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LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

Prepared in cooperation with the Louisiana Department of Transportation and Development

Water Resources of West Carroll Parish, Louisiana

Introduction

Information concerning the availability, use, and quality of water in West Carroll Parish, Louisiana (fig. 1), is critical for proper water-supply management. The purpose of this fact sheet is to present information that can be used by water managers, parish residents, and others for stewardship of this vital resource. In 2014, 21.27 million gallons per day (Mgal/d) of water were withdrawn in West Carroll Parish, including 17.91 Mgal/d from groundwater sources and 3.37 Mgal/d from surface-water sources[1] (table 1). Withdrawals for agricultural use, composed of general irrigation, rice irrigation, and livestock, accounted for 93 percent (19.76 Mgal/d) of the total water withdrawn (table 2). Other use categories included public supply and rural domestic. Water-use data collected at 5-year intervals from 1960 to 2010 and again in 2014 indicated that water withdrawals peaked in 2000 at 31.7 Mgal/d (fig. 2). The large decreases in water use from 1985 to 1990 and again from 2005 to 2010 are primarily attributable to declines in groundwater withdrawals for rice irrigation from 10 Mgal/d in 1985 to 2.22 Mgal/d in 1990 and from 10.52 Mgal/d in 2005 to 5.14 Mgal/d in 2010 (U.S. Geological Survey [USGS], 2016b). Surface-water withdrawals for general irrigation declined from 2.44 Mgal/d in 1985 to 0.42 Mgal/d in 1990 and from 2.2 Mgal/d in 2005 to 1.1 Mgal/d in 2010. Surface-water withdrawals for rice irrigation declined from 1.41 Mgal/d in 1985 to 0.66 Mgal/d in 1990 and from 2.06 Mgal/d in 2005 to 1.01 Mgal/d in 2010.

[1]Water-withdrawal data are based on estimated or reported site-specific data and aggregated data, which are distributed to sources. For a full description of water-use estimate methodology, see "Data Collection" in Sargent (2011). Tabulation of numbers in text and tables may result in different totals because of rounding; nonrounded numbers are used for calculation of totals.

Groundwater Resources

The primary freshwater-bearing aquifers in West Carroll Parish are the Mississippi River alluvial aquifer (called the Mississippi River Valley alluvial aquifer in some publications) (fig. 3) and the Cockfield aquifer (figs. 1 and 3). The base of fresh groundwater (water with a chloride concentration of 250 milligrams per liter [mg/L] or less) ranges from less than 100 feet (ft) below the National Geodetic Vertical Datum of 1929 (NGVD 29) in the northeastern part of the parish to greater than 300 ft below NGVD 29 in the southern part of the parish in the Cockfield aquifer (fig. 1) (Smoot, 1988).

Mississippi River Alluvial Aquifer

The Mississippi River alluvial aquifer, which extends across West Carroll Parish, is a large regional aquifer that is present in various States (Saucier, 1994). The Mississippi River alluvial aquifer is composed of the sand-and-gravel part of the alluvial sediments deposited primarily by the Mississippi River. These

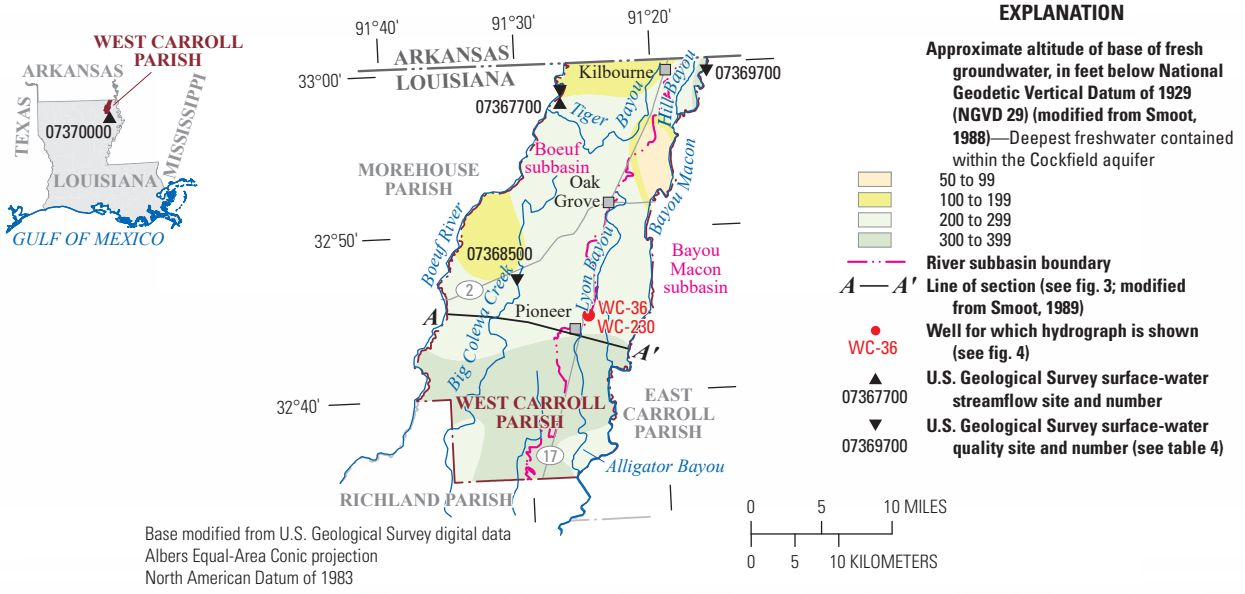

Figure 1. Location of study area, West Carroll Parish, Louisiana.

Table 1. Water withdrawals, in million gallons per day, by source in West Carroll Parish, Louisiana, 2014 (Collier, 2018).

Aquifer or surface-water body	Groundwater	Surface water
Mississippi River alluvial aquifer	16.89	
Cockfield aquifer	1.01	
Bayou Macon		2.01
Miscellaneous surface waters		1.36
Total	**17.91**	**3.37**

Table 2. Water withdrawals, in million gallons per day, by use category in West Carroll Parish, Louisiana, 2014 (Collier, 2018).

[<, less than]

Use category	Groundwater	Surface water	Total
Public supply	1.44	0.00	1.44
Rural domestic	0.07	0.00	0.07
Livestock	<0.01	<0.01	<0.01
Rice irrigation	3.03	1.01	4.04
General irrigation	13.36	2.36	15.72
Total	**17.91**	**3.37**	**21.27**

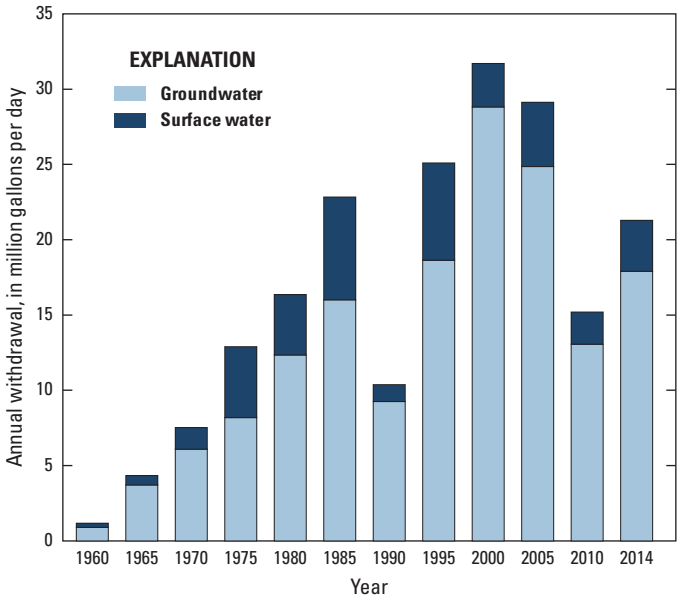

Figure 2. Water withdrawals in West Carroll Parish, Louisiana, 1960–2014 (U.S. Geological Survey, 2016b; Collier, 2018).

deposits generally grade from silt and clay at land surface to coarse sand and gravel at the base. The thickness of the Mississippi River alluvial deposit ranges from less than 100 ft in the northern part of the parish to greater than 140 ft in the southeastern part. The altitude of the base of the aquifer ranges from greater than NGVD 29 in the northern part of the parish to greater than 60 ft below NGVD 29 in the southeastern part (Whitfield, 1975).

The primary source of recharge to the alluvial aquifer is the infiltration of precipitation, with secondary sources of recharge from streams and rivers during high stage. Groundwater in the alluvial aquifer generally flows southward but also moves westward towards the Boeuf River in the western part of the parish and eastward towards Bayou Macon in the eastern part of the parish (fig. 1). Groundwater discharge is by evapotranspiration, natural flow into streams and rivers, and well withdrawals (Whitfield, 1975). Well withdrawal rates can affect the direction of groundwater flow either locally or regionally.

In 1990, a regional survey of water-level altitudes indicated that levels in wells screened in the Mississippi River alluvial aquifer ranged from greater than 80 ft above NGVD 29 in the northern part of the parish to less than 70 ft above NGVD 29 in the southeastern part of the parish (Seanor and Smoot, 1995). Water levels at well WC-230 (USGS site number 324508091252302), located northeast of Pioneer (fig. 1), fluctuated between about 74 and 78 ft above NGVD 29 from the mid-1950s to the mid-1990s, but declined about 6 ft from the mid-1990s to 2016 (fig. 4). Overall groundwater use increased from 1995 to 2005 and declined from 2005 to 2014. Groundwater levels at WC-230 appear to be stabilizing from 2014 to 2016.

State well-registration records listed 752 active water wells screened in the Mississippi River alluvial aquifer in West Carroll Parish in 2016: 650 irrigation wells, 91 domestic wells, 6 public-supply wells, and 5 industrial wells. Well depths ranged from 19 to 140 ft below land surface, and reported yields ranged from 9 to 4,000 gallons per minute (gal/min) (Louisiana Department of Natural Resources, 2016). In 2014, about 16.89 Mgal/d were withdrawn from the Mississippi River alluvial aquifer: 0.07 Mgal/d for rural domestic, 13.36 Mgal/d for general irrigation, less than 0.01 Mgal/d for livestock, 3.03 Mgal/d for rice irrigation, and 0.44 Mgal/d for public supply (Collier, 2018).

Cockfield Aquifer

The Cockfield aquifer is a regional aquifer that contains freshwater in much of northeastern and parts of west-central Louisiana (Brantly and Seanor, 1996). The aquifer is composed of sands and silts interbedded with discontinuous layers of clay and lignite. Sands range from very fine to medium grained. The layers of the aquifer dip in a southeasterly direction. The altitude of the base of the Cockfield aquifer ranges from about 250 ft below NGVD 29 in the western part of the parish to greater than 350 ft below NGVD 29 in the eastern part (Poole, 1961). The Mississippi River alluvial aquifer unconformably overlies the Cockfield aquifer throughout West Carroll Parish (fig. 3), and the aquifers are in direct hydraulic connection. The hydraulic connection allows the Mississippi River alluvial aquifer to recharge the Cockfield aquifer (Brantly and Seanor, 1996). Freshwater is available from the Cockfield aquifer throughout the parish (Smoot, 1988).

In 1993, a study of water-level altitudes in wells screened in the Cockfield aquifer indicated that levels were between 90 ft above NGVD 29 in the northern part of the parish and about 72 ft above NGVD 29 in the southern part of the parish with flow generally toward the south-southwest (Brantly and Seanor, 1996). Water levels at well WC-36 (USGS site number 324508091252301), located northeast of Pioneer (fig. 1), mimicked water levels in the overlying alluvial aquifer because

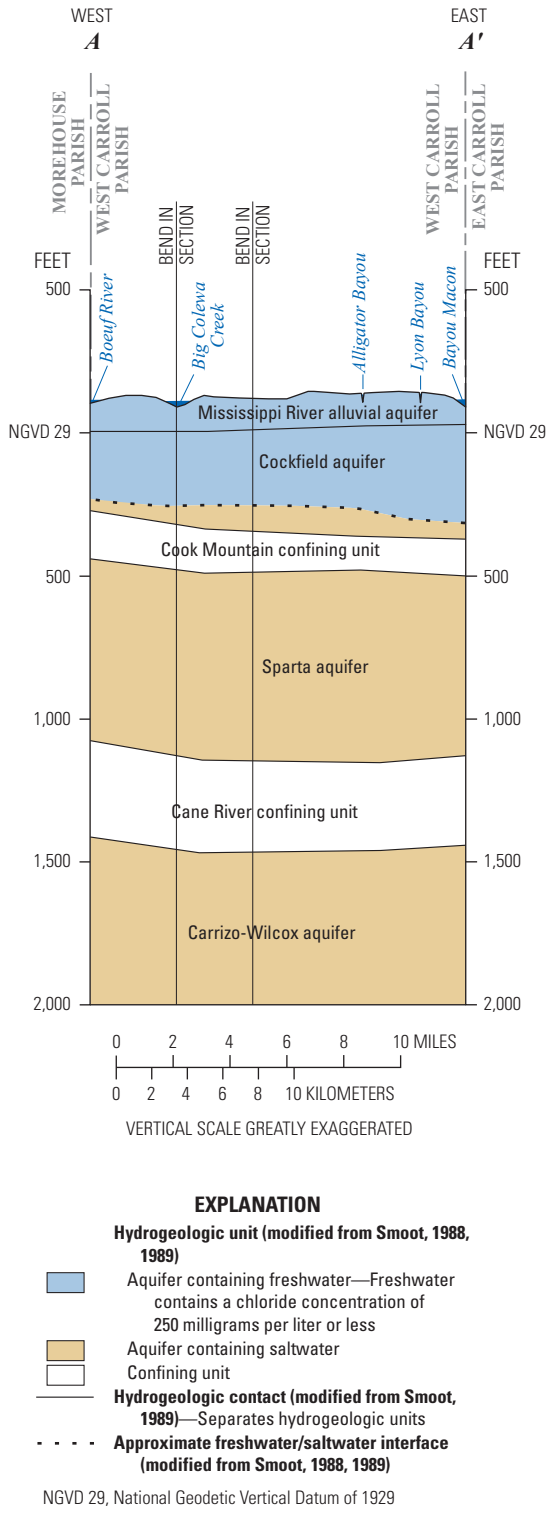

Figure 3. Idealized west-to-east hydrogeologic section through West Carroll Parish, Louisiana, showing aquifer and confining unit intervals (individual sand and clay layers not shown). Trace of section shown on figure 1.

of hydraulic connection, declining about 6 ft from the early 1990s to 2016 (fig. 4).

State well-registration records listed 31 active water wells screened in the Cockfield aquifer in West Carroll Parish in 2016: 6 domestic wells, 24 public-supply wells, and 1 industrial well. Well depths ranged from 145 to 462 ft below land surface, and reported yields ranged from 10 to 500 gal/min (Louisiana Department of Natural Resources, 2016). In 2014, more than 1.01 Mgal/d were withdrawn from the Cockfield aquifer, with use categories including less than 0.01 Mgal/d for rural domestic and 1.01 Mgal/d for public supply (Collier, 2018).

Groundwater Quality

Groundwater samples were collected from 35 wells screened in the Mississippi River alluvial aquifer during 1941–2011 and from 34 wells screened in the Cockfield aquifer during 1941–84 as part of an ongoing program to monitor the State's groundwater resources. These samples were within the U.S. Environmental Protection Agency's Secondary Maximum Contaminant Levels[2] (SMCLs) for pH (6.5–8.5 standard units) and sulfate concentrations (250 mg/L) (table 3). The median hardness value of 398 mg/L as calcium carbonate for the Mississippi River alluvial aquifer and 195 mg/L as calcium carbonate for the Cockfield aquifer were within the very hard[3] range. Median concentrations of iron and manganese exceeded the SMCLs (300 micrograms per liter [µg/L]) and 50 µg/L, respectively) for both aquifers. The median dissolved-solids concentration was below the SMCL (500 mg/L) for the Mississippi River alluvial aquifer and slightly exceeded the SMCL for the Cockfield aquifer.

Surface-Water Resources

Numerous surface-water resources are present in West Carroll Parish in primarily two drainage subbasins (fig. 1). The Boeuf subbasin (Hydrologic Unit Code [HUC] 08050001) drains the western part of the parish, and the Bayou Macon subbasin (HUC 08050002) drains the eastern part of the parish (USGS, 2016a). In 2014, 1.36 Mgal/d were withdrawn from miscellaneous streams: less than 0.01 Mgal/d for livestock, 0.94 Mgal/d for general irrigation, and 0.41 Mgal/d for rice irrigation (tables 1–2) (Collier, 2018).

Boeuf Subbasin

The Boeuf River is the primary river draining the Boeuf subbasin in West Carroll Parish. The Boeuf River enters Louisiana from Arkansas and flows in a southerly direction along much of the western border of the parish. Many other streams are present in the subbasin, including Big Colewa Creek[4] and Tiger Bayou (fig. 1). The average of daily mean streamflow values for the Boeuf River near AR/LA State Line (USGS site number 07367700) was about 347 cubic feet per second (ft^3/s) during 1986–2012 from a drainage area of 785 square miles (mi^2).

[2]The SMCLs are Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration), aesthetic effects (such as taste, odor, or color), or technical effects (such as damage to water equipment or reduced effectiveness of treatment for other contaminants) of potential constituents of drinking water. SMCLs were established as guidelines by the U.S. Environmental Protection Agency (2016).

[3]Hardness ranges, expressed as milligrams per liter of calcium carbonate, are as follows: 0–60, soft; 61–120, moderately hard; 121–180, hard; greater than 180, very hard (Hem, 1985).

[4]USGS topographic map presents the upper reaches of Big Colewa Creek under the name Big Colewa Bayou; other publications may also use this naming convention.

Table 3. Summary of selected water-quality characteristics for 35 freshwater wells screened in the Mississippi River alluvial aquifer and 34 freshwater wells screened in the Cockfield aquifer in West Carroll Parish, Louisiana (U.S. Geological Survey, 2016a).

[Values are in milligrams per liter, except as noted. °C, degrees Celsius; µS/cm, microsiemens per centimeter; SU, standard unit; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; SMCL, Secondary Maximum Contaminant Level established by the U.S. Environmental Protection Agency (2016); NA, not applicable]

	Temperature (°C)	Color (platinum cobalt units)	Specific conductance, field (µS/cm at 25 °C)	pH, field (SU)	Hardness (as $CaCO_3$)	Calcium, filtered (as Ca)	Magnesium, filtered (as Mg)	Sodium, filtered (as Na)	Chloride, filtered (as Cl)	Sulfate, filtered (as SO_4)	Iron, filtered, in µg/L (as Fe)	Manganese, filtered, in µg/L (as Mn)	Dissolved solids, filtered
Mississippi River alluvial aquifer (1941–2011)													
Median	19.6	5	916	7.4	398	100	43	41	60	18	940	278	406
10th percentile	19.0	0	430	6.9	108	71.8	26.8	20.6	13.9	2.8	94	51.2	221
90th percentile	20.3	10	1,300	7.9	515	132	53	81.4	191	62.4	4,660	543	714
Number of samples	32	8	28	18	29	19	19	9	35	19	15	15	15
Percentage of samples that do not exceed SMCLs	NA	100	NA	100	NA	NA	NA	NA	100	100	27	13	60
Cockfield aquifer (1941–84)													
Median	21	5	854	7.6	195	53.5	17.5	100	78	0.2	725	130	502
10th percentile	20.5	5	684	7.2	19.5	4.9	2.6	38	26.7	0	249	10	369
90th percentile	22	20	1,200	8.24	360	84.9	32.9	260	145	8.6	1,620	280	628
Number of samples	21	31	32	34	38	32	32	31	38	33	30	11	29
Percentage of samples that do not exceed SMCLs	NA	87	NA	100	NA	NA	NA	NA	100	100	17	18	48
SMCLs	NA	15	NA	6.5–8.5	NA	NA	NA	NA	250	250	300	50	500

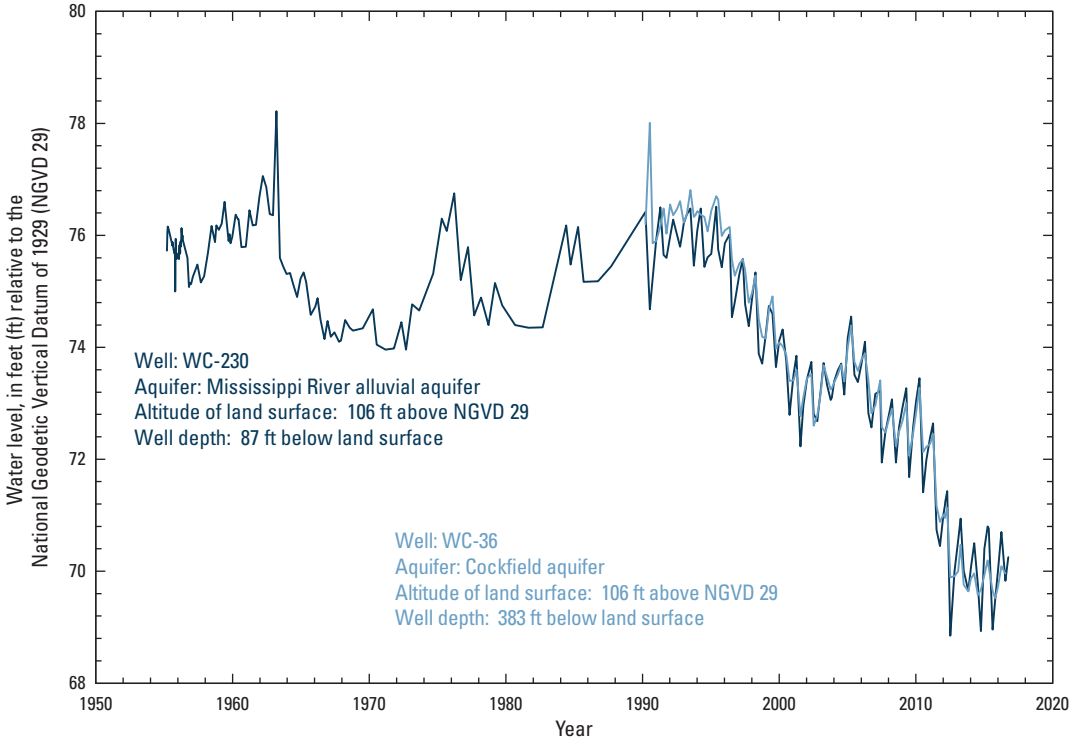

Figure 4. Water levels in well WC-230 screened in the Mississippi River alluvial aquifer and well WC-36 screened in the Cockfield aquifer in West Carroll Parish, Louisiana (see fig. 1 for well location; U.S. Geological Survey, 2016a).

Table 4. Summary of selected water-quality characteristics for samples from Big Colewa Creek, Bayou Macon, and Boeuf River, West Carroll Parish, Louisiana (U.S. Geological Survey, 2016a).

[Values are in milligrams per liter, except as noted. °C, degrees Celsius; µS/cm, microsiemens per centimeter; SU, standard unit; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; SMCL, Secondary Maximum Contaminant Level established by the U.S. Environmental Protection Agency (2016); NA, not applicable; <, less than; USGS, U.S. Geological Survey]

	Temperature (°C)	Color (platinum cobalt units)	Specific conductance, field (µS/cm at 25 °C)	pH, field (SU)	Hardness (as $CaCO_3$)	Calcium, filtered (as Ca)	Magnesium, filtered (as Mg)	Sodium, filtered (as Na)	Chloride, filtered (as Cl)	Sulfate, filtered (as SO_4)	Dissolved solids, filtered
Big Colewa Creek near Oak Grove (1956–67)[1]											
Median	17.2	NA	58	6.3	15	4	1.4	2.7	3.1	2	NA
10th percentile	10.1	NA	42	5.6	11.6	3.5	0.5	1.4	1.1	1.1	NA
90th percentile	20.3	NA	74	6.6	26.8	6.2	2.2	3.5	5.6	6.8	NA
Number of samples	3	3	17	17	17	15	15	16	15	17	3
Percentage of samples that do not exceed SMCLs	NA	0	NA	29	NA	NA	NA	NA	100	100	100
SMCLs	NA	15	NA	6.5–8.5	NA	NA	NA	NA	250	250	500

	Temperature (°C)	Color (platinum cobalt units)	Specific conductance, field (µS/cm at 25 °C)	Dissolved oxygen	pH, field (SU)	Hardness (as $CaCO_3$)	Chloride, filtered (as Cl)	Sulfate, filtered (as SO_4)	Iron, filtered, in µg/L (as Fe)	Manganese, filtered, in µg/L (as Mn)	Dissolved solids, filtered
Bayou Macon near Kilbourne (1957–91)[2]											
Median	18	15	290	7.8	7.3	120	13.5	15	50	50	186
10th percentile	7	5	124	6.1	6.7	52	4.9	7.4	<10	18	110
90th percentile	29	60	421	10.9	7.9	170	25.9	24	220	144	247
Number of samples	104	86	112	58	113	101	114	102	8	9	82
Percentage of samples that do not exceed SMCLs	NA	57	NA	NA	95	NA	100	100	88	56	100
Boeuf River near Arkansas-Louisiana State Line (1957–98)[3]											
Median	20	30	309	7.9	7.3	100	34	18	30	40	206
10th percentile	8	10	96	5.7	6.7	37	5.3	8	<8.6	9.2	96
90th percentile	29.8	120	706	10.7	8	240	97	38.1	164	72	420
Number of samples	145	114	132	92	153	97	131	120	9	9	103
Percentage of samples that do not exceed SMCLs	NA	33	NA	NA	92	NA	100	100	100	67	95
SMCLs	NA	15	NA	NA	6.5–8.5	NA	250	250	300	50	500

[1]USGS site number 07368500 (see fig. 1). Referred to in the USGS National Water Information System as Big Colewa Bayou near Oak Grove.

[2]USGS site number 07369700 (see fig. 1).

[3]USGS site number 07367700 (see fig. 1).

During this period, the highest monthly average flow occurred during February (619 ft^3/s), and the lowest occurred during September (152 ft^3/s) (USGS, 2016a). Flow is affected at this site by irrigation withdrawals and interconnected bayous and drainage ditches.

Bayou Macon Subbasin

Bayou Macon originates north of the Louisiana State line and flows in a general southerly direction along much of the eastern border of the parish. Bayou Macon receives flow from Alligator, Lyon, and Hill Bayous and other tributaries. The average streamflow for Bayou Macon near Delhi (USGS site number 07370000), located south of West Carroll Parish on the eastern border of Richland Parish (fig. 1), was 975 ft^3/s during 1934–92 from a drainage area of 782 mi^2 (USGS, 2016a). In 2014, 2.01 Mgal/d were withdrawn from Bayou Macon: 0.60 Mgal/d for rice irrigation and 1.41 Mgal/d for general irrigation (Collier, 2018).

Surface-Water Quality

Water-quality samples were collected from Big Colewa Creek[5] near Oak Grove (USGS site number 07368500) during 1956–67, Bayou Macon near Kilbourne (USGS site number 07369700) during 1957–91, and Boeuf River near AR/LA State Line (USGS site number 07367700) during 1957–98 (fig. 1) as part of an ongoing program to monitor the State's surface-water resources. These samples were generally within the SMCLs for chloride, sulfate, and dissolved solids (table 4). Median hardness values were within the moderately hard range for Bayou Macon and Boeuf River samples and within the soft range for Big Colewa Creek samples. Median values for dissolved-oxygen concentrations were greater than 7.5 mg/L in samples from Bayou Macon and Boeuf River. A dissolved-oxygen concentration of 5 mg/L is considered the minimum value for a diverse population of fresh, warm water biota, including sport fish (Louisiana Department of Environmental Quality, 2008). Dissolved-oxygen samples were not available for the Big Colewa Creek near Oak Grove site. More than 70 percent of Big Colewa Creek samples exceeded the SMCL for pH, whereas more than 90 percent of samples from Bayou Macon and Boeuf River had a pH within the SMCL.

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This fact sheet has been prepared by the USGS, in cooperation with the Louisiana Department of Transportation and Development (DOTD), as part of a program to document water use, availability, and quality in the parishes of Louisiana. Information on the availability, past and current water use, use trends, and water quality from groundwater and surface-water sources in the parish is presented here. Previously published reports (see References Cited section) and data stored in the USGS National Water Information System (USGS, 2016a) are the primary sources of the information presented here. Special thanks are given to Doug Taylor, Director, and Zahir "Bo" Bolourchi (retired), DOTD Cooperative Program with the USGS.

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[5]The National Water Information System refers to USGS site number 07368500 as Big Colewa Bayou near Oak Grove.

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