Teche flow to the Vermilion for rice irrigation. Flow is regulated by a reinforced concrete control structure with three manually operated gates.

Bayou Teche is today a comparatively small stream occupying the highest part of a very large alluvial ridge similar in size to the nearby ridge of the Mississippi River. Elevations on the ridge near the

bayou range from 30 feet above sea level at Port Barre to 20 feet at New Iberia and 10 feet at Franklin. The ridge slopes gently to the swamps which lie from one to three miles back on either side where elevations are generally from 5 to 10 feet lower than near the bayou. Since all local drainage is away from the stream, it functions principally as a flume, conveying drainage from Bayou Courtableau to the Vermilion and lower Teche systems.

The drainage from the upper 1,560 square miles of the Vermilion-Teche River Basin, conveyed principally by the Bayous Rapides, Boeuf and Cocodrie diversion canal on the west and the upper portion of the West Atchafalaya Basin Protection Levee (WABPL) borrow pit on the east, is intercepted by Bayou Courtableau near the center of the watershed. Under normal conditions about 20 percent of the flow leaves Bayou Courtableau and enters Bayou Teche at Port Barre, the balance continuing down the WABPL borrow pit to rejoin the Teche at Charenton. There it is diverted to West Cote Blanche Bay through the Charenton Drainage and Navigation Canal.

Drainage is diverted from the watershed at several points when stages are favorable: into Red River at Alexandria through the Rapides floodgates; into the Red River backwater area through the Coulee des Grues floodgate near Marksville; into the Atchafalaya River through the Bordelonville floodgates on Bayou des Glaises; and into the West Atchafalaya Basin Floodway through the Darbonne, Courtableau and Charenton control structures. The two weirs in the borrow pit immediately below the Courtableau drainage structure serve to divert all flow in the system below a stage of 18.0 feet msl down Bayou Teche.

Principal features of the Teche-Lower Atchafalaya system are the Berwick Locks in the Lower Atchafalaya River; Wax Lake Outlet, which diverts Atchafalaya basin floodwaters across Bayou Teche; the east and west Calumet floodgates; the Hanson Canal and lock on the right bank; the Charenton Drainage and Navigation Canal which conveys the WABPL borrow pit flow through and across Bayou Teche, entering the bayou; the Loreauville Canal on the left bank which connects the Teche to Lake Fausse Pointe and the WABPL borrow pit; Keystone Lock and Dam; Ruth Canal and Control Structure on the right bank which connects the Teche with the Vermilion River; and Bayou Fusilier on the right bank which also connects the Teche to the Vermilion River.

The U.S. Army Corps of Engineers constructed a flow augmentation project that is designed to supplement the low flows in the Vermilion River and Bayou Teche by pumping water from the Atchafalaya River just north of Krotz Springs through a series of diversion structures. Atchafalaya River water is pumped into the Bayou Teche and from there into the Vermilion River by way of the Ruth Canal and Bayou Fusilier. This project was designed both to improve water quality in the Vermilion and Teche during summer low flow conditions and to provide additional water for irrigation of the area's crops. The first pumping began in November 1982, and the project plan was implemented in June 1983.

Mississippi River Basin (07)

1.0 Physical Description

The upper Mississippi River forms the boundary between Louisiana and Mississippi, flowing in a southerly direction. The lower Mississippi River flows southeasterly through the southeastern section of Louisiana. The upper stretch of the Mississippi does not get any tributary flow from the Louisiana side, which is leveed. Tributaries do enter from Mississippi, including the Yazoo River, the Black River, the Homochitto River, the Buffalo River, and Bayou Pierre. The stretch of the Mississippi River between the Old River Control Structure and Baton Rouge does receive tributary flow from Thompson's Creek, Bayou Sara, Tunica Bayou, and Monte Sano Bayou. The river is leveed on both the east and west banks from Baton Rouge below Monte Sano Bayou to Venice. This stretch of the river is also heavily industrialized, receiving numerous industrial discharges from Baton Rouge to New Orleans. The birdfoot delta of the Mississippi, where it flows into the Gulf, consists of fresh and intermediate marshes. The Mississippi River drains over 40% of the continental United States. Four parishes lie partially within the upper reach of the Basin: Concordia, Tensas, Madison, and East Carroll.

The Lower reach of the Mississippi River Basin, located below the Old River control structure, contains portions of the following parishes:

Pointe Coupee	Iberville	St. Charles
West Baton Rouge	Ascension	Jefferson
West Feliciana	St. James	Orleans
East Baton Rouge	St. Bernard	St. John the Baptist
Plaquemines		

2.0 Physiography and Geology

2.1 Geology

The Upper Mississippi River Basin lies in the Mississippi River Flood Plain, and the predominant soil type is the Sharkey-Commerce-Crevasse Association. These soil types are level to gently sloping, vary from slightly acid to mildly alkaline, and are loamy and clayey. Sharkey soils are clayey and are found in level or depressed areas. At higher elevations, the clayey, loam Commerce soils are found. Crevasse soils are recent river deposits and are mostly sand. The land is almost entirely pasture and woodland.

The Lower Mississippi River Basin lies entirely in what is known as the Quaternary Lowlands. The Quaternary Lowlands of the basin are composed of the Bently Terrace, the Red River Alluvial Cone, the Mississippi Alluvial Plain and the Deltaic Plain. The lower portion of the basin lies in what is known as the East Gulf Coastal Plain. The elevation of the basin ranges from a minus two feet to over 200 feet above msl in the northern part of the lower basin. The soils of the lower basin are made up of the Mississippi Terrace Hills and Loessial, which are wind-blown or aeolian silts, the Mississippi Alluvium, which are recent silty and sandy soils found at higher elevations on front lands close to the river channel, and the Coastal Marsh, comprised of grass, sedge, water plants, and soil materials which are silt and clay sediments.

3.0 Hydrology

The Mississippi River drains over 40% of the continental United States. The major tributaries are shown below:

Tributary	Drainage Area (sq. mi.)	Average Discharge (cfs)	Unit Discharge (cfs/sq. mi.)
Missouri River	529,000	70,100	0.13
Ohio River	203,900	255,000	1.25
Arkansas River	160,500	45,200	0.28
Red River	91,400	57,300	0.63

A history of disastrous floods and the projection that the Lower Mississippi River would change its course provided the impetus for construction of an extensive complex of levees, control structures, and floodways which regulate the high and low flows of the river. The structures limit flow from the Mississippi River entering Old River, a branch channel at RM 314.7, except under flood conditions and discharge flood waters to distributaries, namely the Atchafalaya Basin Floodway and Bonnet Carre Spillway. Under normal river flow conditions the control structures of the Morganza Floodway, the West Atchafalaya Floodway, and the Bonnet Carre Spillway remain closed. The control structure at Old River, which is located between Vicksburg (RM 435) and Tarbert Landing (RM 306.6), diverts approximately 25% of the water from the main stem. The actual percentage diverted is dependent on discharges and stages in both the Mississippi River and Red River-Old River Complex.

In the Upper Mississippi River Basin, levees prevent flow from entering the river from the Louisiana side; however, tributary flows do enter from the Mississippi side. The Yazoo River, entering from Vicksburg, and various local streams including Bayou Pierre, and Homochitto, Big Black, and Buffalo Rivers all enter between Vicksburg and the Old River structure.

In the Lower Mississippi Basin levees prevent flow from entering the river from both sides of the river except for an area of 855 square miles drained by Tunica Bayou, Bayou Sara, Thompson Creek, and Bayou Baton Rouge. The streams in this area are of rather low flow contributing less than 0.1 percent of the flow of the Mississippi River.

The Upper and Lower Mississippi River Basins, being located between the levee crests and made of relatively impermeable soils, are not significantly affected by groundwater. Beyond the levees a shallow fresh groundwater aquifer system is maintained almost entirely by fluvial recharge and remains near the land surface year-round due to the low elevation. Most groundwater utilized in this area is from deep artesian aquifers.

Ouachita River Basin (08)

1.0 Physical 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 within Louisiana. 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.

2.0 Physiography and Geology

2.1 Land Resource Areas

Based on physical factors such as soils, climate, vegetation and elevation, the Ouachita River Basin can be divided into three natural regions: the Mississippi Floodplain, the Terraces, and the Hills. The rich Mississippi Floodplain is often referred to as the "lowlands" because of its low relief characteristics. This flat delta country is the primary agricultural area within the basin. In 1973 and again in 1974, this area was severely flooded. Flood levels were the highest ever recorded and greatly affected the agricultural industry in the area.

A small area of northeast Louisiana called Macon Ridge is considered the Terraces. It is in this region that the blufflands, flatwoods and prairies are found. The relief is moderate in the blufflands but low elsewhere. The Hills are located in the western section of the basin between the Red River and Ouachita River. The area is characterized by the upland forests. Because of the vast pine forests, wood, paper, pulp and plywood mills are in abundance.

2.2 Geology

Geologically considered, Louisiana is "new". Much of it consists of marine and alluvial sediments deposited after the principal structural features of surrounding regions had assumed their final form. Subsidence of the original structures was so great that few if any of the basic formations are visible. Most such rocks as appear on the surface, as well as the cores brought up in the drilling of oil wells, show that the structures, even at great depths, are comparatively recent ones. Most observable evidence belongs to the Cenozoic Era, the final and shortest unit in geological time. The Ouachita River flows through the Lower Mississippi alluvial plain. Near the Mississippi is the rich, flat delta country.

3.0 Hydrology

The Ouachita River Basin comprises the mainstem Ouachita River, the Black River, the Tensas River; and principal and minor tributaries. A number of major lakes and reservoirs are located in the Ouachita River Basin. These are listed with their surface areas in Table 8-2. For purposes of stream quality management and planning, the basin has been further divided into basin subsegments corresponding to major tributaries and portions of the mainstem. Table 8-3 identifies and describes these subsegments.

At the Arkansas/Louisiana state line, the Ouachita River has a drainage area of 10,835 square miles. The river has a total drainage area of 18,864 square miles at the point where the Tensas joins the Ouachita to form the Black River. The Black River at its confluence with the Red River has a total drainage area of 24,509 square miles. The 50 percent duration flow in the Ouachita and its major tributaries ranges from 0.18 to 0.58 cfs/mi^2 of drainage area.

The Ouachita River Basin is located within a water-rich area of the United States. Major aquifers include the Ouachita River Alluvial Aquifer, Sparta Sands, Terrace Aquifer, Alluvial Aquifer, Cockfield Formation, Cock Mountain Formation, and the Mississippi River Alluvial Aquifer.

Both the Ouachita River and the Tensas River are navigable waterways with numerous locks and dams. The Ouachita and Black Rivers combine to form 104.8 miles of navigable waterways. The Tensas River has 137.8 miles of navigable routes.

Pearl River Basin (09)

1.0 Physical Description

The Pearl River Basin lies along the southeastern Louisiana southwestern Mississippi border. This basin is bordered on the north by the Mississippi state line and on the west and south by the Lake Pontchartrain Basin. Elevations in the basin range from 350 feet above mean sea level in the northwest portion to sea level at the southern end. Correspondingly, the vegetation varies from pine forests to brackish marsh. The Pearl River Basin encompasses approximately 900 square miles, consisting of portions of Washington Parish, St. Tammany Parish, and Tangipahoa Parish.

2.0 Physiography and Geology

2.1 Land Resource Areas

Major land resource areas within the Pearl River Basin consist of Gulf Coast Marsh in the coastal regions, Southern Mississippi Valley Silty Uplands in the northeast region and Southern Coastal Plain in the rest of the basin.

In most cases, Gulf Coast Marsh soils are relatively flat with elevations ranging from sea level to less than five feet above sea level. Marshes and swamps blanket much of the area and are hydraulically connected by shallow lakes, bayous and stream channels. The principal uses of the area are for hunting, trapping and fishing. The drier areas are grazed seasonally, but most of the land is not suitable for agricultural use because the land is subject to periodic flooding from tide flows or stream overflows with water of high salinity. Reeds, cattails, bulrushes, freshwater marsh grasses and salt grasses are common to the area. Near coastal sections, mangrove may be found, while along the landward boundaries of the region, forests of cypress-tupelo-gum and other wetland hardwoods are prominent.

Southern Mississippi Valley Silty Uplands lie in hilly to steep plains with elevations ranging from 100 to 400 feet. The sharply dissected plains have a thick loess mantle which is underlain by unconsolidated sands, silts and clays, mainly of marine origin. Most of the land is in pastureland and forests. Much of the area is owned by pulp and paper companies with lumber, pulpwood and naval stores comprising the principal forest products.

The Southern Coastal Plain lies in a gently to strongly sloping dissected coastal plain which is underlain by unconsolidated sands, silts and clays. Elevations range from 100 to 350 feet with local relief usually in the tens of feet. Nearly all of the area is farmed but only about one-tenth to one-third of the area is used as cropland and less than one-tenth is used as pastures. As much as 75 percent of the area is woodland, and lumber, pulpwood, and naval stores are major products. Peanuts, tobacco, melons, strawberries, various vegetable crops and corn are important produce in this region. Rainfall, numerous perennial streams, and ground water supplies provide abundant water.

2.2 Geology

Quaternary deposits blanket the entire basin area and occur as stream terrace and alluvial valley fill. Underlying Miocene and Pliocene deposits are generally laminated and consist of a vast thickness of alternating sands and clays. These deposits are quite uniform in the horizontal direction but change erratically in the vertical direction. The Miocene and Pliocene deposits are virtually identical lithologically and together form a gulfward thickening wedge of sand, silt and clay beds, many thousands of feet thick at the southern limit. The Miocene deposits are overlain by Pliocene deposits which in turn are covered by Quaternary deposits. All of these deposits possess water bearing capacities and are used extensively as sources of groundwater.

General soil areas within the study area include Coastal Plain, Flatwoods, Recent Alluvium and Coastal Marsh. The Coastal Plain association is found in the north central portion of the basin and includes Ruston, Orangeburg, Bowie and Beauregard soils. Ruston and Orangeburg soils are gently to strongly sloping while Bowie and Beauregard soils are nearly level to gently sloping. Surface soils are grayish brown sandy loams; subsoils are sandy clay loams. Soils of this association are low in organic matter and are used chiefly for growing pine timber and for grazing cattle and sheep.

The Flatwoods association is found between the Coastal Plain associations in the north central portion of the basin and the Recent Alluvium association which borders the Bogue Chitto and Pearl Rivers. This association includes Caddo, Beauregard, Hammond and Wrightsville soils, all of which are level or nearly level. Caddo and Wrightsville soils contain very fine sandy loam surface soils and grayish-brown to gray silt loam subsoils. Hammond soils are yellow and gray in color, consist of a mottled sandy clay loam, and are overlain by very fine sandy loam surface soils which are grayish brown in color. In general, soils of this association are poorly drained, moderately to strongly acidic and low in organic matter. Principal uses are for pine forests and grazing.

The Bibb, Ochlockonee, Chastain and Waverly soils comprising the Recent Alluvium association are found along the bottom lands of the Bogue Chitto and Pearl Rivers. Sediments range in composition from silty to sandy and clayey. Bibb loams are gray and sandy, Ochlockonee loams are brown and sandy and Waverly loams are gray and silty. Chastain soils have a gray silty clay loam or silty clay surface underlain by grayish-brown or gray clay subsoils. The soils are acidic, contain low to moderate amounts of organic matter and are used primarily for hardwoods and grazing.

Coastal Marsh soils lie along the extreme southern section of the basin and contain considerable amounts of peat, muck and clay. Marsh clays are dark gray in color and may at times be covered with peat or muck layers which are two feet or more in thickness. The land is used chiefly for hunting, fishing, trapping and recreation.

3.0 Hydrology

3.1 Surface Water

Surface water areas within the Pearl River Basin consist of the Pearl, East Pearl and West Pearl Rivers, the Bogue Chitto River, Bogue Lusa Creek and Pushepatapa Creek. There are no major lakes or reservoirs contained in the basin boundaries. The Pearl River defines the eastern boundary of the basin, flowing north to south for approximately 70 miles. Average, maximum and minimum flows at Bogalusa (1977) were 9442 cfs, 56,100 cfs and 1560 cfs, respectively. The river splits into the West Pearl and Pearl Rivers midway down the basin. The rivers flow parallel to one another and empty into the Mississippi Sound. Land between the two rivers is poorly drained - consisting of numerous swamps, marshes and bayous.

The Bogue Chitto River flows southward for about 40 miles from north of Franklinton to the West Pearl River. Average, maximum and minimum flows near Bush (1977) were 1943 cfs, 33,900 cfs and 600 cfs, respectively. Bogue Lusa Creek originates in central Washington Parish and flows south and east for about 20 miles to the Pearl River at Bogalusa. Average, maximum and minimum flows at Bogalusa (1977) were 85.5 cfs, 751 cfs and 23 cfs, respectively. Pushepatapa Creek flows in a southeasterly direction for about 15 miles from north of Bogalusa. No flow on Pushepatapa Creek is available.

3.2 Groundwater

Aquifers containing fresh groundwater underlie the entire Pearl River Basin with the exception of the extreme coastal regions where salt water intrusion is likely. Major aquifers include the Mio-Pliocene aquifer, the Pleistocene aquifer and the Mississippi River Valley alluvial aquifer.

The Mio-Pliocene aquifer is the deepest within the basin and extends to depths of over 3500 feet. Sands associated with the aquifer are uniformly graded with coefficients of permeability generally within

the range of 250 to 1000 gpd per square foot. Variable sand thicknesses result in coefficients of transmissibility on the order of 100,000 to 300,000 gpd per foot. Well yields of several hundred to 1000 gpm are common and yields in excess of 3000 gpm are possible. Water in the Mio-Pliocene sands is generally soft, locally corrosive and of a sodium bicarbonate type. Fluoride content varies and may locally exceed recommended limits. Dissolved solids content increases southward where saltwater intrusion becomes significant.

Groundwater associated with Quaternary deposits is contained in the Pleistocene and Mississippi Valley alluvial aquifers. The Pleistocene aquifer overlies the Mio-Pliocene deposits and consists of poorly sorted sands ranging from fine to coarse and graveliferous. Sand thicknesses vary, permeability is limited and coefficients of transmissibility are generally less than 200,000 gpd per foot. Well yields are low to moderate. Freshwater in the Pleistocene aquifer is generally soft and low in dissolved solids content. Water in St. Tammany Parish, however, is corrosive and along the coastal reaches of the basin is high in chloride content.

The Mississippi River Valley alluvial aquifer is contiguous with the Pleistocene aquifer and is also in hydraulic contact with the Mississippi River. Deposits range from very fine sand to gravel and thicknesses are variable from less than 50 feet to more than 250 feet. Permeability coefficients range from less than 500 to more than 3000 gpd per square foot. Coefficients of transmissibility range from 40,000 to about 600,000 gpd per foot. Water from the Mississippi River Valley alluvial aquifer is hard and high in iron content. Despite the chemical quality of the water, the aquifer possesses the greatest potential for further development with well yields as high as 6000 gpm.

Red River Basin (10)

1.0 Physical Description

The Red River has its origin in eastern New Mexico and flows across portions of Texas, Oklahoma, and Arkansas before entering northwestern Louisiana. The river flows southward to Shreveport, where it turns southeastward and flows for approximately 160 miles to its junction with the Atchafalaya River. From the Arkansas state line to Alexandria, the Red River is contained within high banks which range from 20 to 35 feet above low water level. Below Alexandria, the river flows through a flat alluvial plain which is subject to backwater flooding during periods of high water. The Sabine River Basin lies to the southwest of the Red River Basin, and the Ouachita River Basin lies to the east. The Calcasieu, Vermilion-Teche, and Atchafalaya River Basins lie south of the Red River Basin. The Red River drains approximately 7,760 square miles within Louisiana and includes portions of 14 parishes and all of Bossier, Webster, and Red River Parishes.

2.0 Physiography and Geology

2.1 Land Resource Areas

Major land resource areas contained within the Red River Basin consist of Southern Coastal Plain in the eastern and western portions of the basin, Southern Mississippi Valley Alluvium along the main stem of Red River, and a small amount of Southern Mississippi Valley Silty Upland in Avoyelles Parish.

The Southern Coastal Plain is characterized by a gently to strongly sloping dissected coastal plain underlain by unconsolidated sands, silts and clays. Elevations range from 100 feet to more than 400 feet. Between one-half and three-fourths of the area is woodland, much of which is farmed. Only one-tenth is in pasture. Lumber, pulpwood and naval stores are major forest products and rice, melons and corn are principal cash crops. Rainfall, numerous perennial streams and abundant groundwater supplies provide most of the water needs.

The Southern Mississippi Valley Alluvium is characterized by level to gently sloping broad flood plains with elevations ranging from less than 100 feet to more than 400 feet. Most of the region is used for farming but artificial drainage is often needed before the land can be successfully used for crops. About 10 percent of the region is in woodlands with the remainder being a fairly even distribution between croplands and pastures. Major cash crops include small grain, soybeans, corn, cotton, and grain sorghum. Water needs are supplied by an abundance of rainfall, streamflow and groundwater.

Southern Mississippi Valley Silty Uplands lie in hilly to steep plains with elevations ranging from 100 to 400 feet. The sharply dissected plains have a thick loess mantle which is underlain by unconsolidated sands, silts and clays, mainly of marine origin. Most of the land in this category in the Red River Basin is in cropland.

2.2 Geology

Quaternary and tertiary deposits comprise the major geological formations in the basin. Significant structural features in the basin include the Sabine Uplift and numerous salt domes. Quaternary formations are commonly found adjacent to the Red River and its tributaries and are of alluvial origin. The Pleistocene deposits associated with the Quaternary system typically consist of clays and silts overlying sands and gravels. These flood plain deposits are well developed north of the Red River and were formed as a result of worldwide changes in sea level during the Ice Age.

Holocene sediments, also of the Quaternary system, were deposited directly by the Red River and may be subdivided into a substratum and topstratum zone. The gravels and sands associated with the substratum were deposited when the Red River was a braided stream. The topstratum, on the other hand, consisting of lays, silts, silty sands and sands, was formed when the Red River changed from a braided stream to a meandering one. Depositional characteristics of these Holocene and Pleistocene deposits are often complex due to the continual shifting of the Red River's course..

The most significant geological feature in the basin is the Sabine Uplift. Situated in Caddo Parish, this domal feature is approximately 80 miles long and 65 miles wide. The oldest exposed strata found on the formation are of Tertiary age. Numerous salt domes blanket the central portion of the basin and may be found in Webster, Bienville, Natchitoches, Winn and Rapides Parishes. Important accumulations of hydrocarbons, sulfur and gypsum, as well as salt may be found in these structures. Only one dome in the basin (near Minden), however, is being used for petroleum production.

General soil areas within the study area include Recent Alluvium, Coastal Plain and Flatwoods. The Yahola, Norwood, Miller and Perry soils comprising the Recent Alluvium association are found along the bottom lands of the Red River. Yahola soils are very fine reddish brown sandy loams found on level and nearly level natural levee ridges. The reddish brown silt loams associated with the Norwood soils are also found along these natural levee ridges whereas the reddish brown clay and silty clay surface soils of the Miller soils are generally restricted to the level backslopes of the ridges. Perry soils are gray or dark gray in color and may be found in the backswamps at elevations below the Yahola, Norwood or Miller soils. All soils contain moderate amounts of organic matter and abundant mineral plant nutrients. Most of the Yahola and Norwood soils can be cultivated while Miller and Perry soils are used principally for forests and pastures.

Soils within the Coastal Plain association can be found in the sandy hill lands of the central and north central part of the basin (Ruston, Orangeburg, Bowie and Beauregard soils), the red hill lands of the northeastern, central and northern part of the basin (Shubuta, Kirvin, Nacodotches and Luverne soils), and the rolling pine hill lands of the central and northwestern part of the basin (Susquehanna, Sawyer and Boswell soils). Ruston and Orangeburg soils are gently to strongly sloping while Bowie and Beauregard soils are nearly level to gently sloping. Surface soils are grayish-brown sandy loams; subsoils are clay loams. These soils are low in organic matter and are used chiefly for growing pine timber and for grazing cattle and sheep.

Surface soils of the red hill lands contain grayish-brown and brown fine sandy loams. Sandy clay subsoils are red for Kirvin soils and yellowish-red to red for Shubuta soils. Subsoils for Nacodotches soils contain red clay and for Luverne soils contain dark red sandy clay loams. These soils contain low to moderate amounts of organic matter and mineral plant nutrients and are strongly to moderately acidic. Major uses are for grazing and hay as well as for pine and mixed forests.

Soils found in the rolling pine hill lands are strongly sloping (Susquehanna) to moderately and gently sloping (Sawyer and Boswell). Susquehanna soils have brownish-gray fine sandy loam surface soils and gray mottled red clay subsoils. Sawyer soils have grayish-brown fine sandy loam surface soils and gray mottled red clay subsoils. Sawyer soils have grayish-brown fine sandy loam surface soils and yellow mottled sandy clay subsoils. Surface soils of the Boswell group are the same as that of Sawyer soils but subsoils are red clay. These soils are low in organic matter and plant nutrients, moderately to strongly acidic, and highly susceptible to erosion when cultivated. Major uses are for growing pine timber and for grazing.

3.0 Hydrology

3.1 Surface Water

By far, the most significant hydrologic element in the Red River Basin is the Red River itself. In addition to the Red River, there are numerous major tributaries and several large lakes which are found throughout the basin.

The Red River originates in the high plains of west Texas and New Mexico, flows eastward forming a natural boundary between Texas and Oklahoma as well as Texas and Arkansas, and then passes through Arkansas before finally turning south to enter the northwest corner of Louisiana. The Red River, between the Louisiana state line to its confluence with the Atchafalaya River and its mouth, covers a distance of 328 miles. The average annual flow is 17,920 cfs at Hosston, Louisiana, and is 30,400 cfs at Alexandria, Louisiana. The flow in this reach has been regulated by Lake Texoma since October 1942, by Lake Wright Patman since 1953 and by Millwood Reservoir since 1966. Surface water records in this reach are maintained at stations near Hosston, at Shreveport and at Alexandria. These records show that at Shreveport and Alexandria the maximum discharge on the river occurred during February-May 1945 when heavy rainfall throughout the basin produced extensive flooding. A record discharge of 303,000 cfs was measured at Shreveport on April 5 and a peak discharge of 233,000 cfs occurred at Alexandria twelve days later. The maximum discharge recorded at Hosston, 214,000 cfs, occurred during flooding in April-May 1958.

Ten major tributaries with drainage basins comprising 93 percent of the total basin area enter the Red River within the basin. Of these, the Cypress Creek-Twelve Mile Bayou, Loggy Bayou, Bayou Pierre, Saline Bayou, and Cane River Basins account for 86 percent of the combined drainage basin areas.

Cypress Creek-Twelve Mile Bayou Basin has a total drainage area of 3522 square miles and is located in the northwestern portion of the basin near Shreveport. Major tributaries include Black Cypress Creek, Little Cypress Creek and James, Black and Cross Bayous. Average discharge of Twelve Mile Bayou near Dixie, Louisiana, has been determined to be 2492 cfs. A maximum discharge of 38,400 cfs was recorded in May, 1968.

Bayou Pierre, located in the east-central portion of the basin, has a drainage area of 1119 square miles. Major tributaries include Wallace Bayou, Smithport Lake, Jim's River and Johnson Chute.

Located on the east side of the Red River, the Saline Bayou Basin has a drainage area of 1379 square miles. The stream flows southward from Arcadia, Louisiana, approximately 100 miles to the Red River below Natchitoches. Major contributing streams include Black Lake Bayou and Leatherman Creek.

Extending from Clarence, through Natchitoches, to Colfax, the Cane River drains 748 square miles on the west bank of the Red River. Major contributing tributaries include Bayou Santabarb, Kisatchie Bayou and Old River.

Of the ten major tributaries comprising the Red River Basin, the remaining five, Porten Bayou, Bayou Rigolette, Big Larto Bayou, Bayou Cocodrie and Bayou Natchitoches, have a combined drainage area of approximately 2000 square miles. Other less significant tributaries account for the remaining seven percent of the total drainage area within the Red River Basin.

There are numerous man-made hydrologic structures in the Red River Basin. Perhaps the most common ones are the various lake-dam structures for flood control. They include Bayou Bodcau Flood Control Reservoir, Ferry Lake, Black Lake, Lake Bistineau, Smithport Lake, Sibley Lake, Lake Iatt and Cotile Reservoir. In addition along the Red River itself, several levee and hydrographic modifications

have been made. They include Campti-Clarence Levee, Index, Arkansas to Pineville, Louisiana and to Boyce, Louisiana Levee, Sabine and Double Eddy Cutoffs, Pineville levee, embankment and drainage improvement, and Red River Parish levee. Levee improvement or construction along Loggy Bayou and Cane River are examples of other works in the basin.

The U.S. Army Corps of Engineers finished the Red River Waterway Project, a navigation, bank stabilization and recreation project in 1994. The project provided a navigation route from the Mississippi River via Old River to Shreveport, Louisiana. Five locks and dams were constructed which furnish a maximum lift of 141 feet. Bank revetment and other complementary stabilization and river training works were constructed to hold the developed channel in position. These works preserve lands and improvements along the navigation route.

3.2 Groundwater

The Quaternary deposits (Pleistocene and Holocene) which blanket the study area possess large water bearing capabilities. Most of the potable water supply, however, is obtained from the underlying Tertiary formation (Eocene and Miocene). Groundwater obtained from the shallow Holocene alluvium and Pleistocene deposits is generally unsuited for a potable water supply. With proper treatment, however, the large quantities of water obtained from these deposits may be used for livestock, irrigation and industry. Water from the Quaternary aquifers is characteristically very hard and high in iron, calcium and magnesium content. Groundwater associated with aquifers contained in Tertiary deposits, on the other hand, is generally soft and of the sodium bicarbonate type. Significant aquifer formations include the Wilcox and Claiborne Groups of Eocene age in addition to beds of Miocene age. The Wilcox Group is the oldest geologic formation but all are used extensively as a potable water source.

Sabine River Basin (11)

1.0 Physical Description

The Sabine River Basin lies along the Texas-Louisiana border, encompassing approximately 2,870 square miles of drainage area within Louisiana. The basin stretches from the Texas state line near Shreveport to the Gulf of Mexico, and it includes portions of all the western Louisiana parishes. It is bounded on the east by the Red River Basin and Calcasieu River Basin. Characteristic vegetation ranges from mixed forests in the upper basin to hardwoods in the mid-section and brackish and saline marshes in the lower end.

2.0 Physiography and Geology

2.1 Land Resource Areas

The three major land resource areas within the Sabine River Basin consist of Gulf Coast Marsh, Gulf Coast Prairies and Southern Coastal Plain.

The Gulf Coast Marsh occupies most of Cameron Parish and portions of Calcasieu Parish in the basin. It is relatively flat with elevations from sea level to less than five feet above sea level. Marshes and swamps cover much of the area and are broken by shallow lakes, bayous and stream channels. High water salinities, in addition to periodic flooding from tide flows or by stream overflows, prevent the use of most of the area for agriculture. The drier portions are grazed seasonally, but the principal uses of the area are for hunting, trapping and fishing. Reeds, cattails, bulrushes, freshwater marsh grasses and salt grasses occupy most of the area. Near coastal sections, mangrove may be found, while along the landward boundaries of the region, forests of cypress, tupelo, gum and other wetland hardwoods are prominent.

The Gulf Coast Prairies occupies a small belt in Calcasieu Parish between the Southern Coastal Plain and the Gulf Coast Marsh. This LRA varies in elevation from sea level to about 200 feet. Nearly all the area is in farms. Rice, cotton, corn, grain sorghum and alfalfa and other hay are the major crops.

The Southern Coastal Plain extends northward from northern Calcasieu Parish and lies in a gently to strongly sloping dissected coastal plain with elevations from 100 to more than 400 feet. Between one-half and three-fourths of the area is woodland and nearly all of the area is farmed. Only one-tenth to one-third of the area, however, is cropland and less than one-tenth is in pasture. Lumber, pulpwood and naval stores are major forest products and rice, soybeans, grain sorghum and corn are important cash crops. Rainfall, numerous perennial streams and groundwater supplies provide an abundant source of water.

2.2 Geology

Quaternary deposits blanket the basin and occur as stream terrace or alluvial valley fill. Underlying Miocene and Pliocene deposits of the Tertiary age are generally laminated and consist of a vast thickness of alternating sands and clays.

The Pleistocene and recent alluvial deposits associated with the Quaternary system comprise the major geological features in the basin. The Pleistocene terrace deposits were formed as a result of drastic changes in sea level following the Ice Age while recent alluvial deposits, on the other hand, were deposited from the numerous rivers and streams which flow throughout the basin. In general, the composition of each terrace deposit ranges from gravel near the base to sands, silts and clays near its surface. Silts and sands are the dominant types of sediments and occur in the shape of large or small lenses, depending on local conditions and time of deposition.

The Miocene and Pliocene deposits are virtually identical lithologically and together form a gulfward thickening wedge of sand, silt and clay beds many thousands of feet thick at the southern limit. These deposits possess large water bearing capacities and are used extensively as a source of potable groundwater.

General soil areas within the study area include Coastal Marsh, Recent Alluvium, Coastal Prairie, Flatwoods and Coastal Plain.

Coastal Marsh soils lie along the extreme southern and coastal sections of the basin and contain considerable amounts of peat, muck and clay. Marsh clays are dark gray in color and may, at times, be covered with peat or muck layers which are two or more feet in thickness.

The Bibb, Ochlockonee, Chastain and Waverly soils comprising the Recent Alluvium association are found along the bottom lands of the Sabine River. Sediments range from silty to sandy and clayey. Loams associated with these soils are gray and sandy for Bibb, brown and sandy for Ochlockonee and gray and silty for Waverly. Chastain soils have a gray silty clay loam or silty clay surface underlain by grayish-brown or gray clay subsoils. The soils are acidic, contain low to moderate amounts of organic matter and are used primarily for hardwoods and grazing.

Very few areas containing Coastal Prairie soils are found in the basin area. Isolated products may be found within the Coastal Marsh region and along the eastern boundary of the basin in Calcasieu Parish. In general, the soils of this association (Crowley, Midland, Lake Charles and Katy) are comprised mostly of silt and clays and contain moderate amounts of organic matter and plant nutrients.

The Flatwoods association stretches along the eastern boundary of the basin from northern Calcasieu Parish to northern Beauregard Parish. The association includes Caddo, Beauregard, Hammond and Wrightsville soils, all of which are level to nearly level. Caddo and Wrightsville soils contain very fine sandy-loam surface soils and grayish-brown to gray silt-loam subsoils. Hammond soils are yellow and gray in color, consist of a mottled sandy clay loam and are overlain by very fine sandy loam surface soils which are grayish-brown in color. In general, soils of this association are poorly drained, moderately to strongly acidic and low in organic matter. Principal uses are for pine forests and grazing.

Soils within the Coastal Plain association can be found in the sandy hill lands of the central part of the basin (Ruston, Orangeburg, Bowie and Beauregard soils), the red hill lands of southern Sabine Parish (Shubuta, Kirvin, Nacogdoches and Luverne soils), and the rolling pine hill lands of the northern part of the basin (Susquehanna, Sawyer and Boswell soils).

Ruston and Orangeburg soils are gently to strongly sloping while Bowie and Beauregard soils are nearly level to gently sloping. Surface soils are grayish-brown sands loams, subsoils are clay loams. The soils are low in organic matter and are used chiefly for growing pine timber and for grazing cattle and sheep.

Surface soils of the red hill lands contain grayish-brown and brown fine sandy loams. Sandy clay subsoils are red for Kirvin soils and yellowish-red to red for Shubuta soils. Subsoils for Nacogdotches soils contain red clay and for Luverne soils contain dark red sandy clay loams. These soils contain low to moderate amounts of organic matter and mineral plant nutrients and are strongly to moderately acidic. Major uses are for grazing and hay as well as for pine and mixed forests.

Soils found in the rolling pine hill lands are strongly sloping (Susquehanna) to moderately and gently sloping (Sawyer and Boswell). Susquehanna soils have brownish-gray fine sandy loam surface soils and gray mottled red clay subsoils. Sawyer soils have grayish-brown fine sandy loam surface soils and yellow mottled sandy clay subsoils. Surface soils for Boswell soils are the same as that of Sawyer soils but subsoils are red clay. These soils are low in organic matter and plant nutrients, moderately to

strongly acidic and highly susceptible to erosion when cultivated. Major uses are for growing pine timber and for grazing.

3.0 Hydrology

3.1 Surface Water

By far, the most significant surface water feature in the basin is the Toledo Bend Reservoir which extends approximately 72 miles northward from the Sabine-Vernon parish line along the Sabine River. Completed in October, 1966, the rolled earthfill dam reservoir is operated for hydroelectric power generation and water conservation. The reservoir covers about 186,000 acres and is the nation's fourth largest man-made lake. There are three other man-made reservoirs in the basin, all of which are significantly smaller than the Toledo Bend. Lake Vernon and Anacoco Lake are located on Anacoco Bayou in Vernon Parish while the remaining unnamed reservoir is located on the Sabine National Wildlife Refuge in Cameron Parish.

The largest natural occurring lake is Sabine Lake which is located at the southern end of the basin just above the Sabine River's entrance into the Gulf of Mexico. The southern reaches of Sabine Lake contain saline waters and are tidally influenced. Table 11-2 lists the lakes of the Sabine River Basin and their surface areas.

The Sabine River is the largest river in the basin and includes eight major tributaries. Six of these, Bayou Castor, Grand Cane, San Patricio, San Miguel, La Nana and Negreet, flow into the Toledo Bend Reservoir while the remaining two, Bayou Toro and Anacoco, flow into the Sabine below the dam. Stream segment descriptions for the Sabine River Basin are provided in Table 11-3.

3.2 Groundwater

Freshwater aquifers within the basin originated from Quaternary and Tertiary deposits. Of these water bearing deposits, the Miocene are the deepest extending down to 3100 feet below sea level, while Quaternary are the shallowest extending down to 100 feet below sea level.

Groundwater obtained from Pleistocene deposits is generally unsuited for a potable water supply. The water is characteristically hard, high in iron content, and increasingly salty with depth. With proper treatment, however, the large quantities of water obtained from these deposits may be used for livestock, irrigation and industry. Water obtained from Miocene deposits is generally soft and used extensively for a potable water supply. Aquifers associated with these deposits slope gulfward where saltwater intrusion increases the dissolved solids content and results in a deterioration of water quality.

Terrebonne Basin (12)

1.0 Physical Description

The Terrebonne Basin covers an area extending approximately 120 miles from the Mississippi River at Morganza on the north to the Gulf of Mexico on the south. It varies in width from 18 miles to 70 miles. This basin is bounded on the west by the Atchafalaya River Basin and on the east by the Mississippi River and Bayou Lafourche. The Terrebonne Basin drains an area of approximately 3,200 square miles. The topography of the entire basin is lowland, and all the land is subject to flooding except the natural levees along major waterways. The coastal portion of the basin is prone to tidal flooding and consists of marshes ranging from fresh to saline. All of Terrebonne Parish and portions of Pointe Coupee, West Baton Rouge, Iberville, Assumption, Ascension, St. Martin, St. Mary, Iberia and Lafourche Parishes are included in this basin.

2.0 Physiography and Geology

2.1 Land Resource Areas

Major land resource areas within the Terrebonne Basin consist of Gulf Coast Marsh in the southern portion of the basin and Southern Mississippi Valley Aluvium in the central and northern sectors.

Gulf Coast Marsh is relatively flat with elevations ranging from sea level to less than five feet above sea level. Marshes and swamps cover much of the area and are broken by shallow lakes, bayous and stream channels. High water salinities, in addition to periodic flooding from tide flows or by stream overflows, prevent the use of most of the area for agriculture. The drier portions are grazed seasonally, but the principal uses of the area are for hunting, trapping and fishing. Reeds, cattails, bulrush, freshwater marsh grasses and salt grasses occupy most of the area. Near coastal sections mangrove may be found and along the landward boundaries of the region, forests of cypress, tupelo, gum and other wetland hardwoods are prominent.

The Southern Mississippi Valley Alluvium is mostly flat, consisting of nearly level to gently sloping broad flood plains and low terraces. Most of the region is used for farming, but artificial drainage of surplus water is necessary before the land can be successfully used for crops. About 10 percent of the region is in woodlands with the remainder being fairly evenly distributed between croplands and pastures. Major cash crops within the area include rice, soybeans, corn, cotton and sugarcane.

2.2 Geology

The study area consists of low lying coastal marshlands in the south and gently sloping broad flood plains with low terraces and natural levees elsewhere. Quaternary deposits blanket the area and occur as stream terrace and alluvial valley fill. Underlying Miocene and Pliocene deposits are generally laminated and consist of a vast thickness of alternating sands and clays. These deposits are horizontally uniform but change vertically in an erratic fashion.

The Miocene and Pliocene deposits are virtually identical lithologically and together form a gulfward thickening wedge of sand, silt and clay beds many thousands of feet thick at the southern limit. The Miocene deposits are overlain by Pliocene deposits which, in turn, are covered by Quaternary deposits. All of these deposits possess water bearing capacities and are used extensively as sources of groundwater.

General soil areas within the study area include Recent Alluvium and Coastal Marsh. Recent Alluvium soils in the basin are classified in either the Commerce or Sharkey series depending on their location. Commerce soils predominate along the natural levee ridges which parallel the stream channels

of the Mississippi River and Bayou Lafourche. These brown, grayish brown or yellowish brown soils vary from silt loams to very fine sandy loams and may be mottled with gray at depths below 24 inches. They contain moderate amounts of organic matter and an abundance of mineral plant nutrients. As a result, those areas protected from overflow are often used for crops and pastures.

Sharkey soils occupy the backswamp and backland area adjacent to the Mississippi River and Bayou Lafourche. Often accompanied with Tunica soils and swamp clays, these poorly drained soils consist of dark gray to dark grayish brown clays. They contain moderate to high amounts of both organic matter and mineral plant nutrients but are infrequently used for agricultural benefits because of repeated flooding.

Coastal Marsh soils lie along the southern and coastal extremities of the basin and are characterized by considerable amounts of peat, muck and clay. Marsh clays are dark gray in color, high in organic matter and mineral plant nutrients and may, at times, be covered with peat or muck layers which are two or more feet in thickness. Coastal regions are inundated by daily tides which may occasionally rise from their normal depths of 12 to 18 inches to depths in excess of six feet during tropical storms.

3.0 Hydrology

3.1 Surface Water

Surface water areas within the Terrebonne Basin comprise a complex combination of interconnecting rivers, lakes, bayous and canals. Most of this surface water is found in the southern half of the basin where coastal marsh and estuarine regions prevail. Navigable canals throughout the basin are numerous, the largest of which include the Intracoastal Waterway, the Port Allen to Morgan City Intracoastal Waterway, and the Houma Navigation Canal. The Intracoastal Waterway has a project depth of twelve feet, is 125 feet wide and stretches 1115 miles from Brownsville, Texas to Apalachicola, Florida, of which approximately 65 miles lie within the Terrebonne Basin between Morgan City and Larose. The Port Allen to Morgan City Intracoastal Waterway connects the two cities and is twelve feet deep and 125 feet wide. The Houma Navigation Canal runs 16 miles southward from the Intracoastal Waterway at Houma and then southeasterly for 10.5 miles to the Terrebonne Bay. The canal has a project depth of 15 feet and extends to a width of 150 feet.

Surface water flow over the basin is generally toward the Gulf of Mexico. The shallowness of most of the water, particularly in the southern and coastal regions of the basin, creates flow conditions which are highly susceptible to tidal and aeolian influences. A combination of tidal factors and southerly winds, for example, may produce conditions of no flow, and in some instances even a northerly flow. Interconnections between shallow bodies of water (bayous, canals, bays marshland and estuarine areas) result in a different flow pattern for each set of wind, tide and rainfall conditions. During hurricanes, water can move inland in vast quantities, endangering both life and property. Salinities in the coastal region range from that of sea water, through brackish, to fresh. These conditions result from fresh water flowing from the north, meeting salt water. Streams may or may not be stratified and may vary with time from fresh to very salty at a single location.

3.2 Groundwater

Freshwater aquifers within the Terrebonne Basin originate from Quaternary, Pliocene and Miocene deposits. Of these water-bearing deposits, the Miocene are the deepest (up to 3500 feet below sea level) while the Quaternary are the shallowest (up to 1000 feet below sea level).

Deposits within the Miocene and Pliocene (Mio-Pliocene) zones make up the Mio-Pliocene aquifer. Sands within this aquifer are uniformly graded with coefficients of permeability generally within the range of 250 to 1000 gpd per square foot. Variations in sand thickness and continuity result in a wide range for coefficients of transmissibility (usually between 100,000 to 300,000 gpd per foot). Well yields as

high as 1000 to 3000 gpm are possible in most areas, with even higher well yields possible where screening of all or nearly all available sands is implemented. Water in the Mio-Pliocene aquifer is generally soft. Dissolved solids content (associated with sodium chloride) increases southward where saltwater intrusion becomes significant.

Aquifers associated with the Quaternary deposits include the Pleistocene aquifer and the Mississippi River Valley Alluvial aquifer. The Pleistocene aquifer overlies the Mio-Pliocene deposits and consists of poorly sorted sands ranging from fine to coarse and graveliferous. Sand thicknesses vary, permeability is limited and coefficients of transmissibility are generally less than 200,000 gpd per foot. Well yields are low to moderate. Water is generally soft and low in dissolved solids content, except in the southern downdip where saltwater intrusion may be significant.

The Mississippi River Valley Alluvial aquifer is contiguous with the Pleistocene aquifer and also in hydraulic contact with the Mississippi River. The very fine sand to gravel deposits are highly variable in thickness and range from less than 50 feet to more than 250 feet. Coefficients of permeability range from less than 500 to more than 3000 gpd per square foot, and coefficients of transmissibility extend from 40,000 to about 600,000 gpd per foot. The aquifer possesses the greatest potential for further development with well yields as high as 6000 gpm. Water is generally hard and high in iron content.

Large quantities of groundwater are available throughout the basin for both industrial and domestic use. The use of this groundwater, however, is significantly affected by its quality, which varies greatly because of vast amounts of brackish and saline waters within the basin.

In general, aquifers from Quaternary, Pliocene and Miocene deposits north of the 30° latitude have no major groundwater problems and commonly yield more than 1000 gallons per minute of freshwater suitable for domestic use. Heavy industrial withdrawals in the Baton Rouge area, however, have resulted in a decline of water levels by 100 to 300 feet or more in the West Baton Rouge and southeastern Pointe Coupee Parishes and have increased the potential of contamination from saltwater encroachment.

South of the 30° latitude, groundwater sources are found in Quaternary deposits alone and range from brackish to saline. Much of this water is suitable for little else but industrial cooling. Sufficient quantities of fresh groundwater for domestic and industrial use are difficult to obtain with the exception of isolated layers or lenses from which pumping must be carefully controlled to prevent saltwater encroachment.