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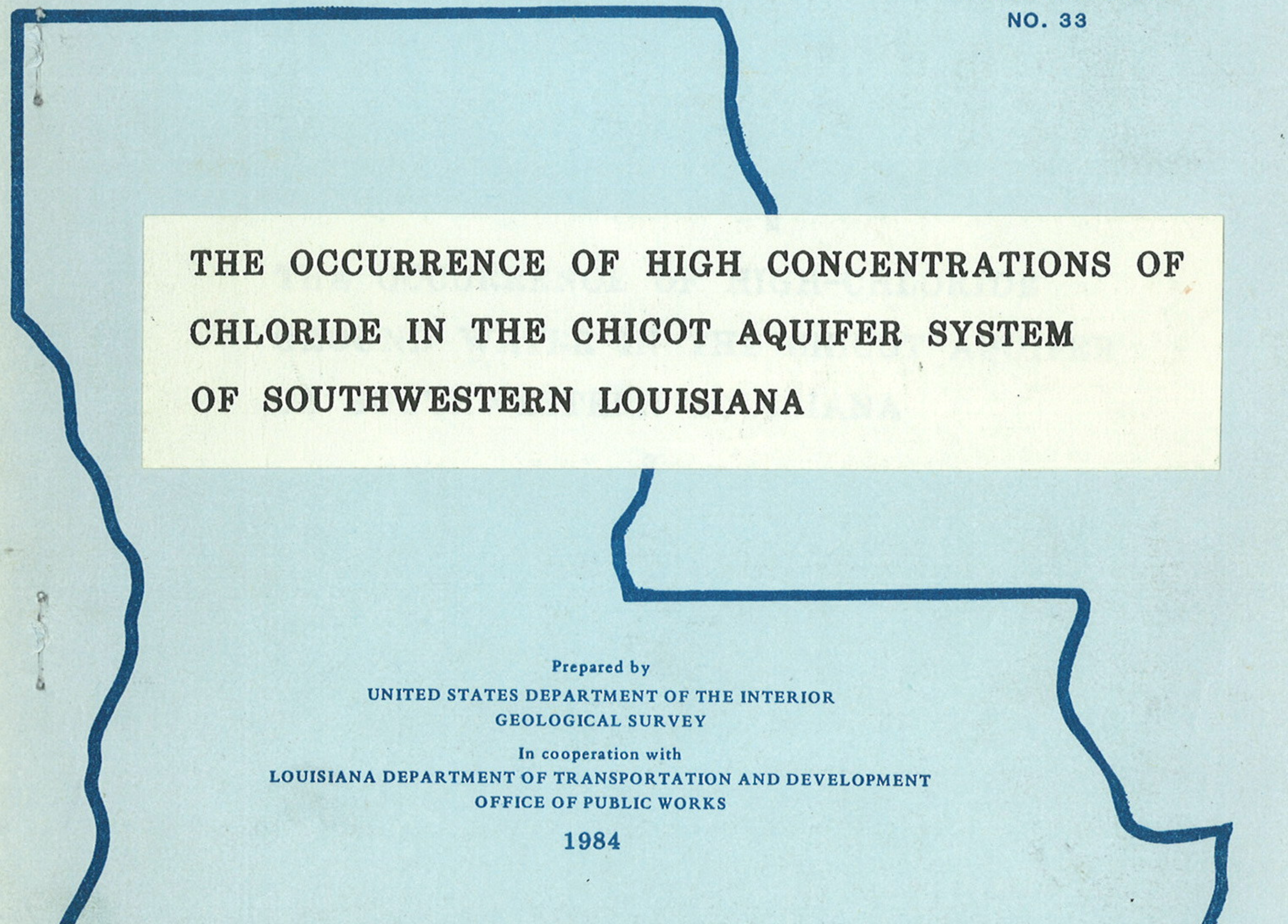
WATER RESOURCES
TECHNICAL REPORT
NO. 33



THE OCCURRENCE OF HIGH CONCENTRATIONS OF CHLORIDE IN THE CHICOT AQUIFER SYSTEM OF SOUTHWESTERN LOUISIANA

Prepared by
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
In cooperation with
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
OFFICE OF PUBLIC WORKS

1984

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Water Resources

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By

Dale J. Nyman

U.S. Geological Survey

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GLOSSARY

Aquifer

A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian well

A well in which the water level rises above the base of the bed confining the aquifer; an artesian well may be either flowing or nonflowing.

Base of freshwater

Top of the transition zone between freshwater and saline water.

Brackish water

An indefinite term for water with a salinity intermediate between that of normal seawater and that of normal freshwater (American Geological Institute, 1980, p. 79).

Brine

Water with dissolved solids exceeding 35,000 mg/L (Hem, 1970, p. 219).

Cone of depression

The depression, roughly conical in shape, produced in a potentiometric surface by pumping (or artesian flow).

Confining bed

A body of "impermeable" material stratigraphically adjacent to one or more aquifers that serves to confine water in the aquifer so that the water level rises above the base of the confining bed.

Dip

The angle at which a stratum or any planar feature is inclined from the horizontal.

Freshwater

Variously defined as water containing less than 1,000 mg/L dissolved solids and (or) water containing less than 250 mg/L chloride or less. In this report freshwater is defined as having 250 mg/L of chloride or less.

Freshwater-saltwater interface

The boundary surface between two fluids of different density (American Geological Institute, 1980, p. 321); the boundary is the sloping surface between freshwater and slightly saline water in this report.

High-chloride water

Water containing a significantly higher chloride concentration than is typically found locally.

Hydraulic conductivity

The volume of water at the existing kinematic viscosity that will move through a unit area of an isotropic porous medium in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. Replaces the term "field coefficient of permeability." The hydraulic conductivity multiplied by 7.48 is equal to the coefficient of permeability. For conversion of hydraulic conductivity in feet per day to meters per day, multiply by 0.3048.

Hydraulic (water-level) gradient

The difference in head per unit distance measured normal to lines connecting points of equal head. The hydraulic gradient, hydraulic conductivity (permeability), and porosity determine the velocity, or rate of ground-water movement.

Milligrams per liter (mg/L)

For the purpose of converting to the metric system, the unit "milligrams per liter" replaces the unit "parts per million," formerly used by the U.S. Geological Survey. The two units are equivalent at dissolved-solids concentrations less than about 7,000 mg/L.

Potentiometric (water-level) surface

The surface which represents the static head with reference to a specified datum, such as mean sea level. As related to an aquifer, it is defined by the levels to which water will rise in tightly cased wells. The water table is a particular potentiometric surface.

Recharge

The process by which water is absorbed and added to the zone of saturation, either directly into a formation or indirectly by way of another formation.

Saline water

Water with a dissolved solids content between 1,000 and 35,000 mg/L (Hem, 1970, p. 219). Three classes of salinity were defined according to the concentration of dissolved solids in milligrams per liter: (1) slightly saline water (1,000 to 3,000), (2) moderately saline (3,000 to 10,000), and (3) very saline (10,000 to 35,000).

Saltwater coning (or vertical intrusion)

A phenomenon caused when two fluids of different density at dynamic equilibrium are made dynamically unstable because of pumping one of the fluids (Muskat, 1946, p. 482).

Saltwater encroachment (or intrusion)

The phenomenon occurring when a body of saline water, because of its greater density, invades a body of freshwater. The balance between the freshwater and salty water, in static situations, is expressed by the Ghyben-Herzberg equation.

Saltwater wedge

Saltwater is generally wedge shaped as it invades a body of freshwater. The leading edge of the wedge is at the base of the aquifer, the top of the wedge intersects the top of the aquifer in the coastal zone.

Transmissivity

The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths. (Formerly termed "transmissibility," defined as the rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated height of the aquifer under a unit hydraulic gradient.) The transmissivity multiplied by 7.48 is equal to the coefficient of transmissibility. For conversion of transmissivity in feet squared per day to meters squared per day, multiply by 0.0929.

Water table

That surface in an unconfined water body at which the pressure is atmospheric (water level below the top of the aquifer). It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water. In wells which penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of ground-water flow exists.

FACTORS FOR CONVERTING INCH-POUND UNITS TO THE INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply	By	To obtain
billion gallons per day (Bgal/d)	3,785,000	cubic meter per day (m^3/d)
foot (ft)	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
square foot per day (ft^2/d)	0.09290	square meter per day (m^2/d)
gallon per minute (gal/min)	0.003785	cubic meter per minute (m^3/min)
gallon per minute per foot [(gal/min)/ft]	0.0002070	cubic meter per second per meter [$(m^3/s)/m$]
gallon per minute per square mile [$(gal/min)/mi^2$]	0.00002436	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
million gallons per day (Mgal/d)	3,785	cubic meter per day (m^3/d)
grains per gallon (gr/gal) of sodium chloride (NaCl)	17.1	milligram per liter (mg/L) of chloride (Cl)
milligram per liter (mg/L)	1	part per million (ppm)
mile (mi)	1.609	kilometer (km)

To convert temperature in degree Fahrenheit (°F) to degree Celsius (°C), subtract 32 and divide by 1.8.

THE OCCURRENCE OF HIGH CONCENTRATIONS OF CHLORIDE IN THE CHICOT AQUIFER SYSTEM OF SOUTHWESTERN LOUISIANA

By Dale J. Nyman

ABSTRACT

High-chloride water in the Chicot aquifer system of southwestern Louisiana occurs in the coastal zone and in isolated bodies north of the coast. Before 1900 the natural flow of freshwater was gulfward, but industrial and irrigation pumping have reversed the water-level gradient and water now flows northward from the coast. The small northward water-level gradient has generally caused no detectable change in salinity in the coastal area, indicating that, in most of the area, saltwater encroachment is not a current problem.

However, despite the slow rate of saltwater movement local areas are particularly susceptible to encroachment. In the "upper sand" of the Chicot aquifer system near Franklin (St. Mary Parish), Gueydan (Vermilion Parish), and Sweet Lake (south of Lake Charles), saltwater has moved northward toward pumping centers or has a potential for movement. Encroachment is indicated near Sweet Lake by chloride concentrations that have been increasing more than 20 milligrams per liter per year in the "upper sand," and in the southern part of Lake Charles where chloride concentrations are increasing about 25 milligrams per liter per year in the "700-foot" sand. Changes in chloride concentration generally correspond to changes in pumping at pumping centers and the consequent increased rate of ground-water movement.

Most of the saltwater problems in southwestern Louisiana are the result of saltwater coning. Saltwater at the base of the aquifer moves upward toward large-capacity producing wells. The upconing causes water from a well to become increasingly saline with time and presently affects a minimum area of 150 square miles near and, locally, north of the coastal freshwater-saltwater interface. Local, isolated saltwater bodies at the base of the "upper sand" near Abbeville (Vermilion Parish) and Iowa (Calcasieu and Jefferson Davis Parishes) and in the "500-foot" sand of the Lake Charles industrial area yield water to wells generally ranging in chloride concentration from 50 to 500 milligrams per liter. Saltwater coning can be minimized by shorter pumping intervals, setting well screens higher above the saltwater, or by using scavenger wells that intercept the saltwater before it reaches the production well.

INTRODUCTION

The 13 parishes of southwestern Louisiana (fig. 1) comprise less than a quarter of the land area of the State, yet raise about two-fifths of the crops sold,[1] produce more than one-fourth of the oil and condensate,[2] and nearly half of the natural gas.[2] This high level of productivity is sustained by a plentiful supply of freshwater used for agriculture, industrial processes, and human consumption. One of this area's greatest concerns is the protection of the freshwater resource from increases in salinity and from pollution. In this report freshwater is defined as water having a concentration of 250 mg/L of chloride or less. The chloride concentration of the water discussed ranges from slightly above background concentrations (about 30 mg/L), to slightly saline (about 400 to 1,500 mg/L chloride).

Purpose and Scope

The purpose of this report is to document the occurrence of high-chloride water in the Chicot aquifer system, describe the processes causing saltwater problems, indicate areas having potential saltwater problems, and publish the existing salinity data. A knowledge of the areas susceptible to saltwater encroachment is important in order to control encroachment, because once saltwater moves into an aquifer and replaces the freshwater, it is very difficult to reclaim the aquifer.

This report summarizes and tabulates chloride and conductance data accumulated by the U.S. Geological Survey since 1937, with particular attention to the results of saltwater monitoring programs that began about 1961. Geologic and hydrologic maps have been drawn based on geophysical and driller's logs. These maps define the base of freshwater and the top of major aquifers and can be used to estimate the thickness of freshwater section available. Chlorographs and hydrographs for key wells were drawn and tabulations of data for other important saltwater-monitor wells compiled to show chloride trends and to illustrate the relation between water-level change and change in chloride concentration. Chloride-concentration maps have been drawn for local areas with saltwater problems--such as the lower Vermilion River basin; the Iowa area, east of Lake Charles; and the Lake Charles industrial area--to indicate the areas of greatest concern.

Acknowledgments and Cooperation

The author greatly appreciated the cooperation of the many owners and operators of rural, public, and industrial water systems, who allowed access to their wells for hydrologic information. The author also wishes to express his appreciation for the advice and encouragement of Dr. P. H. Jones, formerly of the Department of Geology, and Dr. Charles Kolb

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[1] Based on parish crop evaluations for 1976, compiled by Louisiana State University Agriculture Extension Service.

[2] Based on parish oil and gas production for 1980, compiled by the Louisiana Department of Natural Resources, Office of Conservation.

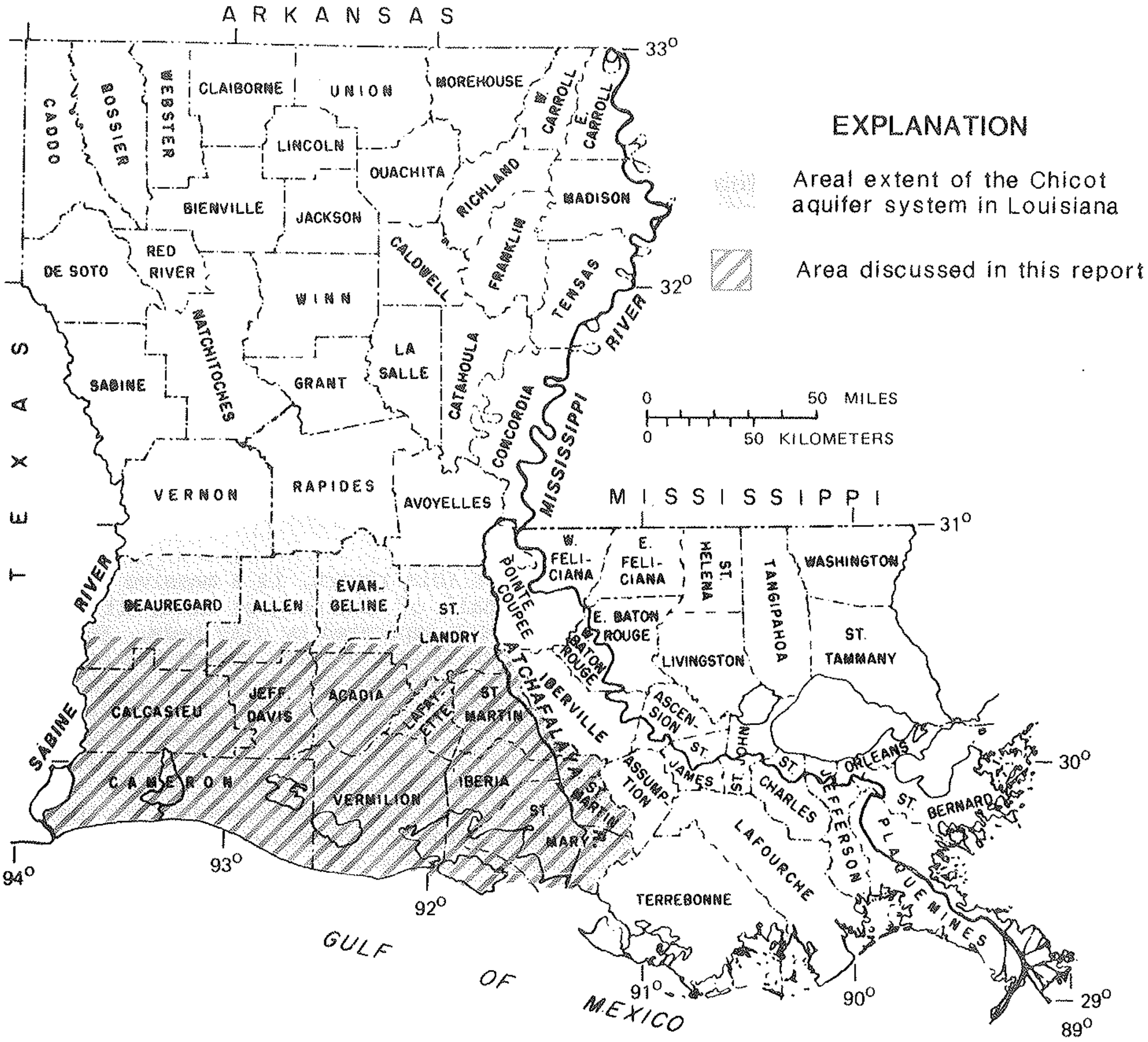

Figure 1.--Location of project area.

(deceased) formerly of the Department of Environmental Sciences at Louisiana State University, and to Mr. R. H. Wallace, Jr. of the Gulf Basin Hydrogeology Project (U.S. Geological Survey). Mr. R. M. Lawrence, Offshore Division Geologist for AMOCO, New Orleans office, and Mr. Fines Martin, Division Manager for Superior Oil Co. at Lafayette, Louisiana, provided information for the hydrogeologic sections. Historical insight was provided by Mr. H. G. Chalkley (deceased) of the Sweetlake Land and Oil Co., and by Mr. V. S. Scoggins (deceased), founder of Coastal Water Wells, Inc., of Welsh, Louisiana.

Special appreciation is expressed to D. G. Sheppard, S. T. Mumme, and J. R. McKay; formerly graduate students at Northeast Louisiana University, Louisiana State University, and Louisiana Technical University, respectively; who assisted in the preparation of the geohydrologic maps.

This study was made through a cooperative program between the U.S. Geological Survey and the Louisiana Office of Public Works, Department of Transportation and Development. Electrical logs of oil-test wells were made available by the Louisiana Office of Conservation, Department of Natural Resources, and the U.S. Geological Survey, Conservation Division (now Minerals Management Service).

CHICOT AQUIFER SYSTEM

The Chicot aquifer system, as used in this report, is a massive sand in the outcrop area and the northern half of the project area; it is divided downdip into two or more sand layers separated by clay beds. East of Calcasieu Parish the massive sand of the Chicot aquifer system has been divided into two units called the "upper sand" and "lower sand"; whereas in Calcasieu and Cameron Parishes, the massive sand has been divided into three units called the "200-foot", "500-foot", and "700-foot" sands (table 1). The "upper sand" is connected to the "200-foot" sand, Abbeville unit, and Atchafalaya River alluvium; thus, together these units constitute essentially one hydrologic unit. The "lower sand" is connected to the "700-foot" sand. The "500-foot" sand is largely isolated except where it merges with the "700-foot" sand toward the outcrop area (fig. 2).

Geohydrology

The Chicot aquifer system was named by Jones and others (1954, p. 7) for a deltaic sequence consisting mostly of thick sand and gravel deposits that dip and thicken southward from southern Vernon and Rapides Parishes. The aquifer thins slightly to the west and continues into Texas. To the east the aquifer thickens toward the axis of the Mississippi Embayment trough where it is cut by or overlain by the alluvium of the Atchafalaya and Mississippi Rivers; thus, the Chicot aquifer system and Atchafalaya aquifer are hydraulically connected. The aquifer units thicken gulfward but become increasingly subdivided by clays and individual sand beds may thin and become finer textured.

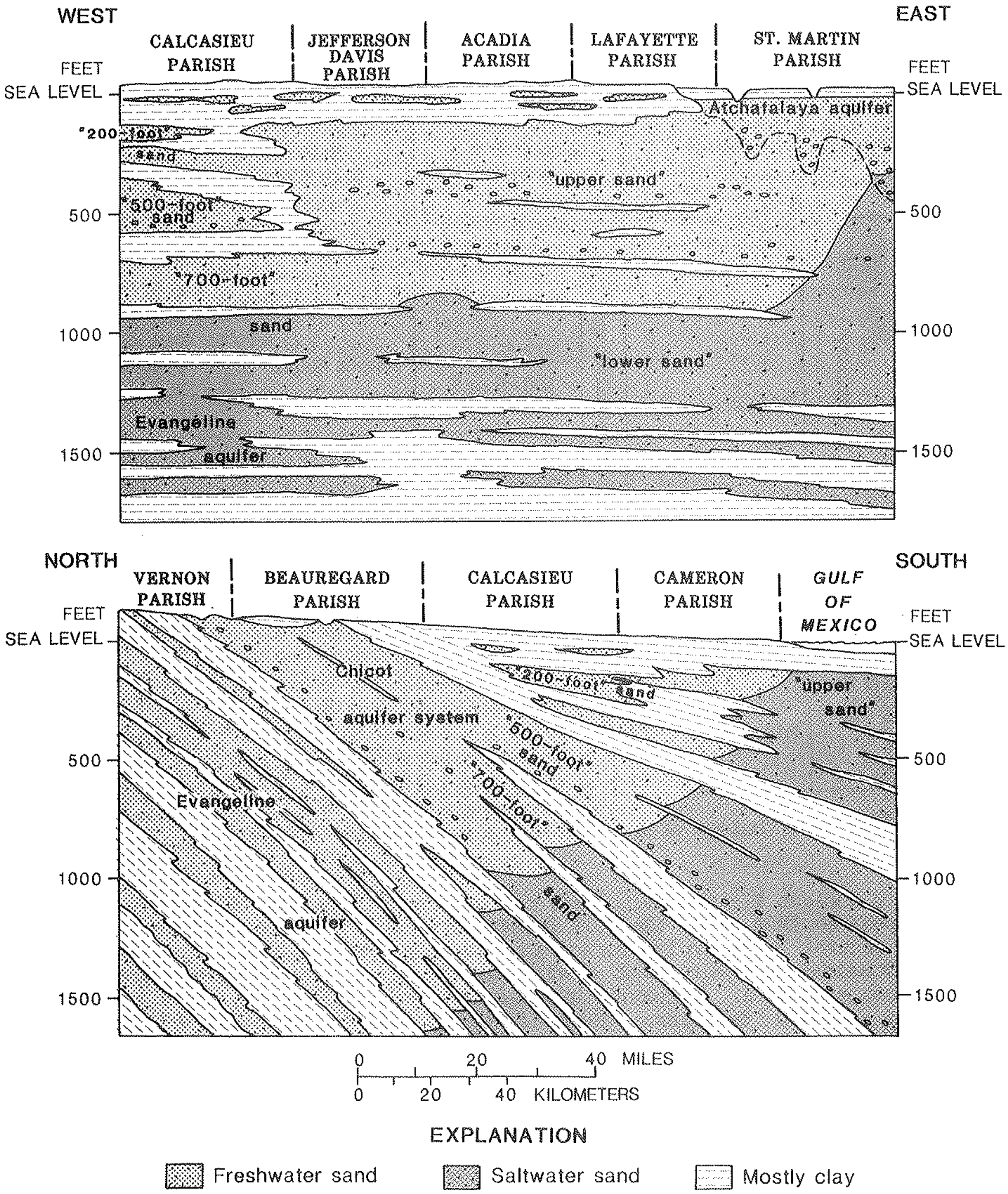

Figure 2.--Idealized geologic sections through southwestern Louisiana.

Table 1.--Geologic and aquifer correlations

System	Series	This report			Harder
		Lake Charles area		East of Lake Charles	Formation
Quaternary	Holocene	Chicot aquifer system	Alluvium	Alluvium, Atchafalaya aquifer, and Abbeville unit	
	Pleistocene				Prairie
			"200-foot" sand	"Upper sand"	Montgomery
			"500-foot" sand	Undifferentiated "lower sand"	Bentley
			"700-foot" sand		Williana
Tertiary	Pliocene and Miocene	Evangeline aquifer		Evangeline aquifer	Foley
	Miocene			Jasper aquifer	Fleming

1/ For Lake Charles area. 2/ For area east of Lake Charles.

Ancient Pleistocene rivers carried large quantities of sediments and deposited them along the gulf coast. The thick, coarse-sand units south of central Jefferson Davis, Acadia, and Lafayette Parishes are flood-plain and deltaic deposits that grade southward into buried beaches and offshore sand bars. The confining clay beds are flood-plain, natural-levee, and lagoonal deposits. These features can be interpreted from the geohydrologic sections, which show that the sand units interfinger and become increasingly subdivided by clay units toward the gulf coast. Sand thickness and the presence of clay beds are very important to the understanding of saltwater movement because as sand units thicken laterally sand-grain size and hydraulic conductivities typically increase. The hydraulic conductivity[3] of the sand controls the potential rate of ground water, and therefore saltwater movement. The clay beds are the primary restriction on the vertical movement of saline water.

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[3] See Glossary, p. V.

for southwestern Louisiana and eastern Texas

(1960)1/ Hydrologic unit	Harder and others (1967)2/	Wesselman (1965)	Wesselman (1971)	Whitfield (1975)	Jones (1956)
		Hydrologic unit			
		Upper aquifer	Upper aquifer	Chicot aquifer	Atchafalaya reservoir
Chicot shallow	Shallow sand				
"200-foot" sand	"Upper-sand unit"				
"500-foot" sand	Undifferentiated "lower-sand unit"	Middle aquifer	Lower aquifer		Chicot reservoir
"700-foot" sand					
Evangeline aquifer	Evangeline aquifer	Lower aquifer	Evangeline aquifer	Evangeline aquifer	Evangeline aquifer
			Burkeville aquiclude	Burkeville aquiclude	
			Jasper aquifer	Jasper aquifer	

In Calcasieu and Cameron Parishes the Chicot aquifer system was subdivided by Jones (1950, p. 4) into the "200-foot", "500-foot", and "700-foot" sands, based on their depths in the Lake Charles industrial area. These aquifers are described in detail by Harder (1960). The "200-foot" sand correlates with the top of the "lower Chicot" of Wesselman (1971) in Texas, and the Chicot "upper sand" of Harder and others (1967). The "500-foot" and "700-foot" sands correlate with the lower part of the "lower aquifer" in Texas (Wesselman, 1971), and the "lower sand unit" of the Chicot aquifer system to the east. The Chicot aquifer system overlies the Evangeline and Jasper aquifers. The relations between aquifer names used in the study area are shown in table 1.

East of Calcasieu and Cameron Parishes the Chicot aquifer system has been informally divided into upper and lower units (Whitman and Kilburn, 1963, p. 10). In the same area, subdivisions of the aquifer were correlated with the Williana, Bentley, Montgomery, and Prairie Formations, which correspond to the four periods of Pleistocene glaciation. A regional subsurface correlation of terrace formations is not obvious, therefore the names "upper sand" and "lower sand" are used to designate units of the Chicot aquifer system in the eastern part of the report area.

Ground-Water Hydrology

Water Levels

Water levels in the Chicot aquifer system have ranged from near land surface to about 150 ft below land surface. Water levels are lowest in the Lake Charles industrial area and highest near rivers in the recharge area (pl. 1).[4] Annual water-level fluctuations range from 2 to 3 ft in essentially unpumped areas in parts of Beauregard and Allen Parishes and from 20 to 40 ft near pumping centers for rice irrigation in Jefferson Davis and Acadia Parishes. Total pumpage from the Chicot aquifer system averaged about 1 Bgal/d in 1980 (Walter, 1982). Centers of concentrated pumping cause cones of depression in the potentiometric surface of the aquifer that induce the flow of water from all directions causing a slope (gradient) in the water-level surface toward the area of heavy pumping. The slope of the water-level surface is indicative of the rate of ground-water movement; the steeper the slope the faster ground water moves through the aquifer, assuming aquifer transmissivity and other factors are constant.

Water levels in wells tapping the "200-foot", "500-foot", and "700-foot" sands in the Lake Charles area are significantly different near pumping centers. Levels of the "200-foot" sand are the nearest to land surface, levels of the "500-foot" sand generally are farthest below land surface, and the water level in the "700-foot" sand is generally intermediate. Drawdown of the potentiometric surface of the "500-foot" sand was primarily caused by industrial ground-water withdrawals, which averaged about 100 Mgal/d during 1980 (Walter, 1982). The center of the drawdown cone in the "200-foot" sand is primarily related to withdrawals of water from the "500-foot" sand and leakage between the two sands. The cone of depression for the "700-foot" sand is caused by ground-water withdrawals averaging about 10 Mgal/d and leakage to the "500-foot" sand.

The water-level map for 1903 (Jones and others, 1954, pl. 17; 1956, pl. 13) shows the natural southward gradient that probably existed before extensive ground-water development began. Rain falling on the recharge areas of the Chicot aquifer system during pre-development years provided base flow to the Sabine, Vermilion, and Atchafalaya Rivers (and other coastal streams) and also created the hydrostatic pressure that flushed saltwater southward and stabilized the saltwater wedge in the coastal area.

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[4] The regional potentiometric map is based on the massive sand in the northern part of the area, the "upper sand" in the coastal area, and the "200-foot" sand in the Lake Charles area.

The water-level gradients that sloped southward in 1900 have now been reversed in the coastal area and slope northward toward pumping centers in Calcasieu, Jefferson Davis, and Acadia Parishes (pl. 1). The northward gradient is very low (generally less than 1 ft/mi) in the coastal wetlands area because of little pumping and because of recharge from vertical leakage. Because of these factors, the northward movement of the freshwater-saltwater interface has been very slow and probably averages less than 100 ft/yr in the gulf coast area. However, a potentially serious problem may develop if the water-level gradient near the coast is increased. Saltwater encroachment, which has occurred in the Texas-Gulf region at Houston and Orange (Baker and Wall, 1976, p. F21; Gabrysch and McAdoo, 1972, p. 10), could render large parts of the Chicot and other aquifers unusable.

Water Movement

Ground water moves from areas of recharge to areas of discharge, which under current conditions coincide with pumping centers. The recharge areas are indicated by the large patterned area of the water-level map (pl. 1); the pumping centers are generally located in areas indicated by closed contours. Water pumped in southwestern Louisiana may originate as rain falling on the outcrop area to the north, as flow from the Atchafalaya River to the east, or as water moving downward through the clays to the Chicot aquifer system from marshlands in the coastal area to the south. There is very little movement of ground water from the west toward Lake Charles because of pumping at Orange, Texas. Additional recharge is received through direct interconnections with underlying aquifers (Whitfield, 1975, p. 12), or directly from streams, such as the Calcasieu River in the reach above Kinder and the Vermilion River in the reach below Abbeville.

Recharge from the outcrop area in Beauregard and Allen Parishes and areas to the north supplies about 50 percent of the total water pumped from the Chicot aquifer system, and most of the water pumped in Calcasieu and Jefferson Davis Parishes, according to analog-model studies (A. L. Zack and A. N. Turcan, written commun., 1975). Recharge to the aquifer from the outcrop area in Evangeline Parish supplies less than 5 percent of the total water pumped. The amount of flow through Evangeline Parish is small because an east-west trending zone of low transmissivity (Fader and Harder, 1954) north of Ville Platte inhibits ground-water movement. On the water-level map (pl. 1) this zone is indicated by closely spaced water-level contours in central Evangeline Parish. In general, therefore, the amount of recharge in the outcrop area to the north is not determined solely by the amount of rainfall, but also by the aquifer's ability to transmit the water away from the recharge area.

The Atchafalaya aquifer (Jones and others, 1956 p. 293) and the Chicot aquifer system are essentially one continuous hydrologic unit from St. Landry Parish to near St. Martinville. Water levels in the Atchafalaya River alluvium change with river stage. Water levels are higher in the alluvium, causing water to move down gradient to the west into the Chicot aquifer system. The water-level map (pl. 1) indicates recharge from the Atchafalaya alluvium because of the essentially north-south trending water-level contours near the cities of Lafayette and Opelousas and the westward water-level gradient. Water is moving from the Atchafalaya Basin toward pumping centers in St. Landry and Acadia Parishes. About 15 percent of the total water pumped from the Chicot aquifer system is supplied from the Atchafalaya Basin (A. L. Zack and A. N. Turcan, written commun., 1975).

South of St. Martinville the Chicot aquifer system is often poorly connected to the Atchafalaya alluvium and much of the recharge to the Chicot aquifer system in Iberia, St. Mary, and southern St. Martin Parishes is from vertical leakage. The ground-water contribution from the south and west totals less than 5 percent of the total withdrawals from the aquifer (A. L. Zack and A. N. Turcan, written commun., 1975).

Recharge from vertical leakage is the water that moves very slowly through the clays from aquifers of higher hydrostatic head (water level) to aquifers having lower hydrostatic head. In the coastal area the water level in the Chicot aquifer system is lower than the water level in the wetlands above it and the Evangeline aquifer below it. About 25 percent of all the water pumped from the Chicot aquifer system is derived from vertical leakage and much of the vertical leakage occurs in the coastal wetland area (A. L. Zack and A. N. Turcan, written commun., 1975). This recharge is extremely important because it deters saltwater encroachment by decreasing the water-level gradient. Increases in withdrawals from the coastal area and the immediate area to the north would probably increase vertical leakage; however, increased withdrawals would also increase the northward water-level gradient and would therefore increase the rate of northward ground-water (saltwater) movement.

Ground-Water Salinity

High-chloride water occurs mainly in the coastal area of the major sand units, as well as in small isolated bodies in the freshwater areas to the north. In the coastal area, movement of the saltwater wedge is controlled by the hydrostatic balance between freshwater and saline water and retarded locally by areas of decreasing transmissivity. High-chloride water in isolated bodies or associated with the coastal-saltwater wedge accounts for most of the saltwater problems in the "upper sand."

The Freshwater-Saltwater Interface

The freshwater-saltwater interface is the sloping surface between the freshwater body and the saltwater body below. The vertical shape of the interface can generally be described as a low-angle wedge with a slight upward (concave) curve toward the gulf (fig. 2). There is a downdip saltwater wedge in each sand. The leading edge of the wedge lies at the base of each sand and generally extends many miles north from the main body of salty water.

The configuration of the base of freshwater reflects the history of saltwater movement in the coastal area. Seventeen thousand years ago, the sea level was about 300 ft lower than it is today (Shepard, 1960, p. 338-344). The steeper ground-water gradients during this period of low sea level probably flushed out most of the saltwater in the "upper sand" some distance seaward of the current shoreline. As sea level rose, the offshore migration of freshwater ceased and saltwater started migrating northward, with highest rates of encroachment in areas where the aquifer materials were most permeable. One such area is the permeable zone underlying the Atchafalaya River basin. Ground-water development, primarily irrigation, has slightly altered movement of the saltwater interface locally. The configuration of the base of freshwater has largely developed in response to sea-level change.

A saltwater "high" can be caused by a hydraulic connection between the "upper" and "lower sand." A hydraulic connection is probable where a clay thickness of less than 20 ft separates the "upper" and "lower sands." The "lower sand" generally has a slightly higher artesian head than the "upper sand." For example, saltwater "highs" in Vermilion Parish are related to hydraulic connections. The "lower sand" contains only saltwater below the interconnection, and salty water has moved upward through openings in the clay into the "upper sand."

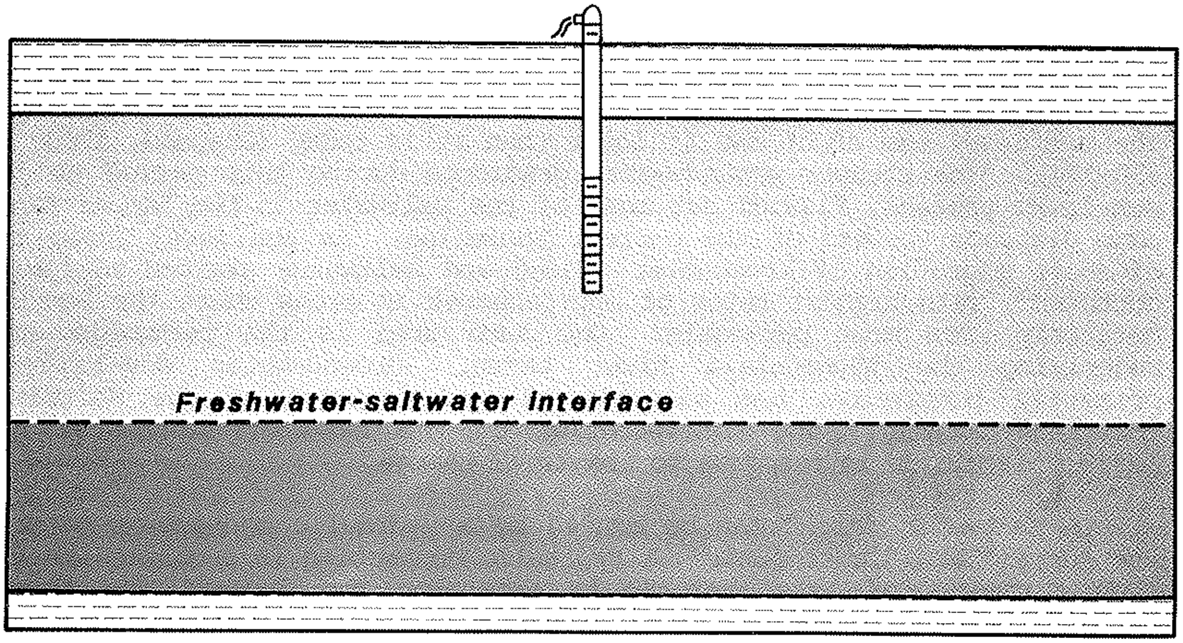
Saltwater Coning

Saltwater coning, also termed "upconing" or "vertical-saltwater encroachment," is the most common cause of wells pumping saline water in southwestern Louisiana. The phenomenon of coning results when two fluids of different density at equilibrium are made dynamically unstable because of pumping one of the fluids (Muskat, 1946, p. 482). Because saline water is more dense than freshwater, the freshwater floats on top (fig. 3A). High-capacity wells pumping from just the freshwater portion of the aquifer will cause the level of slightly saline water to rise and eventually enter the well. Figure 3B diagramatically shows the components of flow through an aquifer having a freshwater-saltwater interface. In the situation shown by figure 3B, as pumping continues, an increasing proportion of water comes from the lower part of the aquifer.

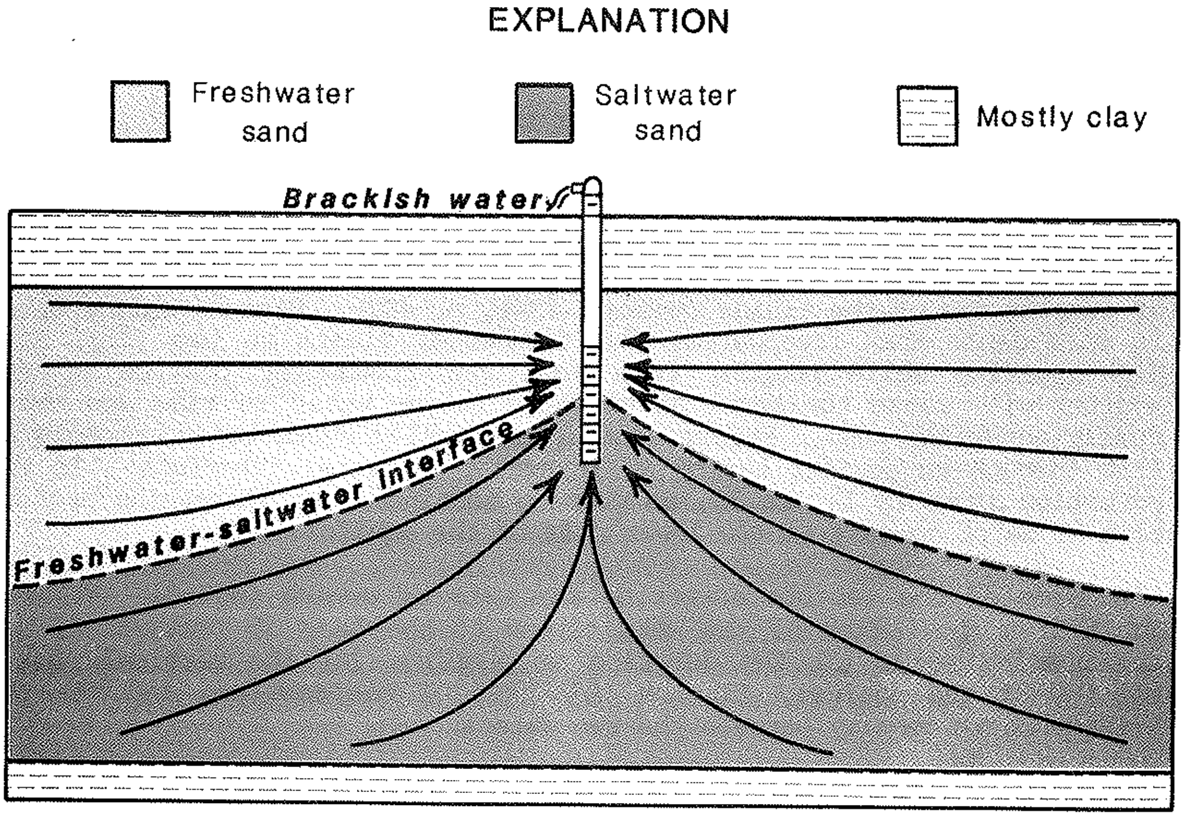
Some of the factors affecting the rate of coning include: (1) the depth from the bottom of the well screen to the base of freshwater, (2) the pumping rate, (3) the duration of pumping, (4) the vertical permeability of the aquifer, (5) the thickness of the aquifer, and (6) the difference in density between the two waters.

High-Chloride Water in the Chicot "Upper Sand"

Saltwater coning causes most of the saltwater problems because the saltwater wedge at the base of the "upper sand" extends from 5 to nearly 40 mi north of the gulf coast. The northern limit of the wedge is shown on plate 2. North of the patterned area the entire aquifer contains freshwater; south of the patterned area the aquifer contains only saline



3a. Relationship between freshwater and saltwater before pumping begins.



3b. The development of a saltwater cone during pumping.

Figure 3.--Idealized profiles showing saltwater coning.

water. Generally speaking, the concentration of chloride is highest and the water at the base of the aquifer is most saline where the saltwater wedge is broadest and thickest. The thickness of the freshwater section can be estimated by subtracting the altitude of the top of the aquifer (pl. 2) from the altitude of the base of freshwater.

Although saltwater coning is the most common cause of saltwater problems in the coastal area, several areas are susceptible to saltwater encroachment by lateral movement. This is generally of greater concern than saltwater coning because the effects of lateral encroachment are essentially permanent (not seasonal). Areas that have a high potential for saltwater encroachment are: (1) along a north-south trending saltwater high underlying the Atchafalaya River basin, (2) along the north-south trending saltwater high underlying the Vermilion-Cameron Parish boundary, and (3) along the leading edge of the saltwater wedge near Sweet Lake in central Cameron Parish and the town of Hayes in Calcasieu Parish (pl. 2).

Atchafalaya River Basin

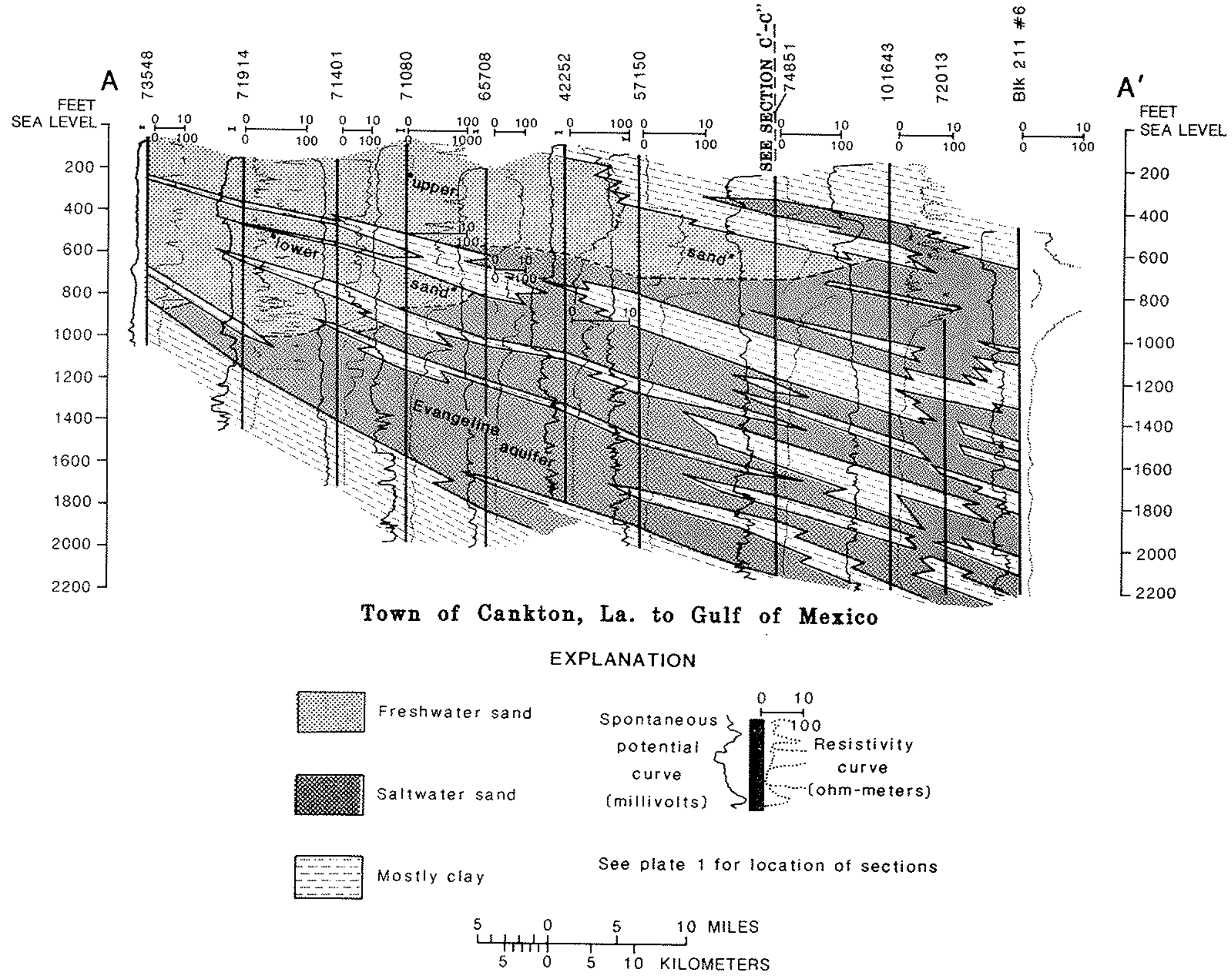
The west side of the north-south trending saltwater high underlying the Atchafalaya River basin is defined by the 400-foot contour on the base of freshwater (pl. 2). Currently there is no evidence of saltwater movement; in fact, data for the key monitor well (I-93) shows a reduction in chloride concentration. The reduction in chloride is probably related to movement of fresh ground water from the northeast as in the New Iberia area (pl. 1). Chloride and water-level trends in wells monitoring saltwater are given in table 2, well locations are on plate 2, and chloride data are given in table 7.

Vermilion Parish

There is little indication of movement of the coastal-saltwater wedge in Vermilion Parish; however, there are local saltwater problems near the mouth of the Vermilion River which are described in the next section. Ground water in northern Vermilion Parish is protected from saltwater encroachment by a large body of freshwater which extends offshore near Southwest Pass on the west side of Marsh Island (pl. 2). Saltwater encroaching from the south would first have to displace this volume of freshwater before the mainland would be affected. Profiles through this area are shown in figures 4 and 5, the location of the geohydrologic sections is shown on plate 1.

Cameron Parish

In northern Cameron Parish, the leading edge of the saltwater wedge probably is being drawn northward. Well Cn-92 (well location on pl. 2) showed an increase in chloride concentration of 20 (mg/L)/yr until 1975 when the rate of increase reduced to about 3 (mg/L)/yr. A chlorograph and hydrograph for well Cn-92 is shown in figure 6. The decrease in the



Town of Cankton, La. to Gulf of Mexico

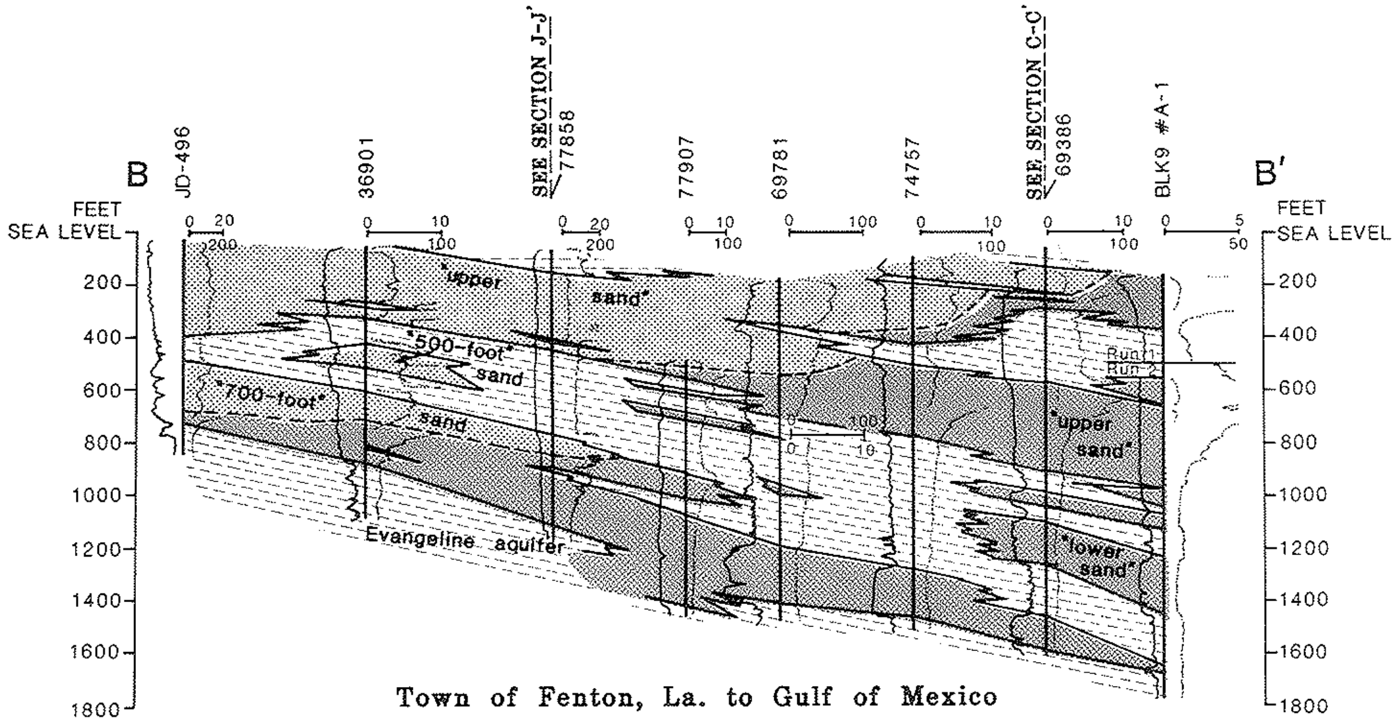
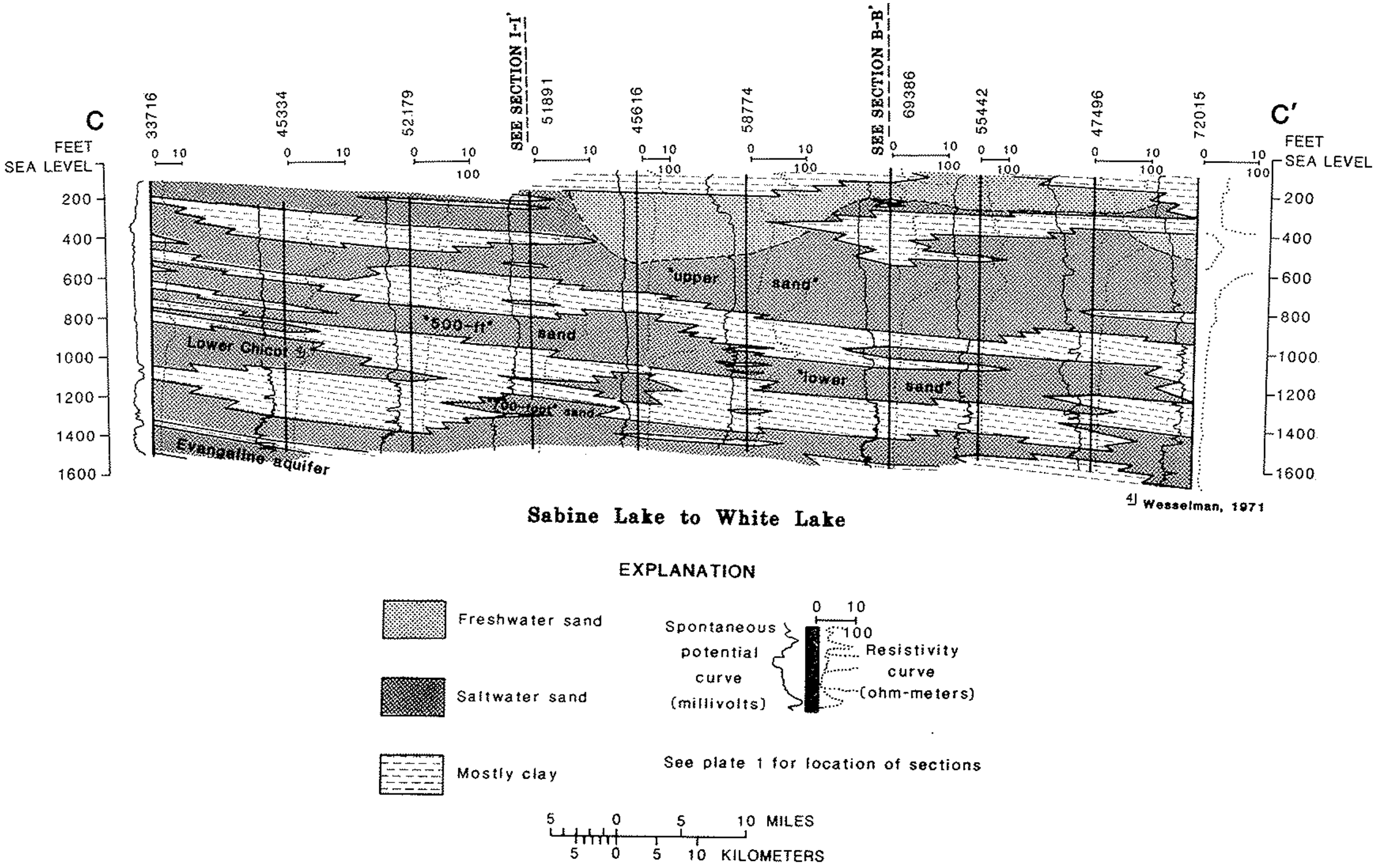
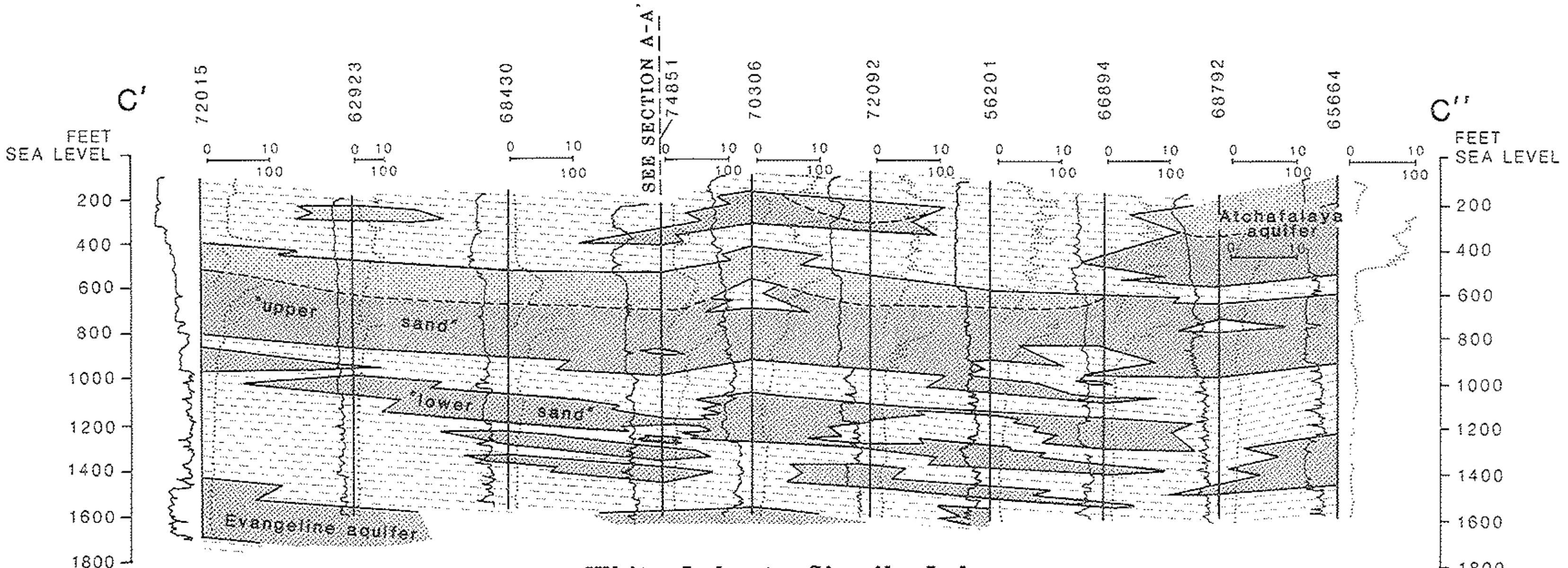

Town of Fenton, La. to Gulf of Mexico

Figure 4.--North-south geohydrologic sections from Cankton and Fenton to the gulf.



Sabine Lake to White Lake



White Lake to Sixmile Lake

Figure 5.--East-west geohydrologic sections across coastal southwestern Louisiana.

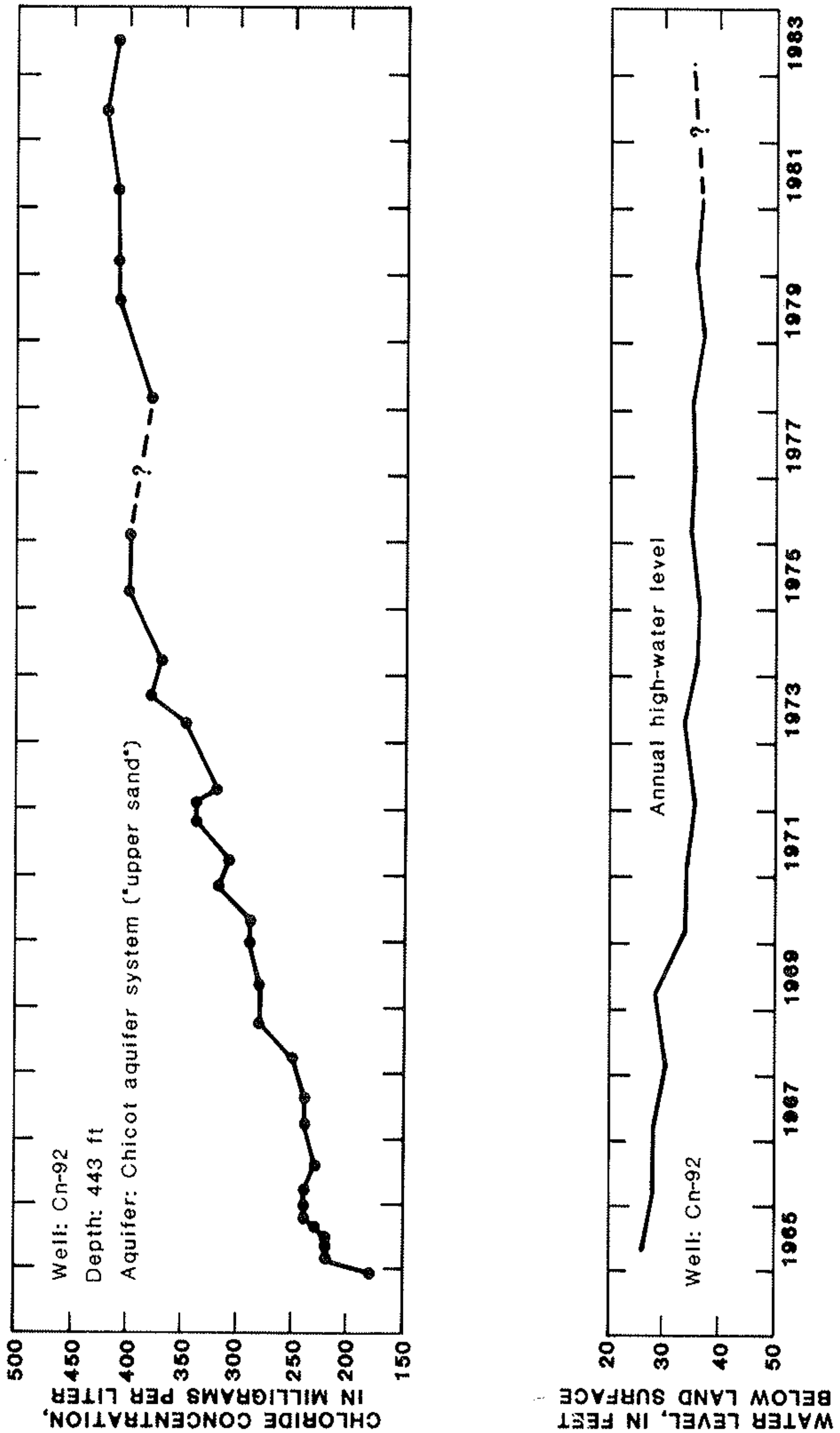


Figure 6.--Chlorograph and hydrograph for a well in Cameron Parish.

Table 2.--Summary of wells in the Chicot "upper sand" in the Atchafalaya River basin and Vermilion Parish

[See plate 2 for location of wells]

Well No.	Area monitored	Chloride trend	Water-level gradient	Rate of water-level decline
SMn-108	Monitors west side of saltwater high underlying the Atchafalaya River basin and locally near the Section 28 salt dome (2,000 ft below) (well depth 505 ft).	Increasing 5 (mg/L)/yr.	0.4 ft/mi toward southwest.	No trend (water level in aquifer reflects river stage).
I-93	Monitors front of "toe" of saltwater wedge (well depth 585 ft).	Decreasing 5 (mg/L)/yr.	0.4 ft/mi toward southwest.	0.5 ft/yr.
SM-57U	Monitors changes in base of freshwater zone north of an offshore fault (well depth 638 ft).	No consistent trend 2 (mg/L)/yr.	0.3 ft/mi.	No consistent trend.
SM-57L	Monitors changes in salinity below interface zone (well depth 738 ft).	No consistent trend.	0.3 ft/mi west.	No consistent trend.
Ve-639	Monitors potential saltwater encroachment near the gulf coast (well depth 608 ft).	No change-----	0.5 ft/mi north-northwest.	0.2 ft/yr.
Ve-630U	Monitors change in salinity above base of freshwater 10 mi south of "toe" of saltwater wedge and 10 mi east of north-south trending saltwater ridge (well depth 498 ft).	No change-----	1.0 ft/mi north.	0.2 ft/yr.
Ve-630L	Monitors change in salinity below base of freshwater (well depth 528 ft).	Increasing 5 (mg/L)/yr.	1.0 ft/mi north.	0.2 ft/yr.

upward trend of the chloride concentration following 1975 occurred because water levels stabilized after 1970 and there was a decrease in the water-level gradient. If there is another period of several years of increasing withdrawals, and a steepening of the water-level gradient, chloride concentrations will probably begin to increase significantly, indicating northward saltwater movement. Increasing salinity at wells Cn-92 and Cu-971 (pl. 2, Calcasieu Parish) suggests that there was movement along a 20-mi width of the saltwater wedge northeast of Sweet Lake in Cameron Parish and near Hayes in Calcasieu Parish. This part of the saltwater wedge is affected by irrigation pumping in Calcasieu and Jefferson Davis Parishes. Areas of concentrated ground-water withdrawals are indicated by the closed contours on plate 1. The wells monitoring saltwater movement in Cameron Parish are summarized in table 3.

The northward movement of the saltwater wedge in this area has yet to cause major problems because the aquifer is generally more than 400 ft in thickness and there is enough distance between the bottom of wells and the

Table 3.--Summary of wells monitoring the Chicot "upper sand" in Cameron Parish

[See plate 2 for location of wells]

Well No.	Area monitored	Chloride trend	Water-level gradient	Rate of water-level decline
Cn-81U	Monitors changes near west side of saltwater ridge and near irrigation pumping, screened above base of freshwater (well depth 448 ft).	Decreasing 5 (mg/L)/yr.	0.8 ft/mi northwest.	1.0 ft/yr.
Cn-81L	As above but well screened below base of freshwater (well depth 478 ft).	Decreasing 5 (mg/L)/yr.	0.8 ft/mi northwest.	1.0 ft/yr.
Cn-93	Monitors changes in salinity in coastal area at town of Cameron (well depth 360 ft).	Decreasing 3 (mg/L)/yr.	0.5 ft/mi north.	0.8 ft/yr.
Cn-90	Monitors changes in salinity in central part of parish (well depth 396 ft).	Decreasing 5 (mg/L)/yr.	1.0 ft/mi north-northwest.	0.9 ft/yr until 1975, 0.7 ft/yr.
Cn-92	Monitors saltwater encroachment near leading edge of saltwater wedge 15 mi southeast of Lake Charles (well depth 443 ft).	Increasing 20 (mg/L)/yr until 1975, 3 (mg/L)/yr since 1975.	1.5 ft/mi north-northeast.	1.2 ft/yr until 1975, 0.9 ft/yr since 1975.

base of freshwater to minimize saltwater coning. Further ground-water development in most of eastern Cameron Parish for domestic use and small municipal and industrial supplies should cause no significant changes in the rate of saltwater movement, but large industrial development should be carefully studied as saltwater encroachment could shorten the life of the water supply.

The aquifers in most of the western half of Cameron Parish probably have contained saline water since the sediments were deposited.

High-Chloride Water in the Lower Vermilion River Basin

The lower Vermilion River basin is the location of unique saltwater problems in the Abbeville unit and in the "upper sand" of the Chicot aquifer system (table 1). Salinity problems are not related to offshore saltwater encroachment, but represent local saltwater problems caused by: (1) movement of saltwater from the Vermilion River into the Abbeville unit, and (2) the upward movement of salty water from the "lower sand" into the "upper sand," which is increasing owing to pumping.

Abbeville unit.--The Abbeville unit of the Chicot aquifer system is the "shallow sand" described by Harder, and others (1967, p. 35). They stated, "This shallow sand is a distinct hydrologic unit throughout most of the [lower Vermilion River] basin and generally consists of fine to sandy silt at the top and grades downward within a few tens of feet into sand and gravel. The thickness of the sand usually ranges between 100 to 250 feet." Before large-scale irrigation began, ground-water discharge from the Abbeville unit supplied the base flow of the Vermilion River. However, because of ground-water withdrawals in Vermilion Parish and parishes to the north, water levels in the Abbeville unit gradually declined below the channel of the Vermilion River. By 1951, the river began recharging the aquifer in the Bancker area (fig. 7). Since that time brackish water has infiltrated the Abbeville unit on the infrequent occasions when brackish water was pushed that far upstream (Harder and others, 1967, p. 37-40). The saline-water contribution from the Vermilion River to the Abbeville unit has been very small in the Bancker area and the saline water that has infiltrated is being slowly flushed out. (See chlorograph of well Ve-626, fig. 8.) The Vermilion River at Bancker contains water of more than 200 mg/L chloride only 15 percent of the time (fig. 9). Flushing action (decreasing salinity) will continue until either the chloride concentration in the aquifer reflects the average annual chloride concentration of the river, the infiltration of rainwater continues to locally dilute the salty water in the aquifer, or saline water again recharges the aquifer in the Bancker area following an unusual hydrologic event, such as a series of very high tides accompanying storms. After the high tides occur, the flushing (or dilution) phase will be repeated.

The Abbeville unit in the reach of the Vermilion River between Little Bayou and the mouth is being recharged by brackish water more frequently than in the Bancker area because of tides bringing brackish water upstream during periods of low stream flow. Because of this the

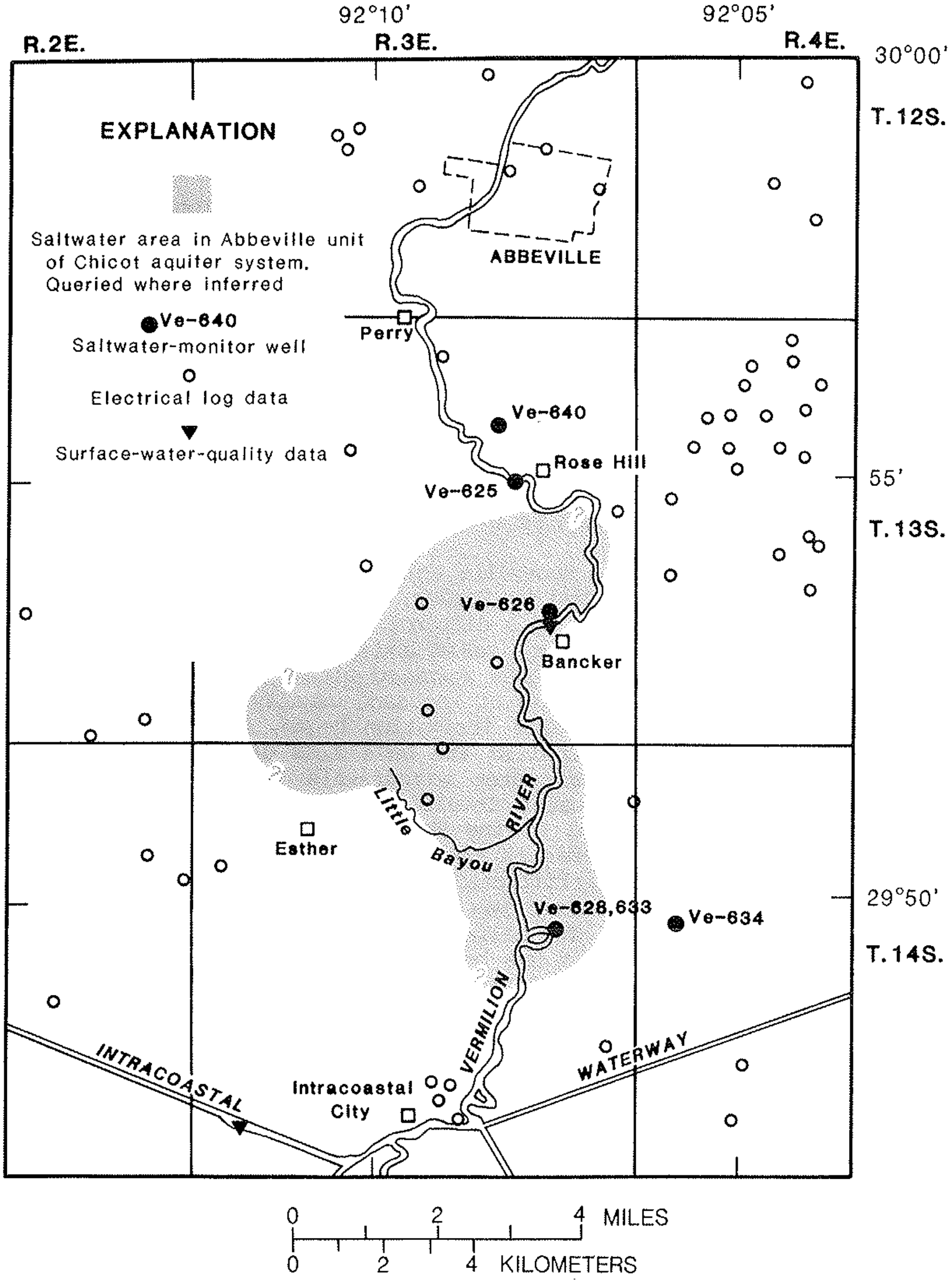


Figure 7.--Extent of saltwater in the Abbeville unit of the Chicot aquifer system and location of monitor wells.

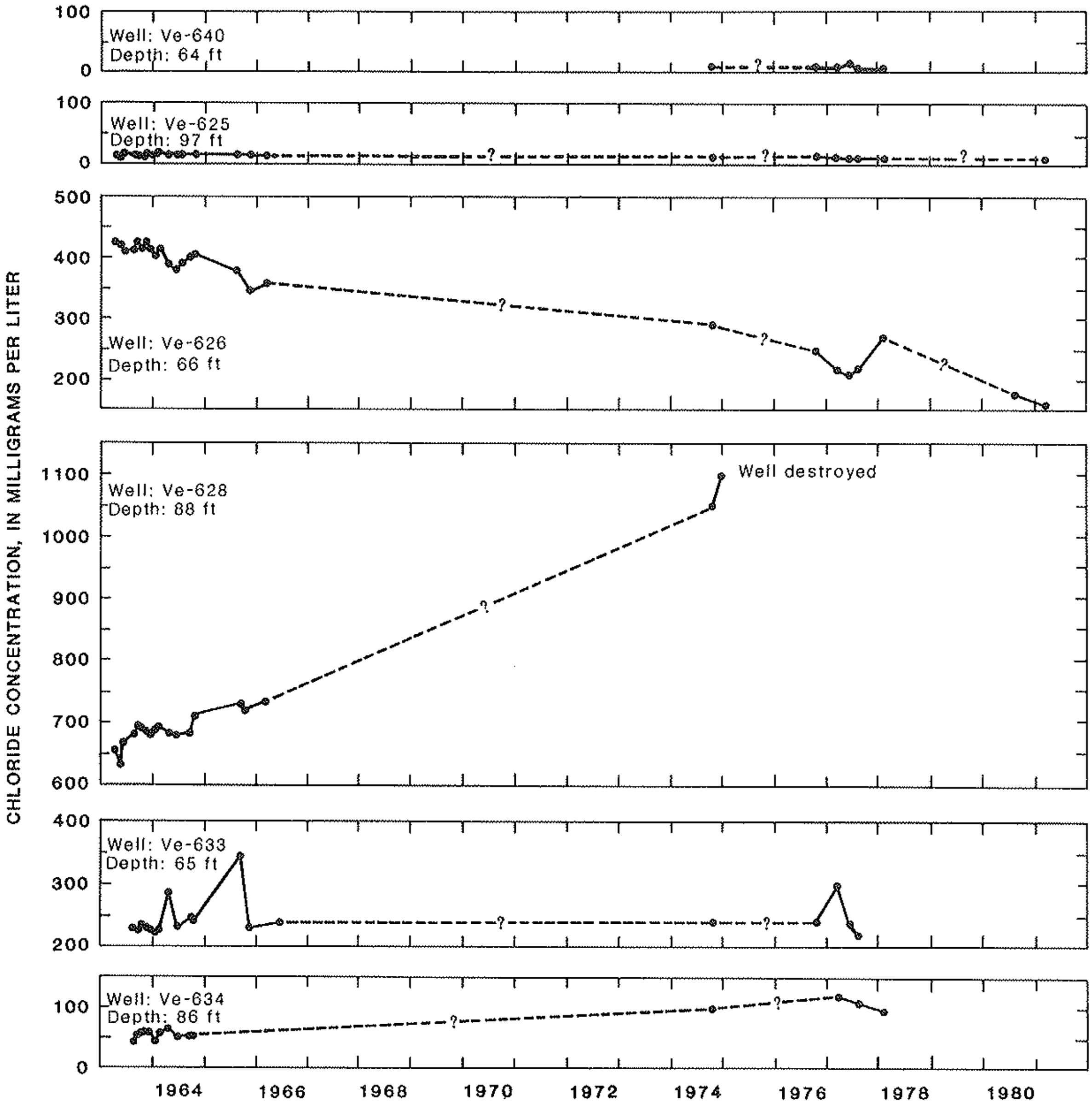


Figure 8.--Wells along the lower Vermilion River screened in the Abbeville unit.

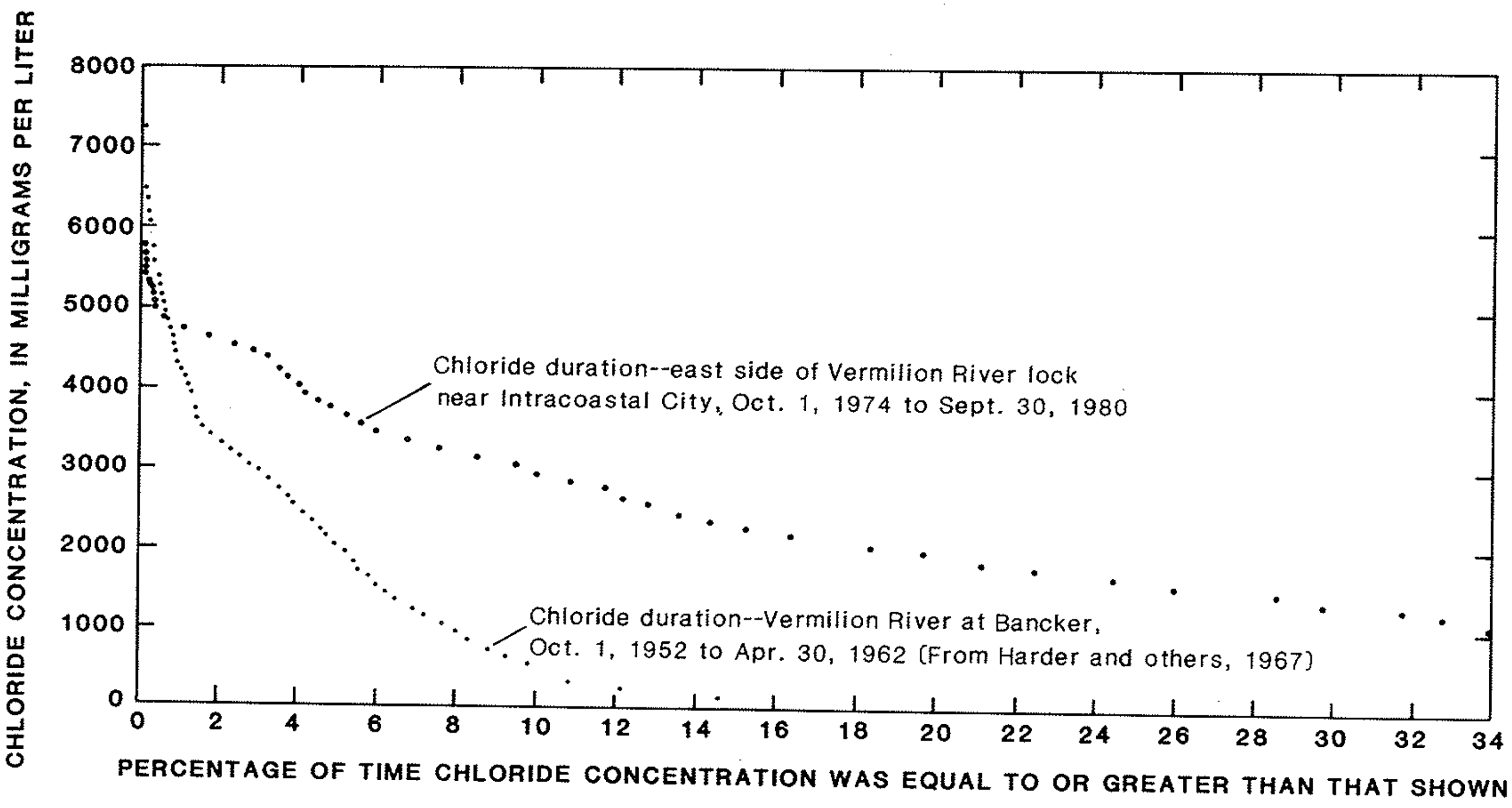


Figure 9.--Duration of high chloride concentration in the lower Vermilion River.

saltwater body in the Abbeville unit south of Little Bayou is increasing in size and in chloride concentration and will continue to grow until the upstream movement of brackish water from Vermilion Bay is controlled. Water in the Vermilion River near the mouth has chloride concentrations exceeding 1,000 mg/L more than 4 months each year (fig. 9), generally during the late summer and fall. Water from the Vermilion River has been recharging the Abbeville unit near Intracoastal City since 1962, when water levels in the aquifer were lowered below the river stage (Harder and others, 1967, p. 39).

The growth of the saltwater body is indicated by the increasing chloride concentration at well Ve-628 (fig. 8), about 4 mi north of Intracoastal City (fig. 7). The average increase in chloride concentration was 30 (mg/L)/yr. The chlorograph for well Ve-634 (fig. 8) shows an increase of about 5 (mg/L)/yr, indicating that the saltwater body was also moving eastward until 1977. Growth to the north and east means that the saltwater body is probably expanding in all directions. A summary of these data and hydrologic factors affecting the wells in the Abbeville unit is given in table 4.

Table 4.--Summary of data from saltwater-monitor wells in the Abbeville unit in the lower Vermilion River basin

Well No.	Area monitored	Chloride trend
	Wells along the river	
Ve-640	Monitors changes in salinity in the Abbeville unit north of Bancker (well depth 64 ft).	Decrease of 2 (mg/L)/yr 1974-78.
Ve-625	Monitors salinity changes in Abbeville unit north of leading edge of saltwater high below river (well depth 97 ft).	No consistent trend.
Ve-626	Monitors saline zone at Bancker (well depth 66 ft).	Decrease of 25 (mg/L)/yr 1963-66, 20 (mg/L)/yr 1974-80.
Ve-628	Monitored salinity changes below base of freshwater (well depth 88 ft, destroyed before 1975).	Increase of 30 (mg/L)/yr 1964-74.
Ve-633	Monitored salinity changes above base of freshwater (well depth 65 ft deep, destroyed 1978).	No change.
Ve-634	Monitors salinity changes near base of freshwater 1.5 mi east of river (well depth 86 ft, destroyed 1981).	Increased 4 (mg/L)/yr 1967-78.

"Upper Sand".--Below the Abbeville unit lies a saltwater body in the "upper sand," about 50 mi^2 in extent. This saltwater body is slowly enlarging because saline water is moving upward into the "upper sand" from the "lower sand" through a sandy zone in the confining layer between the two aquifers near well Ve-649 (figs. 10 and 11). The areas between Perry and Little Bayou are particularly susceptible to saltwater encroachment from this saline source. Chlorographs for wells in the "upper sand" show a steady, small increase in chloride concentration, indicating that the saltwater body is probably spreading in all directions. As water levels decline in the "upper sand," the differential head between the "upper sand" and the "lower sand" becomes greater, thus increasing the rate of saltwater movement upward through in the confining layer.

The largest volume of saltwater in the "upper sand" underlies the Vermilion River. Most of the salty water in the "upper sand" was not induced from the Vermilion River because it would take longer than the approximately 30 years since water levels in the aquifer dropped below river level to induce the saltwater present. The saltwater in the "upper sand" probably moved upward from the "lower sand" over thousands of years. Wells monitoring the saltwater body have yielded water containing nearly 700 mg/L chloride, according to Harder and others (1967, p. 42); the highest chloride concentration observed was 14,000 mg/L. Wells Ve-637U, -637L, and -649 monitor the "upper sand" in the lower Vermilion River basin (figs. 10 and 12, table 5). Well Ve-637U, for example, shows an increase in chloride concentration of 10 (mg/L)/yr from 1974 to 1977 and 4 (mg/L)/yr from 1977 to 1981. This change, although small, nevertheless indicates the slow, steady, northward expansion of the saltwater body in the most important freshwater aquifer ("upper sand") supplying this area. The "upper sand" supplies the high-capacity wells in the area, which include most of the irrigation, industrial, and municipal wells in Vermilion Parish.

High-Chloride Water in the Iowa Area

A local saltwater problem in the "upper sand" is located north and east of the town of Iowa (pl. 3), about 5 mi east of Lake Charles. The problem has been an important concern to farmers having irrigation wells in a 90 mi^2 area. The wells have yielded water ranging in chloride concentration from 50 to 550 mg/L. The highest chloride concentration in the saltwater body is unknown. There is little indication that this body of high-chloride water is spreading or increasing in salinity.

The shape of the saltwater body is related to channel and flood-plain features incised into the lower confining clay of the Chicot "upper sand," features now buried under about 300 ft of sediment. The structure contours define a flood plain located mostly in Jefferson Davis Parish and a serpentine channel that curves around the town of Iowa and lies at the base of a buried bluff which is 60 ft high in most places. Geohydrologic sections E-E' and F-F' (pl. 3) show the configuration of the base of the aquifer and of chloride zones increasing in concentration with depth. It should be noted that wells screened above the buried channel and its flood plain (about 3 mi to the east and north of Iowa) may have

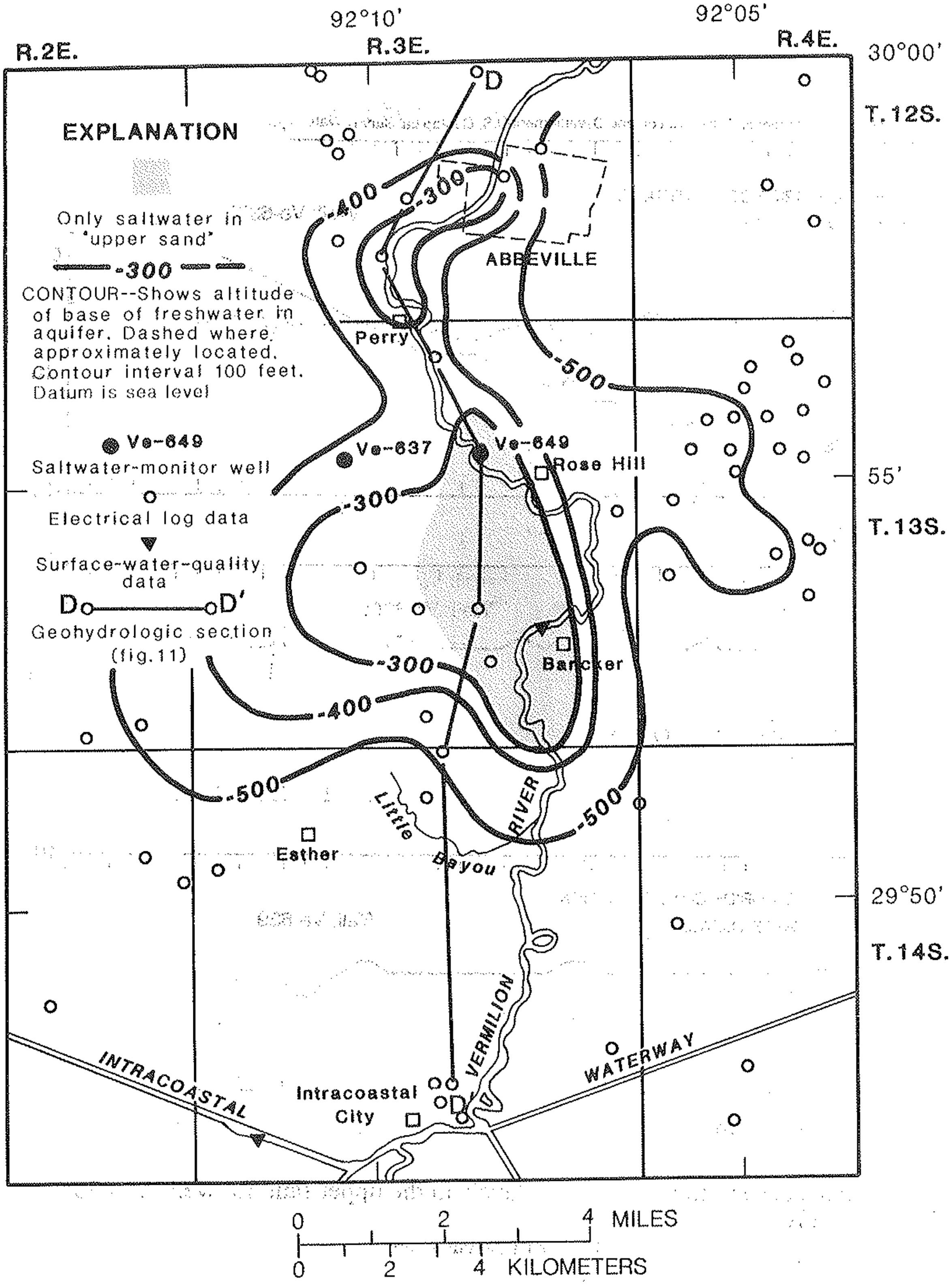


Figure 10.--Base of freshwater in the "upper sand" in the lower Vermilion River basin.

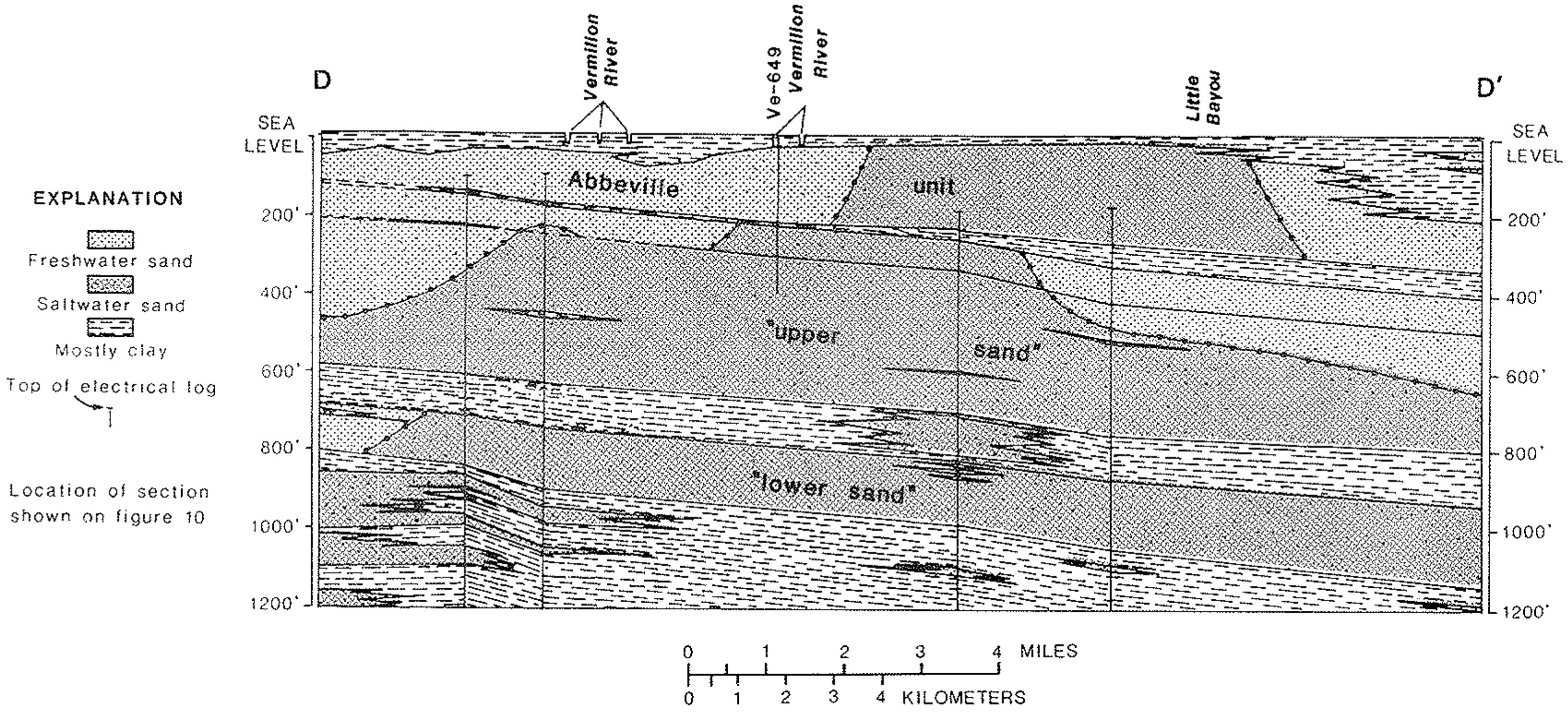


Figure 11.--North-south geohydrologic section along lower Vermilion River.

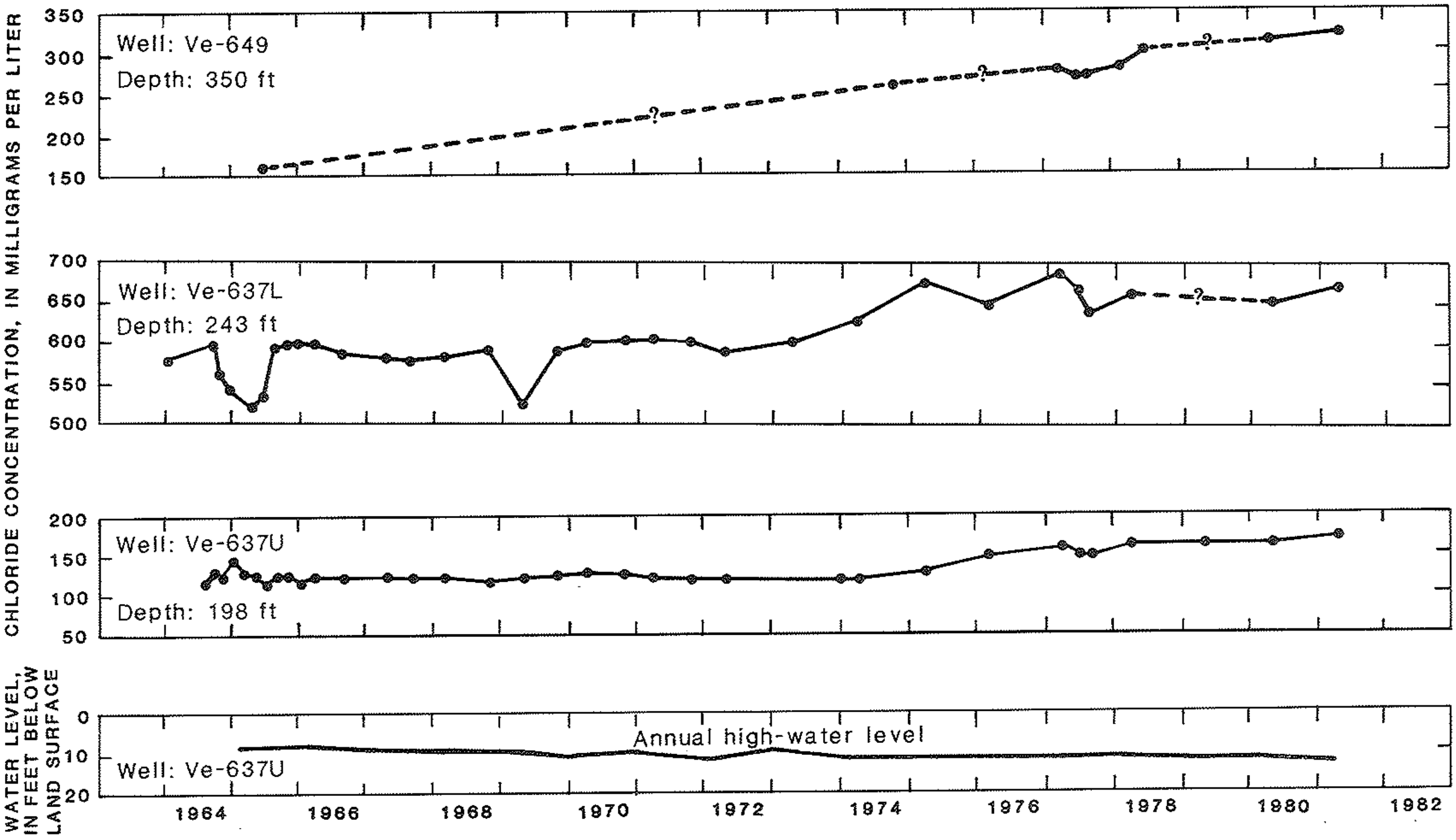


Figure 12.--Chlorographs and hydrograph for wells in the "upper sand" underlying the lower Vermilion River basin.

Table 5.--Summary of data from saltwater-monitor wells in the "upper sand" in the lower Vermilion River basin

Well No.	Area monitored	Chloride trend	Water-level gradient	Rate of water-level decline (ft/yr)
	Wells away from the river			
Ve-637U	Monitors salinity changes in saltwater high 2 mi west of Vermilion River, 5 mi south of Abbeville. Monitors above base of freshwater (well 198 ft deep).	Increasing 7 (mg/L)/yr 1975-81.	0.5 ft/mi northwest.	0.2
Ve-637L	As above, but monitors below the base of freshwater (well 243 ft deep).	Increasing 8 (mg/L)/yr 1970-81.	0.5 ft/mi northwest.	.2
Ve-649	Monitors salinity changes below base of freshwater near well Ve-640 (table 4) (well 350 ft deep).	Increasing 6 (mg/L)/yr 1965-81.	0.5 ft/mi northwest.	.2

about twice the chloride concentration as wells to the west. Movement of the saltwater probably has been southerly, the direction of the slope of the buried channel at the base of the bluff.

Comparisons of analyses of samples collected during the past 30 years indicate that the entire body is now essentially static in all directions. Three analyses (spanning 18 years) for well JD-113, which is directly above the buried channel, show no definite trend (table 6). Wells JD-410 and JD-411, near the channel, have the same depth and have had about the same chloride concentration for the past 19 years. (See pl. 3 and table 6). The high-chloride water has probably existed at its present location since ground-water development began in the area. Wells east and northeast of Iowa that are screened near the base of the aquifer and pumped continuously for long periods of time probably eventually will experience saltwater coning. This is less of a problem to the west (on top of the buried bluff) in Calcasieu Parish, where salinities are lower at the base of the aquifer. The most practical solution to salinity problems in this area is to screen high-capacity wells as far above the base of the aquifer as possible.

Table 6.--Chloride analyses of water from wells in the Iowa area

Well No.	Owner	Well depth, in feet below land surface	Chloride concentration, in milligrams per liter 1948-49	1955-58	1962-68	1973-78
	CALCASIEU PARISH					
Cu-144	R. & R. Hardy	312	150	150	Destroyed	----------
Cu-347	Amy Waite Est	280	290	---	----------	----------
Cu-640	do	200	---	300	310	----------
Cu-646	J. Metzger	330	---	140	----------	200
Cu-651	Town of Iowa	237	---	170	180	----------
Cu-652	do	240	---	---	180	----------
Cu-659	Richardson-Bass Oil Co.	225	---	300	----------	----------
Cu-681	B. L. Pugh	350	---	140	140	----------
Cu-752	C. H. Findley	307	---	---	140	----------
Cu-837	C. Foreman	200+	---	---	----------	260
Cu-969	U.S. Geological Survey.	190	---	---	----------	200
Cu-975	do	237	---	---	----------	260
Cu-992	W. Grout	250	---	---	----------	320
	JEFFERSON DAVIS PARISH					
JD-20	O. Le Jeune	Unknown	200	---	----------	----------
JD-24	O. David	410	200	---	----------	----------
JD-113	L. Bourgeais	355	330	250	300	----------
JD-159	W. M. Fear & Son.	277	90	120	----------	----------
JD-410	R. Fontenot	400	---	---	----------	120
JD-411	do	406	---	100	----------	----------
JD-447	C. Leger	262	---	56	51	46
JD-448	D. J. Forman	311	---	550	----------	----------
JD-449	W. R. Firestone	325	---	280	----------	240
JD-450	I. J. Spalding	178	---	94	----------	----------
JD-451	E. A. Sharp	303	---	180	----------	----------
JD-452	R. Vidrine	280	---	84	----------	----------
JD-453	Shell Oil Co	352	---	100	----------	----------
JD-455	Richardson-Bass Oil Co.	350	---	410	----------	----------
JD-458	W. Jones	156	---	120	----------	----------
JD-462	C. Oliver	215	---	210	----------	----------
JD-463	Mrs. F. Gary	222	---	290	----------	----------
JD-464	L. Ardoin	220	---	120	----------	----------
JD-485	U.S. Geological Survey.	250	---	---	200	----------
JD-485A	do	290	---	---	----------	310(2-78)

Table 6.--Chloride analyses of water from wells in the Iowa area--Continued

Well No.	Owner	Well depth, in feet below land surface	Chloride concentration, in milligrams per liter			
			1948-49	1955-58	1962-68	1973-78
JEFFERSON DAVIS PARISH--Continued						
JD-488B	H. & L. Pousson-	218	---	---	300(3-64)	----------
JD-489A	-----do---------	323	---	---	293(3-64)	----------
JD-490	-----do---------	240	---	---	180(6-64)	250(7-77)
JD-505	R. Geary--------	321	---	---	---------	300(7-73)
JD-506	B. Bourgeois, No. 1.	287	---	---	---------	320(7-77)
JD-507	B. Bourgeois, No. 2.	322	---	---	---------	250(7-77)
JD-527	Shell Oil Co----	252	---	---	---------	130(5-77)
JD-528	Mobile Oil Co---	259	---	---	---------	75(7-77)

High-Chloride Water in the "500-Foot" Sand

In the "500-foot" sand, the coastal freshwater-saltwater interface currently lies near the Calcasieu-Cameron Parish line (pl. 4). The zone is currently essentially static but represents a potential problem for large ground-water-using industries that might locate in that area. The "500-foot" sand is extensively developed in the Lake Charles industrial area and significant increases in pumping could draw the freshwater-saltwater interface northward. The saltwater problems in the Lake Charles industrial area are of local origin and not the result of encroachment from the coastal area.

The Coastal Area

The high-chloride water in the Lake Charles "500-foot" sand occurs primarily in Cameron and southeastern Calcasieu Parishes (pl. 4). The interface, as mapped for this report, is in about the location shown in the report by Harder and others (1967, p. 26). The stratigraphic correlation of the "500-foot" sand is shown in section C'-C" (fig. 5) and sections I-I' and J-J' (fig. 17). Despite heavy pumping in the Lake Charles area, there is little to indicate that the saltwater wedge in the "500-foot" sand is moving northward.

Wells Cu-787, Cn-88U, and Cn-88L monitor changes in chloride concentration in the "500-foot" sand near the Cameron-Calcasieu Parish line (pl. 4). Changes in chloride concentration (table 7) in these wells are small, even though water levels declined about 2 ft/yr prior to 1974; water-level contours on plate 1 show a northward gradient of about 2.5 ft/mi.

The northward movement of high-chloride water in Cameron Parish is partially controlled by a thinning of the aquifer (fig. 17) near the West and East Hackberry and the Black Bayou salt domes (pl. 4). The primary barrier to the movement of water is the reduction in transmissivity of the aquifer.

The "500-foot" sand is about 200 to 300 ft thick south of the Hackberry salt domes and near Calcasieu Lake. North of the Hackberry salt domes, the "500-foot" sand becomes especially thick in areas where the "500-foot" and "700-foot" sands are possibly interconnected. This is an area where the "700-foot" sand is entirely salty and could possibly contribute salty water to the "500-foot" sand.

The Lake Charles Industrial Area

The Lake Charles industrial area was originally developed primarily to support the petrochemical needs for World War II. Most of the water pumped has been used for cooling, however, the use of water for other purposes is increasing. Harder (1960, p. 34) determined that the typical water from the "500-foot" sand had an average concentration of dissolved solids of about 300 mg/L, chloride of about 30 mg/L, and hardness generally ranged from 60 to 120 mg/L. Most of the wells pumping from the "500-foot" sand produce this type of water for the life of the well, but in an 8 mi^2 area the quality of water may change drastically within a few months or years after the well is put in service. Industrial wells affected yield water ranging in chloride concentration from 75 to 370 mg/L. The saltwater body is known to contain chloride concentrations ranging from 50 to 550 mg/L.

Increased industrial pumpage lowered water levels an average of 8 ft/yr during the 4-year period, 1967 to 1970. As a result, the chloride concentration in some industrial wells began increasing during 1970 and continued to increase for several years thereafter, although water levels remained reasonably constant. About 1972, many of the local industries became alarmed at the increased salinity, and an investigation was begun to determine the source and extent of the salty water and the potential severity of the salinity problem.

During the investigation it was found that: (1) there was no consistent correlation between the basal topography of the aquifer and the location of high-chloride water (the water does not have the chemical characteristics of seawater; therefore seawater trapped in depressions at the time of deposition appeared an unlikely source); (2) in clay cores obtained from the confining clays above and below the "500-foot" sand, the chloride concentration of the pore water was found to average about 70 mg/L, which is much lower than the chloride concentration in water from the high-chloride areas; and (3) plugging reports (William Wilhite, Louisiana Office of Conservation, oral commun., 1978) indicated that all known oil- and gas-test wells that might have caused the problem (for example, well 50999 in central chloride body, pl. 5) were properly drilled and plugged. The possibility still remains that improperly drilled and plugged oil- and gas-test wells were abandoned and forgotten before laws were enacted to safeguard energy resources and freshwater aquifers. No other sources of chloride were found in the area. The areal distribution of high-chloride water in the industrial area is shown on plate 5 for the fall of 1981. The map outlines a large area where the chloride concentration exceeds 50 mg/L and shows three saline water bodies exceeding 100 mg/L chloride--a central body south of Hollywood, a southern body within the Cities Service oil refinery, and a northern body near Westlake. Profiles through the chloride bodies are shown on plate 6.

Central Chloride Body.--The central chloride body is a thin layer of salty water occurring at the base of the "500-foot" sand in an essentially unpumped part of the industrial area. The central chloride body lies between two pumping centers (pl. 5), and the salty water is being drawn toward both cones of depression. The demand for water is seasonal, causing water levels in the two cones of depression to be higher in the spring and lower in late summer and fall. The change in chloride concentration in the central body also has a cyclic nature, but not as clearly defined as the pumping cycles. The monitor wells in the central body show that the chloride cycles have the greatest amplitude and shortest wave length near the center of the chloride body, and the chloride cycles are generally reduced in amplitude, have longer wave lengths and are less symmetrical away from the center of the chloride body (area of highest chloride concentration, fig. 13).

The cyclic nature of the chloride concentration probably is related to the rate of ground-water movement toward the cones of depression. When water-level depressions (pumping cones) are deep, chloride concentrations increase; conversely, when drawdowns are less, chloride concentrations decrease. The different characteristics of the chloride cycles at each well probably reflect a composite of conditions unique to that site, such as local transmissivity, rate of movement, and distance from the chloride source. The source of the salty water is unclear, but it may be related to incidents that occurred during the early development of the Lockport oilfield (H. G. Chalkley, oral commun., 1977). The salty water may have been injected during the "blowout" of an oil-test well drilled in the early 1900's, or the source could be an early oil well that was improperly abandoned and continues to inject brine, under high pressure, into the base of the "500-foot" sand. It is likely that the saltwater source is near saltwater monitor well Cu-851.

The chlorographs in figure 13 are arranged in sequence through the central chloride body from north (well Cu-847) to south (well Cu-842). (See pl. 5 for locations.) Well Cu-847 is north of the chloride body and has the lowest chloride concentration and poorly defined chloride cycles. Well Cu-851 generally has the highest salinity and the greatest range in concentrations. Wells Cu-850, -852, and -842 are in a line southward and generally have lower chloride concentrations and a less distinct cyclic response as distance from well Cu-851 increases. The chloride cycles can be expected to become less defined and more distorted because the pumping (drawdown) cycles since 1978 have been more poorly defined. (See water-level hydrograph for Cu-445, fig. 13.) Water levels have been rising sharply since 1981; this will further confuse the chloride cycles, but

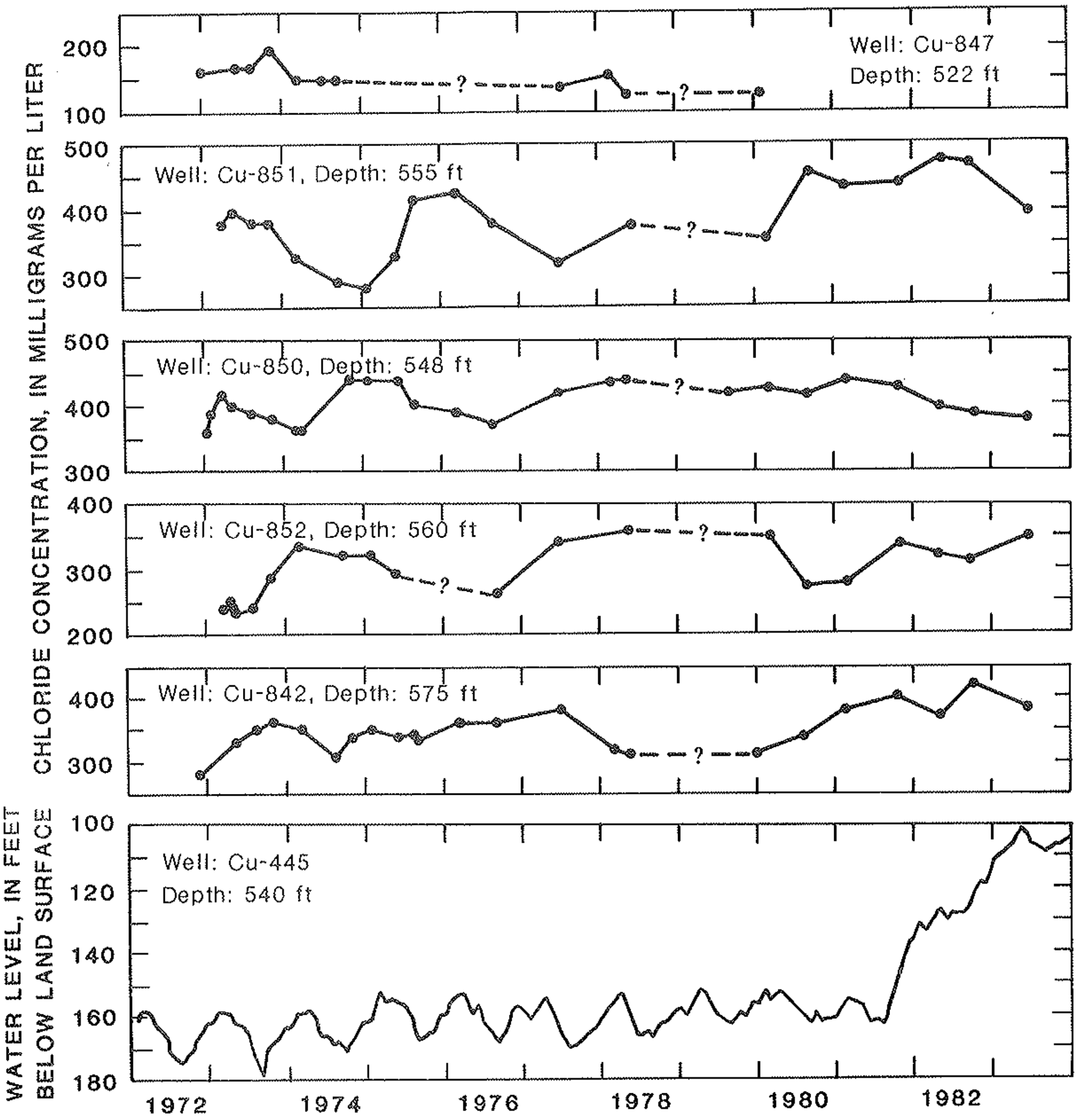


Figure 13.--Chlorographs for selected wells monitoring chloride concentrations in the central saltwater body and hydrograph for well Cu-445.

should have the net effect of slowing the movement of the salty water, and in the long term reduce the saltwater problems related to the central chloride body.

Southern Chloride Body.--The southern chloride body underlies the Cities Service oil refinery (pl. 5). Industrial well Cu-694 (Cities Service No. 13) is near the center of the body. A significant chloride increase was noted between 1970 and 1972, and the concentration continued to increase until 1976 (fig. 14). The most probable cause of the increase

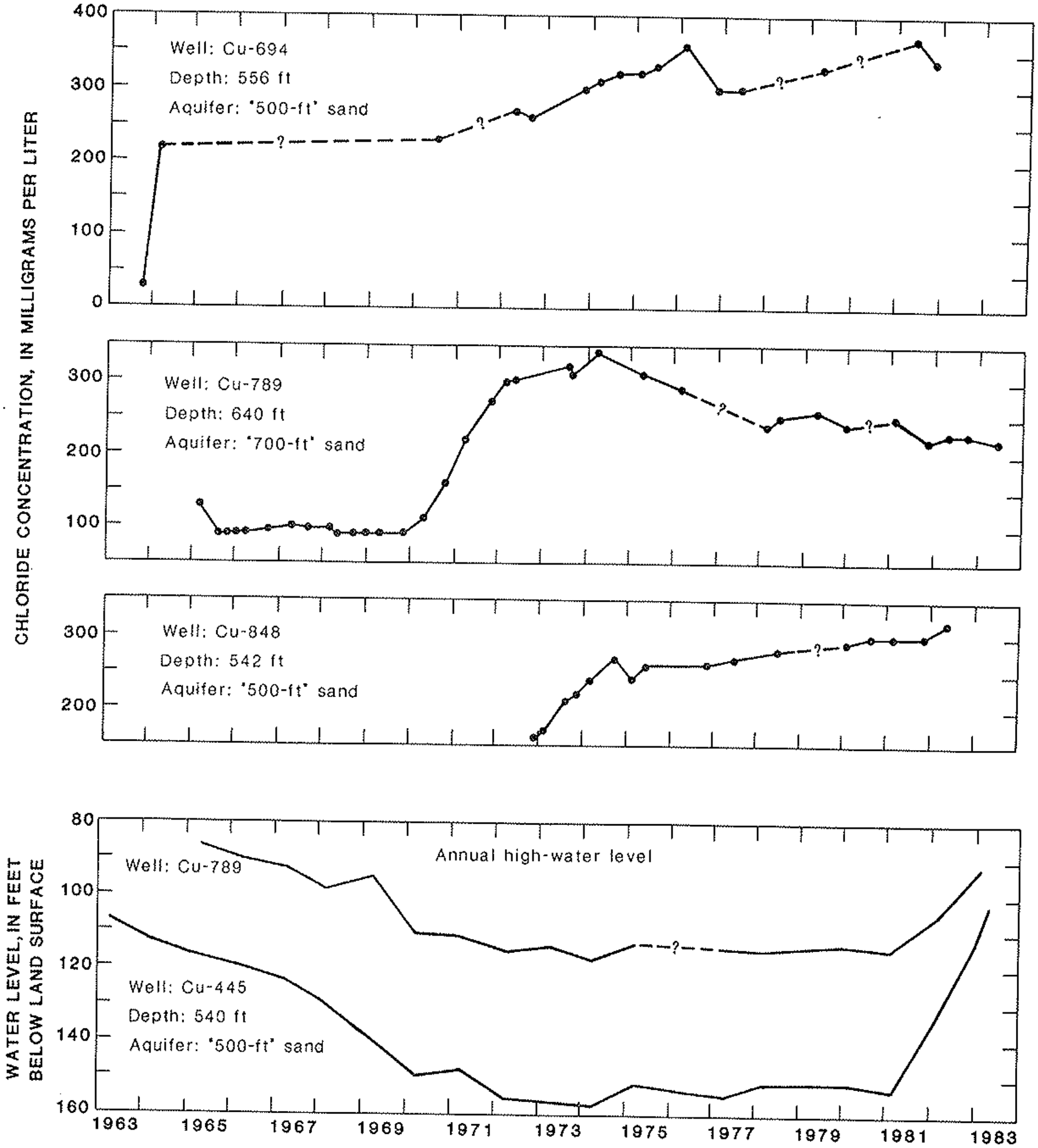


Figure 14.--Chlorographs for selected wells monitoring chloride concentrations in the southern chloride body and hydrographs for wells Cu-445 and 789.

is an indirect connection between the "500-foot" and "700-foot" sands. The "500-foot" sand is intensively pumped; therefore, the artesian head in the "700-foot" sand has typically been about 40 ft higher than in the "500-foot" sand. This difference in artesian head may have been sufficient to push salty water through the interconnection into the base of the "500-foot" sand near well Cu-694.

The movement of the salty water is monitored by well Cu-789, screened at the top of the "700-foot" sand (pls. 5 and 6). Chloride concentrations rose sharply between 1970 and 1972 and since then the chloride concentration in well Cu-789 has been sensitive to rates of withdrawal from the "500-foot" sand. (Compare the chlorograph for well Cu-789 and the hydrograph for Cu-445, fig. 14.) Corresponding chloride changes in wells in the southern chloride body ("500-foot" sand) may be delayed more than a year after a change in chloride trend occurs in the "700-foot" sand. Well Cu-848 monitors the west side of the southern chloride body and it reflects chloride trends in the "500-foot" sand more slowly than well Cu-694. The chloride trends indicated by well Cu-848 are possibly delayed and distorted because the well is in a part of the pumping cone where easterly moving ground water opposes the westerly moving component of the growing saltwater body (pl. 5). Higher water levels in the "500-foot" sand (fig. 13, well Cu-445) will reduce the differential artesian pressure between the "500-foot" and "700-foot" sands and reduce the movement of salty water into the "500-foot" sand. However, vertical upward movement of salty water will not stop completely until the artesian heads in the two aquifers are equal or the water level in the "500-foot" sand is higher than in the "700-foot" sand.

Northern Chloride Body.--The northern chloride body primarily underlies PPG Industries (pl. 5). It is the smallest of the three high-chloride bodies and currently (1983) has the smallest range of chloride concentrations (about 50 to 160 mg/L chloride). The small chloride range reflects a chloride source of lower salinity than that occuring in the central and southern chloride bodies.

The northern chloride body was formed by salty water moving upward from the "700-foot" sand into the "500-foot" sand through connections between the two aquifers, indicated by pumping tests near well Cu-754 (pls. 5 and 6). The intervening clay is indicated to be very thin and probably is missing locally. Salty water moves upward from the "700-foot" sand when water levels in wells in the "500-foot" sand are below water levels in wells in the "700-foot" sand. This relationship can be seen by comparing the chlorographs and hydrographs in figure 15. From 1969 to 1971, water levels in wells in the "500-foot" sand were below levels in wells in the "700-foot" sand (fig. 15, comparing wells Cu-725 and Cu-726). By 1973 chloride concentrations had risen in wells Cu-754, Cu-709, and Cu-725. Between 1971 and 1975 concentrations in the northern chloride body of the "500-foot" sand increased from 120 to 260 mg/L at well Cu-754. This followed a 25-ft water-level decline (1968-70) that resulted in water levels that were 5 to 20 ft lower in wells in the "500-foot" sand than in the "700-foot" sand (fig. 15). Locally since 1975, water levels in wells in the "500-foot" sand have been higher than in the "700-foot" sand, and chloride concentrations have been steadily declining in well Cu-754. A water-level decline of 28 ft was observed in well Cu-725 ("700-foot" sand) from 1969 to 1971 (fig. 15) and since 1971 water levels in wells in the "700-foot" sand have been below those in the "500-foot" sand. In response to lower water levels in the deeper aquifer, water from the "500-foot" sand began recharging the "700-foot" sand. Chloride levels at well Cu-725 ("700-foot" sand) have declined from 230 mg/L in 1973 to about 50 mg/L in 1979 (well Cu-725 was replaced by well Cu-1040) and are now (1982) at the lowest concentrations recorded since monitoring began in 1961.

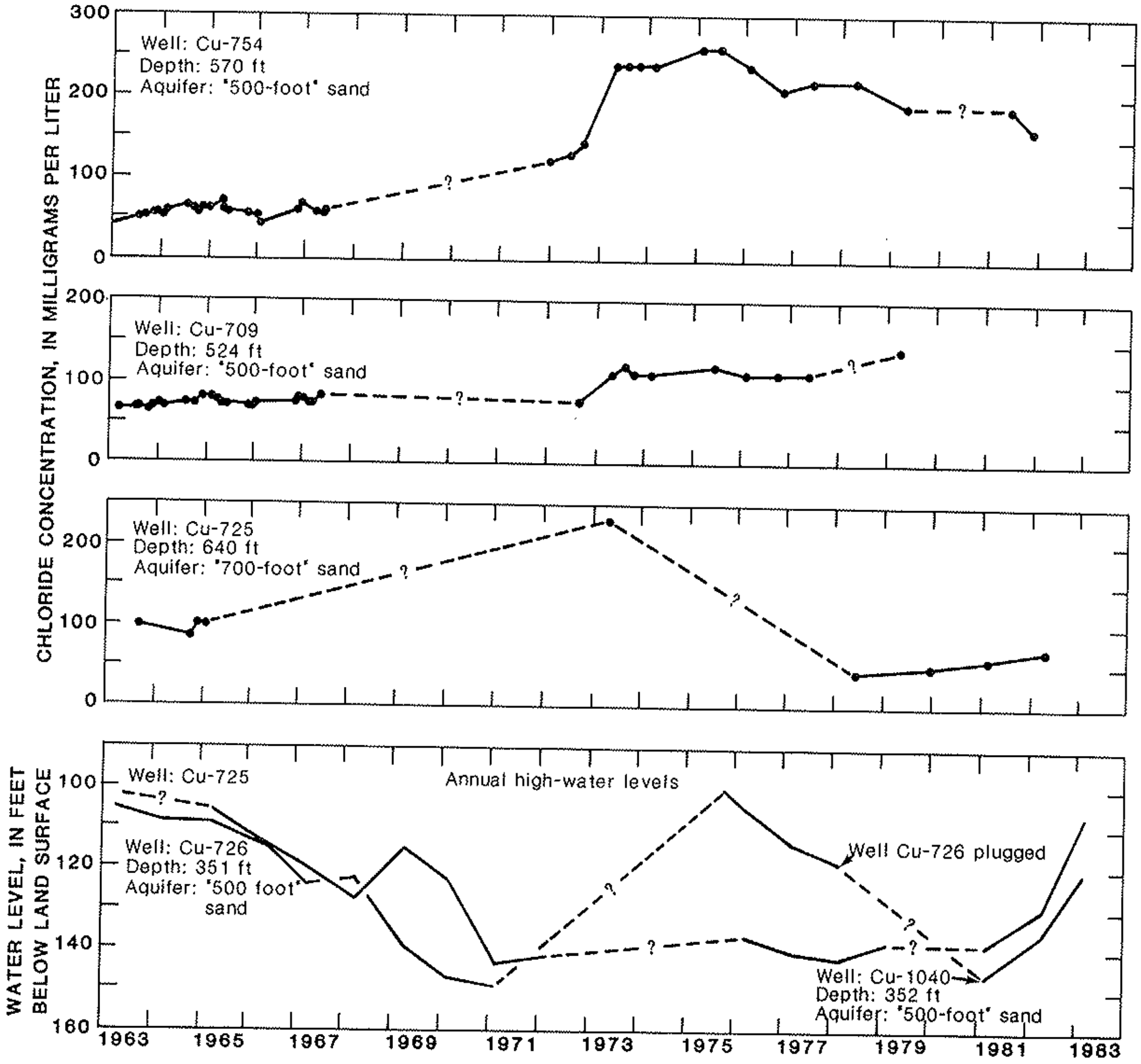


Figure 15.--Chlorographs for selected wells monitoring chloride concentrations in the northern chloride body and hydrographs for wells Cu-725 and 726.

High-Chloride Water in the "700-Foot" Sand

The transition zone from slightly saline to freshwater in the "700-foot" sand underlies the central half of Calcasieu Parish (pl. 7). The transition zone ranges from 10 to 18 mi wide. The northward movement of slightly saline water is related to water-level gradients (fig. 16) caused by the cone of depression at Lake Charles, and the rate of movement is influenced by aquifer thickness and intercalated clays. In western Calcasieu Parish the "700-foot" sand is divided by numerous clay lenses (fig. 17), which thicken southward. Only the thickest and most continuous clay lenses are shown on geohydrologic sections I-I' and J-J'. (See pl. 1 for location of geohydrologic sections.)

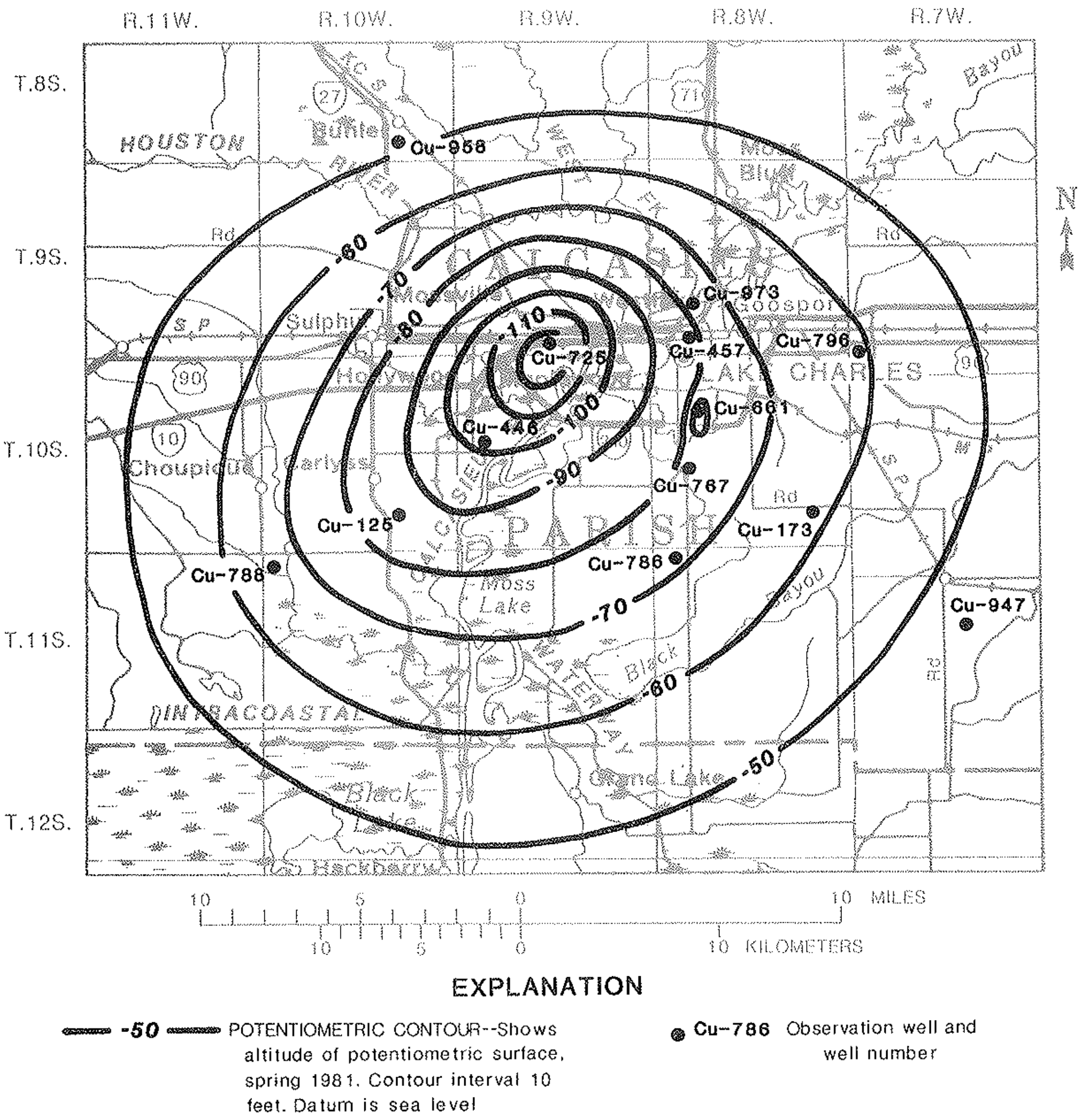
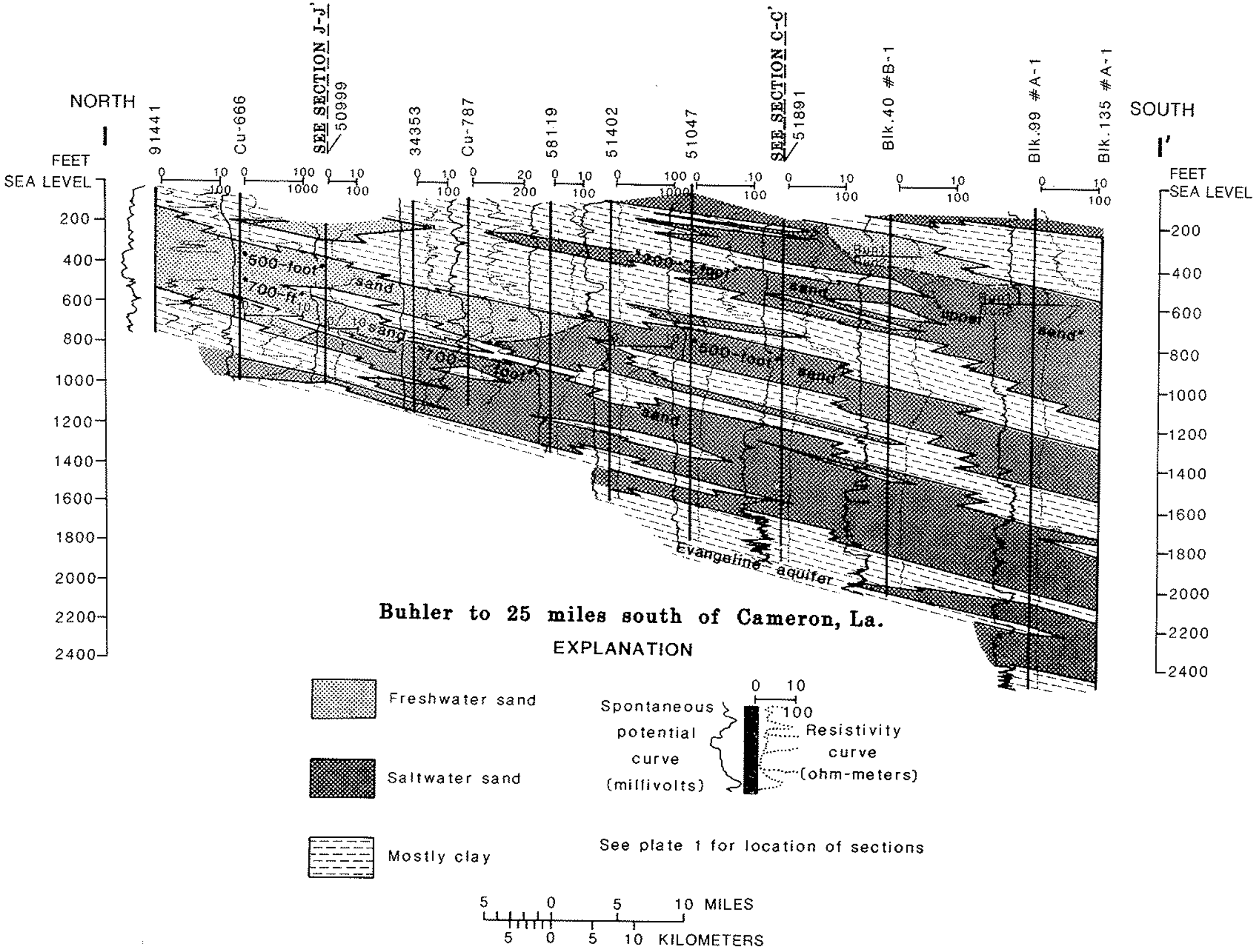


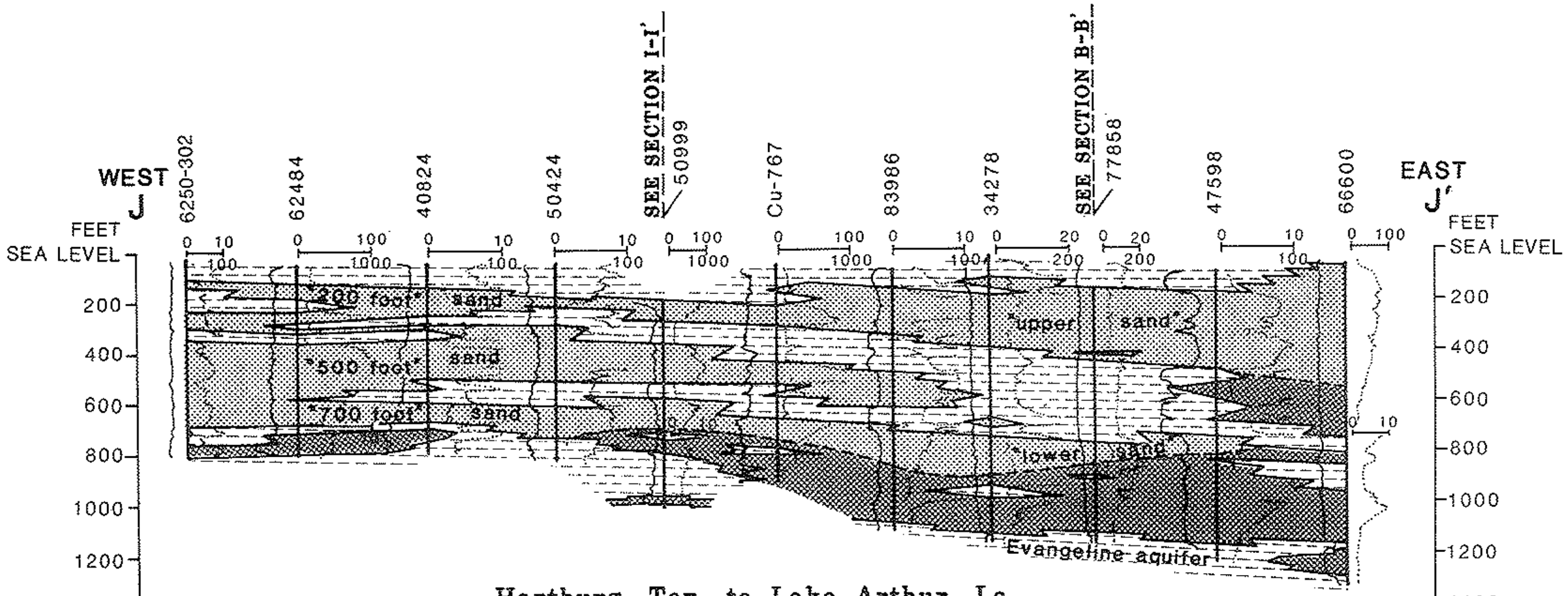
Figure 16.--Potentiometric surface of the "700-foot" sand of the Lake Charles area.

Saltwater encroachment is occurring in most of the "700-foot" sand in the Lake Charles area. Saltwater movement is more rapid near pumping centers and slowest farthest from pumping. The rate of saltwater movement is greatest in southern Lake Charles where chlorides have been increasing steadily at an average of 25 (mg/L)/yr since 1971 (fig. 18). The lowest chloride concentration was 370 mg/L in 1965. Currently (1983) the chloride concentration is 770 mg/L in well Cu-767 (figs. 16 and 18, screened in middle of "700-foot sand), which is 1.5 mi south of a municipal well pumping from the "700-foot" sand (well Cu-661, fig. 16, screened at the



Buhler to 25 miles south of Cameron, La.

EXPLANATION



Hartburg, Tex. to Lake Arthur, La.

Figure 17.--Geohydrologic sections through the Lake Charles area.

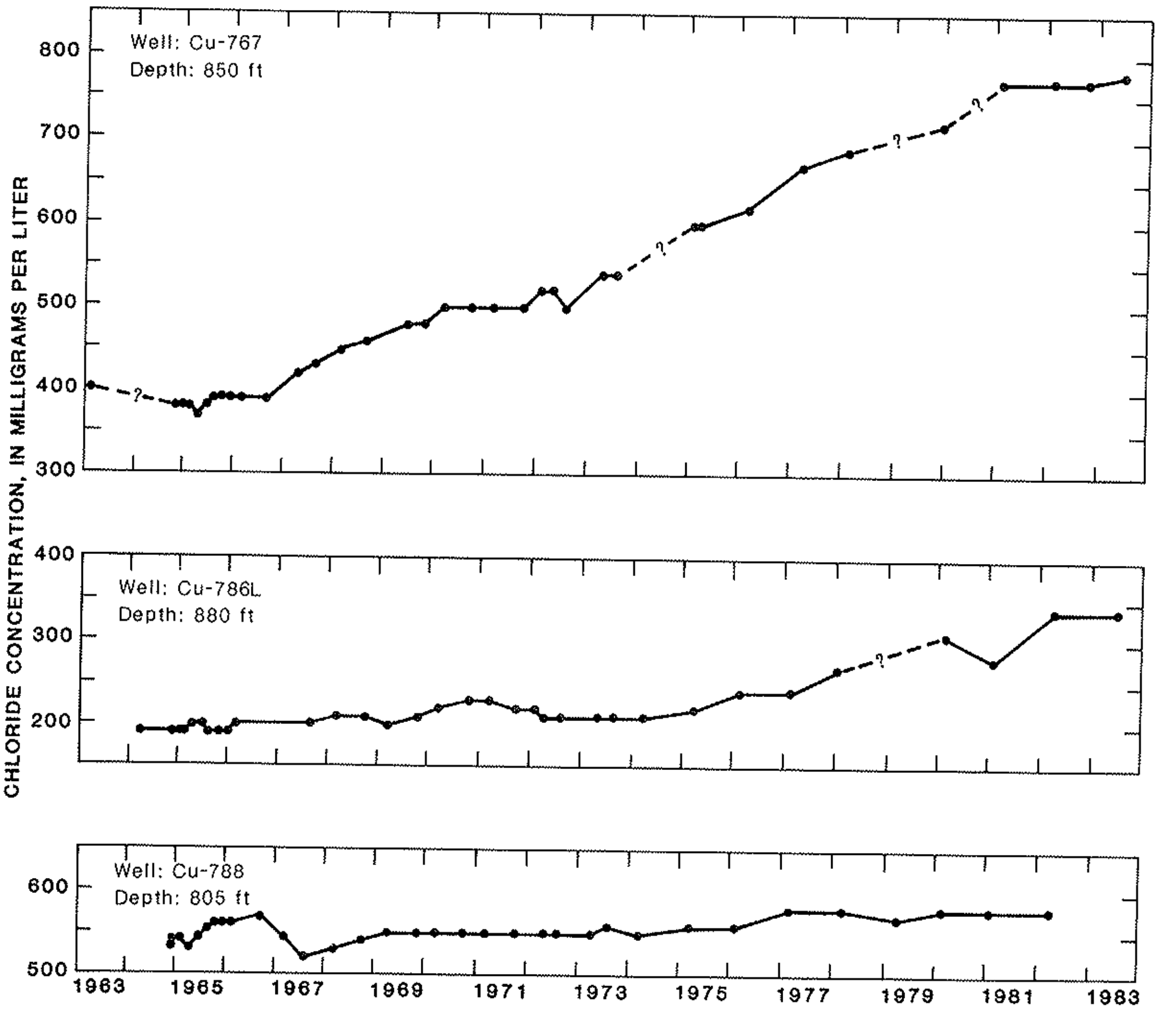


Figure 18.--Selected wells in the "700-foot" sand.

top of "700-foot" sand). The chloride concentration in well Cu-786L, 2.5 mi south from well Cu-767, has increased at an average rate of about 15 (mg/L)/yr from 1974 to 1980. The chloride concentration in water from well Cu-788 in the western half of Calcasieu Parish, has increased at the rate of 5 (mg/L)/yr since 1974 because the location is more remote from pumping.

Total pumpage from the "700-foot" sand is about 10 Mgal/d (1980); however, the pumping cone shown in figure 16 appears larger than the cone that this amount of pumping should create. This is very likely the result of heavy pumping from the "500-foot" sand causing water to move through widely scattered interconnections between the two aquifers, thus lowering water levels in the "700-foot" sand.

DISCUSSION OF SALTWATER PROBLEMS

Solutions to Saltwater Coning

Solutions to the problem of saltwater coning (upconing) include reduced or controlled pumping to minimize vertical movement and screening the wells higher above the saltwater. Other solutions include the use of skimmer wells or scavenger wells.

Ground-Water Augmentation

Saltwater problems in the Lake Charles industrial area are being reduced by the substitution of Sabine River water for some of the ground water previously pumped. The Sabine River Diversion Canal, created by renovating the old Krause and Managan Irrigation Canal, went into operation during the summer of 1981. With this new source of water for industrial use, the probability of coning, or of northward saltwater encroachment from the coastal area, should lessen. Reduced pumping from the "500-foot" and "700-foot" sands in the Lake Charles industrial area will decrease water-level gradients toward the pumping centers, reducing the risk of encroachment and possibly reducing saltwater problems in the Lake Charles area. The combination of the initial effects of this project are evident in the sharply rising water levels during the later part of 1981. (See hydrograph for well Cu-445, fig. 13.)

Skimmer Wells

Skimmer wells are groups of low-yielding wells, screened near the top of an aquifer and spaced to minimize well interference and vertical movement of saltwater. Although the individual wells may produce small yields, collectively the wells would provide the quantity of water needed. Skimmer wells can be used in an interior area to minimize coning or along a coastline to intercept water that would normally be discharged seaward (Bear and Dagan, 1963).

Scavenger Wells

Scavenger wells were first proposed in Louisiana by Fader (1957, p. 18); and a working system was described by Long (1965). Factors that Long (1965) found to affect rate of coning, and thus the design of a scavenger-well system, were: (1) transmissivity of the aquifer, (2) the relation of horizontal to vertical permeability (hydraulic conductivity), (3) distance between bottom of screen and base of freshwater, (4) length and location of screen with respect to the top and bottom of the aquifer, (5) salinity of the water below the base of freshwater, and (6) the quantity of water pumped and resultant water-level decline. The principle involved is shown in figure 19. A scavenger well is screened below a production well at the same site to intercept salty water rising toward the screen of the production well. A problem related to a scavenger-well system is the proper disposal of the saline water.

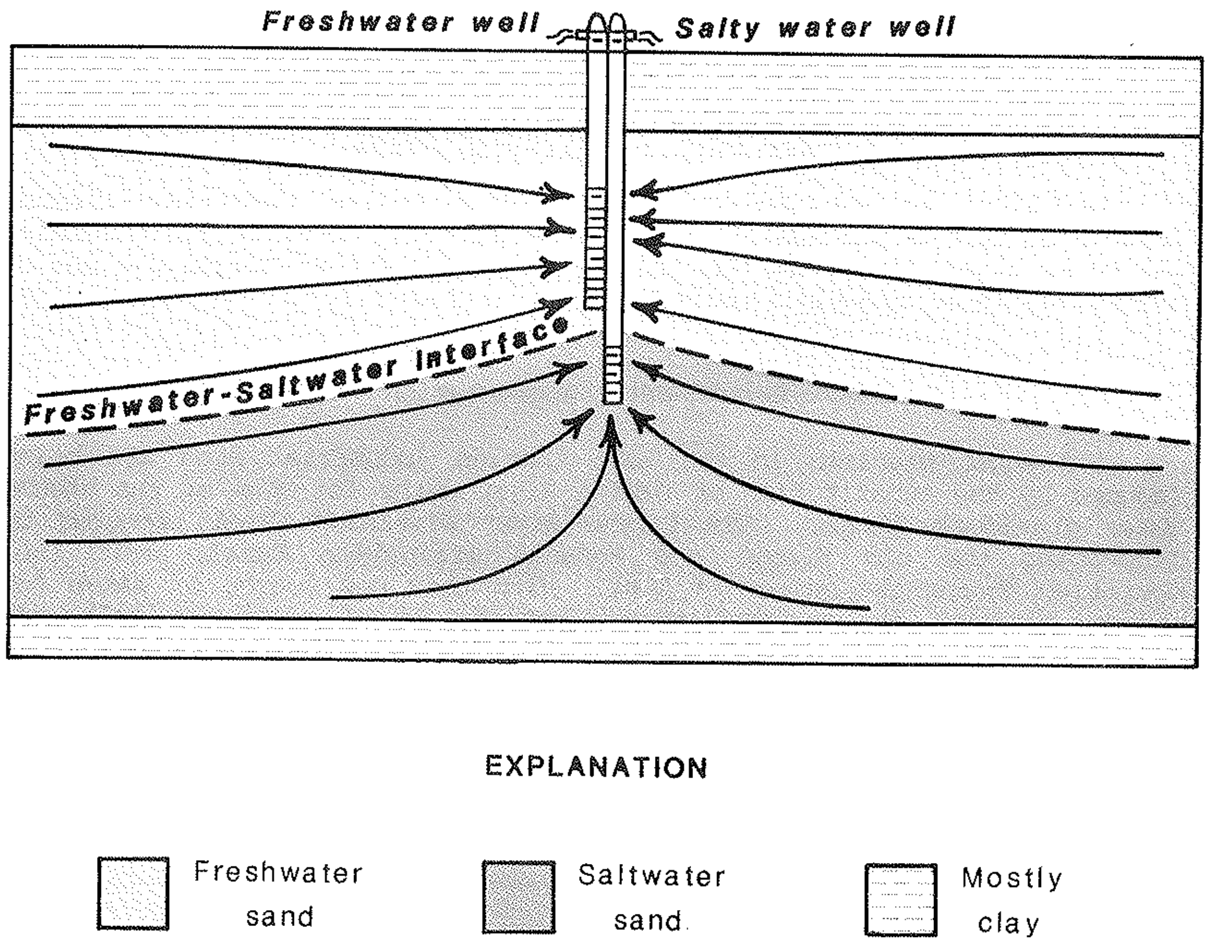


Figure 19.--Operation of a scavenger-well system.

Long (1965) tested a scavenger well system at Gonzales, Louisiana, where the basal part of the Gonzales-New Orleans aquifer contained saline water. The 23-ft screen of an existing public-supply well was divided by a packer and the lower 4 ft of screen was pumped at rates of 30-75 gal/min and the upper 19 ft of screen was pumped at 45-200 gal/min. During the test the upper screen yielded water having chloride concentrations ranging from 14 to 238 mg/L and the lower screen (scavenger portion) yielded water containing 700 to 1,450 mg/L of chloride. A pumping ratio of 4:1 (supply well to scavenger well) generally yielded water of acceptable quality.

The doublet well is a unique type of scavenger well patented by C. E. Jacob in 1965 to eliminate the saltwater disposal problem. An actual working prototype has not yet been built according to Wickersham (1977, p. 344-347). Basically the doublet well is two wells in one--two pumps are operated on a common drive shaft--the upper pump yields freshwater and the lower pump circulates salty water by intaking salty water from just below the base of freshwater and discharging the salty water deeper in the aquifer through the bottom of the well. The upper pump is separated from the lower pump by a packer and there is no mixing of freshwater and high-chloride water within the well casing. The lower part of the well is also separated into two parts by a packer--the upper part screened below the base of freshwater intakes salty water and the lower pump discharges the salty water through a screen at the bottom of the well. The doublet well has been described in detail by Wickersham (1977).

Controlling Saltwater Encroachment

The quality of water yielded by wells pumping in and near the freshwater-saltwater interface is potentially subject to deterioration because of the encroachment of saline water. The problem becomes more serious toward the southern limit of freshwater (patterned areas, pls. 2 and 7) where the layer of freshwater becomes increasingly thin. As stated in earlier sections, intensive pumping in coastal areas can cause local saltwater encroachment and result in degradation of water quality and loss of freshwater storage.

Methods of controlling saltwater encroachment may involve reducing pumping rates and (or) some form of artificial recharge. There are many techniques for artificial recharge and most of them either involve collecting water at the earth's surface and allowing it to infiltrate into the aquifer by gravity, such as using recharge basins, or by using injection wells. A combination of the two techniques may also be used.

Artificial recharge using surface basins generally involves the collection of rainwater, floodwater, or storm runoff in an area where the upper part of the aquifer is very shallow and permeable, thereby allowing the water collected to percolate directly into the aquifer. Although this method of artificial recharge has some application in the outcrop area (pl. 1) of the Chicot aquifer system and in the lower Vermilion River basin (p. 21), the method has little application for controlling saltwater encroachment in most of southwestern Louisiana. The primary problem is the thick clay (generally more than 100 ft in thickness) that separates the main body of the "upper sand," for example, from surface sands or permeable soils. In the coastal areas where the additional recharge is needed, the confining clays are often the thickest. (See geologic section A-A', fig. 4.) Another problem is that there are extensive areas of tidally-affected saltwater marsh, and unlined surface impoundments may become brackish.

Injection wells using storm runoff, or using treated industrial and irrigation effluent are applicable to southwestern Louisiana. Just as wells can be designed to withdraw water from an aquifer, they can be designed to inject water into an aquifer. An injection well may be used alone--simply to locally raise water levels or improve the quality of water in the immediate vicinity of the well; or there may be a series of wells working together--a line of injection wells to create a pressure ridge (in an artesian aquifer system such as the Chicot) or a ground-water mound (in a water-table aquifer).

A line of wells injecting freshwater near the toe of the freshwater-saltwater transition zone, or in an area where the base of freshwater has a steep gradient, has the local effect of reducing or reversing the water-level gradient and generally slowing or temporarily stopping saltwater encroachment. The major drawback to injection wells is the cost of treating the injection water and the cost of maintaining the wells. (See Bruington and Seares, 1965.)

SUMMARY AND CONCLUSIONS

Saltwater encroachment is a potential problem in the three most heavily pumped units of the Chicot aquifer system--the "upper sand" east of Lake Charles and the "500-foot" and "700-foot" sands of the Lake Charles industrial area. Ground-water withdrawals have created pumping cones in all three aquifers, reversing the natural southerly gradients in the coastal areas. These reversed gradients are causing a very slow northward movement of the freshwater-saltwater interface, and some of the saltwater-monitor wells have shown a significant increase in chloride concentration.

This slow rate of saltwater movement is primarily caused by water-level gradients of less than 1 ft/mi in the coastal zone (wetlands areas and offshore). The gradients are low because of vertical recharge and the relatively small amount of ground-water development in the wetland areas.

Although there has been little change in chloride concentration, some areas of the "upper sand" are very susceptible to encroachment--such as along the Atchafalaya River basin near New Iberia, in western Vermilion Parish south of Gueydan, and along the Vermilion River south of Abbeville. In north-central Cameron Parish chlorides have increased more than 20 (mg/L)/yr at well Cn-92, primarily in response to irrigation pumping. The saltwater front is currently essentially static; but if pumping for rice irrigation increases significantly causing additional water-level declines, the northward movement of the saltwater will accelerate. Freshwater resources in areas irrigated for rice in southern Calcasieu and Jefferson Davis Parishes could deteriorate with the northward movement of saltwater.

Water-level declines in the rice-growing area increase the differential artesian pressure between the saline Chicot "lower sand" and the freshwater "upper sand," thereby increasing the movement of salty water upward through openings in the confining layer separating the two aquifers. Existing saltwater highs are now enlarging at a faster rate in response to water-level declines caused mostly by irrigation pumping. Local saltwater mounds and ridges, for example in Vermilion Parish, are enlarging in response to this mechanism.

The Abbeville unit of the Chicot aquifer system in Vermilion Parish has reflected the quality of water in the Vermilion River since water levels in the aquifer were drawn down below the river level. Near Bancker the Abbeville unit generally is recharged by freshwater more than 85 percent of the time; however, high tides may cause inland movement of seawater in the river and the temporary recharge of brackish water into the aquifer. This brackish water is then diluted and the salinity reduced because of recharge by the fresh river water that follows.

The Abbeville unit near Intracoastal City is also recharged directly from the Vermilion River. Because this area is near the mouth of the Vermilion River, the river water contains chloride concentrations exceeding 1,000 mg/L more than 4 months each year, generally during the low-flow season (August-November). This brackish water has been recharging the aquifer since 1951. The nearly continuous recharge of brackish water since that time has caused a saltwater body to grow beneath the river. Currently (1983), chloride concentrations are increasing 30 (mg/L)/yr north of the mouth of the Vermilion River and 5 (mg/L)/yr to the east, but there is probably saltwater movement in all directions. If current conditions continue, salty water in the Abbeville unit will begin moving into the "upper sand," which provides water to most of the high-capacity wells in the area. Saltwater recharge will continue along the Vermilion River until the upstream movement of brackish water from Vermilion Bay is controlled.

Increases in salinity of water in the "500-foot" sand of the Lake Charles industrial area are not related to coastal saltwater encroachment. The increases are mostly the result of vertical movement of saltwater from the "700-foot" sand related to changes in water level caused by pumping. The increases in chloride concentration noted by industries after 1970 were primarily caused by water-level declines from 1967 to 1969. Saltwater in the "700-foot" sand is moving laterally in response to pumping, and northward saltwater encroachment is evident in the lower half of Calcasieu Parish. The largest increase in chloride concentration observed to date (1982) is 25 (mg/L)/yr within the southern city limits of Lake Charles at well Cu-767. The lowest chloride concentration was 370 mg/L during 1965 and the highest 770 during 1981-82. The use of Sabine River water to replace ground-water withdrawals should lessen saltwater problems in the Lake Charles area.

Most of the current saltwater problems in the project area result from saltwater coning--where large-capacity wells tap a sand that contains saltwater at the base of the sand unit. Wells screened above the coastal freshwater-saltwater interface, and wells screened above local inland saltwater bodies, may have upconing problems. Such problems have been best documented locally in Vermilion, Jefferson Davis, and Calcasieu Parishes, but may occur near the freshwater-saltwater interface in all of the major sand units. Inland saltwater bodies include an area of at least 150 mi^2, and affected wells typically yield water having a chloride concentration of 50 to 500 mg/L.

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TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA

WELL NO.	LOCATION T.	R.	SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
				ABBEVILLE UNIT				
VE-625	13S	3E	49	97	63-04-09	434	14	230
					63-05-27	428	11	---
					63-06-27	437	15	---
					63-08-05	440	11	---
					63-11-27	430	14	200
					63-12-31	426	11	210
					64-01-30	430	13	230
					64-02-27	----	15	210
					64-03-31	433	---	190
					64-04-29	447	12	190
					64-05-21	453	---	200
					64-06-24	428	14	---
					64-09-02	416	14	---
					64-09-24	424	13	---
					65-08-13	449	12	---
					66-03-02	445	12	---
					74-10-22	449	10	---
					76-10-27	463	13	---
					77-03-17	453	11	180
					77-06-22	465	10	190
					77-08-10	456	10	200
					78-02-24	453	9	---
					81-07-31	452	8	190
VE-626	13S	3E	54	66	63-04-10	1640	420	340
					63-05-27	1640	420	---
					63-06-27	1630	410	---
					63-08-05	1610	410	---
					63-09-12	1620	410	---
					63-09-25	1600	430	---
					63-10-31	1600	420	---
					63-11-27	1580	420	310
					63-12-31	1560	420	320
					64-01-30	1540	400	---
					64-02-27	----	410	320
					64-03-31	1620	---	310

WELL NO.	LOCATION T.	R.	SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
				ABBEVILLE UNIT--CONTINUED				
VE-633	14S	3E	79	65	64-06-24	1260	230	---
					64-09-02	1190	220	---
					64-09-24	1240	240	---
					64-10-29	1290	240	---
					65-09-30	----	340	---
					65-11-28	1390	240	---
					66-05-02	1390	240	---
					74-10-22	1350	240	---
					76-10-27	1340	240	---
					77-03-17	1560	300	300
					77-06-21	1260	240	310
					77-08-12	1220	220	320
VE-634	14S	4E	18	86	63-09-04	872	52	---
					63-09-25	866	55	---
					63-10-30	862	56	220
					63-11-26	842	59	190
					63-12-31	667	57	---
					64-01-30	840	48	---
					64-02-26	----	57	260
					64-03-31	875	---	280
					64-04-28	930	65	---
					64-05-21	886	---	270
					64-06-24	831	52	---
					64-09-02	803	53	---
					64-09-24	816	53	---
					64-10-29	829	53	---
					74-10-22	1030	100	---
					77-03-20	1110	120	360
					77-08-12	1100	110	400
					78-02-23	1030	96	---
VE-640	13S	3E	44	64	74-10-22	416	12	---
					76-10-27	431	12	---
					77-03-17	424	11	150
					77-06-21	436	15	160

					64-04-29	1650	390	---
					64-05-21	1670	---	340
					64-06-24	1520	380	---
					64-09-02	1430	390	---
					64-09-24	1470	400	---
					64-10-29	1510	400	---
					65-08-13	1560	370	---
					65-11-24	1540	350	---
					66-03-02	1540	360	---
					74-10-22	1340	290	---
					76-10-27	1210	250	---
					77-03-03	1140	220	---
					77-06-21	1150	210	240
					77-08-10	1160	220	260
					80-03-20	1030	180	260
					81-07-31	1030	160	240
VE-628	14S	3E	79	88	63-04-11	2400	660	860
					63-05-27	2460	660	---
					63-06-27	2460	630	---
					63-08-05	2410	680	---
					63-09-12	2510	700	---
					63-10-30	2460	690	450
					63-11-26	2440	690	680
					63-12-31	----	680	760
					64-01-31	2390	680	800
					64-02-26	----	690	750
					64-03-31	3010	---	950
					64-04-28	2680	680	590
					64-05-21	2700	---	750
					64-06-24	2440	680	---
					64-09-02	2270	680	---
					64-09-24	2390	710	---
					64-10-29	2490	710	---
					65-09-30	2810	730	---
					65-11-24	2820	720	---
					66-03-02	2870	740	---
					74-10-22	4000	1000	---
VE-633	14S	3E	79	65	63-08-22	1310	230	---
					63-09-25	1270	220	---
					63-10-30	1270	230	290
					63-11-26	1250	230	380
					63-12-31	1250	230	280
					64-01-31	1240	220	390
					64-02-26	----	230	390
					64-04-28	1540	290	---
					64-05-21	1680	---	510
					77-08-10	431	8	160
					78-02-23	420	7	---
"UPPER SAND"								
CU-451	11S	7W	3	380	46-05-08	----	76	180
					47-09-10	----	65	---
					48-05-24	----	50	---
					48-07-14	948	77	280
					49-08-09	981	80	---
					56-08-01	----	88	---
					62-06-11	----	80	---
					63-07-19	927	80	---
CU-652	9S	6W	29	240	62-06-07	----	180	---
					63-04-25	845	180	---
					63-05-30	849	180	---
					63-06-28	850	170	---
					63-07-26	847	180	---
					63-09-13	859	180	---
					63-09-26	850	180	---
					63-10-31	876	190	---
					64-01-02	843	190	---
					68-04-17	----	190	120
CU-752	9S	6W	31	307	63-05-07	881	140	---
					63-05-21	885	150	---
					63-06-13	884	140	---
					64-05-12	871	140	---
					65-07-12	920	---	---
					66-06-07	----	140	---
					67-06-19	908	140	---
CU-971	11S	5W	18	500	75-01-30	----	280	---
					77-03-02	1400	300	---
					79-08-03	1380	280	140
					81-02-24	1360	300	110
					82-05-06	1390	290	---
					83-06-21	1400	280	---
CU-992	9S	6W	19	250	77-05-05	1410	320	---
CN-81U	12S	3W	11	448	64-09-08	1820	440	310
					64-10-19	1730	450	---
					64-12-09	1710	460	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

"UPPER SAND"--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
CN-81U	12S	3W	11	448	65-02-10	1770	450	---
					65-04-14	1840	450	---
					65-06-15	1830	450	---
					65-08-13	1830	500	---
					65-10-20	1830	460	---
					65-12-16	1860	440	---
					66-03-09	1840	450	---
					66-08-24	1800	430	---
					67-04-12	1840	440	---
					67-08-16	1800	430	---
					68-02-28	1820	430	---
					68-09-19	----	420	---
					69-04-04	----	440	---
					69-10-28	----	420	---
					70-01-17	----	420	---
					70-03-17	----	420	---
					70-10-00	----	420	---
					71-03-00	----	410	---
					72-02-10	----	410	---
					72-04-27	----	400	---
					73-04-11	----	410	---
					74-03-20	----	450	---
					75-03-27	1710	440	---
					76-02-25	1700	390	---
					77-03-02	1730	400	---
					79-03-29	1620	360	---
					80-02-19	1600	370	300
					81-03-09	1630	360	300
					82-05-11	1630	360	---
CN-81L	12S	3W	11	478	64-09-08	1980	490	320
					64-10-19	1870	500	---
					64-12-09	1880	520	---
					65-02-10	1930	510	---
					65-04-14	1980	500	---
					65-06-15	1990	500	---
CN-90	13S	7W	4	396	71-03-00	----	210	---
					71-10-00	----	200	---
					72-02-07	----	200	---
					72-04-25	----	200	---
					73-08-14	----	210	---
					74-03-11	----	190	---
					75-03-18	1050	200	92
					76-02-20	1010	190	---
					77-02-24	1020	190	---
					78-02-15	1010	200	---
					79-03-28	987	160	---
					80-02-13	940	160	86
					81-03-05	971	160	84
					82-05-06	950	150	---
					83-07-20	960	160	---
CN-92	12S	7W	12	443	64-12-24	----	220	---
					65-02-09	1190	220	---
					65-04-13	1200	220	---
					65-06-14	1200	220	---
					65-08-11	1230	230	---
					65-10-19	1250	240	---
					65-12-15	1270	240	---
					66-03-08	1280	240	---
					66-08-23	1230	230	---
					67-04-11	1270	240	---
					67-08-15	1290	240	---
					68-02-27	1320	250	---
					68-09-18	----	280	---
					69-04-05	----	280	---
					69-10-28	----	290	---
					70-03-17	----	290	---
					70-10-00	----	320	---
					71-03-00	----	310	---
					71-10-00	----	340	---
					72-02-08	----	340	---

					65-08-13	2000	500	---
					65-10-20	2020	510	---
					65-12-16	2020	500	---
					66-03-09	2020	500	---
					66-08-24	1950	500	---
					67-04-12	1990	490	---
					67-08-16	1960	480	---
					68-02-28	1980	480	---
					68-09-19	----	480	---
					69-04-04	----	480	---
					69-10-28	----	480	---
					70-03-17	----	470	---
					70-10-00	----	480	---
					71-03-00	----	470	---
					71-10-00	----	470	---
					72-02-10	----	460	---
					72-04-27	----	460	---
					73-04-11	----	470	---
					74-03-20	----	460	---
					75-03-27	1910	470	330
					76-02-25	1910	460	---
					77-03-02	1910	460	---
					79-03-29	1870	420	---
					80-02-19	1840	430	320
					81-03-09	1860	420	320
					82-05-11	1800	420	---
					83-08-23	1760	400	---
CN-90	13S	7W	4	396	64-03-24	1160	230	120
					64-10-13	1110	240	---
					64-12-09	1110	250	---
					65-02-09	1130	240	---
					65-04-13	1160	240	---
					65-06-14	1170	240	---
					65-08-10	1170	240	---
					65-10-19	1160	240	---
					65-12-15	1170	240	---
					66-03-08	1170	240	---
					66-08-23	1130	220	---
					67-04-11	1150	230	---
					67-08-15	1140	230	---
					68-02-27	1130	220	---
					68-09-17	----	220	---
					69-04-03	----	230	---
					69-10-28	----	210	---
					70-03-17	----	210	---
					70-10-00	----	220	---
					72-04-24	----	320	---
					73-04-10	----	350	---
					73-08-14	----	380	---
					74-03-19	----	370	---
					75-03-25	1720	400	200
					76-02-20	1750	400	---
					77-02-25	1750	410	---
					78-02-16	1760	380	---
					79-08-02	1810	410	220
					80-02-15	1780	410	---
					81-03-05	1820	410	220
					82-05-06	1820	420	---
					83-07-20	1820	410	---
CN-93	15S	9W	16	360	64-12-29	----	320	---
					64-12-31	1520	300	110
					65-02-09	1490	320	---
					65-04-13	1530	310	---
					65-06-17	1530	320	---
					65-08-11	1520	320	---
					65-10-19	1500	310	---
					65-12-15	1520	310	---
					66-03-08	1520	310	---
					66-08-23	1480	310	---
					67-04-11	1490	300	---
					67-08-15	----	300	---
					68-02-27	1480	300	---
					68-04-03	----	300	---
					68-09-17	----	300	---
					69-10-28	----	310	---
					70-03-17	----	300	---
					70-10-00	----	300	---
					71-03-00	----	300	---
					71-10-00	----	290	---
					72-02-08	----	290	---
					72-04-27	----	280	---
					72-04-27	----	290	---
					72-04-27	----	280	---
					73-04-10	----	280	---
					73-08-14	----	280	---
					74-03-19	----	280	---
					74-09-04	1450	300	---
					75-03-18	1450	290	---
					76-02-20	1440	280	---
					77-02-27	1450	290	---
					78-02-15	1430	270	---
					80-02-14	1390	260	110
					81-03-05	1420	270	110

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"UPPER SAND"--CONTINUED								
CN-93	15S	9W	16	360	82-04-08	1410	270	120
					83-06-29	1420	260	---
CN-131	12S	3W	8	642	76-01-10	710	88	140
I-93	12S	7E	5	585	65-01-30	1330	260	---
					65-02-11	1410	240	310
					65-04-15	1250	210	---
					65-06-16	1240	210	---
					65-08-11	1260	220	---
					65-10-21	1260	220	---
					65-12-17	1260	210	---
					66-03-10	1270	220	---
					66-08-25	1200	210	---
					67-04-13	1240	210	---
					67-08-17	1230	210	---
					68-02-29	1230	210	---
					68-10-02	----	200	---
					70-03-17	----	200	---
					70-10-00	----	200	---
					71-03-00	----	200	---
					71-10-00	----	190	---
					72-04-26	----	190	---
					73-04-12	----	180	---
					73-08-16	----	180	---
					74-03-21	----	180	---
					75-03-20	----	180	280
					76-02-11	1120	180	---
					77-03-04	1130	180	---
					78-02-22	1120	160	---
					79-04-04	1100	160	---
					80-03-21	1050	140	230
					81-03-11	1050	140	220
					82-05-13	1010	130	---
					83-08-31	970	110	---
"UPPER SAND"--CONTINUED								
JD-485A	10S	6W	4	290	78-02-16	1390	310	---
					80-01-09	1360	300	160
JD-490	9S	6W	16	242	64-05-04	773	---	---
					64-05-12	793	170	---
					64-05-13	815	---	---
					64-05-14	823	---	---
					64-05-15	825	---	---
					64-05-18	831	---	---
					64-05-20	824	---	---
					64-05-24	836	---	---
					64-05-24	839	---	---
					64-06-07	814	180	---
					64-06-08	827	180	---
					64-06-11	826	170	---
					64-06-19	829	170	---
					64-06-23	826	180	---
					64-06-26	831	180	---
					64-06-29	834	180	---
					64-07-11	815	180	---
					64-07-12	819	180	---
					64-07-13	818	170	---
					65-04-22	817	150	---
					65-04-23	848	170	---
					65-04-24	863	160	---
					65-04-25	870	180	---
					65-04-26	870	180	---
					65-04-27	877	180	---
					65-04-28	881	180	---
					65-04-29	884	180	---
					65-04-30	881	180	---
					65-05-01	837	---	---
					65-05-02	853	---	---
					65-05-03	825	---	---
					65-05-04	821	---	---
					65-05-18	821	---	---

JD-20	10S	6W	14	---	49-08-10	1070	200	---
JD-24	10S	6W	11	410	49-06-07	1100	200	---
JD-113	9S	6W	33	355	48-07-13	1450	330	120
					48-07-14	1470	330	---
					49-08-10	1440	320	---
					55-05-16	----	250	---
					62-05-08	----	320	160
					62-07-17	1300	310	---
					62-08-14	----	310	---
					63-04-29	1260	290	---
					63-05-21	1290	300	---
					63-06-13	1280	310	---
					63-07-05	1270	300	---
					64-05-12	1250	310	---
					65-04-29	1280	270	---
					66-05-09	----	300	---
JD-159	9S	6W	14	277	49-06-08	610	91	---
					55-05-16	----	120	---
JD-222	11S	5W	32	300	48-07-14	1260	200	230
JD-411	10S	6W	16	406	51-07-00	1040	100	270
					58-06-11	----	100	250
JD-448	9S	6W	21	314	55-05-16	2020	530	160
					55-06-23	----	510	---
					55-07-14	----	550	---
JD-449	9S	6W	26	328	55-05-16	----	280	---
					77-07-12	1410	240	---
					77-07-12	----	260	---
JD-451	9S	6W	28	303	55-05-16	----	180	---
					55-11-17	----	170	---
					58-05-26	----	150	140
					58-07-24	----	160	120
					59-06-17	----	160	140
					61-05-18	----	160	130
					61-06-06	----	160	---
					61-07-13	----	160	---
JD-462	9S	6W	15	215	55-11-09	----	210	---
JD-463	9S	6W	22	222	55-11-10	----	290	---

					65-05-19	847	---	---
					66-05-09	----	180	---
					66-07-20	845	180	---
					66-08-29	892	180	---
					67-06-05	891	180	---
					77-05-18	1130	---	---
					77-07-13	1130	250	---
JD-505	10S	6W	3	321	73-07-05	1380	300	170
					76-11-00	1410	310	---
					77-06-01	1410	330	---
					78-06-20	1410	310	---
					80-05-12	1320	310	160
					80-06-10	1380	310	---
					81-04-30	1400	320	---
					81-06-16	1400	300	---
JD-506	9S	6W	33	287	77-07-12	1420	320	---
JD-507	9S	6W	34	322	77-07-12	1280	250	---
SMN-108	9S	7E	36	505	65-01-18	1660	260	240
					65-02-11	1620	280	---
					65-04-14	1650	---	---
					65-04-15	1650	270	---
					65-06-16	1650	280	---
					65-08-12	1660	270	---
					65-10-21	1660	270	---
					65-12-17	1670	270	---
					66-03-10	1660	270	---
					66-08-25	1610	270	---
					67-04-13	1650	260	---
					67-08-17	1640	260	---
					68-02-29	1650	260	---
					68-09-20	----	270	---
					69-03-04	----	270	---
					70-03-17	----	270	---
					70-10-00	----	280	---
					71-10-21	----	270	---
					72-04-26	----	270	---
					73-04-13	----	280	---
					74-03-22	----	300	---
					75-03-20	1720	280	250
					78-02-22	1740	280	---
					78-06-22	1750	300	---
					79-04-04	1750	280	---
					80-03-24	1710	300	250
					81-03-12	1810	310	250

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION			DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
	T.	R.	SEC.					
"UPPER SAND"--CONTINUED								
SMN-108	9S	7E	36	505	82-05-13	1810	320	---
					83-08-31	1830	310	---
SM-57U	14S	8E	27	638	64-01-15	1240	250	330
					64-09-26	1080	210	---
					64-10-14	1110	210	---
					64-12-10	1100	220	---
					65-02-11	1130	210	---
					65-04-15	1170	200	---
					65-06-16	1170	210	---
					65-08-12	1170	210	---
					65-10-21	1160	200	---
					65-12-17	1170	210	---
					66-03-10	1170	210	---
					66-08-25	1120	200	---
					67-04-13	1150	200	---
					67-08-17	1140	200	---
					68-02-29	1170	200	---
					68-09-20	----	200	---
					69-04-03	----	200	---
					69-10-28	----	200	---
					70-03-17	----	200	---
					70-10-00	----	200	---
					71-03-00	----	200	---
					71-10-00	----	200	---
					72-04-26	----	190	---
					73-04-13	----	190	---
					73-08-16	----	200	---
					74-03-21	----	200	---
					75-03-20	1140	200	300
					76-02-23	1150	190	---
					77-03-04	1190	200	---
					78-02-22	1150	190	---
					79-04-04	1140	190	---
					80-03-21	1140	180	300
					81-03-11	1170	190	310
"UPPER SAND"--CONTINUED								
VE-630U	14S	1E	10	498	64-04-12	----	130	---
					64-09-02	1020	140	250
					64-10-15	948	130	---
					64-12-10	950	140	---
					65-02-10	975	130	---
					65-04-14	1000	130	---
					65-06-15	951	130	---
					65-08-12	1020	130	---
					65-10-20	1010	130	---
					65-12-16	1030	130	---
					66-03-09	1020	130	---
					66-04-12	1000	130	---
					66-08-24	981	130	---
					67-08-16	1000	130	---
					68-02-29	1020	130	---
					68-09-19	----	130	---
					69-04-04	----	130	---
					69-10-28	----	130	---
					70-03-17	----	130	---
					70-10-00	----	140	---
					71-10-00	----	130	---
					72-04-27	----	140	---
					73-04-12	----	130	---
					75-03-26	1040	140	270
					76-02-23	1040	130	---
					77-03-03	1070	130	---
					77-08-11	1070	140	270
					78-02-17	1060	130	---
					79-04-03	1050	140	---
					80-03-18	1050	130	270
					81-03-09	1060	130	270
					82-05-12	1060	130	---
					83-08-24	1060	130	---
VE-630L	14S	1E	10	528	63-11-05	1470	320	---
					64-09-02	1620	340	350

					82-05-13	1150	190	---
					83-08-31	1140	180	---
					84-03-20	1150	---	---
SM-57L	14S	8E	27	738	64-01-15	4950	1500	600
					64-09-26	4640	1600	---
					64-10-14	4760	1600	---
					64-12-10	4800	1600	---
					65-02-11	5040	1600	---
					65-04-15	5280	1600	---
					65-06-16	5320	1600	---
					65-08-12	5330	1600	---
					65-10-21	5300	1600	---
					65-12-17	5350	1600	---
					66-03-10	5330	1600	---
					66-08-25	5260	1600	---
					67-04-13	5300	1600	---
					67-08-17	5250	1600	---
					68-02-29	5300	1600	---
					68-09-20	----	1600	---
					69-04-03	----	1600	---
					69-10-28	----	1600	---
					70-03-17	----	1600	---
					70-10-00	----	1600	---
					71-03-00	----	1600	---
					71-10-00	----	1600	---
					72-04-26	----	1600	---
					73-08-16	----	1500	---
					74-03-21	----	1600	---
					75-03-20	5330	1600	300
					76-02-23	5310	1600	---
					77-03-04	5480	1500	---
					78-02-22	5440	1600	---
					79-04-04	5330	1500	---
					80-03-21	5200	1500	580
					81-03-11	5420	1600	580
					82-05-13	5420	1600	---
					83-08-31	5350	1500	---
VE-78	13S	3E	14	295	51-07-26	----	320	---
VE-333	11S	1E	35	280	64-06-25	762	80	---
					73-07-25	----	65	---
VE-586	11S	3E	34	264	60-05-25	----	56	100
					61-04-25	----	58	180
					64-05-15	619	53	---
					64-10-15	1500	350	---
					64-12-10	1510	350	---
					65-02-10	1550	350	---
					65-06-15	1610	340	---
					65-08-12	1620	340	---
					65-10-21	1620	340	---
					65-12-16	1630	350	---
					66-03-09	1630	350	---
					66-04-12	1630	340	340
					66-08-24	1610	340	---
					67-08-16	1620	340	---
					68-02-29	1650	340	---
					68-09-19	----	350	---
					69-04-04	----	360	---
					69-10-28	----	360	---
					70-03-17	----	360	---
					70-10-00	----	370	---
					71-10-00	----	360	---
					72-04-27	----	360	---
					73-04-12	----	370	---
					75-03-26	1810	380	400
					76-02-23	1770	380	---
					77-03-03	1850	400	---
					77-08-11	1840	390	420
					79-04-03	1850	400	---
					80-03-18	1860	400	430
					81-03-09	1950	420	440
					83-08-24	1950	420	---
VE-637U	13S	3E	15	198	64-01-30	857	120	---
					64-09-26	865	130	---
					64-10-14	875	130	---
					64-12-09	881	120	---
					65-02-11	908	130	---
					65-04-14	943	130	---
					65-06-15	947	130	---
					65-08-12	941	120	---
					65-10-21	937	120	---
					65-12-16	945	120	---
					66-03-09	942	130	---
					66-08-24	841	130	---
					67-04-12	940	130	---
					67-08-16	938	120	---
					68-02-29	944	120	---
					68-10-02	----	120	---
					69-04-04	----	120	---
					69-10-28	----	130	---
					70-03-17	----	130	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"UPPER SAND"--CONTINUED								
VE-637U	13S	3E	15	198	70-10-00	----	130	---
					71-03-00	----	120	---
					71-10-00	----	120	---
					72-04-26	----	120	---
					73-04-12	----	120	---
					74-03-20	----	120	---
					75-03-26	959	130	220
					76-02-12	1010	140	---
					77-03-03	1060	160	---
					77-06-22	1070	150	280
					77-08-09	1050	150	290
					78-02-22	1060	160	---
					79-04-04	1070	160	---
					80-03-19	1070	160	300
					81-03-10	1110	170	300
					82-05-12	1120	180	---
					83-08-24	1130	180	---
VE-637L	13S	3E	15	243	64-01-30	2290	580	500
					64-02-11	2230	600	---
					64-09-26	2070	600	---
					64-10-14	2130	590	---
					64-12-09	2140	600	---
					65-02-11	2230	600	---
					65-04-14	2320	580	---
					65-06-15	2290	600	---
					65-08-12	2350	600	---
					65-10-21	2330	600	---
					65-12-16	2360	600	---
					66-03-09	2360	600	---
					66-08-24	2310	590	---
					67-04-12	2360	580	---
					67-08-16	2350	580	---
					68-02-29	2370	580	---
					68-10-02	----	590	---
					69-04-04	----	600	---
"UPPER SAND"--CONTINUED								
VE-649	13S	3E	44	350	65-06-07	1110	160	280
					74-10-22	1370	260	---
					77-03-17	1440	280	320
					77-06-20	1460	270	350
					77-08-10	1440	270	280
					78-02-23	1470	280	---
					78-06-23	1500	300	---
					80-03-20	1520	310	350
					81-03-10	1580	320	380
					82-05-12	1610	340	---
VE-658	17S	2E	19	645	77-11-22	1270	200	---
"200-FOOT" SAND								
CU-144	9S	6W	32	312	48-07-15	862	150	140
					49-06-06	853	150	---
					55-05-16	----	140	---
					55-07-28	----	150	---
					56-06-08	----	160	---
					56-07-19	----	120	---
					57-07-31	----	140	---
					58-06-11	----	140	---
					58-07-22	----	140	110
					59-06-16	----	140	130
CU-347	9S	7W	26	280	47-07-31	----	440	---
					48-05-24	----	280	---
					48-07-19	1340	290	140
					49-06-08	1360	300	---
CU-453	10S	10W	34	345	48-05-24	----	25	---
					48-07-19	414	19	140
					49-06-08	413	20	---

					69-10-28	----	590	---
					70-03-17	----	600	---
					70-10-00	----	600	---
					71-03-00	----	610	---
					71-10-00	----	600	---
					72-04-26	----	610	---
					73-04-12	----	600	---
					74-03-20	----	630	---
					75-03-26	2550	680	570
					77-03-03	2650	690	---
					77-06-22	2660	670	570
					77-08-09	2610	640	520
					78-02-22	2610	660	---
					80-03-19	2560	650	---
					81-03-10	2670	670	550
					82-05-12	2580	620	---
					83-08-24	2610	650	---
VE-639	16S	1W	2	608	65-01-05	----	300	---
					65-01-12	1490	310	280
					65-02-10	1440	310	---
					65-04-14	1480	300	---
					65-06-15	1470	310	---
					65-08-12	1480	300	---
					65-10-20	1470	300	---
					65-12-16	1490	300	---
					66-03-09	1490	300	---
					66-08-24	1440	300	---
					67-04-12	1480	300	---
					67-08-16	1470	300	---
					68-02-28	1480	300	---
					69-04-04	----	300	---
					69-09-19	----	300	---
					69-10-28	----	300	---
					70-03-17	----	300	---
					70-10-00	----	300	---
					71-03-00	----	300	---
					71-10-00	----	300	---
					72-04-27	----	300	---
					73-04-12	----	300	---
					73-08-15	----	300	---
					74-03-21	----	300	---
					75-03-20	1500	300	260
					76-02-23	1490	310	---
					77-03-02	1540	310	---
					78-02-17	1510	300	---
					79-04-03	1500	300	---
					83-08-24	1520	300	---

					49-08-18	422	20	---
					51-07-10	413	16	---
					55-05-26	410	16	130
CU-519	11S	7W	17	367	56-08-01	----	56	---
CU-640	9S	7W	26	200	55-05-16	----	300	---
					55-06-23	----	300	---
					55-06-24	1440	300	220
					56-08-01	----	310	---
					63-07-13	1270	310	220
					77-05-18	1390	300	210
CU-642	9S	7W	10	287	55-02-23	----	230	---
					77-05-18	1040	130	---
CU-646	10S	6W	18	330	56-08-01	----	140	---
					77-05-18	1010	200	---
CU-651	9S	6W	29	237	55-06-23	----	170	---
					60-04-06	855	170	120
					62-06-07	----	180	---
					62-12-05	----	190	---
					62-12-28	----	180	---
					63-01-31	----	180	---
					63-03-28	833	180	---
CU-659	9S	6W	19	225	55-11-16	----	300	---
CU-681	10S	6W	17	354	58-06-11	----	140	---
					59-06-12	----	140	220
					59-07-23	----	140	190
					60-05-24	----	150	200
					60-08-03	----	140	130
					61-06-02	----	140	72
					61-08-03	----	140	88
					61-08-22	----	140	96
					62-06-11	----	140	---
					62-07-16	946	---	---
					62-07-17	----	140	---
					63-06-13	945	150	---
					63-07-09	943	140	---
					63-09-04	930	140	---
					64-06-19	924	130	---
					65-04-14	983	---	---
					65-05-07	----	140	---
					66-06-22	988	140	---
					67-06-19	979	140	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"200-FOOT" SAND--CONTINUED								
CU-837	9S	7W	23	---	73-07-05	1240	260	230
CU-861	10S	9W	5	225	69-08-01	----	34	---
					69-10-25	----	34	---
					70-04-08	----	38	---
					70-09-19	----	40	---
					71-03-16	----	36	---
					74-02-20	----	18	---
					74-07-25	----	20	---
					75-01-20	391	19	---
					75-06-05	395	19	---
					76-10-26	402	22	---
					78-04-24	390	21	130
					79-04-18	394	19	---
					80-09-11	387	16	---
					81-05-15	399	17	120
					81-11-05	401	18	120
					82-06-04	400	18	120
					83-06-05	399	18	---
CU-962	11S	9W	3	287	74-05-00	563	20	---
					74-08-27	561	26	---
					77-03-15	550	33	---
					79-11-29	538	18	76
CU-965	10S	10W	21	270	74-08-29	403	18	---
					77-03-16	----	16	---
					80-02-22	455	17	140
CU-966	9S	7W	33	235	74-08-27	1030	180	---
					75-01-30	----	190	---
					77-03-01	----	200	---
					79-12-05	1050	190	260
					83-06-21	1090	190	---
CU-969	10S	7W	12	190	74-09-06	1250	200	---

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"500-FOOT" SAND--CONTINUED								
CU-450	9S	9W	35	523	49-08-11	----	38	---
					63-10-08	397	48	---
					64-02-20	401	49	---
					72-08-01	----	45	---
					73-08-02	----	40	---
					74-02-20	----	35	---
					74-07-02	----	43	---
					75-01-19	395	40	---
					75-06-05	398	42	---
					76-10-20	399	43	---
					78-04-26	535	81	130
					79-04-24	390	38	---
CU-452	8S	12W	23	433	55-05-25	361	33	81
					56-07-31	----	32	---
					60-05-24	----	36	72
					61-06-08	----	32	42
CU-461	10S	9W	18	540	67-00-00	----	24	---
					68-00-00	----	36	---
					72-00-00	----	54	---
					74-02-21	----	40	---
					75-01-19	464	37	130
CU-463B	10S	10W	13	516	63-10-09	381	27	---
					66-12-20	----	33	---
					67-05-15	----	33	---
					67-08-21	----	32	---
					68-02-08	----	32	---
					69-01-31	----	32	---
					69-08-06	----	32	---
					69-10-07	----	32	---
					70-04-02	----	34	---
					70-08-27	----	48	---
					71-03-30	----	34	---
					72-08-05	----	26	---

					77-03-01	1270	150	---
					79-12-05	1240	140	320
					83-06-21	1250	140	---
CU-975	8S	7W	27	237	75-01-31	1100	260	260
					75-02-19	1100	260	---
					77-06-16	1170	270	---
					79-11-30	----	260	250
					83-06-09	1160	260	---
CU-987	9S	9W	33	200	78-05-04	390	21	130
					79-04-19	396	17	---
					80-09-11	393	16	---
					81-05-15	399	17	120
					81-11-06	398	17	120
					83-06-05	397	22	---
CU-989	10S	8W	19	330	78-05-23	418	18	---
					80-02-28	423	20	140
CN-118	15S	6W	5	638	75-03-18	2880	780	---
					77-02-27	2900	760	---
					79-12-06	----	750	190
					83-06-29	----	760	---

"500-FOOT" SAND

CU-445	10S	9W	18	540	72-07-31	----	24	130
					73-10-24	----	27	---
					74-10-24	----	24	---
					74-10-25	427	38	---
CU-449	9S	9W	34	517	64-02-25	414	55	---
					73-04-27	425	48	110
					75-06-05	451	57	---
					78-04-26	436	52	110
					79-04-24	410	42	---
					80-09-09	388	38	---
					83-06-02	----	32	---
					74-02-20	----	26	---
					74-08-02	----	30	---
					75-06-06	393	26	---
					76-11-00	397	25	---
					78-05-01	393	30	120
					79-04-18	396	26	---
					80-10-15	393	26	---
					81-05-29	----	28	120
CU-464	10S	10W	13	530	63-10-09	352	30	---
					64-02-24	354	31	---
					72-08-05	----	26	---
					74-02-06	----	23	---
					74-08-02	----	26	---
					75-06-06	365	24	---
					76-11-00	372	24	---
					78-05-01	365	24	110
					79-04-18	368	25	---
					80-10-15	360	23	---
					81-05-29	371	23	120
					81-11-02	360	24	---
					82-06-02	358	23	100
					83-06-12	366	26	---
CU-465	9S	9W	34	520	63-10-08	441	60	---
					72-08-01	----	74	110
					73-08-02	----	73	---
					74-02-20	----	81	---
					75-01-19	546	82	120
					75-06-05	555	84	---
					76-10-20	561	84	---
					79-04-24	598	94	---
					80-09-09	536	78	---
					81-05-07	509	70	110
					81-11-04	533	73	---
					83-06-02	527	80	---
CU-560	10S	9W	19	563	58-04-16	----	35	---
					70-00-00	----	19	---
					71-00-00	----	23	---
					72-00-00	----	26	---
					72-07-31	----	22	130
					73-10-00	----	21	---
					74-02-21	----	22	---
					74-08-01	----	29	---
					75-01-20	420	30	130
					75-06-06	435	34	---
					76-11-00	432	30	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"500-FOOT" SAND--CONTINUED								
CU-560	10S	9W	19	563	77-05-16	423	29	130
					78-04-28	419	31	150
					79-04-17	425	28	130
					80-10-16	497	53	---
					81-05-28	514	57	140
					81-10-28	519	57	---
					82-06-03	598	77	160
					83-06-12	651	95	---
CU-619	10S	9W	19	586	58-04-16	----	28	---
					63-10-09	408	26	---
					64-02-24	410	27	---
					70-00-00	----	21	---
					72-00-00	----	25	---
					73-10-02	----	22	---
					74-02-21	----	21	---
					74-08-01	----	24	---
					75-01-20	403	20	130
					75-06-06	413	21	---
					76-11-00	416	19	---
					78-04-28	---	----	120
					79-04-17	402	21	---
					80-10-16	400	24	---
					81-05-28	410	22	130
					81-10-28	405	21	---
					82-06-03	404	20	130
					83-06-12	412	23	---
CU-660	10S	9W	18	548	63-10-09	441	59	---
					64-02-24	455	66	---
					68-00-00	----	98	---
					71-00-00	----	98	---
					72-00-00	----	160	---
					72-08-05	----	140	---
					73-07-25	----	140	---
					73-10-11	----	140	---
CU-689	10S	9W	19	531	64-02-24	463	60	---
					70-00-00	----	100	---
					71-00-00	----	120	---
					72-00-00	----	130	---
					72-07-31	----	140	180
					73-10-10	----	150	---
					74-02-21	----	160	---
					74-08-01	----	160	---
					75-01-20	834	170	200
					75-06-06	837	160	---
					76-02-12	----	190	---
					76-11-00	952	190	---
					77-05-16	991	200	230
					78-04-28	1020	230	240
					79-04-17	1080	230	---
					80-10-16	1100	240	---
					81-05-28	1170	260	270
					81-10-28	1200	270	270
CU-690	10S	9W	18	601	63-10-09	391	46	---
					68-00-00	----	42	---
					71-00-00	----	42	---
					72-00-00	----	46	---
					73-10-11	----	40	---
					74-02-20	----	41	---
					74-10-23	413	40	---
					75-01-20	392	39	---
					75-06-05	386	37	---
					79-04-17	424	47	---
					80-10-16	416	45	---
					81-05-28	409	42	110
					81-11-06	426	47	110
CU-692	10S	10W	13	560	63-10-09	371	29	---
					64-02-24	376	31	---
					66-12-20	----	30	---

					74-02-20	----	140	---
					74-07-03	----	140	---
					74-10-23	748	140	---
					75-01-20	743	140	160
					75-06-05	773	150	---
					76-11-00	773	140	---
					79-04-17	752	140	---
					80-10-16	456	54	---
					80-10-17	457	53	---
CU-664	10S	10W	13	501	64-02-24	390	33	---
					66-12-21	----	34	---
					67-05-15	----	34	---
					67-08-21	----	34	---
					68-02-08	----	34	---
					69-01-31	----	32	---
					69-08-05	----	32	---
					69-10-31	----	32	---
					70-03-25	----	36	---
					70-08-25	----	40	---
					71-02-26	----	34	---
					72-08-05	----	26	---
					74-07-03	----	26	---
					78-05-01	368	25	120
					79-04-18	378	25	---
					80-10-15	362	25	---
					81-05-29	384	21	100
					81-11-02	380	22	---
					82-06-02	381	22	120
					83-06-12	385	26	---
CU-676	10S	9W	19	550	63-10-09	496	---	---
					64-02-24	507	68	---
					70-00-00	----	100	---
					71-00-00	----	110	---
					72-00-00	----	130	---
CU-677	9S	9W	27	568	60-01-15	----	64	---
					62-10-25	----	73	---
					63-10-08	499	81	---
					75-06-11	428	52	---
					78-05-04	455	62	100
					79-04-27	437	54	---
					80-10-28	422	51	---
					81-06-03	439	56	82
CU-689	10S	9W	19	531	57-11-19	----	19	140
					63-10-09	448	53	---
					67-05-15	----	30	---
					67-08-21	----	34	---
					68-02-08	----	34	---
					69-01-31	----	36	---
					69-08-11	----	30	---
					69-10-08	----	30	---
					70-03-26	----	40	---
					70-09-08	----	40	---
					71-03-30	----	38	---
					72-08-05	----	26	---
					76-11-00	397	26	---
					78-05-01	388	28	120
					79-04-18	392	25	---
					80-10-15	388	24	---
					81-05-29	396	25	120
					82-06-02	393	23	120
					83-06-12	400	28	---
CU-694	10S	9W	19	556	64-02-24	940	220	---
					70-00-00	----	230	---
					72-00-00	----	270	---
					72-07-31	----	260	170
					73-10-00	----	300	---
					74-02-21	----	310	---
					74-08-01	----	320	---
					75-01-20	1360	320	160
					75-06-06	1390	330	---
					76-02-12	----	360	---
					76-11-00	1370	300	---
					77-05-16	1360	300	170
					79-04-17	1380	330	---
					80-10-16	1420	---	---
					81-05-28	1490	370	180
					81-10-28	1450	340	---
CU-709	10S	9W	4	524	61-02-09	----	60	130
					61-03-14	----	62	130
					62-08-02	497	60	120
					62-11-19	----	67	---
					62-12-20	----	67	---
					63-02-04	----	66	---
					63-06-24	491	66	---
					63-07-23	488	68	---
					63-10-01	488	66	---
					63-10-07	487	69	---
					63-10-30	502	67	---
					63-11-27	481	69	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"500-FOOT" SAND--CONTINUED								
CU-709	10S	9W	4	524	64-01-02	477	69	---
					64-01-29	484	71	---
					64-02-17	----	69	---
					64-02-18	500	---	---
					64-07-30	493	73	---
					64-09-08	490	74	---
					64-09-30	497	77	---
					64-11-25	529	81	---
					65-01-12	528	82	---
					65-01-28	518	79	---
					65-03-01	524	77	---
					65-03-29	527	78	---
					65-04-30	528	75	---
					65-05-27	546	73	---
					65-08-03	530	---	---
					65-10-07	526	---	---
					65-11-04	526	---	---
					65-11-29	----	70	---
					65-12-30	524	70	---
					66-01-25	530	72	---
					66-03-29	523	---	---
					66-06-27	518	---	---
					66-07-28	530	---	---
					66-09-29	528	---	---
					66-11-02	534	75	---
					66-11-28	539	79	---
					67-01-18	544	78	---
					67-02-01	540	75	---
					67-03-02	539	73	---
					67-05-23	567	83	---
					72-08-05	----	76	---
					73-04-27	675	110	110
					73-07-27	----	120	---
					73-10-09	----	110	---
					74-02-20	----	110	---
					75-06-05	710	120	---

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"500-FOOT" SAND--CONTINUED								
CU-754	9S	9W	33	570	63-10-07	409	54	---
					63-11-27	409	55	---
					64-01-02	414	55	---
					64-01-29	419	55	---
					64-02-17	----	59	---
					64-02-18	429	---	---
					64-07-30	434	64	---
					64-09-30	437	62	---
					64-10-28	442	59	---
					64-11-25	446	63	---
					65-01-12	443	62	---
					65-01-28	443	61	---
					65-03-01	470	68	---
					65-03-29	467	65	---
					65-04-30	476	62	---
					65-05-27	455	58	---
					65-08-03	463	---	---
					65-10-07	455	---	---
					65-11-04	446	---	---
					65-11-29	----	55	---
					65-12-30	442	53	---
					66-01-25	455	43	---
					66-04-29	452	---	---
					66-09-07	491	---	---
					66-11-02	491	61	---
					66-11-28	459	68	---
					67-03-02	450	58	---
					67-03-28	449	---	---
					67-05-01	447	57	---
					67-05-23	452	60	---
					71-11-00	---	120	---
					72-05-01	----	130	---
					72-08-05	----	140	---
					73-04-27	1110	240	150
					73-07-27	----	240	---
					73-10-09	----	240	---

					76-02-03	665	110	---
					76-10-20	683	110	---
					77-05-09	676	110	100
					79-04-19	771	140	---
CU-718	9S	8W	31	500	62-10-17	----	40	---
					64-02-17	373	39	---
					75-03-10	383	35	120
					81-10-13	398	35	120
					83-06-09	569	80	---
CU-726	9S	9W	33	351	61-11-03	468	52	150
					62-00-00	----	40	---
					63-08-21	388	32	---
					64-09-15	383	31	---
					64-11-10	404	35	---
					65-01-18	----	33	---
					65-05-11	421	38	---
					73-04-27	656	73	190
CU-738	10S	9W	3	560	62-02-11	385	35	120
					62-02-15	385	35	120
					65-01-19	----	51	---
					74-03-07	----	47	---
					78-06-21	374	35	---
CU-747	10S	9W	3	540	63-08-22	363	29	---
					64-10-07	----	28	---
					64-11-13	361	29	---
					65-01-20	----	32	---
					74-03-01	----	27	---
					78-06-21	384	25	---
CU-753	10S	9W	18	553	62-06-15	----	27	---
					71-11-22	----	130	---
					72-01-31	----	160	---
					74-11-01	760	140	200
					78-05-01	1000	220	210
					79-04-17	942	190	---
CU-754	9S	9W	33	570	62-07-15	458	55	110
					62-08-02	400	39	120
					62-08-09	379	---	---
					63-06-04	405	49	---
					63-06-24	403	49	---
					63-07-23	411	51	---
					63-10-01	413	54	---
					74-02-20	----	240	---
					75-01-20	1120	260	140
					75-06-05	1100	260	---
					76-02-03	1080	240	---
					76-10-20	1000	210	---
					77-05-09	1050	220	140
					78-04-24	1000	220	140
					79-04-19	918	190	---
					81-05-11	948	190	130
					81-11-03	845	160	---
CU-756	9S	9W	27	530	63-10-08	386	47	---
					75-06-11	409	47	---
					82-02-01	430	48	100
					83-06-17	413	48	---
CU-770	10S	9W	5	490	63-02-18	376	35	110
					63-08-23	367	35	---
					64-09-23	388	55	---
					64-11-12	353	38	---
					65-01-18	----	40	---
					65-05-12	392	37	---
					73-07-25	----	26	---
					74-02-21	----	27	---
					74-09-11	345	32	---
					75-03-19	352	24	89
					77-03-15	358	26	87
					79-12-11	346	22	80
CU-778	10S	9W	19	525	75-06-06	809	160	---
					78-04-28	890	180	210
					79-04-17	906	180	---
					80-10-16	928	180	---
					81-05-28	916	180	210
					82-06-03	----	180	220
					83-06-05	----	190	---
CU-784	10S	9W	9	532	64-03-02	485	62	98
					72-12-08	471	55	90
					73-04-26	465	54	85
					73-10-16	----	54	---
					74-02-20	----	53	---
					74-09-09	498	66	---
					75-03-19	499	64	100
					77-06-16	736	130	---
					79-12-07	865	170	210
					81-02-10	807	160	200
					82-04-29	749	130	---
					83-06-09	466	50	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"500-FOOT" SAND--CONTINUED								
CU-787	11S	10W	36	734	64-11-18	507	48	88
					65-02-09	438	31	---
					65-04-13	440	29	---
					65-06-14	432	27	---
					65-08-10	432	29	---
					65-10-18	433	28	---
					65-12-14	440	28	---
					66-03-07	436	28	---
					66-09-23	425	29	---
					67-04-10	432	28	---
					67-08-16	429	27	---
					68-02-27	436	29	---
					68-09-16	----	26	---
					69-04-03	----	27	---
					69-10-28	----	27	---
					70-03-17	----	27	---
					70-10-00	----	29	---
					71-03-00	----	33	---
					71-10-00	----	26	---
					72-04-25	----	29	---
					72-08-05	----	27	---
					73-04-10	----	27	---
					73-08-14	----	30	---
					74-03-13	----	28	---
					75-03-18	464	36	84
					76-02-19	473	40	---
					77-02-28	492	42	---
					78-02-14	496	40	---
					79-03-27	489	39	---
					79-12-03	488	38	89
					82-04-14	493	42	94
CU-796	9S	8W	36	490	65-05-12	408	33	---
					65-05-13	404	32	---
					65-05-14	391	31	---
					65-05-17	395	30	---
CU-842	10S	9W	18	575	74-07-24	----	310	---
					74-10-24	1530	360	---
					75-01-20	----	350	---
					75-05-28	1410	340	---
					75-08-19	1440	340	160
					75-08-28	1440	330	---
					76-02-27	1470	360	---
					76-08-23	1530	360	---
					77-06-07	1620	380	150
					78-02-21	1400	320	---
					78-05-18	1290	310	---
					79-12-10	1350	310	150
					80-08-04	1380	340	120
					81-02-04	1520	380	140
					81-10-27	1640	400	160
					82-04-27	1660	370	---
					82-09-21	1710	420	---
					83-06-07	1650	380	---
CU-847	10S	9W	7	522	72-12-02	819	160	140
					73-04-25	841	170	130
					73-07-24	----	170	---
					73-10-15	----	200	---
					74-02-20	----	150	---
					74-07-03	----	150	---
					74-09-09	777	150	---
					77-06-13	767	140	100
					78-02-21	805	160	---
					78-05-16	727	130	---
					80-01-11	738	130	83
CU-848	10S	10W	24	542	72-12-15	----	160	---
					73-02-27	880	170	230
					73-07-26	----	210	---
					73-10-19	----	220	---
					74-02-22	----	240	---

					65-05-19	403	31	120
					73-07-28	392	32	120
CU-804	11S	9W	16	697	68-05-28	456	31	110
CU-827	10S	9W	18	560	71-11-00	----	73	---
					72-01-00	----	87	---
					72-02-00	----	110	---
					72-03-00	----	100	---
					72-03-24	----	73	---
					72-05-00	----	82	---
					72-06-00	----	84	---
					72-07-00	----	81	---
					72-08-00	----	81	---
					72-08-05	----	84	---
					72-09-00	----	80	---
					72-10-00	----	77	---
					72-11-00	----	84	---
					72-12-00	----	84	---
					73-01-00	----	85	---
					73-02-00	----	90	---
					73-03-00	----	89	---
					73-04-27	617	98	170
					73-07-24	----	100	---
					73-10-00	----	110	---
					74-02-20	----	110	---
					75-06-05	546	74	---
					75-06-20	----	78	---
					75-06-27	----	78	---
					75-07-25	----	93	---
					75-08-09	----	89	---
					76-02-12	625	100	---
					76-11-00	710	120	---
					77-05-06	702	120	150
					78-05-01	686	120	160
					79-04-17	728	130	---
					80-09-19	744	130	---
					81-05-15	753	130	150
					81-11-05	742	130	150
					82-06-04	856	170	170
					83-06-05	877	170	---
CU-842	10S	9W	18	575	72-11-04	1250	280	160
					73-04-25	1430	330	150
					73-07-24	----	350	---
					73-10-15	----	360	---
					74-02-21	----	350	---
					74-09-12	1170	270	---
					75-02-03	----	240	---
					75-05-30	1120	260	---
					76-11-02	1200	260	---
					77-06-16	1230	270	290
					78-06-23	1200	280	---
					80-01-15	1220	290	270
					80-08-07	1300	300	300
					81-02-09	1270	300	300
					81-10-28	1300	300	290
					82-04-30	1240	320	---
CU-849	10S	9W	8	564	72-12-20	534	74	110
					73-07-24	----	75	---
					74-02-19	----	74	---
					74-09-12	524	77	---
					75-03-19	508	68	110
					77-06-10	541	71	---
					78-05-16	537	72	---
					79-07-31	518	65	71
					80-08-08	539	74	110
CU-850	10S	9W	7	548	72-12-21	----	360	---
					73-01-10	----	390	---
					73-03-01	1690	420	270
					73-04-26	1620	400	250
					73-07-25	----	390	---
					73-10-19	----	380	---
					74-02-00	----	360	---
					74-03-05	----	360	---
					74-10-23	1740	440	---
					75-01-21	----	440	---
					75-05-29	1730	440	---
					75-08-19	1660	400	---
					75-08-27	1660	400	---
					76-02-27	1530	390	---
					76-08-23	1520	370	---
					77-06-15	1750	420	---
					78-02-21	1770	440	---
					78-05-16	1680	440	---
					79-08-01	1720	420	210
					80-02-08	1720	430	200
					80-08-06	1660	420	210
					81-02-10	1710	440	210
					81-10-27	1690	430	210
					82-04-28	1690	400	---
					82-09-24	1620	390	---
					83-06-10	1590	380	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

"500-FOOT" SAND--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
CU-851	10S	9W	7	555	73-03-03	1620	380	180
					73-04-25	1630	400	150
					73-07-25	----	380	---
					73-10-19	----	380	---
					74-02-00	----	330	---
					74-09-10	1290	290	---
					75-01-27	----	280	---
					75-05-29	1400	330	---
					75-08-19	1690	420	---
					75-08-20	1660	420	---
					75-08-27	1690	420	---
					76-02-29	1680	430	---
					76-08-23	----	380	---
					76-08-26	1540	380	---
					77-06-15	1400	320	---
					78-05-16	1530	380	---
					80-02-08	1500	360	130
					80-08-06	1770	460	180
					81-02-11	1760	440	160
					81-10-28	1740	440	150
					82-04-29	1830	480	---
					82-09-23	1700	470	---
					83-06-10	1660	400	---
CU-852	10S	9W	7	560	73-03-19	----	240	---
					73-04-06	----	250	---
					73-04-09	----	240	---
					73-04-29	1070	230	180
					73-07-25	----	240	---
					73-10-19	----	290	---
					74-02-19	----	340	---
					74-09-11	1380	320	---
					75-01-27	----	320	---
					75-05-29	1260	290	---
					76-08-23	1020	260	---
					77-06-10	1470	340	---

"500-FOOT" SAND--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
CU-957	10S	9W	18	500	74-08-01	590	90	---
					74-11-01	590	100	---
					75-01-20	622	86	190
					75-06-05	630	99	---
					75-06-20	----	96	---
					75-06-27	----	90	---
					75-07-25	----	99	---
					75-08-02	----	96	---
					75-08-09	----	90	---
					77-05-06	668	110	190
					78-05-01	678	120	210
					79-04-17	671	110	---
					80-09-19	688	110	---
					81-05-15	706	120	180
					81-11-05	675	110	180
					82-06-04	667	110	170
					83-06-05	613	88	---
CU-974	9S	8W	30	466	74-10-31	----	30	---
					79-11-28	320	23	92
					83-06-08	320	26	---
CU-976	10S	9W	8	550	74-11-11	----	280	---
					75-05-29	1220	280	---
					75-08-19	1160	260	---
					75-08-27	1160	260	---
					76-11-02	1230	280	---
					77-06-13	1290	290	210
					78-05-18	1250	300	---
					79-12-11	1380	320	230
					80-08-08	1350	340	220
					81-02-11	1380	340	230
					81-10-29	1410	340	230
					82-04-29	1380	320	---
					82-09-23	1000	260	---
					83-07-19	1020	210	---

					78-05-16	1450	360	---
					80-02-12	1410	350	160
					80-08-06	1180	270	130
					81-02-10	1240	280	140
					81-10-29	1380	340	160
					82-04-28	1440	320	---
					82-09-24	1290	310	---
					83-06-10	1510	350	---
CU-863	10S	9W	18	540	70-00-00	----	19	---
					72-00-00	----	28	---
					73-07-24	----	24	---
					73-10-19	----	26	---
					74-02-20	----	20	---
					74-08-01	----	28	---
					75-01-20	396	26	110
					75-06-05	420	33	---
					76-10-20	443	40	---
					77-05-13	461	44	150
					78-04-25	451	48	140
					79-04-17	543	66	---
					80-10-16	500	58	---
					81-05-28	615	88	170
					81-10-28	601	86	170
					82-06-04	611	86	170
CU-868	9S	9W	33	520	72-08-05	----	41	---
					73-07-27	----	44	---
					73-10-11	----	42	---
					74-02-20	----	43	---
					75-01-20	434	43	110
					75-06-05	452	46	---
					76-10-20	474	53	---
					78-04-24	458	54	110
					80-09-10	447	44	---
					81-05-11	467	52	110
					81-11-03	484	57	---
					83-06-03	450	47	---
CU-949	10S	9W	4	504	76-11-00	488	67	---
					78-05-04	802	150	90
					79-04-19	460	56	---
					80-09-11	837	160	---
					81-05-15	892	170	94
					81-11-06	549	75	42
					82-06-04	808	160	72
					83-06-05	429	50	---
CU-1020	10S	8W	17	375	78-02-28	601	77	---
					78-05-23	427	19	---
					80-02-27	413	20	120
CU-1021	9S	9W	26	487	78-03-04	348	31	---
					80-01-11	322	28	83
					83-06-08	315	28	---
CU-1040	9S	9W	33	352	79-12-20	407	31	130
					81-02-23	411	30	130
					82-04-30	419	32	---
CN-86U	12S	12W	13	535	64-09-30	903	170	62
					64-10-12	870	170	---
					64-12-07	867	180	---
					65-02-09	873	170	---
					65-04-12	896	170	---
					65-06-13	909	170	---
					65-08-10	908	170	---
					65-10-19	908	170	---
					65-12-14	916	170	---
					66-03-07	854	170	---
					66-08-22	897	170	---
					67-04-10	905	170	---
					67-08-14	913	170	---
					68-02-26	918	180	---
					68-09-16	----	180	---
					68-10-28	----	180	---
					69-04-06	----	180	---
					69-10-28	----	180	---
					70-03-17	----	180	---
					70-10-00	----	190	---
					71-03-00	----	180	---
					71-10-00	----	190	---
					72-02-07	----	190	---
					72-04-24	----	190	---
					73-04-09	----	200	---
					74-03-18	----	220	---
					75-03-13	1090	220	---
					76-02-14	1080	210	---
					76-02-19	1080	220	---
					76-10-26	1100	230	---
					77-02-23	----	190	---
					80-02-12	1050	210	77
					81-02-02	1070	220	75
					82-05-03	1080	210	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION			DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	HARD-NESS (MG/L AS CACO3)
	T.	R.	SEC.					
"500-FOOT" SAND--CONTINUED								
CN-86L	12S	12W	13	641	64-09-30	1480	370	---
					64-10-12	1500	370	---
					64-12-07	1500	390	---
					65-02-09	1520	380	---
					65-04-12	----	370	---
					65-06-13	1590	380	---
					65-08-10	1580	380	---
					65-10-19	1570	370	---
					65-12-14	1590	370	---
					66-03-07	1580	370	---
					66-08-22	1560	380	---
					67-04-10	1560	370	---
					67-08-14	1570	360	---
					68-02-26	1560	360	---
					68-09-16	----	360	---
					69-04-06	----	370	---
					69-10-28	----	360	---
					70-03-17	----	360	---
					70-10-00	----	360	---
					71-03-00	----	360	---
					71-10-00	----	370	---
					72-02-07	----	370	---
					72-04-24	----	360	---
					73-04-09	----	370	---
					74-03-13	----	370	---
					75-03-13	1660	400	---
					76-02-19	1650	380	---
					76-10-26	1760	420	---
					77-02-23	1760	410	---
					78-02-14	1810	400	---
					79-03-15	1840	420	70
					80-02-12	1790	430	71
					81-02-02	1810	440	68
					82-05-03	1830	440	---
CN-88U	12S	8W	14	666	64-02-21	888	161	124
"500-FOOT" SAND--CONTINUED								
CN-88L	12S	8W	14	810	72-08-05	----	540	---
					73-04-11	----	540	---
					74-03-19	----	540	---
					78-02-16	2220	560	---
					79-03-28	2240	520	---
CN-103	12S	13W	18	823	52-05-17	----	1200	100
CN-119	15S	9W	16	910	74-09-04	3360	920	---
					75-03-18	3320	900	120
					78-02-15	3360	880	---
					80-02-14	3300	880	130
					83-06-29	----	860	---
"700-FOOT" SAND								
CU-75	10S	9W	18	752	47-07-15	----	180	---
					48-08-25	726	130	110
					54-04-29	----	160	---
					73-10-24	----	340	140
CU-92	9S	9W	34	701	43-09-04	----	150	140
					44-05-02	----	160	110
					48-08-25	934	190	140
					50-07-18	677	120	120
					55-05-07	----	210	---
					56-02-24	934	200	130
					60-01-15	----	200	---
					64-02-19	559	100	---
					64-09-22	644	130	---
CU-125	10S	10W	34	700	47-09-10	----	75	---
CU-173	10S	8W	26	726	47-08-04	----	400	---

					64-10-13	864	180	---
					64-12-09	859	180	---
					65-02-09	871	170	---
					65-04-13	891	170	---
					65-06-14	896	160	---
					65-08-11	894	170	---
					65-10-19	887	160	---
					65-12-15	903	160	---
					66-03-08	896	170	---
					66-08-23	877	170	---
					67-04-11	904	170	---
					67-08-15	887	160	---
					68-02-27	891	160	---
					69-04-12	----	160	---
					70-03-17	----	160	---
					70-10-00	----	160	---
					71-03-00	----	160	---
					71-10-00	----	160	---
					72-04-25	----	160	---
					73-04-11	----	170	---
					74-03-19	----	160	---
					76-02-20	887	160	---
					77-02-24	903	160	---
					78-02-16	892	160	---
					79-03-28	895	150	---
CN-88L	12S	8W	14	810	64-02-20	2070	520	120
					64-10-13	1990	550	---
					64-12-09	1970	560	---
					65-02-09	2030	550	---
					65-04-13	2090	540	---
					65-06-14	2140	540	---
					65-08-11	2120	550	---
					65-10-19	2100	550	---
					65-12-15	2130	550	---
					66-03-08	2120	560	---
					66-08-23	2090	540	---
					67-04-11	2130	530	---
					67-08-15	2110	530	---
					68-02-27	2120	530	---
					68-09-18	----	540	---
					69-04-12	----	550	---
					69-10-28	----	540	---
					70-03-17	----	540	---
					70-10-00	----	540	---
					71-03-00	----	550	---
					71-10-00	----	540	---
					72-04-25	----	550	---
					48-05-24	----	290	---
					48-07-15	1300	290	170
					49-05-25	1140	240	---
					49-08-09	1280	290	---
					55-06-22	----	300	---
					56-06-13	----	280	---
					56-06-20	----	270	---
					56-06-28	----	280	---
					56-07-06	----	300	---
					56-07-13	----	300	---
					56-07-20	----	290	---
					56-07-28	----	290	---
					56-08-01	----	300	---
					56-08-12	----	100	---
					60-06-21	----	260	200
					61-05-11	----	220	160
					62-05-29	----	230	160
					63-06-14	1120	260	---
CU-446	10S	9W	18	738	73-10-23	----	340	200
CU-457	9S	8W	31	697	48-08-24	581	96	92
					49-10-25	580	99	110
					51-08-10	606	100	---
					56-12-18	----	88	---
					62-10-17	----	82	---
					63-03-11	----	73	---
					63-10-07	477	78	---
					64-02-17	475	79	---
					68-04-16	515	76	90
					79-04-27	551	29	---
					80-10-08	552	92	110
					81-07-10	560	100	99
					83-05-29	511	78	---
CU-587	9S	8W	31	626	56-12-18	----	72	---
					63-10-07	486	81	---
					64-02-17	515	90	---
					79-04-27	655	120	---
					81-10-13	678	130	130
					83-06-02	597	100	---
CU-725	9S	9W	33	640	61-11-03	672	110	75
					61-11-18	891	180	---
					61-11-28	893	180	---
					61-11-29	891	180	---
					62-00-00	110	180	---
					63-08-21	569	96	---

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION T.	LOCATION R.	LOCATION SEC.	DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
"700-FOOT" SAND--CONTINUED								
CU-725	9S	9W	33	640	64-09-15	491	87	---
					64-11-10	568	100	---
					65-01-18	----	100	---
					73-04-27	1040	230	240
					78-05-19	443	45	---
					79-12-20	526	51	140
					81-02-23	404	59	64
					82-04-30	397	72	---
CU-731	10S	9W	4	660	62-01-12	379	28	86
					64-09-22	381	38	---
					64-11-13	386	34	---
					65-01-19	----	34	---
					74-03-00	----	30	---
CU-746	10S	9W	3	780	63-08-22	357	42	---
					64-10-07	----	38	---
					64-11-13	374	40	---
					65-01-20	----	40	---
					74-03-01	----	43	---
					78-06-21	448	49	---
CU-767	10S	8W	20	850	63-02-04	1650	400	71
					64-10-12	1460	380	---
					64-12-08	1440	380	---
					65-02-10	1460	380	---
					65-04-13	1510	---	---
					65-04-14	----	370	---
					65-06-15	1540	380	---
					65-08-11	1550	390	---
					65-10-20	1540	390	---
					65-12-15	1570	390	---
					66-03-08	1550	390	---
					66-09-23	1550	390	---
					67-04-13	1640	420	---
					67-08-16	1680	430	---
"700-FOOT" SAND--CONTINUED								
CU-786U	11S	8W	6	840	73-04-11	----	89	---
					73-08-17	----	91	---
					74-03-15	----	95	---
					75-03-11	683	110	120
					76-02-18	703	120	---
					77-03-01	739	120	---
					78-02-15	745	130	---
					80-02-13	815	140	140
					81-02-25	851	160	140
					82-04-15	872	170	150
					83-07-13	901	170	---
CU-786L	11S	8W	6	880	64-03-11	975	190	64
					64-10-13	910	190	---
					64-12-08	907	190	---
					65-02-10	933	190	---
					65-04-14	978	200	---
					65-06-14	986	200	---
					65-08-11	974	190	---
					65-10-19	957	190	---
					65-12-15	982	190	---
					66-03-08	999	200	---
					66-09-23	966	200	---
					67-08-16	976	200	---
					68-03-01	1020	210	---
					68-09-18	----	210	---
					69-04-04	----	200	---
					69-10-28	----	210	---
					70-03-17	----	220	---
					70-10-00	----	230	---
					71-03-00	----	230	---
					71-10-00	----	220	---
					72-02-09	----	220	---
					72-04-25	----	210	---
					72-08-05	----	210	---
					73-04-11	----	210	---

					68-03-01	1750	450	---
					68-09-16	----	460	---
					69-04-04	----	480	---
					69-10-28	----	480	---
					70-03-17	----	500	---
					70-10-28	----	500	---
					71-03-00	----	500	---
					71-10-20	----	500	---
					72-02-09	----	520	---
					72-04-28	----	520	---
					72-08-05	----	500	---
					73-04-11	----	540	---
					73-08-13	----	540	---
					75-02-04	----	600	---
					75-03-19	2230	600	360
					76-02-24	2350	630	---
					77-03-01	2500	670	---
					78-02-16	2550	690	---
					79-12-17	2570	720	440
					81-02-09	2670	770	510
					82-04-15	2770	770	550
					82-09-23	2780	770	---
					83-07-15	2850	780	---
CU-786U	11S	8W	6	840	64-03-12	568	69	96
					64-09-14	537	70	---
					64-10-13	537	66	---
					64-12-08	521	67	---
					65-02-10	534	67	---
					65-04-14	541	65	---
					65-06-14	545	64	---
					65-08-11	548	66	---
					65-10-20	545	66	---
					65-12-15	555	65	---
					66-03-08	551	67	---
					66-09-23	544	67	---
					67-04-11	560	71	---
					67-08-16	553	69	---
					68-03-01	575	75	---
					68-09-18	----	73	---
					69-10-28	----	79	---
					70-03-17	----	82	---
					70-10-00	----	87	---
					71-03-00	----	78	---
					71-10-00	----	79	---
					72-02-00	----	82	---
					72-04-00	----	81	---
					72-08-05	----	85	---
					73-08-17	----	210	---
					74-03-15	----	210	---
					75-03-11	1080	220	80
					76-02-18	1110	240	---
					77-03-01	1190	240	---
					78-02-15	1230	270	---
					80-02-13	1340	310	130
					81-02-25	1370	280	130
					82-04-15	1430	340	140
					83-07-13	1490	340	---
CU-788	10S	11W	36	805	64-12-04	2110	530	160
					64-12-07	1980	540	---
					65-02-08	2030	540	---
					65-04-12	2110	530	---
					65-06-14	2130	540	---
					65-08-10	2130	550	---
					65-10-18	2120	560	---
					65-12-14	2160	560	---
					66-03-07	2140	560	---
					66-09-22	2110	570	---
					67-04-10	2140	540	---
					67-08-15	2130	520	---
					68-02-27	2150	530	---
					68-09-17	----	540	---
					69-04-06	----	550	---
					69-10-28	----	550	---
					70-03-17	----	550	---
					70-10-00	----	550	---
					71-03-00	----	550	---
					71-10-00	----	550	---
					72-04-24	----	550	---
					72-08-05	----	550	---
					73-04-09	----	550	---
					73-08-13	----	560	---
					74-03-13	----	550	---
					75-03-13	2240	560	160
					76-02-18	2250	560	---
					77-02-28	2300	580	---
					78-02-14	2310	580	---
					79-03-26	2300	570	---
					80-02-13	2240	580	180
					81-02-03	2330	580	180
					82-04-16	2370	580	---
CU-789	10S	9W	19	640	65-02-08	671	130	---
					65-08-10	553	88	---
					65-10-18	571	88	160

TABLE 7.--CONDUCTANCE, HARDNESS, AND CHLORIDE DATA FOR WELLS IN THE CHICOT AQUIFER SYSTEM, SOUTHWESTERN LOUISIANA--CONTINUED

WELL NO.	LOCATION			DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
	T.	R.	SEC.					
"700-FOOT" SAND--CONTINUED								
CU-789	10S	9W	19	640	65-12-14	564	89	---
					66-03-07	575	89	---
					66-09-22	560	93	---
					67-04-10	589	98	---
					67-08-14	578	96	---
					68-02-26	580	97	---
					68-04-05	----	89	---
					68-09-16	----	89	---
					68-11-01	----	89	---
					69-04-25	----	89	---
					69-10-28	----	92	---
					70-03-17	----	110	---
					70-10-00	----	160	---
					71-03-00	----	220	---
					71-10-00	----	270	---
					72-02-07	----	300	---
					72-04-24	----	300	---
					73-07-25	----	320	---
					73-08-13	----	310	---
					74-03-13	----	340	---
					75-03-19	1320	310	290
					76-02-19	1250	290	---
					78-02-12	1140	240	---
					78-05-18	1160	250	---
					79-03-26	1160	260	---
					79-12-07	1120	240	150
					81-02-03	1080	250	160
					81-10-27	1070	220	---
					82-04-14	1060	230	140
					82-09-21	980	230	---
					83-06-06	1070	220	---
CU-958	8S	10W	35	707	74-08-28	472	41	---
					79-11-28	467	32	38
CU-972	8S	7W	27	595	79-11-30	1120	260	170

WELL NO.	LOCATION			DEPTH OF WELL (FEET)	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	CHLORIDE, DISSOLVED (MG/L AS CL)	HARDNESS (MG/L AS CACO3)
	T.	R.	SEC.					
CHICOT AQUIFER, UNDIFFERENTIATED								
AC-290	7S	2E	18	300	62-05-16	----	43	190
					62-06-20	----	42	---
					62-07-20	547	34	---
					62-08-15	----	43	---
					63-05-23	685	42	---
					63-07-11	685	42	---
					64-05-13	677	44	---
AC-428	7S	2W	9	203	77-02-15	492	76	130
AL-298	5S	2W	17	137	79-08-09	251	24	71
BE-98	2S	10W	35	223	63-05-15	72	6	---
					76-05-04	72	10	---
BE-382	5S	10W	25	253	76-05-04	174	20	---
BE-446	5S	12W	4	157	78-12-12	180	13	41
CU-215	7S	10W	18	365	49-07-27	221	21	50
JD-31	7S	3W	21	250	49-08-10	425	45	---
					58-05-29	----	44	---
					58-06-26	----	40	---
					59-06-10	----	48	---
					60-05-25	----	48	88
					61-05-08	----	46	95
					61-06-06	----	44	46
					61-08-22	----	46	59
					62-05-09	----	42	---
					62-06-15	----	42	---
					62-07-12	380	44	---
					63-05-07	316	41	---
					63-06-20	320	40	---
					64-06-11	313	53	---

					83-06-09	1050	230	---
CU-973	9S	8W	30	661	74-10-31	----	240	---
					75-01-29	----	230	---
					77-03-18	948	180	100
					79-11-28	781	140	70
					83-06-08	916	180	---
JD-493	7S	5W	28	223	76-06-02	211	24	---
SL-201	6S	1W	13	214	65-06-22	578	56	190