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

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER-RESOURCES INVESTIGATIONS
REPORT 90-4170 (SHEET 1 OF 2)
Barataria Basin--Water Quality

INTRODUCTION

The Barataria basin is one of the most important estuary systems along the Louisiana coast. The system, located west of the Mississippi River and south of New Orleans (fig. 1), is a productive area for sport and commercial fishing, oyster production, and shrimping. This area also supports active oil production, both onshore and in Barataria Bay. The system provides navigational access to New Orleans and the Mississippi River by way of the Barataria Waterway, Algiers Canal, and Harvey Canal. Seafood and oil production in the basin make this area vital to the economy of the State.

This area has historically lacked a comprehensive water-quality data base, and many of the current water-quality problems thought to exist in the basin are poorly documented. In an effort to identify potential adverse environmental effects in the basin, the Louisiana Department of Environmental Quality has listed several areas and associated water-quality problems that are of general public concern (Michael Schurtz, written commun., 1985). These areas and their water-quality problems are:

1. Bayou Segnette, where fish kills have resulted from low concentrations of dissolved oxygen (DO) caused by municipal wastewater discharges at Westwego, Marrero, Bridge City, and Avondale;
2. Harvey Canal, where water quality has been adversely affected by industrial and municipal discharges and urban runoff; and
3. Bayou Barataria, where shellfish culture areas have been affected by fecal-coliform bacteria related to municipal discharges of treated sewage from Jefferson Parish and untreated sewage from privately owned camps and unsewered communities.

In addition, the Barataria basin has, at one time or another, been thought to suffer from nutrient overloading, bacterial contamination of oyster beds, and saltwater intrusion. Urban and agricultural runoff in the upper basin, population growth, and increased recreational use of the basin have been mentioned as possible sources of excessive nutrients and fecal-coliform bacteria contamination in the area (Conner and Day, 1987).

In response to the above concerns, State and Federal agencies are conducting long-term water-quality monitoring in the basin. The Louisiana Department of Health and Hospitals conducts an Oyster Water Monitoring Program in which 42 sites in the Barataria basin are monitored approximately monthly for fecal-coliform bacteria, salinity, turbidity, and pH. Tidal stage and rainfall also are monitored at selected sites.

The Louisiana Department of Environmental Quality collects water-quality data monthly at sites at Little Lake and Bayou Lafourche. The water at these sites is monitored for inorganic constituents, DO, nutrients, fecal-coliform bacteria, and trace elements.

The Louisiana Department of Wildlife and Fisheries monitors petroleum hydrocarbons, sediment particle size, pH, and interstitial salinity in the bottom material, and inorganic constituents, nutrients, and chlorophyll in the water. In this monitoring program, samples are collected monthly at 15 sites from Little Lake to Barataria Pass.

The U.S. Army Corps of Engineers monitors chloride and salinity of the Barataria Waterway at Lafitte, Louisiana, and is developing a mathematical flow model of the area. Samples are collected daily.

The U.S. National Park Service has monitored inorganic constituents, nutrients, trace elements, fecal-coliform bacteria, and pesticides at four to seven sites within the boundaries of the Jean Lafitte National Historical Park. The number of samples collected and the constituents sampled at each site vary from year to year at these sites (C.R. Garrison, U.S. Geological Survey, oral commun., 1990).

The U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development, began a study in 1988 to better define the water quality of the basin. The study included the collection of data at 16 sites throughout the basin. Water, bottom material, and biota from these sites were analyzed for a variety of constituents to detect potential water-quality problems. The study was conducted during a period of high summer temperatures and low freshwater inflow. The comprehensive data base generated by this study provides background information that may be useful for other ongoing studies by other agencies and indicates areas where further investigation may be needed.

Purpose and Scope

This report presents results of a study to determine the occurrence and distribution of selected water-quality constituents that describe current water-quality conditions in the Barataria basin. The report describes the results of a water-quality sampling survey conducted August 26, to September 2, 1988. Analyses of samples collected at 16 sampling sites are included. Constituents reported include inorganics, nutrients, trace elements, volatile organic compounds, acid-base/neutral organic compounds, and pesticides. Data are presented for samples of water, bottom material, and oyster tissue.

Study Area

The Barataria estuarine system begins at the Harvey and Algiers Canals, through which water can move from the Mississippi River into the Barataria basin. The Barataria basin, in this study, includes the Barataria Bay, Bayou Segnette, the Barataria Waterway, Lakes Cataouatche and Salvador, and Little Lake.

The Barataria basin is a typical example of the coastal Louisiana estuaries formed by sedimentation from the Mississippi River over the past few thousand years (Morgan, 1967). Since its formation between the Bayou Lafourche distributary and the current main stem of the Mississippi River, the bays, lakes, and bayous of the basin have enlarged by subsidence and erosion to form an extensive network of interconnecting waterbodies which allow transport of water throughout the basin (Conner and Day, 1987).

The basin essentially has been closed to river flow since the leveeing of the Mississippi River in the 1930-40's and the closing of the Bayou Lafourche-Mississippi River connection in 1902, although some water enters the basin from the Intracoastal Waterway locks at New Orleans (Conner and Day, 1987). The lower part of the Barataria basin is a typical bar-built estuary, shallow with bars at the mouth and a low tidal range (Adams and others, 1976).

Suburbs of the City of New Orleans are located in the northern part of the basin, and small communities, oil and gas production facilities, and commercial fishing facilities are located throughout the basin. Vegetation in the basin occurs in a series of zones oriented in a roughly northwest-southeast direction and reflects the change from freshwater to saltwater. The vegetation ranges from freshwater swamp in the northern part of the basin, to freshwater and brackish marsh in the middle part of the basin, to saltwater marsh in the southern part near Barataria Bay (Chabreck and Linscombe, 1978).

Methods

The water-quality sampling sites were selected to account for the water entering and leaving the Barataria estuarine system during a tidal cycle. Site selection also was influenced by the potential for contamination of the system by natural or manmade constituents. Thus, some sites were clustered in the industrial-commercial Harvey Canal area (sites 1-3) or the Bayou Segnette area (sites 5-7), where nonpoint nutrient sources may be a cause for concern (table 1).

Discharge measurements were made at Barataria Waterway at site 14 on August 30 and 31 to give an indication of the overall streamflow conditions during sampling. A directional-velocity flowmeter was used to determine the velocity and direction of flow.

Four sites were equipped with automated monitoring equipment that measured temperature, specific conductance, DO, and pH at a depth of 2 ft below the water surface hourly from August 26 to September 2. These data provided information on short-term variations in water-quality conditions before, during, and after sampling. DO concentrations were measured at the water surface at the time water samples were collected.

All water velocities measured during the study were less than 1.5 ft/s (feet per second). This precluded the use of point-samplers, which require water velocities of 1.5 ft/s or greater for the collection of representative samples. Depth-integrated water samples were, therefore, collected using hand-operated wire-basket samplers containing a narrow-mouth glass bottle. Water samples for the analysis of dissolved organic carbon (DOC) were filtered through 0.45 µm (micrometer) silver filters to prevent contamination of the sample by organic nitrocellulose filters and to inhibit bacterial action. Water samples for the analysis of biochemical oxygen demand (BOD) were collected in glass bottles using stainless-steel sewage samplers. The BOD analyses were begun within two hours of collection. All water samples were packed in ice until delivery to the on-site mobile laboratory. Water samples for the analysis of dissolved inorganic constituents, nutrients, and trace elements were filtered through 0.45 µm nitrocellulose filters and treated with the appropriate preservatives for later analysis by a U.S. Geological Survey laboratory using methods described by Fishman and Friedman (1985). Water samples for the analysis of volatile organic compounds were collected using stainless-steel sewage samplers, containing 40 mL (milliliters) vials with Teflon[1]-septum caps. Water samples for analysis of acid-base/neutral extractable organic compounds and pesticides were collected in glassware that had been baked overnight at 350 °C (degrees Celsius) to remove any organic residues, and stored at 4 °C. Chemical analyses were performed by a Tennessee Valley Authority laboratory. All samples for synthetic organic compounds were analyzed according to methods described by Wershaw and others (1987) and the U.S. Environmental Protection Agency (USEPA) (1979a, 1979b).

Bottom-material samples were collected and analyzed for nutrients, trace elements, and synthetic organic compounds. Samples for nutrient and trace element analyses were collected using Teflon-lined bottom samplers and stored at 4 °C until they were analyzed by a U.S. Geological Survey laboratory. Bottom-material samples for the analysis of acid-base/neutral extractable organic compounds and pesticides were collected using a stainless-steel bottom-material sampler and stored at 4 °C until they were analyzed by a Tennessee Valley Authority laboratory.

Oysters were collected at two sites in the northern part of Barataria Bay and analyzed for the presence of trace elements and synthetic organic compounds. Oyster tissue samples were analyzed by the Mississippi State University laboratory.

Water samples for fecal-coliform and fecal-streptococcus bacteria analyses were collected in sterilized glass containers and packed in ice. Bacteriological analyses were initiated in the mobile laboratory within four hours of sample collection. The membrane filter method was used, as described by Britton and Greeson (1988). Water samples also were collected and analyzed for the presence of selected enteric pathogenic bacteria.

1 Use of trade, product, industry, or firm names in this report is for identification or location purposes only, and does not constitute endorsement of products by the U.S. Geological Survey.

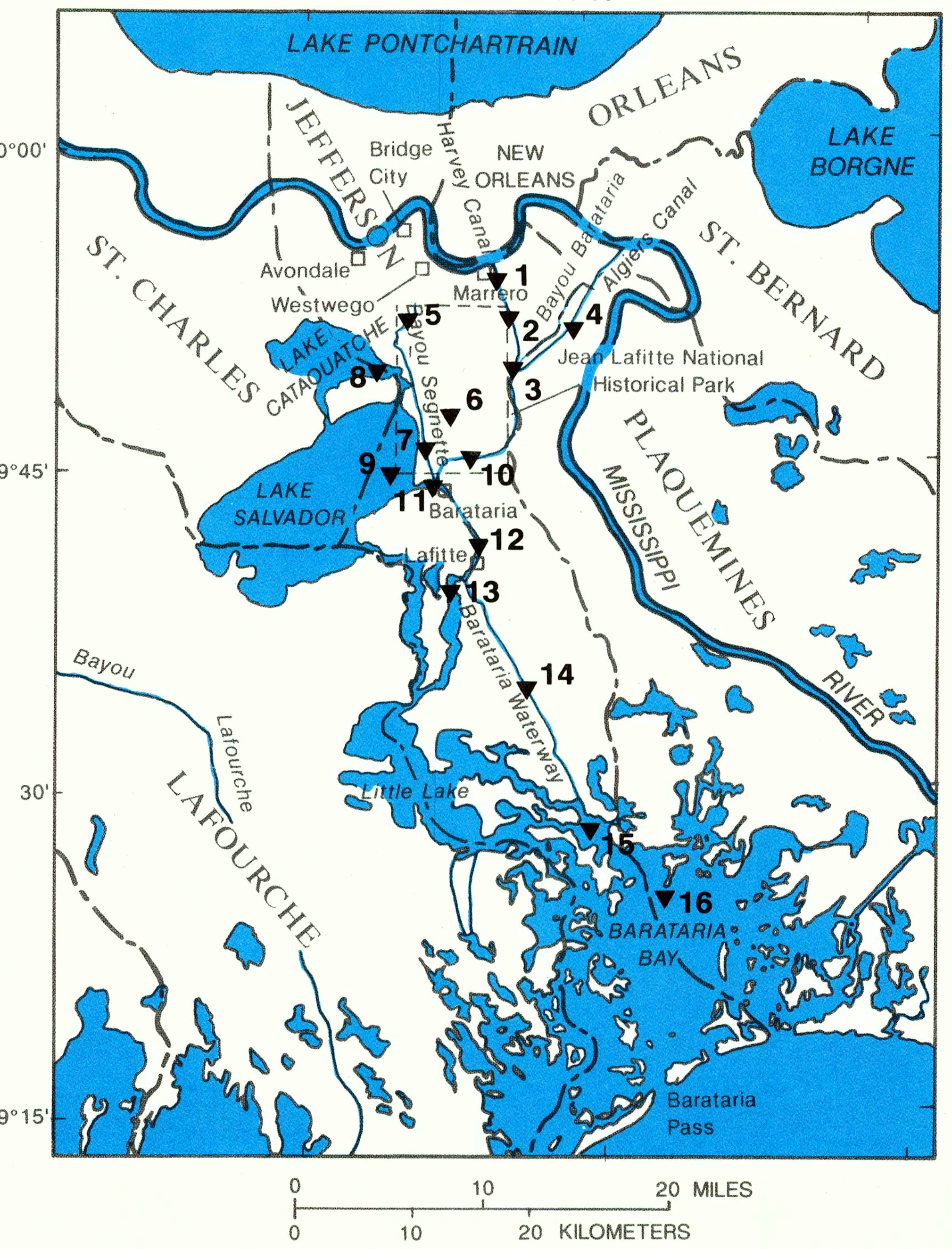


Figure 1.--Location of study sites (see table 1).

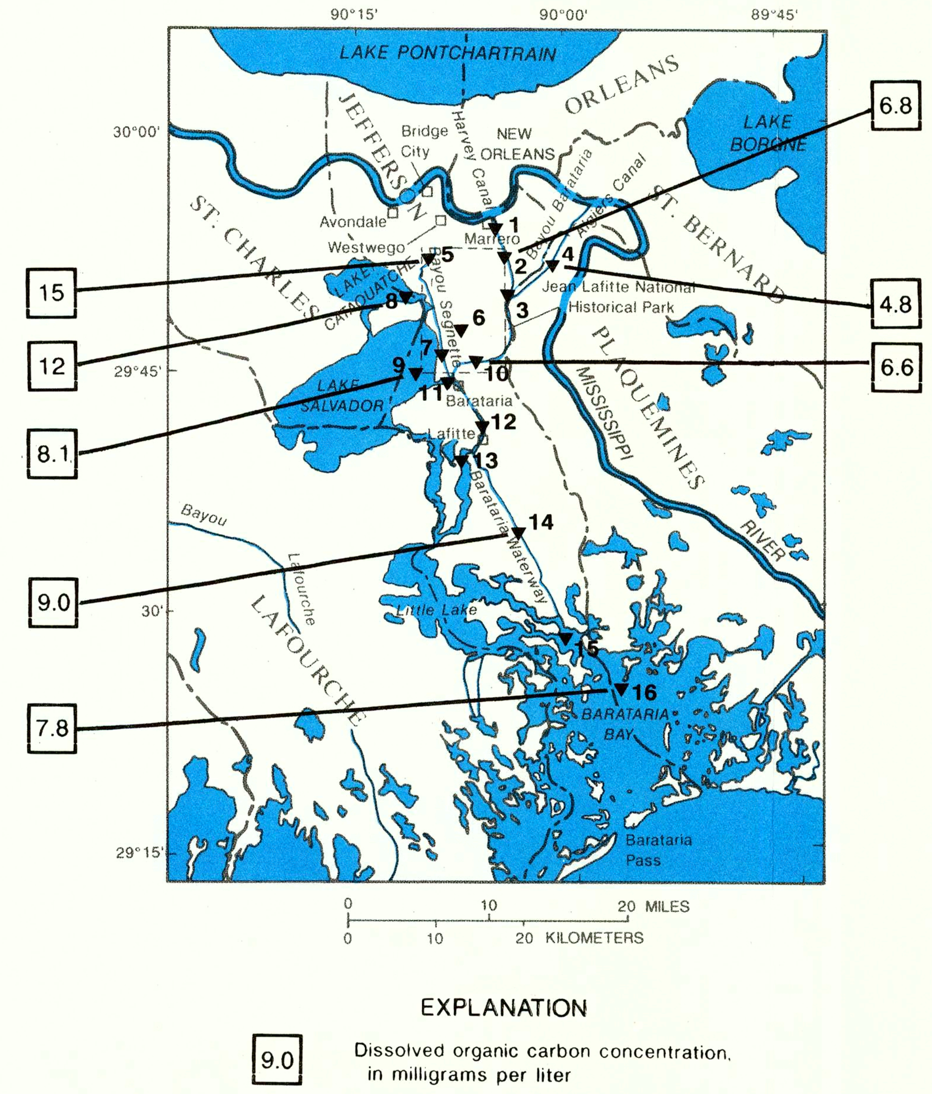


Figure 2.--Distribution of dissolved organic carbon concentrations, August 30, 1988.

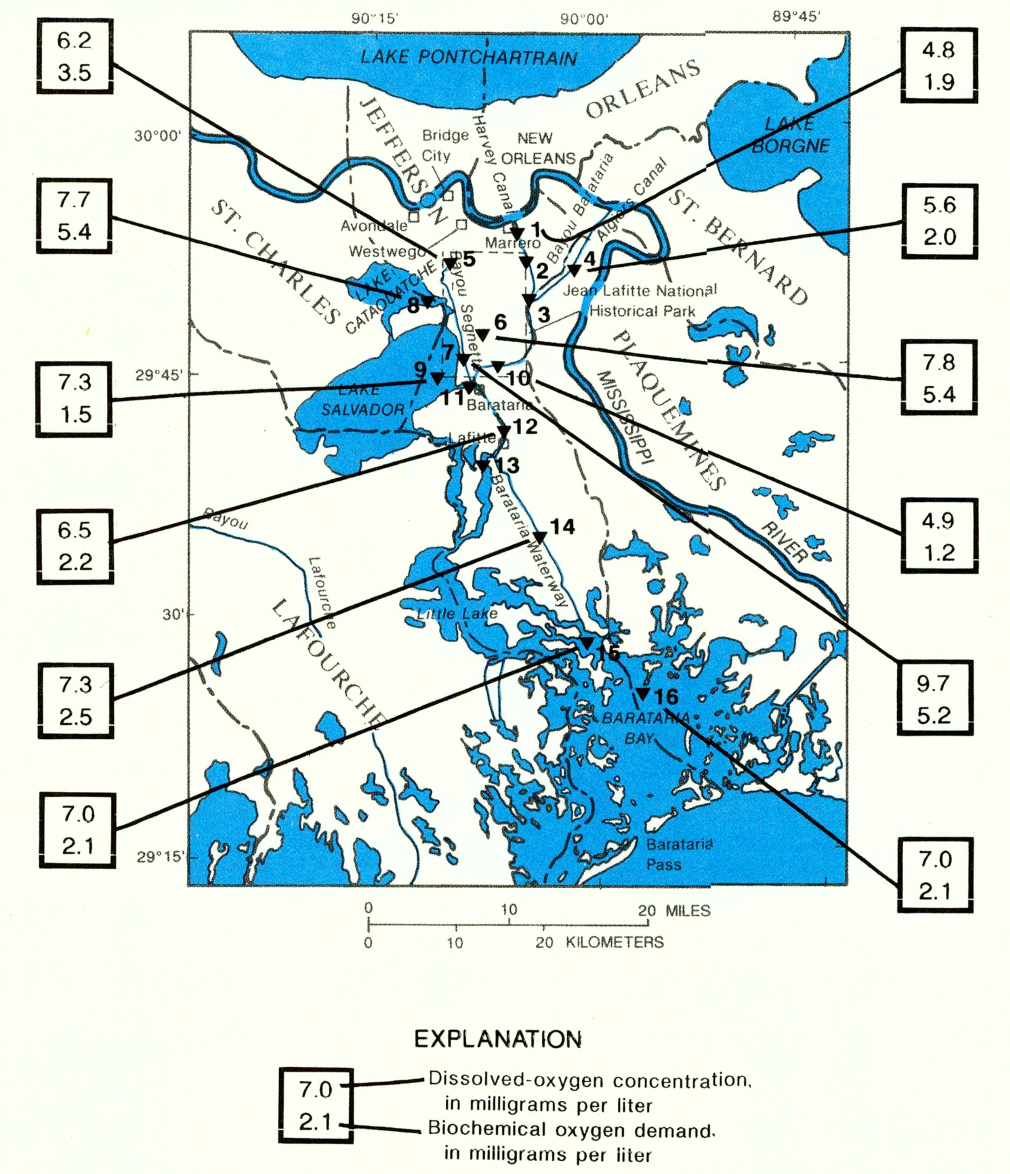


Figure 3.--Distribution of dissolved oxygen concentrations and biochemical oxygen demand, at a depth of 3.3 feet, 11:00 A.M. to 4:00 P.M., August 30, 1988.

Standards and Criteria for Constituents Detected During Study

The criteria for selected constituents cited in this report (table 2) have been established for various categories of water use by the U.S. Environmental Protection Agency (1976; 1986; 1988). In general, criteria have not yet been established for constituents in bottom material.

Standards for fecal-coliform bacteria concentrations in water in Louisi-ana, established by the Louisiana Department of Environmental Quality (1984), are as follows:

1. Primary contact recreation.--Based on a minimum of not less than 5 samples collected over not more than a 30-day period, the fecal-coliform content shall not exceed a log mean of 200 cols/100 mL (colonies per 100 milliliters), nor shall more than 10 percent of the total samples during any 30-day period exceed 400 cols/100 mL.
2. Secondary contact recreation.--Based on a minimum of not less than 5 samples collected over not more than a 30-day period, the fecal-coliform content shall not exceed a log mean of 1,000 cols/100 mL, nor shall more than 10 percent of the total samples during any 30-day period equal or exceed 2,000 cols/100 mL.
3. Public water supply.--The monthly arithmetic mean of total coliform shall not exceed 10,000 cols/100 mL, nor shall the monthly arithmetic mean of fecal coliform exceed 2,000 cols/100 mL.
4. Shellfish propagation.--The fecal-coliform median most probable number shall not exceed 14 cols/100 mL, and not more than 10 percent of the samples shall ordinarily exceed a most probable number of 43 cols/100 mL for a 5-tube decimal dilution test in those parts of the area most probably exposed to fecal-coliform contamination during the most unfavorable hydrographic and pollution conditions.

Table 1.--Sites and constituents sampled

Site no.	Site name	Water: Inorganics	Water: Nutrients	Water: Dissolved organic carbon	Water: Trace elements	Water: Volatile organic compounds	Water: Acid-base/neutral organic compounds	Water: Polychlorinated biphenyl compounds	Water: Phenols	Water: Insecticides	Water: Herbicides	Bottom material: Nutrients	Bottom material: Trace elements	Bottom material: Acid-base/neutral organic compounds	Bottom material: Polychlorinated biphenyl compounds	Bottom material: Insecticides
1	Harvey Canal at Highway 90 bridge at Harvey.				X	X	X	X					X	X	X	
2	Harvey Canal at Highway 428 bridge at Harvey.	X	X	X	X	X	X	X	X			X	X	X	X	
3	Harvey Canal at entrance to Hero Cutoff.												X	X	X	
4	Algiers Canal near Belle Chasse.	X	X	X	X	X						X	X			
5	Bayou Segnette 2.9 miles south of Westwego.	X	X	X	X	X	X	X	X			X	X	X	X	
6	Bayou Coquille south of Westwego.	X	X		X			X					X	X	X	
7	Bayou Segnette near Barataria.	X	X	X	X	X	X	ˇ	X			X	X		X	
8	Lake Cataouatche at southeast end.	X	X	X				X		X	X	X	X			X
9	Lake Salvador at northeast end.	X	X	X	X			X		X	X	X	X			X
10	Bayou Barataria at Rosethorn Park.	X	X	X	X	X	X	X	X	X	X		X	X	X	X
11	Bayou Villars at entrance to Lake Salvador.	X														
12	Barataria Waterway at Lafitte.	X														
13	Bayou Rigolets near Lafitte.	X														
14	Barataria Waterway at Lafitte Oilfield.	X	X	X	X	X		X				X	X		X	
15	Barataria Waterway at Bayou St. Denis.	X	X					X	X	X	X					X
16	Barataria Bay 1/2 mile south of St. Mary's Point.	X	X	X	X	X	X	X				X	X	X	X	

WATER QUALITY OF BARATARIA BASIN

Organic Carbon, Oxygen, and Biochemical Oxygen Demand

The DOC concentrations of 15 and 12 mg/L (milligrams per liter) at sites 5 and 8 (fig. 2) are typical of marshes and eutrophic lakes. The other concentrations, although lower, indicate that organic enrichment is occurring, probably due to natural sources such as swamps and marshes, and possibly, to human inputs such as effluent from sewage treatment plants (Thurman, 1985).

The DO measurements made between 11:00 a.m., and 4:00 p.m., August 30, 1988, indicate that DO concentrations generally were near or above the 5.0 mg/L minimum (fig. 3) considered necessary to support a varied fish population (Louisiana Department of Environmental Quality, 1984). DO concentrations that were recorded hourly by water-quality monitors at sites 1, 11, 15, and 16 indicate that these readings were typical for the study area during late morning to mid-afternoon. Within the 24-hour period, DO concentrations ranged from about 4 to 9 mg/L at sites 1 and 11, and from 5 to 7 mg/L at sites 15 and 16. These concentrations are generally within a range that would support a varied fish population.

The water at site 7 was supersaturated with oxygen, probably a result of excessive algal growth. Generally, when algae are present in sufficient concentration to produce supersaturated conditions during the day, they also deplete the water of DO at night before renewed photosynthesis begins to produce more oxygen (Hynes, 1970).

The highest BOD's in the study area occurred at sites 6, 7, and 8 (fig. 3). The relatively high BOD's are a rough indication of the total amount of organic material present in water. The relatively high BOD's correspond to relatively high DOC's. For example, site 8 had a DOC of 12 mg/L and a BOD of 5.4 mg/L.

Inorganic Constituents

The concentrations of inorganic constituents in water at the study sites are typical of a coastal Louisiana estuary. The chloride concentrations, for example, increase in a fairly predictable manner as water flows downstream toward Barataria Bay. Concentrations increased from 50 mg/L at site 4 in the Algiers Canal to 5,200 mg/L at site 16 in Barataria Bay (table 3).

The ratio of calcium to magnesium is useful for determining whether saltwater or freshwater is predominant at a location in Louisiana estuary systems: when the ratio is greater than one, freshwater is predominant; when the ratio is less than one, saltwater is predominant. This is because magnesium is present in seawater in much greater concentrations than calcium (Hem, 1985); while in freshwater, calcium is predominant. The ratio of calcium to magnesium is a useful tool in determining the areas of saltwater or freshwater predominance in the surface waters of coastal Louisiana; however, it may not be applicable to other areas with different hydrologic conditions. During the sampling, the change from primarily freshwater to primarily saltwater occurred at sites 9 and 13 (table 3). The ratio will change with the tidal cycle or heavy rainfall.

The specific conductance data indicate the effect of tides in an estuary such as the Barataria basin (fig. 4). Water at site 2 in the Harvey Canal had a specific conductance that ranged from 600 to 700 µS/cm (microsiemens per centimeter at 25 °C), which is indicative of freshwater. Site 16 had specific conductances that ranged from about 13,000 to almost 30,000 µS/cm, as a result of high-conductance saltwater moving into and out of the study area with the tides.

Table 2.--Water-quality criteria for constituents detected

[Concentrations in micrograms per liter; NE, no established criteria; source: U.S. Environmental Protection Agency, 1976; 1986]

Constituent	Chronic lowest observed effect level-freshwater aquatic organisms[1]	Chronic lowest observed effect level-saltwater aquatic organisms	Maximum contaminant level (MCL) for water supply
Trace elements			
Arsenic	190	36	50
Barium	NE	NE	1,000
Cadmium[2]	1.1	9.3	10
Chromium hexavalent	11	50	170
Chromium trivalent	210	NE	50
Cobalt	NE	NE	NE
Copper[2]	12	NE	1,000
Iron	1,000	NE	300
Lead[2]	3.2	5.6	50
Manganese	NE	NE	50
Mercury	.012	.025	2
Nickel[2]	96	7.1	NE
Selenium	35	54	10
Silver	4.1	2.3	50
Zinc	320	170	NE
Synthetic organic compounds[3]			
Atrazine	NE	NE	[4]2.0
Simazine	NE	NE	NE
Prometone	NE	NE	NE
Benzene	NE	700	NE
Ethylbenzene	NE	NE	NE
Phenol	2,560	5,800	1.0
Toluene	NE	5,000	NE

1 Chronic lowest observed effect level refers to 96-hour toxicity tests on a wide variety of aquatic organisms.

2 Toxicity is hardness-dependent. The indicated criterion assumes a hardness (as calcium carbonate) of 100 mg/L.

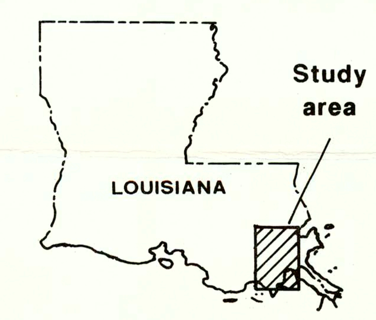
3 The lack of established criteria for some of these synthetic organic compounds generally are due to insufficient information, not a generally recognized lack of toxicity.

4 Proposed.

Table 3.--Inorganic constituents in water and calcium to magnesium ratio, August 30, 1988

[Alkalinity, total as calcium carbonate; all other constituents are dissolved; concentrations in milligrams per liter]

Site no.	Alkalinity	Calcium	Chloride	Fluoride	Magnesium	Potassium	Silica	Sodium	Sulfate	Calcium to magnesium ratio
2	115	50	61	0.4	17	4.4	8.3	48	95	2.94
4	127	44	50	.5	17	4.3	2.8	46	80	2.50
5	113	46	140	.5	19	4.7	11.0	100	82	2.42
6	110	40	280	.5	22	2.1	11.0	150	11	1.82
7	77	30	290	.4	25	8.0	3.4	180	68	1.20
8	59	24	200	.5	18	5.7	3.4	130	58	1.33
9	49	20	480	.3	31	11	1.9	260	70	.64
10	115	49	67	.6	19	4.7	7.1	54	100	2.58
11	79	35	260	.3	25	7.6	3.4	160	82	1.40
12	87	36	250	.4	24	7.3	3.4	160	86	1.50
13	82	35	480	.4	36	11	2.8	280	98	.97
14	77	50	1,400	.5	88	300	1.7	800	210	.16
15	65	93	3,700	.5	250	81	3.6	2,100	530	.37
16	70	120	5,200	.6	340	110	3.9	3,040	700	.35



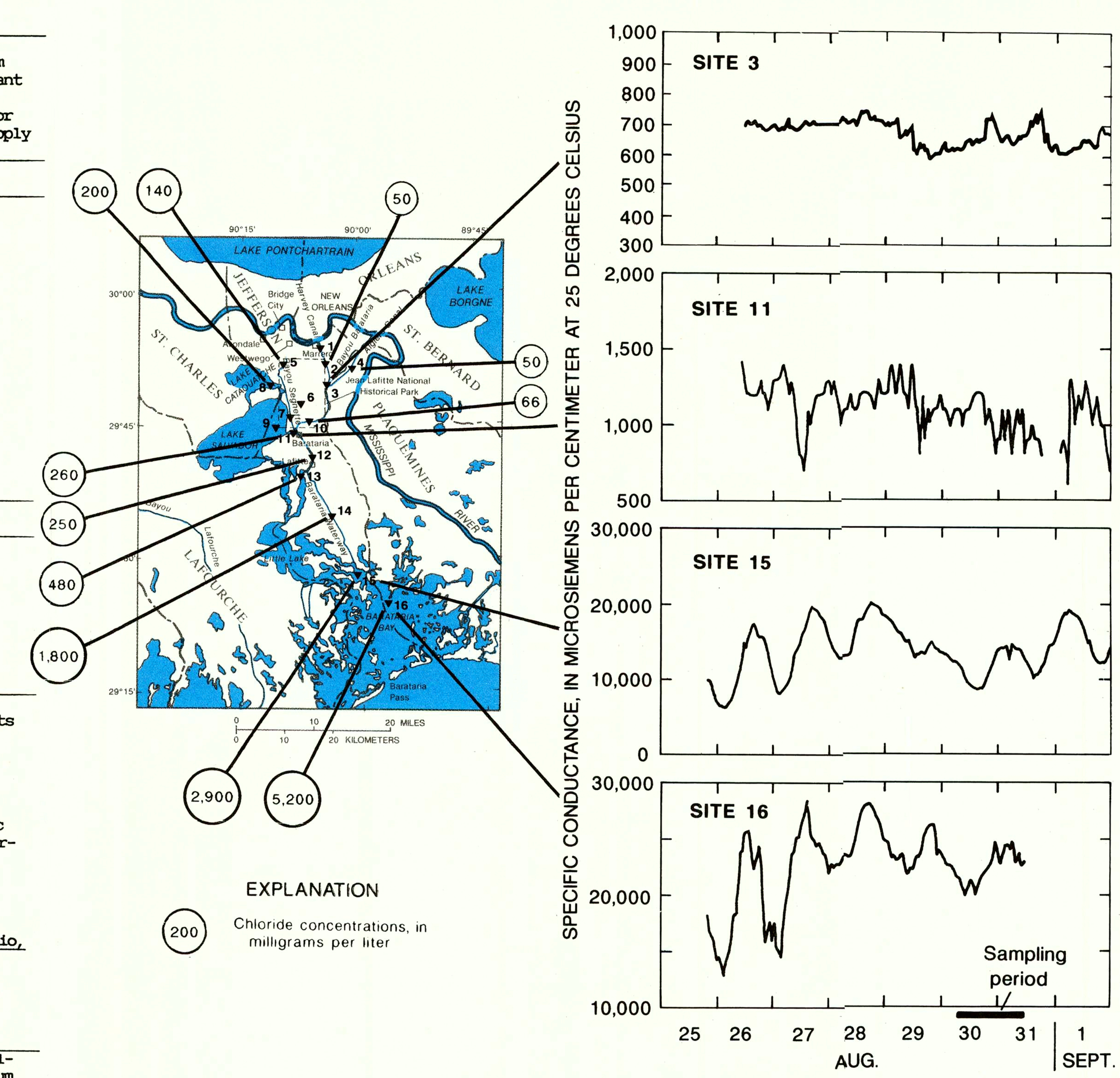


Figure 4.--Chloride concentrations on August 31, 1988, at selected sites, and specific conductances during the period August 26-September 2, 1988.

LOUISIANA HYDROLOGIC ATLAS MAP NO. 6: WATER-QUALITY SURVEY OF THE BARATARIA BASIN, 1988

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1991

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