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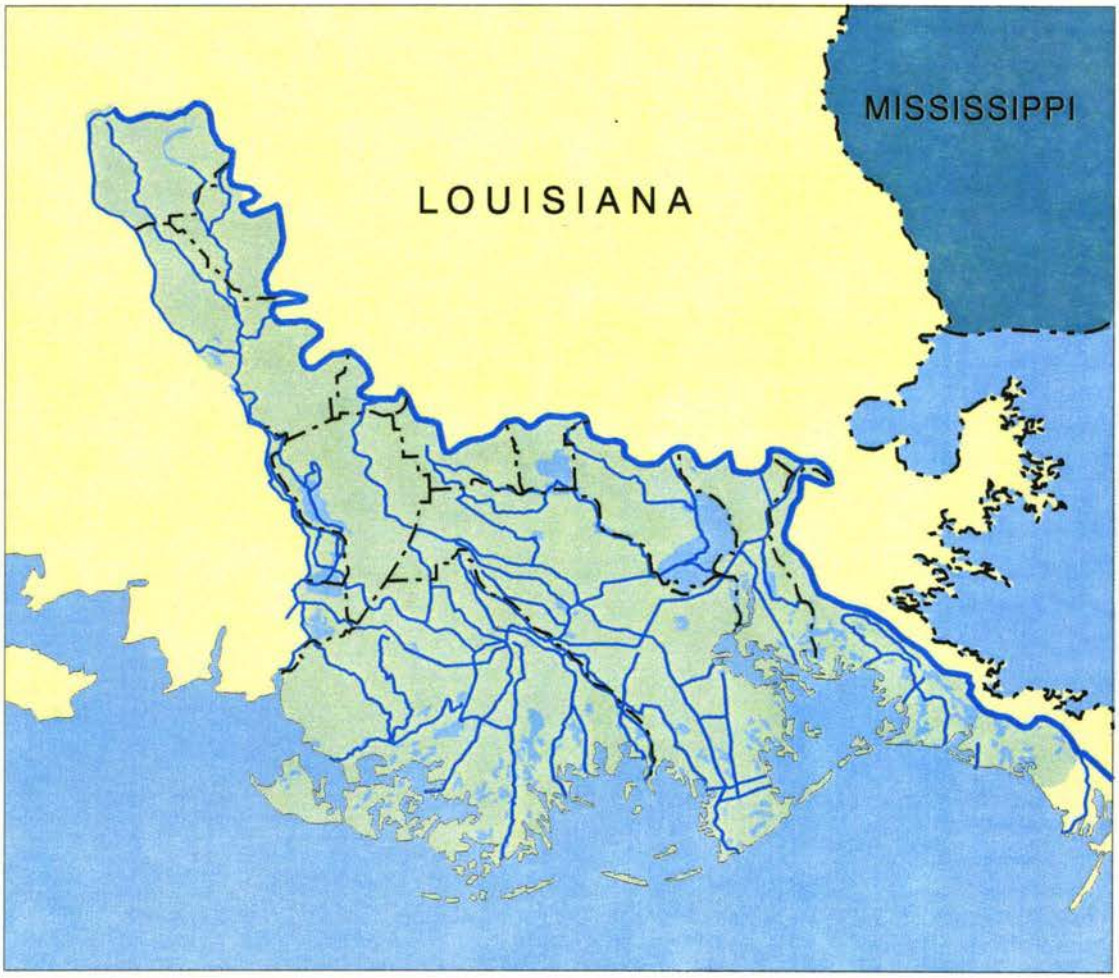
Water Use and Quality of Fresh Surface-Water Resources in the Barataria-Terrebonne Basins, Louisiana

U.S. GEOLOGICAL SURVEY
Open-File Report 98-632



Prepared in cooperation with the
BARATARIA-TERREBONNE NATIONAL ESTUARY PROGRAM

1998

WATER USE AND QUALITY OF FRESH SURFACE-WATER RESOURCES IN THE BARATARIA-TERREBONNE BASINS, LOUISIANA

By Penny M. Johnson-Thibaut, Dennis K. Demcheck, Christopher M. Swarzenski, and Paul A. Ensminger

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U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, SECRETARY

U.S. GEOLOGICAL SURVEY

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ABSTRACT

Approximately 170 Mgal/d (million gallons per day) of ground- and surface-water was withdrawn from the Barataria-Terrebonne Basins in 1995. Of this amount, surface water accounted for 64 percent (110 Mgal/d) of the total withdrawal rates in the basins. The largest surface-water withdrawal rates were from Bayou Lafourche (40 Mgal/d), Bayou Boeuf (14 Mgal/d), and the Gulf Intracoastal Waterway (4.2 Mgal/d). The largest ground-water withdrawal rates were from the Mississippi River alluvial aquifer (29 Mgal/d), the Gonzales-New Orleans aquifer (9.5 Mgal/d), and the Norco aquifer (3.6 Mgal/d).

The amounts of water withdrawn in the basins in 1995 differed by category of use. Public water suppliers within the basins withdrew 41 Mgal/d of water. The five largest public water suppliers in the basins withdrew 30 Mgal/d of surface water: Terrebonne Waterworks District 1 withdrew the largest amount, almost 15 Mgal/d. Industrial facilities withdrew 88 Mgal/d, fossil-fuel plants withdrew 4.7 Mgal/d, and commercial facilities withdrew 0.67 Mgal/d. Aggregate water-withdrawal rates, compiled by parish for aquaculture (37 Mgal/d), livestock (0.56 Mgal/d), rural domestic (0.44 Mgal/d), and irrigation uses (0.54 Mgal/d), totaled about 38 Mgal/d in the basins. Ninety-five percent of aquaculture withdrawal rates, primarily for crawfish and alligator farming, were from surface-water sources.

Total water-withdrawal rates increased 221 percent from 1960-95. Surface-water withdrawal rates have increased by 310 percent, and ground-water withdrawal rates have increased by 133 percent. The projection for the total water-withdrawal rates in 2020 is 220 Mgal/d, an increase of 30 percent from 1995. Surface-water withdrawal rates would account for 59 percent of the total, or 130 Mgal/d. Surface-water withdrawal rates are projected to increase by 20 percent from 1995 to 2020.

Analysis of water-quality data from the Mississippi River indicates that the main threats to surface-water resources are from the herbicide atrazine and excessive nutrients. Atrazine concentrations in the Mississippi River at Baton Rouge briefly exceed the U.S. Environmental Protection Agency maximum contaminant level of 3.0 micrograms per liter during periods in the late spring and early summer. Trace metals in bottom material collected from Bayou Lafourche indicate that the reach of Bayou Lafourche from Donaldsonville to Golden Meadow is adversely affected by low-level contamination. Dissolved nitrate had a mean concentration of 1.4 milligrams per liter in the Mississippi River near Bayou Lafourche and can contribute to excessive plant growth.

Long-term salinity records near Bayou Lafourche indicate no pronounced trends, with the exception of the Gulf Intracoastal Waterway at Houma. At this site, salinities remained low until 1961, when the Gulf Intracoastal Waterway was connected to the Gulf of Mexico by the Houma Navigation Canal. The sources of saltwater are variable. Some saltwater has entered Bayou Lafourche south of the Gulf Intracoastal Waterway; at other times saltwater has moved up the Houma Navigation Canal and has flowed east in the Gulf Intracoastal Waterway, north into Company Canal, and southeast in Bayou Lafourche towards Larose, Louisiana.

INTRODUCTION

In the Barataria-Terrebonne Basins, Bayou Lafourche is the principal source of drinking water for 250,000 people, as well as 50 percent of the water supply for the offshore oil and gas exploration and production industry in the central Gulf of Mexico. All of Lafourche and Assumption Parishes, most of Terrebonne Parish, and parts of Jefferson Parish, get their potable water from Bayou Lafourche (Kirk Cheramie, Bayou Lafourche Freshwater District, written commun., 1997). The Bayou Lafourche Freshwater District (BLFWD) was created in 1950 to provide freshwater to the communities along Bayou Lafourche. Information on water use is essential for planners and managers to resolve problems involving resource allocations, environmental effects, economic development, and water quality. The identification of potential threats to the quality of fresh surface-water resources, especially in areas of extensive water use, is also important. In December 1995, the U.S. Geological Survey (USGS), in cooperation with the Barataria-Terrebonne National Estuary Program (BTNEP), began a 6-month study to evaluate water use and the quality of fresh surface-water resources in the Barataria and Terrebonne Basins, including an analysis of potential threats to the quality of fresh surface-water resources.

The BTNEP was created in 1990 as a partnership between the U.S. Environmental Protection Agency (USEPA) and the State of Louisiana. The BTNEP program's goal is to protect the Barataria-Terrebonne estuary from further degradation and to undertake programs that would begin to check human-induced or natural damage that already had occurred to habitats throughout the estuary (Moore and Rivers, 1995). BTNEP was established under the authority of Section 320 of the Clean Water Act.

Purpose and Scope

This report describes ground- and surface-water use and the quality of fresh surface-water resources in the Barataria-Terrebonne Basins. This report also addresses projected water-use demands for the years 2000, 2005, 2010, 2015, and 2020; and threats to the quality of fresh surface-water resources in the basins.

Aggregate ground- and surface-water withdrawal rates from 1960-95 are presented in bar graphs, with projected future water demand through 2020. Ground- and surface-water withdrawal points for public supply, industrial, commercial, and power generation facilities within the Barataria-Terrebonne Basins in 1995 are tabulated, and surface-water withdrawal points are located on a map. Aggregate water-withdrawal rates in 1995 for irrigation, aquaculture, domestic, and livestock categories are presented in appendix A, and surface-water withdrawal sites along the Mississippi River are listed in appendix B. The discussion on water-quality-related threats to fresh surface-water resources includes potential contamination by toxic compounds, excessive nutrients, and salinity.

Description of Study Area

The study area consists of Barataria-Terrebonne Basins in southern Louisiana (pl. 1). The basins, which include more than 4.1 million acres, are bounded by the Mississippi River on the east and the Atchafalaya River on the west. The study area narrows toward the north to the town of Morganza and widens toward the south to the Gulf of Mexico. The basins include all of Assumption, Lafourche, and Terrebonne Parishes and parts of Ascension, Iberville, Jefferson, Plaquemines, Pointe Coupee, St. Charles, St. James, St. John the Baptist, St. Mary, and West Baton Rouge Parishes.

Major streams and canals draining the basins are generally distributaries of the Mississippi River. The Gulf Intracoastal Waterway is a major inland navigation channel that runs east-west across the basins; roughly paralleling the coastline.

The wetlands and open water which comprise almost 80 percent of the basins' area are home to shrimp, oysters, blue crab, and over 60 species of fish. Oil and gas exploration in the basin has created a vast network of canals throughout the basins (Moore and Rivers, 1995). These canals and numerous major navigation channels have increased the potential for inland movement of saltwater into freshwater habitats.

METHODS

Compilation of Withdrawal Rates

Data on the ground- and surface-water withdrawal rates were compiled from two sources. Water-withdrawal data were compiled from the following published reports: Snider and Forbes (1961); Bieber and Forbes (1966); Dial (1970); Cardwell and Walter (1979); Walter (1982); Lurry (1987); Lovelace (1991); and Lovelace and Johnson (1996). The USGS, in cooperation with the Louisiana Department of Transportation and Development (DOTD), has compiled information on water withdrawals and usage on a 5-year interval since 1960. The data are stored in the Louisiana Site-Specific Water Use Data System, a part of the USGS National Site-Specific Water Use Data System (SWUDS). To facilitate the timely completion of each 5-year report, data from the current year and previous year are used. For example, data that were collected for the 1995 water-use report include a composite of water-use data from both 1994 and 1995. Table 4 (presented later in report) includes data taken from quarterly reports with data on a yearly basis from 1988-95. Data included in this table were taken from quarterly reports starting in 1988-89, when several large users in the State were contacted and asked to report withdrawal rates on a quarterly basis.

Description of Trends and Projections

Historical ground- and surface-water withdrawal rates were compiled and estimated from USGS paper files and the above mentioned published reports. The first task was to develop a data set that could be used in a regression analysis to project total water-withdrawal rates to the years 2000, 2005, 2010, 2015, and 2020. Site-specific and aggregate data from SWUDS were used to determine ground- and surface-water withdrawal rates for parishes and parts of parishes within the study area for the years 1985, 1990, and 1995. For the period 1960-80, three methods (described below) were used to compile and estimate ground- and surface-water withdrawal rates (determined separately throughout the procedure) that could be used in the regression analysis. These methods were developed through discussions with Susan Hutson (U.S. Geological Survey, oral and written communs., 1998).

(1) For Assumption, Lafourche, and Terrebonne Parishes, which lie completely within the study area, ground- and surface-water withdrawal rates for the period 1960-80 (every 5 years) were compiled from published water-use reports. For the other 10 parishes, which lie partially within the study area, ground- and surface-water withdrawal rates were estimated for the period 1960-80 as discussed below.

(2) Site-specific withdrawal data that could be traced back to 1960, using USGS paper files, were desirable for estimating the withdrawal rates that were used in the regression analysis. Five of the parishes that lie partially within the study area (Ascension, Iberville, Pointe Coupee, St. Mary and West Baton Rouge) had site-specific public-supply withdrawal rates available. For those five parishes, site-specific public-supply withdrawal rates (*ps area* $wu_{60\text{-}80}$) were totaled for each parish for the area that lies within the study area, for the years 1960-80. Those amounts were then subtracted from the total ground- and surface-water withdrawal rates (*tot* $wu_{60\text{-}80}$) in the parish for the years 1960-80 to obtain an adjusted total withdrawal rate (*tot adj* $wu_{60\text{-}80}$).

$$tot\ wu_{60\text{-}80} - ps\ area\ wu_{60\text{-}80} = tot\ adj\ wu_{60\text{-}80} \qquad (1)$$

Ground- and surface-water withdrawal rates (*tot area* $wu_{85\text{-}95}$) were totaled for each parish for the areas that lie within the study area for 1985-95 (every 5 years). Public-supply withdrawal rates within the study area (*ps area* $wu_{85\text{-}95}$) were then subtracted from the total withdrawal rates (*tot area* $wu_{85\text{-}95}$) to obtain a rate for each parish (*tot area adj* $wu_{85\text{-}95}$) for the years 1985-95.

$$tot\ area\ wu_{85\text{-}95} - ps\ area\ wu_{85\text{-}95} = tot\ area\ adj\ wu_{85\text{-}95} \qquad (2)$$

These totals (*tot area adj* $wu_{85\text{-}95}$) were then divided by the parish totals for ground- and surface-water withdrawal rates (*tot* $wu_{85\text{-}95}$) for each of the three years (1985, 1990, and 1995) to determine the percentages of total withdrawal rates that occur within the study area ($pct_{85\text{-}95}$). The three percentages were then averaged (*av* $pct_{85\text{-}95}$).

$$[(tot\ area\ adj\ wu_{85\text{-}95} / tot\ wu_{85\text{-}95}) = pct_{85\text{-}95}] / 3 = av\ pct_{85\text{-}95} \qquad (3)$$

The average (*av* $pct_{85\text{-}95}$) was then multiplied by the adjusted total (*tot adj* $wu_{60\text{-}80}$) ground- and surface-water withdrawal rates for each parish for 1960-80 to obtain new adjusted totals (*tot area* $adj_{60\text{-}80}$) representative of the area within the study area, excluding site-specific public-supply withdrawal rates for the area. The total site-specific public-supply withdrawal rates (*ps area* $wu_{60\text{-}80}$) within the study area were then added back to the new adjusted totals (*tot area* $adj_{60\text{-}80}$) to obtain withdrawal rates that were representative of the area of the parish within the study area ($wu_{60\text{-}80}$). These ground- and surface-water withdrawal rates were then used in the regression analysis.

$$(av\ pct_{85\text{-}95} * tot\ adj\ wu_{60\text{-}80}) + ps\ area\ wu_{60\text{-}80} = wu_{60\text{-}80} \qquad (4)$$

(3) For the five parishes that did not contain any site-specific public-supply withdrawal rates for the part of the parish within the study area (Jefferson, Plaquemines, St. Charles, St. James, and St. John the Baptist), the total site-specific public-supply withdrawal rates for each parish for the years 1960-80 (*tot ps* $wu_{60\text{-}80}$) were subtracted from the total withdrawal rates in the parish (*tot* $wu_{60\text{-}80}$) to get an adjusted total (tot_1 *adj* $wu_{60\text{-}80}$) for each parish.

$$tot\ wu_{60\text{-}80} - tot\ ps\ wu_{60\text{-}80} = tot_1\ adj\ wu_{60\text{-}80} \qquad (5)$$

Ground- and surface-water withdrawal rates (*tot area* $wu_{85\text{-}95}$) were totaled for each parish for the areas that lie within the study area for 1985-95. These totals (*tot area* $wu_{85\text{-}95}$) were then divided by the parish totals for ground- and surface-water withdrawal rates (*tot* $wu_{85\text{-}95}$) for each of the three years (1985, 1990, and 1995) to determine the percentages of total withdrawal rates that occur within the study area ($pct_{85\text{-}95}$). The three percentages were then averaged (*av* $pct_{85\text{-}95}$).

$$[(tot\ area\ wu_{85\text{-}95} / tot\ wu_{85\text{-}95}) = pct_{85\text{-}95}] / 3 = av\ pct_{85\text{-}95} \qquad (6)$$

The average (*av* $pct_{85\text{-}95}$) was then multiplied by the adjusted total (tot_1 *adj* $wu_{60\text{-}80}$) ground- and surface-water withdrawal rates for each parish for 1960-80 to obtain withdrawal rates that were representative of the area of the parish within the study area ($wu_{60\text{-}80}$). These ground- and surface-water withdrawal rates were then used in the regression analysis.

$$av\ pct_{85\text{-}95} * tot_1\ adj\ wu_{60\text{-}80} = wu_{60\text{-}80} \qquad (7)$$

Population data for 1960, 1970, 1980, and 1985 were compiled from the "Missouri State Census Data Center Population Trends Report, 1960-1985," (Urban Information Center, accessed Aug. 1, 1996). Population data for 1965 and 1975 were compiled from USGS files. Population data for 1990-2010 were taken from "Post-Censal Population Projections to 2010 of Louisiana Parishes, 1994," (Louisiana State University Department of Sociology and the Louisiana Population Data Center for the Louisiana Division of Administration, accessed Aug. 1, 1996). Projections of population for 1995 were used instead of the 1995 U.S. Bureau of Census estimates, based on a discussion with the State Demographer, Karen Patterson (oral commun., 1996). Projections of population for 2015 and 2020 were estimated using a ln-ln regression model of population (POPU) against date (YEAR).

$$ln(POPU) = lnb_0 + b_1 ln(YEAR) + r_p \qquad (8)$$

where,

ln is the base-e (natural) logarithm, where e = 2.7183;

b_0, b_1 are the regression coefficients and,

r_p is the residual error equal to $\ln(POPU) - \ln(\hat{POPU})$ where $\ln(\hat{POPU}) = \ln b_0 + b_1 \ln(YEAR)$ which can also be expressed as $\hat{POPU} = b_0 YEAR^{b_1}$

Standard stepwise regression procedures were performed to project ground- and surface-water withdrawal rates for the period 2000 - 2020 using the following multiple regression equation:

$$WU = d_0 + d_1 YEAR + d_2 POPU + r_{wu} \qquad (9)$$

where

WU is either the ground- or surface-water withdrawal rate, and

d_0, d_1, d_2 are the regression coefficients, and

r_{wu} is the residual equal to $WU - \hat{WU}$, where

$$\hat{WU} = d_0 + d_1 YEAR + d_2 POPU$$

The stepwise regression procedure used only explanatory parameters that achieved the significance level of $\alpha = 0.15$. Because the withdrawal rates are projected beyond the range of actual data, the results were visually inspected for reasonableness and feasibility. The resulting regression equations are listed in table 1, with 95-percent confidence limits on the 2020 ground- and surface-water withdrawal projections listed in table 2. If no explanatory parameter achieved significance, then the projected rate was assumed to be the mean ground- or surface-water withdrawal calculated for 2000-2020.

Table 1. *Regression equation or mean withdrawal rate used to project future ground- and surface-water withdrawal rates for each parish within the Barataria-Terrebonne Basins, Louisiana*

[Mgal/d, in million gallons per day; WU, ground- or surface-water withdrawal rate]

Parish	Regression equation or mean withdrawal rate (Mgal/d)	
	Ground water	Surface water
Ascension	WU = -323 + 0.165 (YEAR)	WU = -0.305 + 0.000247 (POPU)
Assumption	6.545	WU = -0.584 + 0.300 (YEAR)
Iberville	20.342	19.457
Jefferson	9.09500	0.150
Lafourche	WU = -134.715+ 0.068 (YEAR)	36.075
Plaquemines	0.0	1.263
Pointe Coupee	WU = -537.728+ 0.275 (YEAR)	0.366667
St. Charles	2.202	6.553
St. James	2.218	18.828
St. John the Baptist	0.227	3.645
St. Mary	0.0	4.265
Terrebonne	[1]0.12	15.747
West Baton Rouge	WU = -548.142+ 0.281 (YEAR)	0.113

[1]Mean withdrawal rate of 1980-95 ground-water values.

Table 2. *The 95-percent confidence intervals for ground- and surface-water withdrawal rate projections for each parish within the Barataria-Terrebonne Basins, Louisiana*
[Mgal/d, in million gallons per day; n/a, no ground-water withdrawal in that part of the parish within the basins]

Parish	Lower bound on the 95-percent confidence interval for 2020 (Mgal/d)		Upper bound on the 95-percent confidence interval for 2020 (Mgal/d)	
	Ground water	Surface water	Ground water	Surface water
Ascension	3.250	2.128	17.220	3.669
Assumption	-.386	9.181	13.476	36.029
Iberville	.303	-2.454	40.380	41.367
Jefferson	4.028	-.673	14.162	.973
Lafourche	1.578	23.630	4.867	48.520
Plaquemines	n/a	-.949	n/a	3.475
Pointe Coupee	.955	-2.033	34.012	2.766
St. Charles	-5.341	-14.250	9.745	27.356
St. James	.362	-27.623	4.075	65.280
St. John the Baptist	.046	.813	.419	6.477
St. Mary	n/a	-9.667	n/a	18.197
Terrebonne	-.901	3.070	-.280	28.424
West Baton Rouge	6.171	-.467	34.286	.694

Description of Water Quality

USGS water-quality data were compiled from the following published reports: Demas and Curwick (1987), Goolsby and others (1995), McGee and Demcheck (1995), Garrison and others (1997), and Wells (1980). Nutrient data from Bayou Lafourche for October 1996 were collected and analyzed by the USGS. The nutrient data were part of the Bayou Lafourche re-evaluation process authorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and sponsored by the USEPA. All USGS reports and data are available at the USGS office in Baton Rouge, La. Assessments of water bodies in this report as supporting or not supporting designated uses were obtained from Louisiana Department of Environmental Quality publications.

Salinity and chloride data were compiled from various government agencies and public and private sources. The sources utilized included the following organizations: Lafourche Waterworks District 1; U.S. Army Corps of Engineers (COE); Louisiana Department of Health and Hospitals (DHH); City of Lockport Water System; Assumption Waterworks District 1; Nicolaus Paper, Inc.; City of Thibodaux Water System; Louisiana Department of Environmental Quality (DEQ); BTNEP; Terrebonne Waterworks District1; and the USGS.

All water-quality samples collected by the USGS were collected and analyzed according to methods described in Britton and Greeson (1988), Fishman and Friedman (1989), and Shelton (1994). Salinity data were subjected to the nonparametric Kendall's Tau test for trends and magnitude, as described in Wiseman and Swenson (1988). Methods for salinity collection and analysis also are discussed in Reed (1995).

WATER USE

In 1995, approximately 170 Mgal/d (million gallons per day) of water were withdrawn from ground- and surface-water sources within the Barataria-Terrebonne Basins. Of this amount, surface water accounted for 64 percent (110 Mgal/d) of the total withdrawals. The largest surface-water withdrawal rates were 40 Mgal/d from Bayou Lafourche, 14 Mgal/d from Bayou Boeuf, and 4.2 Mgal/d from the Gulf Intracoastal Waterway (GIWW). The largest ground-water withdrawal rates were 29 Mgal/d from the Mississippi River alluvial aquifer, 9.5 Mgal/d from the Gonzales-New Orleans aquifer, and 3.6 Mgal/d from the Norco aquifer. Together, these withdrawal rates accounted for 67 percent of the ground water used in the basins. Thirty-eight public water suppliers, 48 industrial facilities, 8 commercial facilities, and 2 fossil-fuel power plants reported withdrawal rates of ground- and surface-water in 1995 (table 3). Of these, 8 public water suppliers, 14 industrial facilities, and 1 commercial facility withdrew only surface water.

Public water suppliers within the basins withdrew 41 Mgal/d of ground and surface water in 1995. Of this amount, 25 Mgal/d were withdrawn from Bayou Lafourche, approximately 4.2 Mgal/d from the GIWW, 1.0 Mgal/d from Lower Grand River, and 1.0 Mgal/d from Bayou Boeuf and Bayou Black. Ground-water sources provided the remaining 9.8 Mgal/d withdrawn for public supply.

The five largest public water suppliers in the basins (table 4) withdrew 30 Mgal/d of surface water in 1995. Of the five largest public suppliers, Terrebonne Waterworks District 1 withdrew the largest amount in 1995, almost 15 Mgal/d. Industrial facilities withdrew 88 Mgal/d, and fossil-fueled power-generation plants withdrew 4.7 Mgal/d. Aggregate water-withdrawal rates, compiled by parish for aquaculture, livestock, rural domestic and irrigation uses, totaled about 38 Mgal/d in the basins. Of this amount, withdrawal rates for aquaculture were 37 Mgal/d; livestock, 0.56 Mgal/d; irrigation, 0.54 Mgal/d; and rural domestic, 0.44 Mgal/d. Ninety-five percent of aquaculture withdrawal rates, primarily for crawfish and alligator farming, were from surface sources.

Table 3: *Ground- and surface-water withdrawal sites by selected categories of use, Barataria-Terrebonne Basins, Louisiana, 1995*

[Surface-water withdrawal sites are shown on plate 1, in pocket. Dashes (--) indicate that some withdrawal rates are aggregated under one well or surface-water intake. Mgal/d, in million gallons per day; WS, public supply; IN, industry; CO, commercial; PF, fossil fuel power]

Facility identification number	Facility	Use	Surface-water body or well number	Latitude	Longitude	Hydrologic unit code	Aquifer[1]	Withdrawal rate (Mgal/d)
			ASCENSION PARISH					
357	People's Water Service	WS	Bayou Lafourche	300624	905931	08090301		1.636
374	Industry	IN	An- 83	300658	910257	08090302	112MRVA	--
		IN	An- 282	300657	910256	08090302	112MRVA	--
		IN	An- 283	300657	910256	08090302	112MRVA	--
		IN	An- 297	300656	910249	08090302	112MRVA	4.798
		IN	An- 298	300650	910250	08090302	112MRVA	--
		IN	An- 380	300652	910248	08090302	112MRVA	--
		IN	An- 550	300653	910255	08090302	112MRVA	--
		IN	An- 551	300653	910258	08090302	112MRVA	--
			ASSUMPTION PARISH					
381	Industry	IN	As- 76	295704	910241	08090301	112MRVA	--
		IN	As- 77	295703	910243	08090302	112MRVA	.112
		IN	Bayou Lafourche	295704	910132	08090302		2.144
382	Industry	IN	Bayou Lafourche	300222	910300	08090301		2.642
383	Industry	IN	Bayou Lafourche	[2]295500	[2]905900	08090301		5.162
384	Industry	IN	As- 72	300040	910825	08090302	112MRVA	5.200
		IN	As- 73	300037	910825	08090302	112MRVA	--
		IN	As- 79	300026	910800	08090302	112MRVA	--
		IN	As- 80	300050	910744	08090302	112MRVA	--
		IN	As- 81	300046	910735	08090302	112MRVA	--
		IN	As- 87	300049	910737	08090302	112MRVA	--
385	Industry	IN	Lake Verret	295802	910529	08090302		3.200
387	Assumption Waterworks District 1	WS	Bayou Lafourche	295602	910102	08090301		3.136
390	Industry	IN	As- 15	300022	910647	08090302	112NORC	--
		IN	As- 16	300037	910647	08090302	112NORC	3.572
		IN	As- 17	300042	910635	08090302	112MRVA	1.760
		IN	As- 59	300038	910724	08090302	112NORC	--
		IN	As- 60	300044	910644	08090302	112NORC	--
		IN	As- 85	300024	910630	08090302	112MRVA	--
		IN	([3])	300040	910725	08090302	112MRVA	--
1723	Commercial	CO	([3])	300050	910815	08090302	112MRVA	.095
		CO	([3])	300045	910814	08090302	112MRVA	--
			IBERVILLE PARISH					
509	Industry	IN	([3])	302000	911445	08070300	112MRVA	.002
577	Industry	IN	([3])	301900	911415	08070300	112MRVA	--
		IN	Cavern Lake	301831	911409	08070300		1.104
578	Industry	IN	Ib- 134	301856	911429	08070300	112MRVA	--
		IN	Ib- 180A	301911	911401	08070300	112SLBR	--
		IN	Ib- 180B	301911	911401	08070300	112SLBR	--
		IN	Ib- 180C	301911	911401	08070300	112SLBR	--
		IN	Ib- 180D	301911	911401	08070300	112MRVA	--
		IN	Ib- 181	301857	911345	08070300	112PLQM	--
		IN	Ib- 182	301912	911402	08070300	112PLQM	--
		IN	Ib- 183	301922	911408	08070300	112PLQM	.170
		IN	Ib- 184	301905	911352	08070300	112PLQM	--
		IN	Ib- 242	301911	911429	08070300	112MRVA	.057
		IN	Ib- 260	301918	911458	08070300	112MRVA	--
		IN	Ib- 261	301914	911501	08070300	112MRVA	--
		IN	WBR- 151	301925	911427	08070300	112MRVA	--
		IN	WBR- 163	301925	911427	08070300	112MRVA	--
		IN	WBR- 162	301925	911449	08070300	112MRVA	--
		IN	WBR- 142	301936	911443	08070300	112MRVA	--
		IN	WBR- 157	302007	911447	08070300	112MRVA	--
580	Industry	IN	Ib- 62	301008	910813	08090302	112MRVA	--
		IN	Ib- 63	301011	910803	08090302	112MRVA	--
		IN	Ib- 65	301036	910755	08090302	112MRVA	--
		IN	Ib- 68	301011	910814	08090302	112MRVA	--

Table 3: *Ground- and surface-water withdrawal sites by selected categories of use, Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Facility	Use	Surface-water body or well number	Latitude	Longitude	Hydrologic unit code	Aquifer[1]	Withdrawal rate (Mgal/d)
			IBERVILLE PARISH--Continued					
		IN	Ib- 69	301009	910815	08090302	112MRVA	--
		IN	Ib- 101	301009	910815	08090302	112MRVA	--
		IN	Ib- 159	300756	910753	08090302	112MRVA	--
		IN	Ib- 269	301015	910811	08070300	112MRVA	4.234
		IN	Ib- 343	301014	910805	08090302	112MRVA	--
584	Industry	IN	Ib- 227	301555	911102	08070300	112DDMRO	--
		IN	Ib- 228	301558	911052	08070300	112DDMRO	--
		IN	Ib- 244	301553	911059	08070300	112MRVA	3.189
		IN	Ib- 249	301547	911105	08070300	112DDMRO	1.595
		IN	Ib- 305	301558	911101	08070300	112MRVA	--
590	Grosse Tete water system	WS	Ib- 39B	302520	912615	08070300	12220BR	--
591	Maringouin water system	WS	Ib- 198	302926	913104	08070300	12224BR	1.176
		WS	Ib- 29	302919	913111	08070300	12220BR	--
592	White Castle water system	WS	Ib- 196	300959	910848	08070300	112MRVA	--
		WS	Ib- 223	300936	910903	08070300	112MRVA	.127
595	Rosedale water system	WS	Ib- 209A	302629	912709	08070300	12220BR	.072
596	Iberville Waterworks District 3	WS	Ib- 231	301541	910731	08070300	112DDMRO	--
		WS	Ib- 232	301539	910728	08070300	112DDMRO	--
		WS	Ib- 271	301559	910805	08070300	112DDMRO	.000
		WS	Lower Grand River	301310	911902	08070300		1.035
994	Commercial	CO	Ib- 300	301904	911840	08070300	112PLQM	.002
		CO	Cavern Lake	301901	911826	08070300		.130
1489	Myrtle Grove Mobile Home Park	WS	Ib- 276	301740	911445	08070300	112MRVA	.012
		WS	Ib- 275	301740	911445	08070300	112MRVA	--
1491	Industry	IN	Ib- 250	301542	911033	08070300	112DDMRO	.003
		IN	Ib- 229D	301542	911033	08070300	112DDMRO	--
1492	Iberville Waterworks District 4	WS	([3])	301705	911415	08070300	112MRVA	.311
1494	Commercial	CO	([3])	301705	911415	08070300	112MRVA	.000
1703	Industry	IN	Ib- 270	301902	911330	08070300	112PLQM	2.898
		IN	Ib- 224	301900	911335	08070300	112PLQM	--
		IN	Ib- 225	301901	911333	08070300	122PLQM	--
		IN	Ib- 248	301900	911331	08070300	122PLQM	--
		IN	Ib- 287	301858	911335	08070300	112PLQM	--
1933	Industry	IN	([3])	301700	911400	08070300	112MRVA	.005
			JEFFERSON PARISH					
617	Fossil-fuel power plant	PF	Jf- 25	295647	900845	08090301	112GZNO	--
		PF	Jf- 28	295643	900847	08090301	112GZNO	--
		PF	Jf- 43	295655	900849	08090301	112GZNO	3.400
618	Industry	IN	Jf- 161	295549	901041	08090301	112GZNO	--
		IN	Jf- 160	295518	901123	08090301	112GZNO	5.100
		IN	Jf- 159	295536	901049	08090301	112GZNO	--
619	Industry	IN	Jf- 151	295401	900456	08090301	112GRMC	--
620	Industry	IN	Jf- 158	295527	900839	08090301	112GZNO	--
638	Industry	IN	Jf- 191	295418	900741	08090301	112GZNO	.804
1603	Industry	IN	Jf- 132	295357	900914	08090301	112GZNO	.164
		IN	Jf- 193	295356	900915	08090301	112NORC	--
			LAFOURCHE PARISH					
189	Lafourche Waterworks District 1	WS	Bayou Lafourche	294656	904651	08090301		7.939
190	Lockport water system	WS	Bayou Lafourche	293849	903216	08090301		.216
191	Thibodaux water system	WS	Bayou Lafourche	294760	904912	08090301		3.292
194	Industry	IN	Bayou Lafourche	[2]294800	[2]905100	08090301		.081
195	Industry	IN	Bayou Lafourche	[2]294900	[2]905300	08090301		.025
239	[4]Terrebonne Waterworks District 1	WS	Bayou Lafourche	294545	904530	08090302		8.495
982	Industry	IN	Lf- 34	294357	905625	08090302	112MRVA	--
		IN	Lf- 35	294357	905625	08090302	112MRVA	1.197

Table 3: *Ground- and surface-water withdrawal sites by selected categories of use, Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Facility	Use	Surface-water body or well number	Latitude	Longitude	Hydrologic unit code	Aquifer[1]	Withdrawal rate (Mgal/d)
			LAFOURCHE PARISH--Continued					
1804	Industry	IN	Bayou Lafourche	294000	903500	08090302		.338
1805	Industry	IN	Bayou Lafourche	293800	902830	08090302		2.133
1993	Industry	IN	Bayou Lafourche	294355	903521	08090301		2.766
			POINTE COUPEE PARISH					
32	New Roads water system	WS	PC- 65	304147	912522	08070300	12228BR	.345
		WS	PC- 170	304155	912628	08070300	12228BR	.575
		WS	PC- 321	304157	912832	08070300	12203FP	.575
33	Morganza water system	WS	PC- 69	304411	913547	08070300	12228BR	.066
		WS	PC- 150	304411	913549	08070300	12228BR	.000
		WS	PC- 301	304430	913549	08070300	12112BR	.000
34	Fossil-fuel power plant	PF	PC- 161	304023	912111	08070300	12101FP	--
		PF	PC- 162	304019	912121	08070300	12101FP	.372
		PF	PC- 163	304018	912116	08070300	12101FP	.411
		PF	PC- 180	304322	912219	08070300	12112BR	.011
		PF	PC- 181	304323	912218	08070300	12112BR	.012
		PF	PC- 245	304321	912219	08070300	12101FP	.041
		PF	PC- 288	304025	912112	08070300	12101FP	.413
224	Fordoche water system	WS	PC- 282	303552	913759	08070300	12102FP	.109
		WS	PC- 151	303530	913629	08070300	12117BR	--
		WS	PC- 57	303544	913757	08070300	12112BR	--
		WS	PC- 54	303542	913650	08070300	12220BR	--
812	Livonia water system	WS	PC- 138	303357	913304	08070300	12220BR	--
		WS	PC- 147	303404	913254	08070300	12220BR	.101
		WS	PC- 276	303404	913254	08070300	12115BR	.050
813	Lottie Waterworks	WS	PC- 148	303315	913836	08070300	12117BR	.020
814	Pointe Coupee Waterworks District 2	WS	PC- 292B	304343	913858	08070300	12102FP	.039
816	Brownview Community water system	WS	PC- 196	304316	913457	08070300	12228BR	.043
		WS	PC- 189	304320	913452	08070300	12228BR	--
		WS	PC- 194	304305	913402	08070300	12228BR	--
817	Industry	IN	PC- 17	303538	912328	08070300	12117BR	.088
		IN	PC- 19	303538	912326	08070300	112MRVA	.913
		IN	PC- 21	303537	912328	08070300	11206BR	.913
		IN	PC- 22	303538	912326	08070300	11206BR	--
		IN	PC- 154	303538	912325	08070300	12117BR	.135
		IN	PC- 291	303542	912327	08070300	11206BR	.428
		IN	PC- 319	303537	912323	08070300	112MRVA	.917
990	Industry	IN	PC- 224	303206	912510	08070300	12220BR	1.015
997	Pointe Coupee Water District 1	WS	PC- 268	303802	912100	08070300	12115BR	.126
		WS	PC- 267	303827	912845	08070300	12203FP	.086
		WS	PC- 176	303840	912000	08070300	12220BR	.000
		WS	PC- 215	303640	912434	08070300	12224BR	.000
1535	False River Waterworks Corp.	WS	PC- 203	303926	912910	08070300	12228BR	.198
		WS	PC- 157	303927	912912	08070300	12228BR	--
		WS	PC- 152	303600	912418	08070300	12224BR	.097
1536	M & S water system	WS	PC- 257	304056	912449	08070300	12228BR	--
		WS	PC- 131	304031	912727	08070300	12203FP	.053
		WS	PC- 122	304052	912518	08070300	12203FP	--
		WS	PC- 112	303637	912419	08070300	12102FP	.027
		WS	PC- 59	304036	912155	08070300	12224BR	.027
		WS	PC- 262	304047	912658	08070300	12228BR	0.053
1543	Pointe Coupee Waterworks Corporation	WS	PC- 211	304339	912557	08070300	12228BR	.077
1656	John Lefeaux water system	WS	PC- 159	303138	913205	08070300	12220BR	.025
1772	Commercial	CO	[3]	303155	913148	08070300	12220BR	.007
1834	Commercial	CO	[3]	304344	912920	08070300	12228BR	.004
1835	Frisco water well	WS	PC- 204	303505	913142	08070300	12220BR	.003
1987	Torbert-Frisco water system	WS	PC- 153	303425	913008	08070300	12220BR	.050
1989	Pointe Coupee Area Water	WS	[3]	304237	912546	08070300	12228BR	.029

Table 3: *Ground- and surface-water withdrawal sites by selected categories of use, Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Facility	Use	Surface-water body or well number	Latitude	Longitude	Hydrologic unit code	Aquifer[1]	Withdrawal rate (Mgal/d)
			POINTE COUPEE PARISH--Continued					
2006	E. Lejeune water system	WS	([3])	303456	913136	08070300	12117BR	.012
2008	Waterloo Water Service	WS	([3])	304125	912420	08070300	12228BR	.040
			ST. CHARLES PARISH					
1848	Industry	IN	SC- 167	295849	902712	08090301	112NORC	.003
1937	Industry	IN	Humble Canal	295124	902727	08090301		5.900
		IN	SC- 166	295136	902712	08090301	112NORC	.036
		IN	SC- 165	295140	902705	08090301	112NORC	--
			ST. JAMES PARISH					
910	Industry	IN	SJ- 4	295938	905045	08090301	112GRMC	--
		IN	SJ- 5	295938	905045	08090301	112GRMC	--
		IN	SJ- 6	295940	905050	08090301	112GRMC	--
		IN	SJ- 7	295941	905045	08090301	112GRMC	--
		IN	SJ- 172	295938	905030	08090301	112GRMC	--
		IN	SJ- 173	295938	905050	08090301	112GRMC	1.091
			ST. JOHN THE BAPTIST PARISH					
924	Industry	IN	SJB- 169	300214	903421	08090301	112GRMC	--
		IN	SJB- 171	300215	903416	08090301	112GRMC	.172
		IN	Des Allemands	300245	903400	08090301		2.671
			ST. MARY PARISH					
1122	St. Mary Water District 3	WS	Bayou Boeuf	[2]294100	[2]910700	08090302		.800
1128	Commercial	CO	Bayou Boeuf	[2]294100	[2]910600	08090302		.243
		CO	Bayou Caroline	[2]294100	[2]910600	08090302		.005
1564	Industry	IN	Bayou Boeuf	[2]294200	[2]910700	08090302		12.839
1861	Industry	IN	Gulf Intracoastal Waterway	[2]294100	[2]910600	08090302		.002
			TERREBONNE PARISH					
239	[4]Terrebonne Waterworks District 1	WS	Gulf Intracoastal Waterway	293428	904302	08090302		4.170
		WS	Bayou Black	293431	904330	08090302		.581
1692	Industry	IN	([3])	292600	903700	08090302	112MRVA	.054
1901	Industry	IN	Bayou Black	[2]293400	[2]905800	08090302		.003
1902	Industry	IN	Private Canal	293740	905545	08090302		.065
1903	Industry	IN	Houma Navigation Canal	[2]292100	[2]904400	08090302		2.235
			WEST BATON ROUGE PARISH					
35	W. Baton Rouge Gas And Water	WS	WBR- 98	302842	911226	08070300	12110BR	--
		WS	WBR- 132	302505	911320	08070300	12115BR	--
		WS	WBR- 150	302827	911254	08070300	12110BR	0.856
		WS	WBR- 152	302927	911302	08070300	12108BR	.856
		WS	WBR- 153	302959	911248	08070300	12108BR	.000
		WS	WBR- 154	303002	911858	08070300	12112BR	--
		WS	WBR- 164	303002	911858	08070300	12110BR	--
36	Commercial	CO	WBR- 36	302610	911211	08070300	12112BR	--
		CO	WBR- 37	302613	911215	08070300	12112BR	--
		CO	WBR- 181	302644	911212	08070300	12117BR	.177
37	Plaquemine water system	WS	WBR- 111	302550	911241	08070300	12220BR	.000
		WS	WBR- 112	302550	911241	08070300	12115BR	.774
		WS	WBR- 113	302547	911232	08070300	12115BR	.774
38	Port Allen water system	WS	WBR- 35	302657	911242	08070300	12112BR	.155
		WS	WBR- 110	302733	911254	08070300	12112BR	.372
		WS	WBR- 4	302733	911224	08070300	12117BR	.105
39	W. Baton Rouge Water District 4	WS	WBR- 164	303002	911858	08070300	12110BR	.046
		WS	WBR- 176	303229	912146	08070300	12115BR	.163

Table 3: *Ground- and surface-water withdrawal sites by selected categories of use, Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Facility	Use	Surface-water body or well number	Latitude	Longitude	Hydrologic unit code	Aquifer[1]	Withdrawal rate (Mgal/d)
			WEST BATON ROUGE PARISH--Continued					
		WS	WBR- 177	303227	912414	08070300	12115BR	.163
41	W. Baton Rouge Water District 2	WS	WBR- 173	302456	911302	08070300	12115BR	.302
		WS	WBR- 173	302456	911302	08070300	12115BR	.302
		WS	WBR- 132	302505	911320	08070300	12115BR	.287
415	Commercial	CO	WBR- 103	302522	911227	08070300	12115BR	.013
578	Industry	IN	WBR- 140	301948	911424	08070300	112MRVA	--
		IN	WBR- 141	302007	911447	08070300	112MRVA	.775
1059	Industry	IN	WBR- 155	302042	911515	08070300	112MRVA	--
		IN	WBR- 156	302038	911516	08070300	112MRVA	.607
1060	Industry	IN	WBR- 171	302019	911508	08070300	112MRVA	--
		IN	WBR- 174	302016	911502	08070300	112MRVA	1.164
		IN	WBR- 197	302023	911508	08070300	112MRVA	--
1061	Industry	IN	WBR- 118	301942	911643	08070300	112MRVA	.175
		IN	WBR- 203	301946	911644	08070300	112MRVA	--
1062	Industry	IN	WBR- 24	302348	911403	08070300	112SLBR	--
		IN	WBR- 79	302349	911400	08070300	112MRVA	1.556
		IN	WBR- 191	302343	911402	08070300	112MRVA	--
		IN	WBR- 192	302344	911352	08070300	112MRVA	--
		IN	WBR- 193	302347	911358	08070300	112MRVA	--
1065	Industry	IN	WBR- 167	301924	911504	08070300	112MRVA	--
		IN	WBR- 168	301928	911508	08070300	112MRVA	.091
1066	W. Baton Rouge Waterworks District 1	WS	WBR- 126	302133	911552	08070300	112MRVA	--
		WS	WBR- 145	302128	911556	08070300	112MRVA	.231
1103	Industry	IN	WBR- 38	302836	911249	08070300	12112BR	.072
		IN	WBR- 44	302833	911245	08070300	12112BR	.072
1473	Westport Properties	WS	WBR- 137	302657	911421	08070300	12112BR	.144
1593	Industry	IN	([3])	302920	911220	08070300	12110BR	.000
1958	Industry	IN	([3])	302700	911200	08070300	12112BR	.005
1982	Industry	IN	([3])	302800	911300	08070300	112MRVA	.002

[1]Aquifer: 112MRVA, Mississippi River alluvial; 112NORC, Norco; 112SLBR, Shallow sands of Baton Rouge area; 112DDMRO, Deltaic deposits of Mississippi River Valley, older; 12220BR, "2,000-foot" sand of Baton Rouge area; 12224BR, "2,400-foot" sand of Baton Rouge area; 112PLQM, Plaquemines; 112GZNO, Gonzales-New Orleans; 12228BR, "2,800-foot" sand of Baton Rouge area; 12203FP, Zone 3 Florida Parishes and Pointe Coupee Parish; 12112BR, "1,200-foot" sand of Baton Rouge area; 12101FP, Zone 1 Florida Parishes and Pointe Coupee Parish; 12102FP, Zone 2 Florida Parishes and Pointe Coupee Parish; 12117BR, "1,700-foot" sand of Baton Rouge area; 12115BR, "1,500-foot" sand of Baton Rouge area; 11206BR, "600-foot" sand of Baton Rouge area; 112GRMC, Gramercy; 12110BR, "1,000-foot" sand of Baton Rouge area; 12108BR, "800-foot" sand of Baton Rouge area.

[2] Estimated latitude and longitude.

[3] Not available.

[4] Terrebonne Waterworks District 1 is listed in Lafourche and Terrebonne Parishes but is counted as one public water supplier.

Table 4. *Water-withdrawal rates for the five largest surface-water public suppliers in the Barataria-Terrebonne Basins, Louisiana, 1988-95*

[Withdrawal rates are in million gallons per day. --, no data collected from these public suppliers in 1988]

Water supplier	1988	1989	1990	1991	1992	1993	1994	1995
Terrebonne Waterworks District 1	14.61	16.50	15.31	13.17	12.86	13.02	13.25	14.62
Lafourche Waterworks District 1	7.53	7.94	8.20	8.19	7.91	7.66	7.94	8.32
Assumption Waterworks District 1	--	2.63	2.68	2.60	3.05	2.95	3.14	3.17
Thibodaux water system	--	2.64	3.04	2.97	2.82	2.87	3.29	2.88
Iberville Waterworks District 3	--	1.04	.83	.80	.80	.92	1.04	1.03

POPULATION AND WATER-USE TRENDS AND PROJECTIONS

Population projections were presented for each parish for the period 2000-2020. Water-use projections for each parish were made for the period 2000-2020. The methods used for the projections are described in the "Methods" section. Projections for each of the 13 parishes are discussed, and large increases or decreases in historical water use are explained.

Trends and Projections by Parish

Ascension Parish

About 8.5 percent of Ascension Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates for public supply accounted for 25 percent (1.6 Mgal/d) of the total water-withdrawal rates of 6.6 Mgal/d. Total water-withdrawal rates increased 189 percent from 1960-95 (fig. 1). Multiple regression was used for the projected ground- and surface-water withdrawal rates. In 2020, total water-withdrawal rates are projected as 13 Mgal/d for an increase of 100 percent from 1995. The fluctuation in ground-water withdrawal rates from 1985-95 was due to one industrial facility.

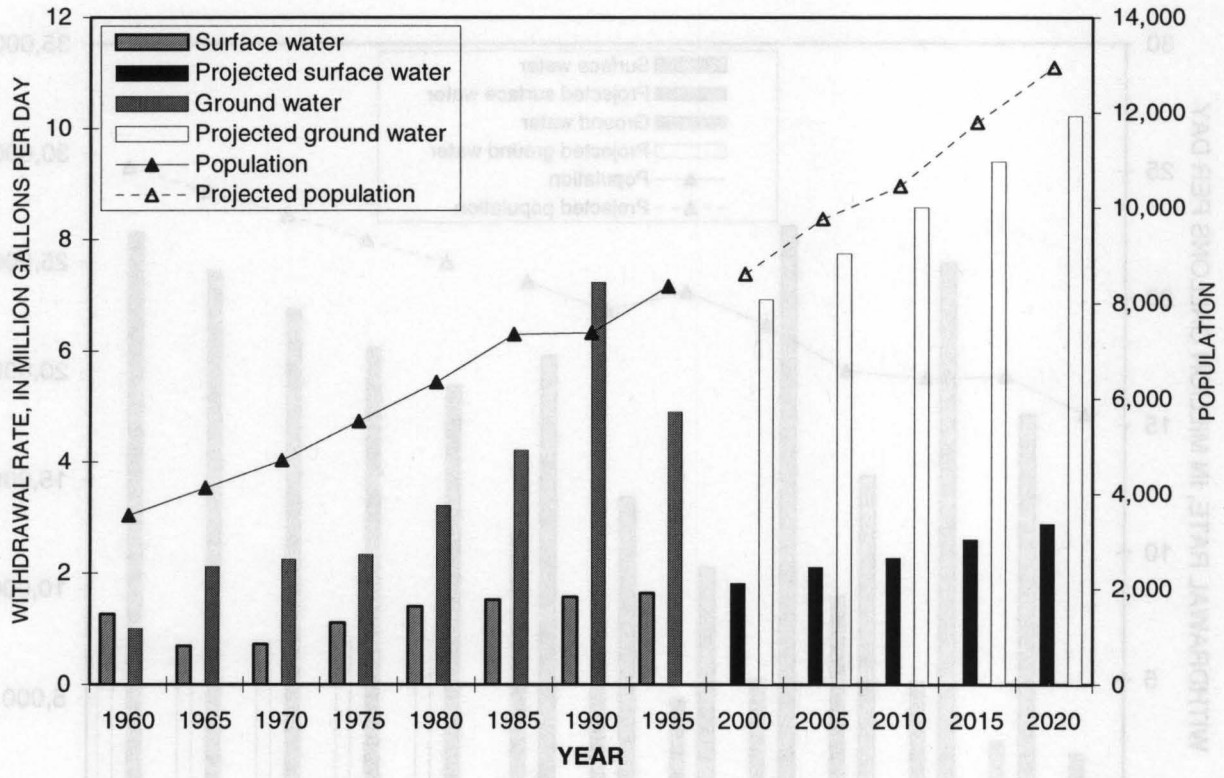

Figure 1. Historical and projected population and water-withdrawal rates, 1960-2020, for Ascension Parish within the Barataria-Terrebonne Basins, Louisiana.

Assumption Parish

All of Assumption Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates accounted for 18 Mgal/d or 62 percent of the total withdrawal rates of 29 Mgal/d. Total water-withdrawal rates increased 869 percent since 1960 (fig. 2). Neither variable in the ground-water regression model met the 0.15 significance level, so the mean was used for the projections. Multiple regression was used for the predicted surface-water withdrawal rates. In 2020, the projected total water-withdrawal rate is 29 Mgal/d or an increase of 2.3 percent from the 1995 total water-withdrawal rate. The overall water-use trend from 1960-95 was uneven. The large fluctuation in surface-water withdrawal rates of 9.4 Mgal/d up to 22 Mgal/d from 1970-95 is primarily due to an industrial facility. The facility used large amounts of surface water in some years and significantly reduced its surface-water withdrawals in other years. The industry closed in early 1996. Because of these large fluctuations and its closure, the industrial facility's water-use values were excluded from the multiple regression analysis. Consequently, the projected withdrawal rates for the year 2000 show a small decrease, then a steady small increase in withdrawal rates after 2000.

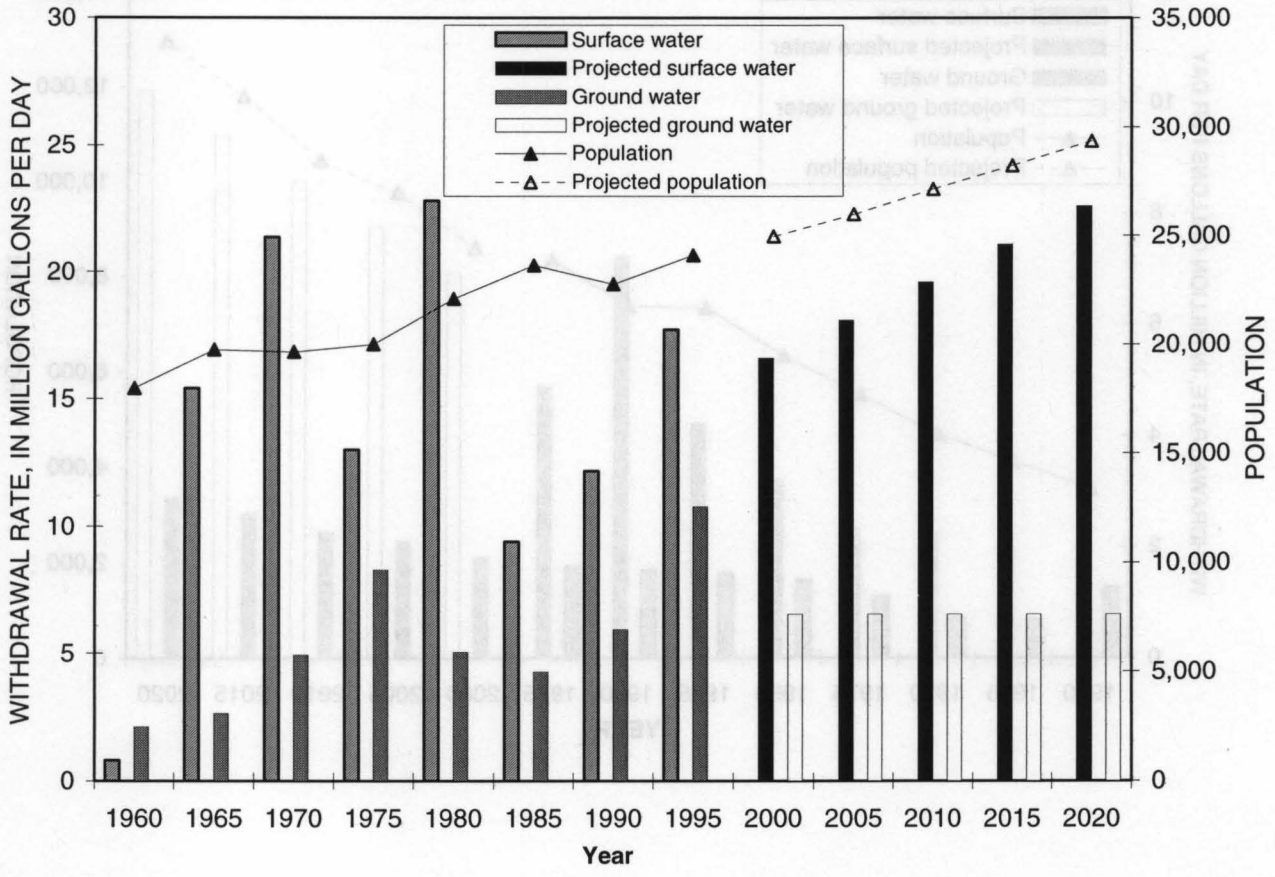

Figure 2. Historical and projected population and water-withdrawal rates, 1960-2020, for Assumption Parish within the Barataria-Terrebonne Basins, Louisiana.

Iberville Parish

Fifty-seven percent of Iberville Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, total water-withdrawal rates in Iberville Parish within the study area were 24 Mgal/d. Surface-water withdrawal rates accounted for 42 percent or 10 Mgal/d of that amount. Total water-withdrawal rates increased 120 percent from 1960 to 1995 (fig. 3). In 1995, more than 54 percent of the ground- and surface-water withdrawal rates within the study area were from industrial facilities. The projection for total water-withdrawal rates in 2020 is 40 Mgal/d or an increase of 64 percent from 1995. Because there is no significant historic trend, neither variable in the ground- or surface-water regression model met the 0.15 significance level, and the means were used for the projected withdrawal rates. The large increase in surface-water withdrawal rates in 1990 was due to higher per-acre application rates for crawfish farming. The decrease in ground-water withdrawal rates from 1990-95 was due in part to decreased use by one industrial facility. The decrease in surface-water withdrawal rates was due in part to a decrease in industrial withdrawal rates and lower per-acre application rates (modified in 1995) for crawfish farming.

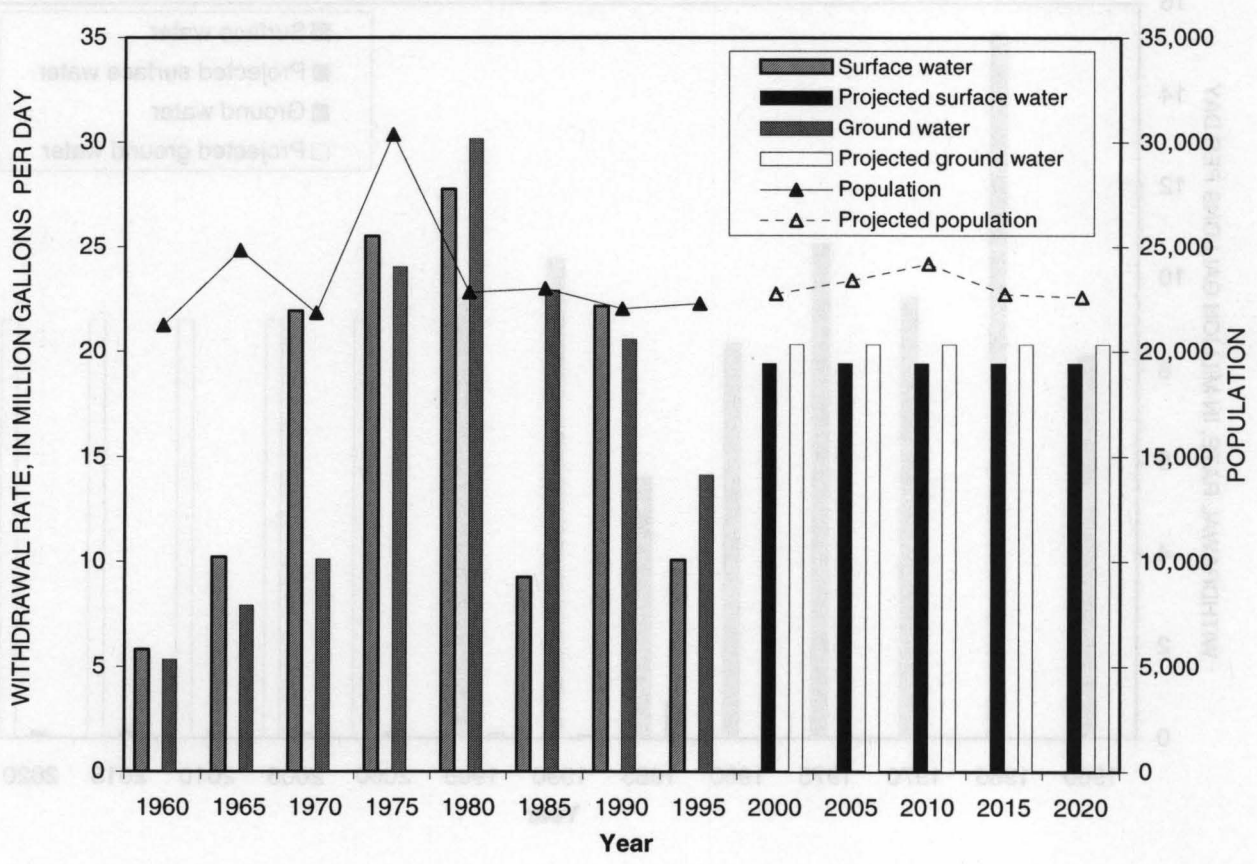

Figure 3. Historical and projected population and water-withdrawal rates, 1960-2020, for Iberville Parish within the Barataria-Terrebonne Basins, Louisiana.

Jefferson Parish

Sixty-three percent of Jefferson Parish is located within the boundaries of the Barataria-Terrebonne Basins. Although the Mississippi River supplies more than 99 percent of all water used in Jefferson Parish, ground water accounts for the majority of water pumped in the part of the parish that lies within the study area. In 1995, surface-water withdrawal rates accounted for only about 1 percent or 0.09 Mgal/d of the total withdrawal rates of 9.6 Mgal/d. Total water-withdrawal rates increased 12 percent from 1960-95 (fig. 4). Most of the ground- and surface-water withdrawal rates, 63 percent, were from industrial facilities in 1995. Because no public-supply withdrawal rates were reported in the part of this parish that is in the study area, population could not be used in the regression model. The date variable in the ground- and surface-water regression models failed to meet the 0.15 significance level, and the means were used for the projected withdrawal rates. The projection for total water-withdrawal rates in 2020 is projected as 9.3 Mgal/d, a slight decrease of 3 percent from the 1995 total water-withdrawal rates for the parish.

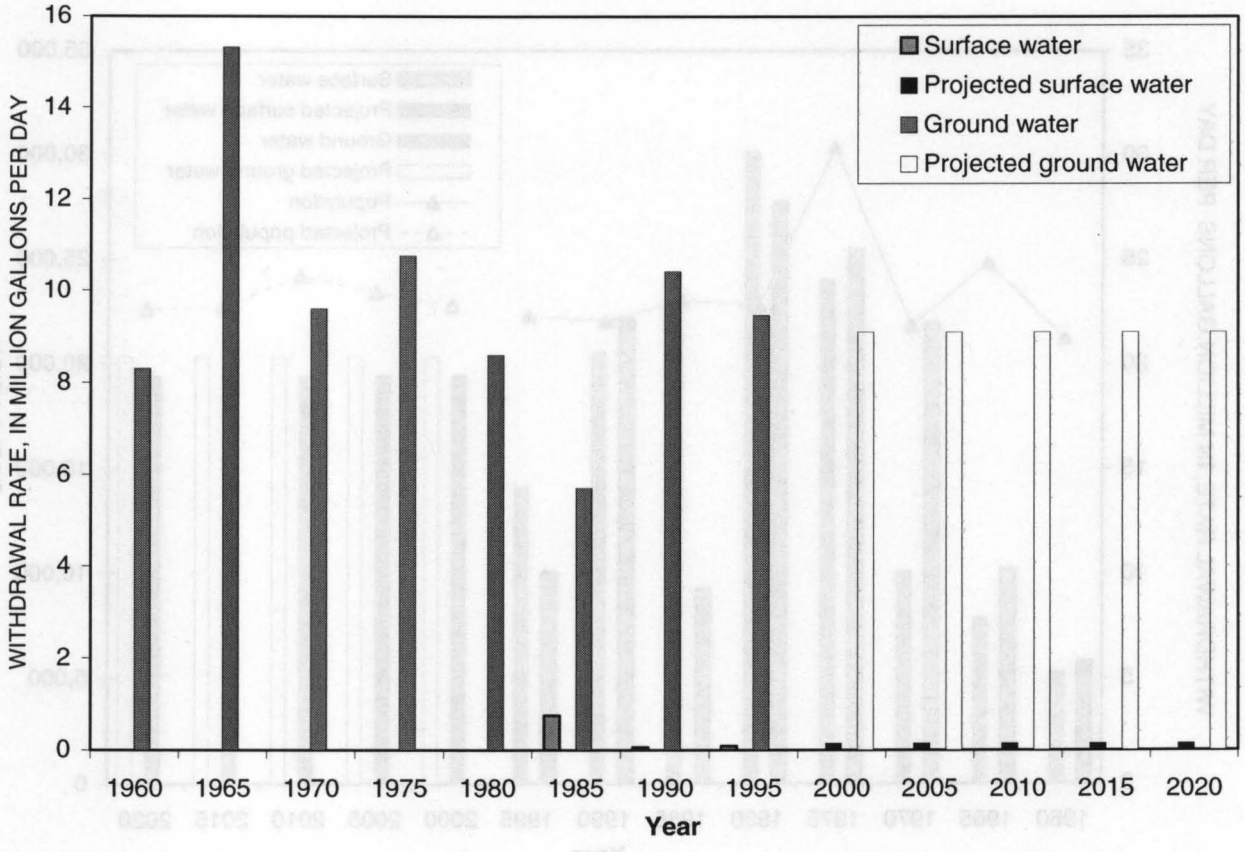

Figure 4. Historical and projected water-withdrawal rates, 1960-2020, for Jefferson Parish within the Barataria-Terrebonne Basins, Louisiana.

Lafourche Parish

All of Lafourche Parish is located within the boundaries of the Barataria-Terrebonne Basins. Lafourche Parish also had the largest water-withdrawal rates within the basins, 36 Mgal/d in 1995. Of that amount, surface-water withdrawal rates accounted for 96 percent or 35 Mgal/d. In 1995, more than 55 percent of ground- and surface-water withdrawal rates within the study area were from public water suppliers. Total water-withdrawal rates increased 327 percent from 1960 to 1995 (fig. 5). Multiple regression was used for the projected ground-water withdrawal rates. Neither variable in the surface-water regression model met the 0.15 significance level, and the mean was used for the projected withdrawal rates. Total water-withdrawal rates in 2020 is projected to be 39 Mgal/d, an increase of 8 percent from the 1995 total water-withdrawal rates. The large increase in surface-water withdrawal rates in 1990 and subsequent decrease in 1995 were due to higher per-acre application rates (modified in 1995) for crawfish farming.

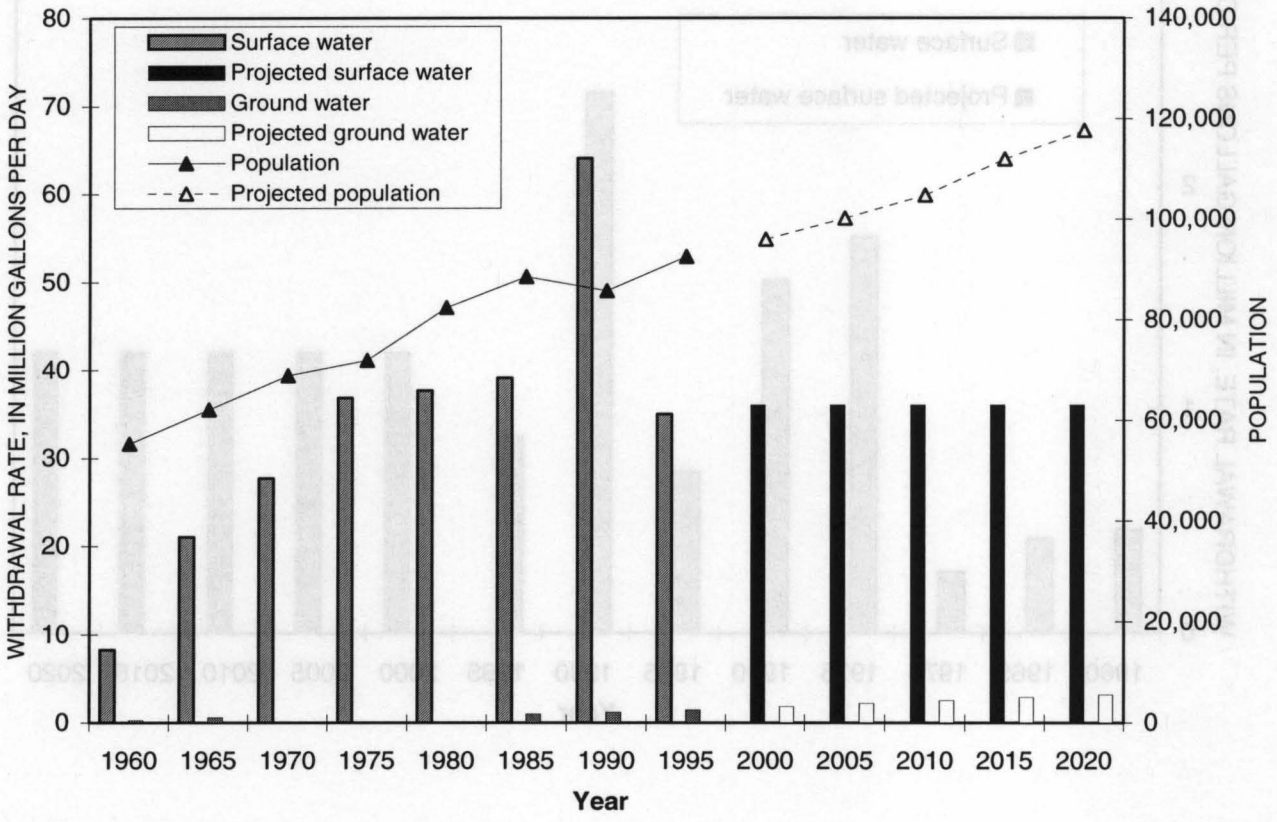

Figure 5. Historical and projected population and water-withdrawal rates, 1960-2020, for Lafourche Parish within the Barataria-Terrebonne Basins, Louisiana.

Plaquemines Parish

Thirty percent of Plaquemines Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates for livestock and aquaculture accounted for 100 percent or 0.82 Mgal/d of the total withdrawal rates in the part of the parish within the study area. Aquaculture withdrawal rates accounted for 91 percent of that total. For this reason, population could not be used in the regression model. Because the date variable in the surface-water regression model failed to meet the 0.15 significance level, the mean was used for the projected withdrawal rates. Total water-withdrawal rates increased 77 percent from 1960 to 1995 (fig. 6). The projection for total water-withdrawal rates in 2020 is 1.3 Mgal/d, an increase of 53 percent from the 1995 total water-withdrawal rates.

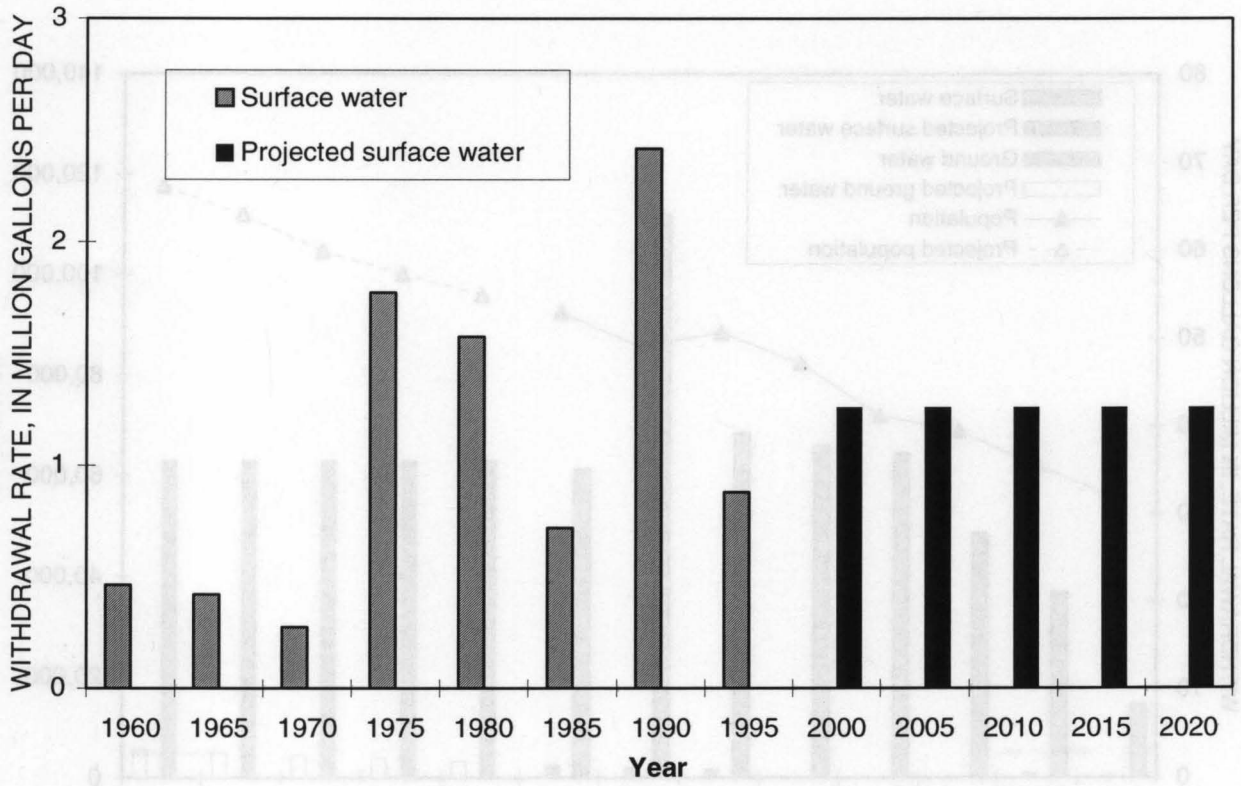

Figure 6. Historical and projected water-withdrawal rates, 1960-2020, for Plaquemines Parish within the Barataria-Terrebonne Basins, Louisiana.

Pointe Coupee Parish

Thirty-nine percent of Pointe Coupee Parish is located within the boundaries of the Barataria-Terrebonne Basins. Ground water is the primary source of water. In 1995, surface-water withdrawal rates accounted for only 2.1 Mgal/d or 19 percent of the total withdrawal rates of 11 Mgal/d. Most of those withdrawal rates are from miscellaneous streams and are used for aquaculture and irrigation. Total water-withdrawal rates increased 490 percent from 1960 to 1995 (fig. 7). Multiple regression was used for the projected ground-water withdrawal rates. Neither variable in the surface-water regression model met the 0.15 significance level, and the mean was used for the projected withdrawal rates. The projection for total water-withdrawal rates in 2020 is 18 Mgal/d or an increase of 58 percent from the 1995 total water-withdrawal rates. The large increase in ground-water withdrawal rates in 1990 was due in part to an increase in withdrawal rates for crawfish farming. Ground-water withdrawal rates at a fossil-fuel plant located in this parish are included. Withdrawal rates of Mississippi River water at this plant are not included.

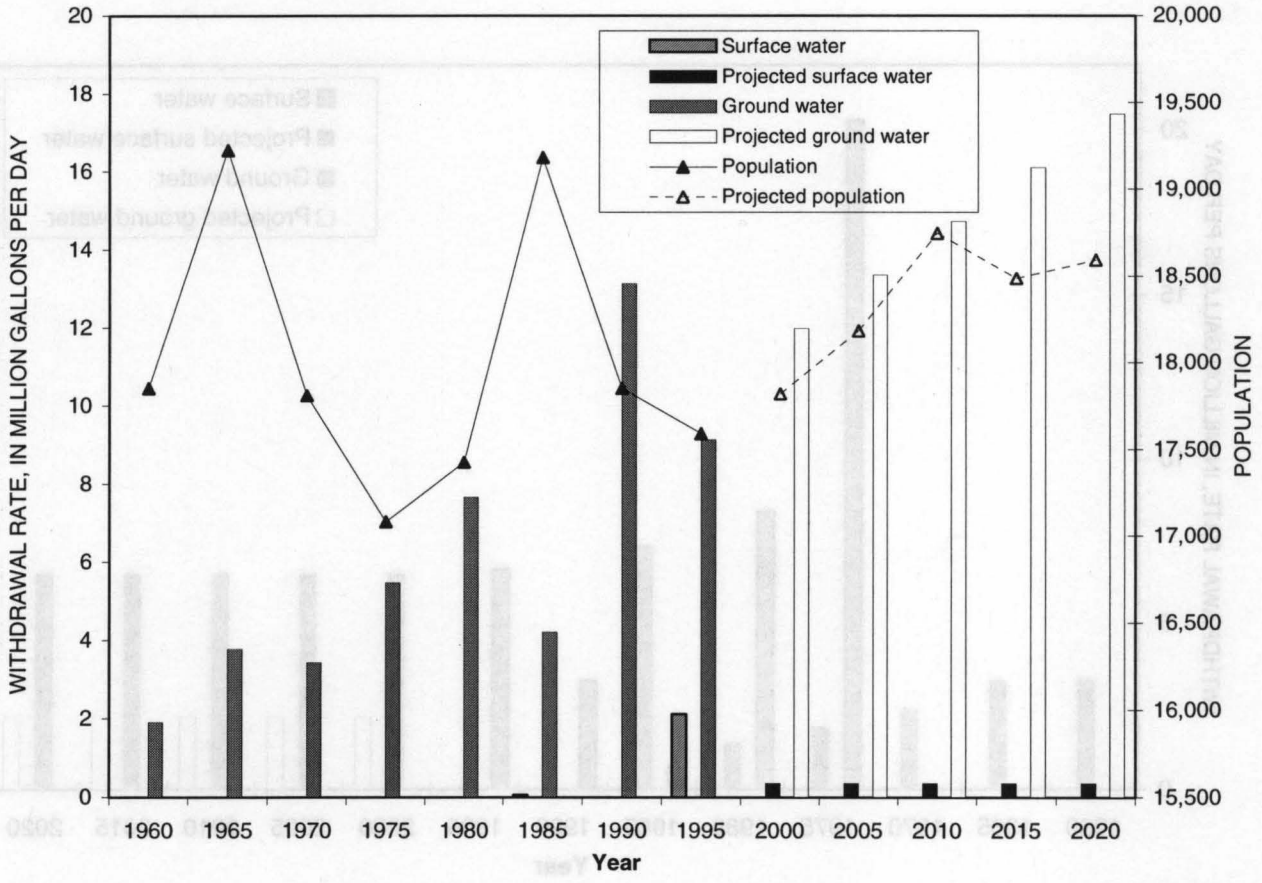

Figure 7. Historical and projected population and water-withdrawal rates, 1960-2020, for Pointe Coupee Parish within the Barataria-Terrebonne Basins, Louisiana.

St. Charles Parish

Sixty percent of St. Charles Parish is located within the boundaries of the Barataria-Terrebonne Basins. Surface water has been the predominate source of water for the parish within the basins since 1990. In 1995, surface-water withdrawal rates accounted for 6.6 Mgal/d or 99 percent of the total withdrawal rates of 6.7 Mgal/d. Of the total ground- and surface-water withdrawal rates within the study area in 1995, almost 88 percent were from industrial facilities. Because no public-supply withdrawal rates were reported in the part of this parish that is in the study area, population could not be used in the regression model. The date variable in the ground- and surface-water regression models failed to meet the 0.15 significance level, and the means were used for the projected withdrawal rates. Total water-withdrawal rates increased 102 percent from 1960 to 1995 (fig. 8). The projection for total water-withdrawal rates in 2020 is 8.8 Mgal/d, an increase of 30 percent from the 1995 total water-withdrawal rates. The large surface-water withdrawal rates in 1975 are due largely to one industrial facility. This facility did not report withdrawal rates in 1985 or 1990.

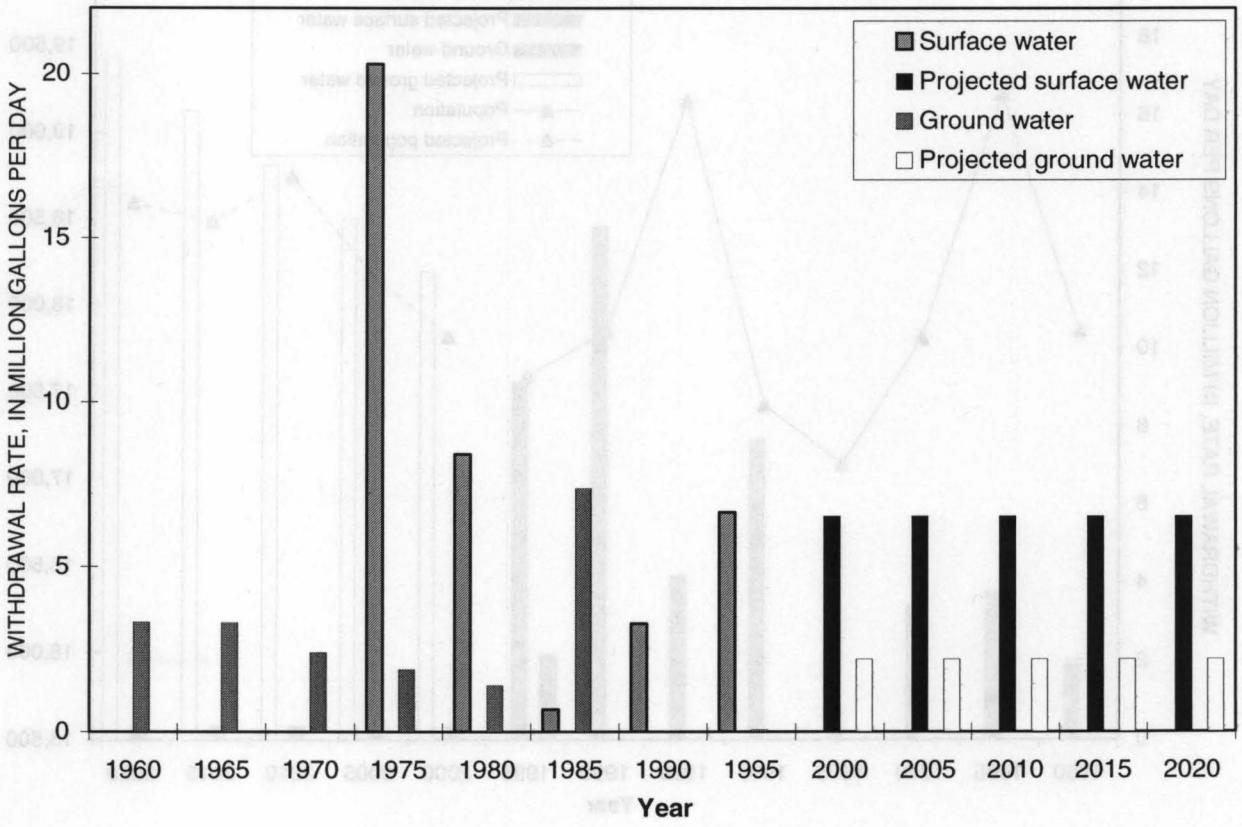

Figure 8. Historical and projected water-withdrawal rates, 1960-2020, for St. Charles Parish within the Barataria-Terrebonne Basins, Louisiana.

St. James Parish

Forty-one percent of St. James Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates for aquaculture accounted for 8.0 Mgal/d or 88 percent of the total withdrawal rates of 9.1 Mgal/d within the study area. Total water-withdrawal rates increased 82 percent from 1960 to 1995 (fig. 9). There were no surface-water withdrawal rates in 1985. Because no public-supply withdrawal rates were reported in the part of this parish that is in the study area, population could not be used in the regression model. The date variable in the ground- and surface-water regression models failed to meet the 0.15 significance level, and the means were used for the projected withdrawal rates. Total water-withdrawal rates in 2020 are projected as 21 Mgal/d, an increase of 130 percent from 1995. The large increase in surface-water withdrawal rates in 1990 was due to higher per-acre application rates (modified in 1995) for crawfish farming.

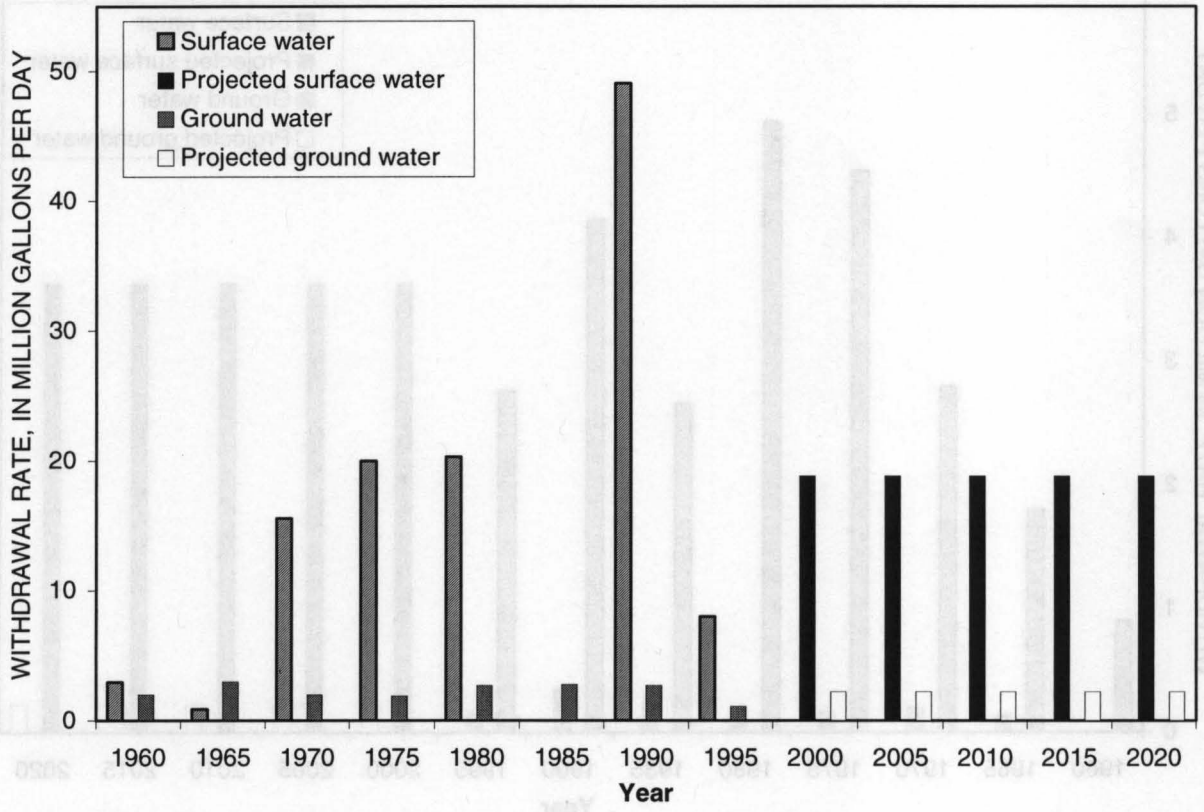

Figure 9. Historical and projected water-withdrawal rates, 1960-2020, for St. James Parish within the Barataria-Terrebonne Basins, Louisiana.

St. John the Baptist Parish

Seventeen percent of St. John the Baptist Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates accounted for almost all of the withdrawal rates in the parish within the basins, or 94 percent (2.8 Mgal/d) of the total withdrawal rates. Of the total surface-water withdrawal rates for 1995, about 96 percent of the withdrawal rates were from industrial facilities within the study area, with the remaining withdrawal rates for alligator farming. Total water-withdrawal rates increased 220 percent from 1960 to 1995 (fig. 10). Because no public-supply withdrawal rates were reported in the part of this parish that is in the study area, population could not be used in the regression model. The date variable in the ground- and surface-water regression models failed to meet the 0.15 significance level, and the means were used for the projected withdrawal rates. The projection for total water- withdrawal rates in 2020 is 3.9 Mgal/d, an increase of 32 percent from 1995.

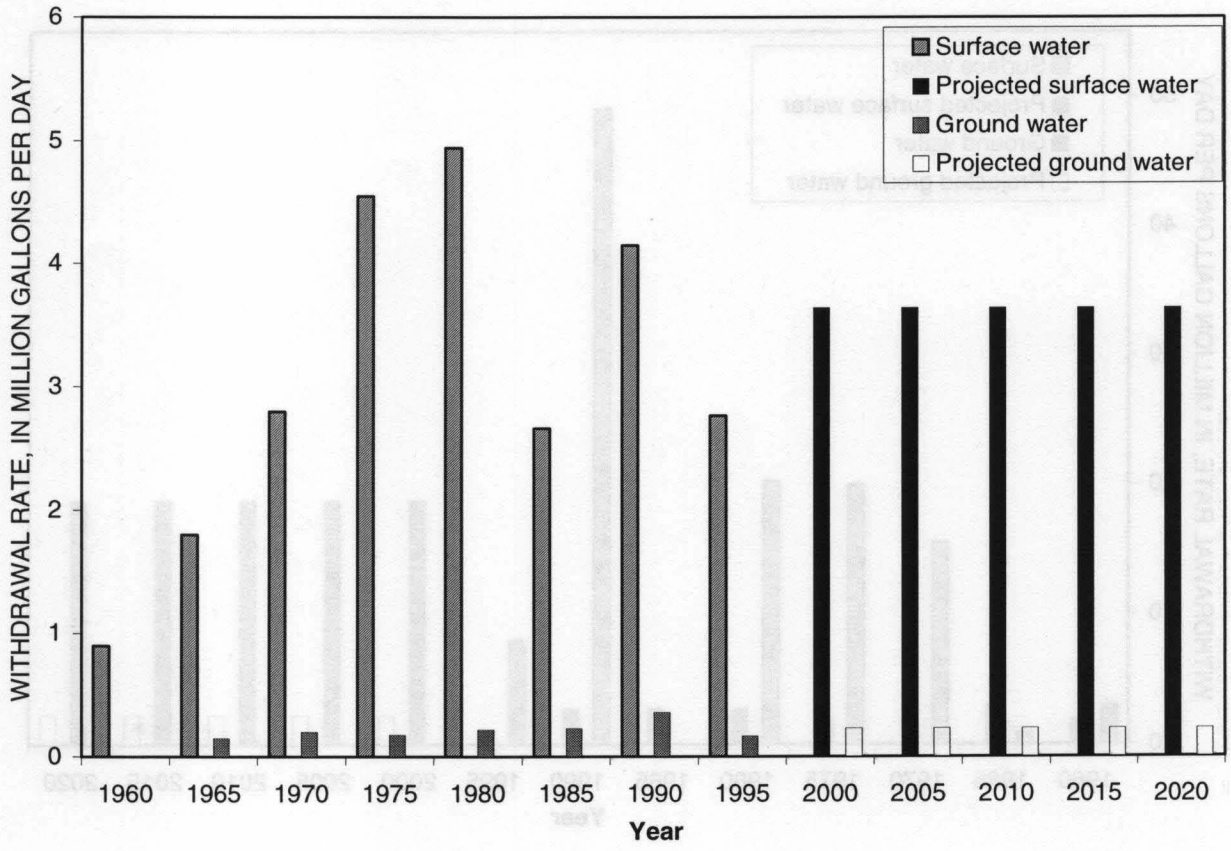

Figure 10. Historical and projected water-withdrawal rates, 1960-2020, for St. John the Baptist Parish within the Barataria-Terrebonne Basins, Louisiana.

St. Mary Parish

About 7.1 percent of St. Mary Parish is located within the boundaries of the Barataria-Terrebonne Basins. Surface water is the predominant source of freshwater in this parish within the basins. In 1995, surface-water withdrawal rates accounted for almost 14 Mgal/d or 100 percent of the withdrawal rates in the parish within the basins. Of that amount, one industrial facility withdrew more than 92 percent of the total withdrawal rates in the parish within the study area. Surface-water withdrawal rates increased 790 percent from 1960 to 1995 (fig. 11). There were no withdrawal rates reported in the parish within the study area in 1985. Neither variable in the surface-water regression model met the 0.15 significance level, and the mean was used for the projected withdrawal rates. The projection for total surface-water withdrawal rates in 2020 is 4.3 Mgal/d, a decrease of 69 percent from 1995. Should the industrial facility, which has been closed since 1995, begin operations, this amount would sharply increase.

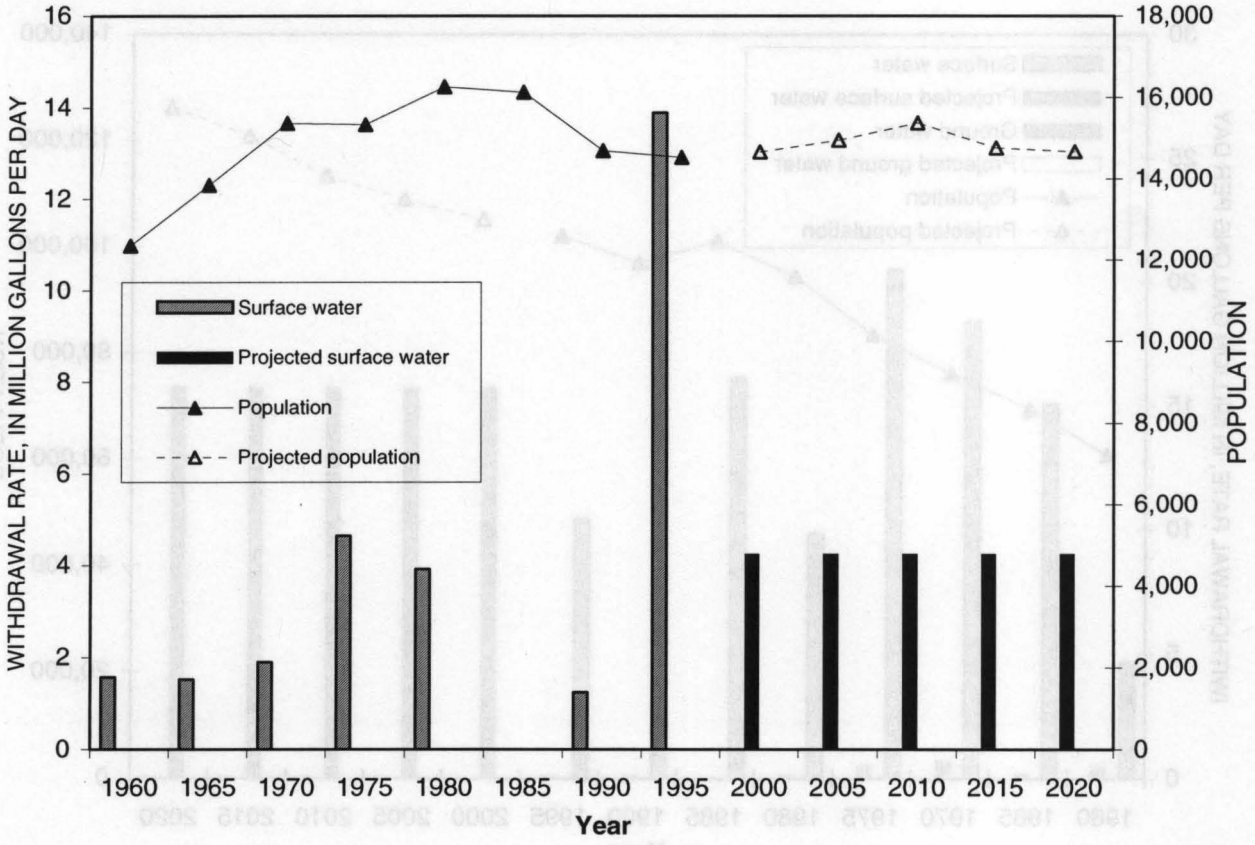

Figure 11. Historical and projected population and water-withdrawal rates, 1960-2020, for St. Mary Parish within the Barataria-Terrebonne Basins, Louisiana.

Terrebonne Parish

All of Terrebonne Parish is located within the boundaries of the Barataria-Terrebonne Basins. In 1995, surface-water withdrawal rates accounted for about 99 percent or 10 Mgal/d of the total withdrawal rates. Withdrawal rates from public water suppliers accounted for almost 46 percent of the total withdrawal rates, followed by withdrawal rates for alligator farming and industry. Total water-withdrawal rates increased over 100 percent from 1960 to 1995 (fig. 12). Multiple regression was used for the projected ground-water withdrawal rates. Ground-water use has considerably declined since 1970. Based on visual inspection of the regression results which reduced the projected ground-water withdrawal to a negative number by 2000, the average of the 1980-95 values was used for the projected ground-water withdrawal rates. There is no significant trend in water use from 1960-95. Neither variable in the surface-water regression model met the 0.15 significance level, and the mean was used for the projected surface-water withdrawal rates. The projection for total water-withdrawal rates in 2020 is 16 Mgal/d, an increase of 50 percent from 1995.

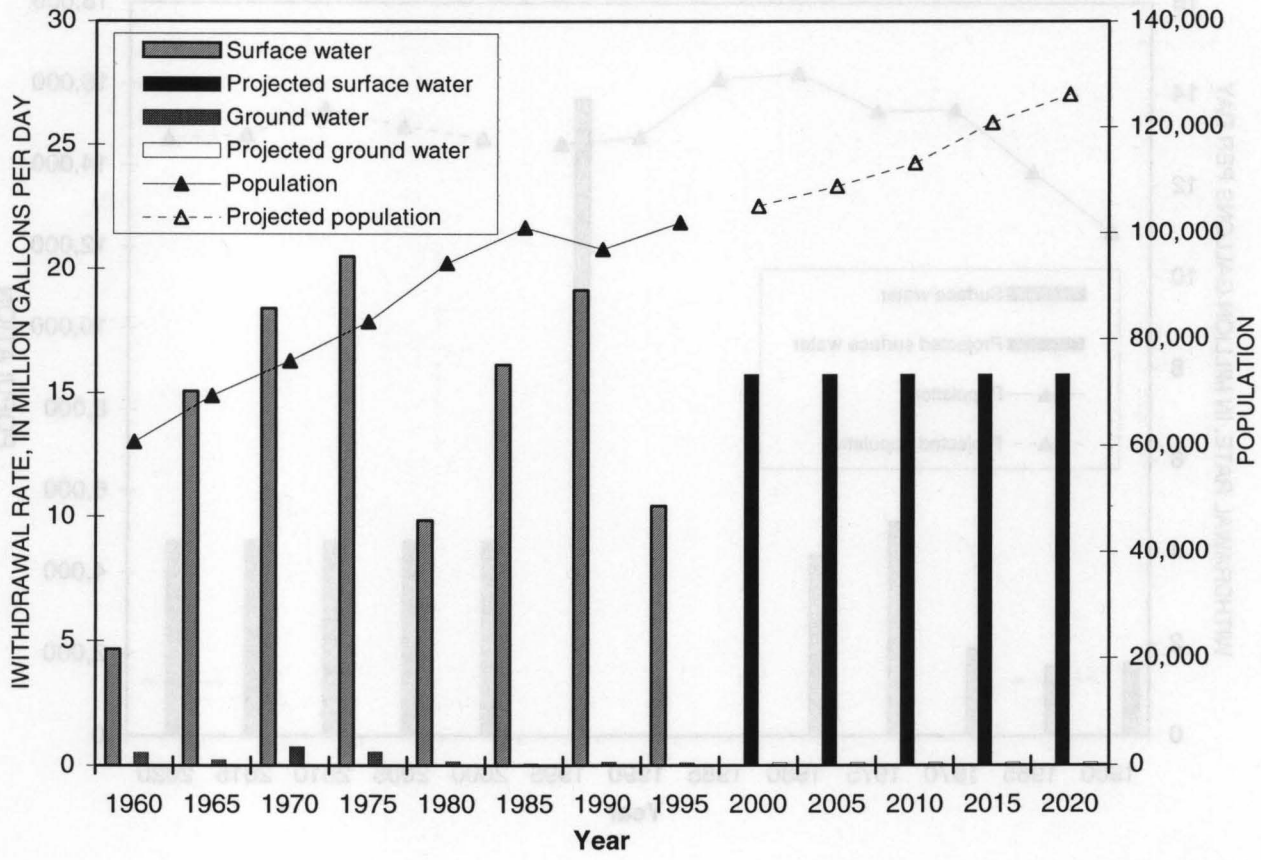

Figure 12. Historical and projected population and water-withdrawal rates, 1960-2020, for Terrebonne Parish within the Barataria-Terrebonne Basins, Louisiana.

West Baton Rouge Parish

Seventy-one percent of West Baton Rouge Parish is located within the boundaries of the Barataria-Terrebonne Basins. Ground water is the predominate source of water in this parish within the basins. In 1995, surface-water withdrawal rates accounted for only 4.4 percent or 0.53 Mgal/d of the total withdrawal rates of 12 Mgal/d. Most of the withdrawal rates in the parish within the study area were from public water suppliers and industrial facilities in 1995. Total water-withdrawal rates increased 460 percent from 1960 to 1995 (fig. 13). Multiple regression was used for the projected ground-water withdrawal rates. Neither variable in the surface-water regression model met the 0.15 significance level, and the mean was used for the projected withdrawal rates. The projection for total water-withdrawal rates in 2020 is 20 Mgal/d, an increase of 70 percent from 1995.

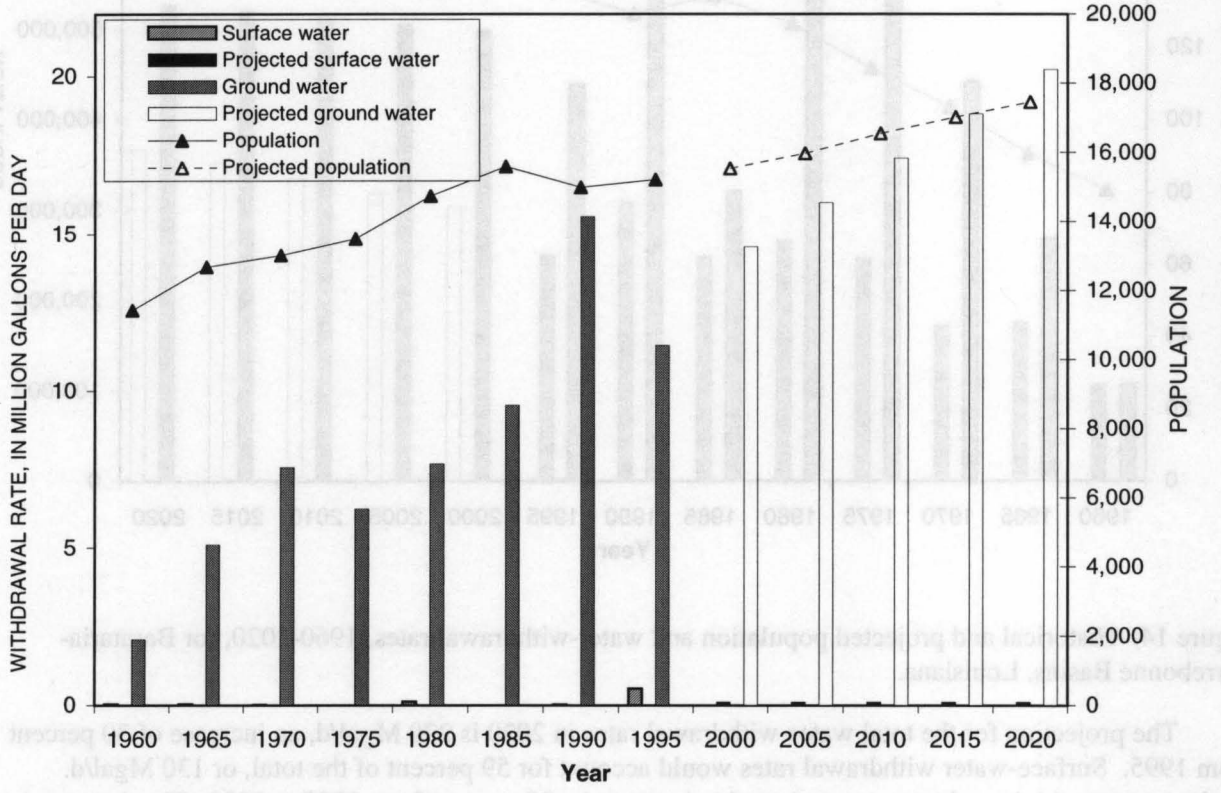

Figure 13. Historical and projected population and water-withdrawal rates, 1960-2020, for West Baton Rouge Parish within the Barataria-Terrebonne Basins, Louisiana.

Trend and Projection for Barataria-Terrebonne Basins

In 1995, total water-withdrawal rates of 170 Mgal/d in the basins increased 221 percent since 1960 (fig. 14). Surface-water withdrawal rates increased by 310 percent, and ground-water withdrawal rates increased by 133 percent.

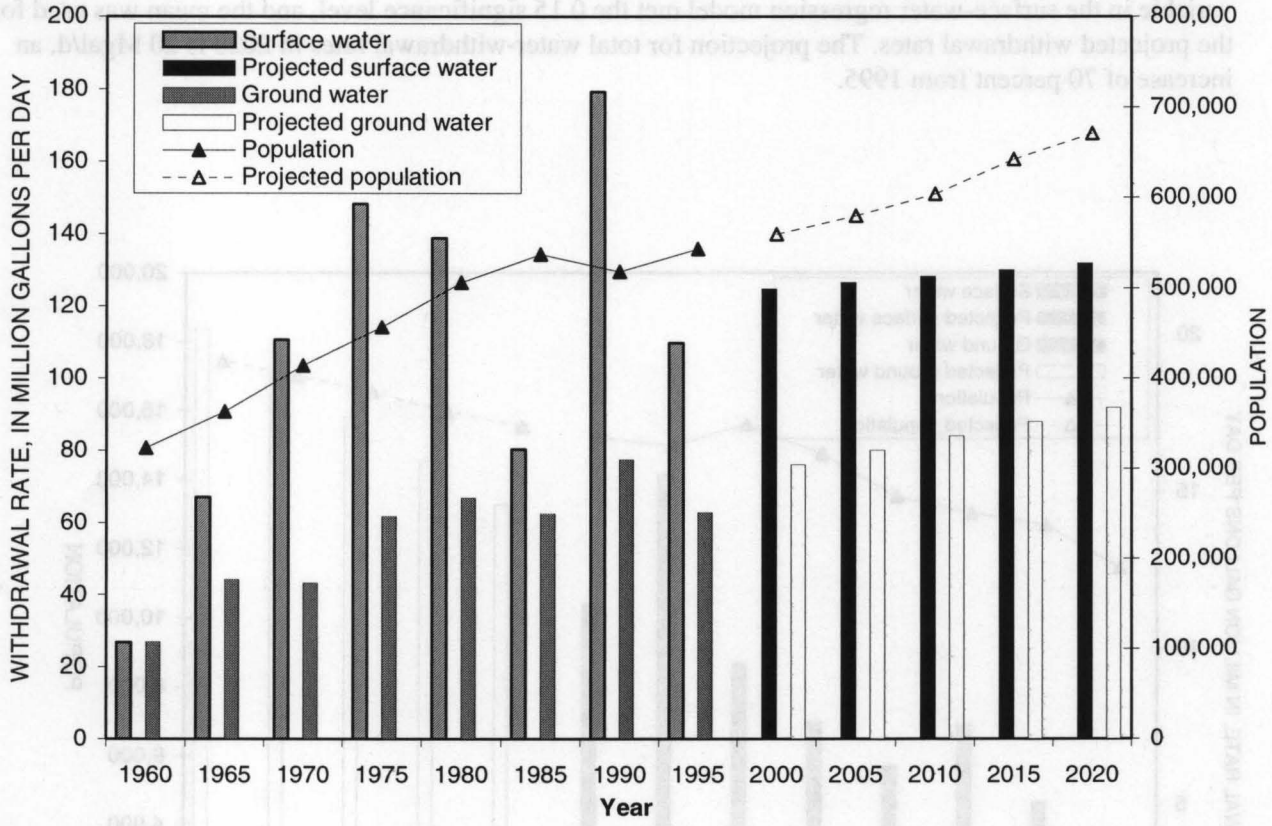

Figure 14. Historical and projected population and water-withdrawal rates, 1960-2020, for Barataria-Terrebonne Basins, Louisiana.

The projection for the total water-withdrawal rates in 2020 is 220 Mgal/d, an increase of 30 percent from 1995. Surface-water withdrawal rates would account for 59 percent of the total, or 130 Mgal/d. Surface-water withdrawal rates are projected to increase by 20 percent from 1995 to 2020. The decrease in surface-water withdrawal rates in 1985 is due in part to a decrease in industrial withdrawal rates for that year. The increase in withdrawal rates in 1990 and subsequent decrease in 1995 are mainly due to the different methods in calculating the amount of water used in crawfish farming. Past trends of ground-and surface-water use show an uneven pattern with a net increase over time. Taking this into account, the 30 percent increase in total withdrawal rates from 1995 to 2020 within the basins would probably follow an uneven pattern. Total ground-and surface-water withdrawal rates and population for each parish within the basins are included in table 5, from 1960 through 1995, with projected ground- and surface-water withdrawal rates from 2000 through 2020.

Table 5. *Ground- and surface-water withdrawal rates and population in the Barataria-Terrebonne Basins, in Louisiana, 1960-95, and projected ground- and surface-water withdrawal rates and population through 2020*

Year	Withdrawal rates (million gallons per day)		Population (thousands)
	Surface water	Ground water	
1960	26.77	26.96	3,228
1965	67.09	44.25	3,628
1970	110.65	43.35	4,145
1975	148.25	61.73	4,565
1980	138.80	66.96	5,062
1985	80.33	62.45	5,372
1990	179.33	77.45	5,181
1995	109.77	62.88	5,431
2000	124.88	76.13	5,597
2005	126.67	80.07	5,801
2010	128.34	84.01	6,040
2015	130.17	87.97	6,425
2020	131.95	91.91	6,712

QUALITY OF FRESH SURFACE-WATER RESOURCES

Bayou Lafourche receives almost all of its discharge from the Mississippi River. Therefore, an understanding of Mississippi River water quality and its relation to Bayou Lafourche is important. From 2,500 to 800 years ago, the main channel of the Mississippi River flowed down Bayou Lafourche (Spearing, 1995, p. 76). The Mississippi River retained a small connection with the bayou until it was closed off in 1904 to lessen the threat of flooding. In 1997, several hundred cubic feet per second of Mississippi River water were pumped from the river by the BLFWD to maintain flow in the bayou. (Kirk Cheramie, Bayou Lafourche Freshwater District, written commun., 1997).

The USGS and the Louisiana Department of Environmental Quality (DEQ) have compiled an extensive data base of water-quality information from the lower Mississippi River. Also, DEQ has compiled a water-quality assessment of all major water bodies in Louisiana (Louisiana Department of Environmental Quality, 1996). In the category "Degree of Support," the 68-mile reach of Bayou Lafourche from Donaldsonville to Larose was determined to be "Not Supporting" for primary contact recreation (swimming), secondary contact recreation (boating), and fish and wildlife propagation. Suspected sources include minor industrial and municipal point sources, nonpoint agricultural runoff, spills, and improperly maintained septic tanks (Louisiana Department of Environmental Quality, 1996, p. A-10). The remaining reach of the bayou was assessed as "Partially Supporting" its designated uses. Other major waterways in the Barataria-Terrebonne Basins assessed as "Not Supporting" include Bayou Terrebonne, Company Canal, parts of the GIWW, and the upper 20 miles of Bayou Grand Caillou.

Potential Water-Quality Problems Concerning Diversion of Water from the Mississippi River

Bayou Lafourche is being evaluated as a means of conveying freshwater from the Mississippi River to coastal Louisiana wetlands south of Larose (fig. 15) as a major component of Louisiana marsh restoration efforts. Various scenarios under study include Bayou Lafourche conveying an additional 500 to 700 cubic feet per second of freshwater. However, there is a widespread public perception that the river is highly contaminated by a wide variety of toxic compounds, and that the adverse effects of these pollutants would outweigh the benefits of additional freshwater, sediments, and nutrients. In response to these needs and concerns, both the water quality and hydrology of the Bayou Lafourche and GIWW systems have received increased monitoring by Federal agencies and universities. Discharge measurements conducted by the USGS in cooperation with the COE during 1995-97 have shown that the GIWW, which crosses Bayou Lafourche at Larose, has carried as much as 4,000 cubic feet per second of freshwater eastward across Bayou Lafourche. This flow is driven in large part by a favorable hydraulic gradient in the GIWW from west to east, and controlled by the amount of water flowing down the Atchafalaya River Basin. This flow is seasonal.

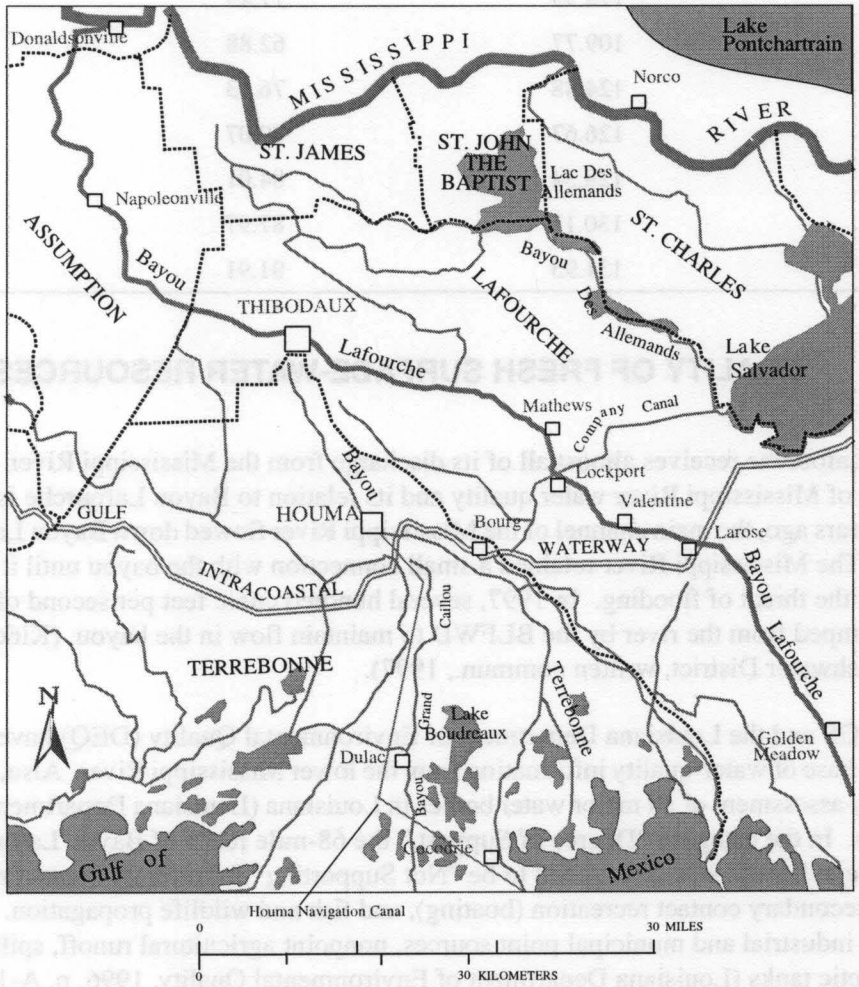

Figure 15. Bayou Lafourche area, Louisiana.

Toxic Compounds

An analysis of the water quality of the lower Mississippi River in Louisiana using USGS and DEQ data indicates no constituents that exceed USEPA criteria for drinking water. The herbicide atrazine (fig. 16) is the only water-quality constituent that briefly exceeds the USEPA maximum contaminant level (MCL) of 3.0 micrograms per liter in the Mississippi River at Baton Rouge during the late spring and early summer. However, as the MCL is based on yearly averages of samples, the concentrations detected during the annual spring flush do not necessarily mean that the criterion is exceeded.

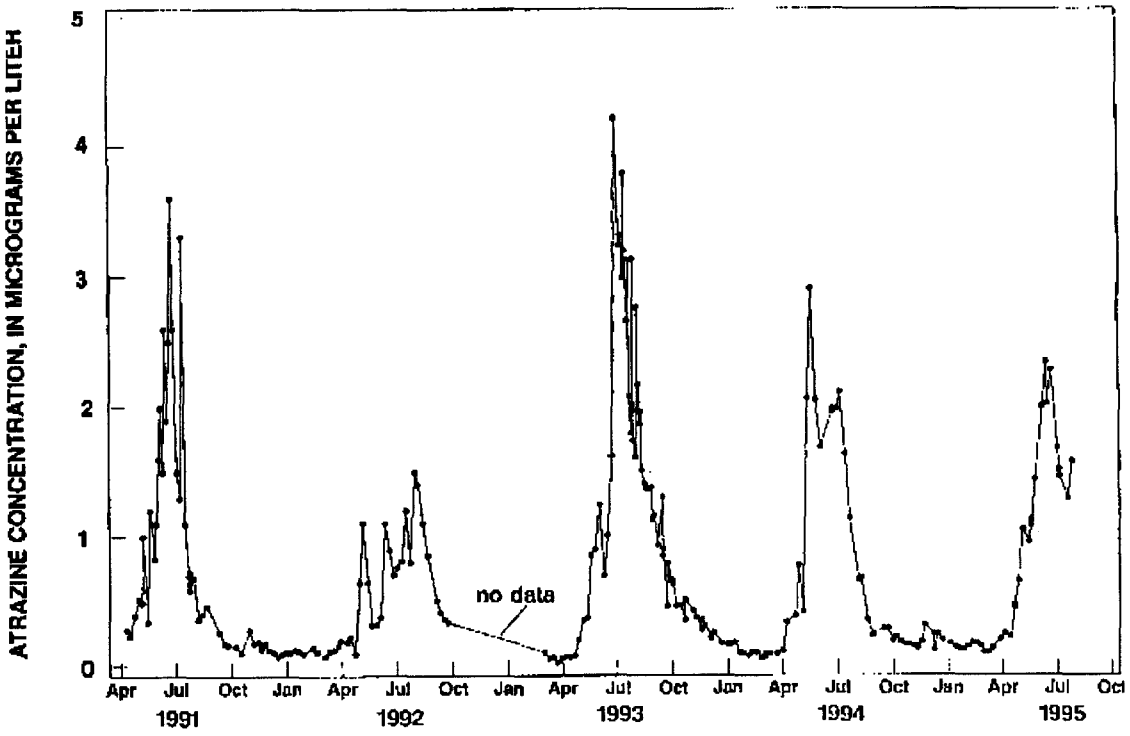

Figure 16. Atrazine concentration in the Mississippi River at Baton Rouge, Louisiana, 1991-95 (Goolsby and others, 1995).

Past studies (Wells, 1980; Demas and Curwick, 1987) indicate that trace metals are within recommended USEPA criteria for drinking water 99 percent of the time, and should not pose any serious ecological problems (Wells, 1980, p. 24). Trace elements have not become a problem primarily because of the physical and chemical characteristics of the river itself--the river has relatively coarse bottom sediments, a continuous downstream bed movement that does not allow trace elements to accumulate, and a relatively low amount of organic matter in the sediments.

In April 1991, a survey of trace elements in bottom material in Bayou Lafourche (McGee and Demcheck, 1995) indicated that arsenic, copper, lead, mercury, and zinc were found in concentrations that exceeded expected background concentrations between Donaldsonville and Golden Meadow. Arsenic concentrations ranged from 7.5 to 16 mg/kg (milligrams per kilogram) between Donaldsonville and Golden Meadow. In the same reach of the bayou, copper ranged from 18 to 53 mg/kg; lead ranged from 28 to 57 mg/kg; mercury ranged from 0.05 to 0.20 mg/kg; and zinc ranged from 92 to 208 mg/kg. Trace-element concentrations decreased near the mouth of Bayou Lafourche, possibly due to the effects of salinity. Trace elements tend to precipitate out of solution or suspension at freshwater-saltwater interfaces (Forstner and Wittmann, 1981, p. 191-194). Overall, the trace-element data indicate that Bayou Lafourche is adversely affected by low-level contamination upstream from the saltwater-freshwater interface generally located near Golden Meadow.

Nutrients

Concentrations of dissolved nitrate in the Mississippi River at Baton Rouge are higher than other Louisiana streams, averaging 1.4 mg/L (milligrams per liter) during 1991-95 (fig. 17). This is far below the USEPA MCL of 10 mg/L for drinking water. This concentration can contribute to excessive plant growth, both of submerged aquatic vegetation and phytoplankton. In the spring through the fall of 1996, Bayou Lafourche had a large amount of submerged aquatic vegetation (SAV). The submerged aquatics caused water velocities to decrease, bayou stage to increase, and deposition of suspended sediments to increase. In June and October 1996, CWPPRA authorized the USGS to conduct water-quality surveys of Bayou Lafourche. The results of nutrient analyses indicated that the large amounts of SAV present in the bayou from Thibodaux to Lockport stripped the available dissolved nitrates from the water column (fig. 18), outcompeting the phytoplankton and causing the water column to be extremely clear and colorless. Late in 1996, the Lafourche Parish Water District began a program to remove excess SAV from the bayou. The program was successful in clearing the channel of most of SAV, as of the summer of 1997 (Kirk Cheramie, personal commun., 1997). However, this can increase the possibility of algal blooms. Considering the high nitrate levels in Mississippi River source water, algal blooms and the associated hypoxic events and fish kills are more likely to occur after the competing SAV are removed. Although not a threat to human health, taste and odor problems in drinking water often are associated with algal blooms.

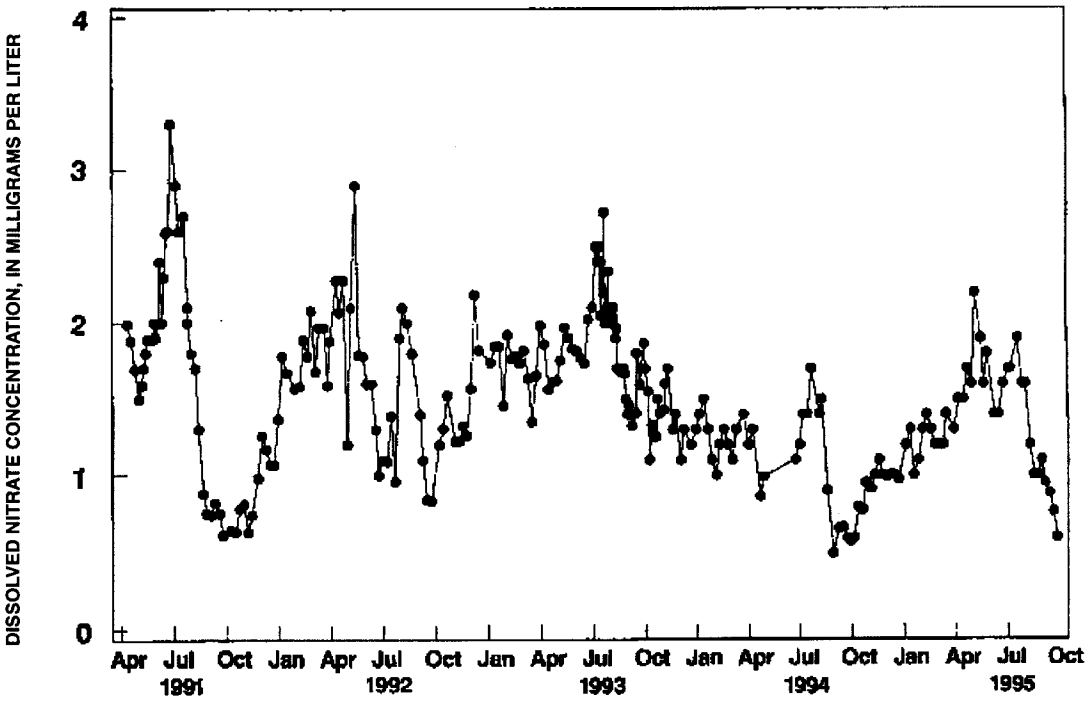

Figure 17. Dissolved nitrate concentration in the Mississippi River at Baton Rouge, Louisiana, 1991-95.

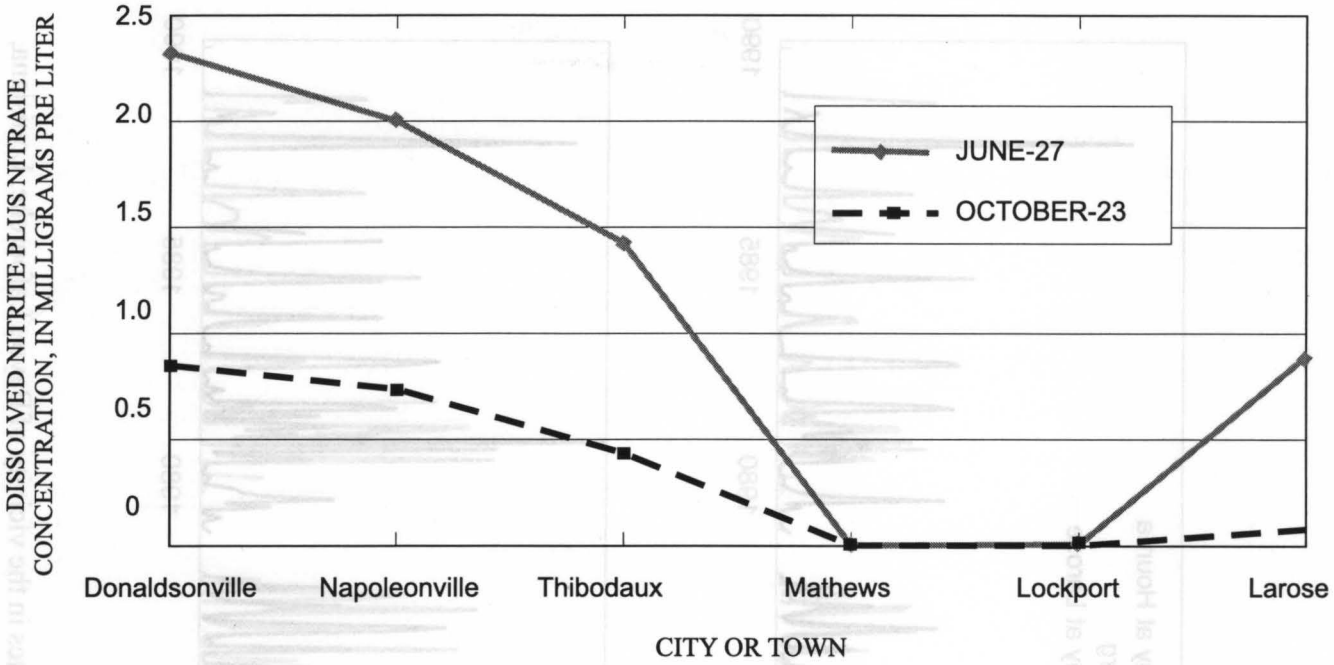

Figure 18. Dissolved nitrite plus nitrate concentration, Bayou Lafourche, Louisiana, June 27 and October 23, 1996.

Salinity

Long-term records of salinities at three stations near Bayou Lafourche and the GIWW, sampled by the COE, show no pronounced trends (fig. 19). In the GIWW at Houma, salinities remained low until 1961, when the GIWW was connected to coastal waters through the Houma Navigation Canal (HNC) (fig. 15). Peak mean monthly salinities occurred at all three sites at the same time (fig. 19A). Peaks were generally higher in the GIWW at Larose, compared to the GIWW at Houma and Bayou Terrebonne at Bourg, Louisiana. Maximum monthly salinities were generally higher at Bayou Terrebonne than at the other two sites (fig. 19B). The same data were subjected to the Kendall's Tau test (Swenson and Swarzenski, 1995) for trends and magnitude (tables 6 and 7). The GIWW at Larose apparently showed slightly decreasing salinities over time, whereas at Bayou Terrebonne, the trend was increased salinities. The periods of record were not the same, and the early period of salinity data at Houma may have been skewed because the HNC had not yet opened.

Encroaching saltwater is a threat to drinking water in the study area, as indicated in table 8. At the intakes for the Terrebonne Waterworks District 1 at Houma, just east of the HNC, chloride concentrations exceeded the secondary maximum contaminant level (SMCL)[1] of 250 mg/L during parts of every year except 1993. Prior to completion of the HNC (1961), this was unusual (see fig. 19a). Frequently, chloride concentrations from the site on Bayou Lafourche at Valentine also exceeded standards (table 8). This site is located between Lockport and Larose. For the period 1990-96, chloride concentrations did not exceed USEPA standards in Bayou Lafourche at Mathews.

[1]Concentrations of chloride greater than 250 mg/L exceed the secondary maximum contaminant level (SMCL) for drinking water (U.S. Environmental Protection Agency, 1977, 1992). SMCL's are established for contaminants that can adversely affect the aesthetic quality of drinking water. At high concentrations or values, health implications as well as aesthetic degradation may also exist. SMCL's are not federally enforceable, but are intended as guidelines for the states.

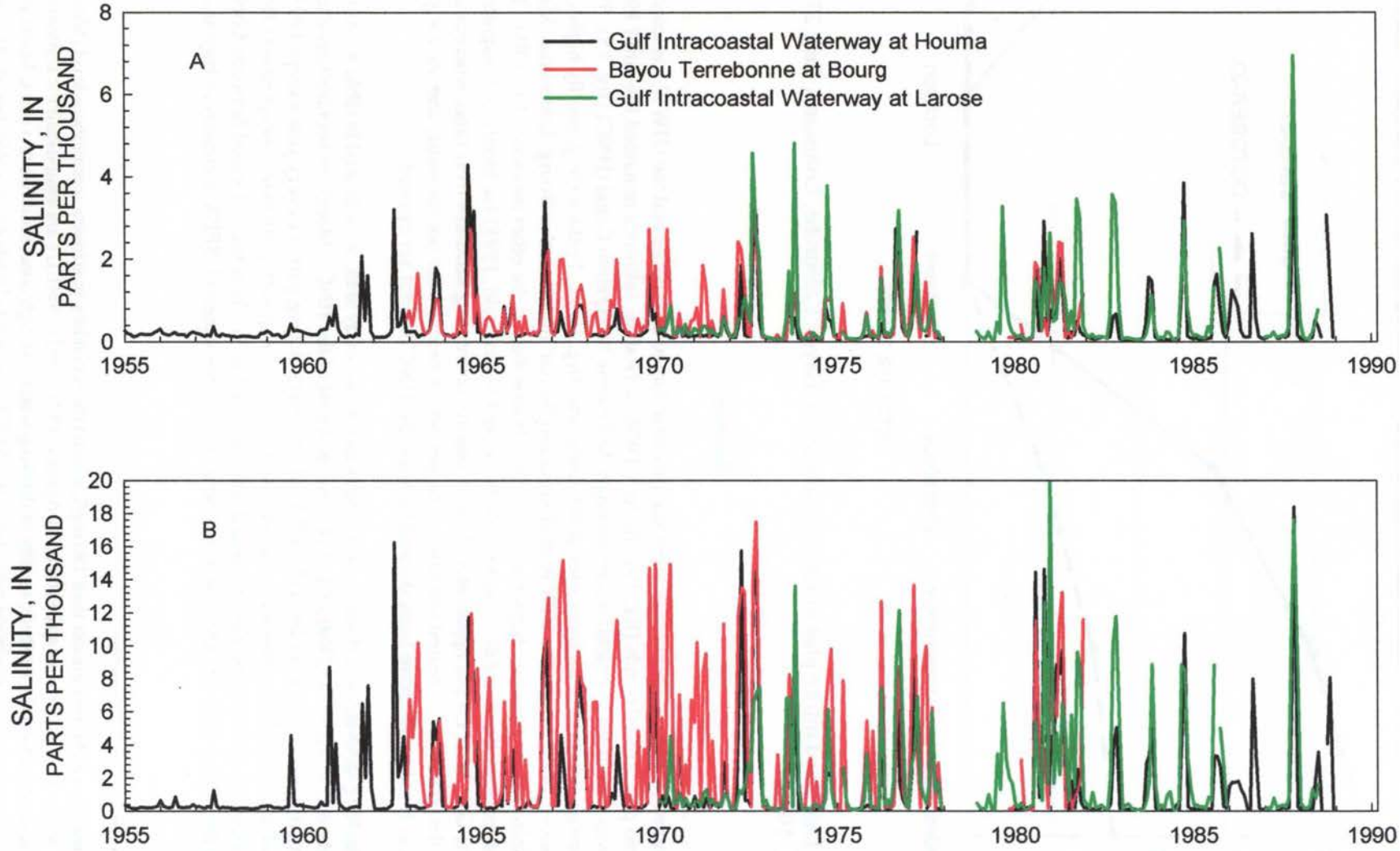

Figure 19. **A**, Mean monthly salinity, and **B**, maximum monthly salinity at selected sites in the vicinity of Bayou Lafourche, Louisiana, 1955-90 (Data from U.S. Army Corps of Engineers).

Table 6. Daily *mean and maximum salinity, and trends in magnitude for three sites in the Bayou Lafourche-Houma area, Louisiana*

[Modified from: Swenson and Swarzenski, 1995; --, the value is less than the reporting level]

Station number	Station name	Period of record	Salinity (parts per thousand)		Trend (parts per thousand)	
			Mean	Maximum	Mean	Maximum monthly
S76320	Gulf Intracoastal Waterway at Houma	1946-88	0.4±1.06	18.4	--	--
S76403	Bayou Terrebonne at Bourg	1962-82	.6±1.59	17.5	+.041	+.115
S82203	Gulf Intracoastal Waterway at Larose	1970-88	.6±1.48	19.8	-.034	-.120

Table 7. *Months of lowest and highest salinity for three sites in the Bayou Lafourche-Houma area, Louisiana*

[Modified from: Swenson and Swarzenski, 1995]

Station name	Period of record	Months of lowest salinity	Months of highest salinity
Gulf Intracoastal Waterway at Houma	1946-88	June, July	October, November, April
Bayou Terrebonne at Bourg	1962-82	July	April, October
Gulf Intracoastal Waterway at Larose	1970-88	February, March, July	April, October, November

The source of saltwater encroaching on Bayou Lafourche is variable. Some saltwater originates in Bayou Lafourche south of the GIWW; at other times saltwater moving up the HNC has flowed east in the GIWW, north into Company Canal and southeast in Bayou Lafourche towards Larose. Hurricane flood gates at Bayou Lafourche south of the GIWW, and exceptionally low flows in Bayou Lafourche in 1996, due in large part to the invasion of SAV, have made generalizations about saltwater encroachment in the study area tenuous. A more rigorous analysis of historical data, supplemented with limited new sampling, would improve the current understanding of saltwater movement into the areas of concern on Bayou Lafourche and the entire Barataria-Terrebonne estuary.

The USGS also has compiled salinity data at 12 sites in the Barataria-Terrebonne estuary; the data were collected by DHH as part of their shellfish monitoring program. Analysis of information in the Barataria-Terrebonne National Estuary Program Status and Trends publication number 20 (Reed, 1995) on hydrologic modification indicates no general coastwide trends of increase or decrease for salinity. However, there was a visible trend in an increase of "spikiness" after about 1960-62 (Reed, 1995, p. 189). The term "spikiness" refers to pulses in salinity which tend to be a factor of 2 or 3 greater than the baseline salinity. This is especially noticeable at the GIWW at Houma, Lafitte, and Barataria. Possibly this is a result of the dredging of the Barataria Waterway and the HNC (Reed, 1995, p. 189).

Table 8. *Numbers of days per year exceeding chloride concentrations of 250 milligrams per liter at three sites in the Bayou Lafourche area, Louisiana*

[Sources of data: Nicolaus Paper, Inc. for Valentine site; Terrebonne Waterworks District 1 for Gulf Intracoastal Waterway site; Lafourche Waterworks District 1 for Mathews site]

Year	Bayou Lafourche at Valentine	Gulf Intracoastal Waterway east of Houma Navigation Canal at Houma	Bayou Lafourche at Mathews
1972	3	39	Data not available
1973	0	15	
1974	0	30	
1975	0	13	
1976	3	57	
1977	0	43	
1978	0	40	
1979	0	20	
1980	0	32	
1981	5	78	
1982	4	28	
1983	0	52	
1984	34	38	
1985	6	87	
1986	0	45	
1987	28	49	
1988	18	83	
1989	3	5	
1990	0	5	0
1991	12	40	0
1992	0	31	0
1993	0	0	0
1994	6	29	0
1995	2	29	0

SUMMARY AND CONCLUSIONS

Approximately 170 Mgal/d (million gallons per day) of ground- and surface-water was withdrawn from the Barataria-Terrebonne Basins in 1995. Of this amount, surface water accounted for 64 percent (110 Mgal/d) of the total withdrawal rates in the basins. The largest surface-water withdrawal rates were from Bayou Lafourche (40 Mgal/d), Bayou Boeuf (14 Mgal/d), and the Gulf Intracoastal Waterway (4.2 Mgal/d). The largest ground-water withdrawal rates were from the Mississippi River alluvial aquifer (29 Mgal/d), the Gonzales-New Orleans aquifer (9.5 Mgal/d), and the Norco aquifer (3.6 Mgal/d).

The amounts of water withdrawn in the basins in 1995 differed by category of use. Public water suppliers within the basins withdrew 41 Mgal/d of water. The five largest public water suppliers in the basins withdrew 30 Mgal/d of surface water; Terrebonne Waterworks District 1 withdrew the largest amount, almost 15 Mgal/d. Industrial facilities withdrew 88 Mgal/d, fossil-fuel plants withdrew 4.7 Mgal/d, and commercial facilities withdrew 0.67 Mgal/d. Aggregate water-withdrawal rates, compiled by parish for aquaculture (37 Mgal/d), livestock (0.56 Mgal/d), rural domestic (0.44 Mgal/d), and irrigation uses (0.54 Mgal/d), totaled about 38 Mgal/d in the basins. Ninety-five percent of aquaculture withdrawal rates, primarily for crawfish and alligator farming, were from surface-water sources.

Total water-withdrawal rates increased 221 percent from 1960-95. Surface-water withdrawal rates increased by 310 percent, and ground-water withdrawal rates increased by 133 percent. The projection for the total water-withdrawal rates in 2020 is 220 Mgal/d, an increase of 30 percent from 1995. Surface-water withdrawal rates would account for 59 percent of the total, or 130 Mgal/d. Surface-water withdrawal rates are projected to increase by 20 percent from 1995 to 2020. The decrease in surface-water withdrawal rates in 1985 is due in part to a decrease in industrial withdrawal rates for that year. The increase in withdrawal rates in 1990 and subsequent decrease in 1995 are mainly due to the different methods in calculating the amount of water used in crawfish farming. Past trends of ground-and surface-water use show an uneven pattern with a net increase over time. Taking this into account, the 30 percent increase in total withdrawal rates from 1995 to 2020 within the basins would probably follow an uneven pattern.

Bayou Lafourche is being evaluated as a means of conveying additional freshwater from the Mississippi River to coastal Louisiana marshes. Discharge measurements made in 1995-97 have shown that the Gulf Intracoastal Waterway has carried up to 4,000 cubic feet per second of water eastward across Bayou Lafourche.

Analysis of water quality of the lower Mississippi River indicates that the main threats to surface-water resources are from the herbicide, atrazine, and from excessive nutrients. An understanding of Mississippi River water quality is important because Bayou Lafourche receives almost all of its discharge from the river. Atrazine concentrations in the Mississippi River at Baton Rouge exceed the U.S. Environmental Protection Agency maximum contaminant level of 3.0 micrograms per liter during the late spring and early summer. However, as the maximum contaminant level is based on yearly average samples, the concentrations detected during the annual spring flush do not represent an exceedence of the criterion. Although trace elements should not pose any serious ecological problems in the lower Mississippi River, trace-metals in bottom material collected from Bayou Lafourche indicate that the reach of Bayou Lafourche from Donaldsonville to Golden Meadow is adversely affected by low-level contamination. Dissolved nitrate had a mean concentration of 1.4 milligrams per liter from 1991-95 in the Mississippi River near Bayou Lafourche.

Long-term salinity records near Bayou Lafourche indicate no pronounced trends. In the Gulf Intracoastal Waterway at Houma, salinities remained low until 1961, when the Gulf Intracoastal Waterway was connected to the Gulf of Mexico by the Houma Navigation Canal. The source of saltwater encroaching on Bayou Lafourche is variable. Some saltwater has entered Bayou Lafourche south of the Gulf Intracoastal Waterway; at other times saltwater has moved up the Houma Navigation Canal and has flowed east in the Gulf Intracoastal Waterway, north into Company Canal and southeast in Bayou Lafourche towards Larose, Louisiana.

SELECTED REFERENCES

Bieber, P.P., and Forbes, M.J., Jr., 1966, Pumpage of water in Louisiana, 1965: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 20, 8 p.

Britton, L.J., and Greeson, P.E., eds., 1988, Methods for the collection and analysis of aquatic biological and microbiological samples: U.S. Geological Survey Open-File Report 88-0190, 685 p.

Cardwell, G.T., and Walter, W.H., 1979, Pumpage of water in Louisiana, 1975: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 2, 15 p.

Demas, C.R., and Curwick, P.B., 1987, Suspended-sediment, bottom-material, and associated chemical data from the lower Mississippi River, Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 14, 117 p.

Dial, D.C., 1970, Pumpage of water in Louisiana, 1970: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 26, 10 p.

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

Forstner, U., and Wittmann, G.T.W., 1981, Metal pollution in the aquatic environment (2d revised ed.): New York, Springer-Verlag, 486 p.

Garrison, C.R., Goree, B.B., Lovelace, W.M., Montgomery, P.A., and Resweber, J.C., 1997, Water resources data--Louisiana, water year 1996: U.S. Geological Survey Water-Data Report LA-97-1, 495 p.

Goolsby, D.A., Thurman, E.M., Kolpin, D.W., and Battaglin, W.A., 1995, Occurrence of herbicides and metabolites in surface water, and rainwater in the Midwestern United States: Proceedings of the American Water Works Association 1995 Annual Conference, June 18-22, 1995, Anaheim, California, p. 583-591.

Kinne, A.O., 1971, Salinity in Marine Ecology: New York, Wiley Science, vol. 1, part 1.

Louisiana Department of Environmental Quality, 1996, Water quality inventory 1996 *in* State of Louisiana water quality management plan, v. 5, pt. B: Baton Rouge, Louisiana, Louisiana Department of Environmental Quality, Office of Water Resources, Water Quality Management Division, 314 p.

Louisiana State University Department of Sociology and the Louisiana Population Data Center for the Louisiana Division of Administration, "Post-Censal Population Projections to 2010 of Louisiana Parishes," 1994, accessed August 1, 1996, at URL http://www.state.la.us/state/census/parish/index.htm

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

-----1994, Water requirements for crawfish farming at selected sites in south-central Louisiana, 1992-94: Louisiana Department of Transportation and Development Water Resources Special Report no. 8, 12 p.

Lovelace, J.K., and Johnson, P.M., 1996, Water use in Louisiana, 1995: Louisiana Department of Transportation and Development, Water Resources Special Report no. 11, 127 p.

Lovelace, J.K., and Lovelace, W.M., 1995, Hydrogeologic unit nomenclature and computer codes for aquifers and confining units in Louisiana: Louisiana Department of Transportation and Development Water Resources Special Report no. 9, 12 p.

Lurry, D.L., 1987, Pumpage of water in Louisiana, 1985: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 4, 14 p.

McGee, B.D., and Demcheck, D.K., 1995, Occurrence and estimation of trace elements in bottom material for selected streams in coastal Louisiana, 1991-92: Louisiana Department of Transportation and Development Water Resources Technical Report no. 57, 49 p.

Moore, D.M., and Rivers, R.D, 1995, The estuary compact: A public-private promise to work together to save the Barataria and Terrebonne Basins: Thibodaux, La., Barataria-Terrebonne National Estuary Program, 40 p.

Reed, D.J., ed., 1995, Status and trends of hydrologic modification, reduction in sediment availability, and habitat loss/modification in the Barataria-Terrebonne estuarine system: Thibodaux, Louisiana, Barataria-Terrebonne National Estuary Program, BTNEP Publication no. 20, 338 p. plus appendices.

Shelton, L.R., 1994, Field guide for collecting and processing stream-water samples for the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 94-455, 42 p.

Snider, J.L., and Forbes, M.J., Jr., 1961, Pumpage of water in Louisiana, 1960: Louisiana Department of Public Works, Department of Conservation, and Louisiana Geological Survey, 6 p.

Spearing, Darwin, 1995, Roadside geology of Louisiana: Missoula, Montana, Mountain Press Publishing Company, 225 p.

Swenson, E.M., and Swarzenski, C.M., 1995, Water levels and salinity in the Barataria-Terrebonne estuarine system, Part 6 *of* Reed, Denise, ed., Status and historical trends of hydrologic modification, reduction in sediment availability, and habitat loss/modification in the Barataria and Terrebonne estuarine system, Thibodaux, La., Barataria-Terrebonne National Estuary Program, BTNEP Publication no. 20, 338 p. plus appendices.

Urban Information Center, "Missouri State Census Data Center Population Trends Report, 1960-1995," University of Missouri-St. Louis, March 1996, accessed August 1, 1996, at URL http://www.oseda.missouri.edu/cgi-bin/browse?/mscdc/reports/poptrends/la

Walter, W.H., 1982, Pumpage of water in Louisiana, 1980: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 3, 15 p.

Wells, F.C., 1980, Hydrology and water quality of the lower Mississippi River: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 21, 83 p.

Wiseman, W.J., Jr., and Swenson, E.M., 1988, Long-term trends in Louisiana estuaries, Chapter 6 *of* Turner, R.E., and Cahoon, D.R., eds., Causes of wetlands loss in the Coastal Central Gulf of Mexico, Vol. II: Technical Narrative. Minerals Management Service, New Orleans, Louisiana, OCS/MMS 87-0119, 400 p.

Appendix A:

Aggregate Ground- and Surface-Water Withdrawal Rates And Usage in the Barataria-Terrebonne Basins, Louisiana, 1995

Appendix A: Aggregate ground- and surface-water withdrawal rates and usage in the Barataria-Terrebonne Basins, Louisiana, 1995

[Mgal/d, million gallons per day; DO, domestic; LV, livestock; AQ, aquaculture; IR, irrigation; GW, ground water; SW, surface water, Misc, miscellaneous]

Facility identification number	Parish or facility	Use	Type	Source		Withdrawal rate (Mgal/d)
				Surface water	Aquifer[1]	
379	Ascension Parish	DO	GW		112MRVA	0.054
		DO	GW		112NORC	0.027
1157	Ascension Parish	LV	GW		112MRVA	0.013
		LV	GW		112NORC	0.003
1349	Ascension Parish	AQ	GW		112MRVA	0.011
391	Assumption Parish	DO	GW		112MRVA	0.029
1158	Assumption Parish	LV	SW	Misc streams		0.004
1350	Assumption Parish	AQ	SW	Misc streams		0.644
		AQ	SW	Lake Verret		0.625
		AQ	SW	Bayou Lafourche		0.625
597	Iberville Parish	DO	GW		112MRVA	0.109
1172	Iberville Parish	LV	SW	Misc streams		0.007
		LV	GW		112MRVA	0.024
1364	Iberville Parish	AQ	GW		112MRVA	0.189
		AQ	SW	Misc streams		7.870
1174	Jefferson Parish	LV	SW	Misc streams		0.003
1366	Jefferson Parish	AQ	SW	Misc streams		0.089
311	Lafourche Parish	DO	GW		112MRVA	0.021
1148	Lafourche Parish	LV	SW	Misc streams		0.048
		LV	GW		112MRVA	0.058
		LV	GW		112MRVA	0.135
1340	Lafourche Parish	AQ	GW		112MRVA	0.025
		AQ	SW	Misc streams		3.803
		AQ	SW	Bayou Lafourche		3.691
		AQ	SW	Intracoastal Waterway		3.691
		AQ	GW		112MRVA	0.087
1183	Plaquemines Parish	LV	SW	Misc streams		0.075
1375	Plaquemines Parish	AQ	SW	Misc streams		0.802
844	Pointe Coupee Parish	DO	GW		112MRVA	0.007
		DO	GW		12101FP	0.003
		DO	GW		12102FP	0.017
		DO	GW		12110BR	0.003
		DO	GW		12112BR	0.010
		DO	GW		12117BR	0.014
		DO	GW		12203FP	0.010
		DO	GW		12220BR	0.048

Appendix A: *Aggregate ground- and surface-water withdrawal rates and usage in the Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Parish or facility	Use	Type	Source		Withdrawal rate (Mgal/d)
				Surface water	Aquifer[1]	
		DO	GW		12224BR	0.021
		DO	GW		12228BR	0.010
1184	Pointe Coupee Parish	LV	GW		12102FP	0.020
		LV	GW		12112BR	0.010
		LV	GW		12224BR	0.010
		LV	GW		12228BR	0.010
1312	Pointe Coupee Parish	IR	GW		112MRVA	0.490
		IR	SW	Misc streams		0.049
1376	Pointe Coupee Parish	AQ	GW		12102FP	0.089
		AQ	GW		12112BR	0.045
		AQ	GW		12224BR	0.045
		AQ	GW		12228BR	0.045
		AQ	SW	Misc streams		2.081
896	St. Charles Parish	DO	GW		112GRMC	0.005
		DO	GW		112NORC	0.005
1189	St. Charles Parish	LV	SW	Misc streams		0.027
		LV	GW		111PNBR	0.003
		LV	GW		112GRMC	0.013
		LV	GW		112NORC	0.007
1381	St. Charles Parish	AQ	SW	Misc streams		0.767
918	St. James Parish	DO	GW		112GRMC	0.002
		DO	GW		112MRVA	0.001
		DO	GW		112NORC	0.002
1191	St. James Parish	LV	GW	Misc streams	112GRMC	0.001
		LV	GW		112MRVA	0.001
1383	St. James Parish	AQ	SW	Misc streams		8.021
		AQ	GW		112GRMC	0.002
		AQ	GW		112MRVA	0.001
1384	St. John Parish	AQ	SW	Misc streams		2.869
314	Terrebonne Parish	DO	GW		112MRVA	0.008
1151	Terrebonne Parish	LV	SW	Misc streams		0.006
		LV	GW		112MRVA	0.054
1343	Terrebonne Parish	AQ	SW	Misc streams		17.443
1069	West Baton Rouge Parish	DO	GW		11204BR	0.001
		DO	GW		11206BR	0.003
		DO	GW		112MRVA	0.005

Appendix A: *Aggregate ground- and surface-water withdrawal rates and usage in the Barataria-Terrebonne Basins, Louisiana, 1995—Continued*

Facility identification number	Parish or facility	Use	Type	Source		Withdrawal rate (Mgal/d)
				Surface water	Aquifer[1]	
1069	West Baton Rouge Parish	DO	GW		112SLBR	0.005
		DO	GW		12112BR	0.003
		DO	GW		12115BR	0.007
		DO	GW		12117BR	0.005
		DO	GW		12220BR	0.001
		DO	GW		12223BR	0.001
		DO	GW		12224BR	0.003
1199	West Baton Rouge Parish	LV	SW	Misc streams		0.009
		LV	GW		12115BR	0.010
		LV	GW		112MRVA	0.010
1391	West Baton Rouge Parish	AQ	GW		12115BR	1.466
		AQ	SW	Intracoastal Waterway		0.517

[1]Aquifer: 112MRVA, Mississippi River alluvial; 112NORC, Norco; 111SLNO, Shallow aquifers of New Orleans area; 112GRMC, Gramercy; 12101FP, Zone 1 Florida Parishes and Pointe Coupee Parish; 12102FP, Zone 2 Florida Parishes and Pointe Coupee Parish; 12110BR, "1,000-foot" sand of Baton Rouge area; 12112BR, "1,200-foot" sand of Baton Rouge area; 12117BR, "1,700-foot" sand of Baton Rouge area; 12203FP, Zone 3 Florida Parishes and Pointe Coupee Parish; 12220BR, "2,000-foot" sand of Baton Rouge area; 12224BR, "2,400-foot" sand of Baton Rouge area; 12228BR, "2,800-foot" sand of Baton Rouge area; 111PNBR, Point-bar deposits; 11204BR, "400-foot" sand of Baton Rouge area; 11206BR, "600-foot" sand of Baton Rouge area; 112SLBR, Shallow sands of Baton Rouge area; 12115BR, "1,500-foot" sand of Baton Rouge area; 12223BR, "2,000 and 2,400 foot sands of Baton Rouge area.

Appendix B:

Surface-Water Withdrawal Sites along the Mississippi River adjacent to the Barataria-Terrebonne Basins, Louisiana

Appendix B: Surface-water withdrawal sites along the Mississippi River adjacent to the Barataria-Terrebonne Basins, Louisiana

[IN, industry; WS, public supply; PF, fossil fuel power; CO, commercial; PN, nuclear power]

Facility identification number (pl. 1)	Facility	Use	Source	Latitude	Longitude
		ASCENSION PARISH			
371	Industry	IN	Mississippi River	301344	0910317
375	Industry	IN	Mississippi River	301115	0910044
372	Industry	IN	Mississippi River	300611	0905732
373	Industry	IN	Mississippi River	300730	0905443
362	Industry	IN	Mississippi River	300815	0905452
1722	Industry	IN	Mississippi River	[1]301300	[1]0910200
361	Industry	IN	Mississippi River	301039	0910023
363	Industry	IN	Mississippi River	300551	0905716
		JEFFERSON PARISH			
1774	Industry	IN	Mississippi River	295450	0900820
634	Gretna Waterworks	WS	Mississippi River	295529	0900324
632	Jefferson Parish Waterworks District 1	WS	Mississippi River	295739	0900953
633	Jefferson Parish Waterworks District 2	WS	Mississippi River	295357	0900543
617	Fossil fuel power plant	PF	Mississippi River	[1]295600	[1]0900800
635	Westwego water system	WS	Mississippi River	295438	0900835
		ORLEANS PARISH			
744a	New Orleans Sewage & Water-Carrollton	WS	Mississippi River	295727	0900746
744b	New Orleans Sewage & Water-Algiers	WS	Mississippi River	295634	0900746
986	Fossil fuel power plant	PF	Mississippi River Gulf Outlet	[1]300030	[1]0895610
985	Fossil fuel power plant	PF	Inner Harbor Navigation Canal	[1]300056	[1]0900130
		PLAQUEMINES PARISH			
803	Industry	IN	Mississippi River	295143	0895819
807	Industry	IN	Mississippi River	[1]294200	[1]0895900
808	Industry	IN	Mississippi River	294833	0900027
802a	Plaquemines Parish Waterworks - Belle Chase	WS	Mississippi River	294817	0901051
802b	Plaquemines Parish Waterworks - Buras	WS	Mississippi River	292130	0892607
802c	Plaquemines Parish Waterworks - Dalcour	WS	Mississippi River	295143	0895519
802d	Plaquemines Parish Waterworks - Pointe-a-la-Hache	WS	Mississippi River	293503	0894826
802e	Plaquemines Parish Waterworks - Port Sulphur	WS	Mississippi River	[1]293500	[1]0894800
804	Industry	IN	Mississippi River	291318	0892339

Appendix B: *Surface-water withdrawal sites along the Mississippi River adjacent to the Barataria-Terrebonne Basins, Louisiana*—Continued

Facility identification number (pl. 1)	Facility	Use	Source	Latitude	Longitude
		ST. BERNARD PARISH			
1549	Industry	IN	Mississippi River	295554	0895849
1847	Industry	IN	Mississippi River	295642	0900012
999	Industry	IN	Mississippi River	295545	0895820
878	Industry	IN	Mississippi River	295553	0895634
880	St. Bernard Water & Sewage	WS	Mississippi River	295545	0895734
		ST. CHARLES PARISH			
889	Commercial	CO	Mississippi River	[1]295700	[1]0901900
892	Fossil fuel power plant	PF	Mississippi River	[1]300100	[1]0902700
893	Fossil fuel power plant	PF	Mississippi River	295950	0902750
894	Nuclear power plant	PN	Mississippi River	295950	0902750
888	Industry	IN	Mississippi River	295538	0902103
895	Industry	IN	Mississippi River	295910	0902725
890	St. Charles Waterworks District 1	WS	Mississippi River	295900	0902330
891	St. Charles Waterworks District 2	WS	Mississippi River	295544	0902150
885	Industry	IN	Mississippi River	295925	0902430
887	Industry	IN	Mississippi River	[1]295900	[1]0902700
		ST. JAMES PARISH			
909	Industry	IN	Mississippi River	300231	0904854
911	Industry	IN	Mississippi River	300258	0904103
912	Industry	IN	Mississippi River	300309	0903955
916	Lutcher water system	WS	Mississippi River	300215	0904135
917	Gramercy water system	WS	Mississippi River	300236	0904107
1024	Industry	IN	Mississippi River	[1]300300	[1]0904000
1550	Industry	IN	Mississippi River	[1]300200	[1]0904800
1551	Industry	IN	Mississippi River	300635	0905440
907	St. James Waterworks District 1	WS	Mississippi River	300021	0904749
908	St. James Waterworks District 2	WS	Mississippi River	300006	0904713
2037	Industry	IN	Mississippi River	300531	0905450
		ST. JOHN THE BAPTIST PARISH			
1853	Commercial	CO	Mississippi River	300318	0903408
1553	Industry	IN	Mississippi River	300223	0902801
921	Industry	IN	Mississippi River	300258	0903122
922	Industry	IN	Mississippi River	300341	0903601
923	Industry	IN	Mississippi River	[1]300300	[1]0903800
989a	St. John Waterworks District 3 - Edgard	WS	Mississippi River	300315	0903445
989b	St. John Waterworks District 3 - Lions	WS	Mississippi River	300245	0903445

[1]Estimated latitude and longitude