GUIDE TO LOUISIANA'S GROUND-WATER RESOURCES

By C.G. Stuart, Darwin Knochenmus, and Benton D. McGee

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CONTENTS

FIGURES

TABLES

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Abstract

Ground water is one of the most valuable and abundant natural resources of Louisiana. Of the 4.4 million people who live in the State, 61 percent use ground water as a source for drinking water. Most industrial and rural users and half of the irrigation users in the State rely on ground water. Quantity, however, is not the only aspect that makes ground water so valuable; quality also is important for its use. In most areas, little or no water treatment is required for drinking water and industrial purposes.

Knowledge of Louisiana's ground-water resources is needed to ensure proper development and protection of this valuable resource. This report is designed to inform citizens about the availability and quality of ground water in Louisiana. It is not intended as a technical reference; rather, it is a guide to ground water and the significant role this resource plays in the State.

Most of the ground water that is used in the State is withdrawn from 13 aquifers and aquifer systems: the Cockfield, Sparta, and Carrizo-Wilcox aquifers in northern Louisiana; Chicot aquifer system, Evangeline aquifer, Jasper aquifer system, and Catahoula aquifer in central and southwestern Louisiana; the Chicot equivalent, Evangeline equivalent, and Jasper equivalent aquifer systems in southeastern Louisiana; and the Mississippi River alluvial, Red River alluvial, and upland terrace aquifers that are statewide.

Ground water is affected by man's activities on the land surface, and the major ground-water concerns in Louisiana are: (1) contamination from surface disposal of hazardous waste, agricultural chemicals, and petroleum products; (2) contamination from surface wastes and saltwater through abandoned wells; (3) saltwater encroachment; and (4) local overdevelopment.

Information about ground water in Louisiana is extensive and available to the public. Several State and Federal agencies provide published and unpublished material upon request.

WHY IS GROUND WATER IMPORTANT IN LOUISIANA?

Louisiana is fortunate to have such an abundant supply of ground water. This reliable resource is continuously replenished by about 56 inches of rainfall each year (Louisiana Office of Climatology, 1989, p. 3). Quantity is not the only aspect that makes ground water a vital resource for the citizens of the State. Quality also is important for its use. In most areas of the State, little or no water treatment is required to improve or enhance quality for drinking-water and industrial purposes.

Ground water is one of the most valuable and abundant natural resources of Louisiana.

Ground water is one of the most valuable and abundant natural resources for approximately 4.4 million people in the State of Louisiana. Of this number, an estimated 2.7 million people, or about 61 percent of the population, use ground water for household use. Most rural users and more than half the irrigation users in the State rely on ground water to meet their daily water needs. (See Lovelace, 1991.)

WHY WAS THIS REPORT WRITTEN AND HOW IS IT ORGANIZED?

FREQUENTLY ASKED QUESTIONS ARE ANSWERED

- ☑ *Why is ground water important in Louisiana?*
- ☑ *What is the overall ground-water situation in Louisiana?*
- ☑ *What is the nature of Louisiana's aquifers?*
- ☑ *How much water is in Louisiana's aquifers?*
- ☑ *What is the quality of water in Louisiana's aquifers?*
- ☑ *How much water is withdrawn from Louisiana's aquifers?*
- ☑ *Where can ground water be found in Louisiana?*
- ☑ *What are potential ground-water problems in Louisiana?*
- ☑ *Where can ground-water information be obtained in Louisiana?*

Knowledge of Louisiana's ground-water resources is needed to ensure proper development and protection of the many productive aquifers and aquifer systems that play a significant role in providing fresh ground water to the people of this State. This report, prepared by the U.S. Geological Survey (USGS), in cooperation with the Louisiana Department of Transportation and Development (DOTD), has been designed to inform citizens about the availability and quality of ground water in Louisiana. It is not intended as a technical reference; the report is a guide to ground water and the significant role the resource plays in the State.

The report begins with a brief introduction to ground-water hydrology. Knowledge of certain terms and concepts are important in forming a basic understanding of the mechanics of ground water. Most of the report consists of descriptions of the 13 aquifers and aquifer systems in Louisiana: (1) Cockfield aquifer, (2) Sparta aquifer, (3) Carrizo-Wilcox aquifer, (4) Chicot aquifer system, (5) Evangeline aquifer, (6) Jasper aquifer system, (7) Catahoula aquifer, (8) Chicot equivalent aquifer system, (9) Evangeline equivalent aquifer system, (10) Jasper equivalent aquifer system, (11) Mississippi River alluvial aquifer, (12) Red River alluvial aquifer, and (13) upland terrace aquifer. Most of the ground water that is used in the State is pumped or withdrawn from these 13 aquifers and aquifer systems.

Following the discussion of the aquifers and aquifer systems in Louisiana is a section that describes potential ground-water problems in the State. A list of sources and types of ground-water information also is included. Responsibilities of each governmental agency, as well as the types of ground-water information available from each agency, are included for interested citizens.

WHAT ARE SOME IMPORTANT GROUND-WATER CONCEPTS?

Hydrology is the science of the behavior of water. Ground water and its movement are a part of this science. Ground water refers to water that lies beneath the land surface. More than 2 million cubic miles of fresh ground water is stored beneath the earth's surface (U.S. Geological Survey, 1984, p. 5). Water fills the pores in the layers of sand and gravel that lie beneath the land surface. Water in these void spaces provides flow to wells and springs; its source is precipitation.

Essential to the understanding of the occurrence of ground water is the concept known as the hydrologic cycle (fig. 1). It is an endless circulation of water that has occurred since the beginning of time. Water evaporates from the land and oceans and is carried into the atmosphere where it precipitates as rain, snow, sleet, or hail.

Some of this precipitation evaporates back into the atmosphere, while some of it falls to the land surface. Precipitation that falls into streams, rivers, and lakes ultimately flows back into the oceans, and the hydrologic cycle starts again.

Part of the precipitation that falls on the surface of the earth infiltrates into the pores and cracks of the soil and percolates into the ground. When the pores and cracks are full, and no more water can be absorbed, the excess water flows down hillsides back into the streams. Some of the water that is stored underground flows back into rivers or is used by plants, which transpire it back into the atmosphere.

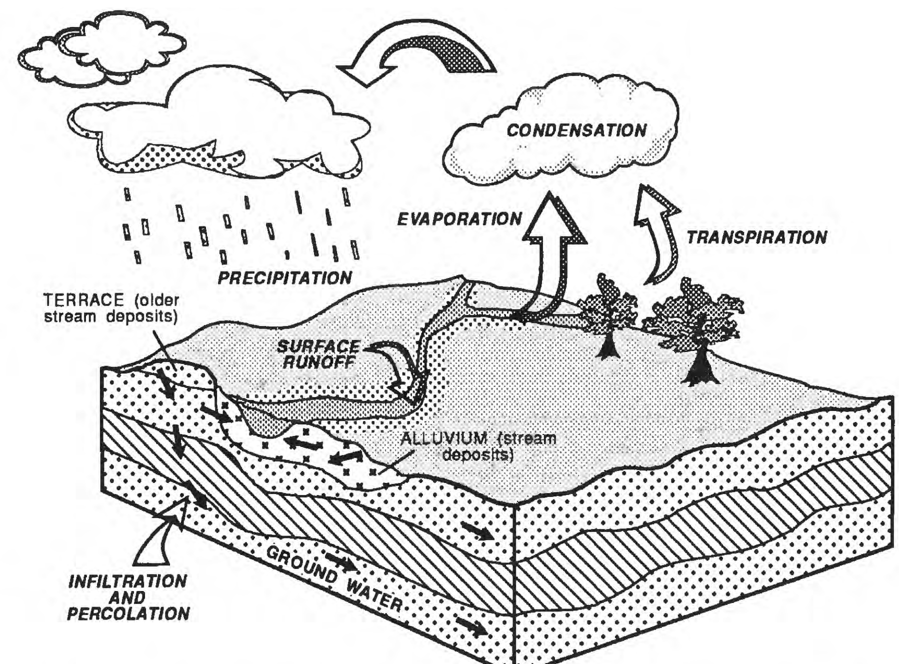


Figure 1. Hydrologic cycle. Arrows indicate direction of ground-water flow.

Ground water is found in aquifers (also referred to as ground-water reservoirs). "Aqua" is the Latin word for "water" and "fer" comes from a word meaning "to carry." Aquifers are geologic formations or parts of formations that yield significant quantities of water to wells and springs. An aquifer system is a group of two or more aquifers which are hydraulically connected, meaning that water can flow from one to the other. Louisiana aquifers are composed primarily of sand and gravel.

The amount of water that is stored underground depends on the porosity of the soil or rock, that is, the proportion of pore space to the total volume. Permeability, or the ability to transmit water, is determined by the size and interconnections among the pores and cracks in an aquifer. Larger, uniform pores that are interconnected will transmit water more readily than smaller ones such as those in clay.

Aquifers generally are classified as artesian or water-table (fig. 2). Artesian aquifers, also known as confined aquifers, are those that are confined by overlying and underlying relatively impermeable formations (clay) that restrict water movement into or out of an aquifer. The water level in a well completed in an artesian aquifer will rise above the top of the aquifer. Water levels in some artesian wells rise above the land surface. These wells are known as flowing artesian wells (fig. 2).

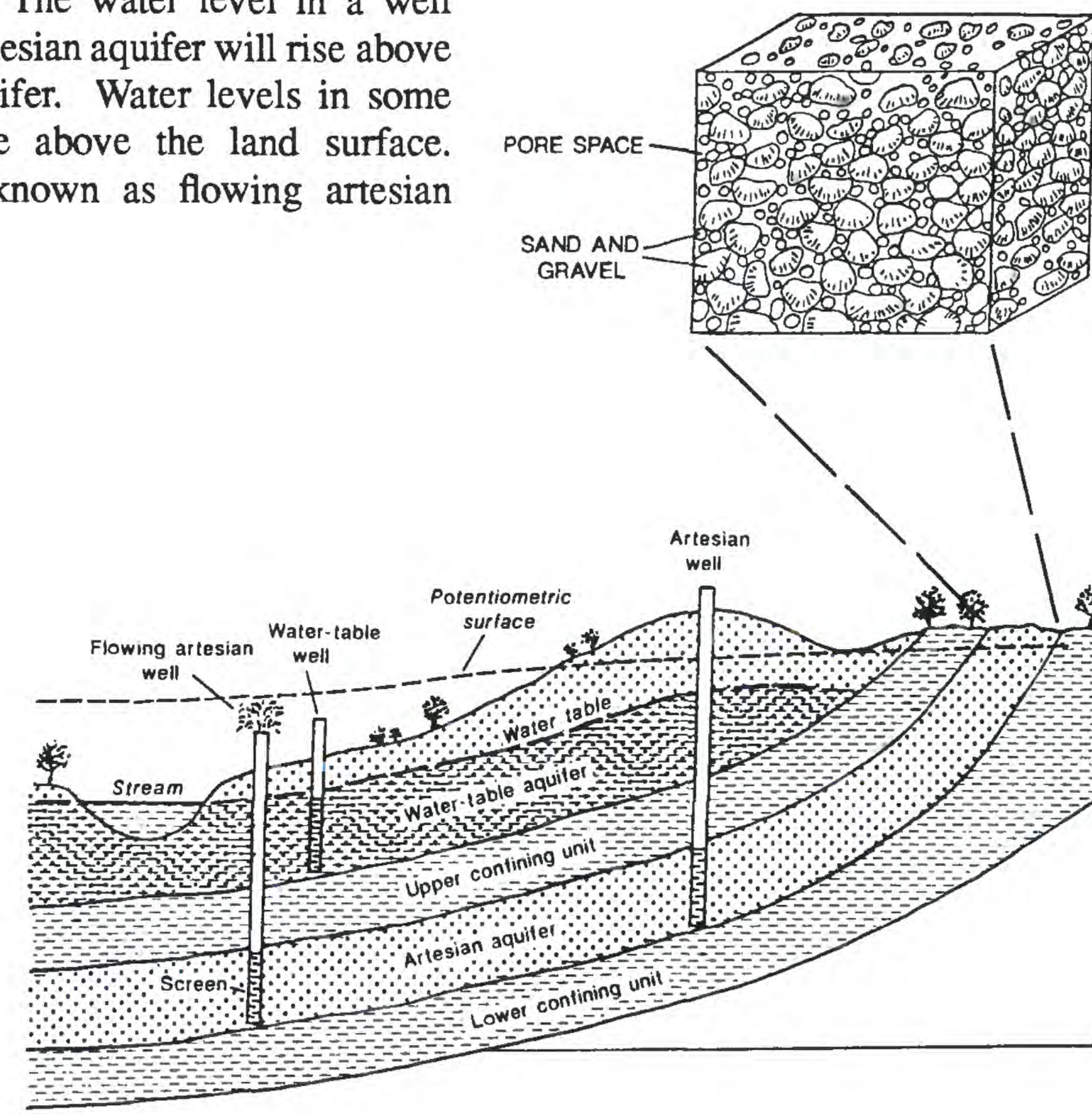


Figure 2. Water table (unconfined), artesian (confined), and flowing artesian conditions and hypothetical packing of aquifer materials.

Water-table aquifers, also referred to as unconfined aquifers, are those in which the water is not confined by low permeability units. The upper surface of the water within an unconfined aquifer is called the water table; thus, the name water-table aquifer. Water in a well completed in a water-table aquifer stands at about the same level as water in the aquifer outside the well. Water can enter a water-table aquifer directly from recharge areas causing a rise in the water level. The water table is a specific type of potentiometric surface. A potentiometric surface is defined as the level to which water will rise in a tightly cased well in an aquifer.

Pumping from a well can lower water levels in and around the well creating what is known as a cone of depression. The well becomes the center of the depression on the water surface. In artesian systems, the effect of drawdowns may extend for many miles. If wells are closely spaced and the pumping is great enough, pumping from one well can significantly affect the water level in nearby wells.

Recharge is the addition of water to the ground-water system. It is the movement of water primarily in a vertical direction. Areas where the aquifer is at or near the land surface and water moves rapidly into the aquifer are called recharge areas. Recharge rates vary from year to year causing seasonal fluctuations in the ground-water level.

Discharge is the loss or removal of water from an aquifer. It can occur naturally by evapotranspiration, by seepage of water into streams and lakes, and by movement of water between adjacent aquifers. Artificially, water is discharged by the pumping of water wells.

Ground water is constantly moving from recharge areas to areas of discharge. Movement, under natural conditions, is very slow. Contrary to what many people believe, ground water moves only at rates of a few feet per year. In some areas, however, where the aquifer consists of coarse sand and gravel and the water surface has a steeper than average slope, the ground water is capable of moving a few feet per day. Ground-water velocities also increase near pumping wells.

WHAT IS THE OVERALL GROUND-WATER SITUATION IN LOUISIANA?

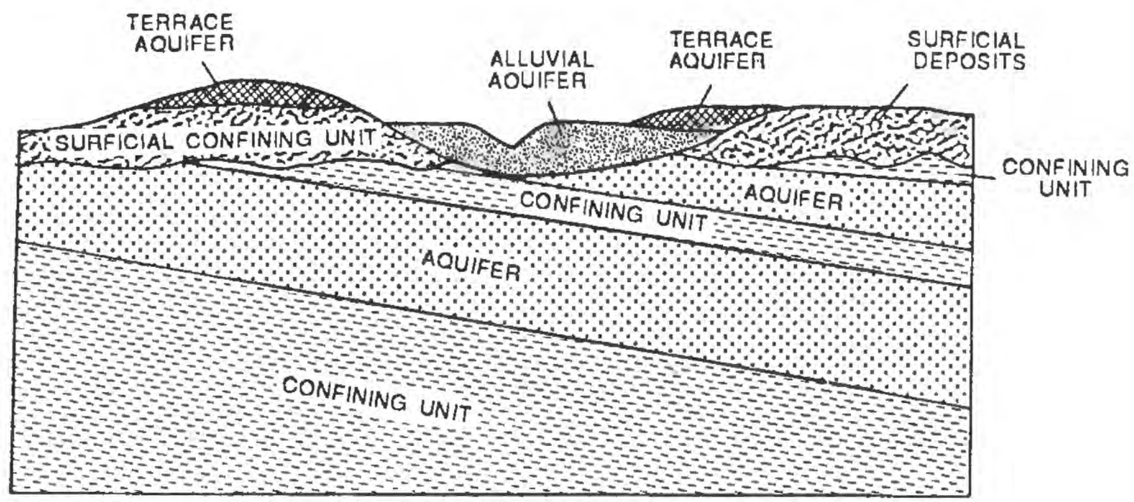


Figure 3. Typical relation between aquifer units in Louisiana.

What is the Nature of Louisiana's Aquifers?

Louisiana's basic hydrologic framework has been in the making for millions of years. Figure 3 gives a generalized picture of hydrologic systems in Louisiana by showing the relative position of aquifers beneath the land surface. Aquifers in Louisiana are primarily composed of sand and gravel and are separated or confined by layers of clay and silt. Water in the aquifers generally moves in a southerly direction and toward stream valleys. Locally, heavy pumping has caused depressions in the water table or potentiometric surface, altering the regional ground-water flow pattern.

Average annual rainfall of 45 to 60 inches filtering through permeable surficial sediments replenishes most of the water that is withdrawn from the aquifers. Recharge rates generally range from 1 to 12 inches annually (U.S. Geological Survey, 1985, p. 229).

Water in aquifers is typically under confined, or artesian, conditions; however, in recharge areas it is common for water-table conditions to exist. In the south-central and southeastern parts of Louisiana, wells in some of the deep aquifers flow at the land surface (U.S. Geological Survey, 1985, p. 229).

Aquifers and aquifer systems in Louisiana are sometimes named for geologic formations in the State, for example, the Sparta and Carnahan Bayou aquifers. Other aquifer names are derived from location or a combination of locations and approximate depth at which the producing sand occurs beneath the land's surface. Examples of these are the Gonzales-New Orleans aquifer, the "200-foot" aquifer of the Lake Charles area and the "1,200-foot" aquifer of the Baton Rouge area. The surface extent of Louisiana aquifers and aquifer systems is shown in figure 4 (all aquifers do not extend to surface). Figure 5 lists the aquifer names that are used in the State of Louisiana.

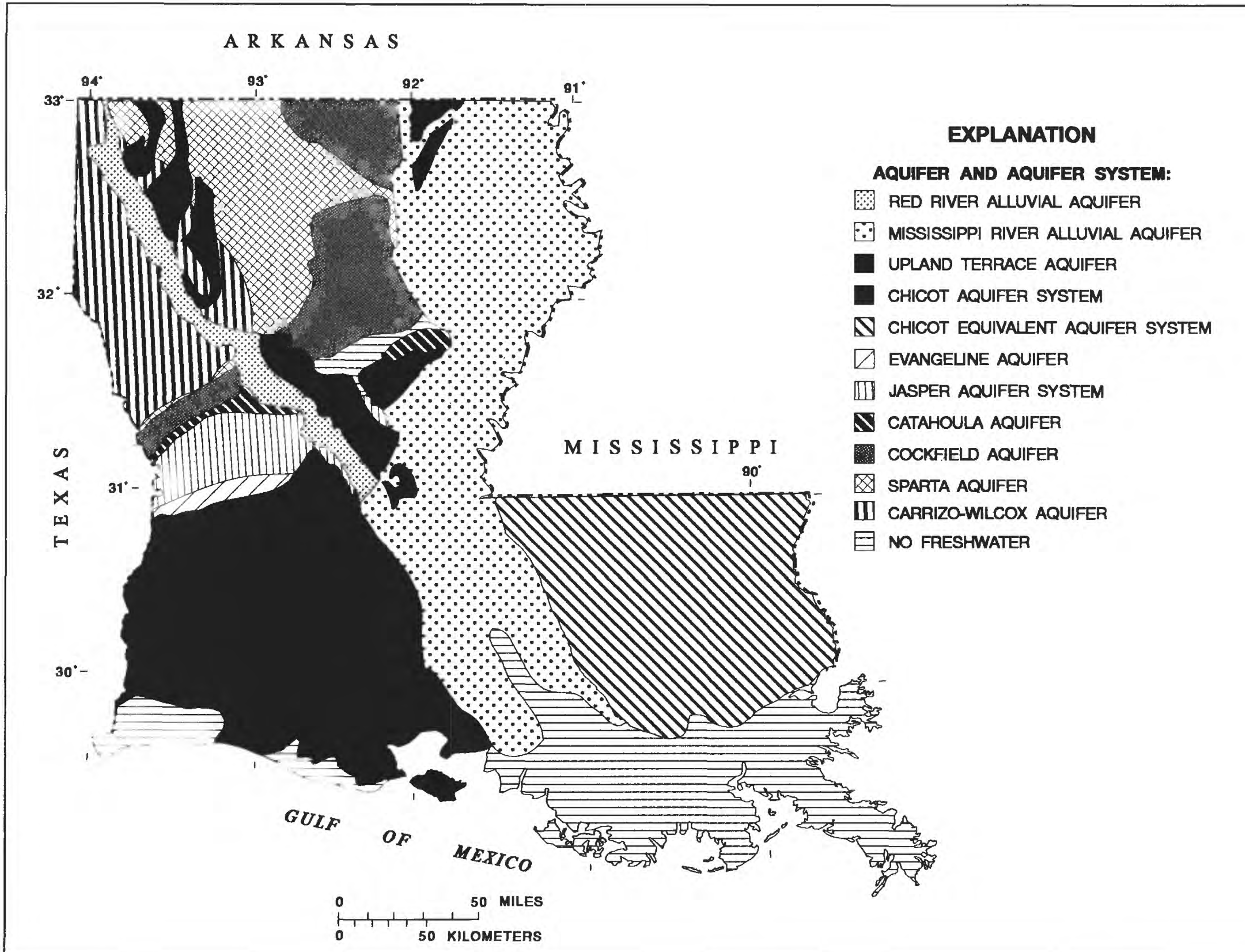


Figure 4. Surface extent of Louisiana's aquifers and aquifer systems.

System	Series	Stratigraphic unit		Hydrogeologic Unit: Northern Louisiana — Aquifer or confining unit	Central and southwestern Louisiana — Aquifer system or confining unit	Central and southwestern Louisiana — Aquifer or confining unit: Lake Charles area	Central and southwestern Louisiana — Aquifer or confining unit: Rice growing area	Southeastern Louisiana — Aquifer system or confining unit	Southeastern Louisiana — Aquifer[1]: Baton Rouge area	Southeastern Louisiana — Aquifer[1]: St. Tammany, Tangipahoa, and Washington Parishes	Southeastern Louisiana — Aquifer[1]: New Orleans area and lower Mississippi River parishes
Quaternary	Pleistocene		Red River alluvial deposits Mississippi River alluvial deposits Northern Louisiana terrace deposits Unnamed Pleistocene deposits	Red River alluvial aquifer or confining unit Mississippi River alluvial aquifer or confining unit, upland terrace aquifer or surficial confining unit	Chicot aquifer system or surficial confining unit	"200-foot" sand "500-foot" sand "700-foot" sand	Upper sand unit Lower sand unit	Chicot equivalent aquifer system or surficial confining unit	Mississippi River alluvial/shallow sand "400-foot" sand "600-foot" sand	Shallow, Upper Ponchatoula	Gramercy Norco Gonzales-New Orleans "1,200-foot" sand
Tertiary	Pliocene — ? —	Fleming Formation	Blounts Creek Member	Pliocene-Miocene aquifers do not crop out in this area	Evangeline aquifer surficial confining unit or Evangeline aquifer			Evangeline equivalent aquifer system	"800-foot" sand "1,000-foot" sand "1,500-foot" sand "1,700-foot" sand	Lower Ponchatoula Big Branch Abita Covington Slidell	
			Castor Creek Member		Castor Creek confining unit			Unnamed confining unit			
	Miocene		Williamson Creek Member Dough Hills Member Carnahan Bayou Member		Jasper aquifer system or surficial confining unit	Williamson Creek aquifer Dough Hills confining unit Carnahan Bayou aquifer		Jasper equivalent aquifer system	"2,000-foot" sand "2,400-foot" sand "2,800-foot" sand	Tchefuncta Hammond Amite Ramsay Franklinton	
			Lena Member		Lena confining unit			Unnamed confining unit			
	— ? —	Catahoula Formation			Catahoula aquifer			Catahoula equivalent aquifer system			
	Oligocene	Vicksburg Group, undifferentiated		Vicksburg-Jackson confining unit	No freshwater occurs in older aquifers						
	Eocene	Jackson Group, undifferentiated									
		Claiborne Group	Cockfield Formation	Cockfield aquifer or surficial confining unit							
			Cook Mountain Formation	Cook Mountain aquifer or confining unit							
			Sparta Sand	Sparta aquifer or surficial confining unit							
			Cane River Formation	Cane River aquifer or confining unit							
			Carrizo Sand — ? —	Carrizo-Wilcox aquifer or surficial confining unit							
		Wilcox Group, undifferentiated									
	Paleocene	Midway Group, undifferentiated		Midway confining unit							

[1]Clay units separating aquifers in southeastern Louisiana are discontinuous and unnamed.

Figure 5. Hydrogeologic column of aquifers and aquifer systems in Louisiana

What is the Quality of Water in Louisiana's Aquifers?

Quality of ground water is as important as quantity, because ground water is the source for about 93 percent of the public-supply facilities in the State (U.S. Geological Survey, 1990, p. 275) and for almost 100 percent of the rural domestic users (U.S. Geological Survey, 1988, p. 273). In much of Louisiana, ground water is available that is suitable for most uses with little or no treatment. In general, the concentration of dissolved solids is less than 500 milligrams per liter.

Freshwater (water having a chloride concentration of 250 milligrams per liter or less) occurs at depths to about 3,500 feet in some areas of central and southeastern Louisiana (Smoot, 1988). Most of the aquifers in the State contain saltwater. Aquifers along the coast contain a zone where coastward the water is completely salty and landward becomes fresher at the top of the aquifer until it is entirely fresh throughout its thickness. This transition zone is known as a saltwater wedge. Saltwater (water having a chloride concentration of 250 mg/L or greater) also is present in aquifers in inland areas. Aquifers dip toward the coast and the Mississippi River valley, and in their downdip parts saltwater is present. The origin of the saltwater in the aquifer is not from present day seawater but from seawater when the aquifer was formed. Saltwater can move into freshwater parts of the aquifer by lowering freshwater levels through pumping. Such movement of saltwater or the saltwater wedge is known as saltwater encroachment. Saltwater can move laterally or vertically in an aquifer. Parishes along the coast (Terrebonne, Lafourche, Assumption, Jefferson, Orleans, Plaquemines, St. Charles, St. Bernard, and St. James), where little or no fresh ground water is present, use large amounts of water withdrawn from surface-water sources for public-supply purposes (Lovelace, 1991). Saltwater encroachment has occurred in a few places in the Chicot aquifer system of southwestern Louisiana and in some of the aquifers in south Baton Rouge.

The use of ground water also is affected by the amount of certain inorganic constituents in the water. Some of these inorganic constituents, their source or cause, effects on water use, and recommended limits are listed in table 1. Constituents that pose health risks when detected above the U.S. Environmental Protection Agency's (USEPA) recommended limits are on the USEPA's list of Primary Drinking Water Standards. Constituents that do not pose a health risk, but can still detract from the aesthetic quality of the water (color, taste, and odor), are included on the USEPA's list of Secondary Drinking Water Standards.

Hardness and high concentrations of dissolved solids and iron are common in the alluvial aquifers. Objectionable amounts of iron are also a concern for users of the Chicot aquifer system, and locally the Cockfield and Sparta aquifers (U.S. Geological Survey, 1988, p. 273). In the New Orleans area, as well as some areas that withdraw water from the Sparta aquifer, Evangeline aquifer, and Jasper aquifer system, high color (15 platinum-cobalt units) in ground water creates a problem for users. High concentrations of sodium in some agricultural areas around the State make water unsuitable for the irrigation of crops (table 1). Figure 6 shows the comparative water quality for selected Louisiana aquifers and aquifer systems.

There is growing public concern about the potential for pollution of ground water by surface wastes and agricultural chemicals. Water samples from approximately 70 wells have been collected and analyzed by the USGS, in cooperation with the DOTD for organic compounds (Stuart and Demas, 1990). Results of these analyses have indicated almost no organic contamination of water in aquifers and aquifer systems across the State.

How Much Water is Withdrawn from Louisiana's Aquifers?

All of the aquifers in Louisiana are used to some extent. The Chicot aquifer system is the most heavily pumped aquifer in the State, and it is pumped mainly for irrigation. The areas around the cities of Baton Rouge (East Baton Rouge Parish), DeRidder (Beauregard Parish), and Lake Charles (Calcasieu Parish) are the most heavily pumped local areas. Five-year water-use information collected and analyzed by the USGS in cooperation with DOTD indicates that ground-water use decreased by approximately 7 percent between 1985 and 1990 (Lovelace, 1991). The primary reason for this decrease was a decrease in pumping in the rice-irrigation areas of southwestern Louisiana.

Table 1. Properties and inorganic constituents that can affect water use

[Data from Heath, 1983; Hem, 1985; and U.S. Environmental Protection Agency, 1977; 1986; and 1987. Table modified from Tomaszewski, 1992; mg/L, milligrams per liter]

Property or constituent	Major natural source or principal cause	Effects on water use	Concentrations or values of significance [1]
pH	Acidic and basic constituents dissolved in water.	The pH of water is a measure of its acidity. Low values of pH, particularly below pH 7, indicate a corrosive water that will tend to dissolve metals and many other substances that it contacts. High values of pH, particularly above pH 8.5, indicate an alkaline water that, on heating, will tend to form scale. The pH significantly affects the treatment and use of water.	6.8 to 8.5[2] pH values (standard units): less than 7--acidic 7--neutral more than 7--basic (alkaline)
Color	Usually results from leaching of natural organic materials.	Has no direct chemical significance on water use, the effects are principally aesthetic.	15 Platinum-cobalt units[2]
Hardness	Calcium and magnesium dissolved in the water.	Calcium and magnesium combine with soap to form an insoluble precipitate (curd) and, thus, hamper the formation of a lather. Hardness also affects the suitability of water for use in the textile and paper industries, other industries, and in steam boilers and water heaters	USGS classification of hardness (mg/L as $CaCO_3$): 0 to 60--Soft 61 to 120--Moderately hard 121 to 180--Hard more than 180--Very hard
Calcium and magnesium	Soils and rocks containing limestone, dolomite, and gypsum. Small amounts from igneous and metamorphic rocks.	Principal cause of hardness and boiler scale and deposits in hot-water heaters.	25 to 50 mg/L
Sodium	Same as for chloride.	See chloride. In large concentrations, may affect persons with cardiac difficulties, hypertension, and certain other medical conditions. Sodium may be detrimental to certain irrigated crops.	20 to 270 mg/L
Sulfate	The minerals gypsum, pyrite, and rocks that contain sulfur compounds.	In certain concentrations, gives water a bitter taste and, at higher concentrations, has a laxative effect. In combination with calcium forms a hard calcium carbonate scale in steam boilers.	250 mg/L[2] 300 to 400 mg/L (taste)

Table 1. Properties and inorganic constituents that can affect water use--Continued

Property or constituent	Major natural source or principal cause	Effects on water use	Concentrations or values of significance [1]
Chloride	In inland areas, primarily from seawater trapped in sediments at time of deposition; in coastal areas, from seawater in contact with freshwater in productive aquifers; also weathering by-product of minerals.	In large amounts, increases corrosiveness of water and, in combination with sodium, gives water a salty taste.	250 mg/L[2]
Fluoride	Both sedimentary and igneous rocks. Not widespread in objectionable quantities.	In certain concentrations, reduces tooth decay; at higher concentrations, causes mottling of tooth enamel.	2.0 mg/L[2] 4.0 mg/L[3]
Dissolved solids	Minerals dissolved in water.	Dissolved solids is a measure of the total amount of minerals dissolved in water and is, therefore, a very useful factor in the evaluation of water quality. Water containing less than 500 mg/L is preferred for domestic use and for many industrial processes.	500 mg/L[2] USGS classification of water based on dissolved solids (mg/L): less than 1,000--Fresh 1,000-3,000--Slightly saline 3,000-10,000--Moderately saline 10,000-35,000--Very saline more than 35,000--Brine
Nitrogen, nitrite plus nitrate	Decomposition of organic material in soils and from industrial and agricultural chemicals.	Essential for plant and animals. High concentrations of nitrate may cause methomoglobinemia in small children. Large concentrations in ground water generally are considered to be to be indicators of pollution.	10 mg/L[3]
Iron and manganese	Iron is present in most soils and rocks. Manganese is less widely distributed.	Stain laundry and are objectionable in food processing, dyeing, bleaching, ice manufacturing, brewing, and certain other industrial processes.	Iron 0.3 mg/L[2] Manganese 0.05 mg/L[2]

[1] A range in concentration is intended to indicate the general level at which the effect on water use might become significant.
[2] Secondary maximum contaminant level as determined by the U.S. Environmental Protection Agency.
[3] Maximum contaminant level as determined by the U.S. Environmental Protection Agency.

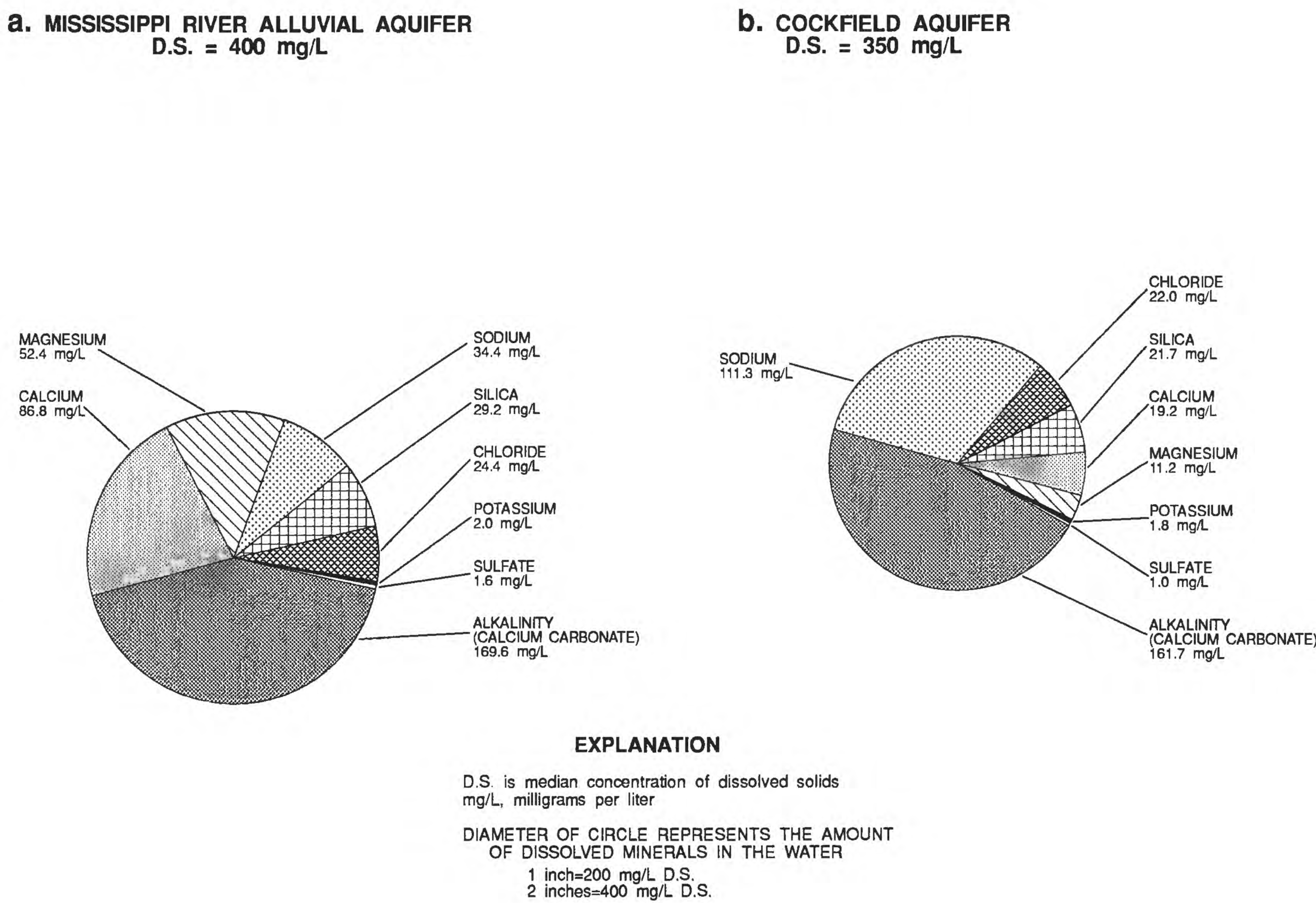
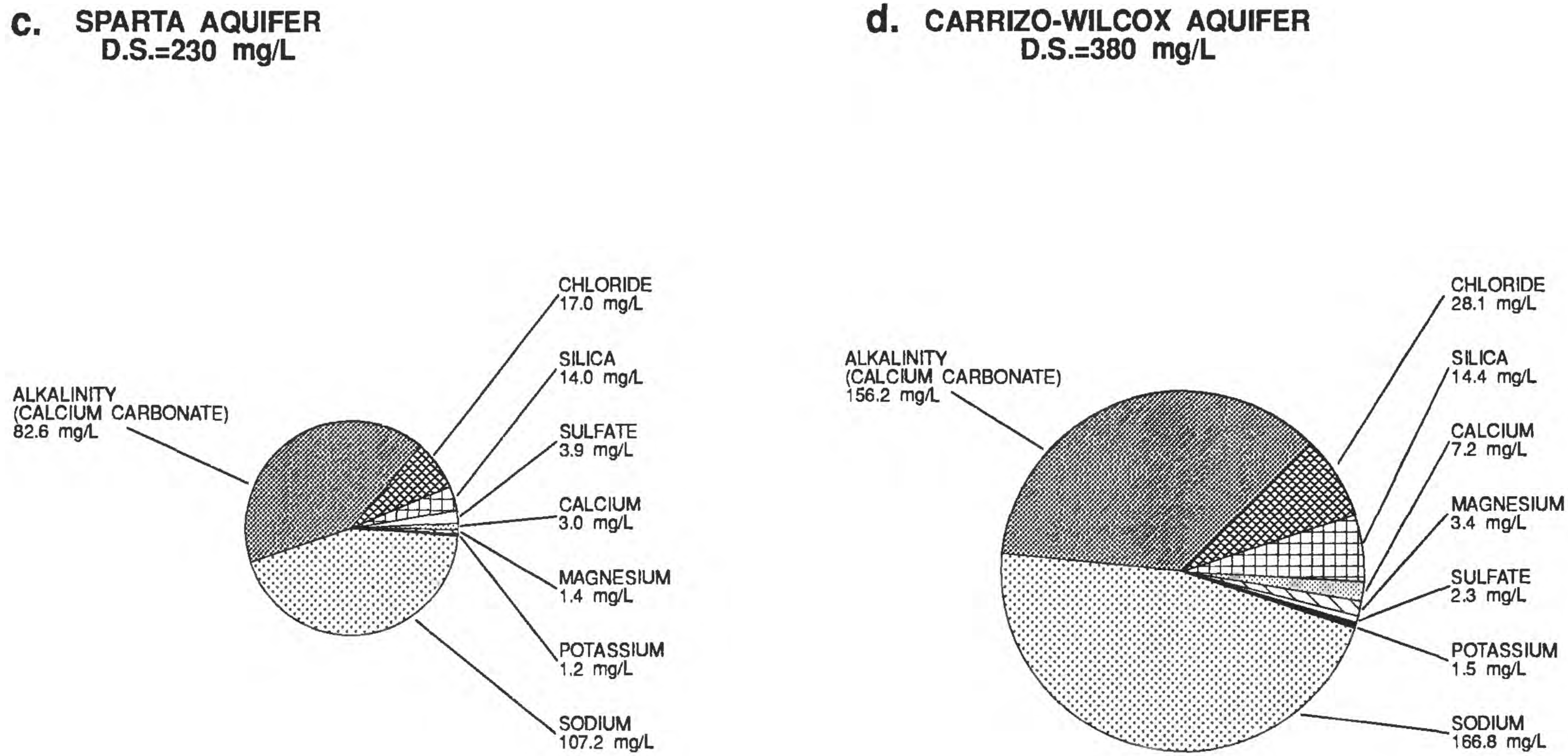


Figure 6. Average water quality for Louisiana's aquifers and aquifer systems.



EXPLANATION

D.S. is median concentration of dissolved solids
mg/L, milligrams per liter

DIAMETER OF CIRCLE REPRESENTS THE AMOUNT OF DISSOLVED MINERALS IN THE WATER
1 inch=200 mg/L D.S.
2 inches=400 mg/L D.S.

Figure 6. Average water quality for Louisiana's aquifers and aquifer systems--Continued.

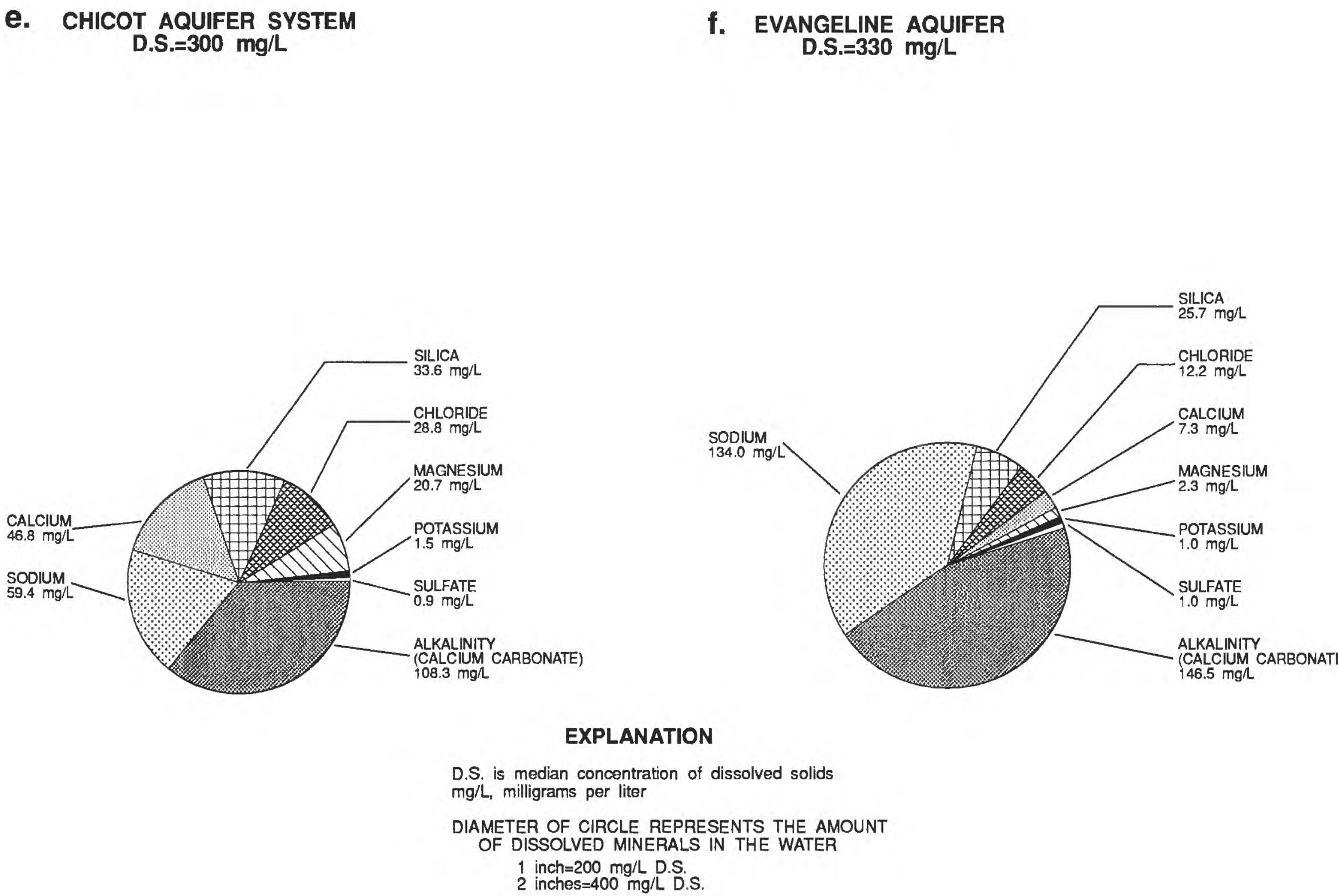


Figure 6. Average water quality for Louisiana's aquifers and aquifer systems--Continued.

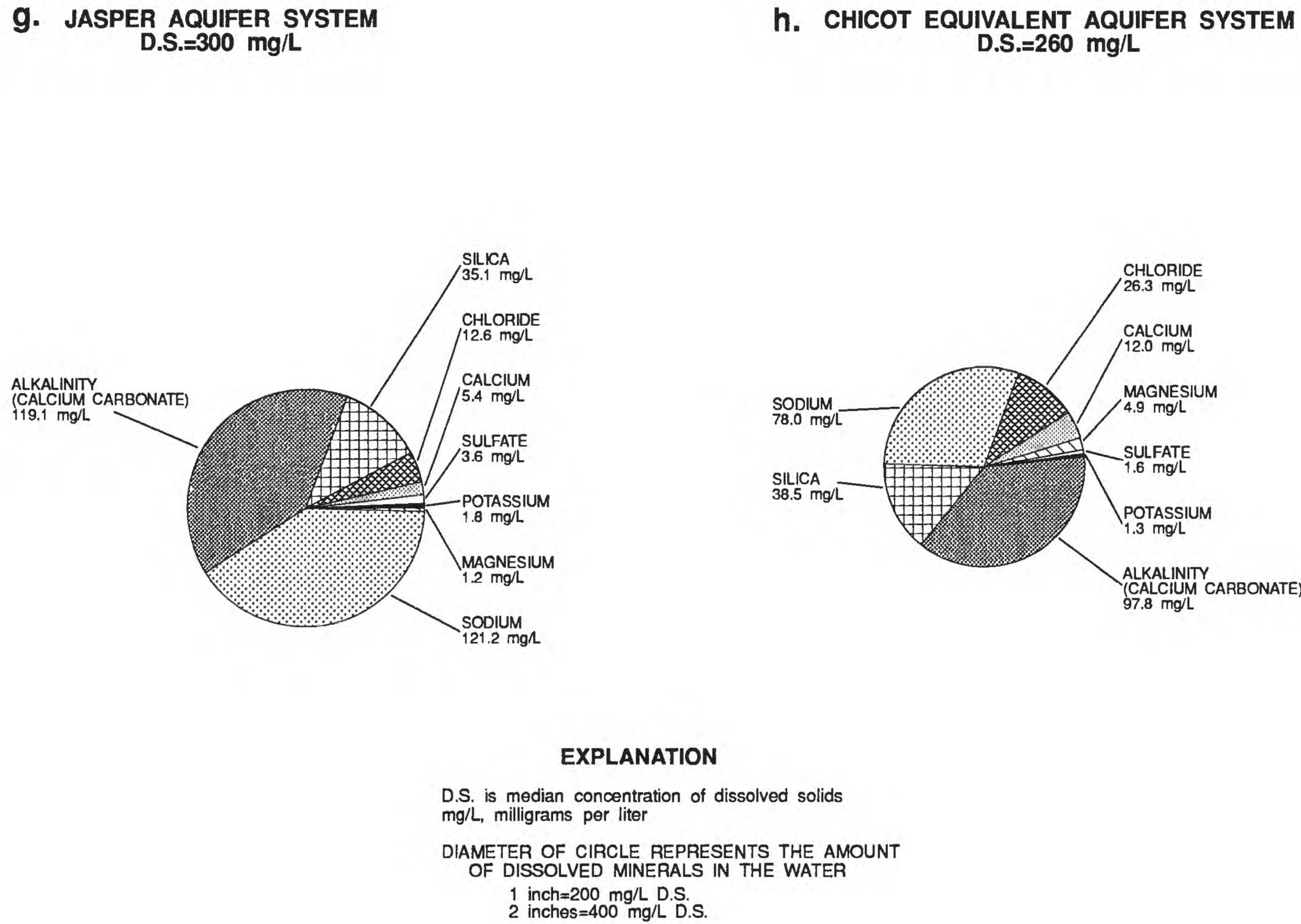
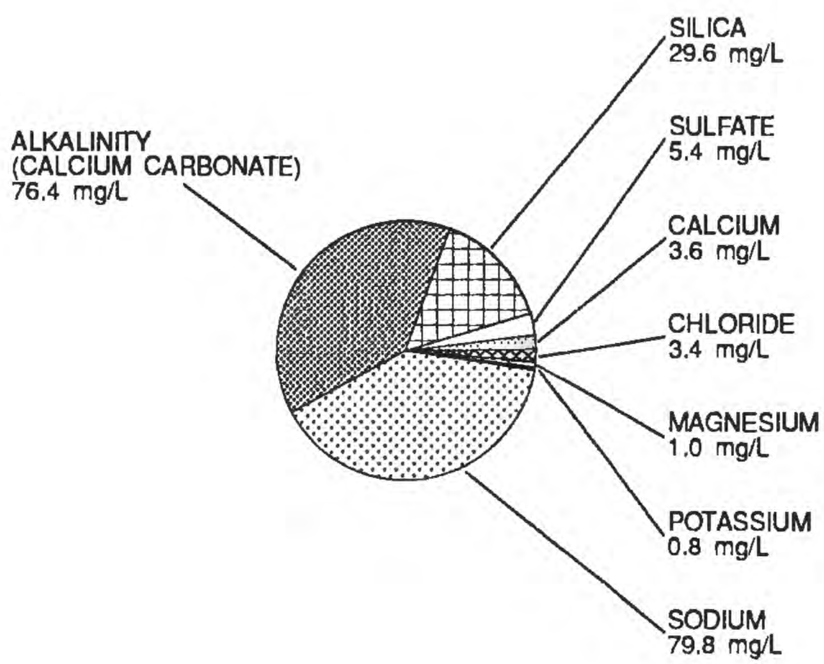
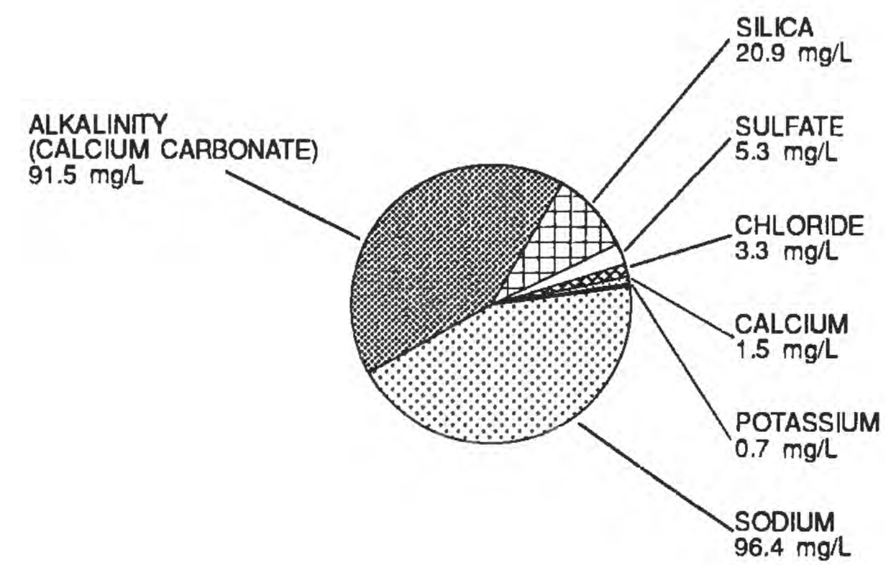


Figure 6. Average water quality for Louisiana's aquifers and aquifer systems--Continued.

i. EVANGELINE EQUIVALENT AQUIFER SYSTEM
D.S.=200 mg/L



j. JASPER EQUIVALENT AQUIFER SYSTEM
D.S.=220 mg/L



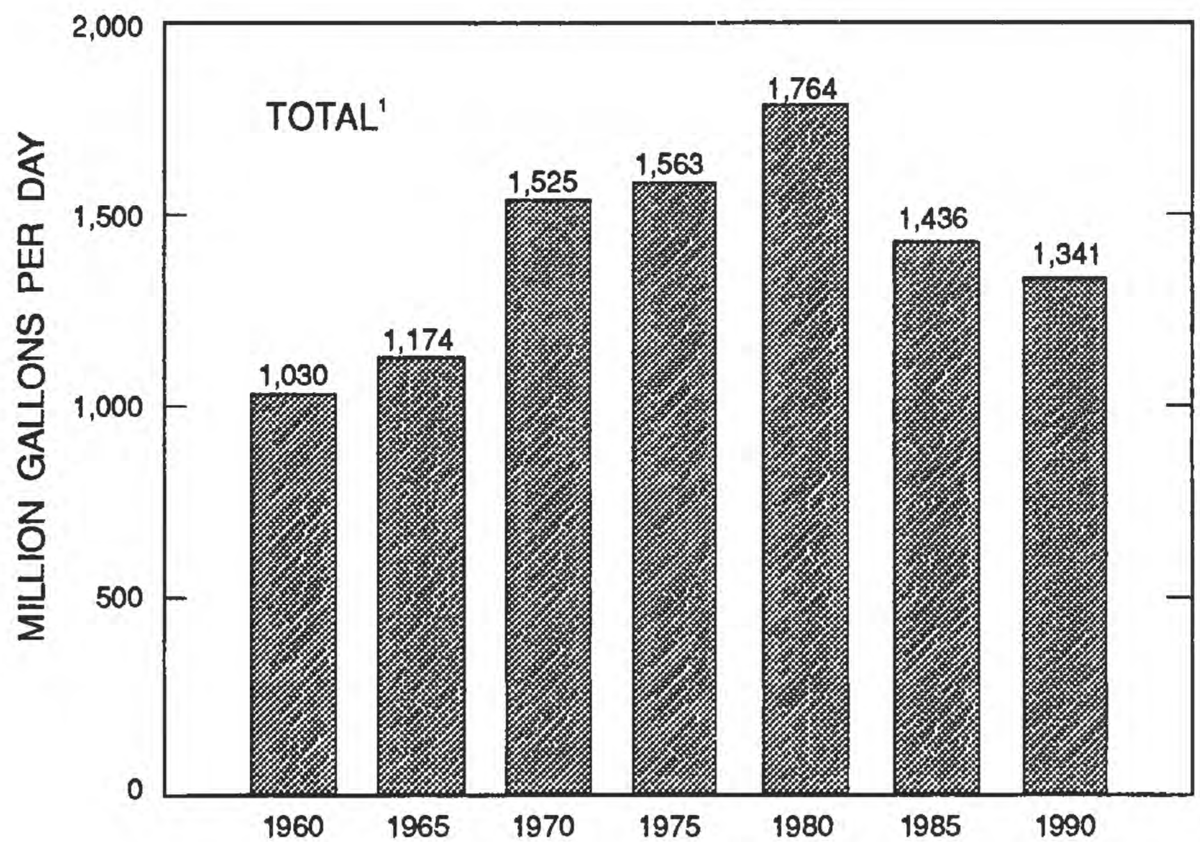
EXPLANATION

D.S. is median concentration of dissolved solids
mg/L, milligrams per liter

DIAMETER OF CIRCLE REPRESENTS THE AMOUNT OF DISSOLVED MINERALS IN THE WATER
1 inch=200 mg/L D.S.
2 inches=400 mg/L D.S.

Figure 6. Average water quality for Louisiana's aquifers and aquifer systems--Continued.

Public supply is the only major ground-water use that steadily increased from 1960 to 1990. Industrial use of ground water reached its highest level of 496 million gallons per day in 1970. Industrial use then gradually decreased, reaching its lowest level (286 million gallons per day) in 1985. Since 1985 industrial use increased slightly to 292 million gallons per day in 1990. Use of ground water for irrigation steadily increased between 1960 and 1980. Ground-water pumping for irrigation decreased about 24 percent between 1980 and 1985. Irrigation still accounts for the largest volume of ground water used every day in Louisiana, with rice-irrigation areas in southwestern Louisiana being the most heavily pumped regions. Rural domestic use did not change substantially from 1960 to 1990. Ground-water use trends from 1960 to 1990 are shown in figure 7. Water withdrawals from selected Louisiana aquifers and aquifer systems are shown in figure 8.



[1] Total includes pumpage for power generation, livestock, and aquaculture

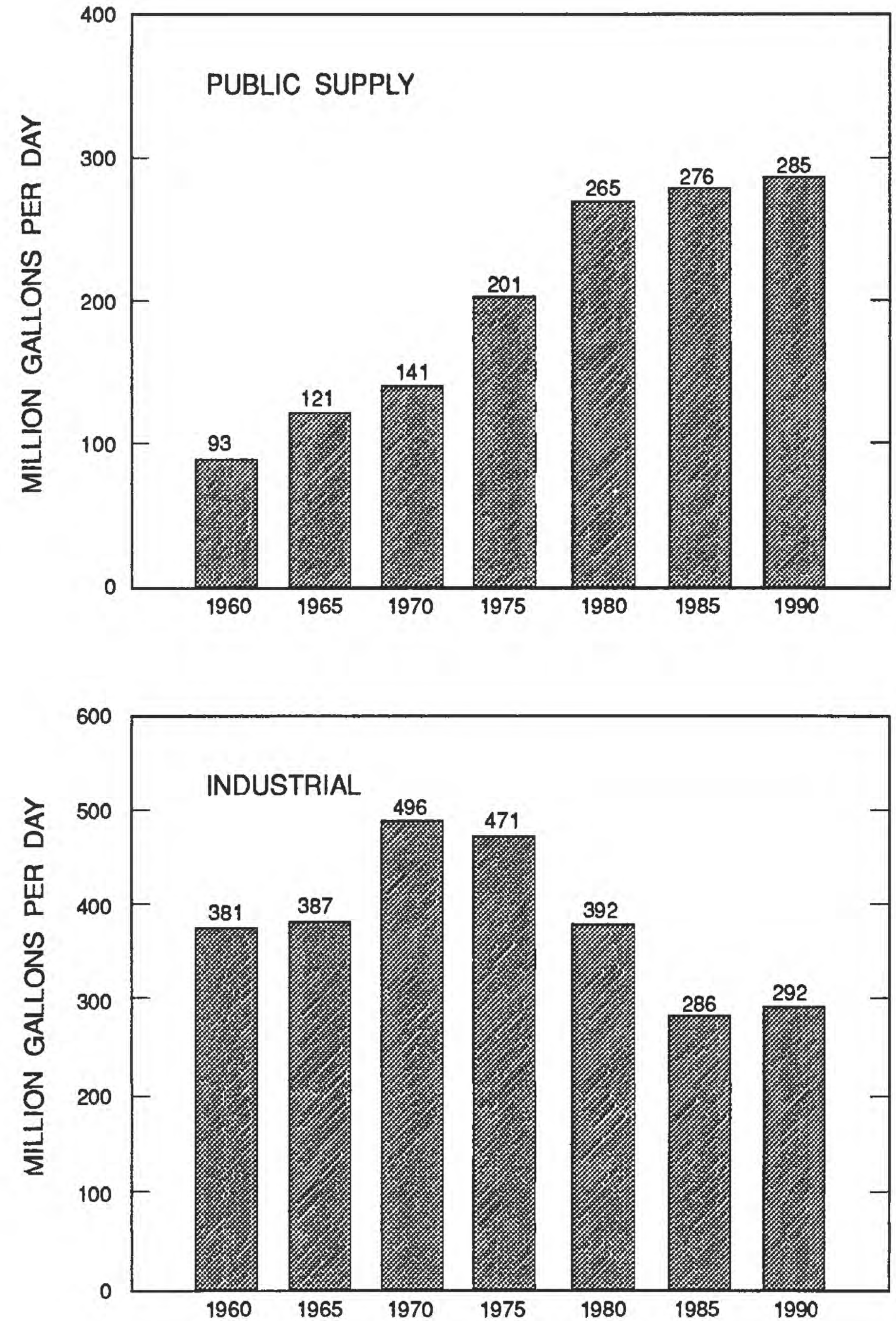


 Figure 7. Louisiana's ground-water withdrawal trends, 1960-90.

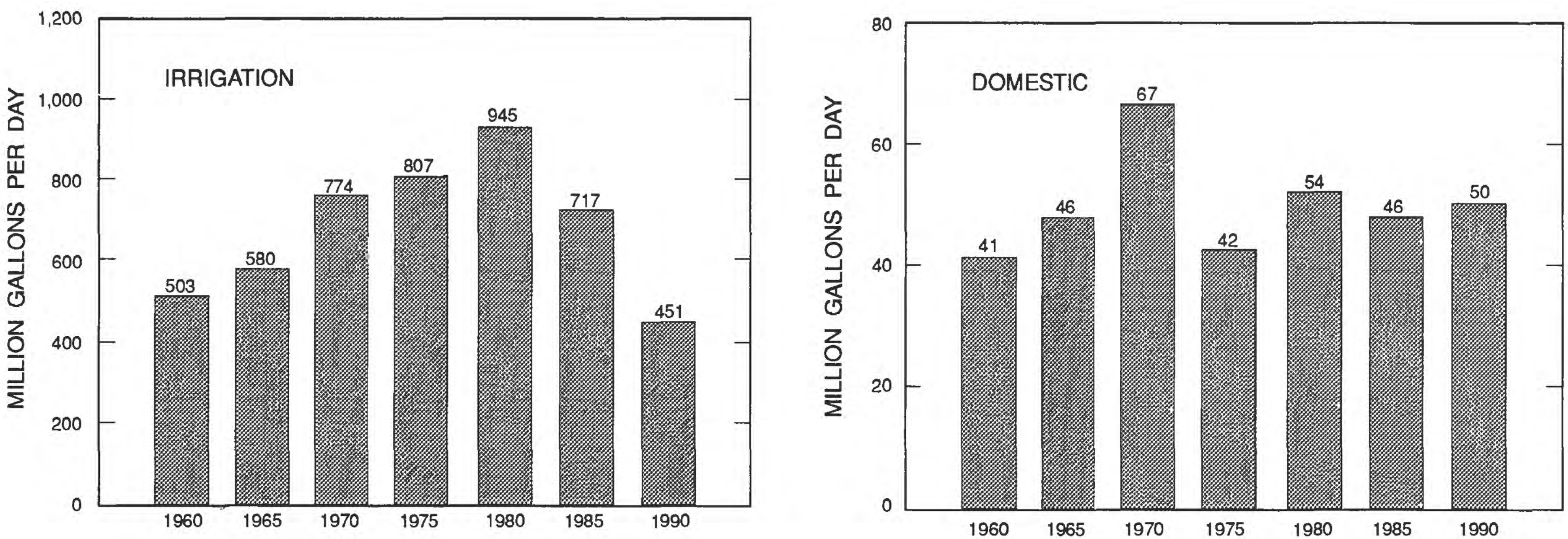


Figure 7. Louisiana's ground-water withdrawal trends, 1960-90--Continued.

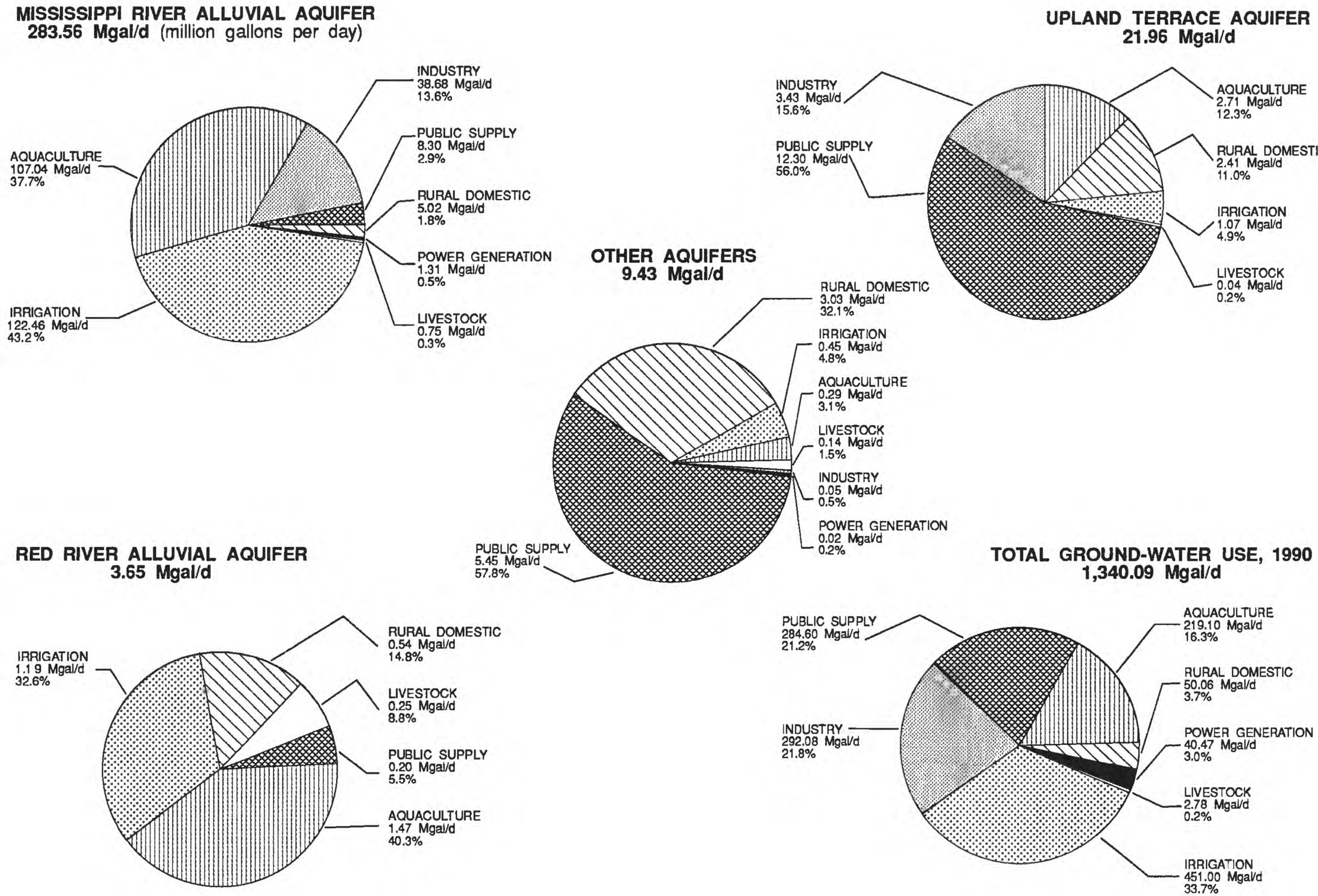


Figure 8. Ground-water withdrawals from Louisiana's aquifers and aquifer systems, 1990 (total is less than that reported by Lovelace, 1991, because very minor aquifers are reported in this report).

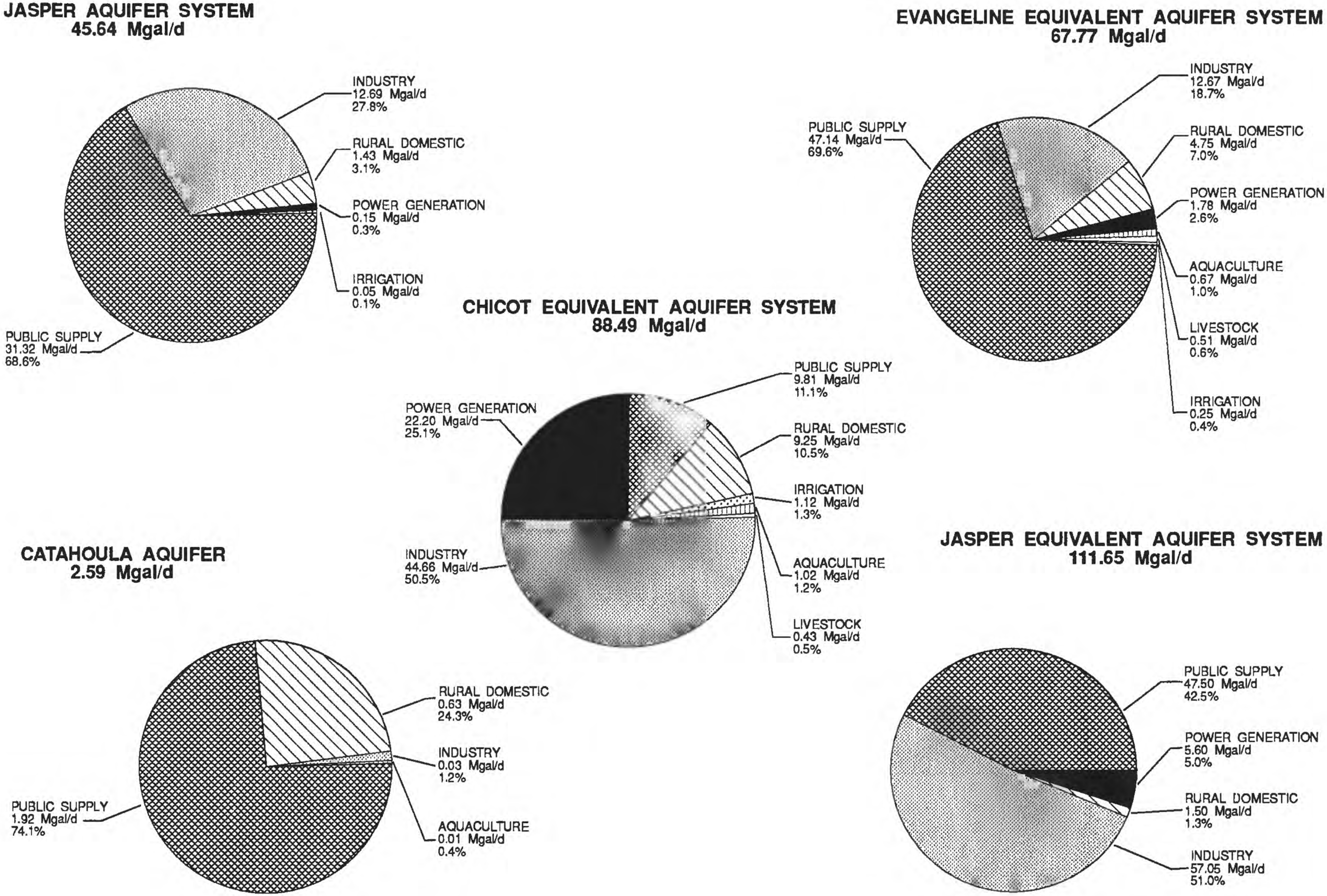


Figure 8. Ground-water withdrawals from Louisiana's aquifers and aquifer systems, 1990 (total is less than that reported by Lovelace, 1991, because very minor aquifers are reported in this report)--Continued.

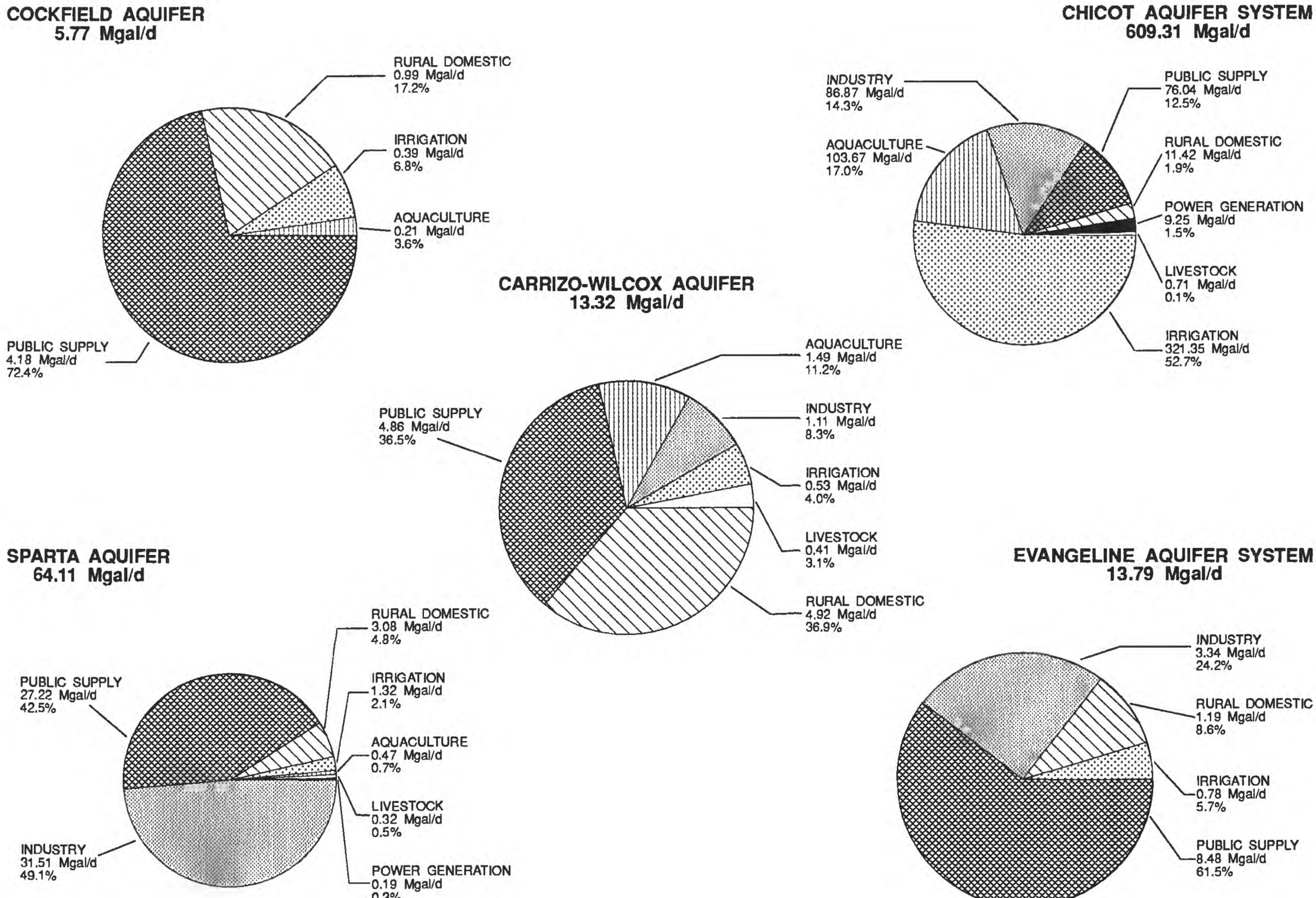


Figure 8. Ground-water withdrawals from Louisiana's aquifers and aquifer systems, 1990 (total is less than that reported by Lovelace, 1991, because very minor aquifers are reported in this report)--Continued.

Northern Louisiana

Cockfield Aquifer

The Cockfield aquifer (fig. 9) is an important aquifer of northeastern Louisiana. Though the aquifer is not capable of producing large quantities of water, it contains water better suited for drinking-water purposes than the overlying Mississippi River alluvial aquifer. Most of the water withdrawn from the Cockfield aquifer is used by municipalities and water districts in the northeastern parishes of the State.

Facts

Sediments

- Very fine to fine sand

Thickness

- 50 to 600 feet

Recharge

- Rainfall on outcrop area
- Leakage from overlying Mississippi River alluvial aquifer
- Leakage from underlying aquifers

Wells[1]

- Approximately 500
- Depth--200 to 2,000 feet, deepest in western Louisiana

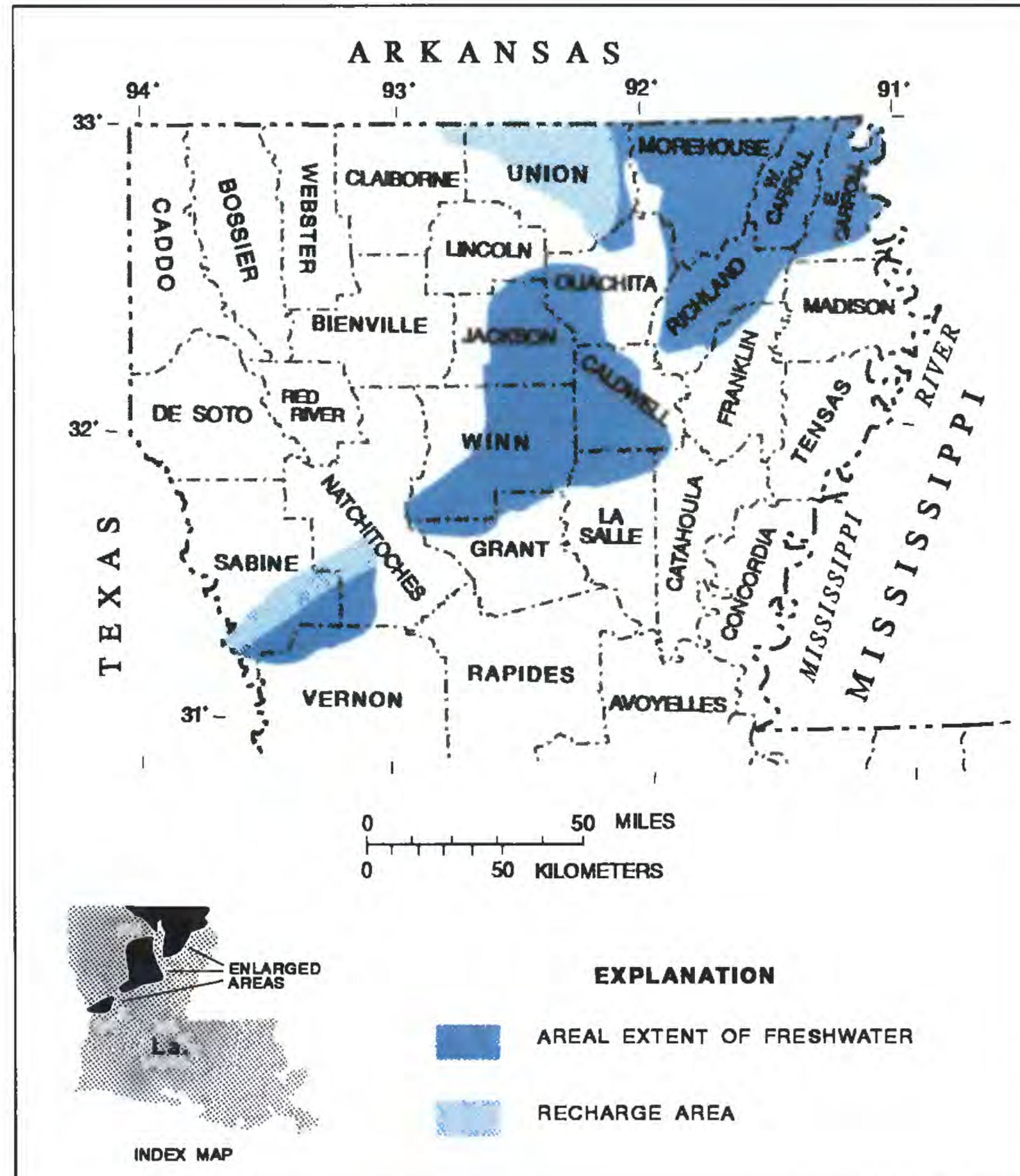


Figure 9. Recharge areas and areas where Cockfield aquifer contains freshwater.

[1] Excludes domestic wells.

Water Levels

- Generally less than 30 feet below land surface (fig. 10)
- Very little change in water level since 1960

Yields

- 50 to 500 gallons per minute
- Large-capacity wells, 700 gallons per minute

Quality

- Locally high in color and hardness and concentration of iron
- Suitable for drinking water
- May require treatment for public-supply use
- Freshwater section 50 to 600 feet thick

Use

- Approximately 6 million gallons per day (1990)
- Primary use--public supply (fig. 8)

General Description

- Water movement is eastward and southeastward
- Source of water in northeastern Louisiana
- Source of water in narrow band across Sabine and Natchitoches Parishes
- Leakage from Mississippi River alluvial aquifer generally causes excessive hardness and iron concentrations in the Cockfield aquifer

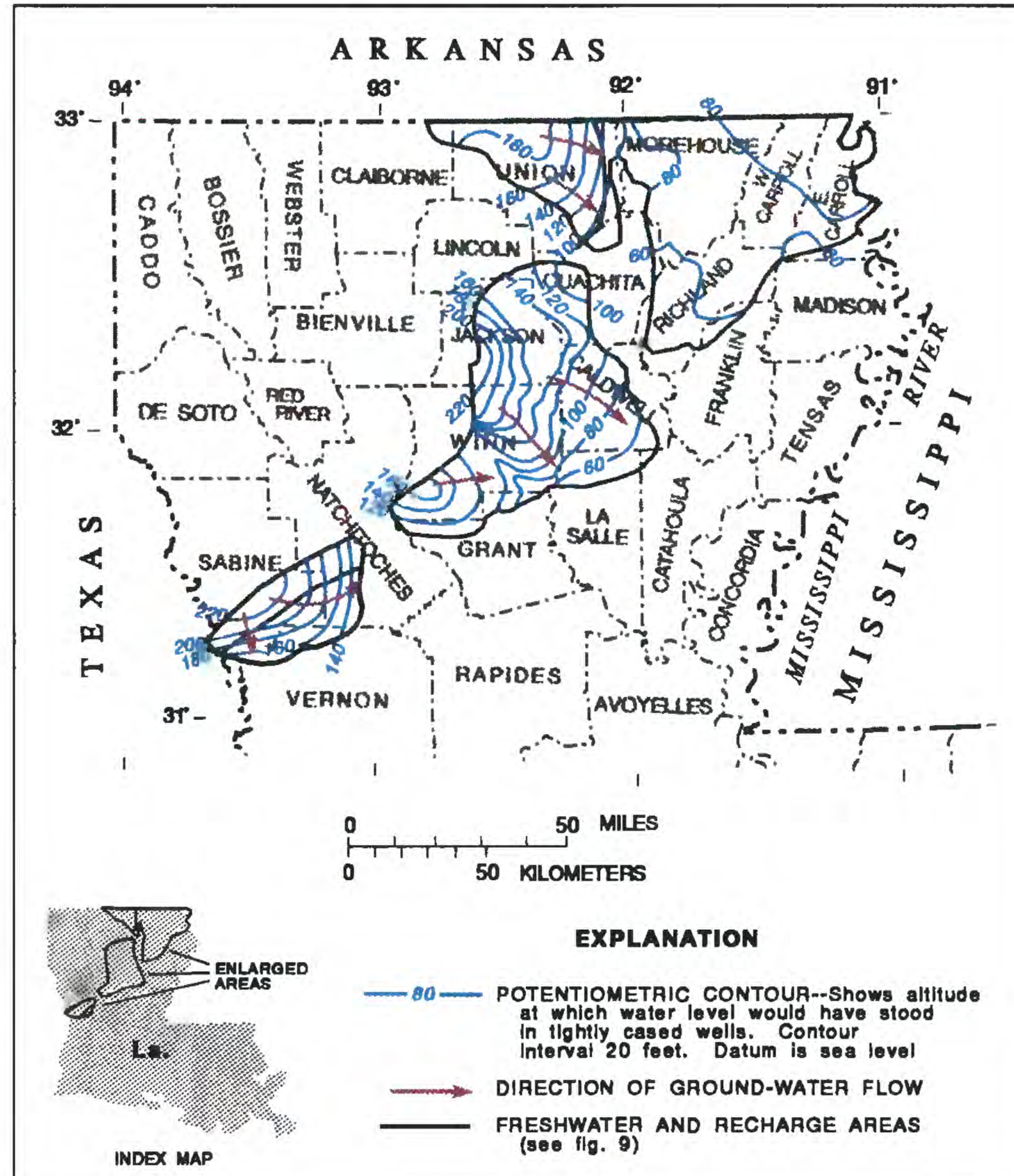


Figure 10. Potentiometric surface and direction of water movement in the Cockfield aquifer.

Sparta Aquifer

The Sparta aquifer is a very important source of ground water for the people of northern Louisiana, particularly north-central Louisiana (fig. 11). The Sparta aquifer also provides water for southern Arkansas. Large quantities of water from this aquifer are pumped for drinking-water and industrial purposes.

Facts

Sediments

- Very fine to medium sand
- Interbedded with thin layers of clay and lignite

Thickness

- 50 to 700 feet, increases toward south and southeast

Recharge

- From rainfall on outcrop area and water moving downward through terrace deposits in Bossier, Webster, and Bienville Parishes
- Leakage from overlying Cockfield and underlying Carrizo-Wilcox aquifers

Wells[1]

- Approximately 1,800
- Depth--200 to 900 feet

[1] Excludes domestic wells.

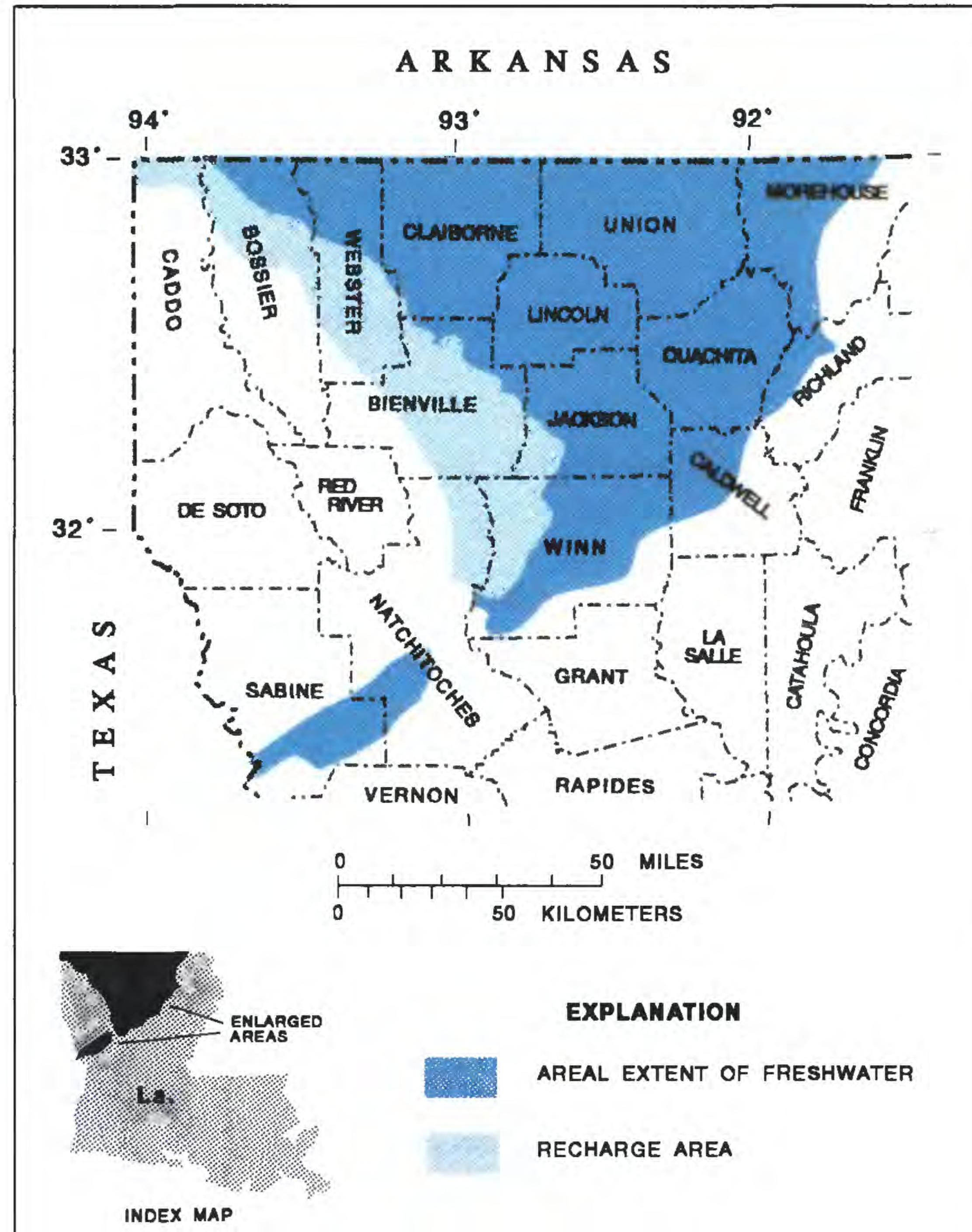


Figure 11. Recharge area and areas where Sparta aquifer contains freshwater.

Water Levels

- Range from 15 to 320 feet below land surface; generally between 50 to 250 feet (fig. 12)
- Water-level change
  - --Regional declines 1 to 3 feet per year in northern Louisiana and southern Arkansas
  - --Recent rises in Morehouse Parish

Yields

- 100 to 1,800 gallons per minute

Quality

- Soft; hardness of less than 60 milligrams per liter
- Treatment to reduce iron and corrosiveness required for water from western half of aquifer extent
- Salinity increases with depth and toward the southeast (fig. 12)
- Locally high in color and concentrations of fluoride, sodium, hydrogen sulfide, and dissolved solids

Use

- Approximately 64 million gallons per day (1990)
- Primary uses--industry (31.5 million gallons per day) and public supply (27.2 million gallons per day) (fig. 8)

General Description

- Water movement:
- --Predevelopment from recharge area toward east and south
- --Currently (1992) toward pumping center at Monroe, Louisiana
- Major pumping centers: Hodge, Monroe, Ruston, Springhill, Louisiana; and El Dorado and Magnolia, Arkansas
- High sodium concentrations in eastern part of aquifer makes water unsuitable for irrigation

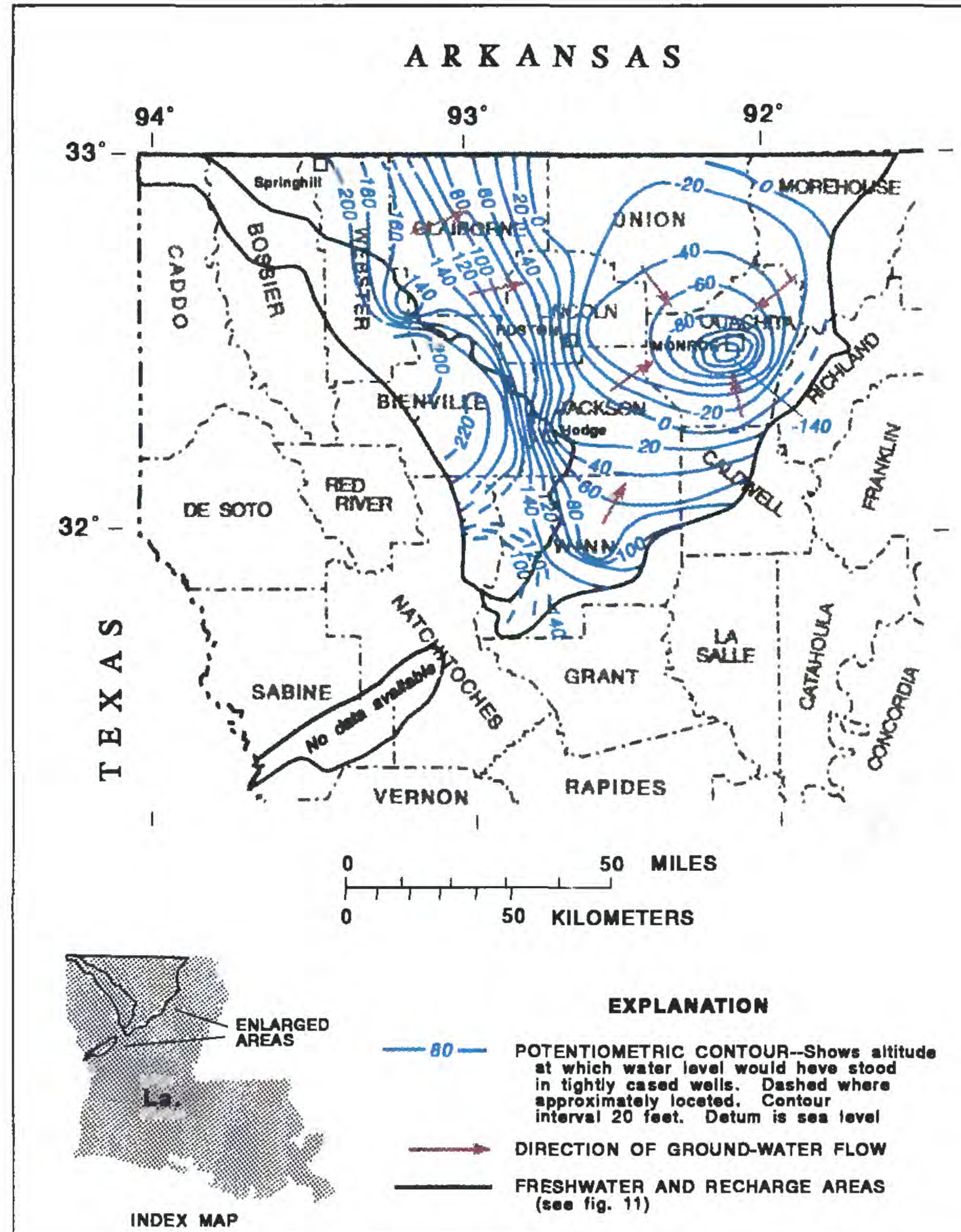


Figure 12. *Potentiometric surface and direction of water movement in the Sparta aquifer.*

Carrizo-Wilcox Aquifer

The Carrizo-Wilcox aquifer is the most important aquifer in northwestern Louisiana. The aquifer is located on both sides of the Red River, extending from the northwestern corner of the State southward into Sabine and Natchitoches Parishes (fig. 13). The Carrizo-Wilcox is a low-yielding aquifer because sand units tend to be thin and fine grained. However, the aquifer is used in many areas of northwestern Louisiana because other sources of water are unavailable.

Facts

Sediments

- Fine to medium sand, silt, clay, and lignite

Thickness

- 50 to 850 feet
- Increases toward south and southeast

Recharge

- From rainfall on surficial sediments

Wells[1]

- Approximately 2,000
- Depth--100 to 650 feet, average depth 230 feet

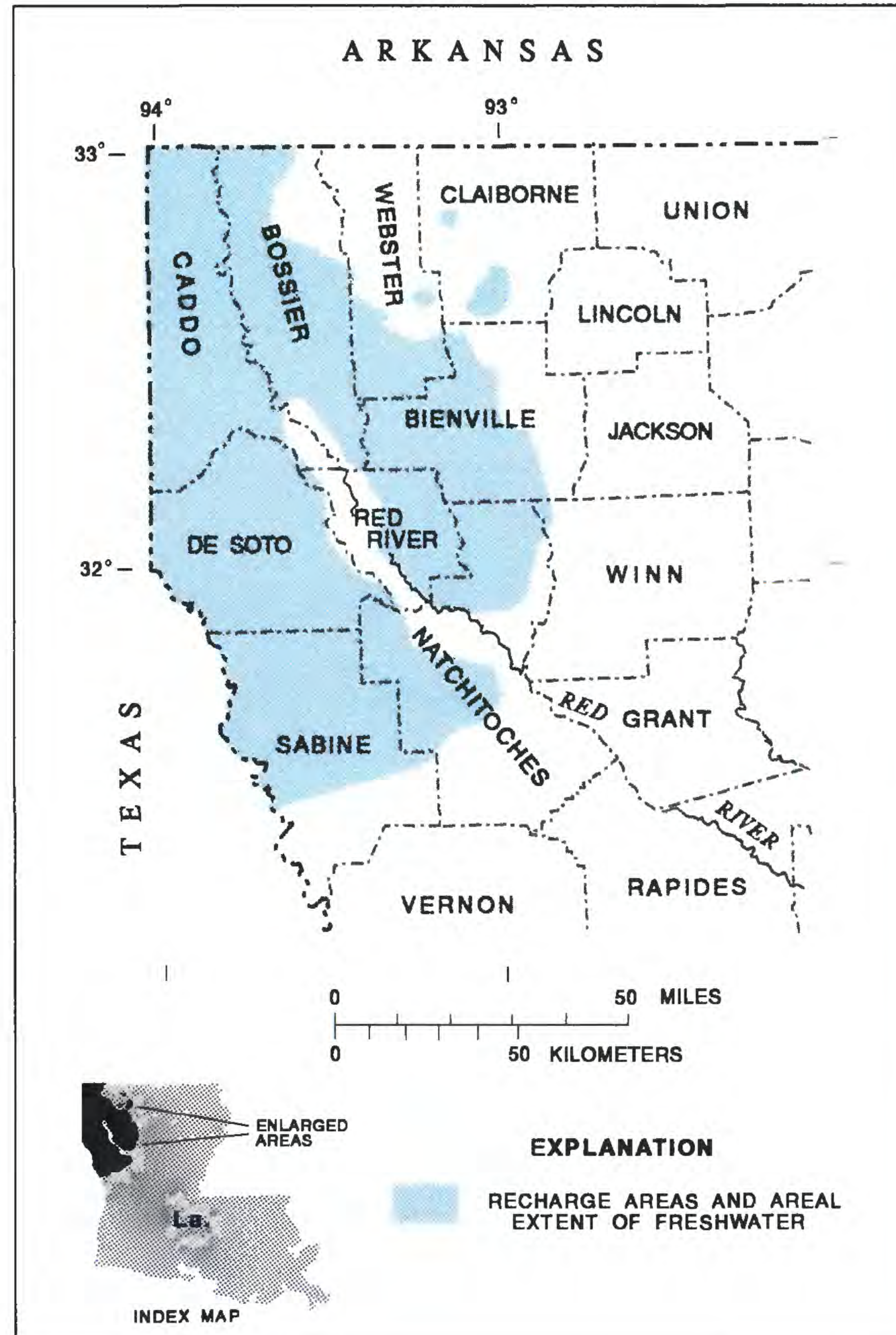


Figure 13. Recharge areas and areas where Carrizo-Wilcox aquifer contains freshwater.

[1] Excludes domestic wells.

Water Levels

- No long-term changes
- Range from slightly above to 200 feet below land surface; generally between 50 and 100 feet (fig. 14)

Yields

- 30 to 150 gallons per minute
- Large-capacity wells, 400 gallons per minute

Quality

- Typically suitable for drinking water purposes with little or no treatment
- Freshwater section 50 to 850 feet thick
- Relatively high in color in southern part of recharge area
- Unsuitable for irrigation--high sodium concentrations
- Soft, generally low iron concentrations
- Locally high concentrations of iron and hydrogen sulfide

Use

- Approximately 13 million gallons per day (1990)
- Primary uses--rural domestic, 5.3 million gallons per day; public supply, 4.9 million gallons per day (fig. 8)

General Description

- Carrizo sand a major unit in the aquifer
- Aquifer discharges into Red and Sabine Rivers
- Most water withdrawn from Carrizo-Wilcox aquifer is used for public supply, domestic use, and small farm supply

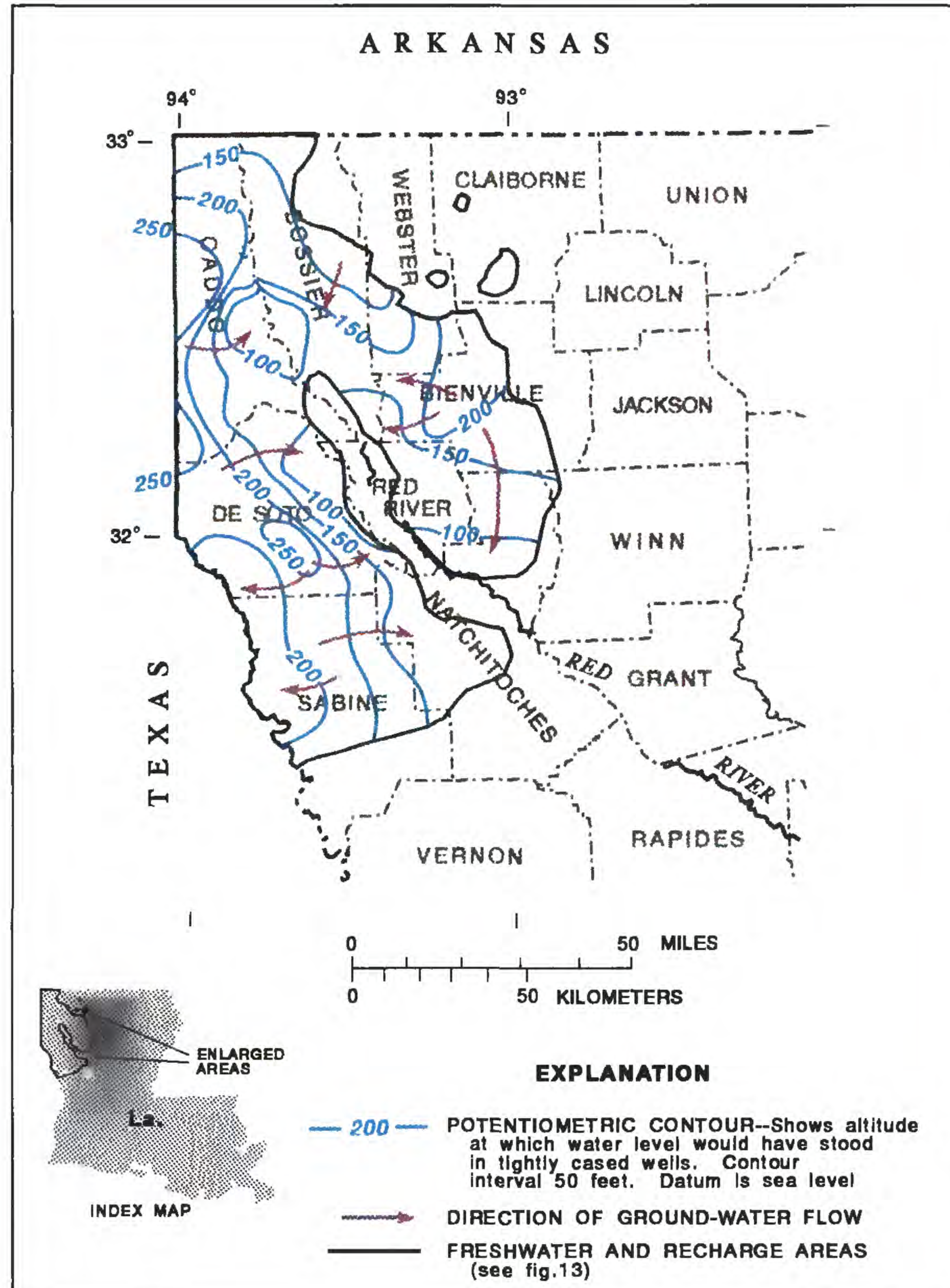


Figure 14. Potentiometric surface and direction of water movement in the Carrizo-Wilcox aquifer.

Central and Southwestern Louisiana

Chicot Aquifer System

The Chicot aquifer system, extending into Texas and eastward to the Atchafalaya River, is the principal aquifer system of southwestern Louisiana (fig. 15). In fact, it is the most heavily pumped aquifer in the State. Coarseness of the sand, as well as an average annual rainfall of 56 inches (Louisiana Office of Climatology, 1989, p. 3), allows for plentiful recharge and high yields to wells in southwestern Louisiana. During 1990, the average daily pumpage from the Chicot aquifer system was approximately 609 million gallons accounting for more than 45 percent of the total ground-water withdrawal for the State (fig. 8) (Lovelace, 1991).

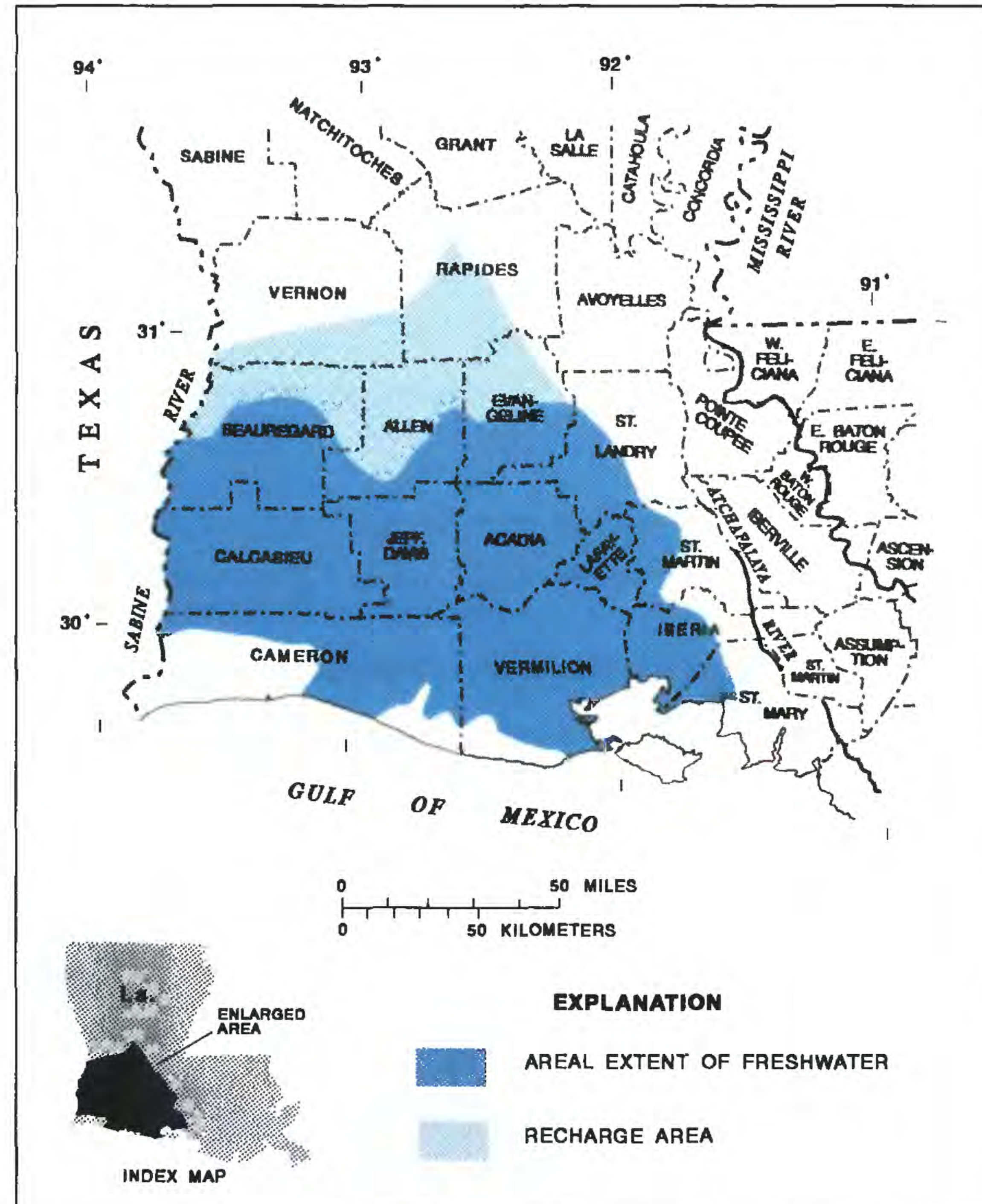


Figure 15. Recharge area and area where Chicot aquifer system contains freshwater.

Facts

Sediments

- Coarse sand and gravel

Thickness

- 50 to 1,050 feet, increases toward the south

Recharge

- Occurs mainly in northern part of aquifer (fig. 16)
- From rainfall in Allen and Beauregard Parishes
- Leakage from overlying and underlying layers

Wells[1]

- Approximately 4,500.
- Depth--20 to 1,100 feet, average depth 290 feet
- Irrigation wells generally 200 to 300 feet

Water Levels

- Range from slightly below land surface to 100 feet below; generally between 25 and 75 feet below land surface (fig. 16)

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[1] Excludes domestic wells.

- Significant rise at Lake Charles since 1982
- Seasonal fluctuations east of Lake Charles

Yields

- 500 to 2,500 gallons per minute
- Large-capacity wells, 4,000 gallons per minute

Quality

- Hardness 20 to 270 milligrams per liter
- Iron greater than 1.0 milligrams per liter
- Freshwater section 50 to 1,050 feet thick
- Saltwater occurs in basal part of aquifer coastal areas
- Most suitable for irrigation

Use

- Approximately 609 million gallons per day (1990)
- Primary use--irrigation at 321 million gallons per day (fig. 8)

General Description

- Ground-water movement:

  --Originally toward the coast

  --Currently toward pumping centers in Acadia, Jefferson Davis, Vermilion, and Calcasieu Parishes (fig. 16)
- Water, softer in recharge area, harder in central and southeastern areas, except soft in deeper units to south
- Aquifer contains freshwater except in southern Cameron, southwestern Vermilion, and southeastern St. Mary Parishes
- In 1970's, saltwater movement toward Lake Charles; since mid 1980's very little movement, no saltwater
- Aquifer system subdivision:

--Lake Charles area	--East of Lake Charles
"200-foot" sand	Upper sand unit
"500-foot" sand	Lower sand unit
"700-foot" sand	

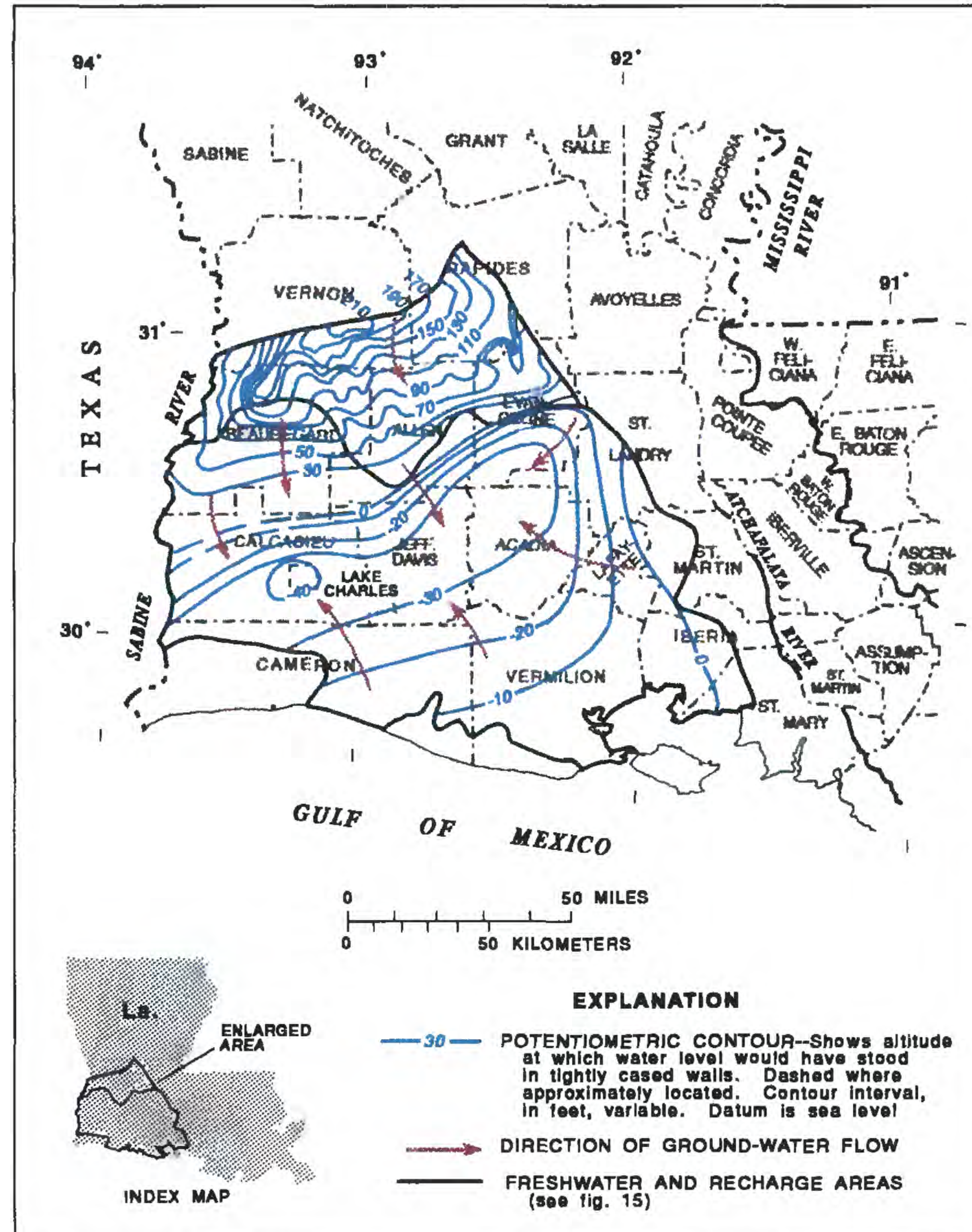

Figure 16. Potentiometric surface and direction of water movement in the Chicot aquifer system.

Evangeline Aquifer

The Evangeline aquifer of southwestern Louisiana (fig. 17) is an excellent source of water for public supply and industry in southwestern Louisiana. It contains less iron and softer water than the overlying Chicot aquifer system, making it much more suitable for drinking-water purposes. Almost 70 percent of the water used in 1990 was for public-supply facilities in the area (Lovelace, 1991).

Facts

Sediments

- Generally fine to medium sand
- Sand units separated by clay

Thickness

- Increases toward south and southeast
- Thickest in southeastern St. Landry Parish
- 50 to 1,900 feet

Recharge

- From rainfall in Vernon, Avoyelles, and Rapides Parishes
- Leakage from Chicot aquifer system in northern Beauregard Parish
- Leakage from underlying aquifers

Wells[1]

- Approximately 700
- Depth--100 to 2,400 feet; average depth less than 300 feet

Water Levels

- Generally less than 60 feet below land surface
- Regional decline less than 1 foot per year
- Locally affected by pumping from Chicot aquifer system

[1] Excludes domestic wells.

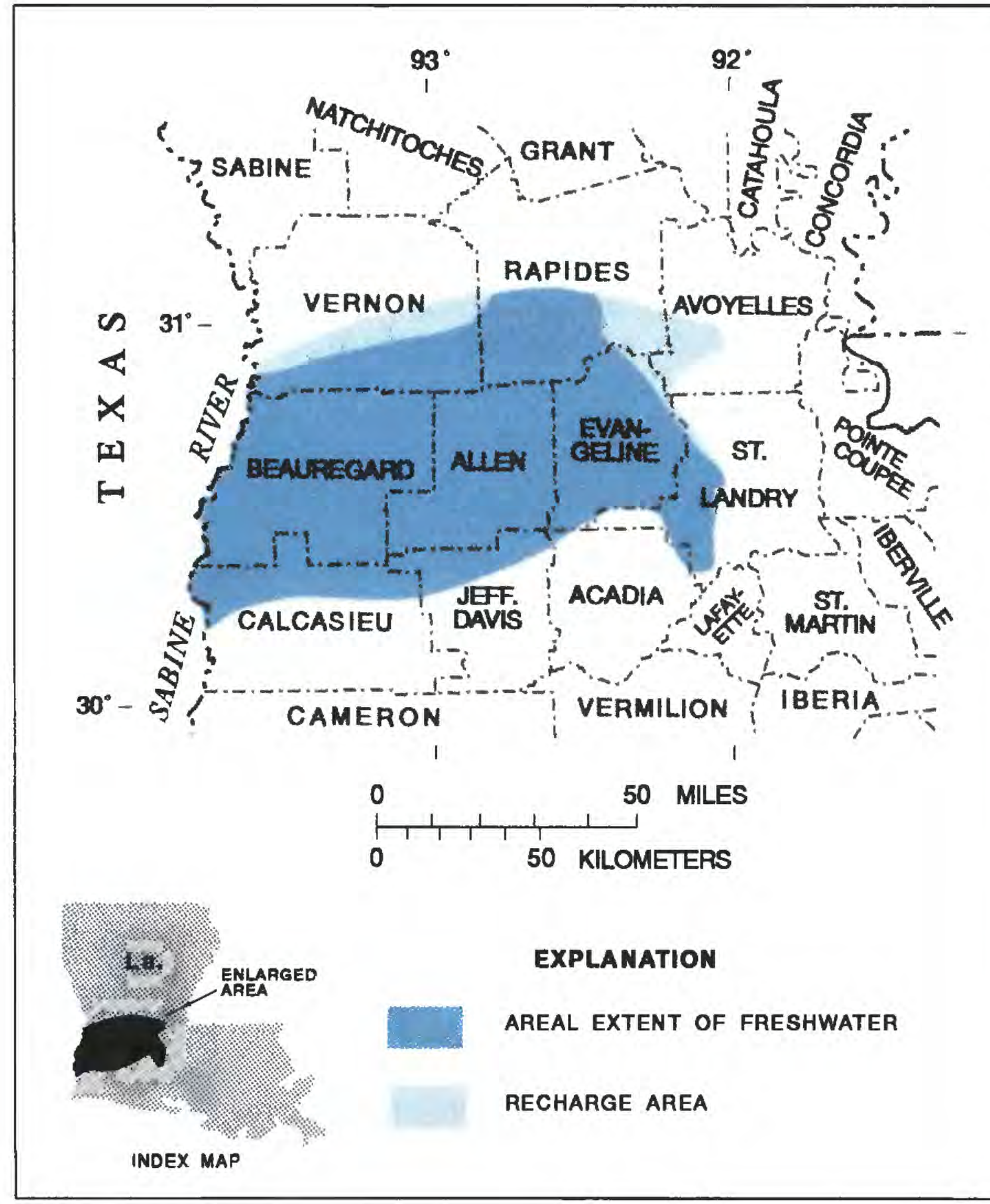

Figure 17. Recharge areas and area where Evangeline aquifer contains freshwater.

Yields

- 200 to 1,000 gallons per minute
- Large-capacity wells, 3,000 gallons per minute

Quality

- Generally soft with low iron concentrations
- Iron generally less than 0.2 milligrams per liter
- Freshwater section 50 to 1,900 feet thick
- Suitable for use with little or no treatment
- Local presence of high color, fluoride, and iron

Use

- Approximately 14 million gallons per day (1990)
- Primary use--public supply, 8 million gallons per day (fig. 8)

General Description

- Water generally moves southeastward (fig. 18)
- Discharge:

  --Seepage into Sabine and Calcasieu Rivers toward west

  --Seepage into Atchafalaya River toward east
- Little interchange of water between Evangeline aquifer and Jasper aquifer system
- Aquifer developed mainly for public supply
- Overlying Chicot aquifer system provides water for irrigation

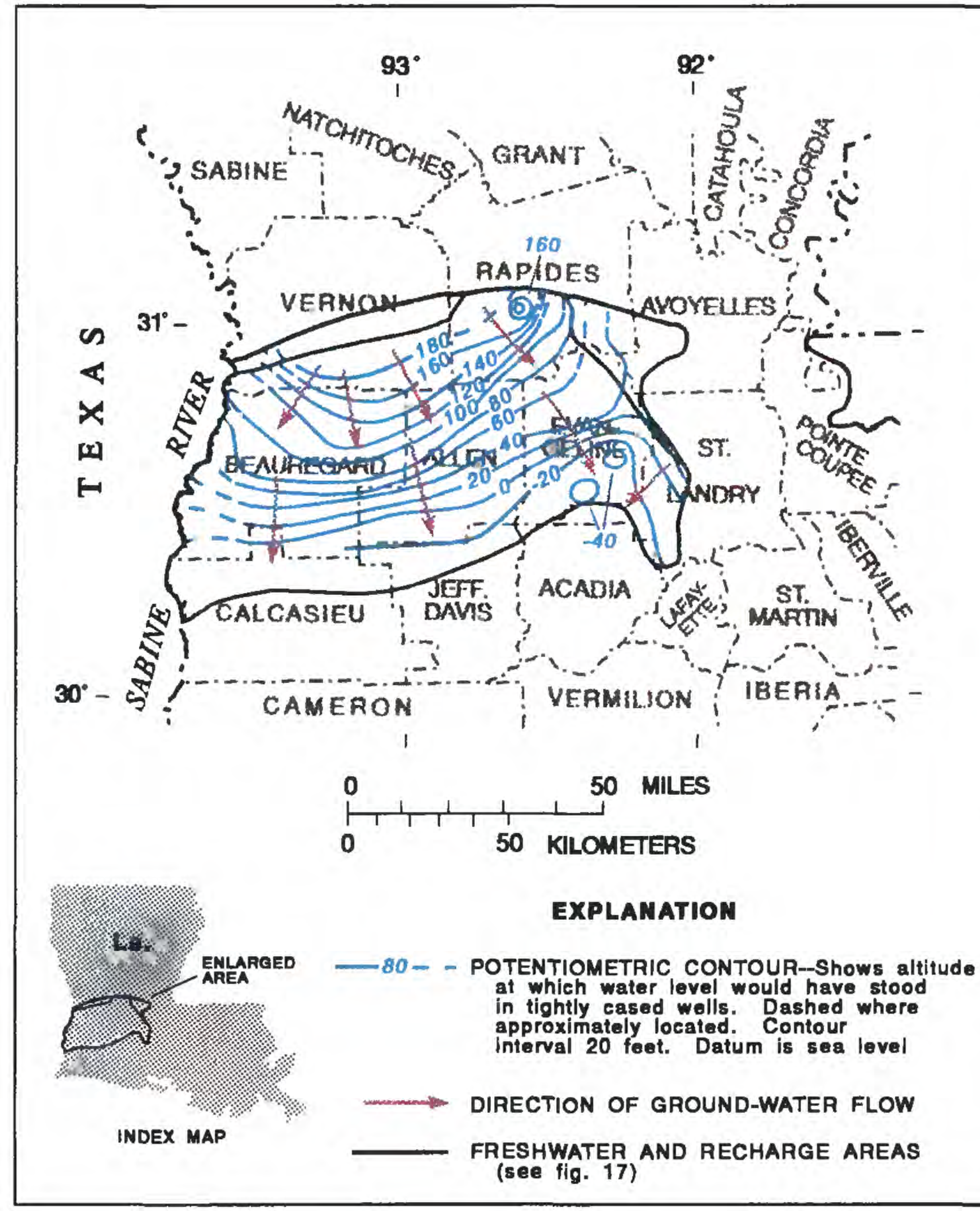

Figure 18. Potentiometric surface and direction of water movement in the Evangeline aquifer.

Jasper Aquifer System

The Jasper aquifer system contains the deepest fresh ground water in southwestern Louisiana. It is comprised of the Williamson Creek (upper) and Carnahan Bayou (lower) aquifers. The Jasper aquifer system underlies most of Vernon, Beauregard, Rapides, and Allen Parishes (fig. 19). The aquifer system also occurs as a narrow west-east band from La Salle Parish to Concordia Parish.

Facts

Sediments

- Fine to medium sand
- Extensive clay layers separate Jasper aquifer system from overlying and underlying aquifers

Thickness

- Thickest in northern Beauregard and southwestern Allen Parishes
- 50 to 2,400 feet

Recharge

- From rainfall in Vernon and Natchitoches Parishes (fig. 19)

Wells[1]

- Approximately 960
- Depth--50 to 3,500 feet, average depth 580 feet

Water Levels

- Generally less than 60 feet below land surface
- Water-level changes
  - --Seasonal fluctuations a few feet per year
  - --Levels have risen slightly in Williamson Creek aquifer since early 1980's
  - --Levels have declined in wells in Carnahan Bayou aquifer 1 foot per year since 1960's

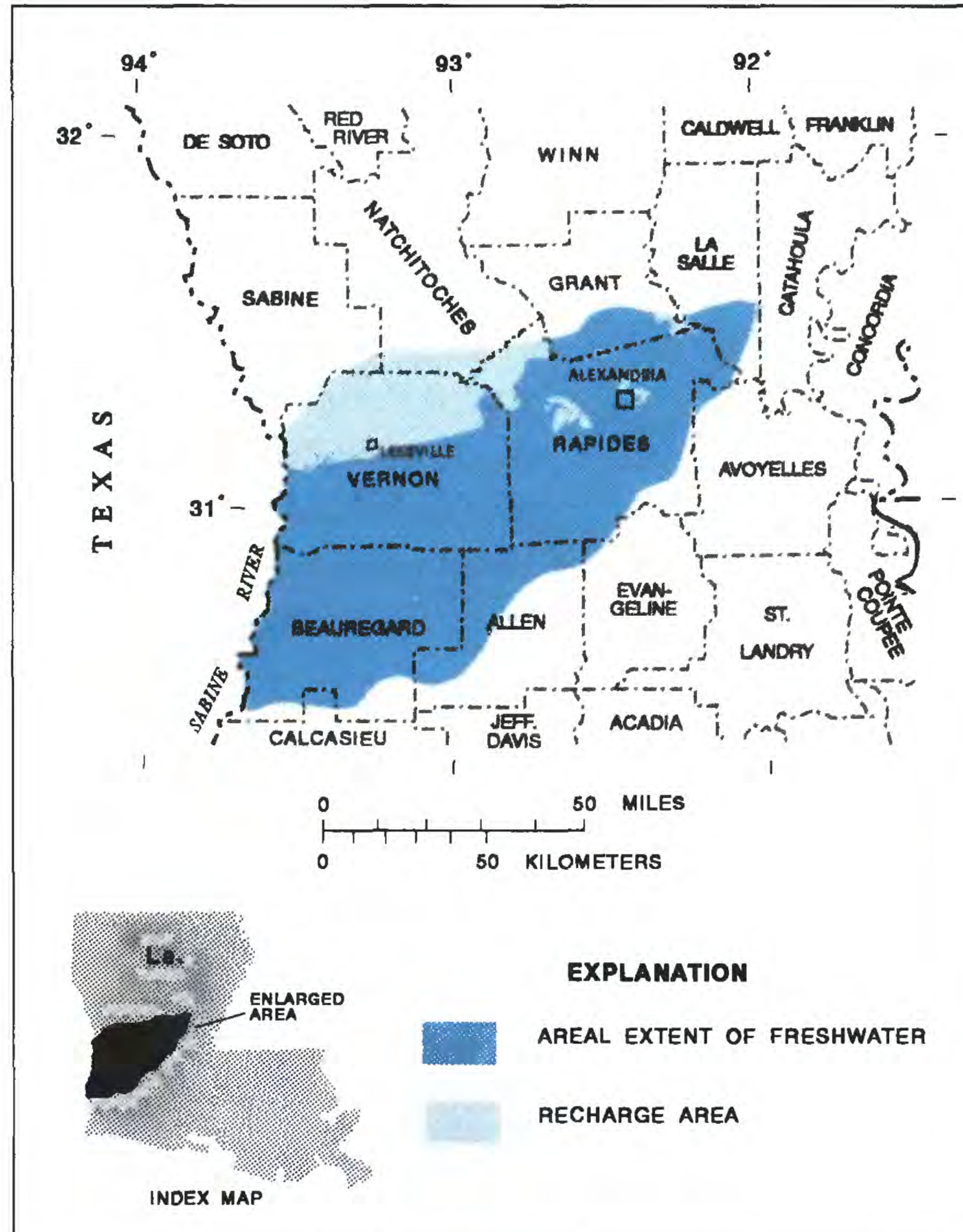

Figure 19. Recharge areas and area where Jasper aquifer system contains freshwater.

[1] Excludes domestic wells.

Yields

- 40 to 800 gallons per minute
- Large-capacity wells in Williamson Creek aquifer, 3,000 gallons per minute

Quality

- Soft water
- Iron generally less than 0.5 milligrams per liter
- Freshwater section up to 2,500 feet thick
- Suitable for drinking-water purposes with little or no treatment
- Local occurrence relatively high color and concentrations of fluoride, iron, and hydrogen sulfide

Use

- Approximately 46 million gallons per day (1990)
- Primary use--public supply at 31 million gallons per day (fig. 8)

General Description

- Ground-water movement:

  --Originally toward the south and southeast

  --Currently (1992) towards pumping centers at Fort Polk, Leesville, DeRidder, and Alexandria (Kisatchie National Forest well field) (fig. 20)

- Water from Carnahan Bayou aquifer is slightly harder than water from Williamson Creek aquifer

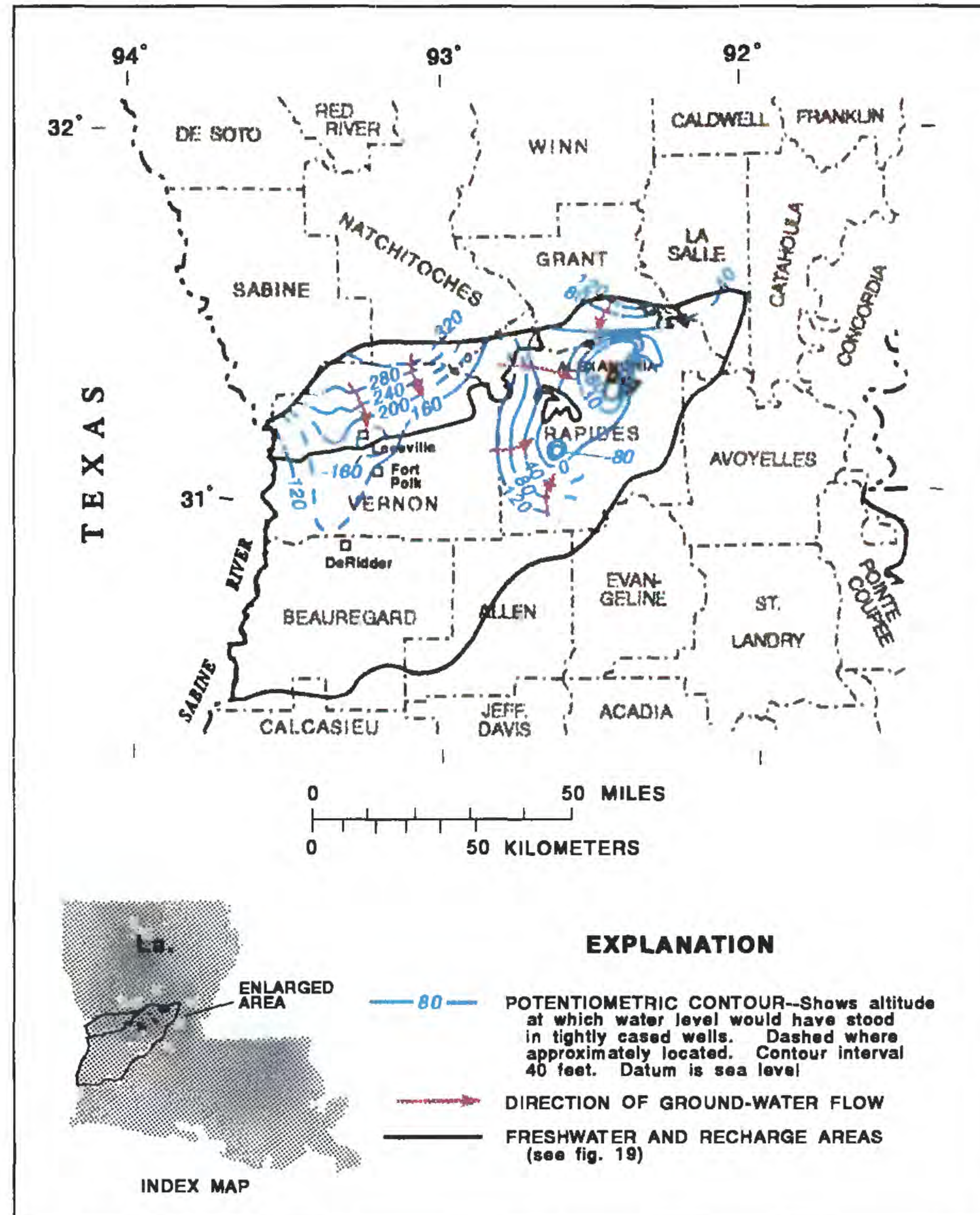

Figure 20. Potentiometric surface and direction of water movement in the Jasper aquifer system.

Catahoula Aquifer

The Catahoula aquifer extends from the western edge of Louisiana in a northeasterly direction across the State and is Miocene in age. The Catahoula aquifer crops out along its northern extent in Sabine, Natchitoches, Grant, LaSalle, and Catahoula Parishes. The Catahoula aquifer has limited use as a source of freshwater and is essentially divided into three freshwater areas by saltwater under the Red River Valley and Little River divide.

Facts

Sediments

- Fine to medium sand
- Forms sandstone in places

Thickness

- 50 to 450 feet
- Increases toward the south

Recharge

- From rainfall on outcrop area
- From rainfall percolating through overlying alluvial and terrace deposits

Wells[1]

- Approximately 340
- Depth--100 to 1,800 feet

[1] Excludes domestic wells.

Water Levels

- Typically are between 20 and 100 feet below the land surface
- Fluctuate 2 feet or less per year

Yields

- 50 to 400 gallons per minute.

Quality

- Soft with high concentrations of iron in Vernon and Natchitoches Parishes
- Freshwater section 50 to 450 feet thick
- Saltwater away from recharge area

Use

- Approximately 3 million gallons per day (1990)
- Primary use--public supply (fig. 8)

Southeastern Louisiana

Chicot Equivalent Aquifer System

In southeastern Louisiana, aquifers equivalent to the Chicot aquifer system of southwestern Louisiana have been given individual aquifer names. The principal Chicot equivalent sands are the "400-foot" and "600-foot" of the Baton Rouge area; the Gramercy, Norco, and Gonzales-New Orleans aquifers, and the "1,200-foot" sand of the New Orleans area; and the shallow sand and upper Ponchatoula aquifer of the Tangipahoa-St. Tammany Parish area. The area where the Chicot equivalent aquifer system contains freshwater is shown in figure 21.

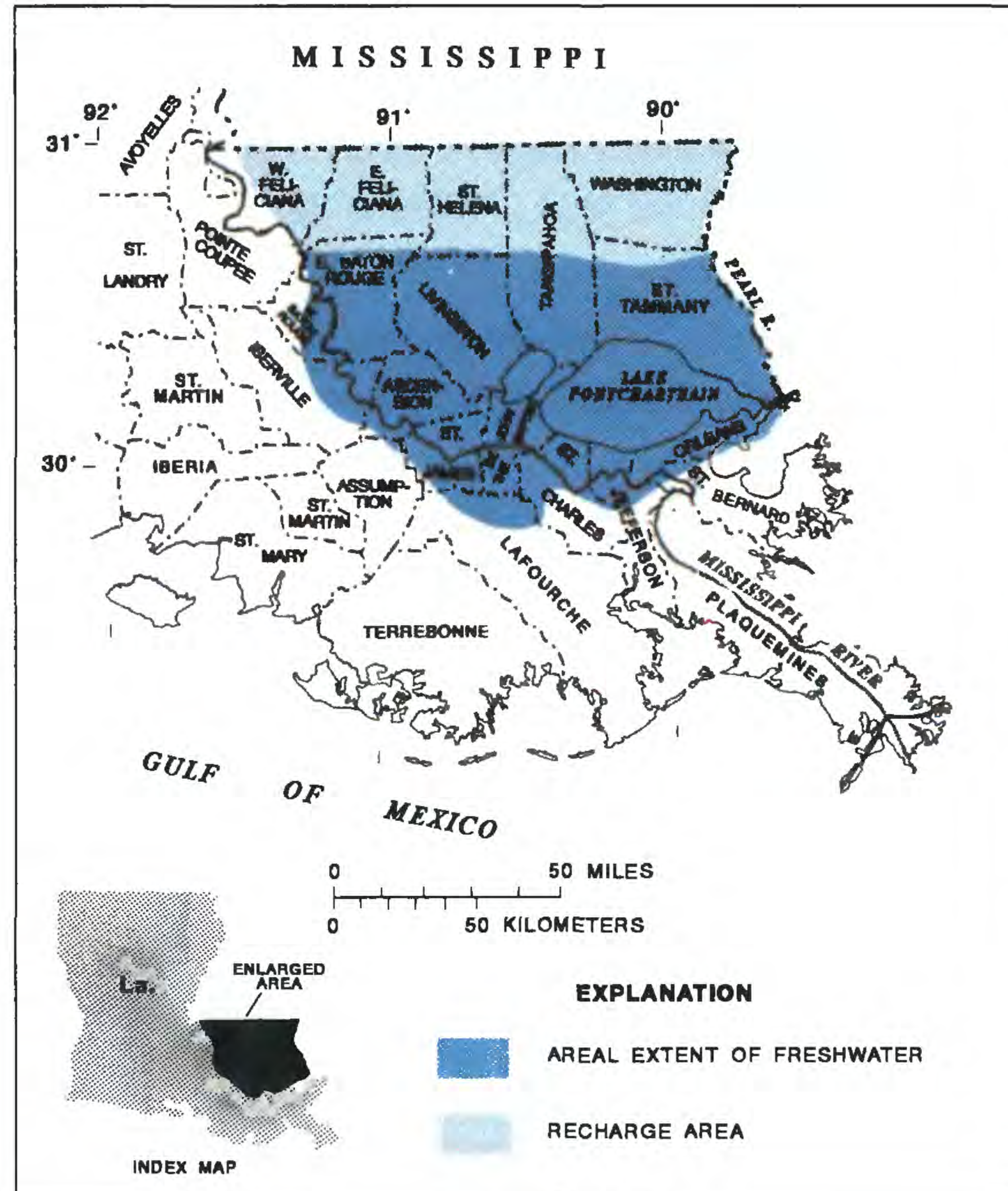

Figure 21. Recharge area and area where Chicot equivalent aquifer system contains freshwater.

Facts

Sediments

- Fine to coarse sand and gravel

Thickness

- 50 to 1,100 feet
- Increases toward the south

Recharge

- Occurs in northern part of aquifer system along the Louisiana-Mississippi State line (fig. 21)
- From rainfall or leakage from surficial sands
- Leakage from underlying aquifers

Wells[1]

- Approximately 1,600
- Depth--60 to 1,000 feet

---

[1] Excludes domestic wells.

Water Levels

- Range from above land surface to 260 feet below; generally between 50 and 100 feet below land surface

- Water-level changes:
  - --1920 to 1970, substantial decline in Baton Rouge and New Orleans areas
  - --1970 to 1992, 40 to 50 feet rise in Baton Rouge area
  - --Mid 1970's to 1992, 10 to 40 feet rise in New Orleans

Yields

- 500 to 1,000 gallons per minute
- Large-capacity wells, 3,500 gallons per minute

Quality

- Soft, low in dissolved solids
- Freshwater as much as 1,000 feet below land surface
- Excellent for drinking-water purposes
- Local presence of iron in "400-foot" and "600-foot" sands
- Local presence of saltwater and color

Use

- Approximately 88 million gallons per day (1990)
- Primary use--industry (fig. 8)

General Description

- Water generally moves southward (fig. 22)
- Saltwater moves northward across Baton Rouge fault into the "600-foot" sand
- Gonzales-New Orleans is most important aquifer in New Orleans area
- "1,200-foot" sand in New Orleans is not pumped because water is saline
- Upper Ponchatoula aquifer is the least developed aquifer in system

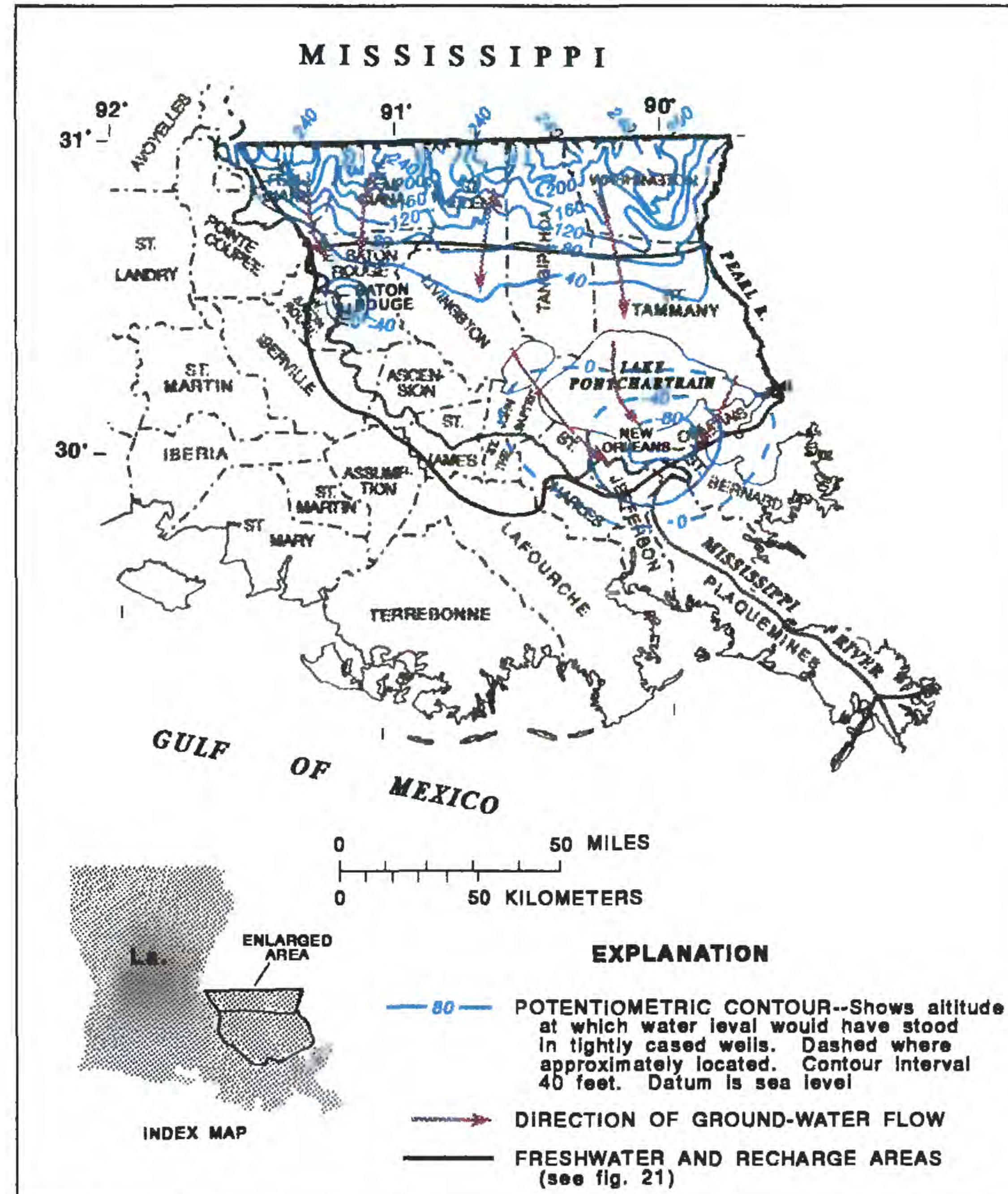

Figure 22. Potentiometric surface and direction of water movement in the Chicot equivalent aquifer system.

Evangeline Equivalent Aquifer System

The Evangeline equivalent aquifer system of southeastern Louisiana (fig. 23) is composed of several aquifers that have been given local names. The most important sands in the Evangeline equivalent aquifer system are the "800-foot," "1,000-foot," "1,200-foot," "1,500-foot," and "1,700-foot" of the Baton Rouge area (East and West Baton Rouge, East and West Feliciana, Pointe Coupee, Iberville, St. Helena, and Livingston Parishes); and the lower Ponchatoula, Big Branch, Kentwood, Abita, Covington, and Slidell aquifers primarily of St. Tammany, Tangipahoa, and Washington Parishes.

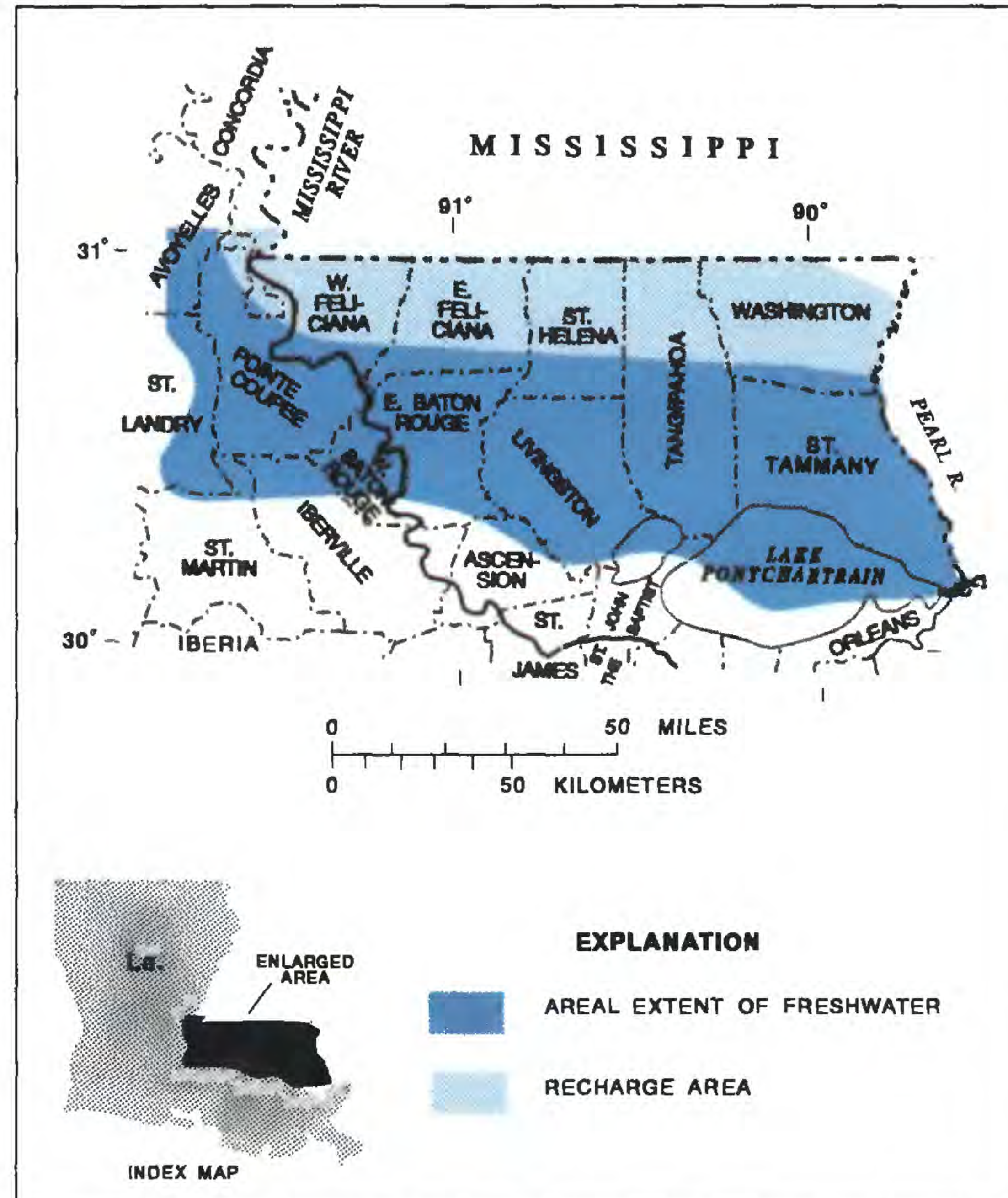

Figure 23. Recharge area and area where Evangeline equivalent aquifer system contains freshwater.

Facts

Sediments

- Fine to medium sand

Thickness

- 50 to 1,000 feet

Recharge

- Occurs in south-central and southwestern Mississippi
- From rainfall on surficial sands

Wells[1]

- Approximately 1,100
- Depth--300 to 2,000 feet

Water Levels

- Range from 80 feet above land surface to 120 feet below, generally more than 25 feet above land surface except in Baton Rouge area where the water level is more than 80 feet below

Yields

- 200 to 4,000 gallons per minute

[1] Excludes domestic wells.

Quality

- Soft
- Iron concentrations from 0.01 to 2.2 milligrams per liter
- Highest iron in eastern quarter and west-central part
- Saltwater encroachment in "1,500-foot" sand in Baton Rouge
- Local occurrence of hydrogen sulfide in St. Tammany, Tangipahoa, and Washington Parishes

Use

- Approximately 68 million gallons per day (1990)
- Primary use--public supply at 47 million gallons per day (fig. 8)

General Description

- Water generally moves southward (fig. 24)
- "800-foot," "1,000-foot," and "1,700-foot" are minor sands of the system
- "1,200-foot" sand used primarily for industry
- "1,500-foot" sand used primarily for public supply

  --Water requires little or no treatment
- Lower Ponchatoula and Big Branch aquifers correlate with "800-foot," "1,000-foot," and "1,200-foot" sands of Baton Rouge

  --Low in hardness and concentrations of iron
- Covington aquifer is an important source for public supply in Tangipahoa, St. Tammany, and western Washington Parishes
- Slidell aquifer is capable of yielding more water to a well than other aquifers in Tangipahoa and St. Tammany Parishes

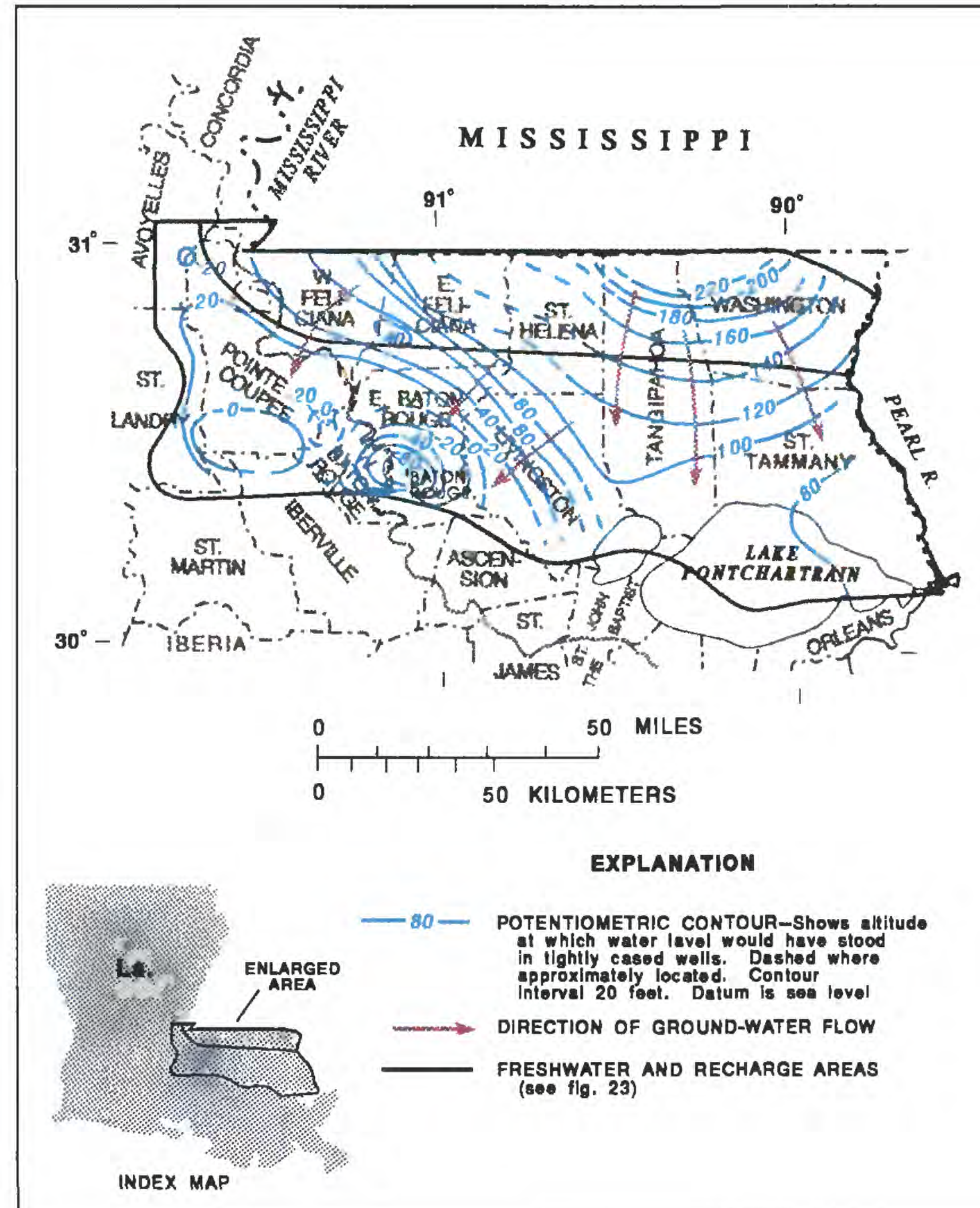

Figure 24. Potentiometric surface and direction of water movement in the Evangeline equivalent aquifer system.

Jasper Equivalent Aquifer System

The Jasper aquifer system of central Louisiana has an equivalent aquifer system in southeastern Louisiana (fig. 25). It is composed of several aquifers that have been given individual aquifer names according to depth or location of the producing sand. Principal Jasper equivalent aquifers include the "2,000-foot," "2,400-foot," and "2,800-foot" sands of the Baton Rouge area and the Tchefuncta, Hammond, Amite, and Ramsay aquifers in St. Tammany, Tangipahoa, and Washington Parishes.

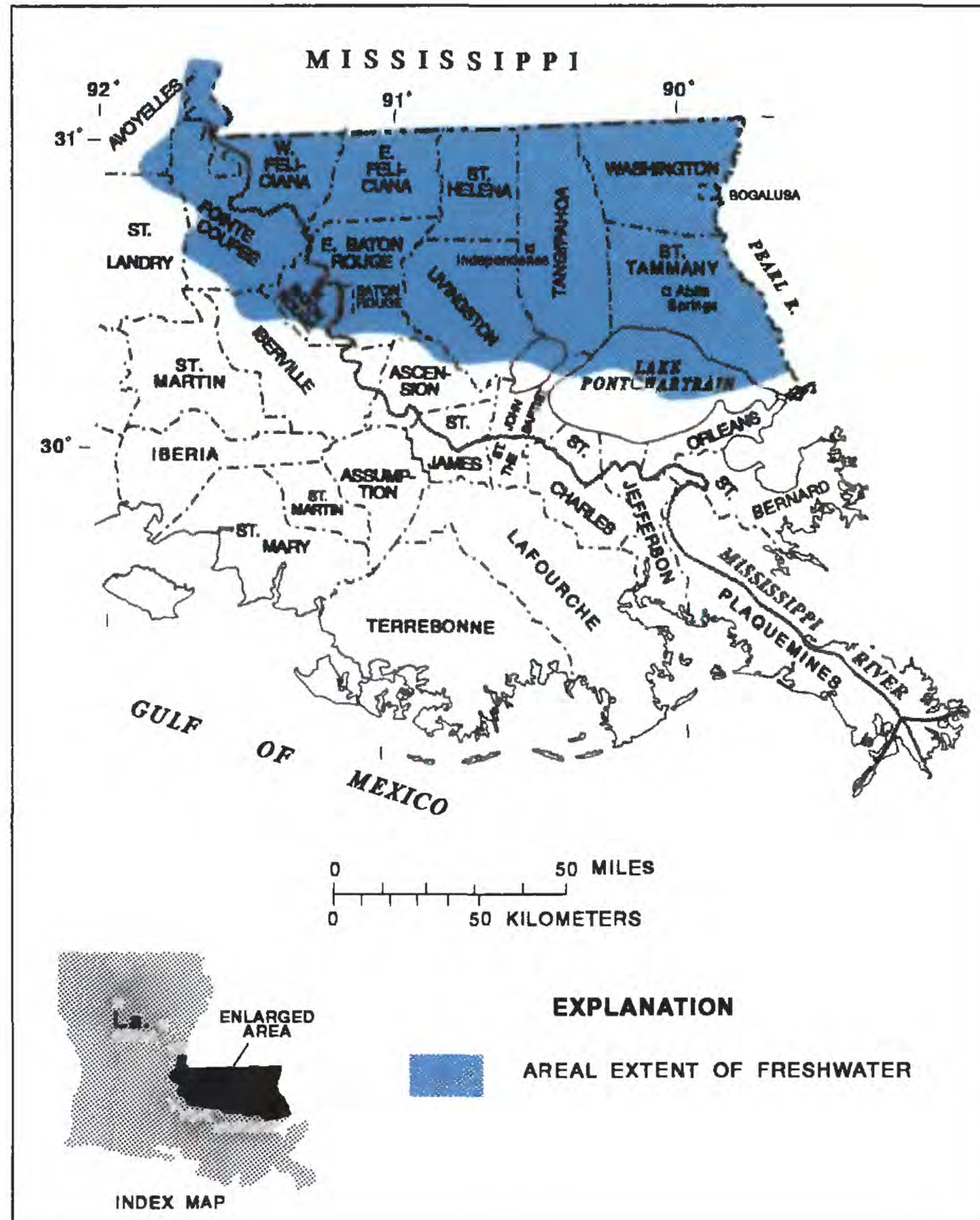

Figure 25. Area where Jasper equivalent aquifer system contains freshwater.

Facts

Sediments

- Fine to coarse sand

Thickness

- 1,200 to 2,350 feet

Recharge

- In southwestern Mississippi
- From rainfall on surficial sands
- Leakage from overlying aquifers

Wells[1]

- Approximately 500
- Depth--560 to 3,350 feet

[1] Excludes domestic wells.

Water Levels

- Range from 40 feet above land surface to 150 feet below, but generally below land surface in the northern part of aquifer extent and above land surface in the south, except in the Baton Rouge area where the water level is more than 60 feet below (fig. 26)
- Water-level changes:
  - --Prior to 1974, long-term declines
  - --Since 1974, water levels generally rising
- Pumping centers in Baton Rouge and Bogalusa

Yields

- 200 to 3,400 gallons per minute

Quality

- Soft and low in iron concentration
- Generally requires little or no treatment
- Deepest presence of freshwater in Louisiana--3,500 feet in southeastern Tangipahoa Parish

Use

- Approximately 112 million gallons per day (1990)
- Primary uses--industry, 57 million gallons per day; public supply, 48 million gallons per day (fig. 8)

General Description

- "2,000-foot" sand
  - --Most intensively pumped
  - --Saltwater encroachment has been detected
- Tchefuncta aquifer correlates with "2,000-foot" sand
- "2,400-foot" sand used primarily for public supply
- Hammond aquifer is capable of yielding more water to wells than other aquifers in the system; correlates with "2,000-foot" and "2,400-foot" sands
- Iron and manganese concentrations higher north of Independence and Abita Springs
- Amite aquifer occurs in St. Tammany, Tangipahoa, and Washington Parishes; correlates with "2,400-foot" and "2,800-foot" sands
  - --Locally contains hydrogen sulfide

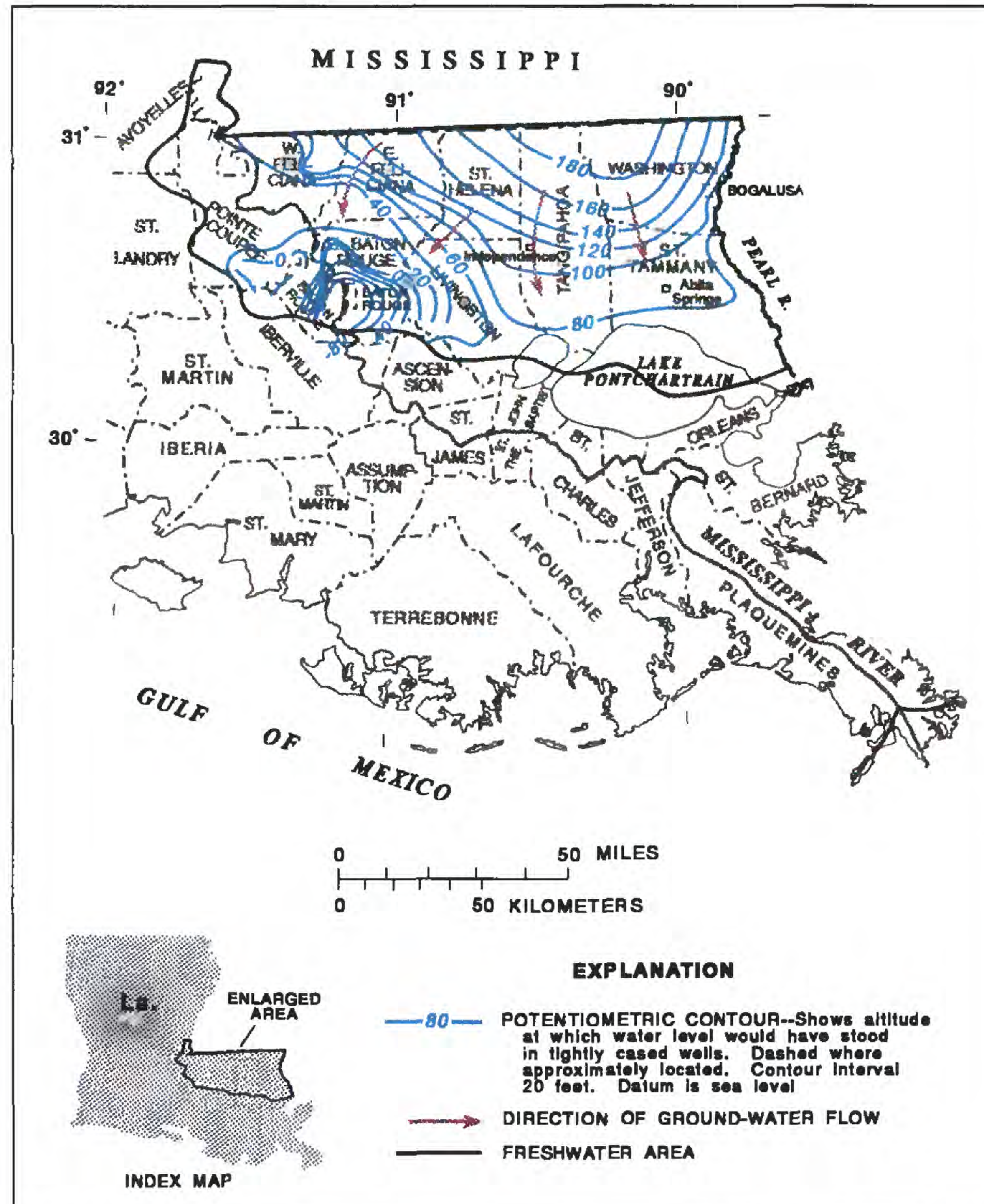

Figure 26. Potentiometric surface and direction of water movement in the Jasper equivalent aquifer system.

Mississippi River Alluvial Aquifer

The Mississippi River alluvial aquifer follows the course of the Mississippi River from northeastern to south-central Louisiana (fig. 27). In southern Louisiana, the aquifer merges with alluvium of the Atchafalaya River to the west to form a single, large alluvial aquifer. One of the major characteristics of this aquifer is its ability to yield large quantities of water to wells; the largest individual well yields in Louisiana are from this aquifer (Whitfield, 1975, p. 1). The Mississippi River alluvial aquifer is also the single largest source of fresh ground water in northeastern Louisiana. In a large part of this area, it is the only source of fresh ground water available for use (Whitfield, 1975, p. 2).

Facts

Sediments

- Sand and gravel
- Fine grained in upper part grading to coarse in lower part
- Confined by overlying fine sand, silt, and clay (0 to 150 feet thick)

Thickness

- 50 to 500 feet
- Increases southeasterly

Recharge

- Occurs from rainfall on the entire aquifer surface, and underlying aquifers
- Leakage from underlying aquifers
- Locally from Mississippi River near pumping centers

Wells[1]

- Approximately 2,800
- Depth--100 to 350 feet, average depth 116 feet

Figure 27. Recharge area and area where Mississippi River alluvial aquifer contains freshwater.

[1] Excludes domestic wells.

Water Levels

- Typically less than 30 feet below land surface (fig. 28)
- Annual change 2 to 20 feet

Yields

- 500 to 4,000 gallons per minute
- Large-capacity wells, 7,000 gallons per minute

Quality

- Generally high hardness and concentrations of iron:
  - --Hardness of 44 to 480 milligrams per liter
  - --Iron concentrations of 0.02 to 15 milligrams per liter; generally greater than 1.0 milligrams per liter
- Freshwater generally occurs throughout aquifer extent (chloride generally less than 250 milligrams per liter)
- Local areas of saltwater

Use

- Approximately 284 million gallons per day (1990)
- Primary use--irrigation, 122 million gallons per day (fig. 8)

General Description

- Water generally moves southward
- Discharge
  - --Seepage into major streams
  - --Withdrawals from wells
- Water requires treatment for hardness and iron for domestic and public supply use
- Source of saltwater
  - --Underlying aquifers
  - --Oil and gas activities
  - --Ancient unflushed seawater
- Potential threats to the aquifer
  - --Improperly plugged or abandoned wells
  - --Misuse of agricultural chemicals
- No detection of major organic contamination of aquifer

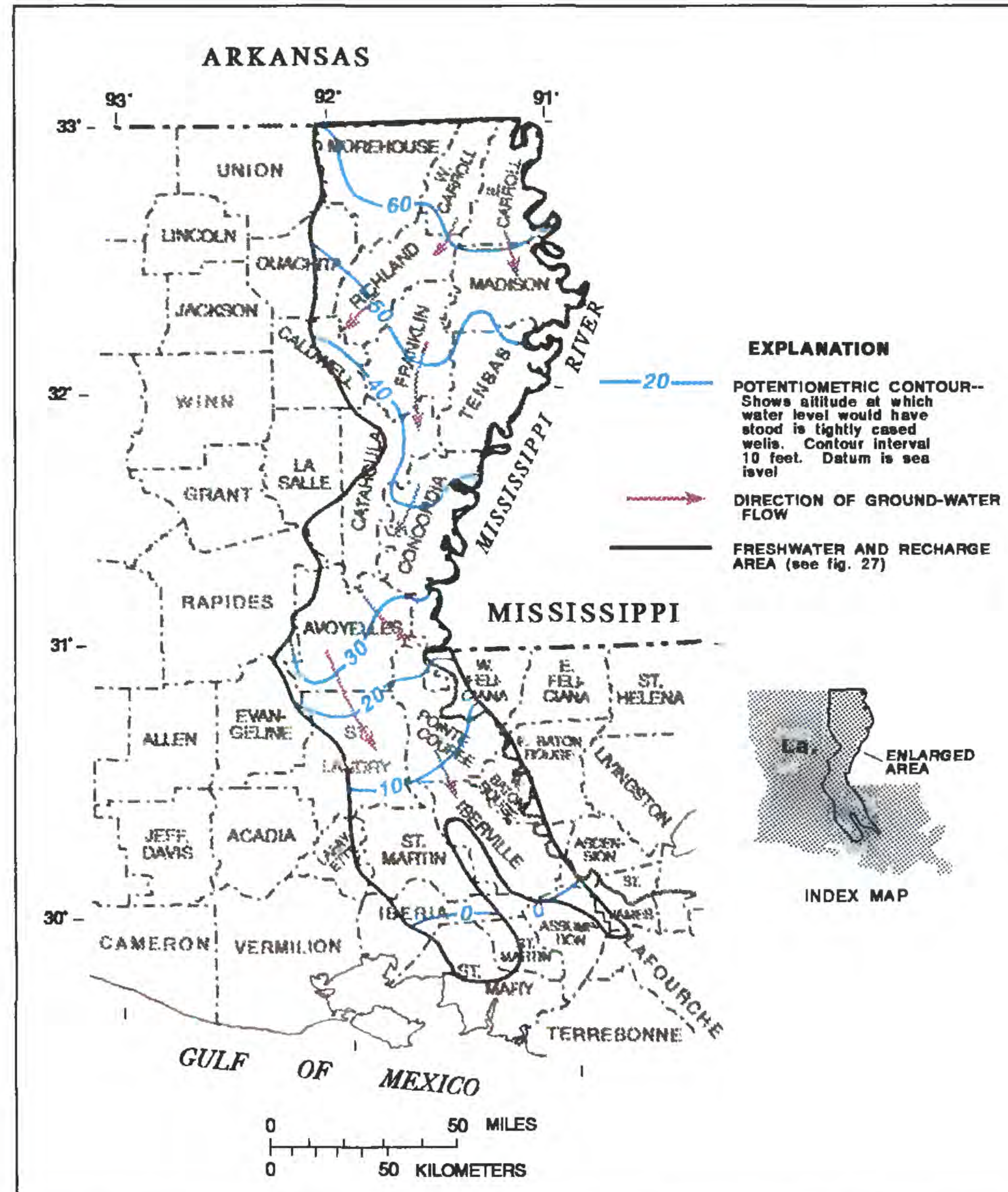

Figure 28. Potentiometric surface and direction of water movement in the Mississippi River alluvial aquifer.

Red River Alluvial Aquifer

The Red River alluvial aquifer is continued within the Red River Valley in Louisiana and is Pleistocene in age. The Red River alluvial aquifer is the largest source of freshwater in the Red River Valley in Louisiana; however, only a small amount of water is pumped for the aquifer because treatment is required for most uses. Recharge to the aquifer is supplied, in part, by adjacent and underlying Tertiary and Pleistocene age deposits.

Facts

Sediments

- Clay, silt, and fine sand grading to coarse sand and gravel at bottom

Thickness

- 50 to 200 feet
- Increases in downstream direction

Recharge

- From rainfall on fine-grained surficial sediments
- Leakage from underlying aquifers

Wells[1]

- Approximately 970
- Depth--100 to 250 feet

Water Levels

- Generally less than 30 feet below land surface
- Fluctuate seasonally
- Larger fluctuations near streams

Yields

- 500 to 2,800 gallons per minute

Quality

- Largest source of fresh ground water in Red River Valley
- Hard to very hard, 100 to 2,300 milligrams per liter
- High iron concentrations, generally greater than 1.0 milligrams per liter
- Chloride generally less than 50 milligrams per liter
- Local areas of saltwater

Use

- Approximately 4 million gallons per day (1990)
- Primary use--Aquaculture

[1] Excludes domestic wells.

Upland Terrace Aquifer

The upland terrace aquifer occurs in a discontinuous band along the northwestern edge of the Red River Valley and the western edge of the Mississippi River Valley. The upland terrace aquifer is Pleistocene in age and was formed by sediments filling channels cut into deposits by the Red River and Mississippi River systems. The upland terrace aquifer is not extensively used as a source of freshwater, in part, due to concerns about the aquifer's ability to supply adequate amounts of freshwater for future needs and the aquifer's potential for contamination.

Facts

Sediments

- Clay, silt, and fine sand grading to coarse sand and gravel at bottom

Thickness

- 25 to 240 feet
- Increases toward south

Recharge

- From rainfall on fine-grained surficial sediments
- Leakage from underlying aquifers

Wells[1]

- Approximately 1,100
- Depth--20 to 150 feet

Water Levels

- Range from near land surface to 80 feet below; average 40 feet below land surface
- Fluctuate seasonally; long term trends relate to rainfall trends.
- Seasonal fluctuation about 2 feet in south-central Louisiana; 10 feet in north-central

Yields

- 100 to 1,700 gallons per minute

Quality

- Soft, generally less than 60 milligrams per liter
- Low iron concentrations, less than 0.3 milligrams per liter
- Water is corrosive, due to low pH
- Local occurrence of saltwater, iron, and hardness

Use

- Approximately 22 million gallons per day (1990)
- Primary uses--public supply, 12 million gallons per day; industry, 3 million gallons per day

[1] Excludes domestic wells.

WHAT ARE POTENTIAL GROUND-WATER PROBLEMS IN LOUISIANA?

Ground water is in abundant supply in the State of Louisiana. However, its abundance should not be taken for granted. Until the last 15 or 20 years, ground water was thought to be a natural resource free from pollution. Located beneath the earth's surface, ground water was thought to be protected from man's activities. It is now realized that ground water may be affected by activities on the land surface. Industrial wastes, landfills, septic tanks, underground storage tanks, overuse of water, animal wastes, and improper handling of agricultural chemicals are just a few sources that pose potential threats to our ground-water supply.

Pollution of ground water is, in many instances, difficult to detect and expensive to treat. Ground-water movement is slow (generally a few feet a year). Once a pollutant enters the ground-water system it may take tens to thousands of years to completely flush or dilute (Freeze and Cherry, 1979). Restoring ground water to its original pristine state is difficult, and in some instances, infeasible. For this reason, it is crucial to understand that the best method of protecting our ground water is to prevent its contamination. Efforts to protect our ground-water resources have intensified in recent years.

Some of Louisiana's major ground-water concerns are: (1) contamination from surface disposal of agricultural chemicals and petroleum products, (2) contamination by hazardous-waste sites around the State, (3) contamination from surface wastes and saltwater through abandoned wells, (4) saltwater encroachment in coastal areas, and (5) locally depressed water levels caused by local concentrations of pumping from some of the major aquifers in the State (U.S. Geological Survey, 1986).

Some of the most common indigenous or "natural" water-quality problems found in ground-water supplies in Louisiana are hardness, iron, acidic water (corrosiveness), hydrogen sulfide (rotten egg odor), color, and taste. Treatment facilities are capable of handling these problems.

In several areas around the state, water levels in wells have declined substantially due to pumping from major aquifers. Declines have ranged from about 180 feet in wells completed in the Chicot aquifer system of southwestern Louisiana to a maximum of about 430 feet in wells completed in the "2,000-foot" sand at Baton Rouge (U.S. Geological Survey, 1984, p. 135). Though water levels in some aquifers have risen or stabilized in recent years, because of a decrease in pumping due to economic conditions and conservation measures, there are still regional water-level declines that need monitoring.

The freshwater-saltwater interface is an arbitrary surface under the land surface that separates water containing more than 250 milligrams per liter chloride (saltwater) from water containing less than 250 milligrams per liter chloride (freshwater). This is not a well defined line; a brackish water transition zone separates the freshwater and the saltwater. The approximate location of the freshwater-saltwater interface in Louisiana is shown in figure 29. Upconing of saltwater may occur in response to heavy pumping of one or more wells in an area. Saltwater is pulled steadily upward as pumping continues. Saltwater is a common source of ground-water degradation; sometimes wells have to be abandoned because of saltwater encroachment or upconing. Proper design of wells and well fields and pumping schemes can prevent the upconing of saltwater in an aquifer.

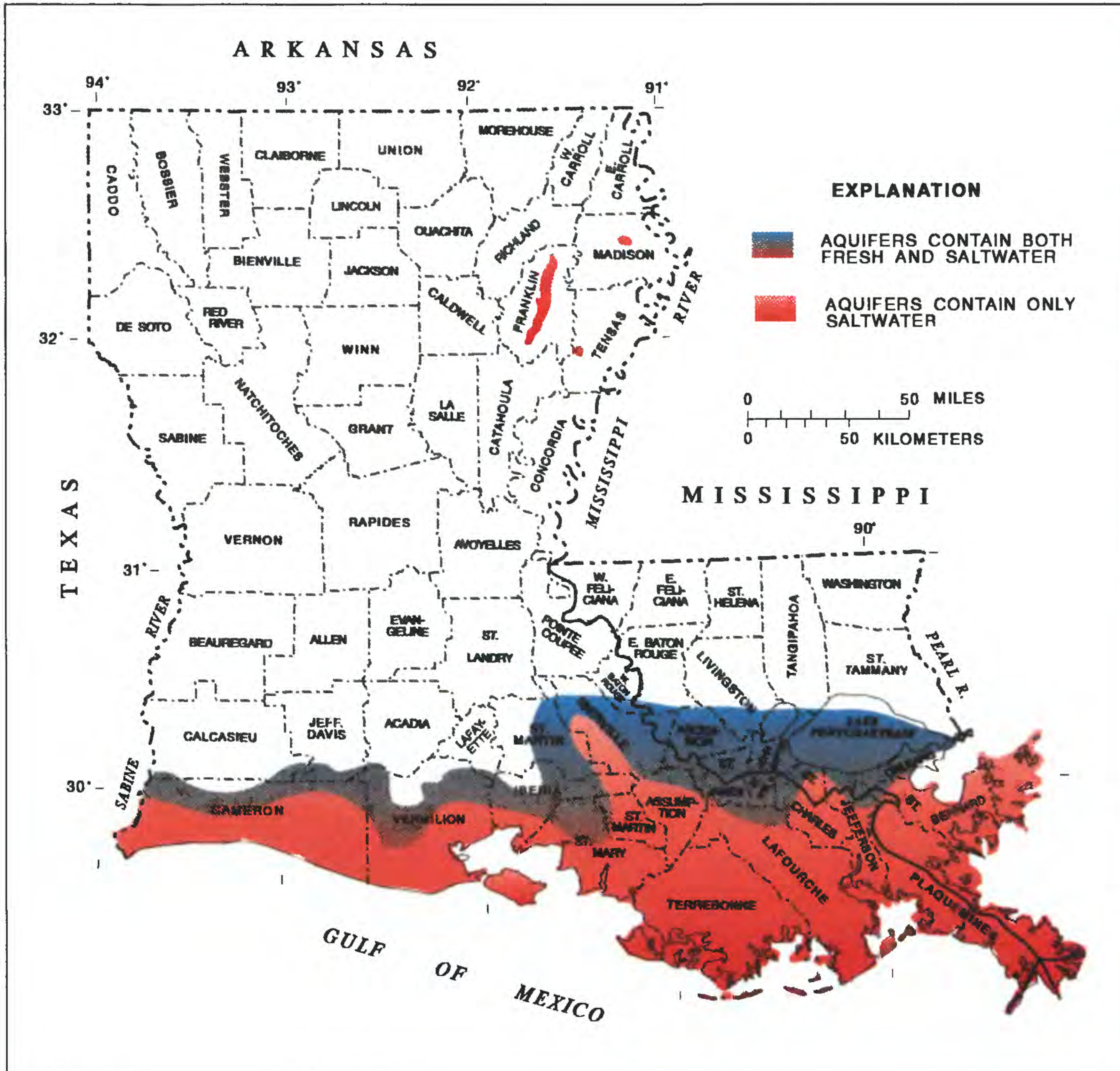

Figure 29. Freshwater-saltwater interface in Mississippi River alluvial aquifer and coastal Louisiana.

In coastal areas, seawater is being drawn landward and locally upward in the Chicot aquifer system of southwestern Louisiana due to intensive pumping by agriculture and industry. Increasing chloride concentrations between 1968 and 1984 indicated a northward or upward movement of the freshwater-saltwater interface in areas east and south of the city of Lake Charles. Since 1984, there has been little increase in chloride concentrations. (See U.S. Geological Survey, 1988, p. 277.)

A potential threat of saltwater encroachment exists in some of the Baton Rouge area aquifers. Chloride data indicate saltwater is moving across barriers such as the Baton Rouge fault toward municipal wells. Use of the Gonzales-New Orleans aquifer system in the New Orleans area is limited because of the potential for saltwater encroachment.

Saltwater occurring locally in aquifers such as the terrace aquifer of northern Louisiana probably resulted from earlier oil and gas activities in the State. Abandoned oil-field disposal pits containing chemicals and saltwater create a potential ground-water problem in Louisiana.

Hazardous-waste sites and landfills also pose a threat to the ground-water resources of Louisiana. Most of these sites were created when few or no State and Federal regulations protecting ground water were enforceable. Abandoned waste sites are in almost every Louisiana parish. Particular areas of concern are Calcasieu Parish and the industrial corridor along the Mississippi River between Baton Rouge and New Orleans.

There are at least 506 potentially hazardous inactive and abandoned sites in Louisiana. Of these, 297 sites are low priority for the USEPA Superfund Program and are classified as requiring "no further action;" and 209 sites require further investigation and/or remedial action. Figure 30 shows the location of 87 of the 209 sites that need remedial action, 11 Superfund sites, and six commercial hazardous-waste sites. (See Cormier and others, 1990, p. 41.)

A minimum amount of contamination from agricultural chemicals has been detected around the State at the present time (1992). However, there is still concern for agricultural chemical contamination in the future. Louisiana has extensive areas used for agricultural purposes; thus, widespread use of pesticides, along with irrigation of permeable soils, creates a potential for these agricultural chemicals to move downward to aquifers in the State.

Although there are very specific rules and regulations enforced by DOTD concerning the plugging and abandoning of unused water wells, many wells still need to be plugged. Improperly abandoned wells can allow the movement of surface contaminants directly into the State's ground-water resources. Contaminants can also enter aquifers through leaks in casings of abandoned wells; saltwater from overlying or underlying aquifers can enter an aquifer through these casing leaks.

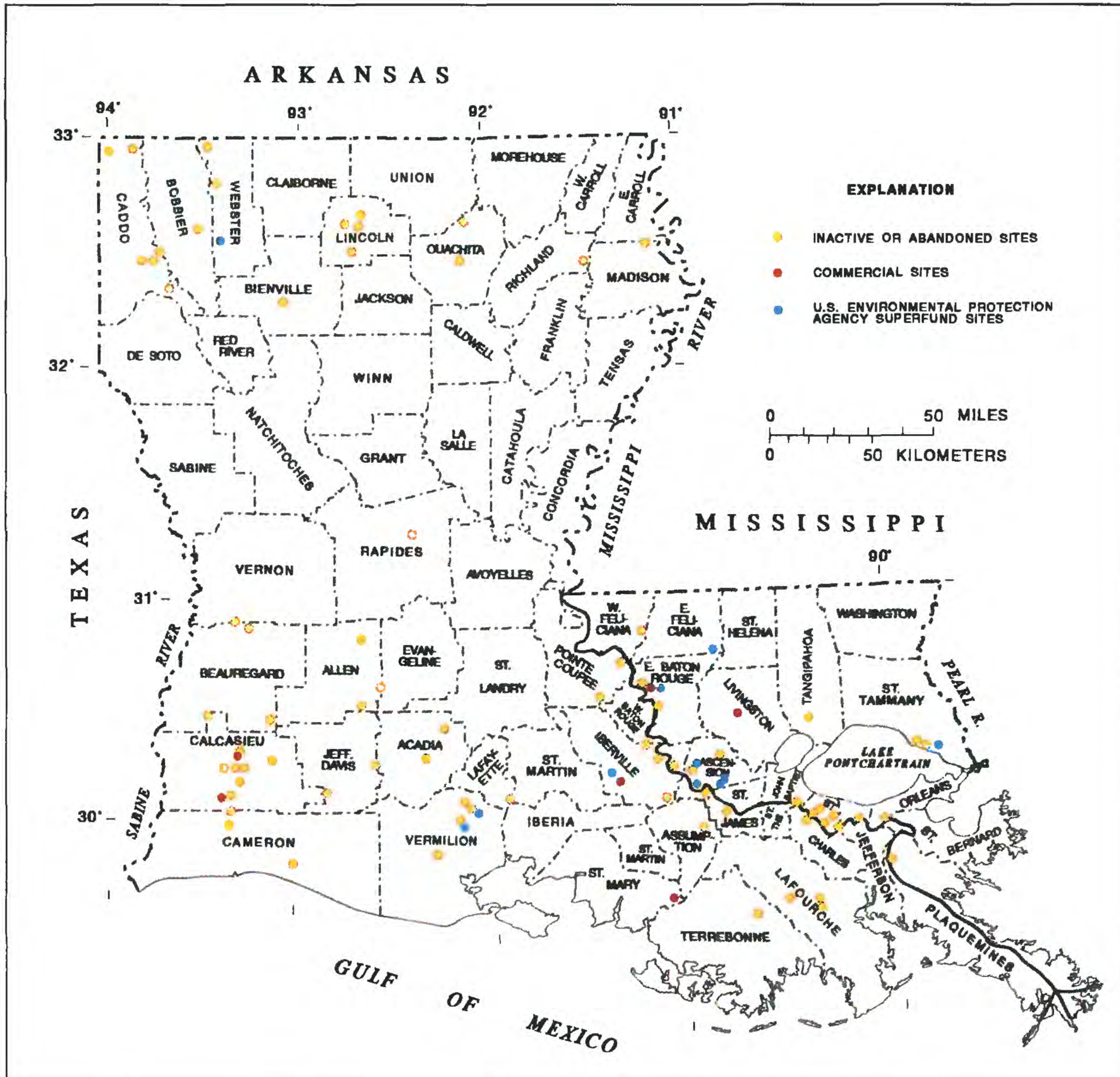

Figure 30. Location of selected hazardous-waste sites in Louisiana, 1990.

WHERE CAN GROUND-WATER INFORMATION BE OBTAINED IN LOUISIANA?

Ground-water information is important to all citizens of Louisiana. Elected officials need the information to aid in making decisions concerning ground-water regulations, enforcement, and development. The well contractor requires ground-water information to assist in drilling high-producing water wells of acceptable quality. Ground-water information is also important to the private citizen who may have questions concerning his own water well or the public-supply system serving his area. Several State and Federal agencies have ground-water responsibilities to ensure that Louisiana's ground-water supply remains plentiful, as well as safe.

The USGS, Water Resources Division, through their cooperative program with DOTD collects all types of ground-water data and reports the findings in publications that range from local to statewide in coverage. Published materials concerning ground water in the State are abundant and available to the public upon request.

The USEPA has the responsibility to develop and enforce regulations for the protection of ground water. It also determines maximum contaminant levels for inorganic and organic compounds in water. USEPA aids the states in developing and implementing ground-water protection programs.

Several State agencies are involved in ground-water activities. The DOTD has the primary statewide ground-water responsibilities. DOTD is responsible for licensing and regulating Louisiana water well drillers, for monitoring water well drilling by requiring that all water wells be registered, and for enforcing rules and regulations for the construction and plugging of water wells. Another function of the Louisiana DOTD is to provide public assistance concerning water problems, water conservation and proper development of the State's ground-water resources. The DOTD has an extensive computerized listing of water wells that have been drilled in Louisiana. This information is available to the general public upon request.

The DOTD and the USGS cooperatively prepare reports describing the collection and interpretation of ground-water information. Most of the data (information on water wells, ground-water levels, ground-water quality data, and pumpage information) are collected and analyzed through the operation of well networks and ground-water studies. The water-level (fig. 31) and ground-water quality (fig. 32) networks consist of 134 wells collectively (Arcement and others, 1991). These wells are used to monitor ground-water conditions in all the major aquifers of the State. This information is stored in a computer database maintained by the USGS. Data are available to interested citizens.

The Louisiana Department of Environmental Quality has the responsibility to protect Louisiana's ground-water resources. This agency is responsible for remediation of abandoned hazardous-waste sites, the regulation of underground storage tanks, and the remediation of contaminated water. The Louisiana Department of Environmental Quality, in cooperation with local, State, and Federal agencies, has developed a ground-water protection strategy for the State.

Another State agency that has a responsibility for protecting ground water is the Louisiana Department of Natural Resources. Louisiana Department of Natural Resources' Office of Conservation regulates all aspects of the oil and gas industry and mining operations in the State, as well as the use of injection wells that dispose of liquid waste in deep underground strata.

Public-water supplies are regulated by the Louisiana Department of Health and Hospitals. Under the Safe Drinking Water Act, this State agency ensures that the water withdrawn for public-supply use is safe to drink by meeting Federal standards. Water samples collected from public-supply wells are analyzed for selected bacteriological, organic, inorganic, and radiological constituents. Results are available to the public. The Louisiana Department of Health and Hospitals reviews and approves plans and specifications for the construction of public water-supply systems and regulates the water quality of water sold or bottled in the State.

The Capital Area Ground Water Conservation Commission requires the reporting of ground-water use by the five parishes within its jurisdiction: East and West Baton Rouge, East and West Feliciana, and Pointe Coupee. The Commission is the only Louisiana agency that has the authority to require permits for the construction of water wells having the capacity of producing 50,000 gallons per day or more. The withdrawal amount, by well and aquifer, is reported to the Commission.

The Louisiana Department of Agriculture and Forestry indirectly ensures that ground-water resources of the State are safe by regulating the use of agricultural chemicals. It also provides information on the proper use of these chemicals.

Local well drillers and contractors are another source of ground-water information. Most have knowledge of the ground-water resources in the areas in which they do most of their drilling.

Table 2 lists the types of ground-water information that are available from the local, State, and Federal agencies in Louisiana.

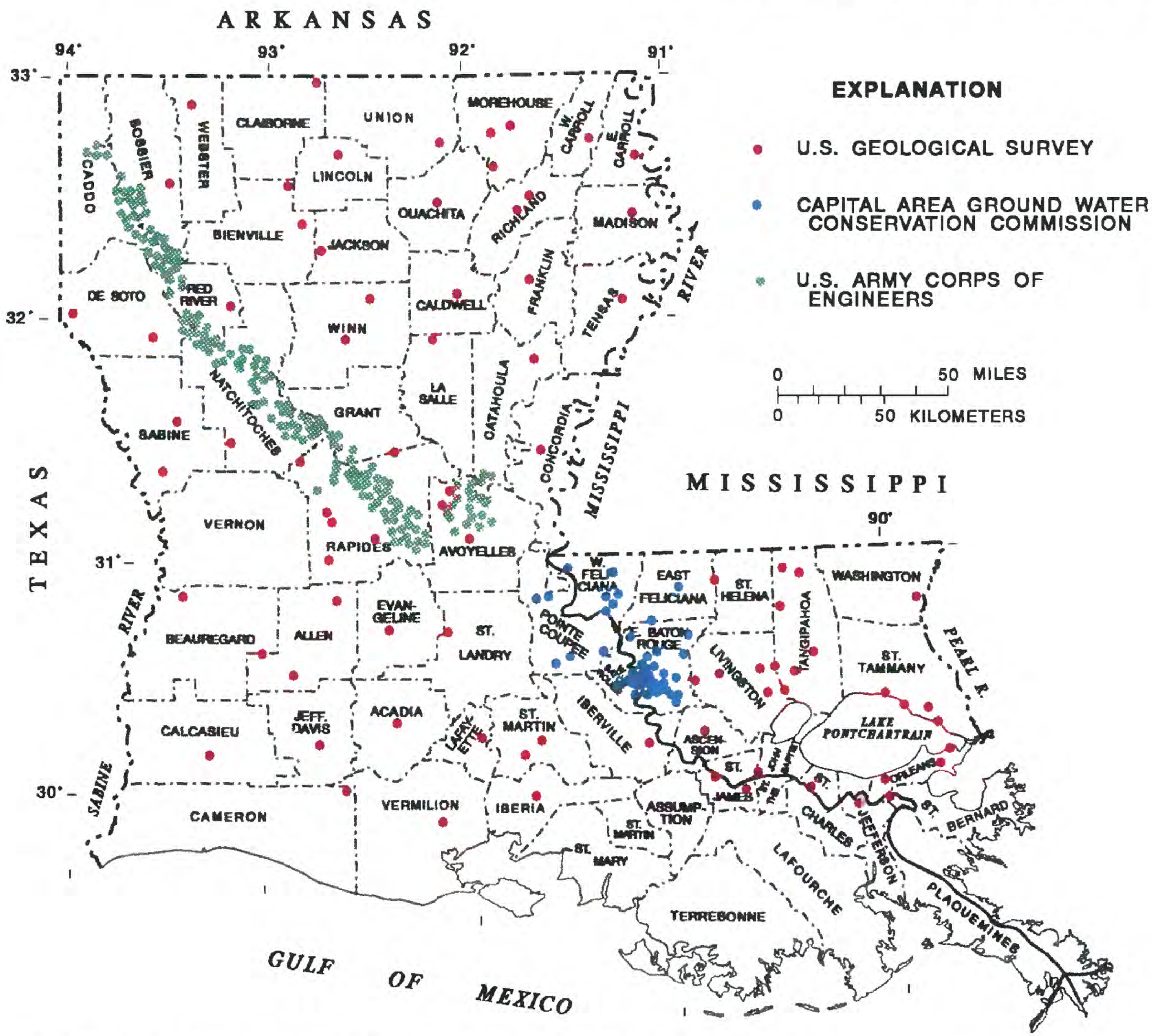

Figure 31. Location of water-level observation wells in Louisiana, 1990.

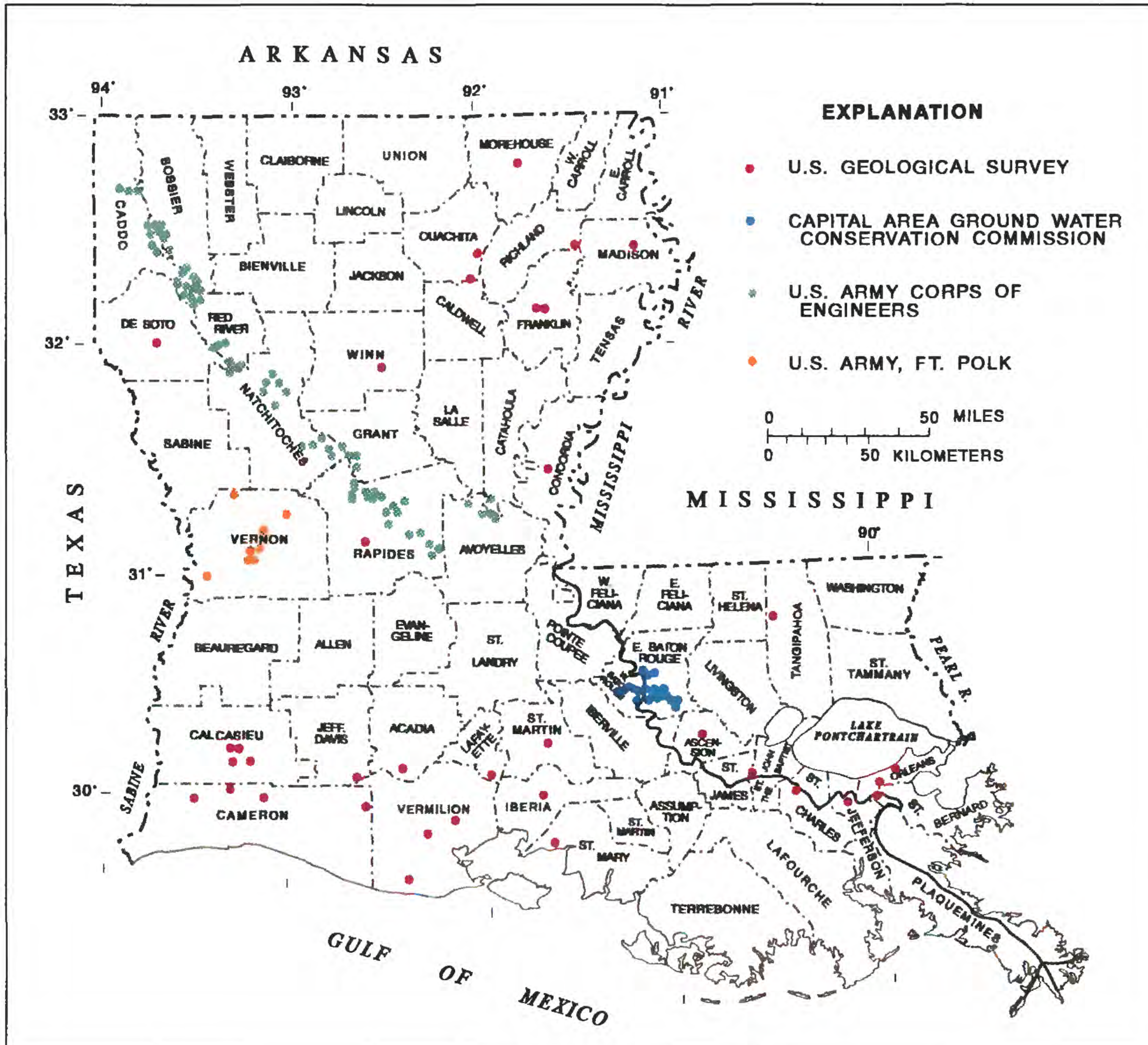

Figure 32. Location of water-quality monitoring wells in Louisiana, 1990.

Table 2. Types of ground-water information for Louisiana available from local, State, and Federal agencies

[CAGWCC, Capital Area Ground Water Conservation Commission; DOTD, Louisiana Department of Transportation and Development; DEQ, Louisiana Department of Environmental Quality; DHH, Louisiana Department of Health and Hospitals; DNR, Louisiana Department of Natural Resources; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency]

	Local[1]	State				Federal	
Information	CAGWCC	DOTD	DEQ	DHH	DNR	USGS	USEPA
Water well records	X	X				X	
Logs of test holes and wells	X	X			X	X	
Chemical analyses of water		X	X	X		X	X
Bacteria analyses of water		X		X		X	X
Water-use data	X	X				X	
Water-level records	X	X				X	
Ground-water research		X				X	X
Legal aspects	X	X	X	X	X		
Well construction and siting standards	X	X		X			
Water-quality standards			X	X			X
Samples of earth material and cuttings from test holes						X	
Ground-water contamination			X	X	X		X
Licensing well drillers		X					
Ground-water reports	X	X				X	X
Abandoned water wells	X	X					

[1] Baton Rouge area.

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