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

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
Office of Public Works and Intermodal
Public Works and Water Resources Division

SCIENTIFIC INVESTIGATIONS MAP 2880
Potentiometric Surface--SHEET 1 OF 1
Fendick, R.B., Jr., 2005, Louisiana Ground-Water Map No. 21:
Generalized Potentiometric Surface of the Evangeline Aquifer in South-Central Louisiana, January-March 2004

INTRODUCTION

The Evangeline aquifer is a source of fresh ground water in south-central Louisiana (fig.1). In 2000, about 22 Mgal/d was withdrawn from the aquifer, primarily for public supply and industrial use (Sargent, 2002). Although the quality of water in the Evangeline aquifer generally is excellent for public supply, the aquifer has not been extensively developed, primarily because the overlying Chicot aquifer system has provided adequate quantities of water for public supply and irrigation at shallower depths (Whitfield, 1975). However, water withdrawals from the Evangeline aquifer increased during the period 1980 to 2000 (fig. 2). Furthermore, withdrawals from the Evangeline aquifer in south-central Louisiana increased about 48 percent (15.2 to 22.5 Mgal/d) during the period 1995 to 2000 (Lovelace, 1991; Sargent, 2002). Most of this increase, more than 5 Mgal/d, was for public supply. In 2000, almost 15 Mgal/d (67 percent) was used for public supply; 5.8 Mgal/d (26 percent) by industry; and the remaining 1.7 Mgal/d (7 percent) primarily for irrigation and domestic purposes.

Heavy pumping from the overlying Chicot aquifer system, primarily for irrigation, directly affects water levels in the Evangeline aquifer in some areas of south-central Louisiana (Martin and Whiteman, 1985). Water-level declines in the Chicot aquifer system and other aquifers in south-central Louisiana could result in additional development of the Evangeline aquifer in the future. In 2003, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development, began a study to describe the potentiometric surface of the Evangeline aquifer in this area.

This report presents maps and data that describe the potentiometric surface of the upper sand beds (less than 1,350 ft below land surface NGVD 29) of the Evangeline aquifer for the period January-March 2004. The potentiometric-surface map can be used to determine ground-water flow direction, hydraulic gradients, and effects of withdrawals on water levels in the aquifer. Hydrographs of water levels from selected wells screened in the Evangeline aquifer and the overlying Chicot aquifer system also are shown. This information is needed by water-resource planners and managers to determine the effects of increased withdrawals and to plan for the future development of this resource.

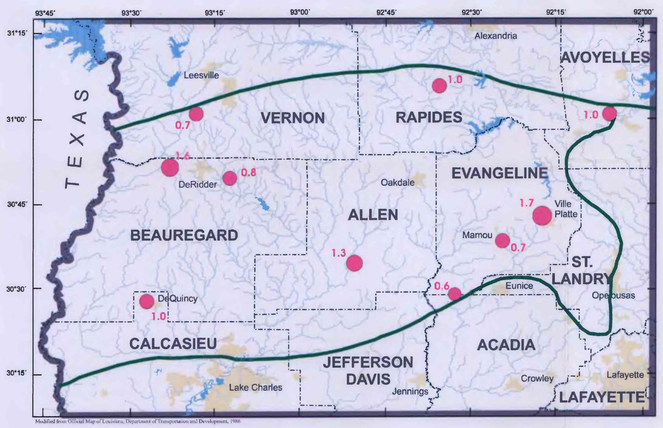

Figure 1. Study area and water-withdrawal sites for the Evangeline aquifer in south-central Louisiana, 2000.

Description of Study Area

The study area (fig. 1) includes the area where the Evangeline aquifer contains freshwater in south-central Louisiana. The area comprises about 7,420 mi^2 and includes all of Beauregard, Allen, and Evangeline Parishes; the northernmost parts of Calcasieu, Jefferson Davis, and Acadia Parishes; western St. Landry Parish; and the southernmost parts of Vernon, Rapides, and Avoyelles Parishes. The largest population centers utilizing the Evangeline aquifer are located in DeRidder (population 9,800), Ville Platte (8,100), and Oakdale (8,100) (U.S. Census Bureau, 2000). Much of the study area is forested, and industry in the area primarily consists of the manufacturing of lumber and paper products. Rice is the primary crop grown in areas along the eastern and southern boundaries of freshwater in the Evangeline aquifer (fig. 1).

The climate in south-central Louisiana is humid and subtropical. The average temperature in the study area was about 67°F in 2003 or 0.3°F below the 30-year (1971-2000) average of 67.3°F. The average rainfall was about 51 in., which was 7 in. below the 30-year average of 58.0 in. (Elizabeth Mons Sanders, Louisiana Office of State Climatology, written commun., 2004).

Acknowledgments

The cooperation of officials of municipalities, industry, and private well owners participating in the data collection process is greatly appreciated. Special thanks to Mr. Zahir "Bo" Bolourchi, Chief, Public Works and Water Resources Division, Louisiana Department of Transportation and Development (DOTD), for providing water well registration data and assistance in the publication of this report.

CONVERSION FACTORS AND DATUMS

Multiply	By	To obtain
inch (in)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
million gallons per day (Mgal/d)	3,785	cubic meter per day (m^3)

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

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.

Horizontal coordinate information in this report is referenced to the North American Datum of 1927 (NAD 27) and 1983 (NAD 83).

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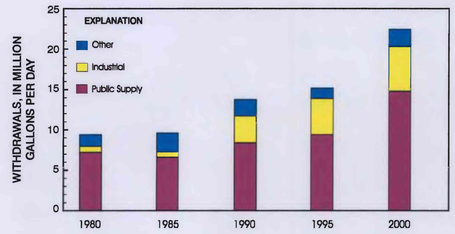

Figure 2. Water withdrawals from the Evangeline aquifer in south-central Louisiana, 1980-2000 (from B.P. Sargent, U.S. Geological Survey, written commun., 2004).

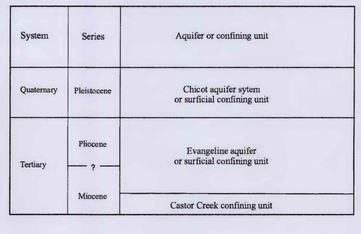

Figure 3. Partial hydrogeologic column of aquifers and aquifer systems in central and southwestern Louisiana (modified from Lovelace and Lovelace, 1995, p. 10).

HYDROGEOLOGY

The Evangeline aquifer of Pliocene and Miocene age is overlain by the Chicot aquifer system of Pleistocene age, and underlain by the Castor Creek confining unit of Miocene age (fig. 3). According to Nyman (1989, p. 13), "The top of the Evangeline aquifer and base of the Chicot aquifer system are considered essentially the same surface." The Evangeline aquifer consists primarily of a deltaic sequence of fine-to-medium sand interbedded with silt, soft to moderately hard greenish-gray laminated clay, and local beds of coarse sand (Whitfield, 1975).

Locally, sand beds within the Evangeline aquifer are separated and confined by extensive clay beds. These sand beds are usually less than 50 ft thick, but may be as thick as 100 ft or more in some localized areas. Generally, however, the sand beds are interconnected sufficiently so they function regionally as one aquifer (Whitfield, 1975). The aquifer pinches out and subcrops beneath the Chicot aquifer system and other overlying aquifers in the northern part of the study area (fig. 4), and no surface exposures of the Evangeline aquifer are known. The Evangeline aquifer ranges in thickness from 0 ft at the northern edge of the subcrop area to more than 2,000 ft along the southern limit of freshwater (Martin and Whiteman, 1985). The base of freshwater in the Evangeline aquifer ranges from 0 to 2,200 ft below NGVD 29 (Whitfield, 1975).

The Evangeline aquifer is recharged by rainfall which has moved downward through overlying aquifers (Rollo, 1960, p. 39). This water then moves downgradient toward lower altitudes in the coastal plain.

POTENTIOMETRIC SURFACE

The potentiometric-surface map (fig. 4) shows generalized contours of water-level altitudes in the Evangeline aquifer in south-central Louisiana. In this area, the sand beds of the upper part of the aquifer contain substantial amounts of freshwater and are more extensively pumped, whereas the lower sand beds contain brackish or saline water. The map was constructed by using water-level data (table 1) from 52 wells screened in various sand beds in the upper part of the Evangeline aquifer. Water levels were measured during January-March 2004 by using either a steel or electric tape. Wells in which water levels were measured were not being pumped at the time of measurement.

Water levels in the Evangeline aquifer ranged from about 262 ft above NGVD 29 to about 74 ft below NGVD 29. The highest water level, 262.06 ft above NGVD 29, was measured in well V-8807Z, located in Vernon Parish, in the subcrop area of the Evangeline aquifer. The two lowest water levels measured were more than 70 ft below NGVD 29 and were located in southern Evangeline Parish near Ville Platte and Mamou (fig. 4 and table 1); some of the largest withdrawals from the Evangeline aquifer occur in this area (fig. 1). Figure 1 also shows areas where largest withdrawals (greater than one-half million gallons per day) from pumping occurred in 2000.

Water in the Evangeline aquifer moves from areas of higher hydraulic head to areas of lower hydraulic head, and the direction of flow is perpendicular to the potentiometric contours. Flow in the aquifer is generally toward the south and southeast and toward pumping centers, such as southern Evangeline Parish near Ville Platte and Mamou (fig. 4). Gradients are generally highest in the recharge area and near pumping centers, ranging from about 8 to 20 ft/mi. The lowest gradients are in northern Evangeline and west-central Beauregard Parishes (fig. 4).

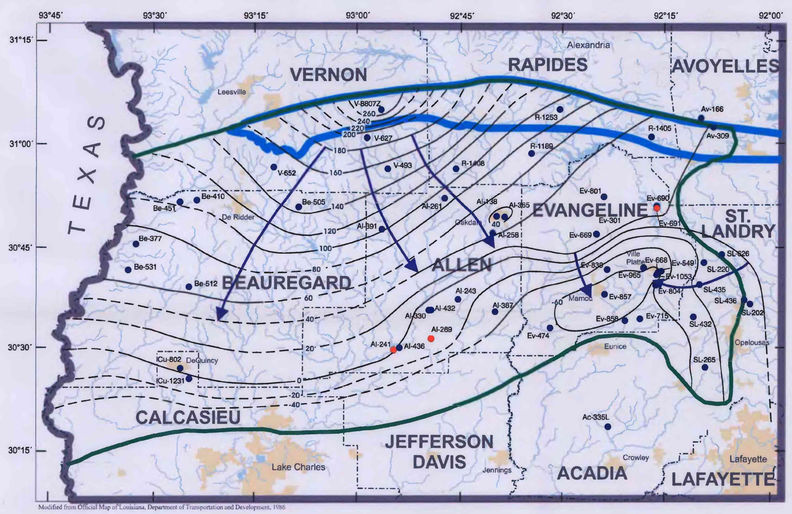

Figure 4. Generalized potentiometric surface of the Evangeline aquifer in south-central Louisiana, January-March 2004.

Table 1. Water-level data used to construct the potentiometric-surface map of the Evangeline aquifer in south-central Louisiana, January-March 2004.

[NGVD 29, National Geodetic Vertical Datum of 1929; NAD 83, North American Datum of 1983; NAD 27, North American Datum of 1927]

Well number	Date measured	Altitude of land surface, in feet above NGVD 29	Altitude of water level, in feet above or below (-) NGVD 29	Horizontal datum
Acadia Parish				
Ac- 335L	1-05-04	24.55	-44.71	NAD 83
Allen Parish				
Al- 138	2-18-04	105.0	29.75	NAD 83
Al- 241[1]	1-07-04	42.97	9.47	NAD 27
Al- 243	3-30-04	70.0	-12.85	NAD 27
Al- 258	2-10-04	105.0	43.23	NAD 83
Al- 261	1-07-04	135.0	85.65	NAD 83
Al- 269	1-07-04	45.0	-7.28	NAD 27
Al- 330	3-10-04	59.0	-16.19	NAD 83
Al- 365	3-09-04	115.0	26.91	NAD 27
Al- 387	3-26-04	69.0	-34.65	NAD 27
Al- 391	3-30-04	124.0	100.74	NAD 27
Al- 432	3-10-04	61.0	-3.40	NAD 83
Al- 436	3-10-04	41.0	-0.55	NAD 83
Avoyelles Parish				
Av- 166	3-09-04	76.0	22.23	NAD 27
Av- 309	2-04-04	65.0	19.97	NAD 27
Beauregard Parish				
Be- 377	1-15-04	83.0	70.95	NAD 27
Be- 410	2-24-04	200.0	100.37	NAD 27
Be- 451	2-18-04	201.0	103.83	NAD 27
Be- 505	1-09-04	181.0	142.70	NAD 27
Be- 512	1-07-04	142.0	62.30	NAD 27
Be- 531	2-10-04	86.0	71.75	NAD 83
Calcasieu Parish				
Cu- 802	3-11-04	80.0	2.20	NAD 27
Cu-1231	3-11-04	75.0	-3.27	NAD 27
Evangeline Parish				
Ev- 301	1-09-04	120.0	29.30	NAD 83
Ev- 474	1-05-04	40.0	-58.95	NAD 27
Ev- 549	3-30-04	75.0	-57.72	NAD 83
Ev- 668	1-06-04	75.0	-61.49	NAD 83
Ev- 669	1-09-04	115.0	27.79	NAD 83
Ev- 690	1-08-04	50.0	35.88	NAD 27
Ev- 691	1-05-04	50.0	30.49	NAD 83
Ev- 715	3-24-04	58.0	-52.84	NAD 83
Ev- 801	1-09-04	125.0	25.48	NAD 83
Ev- 804	3-24-04	67.0	-39.68	NAD 83
Ev- 839	1-07-04	70.0	-49.03	NAD 27
Ev- 857	1-13-04	60.0	-74.16	NAD 83
Ev- 858	2-04-04	50.0	-59.02	NAD 83
Ev- 965	1-07-04	65.0	-56.26	NAD 83
Ev-1053	3-30-04	70.0	-70.48	NAD 83
Rapides Parish				
R-1189	3-30-04	135.0	64.98	NAD 27
R-1253	3-31-04	160.0	96.93	NAD 83
R-1405	2-13-04	65.0	34.67	NAD 27
R-1408	3-30-04	200.0	106.89	NAD 27
St. Landry Parish				
SL- 202	1-05-04	60.0	-10.46	NAD 83
SL- 220	1-08-04	65.0	-6.95	NAD 27
SL- 265	1-15-04	53.7	-27.41	NAD 27
SL- 432	3-9-04	65.0	-34.00	NAD 27
SL- 435	3-26-04	70.0	-17.39	NAD 27
SL- 436	1-14-04	65.0	-7.69	NAD 27
SL- 826	1-14-04	30.0	-3.60	NAD 83
Vernon Parish				
V- 493	2-18-04	170.0	153.02	NAD 83
V- 627	2-10-04	200.0	188.86	NAD 83
V- 652	1-15-04	210.0	147.11	NAD 27
V-8807Z	2-27-04	350.0	262.06	NAD 83

[1]Well screened in the Chicot aquifer system.

WATER-LEVEL TRENDS

Water levels in the Evangeline aquifer appear to be relatively stable or have increased slightly over the past 3 years (2001-2004), after a declining trend the previous 3 years (1998-2000). The trend is shown in the hydrograph for well Al-269 (fig. 5), located in Allen Parish (fig. 4). Drought conditions occurred throughout the State during the period 1998-2000 with an average annual rainfall of 47.9 in. in the study area, during the 3-year period (Jay Grymes, Louisiana Office of State Climatology, written commun., 2002). The increase in water levels over the past 3 years may be due to a return to more normal rainfall amounts (average annual rainfall of 62.9 in. during 2001-03). The hydrograph for well Ev-691 (fig. 6) shows water-level declines of about 0.2 ft/yr for the period 1973-2001. Insufficient water-level data are available to determine any trends since 2001. Well Ev-691 is located in northeast Evangeline Parish (fig. 4).

As mentioned previously, heavy pumping from the overlying Chicot aquifer system, primarily for irrigation, directly affects water levels in the Evangeline aquifer in some areas of south-central Louisiana (fig. 4). Seasonal pumping for rice irrigation typically occurs from February through June, causing water-level declines in the Chicot aquifer system (Lovelace and others, 2002). This seasonal pumping trend illustrated in hydrographs of wells Al-269 (fig. 5) and Al-241 (fig. 7), may indicate a hydraulic connection exists between the Evangeline aquifer and the Chicot aquifer system.

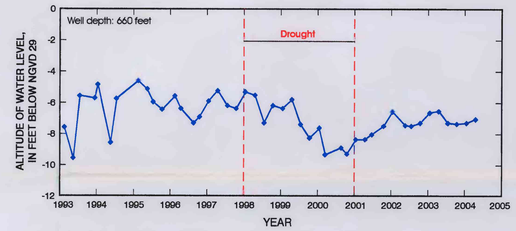

Figure 5. Water levels in well Al-269, screened in the Evangeline aquifer, 1993-2004.

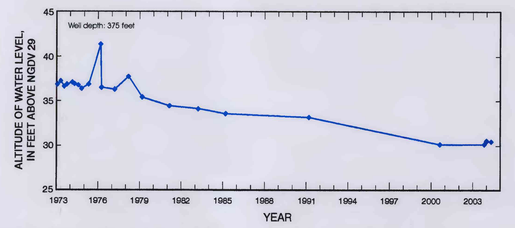

Figure 6. Water levels in well Ev-691, screened in the Evangeline aquifer, 1973-2004.

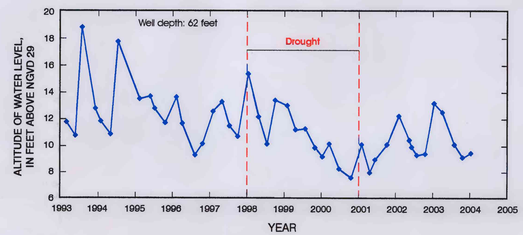

Figure 7. Water levels in well Al-241, screened in the Chicot aquifer system, 1993-2004.

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2005

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