GROUND-WATER RESOURCES OF SOUTHERN TANGIPAHOA PARISH AND ADJACENT AREAS, LOUISIANA

By Timothy R. Rapp

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Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
foot per second (ft/s)	0.3048	meter per second
foot per year (ft/yr)	0.3048	meter per year
foot per mile (ft/mi)	0.1894	meter per kilometer
cubic foot per day per square foot times foot of aquifer thickness $[(ft^3/d)/ft^2]ft$	0.09290	cubic meter per day per square meter times meter of aquifer thickness
cubic foot per day per square foot $(ft^3/d)/ft^2$	0.3048	cubic meter per day per square meter
mile (mi)	1.609	kilometer
pound per square inch (lb/in^2)	6.895	kilopascal
gallon (gal)	3.785	liter
gallon per minute (gal/min)	0.06308	liter per second
million gallons per day (Mgal/d)	3,785	cubic meter per day

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows: $°F = 1.8 \times °C + 32$.

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD 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.

Abbreviated water-quality units used in this report:

micrograms per liter (µg/L)

milligrams per liter (mg/L)

microsiemens per centimeter at 25 degrees Celsius (µS/cm)

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By Timothy R. Rapp

Abstract

Ground-water resources in southern Tangipahoa Parish and adjacent areas were studied to determine their potential for development as an alternative to the Mississippi River as a water-supply source for Jefferson Parish. The complex clay, sand, and gravel sequences in the area are typical of the aquifers and confining units of southeastern Louisiana. Eight major aquifers consisting of thick sand units that underlie the study area are, in descending order, the shallow, upper Ponchatoula, lower Ponchatoula, Abita, Covington, Tchefuncta, Hammond, and Amite.

A fault zone, referred to as the Baton Rouge fault, crosses southern Tangipahoa Parish. The results of the test-well drilling program indicated that the Baton Rouge fault zone disrupts ground-water flow in the aquifers of intermediate depth in the study area. Analyses of geophysical logs indicated that the deep aquifers south of the fault zone have been displaced from 350 to 400 feet, and that the deeper aquifers were not in hydraulic connection with the flow system north of the fault.

The ground-water resources of southeastern Louisiana are immense and the quality of ground water in Tangipahoa Parish is suitable for most uses. The freshwater aquifers of the southeastern Louisiana hydrologic system generally yield a soft sodium bicarbonate type water with dissolved-solids concentration of less than 300 mg/L. The quality of water in these aquifers generally meets the U.S. Environmental Protection Agency's standards for public supply.

The hydrologic system underlying Tangipahoa Parish and adjacent areas in 1990 supplied about 19 Mgal/d (million gallons per day) of water that was suitable for public supply. Based on the thickness and hydrologic characteristics of the aquifers in southern Tangipahoa Parish, it is estimated that a minimum of 28 Mgal/d could be withdrawn from a single well field. At the current (1990) rate of withdrawal, the hydrologic system appears to be approaching equilibrium. However, substantial increases in pumping from the aquifer system would result in renewed water-level declines throughout the hydrologic system until a new equilibrium is established.

A test well, Ta-576, located at the Bedico Community Center in southern Tangipahoa Parish, penetrated eight aquifers. Total thickness of freshwater sand beds penetrated by the 3,003-foot test hole was more than 1,900 feet. Resistivity values from an electric log of the test well typically averaged 200 ohm-meters, which indicated that the water has low dissolved-solids and chloride concentrations.

An analysis of the Abita aquifer at Ruddock in St. John the Baptist Parish, for two of three hypothetical well fields, indicated that for a hypothetical well field with a pumping rate of 112 Mgal/d, the freshwater-saltwater interface could arrive at the outer perimeter well in 10 to 14 years. The current (1990) location of the interface in the Abita aquifer is 1.9 miles from the southernmost part of the potential location of the 112 Mgal/d well field.

INTRODUCTION

In 1990, the Jefferson Parish Department of Water supplied 80 Mgal/d of potable water from its sole source, the Mississippi River, to approximately 468,400 people and industry (Lovelace, 1991). Saltwater intrusion from the Gulf of Mexico during periods of low flow and accidental spills of hazardous substances along the Mississippi River could cause the closing of the parish's raw-water intakes on the river. In addition, pesticides in agricultural runoff (Arcement and others, 1989; Goolsby and others, 1991) have caused mounting concerns about the long-term suitability of the Mississippi River as a source of public water supply.

In response to the above concerns, Jefferson Parish entered into cooperative agreements with the U.S. Geological Survey (USGS) for studies that would determine the availability, quantity, and quality of ground-water resources that could provide an emergency or alternative water supply. Two studies were completed as a result of these cooperative agreements. The first study by Dial and Tomaszewski (1988) focused on evaluation of ground-water resources in and immediately adjacent to northern Jefferson Parish. Results of this study indicated that increasing pumpage from the Gonzales-New Orleans aquifer by 50 Mgal/d would increase the rate of water movement at the freshwater-saltwater interface substantially, from 65 to 200 ft/yr, and would cause water levels to decline as much as 166 ft at some well sites. Results of this study indicated that the ground-water resources in and adjacent to Jefferson Parish had limited potential for further development.

The second study (described in this report) considered available ground-water resources of a larger area north of Jefferson Parish as an alternative water supply. This area included southern Tangipahoa Parish and parts of adjacent parishes.

Purpose and Scope

This report describes the hydrogeology and defines the southern limit of freshwater in the aquifers underlying southern Tangipahoa Parish, adjacent parishes, and northwestern Lake Pontchartrain. The report also presents the results of an analysis of the effects of pumping on the Abita aquifer at Ruddock (St. John the Baptist Parish), Louisiana. Included is a review of published reports and the results of a test-well drilling program (which included the construction of four wells), a water-quality sampling program, and an analysis of seismic survey data. Water-quality data presented for water samples collected from wells in the area include major inorganic constituents, trace elements, and organic compounds, including insecticides and herbicides. The use of seismic survey data to delineate faults in the study area is discussed.

Study Area

The study area includes northern St. John the Baptist Parish, southern Tangipahoa Parish, southwestern St. Tammany Parish, and the northwestern part of Lake Pontchartrain (fig. 1). The land surface of the study area consists of a series of sloping terraces that generally dip toward the gulf coast. The terrain bordering Lakes Pontchartrain and Maurepas and associated waterways includes swamps, marshes, and natural levees (Cardwell and others, 1967, p. 4). This study originally focused on the hydrologic system and the ground-water resources of St. John the Baptist Parish. As the study progressed and the limitations of the Abita aquifer to supply water in excess of 100 Mgal/d became apparent, the study area was expanded north to southern Tangipahoa Parish. The eight principal aquifers in the study area include the shallow, upper Ponchatoula, lower Ponchatoula, Abita, Covington, Tchefuncta, Hammond, and Amite.

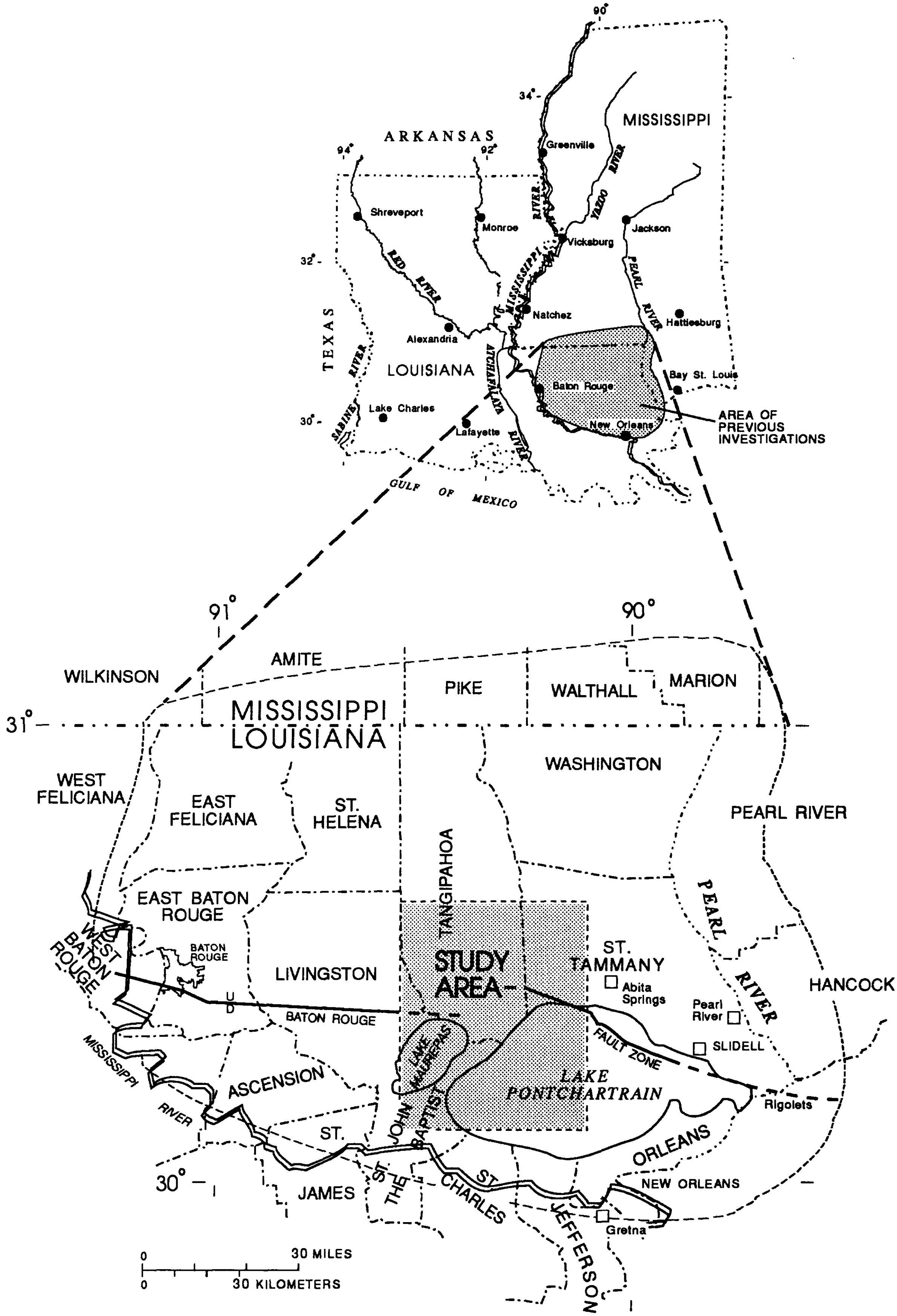


Figure 1. Location of study area in southeastern Louisiana.

Method of Study

Basic data on extent, thickness, water level, and water quality of the aquifers underlying southeastern Louisiana were obtained from previously published USGS reports. Additional data were collected for this study to supplement available data. Seismic geophysical data were used to determine the location of the Baton Rouge fault.

Four test wells were drilled to provide additional hydrogeologic data. Test wells were completed in compliance with Louisiana water-well regulations (Bolourchi, 1985). A suite of geophysical well logs were run on each test well to determine the characteristics of the sediments and to ensure proper well completion.

The four test wells were drilled using a mud-rotary water-well drilling rig. The wells were cased with standard-schedule steel casing, and the entire length of casing was grouted using the pump-down method. This procedure ensured hydraulic isolation of the screened aquifer, prevented migration of saline water in the annulus between the bore hole and well casing, and increased the structural integrity of the well casing and screen unit.

Ground-water quality was assessed by analyzing water samples from wells (fig. 2) completed in the eight principal aquifers in the study area. Water samples were collected from each well for analysis of inorganic constituents, trace elements, and volatile organic compounds; samples were collected from selected wells for analysis of insecticides, herbicides, and polychlorinated biphenyls (PCBs). Samples were collected using techniques described by Wershaw and others (1987). The samples were analyzed at a USGS laboratory, using the methods described by Fishman and Friedman (1989).

Previous Investigations

Reports from previous investigations of the geology, aquifer characteristics, water levels, and water quality in the study area were reviewed. Winner (1963) reported on results of a general reconnaissance of the hydrologic system underlying Livingston, St. Helena, St. Tammany, Tangipahoa, and Washington Parishes. The water resources of the eastern Lake Pontchartrain area were described in detail by Cardwell and others (1967). The test-well drilling program completed as part of the study by Cardwell and others provided information on the location of the fault zone in northern Lake Pontchartrain and the effect of the fault zone on the ground-water system. A comprehensive study of the ground-water resources of Tangipahoa and St. Tammany Parishes was completed by Nyman and Fayard (1978); their study described the hydrologic characteristics of each of the major aquifers that make up the aquifer system. Three reports discuss the effect of the Baton Rouge fault zone on the aquifers underlying East Baton Rouge Parish (Whiteman, 1979; Torak and Whiteman, 1982; Huntzinger and others, 1985). Other reports and scientific papers that provide additional background on relevant topics are listed in "Selected References."

Acknowledgments

The permission and assistance of the following property owners to drill test wells is gratefully acknowledged: Dorothy Schenk, the Dendinger and Dietz families, Wilbur Portier, and Bedico Community Center President, Lawrence Byers, who permitted access to the drill site at test well Ta-576. Mobil Exploration and Production, U.S. Inc., provided seismic geophysical data for the Baton Rouge fault zone.

Also, special thanks are due to Richard P. McCulloh, Research Geologist, Louisiana Geological Survey, who assisted in interpretation and analysis of well logs for the Baton Rouge fault zone, and David J. Macaluso, Director, Jefferson Parish Department of Public Utilities, who contributed significantly to the design and format of the report.

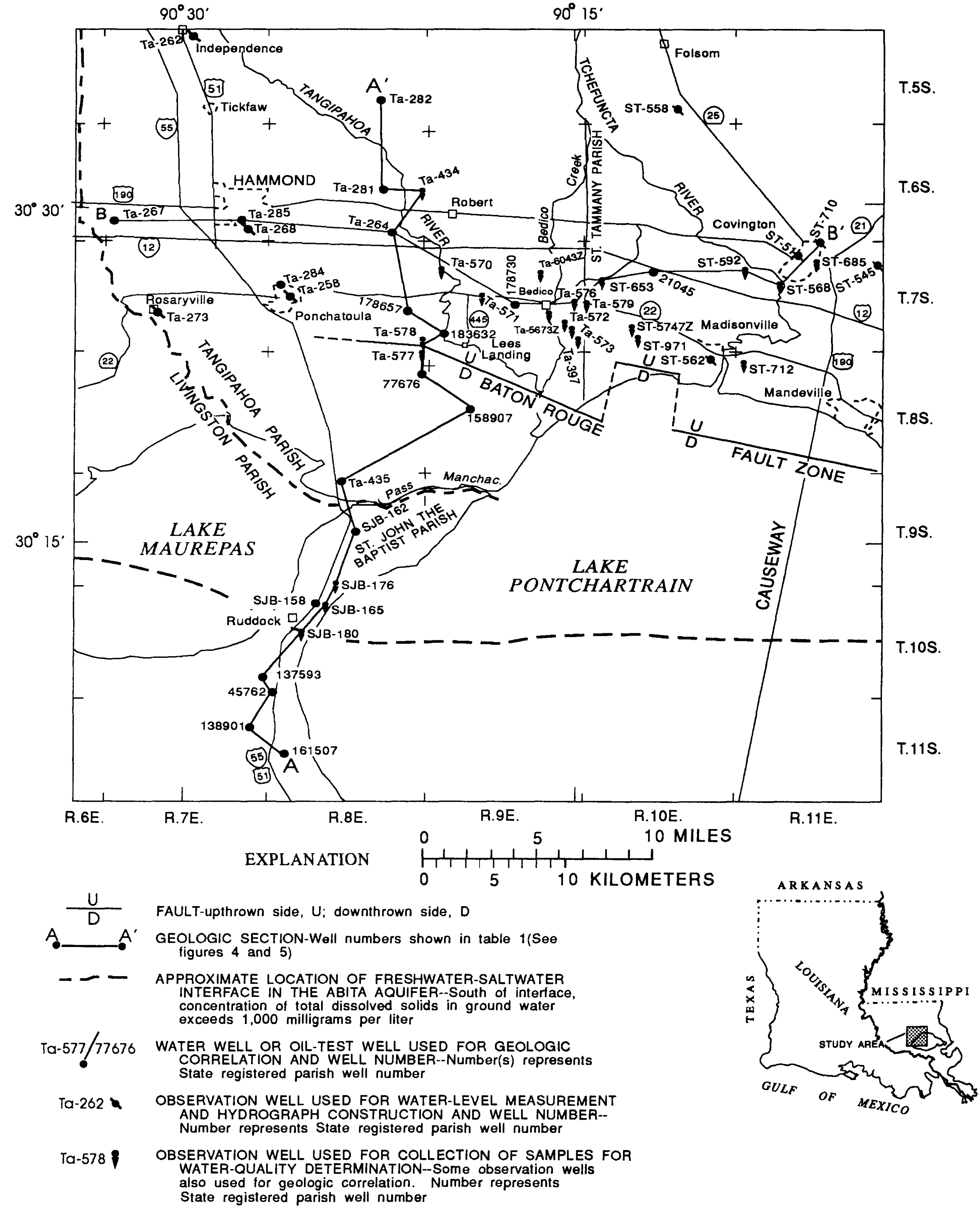


Figure 2. Water-quality sampling sites, hydrogeologic sections, Baton Rouge fault zone, major surface-water bodies, southern extent of freshwater in the Abita aquifer, and major municipalities.

HYDROGEOLOGIC SETTING

The study area lies within the Mississippi River Deltaic Plain and is underlain by sediments deposited during the Tertiary and Quarternary periods. The complex sequence of clay, sand, and gravel beds of southeastern Louisiana are part of a regional aquifer system and are typical of the aquifers and confining layers in the study area. Although the aquifers have a fairly uniform east-west strike, they can thin or thicken abruptly to the north or south (Cardwell and others, 1967, p. 10).

The aquifers underlying southeastern Louisiana primarily are recharged by water percolating through shallow Quarternary sands and gravels in southern Mississippi and southeastern Louisiana parishes bordering the Mississippi-Louisiana State line (fig. 3). Natural ground-water flow in the regional aquifer system generally moves from north to south. In the recharge area, some water flows vertically from shallower aquifers through the separating clay layers into the deeper aquifers. Downdip the hydraulic gradient is reversed, and higher hydraulic heads in the deeper aquifers allow some recharge of shallower aquifers by upward leakage through the confining clay layers. Aquifers deeper than 200 ft generally are confined; most wells completed in these aquifers will flow at land surface without pumping.

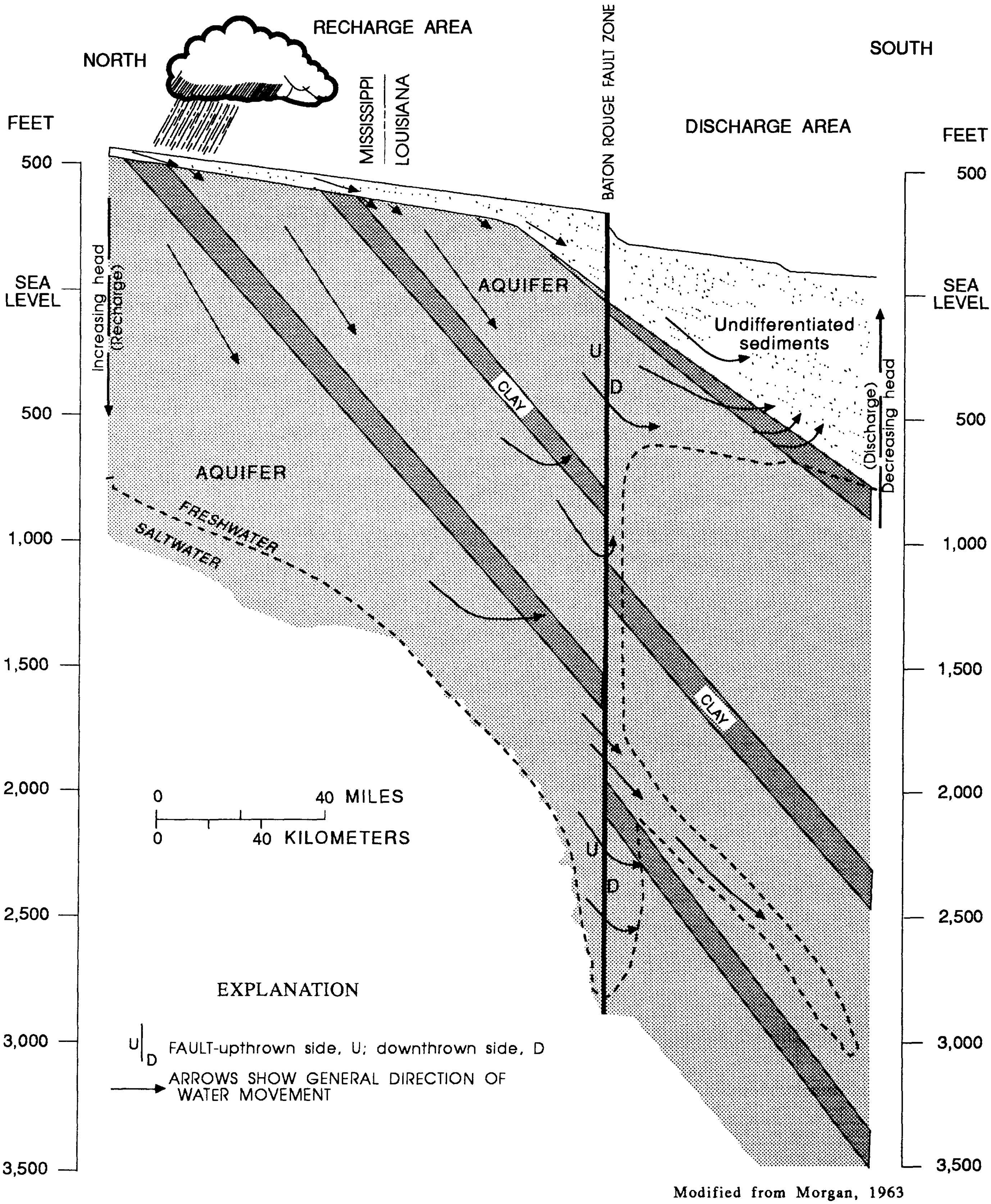
Eight aquifers underlie the study area (figs. 4 and 5). Information for wells used to construct hydrogeologic sections are included in table 1. Hydrogeologic units of the regional aquifer system are shown in figure 6. Dip rates of 20 to 80 ft/mi are common for fluvial sediments containing the aquifers in the study area, because of the original gradient at the time of deposition and downwarping of sediments in subsiding coastal basins. The rate of dip increases with depth and to the southeast, becoming about 100 ft/mi below a depth of 3,000 ft near Slidell, La. (Nyman and Fayard, 1978, p. 6).

BATON ROUGE FAULT

The Gulf Coastal Plain of the United States contains numerous faults. The Baton Rouge fault zone trends approximately west-northwest from a point just north of the Rigolets through southern West Baton Rouge Parish (fig. 1). Where it crosses the study area (fig. 2) the fault shows "increasing displacement with depth on the downthrown block as a result of movement contemporaneous with sediment accumulation" (McCulloh, 1991, p. 1), which is characteristic of a growth fault. The location of the fault zone generally coincides with the first appearance of saline water in the aquifers of intermediate depth of the regional hydrologic system.

Analysis of Seismic Data

The existence of the Baton Rouge fault zone in southeastern Louisiana has been known for some time (Fisk, 1944), but the effect of the displacement on ground-water movement generally is not well understood. The general location of the fault, along the northern border of Lake Maurepas and the northern part of Lake Pontchartrain in southern Tangipahoa Parish, was mentioned in an abstract by Durham and Peeples (1956). A more accurate determination of the fault-zone location was necessary to better evaluate the water-supply potential of the ground-water resource. Seismic data generated from oil and gas exploration by the petroleum industry during mapping of the sedimentary structures in the area provided the basic data necessary to locate the Baton Rouge fault (Scott Brodie, Mobil Exploration and Production, U.S. Inc., oral commun., 1989). Deep seismic data were not available for viewing by USGS personnel, but shallow seismic data (from 0 to 8,000 ft below land surface) were used to identify the displacement of sedimentary layers, which is characteristic of faulting. Location of the Baton Rouge fault at land surface was based on estimates of the dip and strike of the fault from the seismic data. Local geophysical well logs, driller's log information, and water-quality data were utilized to further refine the estimated location of the Baton Rouge fault in the study area.



Modified from Morgan, 1963

Figure 3. Generalized hydrogeologic section showing simplified view of the regional aquifer system, including recharge, ground-water flow, and discharge.

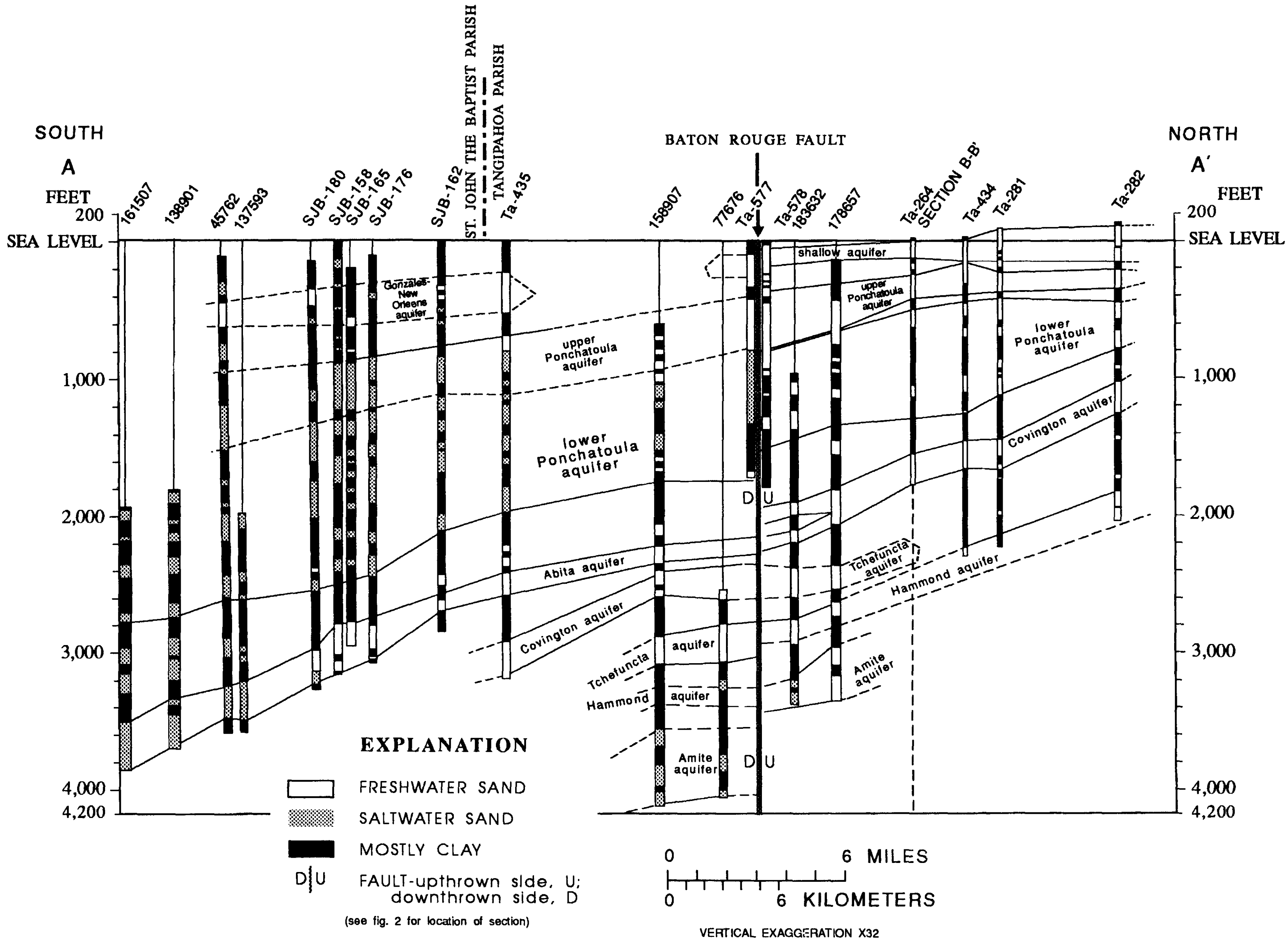


Figure 4. Hydrogeologic section A-A′.

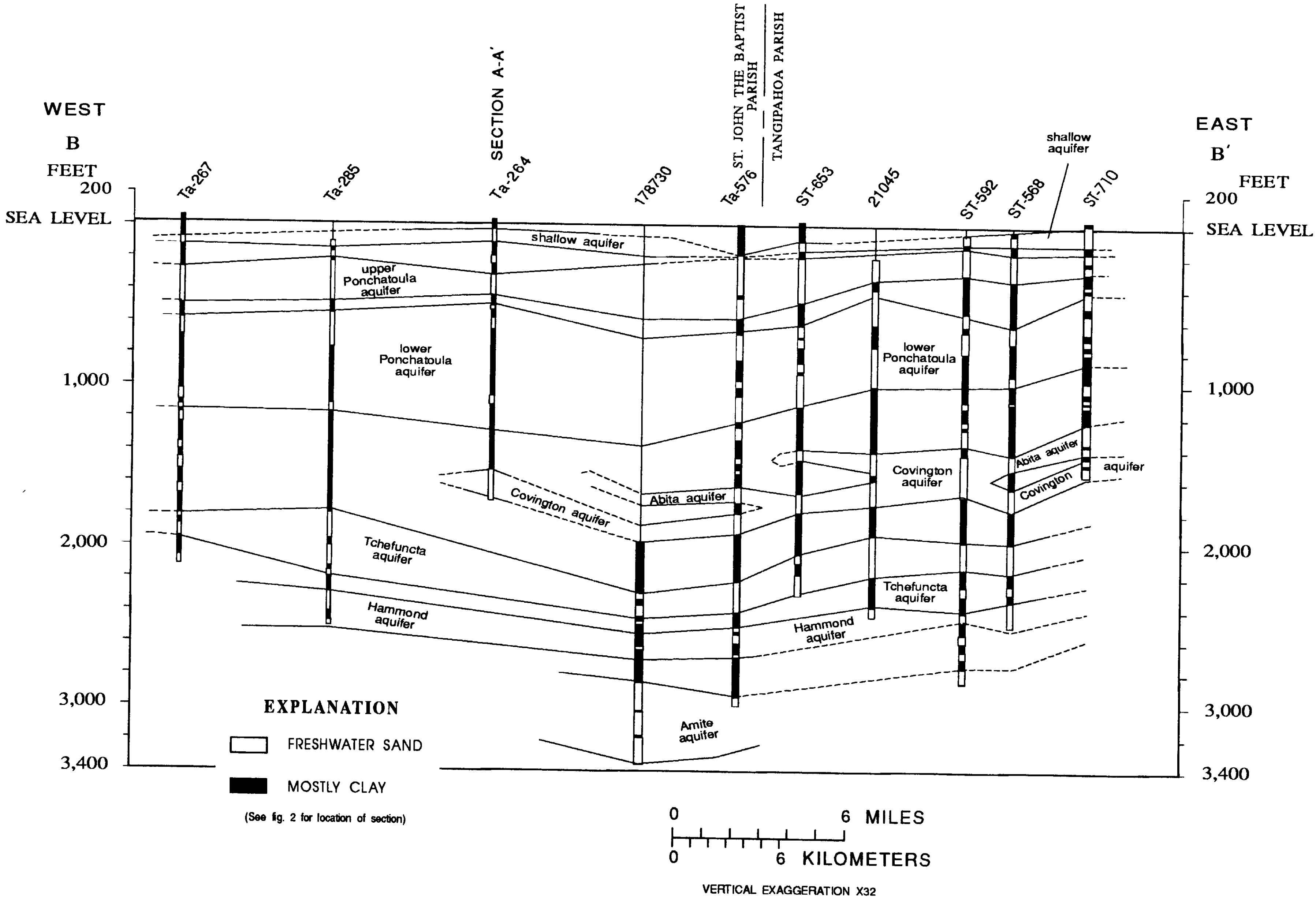


Figure 5. Hydrogeologic section B-B′.

After the location of the Baton Rouge fault in the study area was determined, the USGS completed two test holes (Ta-577 and Ta-578) that bracketed the location of the fault (fig. 2). The well logs for each test hole included dual induction, focused resistivity, spontaneous potential (SP), and natural gamma ray logs. The dual induction and focused resistivity logs were used as water-quality indicators. The deflection in their respective traces was compared and related to known ground water-quality characteristics in the area. The SP log was used to delineate changes in lithology. The natural gamma ray log was used for lithologic determination when the SP was unable to provide conclusive lithologic contacts.

Table 1. Water and oil-test wells in sections A-A′ and B-B′

[Water well identified by parish and number; oil or gas well identified by serial number; SJB, St. John the Baptist Parish; Ta, Tangipahoa Parish; ST, St. Tammany Parish]

Well number	Section, township, range	Total depth drilled (feet)	Year completed
	South-north section A-A′		
161507	7 11S 8E	9,047	1978
138901	1 11S 7E	9,684	1971
45762	25 10S 7E	10,500	1952
137593	24 10S 7E	10,175	1971
SJB-180	7 10S 8E	3,320	1990
SJB-158	5 10S 8E	3,199	1971
SJB-165	5 10S 8E	3,054	1974
SJB-176	33 9S 8E	3,089	1985
SJB-162	15 9S 8E	2,853	1971
Ta-435	33 8S 8E	3,180	1971
158907	8 8S 9E	19,137	1978
77676	36 7S 8E	9,250	1960
Ta-577	25 7S 8E	1,702	1990
Ta-578	25 7S 8E	1,801	1990
183632	47 7S 9E	7,952	1982
178657	14 7S 8E	15,255	1982
Ta-264	39 6S 8E	1,752	1954
Ta-434	13 6S 8E	2,319	1970
Ta-281	37 6S 8E	2,290	1963
Ta-282	15 5S 8E	2,136	1963
	West-east section B-B′		
Ta-267	25 6S 6E	2,169	1956
Ta-285	23 6S 7E	2,516	1964
Ta-264	39 6S 8E	1,728	1954
178730	10 7S 9E	9,055	1981
Ta-576	38 7S 9E	3,000	1990
ST-653	31 6S 10E	2,305	1965
21045	33 6S 10E	2,510	1938
ST-592	31 6S 11E	2,843	1965
ST-568	41 6S 11E	2,540	1958
ST-710	22 6S 11E	1,506	1969

Period	Aquifer system/confining unit	Aquifer[1]		
		Baton Rouge area	Tangipahoa, St.Tammany, St. John the Baptist, and Washington Parishes	New Orleans area and lower Mississippi River parishes
Quaternary	Chicot equivalent/southeast Louisiana	"400-foot" sand "600-foot" sand	shallow upper Ponchatoula	Gramercy Norco Gonzales-New Orleans "1,200-foot" sand
Tertiary	Evangeline equivalent/southeast Louisiana	"800-foot" sand "1,000-foot" sand "1,200-foot" sand "1,500-foot" sand "1,700-foot" sand	lower Ponchatoula Big Branch Kentwood Abita Covington Slidell	no freshwater
	unnamed confining unit			
	Jasper equivalent/southeast Louisiana	"2,000-foot" sand "2,400-foot" sand "2,800-foot" sand	Tchefuncta Hammond Amite Ramsay	
	unnamed confining unit			

[1] Clay units separating aquifers in southeastern Louisiana are discontinuous and unnamed.

Modified from J.K.Lovelace (1991)

Figure 6. Hydrogeologic units in southeastern Louisiana.

Effects of the Fault

Data from test wells Ta-577 and Ta-578 indicate a substantial downward displacement of the aquifers in the downthrown block south of the fault zone relative to the aquifers north of the fault zone. The aquifers south of the fault zone of intermediate depth that correlate to the lower Ponchatoula aquifer north of the fault zone contain ground water with higher chloride concentrations. Aquifers in the downthrown block also have lower water levels than would be expected for aquifers of similar depth in southern Tangipahoa Parish. Thus, the Baton Rouge fault zone has affected ground-water quality and flow in the aquifers of southern Tangipahoa Parish.

Displacement of Sediments by the Fault

Well Ta-577 was drilled south of the Baton Rouge fault and penetrated alternating layers of soft clay and sand (0 to 890, 902 to 1,105, and 1,148 to 1,290 ft below land surface) and thinner layers of pea gravel (890 to 902 and 1,105 to 1,148 ft below land surface). The clay became substantially harder at 1,290 ft and generally predominated to 1,650 ft below land surface, but was interspersed with thin lenses of sand. The top of a sand was reached at 1,650 ft below land surface and the bottom of this sand occurred at a depth of 1,702 ft below land surface.

Sediments penetrated in well Ta-578 were soft clay and fine- to medium-grained sand to a depth of 800 ft. Coarse sand was present from 800 to 865 ft; fine and medium sand and soft clay was present from 865 to 1,080 ft. At approximately 1,080 ft, the clay became substantially harder and was resistant to drilling. The base of the last major sand was at a depth of approximately 1,285 ft with streaky clay present to a total depth of 1,801 ft.

Displacement of sediments by the fault can be estimated by careful analysis of the clay confining units at test wells Ta-577 in the downthrown block and Ta-578 in the upthrown block. The clay layer at approximately 295 ft in well Ta-578 corresponds to a comparable clay layer at 410 ft in well Ta-577. Similarly, the clay layer at 430 ft in well Ta-578 is comparable to a clay layer at 560 ft in well Ta-577. Correlation of these layers indicated a displacement of about 125 ft. In the Baton Rouge metropolitan area, there is 200 ft of displacement at the Baton Rouge fault zone in sands at a depth of about 350 ft (Whiteman, 1979). Additional correlation of the clay layer at 950 ft in well Ta-578 and the clay layer at 1,280 ft in well Ta-577 indicated an increase in displacement of approximately 330 ft.

A sand located at a depth of approximately 1,250 ft in well Ta-578 in the upthrown block corresponds to a sand at a depth of 1,650 ft in well Ta-577 in the downthrown block; this indicates a displacement of approximately 390 to 400 ft. The vertical displacement of about 400 ft in well Ta-577 at a depth of 1,650 ft is 275 ft more than the vertical displacement in the same well at a depth of 560 ft, or 1,000 ft shallower.

Increasing displacement with depth is a characteristic of growth faults. Durham and Peeples (1956) reported that displacement of sedimentary layers was relatively consistent beneath deposits of Pleistocene age--about 350 ft above a depth of 2,000 ft, with displacement increasing to about 450 ft at depths of 5,000 to 10,000 ft. Based on the analysis of logs from nearby oil test-wells north and south of test wells Ta-577 and Ta-578, the maximum displacement is about 500 ft at a depth of about 7,000 ft. Previous studies of the Baton Rouge fault zone indicate that the fault is probably a rejuvenated zone that was last active in the early- to middle-Tertiary period (McCulloh, 1991). The significant displacement in the study area of 350 to 450 ft within the first 5,000 ft agrees with what generally exists at other locations along the fault zone. These large displacements in the sediments at depths of 100 to 5,000 ft have resulted in a disruption of flow in major aquifers of the hydrologic system adjacent to the Baton Rouge fault.

Water Quality in Wells Ta-577 and Ta-578

South of the Baton Rouge fault, the lower Ponchatoula aquifer can be found at an intermediate depth in the freshwater section of the hydrologic system, and contains saline water. The log of well Ta-578 shows high-resistivity freshwater in all sand beds 20 ft or thicker (fig. 7). The log of well Ta-577, located south of the mapped location of the fault zone, shows high-resistivity freshwater in all sand beds 20 ft or thicker to a depth of approximately 760 ft (fig. 7). Although the natural gamma ray curve shows a sand bed below 770 ft, the resistivity has decreased to 9 ohm-meters, thus indicating that the sand contains saline water (fig. 7). The low resistivity of sand beds indicated by the well log corresponds to the first occurrence of saline water in sand beds of intermediate depth in the southern reaches of the hydrologic system.

Well Ta-577, 0.25 mi south of the fault, was screened (from 1,114 to 1,134 ft) in a low-resistivity sand bed that contained water with a specific conductance of 4,720 μS/cm and dissolved-chloride concentration of 1,300 mg/L (appendix). High chloride concentrations were first detected from sand beds of intermediate depth of 770 ft in well Ta-577 (fig. 7). All sand beds below 770 ft in well Ta-577 contain saline water. Water from the screened section of well Ta-578 (from 800 to 840 ft) 0.25 mi north of the fault zone had a significantly lower average specific conductance (245 μS/cm) than water from well Ta-577. Water from well Ta-578 had a dissolved-chloride concentration of 2.0 mg/L, which is significantly less than the dissolved-chloride concentration of 1,300 mg/L in water from well Ta-577.

Water Levels Adjacent to the Fault Zone

The water level in well Ta-578, which is 0.25 mi north of the fault zone and completed in a freshwater aquifer at a depth of about 800 ft, is about 33 ft above sea level. The water level is about 43 ft above sea level in well Ta-6043Z, located about 6 mi northeast of well Ta-577 and completed at a depth of 1,187 ft. These water levels are typical for Louisiana aquifers at these depths (Nyman and Fayard, 1978).

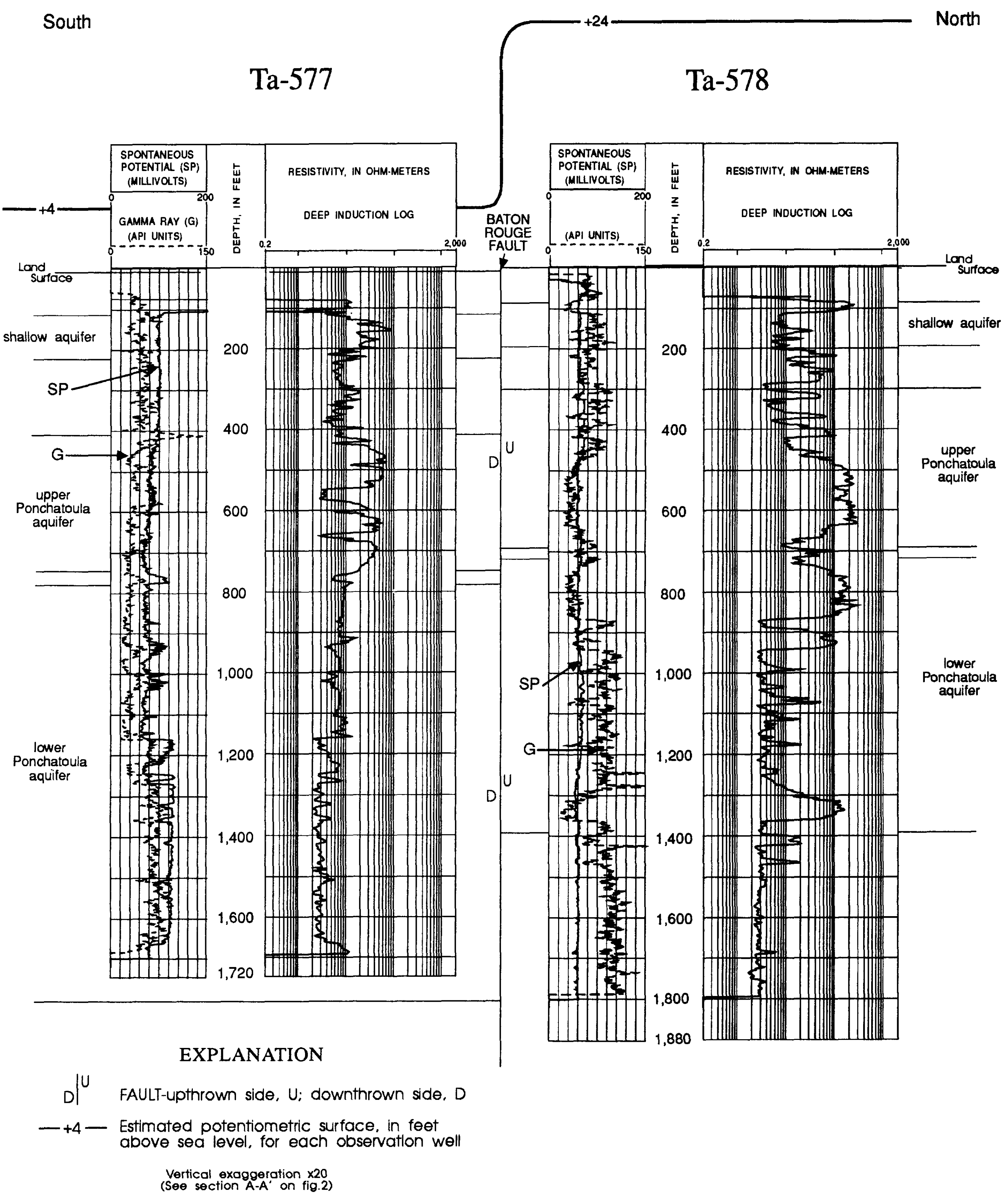


Figure 7. South-north hydrogeologic section showing geophysical logs of wells Ta-577 and Ta-578 and the effects of the Baton Rouge fault.

In contrast to the water levels in aquifers north of the fault zone, the water level in well Ta-577, which is 0.25 mi south of the fault zone and completed in a saline aquifer at a depth of 1,114 ft, is 8.2 ft above sea level. This water level is only 4.0 ft above land surface, indicating that the hydraulic pressure of the aquifer is only slightly elevated above what might be expected for a normally pressured aquifer for that depth. The unusually low hydraulic head in well Ta-577, completed in the downthrown side of the fault zone, is a result of the fault almost totally isolating the aquifers of intermediate depth south of the fault zone from hydraulic connection with the freshwater aquifers north of the fault zone. The slightly elevated water levels of those aquifers of intermediate depth could be accounted for by leakage from overlying and underlying aquifers. Water levels in the aquifers of intermediate depth may be elevated without having a direct hydraulic connection to the aquifer system north of the fault due to leakage across the clay confining units that separate the aquifers.

Hydrogeologic section A-A′ (fig. 4) shows that many of the sand beds in the lower Ponchatoula aquifer of well Ta-577 are not adjacent to freshwater sand in the same aquifer across the fault, and thus are prevented from being flushed by freshwater of the hydrologic system north of the fault zone. The presence of saline aquifers (penetrated by well Ta-577) above 950 ft and adjacent to freshwater aquifers (penetrated by well Ta-578) north of the fault zone indicates that the fault in the study area at these depths acts as a total or partial barrier to flow of ground water. This conclusion is supported by the findings of earlier studies of the Baton Rouge fault zone in localities such as the Baton Rouge metropolitan area. In a study of the Baton Rouge fault and its effect on the aquifer system in the Baton Rouge area, Rollo (1969), determined that the fault was not an effective barrier to ground-water flow above the "600-foot" aquifer but formed a more effective barrier to ground-water flow at depths greater than 600 ft.

GROUND-WATER RESOURCES

The ground-water resources of southeastern Louisiana are immense. Eight of the aquifers in southern Tangipahoa Parish at the site of test well Ta-576 collectively contain 1,900 ft of sand, indicating these aquifers are a potential source of freshwater for public supply. Water in these sands generally is of an acceptable quality for public supply. Selected water-quality characteristics of ground water in Tangipahoa Parish are summarized in the following table (data are from USGS files):

Constituent or property	Equivalent aquifer system: Chicot	Equivalent aquifer system: Evangeline	Equivalent aquifer system: Jasper	Test well Ta-576
Dissolved solids (milligrams per liter)	154-164	149-188	169-257	188
Iron (milligrams per liter)	0.05-0.5	0.02-0.5	0.01-0.1	0.04
Hardness (milligrams per liter)	13-33	10-98	2-5	0-1
pH	7.5-8.1	7.3-8.8	6.9-8.2	8.8
Color (platinum-cobalt units)	0-15	0	0-5	0

Hydrogen sulfide is present in low concentrations in ground water at some localities but generally is below the level detectable by most people.

Aquifers of Southern Tangipahoa Parish

Eight major aquifers consisting of thick sand units that underlie the study area are, in descending order, the shallow, upper Ponchatoula, lower Ponchatoula, Abita, Covington, Tchefuncta, Hammond, and Amite (fig. 6). The aquifers can be grouped into three systems: the Chicot equivalent/southeast Louisiana aquifer system, the Evangeline equivalent/southeast Louisiana aquifer system, and the Jasper equivalent/southeast Louisiana aquifer system. The Baton Rouge fault zone tends to disrupt the natural north-south flow of ground water in southern Tangipahoa Parish; therefore, the area north of the fault zone has the greatest potential source of ground water.

Chicot Equivalent/Southeast Louisiana Aquifer System

Hydrogeology

The Chicot equivalent aquifer system consists of the shallow and the upper Ponchatoula aquifers (fig. 6). The shallow aquifer consists of sand and gravel deposits underlying the upland terraces and flood plain deposits of major streams. Locally, the shallow aquifer can contain a large percentage of silt and clay, resulting in widely varying well yields. Transmissivities for the shallow aquifer ranging from 9,400 to 46,000 $[(ft^3/d)/ft^2]ft$ and hydraulic conductivities ranging from 70 to 140 $(ft^3/d)/ft^2$ were estimated from seepage-runs along the Tangipahoa River main channel (Nyman and Fayard, 1978, p. 14).

The upper Ponchatoula aquifer consists of extensive deposits of sand and gravel and typically is 200 to 300 ft thick, but thins southward. The upper Ponchatoula is thickest in the vicinity of Tickfaw and Hammond, La., and thins to about 200 ft at Ponchatoula, La. An aquifer test conducted at well Ta-284 indicated that transmissivity of the upper Ponchatoula is 27,000 $[(ft^3/d)/ft^2]ft$ and hydraulic conductivity is about 180 $(ft^3/d)/ft^2$. (See Nyman and Fayard, 1978.) At well Ta-576 (fig. 2) the upper Ponchatoula and shallow aquifers combine to form a massive sand unit that is more than 350 ft thick (including interfingered clay stringers).

Water Quality

Water quality in the shallow aquifer generally is suitable for most uses, as indicated by analyses of water from wells Ta-572 and Ta-573 (appendix). Temperature was as low as 21 °C, and pH ranged from 7.0 to 7.6. Hardness of water from wells Ta-572 and Ta-573 was 13 and 33 mg/L. Iron (dissolved) concentrations were 0.05 mg/L in well Ta-573 and 0.11 mg/L in well Ta-572, and dissolved-solids concentrations averaged 162 mg/L.

Water quality in the upper Ponchatoula aquifer generally is excellent for most uses, although hydrogen sulfide can be present locally in concentrations as high as 0.5 mg/L (Nyman and Fayard, 1978, p. 26). Temperature, pH, and hardness averaged 21 °C, 7.4, and 16 mg/L, respectively. Color of water in a sample from well ST-712 was 15 platinum-cobalt units, which was the highest color measured in wells sampled, and is typical of wells completed in the upper Ponchatoula aquifer. The quality of water in these aquifers generally meets the U.S. Environmental Protection Agency's (USEPA) standards for public supply (U.S. Environmental Protection Agency, 1986).

Pumping and Water Levels

Pumping from the shallow aquifer by small public facilities, small water systems, and schools account for the estimated 1.0 Mgal/d withdrawn for public supply (1991). Withdrawals for agriculture, small industrial facilities, and rural domestic use were not estimated but probably are substantially higher. Pumping from the upper Ponchatoula totaled approximately 0.9 Mgal/d in 1990 (Lovelace, 1991). Water levels in the upper Ponchatoula aquifer declined during 1940-76 at an average rate of approximately 0.1 to 0.2 ft/yr. Water-level data are not available after 1976, but based on the relatively large size of this ground-water resource and the estimated small increase in daily pumping since 1975, the rate of water-level decline probably has not increased substantially.

Estimated potential yield from the upper Ponchatoula at test well Ta-576 was 9 Mgal/d. This pumpage was estimated to result in a 26-foot decline in water level in the aquifer at a 1,000-foot radius from the pumped well after 1 yr of continuous pumping. The method used to determine these withdrawal and drawdown estimates is discussed in a later section, "Potential for Development."

Evangeline Equivalent/Southeast Louisiana Aquifer System

Hydrogeology

The lower Ponchatoula, Kentwood, Abita, and Covington aquifers are included in the Evangeline equivalent aquifer system. The lower Ponchatoula aquifer generally is more continuous than the upper Ponchatoula but the sands tend to be thinner and the sand grains are finer. Thickness of sands commonly are less than 100 ft, although at test well Ta-576 one sand was 200 ft thick. This aquifer generally consists of medium sand, but locally gravel also might be present. Estimated hydraulic conductivities, based on grain size, range from 35 to 65 $(ft^3/d)/ft^2$.

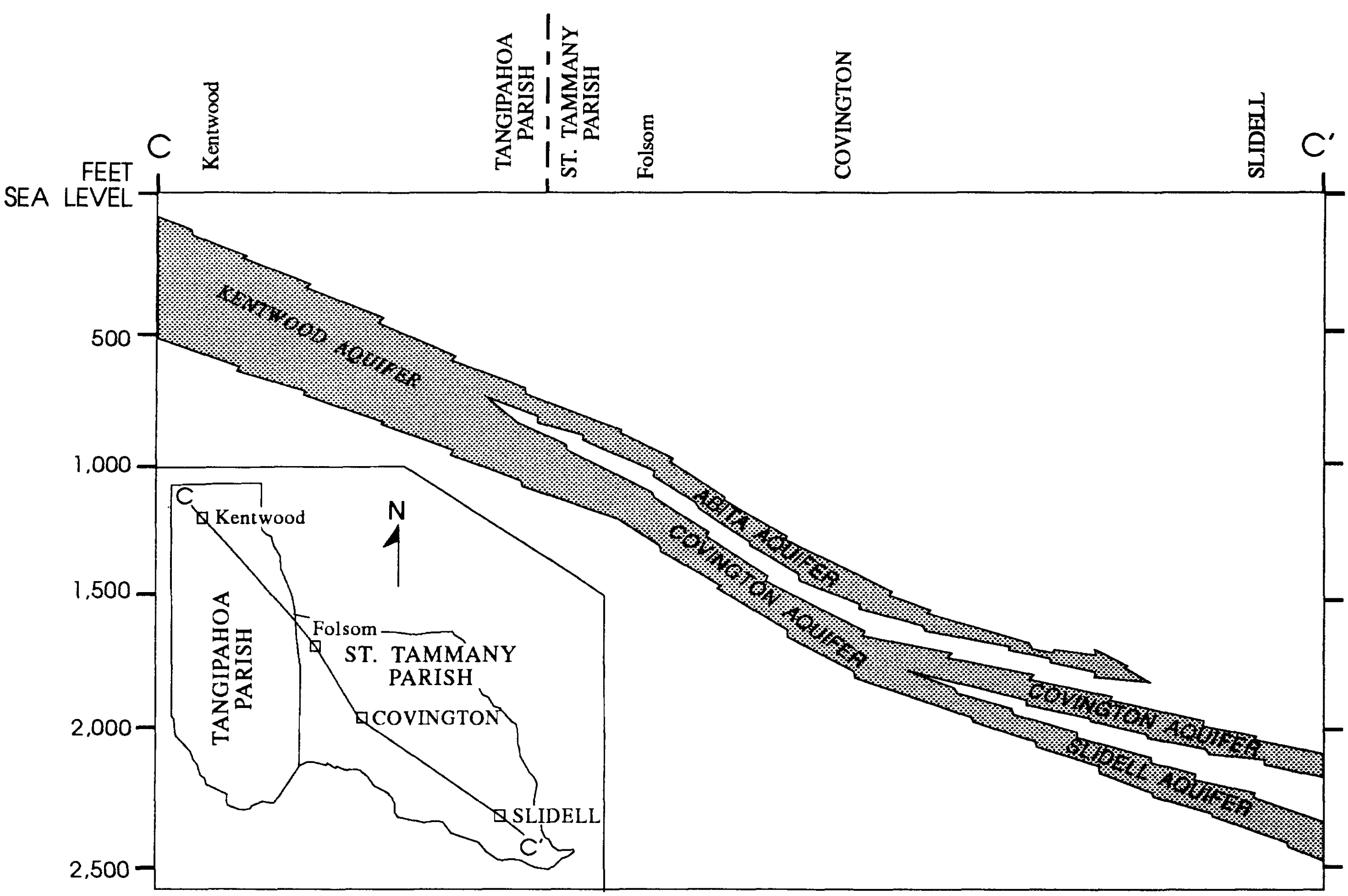
The Kentwood aquifer of northern Tangipahoa and western Washington Parishes bifurcates downdip into the Abita and Covington aquifers (fig. 8). In the southeastern part of St. Tammany Parish, the Covington aquifer (fig. 8) bifurcates into the Covington aquifer and the underlying Slidell aquifer (Nyman and Fayard, 1978, p. 30). The Abita and Covington aquifers underlie the study area. Although the Abita aquifer generally is continuous throughout the study area, it may be absent locally (Nyman and Fayard, 1978). South of the Baton Rouge fault zone this aquifer has been down-faulted and abuts the Covington aquifer north of the fault zone. The Abita aquifer can vary widely in thickness but is typically 50 to 100 ft thick north of the Baton Rouge fault zone and 150 to 300 ft thick south of the fault zone. The Abita aquifer is 80 ft thick at well Ta-576. Sand in the aquifer ranges from medium to coarse grained; coarse sand with some small gravel occurs at 1,659 ft. Transmissivities for this aquifer, north of the Baton Rouge fault zone, range from 10,000 to 13,000 $[(ft^3/d)/ft^2]ft$ (Nyman and Fayard, 1978, p. 34). Transmissivities, south of the fault zone, are estimated to range from 20,000 to 40,000 $[(ft^3/d)/ft^2]ft$, based on aquifer thickness and estimated hydraulic conductivity.

The Covington aquifer is continuous through most of the study area and is an important source of water across much of the southern half of the southeast Louisiana hydrologic system. As with the Abita aquifer, the Covington aquifer is hydraulically connected to the Kentwood aquifer (fig. 8). The Covington aquifer has been displaced 350 to 400 ft along the Baton Rouge fault zone. As a result, the freshwater sand beds north of the Baton Rouge fault zone are adjacent to a younger, mostly clay unit on the south side of the fault zone, and freshwater sand beds south of the fault zone are adjacent to older, freshwater sands of the Tchefuncta aquifer on the north side of the fault zone. The thickness of the Covington aquifer ranges from 100 to 200 ft across the study area north of the Baton Rouge fault zone and is presumed to be thicker south of the fault. The Covington aquifer was determined to be 155 ft thick at well Ta-576. The coarse sand sampled from the Covington aquifer at well Ta-576 was typical of the aquifer across the region. Transmissivities for this aquifer typically average 27,000 $[(ft^3/d)/ft^2]ft$, and hydraulic conductivities about 220 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978).

Water Quality

The water quality of the lower Ponchatoula aquifer generally is suitable for public supply; although, as is typical of the deeper aquifers in the study area, hydrogen sulfide can be present locally in concentrations as high as 0.5 mg/L. Temperature of water in wells completed in the lower Ponchatoula aquifer in the study area ranged from 21 to 26 °C. Color was not detected in water from these wells; pH ranged from 6.9 to 7.7; and hardness averaged 5.5 mg/L. The quality of water in well Ta-579, which supplies water to the Bedico Community Center, is typical of wells completed in this aquifer. Of all wells sampled in the study area, water from this well had the lowest sodium concentration (37 mg/L).

Waters in the Abita and Covington aquifers are similar in chemical composition. Temperature of water in well Ta-576 completed in the Covington aquifer was 29 °C. Iron concentrations in water from the Covington aquifer can be as high as 3 mg/L, and manganese is present at concentrations of 0.1 mg/L or less in water from most wells completed in this aquifer. In the study area, however, iron concentrations in water from the Covington aquifer ranged from less than 0.02 to 0.24 mg/L. Water from well Ta-576 had an iron concentration of 0.04 mg/L and a chloride concentration of 3.0 mg/L. Water from the Abita and Covington aquifers typically have dissolved solids concentrations that range from 50 to 400 mg/L, and pH values that range from 6.5 to 9.0. Hydrogen sulfide is present locally in water from these



Modified from Nyman and Fayard, (1978)

Figure 8. Idealized hydrogeologic section from Kentwood to Slidell, La., showing the aquifer units that are hydraulically connected to the Kentwood aquifer.

aquifers but usually at concentrations less than 0.5 mg/L. (See Nyman and Fayard, 1978.) In the study area, no water wells completed in the Abita aquifer were available for sampling. The quality of water in these aquifers in other areas, however, generally meets the USEPA standards for public supply (U.S. Environmental Protection Agency, 1986).

Water from wells SJB-165, SJB-176, Ta-576, and Ta-579, completed in the Evangeline equivalent aquifer system, were analyzed for the synthetic organic compounds listed in table 2 in addition to the analyses listed in the appendix. With the exception of heptachlor, these organic compounds were below detection limits for all wells sampled; heptachlor was detected in water from well SJB-165 at 0.01 μg/L, the lowest detectable level.

Pumping and Water Levels

Pumping from the lower Ponchatoula aquifer is estimated to be less than that from the upper Ponchatoula aquifer; continuous historic records were not available for this aquifer within the study area. Pumpage from the lower Ponchatoula aquifer for public supply in 1991 was estimated to be about 0.7 Mgal/d.

Data for well ST-449 at Abita Springs, La., indicated average water-level declines of approximately 0.2 ft/yr for the period 1950-67. The rate of decline decreased in 1967, and water levels began to rise in 1972.

Estimated potential yield from the lower Ponchatoula aquifer at test well Ta-576 were 2 Mgal/d. This pumping is estimated to result in a 15-foot decline in water level in the aquifer at a 1,000-foot radius from the pumped well after 1 yr of continuous pumping. The method used to determine these withdrawal and drawdown estimates is discussed in the section, "Potential for Development."

Pumping from the Abita aquifer is moderate compared to pumping from other aquifers in the study area. Total public-supply and industrial pumpage for this aquifer in southeastern Louisiana is estimated to be 1.0 Mgal/d (1991), but pumpage in the study area is estimated at only 0.3 Mgal/d (1991). The hydrograph of well ST-545 indicates a relatively uniform water-level decline of 1 to 2 ft/yr (fig. 9). Water levels in well ST-51, located 0.20 mi from public supply well ST-57, experienced an erratic but similar 1 to 2 ft/yr decline averaged over a 28-year period. The sharp decline in water level and associated decreased rate of water-level decline after 1953, shown in the hydrograph of ST-51, probably results from pumping interference from public supply well ST-57. Estimated potential yield from the Abita aquifer at test well Ta-576 is 4 Mgal/d, based on estimates and assumptions discussed in the section, "Potential for Development." It is estimated that the withdrawal of 4 Mgal/d will result in a 62-foot decline in water level in the aquifer at a 1,000-foot radius from the pumped well after 1 yr of continuous pumping (Lovelace, 1991)

Pumpage from the Covington aquifer in the study area totaled an estimated 1.5 Mgal/d for 1990. This aquifer is used throughout the region because it contains water of uniformly high quality. Water levels in the aquifer are affected by pumping centers outside the study area. Public supply well Ta-258, at Ponchatoula, La., had a 1.2 ft/yr rate of decline in water levels from 1945 to 1974 (fig. 10). The accelerated water-level decline for the period 1954-65 followed by a sharp recovery at well Ta-258 corresponds to a period of increasing demand that was followed by the installation of a new public-supply well to meet the city of Ponchatoula's increasing water demands. After installation of public-supply well Ta-284, the local water-level decline of 1.2 ft/yr was observed at public supply well Ta-258. Water levels in well ST-562, at Madisonville, La., declined at a rate of 1.7 ft/yr over a 27-year period (fig. 10). Potential yield from the Covington aquifer at Ta-576 is estimated to be 3 Mgal/d, based on estimates and assumptions discussed in the section, "Potential for Development." It is estimated that a withdrawal of 3 Mgal/d will result in a 14-foot decline in water level at a 1,000-foot radius after 1 year of pumping.

Table 2. Detection limits for analyzed synthetic organic compounds

[Level of detection in water is in micrograms per liter]

Compound	Lowest level of detection	Compound	Lowest level of detection
Volatile organic compounds			
Benzene	0.27	Trichlorofluoromethane	0.2
Bromoform	.2	1,1-Dichloroethylene	.2
Carbon tetrachloride	.2	1,2-Dibromoethylene	.2
Chlorobenzene	.2	1,1,2-Trichloroethane	.2
Chloroethane	.2	1,1,2,2-Tetrachloroethane	.2
Chloromethane	.2	Dichlorodifluoromethane	.2
Dibromochloromethane	.2	1,2 Dichloroethane	.2
1,1-Dichloroethane	.2	1,2-Dichloropropane	.2
Ethylbenzene	.2	1,3-Dichloropropene	.2
Methyl bromide	.2	1,2-Transdichloroethylene	.2
1,1,1-Trichloroethane	.2	2-Chloroethyl vinyl ether	.2
Chloroform	.2	1,2-Dichlorobenzene	.2
Methylene chloride	.2	Dichlorobromomethane	.2
Styrene	.2	Cis-1,3-Dichloropropene	.2
Tetrachloroethylene	.2	Trans-1,3-Dichloropropene	.2
Toluene	.2	1,3-Dichlorobenzene	.2
Trichloroethylene	.2	Vinyl chloride	.2
Acid-base/neutral extractable (semivolatile) organic compounds			
Acenaphthene	5.0	4-Chloro-3-methylphenol	30.0
Acenaphthylene	5.0	Chysene	10.0
Anthracene	5.0	Di-n-Butyl phthalate	5.0
Benzo(a)anthracene		Di-n-Octyl phthalate	10.0
1,2-Benzanthracene	5.0	Diethyl phthalate	5.0
Benzo(a)pyrene	10.0	Dimethyl phthalate	5.0
Benzo(b)fluoranthene	10.0	4,6-Dinitro-2-methylphenol	30.0
Benzo(ghi)perylene	10.0	Fluoranthene	5.0
Benzo(k)fluoranthene	10.0	Fluorene	5.0
Butyl benzyl phthalate	5.0	Hexachlorobenzene	5.0
Hexachlorobutadiene	5.0	1,4-Dichlorobenzene	5.0
Hexachlorocyclopentadiene	5.0	Bis(2-chloroethoxy)methane	5.0
Hexachloroethane	5.0	Bis(2-chloroethyl)ether	5.0
Indeno(1,2,3-CD)pyrene	10.0	Bis(2-ethylhexyl)phthalate	5.0
Naphthalene	5.0	2-Nitrophenol	5.0
Nitrobenzene	5.0	2,4-Dichlorophenol	5.0
N-nitrosodimethylamine	5.0	2,4-Dimethylphenol	5.0
Phenanthrene	5.0	2,4-Dinitrophenol	20.0
Pentachlorophenol	5.0	2,4-Dinitrotoluene	5.0
Phenol	5.0	2,4,6-Trichlorophenol	20.0
Pyrene	5.0	2,6-Dinitrotoluene	5.0
1,2-Dichlorobenzene	5.0	4-Bromophenyl phenyl ether	5.0
1,2,4-Trichlorobenzene	5.0	4-Chlorophenyl phenyl ether	5.0
1,3-Dichlorobenzene	5.0	4-Nitrophenol	30.0
Isophorone	5.0	2-Chloronaphthalene	5.0
N-nitrosodi-N-proplyamine	5.0	2-Chlorophenol	5.0

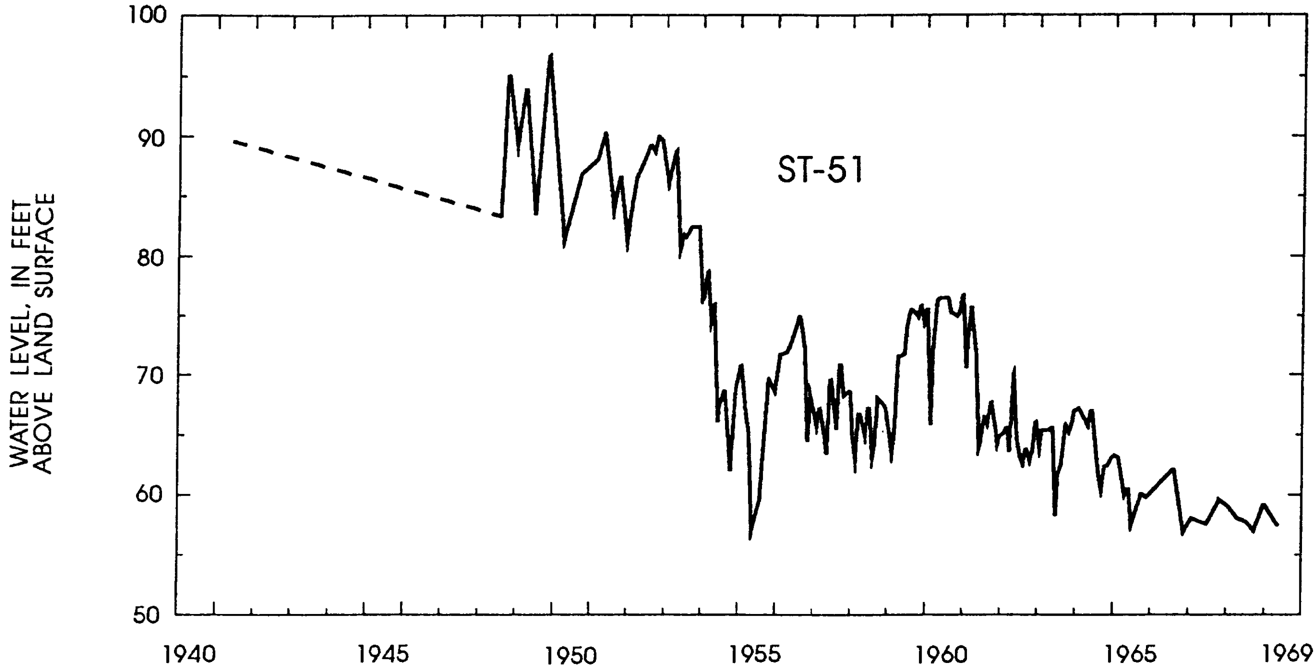
Table 2. Detection limits for analyzed synthetic organic compounds--Continued

Compound	Lowest level of detection	Compound	Lowest level of detection
		Pesticides	
2,4-DP	0.10	P'p"DDE	0.01
2,4-D	.10	O'p"DDD	.01
2,4,5-TP	.10	Endrin	.01
Atrazine	.10	P'p"DDT	.01
2,4,5-T	.10	Methoxychlor	.01
Diazinon	.01	Mirex	.01
Ethion	.01	Prometryne	.1
Malathion	.01	P'p"DDD	.01
Methyl Parathion	.01	O'p"DDT	.01
Methyl Trithion	.01	beta-Endosulfan	.01
Parathion	.01	Perthane	.01
Trithion	.01	Prometone	.1
Chlordane	.01	Propazine	.1
Toxaphene	.50	Simazine	.1
Dieldrin	.10	Simetryne	.1
gamma-BHC	.01	Alachlor	.1
Heptachlor	.01	Metolachlor	.1
Aldrin	.01	Metribuzin	.1
Heptachlor epoxide	.01	Trifluralin	.1
O'p"DDE	.01	Ametryne	.1
Alpha Endosulfan	.01	Cyanazine	.1
		Polychlorinated Biphenyls (PCB's)	
PCB-1016	0.10	PCB-1248	0.10
PCB-1221	.10	PCB-1254	.10
PCB-1232	.10	PCB-1260	.10
PCB-1242	.10		

Jasper Equivalent/Southeast Louisiana Aquifer System

Hydrogeology

The Tchefuncta, Hammond, and Amite aquifers of the Jasper equivalent aquifer system underlie the study area. The Tchefuncta aquifer contains freshwater as far south, possibly, as the northern border of St. John the Baptist Parish. Available data are not sufficient to precisely locate the southern extent of freshwater in this aquifer. The Tchefuncta aquifer on the north side of the Baton Rouge fault at well Ta-578 is adjacent to the Covington aquifer on the south side of the fault because of a 350- to 400-foot vertical displacement (fig. 4, south-north hydrogeologic section A-A'). The top of the Tchefuncta aquifer was encountered at a depth of 2,242 ft at well Ta-576 at the Bedico Community Center. The aquifer is 200 ft thick and consists mostly of coarse sand at this location. This follows a regional trend of medium- and coarse-grained sand in the aquifer. Transmissivities for the aquifer range from approximately 8,000 to 27,000 [$(ft^3/d)/ft^2$]ft and hydraulic conductivities range from 70 to 130 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978, p. 7).



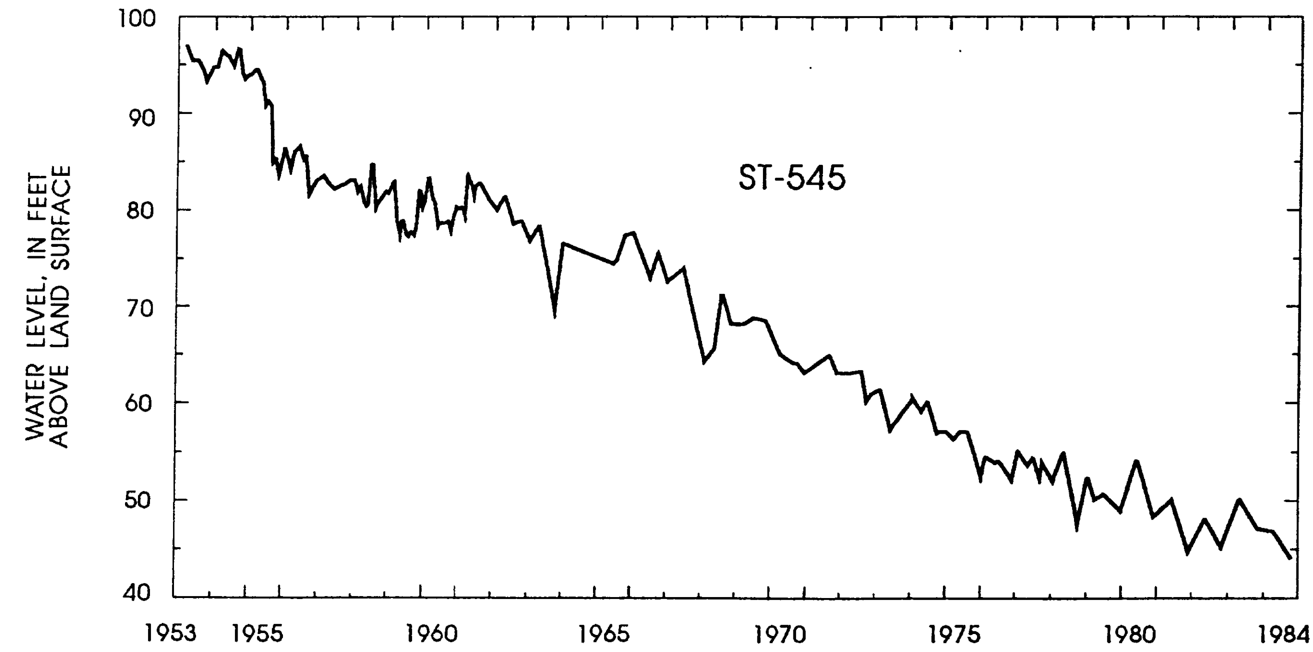
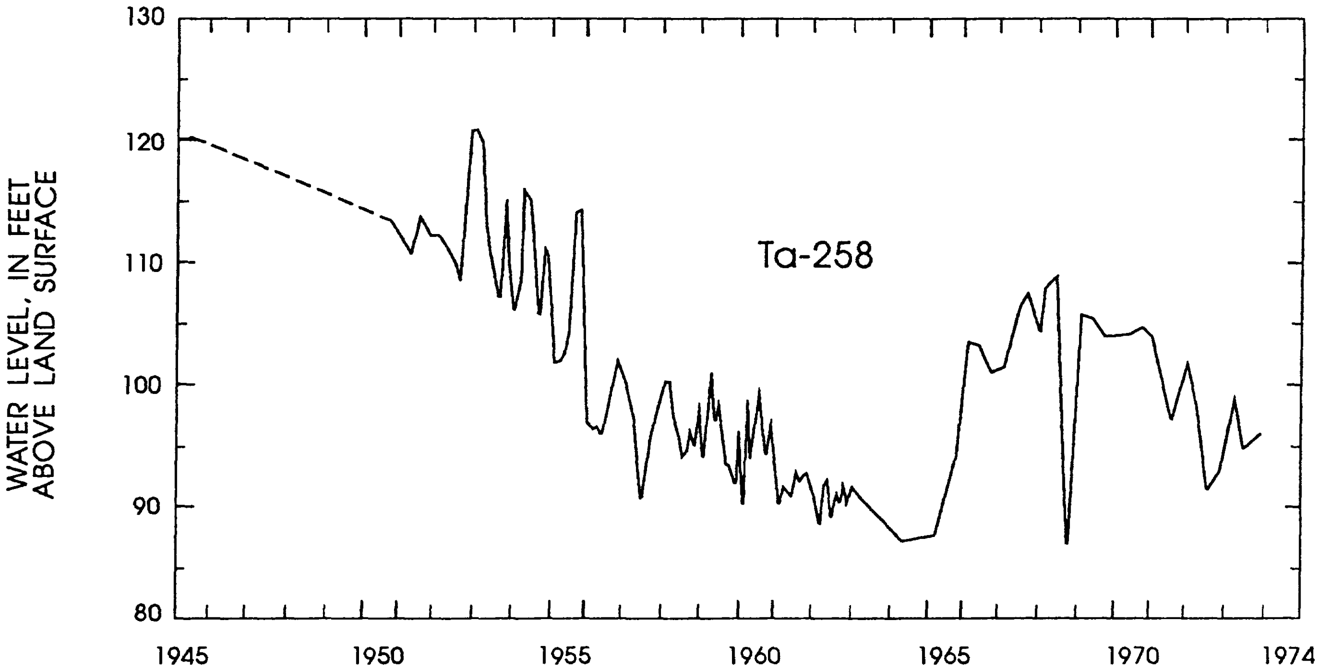


Figure 9. Water levels for wells ST-51 and ST-545 completed in the Abita aquifer.



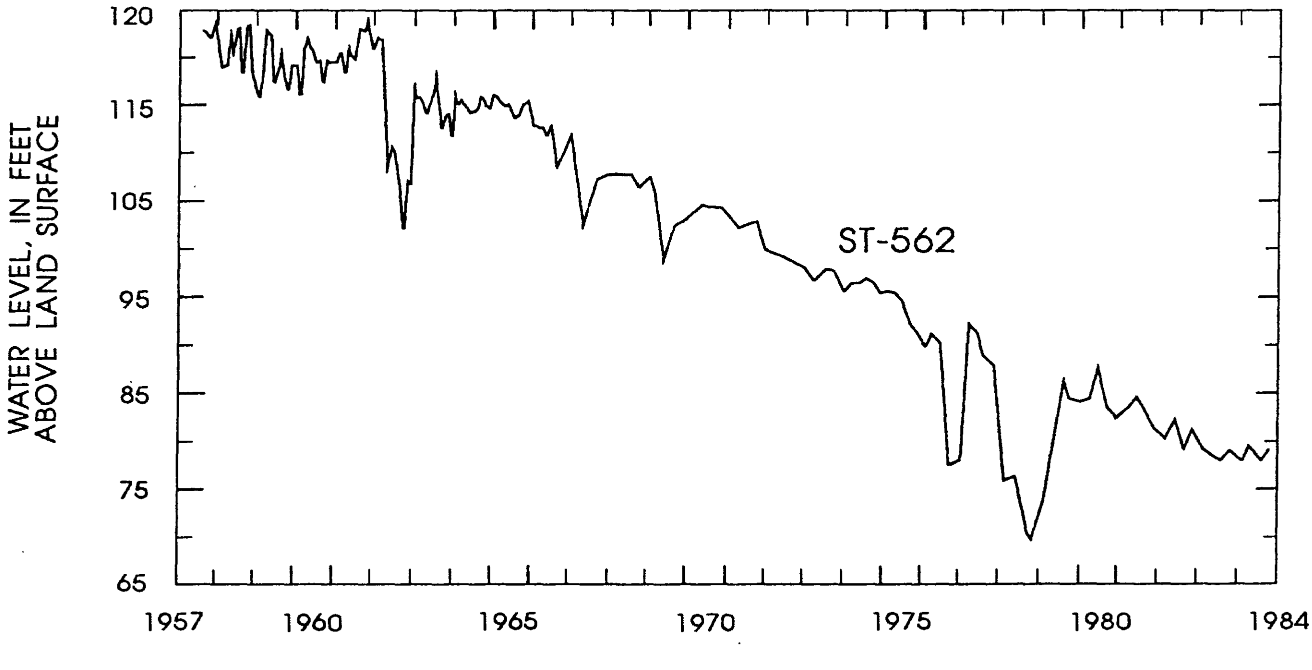


Figure 10. Water levels for wells Ta-258 and ST-562 completed in the Covington aquifer.

The Hammond aquifer is a major aquifer across the region. The thickness of this aquifer generally ranges from 100 to 200 ft in the study area. At well Ta-576 the aquifer consists of two thin sands with a total thickness of 50 ft, but generally thickens in every direction from that location. Results of an aquifer test at well ST-568 at Covington indicated a transmissivity of about 27,000 [$(ft^3/d)/ft^2$]ft and a hydraulic conductivity of more than 200 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978, p. 51). The aquifer at well ST-568 is 200 ft thick and consists of sand that is well sorted, indicating a higher permeability. The aquifer at Hammond, La., consists of fine- to medium-grained sand in the upper part, grading to medium- and coarse-grained sand in the lower one-third. The Hammond aquifer has been down-faulted below the base of freshwater for the southeastern Louisiana aquifer system south of the Baton Rouge fault zone; this represents its approximate southern limit of freshwater in the study area.

The Amite aquifer is one of the most continuous aquifers in the region north of the Baton Rouge fault zone and attains an appreciable thickness in the study area. The thickness is typically 100 to 150 ft, but becomes increasingly variable at the southern limit of freshwater where the aquifer may thin or thicken abruptly. The top of the Amite aquifer is at a depth of 2,965 ft below land surface at well Ta-576. The water in this sand has a resistivity of approximately 48 ohm-meters (measured from the well log), indicating freshwater. Approximately 4 mi southwest of well Ta-576, at oil test well 178730, the Amite aquifer reaches a thickness of approximately 420 ft and contains freshwater. Less than half a mile farther southwest, the aquifer consists of two thin sands having a total thickness of 100 ft and containing brackish water. Reported transmissivities for the aquifer range from 17,000 to 27,000 [$(ft^3/d)/ft^2$]ft, and the hydraulic conductivity is 150 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978, p. 7).

Water Quality

The Tchefuncta aquifer in the study area contains a soft, sodium bicarbonate type water with no color in water sampled from well ST-653. The pH of the water was 8.0 and dissolved-solids concentration was 214 mg/L. The iron concentration in water from the well completed in this aquifer was 0.04 mg/L. Manganese also was present at an average concentration of 0.04 mg/L. Hydrogen sulfide is present in some areas, but generally in concentrations less than 0.1 mg/L (Nyman and Fayard, 1978).

Water in the Hammond aquifer is a soft, sodium bicarbonate type typical of water in other aquifers of this regional ground-water system. Few wells are completed in this aquifer because of the depth to the aquifer in the study area. The temperature of the water flowing from well Ta-434 was approximately 30 °C; color was not detected (appendix). The pH was 7.6 in water from well Ta-434. Iron concentration in water from wells completed in the Hammond aquifer ranged from 0.01 to 1.1 mg/L. The manganese concentration ranged from 0.03 to 0.13 mg/L, and the dissolved-solids concentration ranged from 178 to 207 mg/L. Hydrogen sulfide is present locally, but typical concentrations are 0.1 mg/L or less (Nyman and Fayard, 1978).

The Amite aquifer contains a sodium bicarbonate type water that is low in iron and manganese. Few wells have been completed in the aquifer in southern Tangipahoa Parish because of the extreme depth to the aquifer in the study area. The wells sampled were located in St. Tammany Parish as close to the study area as possible. The color ranged from 0 to 5 platinum-cobalt units. The average pH was 9.0 in water from wells ST-592 and ST-726. Of all wells sampled, well ST-592 contained water with the highest dissolved-sodium concentration, 96 mg/L. The iron concentration was less than 0.01 mg/L. The average manganese concentration was 0.13 mg/L, and dissolved-solids concentration ranged from 169 to 257 mg/L. Hydrogen sulfide is present locally in concentrations as high as 0.5 mg/L (Nyman and Fayard, 1978). The quality of water in these aquifers generally meets the USEPA standards for public supply (U.S. Environmental Protection Agency, 1986).

Pumping and Water Levels

In southern Tangipahoa and St. Tammany Parishes, the city of Hammond is the largest reported user of water from the Tchefuncta aquifer. Total public-supply and industrial pumpage from this aquifer is estimated at approximately 1.5 Mgal/d (1991). The average rate of water-level decline in well Ta-273 near Rosaryville, west of Ponchatoula in Tangipahoa Parish, was about 2.2 ft/yr for the period 1960-77, but the rate of decline has decreased and has been about 1 ft/yr for the last 10 yr (fig. 11). Heavy pumping of water from equivalent aquifers in East Baton Rouge and Livingston Parishes affects the water levels in the Tchefuncta aquifer in the study area.

Potential yield from the Tchefuncta aquifer from a well field near Ta-576 is estimated at 7 Mgal/d. The withdrawal of 7 Mgal/d at this site probably would result in a 37-foot decline in water level in the aquifer at a 1,000-foot radius from the pumped well after 1 yr of continuous pumping. The method and assumptions used to estimate withdrawals and water-level declines due to pumping is discussed in the section, "Potential for Development."

The city of Hammond also is reported to be the largest user of water from the Hammond aquifer in southern Tangipahoa and St. Tammany Parishes. Total public-supply and industrial withdrawals from this aquifer are estimated at approximately 4.6 Mgal/d (1991). The average rate of water-level decline in well Ta-268 in Hammond for the period 1959-76 was 3 to 4 ft/yr, but water-level trends for the last 10 yr indicate that the rate of water-level decline has decreased to about 2 ft/yr (fig. 12). Heavy pumping of water from correlative aquifers in the Baton Rouge area affects water levels in the Hammond aquifer in the study area. The sands of the Hammond aquifer penetrated by well Ta-576 were unusually thin; for this reason, yield was not estimated for the aquifer at this location.

Total public-supply and industrial pumpage for the Amite aquifer in southern Tangipahoa and St. Tammany Parishes is estimated to be 0.8 Mgal/d (1991). Major pumping centers are the communities of Hammond and Independence in Tangipahoa Parish. Average water-level declines at well Ta-262 in Independence for the period 1964-84 was nearly 2.2 ft/yr, but water-level declines have decreased during the last 6 yr (fig. 13). Water well ST-558, located northeast of well Ta-576, had an average water-level decline of 1.5 ft/yr for a 10-year period ending in 1978 (fig. 13).

Estimated potential yield for the Amite aquifer at well Ta-576, assuming an aquifer thickness of 150 ft, is 3 Mgal/d. Withdrawals totaling 3 Mgal/d probably would result in a 19-foot decline in water level in the aquifer at a 1,000-foot radius from the pumped well after 1 yr of continuous pumping. The method and assumptions used to estimate withdrawals and water-level declines due to pumping is discussed in the section, "Potential for Development."

Potential for Development

The potential for development of the six major freshwater aquifers in the study area described in this section is based on a number of data sources, including information obtained from test well Ta-576 in southeastern Tangipahoa Parish. Additional data sources that were referenced to provide hydrologic values for the analysis are listed in the section "Selected References." The general location of test well Ta-576 was chosen after a review of previously published USGS reports to determine the aquifer thickness and sand percentage in southern Tangipahoa Parish. The data collected from the well were similar to data cited in earlier reports and are considered representative of the aquifer system in southern Tangipahoa Parish.

Test well Ta-576, located at the Bedico Community Center, was completed in July 1990. Total depth of the test hole was 3,000 ft, and it penetrated eight major aquifers. The well screen was set at a depth from 1,901 to 1,922 ft in the Covington aquifer.

Interpretation of the well log (fig. 14) indicated that all of the sands penetrated in the test well contain freshwater. Total thickness of the freshwater sands was more than 1,900 ft. Resistivity values from the deep-penetrating resistivity log typically averaged 200 ohm-meters. These high resistivity values indicate water with low dissolved-solids concentrations. The chemical analysis of water from the Covington

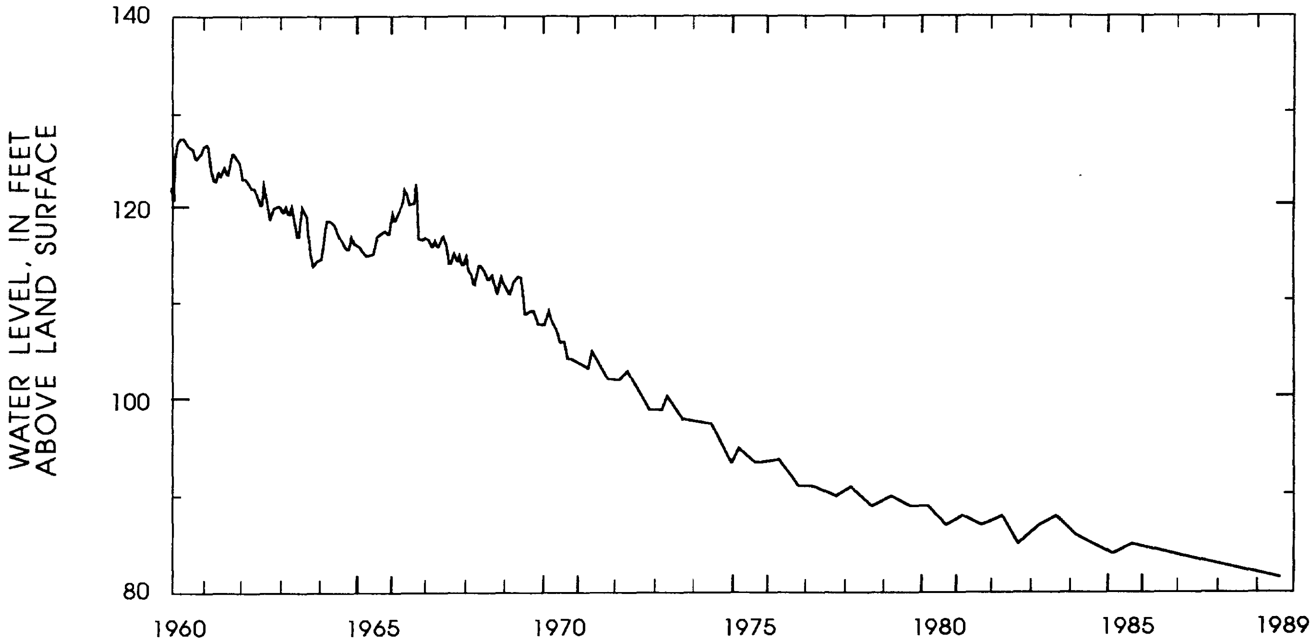


Figure 11. Water level for well Ta-273 completed in the Tchefuncta aquifer.

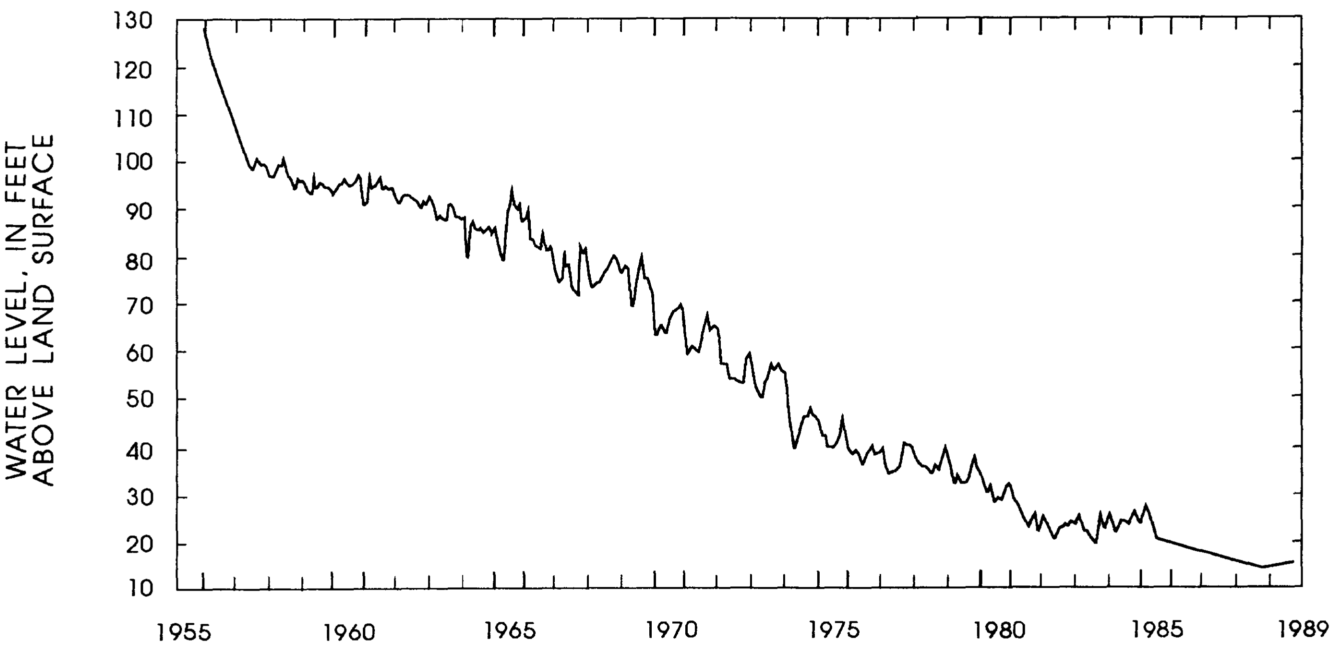
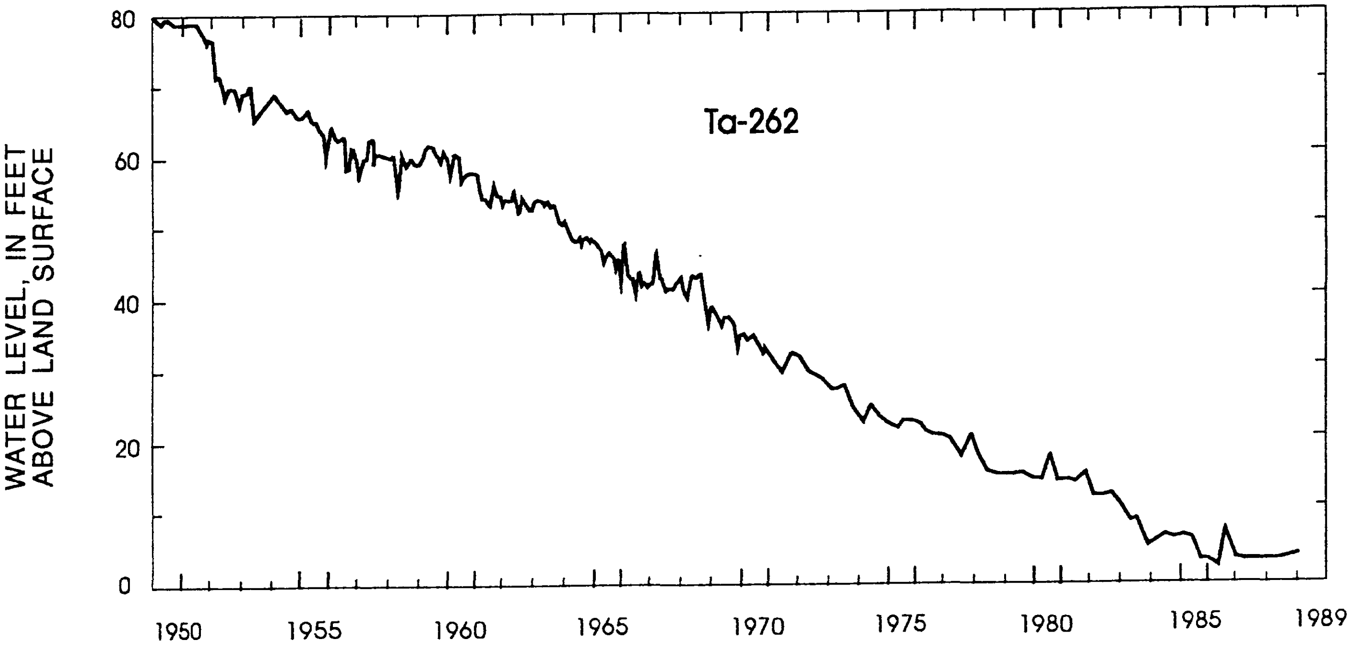


Figure 12. Water level for well Ta-268 completed in the Hammond aquifer.



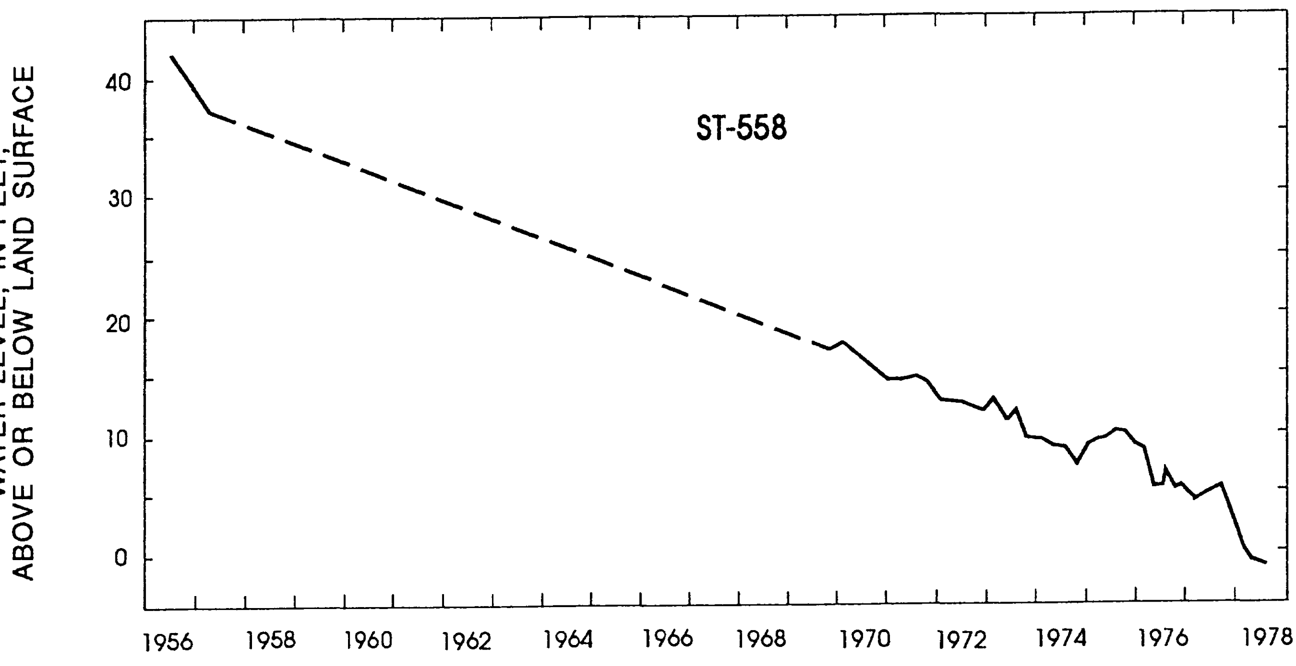


Figure 13. Water levels for wells Ta-262 and ST-558 completed in the Amite aquifer.

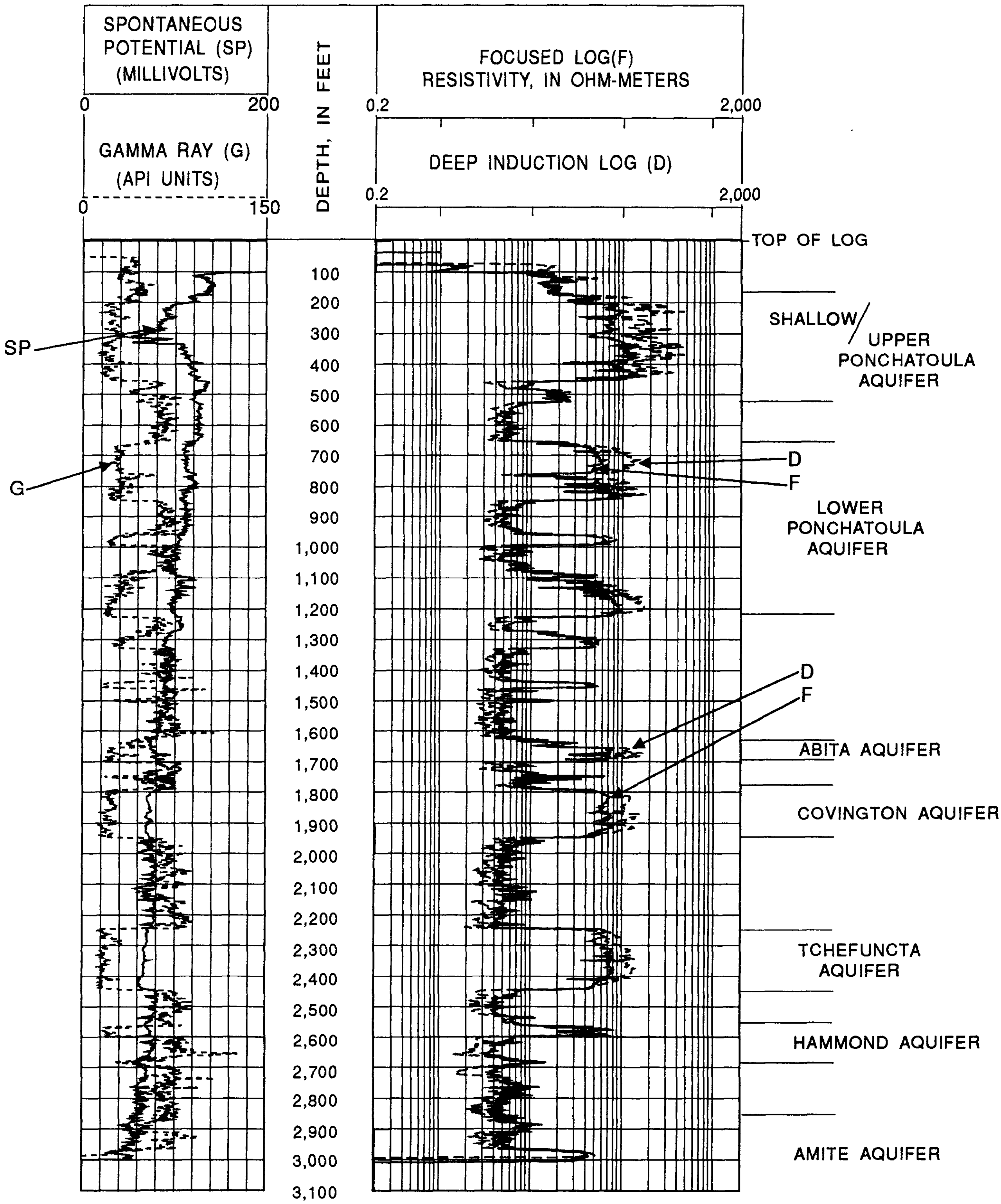


Figure 14. Geophysical log of test well Ta-576.

aquifer verified the presence of high quality water, low in hardness, dissolved solids concentration, and iron concentration.

Potential yields from aquifers in the vicinity of test well Ta-576 could exceed 28 Mgal/d, based on reported hydraulic conductances, grain-size distribution, and thicknesses of the sand beds at this location. Yields from each aquifer was estimated by multiplying the average specific capacity for that aquifer by the maximum allowable drawdown of 75 ft to obtain a total pumping rate from that aquifer unit. Well-screen entrance velocities for a maximum well-screen diameter of 16 in. (and the computed pumping rate) were calculated to ensure that ground-water entrance velocities did not exceed the critical value of 0.1 ft/s, given as a guideline to maximize well-screen life. A Theis analysis of drawdown in the aquifer resulting from the proposed pumping for a period of 1 yr gave estimated drawdowns at a distance of 1,000 ft from the well location. Estimated yields for the individual aquifers at well Ta-576 are included in the "Pumping and Water Levels" section for each aquifer discussed in this report except the Hammond aquifer. Sand in the Hammond aquifer at well Ta-576 was considered to be too thin for substantial water withdrawals at that location. The potential yield and estimated drawdown values are summarized in table 3.

Table 3. Potential yield and estimated drawdown values for a hypothetical well field at test well Ta-576

[Mgal/d, million gallons per day]

Aquifer	Potential yield (Mgal/d)	Estimated drawdown after 1 year at a distance of 1,000 feet from pumping well (feet)
Upper Ponchatoula	9.0	26.0
Lower Ponchatoula	2.0	15.0
Abita	4.0	62.0
Covington	3.0	14.0
Tchefuncta	7.0	37.0
Hammond	(1)	(1)
Amite	3.0	19.0
Total pumpage	28.0	

[1] No estimate of yield was made at test well Ta-576, due to reduced aquifer thickness at this location.

A number of assumptions must be made when applying the Theis method to an aquifer subjected to pumping. The ideal aquifer to which the Theis solution is best applied is (1) horizontal, (2) confined between impermeable formations on top and bottom, (3) infinite in horizontal extent, (4) of constant thickness, and (5) homogeneous and isotropic with respect to its hydrogeological parameters (Freeze and Cherry, 1979, p. 315). To the extent that the actual aquifer differs from an ideal aquifer, the calculated yields and the effect of withdrawals will differ from actual yields and effects of withdrawals on water levels. Although no aquifer in nature will stringently meet the assumptions applied to the ideal Theis aquifer, the Theis equation provides a good method of approximating aquifer response to withdrawals.

Two factors that were not considered with the analysis that would reduce calculated yields are interference from other wells in the same aquifer and the derivation of hydraulic-conductivity values from pumping tests. Interference effects from the drawdown cones of other wells pumping water from the same aquifer will result in lower yields and higher water-level rates of decline at the primary pumped well. The hydraulic-conductivity values are only estimates calculated from aquifer tests that are based on idealized assumptions. The hydraulic conductivity values derived from aquifer tests are then used in the Theis equation. The resulting errors in hydraulic conductivity are assumed to be small enough that the overall analysis is not significantly affected.

At current rates of withdrawal, the hydrologic system seems to be moving towards equilibrium aided by induced recharge across clay confining units. The massive sand beds of the shallower aquifers (the shallow, upper Ponchatoula, and lower Ponchatoula aquifers) seem to be closer to reaching equilibrium than the deeper aquifers (the Abita, Covington, Tchefuncta, Hammond, and Amite aquifers), with modest recovery of water levels in some areas (Nyman and Fayard, 1978). Water levels in the study area are affected by pumping elsewhere in the region for those aquifers that are major sources of public supply in other areas. Water levels also can be affected by disruptions in ground-water flow at the Baton Rouge fault zone in southern Tangipahoa Parish.

Increases in pumpage of 30, 50, or 100 Mgal/d from the aquifer system would result in substantial increases in water-level declines throughout the hydrologic system. A digital model that could be used to simulate the response of all aquifers to the proposed increased pumping is needed to provide a more thorough understanding of the effect of increased pumping on the aquifer system.

Aquifers Underlying Lake Pontchartrain

The Baton Rouge fault zone that extends east-southeasterly from west of Baton Rouge through the northern part of Lake Pontchartrain (fig. 1) disrupts ground-water flow in the intermediate and deep aquifers of the large freshwater aquifer system north of Lake Pontchartrain. For each of the deep freshwater aquifers, the southern limit of freshwater extends south of the fault zone. Beyond this limit, defined as the freshwater-saltwater interface, chloride concentrations generally are greater than the 250 mg/L maximum concentration considered suitable for public-supply use (U.S. Environmental Protection Agency, 1986). Generally, the shallowest of the aquifers below the lower Ponchatoula aquifer have freshwater-saltwater interfaces extending farthest south of the Baton Rouge fault zone (fig. 4). The Abita aquifer is the southernmost of all the deep aquifers that contain freshwater south of the fault zone.

Abita Aquifer at Ruddock, Louisiana

Where the Baton Rouge fault zone crosses the study area, the Abita aquifer has been displaced downward approximately 350 ft and abuts the Covington aquifer on the north side of the fault. The approximate location of the freshwater interface in the Abita aquifer under Lakes Pontchartrain and Maurepas (fig. 2), has been estimated by Smoot (1988). The aquifer dips to the southwest at a rate varying from 40 to 70 ft/mi (Nyman and Fayard, 1978). At Ruddock, La., the Abita aquifer dips at a rate of 60 ft/mi.

Sieve analyses of sand from the Abita aquifer from well SJB-165 (from USGS files), 18.5 mi southwest of the study area at Ruddock, shows a predominantly medium- to fine-grained sand (fig. 15). This aquifer varies in thickness but typically is 150 to 300 ft thick south of the Baton Rouge fault zone, and apparently thickens south of oil-test well Roy W. Guste No. 1, State serial number 161507. The hydraulic conductivity of the Abita aquifer at public supply well SJB-176, calculated from an aquifer test conducted at that well when it was installed, was 120 $(ft^3/d)/ft^2$. The hydraulic conductivity at well SJB-176 was the same as that determined from a pumping test conducted in a well located at the National Space Technology Laboratory near Bay St. Louis, Mississippi (Newcome, 1967, p. H11).

Limit of Freshwater in the Abita Aquifer

To determine the limit of freshwater in the Abita aquifer in northern St. John the Baptist Parish, and to acquire hydrogeologic data in the vicinity of the freshwater-saltwater interface, a test/observation well was constructed 1.5 mi south of well SJB-165 near Ruddock. The well site chosen was at the northern end of the Ruddock boat launch, 0.5 mi north of the Ruddock exit on Interstate 55. Test well SJB-180 was completed on December 10, 1990, to a depth of 3,321 ft (fig. 4, section A-A′).

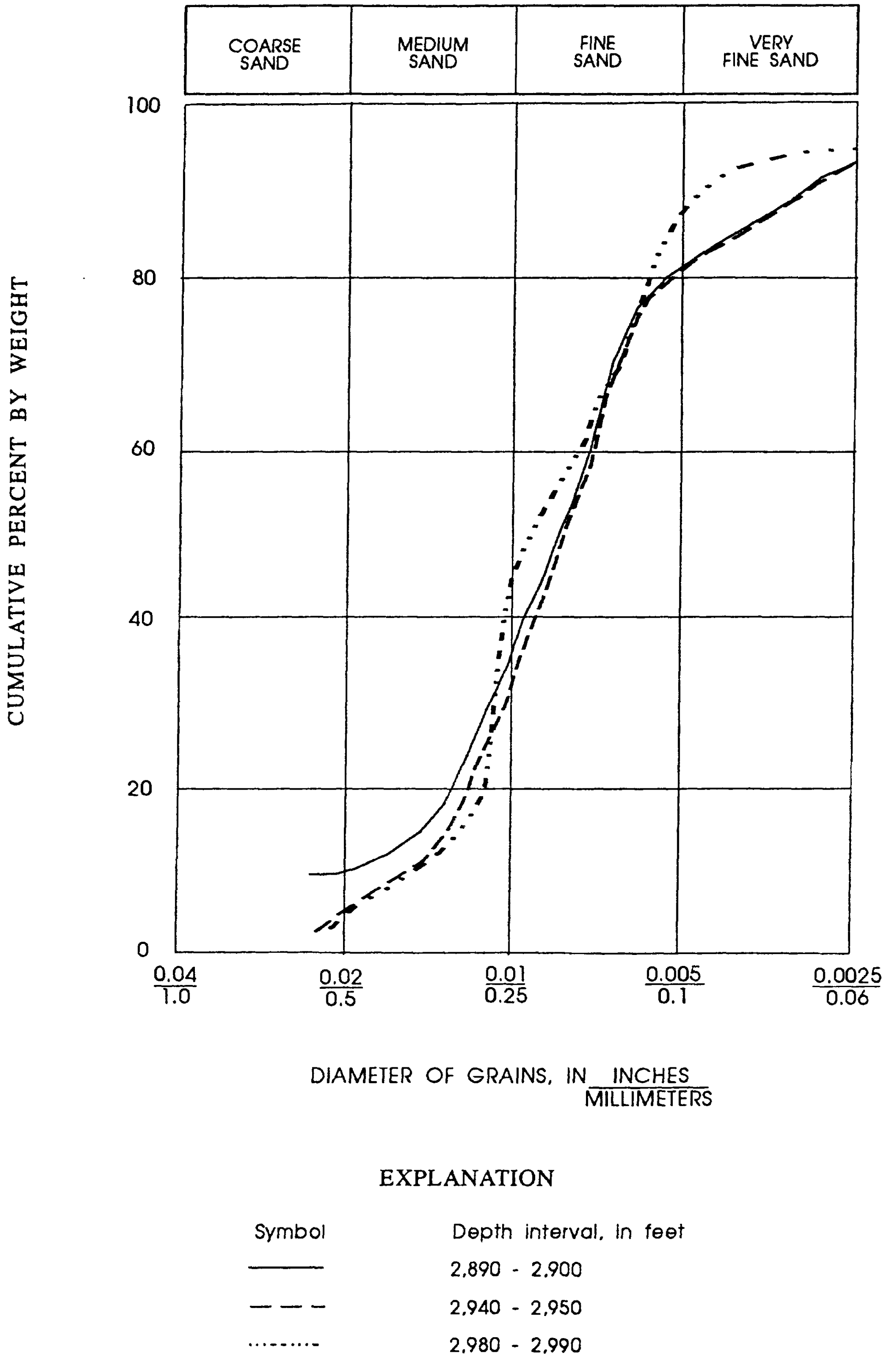


Figure 15. Sieve analysis of sand samples from well SJB-165 completed in the Abita aquifer.

The electric and natural gamma ray logs of test well SJB-180 are shown in figure 16. The sands that constitute the Abita aquifer can be delineated from inspection of these geophysical logs. Based on the deflection of traces of the logs, the Abita aquifer extends from about 2,990 to 3,190 ft. A zone of lower resistivity water begins at 3,100 ft and extends to the base of the aquifer. Resistivity in this zone decreases with depth, indicating that chloride concentrations probably increase with depth. The well screen was set from 3,065 to 3,085 ft. A chloride concentration of 44 mg/L was measured in a water sample from the Abita aquifer at this point immediately above the lower resistivity water zone.

Based on the log, the screen is directly above the extreme forward edge of the freshwater-saltwater interface. This is correct if the interface forms a plane in the aquifer that is offset from vertical by some angle. The angle of the plane is dependent on the relative density difference between the freshwater and saltwater at the interface, vertical and horizontal conductivities of the aquifer, and ground-water flow rates at the interface. Assuming the planar interface surface moves northward in response to higher rates of pumping, the well depth should allow northward movement of the freshwater-saltwater interface to be monitored. The angled surface of the interface will pass the test well as the interface moves northward. The increasingly higher chloride concentration of the saltwater south of the interface should be reflected in a rising chloride concentration in water sampled from the test well.

Freshwater in the Abita aquifer generally is a soft sodium bicarbonate type. Dissolved-solids and chloride concentrations typically are low. However, chloride concentrations in water from the Abita aquifer from well SJB-165 have been rising steadily (fig. 17). This well had been used continuously for public supply by the St. John the Baptist Parish Water District from April 1975 to August 1986. After August 1986, the water district also began withdrawals for public supply from well SJB-176, completed in the Abita aquifer and located approximately 1 mi north of well SJB-165. Both wells have been used since August 1986 to meet the parish public water-supply requirements.

During 1981-84, chloride concentrations increased from approximately 38 to 72 mg/L. This increase in chloride concentration might result from the capture of plumes of saline water from a nearby freshwater-saltwater interface, or from saline water leaking through the confining clay layer above or below the aquifer. Water samples collected above the freshwater-saltwater interface from test well SJB-180 contained a dissolved-chloride concentration of 44 mg/L (appendix). The chloride concentrations at the base of the Abita aquifer at well SJB-180 were estimated from resistivity log values (fig. 16) to range from 200 to 250 mg/L.

Analysis of Aquifer Response to Hypothetical Pumping

The Abita aquifer in St. John the Baptist Parish has been utilized as a public water source since April 1975. Pumping from the aquifer during the first 10 yr of use has averaged about 1.5 Mgal/d. Total pumpage for this aquifer by St. John the Baptist public-supply wells has increased from 2.0 to 2.3 Mgal/d during the last 5 yr (1986 to 1991). In Baton Rouge, withdrawals of 40 Mgal/d in the "2,000-foot" aquifer, an aquifer with hydrologic characteristics similar to the Abita aquifer in St. John the Baptist Parish (Torak and Whiteman, 1982, p. 5), has resulted in a lowering of the potentiometric surface to a level more than 220 ft below land surface (D.J. Tomaszewski, U.S. Geological Survey, oral commun., 1991) which represents a net decline in the potentiometric surface of more than 430 ft (Morgan, 1961). The Theis method of analysis was applied to the Abita aquifer at Ruddock to estimate the effect of pumping on water levels in the aquifer across the region and on ground-water flow in the Ruddock area. Two pumping scenarios with withdrawal rates of 31.5 and 112 Mgal/d for up to 10 yr were evaluated. These withdrawal rates were selected based on estimated requirements for an additional public water supply.

The scenarios for the largest and smallest pumping rates were evaluated for pumping periods of 1 and 10 yr. The orientation of the well fields and the placement of the individual wells are shown in figures 18 and 19. These figures also show the hypothetical location of the Abita aquifer freshwater-saltwater interface. At the time of the analysis, it was not known how close the freshwater-saltwater interface was to the southernmost wells of the hypothetical well fields; so a range of interface travel

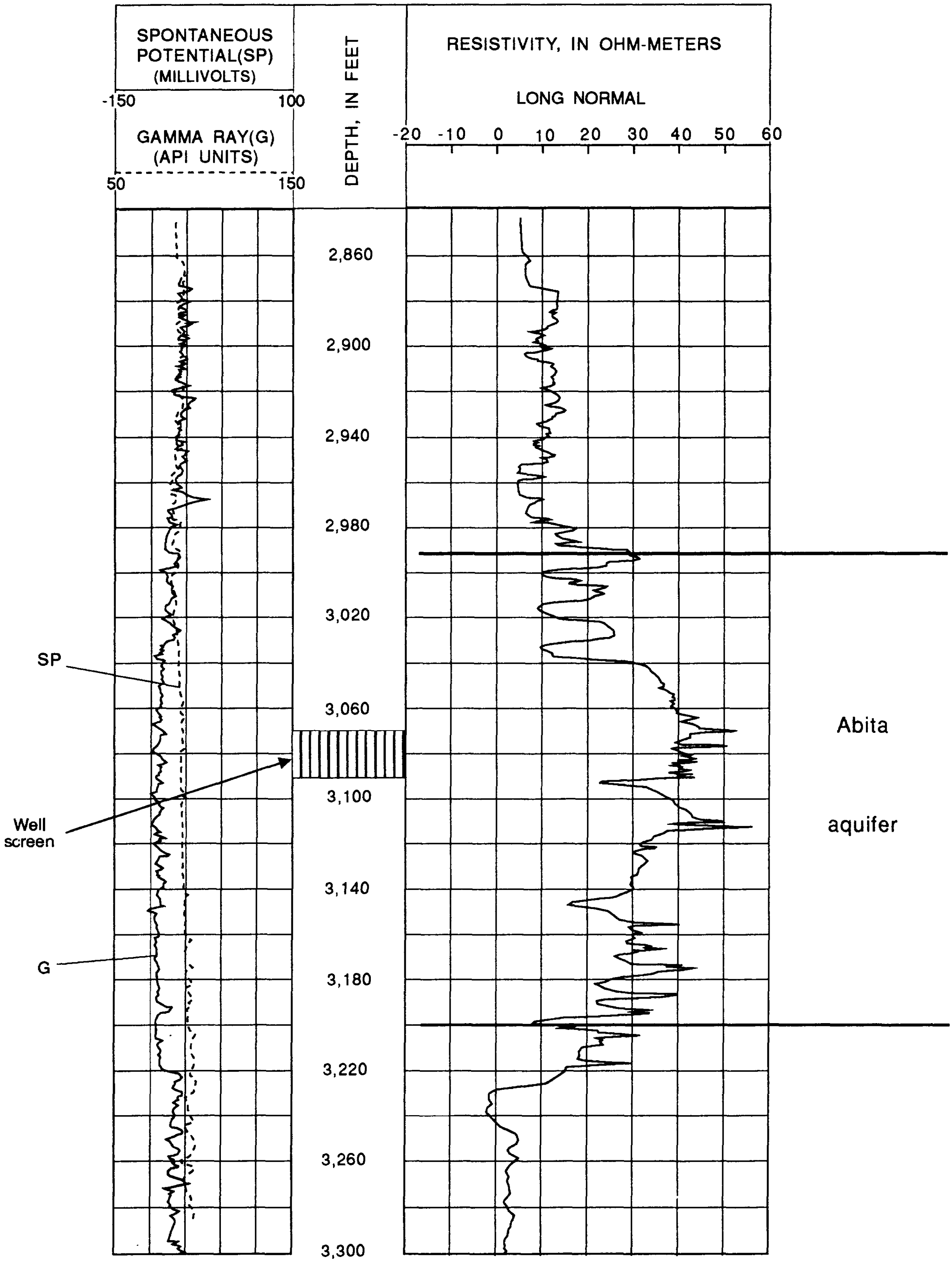


Figure 16. Electric and natural gamma ray logs of well SJB-180 completed in the Abita aquifer.

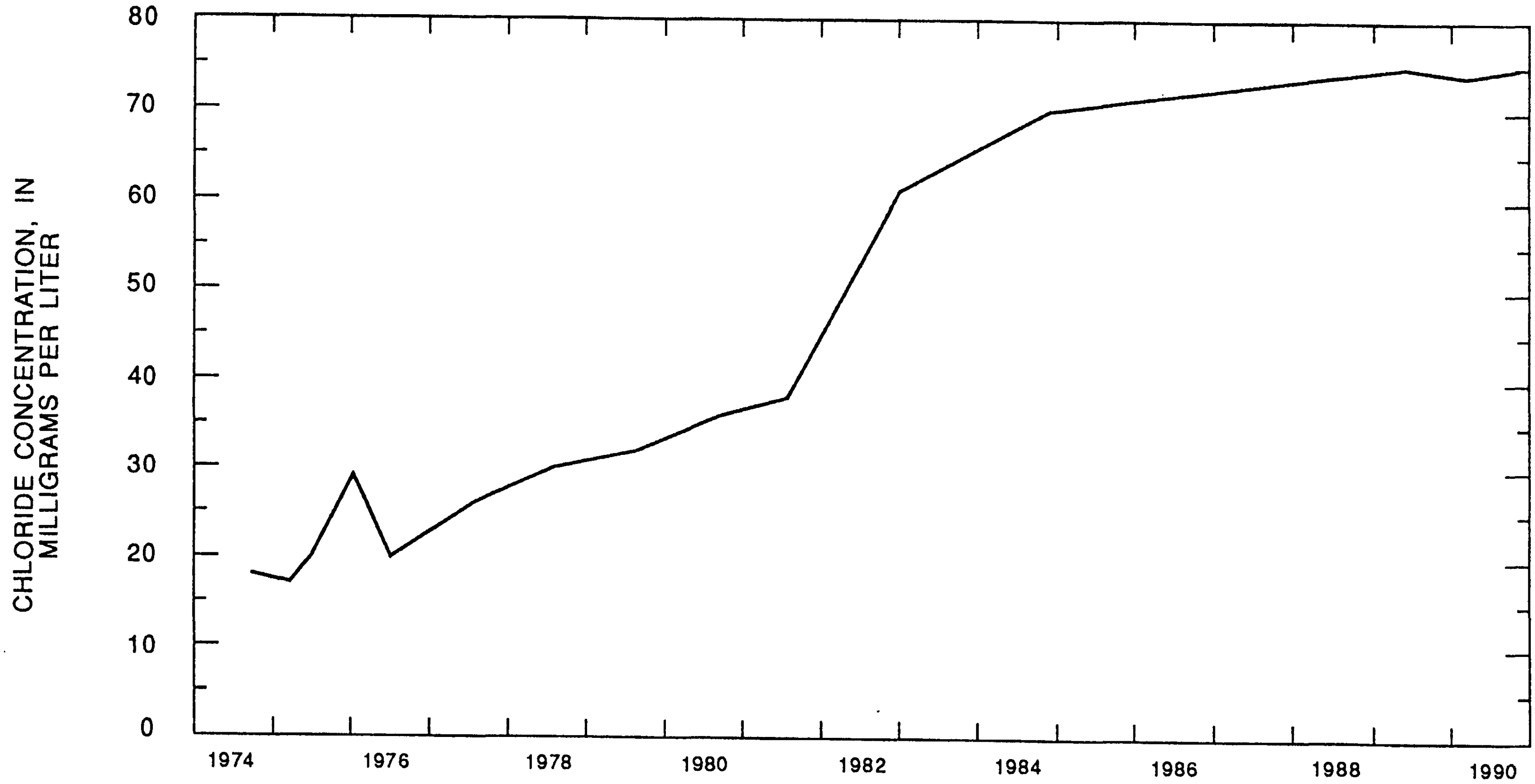


Figure 17. Chloride concentration in water from well SJB-165 completed in the Abita aquifer.

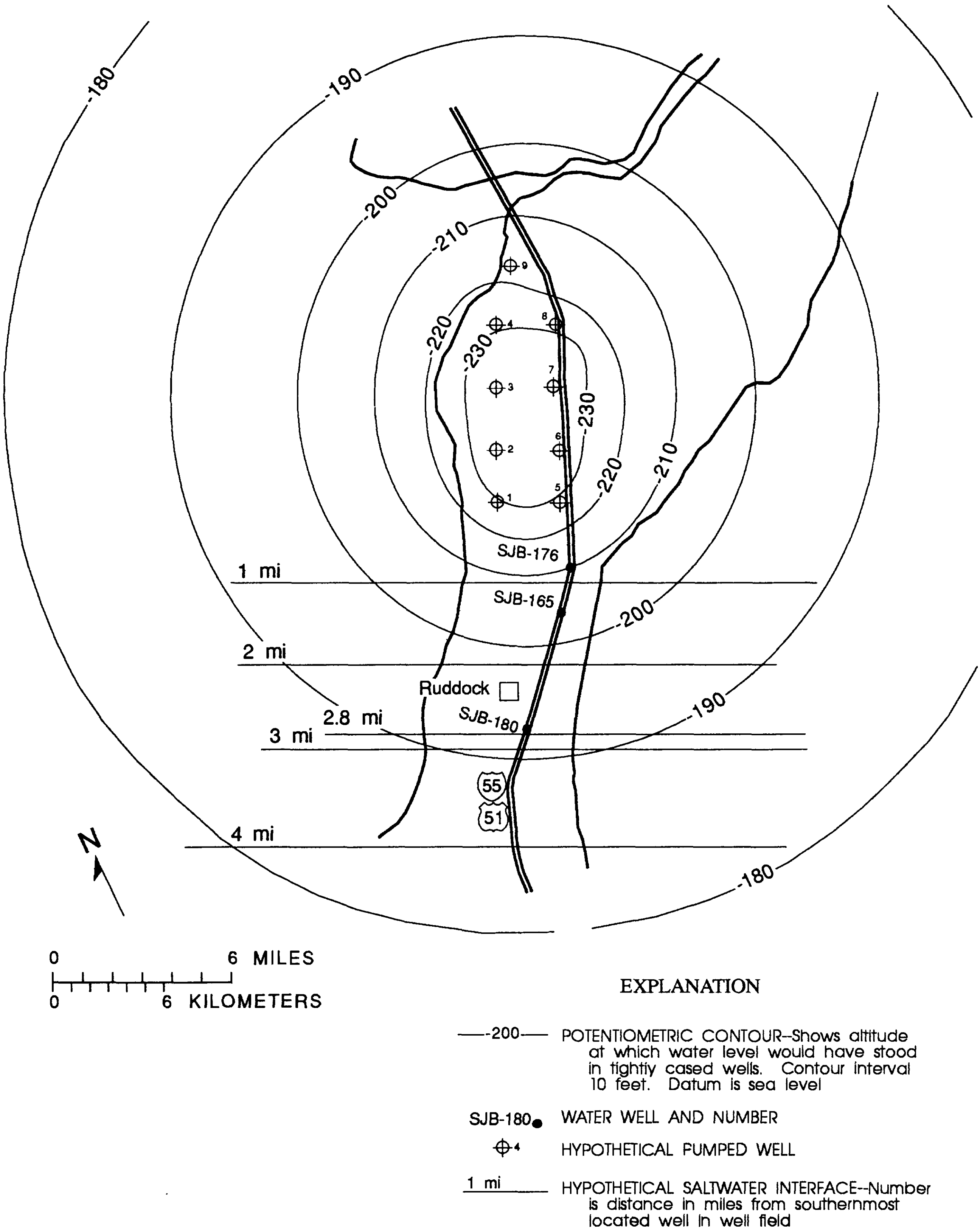


Figure 18. Estimated drawdowns and positions of saltwater-freshwater interface in a hypothetical well field withdrawing 31.5 million gallons per day from the Abita aquifer, Ruddock, La.

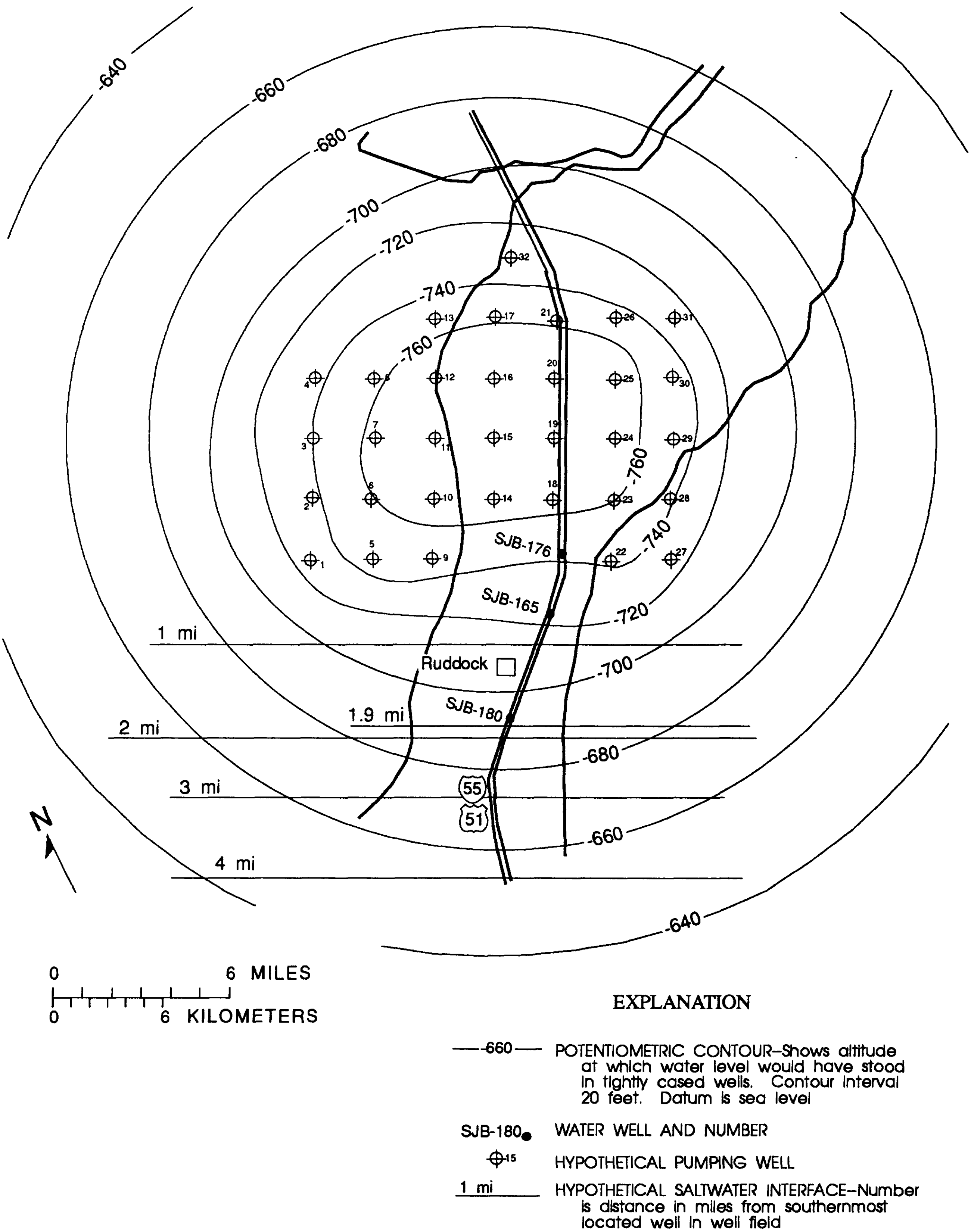


Figure 19. Estimated drawdowns and positions of saltwater-freshwater interface in a hypothetical well field withdrawing 112 million gallons per day from the Abita aquifer, Ruddock, La.

times were estimated, based on the distance of the interface from the southern edge of the hypothetical well fields. The interface travel times for the well field with a pumping rate between 31.5 and 112 Mgal/d would fall somewhere between the calculated time-of-travel values calculated for the two well fields analyzed.

Based on the Theis analysis of the Abita aquifer in northern St. John the Baptist Parish, drawdown maps were constructed. Numerical values for drawdown were calculated, based on assumed hydrologic parameter values, pumping rates, and pumping periods. These drawdown values were then contoured to generate maps of the water-level surface. The original water-level surface was assumed to be horizontal with zero drawdown and were assumed to be at land surface.

Application of the Theis method of analysis to the Abita aquifer indicated that most of the drawdown in the aquifer would occur in the first year of pumping. Additional pumping of the aquifer between the end of the first year and the tenth year produced only slight additional drawdowns in the aquifer. Due to the relatively small additional drawdown after 1 yr, the water-level surface generated by 1yr of continuous pumping was selected to represent steady-state conditions for the purposes of the analysis and was used to determine flow gradients in the aquifer. These gradients were then used with a range of effective porosities and a hydraulic conductivity of 120 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978, p. 7) to calculate flow velocities between equipotential lines. Flow velocities were then summed along flow paths to calculate total travel time. Assuming a constant pumping rate, ground-water flow rates increase as porosity decreases.

The general assumptions applied when analyzing the response of an aquifer to pumping through the use of the Theis methods is discussed in the section, "Potential for Development." An additional assumption applied to this multiple well analysis concerns the additive qualities of the Theis equation that arises from the Theis equation being a solution of the linear partial differential equation (Jacob, 1950):

$$\frac{\partial^2 h}{\partial r^2} + \frac{1}{r}\frac{\partial h}{\partial r} = \frac{S}{T}\frac{\partial h}{\partial t}, \qquad (1)$$

where

h is hydraulic head, ft;
S is storativity, dimensionless;
r is radial distance measured from pumped well, ft;
T is transmissivity $[(ft^3/d)/ft^2]ft$; and
t is time, day.

The additive qualities of linear partial differential equations allow the drawdown of hydraulic head at any point in a confined aquifer in which more than one well is pumping to be equal to the sum of the drawdowns of each of the wells operating independently (Freeze and Cherry, 1979, p. 327).

Data used in Hypothetical Pumping Analysis

St. John the Baptist Parish Water District pumpage records were used for withdrawal data. For periods of missing record, withdrawals were estimated using data preceding and following the period of absent record. Aquifer test data from public-supply well SJB-176 provided values for hydraulic parameters for approximation in the analysis. Regional water-level and hydraulic parameter trends were used as guides for adjusting hydrologic values.

The effective porosity of the Abita aquifer varies locally due to the heterogeneity that is characteristic of fluvial and deltaic aquifer systems. Values for aquifer porosity vary with sorting, the amount of clay mixed with the sand particles, and the size of the particles that make up the aquifer matrix. To facilitate the analysis of the effects of ground-water withdrawals, porosity was allowed to range from 20 to 30 percent (Cardwell and others, 1966, p. 20).

Water withdrawal rates of 31.5 and 112 Mgal/d were selected to analyze the aquifer response to pumping. Average values for transmissivity and storage coefficient were selected that would characterize the behavior of the Abita aquifer across northern and central St. John the Baptist Parish. The thickening of the Abita aquifer in central St. John the Baptist Parish, south of public-supply well SJB-165, necessitated a range of transmissivity values that would characterize the aquifer throughout the area. Based on the thickness of the Abita aquifer south of the Baton Rouge fault zone and its hydraulic conductivity of 120 $(ft^3/d)/ft^2$ (Nyman and Fayard, 1978, p. 7, table 4), aquifer transmissivity values range from 15,600 to 38,000 $[(ft^3/d)/ft^2]ft$. The average value of transmissivity selected for calculations was 26,700 $[(ft^3/d)/ft^2]ft$. A storage coefficient range of 0.0001 to 0.001 was estimated for the confined aquifers of southeastern Louisiana. The storage coefficient value of 0.0001 was selected as a representative regional aquifer value (Nyman and Fayard, 1978, fig. 5).

Results of Analysis

Application of the Theis analysis to the Abita aquifer for a 31.5 Mgal/d well field (fig. 18) produced five sets of interface time-of-travel periods that ranged from a minimum to a maximum time value depending on an assumed porosity. These time-of-travel periods were calculated for five hypothetical interface locations as discussed on page 36 of this report.

The time-of-travel for an interface located 2.8 mi south of the well field ranged from 34 to 51 yr. The location of this hypothetical interface was selected based on the results of test well SJB-180. Minimum time-of-travel estimates calculated for the other hypothetical interface locations ranged from 7 to 64 yr with maximum time-of-travel estimates ranging from 10 to 96 yr (table 4).

Table 4. Estimated rate of movement of the freshwater-saltwater interface for selected well field configurations and pumping rates

[Mgal/d, million gallons per day]

Number of wells	Pumping rate per well (Mgal/d)	Total pumping rate (Mgal/d)	Distance of interface from southern edge of well field (mile)	Travel time in years for assumed porosity of 20 percent	30 percent
9	3.5	31.5	1	6.6	10.0
			2	19.7	29.5
			[1]2.8	34.1	51.2
			3	38.9	58.3
			4	64.0	96.0
32	3.5	112	1	4.8	5.3
			[1]1.9	9.7	14.4
			2	10.2	15.3
			3	16.6	24.8
			4	24.6	36.9

[1] Actual distance of freshwater-saltwater interface in the Abita aquifer from southern edge of hypothetical well field, based on data from test well SJB-180.

Estimates of interface time-of-travel for five hypothetical freshwater-saltwater interface locations also were calculated for the 112 Mgal/d well field. The time-of-travel estimated for a hypothetical interface located 1.9 mi from the southern edge of the well field ranged from 10 to 14 yr. This hypothetical interface location was based on the results of test well SJB-180. Minimum estimates for time-of-travel calculated for other hypothetical interface locations ranged from 5 to 25 yr with maximum time-of-travel ranging from 5 to 37 yr (table 4).

Interpretation of the natural gamma ray log in figure 16 indicates that the Abita aquifer has less clay in the lower part than in the upper part. If a fully penetrating well were installed in this aquifer, the higher hydraulic conductivity of the lower part of the aquifer (based on less clay in this part of the aquifer) would result in a higher percentage of flow from that section of the aquifer. This would allow the lower part of the interface to arrive at a pumping well before all of the overlying freshwater in the top two thirds of the aquifer had been withdrawn. Because the computations of ground-water flow velocity assume uniform flow throughout the vertical extent of the aquifer to be the primary ground-water flow mechanism, any layered conductivity effect with high chloride water in the higher conductivity layer would decrease the useful life of a producing well field below the estimated well-field life.

Because the Theis analysis of aquifer response to pumping assumes there is no leakage through the confining units separating the Abita aquifer from aquifers above and below it, actual drawdown due to pumping may be less than computed in the analysis. The reduction in the drawdown in the potentiometric surface in the aquifer will slow the advancement of the freshwater-saltwater interface toward the hypothetical pumping field location. However, because test wells Ta-577 and Ta-578 had not been drilled at the time of this analysis and the magnitude of the displacement of the aquifers at the Baton Rouge fault zone was not known, it had been assumed that maximum recharge of freshwater to the aquifer from the hydrologic system north of the fault zone was possible. Data that will allow estimation of ground-water flow reduction at the fault zone are not available, but some reduction in freshwater flow to the pumped wells south of the fault zone may be assumed based on the effects of the Baton Rouge fault zone on the aquifer system in the metropolitan Baton Rouge area (Whiteman, 1979). Any reduction in freshwater recharge from the north will increase the rate of advance of the freshwater-saltwater interface movement toward any well field.

Location of Freshwater-Saltwater Interface

Due to the variability of the hydrologic and geologic characteristics of southeastern Louisiana aquifers, the line representing the interface between freshwater and saltwater is not straight as shown in figures 18 and 19 and locally may be quite sinuous. For this reason, the location of the freshwater-saltwater interface at well SJB-180 can only be used as point-source information when considering development of the Abita aquifer. Additional test wells would provide a more definitive confirmation of the general orientation of the interface locally with respect to the southern edge of the well field and provide the data needed for a more accurate assessment of the useful life of the hypothetical well field.

The life of a well field producing water for public supply from the Abita aquifer in St. John the Baptist Parish can be maximized if the southern edge of the well field is placed as far north from the southern limit of freshwater as possible. Limiting withdrawal rates to approximate recharge rates would also extend the life of the well field and prevent the unacceptable lowering of the potentiometric surface. Due to the possible disruption of flow at the Baton Rouge fault zone, recharge rates at the Abita-Covington aquifer interface would be difficult to estimate. For a given well field location, any increase in withdrawal rate above 112 Mgal/d would accelerate the effects of saltwater encroachment and vertical leakage, thus decreasing the useful life of the hypothetical well field. Once saltwater encroachment affected the southernmost public supply wells in the well field, careful management of the well field would be needed to prevent a rapid reduction in the usefulness of the rest of the field.

SUMMARY AND CONCLUSIONS

Jefferson Parish needs an emergency/alternative water supply to its current (1990) primary supply source, the Mississippi River. Ground water in the area surrounding Jefferson Parish has been studied to determine its potential as an alternative source to the Mississippi River.

The study area lies within the Mississippi River Deltaic Plain and is underlain by sediments deposited during the Tertiary and Quarternary periods. The complex sequence of clay, sand, and gravel beds of the aquifers and confining units in the area are typical of southeastern Louisiana. Eight major aquifers consisting of thick sand units underlie the study area; they are, in descending order, the shallow, upper Ponchatoula, lower Ponchatoula, Abita, Covington, Tchefuncta, Hammond, and Amite.

A fault zone, referred to as the Baton Rouge fault, crosses southern Tangipahoa Parish. The results of a test-well drilling program indicated that the Baton Rouge fault zone disrupts ground-water flow in the aquifers of intermediate depth in the study area. Analyses of geophysical logs of water-test wells and adjacent oil-test wells indicated that the deep aquifers south of the fault zone have been displaced from 350 to 400 ft, with the deeper aquifers not in hydraulic connection with the ground-water flow system north of the fault.

The ground-water resources of southeastern Louisiana are immense and the quality of ground water in Tangipahoa Parish is suitable for most uses. The freshwater aquifers of the southeastern Louisiana hydrologic system generally yield a soft sodium bicarbonate type water with a dissolved-solids concentration of less than 300 mg/L. The quality of water in these aquifers generally meets the U.S. Environmental Protection Agency's standards for public supply.

The aquifer systems underlying Tangipahoa Parish and adjacent areas currently (1990) supply about 19 Mgal/d of high-quality ground water for public supply. Based on the thickness and hydrologic characteristics of the aquifers in southern Tangipahoa Parish, a minimum of 28 Mgal/d could be withdrawn from a single well field. At the current (1990) rate of withdrawal, the hydrologic system appears to be approaching equilibrium. Substantial increases in pumping from the aquifer system would result in renewed water-level declines throughout the hydrologic system until a new equilibrium is established.

A test well, Ta-576, located at the Bedico Community Center in southern Tangipahoa Parish, penetrated eight aquifers. Total thickness of freshwater sand beds penetrated by the 3,003-foot test hole was more than 1,900 ft. Resistivity values from the electric log typically averaged 200 ohm-meters, which indicated high quality water, low in concentrations of dissolved solids and chloride.

A Theis analysis of the Abita aquifer at Ruddock in St. John the Baptist Parish was completed for two of three hypothetical well fields. For a hypothetical well field with a pumping rate of 112 Mgal/d and a freshwater-saltwater interface located 1.9 mi from the southernmost well, the interface could arrive at the outer perimeter of the well field in 10 to 14 yr.

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Appendix. Water-quality data for selected wells in the study area

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; --, no data; mg/L, milligrams per liter; µg/L, micrograms per liter. Geologic unit: ABIT, Abita aquifer; HMND, Hammond aquifer; AMIT, Amite aquifer; TCFC, Tchefuncta aquifer; PNCLU, upper Ponchatoula aquifer; PNCLL, lower Ponchatoula aquifer; CVGN, Covington aquifer; UPTC, upland terrace deposits]

Well number	Date	Time	Depth (feet)	Geo-logic unit	Spe-cific con-duct-ance (µS/cm)	pH (stand-ard units)	Temper-ature water (deg. C)	Color (plat-inum-cobalt units)
				St. John the Baptist Parish				
SJB-165	03-14-90	1115	3,000	ABIT	--	--	--	70
	11-13-90	1245		ABIT	987	9.0	34.0	50
	01-15-91	0930		ABIT	--	--	37.0	--
	05-03-91	0900		ABIT	1000	--	33.5	--
SJB-176	03-14-90	1200	2,950	ABIT	--	--	--	40
	11-13-90	1130		ABIT	731	8.8	34.5	30
	01-15-91	0915		ABIT	--	--	38.0	--
	05-03-91	0915		ABIT	753	--	33.5	--
SJB-180	01-29-91	1210	3,091	ABIT	780	--	38.5	--
				St. Tammany Parish				
ST-568	04-16-90	1140	2,545	HMND	268	6.9	35.0	0
	01-22-91	1300		HMND	266	8.2	33.0	--
	05-16-91	0900		HMND	261	7.8	33.0	--
ST-592	04-16-90	1305	2,670	AMIT	425	8.4	31.0	5
ST-653	04-17-90	0830	2,305	TCFC	295	8.0	31.0	0
ST-685	04-17-90	1310	2,629	HMND	272	8.1	31.0	0
ST-712	04-10-90	1615	402	PNCLU	189	7.4	21.0	15
	01-22-91	1100		PNCLU	204	7.2	21.0	--
ST-726	04-18-90	0850	2,254	AMIT	272	7.8	30.0	0
ST-971	06-05-90	0930	960	PNCLL	225	7.7	24.0	0
ST-5747Z	06-05-90	1110	860	PNCLL	235	7.8	23.0	5
				Tangipahoa Parish				
Ta-397	04-10-90	1045	1,857	CVGN	236	7.6	21.0	0
Ta-434	06-06-90	1105	2,307	HMND	184	7.6	30.0	0
Ta-570	03-08-90	1230	1,820	CVGN	243	8.8	26.0	0
Ta-571	03-08-90	1430	525	PNCLU	206	7.3	21.0	0
Ta-572	06-06-90	1520	218	UPTC	215	7.6	23.0	10
Ta-573	04-18-90	1220	110	UPTC	244	7.0	21.0	0
Ta-576	01-17-91	1400	1,922	CVGN	292	8.8	29.0	0
Ta-577	01-17-91	1010	1,134	PNCLL	4720	7.9	26.0	0
Ta-578	01-17-91	1130	840	PNCLL	246	7.6	24.0	0
	05-16-91	1050		PNCLL	244	7.8	24.0	--
Ta-579	01-17-91	1400	1,200	PNCLL	179	7.1	25.0	0
Ta-5673Z	04-11-90	0945	735	PNCLL	234	6.9	21.0	0
Ta-6043Z	04-11-90	1300	1,110	PNCLL	186	7.4	24.5	0
	01-22-91	0930		PNCLL	189	7.4	25.0	--

Appendix. Water-quality data for selected wells in the study area--Continued

Well number	Date	Hardness total (mg/L as $CaCo_3$)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity water whole total fixed end-point titration field (mg/L as $CaCo_3$)	Sulfate dissolved (mg/L as So_4)	Chloride, dissolved (mg/L as Cl)
				St. John the Baptist Parish					
SJB- 165	03-14-90	--	--	--	--	--	--	--	74
	11-13-90	4	1.4	<0.2	230	1.4	404	4.6	75
	01-15-91	--	--	--	--	--	--	--	76
	05-03-91	--	--	--	--	--	--	--	76
SJB- 176	03-14-90	--	--	--	--	--	--	--	19
	11-13-90	3	1.0	<0.2	180	1.1	351	7.4	22
	01-15-91	--	--	--	--	--	--	--	22
	05-03-91	--	--	--	--	--	--	--	24
SJB- 180	01-29-91	--	--	--	--	--	--	--	44
				St. Tammany Parish					
ST- 568	04-16-90	5	1.6	0.3	60	<1.0	118	9.6	3.2
	01-22-91	--	--	--	--	--	--	--	--
	05-16-91	--	--	--	--	--	123	--	--
ST- 592	04-16-90	4	1.4	<0.2	96	<1.0	200	12	2.4
ST- 653	04-17-90	4	1.4	<0.2	66	<1.0	135	8.6	3.1
ST- 685	04-17-90	8	3.1	<0.2	57	<1.0	125	8.7	3.0
ST- 712	04-10-90	14	4.1	0.9	42	2.2	--	10	2.2
	01-22-91	--	--	--	--	--	97	--	--
ST- 726	04-18-90	2	1.0	<0.2	60	<1.0	123	9.6	2.9
ST- 971	06-05-90	5	1.5	0.3	50	1.0	103	10	3.4
ST-5747Z	06-05-90	5	1.5	0.2	53	0.90	109	8.4	4.1
				Tangipahoa Parish					
Ta- 397	04-10-90	28	10	0.8	48	1.4	122	11	2.6
Ta- 434	06-06-90	--	<1.0	<0.2	41	<1.0	83	6.2	4.0
Ta- 570	03-08-90	10	3.2	0.5	51	<1.0	115	7.6	3.1
Ta- 571	03-08-90	19	5.6	1.1	40	1.6	96	9.8	2.1
Ta- 572	06-06-90	13	4.1	0.7	44	1.8	100	7.8	2.2
Ta- 573	04-18-90	33	9.4	2.2	43	2.2	126	0.8	2.2
Ta- 576	01-17-91	--	1.5	<0.2	65	<1.0	135	7.0	3.0
Ta- 577	01-17-91	98	25	8.5	970	3.9	270	15	1300
Ta- 578	01-17-91	3	0.9	0.2	53	1.0	114	8.6	2.0
	05-16-91	--	--	--	--	--	119	--	--
Ta- 579	01-17-91	9	2.8	0.4	37	1.4	76	7.8	2.9
Ta-5673Z	04-11-90	5	1.5	0.3	55	1.2	111	12	3.1
Ta-6043Z	04-11-90	9	2.8	0.4	41	1.2	88	11	2.2
	01-22-91	--	--	--	--	--	83	--	--

Appendix. Water-quality data for selected wells in the study area--Continued

Well number	Date	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 deg. C dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen, No_2+No_3 dissolved (mg/L as N)	Phosphorus dissolved (mg/L as P)	Antimony, dissolved (µg/L as Sb)	Arsenic dissolved (µg/L as As)
St. John the Baptist Parish									
SJB- 165	03-14-90	–	–	–	–	–	–	–	–
	11-13-90	0.9	27	591	–	0.03	0.48	<1	<1
	01-15-91	–	–	–	–	–	–	–	–
	05-03-91	–	–	–	–	–	–	–	–
SJB- 176	03-14-90	–	–	–	–	–	–	–	–
	11-13-90	0.8	27	447	–	<0.02	0.40	<1	<1
	01-15-91	–	–	–	–	–	–	–	–
	05-03-91	–	–	–	–	–	–	–	–
SJB- 180	01-29-91	–	–	–	–	–	–	–	–
St. Tammany Parish									
ST- 568	04-16-90	0.2	57	207	–	<0.02	0.50	–	<1
	01-22-91	–	–	–	–	0.02	–	–	–
	05-16-91	–	–	–	–	–	0.45	–	–
ST- 592	04-16-90	0.3	23	257	–	<0.02	0.23	–	<1
ST- 653	04-17-90	0.3	53	214	–	<0.02	0.53	–	<1
ST- 685	04-17-90	0.1	24	178	–	<0.02	0.18	–	<1
ST- 712	04-10-90	<0.2	46	154	164	<0.02	0.14	–	2
	01-22-91	–	–	–	–	–	–	–	–
		–		–	–	–	–	–	–
ST- 726	04-18-90	<0.2	23	169	–	<0.02	0.24	–	<1
ST- 971	06-05-90	0.2	46	172	174	<0.02	0.19	–	2
ST-5747Z	06-05-90	0.2	44	175	178	<0.02	0.21	–	3
Tangipahoa Parish									
Ta- 397	04-10-90	<0.2	42	181	189	<0.02	0.12	–	<1
Ta- 434	06-06-90	0.2	43	192	–	<0.02	0.40	–	–
Ta- 570	03-08-90	0.1	52	187	–	<0.02	0.31	–	<1
Ta- 571	03-08-90	0.1	52	163	170	<0.02	0.14	–	2
Ta- 572	06-06-90	<0.2	43	164	164	<0.02	0.18	–	7
Ta- 573	04-18-90	<0.2	31	161	167	<0.02	0.12	–	<1
Ta- 576	01-17-91	0.2	30	188	–	<0.02	–	–	<1
Ta- 577	01-17-91	0.8	29	2290	2540	<0.02	–	–	<1
Ta- 578	01-17-91	0.2	49	170	183	<0.02	–	–	<1
	05-16-91	–	–	–	–	–	0.17	–	–
Ta- 579	01-17-91	<0.2	57	149	155	<0.02	–	–	<1
Ta-5673Z	04-11-90	<0.2	42	169	182	<0.02	0.20	–	1
Ta-6043Z	04-11-90	<0.2	56	157	167	<0.02	0.30	–	<1
	01-22-91	–	–	–	–	–	–	–	–

Appendix. Water-quality data for selected wells in the study area--Continued

Well number	Date	Barium, dis-solved (µg/L as Ba)	Beryllium, dis-solved (µg/L as Be)	Cadmium dis-solved (µg/L as Cd)	Chromium, dis-solved (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Iron, dis-solved (µg/L as Fe)	Lead, dis-solved (µg/L as Pb)
				St. John the Baptist Parish				
SJB-165	03-14-90	--	--	--	--	--	--	--
	11-13-90	<100	<10	<1	<1	<1	60	1
	01-15-91	--	--	--	--	--	--	--
	05-03-91	--	--	--	--	--	--	--
SJB-176	03-14-90	--	--	--	--	--	--	--
	11-13-90	<100	<10	<1	<1	<1	<25	<1
	01-15-91	--	--	--	--	--	--	--
	05-03-91	--	--	--	--	--	--	--
SJB-180	01-29-91	--	--	--	--	--	--	--
				St. Tammany Parish				
ST-568	04-16-90	<100	--	<1	<10	<1	30	<1
	01-22-91	--	--	--	--	--	--	--
	05-16-91	--	--	--	--	--	--	--
ST-592	04-16-90	<100	--	<1	<10	<1	<10	<1
ST-653	04-17-90	<100	--	<1	<10	<1	40	<1
ST-685	04-17-90	<100	--	<1	<10	<1	10	<1
ST-712	04-10-90	<100	--	<1	<10	<1	--	<1
	01-22-91	--	--	--	--	--	510	--
ST-726	04-18-90	<100	--	<1	<10	<1	<10	<1
ST-971	06-05-90	<100	--	<1	<10	<1	50	<1
ST-5747Z	06-05-90	<100	--	<1	<10	<1	70	<1
				Tangipahoa Parish				
Ta-397	04-10-90	<100	--	<1	<10	<1	240	<1
Ta-434	06-06-90	<100	--	<1	<10	<1	1100	<1
Ta-570	03-08-90	<100	--	<1	<10	1	120	<1
Ta-571	03-08-90	<100	--	<1	<10	<1	20	<1
Ta-572	06-06-90	<100	--	<1	<10	<1	110	<1
Ta-573	04-18-90	<100	--	<1	<10	<1	50	<1
Ta-576	01-17-91	<100	--	<1	<1	<1	40	<1
Ta-577	01-17-91	800	--	<1	<1	<1	460	<1
Ta-578	01-17-91	<100	--	<1	<1	<1	50	<1
	05-16-91	--	--	--	--	--	--	--
Ta-579	01-17-91	<100	--	<1	<1	<1	110	<1
Ta-5673Z	04-11-90	<100	--	<1	<10	<1	80	<1
Ta-6043Z	04-11-90	<100	--	<1	<10	<1	20	<1
	01-22-91	--	--	--	--	--	--	--

Appendix. Water-quality data for selected wells in the study area--Continued

Well number	Date	Manganese, dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Zinc, dissolved (µg/L as Zn)	Carbon, organic dissolved (mg/L as C)
				St. John the Baptist Parish				
SJB- 165	03-14-90	–	–	–	–	–	–	–
	11-13-90	<20	<0.1	<1	<1	–	<10	2.2
	01-15-91	–	–	–	–	–	–	–
	05-03-91	–	–	–	–	–	–	–
SJB- 176	03-14-90	–	–	–	–	–	–	–
	11-13-90	<20	<0.1	<1	<1	–	<10	3.0
	01-15-91	–	–	–	–	–	–	–
	05-03-91	–	–	–	–	–	–	–
SJB- 180	01-29-91	–	–	–	–	–	–	–
				St. Tammany Parish				
ST- 568	04-16-90	29	<0.1	–	<1	<1	<10	0.9
	01-22-91	–	–	–	–	–	–	–
	05-16-91	–	–	–	–	–	–	–
ST- 592	04-16-90	10	<0.1	–	<1	<1	<10	1.0
ST- 653	04-17-90	42	<0.1	–	<1	<1	<10	0.4
ST- 685	04-17-90	27	<0.1	–	<1	<1	<10	0.6
ST- 712	04-10-90	110	<0.1	–	<1	<1	10	0.3
	01-22-91	–	–	–	–	–	–	–
ST- 726	04-18-90	17	<0.1	–	<1	<1	<10	0.3
ST- 971	06-05-90	10	<0.1	–	<1	<1	<10	0.5
ST-5747Z	06-05-90	10	<0.1	–	<1	<1	<10	0.5
				Tangipahoa Parish				
Ta- 397	04-10-90	73	<0.1	–	<1	<1	10	0.4
Ta- 434	06-06-90	130	<0.1	–	–	<1	<10	0.5
Ta- 570	03-08-90	170	<0.1	–	<1	<1	30	0.6
Ta- 571	03-08-90	150	<0.1	–	<1	<1	<10	0.5
Ta- 572	06-06-90	54	<0.1	–	<1	<1	<10	0.5
Ta- 573	04-18-90	75	<0.1	–	<1	<1	200	0.4
Ta- 576	01-17-91	<20	<0.1	–	<1	–	<10	0.4
Ta- 577	01-17-91	71	<0.1	–	<1	<1	10	1.0
Ta- 578	01-17-91	10	<0.1	–	<1	<1	<10	0.3
	05-16-91	–	–	–	–	–	–	–
Ta- 579	01-17-91	<20	<0.1	–	<1	<1	<10	0.2
Ta-5673Z	04-11-90	21	<0.1	–	<1	<1	<10	0.2
Ta-6043Z	04-11-90	65	<0.1	–	<1	<1	<10	0.3
	01-22-91	–	–	–	–	–	–	–