DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER-RESOURCES INVESTIGATIONS
REPORT 89-4016

INTRODUCTION

The New Orleans aquifer system in and near New Orleans in southeastern Louisiana, consists of five freshwater-bearing aquifers. These aquifers are, from youngest to oldest, the shallow, Gramercy, Norco, Gonzales-New Orleans, and the "1,200-foot" sand (table 1). The Gonzales-New Orleans aquifer is the most extensively and widely used aquifer of the system and the focus of this report. It is primarily used for industrial purposes, such as cooling and electrical generation.

Figure 1 shows the generalized regional potentiometric surface of the Gonzales-New Orleans aquifer in the New Orleans area; the map was constructed using data collected in January 1987 (table 2). Water levels in adjacent wells completed at different depths within the Gonzales-New Orleans aquifer differ vertically due to nearby pumping. Because of these vertical differences in water levels, the contours depicting the potentiometric surface are generalized. Water-level altitudes are shown on the map, and thus, flow directions may be inferred.

Previous studies of ground-water hydrology in southeastern Louisiana are included in Selected References. This report was prepared in cooperation with the Louisiana Department of Transportation and Development.

GEOHYDROLOGY

The Gonzales-New Orleans aquifer and other aquifers in the system are composed of sediments deposited under fluvial, deltaic, and near-shore marine environments and are Holocene to Pleistocene in age. These sediments thicken and dip primarily to the south. Table 1 shows the time-stratigraphic correlation of aquifers in the New Orleans aquifer system as described in Rollo (1966) and Hosman (1972).

The Gonzales-New Orleans aquifer is the principal aquifer in the New Orleans area and underlies the entire study area. The shallow aquifers, the Gramercy, and the Norco aquifers are directly connected to each other in some areas. The underlying Gonzales-New Orleans aquifer may not have a direct hydraulic connection with the overlying or underlying aquifers; however, vertical leakage from those aquifers does occur (Hosman, 1972).

The shallow aquifers are generally less than 150 feet in depth, comprised of silty to fine sand, and are of a limited and irregular areal extent. Like the shallow aquifers, the Gramercy aquifer is irregular in thickness and discontinuous. The Gramercy aquifer is comprised of fine to coarse sand. The Norco aquifer is more continuous; it ranges in thickness from about 25 feet to over 300 feet and is primarily medium to coarse, well-sorted sand.

The Gonzales-New Orleans aquifer ranges in thickness from less than 175 feet to more than 325 feet and averages about 225 feet. The aquifer is made up of very fine to fine sand and is less permeable than the Gramercy and Norco aquifers. It is separated from the overlying Norco aquifer by a thick confining unit consisting primarily of clay.

Underlying the Gonzales-New Orleans aquifer is the "1,200-foot" sand, which contains saltwater (greater than 250 milligrams per liter chloride) throughout the study area (Rollo, 1966). Its thickness ranges from 50 feet to a maximum of 130 feet and is made up of sands similar to those of the Gonzales-New Orleans aquifer. A clay confining unit isolates the "1,200-foot" sand from the overlying aquifer.

Recharge to the New Orleans aquifer system occurs from downward percolation of precipitation and from seepage. The outcrop or subcrop areas of this system are located north of New Orleans in the southern half of Livingston, Tangipahoa, and St. Tammany Parishes. In some areas, west of New Orleans, the Mississippi River is a source of recharge to the shallow aquifer. Due to the hydraulic connection between the shallow aquifer, the Gramercy aquifer, and the Norco aquifer, the downward vertical movement of water between these aquifers serves as a source of recharge to the Gonzales-New Orleans aquifer. The aquifer also is recharged by vertical movement upward from the underlying "1,200-foot" sand. This movement is due to the lower heads in the Gonzales-New Orleans aquifer caused by the heavy pumpage in the New Orleans area.

POTENTIOMETRIC CONTOUR MAP

A potentiometric contour map may be used to determine the direction of ground-water flow, and to show the effects of pumping upon the ground-water system. Ground-water flow is at right angles to the potentiometric contour lines and moves from an area of higher to lower head (water level). The rate of ground-water movement also may be estimated, using the gradient determined from the map and the hydraulic conductivity of the aquifer.

In the Gonzales-New Orleans aquifer, regional ground-water flow is primarily to the south, along the dip of the sediments. However, due to industrial pumping, a cone of depression has formed in and near New Orleans (fig. 1), causing ground water to move radially toward the center of this depression.

Industrial pumpage from the Gonzales-New Orleans aquifer accounts for nearly all ground-water withdrawals in both Orleans and Jefferson Parishes. Figure 2 shows combined pumping trends for the two parishes. The hydrograph of well Or-42 (fig. 2), shows the largest water-level declines occurred during the early 1970's when pumpage was heaviest. As pumpage decreased in the middle to late 1970's water levels began rising. During the 1980's water levels have started leveling off as pumpage has become almost constant.

Aquifer-test data show that the hydraulic conductivity of the Gonzales-New Orleans aquifer ranges from 85 to 110 feet per day (Rollo, 1966, table 3). Assuming an effective porosity of 30 percent, a hydraulic conductivity of 110 feet per day, and using the gradients from this map, ground-water velocities in the area range from 46 to 253 feet per year. These calculations were made by using the equation

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

where, V = average velocity of ground-water movement, in feet per year;

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

$\frac{dh}{dl}$ = hydraulic gradient of the aquifer along a flow path (dimensionless); and

n = effective porosity of the aquifer unit as a decimal fraction (dimensionless).

The lowest velocities occur in St. Charles Parish and increase toward New Orleans because of the steepening gradient.

SELECTED REFERENCES

Cardwell, G.T., and Rollo, J.R., 1960, Interim report on ground-water conditions between Baton Rouge and New Orleans, Louisiana: Louisiana Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet No. 9, 44 p.

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Hosman, R.L., 1972 [1973], Ground-water resources of the Norco area, Louisiana: Louisiana Department of Conservation and Louisiana Department of Public Works Water Resources Bulletin 18, 61 p.

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Rollo, J.R., 1966, Ground-water resources of the greater New Orleans area, Louisiana: Louisiana Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin No. 9, 69 p.

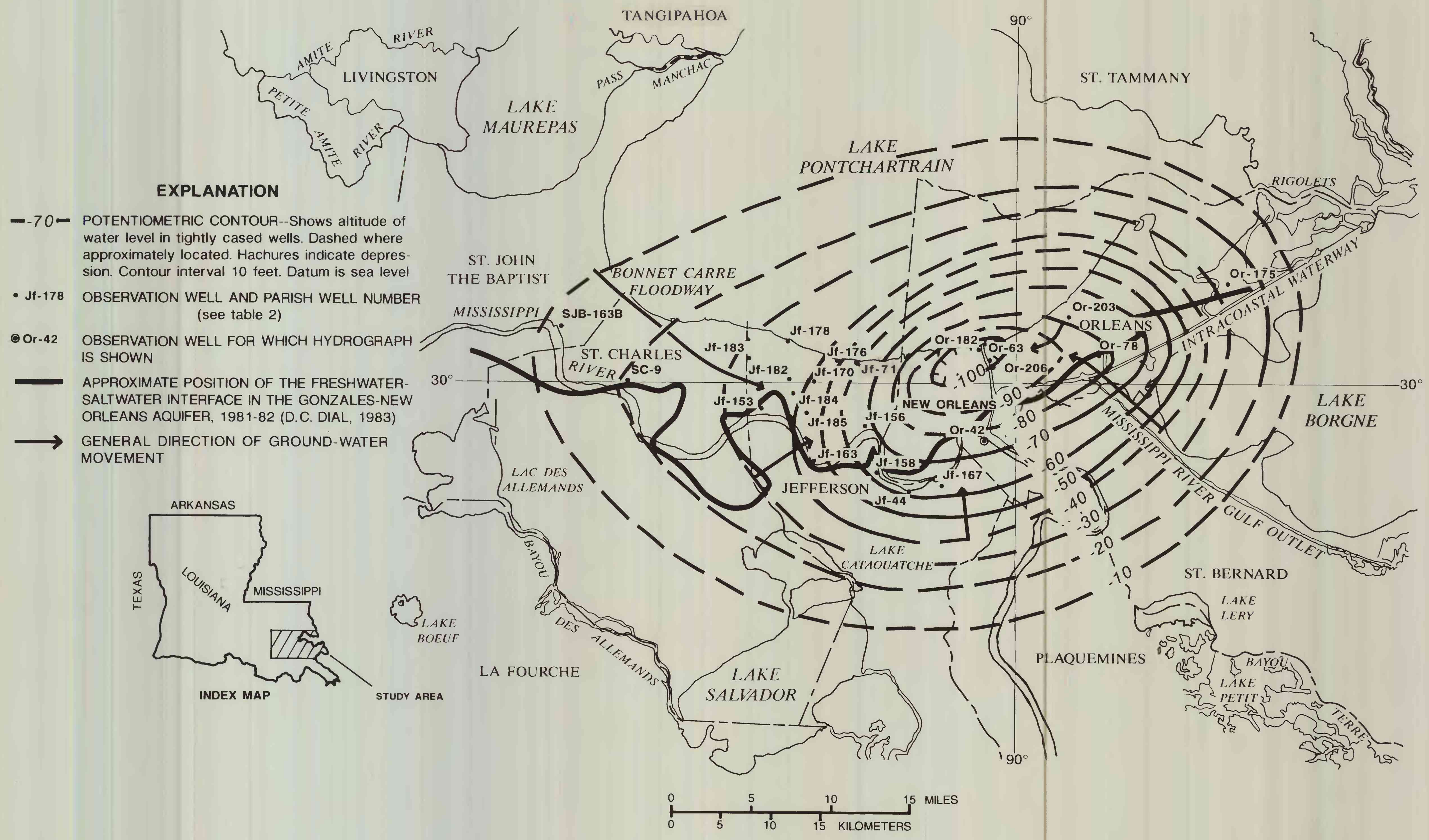

Figure 1.--Potentiometric surface of the Gonzales-New Orleans aquifer, January 1987.

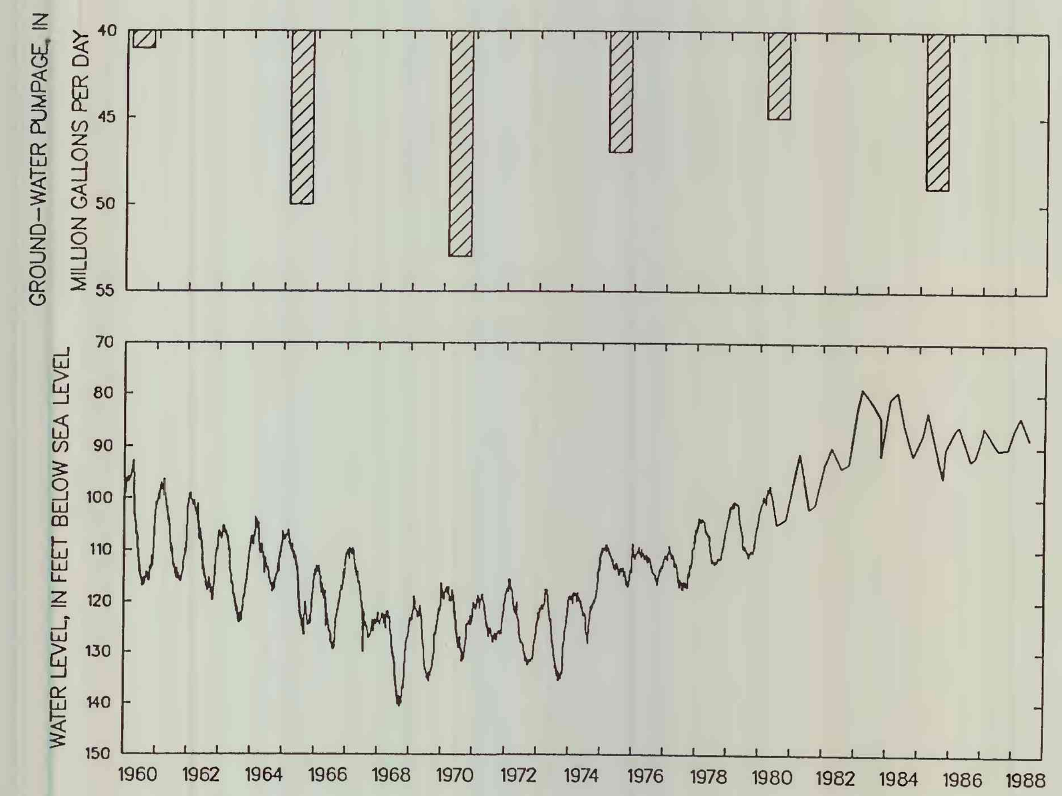

Figure 2.--Hydrograph of well Or-42, completed in the Gonzales-New Orleans aquifer, and ground-water withdrawals from the Gonzales-New Orleans aquifer for Orleans and Jefferson Parishes.

Table 1.--Geohydrologic correlations for aquifers in and near New Orleans in southeastern Louisiana

System	Series	Rollo (1966)	Hosman (1972) and this report
Quaternary	Holocene	Shallow aquifers	Shallow aquifers
	Pleistocene	"200-foot" sand "400-foot" sand "700-foot" sand "1,200-foot" sand	Gramercy aquifer Norco aquifer Gonzales-New Orleans aquifer "1,200-foot" sand

LOUISIANA GROUND-WATER MAP NO. 2: POTENTIOMETRIC SURFACE, 1987, OF THE GONZALES-NEW ORLEANS AQUIFER IN SOUTHEASTERN LOUISIANA

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1989

Table 2.--Water-level measurement data used in constructing potentiometric surface of the Gonzales-New Orleans aquifer in southeastern Louisiana, January 1987

Well number	Date measured	Water level (feet below sea level)	Well number	Date measured	Water level (feet below sea level)
Jefferson Parish			Jefferson Parish--Continued		
Jf-44	1-23	60.40	Jf-170	1-20	42.06
Jf-71	1-20	55.19	Jf-176	1-20	48.37
Jf-153	1-20	33.54	Jf-178	1-20	31.29
Jf-156	1-20	64.53	Jf-182	1-20	33.85
Jf-158	1-23	61.66	Jf-183	1-20	33.46
Jf-163	1-20	44.47	Jf-184	1-20	38.34
Jf-167	1-23	61.60	Jf-185	1-20	42.23
Orleans Parish			Orleans Parish--Continued		
Or-42	1-23	75.95	Or-182	1-20	102.05
Or-63	1-30	100.05	Or-203	1-20	77.75
Or-78	1-30	83.79	Or 206	1-30	100.44
Or-175	1-20	26.20			
St. Charles Parish			St. John the Baptist Parish		
SC-9	1-22	20.92	SJB-163B	1-22	11.84

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