U.S. DEPARTMENT OF THE INTERIOR
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LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
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WATER RESOURCES SECTION

WATER-RESOURCES INVESTIGATIONS
REPORT 95-4169 (SHEET 1 OF 2)
GONZALES-NEW ORLEANS AQUIFER--POTENTIOMETRIC SURFACE

INTRODUCTION

The Gonzales-New Orleans aquifer is the primary source of fresh ground water in the area surrounding New Orleans in southeastern Louisiana. In 1990, a total of 33 million gallons per day was withdrawn from the Gonzales-New Orleans aquifer in Jefferson and Orleans Parishes. Of the total, about 68 percent was used for power generation, 28 percent for industrial use, 3 percent for public supply, and the remaining 1 percent for domestic use and general irrigation (Lovelace, 1991, p. 47, 57).

To assess the potential for ground-water development and for protection of the resource, additional information is needed about the effects of withdrawals on ground-water flow and the potentiometric surface in the Gonzales-New Orleans aquifer. Water-level changes in wells completed in the aquifer are being monitored and changes in the configuration of the potentiometric surface are being evaluated by the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development.

This report presents data and maps that illustrate the potentiometric surface during spring 1993, and water-level changes during 1987-93 for the Gonzales-New Orleans aquifer in southeastern Louisiana. A hydrograph of water levels in a selected well completed in the aquifer also is presented. Water-level data are on file at the U.S. Geological Survey office in Baton Rouge, Louisiana.

The maps in this report are useful for determining direction of ground-water flow, hydraulic gradients, and the effects of withdrawals on the ground-water system. The rate of ground-water flow can be estimated from the hydraulic gradient when the hydraulic conductivity of the aquifer is known.

HYDROGEOLOGY

The aquifers in the New Orleans area are composed of sediments of Holocene and Pleistocene age deposited in fluvial, deltaic, and near-shore marine environments. This complex sedimentary sequence dips and thickens to the south, and generally becomes finer grained, and contains more saline water down dip. The hydrogeologic correlations for aquifers in the New Orleans area as described in Rollo (1966, p. 7) and Hosman (1972, p. 13) are shown in figure 1.

System	Series	Hydrogeologic unit, southeastern Louisiana	
		Modified from Rollo (1966)	This report, modified from Hosman (1972)
Quaternary	Holocene	Shallow aquifers	Shallow aquifers
	?	"200-foot" sand	Gramercy aquifer
	Pleistocene	"400-foot" sand	Norco aquifer
		"700-foot" sand	Gonzales-New Orleans aquifer
		"1,200-foot" sand	"1,200-foot" sand

Figure 1. Correlation for the Gonzales-New Orleans aquifer in southeastern Louisiana.

The Gonzales-New Orleans aquifer is a continuous hydrogeologic unit in most of southeastern Louisiana. The extent, thickness, and recharge area of the Gonzales-New Orleans aquifer are shown in figure 2. The area described in this report represents the part of the aquifer that yields large quantities of freshwater. The aquifer contains freshwater in some areas to the north of the study area; however, in most instances outside the study area, either quantities of freshwater are limited or withdrawals are relatively small (Lovelace, 1991, p. 86).

The Gonzales-New Orleans aquifer is composed mostly of fine to medium sand within the study area. The aquifer ranges from 100 to 300 feet in thickness (fig. 2). The aquifer is separated from the overlying Norco aquifer and the underlying "1,200-foot" sand by confining units composed mostly of clay, ranging in thickness from 50 to 250 feet (Dial and Sumner, 1989, p. 11-16).

The primary recharge area (fig. 2) for the Gonzales-New Orleans aquifer is in southern Livingston, Tangipahoa, and St. Tammany Parishes. Recharge occurs by percolation of rainfall and surface water into near-surface sediments, and by interconnection with underlying aquifers having higher hydraulic heads (Tomaszewski, 1988, p. 10-11). Other possible sources of recharge to the aquifer include leakage from adjacent aquifers, and from adjacent sands near the Mississippi River at high stages (Rollo, 1966, p. 43; Long, 1965, pl. 1).

POTENTIOMETRIC SURFACE AND GROUND-WATER FLOW

The map of the potentiometric surface of the Gonzales-New Orleans aquifer (fig. 3) was prepared using water-level data from wells completed in the aquifer (table 1). The water levels then were adjusted to a sea level[1] datum. During April 1993, the altitude of water levels in the study area ranged from about 11 feet below sea level in St. John the Baptist Parish to about 100 feet below sea level in central Orleans Parish (table 1). The dominant feature in the potentiometric surface of the Gonzales-New Orleans aquifer within the study area is a large cone of depression, centered just northeast of downtown New Orleans, which has formed due to large withdrawals from the aquifer (fig. 3). Ground water flows from areas of higher head to areas of lower head; therefore, the direction of flow is perpendicular to the potentiometric contours. Within the study area, ground-water flow in the Gonzales-New Orleans aquifer is toward the center of the cone of depression, as shown in figure 3.

Aquifer-test data from the New Orleans area indicate that the hydraulic conductivity of the Gonzales-New Orleans aquifer ranges from 85 to 110 feet per day (Rollo, 1966, table 3). Using an average hydraulic conductivity of 100 feet per day, assuming an effective porosity of 30 percent (Dial and Tomaszewski, 1988, p. 8-9), and using gradients from figure 2, ground-water velocities in the area range from about 20 to 350 feet per year. These calculations were made by using a variation of the Darcy equation:

$$V = \frac{Kdh}{ndl} \times 365 \text{ days per year},$$

where V is average velocity of ground-water flow, in feet per year;

K is hydraulic conductivity of the aquifer, in feet per day;

$\frac{dh}{dl}$ is hydraulic gradient of the aquifer along a flow path, dimensionless; and

n is effective porosity of the aquifer as a decimal fraction, dimensionless.

The highest estimated ground-water velocities, up to 350 feet per year, occur in western Orleans Parish near the center of the cone of depression in the area of well Or-206. Velocities decrease outward from this area because of the decrease in gradient of the potentiometric surface (fig. 3). Ground-water velocities were estimated to be approximately 20 feet per year in St. Charles and St. John the Baptist Parishes near wells SJB-163B and SC-9 (fig. 3).

1. Sea level: In this report, sea level refers to the National Geodetic Vertical Datum of 1929, a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

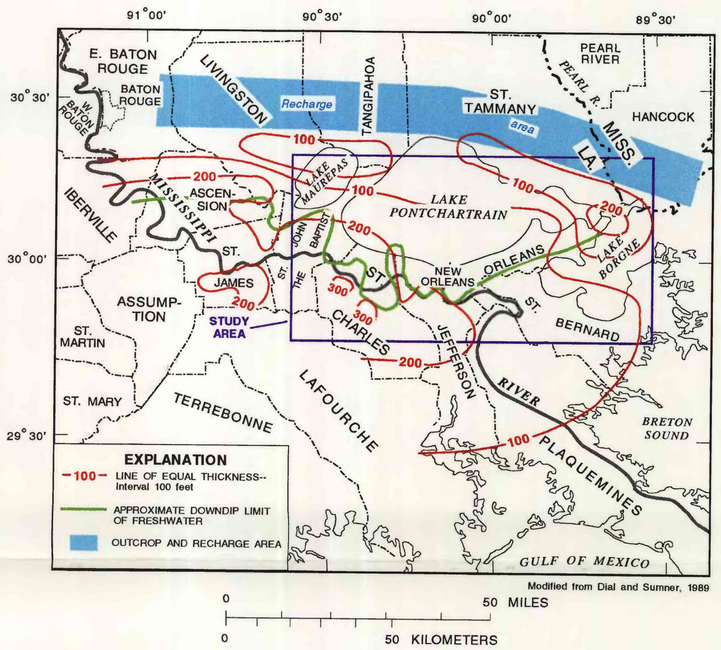

Figure 2. Extent, thickness, recharge area, and downdip limit of freshwater for the Gonzales-New Orleans aquifer.

INDEX MAP OF LOUISIANA

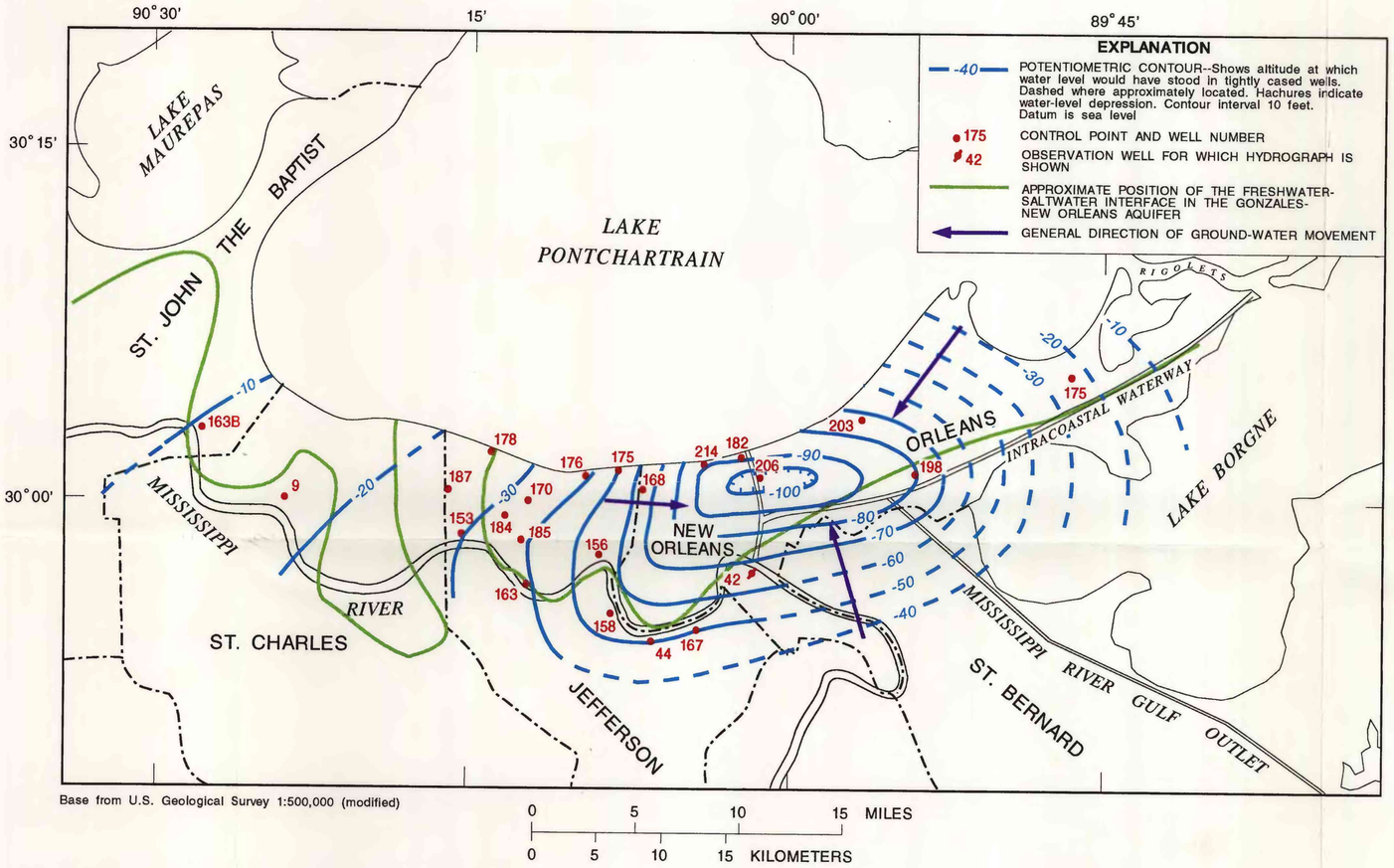

Figure 3. Potentiometric surface of the Gonzales-New Orleans aquifer, spring 1993.

Table 1.--*Water-level data used to construct the potentiometric surface map of the Gonzales-New Orleans aquifer in southeastern Louisiana, spring 1993*

Well number	Well depth (in feet)	Water level (land surface datum, in feet)	Water level (sea level datum, in feet)	Date
Jefferson Parish				
Jf- 44	788	56.99	-51.99	4-21
Jf-153	670	31.09	-29.09	4-13
Jf-156	780	63.79	-54.79	4-21
Jf-158	798	71.89	-56.89	4-21
Jf-163	768	51.49	-38.49	4-14
Jf-167	725	52.22	-50.22	4-21
Jf-170	737	31.75	-35.75	4-14
Jf-175	640	49.89	-49.89	4-14
Jf-176	610	37.69	-37.69	4-14
Jf-178	700	22.92	-22.92	4-21
Jf-184	704	32.10	-32.10	4-21
Jf-185	766	32.94	-37.94	4-13
Jf-187	585	19.38	-24.38	4-14

Well number	Well depth (in feet)	Water level (land surface datum, in feet)	Water level (sea level datum, in feet)	Date
Orleans Parish				
Or- 42	775	72.07	-62.07	5-06
Or-168	720	63.09	-61.09	4-22
Or-175	449	33.59	-23.59	4-22
Or-182	690	90.71	-85.71	4-22
Or-198	593	80.77	-80.77	4-22
Or-203	453	66.93	-71.93	4-23
Or-206	647	103.74	-99.74	4-22
Or-214	630	95.07	-90.07	4-22
St. Charles Parish				
SC- 9	808	22.15	-17.36	5-06
St. John the Baptist Parish				
SJB-163B	635	21.36	-11.36	4-13

LOUISIANA GROUND-WATER MAP NO. 11:
POTENTIOMETRIC SURFACE, SPRING 1993, OF THE GONZALES-NEW ORLEANS AQUIFER IN SOUTHEASTERN LOUISIANA

By David J. Walters

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For additional information write to:

District Chief
U.S. Geological Survey
Suite 120
3535 S. Sherwood Forest Blvd.
Baton Rouge, LA 70816

Chief, Water Resources Section
Louisiana Department of Transportation and Development
P.O. Box 94254
Baton Rouge, LA 70804

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