U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER-RESOURCES INVESTIGATIONS
REPORT 90-4119 (SHEET 1 OF 7)

INTRODUCTION

Ground water is available in abundant quantities throughout most of Louisiana. The usefulness of this water, however, is dependent upon its chemical quality. Water of a particular quality may be suitable for one purpose such as irrigation, but not suitable for other uses, such as industrial or public supply. Knowledge of the areal distribution of the chemical characteristics that determine the suitability for use is vital to the effective management and use of Louisiana's groundwater resources.

This report, prepared as part of an ongoing cooperative program between the U.S. Geological Survey and the Louisiana Department of Transportation and Development, describes the occurrence and distribution of selected properties and inorganic and organic chemical constituents in 12 aquifers of Louisiana. It is based on water-quality data from about 5,000 chemical analyses of water collected from 1960 through 1988. The properties and inorganic constituents are presented by individual aquifers or aquifer systems. Areal distributions of hardness, sodium, dissolved solids, dissolved iron, and dissolved manganese are shown on maps for nine aquifers. The statistical occurrence of properties and inorganic constituents are presented in tables and boxplots.

Data on organic constituents (volatile organic compounds, acid-base/neutral extractable (semivolatile) organic compounds, pesticides, and polychlorinated biphenyls) are presented on a statewide basis. The sampling location, a list of the organic compounds analyzed, and laboratory detection limits for the organic compounds are given. The organic compounds detected and their concentrations are listed.

Aquifers of Louisiana

Aquifers and aquifer systems in Louisiana generally consist of a series of deltaic and alluvial deposits that dip and thicken in a southerly direction. These deposits consist of alternating beds of sand and gravel separated by beds of clay. The aquifers and aquifer systems are regional in extent, but many consist of a series of lenticular sands (sands which pinch out over short distances), which are often difficult to trace and correlate for more than a few miles. However, when considered on a regional basis, these individual lenses of sand collectively form an aquifer capable of supplying large volumes of water for various uses.

In this report, the freshwater aquifers of Louisiana are discussed by generalized age of their sediments. The aquifers, in order from youngest to oldest, occur in sediments of Pleistocene, Pliocene, Miocene, Eocene, and Paleocene age aquifers (table 1). No major freshwater aquifers in southeast Louisiana are in sediments older than Miocene age. The locations of the aquifers in Louisiana are shown on maps.

Aquifers in sediments of Pleistocene age are the Red River and Mississippi River alluvial aquifers, the Chicot aquifer system, and the Chicot equivalent/southeast Louisiana aquifer system. These aquifers supplied nearly 80 percent of the ground water used in Louisiana in 1985 (J.K. Lovelace, U.S. Geological Survey, written commun., 1989). The northern Louisiana terrace aquifers are not included in this report because they supplied only about 1 percent of the water pumped from sediments of Pleistocene age.

Aquifers in sediments of Pliocene (Miocene [?]) age in Louisiana include the Evangeline aquifer and Evangeline equivalent/southeast Louisiana aquifer system which supplied less than 5 percent of the water pumped from aquifers in 1985. Aquifers in sediments of Miocene age include the Jasper aquifer system, the Jasper equivalent/southeast Louisiana aquifer system, and the Catahoula aquifer which can include sediments of Oligocene age. Aquifers in sediments of Miocene age supplied about 10 percent of the water pumped from aquifers in 1985. The Catahoula equivalent/southeast Louisiana aquifer system is not included in this report because it is little used in southeastern Louisiana, and because a limited amount of chemical data is available.

The oldest freshwater aquifers in Louisiana, the Cockfield, Sparta, and Carrizo-Wilcox, are in sediments of Eocene and Paleocene age. These aquifers supplied about 5 percent of the total water pumped from aquifers in Louisiana in 1985.

Previous Studies

Previous hydrologic studies include discussions of the water quality and geohydrology of aquifers and aquifer systems in Louisiana; however, most of these studies are of limited areal extent. The northeastern part of the Mississippi River alluvial aquifer and the Red River alluvial aquifer are described in two reports by Whitfield (1975a; 1980). These reports include discussions of the geohydrology and chemical characteristics of the aquifers, as well as maps of selected constituents. The chemical characteristics of water in the Chicot aquifer system were delineated and mapped by Nyman (1984; 1989)

The chemical characteristics of water in aquifers in southeastern Louisiana in sediments of Pleistocene, Pliocene, and Miocene age is discussed in many reports describing local areas. Selected areas described in specific reports include the Baton Rouge area (Meyer and Turcan, 1955), East and West Feliciana Parishes (Morgan, 1963), Livingston and St. Helena Parishes (Tomaszewski, 1988), Tangipahoa and St. Tammany Parishes (Nyman and Fayard, 1978), and the Greater New Orleans area (Rollo, 1966).

The chemical quality of water in aquifers in sediments of Pliocene and Miocene age in southwestern Louisiana is discussed and mapped in two reports (Nyman, 1989; Whitfield, 1975b). These reports describe the Evangeline aquifer and the Jasper aquifer system for most of the area where they contain freshwater in Louisiana.

The chemical quality of water from aquifers in sediments of Eocene and Paleocene age in northern Louisiana is documented in many reports describing local areas. Specific areas where the chemical characteristics of water from the Cockfield, Sparta, and Carrizo-Wilcox aquifers have been described include Bossier and Caddo Parishes (Page and May, 1964), Ouachita Parish (Rogers and others, 1972), Morehouse Parish (Sanford, 1973), Union Parish (Snider and others, 1972), Arcadia-Minden area (Ryals, 1982), and the West Monroe area (Trudeau and Buono, 1985).

In addition to the reports describing local areas, Rollo (1960) completed a statewide report that summarizes available hydrologic data for aquifers in Louisiana. This report includes generalized chemical quality discussions for aquifers and aquifer systems in Louisiana and a generalized map showing regions of differing water quality throughout the State. Recent map reports document the depth of the base of freshwater (Smoot, 1988) and the areal extent of freshwater in aquifers (Smoot, 1986) throughout Louisiana.

Some water-quality constituents not discussed in this report have been discussed in other reports by the U.S. Geological Survey. The occurrence of minor elements in water from aquifers in Louisiana was discussed by Dial and Huff (1989). They presented tables of chemical analyses of minor elements, as well as detailed discussions and interpretations of results of chemical analyses, for selected areas. Results of chemical analyses, including analyses for minor elements and organic compounds, were published in the annual hydrologic data report of Louisiana (Arcement and others, 1989; Carlson and others, 1984; 1985; 1986; 1988).

Method of Study

Water-quality data used to compile the illustrations, tables, and text in this report are contained in the U.S. Geological Survey Water Data Storage and Retrieval System (WATSTORE) data base. About 5,000 analyses in the data base were selected to delineate areal variations of ground-water properties and constituents. One analysis from each freshwater well in the data base was selected. When multiple analyses were available, generally the most recent or most complete analysis was used. Only chemical analyses from 1960 to 1988 were selected because adequate coverage for the aquifers was available using these data, and earlier analyses did not include many of the properties and constituents summarized in this report. Additionally, earlier analyses may not be as valid as recent (1960 and later) analyses due to changes in laboratory and field techniques, and in a few places, changes in water quality in the aquifers. No analysis of water-quality trends was made for this study.

Maps showing the occurrence and distribution of hardness, sodium, dissolved solids, dissolved iron, and dissolved manganese in this report are generalized to indicate typical chemical water quality that exists in an aquifer. Maps showing the distribution of selected properties and constituents for the various aquifers are presented in a common format to facilitate comparison of water quality between aquifers. The reader should note that the extremes (high or low values) in each range may not be present in each aquifer. The statistical tables are useful for determining the approximate range of values for a property or constituent in an aquifer. The chemical data used to generate the maps are the same as that data used to produce the statistical tables. Potential water users may need to collect additional data in a specific area to determine water quality at specific depths and to determine if any local anomalies occur.

The statistical summary tables include the 5th, 25th, 50th (median), 75th, and 95th percentiles. The general ranges cited for all constituents have been derived from the 5th and 95th percentiles listed in the statistical summary tables.

Table 1.--*Geohydrologic column of aquifers and aquifer systems in Louisiana*

[Modified from Ryals, 1982 and Smoot, 1989]

Period	Epoch	Stratigraphic unit		Geohydrologic unit: Northern and southwestern Louisiana	Southeastern Louisiana	Aquifers, Baton Rouge area	Aquifers, St. Tammany and Tangipahoa Parishes
Quaternary	Holocene	Unnamed flood plain, beach, and marsh deposits		Unnamed	Unnamed	Unnamed	Shallow
	?	Red River alluvial deposits		Red River alluvial aquifer	Mississippi River alluvial aquifer	Shallow	
	Pleistocene	Mississippi River alluvial deposits		Mississippi River alluvial aquifer			
		Northern Louisiana terrace deposits		Northern Louisiana terrace aquifer	Chicot equivalent/southeast Louisiana aquifer system	"400-foot"	Upper Ponchatoula
		Unnamed Pleistocene deposits		Chicot aquifer system		"600-foot"	
Tertiary	Pliocene	Fleming Formation	Blounts Creek Member	Evangeline aquifer	Evangeline equivalent/southeast Louisiana aquifer system	"800-foot" "1,000-foot" "1,200-foot" "1,500-foot" "1,700-foot"	Lower Ponchatoula Kentwood aquifer system
	?		Castor Creek Member	Castor Creek confining unit	Unnamed confining unit		
	Miocene		Williamson Creek Member	Jasper aquifer system: Williamson Creek aquifer	Jasper equivalent/southeast Louisiana aquifer system	"2,000-foot" "2,400-foot" "2,800-foot"	Tchefuncta Hammond Amite Ramsey
			Dough Hills Member	Dough Hills confining unit			
			Carnahan Bayou Member	Carnahan Bayou aquifer			
			Lena Member	Lena confining unit	Unnamed confining unit		
	?	Catahoula Formation		Catahoula aquifer	Catahoula equivalent/southeast Louisiana aquifer system	Unnamed	Franklinton
	Oligocene	Vicksburg Group, undifferentiated		Vicksburg confining unit	No freshwater occurs in deposits older than Miocene in southeastern Louisiana		
	Eocene	Jackson Group, undifferentiated		Jackson confining unit			
		Claiborne Group	Cockfield Formation	Cockfield aquifer			
			Cook Mountain Formation	Cook Mountain confining unit			
			Sparta Formation	Sparta aquifer			
			Cane River Formation	Cane River confining unit			
			Carrizo Sand	Carrizo-Wilcox aquifer			
	Paleocene	Wilcox Group, undifferentiated					
		Midway Group, undifferentiated		Midway confining unit			

PROPERTIES AND INORGANIC CONSTITUENTS THAT AFFECT WATER USE

Considerable variations in water quality occur among and within individual aquifers of Louisiana. In individual aquifers, variations in water quality may be due to depth, changes in mineralogy of the aquifer, distance from recharge area, or mixing of aquifer water with water from adjacent aquifers.

Distributions of hardness, and concentrations of sodium, dissolved solids, and dissolved iron and manganese are mapped for selected aquifers. These properties and constituents are among those of most concern to water users and planners because they often limit use of water or require reduction or removal from water before use. Additional information about these and other properties and constituents is listed in table 2.

Hardness as calcium carbonate ($CaCO_3$), often defined as the soap consuming capacity of water, generally is caused by the dissolution of calcium and magnesium. Water having hardness greater than 150 mg/L is quite noticeable due to curd formation with soap, scale buildup, and staining. Water having a hardness greater than 200 mg/L generally is softened for household use (Driscoll, 1986, p. 91). Aquifers in Louisiana contain water with hardness that ranges from soft to very hard (table 2).

No recommended limit is set for sodium in water for domestic or public supply. For a significant portion of the population, however, physicians suggest a limited sodium intake. Calculations which use certain assumptions of water intake and sodium content of food suggest that for those individuals on very restricted sodium diets, 20 mg/L sodium in water should be a maximum concentration level; and for those on moderately restricted sodium diets, 270 mg/L sodium in water should be a maximum concentration level (U.S. Environmental Protection Agency, 1976, p. 206). Moderate to high concentrations of sodium in irrigation water can have adverse effects on soil properties. Sodium can exchange with calcium and magnesium ions in soil and can affect soil structure, infiltration, and permeability rates (U.S. Environmental Protection Agency, 1976, p. 208).

Dissolved solids is the measure of the amount of minerals dissolved in water. The recommended secondary maximum contaminant level for concentrations of dissolved solids is 500 mg/L for domestic and public supply. Aquifers in Louisiana generally have low concentrations of dissolved solids in and near outcrop areas. As the water moves downdip in the aquifer, solution of minerals from the aquifer commonly cause concentrations of dissolved solids to increase. However, a sharp increase in concentrations can occur near the freshwater-saltwater interface in the aquifer or in local areas where saltwater is contained in the freshwater aquifer.

Iron, an abundant element in the earth's crust, is present in varying concentrations in water from aquifers in Louisiana. Dissolved iron may precipitate when exposed to the atmosphere, thereby causing staining of laundry and plumbing fixtures. The recommended secondary maximum contaminant level for domestic and public supply is 0.3 mg/L (U.S. Environmental Protection Agency, 1986).

Manganese, like iron, may cause staining of laundry and plumbing fixtures. The recommended secondary maximum contaminant level of dissolved manganese for domestic and public supply is 0.05 mg/L (U.S. Environmental Protection Agency, 1986). This limit is also applicable for many industrial operations.

SUMMARY

This report summarizes selected chemical data for about 5,000 water samples collected from 1960 through 1988 from 12 freshwater aquifers or aquifer systems in Louisiana. The aquifers consist of sediments ranging in age from Pleistocene to Paleocene. The chemical quality of water varies among and within the aquifers.

Aquifers in sediments of Pleistocene age (the Red River and Mississippi River alluvial aquifers and the Chicot aquifer system and Chicot equivalent/southeast Louisiana aquifer system) supply nearly 80 percent of the ground water used in Louisiana. With the exception of the Chicot equivalent/southeast Louisiana aquifer system, the aquifers in sediments of Pleistocene age generally contain hard to very hard calcium bicarbonate or calcium-magnesium bicarbonate type water. Water in Red River and Mississippi River alluvial aquifers generally has large iron concentrations; median concentrations of iron are 5.5 and 1.9 mg/L, respectively. Water from the Red River and Mississippi River alluvial aquifers and the Chicot aquifer system generally is suitable for irrigation but requires treatment for many uses such as domestic and municipal supply.

The Chicot equivalent/southeast Louisiana aquifer system generally contains a soft, sodium bicarbonate type water; however, moderately hard to very hard water is present in the southwestern part of the area underlain by this aquifer system. The median concentration of iron in the aquifer system is 0.18 mg/L. Median concentrations of sodium are less than 70 mg/L in water from aquifers in sediments of Pleistocene age.

Water from aquifers in sediments of Pliocene to Paleocene age generally is a soft, sodium bicarbonate type water. Much of the water from these aquifers, including the Evangeline aquifer, Evangeline equivalent/southeast Louisiana aquifer system, the Jasper aquifer system, Jasper equivalent/southeast Louisiana aquifer system, and the Sparta aquifer, is suitable for domestic and municipal supply without treatment. Median concentrations of sodium from aquifers in sediments of Eocene and Paleocene age generally are greater than 70 mg/L. Of these aquifers, the Carrizo-Wilcox aquifer had the largest median sodium concentration at 120 mg/L.

A monitoring program for the detection of synthetic organic compounds in ground water has been in existence since 1983. Analysis of data collected from October 1983 through September 1988 as part of this network, indicate the presence of very few contaminants in wells sampled. Synthetic organic compounds including volatile organic compounds, acid-base/neutral extractable organic compounds, pesticides, and polychlorinated biphenyls have been detected in nine wells. Synthetic organic compounds, which were detected, did not exceed maximum contaminant levels.

Table 2.--*Properties and inorganic constituents of water that may affect water use*

[Data from Heath, 1983; Hem, 1985; and U.S. Environmental Protection Agency, 1977, 1986, and 1987]

Property or constituent	Major natural sources or principal cause	Effects on water use	Concentrations or values of significance in milligrams per liter (mg/L)
Specific conductance	Related to the type and concentration of ions in solution.	Can be used to estimate dissolved-solid concentrations in water.	--
pH [-log (H^+)]	Acids and bases dissolved in water.	The pH of water is a measure of its acidity. Low values of pH, particularly below pH 4, 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 - 8.5[2] pH values (standard units): less than 7 = acidic value is 7 = neutral more than 7 = basic
Color [in platinum-cobalt units]	Usually results from leaching of organic debris.	Has no direct chemical significance on water use, the effects are principally aesthetic.	15 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 and certain industries and in steam boilers and water heaters.	USGS classification of hardness (mg/L as $CaCO_3$): 0-60: Soft[3] 61-120: Moderately hard 121-180: 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.	25-50 mg/L
Sodium	Same as for chloride. In some sedimentary rocks, a few hundred milligrams per liter may occur in freshwater as a result of exchange of dissolved calcium and magnesium for sodium in the aquifer materials.	See chloride. In large concentrations, may affect persons with cardiac difficulties, hypertension, and certain other medical conditions. Depending on the concentrations of calcium and magnesium also present in the water, sodium may be detrimental to certain irrigated crops.	20-270 mg/L
Potassium	Weathering of minerals in igneous and metamorphic rocks.	An essential element for both plants and animals; seldom occurs in high concentrations.	--
Bicarbonate and carbonate	Products of the solution of carbonate rocks, mainly limestone and dolomite by water containing carbon dioxide.	Control the capacity of water to neutralize strong acids. Bicarbonates of calcium and magnesium decompose in steam boilers and water heaters to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium cause carbonate hardness.	150-200 mg/L
Sulfate	Gypsum, pyrite and other rocks that contain sulfur compounds.	In certain concentrations, gives water a bitter taste and, at higher concentations, has a laxative effect. In combination with calcium forms a hard calcium carbonate scale in steam boilers.	250 mg/L[2] 300-400 mg/L (taste)
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.	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 occurrence.	In certain concentrations, reduces tooth decay; at higher concentrations, causes mottling of tooth enamel.	2.0 mg/L[2] 4.0 mg/L[3]
Silica	Silicon is the second most abundant element in the earth's crust.	Essential nutrient for plants, may contribute to boiler scale.	
Dissolved solids	Mineral substances dissolved in water.	Dissolved solids is a measure of the total amount of minerals dissolved in water and is, therefore, a very useful parameter 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=briny
Nitrogen, nitrate plus nitrite	Decomposition of organic material in soils and from industrial and agricultural chemicals.	Essential for plant and animals. High concentrations of nitrate may cause methemoglobinemia in small children. Large concentrations in ground water are generally considered 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]

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

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LOUISIANA HYDROLOGIC ATLAS MAP NO. 5:
QUALITY OF FRESHWATER IN AQUIFERS OF LOUISIANA, 1988

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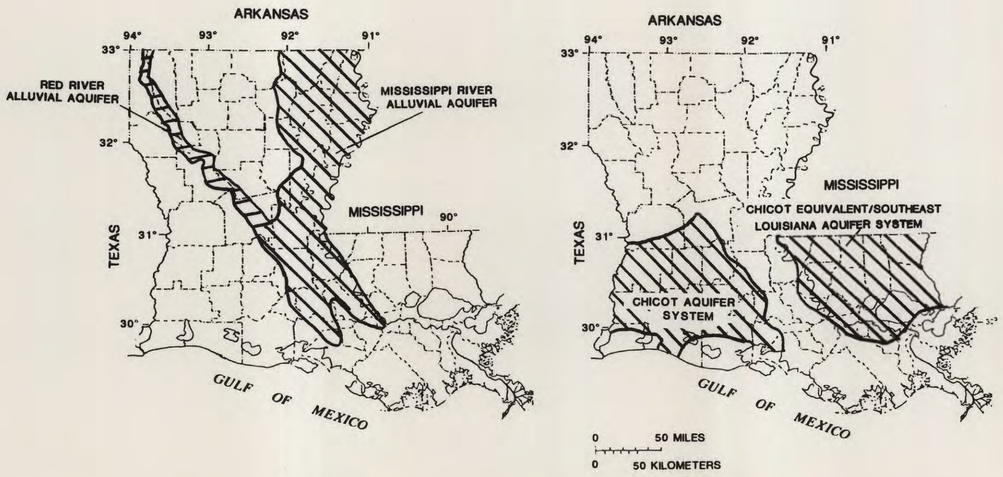

Figure 1.--Location of freshwater aquifers in sediments of Pleistocene age in Louisiana.

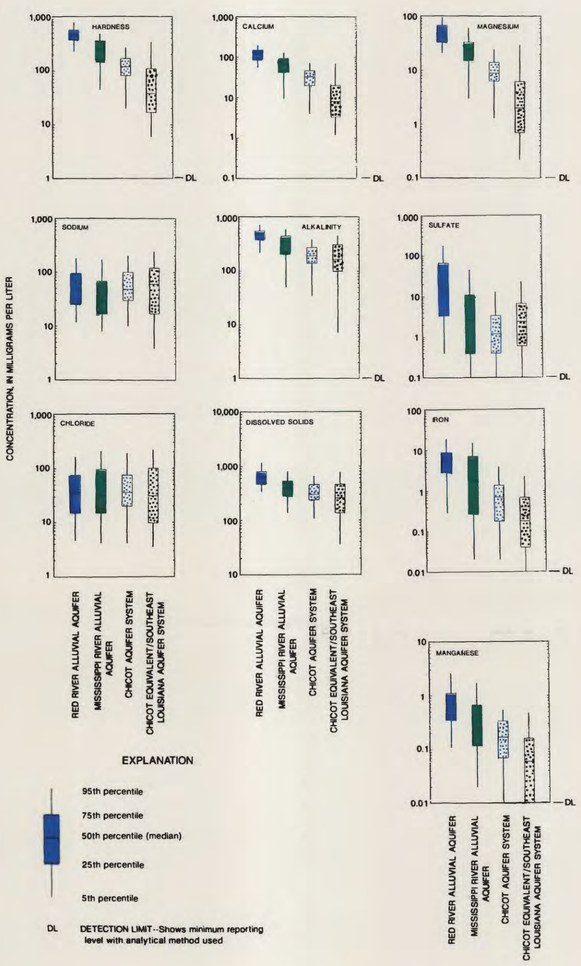

Figure 2.--Statistical summary of selected constituents and characteristics of water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER FROM AQUIFERS IN SEDIMENTS OF PLEISTOCENE AGE

Aquifers in sediments of Pleistocene age (fig. 1) in Louisiana include the Red River and Mississippi River alluvial aquifers, the Chicot aquifer system, and the Chicot equivalent/southeast Louisiana aquifer system. The Red River and Mississippi River alluvial aquifers are heavily pumped for irrigation, and to a lesser extent, for domestic use. The Chicot aquifer system provides most of the ground water withdrawn in Louisiana and supplies much water for irrigation, industry, municipal supply, and domestic use. Water obtained from the Red River and Mississippi River alluvial aquifers and the Chicot aquifer system generally requires treatment for the reduction of hardness, iron, and manganese for many uses including municipal and domestic supply. Withdrawals from the Chicot equivalent/southeast Louisiana aquifer system (the Chicot equivalent/southeast Louisiana aquifer system includes the "400-foot" and "600-foot" aquifers of the Baton Rouge area, the upper Ponchatoula aquifer, and the New Orleans aquifer system) are primarily for industrial uses; additional uses include municipal supply, irrigation, and domestic supply.

Statistical summaries for selected properties and inorganic constituents in water from aquifers in sediments of Pleistocene age are presented in table 3 and figure 2. Maps showing distribution of selected chemical constituents in the Red River and Mississippi River alluvial aquifers and the Chicot and the Chicot equivalent/southeast Louisiana aquifer systems are shown in figures 3-7.

Red River Alluvial Aquifer

The Red River alluvial aquifer consists of sand and gravel grading upward into silt and clay in sediments of Holocene(?) age and generally is from 50 to 200 ft in thickness (Whitfield, 1980, p. 6). Recharge to the aquifer, which generally is confined by the silt and clay, occurs by infiltration of rainfall.

Freshwater from the Red River alluvial aquifer generally is a calcium-magnesium bicarbonate type. The Red River alluvium contains very hard water (hardness greater than 180 mg/L). Hardness ranges from 230 to 780 mg/L as determined by the 5th and 95th percentiles. The median of hardness is 470 mg/L (table 3). Sodium concentrations are moderately low in water from the Red River alluvial aquifer, ranging from 12 to 180 mg/L with a median of 48 mg/L. Most of the Red River alluvial aquifer contains water with dissolved-solids concentrations between 500 and 1,000 mg/L (fig. 5). Dissolved-solids concentrations range from 342 to 1,160 mg/L with a median of 623 mg/L (table 3).

Iron concentrations are very high in the Red River alluvium with 90 percent of the analyses in the range from 0.29 to 19 mg/L with a median of 5.5 mg/L. Iron concentrations greater than 1.0 mg/L can be expected in water throughout the Red River alluvium (fig. 6). Manganese concentrations range from 0.11 to 2.6 mg/L with a median of 0.61 mg/L.

Mississippi River Alluvial Aquifer

The Mississippi River alluvium is made up of clay to coarse sand and gravel-size sediments and generally ranges from 50 to 500 ft in thickness (Smoot, 1986, table 2). The alluvial aquifer (considered to be that part of the alluvium consisting of sand and gravel) generally is confined and is recharged by rainfall and by upward vertical leakage from underlying aquifers.

The Mississippi River alluvial aquifer generally contains calcium bicarbonate type water, which is hard to very hard. Locally, in northwestern parts of the aquifer, soft to moderately hard water may occur. Hardness ranges from 44 to 480 mg/L with a median of 250 mg/L (table 3). Concentrations of sodium which range from 8.0 to 170 mg/L are moderately low (generally less than 70 mg/L); however, in some areas concentrations may be as high as 170 mg/L (fig. 4). Dissolved-solids concentrations range from 140 to 805 mg/L with a median of 403 mg/L. Water containing less than 500 mg/L dissolved solids generally is available throughout most of the alluvium of northeastern and south-central Louisiana (fig. 5).

Iron concentrations usually are high and range from 0.02 to 15 mg/L with a median of 1.9 mg/L. Only 25 percent of the samples collected had iron concentrations less than 0.28 mg/L. The distribution of iron concentrations are shown in figure 5. Manganese concentrations range from 0.02 to 1.7 mg/L with a median of 0.29 mg/L.

Chicot Aquifer System

The Chicot aquifer system consists of thick beds of sand, gravel, and layers of clay. Recharge to the aquifer occurs as rainfall in outcrop areas, flow from the alluvial aquifers, downward leakage of water in coastal marshland, and upward vertical leakage from underlying aquifers (Nyman, 1984, p. 9).

Freshwater from the Chicot aquifer system typically is a calcium bicarbonate type that ranges from soft to very hard. Water is soft in the northern recharge areas where the system outcrops, but hardness increases in central and southeastern areas. Hardness ranges from 20 to 270 mg/L with a median of 120 mg/L (table 3). Sodium concentrations are moderately low (less than 70 mg/L) in the northern half of the aquifer and generally increase southward (fig. 4) to between 70 and 170 mg/L. Locally, sodium concentrations may exceed 170 mg/L. Generally, water containing less than 500 mg/L dissolved solids is available in northern and central areas of the Chicot aquifer system; however, near the coast, dissolved-solids concentrations generally exceed 500 mg/L (fig. 5).

Iron concentrations in water from the Chicot aquifer system range from 0.02 to 4.0 mg/L with a median of 0.72 mg/L (table 3). Concentrations of iron tend to be highest in central areas of the aquifer system (fig. 6). Manganese concentrations range from 0.01 to 0.54 mg/L with a median of 0.17 mg/L. Concentrations of manganese are highest in the central and southeastern areas of the aquifer system (fig. 7).

Chicot Equivalent/Southeast Louisiana Aquifer System

The Chicot equivalent/southeast Louisiana aquifer system consists of sediments ranging from fine sand to coarse gravel with interbedded clay (Tomaszewski, 1988, p. 8-9). Sand beds of the Chicot equivalent/southeast Louisiana aquifer system generally are more than 100 ft thick and may be several hundred feet thick. Recharge to the aquifer system is chiefly by rainfall, and to a lesser extent, by vertical leakage from underlying aquifers.

Freshwater in the Chicot equivalent/southeast Louisiana aquifer system generally is a soft, sodium bicarbonate type, but moderately hard to very hard water is present in southwestern areas. Hardness ranges from 6 to 340 mg/L with a median of 38 mg/L (table 3). Sodium concentrations range from 3.8 to 240 mg/L, with a median of 60 mg/L. Concentrations of sodium increase southward. In extreme southern areas sodium concentrations generally are greater than 170 mg/L (fig. 4). Dissolved-solids concentrations range from 36 to 770 mg/L; the median is 257 mg/L. Concentrations of dissolved solids generally are less than 500 mg/L except in the southern most areas (fig. 5).

Iron concentrations range from less than 0.01 to 2.3 mg/L, but generally are moderate with a median of 0.18 mg/L. Iron concentrations greater than 1.0 mg/L occur in the west-central part of the aquifer system (fig. 6). Manganese concentrations range from less than 0.01 to 0.48 mg/L with a median of 0.06 mg/L. Concentrations of manganese generally are low (less than 0.05 mg/L) in most of the aquifer system, but concentrations increase in the southwestern part of the system (fig. 7).

Table 3.--*Statistical summary of selected properties and inorganic constituents of water from the Red River and Mississippi River alluvial aquifers, and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems*

[Except as noted, all values represent dissolved constituents in milligrams per liter. Dashes, no statistical summary included if number of samples is less than 20. Specific conductance in microsiemens per centimeter at 25 °C; pH in standard units; color in platinum-cobalt units; hardness as $CaCO_3$; dissolved solids, residue at 180 °C; nitrogen, nitrite plus nitrate; <, actual value is known to be less than value shown]

Constituent or property	Number of samples	Percentile[1] 5	25	50	75	95
Red River alluvial aquifer						
Specific conductance	314	595	809	980	1,220	1,800
pH	314	6.5	6.8	6.9	7.1	7.4
Color	87	0		5	5	15
Hardness	427	230	380	470	570	780
Calcium	164	56	90	120	150	200
Magnesium	164	21	33	49	68	94
Sodium	95	12	26	48	94	180
Potassium	95	.8	1.3	2.0	2.8	5.2
Alkalinity	147	217	379	481	550	710
Sulfate	398	.4	3.4	23	67	180
Chloride	429	4.6	15	34	75	160
Fluoride	95	.1	.3	.4	.5	.8
Silica	95	15	19	23	30	42
Dissolved solids	94	342	472	623	804	1,160
Nitrogen	20	<.1	.1	.3	.8	3.1
Iron	375	.29	2.9	5.5	9.0	19
Manganese	383	.11	.36	.61	1.1	2.6
Mississippi River alluvial aquifer						
Specific conductance	374	269	504	713	966	1,430
pH	271	6.1	6.8	7.2	7.6	8.0
Color	224	0	5	5	15	60
Hardness	628	44	160	250	360	480
Calcium	220	9.5	45	66	94	130
Magnesium	220	3.0	15	24	33	61
Sodium	212	8.0	17	30	68	170
Potassium	196	.8	1.8	2.6	3.7	6.8
Alkalinity	168	51	220	321	442	598
Sulfate	240	<.1	.4	2.7	11	46
Chloride	628	4.2	15	33	96	210
Fluoride	205	<.1	.1	.2	.3	.7
Silica	210	17	27	32	38	47
Dissolved solids	192	140	292	403	532	805
Nitrogen	9	--	--	--	--	--
Iron	228	.02	.28	1.9	7.2	15
Manganese	129	.02	.12	.29	.66	1.7
Chicot aquifer system						
Specific conductance	527	119	378	489	732	1,150
pH	512	6.1	6.9	7.3	7.6	8.2
Color	440	0	1	5	10	35
Hardness	653	20	82	120	170	270
Calcium	492	4.0	20	33	47	72
Magnesium	492	1.3	6.4	8.9	14	24
Sodium	477	9.9	30	48	100	200
Potassium	438	1.0	1.7	2.2	2.8	4.0
Alkalinity	455	35	140	190	271	379
Sulfate	463	<.1	.4	1.2	3.4	13
Chloride	634	4.2	20	36	75	190
Fluoride	449	.1	.1	.2	.3	.5
Silica	458	19	32	38	45	53
Dissolved solids	444	109	239	302	455	660
Nitrogen	20	<.1	<.1	.1	.1	.8
Iron	440	.02	.18	.72	1.4	4.0
Manganese	375	.01	.07	.17	.34	.54
Chicot equivalent/southeast Louisiana aquifer system						
Specific conductance	394	56	294	616	942	1,320
pH	261	5.3	6.7	7.4	7.9	8.4
Color	217	0	5	10	40	160
Hardness	435	6	17	38	110	340
Calcium	207	1.2	3.3	8.0	20	70
Magnesium	206	.2	.7	2.0	6.2	30
Sodium	192	3.8	17	60	120	240
Potassium	184	.3	1.0	1.7	2.7	4.8
Alkalinity	163	7.2	100	164	306	444
Sulfate	203	<.1	.6	2.4	6.7	23
Chloride	465	3.5	9.8	31	100	220
Fluoride	188	<.1	.1	.2	.3	1.2
Silica	180	10	18	27	37	58
Dissolved solids	194	36	138	257	462	770
Nitrogen	43	<.1	.1	.1	.5	1.3
Iron	197	<.01	.04	.18	.69	2.3
Manganese	158	<.01	.01	.06	.16	.48

[1] Probability that the constituent or characteristic less than the value shown.

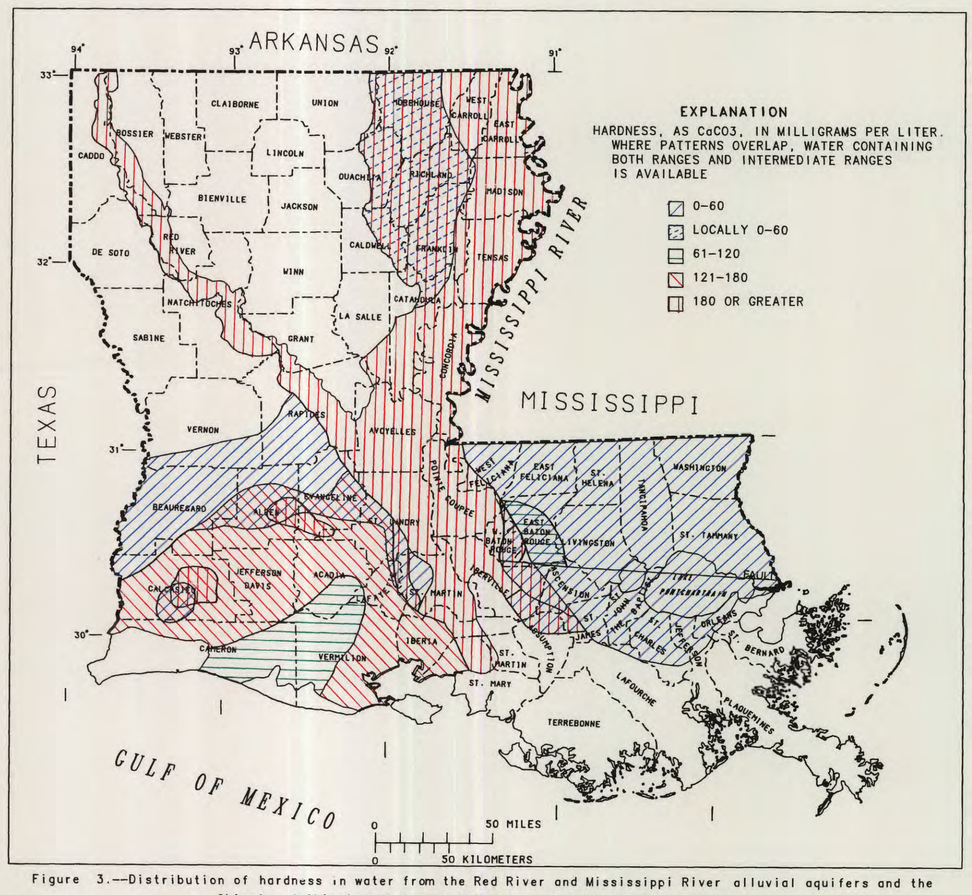

Figure 3.--Distribution of hardness in water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

LOUISIANA HYDROLOGIC ATLAS MAP NO. 5:
QUALITY OF FRESHWATER IN AQUIFERS OF LOUISIANA, 1988

By
Dan J. Tomaszewski
1992

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WATER-RESOURCES INVESTIGATIONS
REPORT 90-4119 (SHEET 3 OF 7)

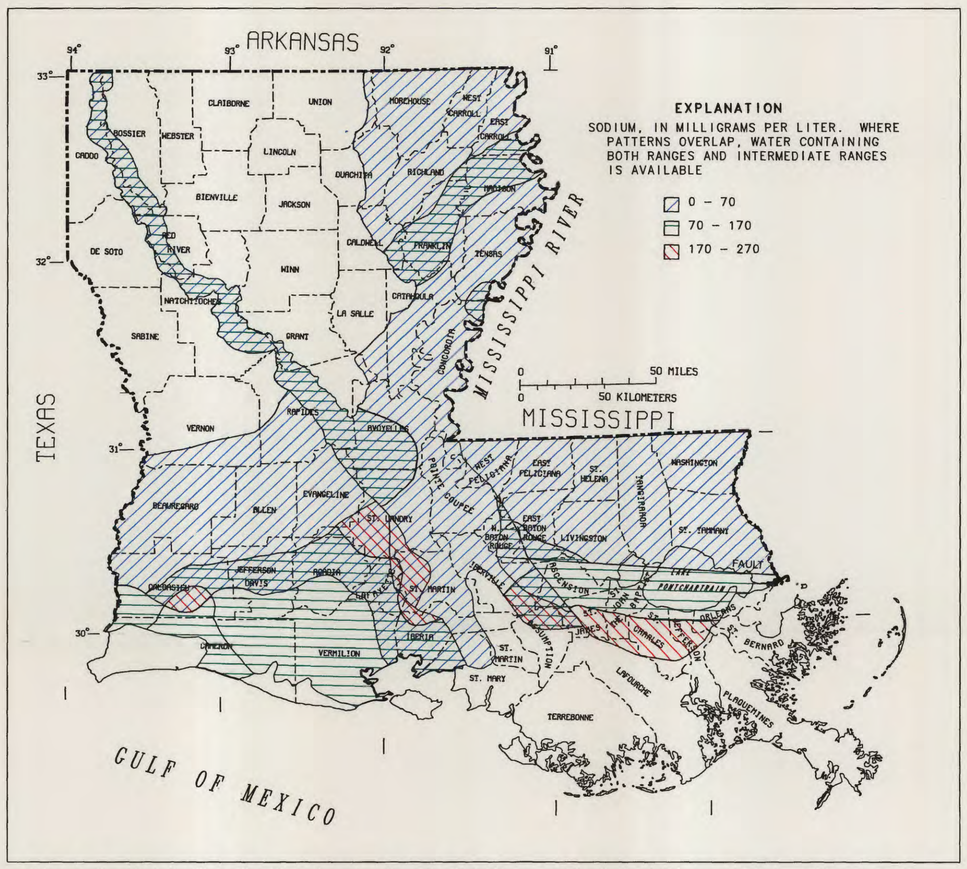

Figure 4.—Distribution of sodium in water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

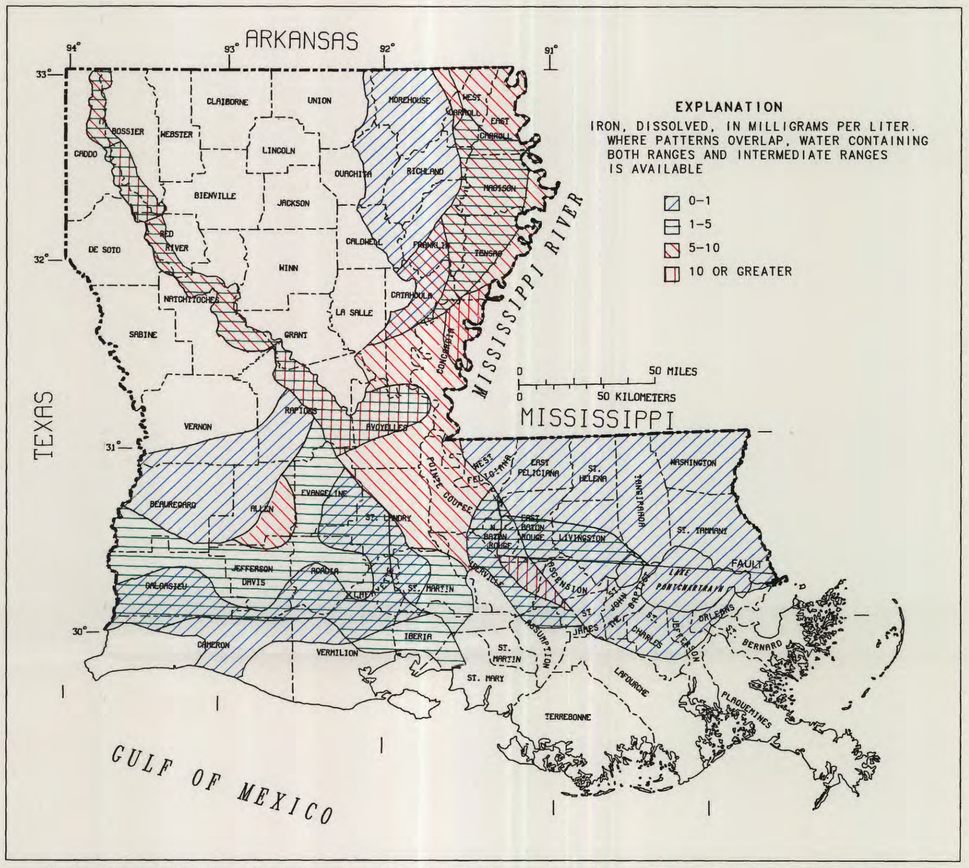

Figure 6.—Distribution of iron in water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

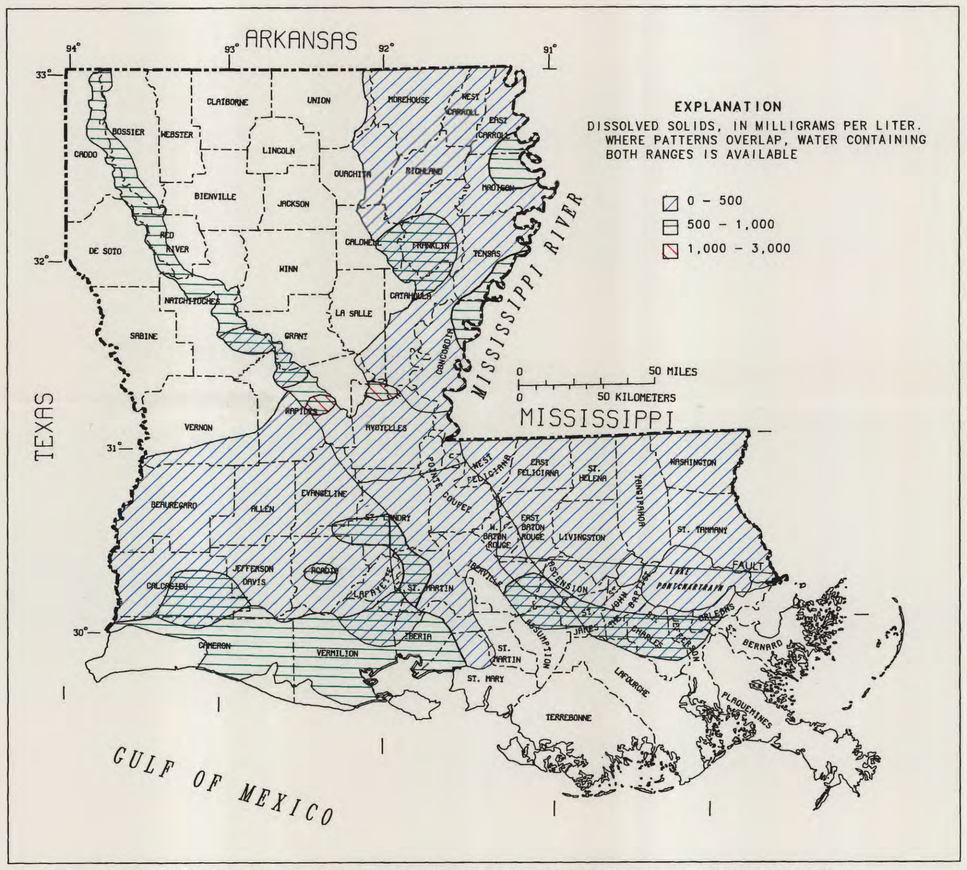

Figure 5.—Distribution of dissolved solids in water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

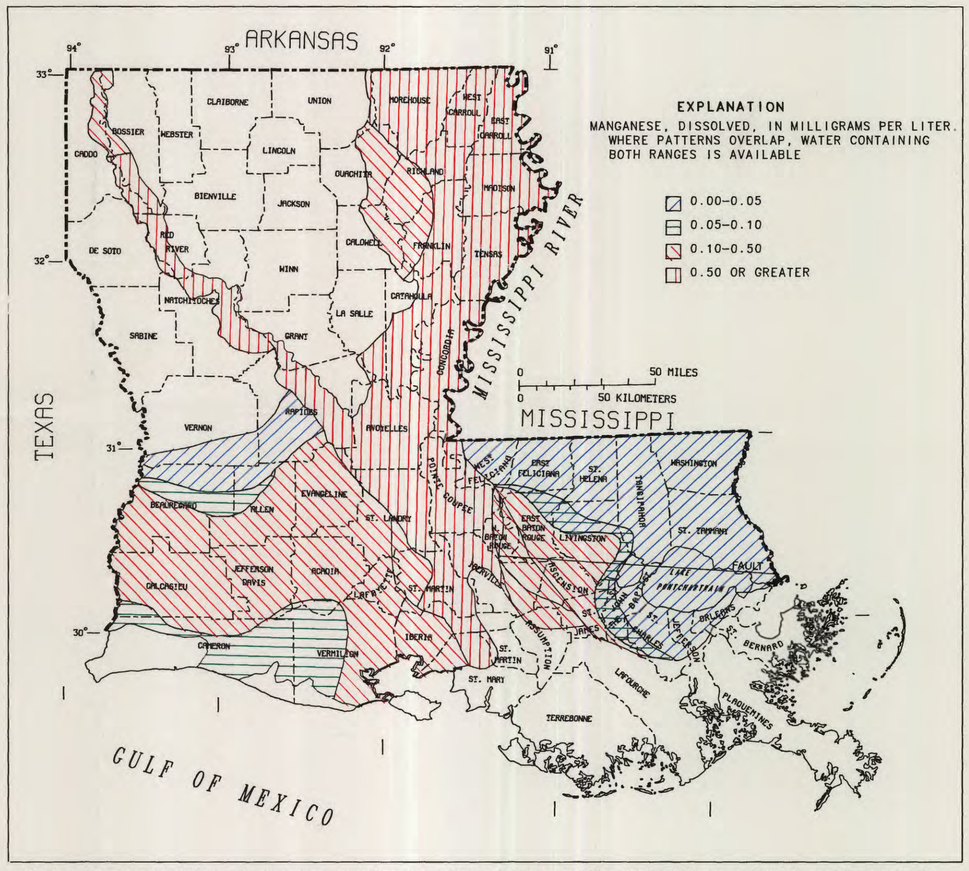

Figure 7.—Distribution of manganese in water from the Red River and Mississippi River alluvial aquifers and the Chicot and Chicot equivalent/southeast Louisiana aquifer systems.

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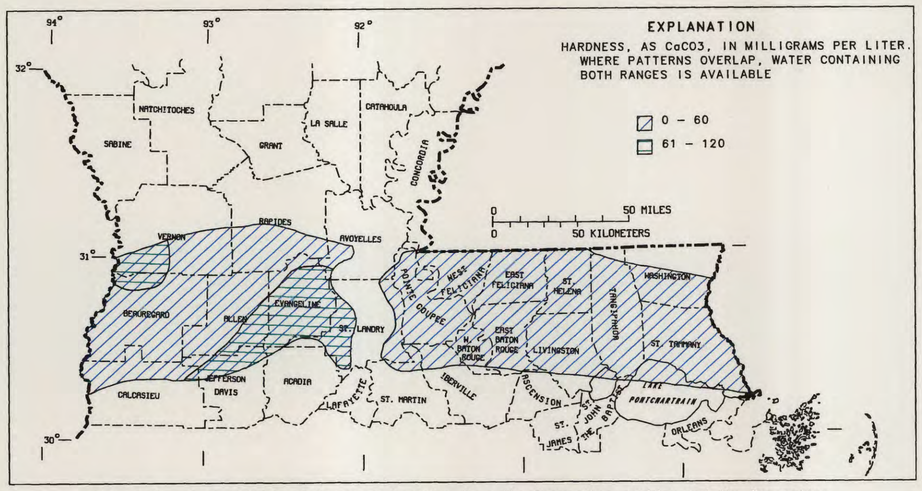

Figure 10.—Distribution of hardness in water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

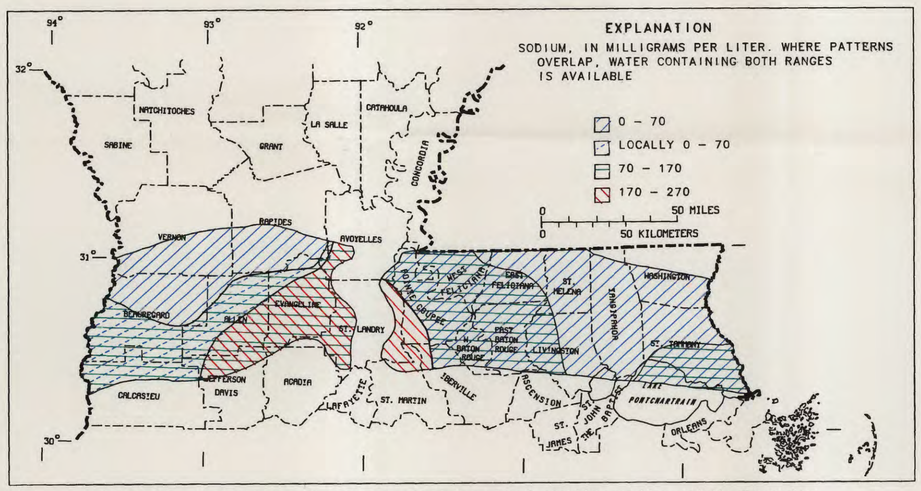

Figure 11.—Distribution of sodium in water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

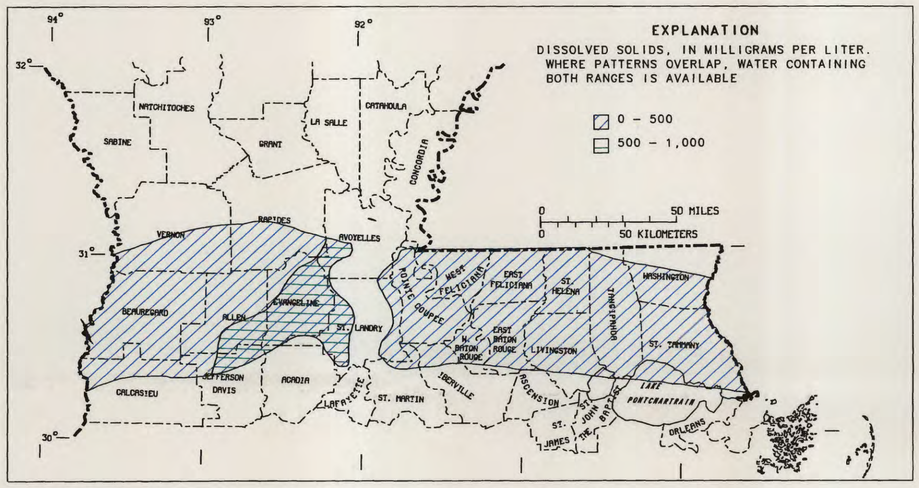

Figure 12.—Distribution of dissolved solids in water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

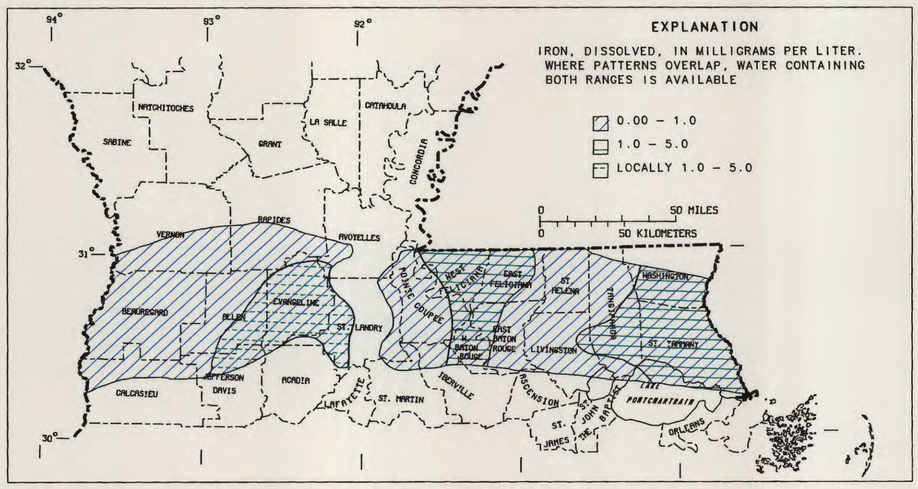

Figure 13.—Distribution of iron in water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

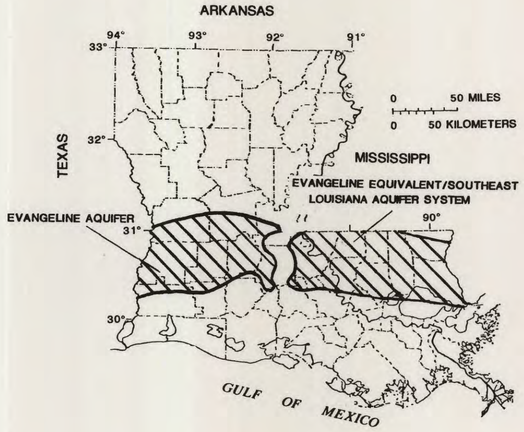

Figure 8.--Location of freshwater aquifers in sediments of Pliocene age in Louisiana.

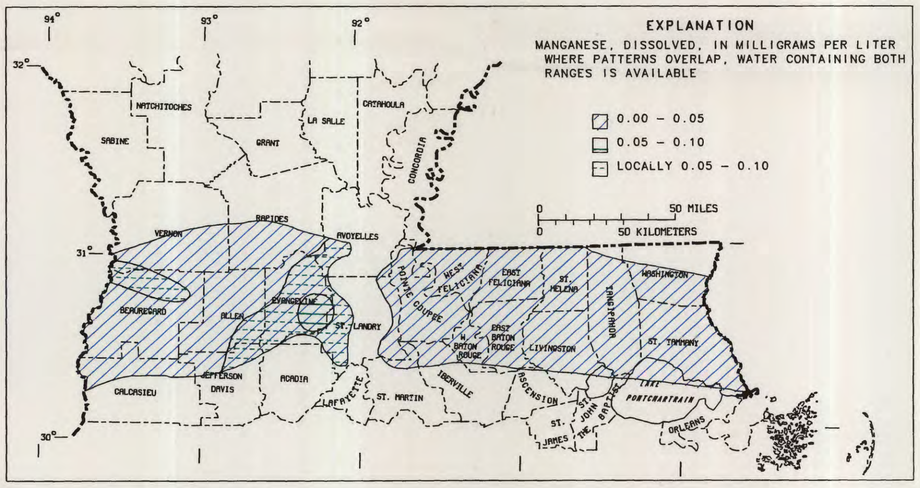

Figure 14.—Distribution of manganese in water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER FROM AQUIFERS IN SEDIMENTS OF PLIOCENE AGE

The Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system in sediments of Pliocene age occur in south-central and southeastern Louisiana (fig. 8). Of these aquifers, the Evangeline equivalent/southeast Louisiana aquifer system is the most heavily pumped and includes the "800-foot," "1,000-foot," "1,200-foot," "1,500-foot," and "1,700-foot" aquifers of the Baton Rouge area and the lower Ponchatoula and Big Branch aquifers and the Kentwood aquifer system of southeastern Louisiana. Water from the Evangeline aquifer and Evangeline equivalent/southeast Louisiana aquifer system is withdrawn for domestic, industrial, and municipal supplies. Statistical summaries for selected properties and inorganic constituents of water from aquifers in sediments of Pliocene age are presented in table 4 and figure 9. Maps showing distribution for selected constituents in the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system are shown in figures 10-14.

Evangeline Aquifer

The Evangeline aquifer generally consists of beds of fine to medium sand with local beds of coarse sand. The sand beds are separated and confined by clay, but on a regional basis the beds of sand act as one aquifer (Whitfield, 1975b, p. 12). Although the aquifer, including confining clay beds, reaches a maximum thickness of about 3,000 ft; total thickness of sand beds that contain freshwater generally are a few hundred feet thick (Whitfield, 1975b, p. 14).

Water from the Evangeline aquifer generally is a soft, sodium bicarbonate type. Hardness ranges from 2 to 130 mg/L (as determined by the 5th and 95th percentiles). The median is 16 mg/L (table 4). Although soft water occurs throughout the aquifer, moderately hard water also occurs in extreme northwestern areas and in the southeastern area of the aquifer (fig. 10). Concentrations of sodium range from 19 to 320 mg/L; the median is 100 mg/L. Sodium concentrations generally are less than 70 mg/L in northern areas (fig. 11). Concentrations of sodium increase southward and eastward and are highest (may be greater than 170 mg/L) in the southeastern part of the area underlain by this aquifer. Dissolved-solids concentrations generally are low (less than 500 mg/L) in freshwater from the Evangeline aquifer, but may exceed 500 mg/L in the eastern part of the area underlain by the aquifer (fig. 12). Dissolved-solids concentrations range from 149 to 817 mg/L with a median of 329 mg/L.

Concentrations of iron and manganese are relatively low in the Evangeline aquifer. With respect to iron and manganese, much of the water from the aquifer is acceptable for public supply without treatment. Concentrations of iron range from less than 0.01 to 1.10 mg/L; the median is 0.20 mg/L (table 4). Concentrations of manganese range from less than 0.01 to 0.18 mg/L; the median is 0.03 mg/L. Concentrations of iron and manganese generally are highest in the southeastern part of the area underlain by the Evangeline aquifer (figs. 13 and 14). Manganese concentrations exceed 0.05 mg/L in a small area in the northwestern part of the aquifer.

Evangeline Equivalent/Southeast Louisiana Aquifer System

The Evangeline equivalent/southeast Louisiana aquifer system consists of fine to medium sand interbedded with beds of clay. Thickness of the freshwater interval ranges from 50 to 1,500 ft (Smoot, 1986, table 2).

Water from the Evangeline equivalent/southeast Louisiana aquifer system is a soft, sodium bicarbonate type. Hardness ranges from less than 1 to 52 mg/L (table 4). The median hardness is 6.5 mg/L. Concentrations of sodium generally range from about 6.3 to 170 mg/L with a median of 61 mg/L. Generally, water from the aquifer system is moderately low in sodium (less than 70 mg/L), but higher concentrations may occur in the western half and in the extreme southeastern part of the aquifer system (fig. 11). Sodium concentrations may exceed 170 mg/L in the southwestern part of the area underlain by the aquifer. Dissolved-solids concentrations in freshwater from the Evangeline equivalent/southeast Louisiana aquifer system are low (fig. 12), less than 500 mg/L throughout the area. The median dissolved-solids concentration is 196 mg/L.

Iron concentrations generally are low, ranging from less than 0.01 to 2.2 mg/L with a median of 0.08 mg/L. Concentrations of iron greater than 1 mg/L occur in eastern and in west-central parts of the aquifer system (fig. 13). Manganese concentrations throughout the aquifer system range from less than 0.01 to 0.25 mg/L; the median is 0.03 mg/L.

Table 4.--*Statistical summary of selected properties and inorganic constituents of water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system*

[Except as noted, all values represent dissolved constituents in milligrams per liter. Dashes, no statistical summary included if number of samples is less than 20. Specific conductance in microsiemens per centimeter at 25 °C; pH in standard units; color in platinum-cobalt units; hardness as $CaCO_3$; dissolved solids, residue at 180 °C; nitrogen, nitrite plus nitrate; <, actual value is known to be less than value shown]

Constituent or property	Number of samples	Percentile[1] 5	25	50	75	95
Evangeline aquifer						
Specific conductance	147	185	309	507	770	1,420
pH	151	6.6	7.4	7.8	8.2	8.7
Color	146	0	5	10	29	100
Hardness	175	2	4	16	47	130
Calcium	149	.4	1.3	4.8	15	30
Magnesium	149	<.1	.3	1.0	2.4	7.8
Sodium	148	19	58	100	190	320
Potassium	140	.4	.8	1.3	1.9	3.5
Alkalinity	141	79	139	238	329	523
Sulfate	148	<.1	.2	1.6	5.4	8.1
Chloride	175	4.4	7.8	14	48	180
Fluoride	150	.1	.2	.5	1.4	3.4
Silica	146	13	19	28	38	51
Dissolved solids	141	149	204	329	494	817
Nitrogen	11	--	--	--	--	--
Iron	160	<.01	.08	.20	.47	1.1
Manganese	101	<.01	.01	.03	.06	.18
Evangeline equivalent/southeast Louisiana aquifer system						
Specific conductance	282	78	205	276	338	700
pH	274	6.2	7.0	7.8	8.6	9.1
Color	262	0	0	5	15	40
Hardness	318	<1	2	6.5	19	52
Calcium	262	.1	.8	2.4	6.0	16
Magnesium	262	<.1	.1	.4	1.3	3.1
Sodium	258	6.3	30	61	78	170
Potassium	243	.3	.5	1.1	2.2	3.7
Alkalinity	205	20	88	127	150	295
Sulfate	259	.6	6.8	8.8	10	14
Chloride	338	2.0	3.0	4.0	5.8	32
Fluoride	257	<.1	.1	.2	.3	.7
Silica	249	14	24	34	48	60
Dissolved solids	252	77	169	196	228	447
Nitrogen	12	--	--	--	--	--
Iron	208	<.01	.03	.08	.38	2.2
Manganese	173	<.01	.01	.03	.10	.25

[1] Probability that the constituent or characteristic less than the value shown.

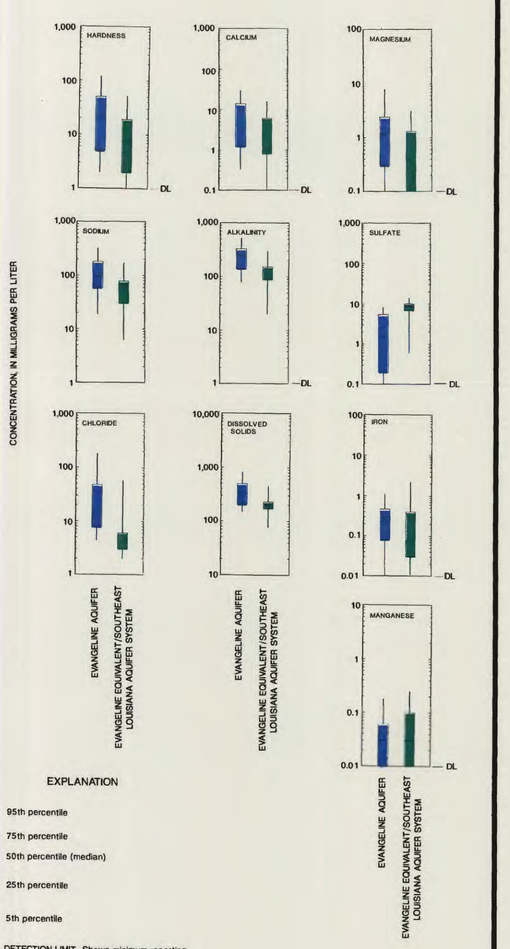

Figure 9.--Statistical summary of selected constituents and characteristics of water from the Evangeline aquifer and the Evangeline equivalent/southeast Louisiana aquifer system.

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REPORT 90-4119 (SHEET 5 OF 7)

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER
FROM AQUIFERS IN SEDIMENTS OF MIOCENE AGE

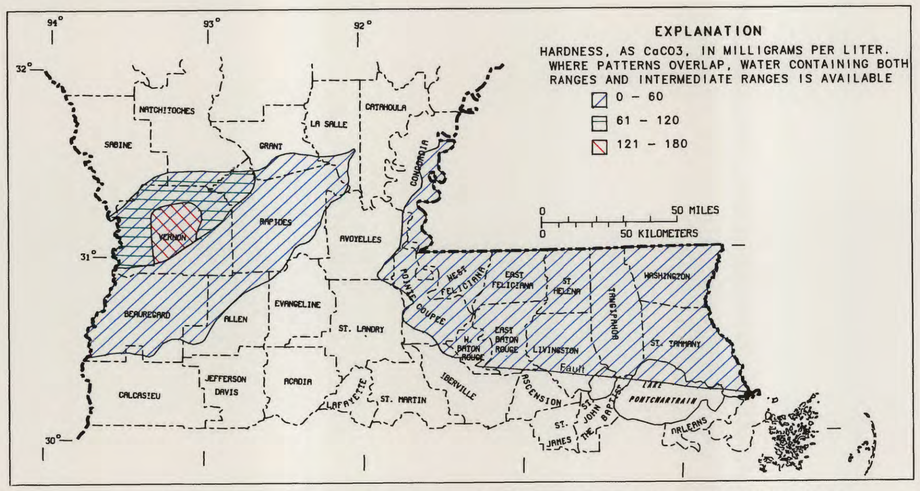

Figure 17.—Distribution of hardness in water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems.

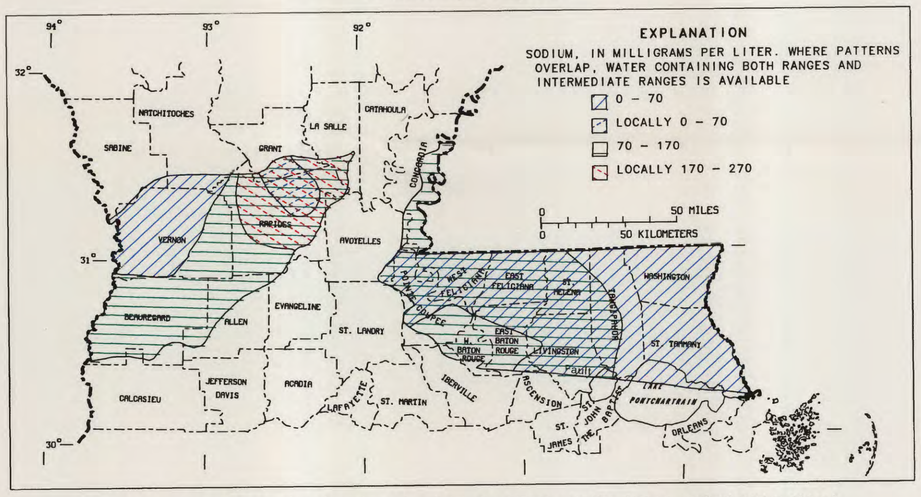

Figure 18.—Distribution of sodium in water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems.

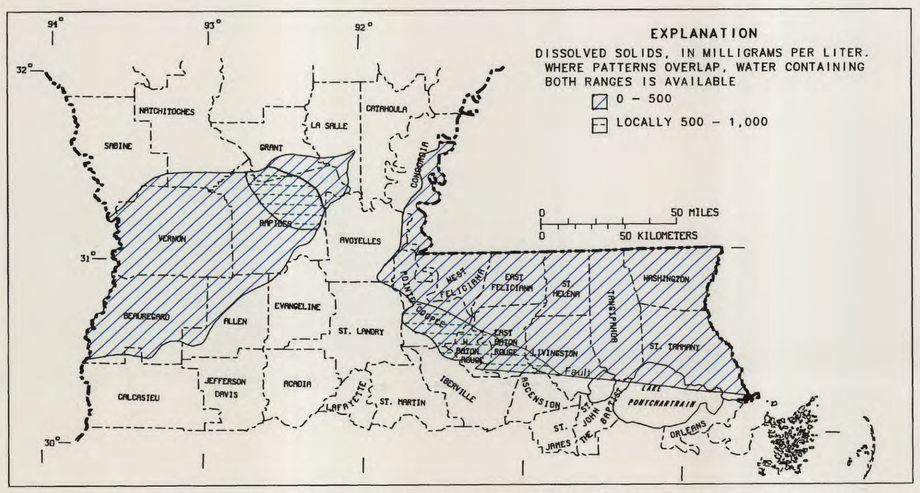

Figure 19.—Distribution of dissolved solids in water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems.

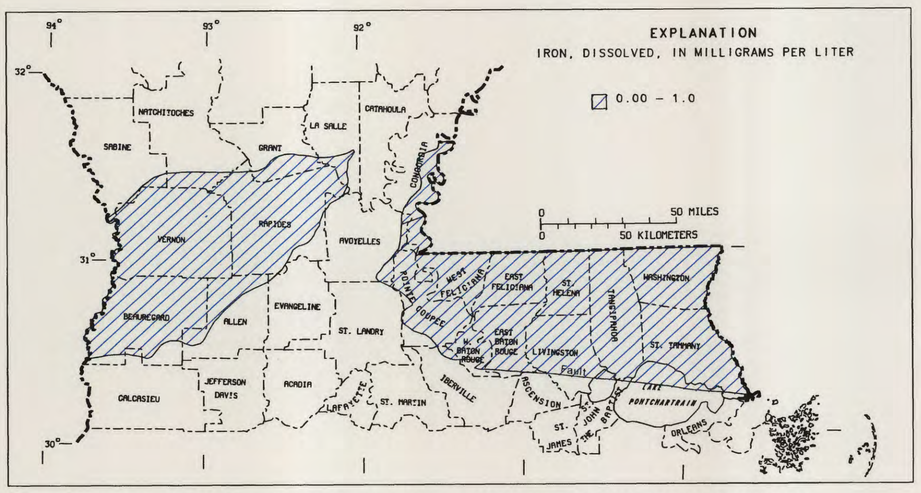

Figure 20.—Distribution of iron in water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems.

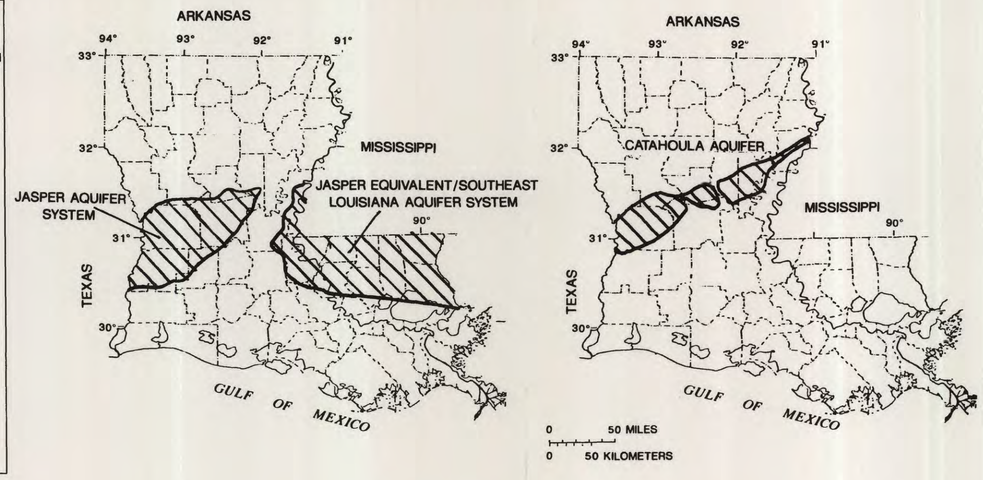

Figure 15.--Location of freshwater aquifers in sediments of Miocene age in Louisiana.

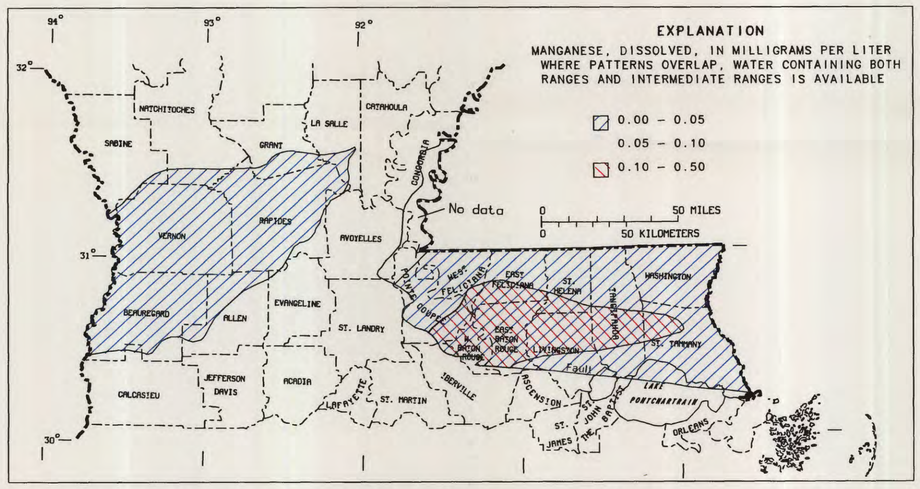

Figure 21.—Distribution of manganese in water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems.

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER FROM AQUIFERS IN SEDIMENTS OF MIOCENE AGE

The Jasper aquifer system, the Jasper equivalent/southeast Louisiana aquifer system, and the Catahoula aquifer are aquifers in sediments of Miocene age in Louisiana (fig. 15). Located in south-central and southeastern Louisiana, water from these aquifers is used for domestic, municipal, and industrial supplies. The Jasper and the Jasper equivalent/southeast Louisiana aquifer systems are the most heavily pumped of the Miocene aquifers. In the Baton Rouge area, the Jasper equivalent/southeast Louisiana aquifer system includes the "2,000-foot," the "2,400-foot," and the "2,800-foot" aquifers and their eastward equivalents (the Tchefuncta, Hammond, and Amite aquifers). Recharge to the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems, and Catahoula aquifer occurs by infiltration of rainfall in outcrop areas. Selected properties and inorganic constituents such as pH are shown in table 5 and figure 16. Maps showing distribution of selected chemical constituents in the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems are shown in figures 17-21.

Jasper Aquifer System

The Jasper aquifer system consists of fine to medium sand with interbedded clay. Maximum aquifer thickness is about 3,400 ft, and maximum thickness of freshwater-bearing sand is about 1,400 ft (Whitfield, 1975b, p. 29).

Water from the Jasper aquifer system generally is a soft, sodium bicarbonate type. Hardness ranges from 1 to 144 mg/L, as determined by the 5th and 95th percentiles. The median hardness is 16 mg/L (table 5, fig. 16). Soft water appears to extend throughout all areas of the aquifer system; however, in northwestern parts of the system moderately hard to hard water occurs in some sand beds (fig. 17). Concentrations of sodium range from 14 to 260 mg/L and have a median of 93 mg/L (table 5). Sodium concentrations generally are less than 70 mg/L in the northwestern part of the Jasper aquifer system. Sodium concentrations between 70 and 170 mg/L generally occur in central and southern areas. In the northeastern area, sodium may exceed 170 mg/L. Dissolved-solids concentrations range from 123 to 682 mg/L with a median of 296 mg/L (table 5). Dissolved-solids concentrations exceed 500 mg/L in part of the northeastern area of the aquifer system (fig. 19).

Concentrations of iron generally are low throughout the Jasper aquifer system (fig. 20) and range from less than 0.01 to 1.2 mg/L; the median is 0.13 mg/L (table 5). Much of the aquifer system supplies water suitable for public supply without treatment (concentration of iron less than 0.3 mg/L). Manganese concentrations range from less than 0.01 to 0.17 mg/L; the median is 0.02 mg/L.

Manganese concentrations generally meet drinking water standards throughout the Jasper aquifer system (fig. 21); however, manganese concentrations may locally exceed 0.05 mg/L.

Jasper Equivalent/Southeast Louisiana Aquifer System

The Jasper equivalent/southeast Louisiana aquifer system consists of interbedded sand, silt, and clay. Total sand thickness ranges from about 170 to 550 ft in the area of Baton Rouge (Morgan, 1963, table 4).

Water from the aquifer system generally is a soft, sodium bicarbonate type. Hardness ranges from less than 1 to 24 mg/L; the median hardness is 4 mg/L (table 5). Soft water extends throughout all areas of the aquifer system. Concentrations of sodium range from 29 to 220 mg/L and have a median of 76 mg/L. Sodium concentrations generally are less than 70 mg/L in the eastern one-third of the Jasper equivalent/southeast Louisiana aquifer system and increase in a western direction (fig. 18). In the southwestern areas of the aquifer, concentrations of sodium may exceed 170 mg/L. Dissolved-solids concentrations range from 156 to 605 mg/L with a median of 219 mg/L (table 5). Dissolved-solids concentrations are below 500 mg/L in most areas but may exceed 500 mg/L near the southwestern edge of the aquifer system (fig. 19).

Concentrations of iron generally are low throughout the aquifer system (fig. 20) and range from less than 0.01 to 1.2 mg/L with a median of 0.06 mg/L (table 5). Much of the aquifer system supplies water suitable for public supply without treatment for iron. Manganese concentrations range from less than 0.01 to 0.24 mg/L; the median is 0.01 mg/L (table 5). Manganese concentrations meet drinking water standards (less than 0.05 mg/L) in much of the aquifer system but may exceed 0.05 mg/L in the west-central area (fig. 21).

Catahoula Aquifer

The Catahoula aquifer consists of fine to medium sand interbedded with clay. The freshwater interval of the Catahoula aquifer ranges from 50 to 450 ft in thickness (Smoot, 1986, table 2).

Water from the Catahoula aquifer generally is a soft, sodium bicarbonate type. Hardness ranges from less than 1 to 80 mg/L with a median of 6.0 mg/L (table 5). Sodium concentrations range from 16 to 230 mg/L; the median is 84 mg/L. Generally, dissolved-solids concentrations are low and range from 113 to 630 mg/L; the median is 270 mg/L. Iron concentrations range from 0.01 to 1.1 mg/L; the median is 0.130 mg/L. Manganese concentrations range from less than 0.01 to 0.10 mg/L with a median of 0.02 mg/L.

LOUISIANA HYDROLOGIC ATLAS MAP NO. 5:
QUALITY OF FRESHWATER IN AQUIFERS OF LOUISIANA, 1988

By
Dan J. Tomaszewski
1992

Table 5.—*Statistical summary of selected properties and inorganic constituents of water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems, and the Catahoula aquifer*

[Except as noted, all values represent dissolved constituents in milligrams per liter. Dashes, no statistical summary included if number of samples is less than 20. Specific conductance in microsiemens per centimeter at 25 °C; pH in standard units; color in platinum-cobalt units; hardness as $CaCO_3$; dissolved solids, residue at 180 °C; nitrogen, nitrite plus nitrate; <, actual value is known to be less than value shown]

Constituent or property	Number of samples	Percentile[1] 5	25	50	75	95
Jasper aquifer system						
Specific conductance	238	134	304	437	620	1,240
pH	257	6.4	7.2	7.8	8.1	8.6
Color	234	0	3	5	15	40
Hardness	351	1	6	16	42	144
Calcium	256	.1	1.3	3.5	7.9	49
Magnesium	256	<.1	.2	.5	1.2	6.0
Sodium	237	14	58	93	140	260
Potassium	194	.8	1.4	2.3	3.5	5.5
Alkalinity	198	47	137	198	285	567
Sulfate	242	<.1	1.2	5.8	12	36
Chloride	351	5.8	11	15	32	130
Fluoride	245	.1	.2	.6	1.1	2.2
Silica	237	10	21	39	47	70
Dissolved solids	221	123	223	296	406	682
Nitrogen	24	.1	.1	.1	.1	.7
Iron	207	<.01	.05	.13	.29	1.2
Manganese	152	<.01	<.01	.02	.03	.17
Jasper equivalent/southeast Louisiana aquifer system						
Specific conductance	208	162	264	328	448	959
pH	213	6.9	7.8	8.5	8.9	9.2
Color	201	0	5	10	20	49
Hardness	252	<1	2	4	8	24
Calcium	190	<.1	.5	1.1	2.6	7.0
Magnesium	190	<.1	.1	.1	.5	1.4
Sodium	193	29	59	76	110	220
Potassium	186	.3	.5	.7	1.2	2.5
Alkalinity	169	71	122	157	225	411
Sulfate	179	.8	6.8	8.8	10	13
Chloride	261	1.9	3.0	4.0	7.2	57
Fluoride	209	.1	.2	.3	.5	1.2
Silica	177	16	20	23	43	64
Dissolved solids	199	156	189	219	295	605
Nitrogen	16	--	--	--	--	--
Iron	178	<.01	.02	.06	.18	1.2
Manganese	144	<.01	.01	.01	.08	.24
Catahoula aquifer						
Specific conductance	135	95	271	377	576	1,070
pH	119	6.2	6.9	7.5	7.8	8.2
Color	127	0	5	5	15	56
Hardness	171	<1	2	6	18	80
Calcium	129	.1	.6	1.5	4.0	20
Magnesium	129	<.1	.1	.3	.8	4.0
Sodium	128	16	57	84	120	230
Potassium	127	.7	1.4	2.1	3.0	6.1
Alkalinity	76	52	103	142	176	258
Sulfate	129	<.1	.2	2.4	14	31
Chloride	172	4.3	9.7	20	72	180
Fluoride	149	<.1	.1	.3	.7	1.6
Silica	128	24	40	43	47	59
Dissolved solids	126	113	202	270	374	630
Nitrogen	12	--	--	--	--	--
Iron	122	.01	.07	.13	.31	1.1
Manganese	89	<.01	.01	.02	.05	.10

[1] Probability that the constituent or characteristic less than the value shown.

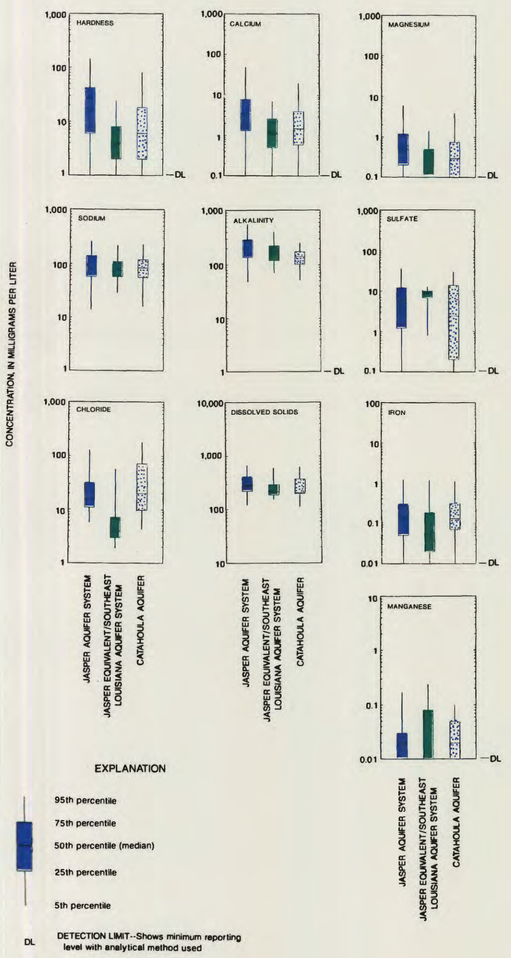

Figure 16.--Statistical summary of selected constituents and characteristics of water from the Jasper and the Jasper equivalent/southeast Louisiana aquifer systems and the Catahoula aquifer.

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER-RESOURCES INVESTIGATIONS
REPORT 90-4119 (SHEET 6 OF 7)

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER FROM AQUIFERS IN SEDIMENTS OF EOCENE AND PALEOCENE AGE

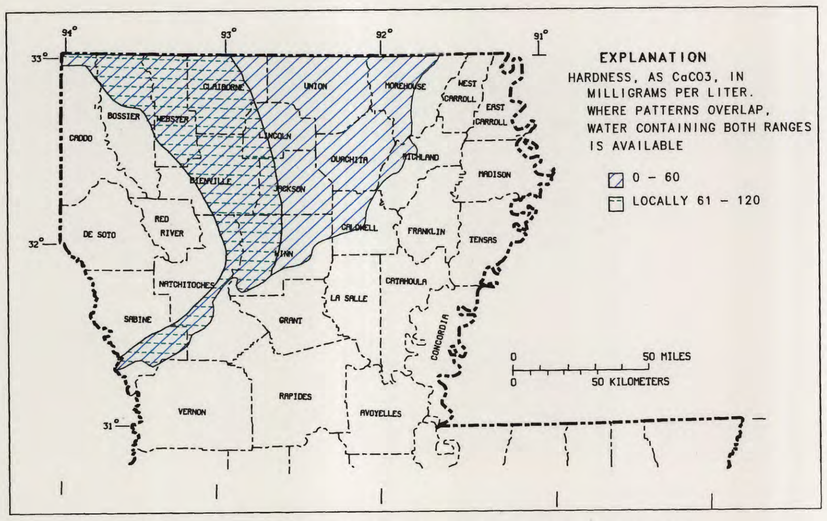

Figure 24.—Distribution of hardness in water from the Sparta aquifer.

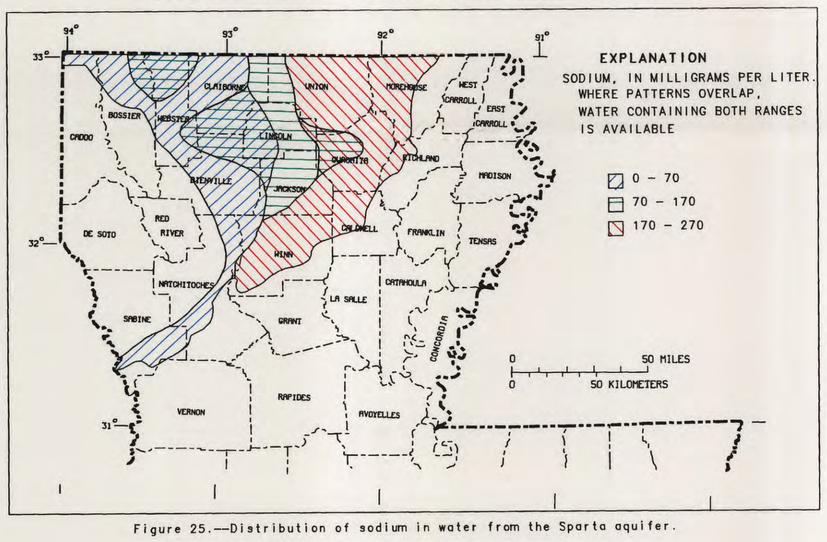

Figure 25.—Distribution of sodium in water from the Sparta aquifer.

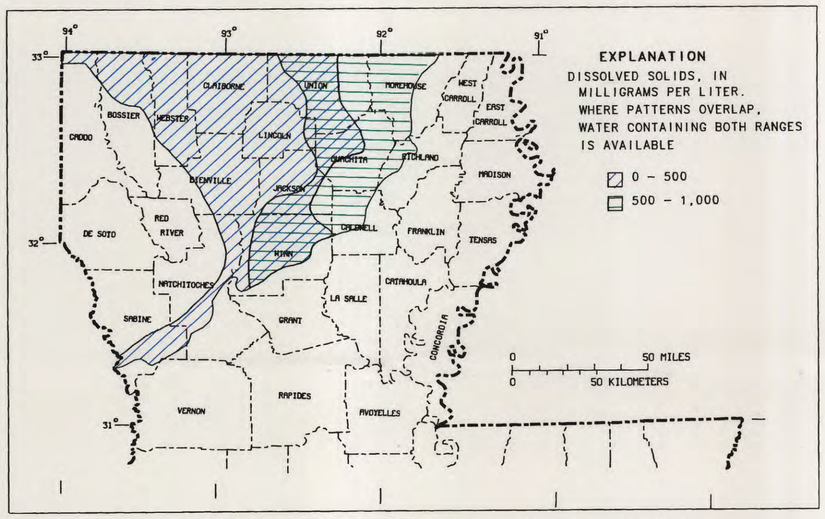

Figure 26.—Distribution of dissolved solids in water from the Sparta aquifer.

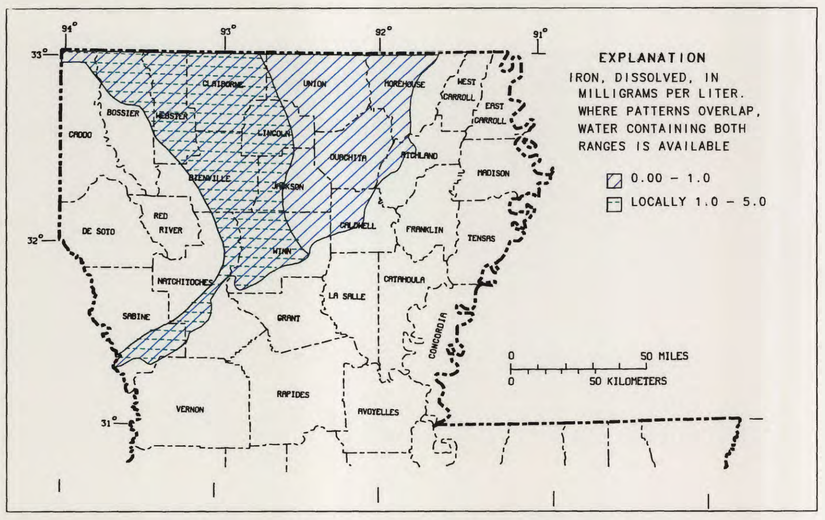

Figure 27.—Distribution of iron in water from the Sparta aquifer.

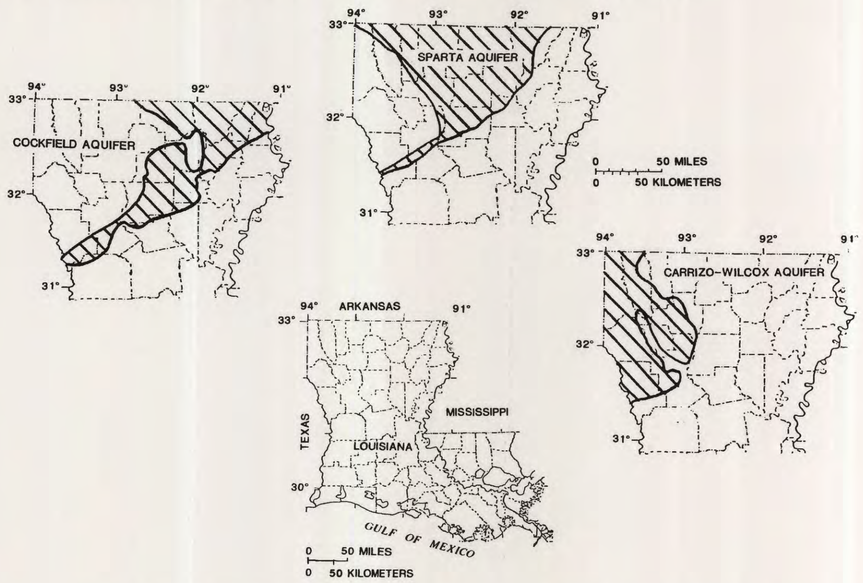

Figure 22.--Location of freshwater aquifers in sediments of Eocene and Paleocene age in Louisiana.

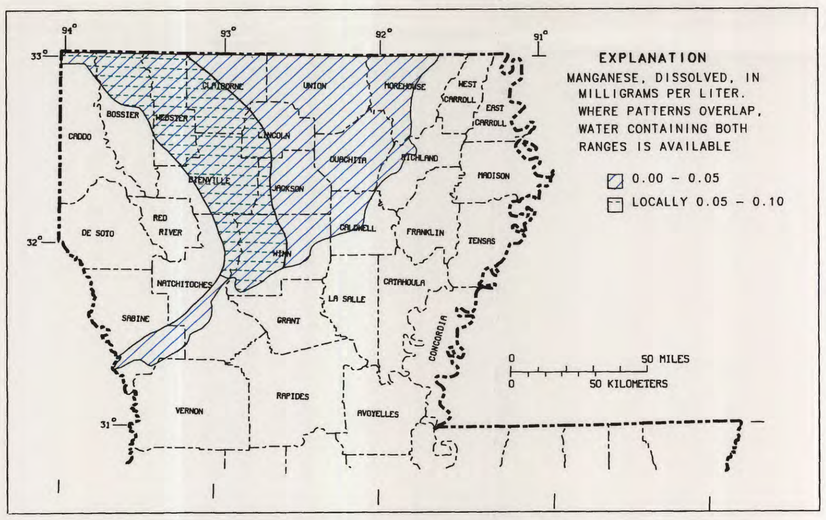

Figure 28.—Distribution of manganese in water from the Sparta aquifer.

PROPERTIES AND INORGANIC CONSTITUENTS IN WATER FROM AQUIFERS IN SEDIMENTS OF EOCENE AND PALEOCENE AGE

The Cockfield, Sparta, and Carrizo-Wilcox aquifers are of Eocene to Paleocene age in Louisiana (fig. 22). Water from these aquifers, located in northern Louisiana is used for domestic, municipal, and industrial supply. The Cockfield aquifer is used mostly for small rural supply. The Sparta is the most heavily pumped of these aquifers. The Carrizo-Wilcox aquifer is used in outcrop areas or is developed locally where thick sands occur (Trudeau and Buono, 1985, table 5). Recharge to the Cockfield, Sparta, and Carrizo-Wilcox aquifers occurs by infiltration of rainfall in subcrop and outcrop areas.

Cockfield Aquifer

The Cockfield aquifer consists of fine lignitic sand and carbonaceous clay. The freshwater interval of the Cockfield aquifer is about 50 to 850 ft in thickness (Smoot, 1986, table 2).

Freshwater from the Cockfield aquifer generally is a mixed calcium-sodium bicarbonate type. Hardness ranges from 2 to 310 mg/L (as determined by the 5th and 95th percentiles). The median hardness is 46 mg/L (table 6). Areas of hard water in the Cockfield aquifer may be caused by infiltration of hard water from the overlying alluvial aquifer (Covay, 1985, p. 16). Sodium concentrations range from 9.7 to 300 mg/L and have a median of 86 mg/L. Dissolved-solids concentrations range from 98 to 736 mg/L; the median is 350 mg/L. Iron concentrations range from 0.03 to 5.9 mg/L; the median is 0.52 mg/L. Manganese concentrations range from less than 0.01 mg/L to 0.36 mg/L; the median is 0.07 mg/L.

Sparta Aquifer

The Sparta aquifer consists of interbedded sand, silt, and clay. Aquifer thickness in the freshwater interval ranges from about 50 to 700 ft (Smoot, 1986, table 2).

Water from the Sparta aquifer generally is a soft, sodium bicarbonate type. Hardness in water from the Sparta aquifer ranges from less than 1 to 75 mg/L; the median is 6 mg/L (table 6 and fig. 23). Soft water extends throughout all areas of the aquifer; however, in western parts of the aquifer, moderately hard water may be encountered (fig. 24). Concentrations of sodium range from 4.0 to 290 mg/L with a median of 81 mg/L. Sodium concentrations less than 70 mg/L generally are obtained in the western parts of the Sparta; concentrations between 70 and 170 mg/L generally occur in central areas (fig. 25). In the approximate eastern one-third of the Sparta, concentrations of sodium exceed 170 mg/L.

Dissolved-solids concentrations range from 49 to 703 mg/L with a median of 231 mg/L. Dissolved-solids concentrations generally are less than 500 mg/L in the western half of the Sparta and increase eastward (fig. 26). Typically, in east-central areas of the Sparta, dissolved-solids concentrations may range from less than 500 to 1,000 mg/L. In the eastern one-third of the Sparta, dissolved solids generally are greater than 500 mg/L.

Concentrations of iron generally are low throughout the Sparta aquifer and range from 0.02 to 3.1 mg/L; the median is 0.20 mg/L. Much of the Sparta supplies water suitable for public supply without treatment for the removal of iron. However, iron concentrations vary and in the western half of the Sparta exceed 1.0 mg/L locally (fig. 27).

Manganese concentrations generally meet drinking water standards (less than 0.05 mg/L) throughout the Sparta aquifer; however, manganese concentrations vary and may exceed 0.05 mg/L in some areas (fig. 28). Manganese concentrations range from less than 0.01 to 0.12 mg/L and have a median of 0.02 mg/L.

Carrizo-Wilcox Aquifer

The Carrizo-Wilcox aquifer consists of fine to medium sand interbedded with clay. The freshwater interval of the aquifer ranges from 50 to 850 ft in thickness (Smoot, 1986, table 2).

Water from the Carrizo-Wilcox aquifer generally is a soft, sodium bicarbonate type. Hardness ranges from 2 to 260 mg/L; the median is 20 mg/L (table 6). Sodium concentrations range from 17 to 360 mg/L with a median of 120 mg/L. Concentrations of dissolved solids generally are low and range from 125 to 844 mg/L with a median of 380 mg/L. Iron concentrations range from 0.02 to 6.0 mg/L; the median is 0.19 mg/L. Manganese concentrations range from less than 0.01 to 0.29 mg/L; the median is 0.02 mg/L.

Table 6.--*Statistical summary of selected properties and inorganic constituents of water from the Cockfield, Sparta, and Carrizo-Wilcox aquifers*

[Except as noted, all values represent dissolved constituents in milligrams per liter. Dashes, no statistical summary included if number of samples is less than 20. Specific conductance in microsiemens per centimeter at 25 °C; pH in standard units; color in platinum-cobalt units; hardness as $CaCO_3$; dissolved solids, residue at 180 °C; nitrogen, nitrite plus nitrate; <, actual value is known to be less than value shown]

Constituent or property	Number of samples	Percentile[1] 5	25	50	75	95
Cockfield aquifer						
Specific conductance	185	104	389	580	900	1,480
pH	170	6.0	6.9	7.5	7.9	8.6
Color	185	0	5	5	18	200
Hardness	235	2	8	46	140	310
Calcium	186	.7	2.1	13	44	85
Magnesium	186	<.1	.7	4.5	12	30
Sodium	186	9.7	32	86	170	300
Potassium	185	.6	1.4	2.3	3.2	5.2
Alkalinity	72	24	128	272	368	555
Sulfate	187	<.1	.2	1.6	14	122
Chloride	235	3.4	14	26	59	142
Fluoride	187	<.1	.1	.2	.4	1.6
Silica	185	11	15	23	30	61
Dissolved solids	174	98	247	350	516	736
Nitrogen	5	--	--	--	--	--
Iron	174	.03	.17	.52	1.5	5.9
Manganese	97	<.01	.02	.07	.18	.36
Sparta aquifer						
Specific conductance	430	42	192	372	710	1,240
pH	415	5.7	6.8	7.6	8.2	8.8
Color	430	0	5.0	15	40	95
Hardness	781	<1	3.0	6.0	19	75
Calcium	453	<.1	.8	2.0	5.4	17
Magnesium	449	<.1	.1	.5	1.5	5.0
Sodium	440	4.0	28	81	148	290
Potassium	420	.5	.9	1.5	2.5	4.2
Alkalinity	275	10	70	136	213	333
Sulfate	450	<.1	1.0	6.0	16	36
Chloride	779	3.1	8.0	20	63	200
Fluoride	440	.0	.1	.2	.4	1.5
Silica	446	10	12	15	31	57
Dissolved solids	432	49	146	231	396	703
Nitrogen	14	--	--	--	--	--
Iron	417	.02	.07	.20	.66	3.1
Manganese	236	<.01	.01	.02	.05	.12
Carrizo-Wilcox aquifer						
Specific conductance	287	148	375	625	951	1,530
pH	269	6.2	7.3	7.9	8.4	8.9
Color	290	0	5	10	25	67
Hardness	359	2	6	20	63	260
Calcium	296	.4	1.8	4.5	15	54
Magnesium	296	.1	.4	1.2	4.6	17
Sodium	295	17	66	120	210	360
Potassium	292	.7	1.3	1.8	2.6	5.4
Alkalinity	222	48	161	244	328	590
Sulfate	291	.0	.7	3.4	16	110
Chloride	359	5.1	14	31	72	200
Fluoride	298	.1	.2	.3	.6	2.5
Silica	285	9.6	11	15	28	50
Dissolved solids	280	125	239	380	541	844
Nitrogen	7	--	--	--	--	--
Iron	280	.02	.06	.19	.76	6.0
Manganese	205	<.01	.01	.02	.07	.29

[1] Probability that the constituent or characteristic less than the value shown.

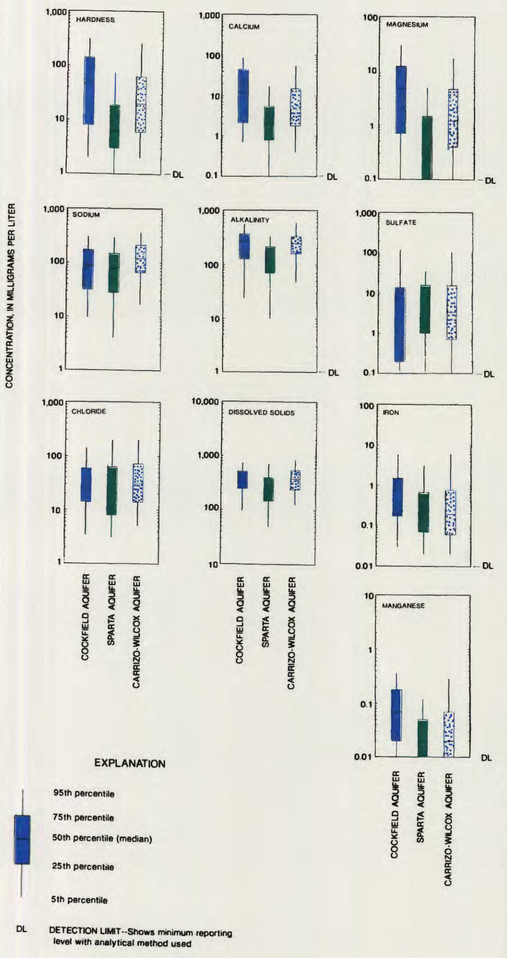

Figure 23.--Statistical summary of selected constituents and characteristics of water from the Cockfield, Sparta, and Carrizo-Wilcox aquifers.

LOUISIANA HYDROLOGIC ATLAS MAP NO. 5:
QUALITY OF FRESHWATER IN AQUIFERS OF LOUISIANA, 1988

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Figure 29.--Location of wells sampled for the ground-water organics monitoring network in Louisiana.

Table 7.--*Aquifers and aquifer systems sampled as part of the ground-water organics monitoring network, October 1983-September 1988*

Aquifer or aquifer system	Number of wells sampled
Holocene sediments	
Shallow aquifers of New Orleans area	5
Pleistocene sediments	
Terrace aquifers of central and northern Louisiana	4
Red River alluvial aquifer	0
Mississippi River alluvial aquifer	4
Chicot aquifer system	14
Chicot equivalent/southeast Louisiana aquifer system	9
Pliocene sediments	
Evangeline aquifer	2
Evangeline equivalent/southeast Louisiana aquifer system	4
Miocene sediments	
Jasper aquifer system	6
Jasper equivalent/southeast Louisiana aquifer system	3
Catahoula aquifer	0
Catahoula equivalent/southeast Louisiana aquifer system	0
Eocene-Paleocene sediments	
Cockfield aquifer	3
Sparta aquifer	7
Carrizo-Wilcox aquifer	4

SYNTHETIC ORGANIC CONSTITUENTS IN WATER FROM AQUIFERS

Until recently, very little data were available to evaluate the occurrence and distribution of synthetic (man-made) organic compounds in ground water. In October 1983, however, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development (1983-88), and the Louisiana Department of Environmental Quality (1986 and 1988), began a statewide monitoring program for synthetic organic compounds in ground water. The purpose of this program is to collect data to detect and document ground-water contamination by synthetic organic chemicals in Louisiana. Through September 1988, a total of 92 samples have been collected from 65 wells throughout Louisiana (fig. 29).

The number of monitor wells sampled in each aquifer is presented in table 7. Wells selected for sampling generally were chosen because they were located along major flow paths in an aquifer or aquifer system. These wells were selected to be representative of the aquifer, not to determine contamination from known nearby sources. All water samples were collected by U.S. Geological Survey personnel and analyzed either by the Survey's National Water Quality Laboratory or the Tennessee Valley Authority Laboratory.

Compounds detected as part of the statewide monitoring program include the following classes: volatile organic compounds, acid-base/neutral extractable (semivolatile) organic compounds, pesticides and polychlorinated biphenyls. Table 8 lists those organic compounds typically included in analyses of samples collected from the monitor well network. This table also includes the detection limit for each organic compound.

No serious ground-water contamination has been detected by 1988 in wells sampled as part of the statewide monitoring program. Although some organic chemicals have been detected in water from nine wells in the monitored aquifers, none of the concentrations detected exceed maximum contaminant levels established by the Environmental Protection Agency. The individual compounds and concentrations detected between October 1983 to September 1988 and the wells from which the water samples were collected are listed in table 9. (See fig. 29 for locations.) It should be noted that preliminary analysis of results from additional sampling (some wells were resampled October 1988 to September 1989) indicate that concentrations of organic compounds in these samples were below detection limits for some compounds previously detected.

Table 9.--*Synthetic organic compounds detected in wells sampled for the ground-water organics monitoring network in Louisiana, October 1983-September 1988*

[µg/L, micrograms per liter]

Local well number [fig. 29]	Aquifer or aquifer system	Organic compound	Concentration detected (µg/L)	Detection limit at time of analysis (µg/L)	Year
SC-188	Shallow aquifers of New Orleans area	Bis (2-ethyl hexyl) phthalate	8.0	5.0	1988
Mo-363	Upland terrace deposits	Benzene	.6	.2	1988
		Chloroform	1.7	.2	1988
		1,2-Dichloroethane	7.9	.2	1988
		Tetrachloroethylene	.8	.2	1988
		Trichloroethylene	.2	.2	1988
Mo-364	Upland terrace deposits	1,2-Dichloroethane	.3	.2	1988
		Tetrachloroethylene	3.4	.2	1988
R-910	Upland terrace deposits	Chloroform	.2	.2	1988
Co-164	Mississippi River alluvial aquifer	Chloroform	1.4	.2	1986
		Toluene	1.6	.2	1986
		Trichloroethylene	3.7	.2	1986
Ac-452	Chicot aquifer system	DDT	.01	.01	1984
		Di-n-butylphthalate	4.0	1.0	1984
		Bis (2-ethyl hexyl) phthalate	5.0	1.0	1984
Be-378	Chicot aquifer system	Di-n-butylphthalate	4.0	.01	1984
		Bis (2-ethyl hexyl) phthalate	5.0	.01	1984
		Ethylbenzene	.2	.2	1986
		Toluene	.2	.2	1986
		Trichloroethylene	.2	.2	1986
SL-257	Chicot aquifer system	Aldrin	.03	.01	1984
		DDD	.08	.01	1984
		DDT	.08	.01	1984
		Dieldrin	.09	.01	1984
		Endrin	.07	.01	1984
		Lindane	.03	.01	1984
		Methoxychlor	.09	.01	1984
SMn-109	Chicot aquifer system	Benzene	.3	.2	1986
		1,2-Dichloroethane	.2	.2	1986
		Tetrachloroethylene	1.8	.2	1986
		Trichloroethylene	.3	.2	1988
		Chloroform	.4	.2	1986
Wa-107	Evangeline equivalent/ southeast Louisiana aquifer system	Trichloroethylene	.2	.2	1988
		1,3-Dichlorobenzene	.2	.2	1988
Ca-129	Cockfield aquifer	1,4-Dichlorobenzene	.2	.2	1988
Ou-467	Sparta aquifer	1,4-Dichlorobenzene	.2	.2	1988
Wb-269	Sparta aquifer	1,1-Dichloroethane	.3	.2	1988
Bo-275	Carrizo-Wilcox aquifer	Diethyl phthalate	14	5.0	1988
Ds-327	Carrizo-Wilcox aquifer	1,4-Dichlorobenzene	.2	.2	1988

Table 8.--*Synthetic organic compounds included in analyses for the ground-water organics monitoring network in Louisiana, October 1983-September 1988*

[All values in micrograms per liter; highest detection limit, highest detection limit for the various laboratories and procedures used for analysis; MCL, maximum contaminant level; NL, no listed MCL; *, proposed MCL]

Organic compound	Highest detection limit	Drinking water MCL	Organic compound	Highest detection limit	Drinking water MCL
Volatile organic compounds					
Benzene	3.0	5.0	Cis-1,3-dichloropropene	3.0	NL
Bromoform	3.0	NL	Trans-1,3-dichloropropene	3.0	NL
Carbon tetrachloride	3.0	5.0	1,3-Dichloropropene	3.0	NL
Chlorobenzene	3.0	NL	Ethylbenzene	3.0	700*
Chloroethane	3.0	NL	Methyl bromide	3.0	NL
2-Chloroethyl vinyl ether	3.0	NL	Styrene	3.0	5.0*
Chloroform	3.0	NL	Methylene chloride	3.0	NL
Chloromethane	3.0	NL	1,1,2,2-Tetrachloroethane	3.0	NL
Dibromochloromethane	3.0	NL	Tetrachloroethylene; PCE	3.0	.5*
Dichlorobromomethane	3.0	NL	Toluene	3.0	2,000*
1,2-Dichlorobenzene	3.0	NL	1,1,1-Trichloroethane	3.0	200
1,3-Dichlorobenzene	3.0	NL	1,1,2-Trichloroethane	3.0	NL
1,4-Dichlorobenzene	3.0	NL	Trichloroethylene; TCE	3.0	5.0
Dichlorodifluoromethane	3.0	NL	Vinyl chloride	3.0	2.0
1,2-Dibromoethylene; EDB	3.0	NL	Xylenes, mixed	3.0	10,000*
1,1-Dichloroethane	3.0	NL	1,2-Trans-dichloroethylene	3.0	100*
1,2-Dichloroethane	3.0	5.0	1,2-Dichloropropane	3.0	NL
			1,1-Dichloroethylene	3.0	7.0
Acid-base/neutral extractable (semivolatile) organic compound					
4-Chloro-3-methylphenol	30	NL	Chrysene	10	NL
2-Chlorophenol	5.0	NL	Dibenzo (a,h) anthracene	10	NL
2,4-Dichlorophenol	5.0	NL	1,2-Dichlorobenzene	5.0	NL
2,4-Dimethylphenol	5.0	NL	1,3-Dichlorobenzene	5.0	NL
2,4-Dinitrophenol	20	NL	Diethyl phthalate	5.0	NL
4,6-Dinitro-2-methylphenol	30	NL	Dimethyl phthalate	5.0	NL
2-Nitrophenol	5.0	NL	Di-n-butyl phthalate	5.0	NL
4-Nitrophenol	30	NL	2,4-Dinitrotoluene	5.0	NL
Pentachlorophenol	30	200*	2,6-Dinitrotoluene	5.0	NL
Phenol	5.0	1.0	Di-n-octylphthalate	10	NL
2,4,6-Trichlorophenol	20	NL	Bis (2-ethyl hexyl) phthalate	5.0	NL
Acenaphthene	5.0	NL	Fluoranthene	5.0	NL
Acenaphthylene	5.0	NL	Fluorene	5.0	NL
Anthracene	5.0	NL	Hexachlorobenzene	5.0	NL
Benzo (a) anthracene	10	NL	Hexachlorobutadiene	5.0	NL
Benzo (b) fluoranthene	10	NL	Hexachlorocyclopentadiene	5.0	NL
Benzo (k) fluoranthene	10	NL	Hexachloroethane	5.0	NL
Benzo (g,h,i) perylene	10	NL	Indeno (1,2,3-cd) pyrene	10	NL
Benzo (a) pyrene	10	NL	Isophorone	5.0	NL
4-Bromophenyl phenyl ether	5.0	NL	Naphthalene	5.0	NL
Butyl benzyl phthalate	5.0	NL	Nitrobenzene	5.0	NL
Bis (2-chloroethoxy) methane	5.0	NL	N-nitrosodimethylamine	5.0	NL
Bis (2-chloroethyl) ether	5.0	NL	N-nitrosodi-n-propylamine	5.0	NL
Bis (2-chloroisopropyl) ether	5.0	NL	N-nitrosodi-n-phenylamine	5.0	NL
2-Chloronaphthalene	5.0	NL	Phenanthrene	5.0	NL
1,4-Dichlorobenzene	5.0	NL	Pyrene	5.0	NL
			1,2,4-Trichlorobenzene	5.0	NL
			4-Chlorophenyl phenyl ether	5.0	NL
Pesticides					
Aldrin	0.01	NL	Lindane	0.01	4.0
Chlordane	.1	2.0*	Malathion	.01	NL
Chlorpyrifos; dursban	.01	NL	Methoxychlor	.01	100
DDD	.01	NL	Methyl parathion	.01	NL
DDE	.01	NL	Methyl trithion	.01	NL
DDT	.01	NL	Mirex	.01	NL
Diazinon	.01	NL	Parathion	.01	NL
Dieldrin	.01	NL	Perthane	.1	NL
Endosulfan	.01	NL	Toxaphene	1.0	5.0
Endrin	.01	.2	Trithion	.01	NL
Ethion	.01	NL	2,4-D	.01	100
Gross polychlorinated biphenyls (ug/L as PCB)	.1	NL	Dicamba	.01	NL
			2,4-DP	.01	NL
Gross polychlorinated naphthalenes (ug/L, PCN)	.1	NL	Picloram	.01	NL
			Silvex	.01	10
Heptachlor	.01	.4*	2,4,5-T	.01	NL
Heptachlor epoxide	.01	.2*			
Polychlorinated biphenyls (PCBs)					
PCB 1016	0.1	0.5	PCB 1248	0.1	0.5
PCB 1221	.1	.5	PCB 1254	.1	.5
PCB 1232	.1	.5	PCB 1260	.1	.5
PCB 1242	.1	.5			

LOUISIANA HYDROLOGIC ATLAS MAP NO. 5:
QUALITY OF FRESHWATER IN AQUIFERS OF LOUISIANA, 1988

By
Dan J. Tomaszewski

1992