STATE OF LOUISIANA

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

OFFICE OF PUBLIC WORKS, HURRICANE FLOOD PROTECTION

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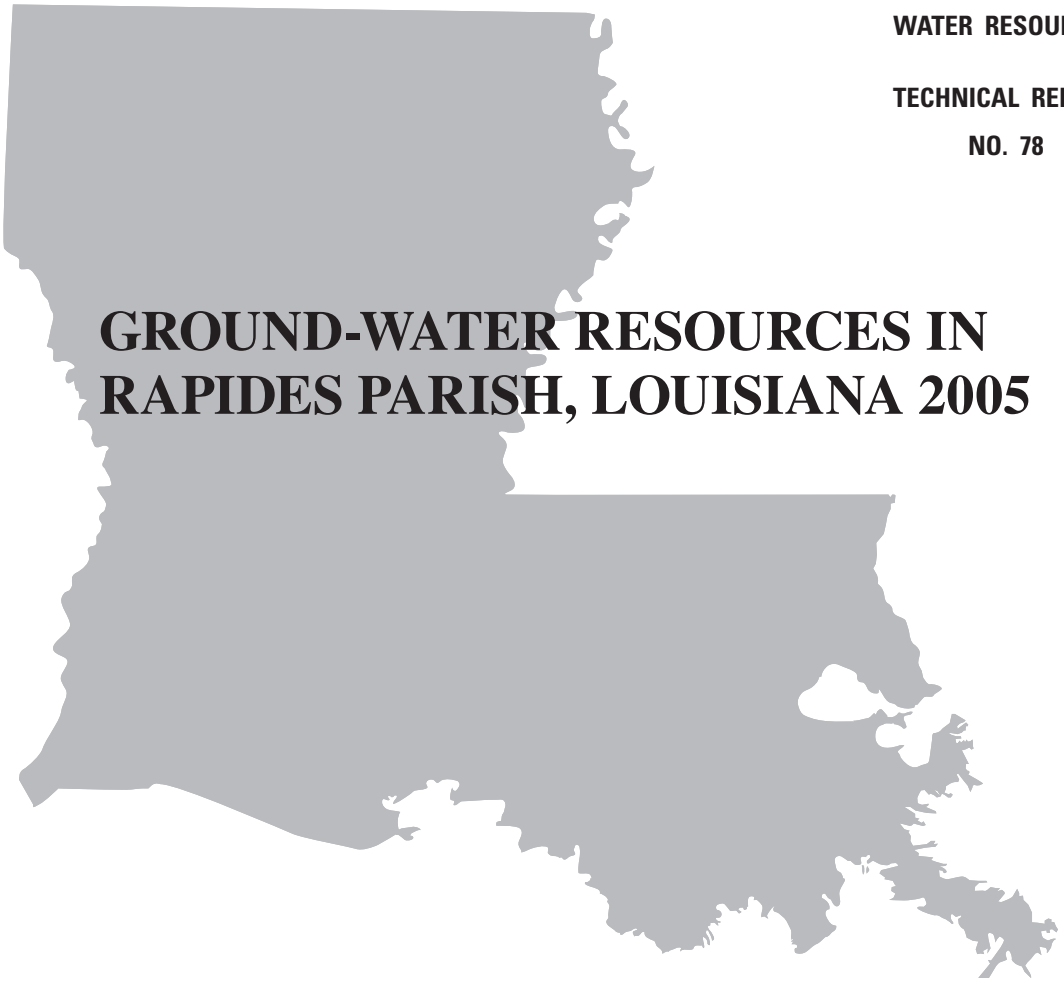
WATER RESOURCES PROGRAMS

WATER RESOURCES

TECHNICAL REPORT

NO. 78

GROUND-WATER RESOURCES IN RAPIDES PARISH, LOUISIANA 2005



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In cooperation with the

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Ground-Water Resources in Rapides Parish, Louisiana, 2005

By

Dan J. Tomaszewski

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Conversion Factors, Datum, and Abbreviated Water-Quality Units

Multiply	By	To obtain
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
mile (mi)	1.609	kilometer (km)
square mile (mi2)	2.590	square kilometer (km2)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m3/s)
gallons per minute (gal/min)	0.06308	liter per second (L/s)

Vertical coordinate information in this report is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada.

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

Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Abbreviated water-quality units:

micrograms per liter (µg/L)

milligrams per liter (mg/L)

Ground-Water Resources in Rapides Parish, Louisiana, 2005

By Dan J. Tomaszewski

Abstract

In 2000, about 36.6 Mgal/d (million gallons per day) of water was withdrawn from aquifers that underlie Rapides Parish. The most used aquifers in the parish include the Carnahan Bayou (12.6 Mgal/d), upland terrace (10.5 Mgal/d), Williamson Creek (7.1 Mgal/d), and Evangeline (2.8 Mgal/d) aquifers. The City of Alexandria Water System is the largest ground-water user (21.1 Mgal/d in 2000). The City of Pineville is the second largest user (2.8 Mgal/d in 2000).

The Red River alluvial aquifer underlies about 30 percent of Rapides Parish. The Red River alluvial aquifer yields water that is very hard (greater than 180 mg/L, milligrams per liter, as calcium carbonate, $CaCO_3$), and iron and manganese concentrations generally exceed the U.S. Environmental Protection Agency Secondary Drinking Water Regulations (SDWR's). Chloride concentrations generally are less than 180 mg/L; however, local areas contain saltwater (chloride concentrations greater than 250 mg/L).

The upland terrace aquifer and Chicot aquifer system combined underlie about 60 percent of the parish. In western Rapides Parish, the upland terrace aquifer and Chicot aquifer system yield freshwater that generally is soft (hardness less than 60 mg/L as $CaCO_3$) and does not exceed SDWR's for dissolved solids, chloride, iron, and manganese. About 8.2 Mgal/d was withdrawn from the Kisatchie well field in 2000. The water table surface is close to predevelopment levels in western Rapides Parish. In the Kisatchie well field area, water levels have declined locally 10 to 20 feet since withdrawal from the well field began (about 1968).

The Evangeline aquifer underlies the approximate southern one third of Rapides Parish. The aquifer contains freshwater that is soft and does not exceed SDWR's for dissolved solids, chloride, iron, and manganese. Chloride concentrations generally range between 2.8 and 36 mg/L at wells sampled.

The Williamson Creek aquifer underlies most of Rapides Parish with the exception of the northern limits. Freshwater in the Williamson Creek aquifer in Rapides Parish is generally soft and does not exceed SDWR's for dissolved solids, iron, and manganese. Chloride concentrations generally range between 7 and 86 mg/L. Large areas of freshwater are underlain with saltwater. Water levels in the Williamson Creek aquifer generally range from 200 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29) in the outcrop area to 40 feet below NGVD 29 in withdrawal centers.

The Carnahan Bayou aquifer is extensive throughout Rapides Parish; however, large areas contain saltwater. In much of the parish, the aquifer can yield water that is soft and does not exceed SDWR's for dissolved solids, chloride, iron, and manganese. Chloride concentrations generally range between 4 and 146 mg/L at freshwater wells sampled.

Movement of saltwater has degraded freshwater quality in some areas of the Carnahan Bayou aquifer. In the Alexandria-Pineville area and the Kisatchie well field area, increased concentrations of chloride have been detected. Saltwater is present in the Carnahan Bayou aquifer east of the Kisatchie well field and in sediments underlying deeper aquifers.

Introduction

Although Rapides Parish has abundant supplies of fresh ground water and surface water, there have been increasing concerns about water withdrawals and their effects on water resources in the parish. Water managers and planners are concerned about the capability of aquifers in Rapides Parish to supply sufficient water for future growth. In 2002, the U.S. Geological Survey (USGS), in cooperation with the Louisiana Department of Transportation and Development (DOTD), began a study to evaluate the ground-water resources of the parish.

The study area includes all of Rapides Parish, which is located in central Louisiana (fig. 1). Based on the period 1971 to 2000, average annual rainfall is 67 in., and average annual temperature is 19° C (Louisiana Office of State Climatology, written commun., 2007). The parish consists of about 1,323 mi^2 of land area and 39 mi^2 of water area, and major cities (population greater than 5,000) include Alexandria and Pineville (U.S. Census Bureau, 2000).

Purpose and Scope

This report describes ground-water resources in Rapides Parish, Louisiana. Information is presented for the Red River alluvial aquifer, upland terrace aquifer and Chicot aquifer system, and the Evangeline, Williamson Creek, and Carnahan Bayou aquifers in Rapides Parish. Water quality and water levels in the aquifers and withdrawals at major well fields are documented. The possible movement of saltwater toward major well fields in the parish is evaluated. The report includes selected water-quality data, maps showing the altitude of the base and generalized potentiometric surface for each aquifer, and hydrographs of water levels for selected wells. This report may improve knowledge of the effects of withdrawals on aquifers in similar settings in other areas of the United States.

Background

Ground-water withdrawal in 2000 was about 36.6 Mgal/d (table 1, fig. 2) in Rapides Parish (Sargent, 2002, p. 61). Although aquifers supplied less than 8 percent of the total water withdrawn (about 450 Mgal/d), ground water is heavily relied on for public supply. Withdrawals are listed by major public supplier in the parish in table 2.

The most used aquifers in the parish include the Carnahan Bayou (12.6 Mgal/d), upland terrace (10.5 Mgal/d), Williamson Creek (7.1 Mgal/d), and Evangeline (2.8 Mgal/d) aquifers (fig. 3). About 3.6 Mgal/d of water was withdrawn from additional aquifers in the parish, including the Red River alluvial aquifer and Chicot aquifer system.

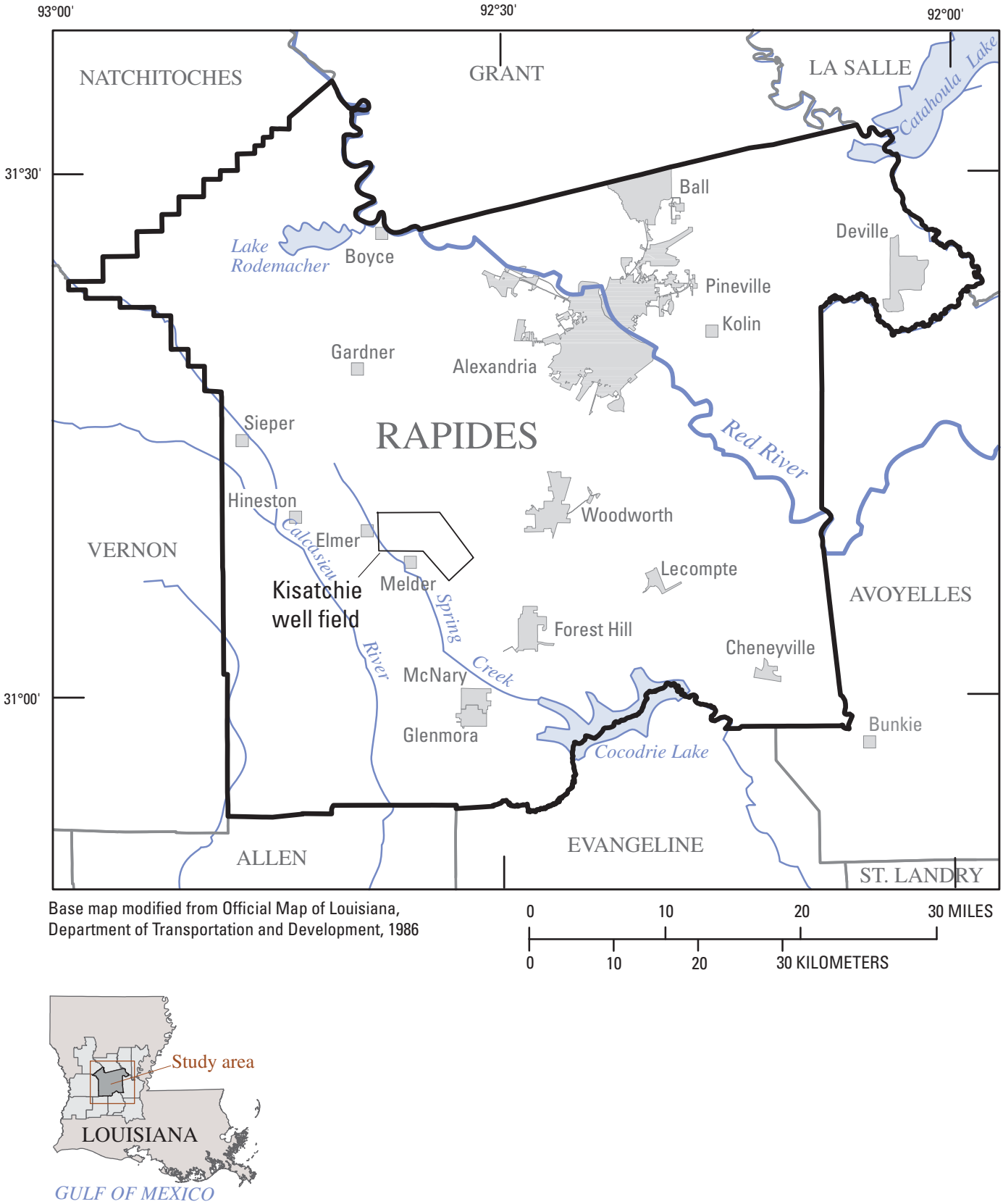


Figure 1. Location of study area, Rapides Parish, Louisiana.

Table 1. Ground-water and surface-water withdrawals and use, Rapides Parish, Louisiana, 2000.

[Source: Sargent, 2002, p. 61]

Water use category	Withdrawals, in million gallons per day		
	Ground water	Surface water	Total
Public supply	29.27	0.00	29.27
Industrial	.02	.00	.02
Power generation	.12	407.48	407.60
Rural domestic	.50	.00	.50
Livestock	.04	.18	.22
Rice irrigation	3.57	5.78	9.35
General irrigation	.40	.40	.80
Aquaculture	2.68	1.34	4.02
TOTAL	36.60	415.18	451.78

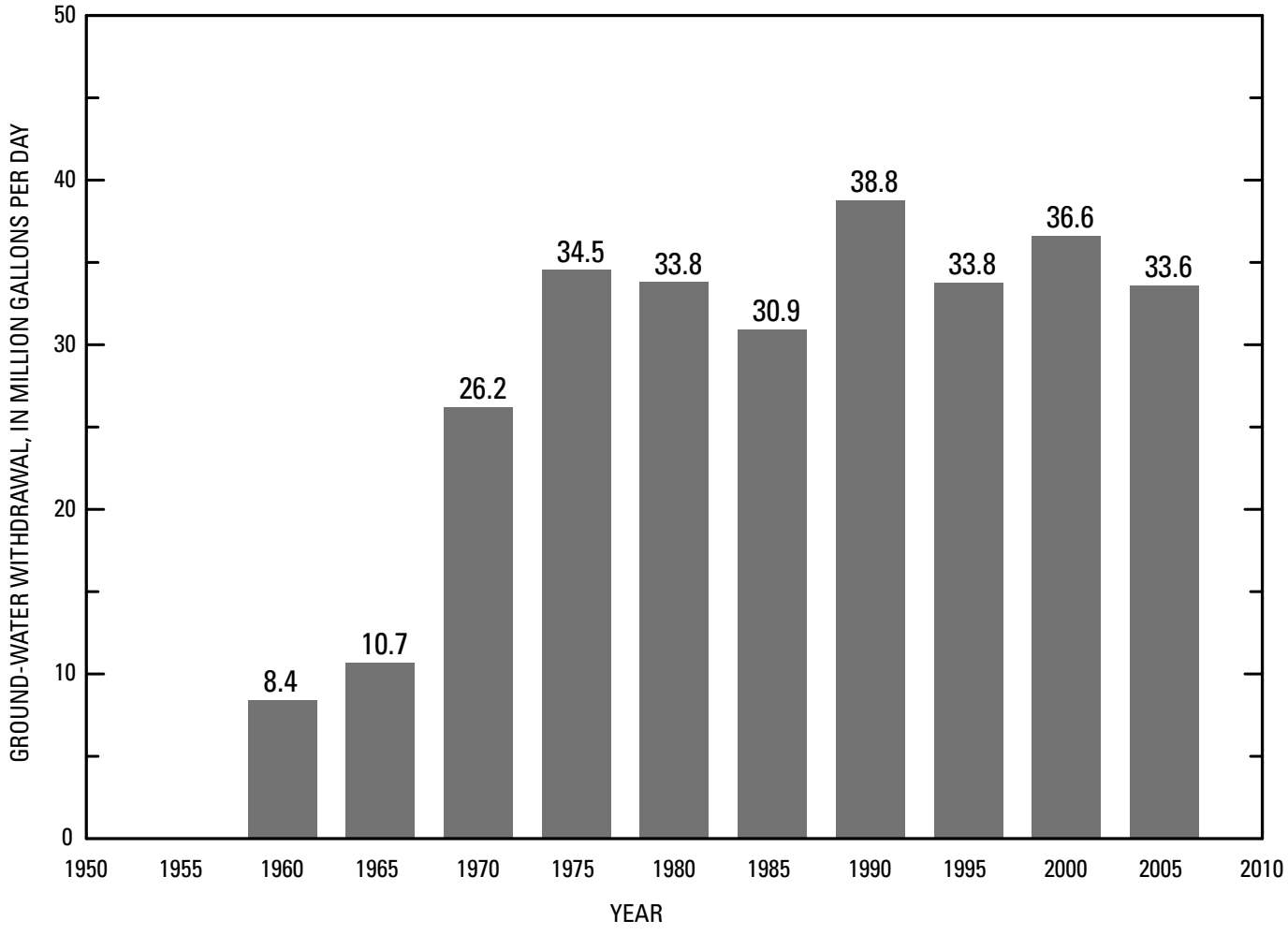


Figure 2. Ground-water withdrawals in Rapides Parish, Louisiana, 1960-2000 (B.P. Sargent, U.S. Geological Survey, written commun., 2002)

Table 2. Ground-water withdrawals by major public supplier, Rapides Parish, Louisiana, 2000.

[Source: Sargent, 2002]

Public supplier	Withdrawal, in million gallons per day	Public supplier	Withdrawal, in million gallons per day
Alexandria Water System	21.10	Hineston Water System	0.08
Avoyelles Parish Ward 1 Water System	.17	Kolin-Ruby-Wise Water District	.35
Boyce Water System	.16	Lecompte Water System	.23
Buckeye Water District 50	.82	Lena Water System	.19
Bunkie Water System	.67	McNary Water System	.06
Cheneyville Water System	.15	Pineville Water System	2.81
Elmer-Melder-Cal Water System	.14	Pollock Area Water System	.08
Forest Hill Water System	.34	Rapides Island Water Association	.44
Gardner Comm Water System	.31	Rapides Water Works District 3	.66
Glenmora Water System	.18	Sieper Area Water System	.10
Hammock Water System	.03	Woodworth Water System	.13

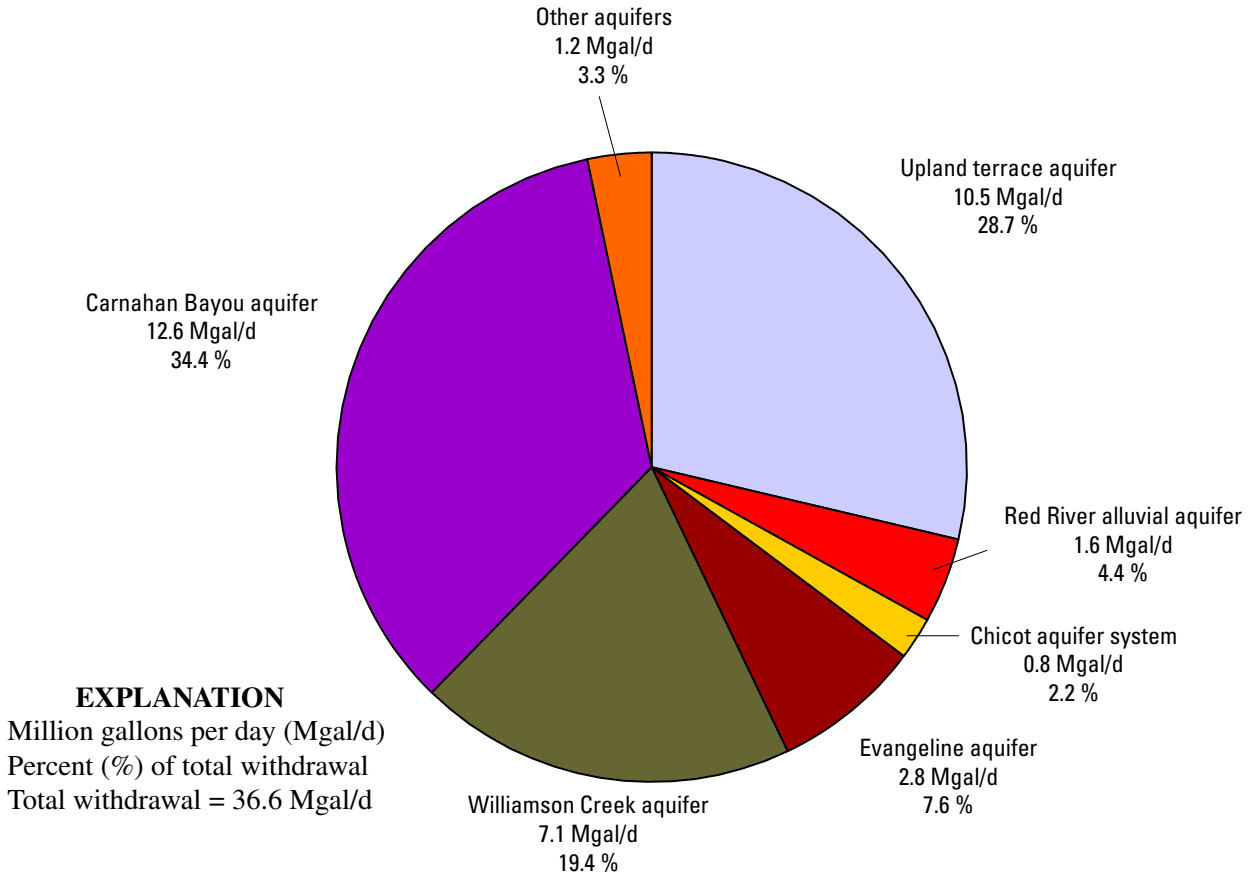


Figure 3. Water withdrawal by aquifer or aquifer system in Rapides Parish, Louisiana, 2000 (B.P. Sargent, U.S. Geological Survey, modified written commun., 2002).

The City of Alexandria Water System is the largest ground-water user in the parish (21.1 Mgal/d in 2000, table 2) and maintains well fields in the Alexandria area and the Kisatchie well field. For the purpose of this report, the well fields located within the city limits of Alexandria and adjacent areas supplying water to the city and surrounding suburbs are referred to as the Alexandria well field. Water withdrawn at the Kisatchie well field, located about 10 mi southwest of Alexandria, is used for public supply and industry. The City of Pineville, located adjacent to Alexandria, is the second largest ground-water user in the parish (2.81 Mgal/d in 2000, table 2). The Alexandria well-field and the Pineville well-field, collectively, are referred to as the Alexandria-Pineville well-field area.

A freshwater-saltwater[1] interface in the Carnahan Bayou and Williamson Creek aquifers trends northeast to southwest across central Rapides Parish. The interface is the approximate boundary between fresh and saltwater (water with chloride concentration greater than 250 mg/L) and is close to or underlies some wells in the Alexandria-Pineville and the Kisatchie well fields (Newcome and Sloss, 1966, fig. 2). Withdrawals in the Alexandria-Pineville and Kisatchie well fields could induce movement of saltwater by upconing and lateral movement into well fields.

Surface-water use in Rapides Parish includes power generation, irrigation, aquaculture, and livestock. In 2000, about 415 Mgal/d of surface water was used. Withdrawals for power generation (407 Mgal/d) were from Lake Rodemacher. Surface-water withdrawals for irrigation, aquaculture, and livestock (about 8 Mgal/d) were from miscellaneous sources (Sargent, 2002).

Acknowledgments

Special thanks are given to Zahir "Bo" Bolourchi, Director, Water Resources Programs, Louisiana Department of Transportation and Development, whose valuable suggestions enhanced the quality of this report. Well-construction records were obtained from the registration files at the Louisiana Department of Transportation and Development. The Louisiana Department of Health and Hospitals provided water-quality data for public-supply wells in Rapides Parish. Additionally, special thanks are given to public supply, private industry, and individual well owners that allowed data collection at their sites.

Methods of Study

The maps showing the altitudes of the base of the Evangeline, Williamson Creek, and Carnahan Bayou aquifers underlying Rapides Parish were compiled from existing maps. The maps showing the altitudes of the base of the Red River alluvial aquifer, upland terrace aquifer, and Chicot aquifer system were constructed during this study using geophysical and drillers' log data in USGS and DOTD files.

Maps showing the water-level surfaces of the aquifers and water-level graphs for selected wells were used to document the water-level conditions in Rapides Parish. Recently published maps showing the potentiometric surface in the Evangeline (Fendick, 2005) and Williamson Creek and Carnahan Bayou (Brantly and Seanor, 2005) aquifers are included. The potentiometric-surface map for the Red River alluvial aquifer was constructed using 2000 data in USGS National Water Information System (NWIS).

[1]Saltwater in this report is defined as water that has concentrations of chloride greater than or equal to 250 mg/L; concentrations of chloride less than 250 mg/L are within the Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 2004).

The water-level map for the upland terrace aquifer and Chicot aquifer system was constructed using data collected in western Rapides Parish in 2005 by USGS personnel using steel or electric tapes. Water-level maps were used to determine ground-water flow direction. Recent water-level maps were compared visually with previous maps to determine regional changes in water levels. Graphs for selected wells in each aquifer show water-level trends over extended periods of time.

The upland terrace aquifer underlying northeastern Rapides Parish was not included in this report. The hydrogeology, water quality, and water levels in the upland terrace aquifer in northeastern Rapides Parish have been described in detail by Snider and Sanford (1981). No major withdrawal centers have been reported in the terrace aquifer in northeastern Rapides Parish. Less than 0.3 Mgal/d is withdrawn from the terrace aquifers in northeastern Rapides Parish.

Major well fields are shown on maps. Withdrawal data in this report are from water-use information compiled for the years 1995-2000 (B.P. Sargent, U.S. Geological Survey, modified written commun., 2002). Aggregate withdrawal data and well locations were used to document approximate locations of concentrated withdrawals. Generalized well-distribution maps are intended to show approximate distribution of withdrawal from an aquifer. Well-distribution maps include wells from the DOTD State registry of wells; some wells may be inactive (unused). Wells shown on maps include wells used for public supply, irrigation, agriculture, domestic, power generation, industry, and aquaculture. The distribution maps do not include wells such as observation and monitor wells or temporary wells that may not be used to routinely withdraw water. Data used in this report are stored in the USGS NWIS data base (http://waterdata.usgs.gov/nwis) and are on file at the USGS office in Baton Rouge, Louisiana.

Chloride and specific-conductance data were evaluated to determine sites where chloride concentrations were increasing. Data (temperature, specific conductance, and chloride) for selected wells screened in the Williamson Creek and Carnahan Bayou aquifers are listed in tables. USGS data were supplemented with additional chloride data from the Louisiana Department of Health and Hospitals (Dean Lowe, Louisiana Department of Health and Hospitals, written commun., 2005) at selected sites.

Freshwater and saltwater areas in the aquifers are shown in maps. Selected water-quality data (temperature, color, specific conductance, pH, hardness[2], chloride, iron, manganese, and dissolved solids) for sites sampled by USGS personnel during the period 1960-2005 are statistically summarized in tables. If multiple samples were obtained at a well site, the most complete or recent analysis was included in the tabulation. Approximate ranges for selected water-quality data were determined between the 5th and 95th percentiles. The quality of water is presented in relation to U.S. Environmental Protection Agency (USEPA) Secondary Drinking Water Regulations (SDWR's) [3] established for public-supply drinking water (U.S. Environmental Protection Agency, 2004).

[2] Hardness, as calcium carbonate (CaCO3), was classified as soft (1-60 mg/L), moderately hard (61-120 mg/L), hard (121-180 mg/L), and very hard (greater than 180 mg/L) (Hem, 1985, p. 159).

[3] The SDWR's are non-enforceable Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water. At high concentrations or values, health implications as well as aesthetic degradation might exist. SDWR's are intended as guidelines for the states (U.S. Environmental Protection Agency, 2004).

General Hydrogeology

In Rapides Parish, freshwater is present in aquifers in sediments that range in age from early Miocene to Recent (figs. 4-6). The aquifers contain freshwater to 500 ft or less below NGVD 29 in northern and southeastern Rapides Parish. Freshwater reaches a maximum of about 3,000 ft below NGVD 29 in southwestern Rapides Parish (fig. 7). The aquifers extend into adjacent parishes.

<table>
<tr><th>System</th><th>Series</th><th colspan="2">Stratigraphic Unit</th><th colspan="2">Hydrogeologic unit</th></tr>
<tr><td>Quaternary</td><td>Pleistocene</td><td colspan="2">Red River alluvial deposits
Northern Louisiana terrace deposits
Unnamed Pleistocene deposits</td><td colspan="2">Red River alluvial aquifer or surficial confining unit
Upland terrace aquifer or surficial confining unit
Chicot aquifer system or surficial confining unit</td></tr>
<tr><td rowspan="7">Tertiary</td><td>Pliocene</td><td rowspan="6">Fleming Formation</td><td>Blounts Creek Member</td><td colspan="2">Evangeline aquifer</td></tr>
<tr><td rowspan="2">?</td><td>Castor Creek Member</td><td colspan="2">Castor Creek confining unit</td></tr>
<tr><td>Williamson Creek Member</td><td rowspan="3">Jasper aquifer system</td><td>Williamson Creek aquifer</td></tr>
<tr><td>Dough Hills Member</td><td>Dough Hills confinint unit</td></tr>
<tr><td>Carnahan Bayou Member</td><td>Carnahan Bayou aquifer</td></tr>
<tr><td rowspan="2">Miocene</td><td>Lena Member</td><td colspan="2">Lena confining unit</td></tr>
<tr><td colspan="2">Catahoula Formation</td><td colspan="2">Catahoula aquifer</td></tr>
</table>

Figure 4. Stratigraphic and hydrogeologic units in Rapides Parish, Louisiana (modified from McWreath and Smoot, 1989).

Aquifers in Rapides Parish generally consist of many freshwater-bearing sands (fine to coarse sand and gravel), separated (vertically and horizontally) by thick confining units. These confining units are sediments containing clay, silt, and a small percentage of sand. Within the Evangeline, Williamson Creek, and Carnahan Bayou aquifers, sands are separated and confined by clays that restrict vertical movement of water between the sands (Whitfield, 1975a, p. 8). The upland terrace aquifer, Chicot aquifer system, and Red River alluvial aquifer generally are composed of a thick bed of sand or gravel with fewer interbedded clay units.

The Red River alluvial aquifer, upland terrace aquifer, and Chicot aquifer system are at or near (generally less than 200 ft below) land surface. Water in the upland terrace aquifer and the Chicot aquifer system is unconfined; water levels generally are below the top of the aquifer. Water in the Red River alluvial aquifer generally is under confined conditions; water levels generally are above the top of the aquifer.

The Evangeline aquifer underlies the approximate southern one-third of Rapides Parish. The Evangeline aquifer is overlain by the Red River alluvial aquifer, upland terrace aquifer, and Chicot aquifer system. The Williamson Creek and Carnahan Bayou aquifers underlie most of the parish. Water in the aquifers generally is confined.

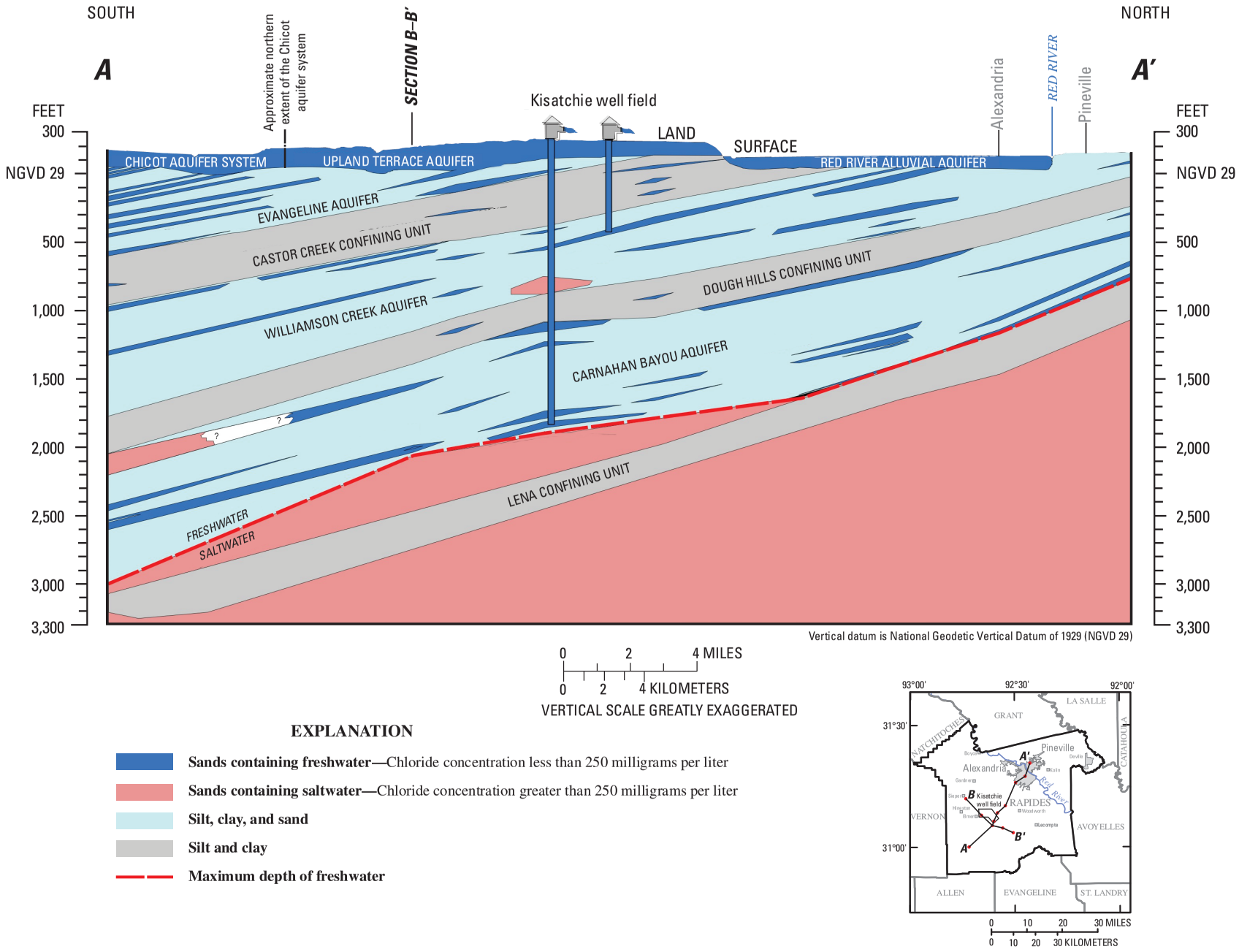
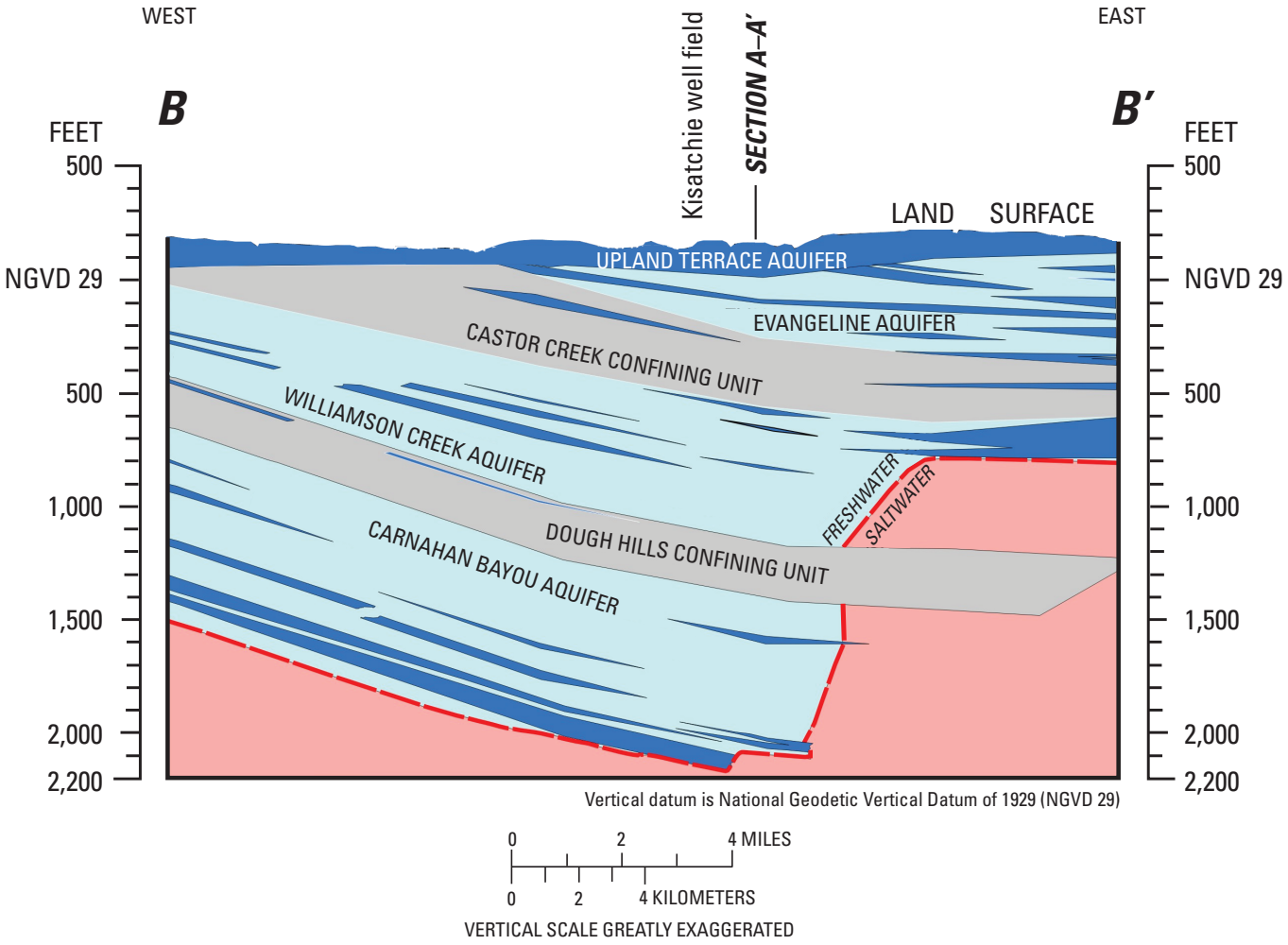


Figure 5. Generalized hydrogeologic section *A-A′* showing freshwater aquifers in Rapides Parish, Louisiana (modified from Smoot and Fendick, 1998).



EXPLANATION

Sands containing freshwater—Chloride concentration less than 250 milligrams per liter

Sands containing saltwater—Chloride concentration greater than 250 milligrams per liter

Silt, clay, and sand

Silt and clay

Maximum depth of freshwater

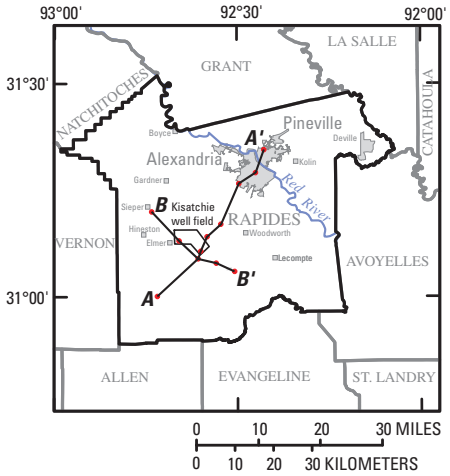


Figure 6. Generalized hydrogeologic section *B*–*B*′ showing freshwater aquifers in Rapides Parish, Louisiana (modified from Smoot and Fendick, 1998).

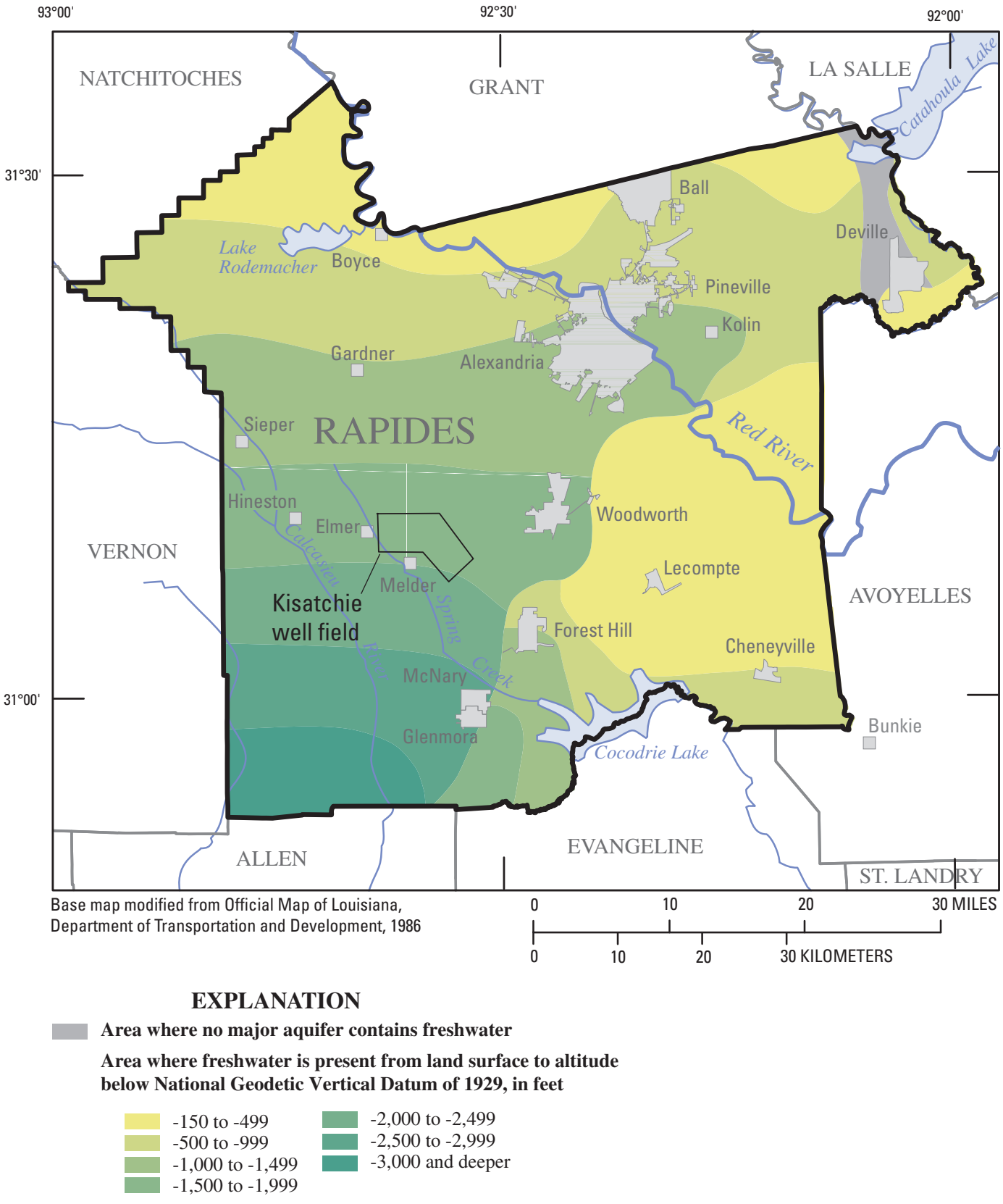


Figure 7. Altitude of freshwater, Rapides Parish, Louisiana (modified from Smoot, 1988).

The Evangeline, Williamson Creek, and Carnahan Bayou aquifers consist of a deltaic sand-clay sequence. Commonly the water-bearing sands capable of supplying substantial quantities of water to wells make up only 50 percent of the aquifer. Locally, individual sand beds vary in thickness and number. The individual sand beds composing these aquifers can be separated from each other and confined by extensive silt and clay deposits within the aquifer. (See Whitfield, 1975a, p. 12, 15, and 29.)

Ground-Water Resources

Red River Alluvial Aquifer

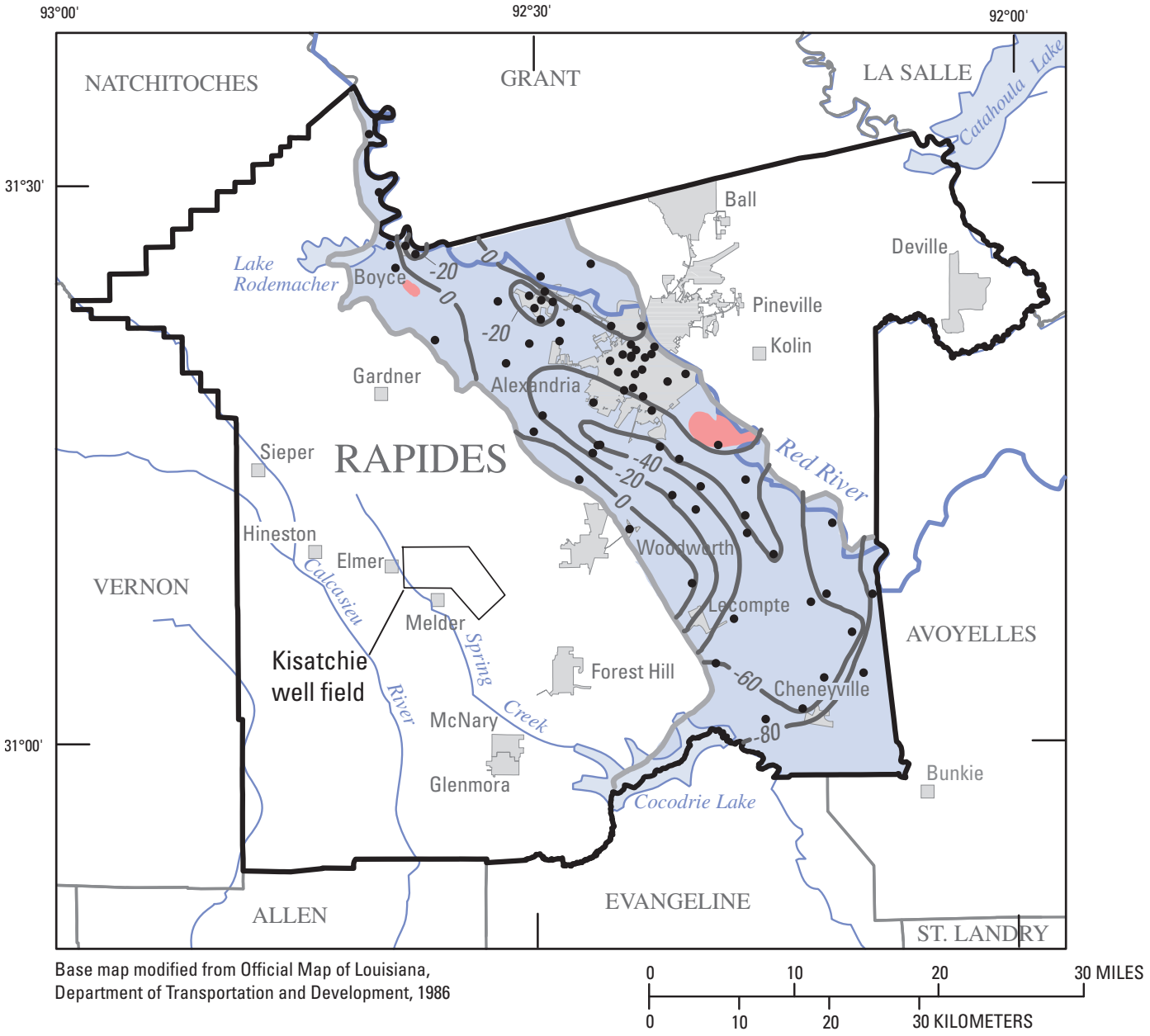
The Red River alluvium consists of two parts: fine-grained upper deposits that constitute a confining layer (silt, clay, and fine sand) and coarse-grained lower deposits (coarse sand or gravel) that form the Red River alluvial aquifer, also referred to as the alluvial aquifer (Rogers, 1983, p. 6). The alluvial aquifer underlies about 30 percent of Rapides Parish (fig. 8). The aquifer extends from north-central to southeastern Rapides Parish and extends north and south of the study area. The aquifer can be in hydraulic connection with the upland terrace aquifer on the eastern and western boundaries.

The Red River alluvial aquifer is recharged by rainfall that moves through the overlying fine-grained sediments and by inflow from adjacent aquifers along the eastern and western boundaries (Newcome and Sloss, 1966, p. 19). Hydraulic conductivity values for the alluvial aquifer have been estimated to range from about 100 to 300 ft/d (Whitfield, 1980, p. 7). Reported well yields at 125 sites (Louisiana Department of Transportation and Development, written commun., 2005) ranged from 1 to 3,700 gal/min in the Red River alluvial aquifer in Rapides Parish. The average reported yield was 382 gal/min, and the median reported yield was 30 gal/min.

In Rapides Parish, the base of the alluvial aquifer ranges from about 0 ft above NGVD 29 in northern and western areas to about 80 ft below NGVD 29 in southeastern areas (fig. 8). Analysis of driller's log data indicates the thickness of the alluvial aquifer ranges from about 20 ft in northern areas and in areas where the aquifer thins, to more than 80 ft in southeastern areas. Local abrupt thickening or thinning of the alluvial aquifer is not shown on the map. In southern Rapides Parish, the Red River alluvial aquifer may be merged with the Mississippi River alluvial aquifer (Saucier, 1994, pl. 23). The map showing the approximate altitude of the base of the Red River alluvial aquifer was constructed from driller's, geologist's, and lithology logs. Geophysical logs were not available for most of the area underlying the aquifer, or the shallow interval was not contained in the logged interval. Driller's, geologist's, and lithology logs may be less accurate than geophysical log data.

Water Quality

In Rapides Parish, the Red River alluvial aquifer yields water that is very hard (greater than 180 mg/L as $CaCO_3$). Chloride concentrations generally are less than 180 mg/L (table 3), although local areas containing saltwater have been documented (Whitfield, 1980, p. 16, pl. 15). Concentrations of dissolved solids, iron, and manganese generally exceed the SDWR's (table 3). Selected water-quality data from wells screened in the Red River alluvial aquifer in Rapides Parish sampled during the period 1960-93 are summarized in table 3. Locations of the wells are shown in figure 9.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Whitfield, 1980, pl. 15)

Aquifer boundary

-60- **Base of aquifer**—Shows altitude of aquifer base. Contour interval 20 feet. Vertical datum is National Geodetic Vertical Datum of 1929

• **Control point**

Figure 8. Location and approximate altitude of the base of the Red River alluvial aquifer in Rapides Parish, Louisiana.

Table 3. Summary of selected water-quality characteristics for the Red River alluvial aquifer in Rapides Parish, Louisiana, 1960–93.

[°C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter at 25 °C; SU, standard units; mg/L, milligrams per liter; µg/L, micrograms per liter; SDWR, Secondary Drinking Water Regulation; --, not applicable]

	Temperature (°C)	Color (PCU)	Specific conductance, field (µS/cm at 25°C)	pH, field (SU)	Hardness, (mg/L as CaCO3)	Chloride (mg/L)	Iron (µg/L)	Manganese (µg/L)	Dissolved solids (mg/L)
Minimum	19	0	147	6.2	40	2	46	70	324
Maximum	22.5	20	3,330	8.4	1,800	530	24,000	7,200	2,120
Median	20.5	0	1,040	6.9	500	30	5,700	840	600
Percentile 0.05	19.5	0	697	6.5	330	3.9	140	240	354
Percentile 0.95	22.1	15	1,854	7.3	810	180	20,000	2,900	1,070
Number of samples	37	43	94	97	84	117	107	113	49
SDWR[1]	--	15	--	6.5–8.5	--	250	300	50	500
Percent of samples less than SDWR[1]	--	95	--	97	--	96	6	0	21

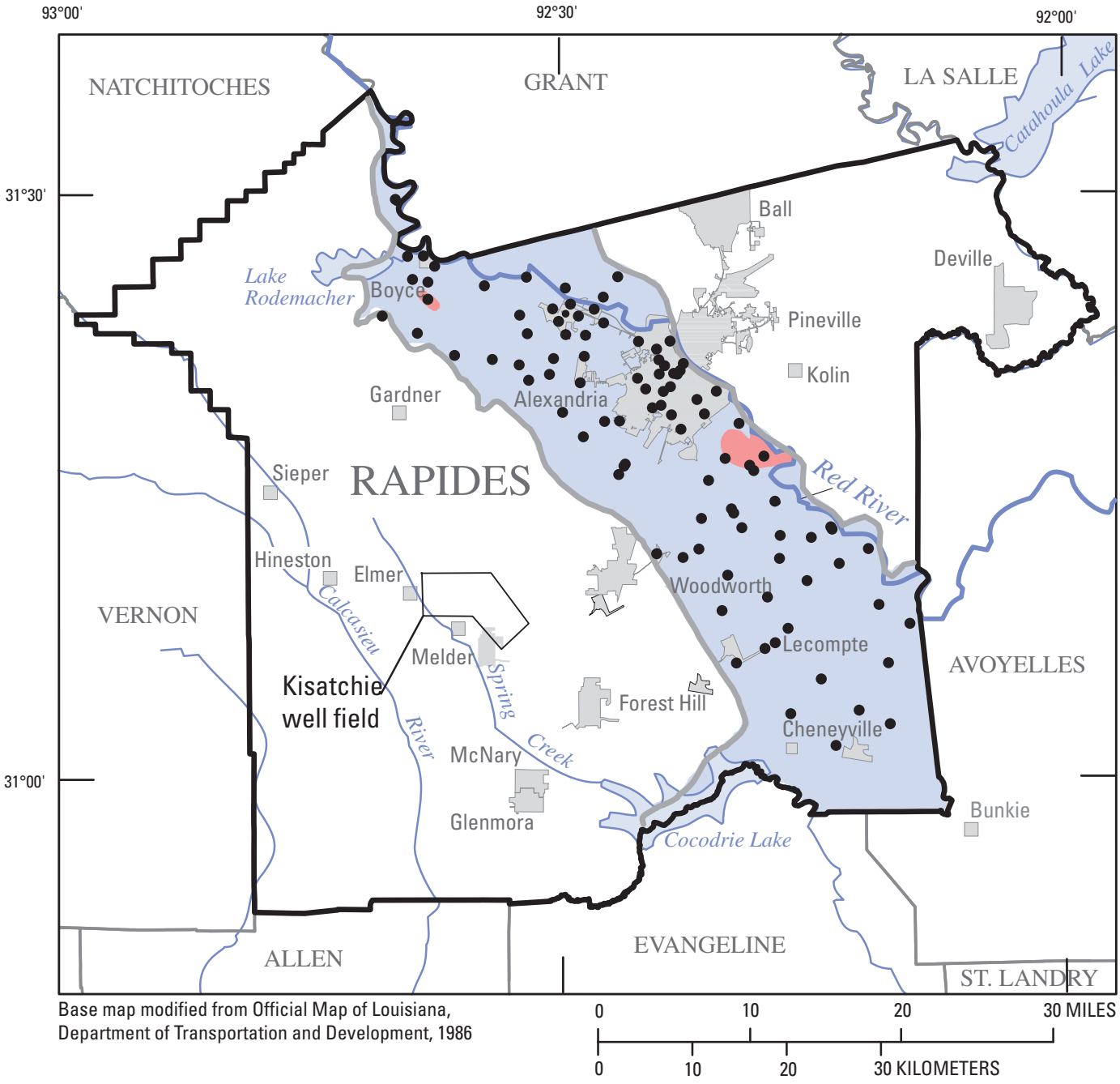
[1] U.S. Environmental Protection Agency (2004).

Withdrawals

In 2000, approximately 1.6 Mgal/d was withdrawn from the Red River alluvial aquifer in Rapides Parish (fig. 3). Water from the aquifer is used for irrigation (1.2 Mgal/d in 2000) and aquaculture (0.4 Mgal/d). Other minor withdrawals (less than 0.03 Mgal/d in 2000) include domestic and livestock. No withdrawals for public supply have been reported from the Red River alluvial aquifer in Rapides Parish (B.P. Sargent, U.S. Geological Survey, written commun., 2002). The distribution of wells withdrawing water from the Red River alluvial aquifer is shown in figure 10.

Water Levels, Water-Level Trends, and Water Movement

A generalized potentiometric-surface map for the Red River alluvial aquifer (fig. 11) was constructed using 32 water-level measurements collected July 2000. Measured water levels ranged from 45.4 to 76.8 ft above NGVD 29 in the parish. Water levels in the Red River alluvial aquifer are 70 ft or more above NGVD 29 in northern areas of the parish and decrease to about 50 ft above NGVD 29 in southern areas. A comparison of the July 2000 potentiometric surface with a composite map for the period 1969-74 (Rogers, 1983, fig. 4) indicates water levels have changed little. The configuration of the potentiometric surface is similar.



EXPLANATION

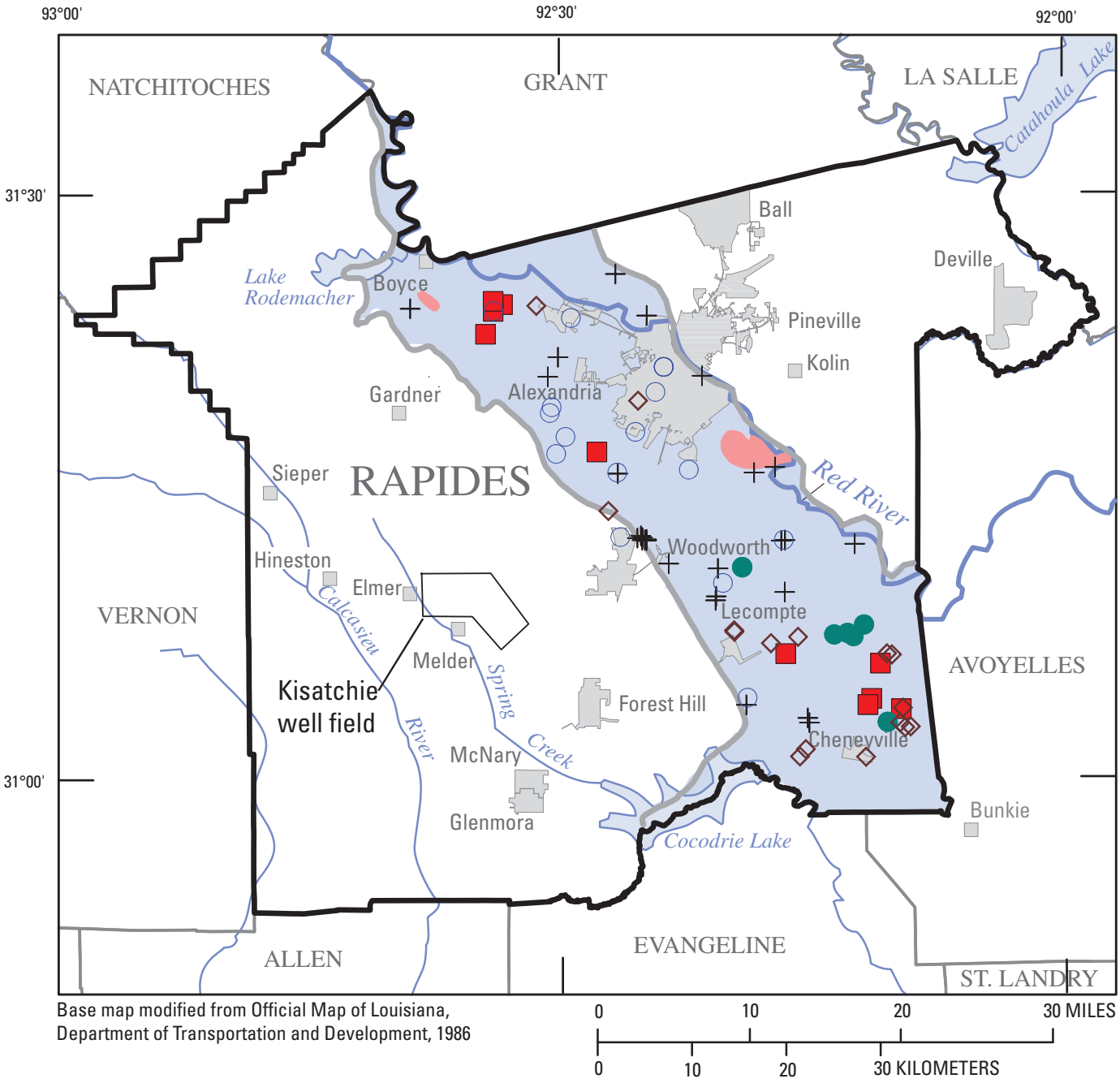
Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Whitfield, 1980, pl. 15)

Aquifer boundary

- **Well location**—Sampled in the Red River alluvial aquifer 1960-93. Well location may include multiple wells. See table 3 for water-quality summary

Figure 9. Location of wells sampled in the Red River alluvial aquifer in Rapides Parish, Louisiana, 1960–93.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

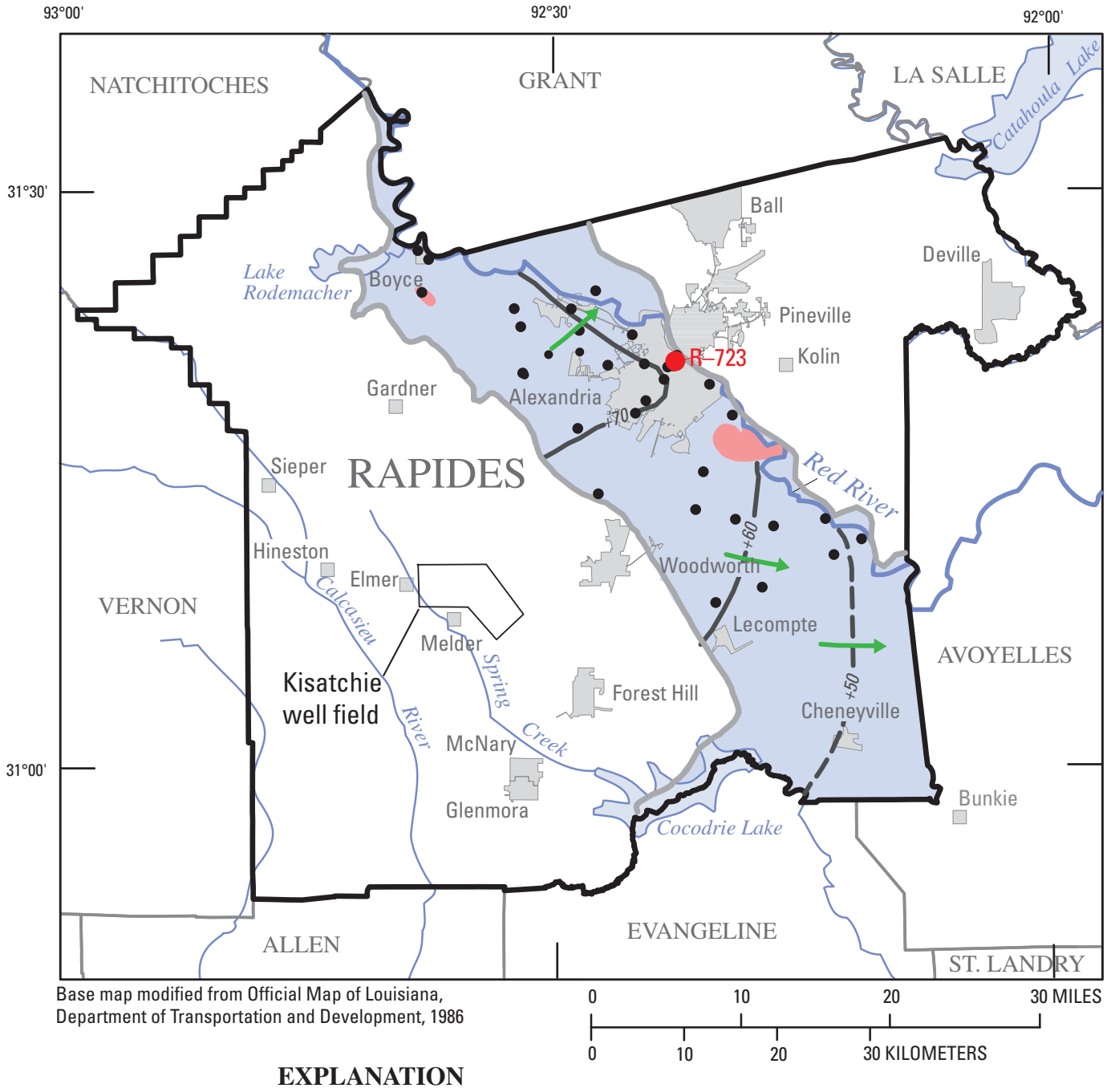
Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Whitfield, 1980, pl. 15)

Aquifer boundary

Well completed in the Red River alluvial aquifer for water withdrawl; symbol shows screen diameter, in inches.

- 1.25 to 4
- 4 to 6
- 6 to 12
- 12 to 16
- 16 to 18.01

Figure 10. Location of wells withdrawing water from the Red River alluvial aquifer in Rapides Parish, Louisiana.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Whitfield, 1980, pl. 15)

Aquifer boundary

60 **Potentiometric contour**—Shows altitude at which water level would have stood in tightly-cased well. Interval 10 feet. Dashed where approximately located. Vertical datum is National Geodetic Vertical Datum of 1929

General direction of ground-water flow

R–723 **Well with hydrograph and number**—See figure 12

Control point for potentiometric surface

Figure 11. Generalized potentiometric surface of the River River alluvial aquifer in Rapides Parish, Louisiana, July 2000.

Water levels in wells completed in the Red River alluvial aquifer fluctuate seasonally, as shown in the hydrograph for well R-723 (fig. 12). Seasonal fluctuations mostly are due to changes in stage of the Red River and, to a lesser degree, in response to local rainfall. Because withdrawals from the aquifer are small (1.6 Mgal/d), long-term declines in water levels may not be occurring in the Red River alluvial aquifer.

Water in the aquifer generally flows southeastward through the parish, discharging into the Red River or one of its tributaries (Rogers, 1983, p. 10). The construction of locks and dams created a rise in stage of about 24 ft in the Red River at Alexandria (Seanor and others, 1996, p. 1). Comparison of water levels in the aquifer with river stage at various sites along the river indicates water levels in the aquifer are higher than adjacent river stage.

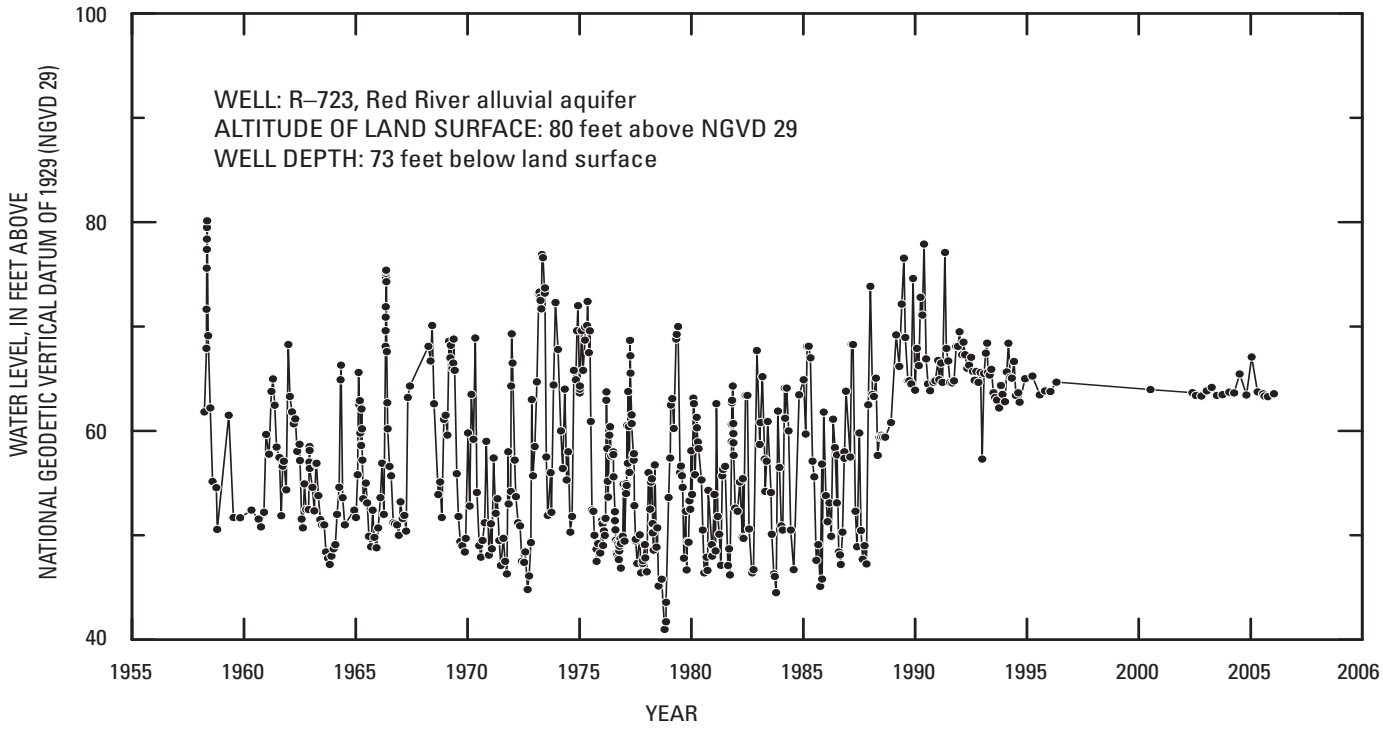
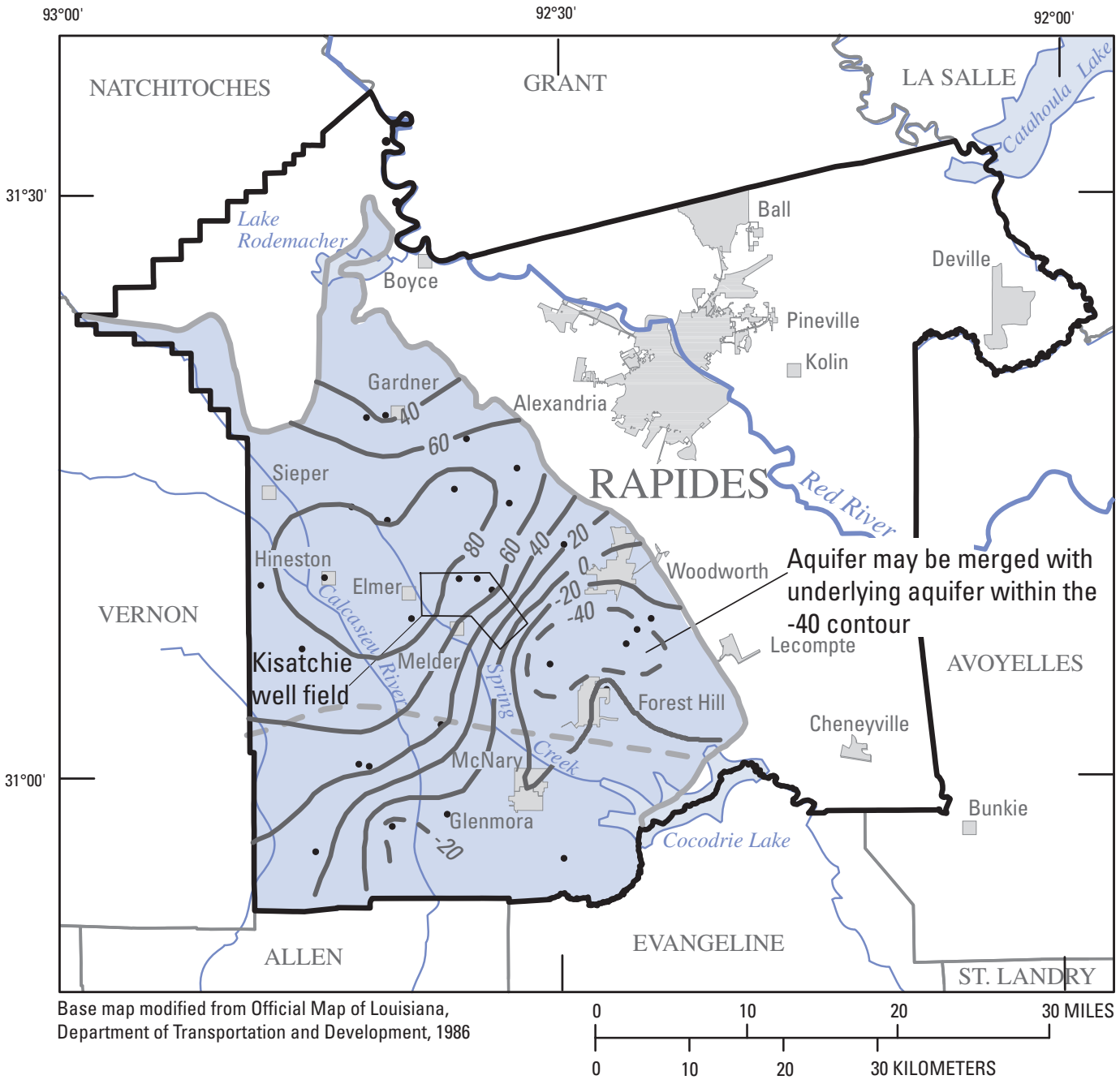


Figure 12. Water levels in well R-723 screened in the Red River alluvial aquifer in Rapides Parish, Louisiana. See figure 11 for well location.

Upland Terrace Aquifer and Chicot Aquifer System

Upland terrace deposits have been characterized as surficial clay or silty clay underlain with coarse deposits (sand and gravel). For the purpose of this report, the terrace aquifer is defined as the sand and gravel portion of the Pleistocene terraces. The Chicot aquifer system is a deltaic sequence consisting mostly of sand and gravel in southwestern Rapides Parish (Nyman, 1984, p. 4, 9). The upland terrace aquifer and Chicot aquifer system combined underlie about 60 percent of Rapides Parish (fig. 13). The upland terrace aquifer merges with the Chicot aquifer system in southwestern Rapides Parish, and no distinct boundary between the two aquifers was determined.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Aquifer boundary—Dashed line is the approximate boundary between the Chicot aquifer system and the upland terrace aquifer.

-20 **Base of aquifer**—Shows altitude of aquifer base. Contour interval 20 feet. In area where the base is merged with underlying aquifers, the boundary between underlying and overlying aquifers was not deteremined. Vertical datum is National Geodetic Vertical Datum of 1929

• **Control point**

Figure 13. Location and approximate altitude of the base of the upland terrace aquifer and Chicot aquifer system in western Rapides Parish, Louisiana.

Rainfall infiltration occurs in areas where surficial clays thin and sand and gravel are at or near the surface (Nyman, 1984, p. 4, 9; Rogers, 1981, p. 10). Hydraulic conductivity values for the upland terrace aquifer were estimated to be about 270 ft/d at the Kisatchie well field (Rogers, 1981, p. 17).

The approximate thickness of sand and gravel in the upland terrace aquifer and Chicot aquifer system in western Rapides Parish determined from electric and drillers' logs ranges from 70 to 160 ft. In the area between Woodworth and Forest Hill, the upland terrace aquifer reaches its maximum thickness and probably is merged with the underlying Evangeline aquifer. The approximate altitude of the base of the upland terrace aquifer and Chicot aquifer system ranges from 80 ft above to 40 ft or more below NGVD 29 (fig. 13).

Water Quality

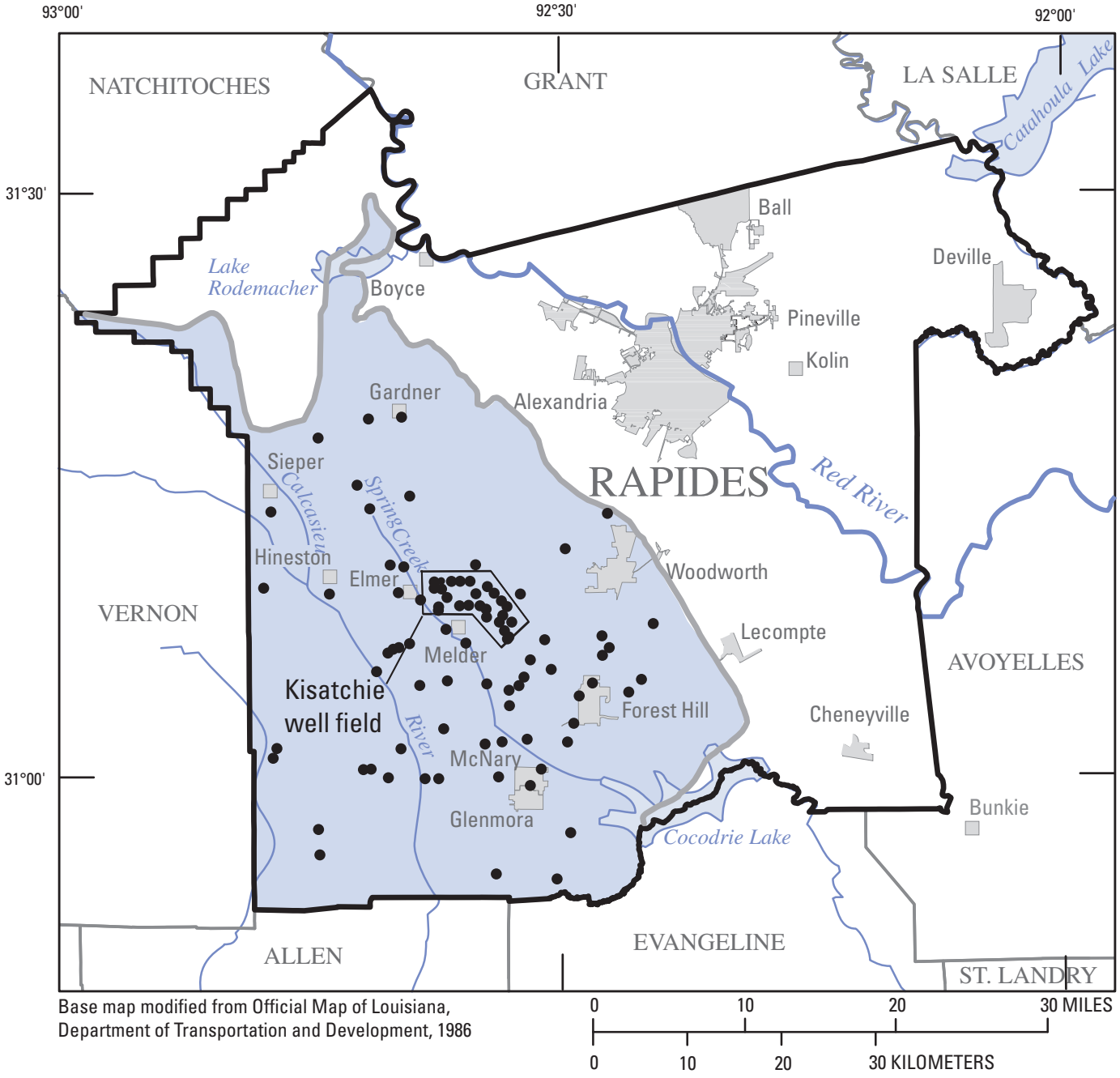
In western Rapides Parish, the upland terrace aquifer and Chicot aquifer system generally yield water that is soft, and less than SDWR's for dissolved solids, chloride, iron, and manganese (table 4). No areas containing chloride concentrations exceeding 250 mg/L have been detected in the upland terrace aquifer or the Chicot aquifer system in western Rapides Parish. Chloride concentrations generally range between 2 and 23 mg/L. Selected water-quality data from wells screened in the upland terrace aquifer and Chicot aquifer system in Rapides Parish sampled during the period 1960-2001 are summarized in table 4. Locations of the wells are shown in figure 14.

Table 4. Summary of selected water-quality characteristics for the upland terrace aquifer and the Chicot aquifer system in western Rapides Parish, Louisiana, 1960–2001.

[°C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter at 25 °C; SU, standard units; mg/L, milligrams per liter; µg/L, micrograms per liter; SDWR, Secondary Drinking Water Regulation; --, not applicable]

	Temperature (°C)	Color (PCU)	Specific conductance, field (µS/cm at 25°C)	pH, field (SU)	Hardness (mg/L as CaCO3)	Chloride (mg/L)	Iron (µg/L)	Manganese (µg/L)	Dissolved solids (mg/L)
Minimum	18.0	0	26	5.3	0	1	0	1.1	31
Maximum	26.5	33	350	7.2	100	32	2,000	140	214
Median	20.0	5	61	6.1	12	6	60	20	65
Percentile 0.05	19.0	0	31	5.4	4	2	4	1.8	34
Percentile 0.95	24.3	11	180	7.0	40	23	1,200	120	126
Number of samples	42	36	64	57	79	91	52	37	58
SDWR[1]	--	15	--	6.5–8.5	--	250	300	50	500
Percent of samples less than SDWR[1]	--	97	--	80	--	100	84	75	100

[1] U.S. Environmental Protection Agency (2004).



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Aquifer boundary

Well location—Sampled in the upland terrace aquifer or Chicot aquifer system 1960–2001. Well location may include multiple wells. See table 4 for water-quality summary

Figure 14. Location of wells sampled in the upland terrace aquifer and Chicot aquifer system in western Rapides Parish, Louisiana, 1960–2001.

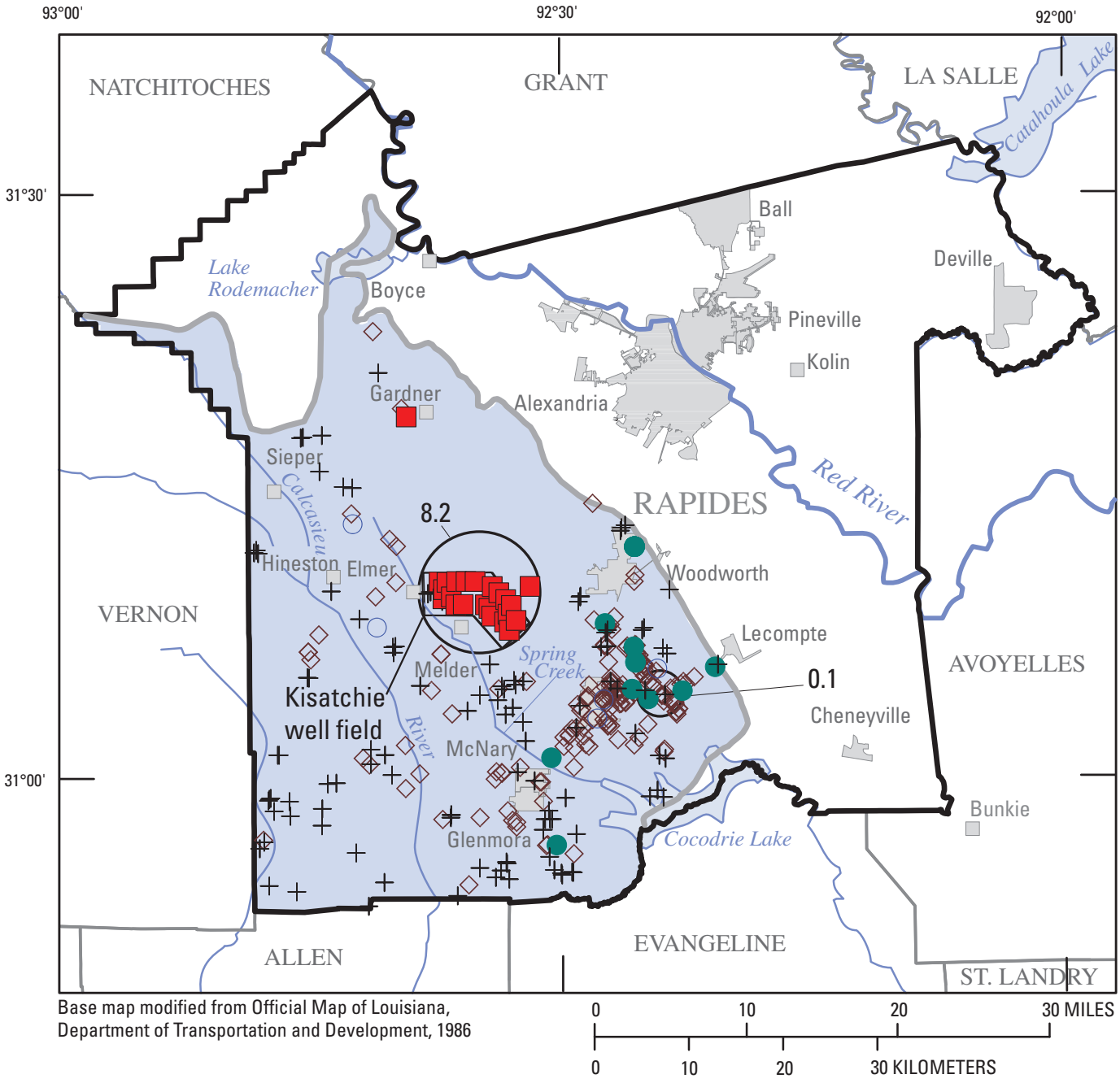
Withdrawals

In 2000, approximately 10.5 Mgal/d was withdrawn from the upland terrace aquifer in Rapides Parish (fig. 3). About 8.3 Mgal/d (80 percent) was for public supply. The largest withdrawal, about 8.2 Mgal/d, was from the Kisatchie well field for the City of Alexandria. The community of Forest Hill, located about 5 mi southeast of the Kisatchie well field, withdrew about 0.1 Mgal/d for public supply. Irrigation withdrawals were about 1.85 Mgal/d from the upland terrace aquifer in the parish. Other minor withdrawals from the upland terrace aquifer, mostly for livestock and domestic use, totaled about 0.15 Mgal/d (B.P. Sargent, U.S. Geological Survey, written commun., modified, 2002).

Withdrawal from the Chicot aquifer system was about 0.8 Mgal/d in 2000 (fig. 3), mainly for irrigation (0.7 Mgal/d). No withdrawals from the Chicot aquifer system have been reported for public supply in Rapides Parish (B.P. Sargent, U.S. Geological Survey, written commun., modified, 2002). The distribution of wells withdrawing water from the upland terrace aquifer and Chicot aquifer system is shown in figure 15.

Water Levels, Water-Level Trends, and Water Movement

A generalized map of the water-level surface in the upland terrace aquifer and Chicot aquifer system in February-March 2005 is shown in figure 16. Water levels ranged from 102 to 169 ft above NGVD 29 at 17 sites in western Rapides Parish in 2005. Comparison of the 2005 surface with the 1990 surface (Smoot and Fendick, 1998, fig. 7) and pre-Kisatchie well field development surface (Rogers, 1981, pl. 3) shows little change in the areas where the surfaces overlap. The 2005 generalized water-level surface indicates the water table surface is similar to the predevelopment surface in most of western Rapides Parish. In the area surrounding the Kisatchie well field, water levels have declined locally 10 to 20 ft since withdrawal from the well field began (about 1968).



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

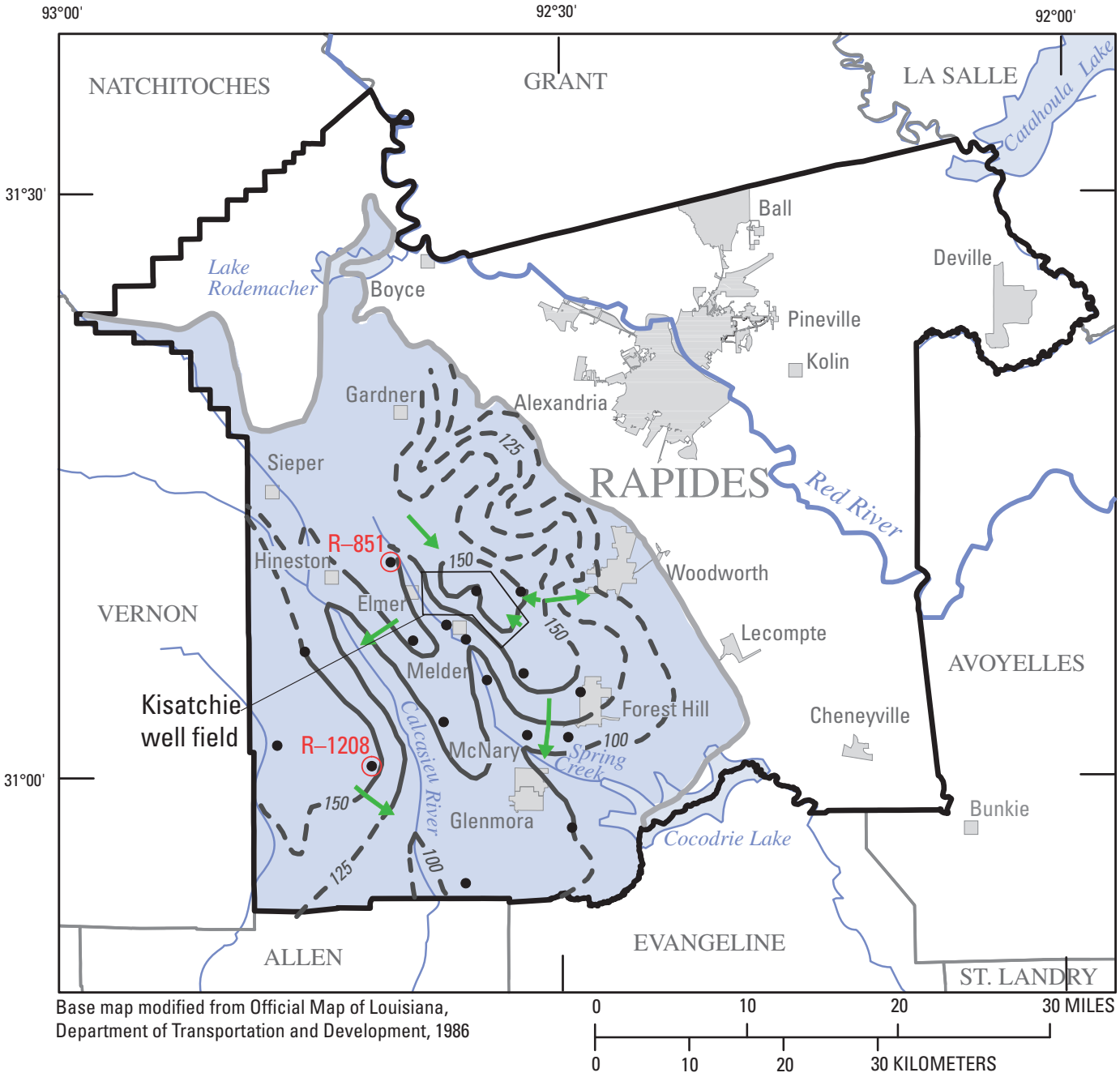
8.2 **Withdrawal center**—Selected site withdrawing 0.1 million gallons per day (Mgal/d) of water or more. Number is withdrawal in Mgal/d

Aquifer boundary

Well completed in the upland terrace aquifer or Chicot aquifer system for water withdrawal; symbol shows screen diameter, in inches

- 0 to 3
- 3 to 4
- 4 to 6
- 6 to 8
- 8 to 16.1

Figure 15. Location of wells withdrawing water from the upland terrace aquifer and Chicot aquifer system in western Rapides Parish, Louisiana.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Aquifer boundary

60 **Water-level contour**—Shows altitude at which water level would have stood in tightly-cased well. Interval 25 feet. Dashed where approximately located. Vertical datum is National Geodetic Vertical Datum of 1929

General direction of ground-water flow

R–1208 **Well with hydrograph and number**—See figure 17

Control point for water-level surface

Figure 16. Generalized water-level surface in the upland terrace aquifer and Chicot aquifer system in western Rapides Parish, Louisiana, February–March 2005.

Long-term declines in water levels in the upland terrace aquifer and Chicot aquifer system have not been detected at wells monitored in Rapides Parish. Water levels in wells screened in the upland terrace aquifer and Chicot aquifer system generally fluctuate a few feet yearly (fig. 17). Water-level fluctuations have been attributed to seasonal changes in evaporation and rainfall (Snider and Sanford, 1981, p. 6; Rogers, 1981, p. 11).

A water-level recorder was installed in well R-1208 to record daily water levels for the period May 2004 to July 2005. Data collected at the well indicate water levels in the Chicot aquifer system fluctuate 3 to 4 ft (fig. 18). Seasonal declines at well R-1208 may be in response to withdrawals from the Chicot aquifer system (regional withdrawals occurring outside the study area). In large areas of the Chicot aquifer system, water levels have been noted to decline February through June and begin to rise after June (Lovelace and others, 2004, p. 6).

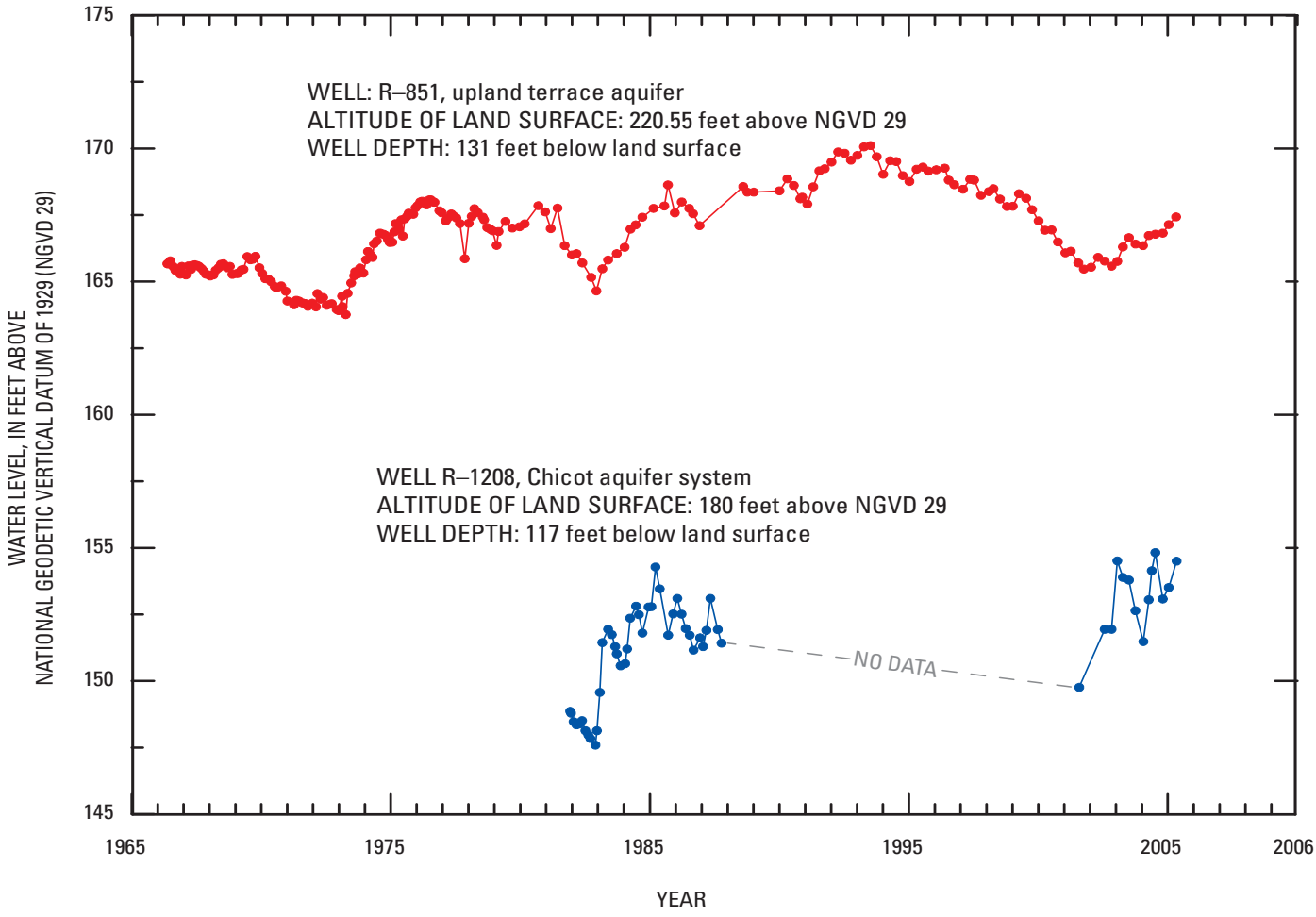


Figure 17. Water levels in wells R-851 and R-1208, screened in the upland terrace aquifer and Chicot aquifer system, in western Rapides Parish, Louisiana (see figure 16 for well locations).

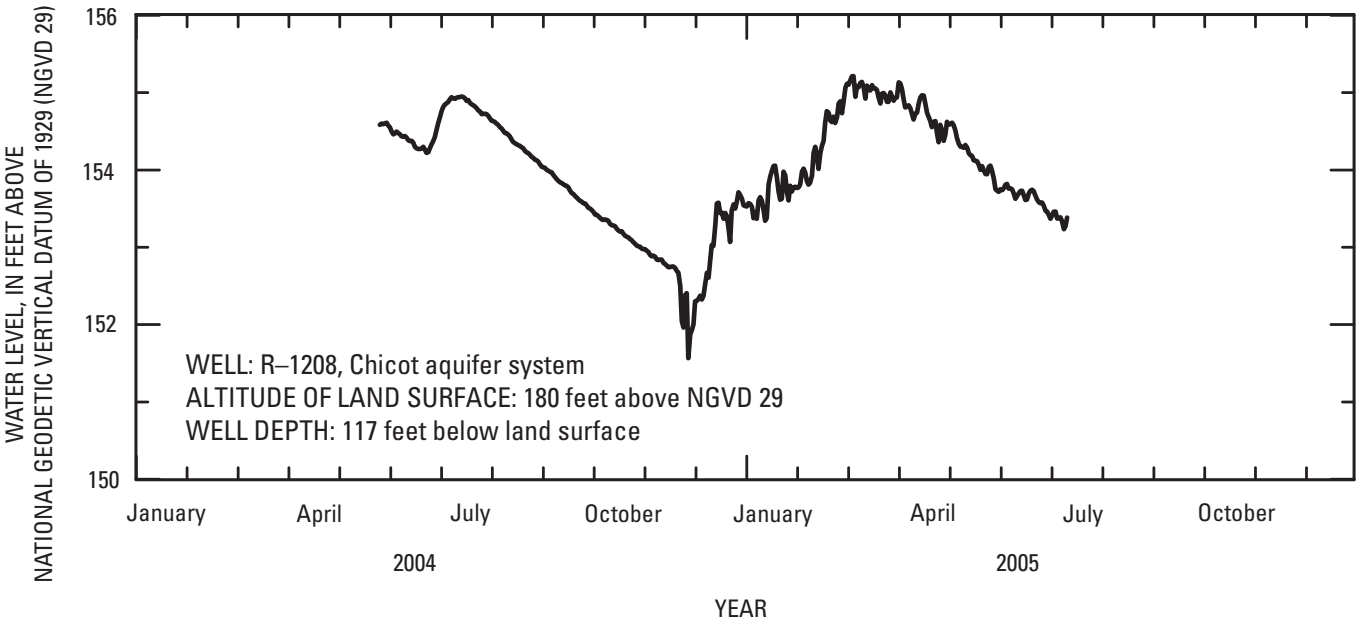


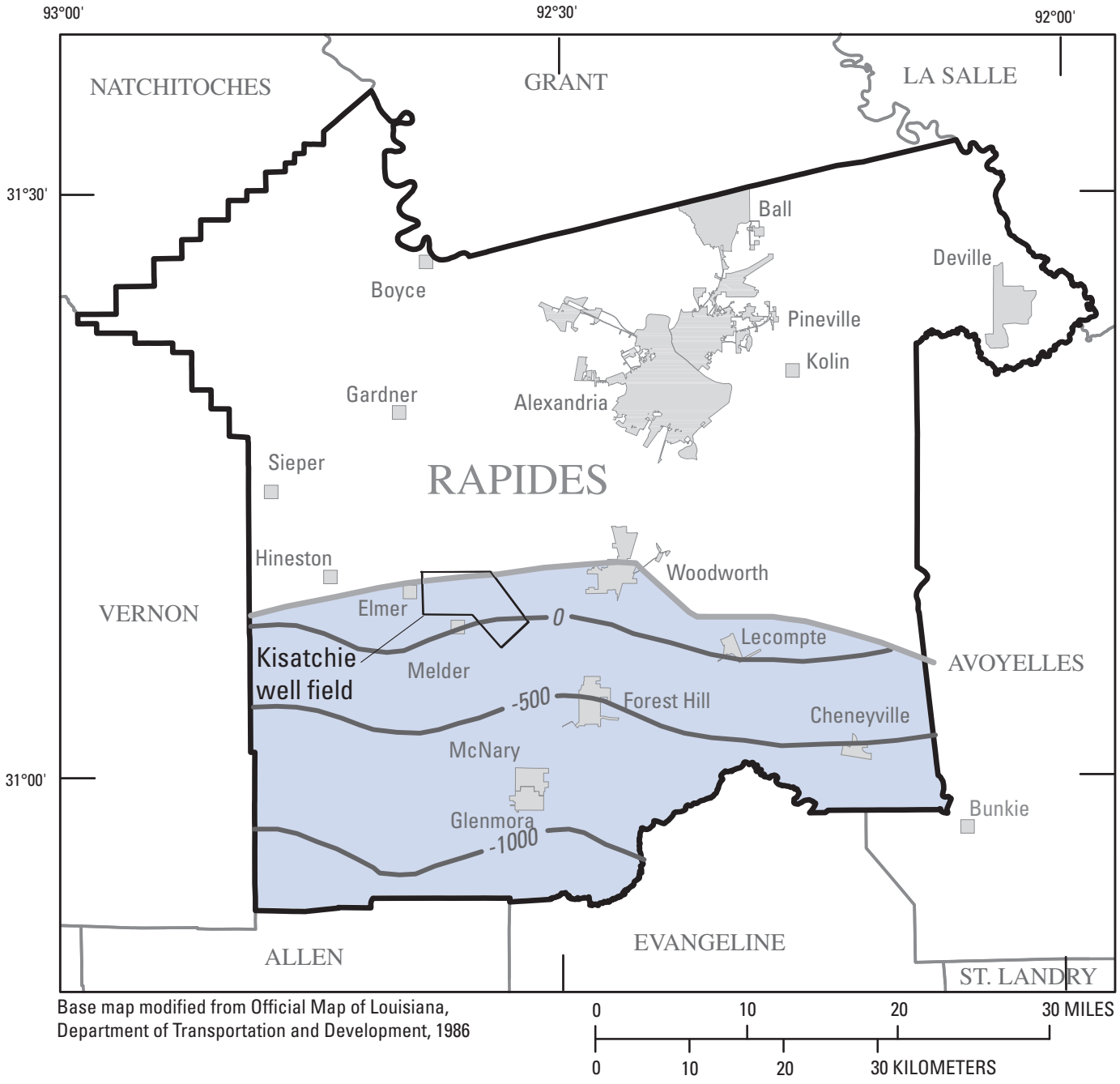
Figure 18. Daily water levels in well R–1208, screened in the Chicot aquifer system in western Rapides Parish, Louisiana, May 2004–July 2005 (see figure 16 for well location).

Water in the upland terrace aquifer and Chicot aquifer system flows from higher altitudes into stream valleys (low altitudes) roughly following topography and discharges to streams, including Calcasieu River and Spring Creek. Discharge also is by leakage from the upland terrace aquifer and Chicot aquifer system into the Red River alluvial aquifer. Additional water is withdrawn from wells, mostly in the Kisatchie well field. A portion of the water in the aquifer moves downward as recharge to the Evangeline aquifer (Martin and Whiteman, 1985b) or southward into the Chicot aquifer system in adjacent parishes.

Evangeline Aquifer

The Evangeline aquifer consists of a deltaic sequence of fine to medium sand interbedded with silt and clay (Whitfield, 1975a, p. 12). Locally coarse beds of sand occur in the aquifer. Regionally, the sand beds compose about 50 percent of the aquifer. Although locally separated by silts and clays, individual sand beds are sufficiently interconnected to function as a regional aquifer. Average thickness of individual sand beds is about 51 ft in Rapides Parish. (See Newcome and Sloss, 1966, p. 11). The aquifer underlies the approximate southern one third of Rapides Parish (fig. 19) and is overlain by the Red River alluvial aquifer, upland terrace aquifer, and Chicot aquifer system. Measured hydraulic conductivity values in the Evangeline aquifer ranged from 50 to 100 ft/d at the Kisatchie well field (Rogers, 1981, p. 22).

The base of the Evangeline aquifer ranges from about 0 ft NGVD 29 near Woodworth to about 1,000 ft below NGVD 29 south of Glenmora (fig. 19). The base of the aquifer dips in a southerly direction about 80 ft/mi in southern Rapides Parish.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Evangeline aquifer boundary

-500 **Base of aquifer—**Shows altitude of aquifer base. Contour interval 500 feet. Vertical datum is National Geodetic Vertical Datum of 1929

Figure 19. Location and altitude of the base of the Evangeline aquifer in Rapides Parish, Louisiana (from Newcome and Sloss, 1966, fig. 2).

Water Quality

Water in the Evangeline aquifer in Rapides Parish is soft. Dissolved solids, chloride, iron, and manganese generally do not exceed SDWR's (table 5). Chloride concentrations generally range between 2.8 and 36 mg/L, and the maximum was 100 mg/L at wells sampled. Selected water-quality data from wells screened in the Evangeline aquifer in Rapides Parish sampled during the period 1960-84 are summarized in table 5. Locations of the wells are shown in figure 20.

Table 5. Summary of selected water-quality characteristics for the Evangeline aquifer in Rapides Parish, Louisiana, 1960–84.

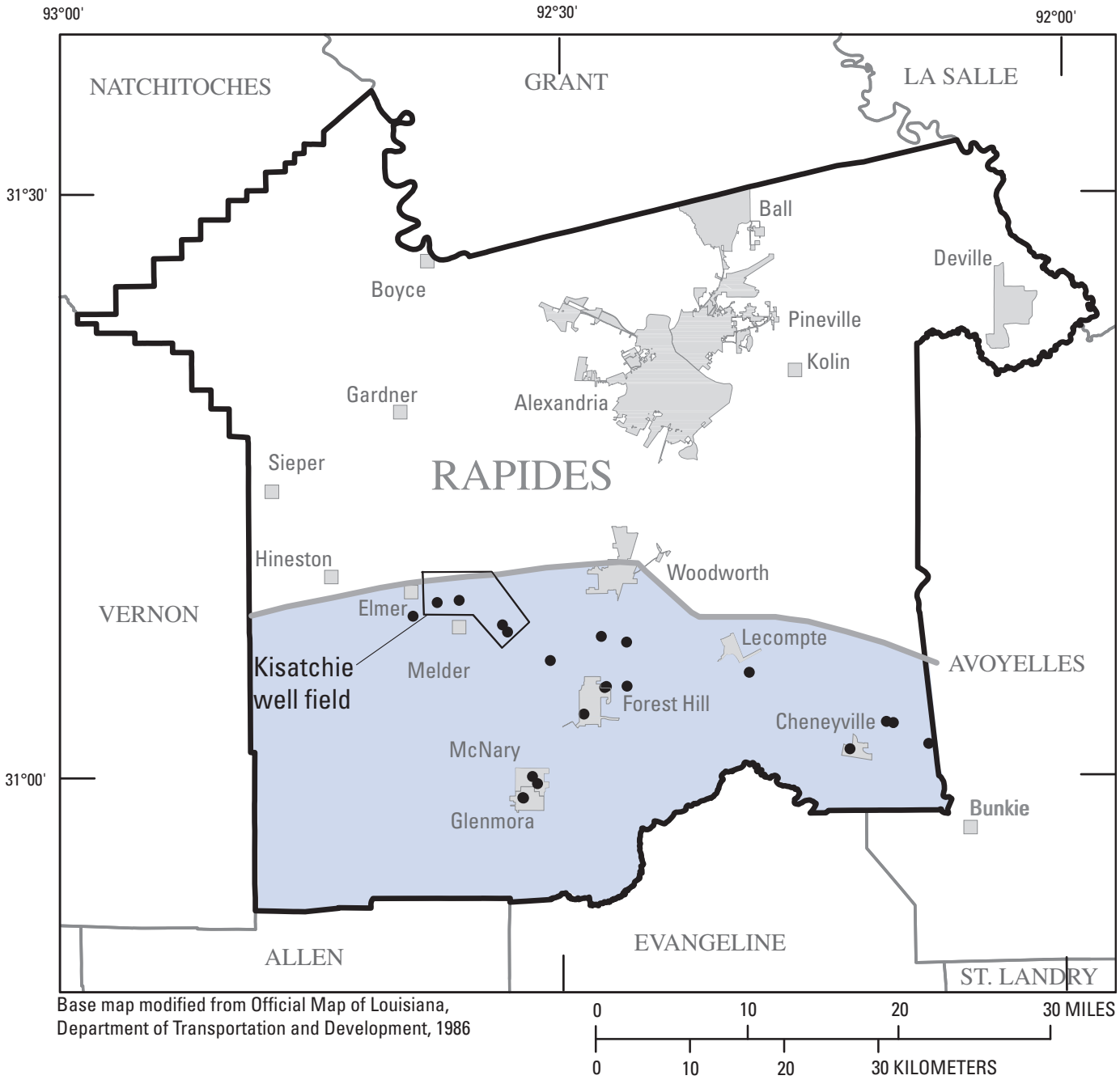
[°C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter at 25 °C; SU, standard units; mg/L, milligrams per liter; µg/L, micrograms per liter; SDWR, Secondary Drinking Water Regulation; --, not applicable]

	Temperature (°C)	Color (PCU)	Specific conductance, field (µS/cm at 25°C)	pH, field (SU)	Hardness, (mg/L as $CaCO_3$)	Chloride (mg/L)	Iron (µg/L)	Manganese (µg/L)	Dissolved solids (mg/L)
Minimum	20	0	85	5.5	0	2	3	0	95
Maximum	30.5	70	960	8.9	86	100	1,300	180	604
Median	21.3	5	320	7.5	11	6.2	120	20	204
Percentile 0.05	20	0	88	5.8	1.1	2.8	9	1	98
Percentile 0.95	24.9	40	740	8.6	59	36	870	130	429
Number of samples	16	26	28	29	24	31	19	17	23
SDWR[1]	--	15	--	6.5–8.5	--	250	300	50	500
Percent of samples less than SDWR[1]	--	64	--	70	--	100	64	68	97

[1] U.S. Environmental Protection Agency (2004).

Withdrawals

In 2000, approximately 2.8 Mgal/d was withdrawn from the Evangeline aquifer in Rapides Parish (fig. 3). Most of the water, about 1.9 Mgal/d, was withdrawn for public supply. Aquaculture and irrigation



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Aquifer boundary

- **Well location—**Sampled in the Evangeline aquifer 1960–1984. Well location may include multiple wells. See table 5 for water-quality summary

Figure 20. Location of wells sampled in the Evangeline aquifer in Rapides Parish, Louisiana, 1960–84.

withdrawals were about 0.9 Mgal/d. Communities that depend on water from the Evangeline aquifer for public supply include Bunkie (0.7 Mgal/d), Forest Hill (0.3 Mgal/d), Glenmora (0.2 Mgal/d), Cheneyville (0.1 Mgal/d), and McNary (0.1 Mgal/d). Although Bunkie is located in Avoyelles Parish, withdrawal for the town is from wells located in Rapides Parish near Cheneyville. Withdrawals from the Evangeline aquifer at the Kisatchie well field for the City of Alexandria totaled about 0.5 Mgal/d (B.P. Sargent, U.S. Geological Survey, written commun., modified, 2002). Locations of withdrawal centers and distribution of wells withdrawing water from the Evangeline aquifer are shown in figure 21.

Water Levels, Water-Level Trends and Water Movement

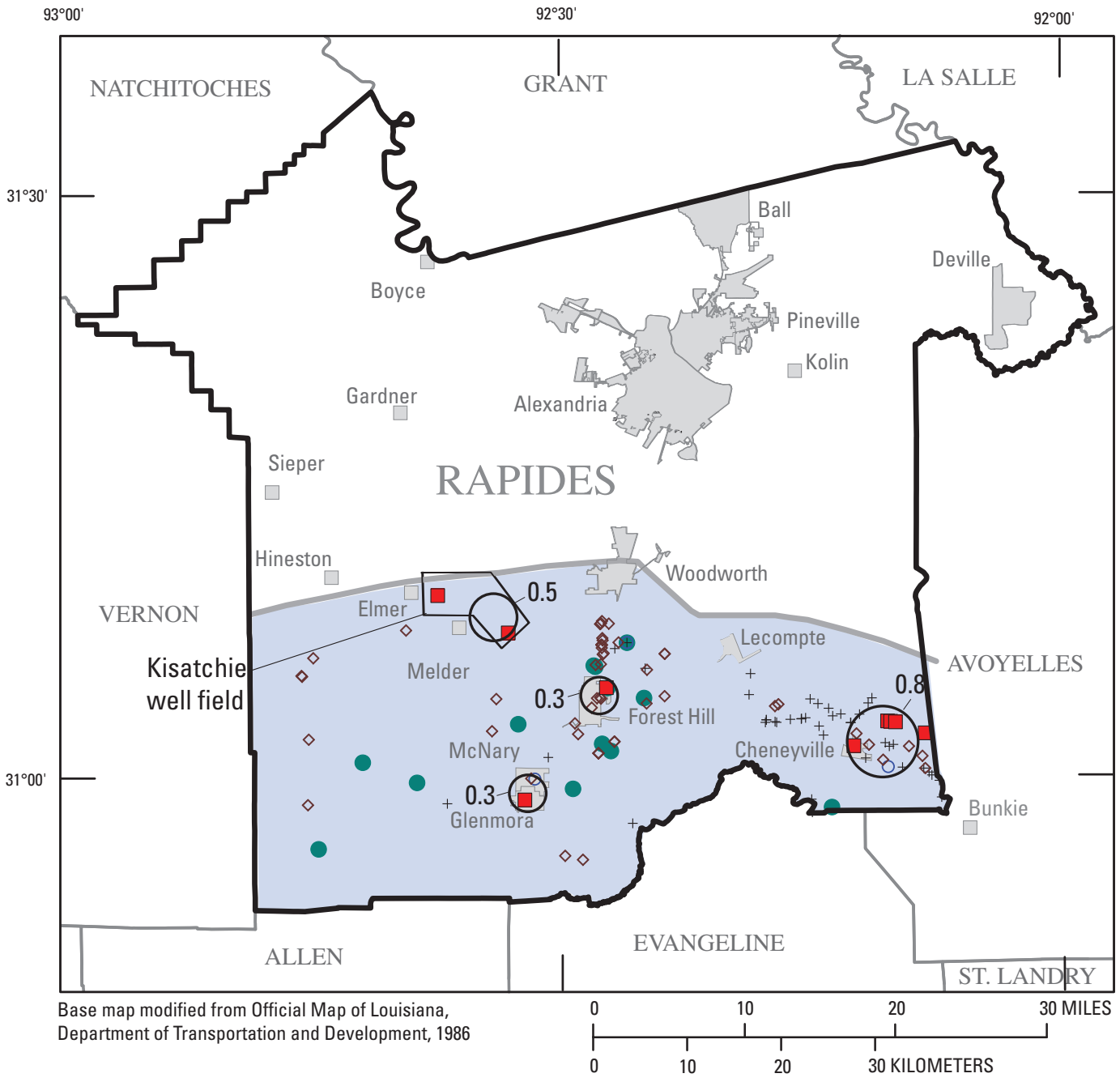
A generalized potentiometric-surface map for the Evangeline aquifer (fig. 22) was constructed using data from the period January-March 2004 (Fendick, 2005, fig. 4). The potentiometric surface in the Evangeline aquifer ranges approximately from 200 ft above NGVD 29 in west-central Rapides Parish to 40 ft above NGVD 29 in southeastern Rapides Parish. A comparison of the January-March 2004 potentiometric surface with the 1980 potentiometric surface (Martin and Whiteman, 1985b) indicates water levels have changed little near the northern limit of the aquifer. In southeastern Rapides Parish, water levels may have declined about 20 ft during the period 1980-2004.

Water levels in well R-930, completed in the Evangeline aquifer, have been periodically measured since 1967 (fig. 23). Well R-930 is located at the southeastern edge of the Kisatchie well field (fig. 22). Periodic water-level fluctuations at the site may be in response to withdrawals at the Kisatchie well field. Long-term water-level declines in the Evangeline aquifer have not been detected at the well during the period of record.

Water in the Evangeline aquifer is derived from rainfall to terrace deposits (Rogers, 1981, p. 13). Recharge entering the overlying aquifers is transmitted into the Evangeline aquifer and then generally moves southeastward (downgradient) through southern Rapides Parish.

Williamson Creek Aquifer

The Williamson Creek aquifer has been characterized as well sorted, very fine to medium sand interbedded with clay (Whitfield, 1975a, p. 29). Average thickness of sand beds in the Williamson Creek aquifer is about 53 ft (Newcome and Sloss, 1966, p. 11) in Rapides Parish. The sands, although



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

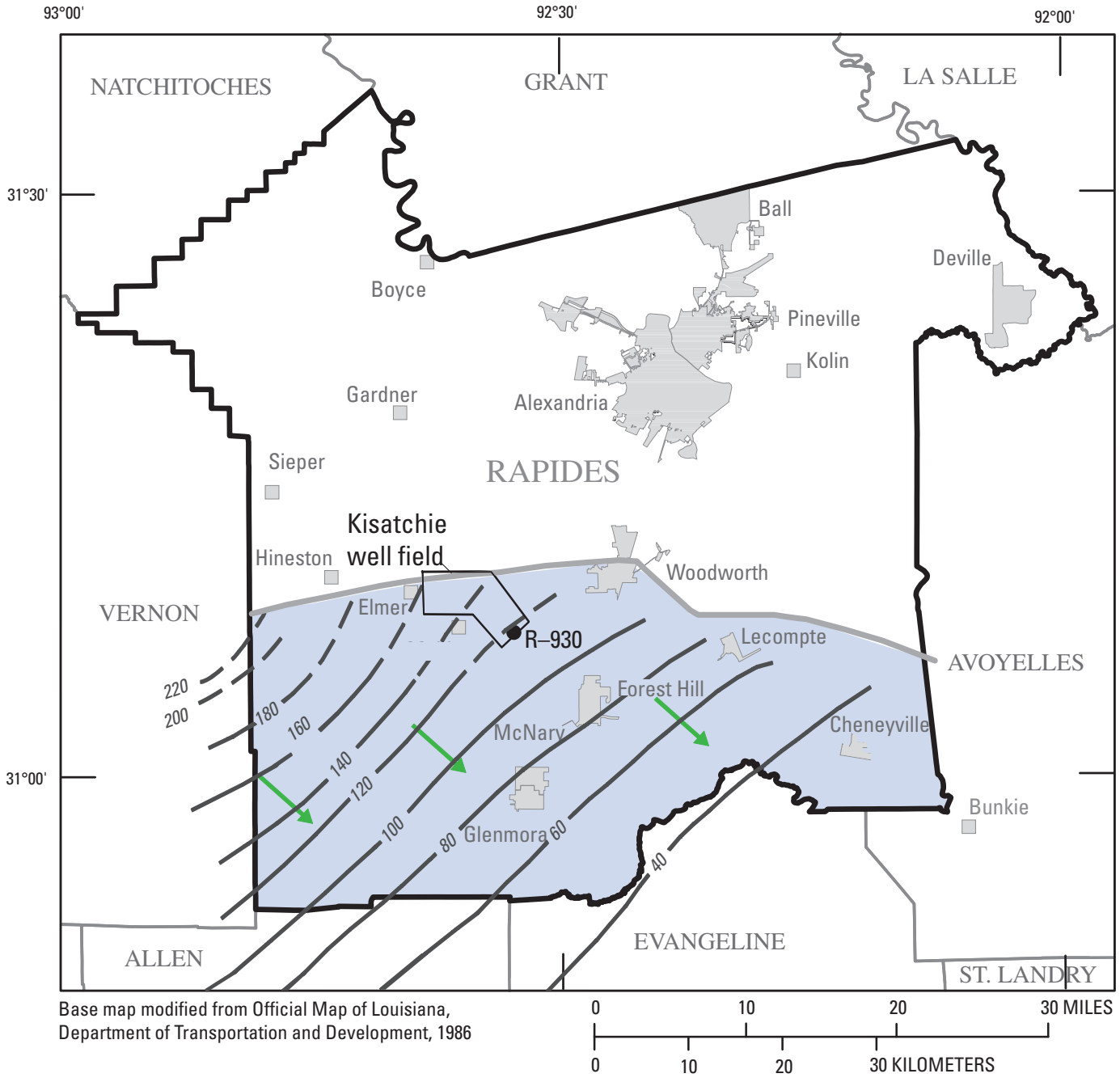
0.5 **Withdrawal center**—Selected site withdrawing 0.1 million gallons per day (Mgal/d) of water or more. Number is withdrawal in Mgal/d

Evangeline aquifer boundary

Well completed in the Evangeline aquifer for water withdrawal; symbol shows screen diameter, in inches

- 1.5 to 3
- 3 to 4
- 4 to 6
- 6 to 8
- 8 to 10.01

Figure 21. Location of wells withdrawing water from the Evangeline aquifer in Rapides Parish, Louisiana.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Evangeline aquifer boundary

60 **Potentiometric contour—**Shows altitude at which water level would have stood in tightly-cased well. Interval 20 feet. Dashed where approximately located. Vertical datum is National Geodetic Vertical Datum of 1929

General direction of ground-water flow

R–930 **Well with hydrograph and number—**See figure 23

Figure 22. Generalized potentiometric surface of the Evangeline aquifer in Rapides Parish, Louisiana, January–March 2004 (from Fendick, 2005, fig. 4).

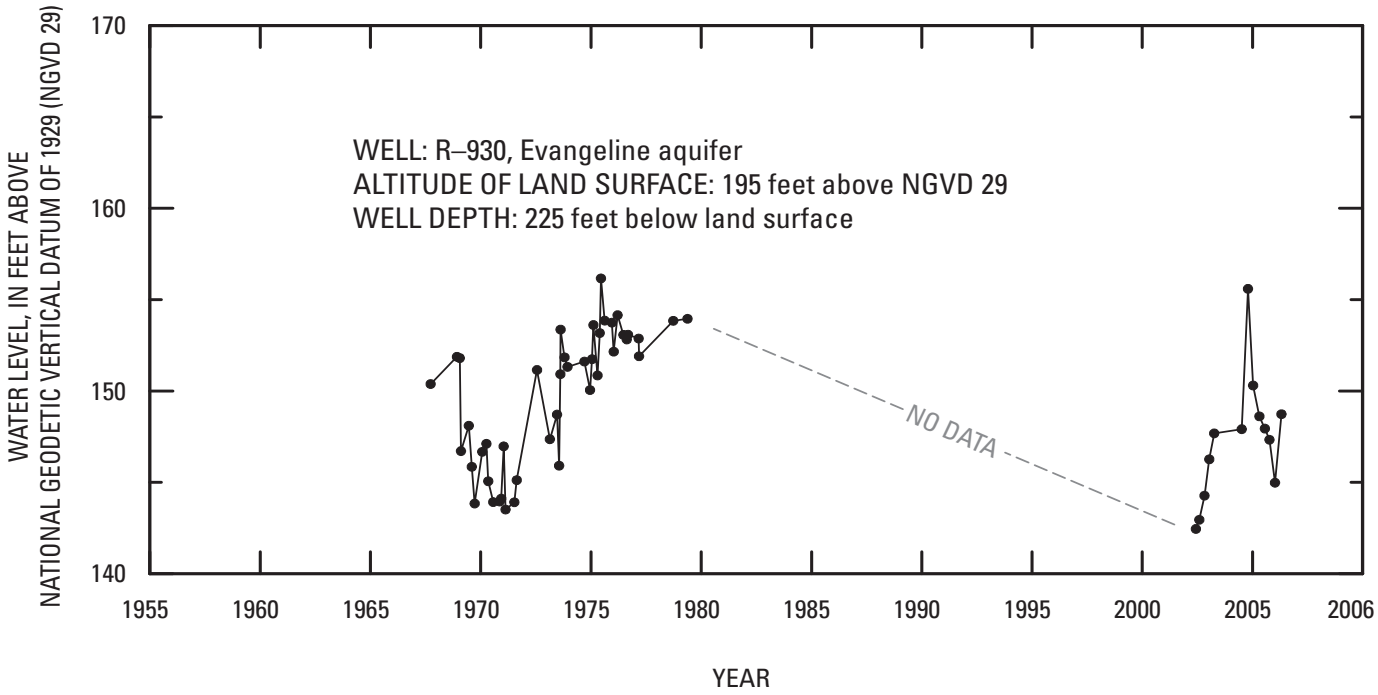
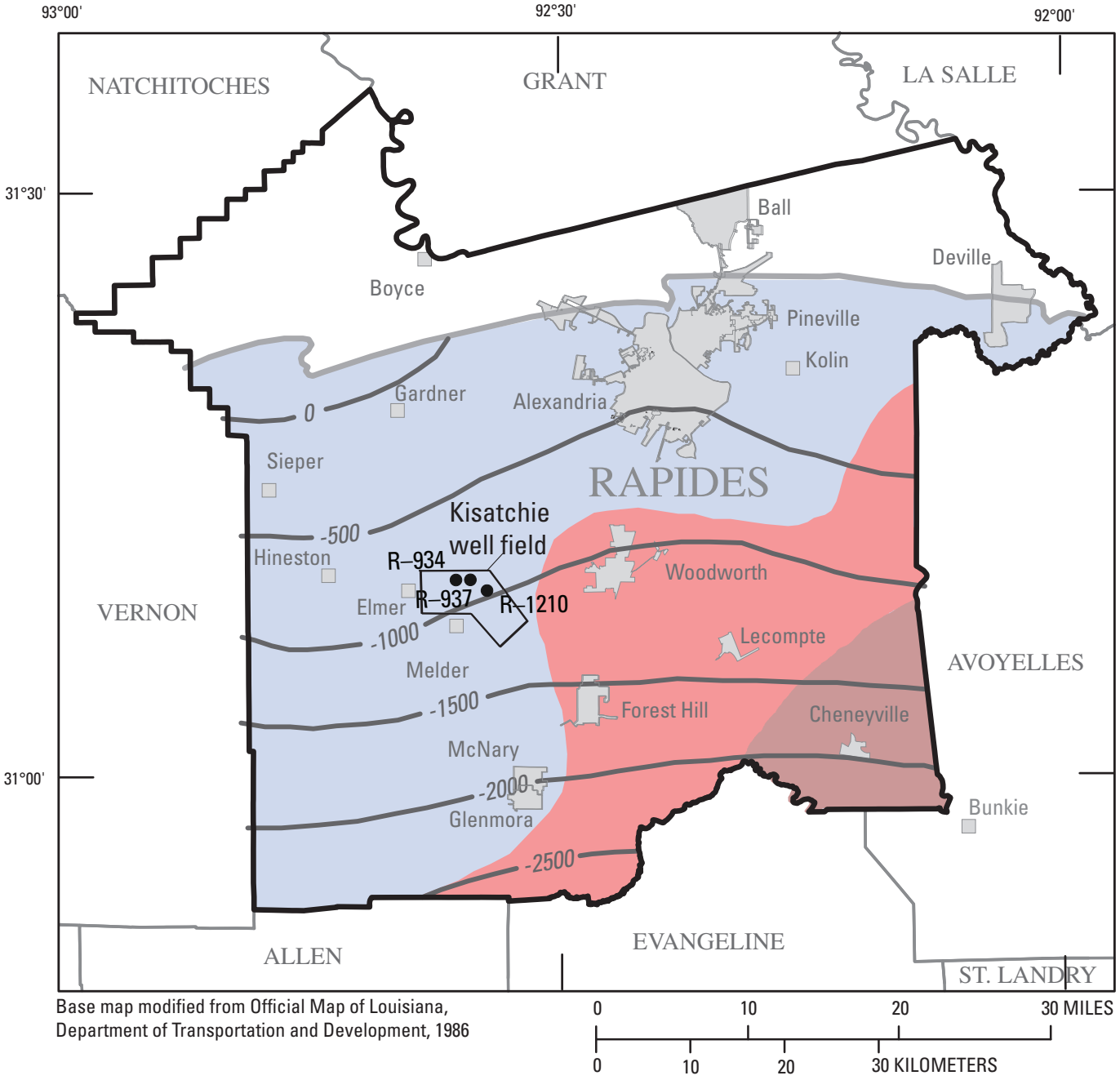


Figure 23. Water levels in well R-930 screened in the Evangeline aquifer, Rapides Parish, Louisiana. See figure 22 for well location.

locally separated by extensive silts and clays, are sufficiently interconnected to function as a regional aquifer. Coarse beds of sand occur locally in the aquifer (Whitfield, 1975b, p. 29). The Williamson Creek aquifer underlies most of the parish with the exception of the northern limits (fig. 24). Electric-log data at the Kisatchie well field (for wells R-934, R-937, and R-1210 located in fig. 24) indicate sands vary in thickness and lateral extent. Cumulative sand thickness in the interval containing the Williamson Creek aquifer at the well sites ranged from 60 ft (well R-934) to 150 ft (well R-1210). Average sand thickness was about 50 ft, and maximum individual sand thickness was 90 ft. Hydraulic conductivity values for the Williamson Creek aquifer range from 20 to 130 ft/d at the Kisatchie well field (Rogers, 1981, p. 22).

Water enters the Williamson Creek aquifer in outcrop areas (Martin and others, 1988, pl. 1) and from overlying aquifers. In Rapides Parish, water levels are higher in the Red River alluvial, upland terrace, and Evangeline aquifers than in the underlying Williamson Creek aquifer.

In Rapides Parish, the base of the Williamson Creek aquifer ranges from 0 ft NGVD 29 in the northwest to 2,500 ft below NGVD 29 in the south (Newcome and Sloss, 1966, fig. 2) (fig. 24). The base of the aquifer dips in a southerly direction about 100 ft/mi.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig. 2)

Saltwater—Area where the aquifer contains no freshwater

Aquifer boundary

-500 **Base of aquifer**—Shows altitude of aquifer base. Contour interval 500 feet. Vertical datum is National Geodetic Vertical Datum of 1929

● R–1210 **Well mentioned in text**

Figure 24. Location and approximate altitude of the base of the Williamson Creek aquifer in Rapides Parish, Louisiana (from Newcome and Sloss, 1966, fig. 2).

Water Quality

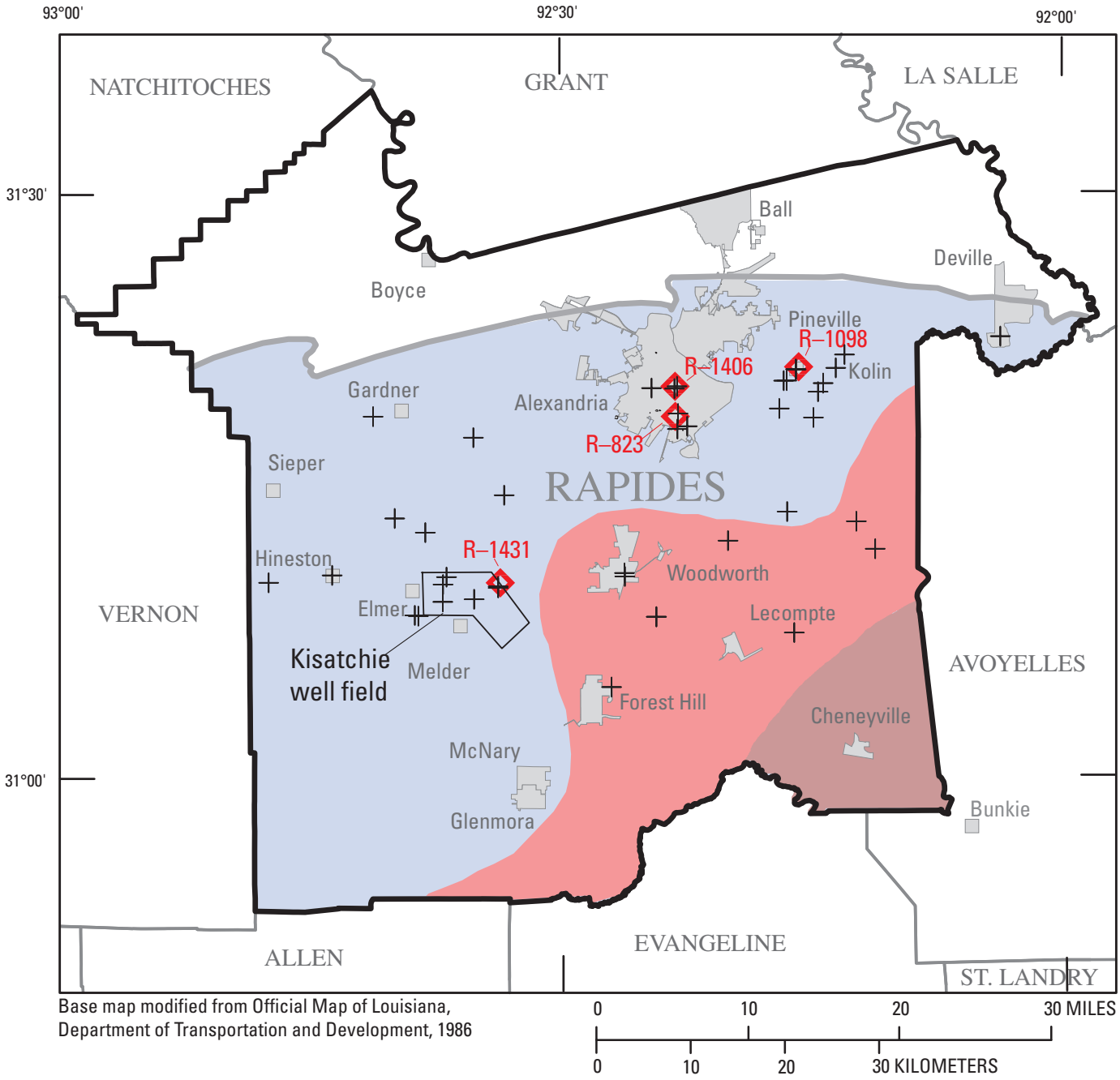
The Williamson Creek aquifer contains freshwater that is generally soft. Concentrations of dissolved solids, chloride, iron, and manganese generally do not exceed SDWR's (table 6). Chloride concentrations generally range between 7 and 86 mg/L in freshwater wells sampled. Selected water-quality data from wells screened in the Williamson Creek aquifer in Rapides Parish sampled during the period 1960-2003 are summarized in table 6. Locations of the wells are shown in figure 25.

Table 6. Summary of selected water-quality characteristics for the Williamson Creek aquifer in Rapides Parish, Louisiana, 1960–2003.

[°C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter at 25 °C; SU, standard units; mg/L, milligrams per liter; µg/L, micrograms per liter; SDWR, Secondary Drinking Water Regulation; --, not applicable]

	Temperature (°C)	Color (PCU)	Specific conductance, field (µS/cm at 25°C)	pH, field (SU)	Hardness, (mg/L as $CaCO_3$)	Chloride (mg/L)	Iron (µg/L)	Manganese (µg/L)	Dissolved solids (mg/L)
Minimum	20	0	37	6	6	2	0	0	42
Maximum	26.5	30	1,220	8.7	180	300	1,200	150	720
Median	22	5	480	7.8	15	16	100	20	298
Percentile 0.05	20	0	104	6.5	7	7	10	0	83
Percentile 0.95	25.5	18	852	8.5	91	86	1,060	130	525
Number of samples	21	35	39	37	39	44	29	21	33
SDWR[1]	--	15	--	6.5–8.5	--	250	300	50	500
Percent of samples less than SDWR[1]	--	94	--	83	--	99	75	70	94

[1] U.S. Environmental Protection Agency (2004).



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig. 2)

Saltwater—Area where the aquifer contains no freshwater

Williamson Creek aquifer boundary

Well location—Sampled in the Williamson Creek aquifer 1960–2003. Well location may include multiple wells. See table 6 for water-quality summary

R–1098 **Well location**—Sampled in the Williamson Creek aquifer 2003. See table 7

Figure 25. Location of wells sampled in the Williamson Creek aquifer in Rapides Parish, Louisiana, 1960–2003.

Freshwater is present in the Williamson Creek aquifer in most of Rapides Parish; however, large areas of freshwater are underlain with saltwater (Newcome and Sloss, 1966, fig. 2). In the Cheneyville area (fig. 24), the aquifer contains only saltwater. East of the cities of Woodworth, Forest Hill, and Glenmora, the aquifer contains freshwater to about 500 ft below NGVD 29. Depth of freshwater in the aquifer reaches a maximum of 2,000 ft below NGVD 29 in southwestern Rapides Parish.

Saltwater encroachment (recent) into freshwater areas of the Williamson Creek aquifer was not detected in Rapides Parish (2005). No substantial increase in specific conductance or chloride concentration was noted at sites (fig. 25) in the Alexandria-Pineville area (wells R-823, R-1098, and R-1406) or at the Kisatchie well field, well R-1431 (table 7).

Because saltwater is present in the Williamson Creek aquifer east of the Kisatchie well field, movement of saltwater toward the well field may occur. Historical chloride data contained in USGS files were compared with recently reported data (Dean Lowe, Louisiana Department of Health and Hospitals, written commun., 2005) at the Kisatchie well field and wells at Kolin and Woodworth. These wells are located near areas containing saltwater in the Williamson Creek aquifer. Increases in chloride concentrations were not detected in these selected wells. Continued monitoring at wells containing saltwater will help to detect future changes in water quality.

Table 7. Water-temperature, specific-conductance, and chloride data from selected wells screened in the Williamson Creek aquifer in Rapides Parish, Louisiana, 1984–2003.

[°C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; DHH, Louisiana Department of Health and Hospitals; --, no data; USGS, U.S. Geological Survey]

Well name	Reporting agency	Depth of well (ft below land surface)	Date sampled	Temperature, (°C)	Specific conductance, field, (µS/cm at 25°C)	Chloride (mg/L)
R–823	DHH[1]	--	12–11–2000	--	--	11.4
	USGS	432	4–9–2003	21.6	--	11
R–1098	USGS	355	7–25–1984	21	334	54
	DHH[1]	--	7–15–2002	--	--	54.4
	USGS	--	4–3–2003	21.4	328	--
R–1406	DHH[1]	--	12–11–2000	--	--	50.8
	USGS	337	7–22–2003	21.6	758	55
R–1431	DHH[1]	--	5–8–2000	--	--	11.3
	USGS	524	7–22–2003	23.7	482	12

[1] Source: Dean Lowe, Louisiana Department of Health and Hospitals, written commun., 2005.

Withdrawals

In 2000, approximately 7.1 Mgal/d was withdrawn from the Williamson Creek aquifer in Rapides Parish (fig. 3). The aquifer supplied about 5.6 Mgal/d freshwater to the City of Alexandria from the Kisatchie and Alexandria area well fields. About 0.2 Mgal/d was withdrawn for public supply adjacent to the Alexandria area. Other communities that withdrew water from the Williamson Creek aquifer for public supply include Kolin (0.2 Mgal/d), Hineston (0.1 Mgal/d), Lecompte (0.2 Mgal/d), Melder (0.1 Mgal/d), and Woodworth (0.1 Mgal/d). Small amounts of water also were withdrawn (0.5 Mgal/d) for uses that include domestic supply, aquaculture, irrigation, and livestock (B.P. Sargent, U.S. Geological Survey, written commun., modified, 2002). The distribution of wells withdrawing water from the Williamson Creek aquifer is shown in figure 26.

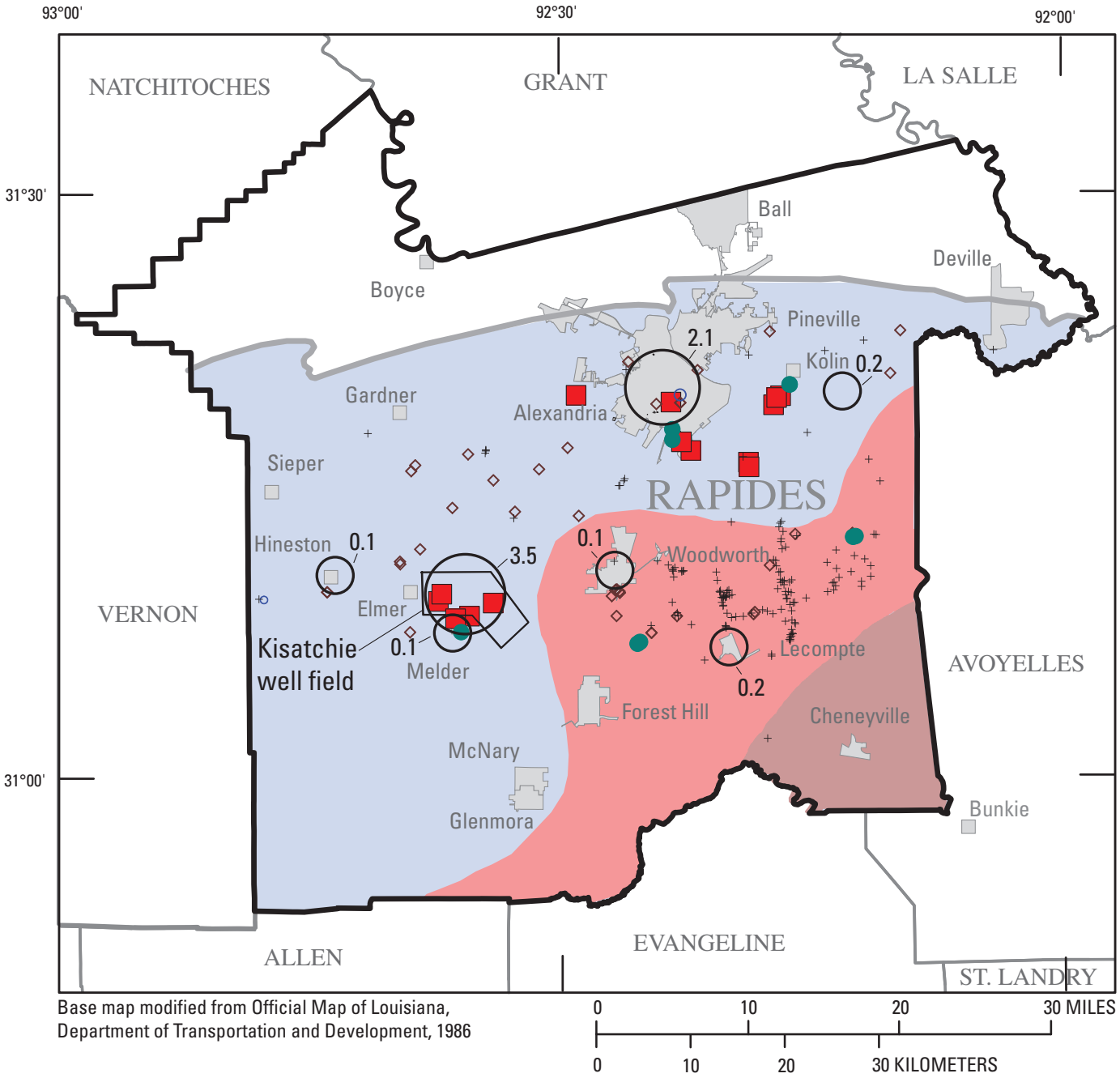
Water Levels, Water-Level Trends, and Water Movement

A generalized potentiometric-surface map for the Williamson Creek aquifer in Rapides Parish in 2003 (Brantly and Seanor, 2005, fig. 1) is shown in figure 27. In Rapides Parish, water levels in the Williamson Creek aquifer generally range from 200 ft above NGVD 29 near the northwestern limit of the aquifer (outcrop area) to 40 ft below NGVD 29 in withdrawal centers at the Alexandria and the Kisatchie well fields (fig. 27).

In Rapides Parish, water levels in the Williamson Creek aquifer have been lowered by withdrawals in the Alexandria area and at the Kisatchie well field. Withdrawals from the aquifer at the Kisatchie well field began about 1968 (Rogers, 1981, p. 6). Since 1968, water levels declined approximately 120 ft at the well field.

The hydrograph for well R-1085B (fig. 28), located about 5 mi southeast of the Kisatchie well field (fig. 27), shows water levels declined prior to 1980, stabilized (1980-96), and have fluctuated annually since 1996. Greatest declines (prior to 1980) may have resulted from additional withdrawals associated with the completion of the Kisatchie well field. Annual fluctuations in water levels, about 15 ft since 1996, may be in response to nearby irrigation withdrawals. Water levels at the well generally reach seasonal lows about March and recover during the year. The DOTD State registry of wells indicates two large-diameter (10-in.) irrigation wells were installed in the area in 1996.

Prior to large withdrawals from the Williamson Creek aquifer (predevelopment), flow in the aquifer was primarily southward from higher altitude (outcrop areas) to lower altitude (Martin and others, 1988, pl. 1). A low in the potentiometric surface (2003) extends from Alexandria to the Kisatchie well field in central Rapides Parish (fig. 27). The potentiometric low caused by withdrawal in the Alexandria and the Kisatchie well fields has altered and in some areas reversed the direction of ground-water flow. In most of Rapides Parish, ground-water flow (2003) is toward the Alexandria and Kisatchie well fields.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig. 2)

Saltwater—Area where the aquifer contains no freshwater

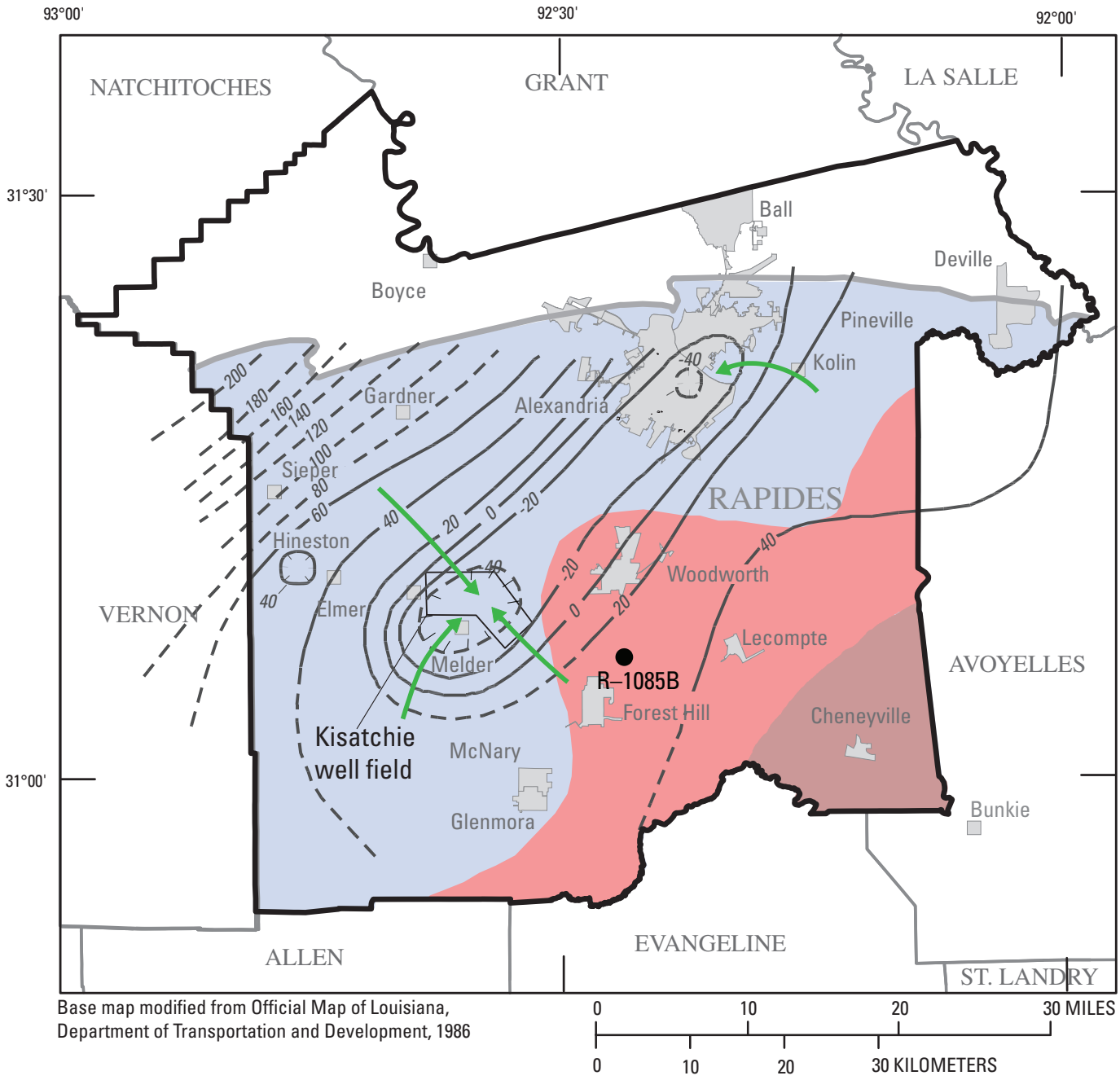
0.1 **Withdrawal center**—Selected area withdrawing 0.1 million gallons per day (Mgal/d) of water or more. Number is withdrawal in Mgal/d

Aquifer boundary

Well completed in the Williamson Creek aquifer for water withdrawal; symbol shows screen diameter, in inches

- + 1.25 to 3
- ○ 3 to 4
- ◇ 4 to 6
- ● 6 to 8
- ■ 8 to 16.1

Figure 26. Location of wells withdrawing water from the Williamson Creek aquifer in Rapides Parish, Louisiana.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig. 2)

Saltwater—Area where the aquifer contains no freshwater

Williamson Creek aquifer boundary

60 **Potentiometric contour**—Shows altitude at which water level would have stood in tightly-cased well. Interval 20 feet. Dashed where approximately located. Vertical datum is National Geodetic Vertical Datum of 1929. Hachures indicate depression

General direction of ground-water flow

R–1085B **Well with hydrograph**—See figure 28

Figure 27. Generalized potentiometric surface of the Williamson Creek aquifer in Rapides Parish, Louisiana, 2003 (from Brantley and Seanor, 2005, fig. 1).

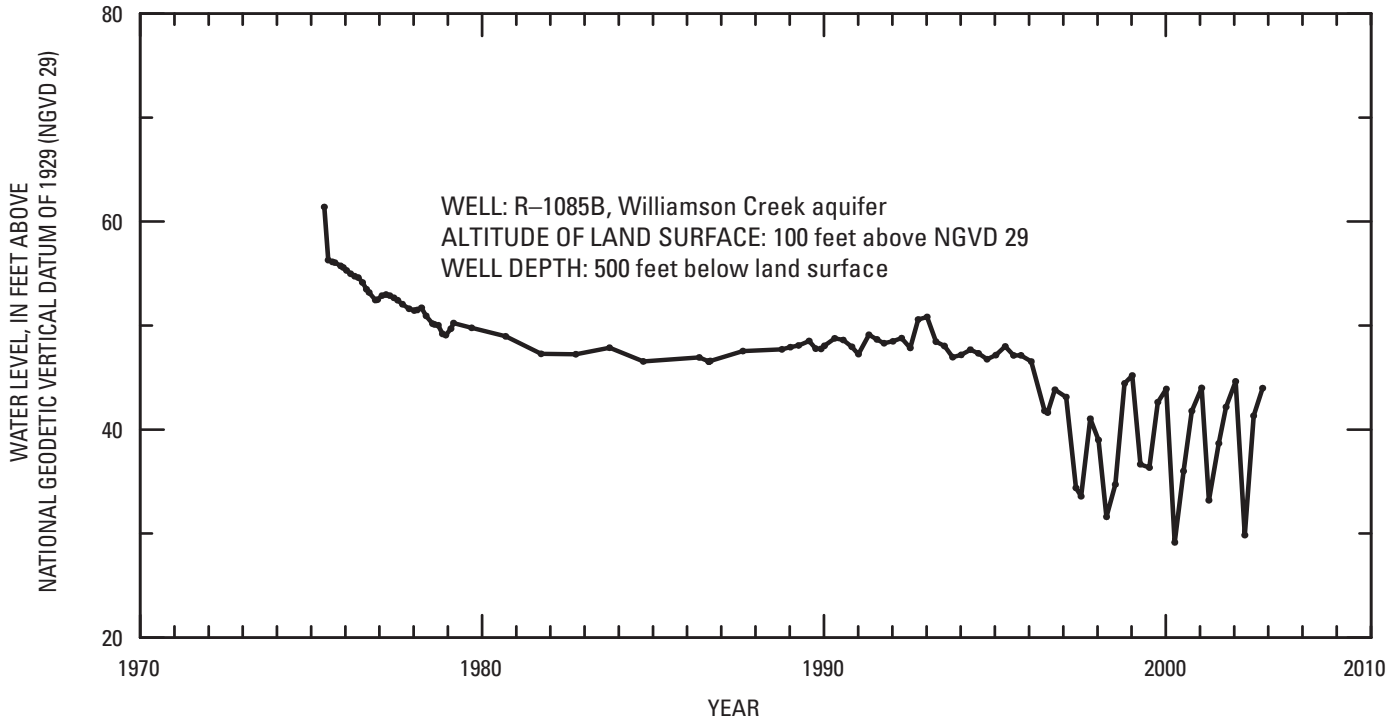


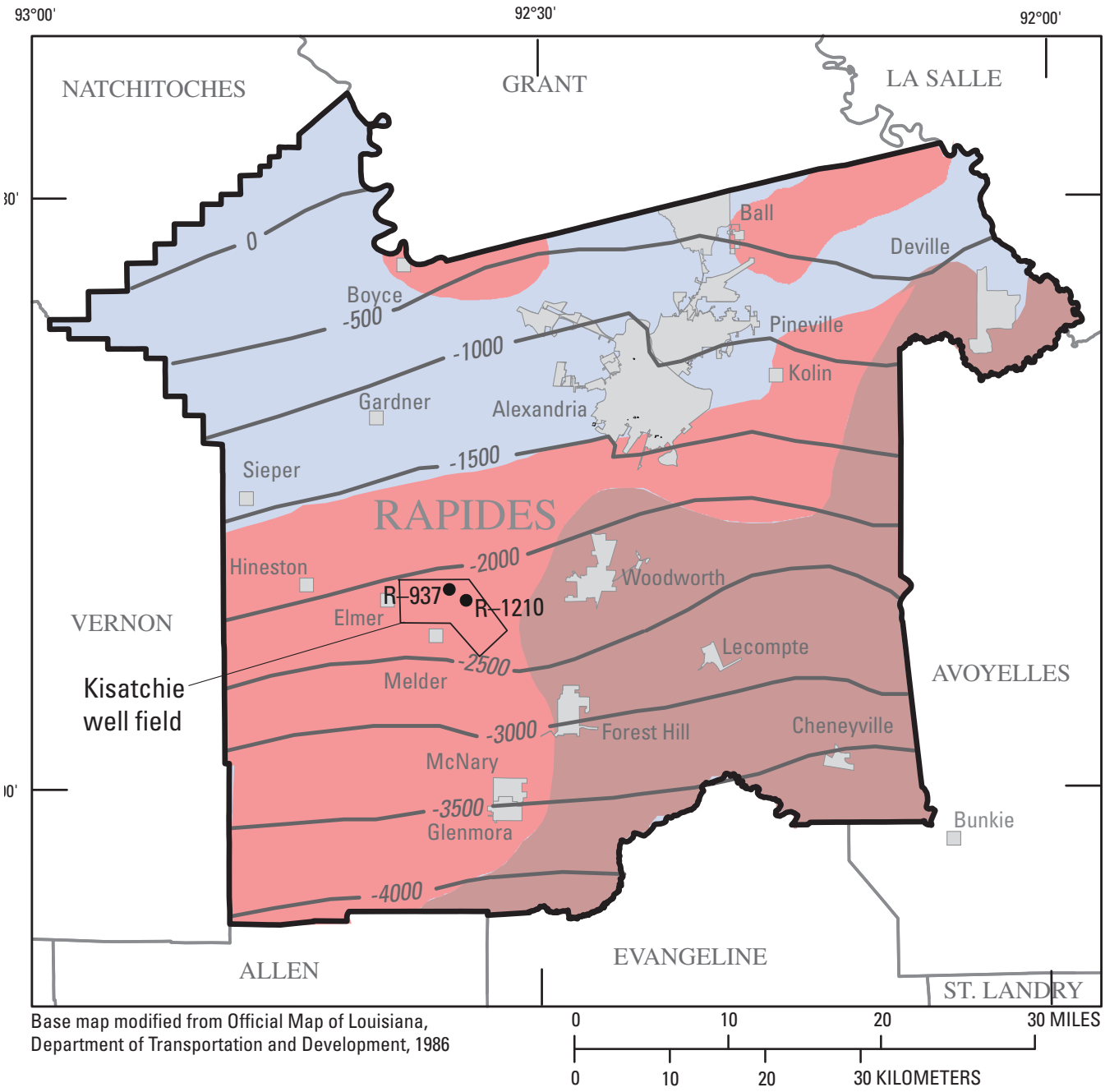
Figure 28. Water levels in well R-1085B screened in the Williamson Creek aquifer in Rapides Parish, Louisiana, See figure 27 for well location.

Carnahan Bayou Aquifer

The Carnahan Bayou aquifer consists of deltaic and marine sediments containing well sorted, very fine to medium sand interbedded with clay (Whitfield, 1975a, p. 27, 29). The sands are sufficiently interconnected to function as a regional aquifer. Although the aquifer is extensive throughout the parish, large areas contain saltwater (fig. 29).

Average thickness of sand beds in the Carnahan Bayou aquifer is about 38 ft in Rapides Parish (Newcome and Sloss, 1966, p. 11). Locally, the aquifer contains coarse beds of sand. Interpretation of electric-log data at the Kisatchie well field, wells R-937 and R-1210 (fig. 29), indicates sands vary locally in thickness and lateral extent. Cumulative sand thickness (determined from the electric-log data) ranged from about 80 ft (well R-1210) to 215 ft (well R-937). Average sand thickness was 50 ft, and maximum individual sand thickness was 130 ft. Hydraulic conductivity values for the Carnahan Bayou aquifer ranged from 60 to 110 ft/d at the Kisatchie well field (Rogers, 1981, p. 22).

In Rapides Parish, the base of the Carnahan Bayou aquifer ranges from 0 ft NGVD 29 in northwestern areas to 4,000 ft below NGVD 29 in southern areas of the parish (fig. 29). The base of the aquifer dips in a southerly direction about 100 ft/mi in Rapides Parish.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig.2)

Saltwater—Area where the aquifer contains no freshwater

-500 **Base of aquifer**—Shows altitude of aquifer base. Contour interval 500 feet. Vertical datum is National Geodetic Vertical Datum of 1929

● R–1210 **Well mentioned in text**

Figure 29. Location and approximate altitude of the base of the Carnahan Bayou aquifer in Rapides Parish, Louisiana (from Newcome and Sloss, 1966).

Water Quality

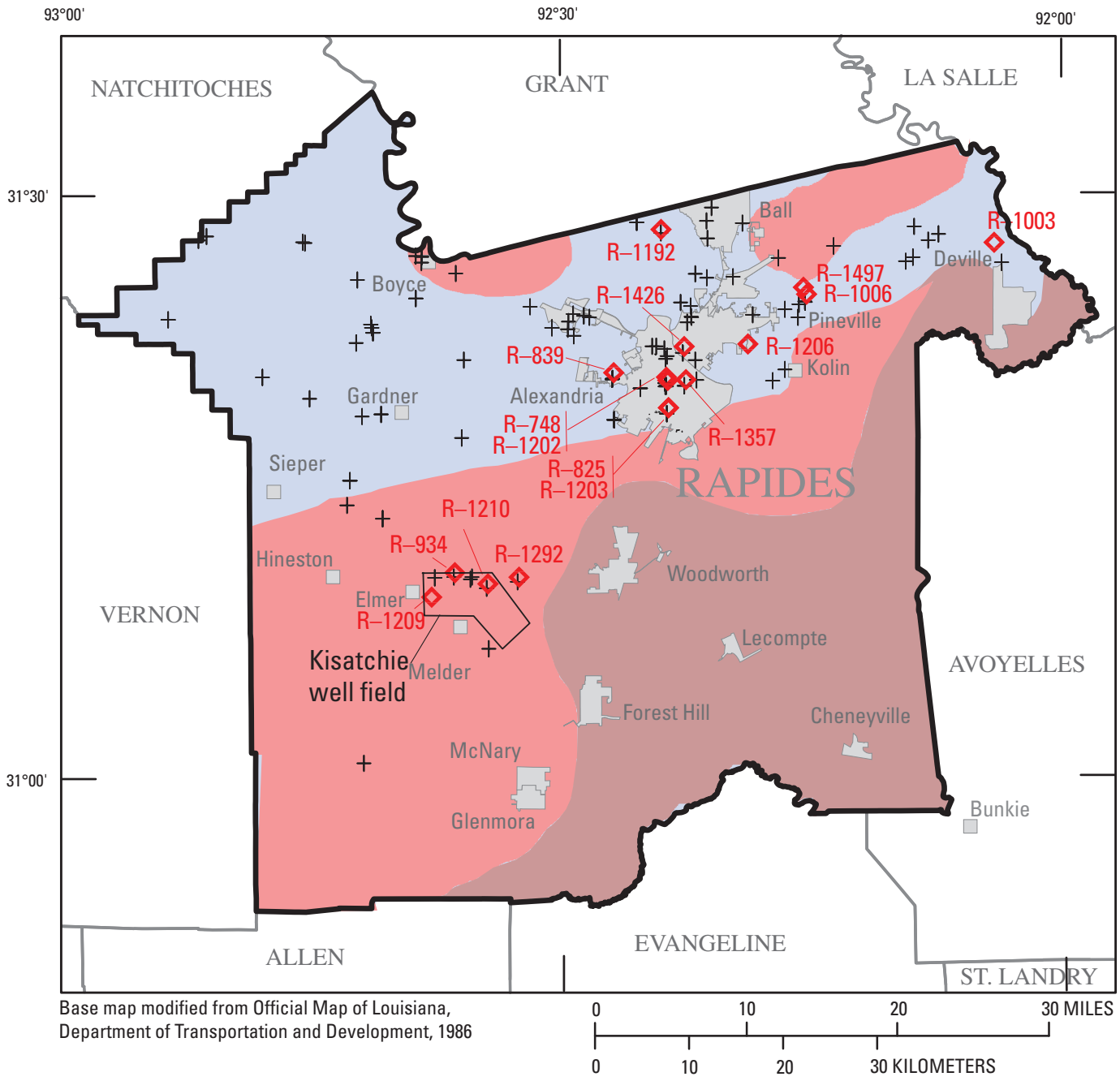
In northern Rapides Parish (north of an approximate line running through Sieper and Kolin), the Carnahan Bayou aquifer contains freshwater extending to the base of the aquifer; however, in large portions of the parish, freshwater is underlain with saltwater. In much of Rapides Parish, the Carnahan Bayou aquifer can yield water that is soft. Concentrations of dissolved solids, chloride, iron, and manganese generally do not exceed SDWR's at sites sampled. Most wells sampled were screened in freshwater portions of the aquifer (areas where freshwater extends to the base of the aquifer or from freshwater areas that were underlain with saltwater). Chloride concentrations generally ranged between 6 and 590 mg/L in all sampled wells (table 8). Chloride concentrations generally ranged between 6.3 and 146 mg/L in freshwater wells (table 8). Selected water-quality data from wells screened in the Carnahan Bayou aquifer in Rapides Parish, sampled during the period 1960-2003, are summarized in table 8. Locations of the wells are shown in figure 30.

Table 8. Summary of selected water-quality characteristics for the Carnahan Bayou aquifer in Rapides Parish, Louisiana, 1960–2003.

[°C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter at 25 °C; SU, standard units; mg/L, milligrams per liter; µg/L, micrograms per liter; SDWR, Secondary Drinking Water Regulation; --, not applicable, () parentheses contain data from wells containing less than 250 mg/L chloride]

	Temperature (°C)	Color (PCU)	Specific conductance, field (µS/cm at 25°C)	pH, field (SU)	Hardness, (mg/L as $CaCO_3$)	Chloride (mg/L)	Iron (µg/L)	Manganese (µg/L)	Dissolved solids (mg/L)
Minimum	20	0	96	6.1	0	4 (3.5)	0	0	97
Maximum	37.6	65	4,630	8.9	340	1,300 (210)	970	900	840
Median	25	10	482	7.8	6	20 (16)	130	20	327
Percentile 0.05	20.4	0	244	6.8	0	7 (6.3)	10	0	195
Percentile 0.95	33.44	9	1,450	8.5	53	590 (146)	470	168	766
Number of samples	56	112	111	106	129	137 (125)	76	38	84
SDWR[1]	--	15	--	6.5 – 8.5	--	250	300	50	500
Percent of samples less than SDWR[1]	--	94	--	92	--	91 (100)	85	81	85

[1] U.S. Environmental Protection Agency (2004).



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig.2)

Saltwater—Area where the aquifer contains no freshwater

\+ **Well location**—Sampled in the Carnahan Bayou aquifer 1960–2003. See table 8 for water-quality summary

R–748 **Well location**—Sampled in the Carnahan Bayou aquifer 2003. See table 9

Figure 30. Location of wells sampled in the Carnahan Bayou aquifer in Rapides Parish, Louisiana, 1960–2003.

A large area of the aquifer contains chloride concentrations exceeding the SWDR of 250 mg/L (fig. 30). South of the cities of Sieper, Alexandria, and Kolin, freshwater in the aquifer is underlain with saltwater or contains saltwater only (fig. 30). The base of freshwater in southwestern Rapides Parish is approximately 2,000 ft below NGVD 29 at the Kisatchie well field and increases to about 3,000 ft below NGVD 29 west of Glenmora (fig .7).

Freshwater quality in some areas of the Carnahan Bayou aquifer has been degraded by movement of saltwater. In the Alexandria-Pineville area and the Kisatchie well field area, increased concentrations of chloride have been detected. Saltwater from underlying aquifers or from adjacent areas containing saltwater has moved into freshwater areas, probably in response to withdrawals.

At the Kisatchie well field, specific conductance (field) and chloride concentrations increased at wells R-1209 and R-1210 (fig. 30, table 9). Both wells are completed in the approximate interval 1,800 to 2,000 ft below NGVD 29. The chloride concentration was 290 mg/L in well R-1209 in 2003 (exceeding the SDWR). Well R-1210 yielded water with chloride concentrations of 54, 76, and 210 mg/L in 1986, 1988 and 2003, respectively. Because saltwater is present in the Carnahan Bayou aquifer east of the Kisatchie well field and in sediments underlying deeper aquifers (sands) in the well field (figs. 5, 6, and 30), movement of saltwater into the lower Carnahan Bayou aquifer sands (strata 1,800 to 2,000 ft below NGVD 29, determined from well log R-1210, at approximate center of well field) will likely continue under present withdrawal conditions. No increase in chloride concentrations (table 9) was detected in wells screened in the approximate interval 1,000 to 1,100 ft below NGVD 29 at the well field.

In the Alexandria area, chloride concentrations have increased at well R- 825 (fig. 30, table 9) screened near the base of freshwater and near the eastern extent of the freshwater interface. Chloride concentration was 53 mg/L (2003) at well R-1203 in the Alexandria area. Chloride concentrations have increased in water from well R-1003 in the Deville area (fig. 30, table 9).

Table 9. Water-temperature, specific-conductance, and chloride data from selected wells screened in the Carnahan Bayou aquifer in Rapides Parish, Louisiana, 1968–2003.

[Well names and chloride concentrations are highlighted where substantial increases have occurred. ft, feet; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; DHH, Louisiana Department of Health and Hospitals; --, no data; USGS, U.S. Geological Survey]

Well name	Reporting agency	Depth of well (ft below land surface)	Date sampled	Temperature (°C)	Specific conductance, field (µS/cm at 25°C)	Chloride (mg/L)
R-748	DHH[1]	1,213	12-11-2000	--	--	9
	USGS	--	7-22-2003	28.6	391	11
R-825	USGS	1,272	8-2-1968		417	12
	DHH[1]		11-12-1996	--	--	116
	DHH[1]	--	12-11-2000	--	--	150
	USGS	--	4-9-2003	29.2	1,096	--
R-839	USGS	820	8-2-1968	--	1,220	46
	USGS	--	8-24-1984	25	1,140	47
	DHH[1]	--	12-18-2000	--	--	44
	USGS	--	4-9-2003	25.2	1,161	--
R-934	USGS	1,350	2-26-1969	30	716	12
	DHH[1]	--	5-88-2000	--	--	12
	USGS	--	4-9-2003	30.3	731	--
R-1003	USGS	844	5-26-1972	--	270	8
	USGS	--	7-22-1983	26	363	22
	USGS	--	4-8-2003	25.6	866	--
	USGS	--	7-21-2003	25.7	865	200
R-1006	USGS	837	5-1-1972	--	280	10
	USGS	--	7-25-1984	26	350	6.7
	USGS	--	4-8-2003	26.4	362	--
	USGS	--	7-21-2003	26.6	366	7.3
R-1192	DHH[1]	314	7-15-2002	--	--	7
	USGS	--	4-3-2003	21.4	272	--
R-1202	USGS	1,190	8-24-1984	28	382	11
	USGS	--	7-22-2003	28.3	396	10
	DHH[1]	--	12-11-2000	--	--	10
R-1203	DHH[1]	990	11-12-1996	--	--	71
	USGS	--	7-22-2003	25.2	1,240	53
R-1206	DHH[1]	--	2-11-2002	--	--	11
	USGS	933	4-28-2003	27.3	373	--
R-1209	DHH[1]	2,151	10-28-1996	--	--	151
	USGS	--	4-9-2003	37.1	1,480	--
	USGS	--	7-22-2003	37.6	1,500	290
R-1210	USGS	2,036	9-7-1986	37	736	54
	USGS	--	8-19-1988	37	816	76
	USGS	--	7-22-2003	36.9	1,250	210
R-1292	DHH[1]	2,126	9-5-2000	--	--	65
	USGS	--	7-22-2003	34.7	627	69
R-1357	USGS	723	7-22-2003	26.2	474	26
R-1426	DHH[1]	1,071	2-18-2002	--	--	78
	USGS	--	7-21-2003	28.1	378	22
R-1497	USGS	1,013	7-21-2003	27.4	1,090	160

[1]Source: Dean Lowe, Louisiana Department of Health and Hospitals, written commun., 2005.

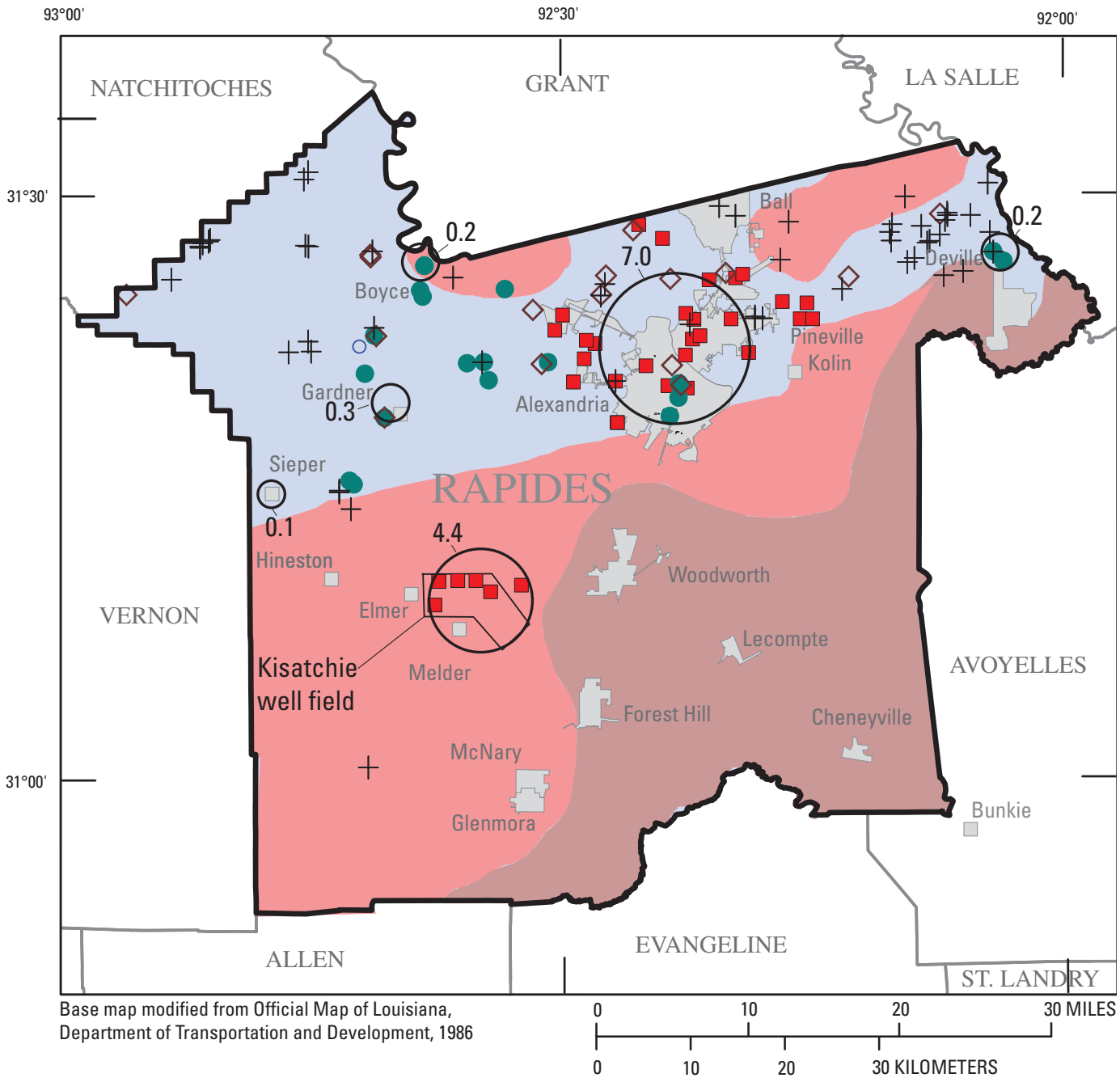
Withdrawals

In 2000, about 12.6 Mgal/d of water was withdrawn from the Carnahan Bayou aquifer in Rapides Parish. Approximately 12.2 Mgal/d was used for public supply; however, a portion of this total may have been supplied for industrial use. Additional withdrawals, 0.4 Mgal/d total, were used for aquaculture, rural domestic, irrigation, and power generation (B.P. Sargent, U.S. Geological Survey, written commun., modified, 2002).

Two areas, the Alexandria-Pineville area and the Kisatchie well field, are extensively developed and supply most of the water (11.4 Mgal/d in 2000) withdrawn from the Carnahan Bayou aquifer in Rapides Parish. In 2000, the largest concentrated withdrawals, 7.0 Mgal/d, were in the Alexandria-Pineville area (fig. 31). Withdrawals in the Alexandria-Pineville area included the City of Alexandria Water System (2.4 Mgal/d) and Pineville Water System (2.8 Mgal/d), as well as additional withdrawals (1.8 Mgal/d total) by smaller public suppliers in nearby communities: Buckeye Water District 50, Rapides Island Water Association, and Rapides Water Works District 3. At the Kisatchie well field, 4.4 Mgal/d was withdrawn from the Carnahan Bayou aquifer. Communities in Rapides Parish that withdraw smaller amounts of water from the Carnahan Bayou aquifer for public supply include Deville (0.2 Mgal/d), Gardner (0.3 Mgal/d), Boyce (0.2 Mgal/d), and Sieper (0.1 Mgal/d). Withdrawal centers and distribution of wells withdrawing water from the Carnahan Bayou aquifer are shown in figure 31.

Water Levels, Water-Level Trends, and Water Movement

The potentiometric surface in the Carnahan Bayou aquifer in Rapides Parish ranged from 100 ft above to 220 ft below NGVD 29 in 2003 (fig. 32). In the Alexandria-Pineville area, water levels generally are 100 to 200 ft or more below NGVD 29. A comparison of water-level data at sites measured in 1989 and 2003 indicates no net decline in water levels in the Carnahan Bayou aquifer in Rapides Parish. In the 1960's, water use in the Alexandria area began to approach or exceed the capacity of the city's well fields. To meet the needs of public supply and water for industry, the Kisatchie well field was established (fig. 1). Large water withdrawals from the Kisatchie well field began in 1968. Increased withdrawals from the well field altered water levels and flow in the Carnahan Bayou aquifer. Since the well field was constructed, water levels have declined approximately 150 ft and are now (2003) 40 ft or more below NGVD 29 in the Kisatchie well-field area (fig. 32).



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig.2)

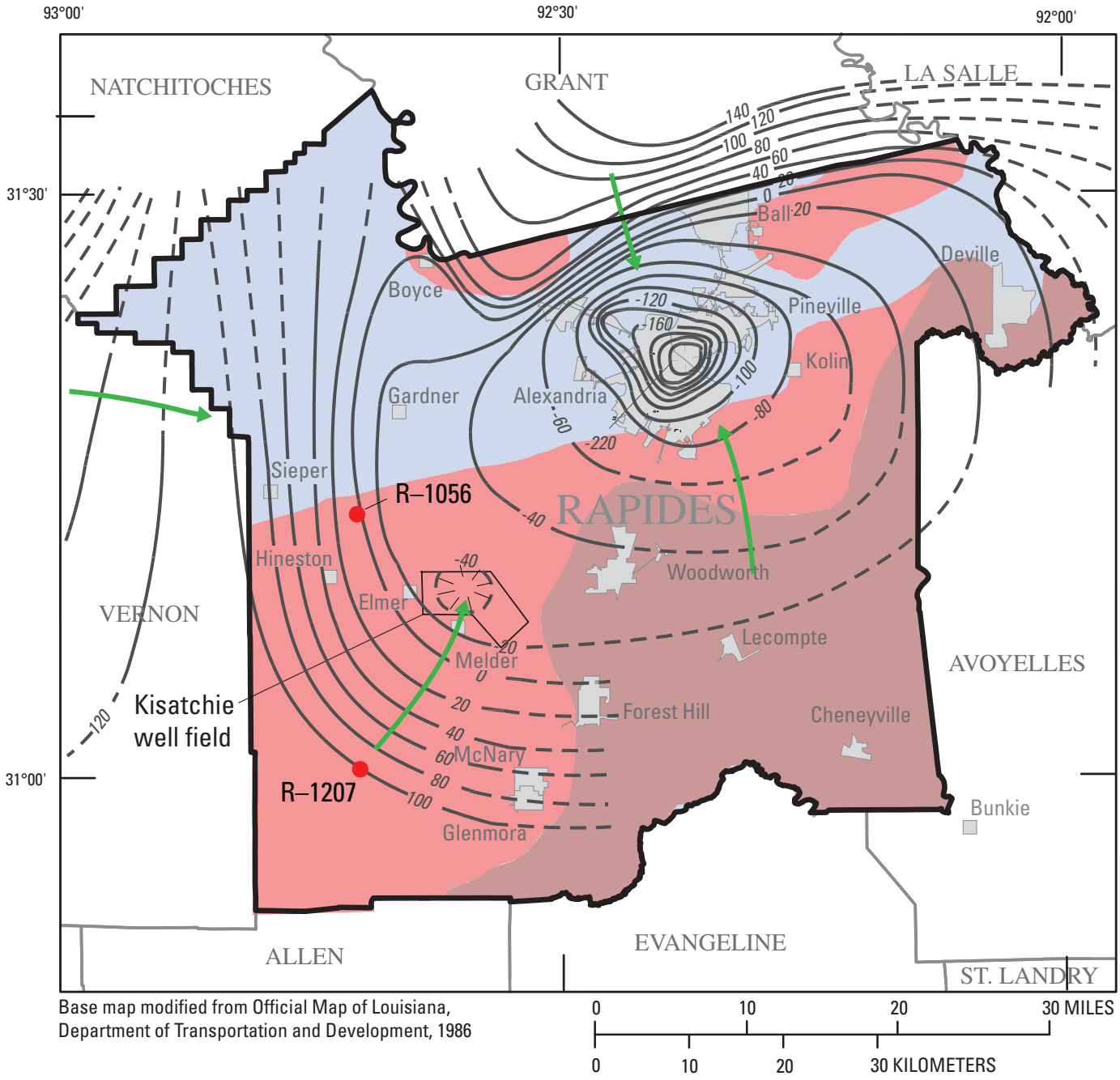
Saltwater—Area where the aquifer contains no freshwater

7.0 ○ **Withdrawal center**—Selected site withdrawing 0.1 million gallons per day (Mgal/d) of water or more. Number is withdrawal in Mgal/d

Well completed in the Carnahan Bayou aquifer for water withdrawal; symbol shows screen diameter, in inches

- \+ 1.5 to 3
- ○ 3 to 4
- ◇ 4 to 6
- ● 6 to 8
- ■ 8 to 10.1

Figure 31. Location of wells withdrawing water from the Carnahan Bayou aquifer in Rapides Parish, Louisiana.



EXPLANATION

Freshwater—Area where freshwater extends to the base of the aquifer

Freshwater underlain with saltwater—Area where the aquifer contains freshwater that is generally underlain with saltwater (chloride concentration is greater than 250 milligrams per liter; from Newcome and Sloss, 1966, fig.2)

Saltwater—Area where the aquifer contains no freshwater

60 **Potentiometric contour**—Shows altitude at which water level would have stood in tightly-cased well. Interval 20 feet. Dashed where approximately located. Vertical datum is National Geodetic Vertical Datum of 1929. Hachures indicate depression

General direction of ground-water flow

R–1207 **Well with hydrograph and number**—See figure 33

Figure 32. Generalized potentiometric surface of the Carnahan Bayou aquifer in Rapides Parish, Louisiana, 2003 (from Brantley and Seanor, 2005, fig. 4).

Hydrographs for wells R-1056 and R-1207 indicate water levels have declined during much of the period shown (fig. 33). Water levels at wells R-1056 and R-1207 probably declined in response to withdrawals from the Kisatchie well field. The initial steep decline in water levels (prior to about 1991) may show the depletion of water from storage in the aquifer as withdrawal from the Kisatchie well field changed the balance among recharge, storage, and discharge from the aquifer. About 1991, the rate of water-level decline slowed at both sites, and since about 1999, water levels have recovered slightly. Recovery in water levels at wells R-1056 (1.3 ft/yr) and R-1207 (0.07 ft/yr) during the period 1999-2003 may be in response to an approximate 4.4 Mgal/d decrease in withdrawal (1995-2002) by the City of Alexandria Water System.

The direction of ground-water flow in most of Rapides Parish is toward the Alexandria-Pineville area. A potentiometric low (cone of depression), produced by withdrawal, surrounds the cities of Alexandria and Pineville (fig. 32). Because water levels in the Kisatchie well field area are also lower than surrounding areas, locally ground-water flow is toward the well field.

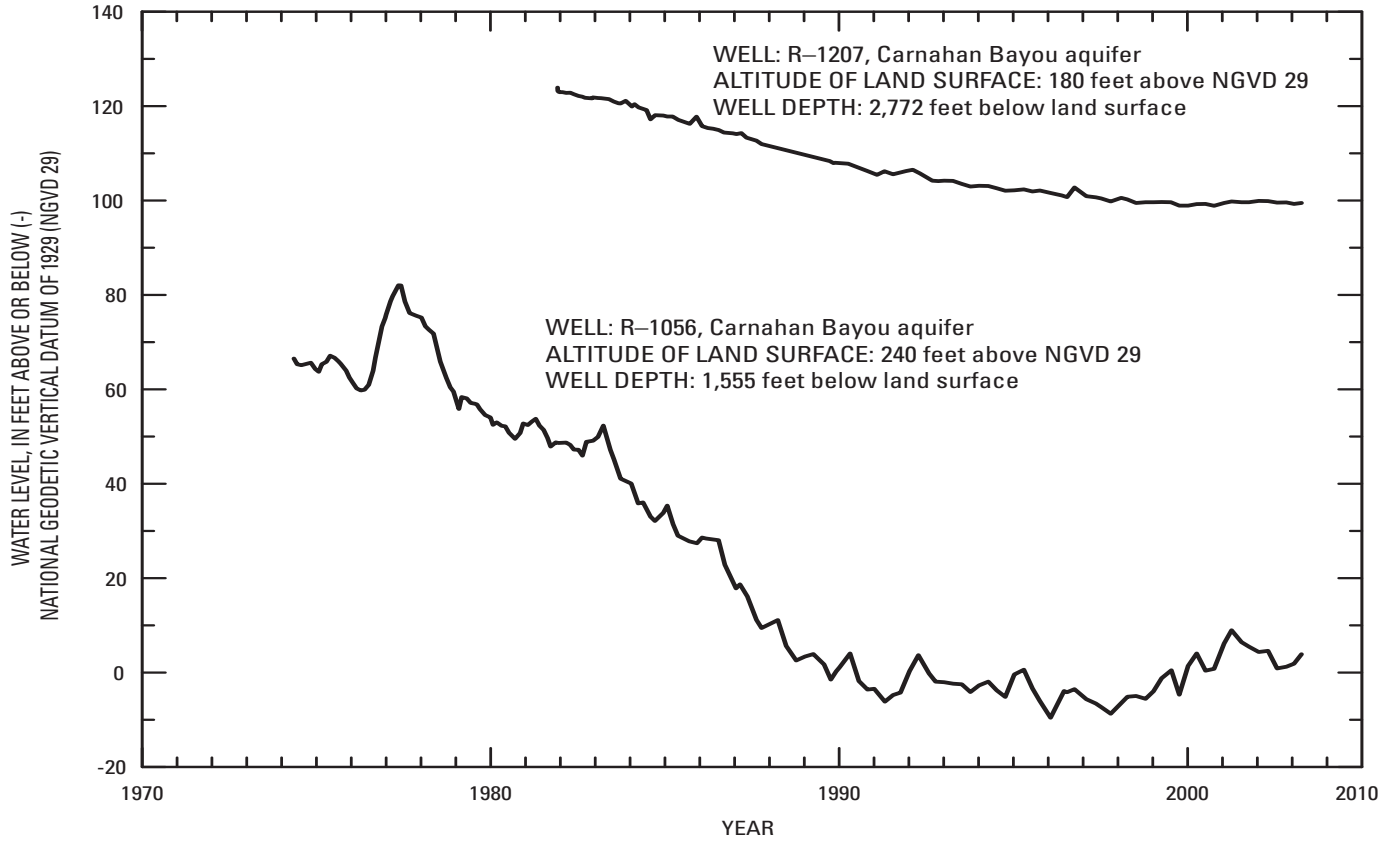


Figure 33. Water levels in wells R-1056 and R-1207 screened in the Carnahan Bayou aquifer in Rapides Parish, Louisiana. See figure 32 for well location.

Summary and Conclusions

In 2000, about 36.6 Mgal/d (million gallons per day) of water was withdrawn from aquifers that underlie Rapides Parish. The most used aquifers in the parish include the Carnahan Bayou (12.6 Mgal/d), upland terrace (10.5 Mgal/d), Williamson Creek (7.1 Mgal/d), and Evangeline (2.8 Mgal/d) aquifers. The City of Alexandria Water System is the largest ground-water user (21.1 Mgal/d in 2000) in the parish. The City of Pineville is the second largest user (2.81 Mgal/d in 2000).

The Red River alluvial aquifer underlies about 30 percent of Rapides Parish and extends from north-central to southeastern Rapides Parish. The Red River alluvial aquifer yields water that is very hard (greater than 180 mg/L, milligrams per liter, as calcium carbonate, $CaCO_3$). Chloride concentrations generally are less than 180 mg/L, which is less than the 250 mg/L SDWR (U.S. Environmental Protection Agency Secondary Drinking Water Regulation). Concentrations of dissolved solids, iron, and manganese generally exceed the SWDR's of 500 mg/L, 300 µg/L (micrograms per liter) and 50 µg/L, respectively. Local areas contain saltwater (chloride concentrations greater than 250 mg/L). A comparison of the potentiometric surface in July 2000 with a composite map for the period 1969-74 indicates water levels have changed little. Water in the Red River alluvial aquifer generally flows southeastward, discharging into the Red River or one of its tributaries.

The upland terrace aquifer and Chicot aquifer system combined underlie about 60 percent of Rapides Parish. In western Rapides Parish, the upland terrace aquifer and Chicot aquifer system generally yield freshwater that is soft (less than 60 mg/L as $CaCO_3$) and less than SDWR's for dissolved solids, chloride, iron, and manganese. About 8.2 Mgal/d was withdrawn from the Kisatchie well field in 2000. The water table surface is similar to the predevelopment surface in most of western Rapides Parish. In the area surrounding the Kisatchie well field, water levels have declined locally 10 to 20 feet since withdrawal from the well field began (about 1968).

The Evangeline aquifer underlies the approximate southern one third of Rapides Parish. The aquifer contains freshwater that is soft and does not not exceed SDWR's for dissolved solids, chloride, iron, and manganese. Chloride concentrations generally range between 2.8 and 36 mg/L at wells sampled.

Water levels in the Evangeline aquifer range approximately from 200 feet above National Geodetic Vertical Datum of 1929 (NGVD 29) in west-central Rapides Parish to about 40 feet above NGVD 29 in southeastern Rapides Parish. Water movement in the aquifer is generally southeastward through the parish.

The Williamson Creek aquifer underlies most Rapides Parish with the exception of the northern limits. Freshwater in the Williamson Creek aquifer in Rapides Parish is generally soft, and concentrations of dissolved solids, chloride, iron, and manganese generally do not exceed SDWR's. Chloride concentrations generally range between 7 and 86 mg/L at wells sampled. Freshwater is present in the Williamson Creek aquifer in most of Rapides Parish; however, large areas of freshwater are underlain with saltwater. Saltwater encroachment into freshwater areas of the Williamson Creek aquifer was not detected in Rapides Parish (2005).

Water levels in the Williamson Creek aquifer generally range from 200 feet above NGVD 29 in the outcrop area to 40 feet below NGVD 29 in withdrawal centers. In most of Rapides Parish, ground-water flow (2003) is toward the Alexandria and Kisatchie well fields.

The Carnahan Bayou aquifer is extensive throughout Rapides Parish; however, large areas contain saltwater. In much of the parish, the aquifer can yield water that is soft and does not exceed SDWR's for dissolved solids, chloride, iron, and manganese. Chloride concentrations generally range between 4 and 146 mg/L at freshwater wells sampled. Movement of saltwater has degraded freshwater quality in some areas of the Carnahan Bayou aquifer. In the Alexandria-Pineville area and the Kisatchie well field area, increased concentrations of chloride have been detected. Saltwater is present in the Carnahan Bayou aquifer east of the Kisatchie well field and in sediments underlying deeper aquifers. Movement of saltwater into the lower Carnahan Bayou aquifer will likely continue under present withdrawal conditions. In the Alexandria area, chloride concentrations have increased at well R-825 screened near the base of freshwater and near the eastern extent of the freshwater interface.

In 2000, the largest concentrated withdrawals from the Carnahan Bayou aquifer were in the Alexandria-Pineville area (7.0 Mgal/d), and in the Kisatchie well field (4.4 Mgal/d). In the Alexandria-Pineville area, water levels generally are 100 to 200 feet or more below NGVD 29. Since the Kisatchie well-field was constructed in 1968, water levels have declined approximately 150 feet in the Kisatchie well-field area.

References Cited

Brantly, J.A., and Seanor, R.C., 2005, Louisiana ground-water map no. 18: Potentiometric surface, 2003, Jasper aquifer system in west-central Louisiana: U.S. Geological Survey Scientific Investigations Map 2861, 2 sheets.

Fendick, R.B., 2005, Louisiana ground-water map no. 21: Generalized Potentiometric Surface of the Evangeline aquifer in south-central Louisiana: U.S. Geological Survey Scientific Investigations Map 2880, 1 sheet.

Hem, J.D., 1985, Study and interpretation of chemical characteristics of natural water (3d ed.): U.S. Geological Survey Water-Supply Paper 2254, 264 p.

Klug, M.L., 1955, Geology and ground-water resources of the Alexandria area, Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 3, 23 p.

Lovelace, J.K., Fontenot, J.W., and Frederick, C.P., 2004, Withdrawals, water levels, and specific conductance in the Chicot aquifer system in southwestern Louisiana, 2000-03: U.S. Geological Survey Scientific Investigations Report 2004-5212, 56 p.

Maher, J.C., 1940, Ground-water resources of Rapides Parish, Louisiana: Louisiana Department of Conservation Geological Bulletin no. 17, 100 p.

Martin, Angel, Jr., and Whiteman, C.D., Jr., 1985a, Generalized potentiometric surface of aquifers of Pleistocene age, southern Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4331, 1 sheet.

Martin, Angel, Jr., and Whiteman, C.D., Jr., 1985b, Generalized potentiometric surface of the Evangeline and equivalent aquifers in Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4359, 1 sheet.

Martin, Angel, Jr., and Whiteman, C.D., Jr., 1986, Generalized potentiometric surface of the Catahoula aquifer in central Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 86-4059, 1 sheet.

Martin, Angel, Jr., Whiteman, C.D., Jr., and Becnel, M.J., 1988, Generalized potentiometric surfaces of the upper and lower Jasper and equivalent aquifers in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4139, 2 sheets.

McWreath, H.C., III, and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4088, 53 p.

Newcome, Roy, Jr., and Sloss, Raymond, 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Nyman, D.J., 1984, The occurrence of high concentrations of chloride in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 33, 75 p.

Rogers, J.E., 1981, Preconstruction and simulated postconstruction ground-water levels at urban centers in the Red River navigation project area, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 83-4154, 33 p.

Rogers, J.E., 1983, Water resources of the Kisatchie well-field area near Alexandria, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 26, 57 p.

Sargent, B.P., 2002, Water use in Louisiana, 2000: Louisiana Department of Transportation and Development Water Resources Special Report no. 15, 133 p.

Saucier, R.T., 1994, Geomorphology and Quaternary geologic history of the Lower Mississippi Valley: Vicksburg, Miss., U.S. Army Corps of Engineers, Waterways Experiment Station.

Seanor, R.C., Lovelace, J.K., and Smoot, C.W., 1996, Relation of water levels in the Red River alluvial aquifer to rainfall and stages of the Red River, pool 2, Red River waterway, Alexandria area, Louisiana, 1971-91: U.S. Geological Survey Water-Resources Investigations Report 96-4053, 38 p.

Smoot, C.W., 1988, Louisiana hydrologic atlas map no. 3: Altitude of the base of freshwater in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4314, 1 sheet.

Smoot, C.W., and Fendick, R.B., Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 63, 36 p., 1 pl.

Snider, J.L., and Sanford, T.H., Jr., 1981, Water resources of the terrace aquifer, central Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 25, 48 p.

U.S. Census Bureau, 2000, State and County Quickfacts- Rapides Parish, Louisiana, accessed January, 2007, at *http://quickfacts.census.gov/qfd/states/22000.html*

U.S. Environmental Protection Agency, 2004, 2004 Edition of the Drinking Water Standards and Health Advisories, winter 2004: Washington, D.C., U.S. Environmental Protection Agency, Office of Water, EPA 822-R-04-005, 20 p.

Veatch, A.C., 1906, Geology and underground water resources of northern Louisiana, with notes on adjoining districts, *in* Geological Survey of Louisiana, report of 1905: Louisiana State Experiment Station, Louisiana Geological Survey Bulletin 4, p. 261-457.

Whitfield, M.S., Jr., 1975a, Geohydrology of the Evangeline and Jasper aquifers of southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 20, 72 p.

Whitfield, M.S., Jr., 1975b, Geohydrology and water quality of the Mississippi River alluvial aquifer, northeastern Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 10, 29 p.

Whitfield, M.S., Jr., 1980, Chemical character of water in the Red River alluvial aquifer, Louisiana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1018, 95 p., 21 pls.