STATE OF LOUISIANA

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

PUBLIC WORKS AND FLOOD CONTROL DIRECTORATE

WATER RESOURCES SECTION

WATER RESOURCES

TECHNICAL REPORT

NO. 55A

STATISTICAL SUMMARY OF SURFACE-WATER QUALITY IN LOUISIANA--SABINE RIVER BASIN, 1952-85

Prepared by
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
In cooperation with
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

1994

STATE OF LOUISIANA

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

PUBLIC WORKS AND FLOOD CONTROL DIRECTORATE

WATER RESOURCES SECTION

In cooperation with the

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Water Resources

TECHNICAL REPORT NO. 55A

Statistical Summary of Surface-Water Quality in Louisiana--Sabine River Basin, 1952-85

By

Charles R. Garrison and Kenneth J. Covay

U.S. GEOLOGICAL SURVEY

Published by
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
Baton Rouge, Louisiana

1994

STATE OF LOUISIANA

EDWIN W. EDWARDS, Governor

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

JUDE W.P. PATIN, Secretary

PUBLIC WORKS AND FLOOD CONTROL DIRECTORATE

Curtis G. Patterson, Director

WATER RESOURCES SECTION

Zahir "Bo" Bolourchi, Chief

Cooperative projects with the

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

For additional information write to:

Edward H. Martin
District Chief
U.S. Geological Survey, WRD
3535 S. Sherwood Forest Blvd.
Suite 120
Baton Rouge, LA 70816
Telephone: (504) 389-0281

Zahir "Bo" Bolourchi, P.E.
Chief, Water Resources Section
Louisiana Department of
Transportation and Development
P.O. Box 94245
Baton Rouge, LA 70804-9245
Telephone: (504) 379-1434

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
acre-foot (acre-ft)	1,233	cubic meter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
cubic foot per second (ft^3/s)	0.0283	cubic meter per second
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.0109	cubic meter per second per square kilometer
ton (t) (short)	0.9072	metric tonne
tons (t) (short)	0.9072	megagram
ton per square mile (t/mi^2)	0.3503	metric tonne per square kilometer

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows: °F = 1.8(°C) + 32.

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

Abbreviated water-quality units used in this report:

colonies per 100 milliliters (cols/100 mL)

microsiemens per centimeter at 25 degrees Celsius (μS/cm)

micrograms per liter (μg/L)

milligrams per liter (mg/L)

nanograms per liter (ng/L)

Statistical Summary of Surface-Water Quality in Louisiana--Sabine River Basin, 1952-85

By Charles R. Garrison and Kenneth J. Covay

Abstract

A statistical summary of surface-water quality in the Sabine River basin was completed using available data from the U.S. Geological Survey's Water-Data Storage and Retrieval System (WATSTORE), a computerized data base. Data for 32 water-quality constituents from 11 sites in the Sabine River basin within Louisiana were statistically analyzed for the period 1952-85. Results are reported as boxplots, linear-regression plots, and tabulated data.

The data were summarized into eight categories: (1) physical properties--specific conductance, pH, water temperature, and dissolved oxygen; (2) major inorganic cations--dissolved calcium, magnesium, sodium, and potassium; (3) major inorganic anions--total alkalinity as calcium carbonate, dissolved sulfate, and dissolved chloride; (4) trace metals--dissolved copper, iron, lead, and zinc; (5) selected nutrients--nitrogen and phosphorus constituents; (6) organic compounds--pesticides and PCB's; (7) biological constituents--fecal coliform and fecal streptococcus bacteria; and (8) suspended sediment.

The physical properties varied for surface waters in the Sabine River basin. The specific conductance values ranged from 27 µS/cm (microsiemens per centimeter at 25 degrees Celsius) at Upper Anacoco Lake near Leesville, to 900 µS/cm at Bayou Castor near Logansport. Values for pH in water from the basin ranged from 5.2 at Bayou Anacoco near Rosepine, to 7.8 at Bayou Anacoco near Knight, and Sabine River at Logansport. Values for water temperatures ranged from 2.5 degrees Celsius at Bayou Anacoco near Knight to 34.0 degrees Celsius at Sabine River at Logansport.

The dissolved-oxygen concentrations exceeded the State's minimum water quality criterion of 5 mg/L (milligrams per liter) in more than 75 percent of the samples analyzed at most sites. However, the statistical data indicated that at Bayou Castor near Logansport and Bayou Grand Cane near Stanley, the water typically had concentrations of dissolved oxygen of less than 5.0 mg/L. The low concentrations possibly were due to low flow and occasional pooling of water in these bayous.

An analysis of the data for major inorganic cations and anions indicated that concentrations of major ions were well below recommended levels for drinking water, where such levels have been established. However, the concentrations of inorganic ions in Bayou Anacoco increased in the reach from the site near Rosepine to the downstream site near Knight, indicating an inflow into the bayou somewhere between the two sites. Additional data collection and analysis are needed to understand the cause for increased mineralization in the bayou between the two sites.

Few data on trace metals, nutrients, organic chemicals, biological, and suspended sediment were available for the Sabine River basin. An analysis of the available data for trace metals indicated that dissolved copper, lead, and zinc were less than the maximum contaminant levels of the U.S. Environmental Protection Agency's primary and secondary drinking water regulations. The iron concentrations in water from the basin often exceeded the Environmental Protection Agency's Secondary Maximum Contaminant Level of 300 µg/L (micrograms per liter) for domestic water supplies at most of the sites but were less than the recommended maximum level of 1,000 µg/L for freshwater aquatic life. An analysis of the nutrient data indicated that the median concentrations of nitrogen species totaled about 1.2 mg/L, and median concentrations of phosphorus were 0.15 mg/L or less at the sites sampled. An analysis of available data for selected organic chemical compounds indicated that concentrations of pesticides, except diazinon and 2, 4-D, rarely exceeded their detection levels. To more completely characterize surface water in the basin in relation to these constituents, additional data collection and analysis are needed.

The median ratios of fecal coliform to fecal streptococcus bacteria were less than 0.7 for most of the sites within the Sabine River basin, indicating that sources of fecal bacteria were probably livestock or poultry. However, the median ratios of the bacteria for Bayou Anacoco at Rosepine and Bayou Anacoco near Knight were 2.0 and 2.3, indicating that the sources of the fecal bacteria were probably human and animal wastes. Additional study is needed to confirm these results.

Daily mean suspended-sediment discharges at three sites for which data were available (Bayou Castor near Logansport, Bayou Grand Cane near Stanley, and Bayou San Patricio near Benson) ranged from 0 during periods of no flow to 2,820 tons per day at Bayou San Patricio near Benson when the corresponding daily mean discharge was 2,640 cubic feet per second. However, to completely describe sediment transport characteristics in the basin, a long-term suspended-sediment data collection program is needed.

ACKNOWLEDGMENTS

The authors extend their appreciation to Mr. Zahir "Bo" Bolourchi of the Louisiana Department of Transportation and Development for guidance and assistance provided during this study.

1.0 INTRODUCTION

THIS REPORT IS ORGANIZED INTO THREE PARTS AND PRESENTED IN "STOP" FORMAT[1]

A single topic is presented in text and pictures on facing pages.

This report, **"Statistical Summary of Surface-Water Quality in Louisiana--Sabine River Basin, 1952-85,"** is the first of a planned series of 10 reports in which surface-water-quality data for the major river basins in Louisiana will be statistically summarized. This report is organized into three parts (excluding the "Abstract"): the "Introduction," the "Sabine River Basin in Louisiana," and "Selected References."

The "Introduction" provides background information about the study, describes the hydrologic setting and land use in Louisiana, and presents a brief description of selected water-quality properties and constituents.

The section titled "Sabine River Basin in Louisiana," presents statistical analyses of the surface-water-quality data at selected representative sites in the basin. This basin summary section contains the following:

- Maps and text giving an overview of the basin, including location, areal extent, drainage area, major drainage and surface-water bodies, land use, and water use.
- Boxplots and text describing statistical summaries of selected physical properties of surface waters at representative sampling sites.
- Graphs and text describing the relation between specific conductance and dissolved solids and specific conductance and dissolved chloride, at representative sampling sites.
- Boxplots, tables, and text describing statistical summaries of major inorganic chemical constituents; selected trace metals, nutrients, and organic chemicals concentrations; selected biological constituents, usually bacteria; and suspended sediment (where available) at the representative sampling sites.
- Summary and conclusions, which pertain only to the basin summary.

The "Selected References" lists all references that pertain to the water quality in the basin.

---

[1]This report is presented in "STOP" (Sequential Thematic Organization of Publications) format (Hobba, Jr., 1981, p. 1). In this format, topics are presented using text and illustrations on two facing pages. Generally, topics are presented on two facing pages in this report, but in a few places the information is continued on additional pages.

1.1 Background

SURFACE-WATER QUALITY OF THE MAJOR DRAINAGE BASINS IN LOUISIANA

A large amount of water-quality data is available for streams, rivers, and lakes in Louisiana.

Water-quality samples from streams, rivers, and lakes in Louisiana have been collected and analyzed by the U.S. Geological Survey (USGS) since 1905, and the USGS, in cooperation with local, State, and other Federal agencies, systematically has operated water-quality sites on streams, rivers, and lakes in the State since 1943. Results of the analyses are stored in the USGS computerized water-quality files and often are used to answer data requests and provide a large source of information for the managers of Louisiana's surface-water resources. Even though these data have been published in the USGS series of annual reports entitled Water Resources Data for Louisiana (Arcement and others, 1993) and in many other reports that describe surface-water quality, descriptive statistics for these data are needed to make the data more useful for water managers, to allow more complete answers to be given for information requests from the public, to indicate the need for additional water-quality data at existing or new sites, and to indicate problem areas where interpretive studies are needed.

In response to the above needs, the USGS, in cooperation with the Louisiana Department of Transportation and Development, began a 3-year study in October 1987 to statistically analyze and summarize water-quality data from about 300 surface-water-quality sites in Louisiana and to present the data in such a manner that trends, overall quality, and basin-wide changes in water quality could be evaluated. The study focused on the surface-water quality of the major drainage basins in Louisiana: the Lake Pontchartrain-Lake Maurepas basin; the Mississippi River Delta basin; the Atchafalaya-Teche-Vermilion basin; and the Calcasieu-Mermentau, Mississippi, Ouachita, Pearl, Red, Sabine, and Tensas River basins (fig. 1.1-1).

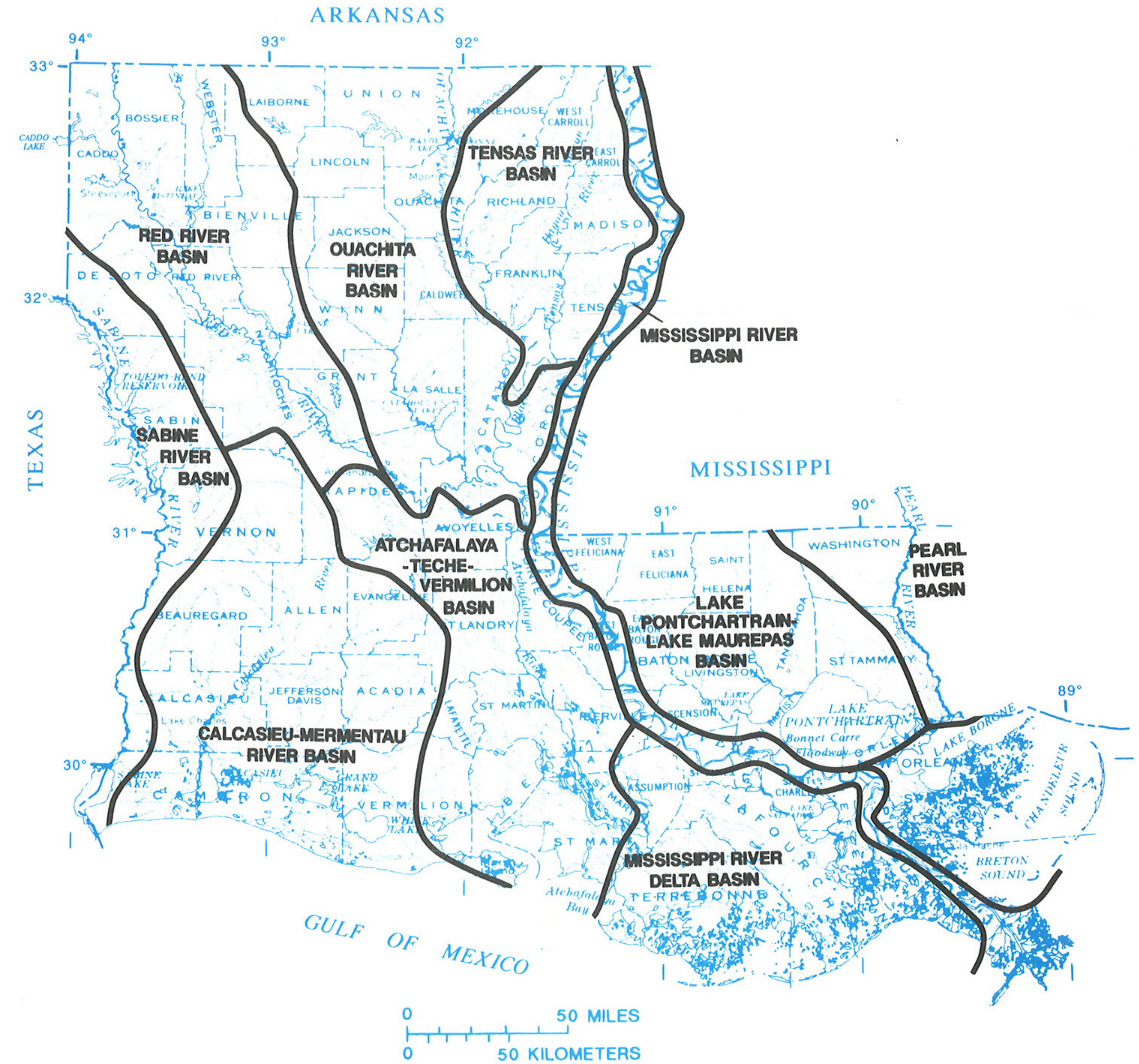


Figure 1.1-1. Major surface-water basins in Louisiana.

1.2 Purpose and Scope

ANALYZE AND SUMMARIZE SURFACE-WATER-QUALITY DATA

Statistical analyses with illustrations describe water quality of the major drainage basins in Louisiana.

Statistical analyses of water-quality data and corresponding illustrations are presented for each major drainage basin in Louisiana. Nine of the 10 basins described in this study are those delineated by the Louisiana Department of Transportation and Development (1984). The mainstem of the Mississippi River is discussed separately from the Mississippi River Delta basin to preserve continuity of data for the Mississippi River. Also, water-quality data for the Bonnet Carré Spillway were statistically analyzed separately from water-quality data for the Lake Pontchartrain-Lake Maurepas basin.

Data for 281 sites in Louisiana for water years 1905 to 1985 were included in these statistical analyses. The number of water-quality sites varied from basin to basin, and the number and type of samples varied from site to site within a given basin. Pesticides, and occasionally, trace metals and nutrients are presented in tables when there are more than 10 samples, and most, or all, of the concentrations are below the largest detection level for the analytical methods used. Daily sediment data were collected at Bayou Grand Cane near Stanley, Bayou Castor near Logansport, and Bayou San Patricio near Benson in the Sabine River basin, and Pearl River near Bogalusa in the Pearl River basin. This information is presented in tables in the Sabine River basin and the Pearl River basin reports. All water-quality data and streamflow data used for the statistical analyses are stored in the USGS's Water-Data Storage and Retrieval System (WATSTORE), a computerized data base (fig. 1.2-1). Only WATSTORE data were used for the study.

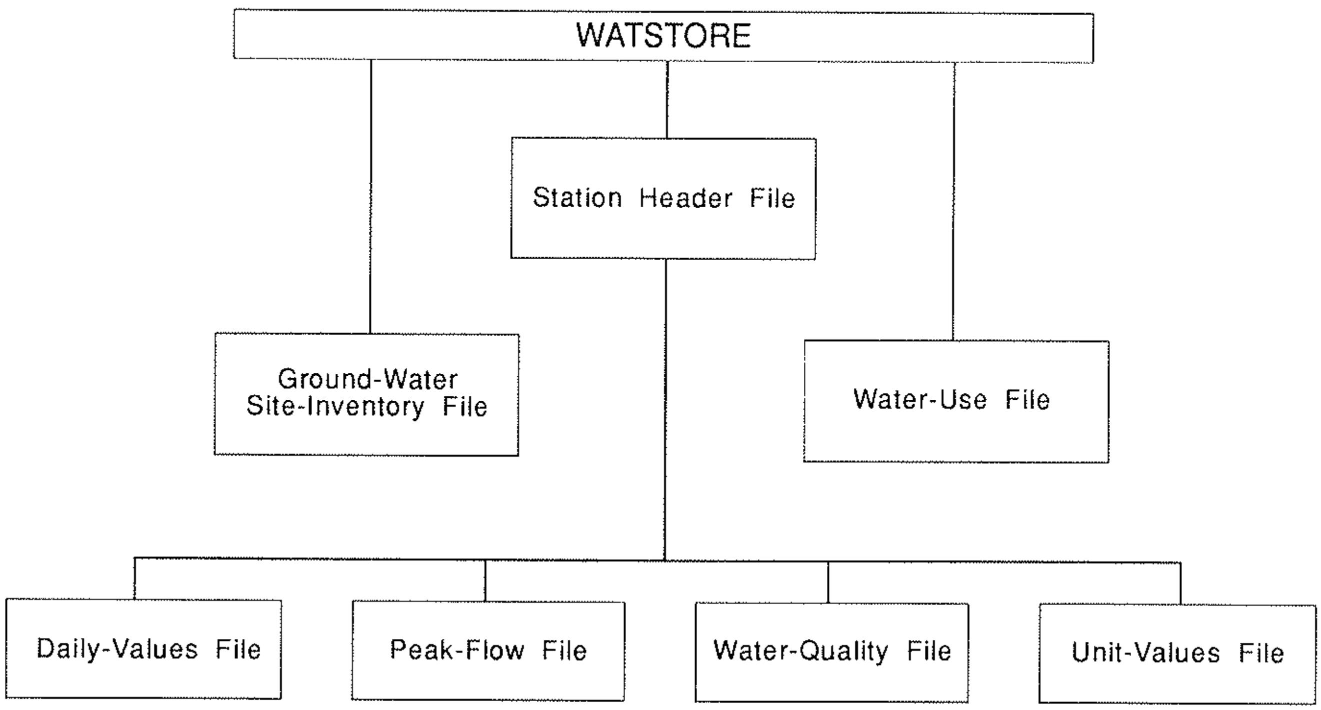


Figure 1.2-1. Diagram showing files in the U.S. Geological Survey's Water-Data Storage and Retrieval System (WATSTORE).

1.3 Methods of Study

BOXPLOTS AND GRAPHS ILLUSTRATE WATER QUALITY AT SIX REPRESENTATIVE SITES IN A BASIN

Tables list statistical information for selected water-quality properties and constituents.

Data from six representative sites within a basin are presented graphically. Data from all sites within a basin that were sampled 10 or more times are summarized in tables for each basin. These tables list the following information and summary statistics for selected properties and constituents for each site: number of analyses; detection level; maximum, minimum, and mean values or concentrations; and values or concentrations representing the 5th, 25th, 50th, 75th, and 95th percentiles of the total sample population. The data for selected sites were used to generate boxplots and linear regression equations and graphs for selected properties and constituents.

Boxplots illustrate a statistical summary of water-quality data at a site (D.R. Helsel, U.S. Geological Survey, written commun., 1989) (fig. 1.3-1). Boxplots of specific conductance, pH, water temperature, dissolved oxygen, major inorganic cations, major inorganic anions, trace metals, nutrients, bacteria, and, phytoplankton (where data were available), were developed for selected sites in each basin.

A boxplot summarizes a data set by displaying the values or concentrations representing the 5th, 25th, 50th, 75th, and 95th percentiles of the data. This format allows comparison among streams in the basin. The term percentile as used in this report refers to a distribution of values in the total data set. For example, the 25th percentile is the data value below which 25 percent of the data values occur (Sokal and Rohlf, 1969, p. 45). The 50th percentile is also the median of the data. The interquartile range is between the 25th and 75th percentiles. Fifty percent of the data are within this range.

A boxplot is constructed so the top and bottom of the box are drawn at the 75th and 25th percentiles. A line across the box indicates the median. The 95th and 5th percentiles are indicated by a vertical line from the top of the box to the 95th percentile and from the bottom of the box to the 5th percentile.

A horizontal dashed line indicates the analytical detection level. Because of changes in analytical procedures the reporting level may have changed over time. When multiple reporting levels were used for some constituents, a dashed line was drawn across the boxplot at the largest reporting level used.

Another method used to evaluate water-quality data in this series of reports is linear regression (fig. 1.3-2). Linear regression equations were calculated in the form of $Y = aX + b$, where a is the slope of the regression line, b is the Y intercept, and Y and X are the dependent and independent variables (Sokal and Rohlf, 1969, p. 408). The number of data pairs, N, and the correlation coefficient, r, also are presented. The correlation coefficient indicates the degree of association between two variables. The closer the r value is to ± 1, the better the association. Linear regression equations and graphs are presented for specific conductance and dissolved solids and for specific conductance and dissolved chloride. However, extrapolation of the equations beyond the data used to define the equation could result in incorrect values because the relation may not be linear in that range.

Water-quality samples were collected and analyzed using techniques and methods prescribed by the USGS. Collection procedures for chemical constituents are determined by the Office of Water Quality within the USGS. Methods for chemical analyses are presented in "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments" (Fishman and Friedman, 1989). Collection procedures and analytical methods for biological constituents are presented in "Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples" (Britton and Greeson, 1988). Collection procedures and analytical methods for organic constituents are presented in "Methods for the Determination of Organic Substances in Water and Fluvial Sediments" (Wershaw and others, 1983).

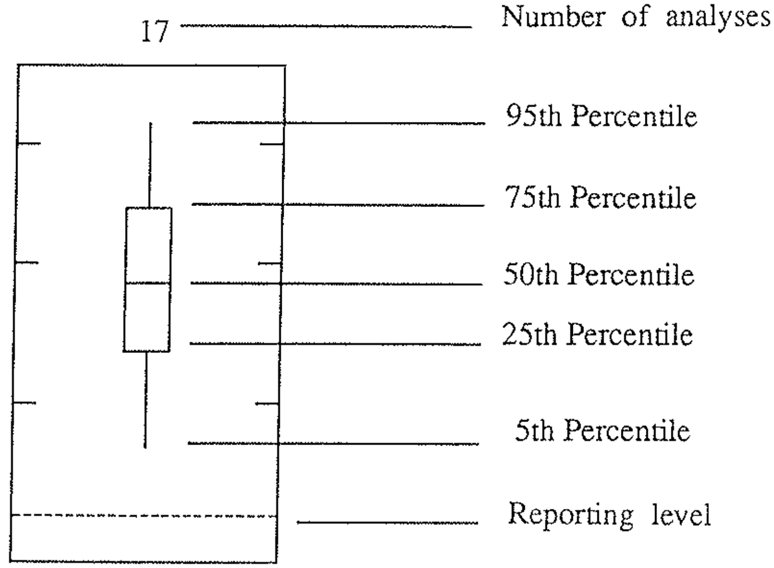


Figure 1.3-1. Example and definition of boxplot.

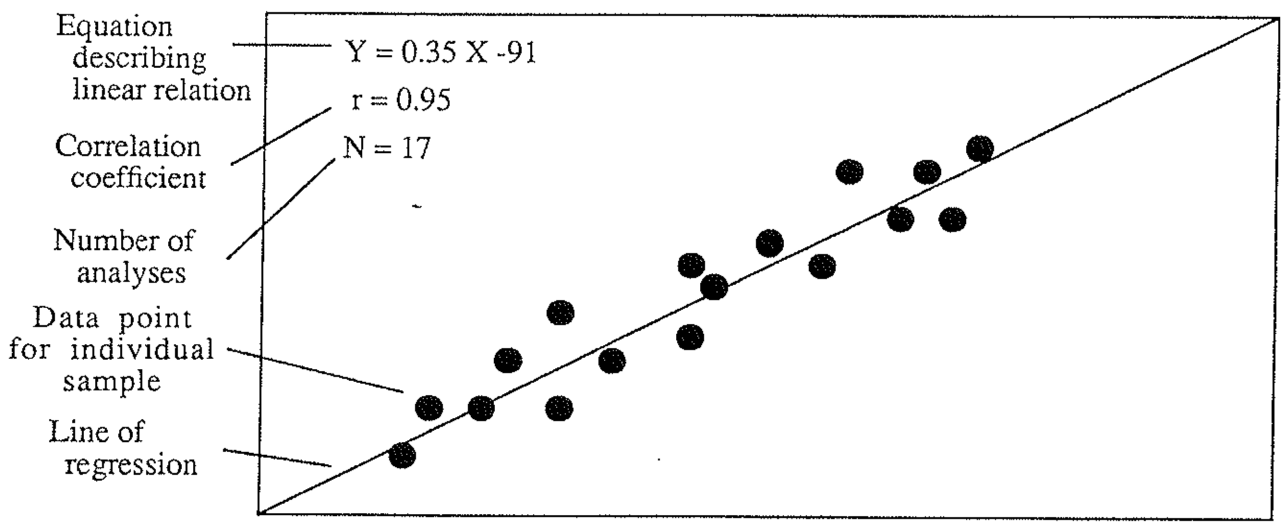


Figure 1.3-2. Example and definition of linear regression.

1.4 Hydrologic Setting and Land Use in Louisiana

CLIMATE AND PHYSIOGRAPHY INDIRECTLY AFFECT WATER QUALITY

Climate and physiography are the primary factors that affect land use in Louisiana, and "the quality of Louisiana's streams, rivers, and lakes depends in large part on the uses of the land they drain" (U.S. Geological Survey, 1993, p. 293).

1.4.1 Climate

HUMID, SUBTROPICAL CLIMATE PREVAILS IN LOUISIANA

The mean annual precipitation ranges from about 48 inches in the northeastern part of the State to 64 inches in the southeastern part.

The relatively high annual rainfall and the year-round moderate air temperatures account for the humid, subtropical climate in Louisiana (McWreath and Lowe, 1986). Annual rainfall ranges from about 48 in. in the northeastern part of the State to about 64 in. in the southeastern part (fig. 1.4.1-1) (McWreath and Lowe, 1986). The most intense rainfall occurs during localized thunderstorms that produce large amounts of rainfall but move rapidly through an area.

Other sources of heavy rainfall are tropical storms and hurricanes. These storms intensify over the warm waters of the Gulf of Mexico and move slowly inland. During this inland movement, extremely heavy rainfall can occur over most of the State in a short period of time and can cause major flooding.

Mean annual air temperatures range from 19.0 °C in the northern part of the State to 20.5 °C in the southern part. The lowest temperatures usually occur during January and February and the highest temperatures occur during July and August (Lee, 1985b, p. 2).

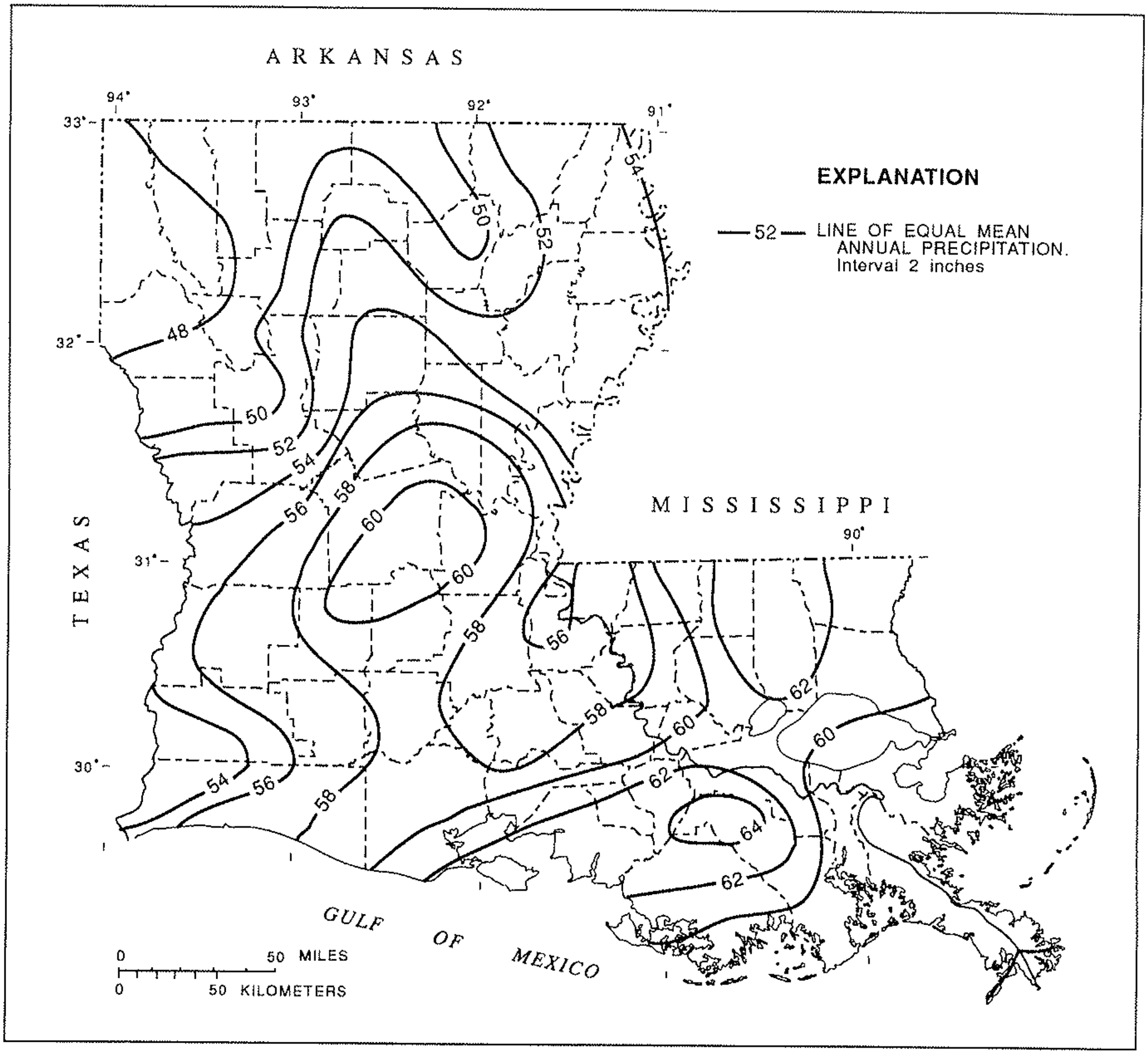


Figure 1.4.1-1. Mean annual precipitation in Louisiana, 1951-80. [Source: McWreath and Lowe, 1986, fig. 1]

1.4 Hydrologic Setting and Land Uses in Louisiana--continued

1.4.2 Physiography

LOUISIANA INCLUDES PARTS OF FOUR PHYSIOGRAPHIC DIVISIONS--PINE HILLS, PRAIRIES, COASTAL MARSHES, AND ALLUVIAL PLAINS

Major land uses include forests and agricultural lands.

Louisiana lies within the Coastal Plain Physiographic Province, and includes parts of four physiographic divisions--the Pine Hills, the Prairies, the Coastal Marshes, and the Alluvial Plains (Fenneman, 1938). These physiographic divisions are shown in figure 1.4.2-1. Parts of north-central, western, and southeastern Louisiana are in the Pine Hills division. The topography of this division is undulating hills with extensive pine and hardwood forests. Parts of southern and southwestern Louisiana are in the Prairies physiographic division. The land surface elevations in the Prairies range from 20 to 30 ft above sea level. This area generally is treeless except along streams. Much of coastal Louisiana is in the Coastal Marshes division. These areas are flat and subject to tidal flooding from the Gulf of Mexico. The flood plains adjacent to the Mississippi, Ouachita, and Red Rivers are in the Alluvial Plains physiographic division. The topography of these areas is flat with interconnecting streams that allow flow between the river basins (Lee, 1985b, p. 3).

The major land uses in the State include forests, cropland, grazing land, and wetlands (Louisiana Department of Transportation and Development, 1984, p. 24-28). Even though most land is well suited to agriculture, some areas support industry, oil and gas production, and aquaculture (U.S. Geological Survey, 1993, p. 293).

The principal rivers draining the State are the Pearl, Mississippi, Atchafalaya, Ouachita, Sabine, and Red Rivers. The Pearl River forms part of the eastern boundary between Louisiana and Mississippi and drains only a small part of the State. The Mississippi River is the largest river in the State but few streams within the State are tributary to it. The Atchafalaya River is a controlled distributary of the Mississippi River, and carries flow from the Red, Mississippi, and Ouachita Rivers to the Gulf of Mexico. The Sabine River forms part of the western boundary between Louisiana and Texas and drains only a small part of the State.

All other streams in the State are tributary to these rivers with the exception of two groups. The first group consists of streams east of the Mississippi River and west of the Pearl River. This group includes the Tchefuncta, Tangipahoa, Natalbany, and Amite Rivers. These rivers eventually flow into the Gulf of Mexico by way of Lake Pontchartrain and Lake Maurepas. The second group includes rivers west of the Mississippi River and east of the Sabine River. Major streams in this group are Bayou Teche and the Vermilion, Mermentau, and Calcasieu Rivers. These rivers flow into the Gulf of Mexico.

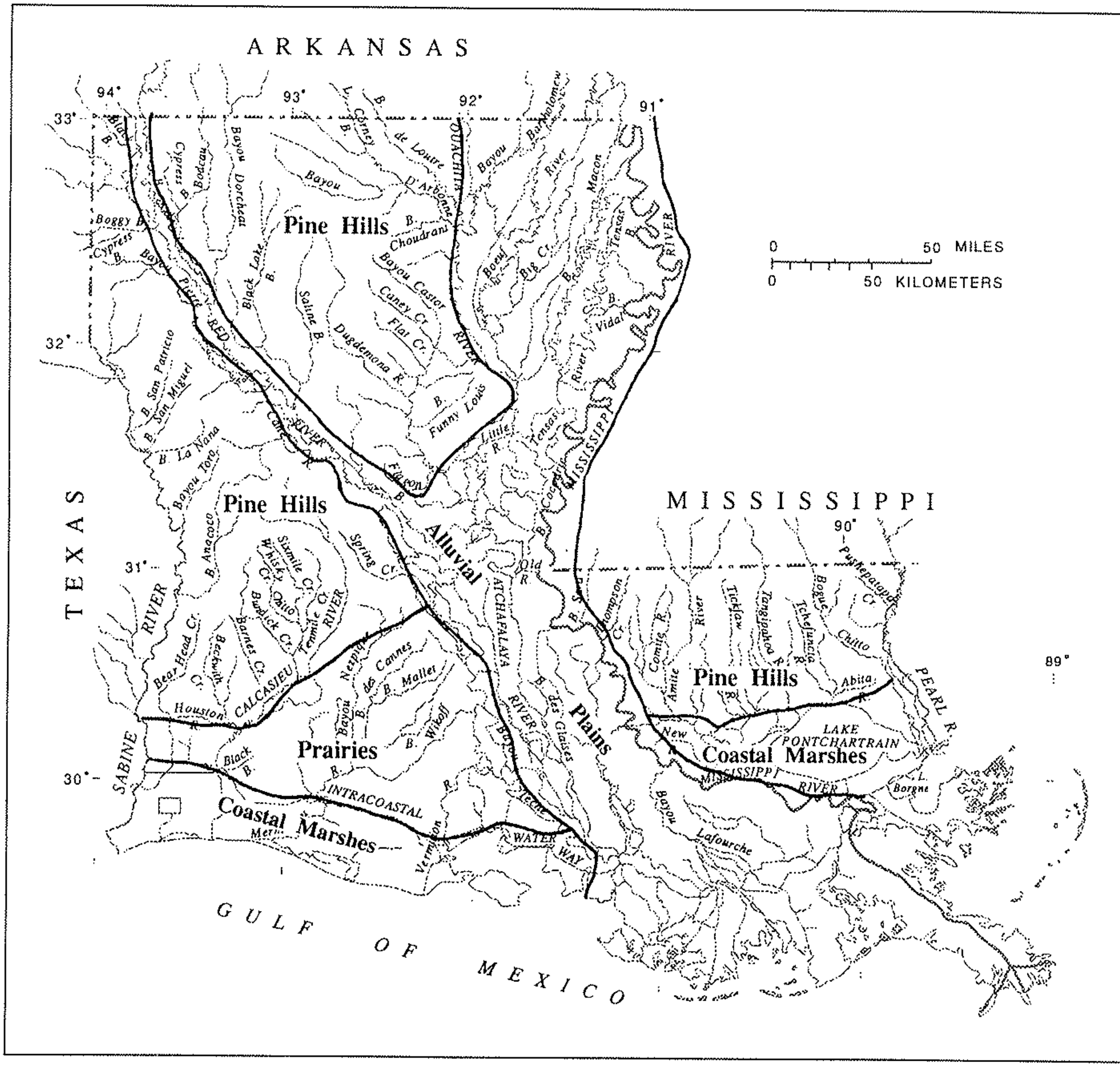


Figure 1.4.2-1. Physiographic divisions and streams in Louisiana. [modified from Lee, 1985, p. 4]

1.5 Surface-Water-Quality Properties and Constituents

DESCRIPTION OF SELECTED PROPERTIES AND CONSTITUENTS

Federal regulations and State criteria have been established for selected properties and constituents analyzed.

Table 1.5-1 describes selected water-quality properties and constituents discussed in this report. The table gives common sources of the properties and constituents and their environmental significance, and where available, the Federal regulations and State criteria are presented.

In addition to the information presented in this table, it may be noted that fecal coliform and fecal streptococcus values have a special importance when compared to each other. "When the ratio (fecal coliform bacteria to fecal streptococcus bacteria) is greater than or equal to 4, it may be taken as strong evidence that pollution derives from human wastes. When the ratio is less than or equal to 0.7, it may be taken as strong evidence that pollution derives predominantly or entirely from livestock or poultry wastes. When the ratio lies between 2 and 4, it can indicate a predominance of human wastes in mixed pollution. When the ratio is between 0.7 and 1.0, it can indicate a predominance of livestock and poultry wastes in mixed pollution. When the ratio falls on values from 1 to 2, it represents a 'grey area' of uncertain interpretation" (Millipore Corporation, 1972, p. 36). This interpretation of ratios is most reliable when the two counts describe samples collected at the same site within 24 hours of flow downstream from the source of pollution. Because the source of contamination in most instances is unknown, the interpretation of these ratios presented in this report should be used with caution.

Table 1.5-1. Common sources of properties and constituents, their environmental significance, and Federal regulations and State criteria
[Source: U.S.Environmental Protection Agency (USEPA), 1976; 1986; 1987; Louisiana Department of Environmental Quality (DEQ), 1984; Hem, 1985; Tobin and Youger, 1977. NE, no established criteria; SMCL, secondary maximum contaminant level; °C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; MCL, maximum contaminant level; Proposed MCL, proposed maximum contaminant level; ng/L, nanograms per liter; cols/100 mL, colonies per 100 milliliters]

Property or constituent	Common source	Environmental significance	USEPA Federal water-quality regulations[1]	DEQ State water-quality criteria
		Physical properties		
Specific conductance	Ions within the water.	Indicates the presence of precipitation, dilution, evaporation, and metabolic uptake and release of chemicals.	NE	NE
pH	Hydrogen-ion activity.	May indicate oxidation of some form of sulfur or iron.	SMCL is 6.5-8.5 and 6.5-9.0 is the recommended range for freshwater aquatic life.	6.0-9.0 and no effluent will cause pH to vary by more than 1.0.
Water temperature	Seasonal changes; daily variance outside discharges into waterbody.	Affects migration patterns and colonization characteristics; accelerates biodegradation; decreases maximum oxygen concentration.	See U.S. Environmental Protection Agency (1976, p. 218).	Freshwater: (1) Maximum of 2.8 °C rise above ambient for streams. (2) Maximum of 1.7 °C rise above ambient for lakes. (3) Maximum temperature of 32.2 °C except where otherwise listed. Estuarine and coastal waters: (1) Maximum of 2.2 °C rise above ambient October through May. (2) Maximum of 0.83 °C rise during June through September. (3) Maximum temperature of 35.0 °C except when natural conditions elevate temperature above this level.
Dissolved oxygen	Transferred from the atmosphere; photosynthesis by aquatic plants.	Inadequate dissolved oxygen can have adverse effect on aquatic life.	For freshwater aquatic life and coastal marine water, 5.0 mg/L.	For freshwater and coastal marine water, 5.0 mg/L.
Total dissolved solids.	Inorganic salts and some organic materials.	Excess can cause pipe corrosion or have detrimental effects on sensitive crops if used for irrigation.	SMCL is 500 mg/L. 250 mg/L for chlorides and sulfates in domestic water supplies (welfare).	State criteria vary from stream to stream.
		Major inorganic cations		
Calcium, dissolved	Occurs in igneous-rock minerals, silicate minerals, and as carbonates in sedimentary rocks.	Important for animal and plant nutrition.	NE	NE
Magnesium, dissolved	Carbonate sedimentary rock forms such as limestone.	Important for animal and plant nutrition.	NE	NE
Sodium, dissolved	Occurs in igneous and sedimentary rocks, especially evaporites.	Excessive sodium in drinking or irrigation water can have detrimental effects on plants and consumers.	No water-quality contaminant level is recommended for home drinking water.	NE
Potassium, dissolved	More abundant in sedimentary rocks than igneous rocks.	Essential plant nutrient.	NE	NE
		Major inorganic anions		
Alkalinity, as calcium carbonate	Caused by the presence of bicarbonates, carbonates, and hydroxides. Function of pH and temperature.	Buffers water against pH changes.	For freshwater aquatic life, 20 mg/L.	NE
Sulfate, dissolved	Can be dissolved from gypsum, sodium sulfate, and some types of shales. Mining activities, industrial waste, and organic matter.	Concentration exceeding a natural, background level indicate contamination from human activity; in sufficient quantity, can cause water to be unsuitable for public supply; can harm aquatic organisms.	SMCL is 250 mg/L.	Maximum contaminant level is 250 mg/L.
Chloride, dissolved	Common in brine and a primary constituent in seawater; evaporite sediment.	Associated with sodium and, if present in excess, can be detrimental if used for drinking or irrigation.	SMCL is 250 mg/L	For instream concentration, 250 mg/L.
		Trace metals		
Copper, dissolved	Malachite and cuprite. Oxides and sulfates are used in algicides, pesticides, and fungicides.	Important for the synthesis of chlorophyll.	SMCL is 1,000 µg/L.	NE
Iron, dissolved	Present in igneous-rock minerals and in sedimentary rocks.	Important for plant and animal nutrition.	SMCL is 300 µg/L.	NE
Lead, dissolved	Often result from mining, smelting, and other industrial operations. May occur naturally as lead sulfide.	Toxic, bioaccumulative. Has no nutritional value.	MCL is 50 µg/L.	NE
Zinc, dissolved	Used in the metallurgy, paint, rubber, and photo-engraving industries.	Important for animal metabolism. However, small quantities can be toxic to aquatic plants, animals, and bacteria.	SMCL is 5,000 µg/L.	NE
		Nutrients		
Ammonia plus organic nitrogen, total	Sewerage or industrial contamination.	Ammonia reactions with chlorine can result in the formation of chloramine compounds. Organic nitrogen can be an indicator of organic pollution.	NE	NE
Nitrate plus nitrate, nitrate, and nitrite as nitrogen total.	Fertilizers and animal and human wastes.	Plant nutrient that can be an indication of wastes.	Proposed MCL for nitrite plus nitrate is 10 mg/L, nitrate is 10 mg/L, and nitrite 1.0 mg/L.	NE
Phosphorus, total	Results from leaching of rocks and soil, decomposition of plants and animals, from fertilizers, sewerage, and industrial waste.	Although it is not toxic to man, it is bioaccumulative and toxic to certain forms of aquatic life. High concentrations promotes undesirable plant growth causing eutrophication of lakes.	NE	NE
		Pesticides and other organics		
DDT, total	Insecticides.	Bioaccumulative and toxic.	For freshwater and marine aquatic life, 0.001 µg/L.	For freshwater, 1.1 µg/L. For public water supply, 0.24 ng/L.
PCB, total	Found in capacitors and transformers used in the electrical industry.	Bioaccumulative and toxic.	For freshwater aquatic life, 0.014 µg/L. Ingestion of contaminated water and aquatic organisms should be zero.	For freshwater, 2.0 µg/L. For public water supply, 0.79 ng/L.
Diazinon, total	Insecticides.	Bioaccumulative and toxic.	NE	NE
Lindane, total	Insecticides.	Bioaccumulative and toxic.	For domestic water supply, 4.0 µg/L. For freshwater aquatic life, 0.01 µg/L.	NE
Chlordane, total	Insecticides.	Bioaccumulative and toxic.	For freshwater aquatic life, 2.4 µg/L.	For freshwater, 2.4 µg/L. For public water supply, 4.6 ng/L.
Malathion, total	Insecticides.	Bioaccumulative and toxic.	For freshwater and marine aquatic life, 0.1 µg/L.	NE
Endrin, total	Insecticides.	Bioaccumulative and toxic.	For freshwater aquatic life, 0.18 µg/L. To protect public health, 1.0 µg/L.	For freshwater, 0.18 µg/L. For public water supply, 1.0 µg/L.
Parathion, total	Insecticides.	Bioaccumulative and toxic.	For freshwater and marine aquatic life, 0.04 µg/L.	NE
Endosulfan, total	Insecticides.	Bioaccumulative and toxic.	For freshwater aquatic life, 0.22 µg/L. To protect public health, 74 µg/L.	NE
2,4-D, total	Herbicides.	Bioaccumulative and toxic.	For domestic water supply, 100 µg/L.	For public water supply, 100 µg/L.
		Biological constituents		
Fecal coliform	Human wastes.	Indicator of pathogens.	Based on minimum of 5 samples collected over a 30-day period, the level should not exceed a log mean of 200 cols/100 mL, nor should more than 10 percent of the total samples collected during any 30-day period exceed 400 cols/100 mL.	Based on a minimum of 5 samples collected over a 30-day period, the level should not exceed a log mean of 200 cols/100 mL, nor should more than 10 percent of the total samples collected during any 30-day period exceed 400 cols/100 mL.
Fecal streptococcus	Livestock and poultry wastes.	Indicator of pathogens.	NE	NE
		Suspended sediment		
Suspended sediment	Sand, silt, clay, and organic material which enter a stream either from hillslope erosion or either directly from the streambed.	Long periods of large sediment concentrations can interfere with photosynthesis, bury benthic organisms, inhibit respiration of gilled organisms, and ultimately alter the aquatic ecosystem.	NE	NE

[1] *Primary Drinking-Water Regulations maximum contaminant level:*
Enforceable, health-based regulation that is to be set as close to the maximum contaminant level goal as is feasible. The definition of feasible means the use of best technology, treatment techniques, and other means that the Administrator of USEPA finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are generally available (taking cost into consideration).

Proposed maximum contaminant level:
Not enforceable.

Secondary Drinking-Water Regulations secondary maximum contaminant level:
Contaminants that affect the aesthetic quality of drinking water. At high concentrations or values, health implications as well as aesthetic degradation may also exist. SMCLs are not federally enforced, but are intended as guidelines for the states.

2.0 SABINE RIVER BASIN IN LOUISIANA

STATISTICAL SUMMARY OF SURFACE-WATER QUALITY IN THE SABINE RIVER BASIN

Data from 11 sites were analyzed.

Statistical analyses of surface-water-quality data for the Sabine River basin are presented in this part of the report. Text, maps, boxplots, graphs, and tables are used to describe the surface-water quality. Data are presented for 32 water-quality properties and constituents from analyses of water stored in the USGS's WATSTORE files. The data were collected from 11 sites (fig. 2.0-1) in the basin during water years 1952 to 1985. This information is useful to Federal, State, and local planners; hydrologists; engineers; scientists; and others who have water-resources management responsibilities for the Sabine River basin.

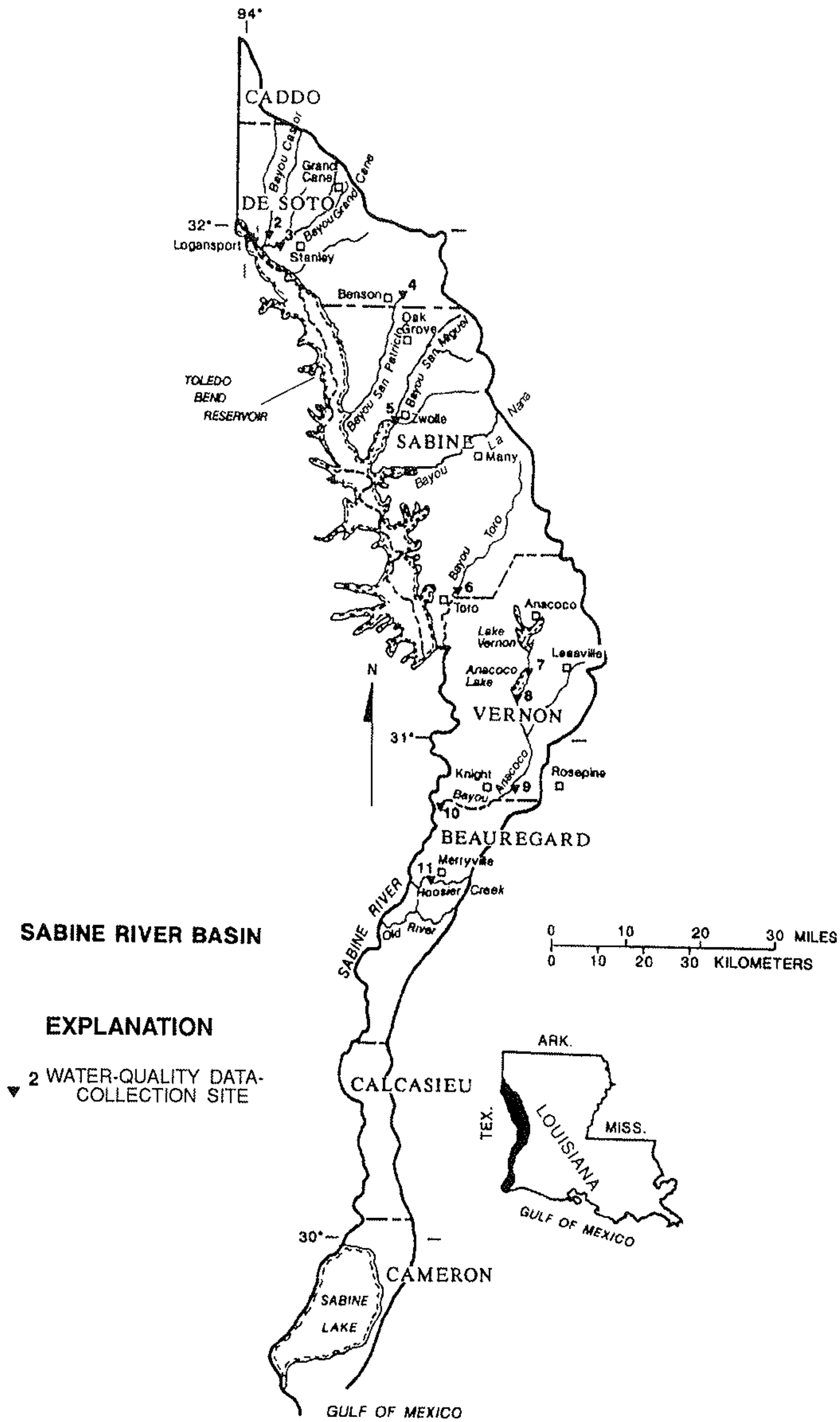


Figure 2.0-1. Location of surface-water-quality data-collection sites in the Sabine River basin, Louisiana.

2.1 Overview

SABINE RIVER, TOLEDO BEND RESERVOIR, ANACOCO LAKE, AND BAYOU ANACOCO ARE PRINCIPAL SOURCES OF SURFACE WATER

The Sabine River is the largest source of surface water in the basin.

The Sabine River basin in Louisiana (fig. 2.0-1) is about 190 mi long and 25 mi wide at its widest point and includes Toledo Bend Reservoir (Louisiana Department of Transportation and Development, 1984). The basin has a total drainage area of 20,944 mi^2 (U.S. Geological Survey, 1986, p. 257), of which about 2,529 mi^2 are in Louisiana. Most of the Sabine River basin is undeveloped, and projected water requirements are expected to remain small. Hence, the basin has an adequate water supply for anticipated future use. Surface waters in the basin are used for recreation, and withdrawals primarily are for industrial use, power generation, and public supply (fig. 2.1-1) (Lovelace, 1991, p. 133).

The principal sources of fresh surface water in the basin are the Sabine River, Toledo Bend Reservoir, Anacoco Lake, and Bayou Anacoco. The Sabine River is the largest source of surface water in the basin, although only about 12 percent of its total drainage is within Louisiana (U.S. Geological Survey, 1986, p. 257). The Sabine River is the main source of water supply for Toledo Bend Reservoir (Lee, 1985b, p. 5). Toledo Bend Reservoir, completed on the Sabine River in 1968, has a storage capacity of 5,102,000 acre-ft. Anacoco Lake, completed on Bayou Anacoco in 1961, has a storage capacity of 57,000 acre-ft (U.S. Geological Survey, 1986, p. 257). The average flow per square mile of drainage area is 0.66 $[(ft^3/s)/mi^2]$ at Sabine River at Logansport and 1.25 $[(ft^3/s)/mi^2]$ at Bayou Anacoco near Rosepine. Other bodies of fresh surface water in the basin include Lake Vernon, Hoosier Creek, and the following bayous: Bayou Castor, Grand Cane, La Nana, San Miguel, San Patricio, and Toro.

Concerns for water quality in the basin include low (less than 5.0 mg/L) concentrations of dissolved oxygen and the effect of lignite mining operations in the northern part of the basin (Snider and Covay, 1987). The concerns about lignite mining operations include potential changes in surface-water quality by acid mine drainage and transport and deposition of large amounts of sediment.

Surface-Water Withdrawals by Parish

Parish	Mgal/d
Beauregard	4.99
De Soto	10.79
Sabine	5.04
Vernon	.20

Surface-water withdrawals, in million gallons per day(Mgal/d)

Public supply	2.46
Industry	14.22
Power generation	3.65
Rural domestic	.00
Livestock	.69
Rice irrigation	.00
General irrigation	.00
Aquaculture	.00
TOTAL	21.02

Surface-Water Withdrawals by Major Water Body

Water Body	Mgal/d
Toledo Bend Reservoir	15.34

Figure 2.1-1. Surface-water withdrawals from the Sabine River basin, Louisiana, 1990. [Source: Lovelace, 1991, p. 133]

2.2 Surface-Water Quality

SELECTED PROPERTIES AND CONSTITUENTS

Physical, chemical, biological, and sediment data describe the surface-water quality of the Sabine River basin.

Figure 2.2-1 shows one of the 11 water-quality data-collection sites in the Sabine River basin. The data for this and other water-quality sites in the basin are presented in table 2.2-1 at the back of this report. The table includes selected water-quality properties and constituents, number of analyses, reporting levels, and values or concentrations for the percentiles used to generate the boxplots shown for 6 of the 11 sites in the Sabine River basin. The format of the data in these tables allows easy comparison among sites within the basin. Results of analyses used for statistical computations are in the files of the USGS.

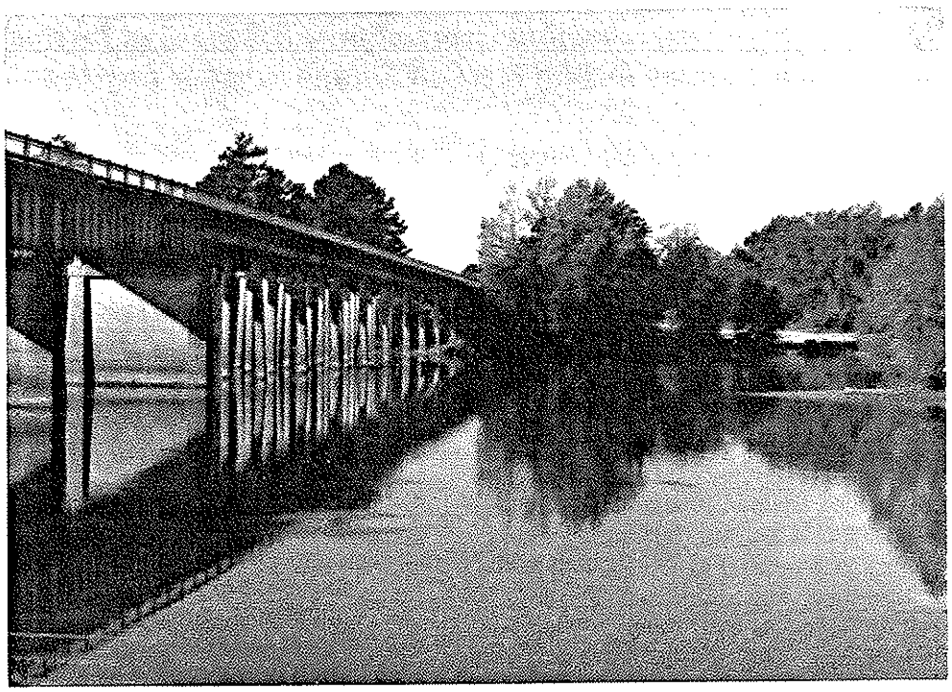


Figure 2.2-1. Water-quality data-collection site at Sabine River at Logansport, Louisiana.

2.2.1 Physical Properties--Specific Conductance, pH, Water Temperature, and Dissolved Oxygen

DISSOLVED OXYGEN REACHES CRITICALLY LOW LEVELS IN THE BASIN

Dissolved-oxygen concentrations ranged from 0.8 mg/L at Bayou Grand Cane near Stanley to 14.8 mg/L at Sabine River at Logansport.

Statistical summaries of water-quality data at 11 sites in the basin are presented in table 2.2-1 in the back of the report and boxplots summarizing the specific conductance, pH, water temperature, and dissolved-oxygen concentration data are presented in figure 2.2.1-1 for six of the sites. Specific conductance values for all sites in the Sabine River basin ranged from 27 µS/cm at Upper Anacoco Lake near Leesville to 841 µS/cm at Bayou Anacoco near Knight (table 2.2-1). The median values for specific conductance ranged from 34 to 322 µS/cm, with the lower values (less than 40 µS/cm) occurring at lake sites. Median specific conductance values on Bayou Anacoco ranged from 54 µS/cm at Rosepine to 233 µS/cm at the site near Knight. Interquartile ranges for specific conductance were 47 to 79 µS/cm at Bayou Anacoco near Rosepine (upstream) and 109 to 384 µS/cm at Bayou Anacoco near Knight (downstream).

Values for pH in water from all sites in the basin ranged from 5.2 at Bayou Anacoco near Rosepine to 7.8 at Bayou Anacoco near Knight and Sabine River at Logansport, within the secondary maximum contaminant level (SMCL) range of 5.0 to 9.0 for domestic water supply (U.S. Environmental Protection Agency, 1976; 1986). Median pH values in the Sabine River basin ranged from 6.2 to 6.9. The boxplots indicate that pH often was less than 6.5, the lower limit of the EPA recommended range for freshwater aquatic life (U.S. Environmental Protection Agency, 1976; 1986). For example, at least 50 percent of the measured values were less than 6.5 at Bayou Grand Cane near Stanley and at Bayou San Patricio near Benson. At Bayou Castor near Logansport, more than 25 percent of the pH values were less than 6.5. Interquartile ranges for pH were 6.1 to 6.6 at Bayou Grand Cane near Stanley and 6.6 to 7.1 at Bayou Anacoco near Knight.

Values for water temperatures at all sites in the basin ranged from 2.5 °C at Bayou Anacoco near Knight to 34.0 °C at Sabine River at Logansport. Median values ranged from 11.1 to 23.6 °C. Maximum water temperatures at Sabine River at Logansport exceeded the State's criterion of 32.2 °C. These temperatures probably occurred during extreme low flow or on very hot days (Louisiana Department of Environmental Quality, 1984, p. 12). Interquartile ranges for water temperature were 15.5 to 22.8 °C at Bayou Grand Cane near Stanley and 11.8 to 24.5 °C at Sabine River at Logansport.

Dissolved-oxygen concentrations in water from the basin ranged from 0.8 mg/L at Bayou Grand Cane near Stanley to 14.8 mg/L at Sabine River at Logansport. The median concentrations for dissolved oxygen ranged from 4.2 to 8.8 mg/L. Although the maximum concentration of 14.8 mg/L occurred at Sabine River at Logansport, the median concentration for that site was 8.4 mg/L. The minimum concentration of 0.8 mg/L occurred at Bayou Grand Cane near Stanley, but the median concentration at that site was 4.2 mg/L.

Dissolved-oxygen concentrations exceeded the State's minimum water-quality criteria of 5 mg/L in more than 75 percent of the samples analyzed at most sites. At Bayou Anacoco near Rosepine and Sabine River at Logansport, 95 percent of the dissolved-oxygen values exceeded the minimum criteria of the U.S. Environmental Protection Agency and the State. The U.S. Environmental Protection Agency's criterion for dissolved oxygen is 5.0 mg/L for freshwater aquatic life (U.S. Environmental Protection Agency, 1976; 1986). The boxplots for dissolved-oxygen concentrations in figure 2.2.1-1 indicate that between 50 and 75 percent of the measured values were less than 5.0 mg/L at Bayou Castor near Logansport and at Bayou Grand Cane near Stanley. At Bayou San Patricio near Benson, slightly less than 25 percent of the measured values were less than 5.0 mg/L. Minimum and maximum interquartile ranges for dissolved-oxygen concentrations were 6.8 to 8.7 mg/L at Bayou Anacoco near Rosepine and 3.0 to 8.0 mg/L at Bayou Castor near Logansport. The low dissolved-oxygen concentrations at Bayou Castor near Logansport and Bayou Grand Cane near Stanley possibly were due to low flow rather than to wastewater input. These sites occasionally experienced no flow and water-quality measurements were sometimes made in stagnant pools.

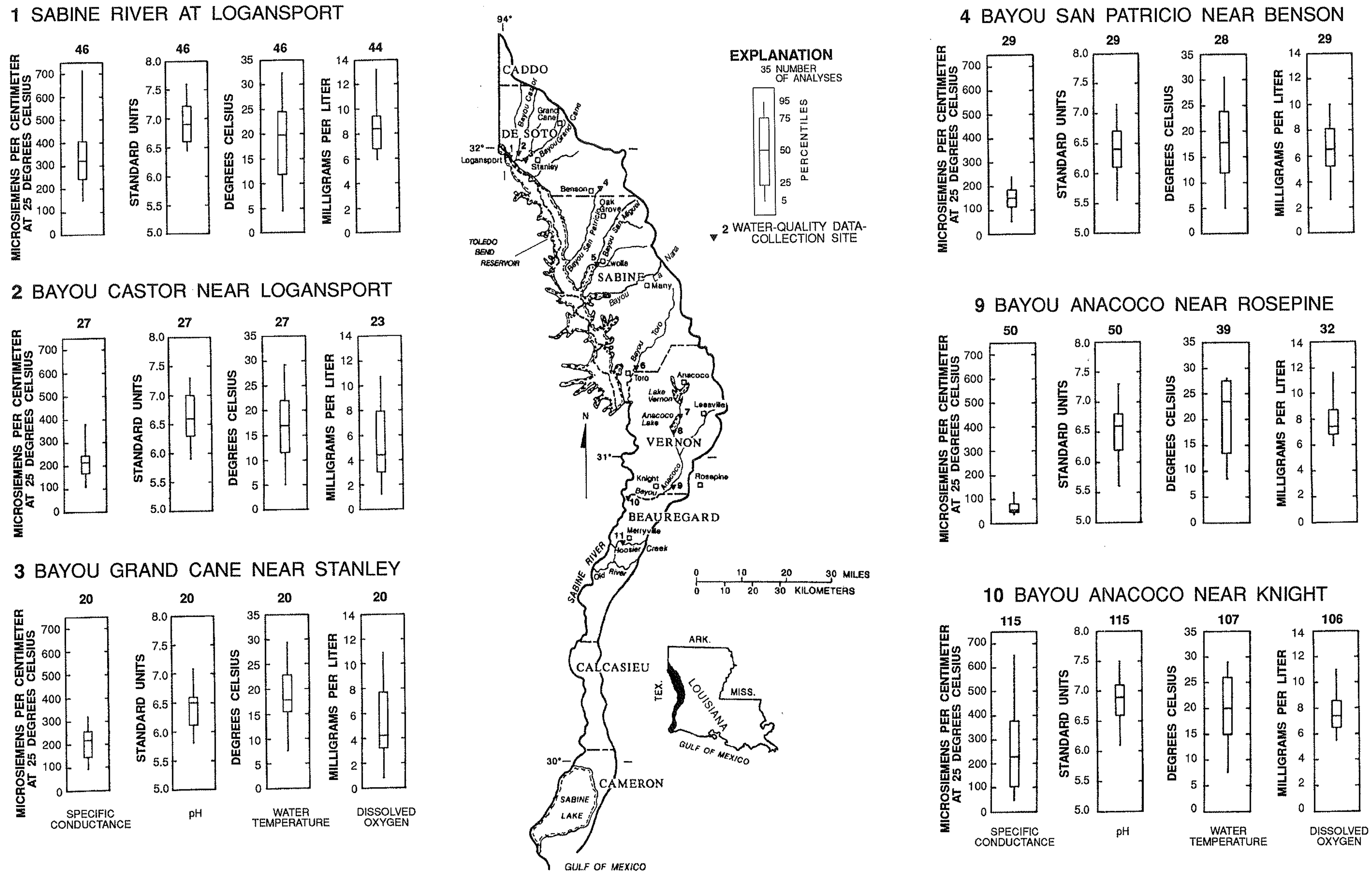


Figure 2.2.1-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots summarizing the specific conductance, pH, water temperature, and dissolved-oxygen data for selected sites.

2.2.2 Relation Between Specific Conductance and Dissolved Solids

DISSOLVED SOLIDS CONCENTRATIONS CAN BE ESTIMATED FROM SPECIFIC CONDUCTANCE VALUES

Dissolved solids concentrations in water from the Sabine River basin met the U.S. Environmental Protection Agency's secondary drinking water regulations for dissolved solids in irrigation water.

Linear regression equations relating dissolved-solids concentrations to specific conductance were calculated for six sites in the Sabine River basin (fig. 2.2.2-1). The correlation coefficient values, r, ranged from 0.87 at Bayou Castor near Logansport to 0.99 at Bayou Anacoco near Knight. The relatively strong correlation between specific conductance and dissolved solids concentrations indicates that dissolved solids concentrations can be estimated from specific conductance values with a reasonable degree of accuracy.

The regression equation for Bayou Anacoco near Knight which was based on 109 chemical analyses indicates that dissolved solids concentrations at that site can exceed 500 mg/L when specific conductance values exceed 756 μS/cm. The boxplot for specific conductance for Bayou Anacoco near Knight (fig. 2.2.1-1) indicates that 756 μS/cm was exceeded in less than 5 percent of the samples analyzed. Although no State criteria for irrigation water quality are available for these streams or for the other streams for which regression equations were developed, the regression equations indicated that the streams in the basin generally met the U.S. Environmental Protection Agency's (1976) criterion for dissolved solids in irrigation water (500 mg/L).

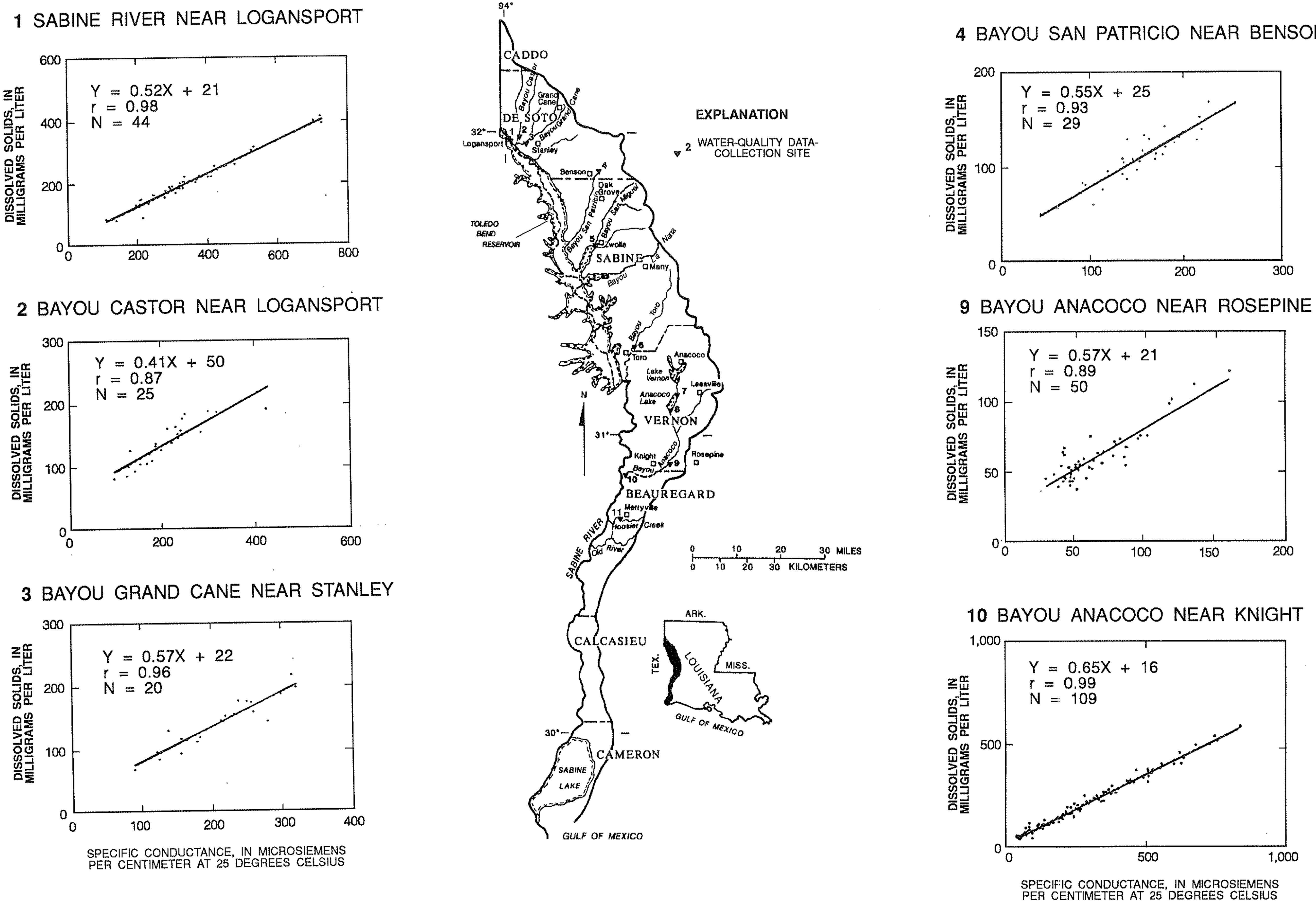


Figure 2.2.2-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and graphs showing relation between specific conductance and dissolved solids in water from selected sites.

2.2.3 Major Inorganic Cations--Dissolved Calcium, Magnesium, Sodium, and Potassium

CONCENTRATIONS OF DISSOLVED CALCIUM, MAGNESIUM, SODIUM, AND POTASSIUM ARE LOW IN WATER FROM THE BASIN

Anacoco Lake had lower concentrations of major inorganic cations than other sites in the basin.

Calcium concentrations at all sites in the Sabine River basin ranged from 1.7 mg/L at Upper Anacoco Lake near Leesville to 29 mg/L at Bayou Castor near Logansport. Concentrations of calcium were lower at the sites at Anacoco Lake than at the other sites in the basin. The median calcium concentrations at the two sites at Anacoco Lake were 2.0 and 3.0 mg/L. Boxplots for six representatives sites in the basin (fig. 2.2.3-1) show that calcium concentrations generally were less than 20 mg/L, except at Sabine River at Logansport where almost 25 percent of the values were greater than 20 mg/L. More than 75 percent of the calcium concentrations in samples from Bayou Anacoco near Rosepine were less than 10 mg/L.

Magnesium concentrations in the basin ranged from less than 0.1 mg/L at Bayou Anacoco near Rosepine to 9.1 mg/L at Bayou Grand Cane near Stanley. The lowest median magnesium concentrations (0.6 mg/L and 0.7 mg/L) occurred at two sites at Anacoco Lake. Boxplots from six representative sites (fig. 2.2.3-1) show that magnesium concentrations in 75 percent or more of the samples collected at these sites were less than 7.0 mg/L. Magnesium concentrations in samples from Bayou Anacoco near Rosepine were less than 2.0 mg/L, in at least 95 percent of the samples.

Sodium concentrations in water from the basin were highest at Bayou Anacoco near Knight, which had a median concentration of 36 mg/L. The minimum sodium concentration (1.6 mg/L) occurred at Anacoco Lake at the dam near Leesville. Boxplots for six representative sites shown in fig. 2.2.3-1 show that at least 95 percent of the samples collected had sodium concentrations less than 35 mg/L, except at Sabine River at Logansport and Bayou Anacoco near Knight. The median concentration at Bayou Anacoco near Knight (36 mg/L) was about 10 times greater than the median at Bayou Anacoco near Rosepine.

Concentrations of potassium in water from the basin ranged from 0.2 mg/L at Hoosier Creek near Merryville to 8.4 mg/L at Sabine River at Logansport. The minimum median concentration (1.3 mg/L) occurred at Upper Anacoco Lake near Leesville. Boxplots for six representative sites (fig. 2.2.3-1) show that concentrations of potassium were less than 5.0 mg/L at all of these sites, except Bayou Castor near Logansport. The lowest concentrations of potassium at these six sites occurred at Bayou Anacoco near Rosepine.

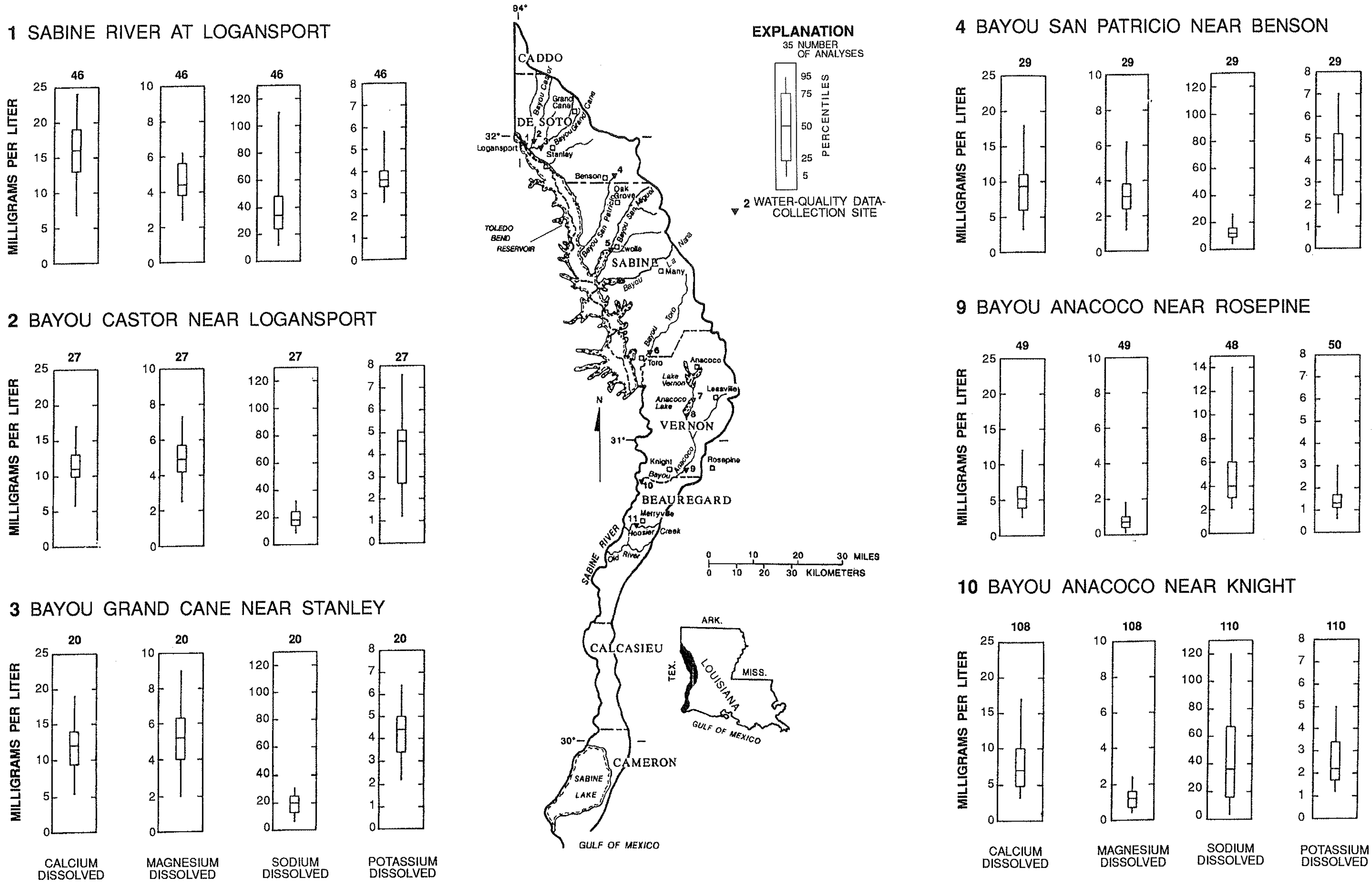


Figure 2.2.3-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots summarizing the concentration data for dissolved calcium, magnesium, sodium, and potassium in water from selected sites.

2.2.4 Major Inorganic Anions--Total Alkalinity as Calcium Carbonate, Dissolved Sulfate, and Dissolved Chloride

TOTAL ALKALINITY AND DISSOLVED SULFATE AND CHLORIDE ARE LESS THAN THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S SECONDARY MAXIMUM CONTAMINANT LEVELS

Median chloride concentrations ranged from 5.4 mg/L at Bayou Anacoco near Rosepine to 53 mg/L at Sabine River at Logansport.

Alkalinity as calcium carbonate in water from the Sabine River basin ranged from 3 mg/L at Bayou Anacoco near Rosepine and Hoosier Creek near Merryville to 158 mg/L at Sabine River at Logansport. The two lowest median concentrations (7 and 8 mg/L) occurred at the sites on Anacoco Lake. The maximum median alkalinity in the basin was 41 mg/L, which occurred at Bayou Castor near Logansport. The boxplots for six representative sites (fig. 2.2.4-1) show that alkalinity values in 75 percent of the samples analyzed were generally 20 mg/L or greater, with the exceptions of Bayou Anacoco near Rosepine and Bayou San Patricio near Benson. The U.S. Environmental Protection's Agency's minimum alkalinity criterion for freshwater aquatic life is 20 mg/L except where alkalinities for natural waters commonly are less (U.S. Environmental Protection Agency, 1976).

Concentrations of sulfate in water from the basin ranged from 0.2 mg/L at Bayou Anacoco near Rosepine to 170 mg/L at Bayou Anacoco near Knight, and were substantially less than the SMCL for drinking water of 250 mg/L (U.S. Environmental Protection Agency, 1986; Louisiana Department of Environmental Quality, 1984). Median concentrations at the two sites at Anacoco Lake and Bayou Anacoco near Rosepine were low (3.3 and 3.6 mg/L). The maximum median concentration (40 mg/L) occurred at Bayou Anacoco near Knight. The boxplots for six representative sites (fig. 2.2.4-1) show that the median concentration of sulfate at Bayou Anacoco near Knight was more than 10 times greater than the median concentration at the upstream site near Rosepine.

Chloride concentrations in water from the basin ranged from 1.7 mg/L at Bayou Anacoco near Rosepine to 160 mg/L at Sabine River at Logansport, which are substantially less than the SMCL for drinking water of 250 mg/L (U.S. Environmental Protection Agency, 1986; Louisiana Department of Environmental Quality, 1984). Median concentrations ranged from less than 4.0 mg/L at the two sites at Anacoco Lake to 53 mg/L at Sabine River at Logansport. The boxplots summarizing the data for six representative sites in the basin (fig. 2.2.4-1) show that more than 75 percent of the samples analyzed had chloride concentrations less than 40 mg/L at all of these sites except Sabine River at Logansport, which had significantly higher concentrations.

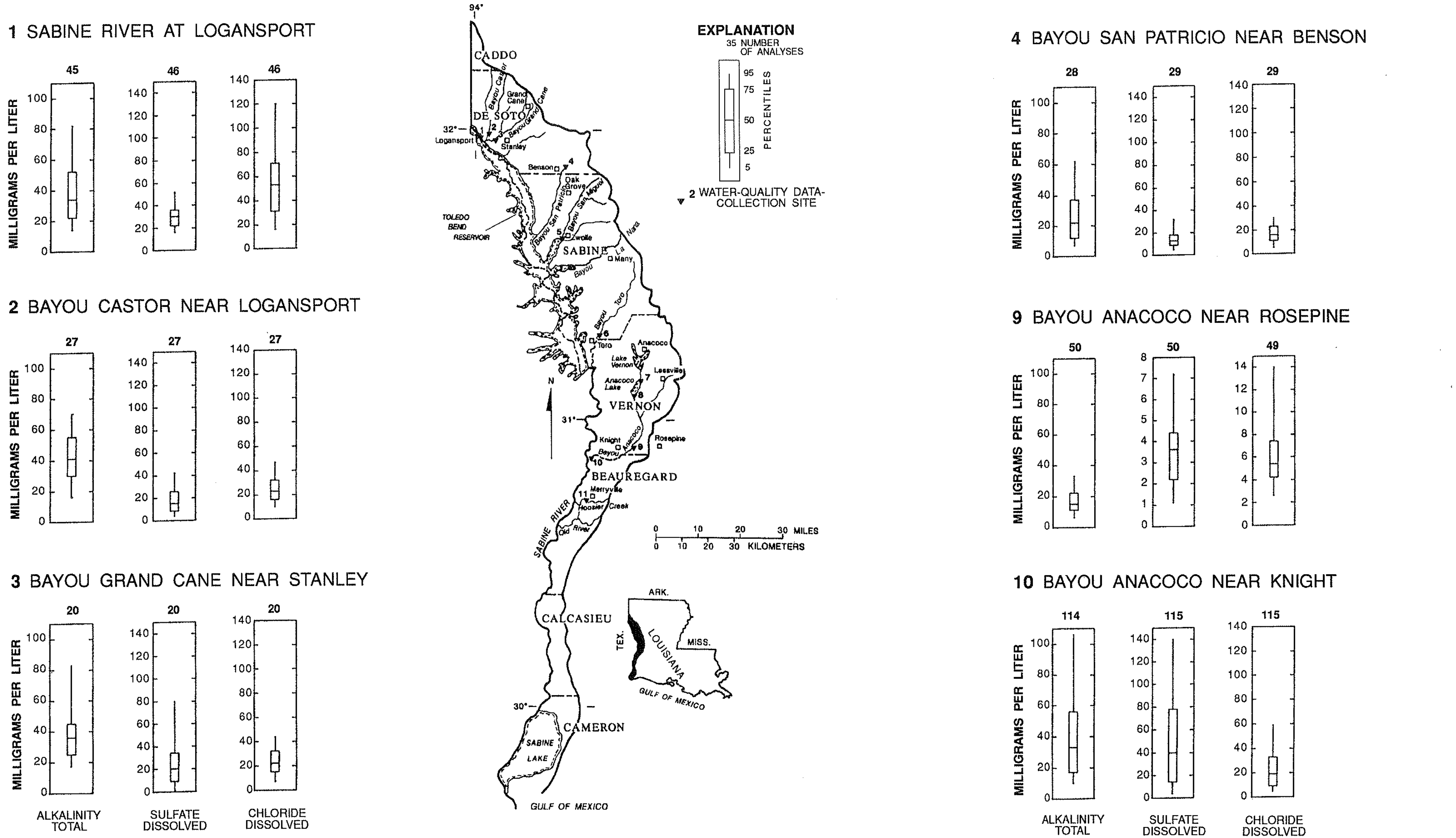


Figure 2.2.4-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots summarizing the data for total alkalinity as calcium carbonate and dissolved sulfate and chloride concentrations in water from selected sites.

2.2.5 Relation between Specific Conductance and Dissolved Chloride

A DIRECT RELATION EXISTS BETWEEN SPECIFIC CONDUCTANCE AND DISSOLVED CHLORIDE

Linear regression equations indicate that dissolved chloride can be estimated from specific conductance for selected streams in the Sabine River basin.

Regression equations relating chloride concentrations to specific conductance values were calculated for six sites in the Sabine River basin (fig. 2.2.5-1). The correlation coefficient values, r, ranged from 0.71 at Bayou Anacoco near Rosepine to 0.96 at Sabine River at Logansport. These equations can be used to estimate chloride concentrations from specific conductance for water uses such as irrigation of chloride sensitive crops. The regression equations indicate that chloride constitutes a greater percentage of the dissolved solids in water from the Sabine River at Logansport than in water from the other five sites. For example, application of the regression equations to specific conductance of 600 µS/cm yields an estimated chloride concentration of 106 mg/L for the Sabine River at Logansport but only 48 mg/L for Bayou Anacoco near Knight.

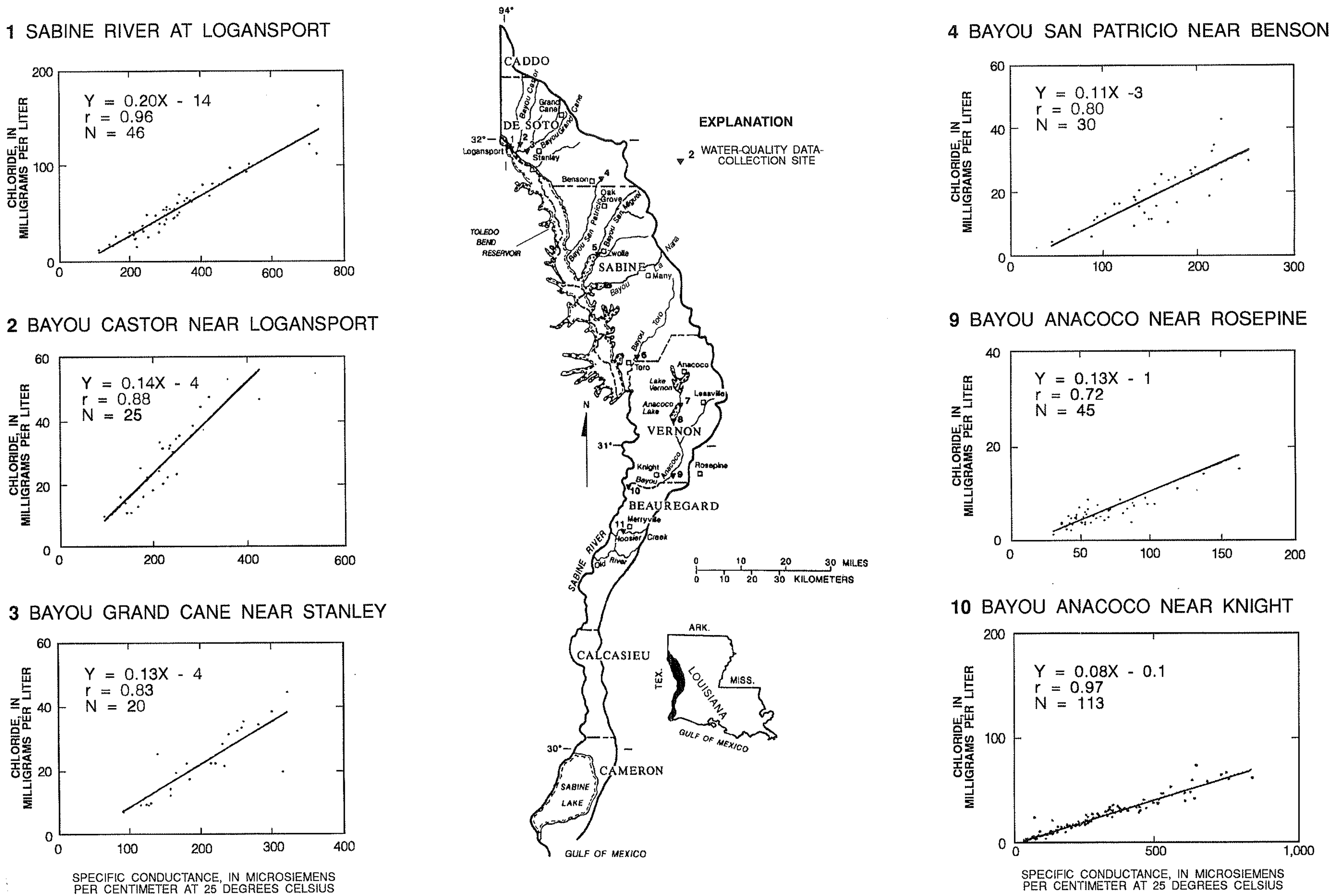


Figure 2.2.5-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and graphs showing relation between specific conductance and dissolved chloride in water from selected sites.

2.2.6 Trace Metals[2]--Dissolved Copper, Iron, Lead, and Zinc

CONCENTRATIONS OF SELECTED DISSOLVED TRACE METALS WERE WITHIN THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S RECOMMENDED LEVELS

Median concentrations of dissolved iron ranged from 70 µg/L at Sabine River at Logansport to 530 µg/L at Bayou San Patricio near Benson.

Concentrations of copper in water samples collected in the Sabine River basin ranged from less than 1 µg/L at Bayou Castor near Logansport, Sabine River at Logansport, and Bayou Grand Cane near Stanley to 12 µg/L at Bayou Grand Cane near Stanley. The median copper concentrations ranged from 2 to 4 µg/L at the three sites (Bayou Castor near Logansport, Sabine River at Logansport, and Bayou Grand Cane near Stanley) for which 10 or more samples were analyzed. Copper concentrations for six representative sites are summarized using boxplots and tables in figure 2.2.6-1. Tables are presented instead of boxplots when there were less than 10 analyses at a site. The boxplots (fig. 2.2.6-1) illustrate that at the three sites with 10 or more analyses, approximately 75 percent of the samples analyzed had copper concentrations of 5 µg/L or less.

Iron concentrations ranged from less than 10 µg/L at Sabine River at Logansport to 740 µg/L at Bayou Castor near Logansport. Median iron concentrations in the basin ranged from 70 to 530 µg/L. Boxplots and tables (fig. 2.2.6-1) summarizing data for six representative sites within the basin show that iron concentrations varied greatly.

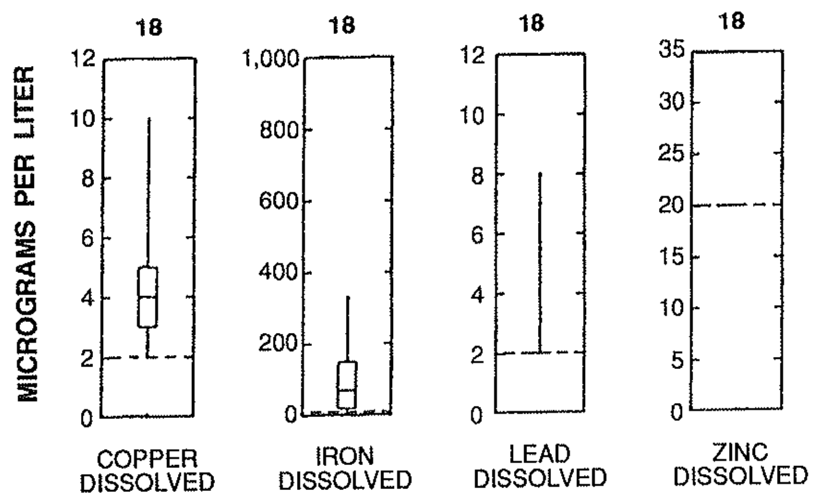
Concentrations of lead in water from the basin were low at all sites. The concentrations ranged from less than the reporting level at all sites to 10 µg/L at Bayou Anacoco near Knight. The median concentrations were less than the reporting levels at the three sites for which 10 or more samples were analyzed. Boxplots and tables for six representative sites (fig. 2.2.6-1) show that at least 75 percent of all analyses were less than the reporting level. At least 95 percent of the analyses were less than the reporting level at Bayou San Patricio near Benson and Bayou Anacoco near Knight.

Zinc concentrations in water from the Sabine River basin generally were low at all sites. The minimum and maximum concentrations within the basin (5 µg/L and 50 µg/L) were for samples collected at Bayou Castor near Logansport. Median zinc concentrations were less than 20 µg/L at the three sites for which 10 or more samples were analyzed. Boxplots and tables for six representative sites (fig. 2.2.6-1) show that zinc concentrations in most of the samples analyzed were less than 25 µg/L.

---

[2] "Traditionally, dissolved trace-element concentrations have been reported at the micrograms per liter level. Recent evidence, mostly from large rivers, indicates that actual dissolved-phase concentrations for a number of trace elements are within the range of 10's to 100's of nanograms per liter (ng/L). Present data above the micrograms per liter level should be viewed with caution. Such data may actually represent elevated environmental concentrations from natural or human causes; however, these data could reflect contamination introduced during sampling, processing, or analysis. To confidently produce dissolved trace-element data with insignificant contamination, the U.S. Geological Survey will begin using new trace-element protocols in the near future."

1 SABINE RIVER AT LOGANSPORT

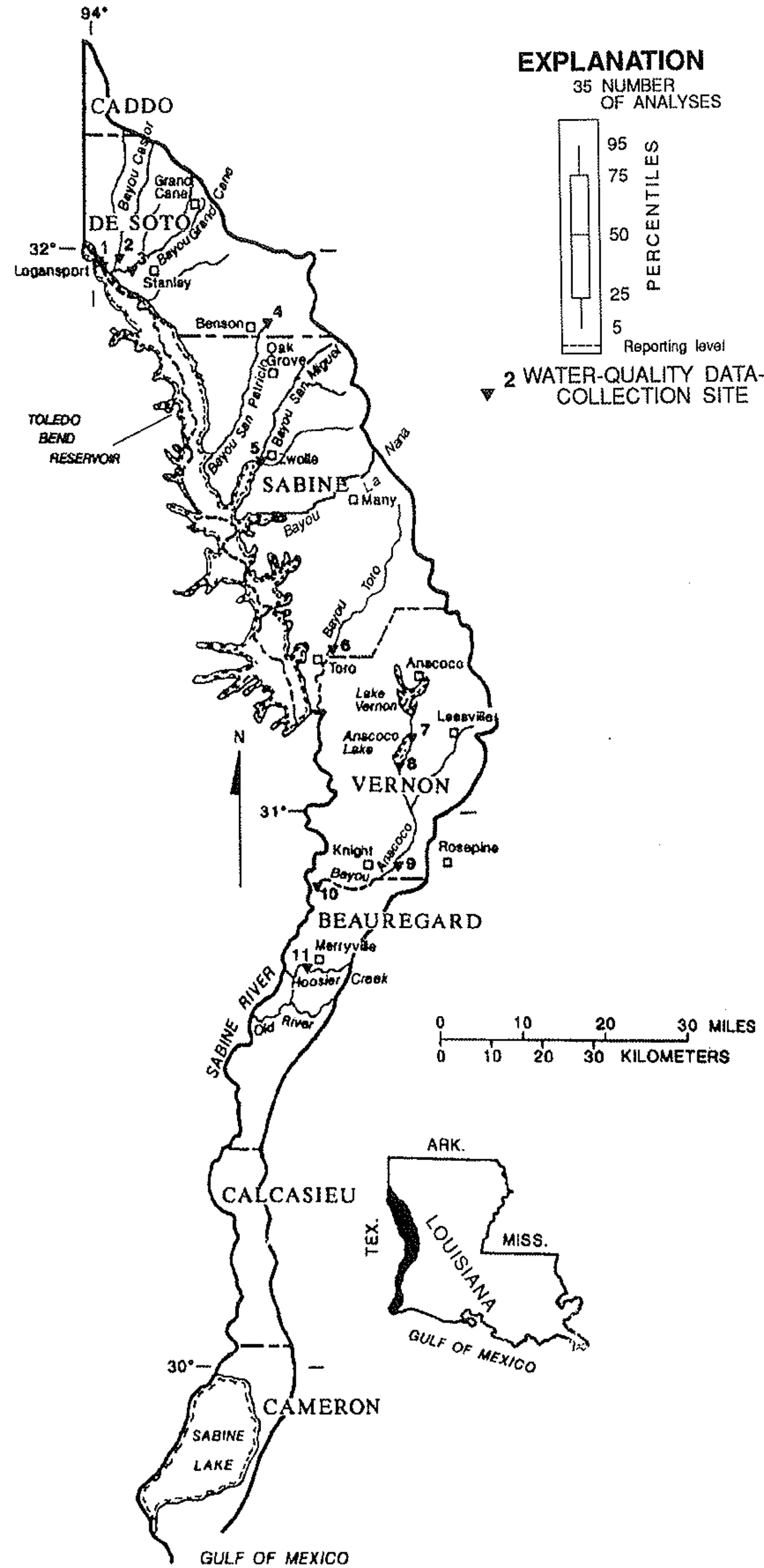


2 BAYOU CASTOR NEAR LOGANSPORT

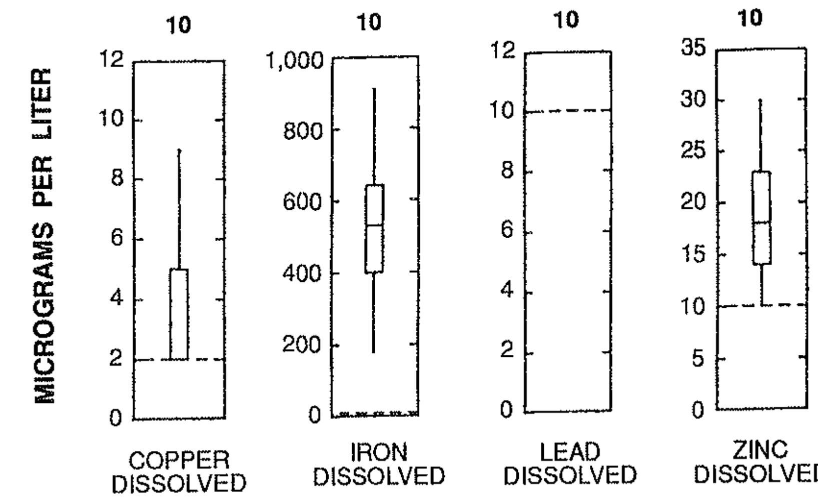
DISSOLVED CONSTITUENT	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
COPPER	9	1	7
IRON	8	10	8
LEAD	9	10	0
ZINC	9	1	9

3 BAYOU GRAND CANE NEAR STANLEY

DISSOLVED CONSTITUENT	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
COPPER	7	1	6
IRON	7	10	7
LEAD	7	1	5
ZINC	7	1	7



4 BAYOU SAN PATRICIO NEAR BENSON



7 ANACOCO LAKE AT DAM NEAR LEESVILLE

DISSOLVED CONSTITUENT	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
COPPER	3	1	3
IRON	3	10	3
LEAD	3	1	2
ZINC	3	20	0

10 BAYOU ANACOCO NEAR KNIGHT

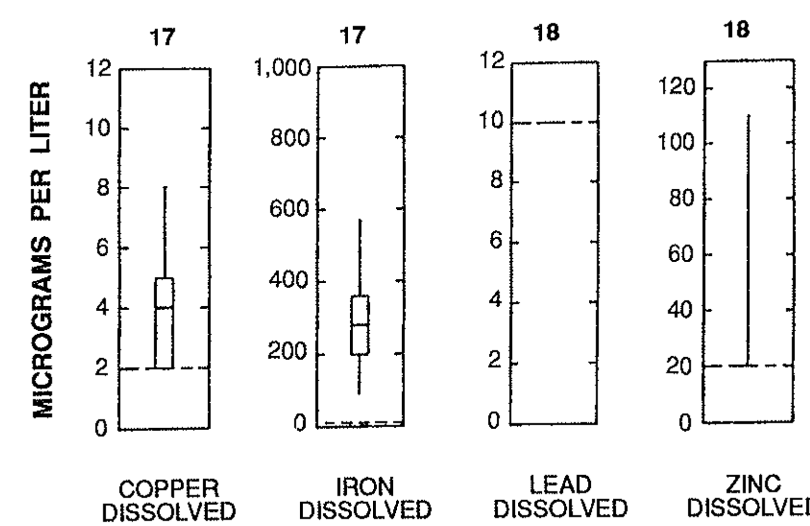


Figure 2.2.6-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots and tables summarizing data for dissolved copper, iron, lead, and zinc concentrations in water from selected sites.

LOW VARIANCE IN CONCENTRATIONS OF NUTRIENTS IN BASIN

Median concentrations of ammonia plus organic nitrogen ranged from 1.0 to 1.1 mg/L and median phosphorus concentrations were less than 0.15 mg/L.

Concentrations of ammonia plus organic nitrogen in water from the basin ranged from less than 0.1 mg/L at a site in Anacoco Lake to 4.9 mg/L at Bayou Anacoco near Knight. Median concentrations were 1.0 or 1.1 mg/L at most sites. Concentrations of ammonia plus organic nitrogen in water from the five representative sites for which boxplots are shown generally were less than 3.0 mg/L (fig. 2.2.7-1). Concentrations in a few samples collected from Bayou Anacoco near Knight exceeded 4.0 mg/L; however, concentrations of ammonia plus organic nitrogen were less than 1.6 mg/L in 75 percent or more of the samples analyzed at all sites.

Concentrations of nitrite plus nitrate as nitrogen in the Sabine River basin ranged from less than 0.1 mg/L at several sites to 1.2 mg/L at Bayou San Patricio near Benson. Median nitrite plus nitrate nitrogen concentrations ranged from less than the reporting level to 0.2 mg/L. Boxplots at six representative sites show that concentrations in 75 percent of all samples analyzed were less than 0.3 mg/L (fig. 2.2.7-1).

Concentrations of total phosphorus in water in the Sabine River basin ranged from 0.01 mg/L at several sites to 2.5 mg/L at Bayou San Patricio near Benson and generally were lower at sites in Anacoco Lake than at other sites in the basin. The lowest median and minimum phosphorus concentrations in water from the basin (0.03 and 0.01 mg/L) were at one of the sites at Anacoco Lake. Boxplots for six representative sites show that phosphorus concentrations in 75 percent of all samples analyzed were less than 0.2 mg/L, and median concentrations were less than 0.15 mg/L at all of these sites (fig. 2.2.7-1).

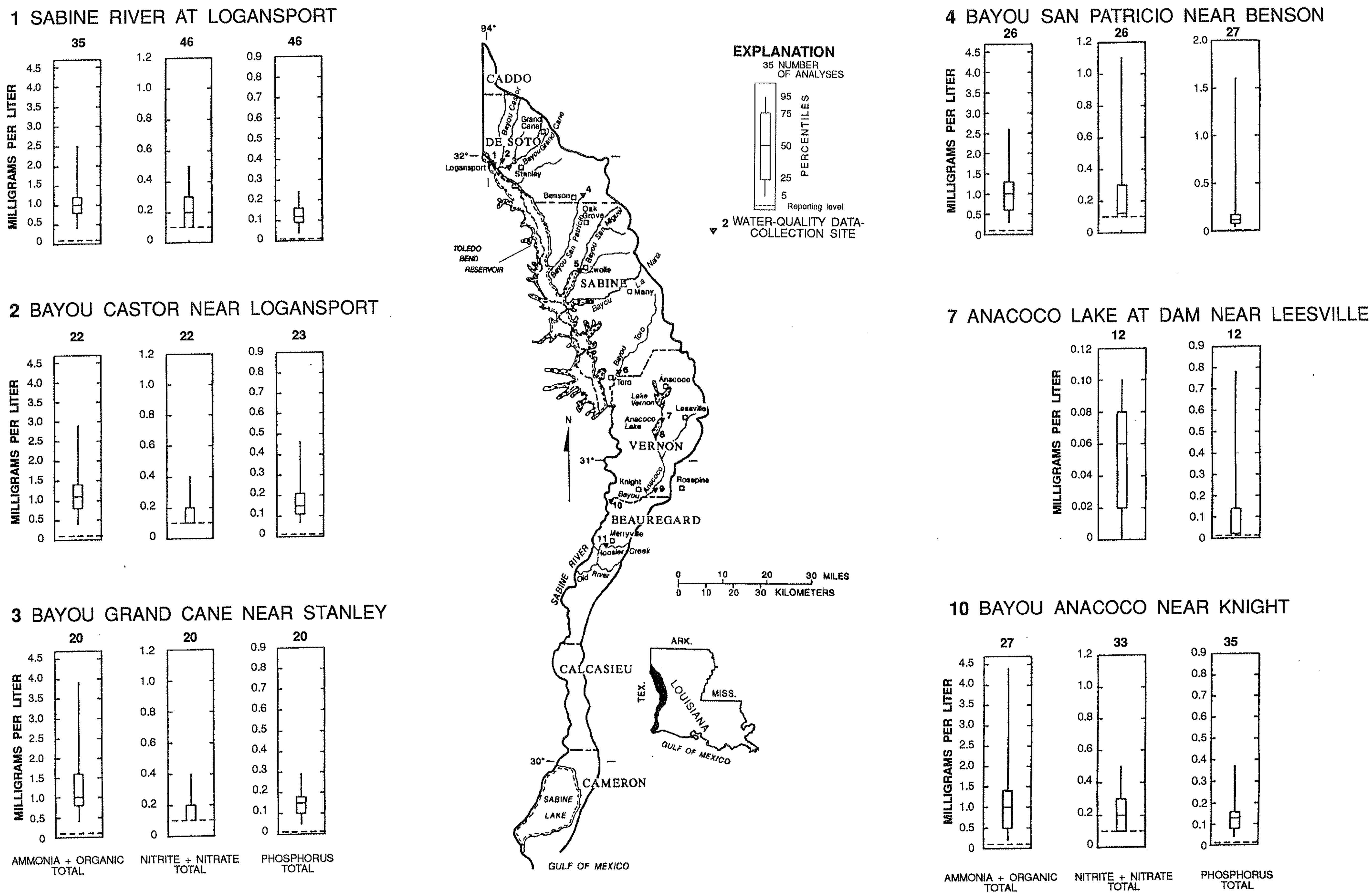


Figure 2.2.7-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots summarizing data for concentrations of selected nutrients in water from selected sites.

2.2.8 Organic Compounds--Pesticides and PCB's

FOUR ORGANIC COMPOUNDS DETECTED IN SURFACE WATERS IN THE BASIN

The most commonly occurring organic compounds in the Sabine River basin were diazinon and 2,4-D.

Diazinon was detected at more sites and with greater frequency than any of the other organic compounds that were analyzed, with the exception of 2,4-D. The highest diazinon concentration was 0.11 µg/L in a sample collected at Bayou San Patricio near Benson. Diazinon was detected at least once at six of the nine sites for which water samples were analyzed for organic compounds. Tables rather than boxplots are used to summarize occurrences of diazinon at six representative sites in figure 2.2.8-1, because the total number of samples analyzed for each site was less than 10 or the number of samples that contained diazinon in concentrations greater than the reporting level was less than 10. Of these six sites, the only site where diazinon was not detected at least once was at Bayou Anacoco near Rosepine, where only one sample was analyzed.

The herbicide 2,4-D was detected at every site for which water samples were analyzed for organic compounds except at Anacoco Lake at the dam near Leesville. The maximum concentration of 2,4-D in water from the basin was 0.90 µg/L, at Bayou Anacoco near Rosepine, where only one sample was analyzed for organic compounds. The tables listing the number of samples in which organic compounds were detected for six representative sites in the basin indicate that 2,4-D was detected in at least 10 percent of the samples collected at these sites (fig. 2.2.8-1).

Dieldrin and DDT also were detected in one water sample collected from Bayou Grand Cane near Stanley. Dieldrin was detected at a concentration of 0.03 µg/L and DDT was detected at a concentration of 0.01 µg/L in that sample.

1 SABINE RIVER NEAR LOGANSPORT

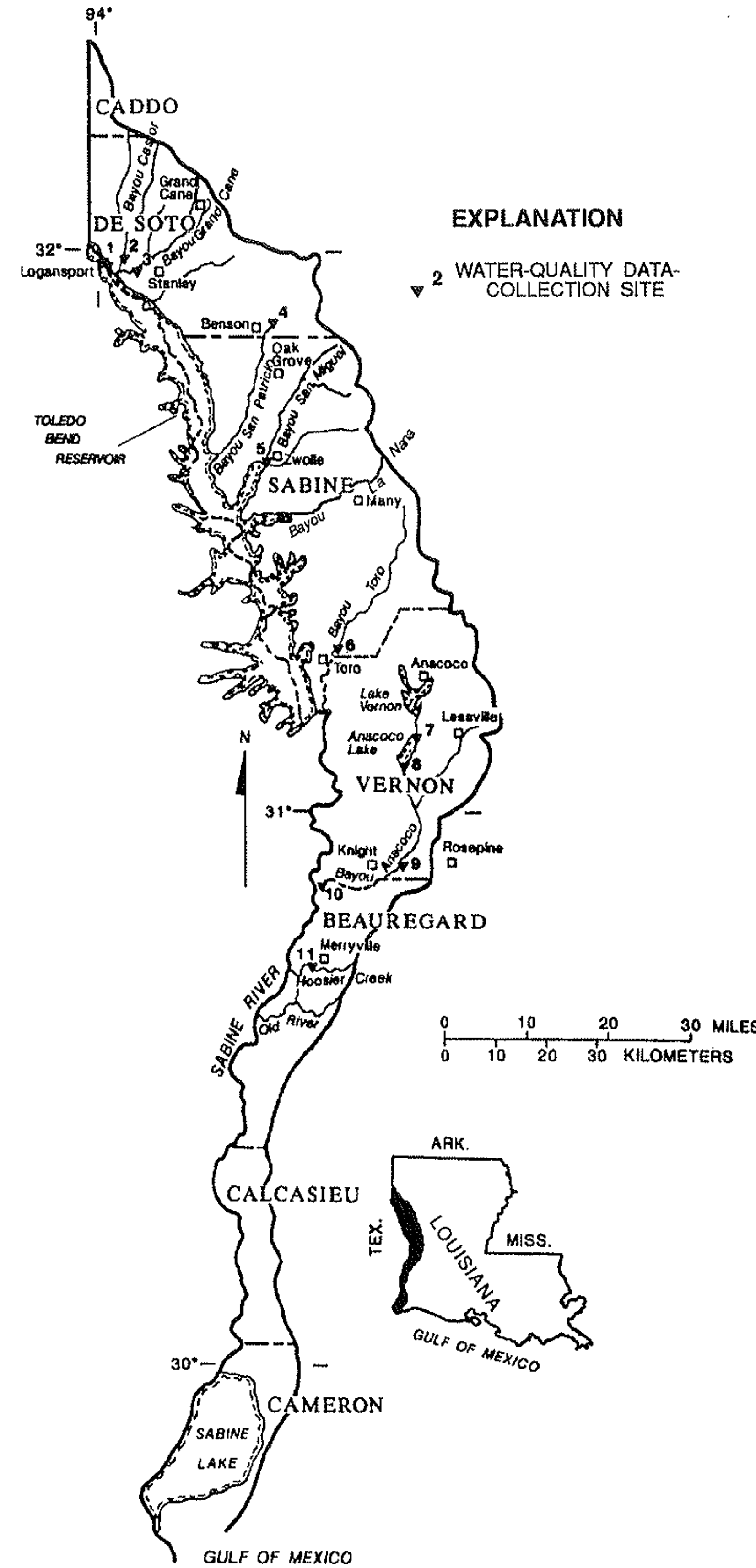
ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	12	0.01	0
PCB	12	0.1	0
DIAZINON	12	0.01	5
LINDANE	12	0.01	0
CHLORDANE	12	0.1	0
MALATHION	12	0.01	0
ENDRIN	12	0.01	0
PARATHION	12	0.01	0
DIELDRIN	12	0.01	0
ENDOSULFAN	7	0.01	0
2, 4-D	12	0.01	4

2 BAYOU CASTOR NEAR LOGANSPORT

ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	6	0.01	0
PCB	6	0.1	0
DIAZINON	6	0.01	2
LINDANE	6	0.01	0
CHLORDANE	6	0.1	0
MALATHION	6	0.01	0
ENDRIN	6	0.01	0
PARATHION	6	0.01	0
DIELDRIN	6	0.01	0
ENDOSULFAN	6	0.01	0
2, 4-D	6	0.01	1

3 BAYOU GRAND CANE NEAR STANLEY

ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	6	0.01	1
PCB	6	0.1	0
DIAZINON	6	0.01	1
LINDANE	6	0.01	0
CHLORDANE	7	0.1	0
MALATHION	6	0.01	0
ENDRIN	6	0.01	0
PARATHION	6	0.01	0
DIELDRIN	6	0.01	1
ENDOSULFAN	6	0.01	0
2, 4-D	6	0.01	2



4 BAYOU SAN PATRICIO NEAR BENSON

ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	9	0.01	0
PCB	8	0.1	0
DIAZINON	9	0.01	3
LINDANE	9	0.01	0
CHLORDANE	9	0.1	0
MALATHION	9	0.01	0
ENDRIN	9	0.01	0
PARATHION	9	0.01	0
DIELDRIN	9	0.01	0
ENDOSULFAN	7	0.01	0
2, 4-D	9	0.01	6

9 BAYOU ANACOCO NEAR ROSEPINE

ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	1	0.0	0
PCB	1	0.1	0
DIAZINON	1	0.0	0
LINDANE	1	0.0	0
CHLORDANE	1	0.0	0
MALATHION	1	0.0	0
ENDRIN	1	0.0	0
PARATHION	1	0.0	0
DIELDRIN	1	0.0	0
ENDOSULFAN	1	0.01	0
2, 4-D	1	0.01	1

10 BAYOU ANACOCO NEAR KNIGHT

ORGANIC COMPOUND TOTAL	TOTAL NUMBER OF ANALYSES	REPORTING LEVEL (µg/L)	NUMBER OF ANALYSES AT OR ABOVE REPORTING LEVEL
DDT	17	0.01	0
PCB	17	0.1	0
DIAZINON	15	0.01	5
LINDANE	17	0.01	0
CHLORDANE	17	0.1	0
MALATHION	15	0.01	0
ENDRIN	17	0.01	0
PARATHION	15	0.01	0
DIELDRIN	17	0.01	0
ENDOSULFAN	12	0.01	0
2, 4-D	16	0.01	2

Figure 2.2.8-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and tables listing organic compounds detected in water from selected sites.

2.2.9 Biological Constituents--Fecal Coliform and Fecal Streptococcus Bacteria

FECAL-COLIFORM AND FECAL-STREPTOCOCCUS BACTERIA CONCENTRATIONS VARIED GREATLY THROUGHOUT THE BASIN

Bacteria concentrations indicated a unique condition at Bayou Anacoco.

Concentrations of fecal-coliform bacteria varied greatly at the nine sites in the Sabine River basin for which data are available. Concentrations ranged from less than 5 cols/100 mL at both sites at Anacoco Lake, Bayou Anacoco near Knight, and Bayou Grand Cane near Stanley to 36,000 cols/100 mL at Anacoco Lake at the dam near Leesville. Median concentrations ranged from less than 5 to 250 cols/100 mL. Although fecal-coliform concentrations exceeded 200 cols/100 mL some of the time at most of the sites, additional data are needed to determine if the U.S. Environmental Protection Agency's (1976; 1986) maximum contaminant level is being exceeded. Boxplots of fecal coliform and fecal streptococcus bacteria concentrations at six representative sites in the basin show that at least 75 percent of all samples analyzed had fecal coliform concentrations of less than 500 cols/100 mL, and most of the samples collected at Bayou Grand Cane near Stanley had concentrations less than 200 cols/100 mL (fig. 2.2.9-1).

Concentrations of fecal-streptococcus bacteria also varied greatly at sites in the basin. Concentrations ranged from less than 5 cols/100 mL at Upper Anacoco Lake near Leesville to 13,000 cols/100 mL at Bayou Anacoco near Knight. Median fecal-streptococcus concentrations, which ranged from 72 to 670 cols/100 mL, generally were higher than the median fecal-coliform concentrations. Boxplots of fecal streptococcus concentrations at six representative sites show that 75 percent of the samples analyzed had concentrations less than 2,000 cols/100 mL, and most of the analyses at Bayou Anacoco near Rosepine were less than 1,400 cols/100 mL (fig. 2.2.9-1).

The median ratio of fecal-coliform to fecal-streptococcus bacteria was less than 0.7 at most of the sites sampled for analysis of bacteria concentrations within the Sabine River basin, indicating that sources of fecal-coliform bacteria probably were livestock or poultry wastes. However, the median ratios for Bayou Anacoco at Rosepine and Bayou Anacoco near Knight were 2.0 and 2.3, possibly indicating that the fecal bacteria at these sites might be attributed to human and animal waste (Millipore Corporation, 1972, p. 36). Additional study is needed to confirm these results.

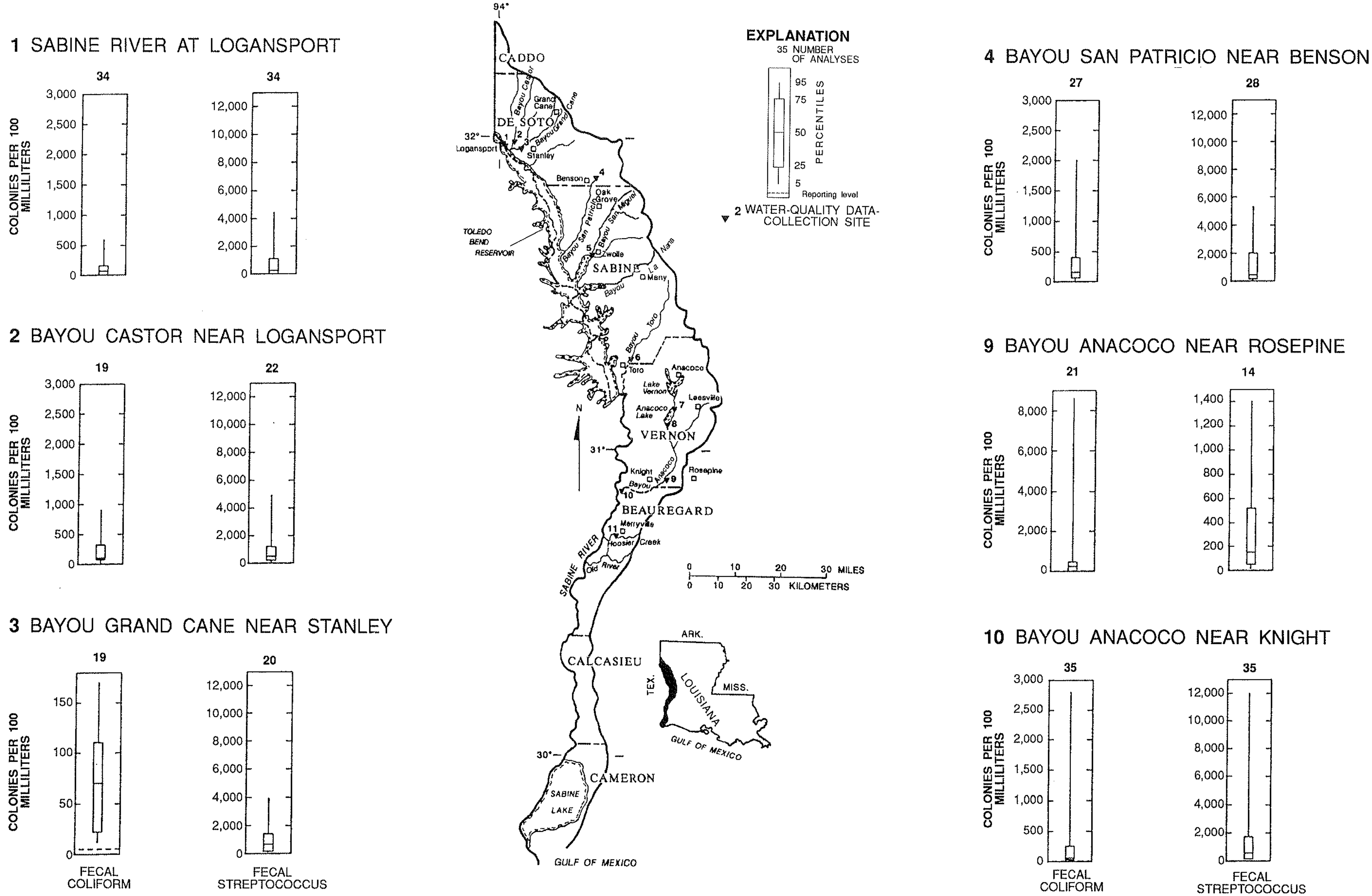


Figure 2.2.9-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and boxplots summarizing data for concentrations of fecal-coliform and fecal-streptococcus bacteria in water from selected sites.

2.2.10 Suspended Sediment

SUSPENDED-SEDIMENT DATA WERE EVALUATED FOR THREE SITES

The maximum daily mean suspended-sediment concentration was 852 mg/L for a water discharge of 39 ft^3/s at Bayou San Patricio near Benson.

Daily mean suspended-sediment data were available for two or more water years during the period 1981-85 at Bayou Castor near Logansport, Bayou Grand Cane near Stanley, and Bayou San Patricio near Benson. Daily suspended-sediment data were available for water years 1981-85 at Bayou San Patricio near Benson, for water years 1981-84 at Bayou Grand Cane near Stanley, and for water years 1983-84 at Bayou Castor near Logansport. The minimum and maximum daily mean suspended-sediment concentrations, daily mean suspended-sediment discharge, and corresponding streamflow for the three sites are shown in figure 2.2.10-1.

Maximum daily mean suspended-sediment concentrations were less than 400 mg/L at sites on Bayou Castor and Bayou Grand Cane but exceeded 850 mg/L at the site on Bayou San Patricio in water year 1982. The calculated maximum daily mean suspended-sediment discharge at the site on Bayou San Patricio during the 1982 water year (2,820 t/d) was four to five times greater than maximum daily mean suspended-sediment discharges at the other sites. The maximum daily mean concentration at the Bayou San Patricio site was more than four times greater in water year 1982 than in other water years. The causes for this high maximum daily mean concentration in water year 1982 is unknown.

Daily mean suspended-sediment discharges ranged from 0 t/d at all three sites when there was no flow to 2,820 t/d at Bayou San Patricio near Benson when the discharge was 2,640 ft^3/s. The maximum daily mean suspended-sediment discharge at the Bayou San Patricio site represents a maximum daily mean suspended-sediment discharge of 35 t/d.

2 BAYOU CASTOR NEAR LOGANSPORT

[Drainage area is 96.5 square miles; mg/L, milligrams per liter; t/day, tons per day; --, total not computed]

Water year	Concentration		Sediment discharge		
	Minimum daily mean (mg/L)	Maximum daily mean (mg/L)	Minimum daily mean (t/day)	Maximum daily mean (t/day)	Yearly total (t/day)
1983	20 (46)[1]	214 (224)[1]	0	507 (1,220)[1]	-
1984	0	320 (458)[1]	0	460 (1,320)[1]	-

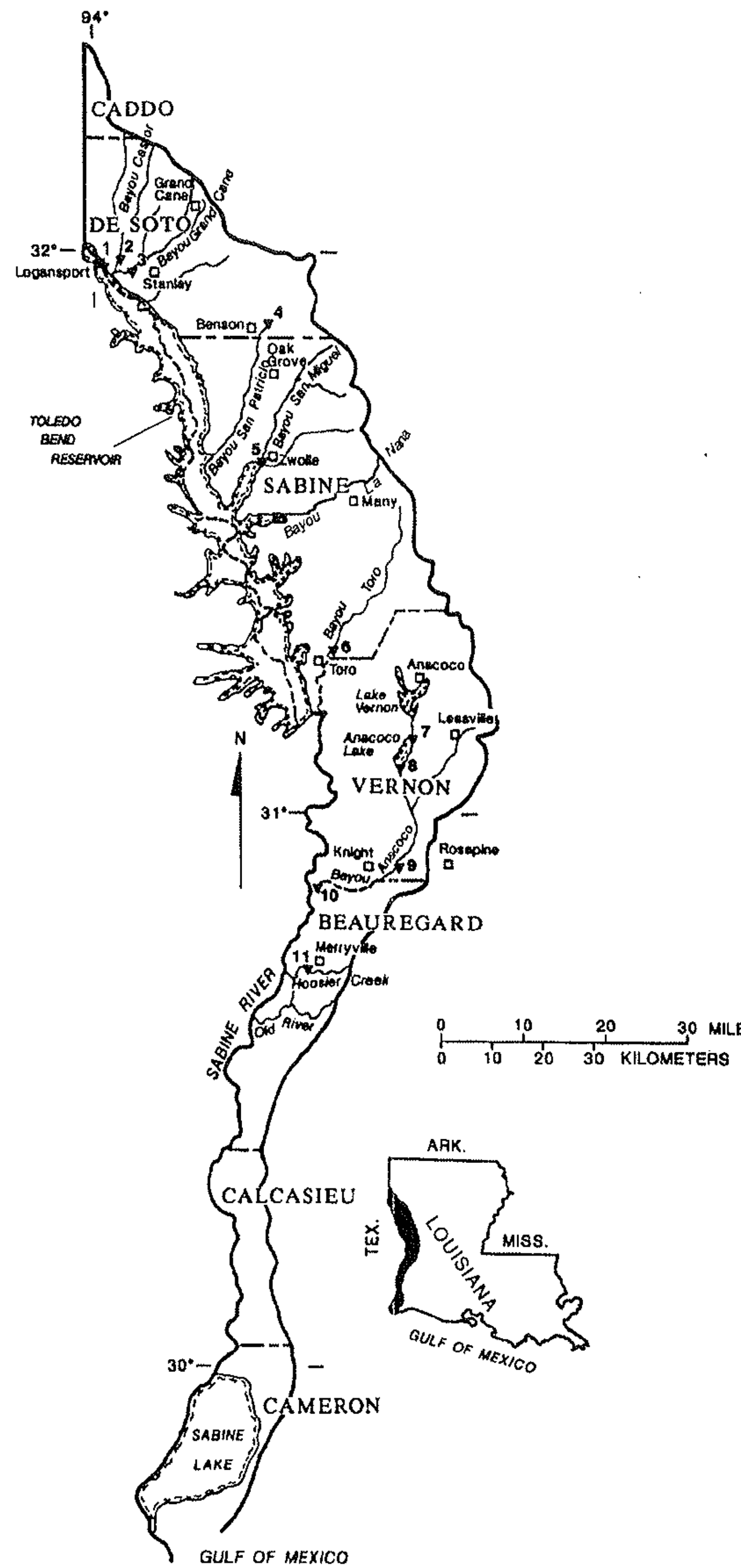
[1]Number in parentheses is the corresponding daily mean water discharge, in cubic feet per second.

3 BAYOU GRAND CANE NEAR STANLEY

[Drainage area is 27.5 square miles; mg/L, milligrams per liter; t/day, tons per day; --, total not computed]

Water year	Concentration		Sediment discharge		
	Minimum daily mean (mg/L)	Maximum daily mean (mg/L)	Minimum daily mean (t/day)	Maximum daily mean (t/day)	Yearly total (t/day)
1981	16 (0.28)[1]	236 (126)[1]	0	259 (1,810)[1]	-
1982	0	372 (1.1)[1]	0	583 (1,220)[1]	3,850
1983	0	264 (86)[1]	0	482 (1,900)[1]	8,980
1984	0	171 (533)[1]	0	454 (2,130)[1]	2,340

[1]Number in parentheses is the corresponding daily mean water discharge, in cubic feet per second.



4 BAYOU SAN PATRICIO NEAR BENSON

[Drainage area is 80.2 square miles; mg/L, milligrams per liter; t/day, tons per day; --, total not computed]

Water year	Concentration		Sediment discharge		
	Minimum daily mean (mg/L)	Maximum daily mean (mg/L)	Minimum daily mean (t/day)	Maximum daily mean (t/day)	Yearly total (t/day)
1981	8 (1.4)[1]	94 (124)[1]	0	44 (355)[1]	-
1982	0	852 (39)[1]	0	2,820(2,640)[1]	-
1983	0	75 (0.75)[1]	0	560 (6,100)[1]	-
1984	0	208 (141)[1]	0	320 (3,200)[1]	-
1985	0	126 (78)[1]	0	212 (575)[1]	-

[1]Number in parentheses is the corresponding daily mean water discharge, in cubic feet per second.

EXPLANATION

▼ 2 WATER-QUALITY DATA-COLLECTION SITE

Figure 2.2.10-1. Water-quality data-collection sites in the Sabine River basin, Louisiana, and tables summarizing suspended-sediment concentrations and suspended-sediment discharges at selected sites.

2.3 Summary and Conclusions

ADDITIONAL WATER-QUALITY DATA NEEDED IN THE SABINE RIVER BASIN IN LOUISIANA

Few data on trace-metals, nutrients, and organic chemicals are available for streams in the basin.

The Sabine River basin in Louisiana lies in the western part of the State along the boundary between Louisiana and Texas. The basin has a total drainage area of 20,944 square miles, of which about 2,529 square miles are within Louisiana. That part of the basin within Louisiana is about 190 miles long and 25 miles wide at its widest point. The streams, rivers, lakes, and a reservoir in the basin provide water for recreation, industrial use, power generation, and public supply. The Sabine River and Toledo Bend Reservoir, which was completed in 1968 by impounding the Sabine River, are the largest sources of surface water in the basin.

Water quality in the Sabine River basin in Louisiana was investigated as part of a statewide investigation to evaluate water-quality conditions in the major surface-water drainage basins in Louisiana. The water-quality conditions in the Sabine River basin were evaluated using data collected from 11 sites during the water years 1952-85. Data for 32 water-quality properties and constituents from water-quality analyses stored in the U.S. Geological Survey's Water-Data Storage and Retrieval System (WATSTORE), a computerized data base, were used for the evaluation.

The data were statistically analyzed and summarized for eight categories of water-quality properties and constituents: (1) physical properties--specific conductance, pH, water temperature, and dissolved oxygen; (2) major inorganic cations--dissolved calcium, magnesium, sodium, and potassium; (3) major inorganic anions--total alkalinity as calcium carbonate, dissolved sulfate, and dissolved chloride; (4) trace metals--dissolved copper, iron, lead, and zinc; (5) selected nutrients--nitrogen and phosphorus constituents; (6) organic compounds--pesticides and PCB's; (7) biological constituents--fecal coliform and fecal streptococcus bacteria; and (8) suspended sediment.

The physical properties varied for waters in the basin. The median values for specific conductance ranged from 54 μS/cm (microsiemens per centimeter at 25 degrees Celsius) at Bayou Anacoco near Rosepine, Louisiana, to 322 μS/cm at Sabine River at Logansport, Louisiana, which indicated low concentrations of dissolved solids. For pH, 90 percent of the measured values were between 6.5 and 8.5 and were within the U.S. Environmental Protection Agency's recommended range for domestic water supply. Median values for water temperature ranged from 17.0 °C (degrees Celsius) at Bayou Castor near Logansport to 23.6 °C at Bayou Anacoco near Rosepine.

Dissolved-oxygen concentrations exceeded the State's minimum water quality criterion of 5 mg/L (milligrams per liter) in more than 75 percent of the samples analyzed for most sites. However, the statistical data indicated that more than 50 percent of the samples collected at Bayou Castor near Logansport, Louisiana, and Bayou Grand Cane near Stanley, Louisiana, had dissolved oxygen concentrations of less than 5.0 mg/L. The low concentrations possibly were due to low flow and occasional pooling of water in these bayous.

The data for major inorganic cations and anions in water from the basin indicated that concentrations of major ions were well below recommended levels for drinking water, where such levels have been established. However, the concentrations of inorganic ions in Bayou Anacoco increased in the reach between the site near Rosepine and the downstream site near Knight, Louisiana. Bayou Anacoco near Knight had consistently higher concentrations of inorganic chemical constituents, indicating an inflow into the bayou somewhere between the two sites. The median concentrations for sodium, sulfate, and chloride at Bayou Anacoco near Rosepine were 4.0, 3.6, and 5.4 mg/L. The median concentrations for sodium, sulfate, and chloride at Bayou Anacoco near Knight were 36, 40, and 19 mg/L. Additional data collection and analysis are needed to identify the cause for the increased mineralization in this reach of Bayou Anacoco.

Little trace-metal, nutrient, organic-chemical, biological, and suspended-sediment data were available for the Sabine River basin. The available data for trace metals, indicated that dissolved copper, lead, and zinc were less than the maximum contaminant levels of the U.S. Environmental Protection Agency's primary and secondary drinking water regulations. Iron concentrations in water from the basin often exceeded 300 micrograms per liter (µg/L), which is the criterion for domestic water supplies. However, iron concentrations were less than the agency's criterion of 1,000 µg/L for freshwater aquatic life. The median concentrations for total ammonia plus organic nitrogen as nitrogen were at or near 1.0 mg/L, and the median concentrations for total nitrite plus nitrate nitrogen were near the reporting level with no median concentration exceeding 0.2 mg/L. Median concentrations of phosphorus were 0.15 mg/L or less. Analysis of the available organic-chemical data indicated that concentrations of pesticides, except diazinon and 2, 4-D, rarely exceeded their reporting levels. Diazinon (maximum concentration, 0.11 µg/L) was detected at six of the nine sites for which data were available and 2,4-D (maximum concentration, 0.90 µg/L) was detected at eight of the nine sites. To more completely characterize surface water in the basin in relation to these constituents, additional data collection and analysis are needed.

The median ratios of fecal-coliform to fecal-streptococcus bacteria were less than 0.7 for most of the sites within the Sabine River basin, indicating that sources of fecal bacteria probably were predominantly livestock or poultry wastes. The median ratios of fecal-coliform to fecal-streptococcus bacteria at Bayou Anacoco near Rosepine (2.0) and Bayou Anacoco near Knight (2.3) indicated that the sources of fecal-coliform bacteria at these sites might include human and animal wastes. However, additional samples closer to the potential source of contamination need to be collected and analyzed to confirm these results.

Daily mean suspended-sediment data were available for two or more water years during the period 1981-85 at Bayou Castor near Logansport, Bayou Grand Cane near Stanley, and Bayou San Patricio near Benson. The data indicated that daily mean suspended-sediment discharges ranged from 0 tons per day at all three sites when there was no flow to 2,820 tons per day at Bayou San Patricio near Benson when the corresponding daily mean discharge was 2, 640 cubic feet per second. To completely describe sediment transport characteristics in the basin, a long-term suspended-sediment data collection program is needed.

3.0 SELECTED REFERENCES

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1993, Water Resources Data--Louisiana, water year 1992: U.S. Geological Survey Water-Data Report LA-92-1, 439 p.

Boyle, J.M., Covay, K.J., and Bauer, D.P., 1984, Quantity and quality of streamflow in the White River basin, Colorado and Utah: U.S. Geological Survey Water-Resources Investigations Report 84-4022, 84 p.

Britton, L.J., and Greeson, P.E., eds., 1988, Methods for collection and analysis of aquatic biological and microbiological samples: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A4, 685 p.

Fenneman, N.M., 1938, Physiography of eastern United States: New York, McGraw-Hill Book Company, 714 p.

Fishman, M.J., and Friedman, L.C., eds., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 545 p.

Hem, J.D., 1985, Study and interpretation of chemical characteristics of natural water (3d ed.): U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Hobba, W.A., Jr., 1981, Effects of underground mining and mine collapse on the hydrology of selected basins in West Virginia: West Virginia Geological and Economic Survey Report of Investigation RI-33, 77 p.

Hynes, H.B.N, 1970, The ecology of running waters: Toronto, University of Toronto Press, 555 p.

Langbein, W.B., and Schumm, S.A., 1958, Yield of sediment in relation to mean annual precipitation: American Geophysical Union Transactions, v. 39, no. 6, p. 1076-1084.

Lee, F.N., 1985a, Analysis of the low-flow characteristics of streams in Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report No. 35, 41 p.

-----1985b, Floods in Louisiana, magnitude, and frequency--Fourth edition: Louisiana Department of Transportation and Development Water Resources Technical Report No. 36, 30 p.

Louisiana Department of Environmental Quality, 1984, Louisiana water quality standards: Louisiana Department of Environmental Quality, Office of Water Resources, 55 p.

Louisiana Department of Transportation and Development, 1984, The Louisiana water resources study commission's report to the 1984 Legislature, Draft: Louisiana Department of Transportation and Development, 438 p.

Lovelace, J.K., 1991, Water use in Louisiana, 1990: Louisiana Department of Transportation and Development Water Resources Special Report No. 6, 131 p.

McKee, J.E., and Wolf, H.W., 1963, Water quality criteria (2d ed.): San Francisco, Calif., California State water resources control board, 548 p.

McWreath, H.C., III, and Lowe, A.S., 1986, Louisiana hydrologic atlas map no. 1: Mean annual runoff in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4149, map (1 sheet).

Millipore Corporation, 1972, Biological analysis of water and wastewater: Bedford, Mass., Millipore Corporation, 81 p.

National Academy of Sciences, National Academy of Engineering, 1974, Water quality criteria, 1972: Washington, D.C., U.S. Government Printing Office, 594 p.

Odum, E.P., 1971, Fundamentals of ecology (3d ed.): Philadelphia, Pa., W.B. Sanders Company, 574 p.

Rainwater, F.H., and Thatcher, L.L., 1960, Methods for collection and analysis of water samples: U.S. Geological Survey Water-Supply Paper 1454, 301 p.

Snider, J.L., and Covay, K.J., 1987, Premining hydrology of the Logansport lignite area, De Soto Parish, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report No. 41, 65 p.

Sokal, R.R, and Rohlf, F.J., 1969, Biometry: San Francisco, Calif., W.H. Freeman and Company, 776 p.

Tobin, R.L., and Youger, J.D., 1977, Limnology of selected lakes in Ohio-1975: U.S. Geological Survey Water-Resources Investigations 77-105, 205 p.

U.S. Environmental Protection Agency, 1976, Quality criteria for water: Washington, D.C., U.S. Environmental Protection Agency, 256 p.

-----1986, Quality criteria for water: Washington, D.C., U.S. Environmental Protection Agency.

U.S. Federal Water Pollution Control Administration, 1968, Report of the committee on water-quality criteria: Washington D.C., 234 p.

U.S. Geological Survey, 1986, National Water Summary 1985 -- Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 p.

-----1993, National water summary 1990-91 -- Hydrologic events and stream water quality: U.S. Geological Survey Water-Supply Paper 2400, 590 p.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E. eds., 1983, Methods for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, Laboratory analysis, chap. A3, U.S. Geological Survey Open-File Report 82-1004, 180 p.

TABLE 2.2-1. STATISTICAL SUMMARY OF WATER-QUALITY DATA FOR THE SABINE RIVER BASIN IN LOUISIANA, 1952-85

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85

[Water temperature is in degrees Celsius, specific conductance is in microsiemens per centimeter at 25 degrees Celsius, and other units are given; <, less than]

Anacoco Lake at dam near Leesville, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles: 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	14	(a)	(a)	51	30	39	30	34	38	42	51
pH (standard units)	14	(a)	(a)	6.9	5.3	6.3	5.3	6.2	6.4	6.6	6.9
Water temperature	12	(a)	(a)	31.5	7.0	19.8	7.0	14.5	17.8	27.8	31.5
Dissolved oxygen (milligrams per liter)	11	(a)	(a)	10.8	7.6	9.0	7.6	8.5	8.8	9.9	10.8
Dissolved solids (milligrams per liter)	13	(a)	(a)	52	33	40	33	35	39	44	52
Major cations (milligrams per liter)											
Calcium, dissolved	13	0.01	13	5.4	2.1	3.2	2.1	2.6	3.0	3.5	5.4
Magnesium, dissolved	13	.01	13	1.4	.40	.68	.40	.55	.60	.75	1.4
Sodium, dissolved	13	.01	13	3.9	1.6	2.8	1.6	2.3	2.9	3.2	3.9
Potassium, dissolved	13	.01	13	1.5	.90	1.2	.90	1.1	1.3	1.4	1.5
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	14	1	14	15	4	9	4	7	8	11	15
Sulfate, dissolved	13	.1	13	5.9	1.2	3.5	1.2	2.0	3.3	4.8	5.9
Chloride, dissolved	13	.1	13	7.0	3.0	4.0	3.0	3.3	3.9	4.4	7.0
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	9	0.1	9	1.6	0.05	(b)	(b)	(b)	(b)	(b)	(b)
Nitrogen, nitrite plus nitrate, total as nitrogen	12	.1	1	.1	<.1	(c)	<0.1	<0.1	<0.1	<0.1	0.1
Phosphorus, total as phosphorus	12	.01	12	.10	.01	0.04	.01	.02	.03	.04	.10

Anacoco Lake at dam near Leesville, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	8	5	7	36,000	<5	(b,c)	(b)	(b)	(b)	(b)	(b)
Fecal streptococcus	7	1	7	4,000	15	(b)	(b)	(b)	(b)	(b)	(b)
Trace metals (micrograms per liter)											
Copper, dissolved	3	1	3	3	1	(b)	(b)	(b)	(b)	(b)	(b)
Iron, dissolved	3	10	3	130	40	(b)	(b)	(b)	(b)	(b)	(b)
Lead, dissolved	3	1	2	2	<1	(b,c)	(b)	(b)	(b)	(b)	(b)
Zinc, dissolved	3	20	0	<20	<20	(b,c)	(b)	(b)	(b)	(b)	(b)
Organic compounds (micrograms per liter)											
DDT, total	3	0.01	0	<0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	3	.01	1	.03	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	2	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou Anacoco near Knight, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	113	(a)	(a)	841	34	274	47	109	233	384	653
pH (standard units)	114	(a)	(a)	7.8	5.7	6.8	6.1	6.6	6.9	7.1	7.5
Water temperature	107	(a)	(a)	32.5	2.5	20.0	7.6	15.0	20.0	26.0	29.0
Dissolved oxygen (milligrams per liter)	106	(a)	(a)	12.0	4.2	7.7	5.5	6.5	7.4	8.6	11.0
Dissolved solids (milligrams per liter)	110	(a)	(a)	569	32	194	43	96	169	270	460
Major cations (milligrams per liter)											
Calcium, dissolved	106	0.01	106	22	2.2	7.8	3.2	4.8	7.0	10	17
Magnesium, dissolved	106	.01	106	3.8	.10	1.2	.40	.70	1.2	1.6	2.4
Sodium, dissolved	108	.01	108	170	2.6	46	3.7	16	36	69	120
Potassium, dissolved	108	.01	108	6.0	.90	2.6	1.2	1.7	2.2	3.4	5.0
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	112	1	112	142	7	40	10	17	33	56	106
Sulfate, dissolved	113	.1	113	170	.6	50	3.4	14	40	78	140
Chloride, dissolved	114	.1	114	73	2.6	23	4.5	8.9	19	33	59
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	27	0.1	27	4.9	0.2	1.2	0.2	0.5	1.0	1.4	4.4
Nitrogen, nitrite plus nitrate, total as nitrogen	33	.1	27	.6	<.1	(c)	<.1	.1	.2	.3	.5
Phosphorus, total as phosphorus	35	.01	34	.50	.01	.14	.04	.08	.13	.16	.37

Bayou Anacoco near Knight, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	35	5	33	12000	<5	(c)	<5	30	56	250	2,800
Fecal streptococcus	32	1	32	13,000	10	1,800	48	170	550	1,700	12,000
Trace metals (micrograms per liter)											
Copper, dissolved	17	2	17	8	2	4	2	2	4	5	8
Iron, dissolved	17	10	17	570	90	290	90	200	280	360	570
Lead, dissolved	18	10	1	10	<10	(c)	<10	<10	<10	<10	10
Zinc, dissolved	18	20	8	110	<20	(c)	<20	<20	<20	20	110
Organic compounds (micrograms per liter)											
DDT, total	17	0.01	0	<0.01	<0.01	(c)	<0.01	<0.01	<0.01	<0.01	<0.01
PCB, total	17	.1	0	<.1	<.1	(c)	<.1	<.1	<.1	<.1	<.1
Diazinon, total	15	.01	5	.05	<.01	(c)	<.01	<.01	<.01	.01	.05
Lindane, total	17	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Chlordane, total	17	.1	0	<.1	<.1	(c)	<.1	<.1	<.1	<.1	<.1
Malathion, total	15	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Endrin, total	17	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Parathion, total	15	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Dieldrin, total	17	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Endosulfan, total	12	.01	0	<.01	<.0	(c)	<.01	<.01	<.01	<.01	<.01
2,4-D, total	16	.01	2	.03	<.01	(c)	<.01	<.01	<.01	<.01	<.01

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou Anacoco near Rosepine, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	55	(a)	(a)	162	30	65	38	47	54	79	124
pH (standard units)	56	(a)	(a)	7.4	5.2	6.5	5.6	6.2	6.6	6.8	7.3
Water temperature	39	(a)	(a)	29.0	8.5	20.9	8.5	13.5	23.0	27.5	28.0
Dissolved oxygen (milligrams per liter)	32	(a)	(a)	12.7	5.8	7.9	5.9	6.8	7.4	8.7	11.6
Dissolved solids (milligrams per liter)	53	(a)	(a)	120	36	60	38	47	56	66	103
Major cations (milligrams per liter)											
Calcium, dissolved	54	0.01	54	14	2.2	5.6	2.3	3.9	5.0	6.4	12
Magnesium, dissolved	54	.01	54	2.2	<.10	(c)	.10	.60	.90	1.0	1.8
Sodium, dissolved	53	.01	53	20	2.0	5.1	2.1	3.0	4.0	5.7	14
Potassium, dissolved	52	.01	52	6.2	.30	1.5	.70	1.1	1.3	1.7	3.0
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	55	1	55	45	3	17	6	11	15	22	33
Sulfate, dissolved	56	.1	56	12	.2	3.4	1.1	2.2	3.3	4.4	6.8
Chloride, dissolved	55	.1	55	32	1.7	6.3	2.6	4.2	5.4	7.0	14
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	21	1	21	9,000	27	1,000	28	52	250	460	8,600
Fecal streptococcus	14	1	14	1,600	10	360	10	50	150	520	1,400

Bayou Anacoco near Rosepine, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles					
							5th	25th	50th (median)	75th	95th
Organic compounds (micrograms per liter)												
DDT, total	1	0.01	0	<0.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	1	.1	0	<.1	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	1	.01	1	.90	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou Castor near Logansport, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles				
							5th	25th	50th (median)	75th	95th
Physical Properties											
Specific conductance	25	(a)	(a)	422	98	208	106	160	213	242	385
pH (standard units)	25	(a)	(a)	7.3	5.8	6.6	5.9	6.3	6.6	7.0	7.3
Water temperature	25	(a)	(a)	30.0	3.0	17.2	4.5	11.2	17.0	21.8	29.4
Dissolved oxygen (milligrams per liter)	21	(a)	(a)	10.9	1.2	5.1	1.2	3.0	4.4	8.0	10.8
Dissolved solids (milligrams per liter)	25	(a)	(a)	187	80	135	81	108	137	156	186
Major cations (milligrams per liter)											
Calcium, dissolved	25	0.01	25	17	4.8	11	5.5	9.9	11	13	17
Magnesium, dissolved	25	.01	25	7.4	2.4	4.9	2.5	4.1	4.9	5.7	7.3
Sodium, dissolved	25	.01	25	32	7.8	19	8.3	14	18	24	32
Potassium, dissolved	25	.01	25	8.4	.70	4.2	1.1	2.6	4.7	5.2	7.8
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	25	1	25	73	15	41	16	28	41	54	71
Sulfate, dissolved	25	.1	25	46	3.6	17	3.8	8.1	14	26	43
Chloride, dissolved	25	.1	25	46	10	24	10	15	23	32	45
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	20	0.1	20	3.0	0.4	1.2	0.5	0.8	1.1	1.4	2.9
Nitrogen, nitrite plus nitrate, total as nitrogen	20	.1	14	.4	<.1	(c)	<.1	<.1	.1	.2	.4
Phosphorus, total as phosphorus	21	.01	21	.50	.07	.17	.07	.11	.15	.21	.48

Bayou Castor near Logansport, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	18	1	18	900	30	240	30	85	110	330	900
Fecal streptococcus	20	1	20	5,200	60	1,000	63	240	500	1,300	5,100
Trace metals (micrograms per liter)											
Copper, dissolved	9	1	7	9	<1	(b,c)	(b)	(b)	(b)	(b)	(b)
Iron, dissolved	8	10	8	740	240	(b)	(b)	(b)	(b)	(b)	(b)
Lead, dissolved	9	10	0	<10	<10	(b,c)	(b)	(b)	(b)	(b)	(b)
Zinc, dissolved	9	1	9	50	5	(b)	(b)	(b)	(b)	(b)	(b)
Organic compounds (micrograms per liter)											
DDT, total	6	0.01	0	<0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	6	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	6	.01	2	.03	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	6	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	6	.01	1	.08	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou Grand Cane near Stanley, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
				Physical properties							
Specific conductance	20	(a)	(a)	320	91	206	92	144	217	256	320
pH (standard units)	20	(a)	(a)	7.1	5.8	6.4	5.8	6.1	6.5	6.6	7.1
Water temperature	20	(a)	(a)	29.5	7.5	18.1	7.6	15.5	17.8	22.8	29.4
Dissolved oxygen (milligrams per liter)	20	(a)	(a)	11.0	.8	5.0	.8	3.2	4.2	7.7	10.9
Dissolved solids (milligrams per liter)	20	(a)	(a)	214	67	139	68	111	146	172	213
				Major cations (milligrams per liter)							
Calcium, dissolved	20	0.01	20	19	5.3	11	5.4	9.4	12	14	19
Magnesium, dissolved	20	.01	20	9.1	2.0	5.2	2.0	4.0	5.2	6.3	9.0
Sodium, dissolved	20	.01	20	31	6.1	19	6.2	13	20	25	31
Potassium, dissolved	20	.01	20	6.4	2.2	4.3	2.2	3.4	4.4	5.0	6.4
				Major anions (milligrams per liter)							
Alkalinity, total as $CaCO_3$	20	1	20	84	17	38	17	25	36	45	83
Sulfate, dissolved	20	.1	20	81	.9	23	1.0	9.0	20	34	80
Chloride, dissolved	20	.1	20	44	6.9	23	7.0	15	22	32	44
				Nutrients (milligrams per liter)							
Nitrogen, ammonia plus organic, total as nitrogen	20	0.1	20	3.9	0.4	1.3	0.4	0.8	1.0	1.6	3.9
Nitrogen, nitrite plus nitrate, total as nitrogen	20	.1	10	.4	<.1	(c)	<.1	<.1	<.1	.2	.4
Phosphorus, total as phosphorus	20	.01	20	.29	.05	.15	.05	.10	.15	.18	.29

Bayou Grand Cane near Stanley, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	19	5	18	170	<5	(c)	12	22	70	110	170
Fecal streptococcus	20	1	20	4,000	40	950	41	150	670	1,400	3,900
Trace metals (micrograms per liter)											
Copper, dissolved	7	1	6	12	<1	(b,c)	(b)	(b)	(b)	(b)	(b)
Iron, dissolved	7	10	7	720	320	(b)	(b)	(b)	(b)	(b)	(b)
Lead, dissolved	7	1	5	5	<1	(b,c)	(b)	(b)	(b)	(b)	(b)
Zinc, dissolved	7	1	7	22	6	(b)	(b)	(b)	(b)	(b)	(b)
Organic compounds (micrograms per liter)											
DDT, total	6	0.01	1	0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	6	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	6	.01	1	.02	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	7	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	6	.01	1	.03	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	6	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	6	.01	1	.04	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou San Miguel southwest of Zwolle, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	13	(a)	(a)	210	61	135	61	80	148	184	210
pH (standard units)	13	(a)	(a)	7.5	5.5	5.6	5.5	6.2	6.7	7.2	7.5
Water temperature	13	(a)	(a)	32.5	5.0	19.7	5.0	9.2	22.0	30.0	32.5
Dissolved oxygen (milligrams per liter)	13	(a)	(a)	11.6	5.2	8.2	5.2	6.2	8.5	9.4	11.6
Dissolved solids (milligrams per liter)	13	(a)	(a)	130	56	89	56	66	86	104	130
Major cations (milligrams per liter)											
Calcium, dissolved	13	0.01	13	9.2	2.8	6.4	9.2	8.4	6.7	3.8	2.8
Magnesium, dissolved	13	.01	13	5.0	1.1	3.0	1.1	1.6	3.1	3.8	5.0
Sodium, dissolved	13	.01	13	21	5.3	14	5.3	7.5	17	19	21
Potassium, dissolved	13	.01	13	3.5	1.4	2.7	1.4	2.2	2.8	3.2	3.5
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	13	1	13	36	5	22	5	12	25	30	36
Sulfate, dissolved	13	.1	13	21	7.4	13	7.4	10	12	16	21
Chloride, dissolved	13	.1	13	31	6.8	17	6.8	9.8	16	24	31
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	9	0.1	9	2.2	.23	(b)	(b)	(b)	(b)	(b)	(b)
Nitrogen, nitrite plus nitrate, total as nitrogen	12	.01	12	.8	.01	0.06	0.01	0.01	0.04	0.08	0.18
Phosphorus, total as phosphorus	12	.01	12	.18	.02	.07	.02	.04	.07	.08	.18

Bayou San Miguel southwest of Zwolle, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles					
							5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)												
Fecal coliform	10	5	8	3,000	<5	(c)	<5	5	36	440	3,000
Fecal streptococcus	10	1	10	5,400	20	690	20	50	98	400	5,400
Trace metals (micrograms per liter)											
Copper, dissolved	3	1	3	4	3	(b)	(b)	(b)	(b)	(b)	(b)
Iron, dissolved	3	10	3	190	60	(b)	(b)	(b)	(b)	(b)	(b)
Lead, dissolved	3	3	2	3	<3	(b)	(b)	(b)	(b)	(b)	(b)
Zinc, dissolved	3	20	2	20	<20	(b)	(b)	(b)	(b)	(b)	(b)
Organic compounds (micrograms per liter)											
DDT, total	3	0.01	0	<0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	1	.01	0	<.01	(d)	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	3	.01	1	.03	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou San Patricio near Benson, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	30	(a)	(a)	254	44	150	54	114	152	186	240
pH (standard units)	30	(a)	(a)	7.2	5.4	6.4	5.6	6.1	6.4	6.7	7.2
Water temperature	28	(a)	(a)	32.5	5.0	17.9	5.0	11.9	17.8	23.9	30.5
Dissolved oxygen (milligrams per liter)	29	(a)	(a)	10.0	2.5	6.5	2.6	5.2	6.5	8.1	10.0
Dissolved solids (milligrams per liter)	29	(a)	(a)	163	50	107	53	84	107	129	156
Major cations (milligrams per liter)											
Calcium, dissolved	30	0.01	30	21	2.6	8.8	3.2	5.7	8.9	11	18
Magnesium, dissolved	30	.01	30	6.3	1.0	3.2	1.2	2.4	3.1	3.8	6.2
Sodium, dissolved	30	.01	30	29	3.4	13	4.2	9.0	12	16	26
Potassium, dissolved	29	.01	29	7.9	1.5	3.9	1.6	2.4	4.0	5.2	7.0
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	29	1	29	65	7	26	7	12	22	37	62
Sulfate, dissolved	30	.1	30	37	3.9	14	4.8	8.8	13	18	32
Chloride, dissolved	30	.1	30	32	4.6	17	5.3	11	16	23	30
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	26	0.1	26	3.0	0.3	1.1	0.3	0.6	1.0	1.3	2.6
Nitrogen, nitrite plus nitrate, total as nitrogen	26	.1	17	1.2	<.1	(c)	<.1	<.1	.12	.30	1.1
Phosphorus, total as phosphorus	27	.01	27	2.5	.04	.22	.05	.08	.12	.17	1.6

Bayou San Patricio near Benson, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	27	1	27	2,800	10	310	18	70	160	400	2,000
Fecal streptococcus	28	1	28	5,400	40	1,200	54	180	460	2,000	5,300
Trace metals (micrograms per liter)											
Copper, dissolved	10	2	6	9	<2	(c)	<2	<2	2	5	9
Iron, dissolved	10	10	10	910	180	530	180	400	530	640	910
Lead, dissolved	10	10	0	<10	<10	(c)	<10	<10	<10	<10	<10
Zinc, dissolved	10	10	10	30	10	19	10	14	18	23	30
Organic compounds (micrograms per liter)											
DDT, total	9	0.01	0	<0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	8	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	9	.01	3	.11	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	9	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	9	.1	0	<.1	<.1	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	9	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	9	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	9	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	9	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	7	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	9	.01	6	.08	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Bayou Toro near Toro, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
				Physical properties							
Specific conductance	17	(a)	(a)	294	64	103	64	78	82	119	294
pH (standard units)	16	(a)	(a)	7.0	5.5	6.4	5.5	6.0	6.5	6.9	7.0
Water temperature	7	(a)	(a)	29.0	9.0	(b)	(b)	(b)	(b)	(b)	(b)
Dissolved oxygen (milligrams per liter)	1	(a)	(a)	4.9	(d)	(b)	(b)	(b)	(b)	(b)	(b)
Dissolved solids (milligrams per liter)	6	(a)	(a)	190	89	(b)	(b)	(b)	(b)	(b)	(b)
				Major cations (milligrams per liter)							
Calcium, dissolved	16	0.01	16	9.0	3.5	5.4	3.5	4.0	5.2	6.7	9.0
Magnesium, dissolved	16	.01	16	3.3	.50	1.3	.50	.93	1.2	1.6	3.3
Sodium, dissolved	16	.01	16	4.3	4.6	11	4.6	5.6	8.2	14	43
Potassium, dissolved	16	.01	16	5.9	.70	1.9	.70	1.1	1.8	2.3	5.9
				Major anions (milligrams per liter)							
Alkalinity, total as $CaCO_3$	16	1	16	27	5	15	5	12	14	16	27
Sulfate, dissolved	16	.1	16	15	5.0	8.7	5.0	6.1	7.8	11	15
Chloride, dissolved	16	.1	16	74	5.2	15	5.2	7.4	9.1	18	74

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Hoosier Creek near Merryville, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
				Physical properties							
Specific conductance	10	(a)	(a)	79	39	58	39	50	60	62	79
pH (standard units)	9	(a)	(a)	6.8	5.7	(b)	(b)	(b)	(b)	(b)	(b)
Water temperature	9	(a)	(a)	26.0	12.0	(b)	(b)	(b)	(b)	(b)	(b)
Dissolved oxygen (milligrams per liter)	1	(a)	(a)	6.8	(d)	(b)	(b)	(b)	(b)	(b)	(b)
Dissolved solids (milligrams per liter)	9	(a)	(a)	84	44	(b)	(b)	(b)	(b)	(b)	(b)
				Major cations (milligrams per liter)							
Calcium, dissolved	9	0.01	9	3.8	2.0	(b)	(b)	(b)	(b)	(b)	(b)
Magnesium, dissolved	9	.01	9	1.1	.10	(b)	(b)	(b)	(b)	(b)	(b)
Sodium, dissolved	9	.01	9	10	3.2	(b)	(b)	(b)	(b)	(b)	(b)
Potassium, dissolved	9	.01	9	2.6	.20	(b)	(b)	(b)	(b)	(b)	(b)
				Major anions (milligrams per liter)							
Alkalinity, total as $CaCO_3$	9	1	9	19	3	(b)	(b)	(b)	(b)	(b)	(b)
Sulfate, dissolved	9	.1	9	6.4	2.4	(b)	(b)	(b)	(b)	(b)	(b)
Chloride, dissolved	9	.1	9	18	4.2	(b)	(b)	(b)	(b)	(b)	(b)

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Sabine River at Logansport, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Physical properties											
Specific conductance	46	(a)	(a)	726	113	341	148	243	322	405	714
pH (standard units)	46	(a)	(a)	7.8	6.4	7.0	6.4	6.6	6.9	7.2	7.6
Water temperature	46	(a)	(a)	34.0	3.0	11.0	4.4	11.8	19.8	24.5	32.3
Dissolved oxygen (milligrams per liter)	44	(a)	(a)	14.8	4.7	8.5	5.9	6.8	8.4	9.4	13.2
Dissolved solids (milligrams per liter)	44	(a)	(a)	403	80	199	86	154	188	219	388
Major cations (milligrams per liter)											
Calcium, dissolved	46	0.01	46	29	3.0	16	6.8	13	16	19	24
Magnesium, dissolved	46	.01	46	7.1	2.2	4.6	2.4	3.8	4.4	5.6	6.2
Sodium, dissolved	46	.01	46	120	9.5	40	12	24	34	48	110
Potassium, dissolved	46	.01	46	6.1	2.2	3.7	2.6	3.3	3.6	4.0	5.8
Major anions (milligrams per liter)											
Alkalinity, total as $CaCO_3$	45	1	45	158	13	40	14	22	34	52	82
Sulfate, dissolved	46	.1	46	62	15	30	16	22	30	36	52
Chloride, dissolved	46	.1	46	160	12	56	16	31	53	71	120
Nutrients (milligrams per liter)											
Nitrogen, ammonia plus organic, total as nitrogen	35	0.1	35	2.7	0.4	1.1	0.4	0.8	1.0	1.2	2.5
Nitrogen, nitrite plus nitrate, total as nitrogen	46	.1	31	.9	<.1	(b,c)	<.1	<.1	.2	.3	.5
Phosphorus, total as phosphorus	46	.01	46	2.3	.03	.17	.04	.09	.12	.16	.24

Sabine River at Logansport, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles: 5th	25th	50th (median)	75th	95th
Biological constituents--bacteria (colonies per 100 milliliters)											
Fecal coliform	34	1	34	790	6	140	8	28	69	160	590
Fecal streptococcus	34	1	34	5,200	11	790	18	79	260	1,100	4,400
Trace metals (micrograms per liter)											
Copper, dissolved	18	1	17	10	<1	(c)	<1	3	4	5	10
Iron, dissolved	18	10	16	330	<10	(c)	<10	20	70	150	330
Lead, dissolved	18	2	7	8	<2	(c)	<2	<2	<2	2	8
Zinc, dissolved	18	20	4	20	<20	(c)	<20	<20	<20	<20	20
Organic compounds (micrograms per liter)											
DDT, total	12	0.01	0	<0.01	<0.01	(c)	<0.01	<0.01	<0.01	<0.01	<0.01
PCB, total	12	.1	0	<.1	<.1	(c)	<.1	<.1	<.1	<.1	<.1
Diazinon, total	12	.01	5	.03	<.01	(c)	<.01	<.01	<.01	.02	.03
Lindane, total	12	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Chlordane, total	12	.1	0	<.1	<.1	(c)	<.1	<.1	<.1	<.1	<.1
Malathion, total	12	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Endrin, total	12	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Parathion, total	12	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Dieldrin, total	12	.01	0	<.01	<.01	(c)	<.01	<.01	<.01	<.01	<.01
Endosulfan, total	7	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	12	.01	4	.04	<.01	(c)	<.01	<.01	<.01	<.01	<.01

Table 2.2-1. Statistical summary of water-quality data for the Sabine River basin in Louisiana, 1952-85—Continued

Upper Anacoco Lake near Leesville, Louisiana

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
				Physical properties							
Specific conductance	12	(a)	(a)	48	27	35	27	32	34	37	48
pH (standard units)	12	(a)	(a)	6.7	5.6	6.2	5.6	6.0	6.2	6.5	6.7
Water temperature	12	(a)	(a)	33.0	6.0	18.8	6.0	11.1	19.0	27.5	33.0
Dissolved oxygen (milligrams per liter)	12	(a)	(a)	12.0	6.1	8.8	6.1	7.1	8.5	10.6	12.0
Dissolved solids (milligrams per liter)	11	(a)	(a)	39	17	32	17	31	32	38	39
				Major cations (milligrams per liter)							
Calcium, dissolved	12	0.01	12	2.6	1.7	2.0	1.7	1.7	2.0	2.2	2.6
Magnesium, dissolved	12	.01	12	1.1	.60	.70	.60	.70	.70	.70	1.1
Sodium, dissolved	12	.01	12	3.4	2.5	2.9	2.5	2.5	2.8	3.3	3.4
Potassium, dissolved	12	.01	12	2.6	1.1	1.4	1.1	1.2	1.3	1.4	2.6
				Major anions (milligrams per liter)							
Alkalinity, total as $CaCO_3$	12	1	12	9	4	6	4	4	7	8	9
Sulfate, dissolved	12	.1	12	6.2	2.0	3.6	2.0	2.4	3.6	4.9	6.2
Chloride, dissolved	12	.1	12	4.8	2.8	3.8	2.8	3.3	3.6	4.6	4.8
				Biological constituents--bacteria (colonies per 100 milliliters)							
Fecal coliform	11	5	4	330	<5	(c)	<5	<5	<5	20	330
Fecal streptococcus	11	5	9	7,600	<5	(c)	<5	5	72	1,600	7,600

Upper Anacoco Lake near Leesville, Louisiana--continued

Water-quality property or constituent	Number of analyses	Reporting level	Number of analyses greater than or equal to reporting level	Maximum	Minimum	Mean	Percentiles 5th	25th	50th (median)	75th	95th
Organic compounds (micrograms per liter)											
DDT, total	3	0.01	0	<0.01	<0.01	(b,c)	(b)	(b)	(b)	(b)	(b)
PCB, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Diazinon, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Lindane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Chlordane, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Malathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Parathion, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Dieldrin, total	3	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
Endosulfan, total	2	.01	0	<.01	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)
2,4-D, total	3	.01	1	.02	<.01	(b,c)	(b)	(b)	(b)	(b)	(b)

a Not applicable.

b Not calculated because sample size was less than 10.

c Not calculated because data base contained remarked values.

d Only one sample in data base.