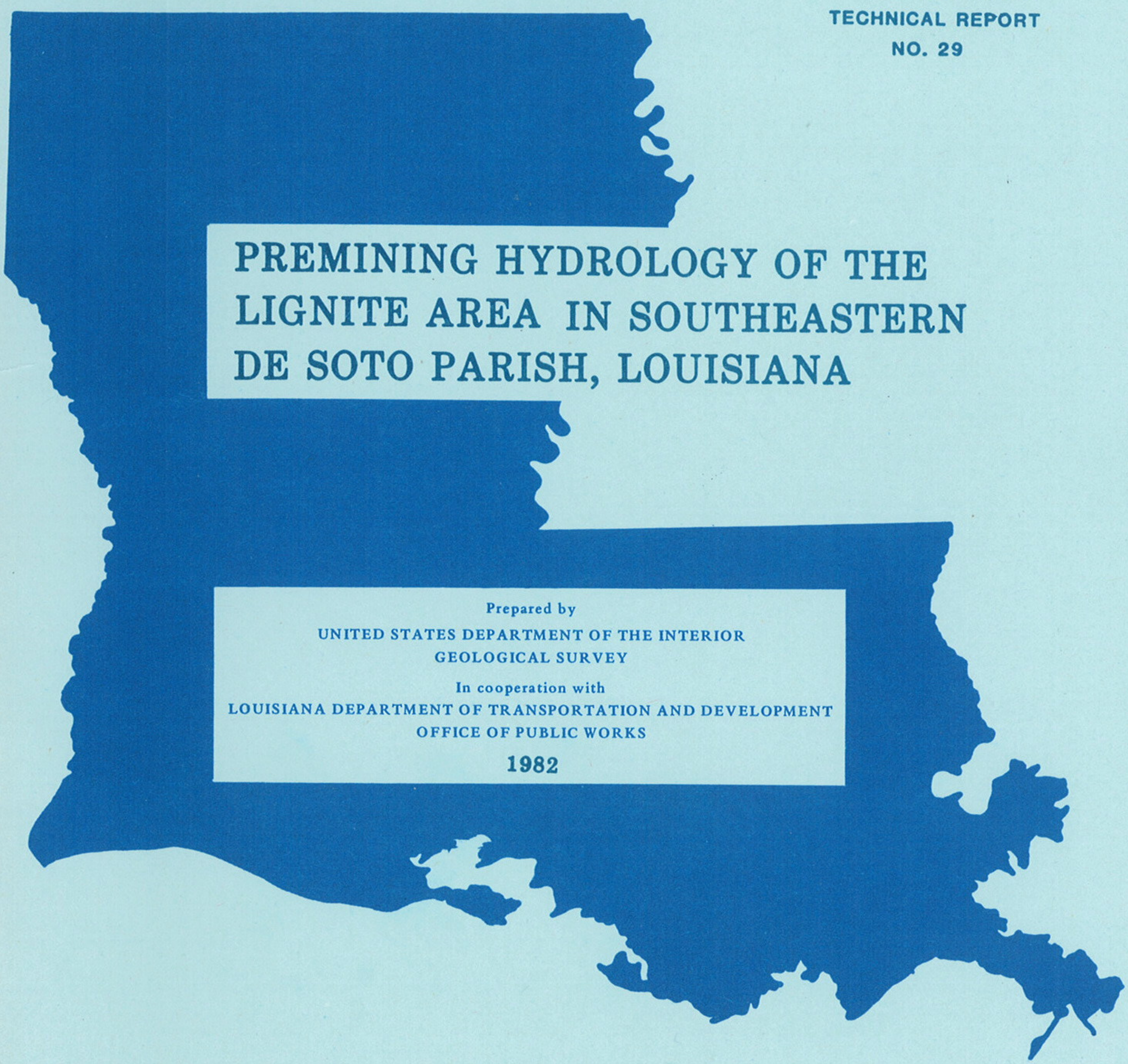
STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
OFFICE OF PUBLIC WORKS

WATER RESOURCES
TECHNICAL REPORT
NO. 29



PREMINING HYDROLOGY OF THE LIGNITE AREA IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA

Prepared by
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
In cooperation with
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
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1982

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By

J. L. Snider
U.S. Geological Survey

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DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

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

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.1093	cubic meter per second per square kilometer [(m^3/s)/km^2]
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)
gallon per minute (gal/min)	6.309×10^{-5}	cubic meter per second (m^3/s)
gallon per minute per foot [(gal/min)/ft]	2.070×10^{-4}	cubic meter per second per meter [(m^3/s)/m]
million gallons per day (Mgal/d)	3.785×10^{6}	liter per day (L/d)
	3.785×10^{3}	meter cubed per day (m^3/d)
inch (in.)	25.40	millimeter (mm)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
ton per day (ton/d)	0.9072	metric ton per day (ton/d)
	0.9072	megagrams per day (Mg/d)
ton per day per square mile [(ton/d)/mi^2]	0.3503	metric ton per day per square kilometer [(ton/d)/km^2]

To convert temperature in degree Celsius (°C) to degree Fahrenheit (°F), multiply by 9/5 and add 32.

PREMINING HYDROLOGY OF THE LIGNITE AREA
IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA

By J. L. Snider

ABSTRACT

Surface mining of the Chemard Lake lignite will have an effect on ground and surface water in southeastern De Soto Parish, La. The mining will involve dewatering and removing the Dolet Hills aquifer, which overlies the lignite. The ground-water gradient will be changed near the mine and recharge to the aquifer will be interrupted in that area. The Dolet Hills aquifer is the source of water for the Rambin-Wallace Water System and the major source of water for the Pleasant Hill Water System. The average hydraulic conductivity of the aquifer is about 20 feet per day, and the average aquifer thickness is about 90 feet.

After mining, the pit will be back-filled with spoil. If the aquifer sands are replaced without being mixed with clay, the resulting transmissivity may be higher initially than that of the original aquifer because of loose packing. Consequently, infiltration of water from precipitation will be enhanced. The transmissivity of the spoil will eventually be reduced by compaction of the sand. If the sand from the aquifer is mixed with clay, the replaced spoil may consist of sand with discrete lumps of clay. Transmissivity of the replaced spoil might be lower than that of the original aquifer because of the clay lumps. Infiltration of water from precipitation to the loosely packed sand may be enhanced. If the sand from the aquifer is intimately mixed with clay, the transmissivity of replaced spoil may be low and water movement through the spoil retarded.

Mining activity could cause a change in water quality of the streams. Concentrations of dissolved solids, aluminum, calcium, iron, magnesium, manganese, and sulfate could increase. In addition, sediment loads of streams draining land disturbed by the mining operations could increase. However, mine operators are required to meet the effluent standards of the Louisiana Surface Mining and Reclamation Act. These requirements may be met by treatment of runoff from the mined area in sediment ponds before the water is released to streams. Treatment of mine runoff in sediment ponds could reduce concentrations of undesirable chemical constituents, and sediment load could be decreased before the water is released to streams.

INTRODUCTION

Energy companies are evaluating areas in northwestern Louisiana for their potential for surface mining of lignite. One area considered favorable is in southeastern De Soto Parish. According to Meagher and Aycock (1942, p. 50) the thickest and most extensive lignite stratum cropping out in Louisiana is located in the Dolet Hills, 12 to 15 mi southeast of Mansfield. The Louisiana Department of Natural Resources, Geological Survey investigated this lignite deposit (called the Chemard Lake lignite lentil) and found that it is 5 to 7 ft thick in an area of approximately 80 mi^2. The Louisiana Geological Survey also reported that a thick, freshwater-bearing sand, which is a principal aquifer in southeastern De Soto Parish, overlies the lignite in all of the area of their investigation (Roland, and others, 1976, p. 11, 20).

Surface mining of the Chemard Lake lignite will have an environmental effect on ground water and surface water in southeastern De Soto Parish. The sand overlying the lignite bed will be dewatered and removed as parts of the mining area are excavated. This will temporarily change the ground-water gradient in the area near the mines. Local recharge to the sand will be disrupted and water levels will decline. The chemical quality of water in the sand may be changed. The discharge and water quality of streams draining the disturbed areas may be changed. Streams also may be rerouted during mining. Runoff from unweathered material and unvegetated slopes could increase the sediment load in streams draining mined or reclaimed land. Mine drainage and water pumped from the Dolet Hills aquifer during the dewatering process may increase the flow and affect the water quality of receiving streams. Because of the disturbance to overlying formations, water may be induced to move upward from sands below the Chemard Lake lignite. Water in sands 30-100 ft below the lignite contains high concentrations of chloride and could effect the quality of water in shallow wells and streams. (Mine operators are required to meet the effluent standards of the Louisiana Surface Mining and Reclamation Act.)

To assess hydrologic changes that the mining may cause, the premining conditions must be known. Therefore, in May 1977 the U.S. Geological Survey began a study of the hydrology of the area in cooperation with the Louisiana Office of Public Works, Department of Transportation and Development. Mining probably will start in the middle 1980's.

Objective

The objective of this report is to describe the hydrology of the project area before mining. The descriptions can be used as a base for (1) estimating changes in the hydrology that may be caused by mining and (2) measuring hydrologic changes during and after mining and reclamation.

Scope

Ground Water

Test holes were drilled and observation wells were installed to obtain geohydrologic data for the water-bearing sand overlying the Chemard Lake lignite. Water wells were inventoried and water samples were collected. Geologic data obtained from electric logs of water and oil tests were used to map the principal aquifer. A contour map of a subsurface marker bed was made to show the geologic structure of the area.

Periodic measurements of water levels made in the observation wells show water-level trends and the range of seasonal fluctuations. A preliminary two-dimensional digital model of the flow system of the principal aquifer was constructed to test concepts of the flow system. As more data become available the model could be improved and used as a predictive tool to simulate the impact of dewatering upon ground-water levels.

Surface Water

Starting in late 1977, periodic discharge or stage measurements have been made at gaging stations installed on two of the principal streams draining the area of potential mining. One of these stations was replaced by another station in the project area in late 1979. Water-quality and sediment samples were collected from these streams. Miscellaneous sediment samples were collected from the principal streams and their tributaries to determine the relation of amount of suspended sediment to discharge. Samples were collected mostly during high-water events to determine sediment load.

Description and Development of the Project Area

The project area (fig. 1) comprises about 350 mi^2, and is mostly rural. Most of the land is used as tree farms to supply papermills. About 80 percent of the rural land is timberland and 20 percent is pasture or cropland. Population of the project area is about 12,000. The rural population is about 3,500. The largest population centers are Mansfield (population 7,000), Pleasant Hill (population 1,100), and South Mansfield (population 400). Most of the population of the project area uses water supplied by public-water systems. Except for Mansfield, the water systems obtain water from wells, most of which are within the project area. The Mansfield water system originally depended entirely on water from wells but in early 1981 started using water from Toledo Bend Reservoir. Wells now serve as a supplemental source of water for Mansfield. Below is a list of the water systems serving the project area.

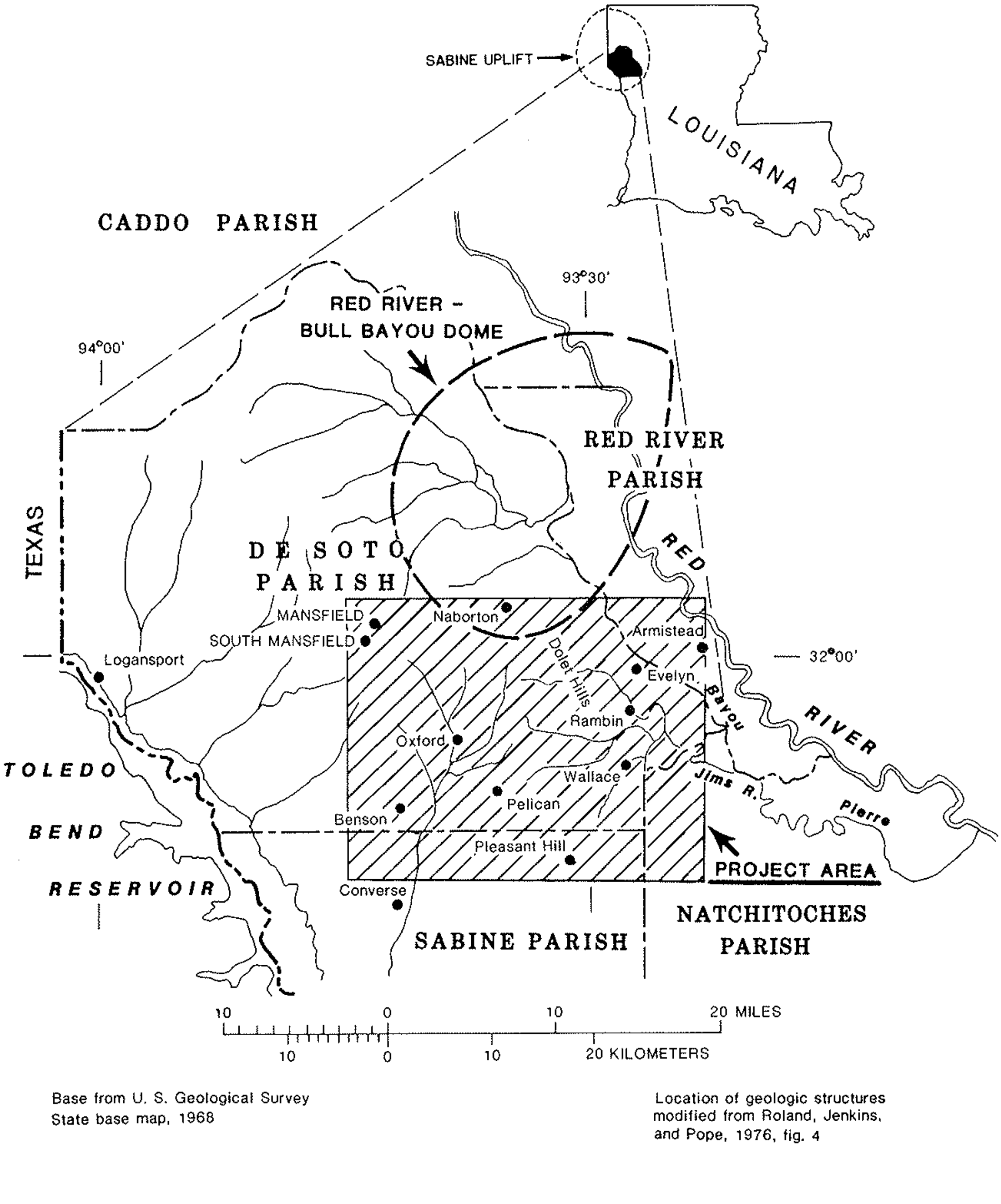

Figure 1.--Location of the project area, communities, and selected physical features.

Water system	Population served, 1980 (within the project area)
East De Soto Water System-------------	200
City of Mansfield---------------------	7,500
Town of Pleasant Hill-----------------	1,100
Rambin-Wallace Water System-----------	900
Village of South Mansfield------------	1,200
Total---------------------------------	10,900

About two-thirds of the rural population in the project area is supplied by the water systems and about one-third by domestic water wells. Most of these domestic wells are less than 100 ft in depth.

Acknowledgments

The author expresses appreciation to the water-supply managers, engineering firms, water-well drillers, and well and land owners who supplied data for the project. The Louisiana Department of Natural Resources, Office of Conservation made electrical logs of oil-test wells available.

Climate

Southeastern De Soto Parish lies within the humid zone of the United States and has warm summers and mild winters. The average annual temperature, 1964-79, at Converse (fig. 1), about 6 mi south of Benson is about 64°F (18°C). January is the coldest month having an average monthly temperature of 44°F (7°C). July and August are the warmest months having average monthly temperatures of about 80°F (26.5°C). The yearly range of temperature is about 80°F (26.5°C); the average minimum temperature is about 20°F (7°C), and the average maximum is about 100°F (38°C) (Page and Pree´, 1964, p. 11).

The average annual precipitation at Converse, 1964-79, is 49.4 in. This is only slightly greater than the average annual rainfall of about 48 in. for De Soto Parish from long-term records (Page and Pree´, 1964, p. 7) and about the same as the average annual rainfall of about 49 in. for the standard 30-year period, 1941-70, for the project area.

Below is a summary of the average monthly rainfall (in inches) at Converse, 1964-79.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
4.42	4.07	4.40	4.54	5.55	3.31	3.86	3.11	4.24	3.19	3.45	5.30	49.44

The average monthly rainfall June through November is 3.5 in. compared to 4.7 in. in December through May. During the period of relatively low rainfall and relatively high evapotranspiration, June through November, water levels in wells screened in surficial aquifers decline and streams in the project area go dry.

The greatest monthly precipitation for the 1964-79 period was 14.61 in. May 1975. The monthly precipitation was greater than 7 in. about 10 percent of the time and greater than 6 in. about 20 percent of the time. The greatest daily precipitation was 5.33 in. on May 31, 1964. Rainfall events of high intensity cause greater erosion--particularly on barren soil--than events of low intensity, and streamflow and sediment loads of streams increase.

Topography

The southwestern half of the project area, which lies in the drainage basin of the Sabine River, is a rolling upland. The rounded hills have local relief ranging from 80 to 150 ft. Hillsides slope at rates of 20 to 160 ft/mi. The altitude of the rolling upland ranges from about 400 ft NGVD (National Geodetic Vertical Datum of 1929) at several places to about 200 ft NGVD at the southern border of the project area. The other half of the area is an erosional scarp that slopes from the rolling upland to the Red River Valley or to valleys in the Red River drainage basin. The erosional scarp southeast of Naborton and north of Louisiana Highway 346 (pl. 1) is called the Dolet Hills.

The erosional scarp has a rugged topography with east and northeast trending ridges and valleys. Local relief of ridges near the edge of the rolling upland is about 200 ft. The ridge crests are narrow, mostly less than a quarter of a mile wide. The valleys are mostly about a quarter of a mile wide, but some are a mile wide near the Red River Valley. Relief in the Dolet Hills is as much as 160 ft within a half mile. Altitude of the erosional scarp ranges from about 360 ft NGVD near the rolling upland to about 140 ft NGVD near the Red River Valley.

Drainage

In the project area, Bayou San Patricio is the principal tributary to Toledo Bend Reservoir on the Sabine River. The stream flows into the reservoir about 10 mi south of the area. Major tributaries to Bayou San Patricio are Brushy Bayou, Ten Mile Bayou, and Chatman Bayou (pl. 1).

West Branch Dolet Bayou drains the northern part of the Dolet Hills and flows into Dolet Bayou about 1/2 mi north of Rambin (pl. 1). Dolet Bayou flows into Jims River about 1/2 mi east of the project area. Jims River flows into Bayou Pierre, a Red River tributary, 3 1/2 mi east of the project area. Louies Bayou, Prairie Bayou, and Rambin Bayou flow into Chemard Lake, which flows into Wallace Bayou. Wallace Bayou flows into Dolet Bayou. Chemard Lake is one of several swampy areas, or brakes, along the edge of the Red River Valley.

The southeastern part of the project area is drained by Hollis Creek and Stacy Creek. Both are part of the Bayou Pierre drainage system.

GEOLOGY

Stratigraphy

The Chemard Lake lignite lentil is in the lower part of the Wilcox Group of Tertiary (Paleocene) age. The Wilcox Group overlies the Porters Creek Clay of the Midway Group of Tertiary (Paleocene) age, and is overlain in part of the area by terrace deposits and alluvium of Quaternary (Pleistocene and Holocene) ages.

The lowest unit in the Wilcox Group in the project area is the Naborton Formation. The Dolet Hills Formation overlies the Naborton and in turn is overlain by undifferentiated Wilcox. The Chemard Lake lignite lentil is at the top of the Naborton Formation (pl. 2).

Porters Creek Clay (Midway Group)

The Porters Creek Clay, which makes up most of the Midway Group, occurs in the subsurface throughout the project area. The top few feet of the Porters Creek consists mostly of silty clay, which is dark to light gray, greenish gray, green or blue in color. Thin indurated layers, lignite beds, and fossil shell fragments also occur. The massive clay of the Porters Creek is easily distinguished on electrical logs and serves as a "marker" bed to indicate the base of the Wilcox Group. The Porters Creek Clay is not a source of water to wells.

Naborton Formation (Wilcox Group)

The Naborton Formation occurs in the subsurface in most of the project area and crops out in the northeastern part. The Naborton ranges in thickness from about 190 ft, 2 1/2 mi west of Pleasant Hill, to about 120 ft, 7 mi south of Rambin. The thickness ranges between 140 and 170 ft at most sites, and the average thickness is about 160 ft.

The Naborton Formation is clay with beds of sand and lignite. The clay is typically silty with some sandy clay and some lignitic clay. The colors of the clay are gray, bluish gray, brownish gray, tan, brown, and maroon. Generally, clay beds occur beneath the Chemard Lake lignite lentil (pl. 2).

The Chemard Lake lignite occurs in most of the project area. In the U.S. Geological Survey test holes the Chemard Lake lignite ranged from 2 to 9 ft in thickness and averaged 8 ft. The Chemard Lake is the thickest lignite in the Naborton. Other lignite beds in the Naborton are mostly 3 ft or less in thickness. Lignite beds constitute less than 10 percent of the Naborton Formation.

Sand or silt beds occur in the Naborton throughout the project area and comprise about 20 percent of the formation. These beds are mostly less than 20 ft thick but are as thick as 80 ft locally. Grain size ranges from very fine (with silt) to fine to medium.

In most of the project area south of T. 12 N., R. 12 and 13 W., the sands in the Naborton Formation are very fine grained, silty, or clayey with calcareous concretions and layers of sandy clay, silt, and lignite. Based on information available from wells and test holes, the thickest and coarsest sands in the Naborton are at Mansfield, where beds are as much as 80 ft thick and grain size ranges from fine to medium.

Dolet Hills Formation (Wilcox Group)

The Dolet Hills Formation occurs in all of the project area except in the northeastern part where it has been removed by erosion. The formation crops out in the Dolet Hills in the northern and eastern parts of the project area and occurs in the subsurface in most of the area. In the subsurface the Dolet Hills Formation ranges in thickness from about 90 ft northeast of Oxford to about 200 ft near the southeastern corner of De Soto Parish. The average thickness is about 150 ft. In most of the project area the Dolet Hills Formation ranges from 120 to 160 ft in thickness. A massive sand or sandy interval interpreted from electrical logs is identified as the Dolet Hills Formation in the subsurface (pl. 2).

Sand occurs in the Dolet Hills Formation in all of the project area and extends beyond the project area. The sand percentage of the formation ranges from about 5 to 100 percent. Sand comprises 80 to 100 percent of the Dolet Hills Formation in the central and southern parts of the project area as shown on plate 4. The sand percentage is less than 20 percent north of Benson and west of Oxford, in a narrow north-south strip in Sabine Parish west of Pleasant Hill, and in the southeastern corner of the project area in Sabine Parish. Sands in the Dolet Hills Formation are referred to as the Dolet Hills aquifer in this report.

The clay of the Dolet Hills Formation is silty or sandy, with lignitic beds. The color of the clay is mostly light to dark gray with some clay being brown, tan, red, orange, or maroon. Lignite beds in the Dolet Hills are mostly less than 1 ft thick. Sands of the Dolet Hills aquifer are mostly very fine-to-fine grained and are silty at places. Locally some sands are fine-to-medium or medium grained. The sand is mostly gray or light gray in color.

Wilcox Group, Undifferentiated

The undifferentiated Wilcox occurs on the surface in most of the project area; and ranges in thickness from 0 in the northern part of the area to about 600 ft in the southeastern corner of the project area. Erosion has removed the undifferentiated Wilcox in parts of an irregular area extending approximately 4 to 6 mi south of the outcrop of the Chemard Lake lignite in the north-central part of the project area. In addition, the deposits are eroded from valleys and some low ridges in the Dolet Hills area and from the valleys of Rambin Bayou and Wallace Bayou and their tributaries. The undifferentiated Wilcox consists of clay and sand with small amounts of lignite and sandstone. Clay in the undifferentiated Wilcox is silty or sandy; mostly light to dark or bluish gray in color; and locally calcareous or lignitic. Lignite and sandstone layers are mostly less than half a foot thick.

Most of the sand in the undifferentiated Wilcox is fine grained, but locally there are beds of medium or coarse-grained sand. Sand beds range from about 5 to 100 ft in thickness and average 25 ft. Generally, sand comprises from 10 to 60 percent of the undifferentiated Wilcox.

Terrace Deposits and Alluvium

Terrace deposits occur in small areas near Rambin and in the southeastern corner of De Soto Parish (Murray, 1948, pl. 1). Generally, terrace deposits in De Soto Parish consist of basal sand and gravel grading upward to silt and silty clay (Page and Preé, 1964, p. 82). Alluvium occurs in the stream valleys. The author does not know of any water wells screened in either the terrace or alluvial deposits in the project area.

Structure

The project area is located on the southeastern flank of the Sabine uplift, a large dome in northwestern Louisiana and eastern Texas (fig. 1). The Red River-Bull Bayou anticline is a structural high on the Sabine uplift, and the project area is on the southern flank of the Red River-Bull Bayou dome. In most of the project area the dip is about 40 ft/mi to the south and southeast (pl. 3). In the northwestern part of the project area the dip is about 20 ft/mi to the west. Several faults were mapped in the southern part of the project area. The Dolet Hills aquifer is offset in a fault zone formed by three of these faults. The northwesternmost fault, which has the largest displacement, trends N. 39° E. through the southeastern corner of De Soto Parish. The base of the Wilcox Group is downthrown about 100 ft on the southeastern side of the fault.

Roland, Jenkins, and Pope, in their structure map of the top of the Chemard Lake lignite (1976, pl. 2), show several faults and lines that are faults or stratigraphic changes. These faults and structural or stratigraphic features are mostly located in the area having potential for mining and trend northeast-southwest or east-west. The Chemard Lake lignite is generally 30 to 50 ft lower on the south or southeast side of the faults or structural features. Data are too sparse to show the effect that these features have on the base of the Wilcox (pl. 3).

GROUND WATER

Naborton Formation

Sand beds in the Naborton Formation in most of the project area are thin. The sand is very fine grained, silty, and broken by clay or lignite beds; therefore, the hydraulic conductivity is low.

In the northern part of the project area the sand beds contain freshwater and are the source of water for public-supply wells at Mansfield, South Mansfield, and for domestic wells. Well yields at Mansfield are mostly 100 to 200 gal/min. However, many test holes were required for each successful well, which illustrates the difficulty of finding thick sands in the Naborton. In most of the project area and in part of the area that may be mined, sands in the Naborton Formation contain salty water (pl. 1). These sands are generally overlain by 30-100 ft of clay. At present the author does not know of any wells screened in saltwater-bearing sands in the Naborton Formation. However, in 1955 a well at Rambin, which yielded salty water from the Naborton, was used for stock water.

The highest altitude of the potentiometric surface of the Naborton Formation is about 260 ft above NGVD about 4 mi east and 4 mi southeast of Mansfield. From this high the potentiometric surface of the Naborton slopes to the east towards the Red River Valley and to the west towards Mansfield and South Mansfield. In the Red River Valley at Armistead, 4 mi east-northeast of Evelyn (fig. 1), the altitude of the potentiometric surface is 112-114 ft above NGVD (Newcome and Page, 1962, table 13). In the southwestern part of Mansfield the altitude of the potentiometric surface was 145 ft above NGVD in August 1962; 1 mi southwest of South Mansfield it was 210 ft above NGVD in July 1967. These random measurements do not define the potentiometric surface clearly. In the southern two-thirds of the area with potential for lignite mining, the potentiometric surface of the Naborton Formation is higher than the top of the Chemard Lake lignite.

Dolet Hills Aquifer

Description

The Dolet Hills aquifer contains freshwater to the base throughout the project area. The downdip limit of freshwater is an east-west line about 1 1/2 mi south of Pleasant Hill.

The Dolet Hills aquifer, which immediately overlies the Chemard Lake lignite in most of the project area, ranges from about 5 to 160 ft in thickness and averages about 90 ft. The altitude of the top and of the base of the aquifer are shown on plates 4 and 5. Both the top and the base dip to the south. The altitude of the top of the aquifer ranges from about 370 ft above NGVD in the northern part of the project area to 280 ft below NGVD in the southern part. Erosion has removed the top of the aquifer in stream valleys in the northern part of the project area and in the Dolet Hills (pl. 4). The altitude of the base of the aquifer ranges from about 320 ft above NGVD in the northern part of the project area to about 440 ft below NGVD in the southern part.

In most of the central and southern part of the project area, where the Dolet Hills Formation consists of 80 percent or more sand (pl. 4), the Dolet Hills aquifer is mostly a massive sand. At well Sa-248 at Pleasant Hill, the aquifer consists of a 98-ft sand bed at the base of the Dolet Hills Formation. In Natchitoches Parish in the southeastern part of the project area, the aquifer consists of sands 10- to 70-ft thick interbedded with clay; the average sand thickness is about 30 ft. In the area to be mined, the aquifer thickness ranges from 0 to about 100 ft, and averages about 40 ft.

Water-Bearing Characteristics, Well Yields, and Specific Capacities

The Dolet Hills aquifer is under artesian conditions in most of the project area but is under water-table conditions in the northern and eastern parts of the area (pl. 1). The hydraulic conductivity, as determined by aquifer tests in the project area, ranges from 11 ft/d to 31 ft/d and averages 23 ft/d; transmissivity ranges from 190 ft^2/d to 1,600 ft^2/d and averages 720 ft^2/d. As the average aquifer thickness in the project area is estimated to be about 90 ft, the aquifer thicknesses at the sites tested apparently were thinner than average. Rounding the average hydraulic conductivity to 20 ft/d and multiplying by the average sand thickness of 90 ft gives an average transmissivity of 1,800 ft^2/d.

The highest yield reported for wells screened in the Dolet Hills aquifer in the project area was a yield of 250 gal/min during a test of well Sa-248 (town of Pleasant Hill). The following table summarizes yield and specific-capacity data for selected wells screened in the Dolet Hills aquifer.

Selected well-yield and specific-capacity data for the Dolet Hills aquifer

Well number	Owner	Yield (gal/min)	Specific capacity [(gal/min)/ft of drawdown]	Pumping period (hour)	Date
DS-238--	Syracuse Enterprises--	100-125	---	-	-----
DS-432--	Rambin-Wallace Water System---------------	60	0.7	6	6/73
DS-433--	Rambin-Wallace Water System---------------	60	.7	8	6/73
Sa-248--	Town of Pleasant Hill-	250	5.9	-	11/55

The following example is indicative of the average potential yield of the aquifer. Assume that a fully developed well, 1 ft in diameter, is screened in the total thickness of a 90-ft sand of the Dolet Hills aquifer, which has an average hydraulic conductivity of 20 ft/d and a storage coefficient of 0.0001. The theoretical specific capacity of the well, after pumping 200 gal/min for 24 hours, would be 6.7 (gal/min)/ft drawdown. The drawdown at the end of 24 hours of pumping would be 30 ft.

Water Levels and Movement

The variation in altitude of the potentiometric surface of the Dolet Hills aquifer in the project area is about 200 ft. The potentiometric surface is highest in the northern part of the project area, 2 to 6 mi east-southeast of Mansfield, and is lowest in the eastern part, about 4 mi south of Rambin. In most of the western part of the project area, the potentiometric surface slopes to the south and southwest (pl. 6). In most of the eastern part the surface slopes to the east, southeast, and north. Streams in the Dolet Hills area, and Wallace Bayou and Rambin Bayou, cut into the aquifer and control the potentiometric surface in the area north of the line indicating the boundary between water-table and artesian conditions (pl. 6). A small pumping cone has been developed around the wells of the Rambin-Wallace Water System, near the center of the project area. A pumping cone probably has been developed around Pleasant Hill, but there are no recent water levels to show the size of the cone.

Water levels of the Dolet Hills aquifer generally range from land surface at springs in the Dolet Hills to about 130 ft below land surface in the southern part of the project area. The water level may be slightly above land surface in the valley of Bayou San Patricio about 1 mi west of Oxford (pl. 2). Water levels of the Dolet Hills aquifer are generally higher than those of the Naborton Formation.

When recharge to the aquifer exceeds discharge, water goes into storage and the water level of the aquifer rises. When discharge exceeds recharge, the water level declines. Well DS-462, 4 1/2 mi east-southeast of Mansfield (pl. 1), is in the part of the project area where erosion has removed clay beds above the aquifer and cut valleys into the aquifer. Consequently, recharge to the aquifer from precipitation and discharge from the aquifer to streams is relatively rapid in the vicinity of the well. The hydrograph of well DS-462 (fig. 2) shows seasonal fluctuations of about 5 ft. The water levels rise in the early part of the year, peak in May and decline to lows about November. Rainfall is high and evapotranspiration is low during the spring. Thus, the aquifer received more recharge during spring than during the fall, and water levels are higher in the spring.

The hydrograph of well DS-448 (fig. 2), 4 mi southwest of Rambin and downdip from the outcrop area, shows fluctuations similar to those shown by the hydrograph of DS-462 but the amplitude is only 2 ft. Both wells tap the same massive sand. Clay beds of the undifferentiated Wilcox overlying the aquifer at well DS-448 retard the rate of recharge to or discharge from the aquifer. In addition, the greater distance of the well from areas of recharge or discharge probably dampens the seasonal fluctuations at well DS-448.

The direction of movement of water in the Dolet Hills aquifer is down the slope of the contours on the potentiometric surface (pl. 6). In the western part of the project area water moves to the west and south-west. In the eastern part of the project area water moves to stream valleys in the Dolet Hills and to Rambin and Wallace Bayous. Water also moves to pumping cones at the Rambin-Wallace Water System wells and at Pleasant Hill.

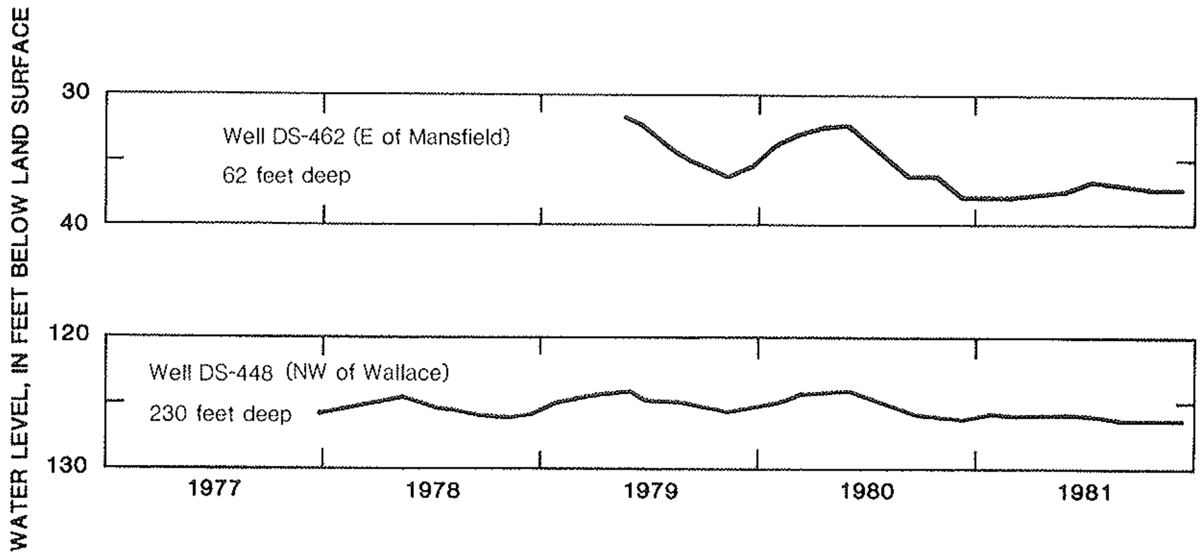

Figure 2.--Hydrographs for wells in the Dolet Hills aquifer.

Water in the aquifers also is moving vertically from aquifers with a relatively higher head to those with a relatively lower head. Thus, water in the Dolet Hills aquifer moves downward toward the Naborton Formation, and water in sands in the undifferentiated Wilcox moves downward into the Dolet Hills aquifer. Water is probably moving from the upper part of the Dolet Hills aquifer to the lower part as shown by differences in head in wells DS-405A and DS-405B, at the junction of Louisiana Highways 175 and 346 (pl. 1). Well DS-405A was screened in the upper part of the aquifer and well DS-405B was screened in the lower part. The static level of DS-405A was 3 ft higher than that of DS-405B in November 1972 (prior to the development of the Rambin-Wallace well field), indicating a potential for downward vertical movement locally. Since development of the well field the potential for downward movement probably has increased because the wells were completed in the lower part of the aquifer.

The Dolet Hills aquifer receives relatively rapid recharge from infiltration of precipitation in the outcrop area of the aquifer in the northern part of the project area. In most of the project area recharge to the aquifer is slowed by clay beds in the overlying undifferentiated Wilcox. Natural discharge is to the streams in the Dolet Hills and to the Rambin Bayou drainage area. In the western part of the project area natural discharge is to the south and southwest, towards the Toledo Bend Reservoir.

The average interstitial velocity of water in the Dolet Hills aquifer was calculated assuming the hydraulic conductivity is 20 ft/d and the effective porosity is 30 percent. Average interstitial velocity is determined by the gradient, which is not uniform throughout the area. In the western part of the project area the gradient ranges from 25 ft/mi to 5 ft/mi. The average interstitial velocity ranges from 0.31 ft/d to 0.06 ft/d. In the eastern part gradients are steeper and range from 60 ft/mi to 9 ft/mi. The average interstitial velocity ranges from 0.8 ft/d to 0.11 ft/d.

A preliminary ground-water flow model that was used to conceptualize the flow system of the Dolet Hills aquifer indicates that the fault zone that offsets the aquifer in the southeastern part of the project area may be a hydrologic boundary and thus, affect water levels in that area. Water-level data are insufficient to document the amount of discontinuity, which may be small under premining conditions. However, pumping may introduce or increase disequilibrium conditions, and water levels may decline more on one side of the fault than the other.

The preliminary model also indicates the need for more water-level data for more precise modeling in the southwestern part of the project area and in the vicinity of the fault zone in the southeastern part of the project area.

Water Quality

Water in the Dolet Hills aquifer is fresh, and in most areas is soft and low in concentration of dissolved solids. Iron and manganese concentrations are high at many wells.

Chloride.--Chloride concentration in water from the Dolet Hills aquifer ranges from 7 to 88 mg/L (milligram per liter, table 1). In most areas concentrations are less than 50 mg/L.

Hardness.--Hardness of water in the Dolet Hills aquifer ranges from 2 to 220 mg/L. In most of the project area the water is soft[1/], but locally it is moderately hard or hard. For example, in the southeast corner of T. 11 N., R. 11 W. the hardness of water from the Dolet Hills aquifer ranges from 120 to 220 mg/L.

Iron.--Iron concentration of water in the Dolet Hills aquifer ranges from 0.01 to 22 mg/L (10-2,200 micrograms per liter, table 1). In most of the area the iron concentration is higher than 0.3 mg/L, the maximum recommended by the U.S. Environmental Protection Agency (1976, p. 78) for public-supply use, and treatment to lower the iron concentration is necessary to make the water satisfactory for public-supply use[1/]. The Rambin-Wallace Water System has a water treatment plant that lowers the iron concentration. The iron concentration is relatively high in three parts of the project area. In the vicinity of Oxford iron concentrations

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[1/] The U.S. Environmental Protection Agency (1976, p. 75) classifies hardness as follows: Water having a hardness of 0-75 mg/L is considered soft, 75-150 mg/L is moderately hard, 150-300 mg/L is hard, and more than 300 mg/L is very hard. In Louisiana, water that is hard or very hard or that contains an iron concentration exceeding 0.3 mg/L generally is treated for public-supply use.

are 22 mg/L (well DS-238) and 15 mg/L (well DS-444). About 2 to 4 mi south of Rambin iron concentrations are 11 mg/L (well DS-396), 7 mg/L (well DS-398), and 4 mg/L (well DS-397). About 1/2 to 1 1/2 mi northwest of Pelican iron concentrations are 4.8 mg/L (well DS-23) and 2.6 mg/L (well DS-443). At well DS-511, 2 1/2 mi north of Pleasant Hill, iron concentration is 3.8 mg/L. Iron concentrations are low in a local area in the southeastern corner of De Soto Parish where concentrations range from 0.11 mg/L (well DS-470) to 0.01 mg/L (well DS-454).

Manganese.--Concentrations of manganese range from below the level of detection to 510 ug/L (microgram per liter). Many wells yield water with concentrations of manganese higher than the 50 ug/L concentration recommended by the U.S. Environmental Protection Agency (1976, p. 95) to minimize staining.

Dissolved solids.--Concentration of dissolved solids is generally low. The range was from 84 mg/L to 681 mg/L. Only two wells yield water with concentrations higher than 500 mg/L, the maximum recommended by the U.S. Environmental Protection Agency (1976, p. 206). These wells are DS-397, where the concentration of dissolved solids was 681 mg/L, September 16, 1971; and Sa-248, where the concentration of dissolved solids was 640 mg/L, October 18, 1955, and 657 mg/L, January 26, 1968.

pH.--The pH of water samples from wells screened in the Dolet Hills aquifer is as high as 8.7 at well Sa-248 at Pleasant Hill and as low as 5.0 at well DS-166, 5 mi southeast of Mansfield. A pH as low as 5.0 could cause the water to be corrosive. Corrosive water can dissolve iron from metal pipes; thus, corrosive water from the Dolet Hills aquifer that has been standing in metal pipes may contain more iron than the water in the aquifer.

Sulfate.--Sulfate concentrations range from about 2 to 130 mg/L and average 37 mg/L. High values occur randomly in the project area. Most values are lower than 35 mg/L. The origin of the high values may be sulfur in lignite beds or lignitic clays.

Color.--The water is almost colorless. Generally color of water from wells screened in the Dolet Hills aquifer is 20 units or less. High color values were reported for wells DS-450 and DS-511. The color value for those wells may have been distorted by precipitated iron in the water samples.

Temperature.--Temperature of water from wells screened in the Dolet Hills aquifer generally ranges from 69°F (20.5°C) for wells about 100 ft deep to 73°F (23°C) for wells about 400 ft deep. Temperature of water from shallower wells completed in the aquifer probably is near the average annual air temperature, which is about 64°F (18°C), in the area. In nearby Natchitoches Parish temperature of water in Wilcox sands increases 1°F for each 60 to 100 ft of increase in depth (Newcome, Page, and Sloss, 1963, p. 31). This correlates with the temperature increase observed in the project area.

Development

The Dolet Hills aquifer is not extensively developed in the project area. The major water users are the Pleasant Hill Water System and the Rambin-Wallace Water System; average pumpage from the aquifer in 1980 was 0.09 and 0.05 Mgal/d, respectively. Average pumpage from the aquifer by rural domestic wells in 1980 was about 0.02 Mgal/d. The rural population served by wells screened in the aquifer was about 400.

In the southeastern corner of De Soto Parish, in an area encompassing wells DS-454, -455, and -470 (pl. 1) the water in the Dolet Hills aquifer is soft to moderately hard, and the iron and manganese concentrations are low enough to meet the requirements for public supply without treatment.

Potential Effect of Mining on the Aquifer

Mining probably will start at the outcrop of the Chemard Lake lignite. Near the outcrop, the Dolet Hills aquifer is under water-table conditions, and the water-table gradient slopes mostly to the south and southeast (pl. 6). As the aquifer is dewatered the water-table gradient south of the mine will be reversed and will slope towards the mine. Recharge to the aquifer south of the mined area will be interrupted causing a water-level decline.

In areas where the overburden is all or mostly sand, the replaced material would be all or mostly sand. Where the overburden is sand with an overlying clay layer, the sand spoil could be replaced without mixing with the clay. The replaced sand layer would be loosely packed, which might enhance recharge by infiltration from precipitation. Water could move through the replaced sand and recharge the Dolet Hills aquifer downdip of the mine. The permeability of the sand fill layer might initially be greater than that of the original Dolet Hills aquifer as the sand would be loosely packed. However, the permeability would decrease and approach that of the original aquifer as compaction proceeds.

If sand and clay are mixed as the mine is refilled, the replaced overburden may consist of discrete lumps of clay in a sand matrix. Water could move through the sand matrix of the replaced spoil and recharge the Dolet Hills aquifer downdip of the mined area. Infiltration of precipitation to the replaced spoil might be enhanced initially because of loose packing of the sand grains of the matrix. Eventually, the rate of infiltration would be slowed by compaction of the sand. Transmissivity of the replaced spoil would be lower than that of the original aquifer because of the clay lumps. The sand of the reconstituted Dolet Hills aquifer also may be mixed intimately with clay and clayey or silty material when being replaced so that transmissivity of the fill is lower than that of the present Dolet Hills aquifer. Then water movement through the fill would be retarded.

The quality of water in the aquifer may be adversely affected by infiltration of mine drainage. The quality of water in the overburden may change after mining because of leaching of clay in the disturbed material. For example, concentrations of dissolved solids may increase.

The fault zone in the southeastern part of the project area probably retards water movement in the Dolet Hills aquifer. Thus, water-level declines caused by mining may be limited, at least initially, to the northwest side of the fault.

Wilcox Group, Undifferentiated

Sands of the undifferentiated Wilcox Group are used as a source of water for wells in most of the area. The highest yield is 125 gal/min at Sa-454, the standby well for the Pleasant Hill Water System. Water levels of the undifferentiated Wilcox Group sands generally range from 20 to 40 ft above those of the Dolet Hills aquifer.

Beds of the undifferentiated Wilcox will be removed during the mining. The maximum thickness in the area considered to have potential for mining is estimated to be less than 100 ft. This surficial material is part of the recharge area for the undifferentiated Wilcox. These sands probably are water-table aquifers and are only partially saturated or unsaturated. If only a few feet of sand require dewatering, the effect of mining on water levels of aquifers of the undifferentiated Wilcox will be relatively small.

SURFACE WATER

Streamflow

Streams in the project area have many days of no flow every year, mostly during July through November. Daily discharge measurements and gage heights of Bayou San Patricio near Benson have been published for water years 1979-81 (Water Resources Data for Louisiana, 1980, v. 1, p. 314-319; 1981, v. 1, p. 300-301). Results of miscellaneous discharge measurement are listed in table 2 of this report. Annual maximums for water years 1954-68 and occasional low-flow measurements for water years 1954-63 have been published in the report "Water Resources Data for Louisiana" for each water year. (See "Selected References".) Miscellaneous low-flow measurements were published in 1964 (Page and Preé, 1964, p. 103).

The mean discharge at Bayou San Patricio near Benson was 22.5 ft^3/s for the water year 1978, 136 ft^3/s for the water year 1979, and 91.4 ft^3/s for the water year 1980. The maximum daily discharge for these water years was 3,440 ft^3/s April 12, 1980. The maximum daily discharge of record was 21,300 ft^3/s September 20, 1958. The number of days of no flow per water year ranged from 119 days in water year 1978 to 58 days in water 1979. The most consecutive days of no flow were 89 days during July-September 1980.

Figure 3 shows the average daily streamflow at Bayou San Patricio near Benson for water year 1979 and precipitation at Converse, about 7 mi south-southwest. The hydrograph shows that streamflow increases with storms and declines quickly after storms. The peak streamflow usually occurs 1 to 3 days after the day with the greatest precipitation. During the months of December through May, when the greatest streamflow occurs, the hydrograph shows sustained flow after storms (fig. 3). During the months of June through November there is no sustained flow. The sustained flow may be augmented during the months of December through May by release of water from ponds upstream from the gaging station. There is less sustained flow after storms during the dry months of June through November as the ponds have less water in storage, or are dry, so the ponds do not augment streamflow. During dry months the higher evaporation rate may cause the soil to be dryer than during wet months. Thus, during June through November, a significant amount of water from storms may be retained as soil moisture. This may also be a factor in the rapid decrease in streamflow after storms during the dry months.

Gage heights and occasional discharge measurements of Chemard Lake near Evelyn for the period September 1977 to September 1979 have been published (Water Resources Data for Louisiana, 1980, p. 93-95). Miscellaneous discharge measurements are listed in table 2 of this report. The highest discharge measured was 282 ft^3/s (December 4, 1978). The maximum gage height was 9.00 ft January 21, 1979; the minimum gage height was less than the lowest recordable stage, 1.12 ft, July 13 to August 28, 1978. The station was discontinued September 1979.

Measurements of discharge and gage height at West Branch Dolet Bayou at Rambin began in December 1979 and are continuing. The highest discharge measured was 353 ft^3/s on May 16, 1980. Miscellaneous discharge measurements for West Branch Dolet Bayou are given in table 2.

Results of miscellaneous discharge measurements for three tributaries to Chemard Lake are available for the period from May 1978 to the present and for Bayou San Patricio near Oxford from April 1979 to the present (table 2). Largest discharges measured were: 177 ft^3/s at Louies Bayou near Evelyn on May 4, 1979; 153 ft^3/s at Prairie Bayou near Evelyn on May 4, 1979; 369 ft^3/s at Rambin Rayou near Evelyn on May 4, 1979; and 3,890 ft^3/s at Bayou San Patricio near Oxford on April 15, 1980.

Physical Characteristics

Suspended-sediment yield under premining conditions in streams in the project area increases with streamflow (figs. 4 and 5). The smallest suspended-sediment yield for five streams in the Bayou Pierre drainage area was 0.020 $(ton/d)/mi^2$ at a discharge of 1.23 $(ft^3/s)/mi^2$ (fig. 4). The greatest suspended-sediment yield was 25 $(ton/d)/mi^2$ at a discharge of 18 $(ft^3/s)/mi^2$. For the Bayou San Patricio drainage area, the smallest suspended-sediment yield was 0.016 $(ton/d)/mi^2$ at a discharge of 0.21 $(ft^3/s)/mi^2$. The greatest suspended-sediment yield was 21 $(ton/d)/mi^2$ at a discharge of 26 $(ft^3/s)/mi^2$ (fig. 5). The graphs for the two drainage areas have similar slopes.

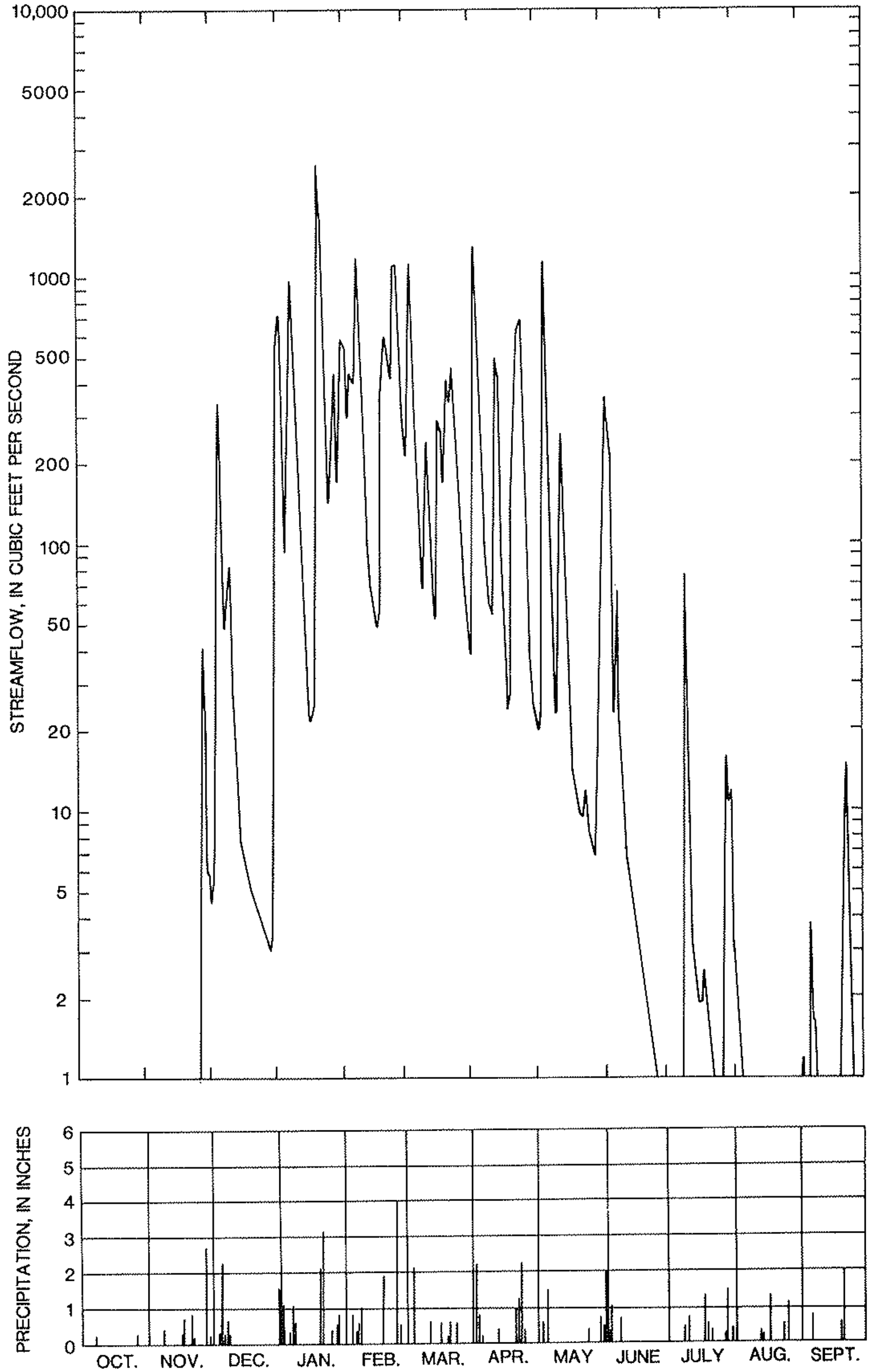

Figure 3.--Daily discharge of Bayou San Patricio near Benson, La., and daily precipitation at Converse, La., for water year 1979.

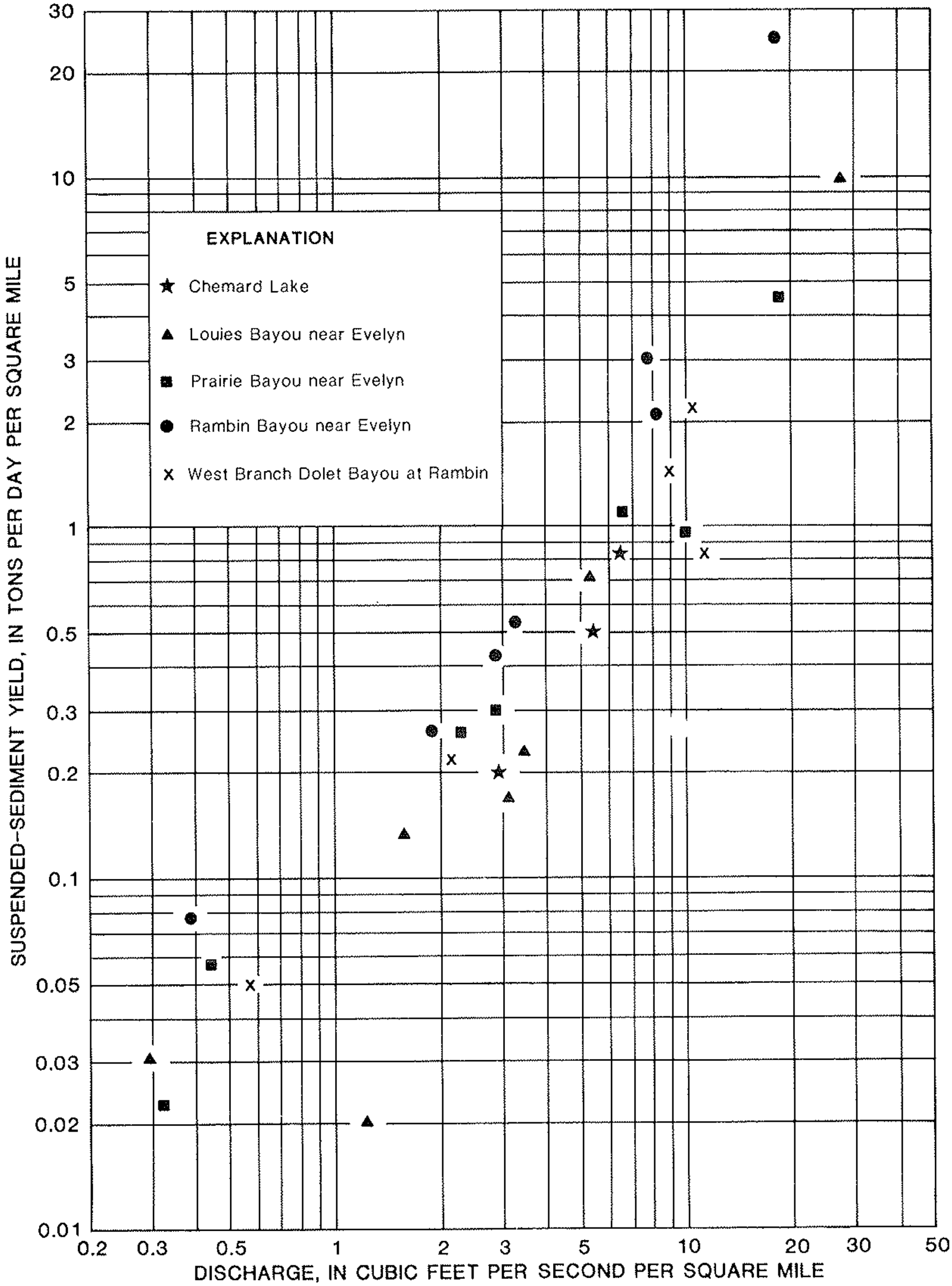

Figure 4.--Suspended-sediment yield in relation to streamflow, Bayou Pierre drainage area.

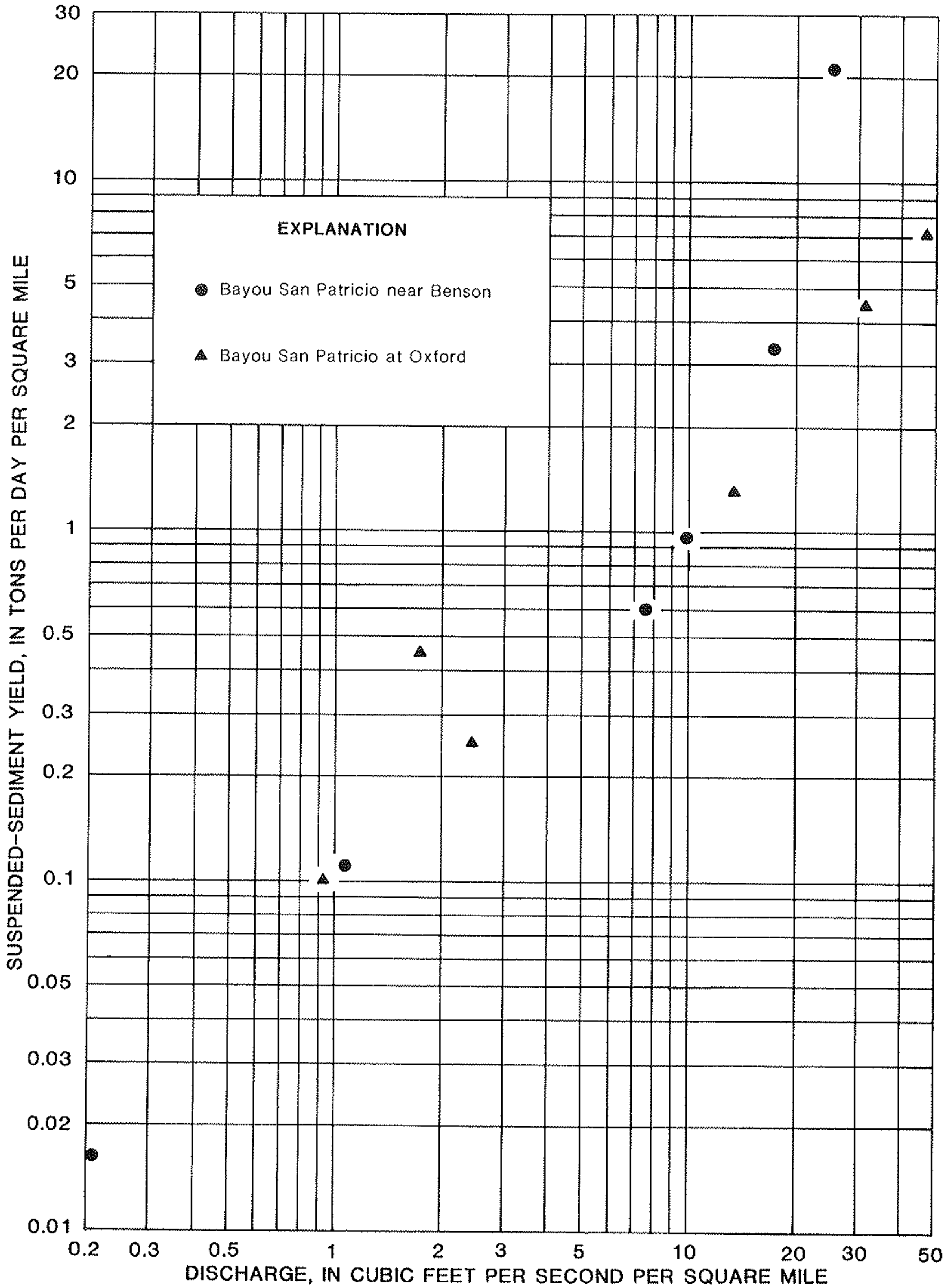

Figure 5.--Suspended-sediment yield in relation to streamflow, Bayou San Patricio.

The greatest streamflow, measured instantaneously with collection of a sediment sample, was 2,070 ft^2/s at the station at Bayou San Patricio near Benson, September 14, 1978. This streamflow is only about 10 percent of the maximum daily discharge of record for the station.

Under premining conditions most of the suspended sediment is in the clay-silt range, or finer than 0.062 mm. Suspended sediment of Bayou San Patricio is finer than suspended sediment in streams draining the Dolet Hills area. Sand concentrations in suspended sediment of Bayou San Patricio ranged from 3 to 43 percent and averaged 14 percent. Sand concentrations in suspended sediment of streams draining the Dolet Hills area ranged from 3 to 48 percent and averaged 25 percent. Soils in the Dolet Hills area are sandier and gradients are steeper. In this area, sand in the Dolet Hills Formation forms steep valley walls. The gradients of the Chemard Lake tributaries and West Branch Dolet Bayou are about 10 to 20 ft/mi, whereas the gradient of Bayou San Patricio is about 6 ft/mi.

Chemical Characteristics

Water-quality data for Bayou San Patricio near Benson, Chemard Lake near Evelyn, and West Branch of Dolet Bayou at Rambin are given in table 3. The quality of water in the three streams is similar. The specific conductance of the water is low and so are the chloride and sulfate concentrations; the water is soft to moderately hard.

Concentrations of some constituents and values of specific conductance vary with the amount of streamflow. The higher concentrations occur during periods of low flow. At Bayou San Patricio near Benson specific conductance ranged from 44 micromhos during high flow to 226 micromhos during low flow. Chloride concentration at the site ranged from 4.6 mg/L at high flow to 32 mg/L at low flow. Hardness ranged from 11 mg/L at high flow to 78 mg/L at low flow. Dissolved iron concentration ranged from 0.18 to 0.91 mg/L; and manganese concentrations, from 0.08 to 14 mg/L.

Although sulfate concentration and pH vary, they do not vary with streamflow. Sulfate concentration at Bayou San Patricio near Benson ranges from 3.9 to 27 mg/L. Values of pH range from 5.7 to 7.1. The surface-water temperature varies with the air temperature. At Bayou San Patricio at Benson, water temperature ranged from 41° to 96°F (5° to 35.5°C). The coldest water temperatures occur during February and the warmest during July and August.

Concentrations of trace elements (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) were either below the limits of detection or lower than the limits recommended by the U.S. Environmental Protection Agency (1976). Concentrations of phenols at Bayou San Patricio near Benson and Chemard Lake near Evelyn ranged from 3 to 7 µg/L, which is higher than the limit of 1 µg/L recommended by the U.S. Environmental Protection Agency (1976, p. 183). Concentrations of organic pesticides were either below the limit of detection or lower than the limit set by the U.S. Environmental Protection Agency (1976), except for the concentration of DDT in the sample collected from Chemard Lake near Evelyn on

October 23, 1979. The DDT concentration was 0.01 μg/L, which is higher than the limit of 0.001 μg/L recommended for aquatic life (U.S. Environmental Protection Agency, 1976, p. 139).

Results of measurements of dissolved-oxygen concentrations and temperature made in water year 1980 are given in table 4. Dissolved-oxygen concentration at Bayou San Patricio near Benson ranged from 6.3 to 10.6 mg/L. At Chemard Lake near Evelyn dissolved oxygen ranged from 3.5 to 9.4 mg/L. Values of dissolved oxygen at Chemard Lake near Evelyn of 4.5 mg/L (June 2, 1980) and 3.5 mg/L (July 16, 1980) were below the recommended limit of 5.0 mg/L (U.S. Environmental Protection Agency 1976, p. 123). At least 5 mg/L of dissolved oxygen is recommended to maintain freshwater aquatic life. Temperatures ranged from 42° to 92°F (5.5 to 33°C).

Potential Effect of Mining on Surface Water

A major potential effect of mining on the physical characteristics of surface water is an increase in sediment load in streams draining disturbed land (Harkins and others, 1980, p. 42). The Louisiana Surface Mining and Reclamation Act requires mining companies to control and minimize sediment in runoff; this is generally accomplished by using ponds to trap sediment during mining and reclamation. If the sediment load in streams draining mined areas in the Dolet Hills were to increase, Chemard Lake would become a sediment trap, and water carrying fine sediment could flow into Dolet Bayou. The coarse fraction of the sediment load would be deposited in the lake.

Streams may be rerouted during mining and returned to their original routes during reclamation. Unless new channels are stabilized before use, streams flowing through excavations used for rerouting and over disturbed land would have a greater sediment load than before mining because of the ready availability of material at these sites.

Mining will probably affect the quality of the surface water. Water in streams draining mined areas commonly is more mineralized than water in streams draining similar, nearby, unmined areas. Streams draining mined areas may have increased specific conductance and increased concentrations of dissolved solids, aluminum, calcium, iron, magnesium, and manganese (Puente and Newton, 1979, p. 22; Harkins and others, 1980, p. 38-48). Louisiana mining regulations require that water from mined areas meet effluent standards before discharge to streams.

Although the Chemard Lake lignite is less permeable than the Dolet Hills aquifer and is not considered to be part of the aquifer in this report, it contains water where the lignite is below the potentiometric surface. If necessary to dewater the lignite bed during mining, the water may require treatment before discharge. However, the sulfur content of the Chemard Lake lignite is low, averaging 0.63 percent (Roland, Jenkins, and Pope, 1976, p. 20). Thus, water from the lignite in southeastern De Soto Parish should have a lower sulfate concentration and a higher pH than water from high-sulfate lignites.

In the southwestern part of the area with potential for mining, the potentiometric surface of the Naborton Formation is higher than the Chemard Lake lignite but lower than the potentiometric surface of the Dolet Hills aquifer. Therefore, under premining conditions, the water-level gradient is from the Dolet Hills aquifer to the Naborton Formation. Where the Naborton contains saltwater and the potentiometric surface is higher than the altitude at the lignite, there could be upward movement of saltwater if the Dolet Hills aquifer and the underlying lignite are removed. If the saltwater from the Naborton should enter the mines, it could pose a disposal problem. However, the saltwater sands of the Naborton Formation are generally separated from the Chemard Lake lignite by clay beds. As the rate of movement of water through clay is slow, the potential for significant quantities of saltwater from Naborton sands entering the mines is small.

Water pumped from the Dolet Hills aquifer during mining and added to the streams would increase streamflow and change the quality of water in streams. If as much as 10 ft^3/s were added to streams during high flows there would not be a significant increase in streamflow. However, when the streams are dry, or during low flows, the water discharged from the Dolet Hills aquifer would substantially increase streamflow. Water in the Dolet Hills is mostly low in dissolved solids, but has high concentrations of iron and manganese; and unless these are removed, there probably would be an adverse affect on the quality of water in the streams.

SUMMARY AND CONCLUSIONS

Planned surface mining of the Chemard Lake lignite in the northeastern part of the project area will involve dewatering of the Dolet Hills aquifer as parts of the lignite area are mined. A description of hydrologic conditions before mining provides a base from which hydrologic changes can be measured during mining and after reclamation.

The Dolet Hills aquifer is recharged by infiltration from precipitation in the northern and eastern parts of the project area. In the western part of the area, water in the aquifer moves mostly to the south and southwest. In the eastern part of the area, the aquifer discharges to streams in the Dolet Hills and to Rambin and Wallace Bayous. Small cones of depression have developed from pumping around wells of the Rambin-Wallace water system and probably also at Pleasant Hill. In most of the project area, water levels of the aquifer are not measurably effected by pumping.

The average thickness of the Dolet Hills aquifer is about 90 ft and the average hydraulic conductivity is about 20 ft/d.

Water in the Dolet Hills aquifer is fresh, generally soft, and low in concentration of dissolved solids. The iron concentration is high in most of the project area and the manganese concentration is high in water from many wells. The pH ranges from 5.0 to 8.7. A pH as low as 5.0 could cause the water to be corrosive. Treatment to lower iron and manganese concentration would be necessary to make the water satisfactory for public-supply use in most of the project area. In a local area in the southeastern corner of De Soto Parish, the iron and manganese concentrations are low, and the water can meet the requirements for public supply without treatment.

A fault zone in the southeastern part of the project area that offsets the Dolet Hills aquifer may be a boundary that retards water movement in the aquifer. Water-level decline caused by mining may be limited initially to the northwest side of the fault zone.

Recharge to the aquifer downdip from mining areas would be interrupted by dewatering of the aquifer during mining. If the aquifer is restored during reclamation, recharge to the aquifer may be enhanced, initially, because of loose packing of the sand grains. If during reclamation the sand of the aquifer is replaced by lumps of clay in a sand matrix, relatively rapid water movement may occur through the sand. However, if clay and clayey or silty material is intimately mixed with the sand so that permeability of the fill is lower than that of the Dolet Hills aquifer, water movement would be retarded. If mine drainage enters the aquifer during mining, the quality of water in the aquifer could be adversely affected.

There is a potential for saltwater from sands in the underlying Naborton Formation to rise into the mines in part of the area of potential mining. However, as the saltwater sands are separated from the Chemard Lake lignite by clay, and as the rate of movement of water through clay is slow, the potential for saltwater from Naborton sands entering the mines is small.

A preliminary two-dimensional digital model of the flow system of the Dolet Hill aquifer was constructed to test concepts of the flow system. As more data become available, the model could be improved and used as a predictive tool to simulate the impact of dewatering upon water levels.

Streams in the project area have many days of no flow during the dry season, July through November. Highest streamflows usually occur during December through May. The hydrograph of Bayou San Patricio near Benson shows that stream discharge increases with storms and declines quickly after storms. The peak discharge usually occurs 1 to 3 days after the greatest rainfall.

Suspended-sediment discharge of streams in the project area increases with increased streamflow. The suspended-sediment loads of streams draining the Dolet Hill area have a larger percentage of sand-size material than those of Bayou San Patricio. This may be because the terrain of the Dolet Hills area (the outcrop of the Dolet Hills Formation) is sandier and steeper than the terrain of the Bayou San Patricio drainage area.

Water in streams in the project area is soft to moderately hard, is low in chloride and sulfate concentrations, and has low specific conductance. Concentrations of some constituents are higher during low flow than during high flow. Concentrations of trace elements and organic pesticides are either below the limits of detection or below limits recommended by the U.S. Environmental Protection Agency.

A major effect of mining on the streams of the area could be a change in the water quality. The weathering of newly disturbed material may increase mineral concentrations in mine drainage entering the streams. Concentrations of dissolved solids, aluminum, calcium, iron, magnesium, manganese, and sulfate may increase, and the pH of the water may be lower. However, the Louisiana Surface Mining and Reclamation Act requires that mine operators meet effluent standards. Water from the Chemard Lake lignite may be part of the mine drainage. The sulfur content of the Chemard Lake lignite is low averaging 0.63 percent; thus, water from the mines should have lower sulfate concentration and higher pH than water from high-sulfate lignites.

Streamflow would be increased if water pumped from the Dolet Hills aquifer during mining operations is discharged to the streams. If as much as 10 ft^3/s were added to the streams it would not be a significant increase during high stages. However, when the streams are dry or at low stages water discharged from the aquifer would substantially increase streamflow.

Concentrations of iron and manganese are high i~ water from the aquifer in most of the area and, unless removed, could have an adverse affect on the quality of water in the stream. There is a potential for increased sediment load in streams draining disturbed land during mining and reclamation operations.

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HYDROLOGIC DATA

Explanation for Tables 1-4

MG/L, milligram per liter

UG/G, microgram per gram

UG/KG, microgram per kilogram

UG/L, microgram per liter

JTU, Jackson turbidity units

UMHOS, micromhos (per centimeter at 25°C)

0.7 UM-MF (COL./100 ML), 0.7 micrometer membrane filter (colonies per 100 milliliters)

K, results based on colony count outside the acceptable range (non-ideal count)

TABLE 1.--CHEMICAL ANALYSES OF WATER FROM WELLS SCREENED IN THE DOLET HILLS AQUIFER

WELL NO.	LOCATION SEC.	T.	R.	DEPTH OF WELL, (FEET)	DATE OF SAMPLE	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	COLOR (PLAT-INUM-COBALT UNITS)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)
DS- 23	3	10N	12W	377	55- 3- 4	228	7.0	21.5	15	24	0	5.2	2.6	38
DS-166	20	12N	12W	43	81- 1-12	217	5.0	--	0	37	30	3.7	6.7	23
				43	81- 1-28	221	5.3	--	0	38	30	3.9	6.9	22
DS-208	35	11N	11W	220	55-11- 4	748	8.1	--	15	11	0	4.2	.1	180
				220	81- 1-14	729	8.3	--	5	6	0	1.7	.4	180
DS-238	37	11N	12W	223	55-11- 4	383	6.6	--	0	56	0	18	2.6	45
DS-396	26	11N	11W	163	71- 8-19	384	7.1	20.5	10	120	0	34	9.5	32
				163	71- 8-19	--	--	--	--	120	--	--	--	--
DS-397	36	11N	11W	136	71- 9-16	1030	7.3	21.5	10	220	0	59	17	140
				136	71- 9-16	--	--	--	--	210	--	--	--	--
DS-398	35	11N	11W	124	71- 9-21	--	--	--	--	170	--	--	--	--
				124	71- 9-22	647	7.2	20.5	5	170	2	44	14	76
DS-402	19B	11N	11W	231	72- 5-26	463	8.3	21.0	0	15	0	5.0	.6	100
				231	72- 5-26	--	8.3	21.0	--	18	--	--	--	--
DS-403	26	11N	12W	260	72- 6-12	403	7.0	21.0	5	9	0	2.2	.9	92
				260	72- 6-12	--	7.0	21.0	--	8	--	--	--	--
DS-404	18B	10N	11W	420	72- 6-26	768	7.9	23.0	5	120	0	30	11	120
				420	72- 6-26	--	7.2	--	--	120	--	--	--	--
DS-405	26A	11N	12W	168	72-11-30	297	7.2	--	--	38	0	8.1	4.3	--
				168	72-11-30	--	--	--	--	50	--	--	--	--
DS-405	26B	11N	12W	266	72-11-17	410	7.9	21.0	20	5	0	1.0	.6	95
				266	72-11-17	--	7.9	21.0	--	54	--	--	--	--
DS-443	37	11N	12W	304	77-10-31	162	6.8	--	20	23	0	5.5	2.3	24
				304	79- 6-22	202	--	--	--	18	0	6.7	.3	32
DS-444	20	11N	12W	241	77-11- 7	560	--	--	10	110	68	22	12	64
				241	79- 6-21	571	--	--	10	140	49	28	17	54
DS-445	22	11N	12W	140	77-12- 8	427	--	--	0	160	0	41	13	30
				140	79- 6-19	437	--	--	0	160	0	40	16	29
DS-446	15	11N	12W	220	77-11-28	103	--	--	10	15	0	3.7	1.4	13
				220	79- 6-21	158	--	--	0	23	0	5.5	2.3	18
DS-448	28	11N	11W	230	77-12- 5	463	--	--	0	24	0	5.7	2.4	95
				230	79- 6-22	474	--	--	5	25	0	7.6	1.5	95
DS-449	2	10N	11W	240	77-12-14	791	--	--	5	2	0	.7	.1	190
DS-450	19	11N	11W	262	78- 2-10	625	--	--	100	2	0	.6	.1	150
				262	79- 6-19	625	--	--	200	4	0	<.1	1.0	150
DS-454	10	10N	11W	365	79- 5- 3	708	--	--	0	96	0	26	7.6	120
DS-455	2	10N	11W	286	79- 5- 3	780	--	--	0	4	0	1.0	.2	180
DS-470	37	10N	11W	152	79- 5-23	737	--	--	0	68	0	15	7.4	140
DS-511	16	10N	11W	350	81- 7-21	215	--	--	75	60	0	17	4.3	17
NA-491	8	10N	10W	493	81- 7-24	807	--	--	5	4	0	1.2	.2	200
SA-248	29	10N	11W	502	55-10-18	1010	8.4	--	--	9	0	3.2	.3	250
				502	68- 1-26	1100	8.7	--	5	3	0	1.0	.1	270

TABLE 1.--CHEMICAL ANALYSES OF WATER FROM WELLS SCREENED IN THE DOLET HILLS AQUIFER--CONTINUED

POTAS-SIUM, DIS-SOLVED (MG/L AS K)	ALKA-LINITY, FIELD (MG/L AS CACO3)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	CARBON DIOXIDE, DIS-SOLVED (MG/L AS CO2)	SULFATE, DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG C, DIS-SOLVED (MG/L)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	IRON, DIS-SOLVED (UG/L AS FE)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)
1.5	71	87	0	14	15	16	0.2	36	159	158	--	--
5.0	7	--	--	--	5.2	27	.3	34	176	158	430	300
4.0	8	--	--	--	5.4	23	.3	31	163	153	40	340
1.4	308	375	0	4.7	45	30	.2	14	462	458	--	--
2.0	312	--	--	--	34	28	.2	12	438	446	380	20
1.7	72	88	0	35	44	47	.1	59	278	266	--	--
1.8	129	157	0	20	28	25	.2	56	260	264	11000	380
--	--	--	--	--	--	--	--	--	--	--	8000	--
3.0	261	318	0	26	130	88	.2	29	681	625	4000	20
--	--	--	--	--	--	86	--	--	--	--	--	--
--	--	--	--	--	--	26	--	--	--	--	--	--
2.4	--	200	0	--	100	40	.2	38	416	417	7200	230
2.1	189	230	0	1.8	21	15	.1	13	272	270	320	70
--	--	--	--	--	--	18	--	--	--	--	360	--
1.0	178	217	0	35	7.2	16	.3	26	267	253	370	70
--	--	--	--	--	--	20	--	--	--	--	--	--
7.5	282	344	0	6.9	67	34	.2	18	469	457	430	50
--	--	--	--	--	--	34	--	--	--	--	500	--
--	120	146	0	15	16	12	--	--	--	--	--	--
--	--	--	--	--	--	16	--	--	--	--	--	--
1.3	179	218	0	4.4	9.8	17	.2	26	280	258	720	10
--	--	--	--	--	--	70	--	--	--	--	150	--
2.9	48	58	0	15	15	13	.1	35	144	130	2600	7
2.7	42	51	0	--	16	21	<.1	--	112	105	--	12
5.4	38	46	0	--	130	50	.1	43	384	366	15000	510
4.2	--	--	0	--	110	44	.1	30	361	341	--	480
4.0	197	240	0	--	16	14	<.1	27	263	263	20	90
3.4	189	230	0	--	12	16	.1	15	257	246	--	--
2.2	22	27	0	--	16	7.0	.1	35	106	92	1200	40
2.2	--	--	0	--	10	5.8	.1	--	94	85	--	140
2.2	186	227	0	--	33	16	<.1	21	287	287	60	2
2.5	179	218	0	--	36	16	<.1	15	283	281	40	20
1.9	325	382	7	--	33	34	.2	14	474	469	40	20
2.4	296	355	3	--	1.8	24	.6	16	423	374	440	50
1.1	280	309	16	--	3.2	24	.4	3.1	384	351	80	5
5.1	262	320	0	--	47	33	.3	28	427	425	<10	36
3.7	321	391	0	--	11	43	.3	14	460	446	40	<10
2.5	309	377	0	--	34	25	.5	20	456	430	110	40
1.9	70	--	--	--	16	13	.4	51	172	163	3800	220
1.2	386	--	--	--	.6	37	.6	38	482	511	140	0
1.7	496	580	12	3.8	3.7	43	.8	11	640	615	--	--
.7	532	574	37	2.1	.2	46	.5	11	657	651	690	--

Table 2.--Miscellaneous measurements of suspended sediment and discharge for streams in southeastern De Soto Parish, Louisiana

Date	Time	Suspended sediment (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended, sieve diam. % finer .062 mm	Streamflow instantaneous (ft^3/s)	Date	Time	Suspended sediment (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended, sieve diam. % finer .062 mm	Streamflow instantaneous (ft^3/s)
08023400 - Bayou San Patricio near Benson, La.											
10-14-78	----	301	1,680	96	2,070	4-23-80	1600	38	--------	95	--------
1-22-79	----	28	47	57	619	5-27-80	1545	29	1.3	93	17
4- 9-79	----	37	8.7	84	87	7- 9-80	1345	99	--------	63	--------
10-24-79	1215	57	--------	79	--------	2- 3-81	1420	48	--------	82	--------
1- 8-80	1215	26	--------	93	--------	4- 8-81	1300	46	--------	96	--------
4-12-80	----	76	265	89	1,400	7-15-81	1310	35	--------	76	--------
4-15-80	----	37	77	95	816	9-10-81	1300	44	--------	87	--------
08023375 - Bayou San Patricio at Oxford, La.											
4- 9-79	1500	40	3.1	74	29	4-16-80	1215	38	7.8	97	76
5-30-79	1500	98	14	86	54	5-16-80	1915	51	156	85	1,130
4-12-80	1510	57	257	82	1,670	5-28-80	1430	47	.08	94	.66
4-14-80	1410	37	48	97	484						
07351748 - West Branch Dolet Bayou at Rambin, La.											
10-23-79	1500	72	--------	88	--------	4-24-80	1045	39	7.1	78	67
1- 9-80	0815	20	--------	83	--------	5-16-80	1200	28	27	96	353
4-13-80	1800	61	46	85	282	5-29-80	1055	31	1.6	89	18
4-14-80	1615	79	69	75	325	1-14-81	1230	80	--------	97	--------
4-22-80	1000	44	--------	80	--------	4- 7-81	1030	63	--------	85	--------

07351749 - Chemard Lake near Evelyn, La.											
12-14-78	----	49	37	73	282	10-23-79	1450	56	---------	90	---------
1-22-79	----	34	22	71	235	1- 9-80	0830	18	---------	94	---------
5- 4-79	----	25	8.6	92	127						
315704093287100 - Louies Bayou near Evelyn, La.											
1- 8-79	1445	25	1.5	76	22	5- 4-79	1103	132	63	53	177
1-22-79	1515	19	1.1	68	20	5-30-79	1615	60	1.3	93	7.9
2- 6-79	1305	31	.86	58	10	5-29-80	1145	37	.20	76	1.9
4- 4- 79	1305	50	4.6	80	34	7- 8-80	1045	127	.05	87	.16
315533093290300 - Prairie Bayou near Evelyn, La.											
1- 8-79	1520	37	2.5	65	24	5- 4-79	1156	91	38	79	153
1-22-79	1550	42	2.2	50	19	5-30-79	1650	45	.45	89	3.7
2- 6-79	1335	36	8.1	64	83	5-29-80	1225	26	.19	96	2.7
4- 4-79	1430	62	9.3	55	55						
315501093282900 - Rambin Bayou near Evelyn, La.											
1- 8-79	1600	55	8.8	58	59	5- 4-79	1230	515	513	86	369
1-22-79	1635	61	11	52	67	5-30-79	1300	72	1.6	83	8.0
2- 6-79	1400	143	62	67	161	4-16-80	1130	51	5.4	96	39
4- 4-70	1400	95	43	85	169	7- 9-80	1215	37	.00	95	.02

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA

08023400 - BAYOU SAN PATRICIO NEAR BENSON, LA.

DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	TEMPERATURE (DEG C)	COLOR (PLATINUM-COBALT UNITS)	TURBIDITY (JTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREPTOCOCCI FECAL, KF AGAR (COLS./100 ML)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)
8-14-55	126	6.6	--	130	--	--	--	--	--	29	1	4.0
9-12-72	87	6.7	23.5	50	--	3.1	1.4	--	--	23	1	6.4
2-15-78	112	5.7	6.5	80	25	9.9	3.8	K800	5400	22	16	5.0
4-19-78	90	6.1	17.0	50	25	6.7	3.8	K2800	5200	18	7	3.7
5- 9-78	180	6.6	22.5	80	15	6.5	--	K95	K2400	39	5	8.5
6-13-78	194	6.5	24.0	80	20	4.0	1.3	100	240	51	0	13
11-16-78	226	7.1	--	50	7	6.2	5.9	K110	520	78	--	21
2- 7-79	63	6.2	5.0	80	25	10.0	1.1	260	360	15	7	3.7
4- 4-79	44	6.1	17.0	120	15	7.6	1.6	K400	K170	11	3	2.6
7-11-79	198	6.7	25.0	15	25	5.5	--	440	980	36	10	9.3
10-24-79	152	6.4	14.5	100	10	5.9	3.4	--	2300	40	2	10
1- 8-80	216	6.7	8.5	100	15	9.4	.6	120	K70	42	19	9.6
4-23-80	117	6.6	18.5	60	15	7.0	.1	K60	K40	25	8	5.5
7- 9-80	213	6.3	32.5	30	10	5.5	3.4	140	400	66	1	16
2- 3-81	162	5.9	5.0	40	--	9.6	2.5	K40	120	33	26	8.0
4- 8-81	254	6.5	18.0	100	--	5.8	.6	K40	K70	43	0	11
7-15-81	134	6.2	28.0	100	--	3.9	.9	200	1800	34	5	8.5
9-10-81	138	5.9	23.0	100	--	5.7	1.5	K170	590	35	19	11

DATE OF SAMPLE	ALUMINUM, DISSOLVED (UG/L AS AL)	ARSENIC DISSOLVED (UG/L AS AS)	ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G AS AS)	CADMIUM DISSOLVED (UG/L AS CD)	CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G AS CD)	CHROMIUM, RECOV. FM BOTTOM MATERIAL (UG/G)	CHROMIUM, HEXAVALENT, DIS. (UG/L AS CR)	COBALT, DISSOLVED (UG/L AS CO)	COPPER, DISSOLVED (UG/L AS CU)	COPPER, RECOV. FM BOTTOM MATERIAL (UG/G AS CU)	IRON, DISSOLVED (UG/L AS FE)	IRON, RECOV. FM BOTTOM MATERIAL (UG/G AS FE)
9-12-72	300	--	6	<5	3	10	0	<5	0	67	--	--
2-15-78	--	1	7	ND	0	30	0	--	<2	4	180	5000
11-16-78	--	1	3	<2	0	0	0	--	4	29	910	3800
10-24-79	--	2	3	1	0	2	0	--	0	4	510	4600
2- 3-81	--	0	4	<1	0	2	0	--	5	5	500	3200
9-10-81	--	--	--	--	--	--	--	--	--	--	610	--

DATE OF SAMPLE	CARBON, ORGANIC TOTAL (MG/L AS C)	CYANIDE TOTAL (MG/L AS CN)	PHENOLS (UG/L)	PCB, TOTAL (UG/L)	PCB, TOTAL IN BOTTOM MATERIAL (UG/KG)	NAPHTHALENES, POLYCHLOR. TOTAL (UG/L)	PCN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ALDRIN, TOTAL (UG/L)	ALDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	CHLORDANE, TOTAL (UG/L)	CHLORDANE, TOTAL IN BOTTOM MATERIAL (UG/KG)
9-12-72	--	--	--	--	--	--	--	0.00	.2	0.00	1.0
2-15-78	12	.00	6	.00	0	.00	.0	.00	.0	.00	5.0
11-16-78	28	.01	3	.00	0	.00	--	.00	.0	.00	.0
10-24-79	15	.00	4	.00	0	.00	.0	.00	.0	.00	.0
2- 3-81	13	.00	0	<.10	<1	<.10	<1.0	<.001	<.1	<.10	<1.0

DATE OF SAMPLE	ENDOSULFAN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ETHION, TOTAL (UG/L)	ETHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	HEPTACHLOR, TOTAL (UG/L)	HEPTACHLOR, TOTAL IN BOTTOM MATERIAL (UG/KG)	HEPTACHLOR EPOXIDE TOTAL (UG/L)	HEPTACHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	LINDANE TOTAL (UG/L)	LINDANE TOTAL IN BOTTOM MATERIAL (UG/KG)
9-12-72	--	0.00	<0.2	--	--	0.00	<0.2	0.00	<0.2	0.00	<0.2
2-15-78	--	.00	.0	.00	.0	.00	.0	.00	.1	.00	.0
11-16-78	.0	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0
10-24-79	.0	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0
2- 3-81	<.1	<.001	<.1	<.01	<.1	<.001	<.1	<.001	<.1	<.001	<.1

DATE OF SAMPLE	MALATHION, TOTAL (UG/L)	MALATHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	METHOXYCHLOR, TOTAL (UG/L)	METHOXYCHLOR, TOT. IN BOTTOM MATL. (UG/KG)	METHYL PARATHION, TOTAL (UG/L)	METHYL PARATHION, TOT. IN BOTTOM MATL. (UG/KG)	METHYL TRITHION, TOTAL (UG/L)	METHYL TRITHION, TOT. IN BOTTOM MATL. (UG/KG)	MIREX, TOTAL (UG/L)	MIREX, TOTAL IN BOTTOM MATERIAL (UG/KG)	PARATHION, TOTAL (UG/L)
9-12-72	0.00	--	--	--	0.00	--	--	--	--	--	0.00
2-15-78	.00	.0	--	--	.00	.0	.00	.0	.00	.0	.00
11-16-78	.00	.0	--	--	.00	.0	.00	.0	.00	--	.00
10-24-79	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0	.00
2- 3-81	<.01	<.1	<.01	<.1	<.01	<.1	<.01	<.1	<.01	<.1	<.01

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA--CONTINUED

08023400 - BAYOU SAN PATRICIO NEAR BENSON, LA.--CONTINUED

MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	POTASSIUM, DISSOLVED (MG/L AS K)	ALKALINITY FIELD (MG/L AS CACO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	PHOSPHORUS, TOTAL (MG/L AS P)
2.6	10	--	28	7.1	11	--	19	--	--	--	--
1.7	5.0	4.9	22	9.2	6.0	.1	7.4	72	--	--	.150
2.4	10	2.7	7	18	16	<.1	9.3	75	.41	.83	2.50
2.1	7.6	2.9	11	12	11	<.1	8.1	82	.08	.98	.120
4.4	17	3.5	34	10	22	.1	19	119	.40	1.10	.170
4.4	19	5.2	51	6.8	25	.1	16	129	.34	.66	.250
6.1	16	5.2	--	3.9	23	.1	8.0	149	.08	2.00	.170
1.3	6.2	1.5	7	8.9	8.3	<.1	6.8	56	.07	.40	.060
1.0	3.4	1.7	7	7.1	4.6	.1	5.9	50	.01	.51	.040
3.1	19	5.7	26	18	27	.1	9.7	134	1.2	1.30	.150
3.6	8.0	7.9	38	15	11	.1	8.8	104	.07	1.10	.190
4.4	22	4.5	23	27	32	.1	17	150	.87	1.10	.080
2.7	11	1.9	16	13	16	.1	16	94	.20	.87	.080
6.3	14	4.0	65	7.8	18	.3	6.1	126	--	--	--
3.1	15	3.6	7	23	25	.1	27	127	.01	1.00	.090
3.8	29	4.9	50	22	29	.1	12	163	.08	1.30	.140
3.1	9.5	6.1	29	6.0	17	.1	13	103	1.0	1.70	.280
1.8	11	5.1	16	24	15	.2	12	127	.19	1.40	.130

IRON (UG/L AS FE)	LEAD, DISSOLVED (UG/L AS PB)	LEAD, RECOV. FM BOTTOM MATERIAL (UG/G AS PB)	MANGANESE, DISSOLVED (UG/L AS MN)	MANGANESE, RECOV. FM BOTTOM MATERIAL (UG/G)	MERCURY TOTAL RECOVERABLE (UG/L AS HG)	MERCURY RECOV. FM BOTTOM MATERIAL (UG/G AS HG)	NICKEL, DISSOLVED (UG/L AS NI)	STRONTIUM, DISSOLVED (UG/L AS SR)	ZINC, DISSOLVED (UG/L AS ZN)	ZINC, RECOV. FM BOTTOM MATERIAL (UG/G AS ZN)
340	<10	68	460	--	<0.5	0.01	<5	160	20	20
--	3	0	80	10000	<.1	.05	--	--	20	150
--	4	10	14000	400	<.1	.02	--	--	30	10
--	0	0	2100	200	.1	.01	--	--	10	4
--	0	10	300	320	.1	.06	--	--	30	2
--	--	--	580	--	--	.01	--	--	--	--

DDD, TOTAL (UG/L)	DDD, TOTAL IN BOTTOM MATERIAL (UG/KG)	DDE, TOTAL (UG/L)	DDE, TOTAL IN BOTTOM MATERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIAZINON, TOTAL (UG/L)	DIAZINON, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIELDRIN TOTAL (UG/L)	DIELDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDOSULFAN, TOTAL (UG/L)
0.00	<0.2	0.00	<0.2	0.00	<0.2	0.00	--	0.00	0.3	--
.00	1.0	.00	5.2	.00	4.0	<.01	.0	.00	.3	--
.00	.0	.00	.0	.00	.0	.00	.0	.00	.0	.00
.00	.0	.00	.0	.00	.0	.00	.0	.00	.0	.00
<.001	<.1	<.001	<.1	<.001	<.1	<.01	<.1	<.001	<.1	<.001

PARATHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	PERTHANE TOTAL (UG/L)	PERTHANE IN BOTTOM MATERIAL (UG/KG)	TOXAPHENE, TOTAL (UG/L)	TOXAPHENE, TOTAL IN BOTTOM MATERIAL (UG/KG)	TOTAL TRITHION (UG/L)	TRITHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	2,4-D, TOTAL (UG/L)	2, 4-DP TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	SILVEX, TOTAL (UG/L)
--	--	--	--	--	--	--	0.08	--	0.04	0.00
.0	--	--	0	.0	.00	.0	.02	.00	.02	.01
.0	.00	.00	0	.0	.00	.0	.00	.01	.00	.02
.0	.00	.00	0	.0	.00	.0	.01	.00	.02	.00
<.1	<.01	<.10	<0.1	<1.0	<.01	<.1	<.01	<.01	<.01	<.01

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA--CONTINUED

07351749 - CHEMARD LAKE NEAR EVELYN

DATE OF SAMPLE	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	TEMPERATURE (DEG C)	COLOR (PLATINUM-COBALT UNITS)	TURBIDITY (JTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREPTOCOCCI FECAL, KF AGAR (COLS./100 ML)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)
11-16-77	167	6.8	18.0	80	10	5.6	3.0	K180	310	40	0	7.9
2-15-78	109	5.7	6.5	130	40	8.8	2.8	480	1200	31	24	5.8
4-19-78	152	6.5	18.0	80	45	3.9	5.0	K3000	11000	37	16	6.9
11-14-78	193	6.3	--	80	4	2.9	2.9	1100	8400	61	22	15
2- 6-79	124	6.5	6.0	60	20	12.3	3.6	K70	160	27	18	4.9
4- 3-79	48	5.9	17.0	160	65	6.0	.1	2200	K2600	13	7	2.8
7-10-79	176	6.5	25.0	40	10	5.5	--	980	1900	44	3	8.4
10-23-79	192	6.3	17.5	120	10	2.3	--	--	1200	50	0	10
1- 9-80	173	6.4	7.5	40	6	9.4	1.1	180	K200	37	18	7.2

DATE OF SAMPLE	ARSENIC DISSOLVED (UG/L AS AS)	ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G AS AS)	CADMIUM DISSOLVED (UG/L AS CD)	CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G AS CD)	CHROMIUM, RECOV. FM BOTTOM MATERIAL (UG/G)	CHROMIUM, HEXAVALENT, DIS. (UG/L AS CR)	COPPER, DISSOLVED (UG/L AS CU)	COPPER, RECOV. FM BOTTOM MATERIAL (UG/G AS CU)	IRON, DISSOLVED (UG/L AS FE)	IRON, RECOV. FM BOTTOM MATERIAL (UG/G AS FE)	LEAD, DISSOLVED (UG/L AS PB)
2-15-78	1	1	ND	0	20	0	2	8	220	900	2
4-19-78	--	29	--	0	11	--	--	13	--	28000	--
11-14-78	1	25	<2	0	10	0	3	59	1400	24000	4
10-23-79	1	9	<1	0	14	0	0	17	180	18000	0

DATE OF SAMPLE	PCB, TOTAL IN BOTTOM MATERIAL (UG/KG)	NAPHTHALENES, POLYCHLOR. TOTAL (UG/L)	PCN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ALDRIN, TOTAL (UG/L)	ALDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	CHLORDANE, TOTAL (UG/L)	CHLORDANE, TOTAL IN BOTTOM MATERIAL (UG/KG)	DDD, TOTAL (UG/L)	DDD, TOTAL IN BOTTOM MATERIAL (UG/KG)	DDE, TOTAL (UG/L)	DDE, TOTAL IN BOTTOM MATERIAL (UG/KG)
2-15-78	--	0.00	0.0	0.00	--	0.00	--	0.00	--	0.00	--
4-19-78	0	.00	--	.00	.0	.00	.0	.00	3.2	.00	3.3
11-14-78	0	.00	--	.00	.0	.00	.0	.00	2.0	.00	1.7
10-23-79	0	.00	.0	.00	.0	.00	.0	.01	.4	.00	.2

DATE OF SAMPLE	ETHION, TOTAL (UG/L)	ETHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	HEPTACHLOR, TOTAL (UG/L)	HEPTACHLOR, TOTAL IN BOTTOM MATERIAL (UG/KG)	HEPTACHLOR EPOXIDE TOTAL (UG/L)	HEPTACHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	LINDANE TOTAL (UG/L)	LINDANE TOTAL IN BOTTOM MATERIAL (UG/KG)	MALATHION, TOTAL (UG/L)	MALATHION, TOTAL IN BOTTOM MATERIAL (UG/KG)
2-15-78	0.00	--	0.00	--	0.00	--	0.00	--	0.00	--
4-19-78	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0
11-14-78	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0
10-23-79	.00	.0	.00	.0	.00	.0	.00	.0	.00	.0

DATE OF SAMPLE	PERTHANE TOTAL (UG/L)	PERTHANE IN BOTTOM MATERIAL (UG/KG)	TOXAPHENE, TOTAL (UG/L)	TOXAPHENE, TOTAL IN BOTTOM MATERIAL (UG/KG)	TOTAL TRITHION (UG/L)	TRITHION, TOTAL IN BOTTOM MATERIAL (UG/KG)	2,4-D, TOTAL (UG/L)	2, 4-DP TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	SILVEX, TOTAL (UG/L)
2-15-78	--	--	0	--	0.00	--	0.01	0.00	0.00	0.00
4-19-78	--	--	0	.0	.00	.0	.36	--	.00	.01
11-14-78	.00	.00	0	.0	.00	.0	.00	.00	.00	.00
10-23-79	.00	.00	0	.0	.00	.0	.03	.00	.00	.00

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA--CONTINUED

07351749 - CHEMARD LAKE NEAR EVELYN--CONTINUED

MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	POTASSIUM, DISSOLVED (MG/L AS K)	ALKALINITY FIELD (MG/L AS CACO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	PHOSPHORUS, TOTAL (MG/L AS P)
4.8	19	5.0	40	4.0	25	0.1	13	123	0.05	0.45	0.100
3.9	8.4	1.9	7	31	8.7	<.1	9.4	88	.05	.49	.100
4.8	12	2.5	21	26	14	.1	9.4	99	.03	.73	.110
5.7	18	3.3	39	13	34	.1	25	159	.01	.69	.120
3.7	9.8	1.3	10	25	12	<.1	13	79	.05	.20	.060
1.5	3.0	1.7	7	10	3.3	.1	7.7	47	.05	.71	.060
5.5	16	2.5	41	18	16	.1	13	113	.02	.42	.090
6.1	14	5.1	57	6.7	19	.1	11	117	.10	.92	.160
4.7	17	2.1	20	25	22	.1	15	113	.03	.53	.030

LEAD, RECOV. FM BOTTOM MATERIAL (UG/G AS PB)	MANGANESE, DISSOLVED (UG/L AS MN)	MANGANESE, RECOV. FM BOTTOM MATERIAL (UG/G)	MERCURY TOTAL RECOVERABLE (UG/L AS HG)	MERCURY RECOV. FM BOTTOM MATERIAL (UG/G AS HG)	ZINC, DISSOLVED (UG/L AS ZN)	ZINC, RECOV. FM BOTTOM MATERIAL (UG/G AS ZN)	CARBON, ORGANIC TOTAL (MG/L AS C)	CYANIDE TOTAL (MG/L AS CN)	PHENOLS (UG/L)	PCB, TOTAL (UG/L)
0	60	900	<.1	0.14	<20	40	11	0.00	5	0.00
50	--	440	--	.09	--	93	--	--	--	.00
200	1200	2200	<.1	.09	30	70	20	.00	5	.00
25	5	730	.1	.05	<3	53	18	.00	7	.00

DDT, TOTAL (UG/L)	DDT, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIAZINON, TOTAL (UG/L)	DIAZINON, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIELDRIN TOTAL (UG/L)	DIELDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDOSULFAN, TOTAL (UG/L)	ENDOSULFAN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)
0.00	--	0.00	--	0.00	--	--	--	0.00	--
.00	.0	.00	.0	.00	.5	--	--	.00	.0
.00	.2	.00	.0	.00	.1	.00	.0	.00	.0
.01	.0	.00	.0	.02	.0	.00	.0	.00	.0

METHOXYCHLOR, TOTAL (UG/L)	METHOXYCHLOR, TOT. IN BOTTOM MATL. (UG/KG)	METHYL PARATHION, TOTAL (UG/L)	METHYL PARATHION, TOT. IN BOTTOM MATL. (UG/KG)	METHYL TRITHION, TOTAL (UG/L)	METHYL TRITHION, TOT. IN BOTTOM MATL. (UG/KG)	MIREX, TOTAL (UG/L)	MIREX, TOTAL IN BOTTOM MATERIAL (UG/KG)	PARATHION, TOTAL (UG/L)	PARATHION, TOTAL IN BOTTOM MATERIAL (UG/KG)
--	--	0.00	--	0.00	--	0.00	--	0.00	--
--	--	.00	.0	.00	.0	.00	.8	.00	.0
--	--	.00	.0	.00	.0	.00	--	.00	.0
.00	.0	.00	.0	.00	.0	.00	.0	.00	.0

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA--CONTINUED

07351748 - WEST BRANCH DOLET BAYOU AT RAMBIN, LA.

DATE OF SAMPLE	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	COLOR (PLAT-INUM-COBALT UNITS)	TUR-BID-ITY (JTU)	OXYGEN, DIS-SOLVED (MG/L)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML)	STREP-TOCOCCI FECAL, KF AGAR (COLS./ 100 ML)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)
10-23-79	190	6.3	19.0	120	35	3.9	3.5	--	4900	45	12	8.7
1- 9-80	165	6.3	7.5	60	8	9.6	1.5	210	150	28	11	5.4
4-22-80	103	5.8	19.0	10	20	3.8	1.8	110	320	20	5	4.1
7- 8-80	264	6.9	27.0	80	25	2.0	3.5	250	365	69	0	14
1-14-81	553	4.8	6.5	5	--	10.8	2.2	K24	K10	150	150	28
4- 7-81	184	5.7	19.5	250	--	4.6	.6	170	120	40	26	8.2

DATE OF SAMPLE	ARSENIC DIS-SOLVED (UG/L AS AS)	ARSENIC TOTAL IN BOT-TOM MA-TERIAL (UG/G AS AS)	CADMIUM DIS-SOLVED (UG/L AS CD)	CADMIUM RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CD)	CHRO-MIUM, RECOV. FM BOT-TOM MA-TERIAL (UG/G)	CHRO-MIUM, HEXA-VALENT, DIS. (UG/L AS CR)	COPPER, DIS-SOLVED (UG/L AS CU)	COPPER, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CU)	IRON, DIS-SOLVED (UG/L AS FE)	IRON, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS FE)	LEAD, DIS-SOLVED (UG/L AS PB)
10-23-79	1	23	<1	0	3	0	3	45	750	5400	0

DATE OF SAMPLE	PCB, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	NAPH-THA-LENES, POLY-CHLOR. TOTAL (UG/L)	PCN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	ALDRIN, TOTAL (UG/L)	ALDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	CHLOR-DANE, TOTAL (UG/L)	CHLOR-DANE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDD, TOTAL (UG/L)	DDD, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDE, TOTAL (UG/L)	DDE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)
10-23-79	2	0.00	0.0	0.00	0.0	0.00	0.0	0.00	5.3	0.00	2.2

DATE OF SAMPLE	ETHION, TOTAL (UG/L)	ETHION, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	HEPTA-CHLOR, TOTAL (UG/L)	HEPTA-CHLOR, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	LINDANE TOTAL (UG/L)	LINDANE TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	MALA-THION, TOTAL (UG/L)	MALA-THION, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)
10-23-79	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

DATE OF SAMPLE	PER-THANE TOTAL (UG/L)	PER-THANE IN BOT-TOM MA-TERIAL (UG/KG)	TOX-APHENE, TOTAL (UG/L)	TOXA-PHENE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	TOTAL TRI-THION (UG/L)	TRI-THION, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	2,4-D, TOTAL (UG/L)	2, 4-DP TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	SILVEX, TOTAL (UG/L)
10-23-79	0.00	0.00	0	0.0	0.00	0.0	0.00	0.00	0.00	0.00

TABLE 3.--CHEMICAL ANALYSES OF WATER FROM STREAMS IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA--CONTINUED

07351748 - WEST BRANCH DOLET BAYOU AT RAMBIN, LA.--CONTINUED

MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	POTASSIUM, DISSOLVED (MG/L AS K)	ALKALINITY FIELD (MG/L AS CACO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N)	PHOSPHORUS, TOTAL (MG/L AS P)
5.7	16	4.2	34	13	27	0.1	10	132	0.05	1.10	0.220
3.5	18	1.7	16	12	29	.1	8.5	105	.05	.63	.030
2.4	7.9	1.8	15	11	10	.1	7.5	79	.01	.93	.130
8.3	25	2.8	74	1.3	36	.3	14	174	.02	1.90	.140
19	47	4.2	--	160	61	.0	26	366	.00	.62	.010
4.8	19	.9	14	26	30	.1	13	141	.02	2.00	.320

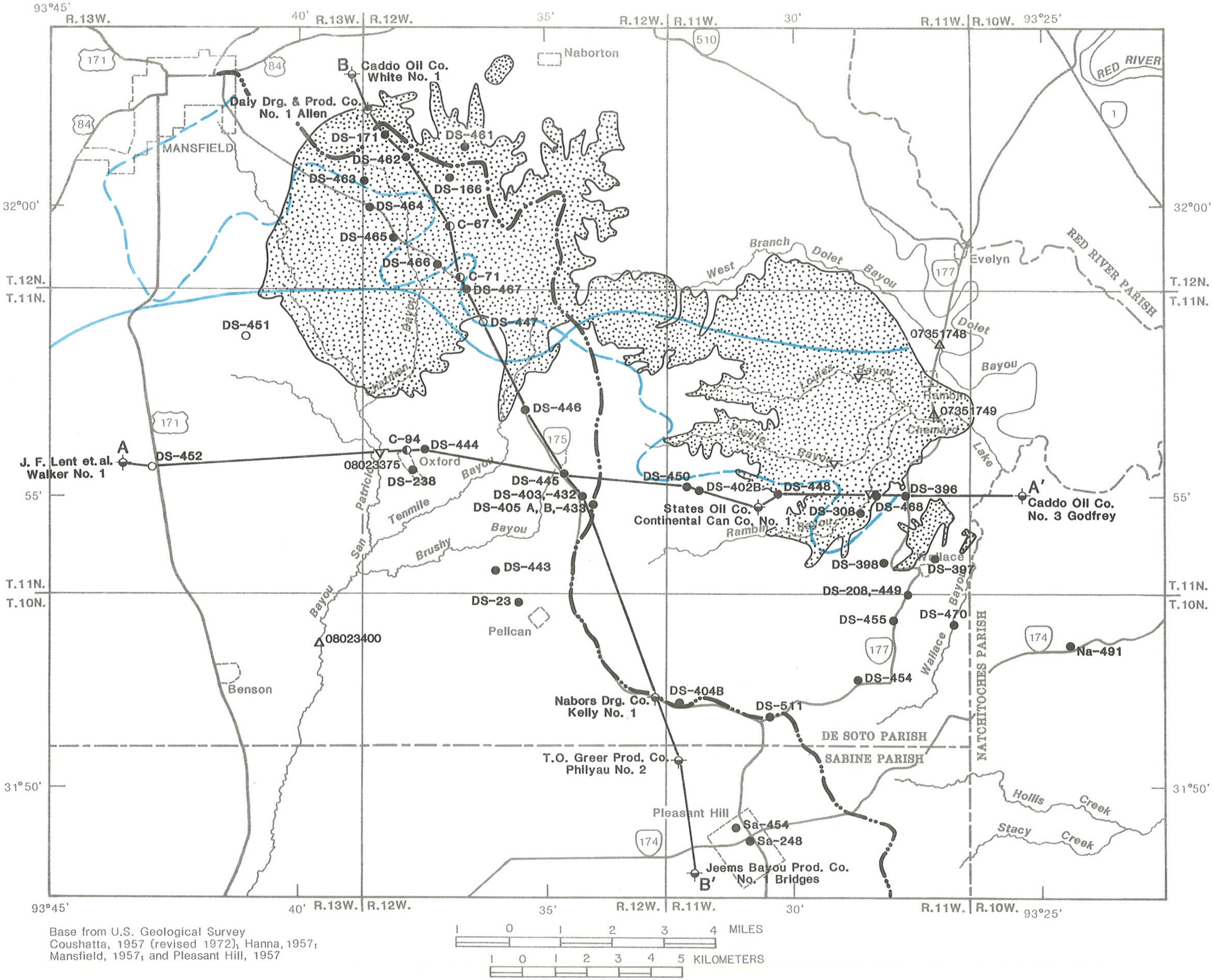
LEAD, RECOV. FM BOTTOM MATERIAL (UG/G AS PB)	MANGANESE, DISSOLVED (UG/L AS MN)	MANGANESE, RECOV. FM BOTTOM MATERIAL (UG/G)	MERCURY TOTAL RECOVERABLE (UG/L AS HG)	MERCURY RECOV. FM BOTTOM MATERIAL (UG/G AS HG)	ZINC, DISSOLVED (UG/L AS ZN)	ZINC, RECOV. FM BOTTOM MATERIAL (UG/G AS ZN)	CARBON, ORGANIC TOTAL (MG/L AS C)	CYANIDE TOTAL (MG/L AS CN)	PHENOLS (UG/L)	PCB, TOTAL (UG/L)
20	690	420	0.1	0.05	10	100	21	0.00	1	0.00

DDT, TOTAL (UG/L)	DDT, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIAZINON, TOTAL (UG/L)	DIAZINON, TOTAL IN BOTTOM MATERIAL (UG/KG)	DIELDRIN TOTAL (UG/L)	DIELDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDOSULFAN, TOTAL (UG/L)	ENDOSULFAN, TOTAL IN BOTTOM MATERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)
0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

METHOXYCHLOR, TOTAL (UG/L)	METHOXYCHLOR, TOT. IN BOTTOM MATL. (UG/KG)	METHYL PARATHION, TOTAL (UG/L)	METHYL PARATHION, TOT. IN BOTTOM MATL. (UG/KG)	METHYL TRITHION, TOTAL (UG/L)	METHYL TRITHION, TOT. IN BOTTOM MATL. (UG/KG)	MIREX, TOTAL (UG/L)	MIREX, TOTAL IN BOTTOM MATERIAL (UG/KG)	PARATHION, TOTAL (UG/L)	PARATHION, TOTAL IN BOTTOM MATERIAL (UG/KG)
0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

Table 4.--Temperatures and dissolved oxygen in streams in southeastern De Soto Parish, Louisiana

Date of collection	Temperature (°C)	Dissoved oxygen (mg/L as DO)	Date of collection	Temperature (°C)	Dissoved oxygen (mg/L as DO)
07351749 - Chemard Lake near Evelyn, La.					
11- 8-79	11.0	----	4-22-80	18.5	---
12-20-79	8.5	9.4	6- 2-80	25.0	4.5
1-23-80	12.0	----	7-16-80	33.5	3.5
3- 3-80	11.0	----	8-18-80	33.5	---
08023400 - Bayou San Patricio near Benson, La.					
11- 6-79	13.0	7.8	3-11-80	15.0	9.6
12-19-79	5.5	10.6	4-15-80	15.0	---
2- 1-80	8.5	----	5-27-80	23.5	6.3



Base from U.S. Geological Survey
Coushatta, 1957 (revised 1972); Hanna, 1957;
Mansfield, 1957; and Pleasant Hill, 1957

EXPLANATION

- Area of potential for mining based on 150 feet or less of overburden
- A—A' Line of geohydrologic section
- △ 08023400 Surface-water station and downstream order number (See tables 2 and 3.)
- 07351749 Discontinued surface-water station (See tables 2 and 3.)
- ● DS-446 Water well and parish number (See table 1.)
- ○ DS-451 Water-test hole and parish number
- Caddo Oil Co. No. 3 Godfrey Oil test
- ◐ C-67 Louisiana Geological Survey test
- ▽ Sediment-measurement site--sediment samples collected occasionally, mostly during high streamflow (See table 2
- Downdip limit of freshwater in the Naborton Formation
- Line showing approximate boundary between water-table and artesian conditions in the Dolet Hills aquifer
- Drainage divide

PLATE 1. MAP SHOWING DRAINAGE FEATURES AND LOCATION OF DATA STATIONS AND AREA OF POTENTIAL MINING, SOUTHEASTERN DE SOTO PARISH, LOUISIANA.

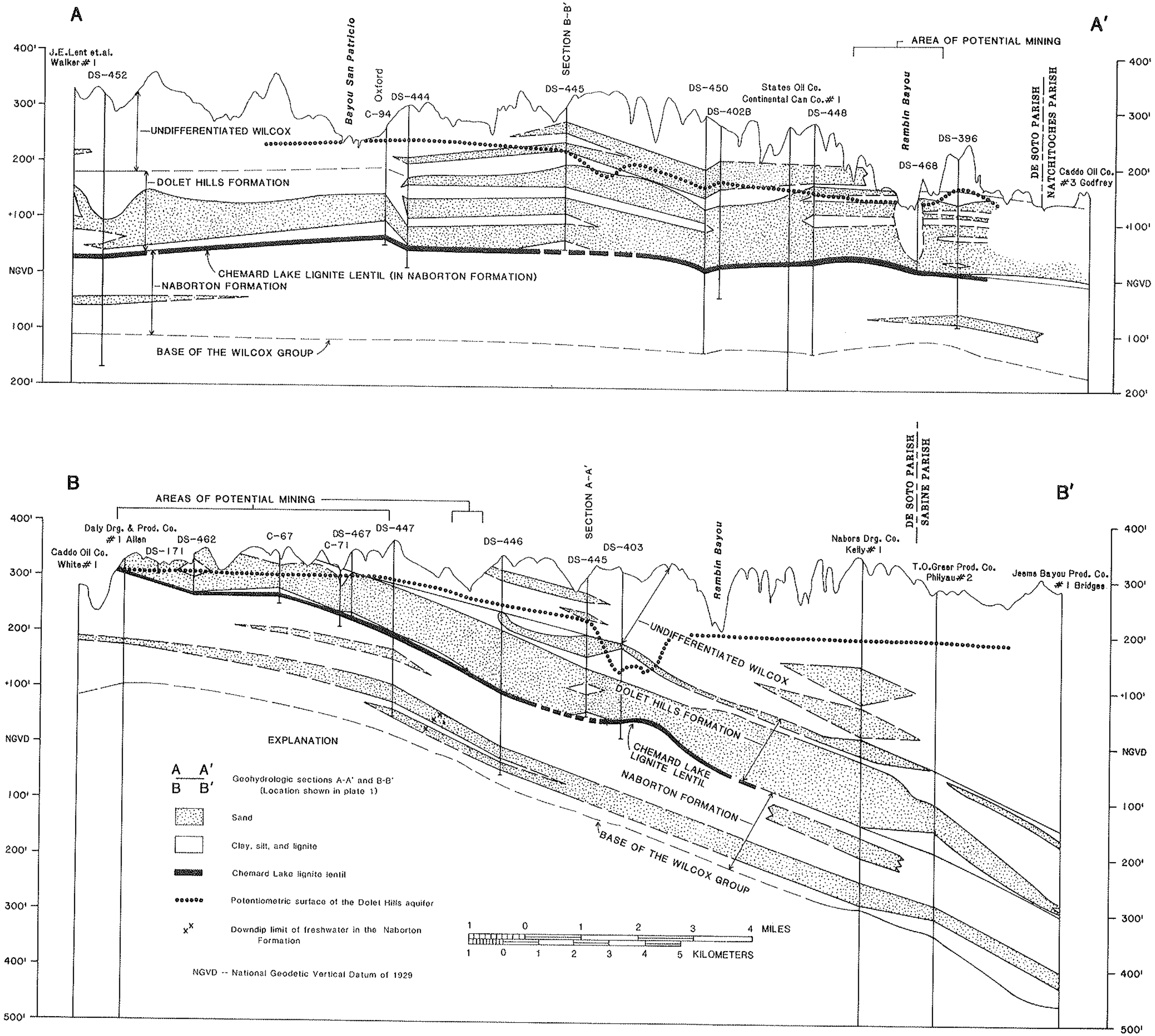


PLATE 2. GEOHYDROLOGIC SECTIONS FOR SOUTHEASTERN DE SOTO PARISH, LOUISIANA.

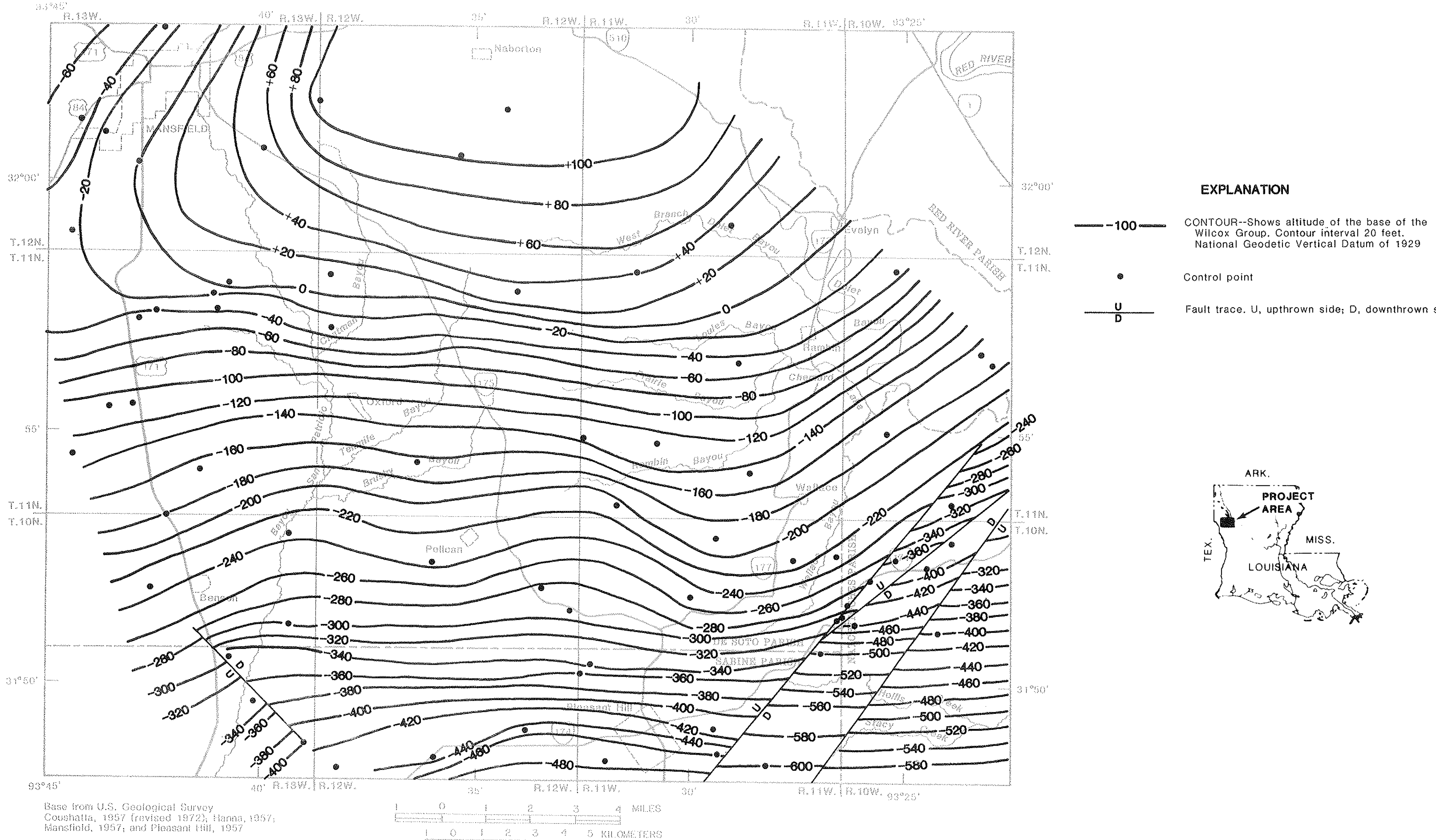
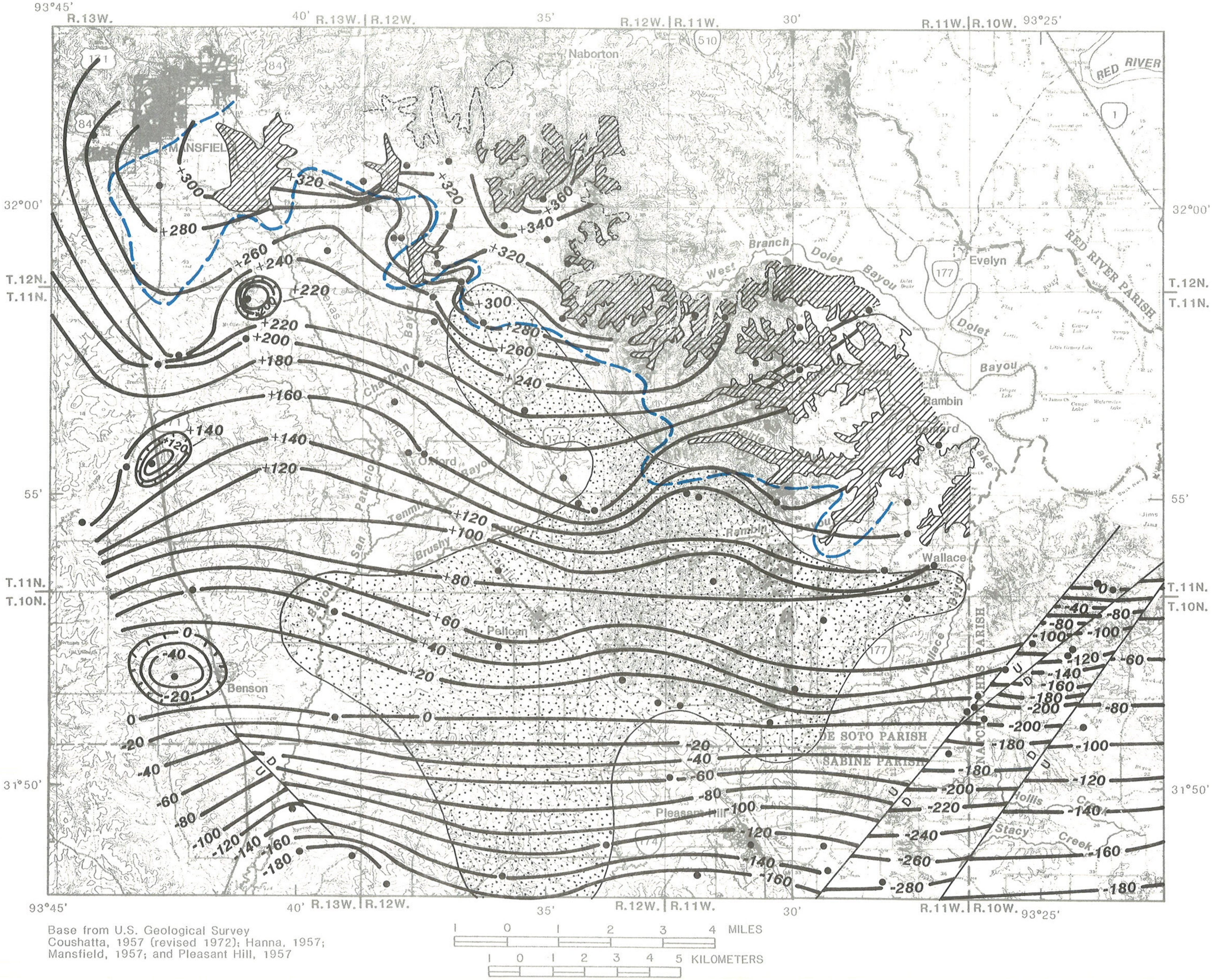


PLATE 3. MAP SHOWING ALTITUDE OF THE BASE OF THE WILCOX GROUP, SOUTHEASTERN DE SOTO PARISH, LOUISIANA.



Base from U.S. Geological Survey
Coushatta, 1957 (revised 1972); Hanna, 1957;
Mansfield, 1957; and Pleasant Hill, 1957

EXPLANATION

Outcrop of Dolet Hills aquifer where top of the aquifer has been removed by erosion

Outcrop of Chemard Lake lignite lentil

U / D — Fault trace. U, upthrown side; D, downthrown side

-80 — CONTOUR -- Shows altitude of top of the Dolet Hills Contour interval 20 feet. National Geodetic Vertical Datum of 1929

• Control point

Area where Dolet Hills Formation is 80 to 100 percen

Line showing approximate boundary between water-ta and artesian conditions in the Dolet Hills aquifer

PLATE 4. MAP SHOWING ALTITUDE OF THE TOP OF THE DOLET HILLS AQUIFER, SOUTHEASTERN DE SOTO PARISH, LOUISIANA.

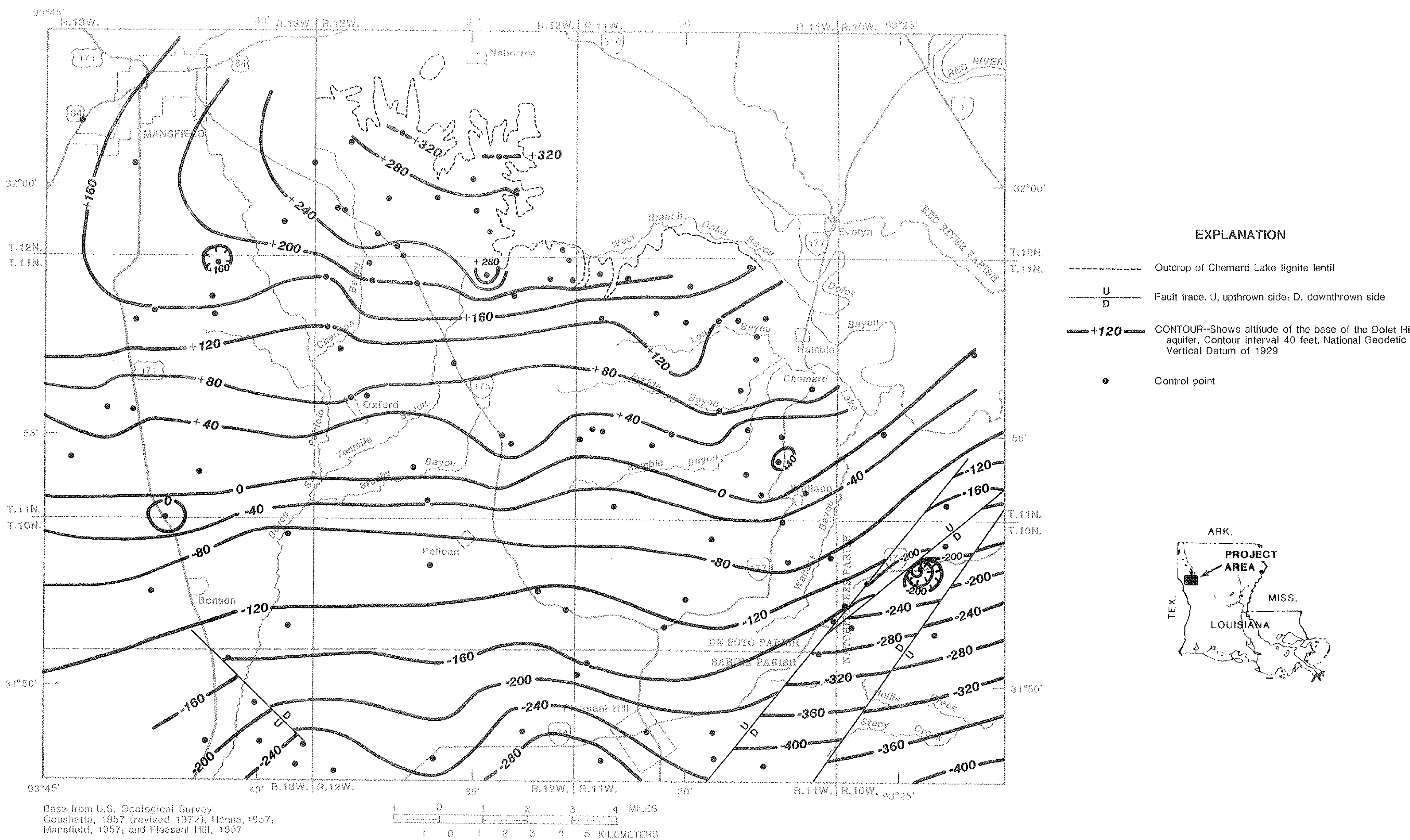


PLATE 5. MAP SHOWING ALTITUDE OF THE BASE OF THE DOLET HILLS AQUIFER, SOUTHEASTERN DE SOTO PARISH, LOUISIANA.

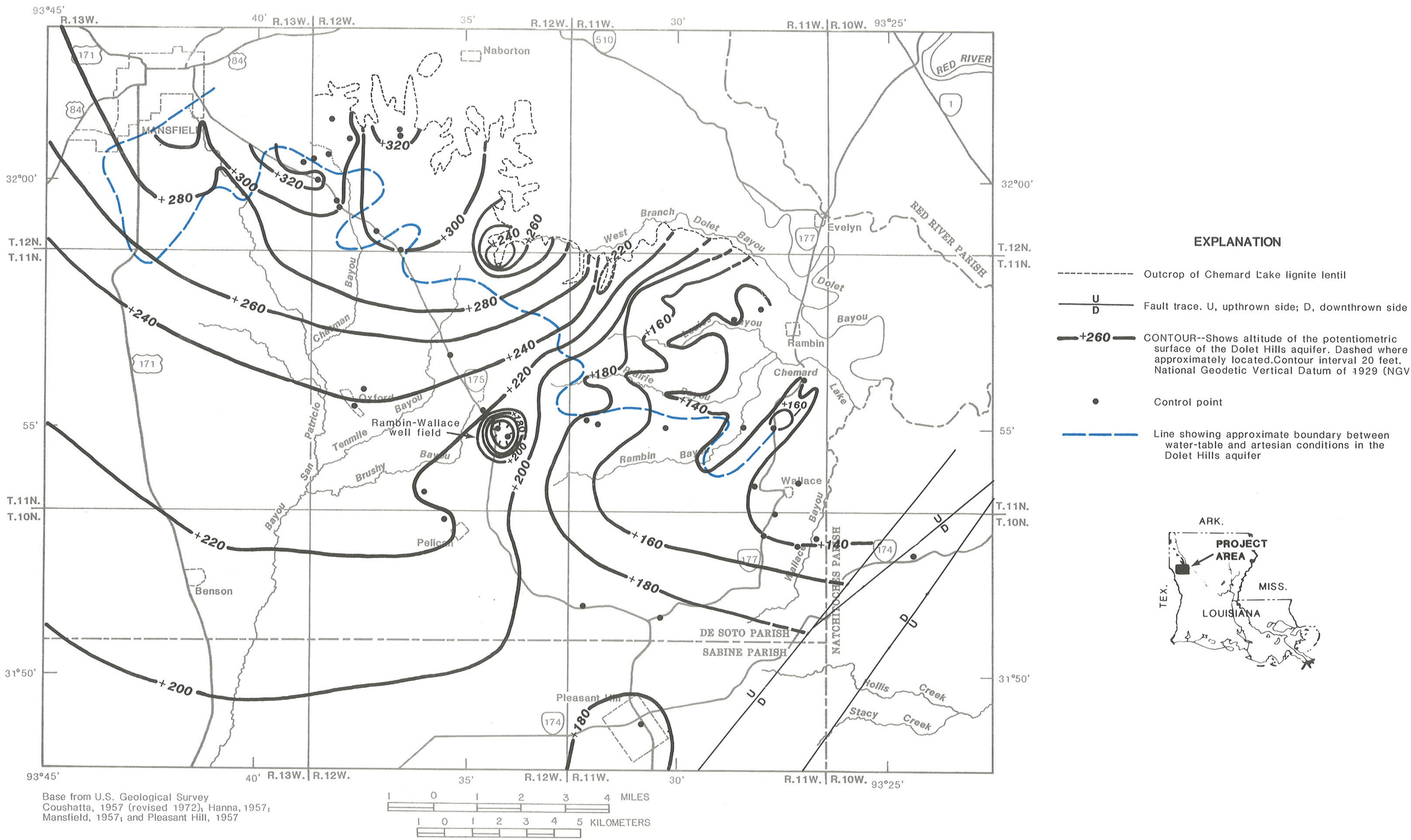


PLATE 6. MAP SHOWING ALTITUDE OF THE POTENTIOMETRIC SURFACE OF THE DOLET HILLS AQUIFER, SOUTHEASTERN DE SOTO PARISH, LOUISIANA.