UNITED STATES
DEPARTMENT OF THE INTERIOR
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BRINE CONTAMINATION OF FRESHWATER AQUIFERS AND STREAMS IN PETROLEUM PRODUCING AREAS IN MISSISSIPPI

by

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Water-Resources Investigations Report 85-4117

Prepared in cooperation with the

Mississippi Department of Natural Resources
Bureau of Pollution Control

Jackson, Mississippi

1986

UNITED STATES DEPARTMENT OF THE INTERIOR

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

Factors for converting inch-pound units to metric units are shown below to four significant figures. In the text, metric equivalents are shown only to the number of significant figures consistent with the accuracy of analytical determinations or measurement.

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
micromho per centimeter at 25° Celsius (umho/cm at 25°C)	1.000	microsiemen per centimeter at 25° Celsius (µS/cm at 25°C)

Abbreviations

milligrams per liter (mg/L)
micrograms per liter (µg/L)
micromhos (µmhos)

Throughout this report water temperatures are reported in degrees Celsius (°C). Temperatures may be converted to degrees Fahrenheit (°F) equivalent with the following formula:

$$°F = 1.8°C+32$$

BRINE CONTAMINATION OF FRESHWATER AQUIFERS AND STREAMS IN PETROLEUM PRODUCING AREAS IN MISSISSIPPI

By Stephen J. Kalkhoff

ABSTRACT

A ground- and surface-water quality study was conducted in 1981 and 1982 to identify brine-contaminated streams and shallow aquifers in five major oil- and gas-producing areas in southern Mississippi. The study encompasses a total area of about 5,200 square miles in 17 counties.

Water samples were collected from wells at depths of less than 300 feet and from streams at low flow during two field reconnaissances of the areas. The background concentrations of selected chemical constituents of uncontaminated native water and the location of apparent brine contamination were determined from analysis of the water samples plus data from published and unpublished reports.

A chloride concentration greater than 50 milligrams per liter is the primary criterion used to determine brine contamination. Bromide and strontium concentrations, specific conductance, pH, and calculated sodium to chloride ratios are supplementary data used to substantiate petroleum brines as the contamination source of freshwaters.

Brine contamination was found in shallow aquifers (less than 300 feet) and in streams in parts of all five study areas. Contamination was prevalent in the Brookhaven, Baxterville, Pistol Ridge, Little Creek, Tinsley oil fields. Numerous areas of contamination were also found in Adams County. Data also indicate that deeper aquifers were contaminated in the Brookhaven and Tinsley oil fields. As a result of the study, five sites for additional detailed geohydrologic studies were identified to determine the extent and movement of contaminants in order to plan for present and future protection of water samples.

INTRODUCTION

Oil and gas occur at depths greater than 2,000 ft in most of the geologic units in Mississippi. Since the first successful oil well was drilled in Yazoo County in 1939, thousands of wells have been drilled and the producing areas have expanded into many parts of the State.

Petroleum production is accompanied by the production of brine. Usually, newly completed wells have a lower saltwater to oil ratio than wells which have been pumping a number of years. This ratio may vary from almost no saltwater to more than 20 barrels of saltwater per barrel of oil (Mississippi State Oil and Gas Board, 1981).

The most common suggested method of saltwater disposal in the past was by "evaporation pits", which in most cases, actually discharged water to underlying unconfined aquifers or nearby streams. Although this practice is now prohibited, thousands of pits were constructed and their impact on the hydrologic system is largely unknown. Brine is now reinjected into an aquifer with water having a dissolved solids concentration of 10,000 mg/L or greater. However, saltwater contamination of freshwater aquifers is still possible from improperly constructed or leaking injection wells.

In order to determine the extent of brine contamination in oil-producing areas of Mississippi, a data-collection program was undertaken by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Pollution Control. Historical data collected by State agencies and the U.S. Geological Survey and data collected during the study were used to define and map areas of brine contamination. Finally, suggestions were made to further study the geohydrology in several areas where brine contamination poses a threat to the water supply.

The writer acknowledges the cooperation of well owners who allowed sampling of their wells and who provided information on potential sources of contamination. A special thanks is extended to the people offering suggestions in the writing of this report and to those who reviewed it.

Objectives and Scope

The main objectives of the study are: (1) determine background chemical quality of shallow aquifers and streams in southern Mississippi; (2) determine and delineate specific areas of oil-field brine contamination; and (3) outline needs for more detailed site studies.

Background or "natural" water quality that represents water in uncontaminated shallow aquifers and streams in southern Mississippi was determined by using a combination of previously published data from the U.S. Geological Survey WATSTORE file and data obtained during the study. The data were compiled and analyzed to determine background levels of selected major ion concentrations. Samples used to determine the levels of dissolved ion concentrations during the study were collected from several wells and surface-water low-flow sites in areas of no known oil production or brine contamination.

Areas of possible contamination were determined by reviewing reports published by the Mississippi Department of Natural Resources, Bureau of Geology; U.S. Geological Survey Open-File Reports; and unpublished reports documenting the presence of oil-field brine contamination.

Water samples were collected in five study areas encompassing a total of approximately 5,200 mi^2 (table 1). Each study area was divided into two or more subareas of related data. Data were collected in two phases -- the reconnaissance phase and documentation phase. In 1980 and 1981 during the reconnaissance phase, 190 stream sites were visited during periods of low streamflow. Samples were collected for chloride analysis if the specific conductance of the water was greater than 100 µS/cm (microsiemens per centimeter). Specific conductance and chloride concentrations were determined at all 224 well sites visited during the reconnaissance phase (Kalkhoff, 1982).

Table 1.--Location, size, and major oil and gas fields in the study areas

Study Area	County	Oil and Gas Fields Included	Area (mi^2)
1	Yazoo, Madison	Pickens, Tinsley	250
2	Adams, Jefferson Franklin, Amite	Numerous	1,800
3	Lincoln, Pike, Amite	McComb, Smithdale Brookhaven, Little Creek, Mallalieu	470
4	Marion, Lamar Forrest Pearl River	Baxterville Pistol Ridge	700
5	Clarke, Wayne Jones, Jasper	Numerous	2,000
		Total	5,200

During the documentation phase in the summer of 1982, a total of 92 ground-water sites and 65 surface-water sites were sampled. Sites were sampled if they had been reported contaminated or found to have chloride concentrations greater than 20 mg/L during the reconnaissance phase. In addition, several sites where chloride concentrations were less than 20 mg/L were resampled to determine background concentrations of selected major ions. Temperature, pH, and specific conductance of water were measured at all sites at the time of sample collection. Additionally, dissolved-oxygen concentrations and stream discharge were measured at each surface-water site. The water samples were analyzed by the U.S. Geological Survey National Water Quality Laboratory in Atlanta, Ga., for Calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl), and sulfate (SO_4). Selected samples were also analyzed for boron (B), bromide (Br), and strontium (Sr).

Needs for detailed site studies are based on size of the area and extent of contamination as determined by interpretation and analysis of data collected during this study and the number of residents in the proximity of the contaminated area.

Previous Studies

The sparse data previously published concerning the effects of oil-field brines in Mississippi are primarily for surface waters. Callahan and others (1964, p. 21) reported that oil-field wastes probably were responsible for the chemical pollution of Coles Creek and South Fork Coles Creek in Jefferson County and St. Catherine Creek and its tributaries, Melvin Bayou and Kittering Creek, in Adams County. Data also indicate the presence of contamination in the Homochitto River near Doloroso and its tributary, Second Creek. Childress and others (1976, table 10) have shown that numerous other streams in Adams County contained chloride concentrations in excess of 250 mg/L during both high and low-flow periods. Of 10 streams sampled by Shows and others (1966, p. 18-23), 6 indicate oil-field brine pollution at times. These sites were Tallahala Creek, Leaf River downstream of Hattiesburg in Forrest County, and Chickasawhay River downstream of Waynesboro in Wayne County. According to Baughman and McCarty (1974, p. 279-286), Eucutta Creek, Yellow Creek, and Hortons Mill Creek, tributaries of the Chickasawhay River in Wayne County, were polluted by oil-field brines and contained chloride concentrations greater than 250 mg/L when sampled.

Although most published data pertains to surface-water sites, Callahan and others (1964, p.5) reported possible brine contamination of ground water on the basis of highly mineralized water obtained from a well in Jefferson County.

Location

Five of the most active petroleum producing areas in southern and central Mississippi were selected for study (fig. 1). Counties in which the study areas are located, the oil fields encompassed by each study area, and the square miles within each study area are listed in table 1.

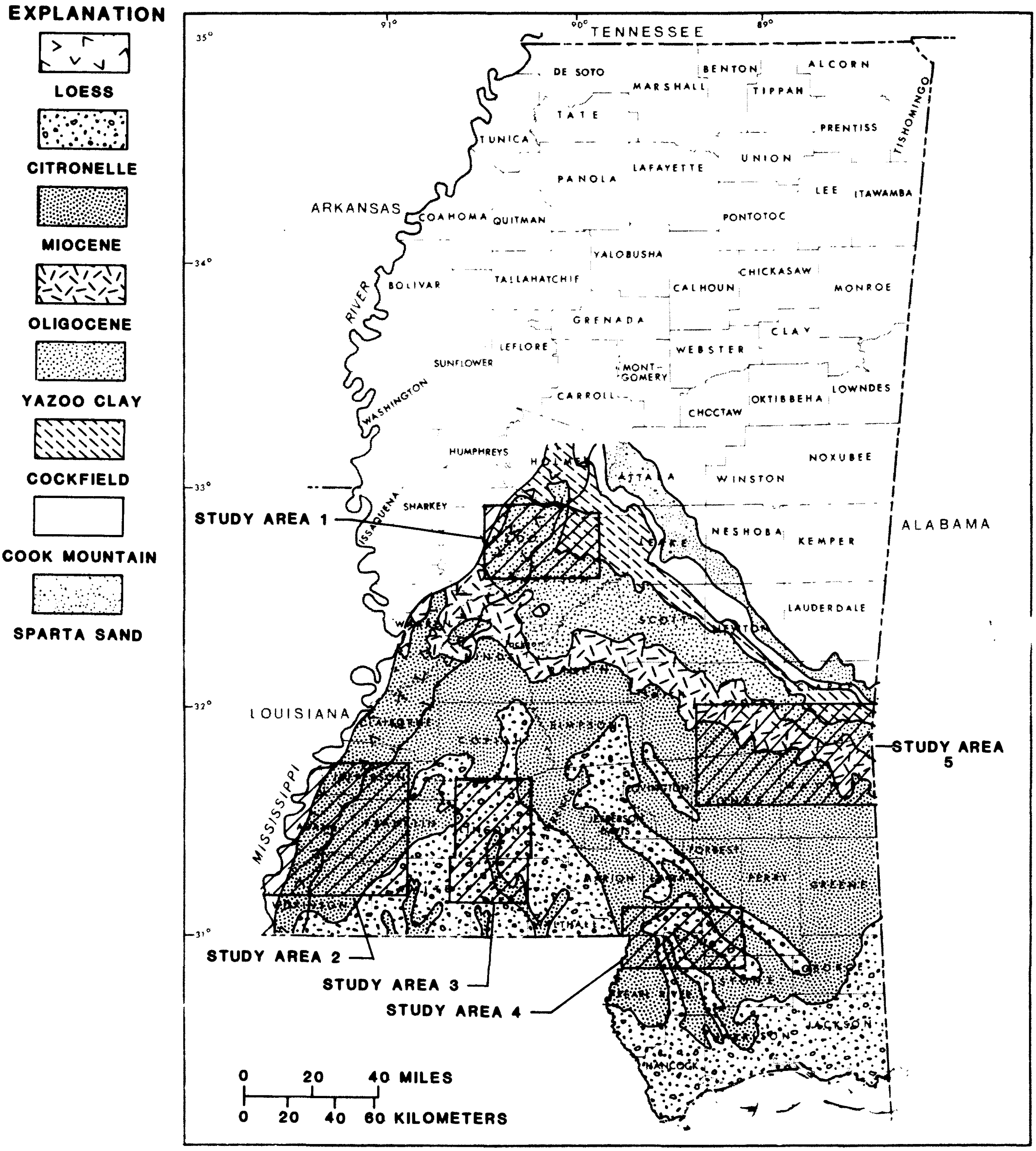


Figure 1.--General location of the five study areas and the outcrops of the major formations in southern Mississippi.

All sampling sites are located within a study area in the vicinity of oil fields and sites to determine background water quality are generally within 10 miles of an oil field.

Topography

Study areas 3 and 4 lie entirely within the Long Leaf Pine physiographic district. The eastern half of study area 2 and a large part of study area 5 also are in the district. Cross and Wales (1974, p. 7) characterize the general surface configuration of the Long Leaf Pine physiographic district as being high and rolling, with moderately high ridges forming divides between streams. Relief in excess of 100 feet between hilltops and stream bottoms is not uncommon. A large part of the study areas in the district is wooded, but land with moderate relief has been cleared and is used for agricultural purposes.

The western parts of study areas 1 and 2 are in both the Mississippi Alluvial Plain and the Loess Hills physiographic district. The topography of the Mississippi Alluvial Plain and Loess Hills physiographic district is developed on two units of the Quaternary System, loess, and the Mississippi River Valley Alluvium. Erosion of older Tertiary deposits by the Mississippi River and subsequent deposition of alluvial material in the valley formed an extremely flat land surface in the western section of study areas 1 and 2. Immediately to the east of this flat valley, wind-blown loess was deposited on upland Tertiary deposits and eroded to form narrow ridges and steep valleys. Most of the alluvial plain is used for agriculture and some lower areas are marshy and wooded. The rugged terrain of the Loess Hills, for the most part, preclude agricultural use, thus the district has remained heavily wooded. As the loess deposits thin eastward, the topographic relief lessens. With more moderate relief, increased agricultural use is made of the land.

A small part of study area 5 lies within the Jackson Prairie district. Cross and Wales (1974, p. 7) describe the topography of the Jackson Prairie as flat to undulating areas of little or moderate topographic relief and ia primarily used for agriculture.

Geology and Hydrology

The Sparta Sand, the Cockfield Formation, the rocks of the Oligocene Series, the rocks of the Miocene Series, the Citronelle Formation, and the Mississippi River Valley Alluvium function as the principal aquifers in the study areas. That is, these units contain sufficient saturated permeable material to yield significant quantities of water to wells. Recharge to aquifers is generally from precipitation on the outcrop area (fig. 1). However, hydrologic connection allows the Miocene aquifer system to be recharged from overlying Citronelle deposits. Water generally moves downdip in all aquifers to the south and southwest and toward areas of heavy pumping. However, in the outcrop area, some water moves laterally towards valley walls to be discharged by springs and seeps. The lithology and hydrologic significance of the major geologic units in the study areas are listed in table 2.

Table 2.--Geologic units and their lithology and hydrologic significance

System	Series	Group	Unit	Lithology	Hydrologic Significance*
Quaternary	Holocene		Alluvium and Terrace Deposits	Clay, sand and gravel	Source of large quantities of water for industrial and agricultural uses in area 2. Source of some small domestic water supplies in other areas.
	Pleistocene		Loess	Fine wind blown alluvial material	Not an aquifer, but may influence the water quality of underlying aquifers in areas 1 and 2.
Tertiary	Pliocene		Citronelle Formation	Quartz sand, chert gravel and lenses and layers of clay	Very permeable, readily receiving and transmitting water from precipitation. Major source of water for domestic wells in study area 3 and 4. Provides high base flow to streams and some recharge to underlying Miocene aquifers.
	Miocene		Hattiesburg Formation and Catahoula Sandstone (Undifferentiated)	Series of irregular and locally lenticular sand and clay beds	Primary source of water for municipal and rural water supply systems in study areas 2-5. Shallower miocene aquifers are an important source for domestic wells in these areas. Provides generally poor yield to streams.
	Oligocene	Vicksburg	Byram Formation Marianna Limestone	Discontinuous interbedded marls, Limestones, and sands	Used as a source of water for domestic water supplies in northern half of study area 5. Provides poor to fair yields to streams.
			Forest Hill Sand	Clay, silt and irregular sand beds	Used primarily for domestic water supplies in the outcrop area and several miles downdip Provides poor yields to streams.
	Eocene	Jackson	Yazoo Clay	Clay, with a few irregular sand beds.	Not an aquifer.
		Claiborne	Cockfield Formation	Sand, sandy clay, and clay, the sand occurs as irregular lenses and beds.	Important source of domestic and rural water supplies in areas 1 and 5. Provides poor yields to streams.
			Cook Mountain	Sand, clay, marl.	Small yields to small wells. Poor yields to streams.
			Sparta Sand	Commonly consists of two or more sand beds separated by clay.	Source of domestic and rural water supplies in area 1. Provides poor to fair yields to streams.

* Yields to streams:

Good--0.2-1. $ft^3/s/mi^2$
Fair--0.05-0.2 $ft^3/s/mi^2$
Poor--Less than 0.05 $ft^3/s/mi^2$
(Tharpe, 1975, Fig. 5)

DETERMINATION OF BRINE CONTAMINATION

In order to identify areas of brine contamination, the characteristics of freshwaters and brines must be known. Knowing the water-quality characteristics of freshwaters and brines and knowing the chemical and physical reactions taking place in freshwater aquifers and streams enables the hydrologist to use these water-quality characteristics to identify contaminated freshwater.

Freshwater Quality

Generally, the quality of shallow (less than 300 ft) ground water in the five study areas is such that the water is usable for many purposes. The water from most aquifers in Tertiary deposits is soft, slightly acidic, and has low dissolved-solids concentration. The specific conductance (an indicator of the dissolved-solids concentraton) is generally less than 100 µS/cm. Although, water-quality differences exist between aquifers, the predominant ions in water in most shallow aquifers are calcium, sodium, and bicarbonate. Chloride concentrations are less than 20 mg/L in water from the Cockfield aquifer and the Mississippi River valley alluvial aquifer. Water in aquifers in Tertiary and Quaternary deposits often are interconnected and mixing of water occurs. Water in Quaternary deposits generally is more mineralized and higher in pH than water in Tertiary deposits. In the Miocene and Citronelle aquifers that underlie loess deposits the water is moderately-hard to hard, has a pH near 7.0 units, and has a moderate amount of dissolved solids. Specific conductance values range from 100 to more than 500 µS/cm and chloride concentrations are less than 20 mg/L. Site locations and the results of chemical analyses of water samples collected from uncontaminated areas are described in the water-quality section of each study area and chloride concentrations are shown in illustrations.

The water quality of streams change throughout the year. During periods of heavy rainfall when most streamflow originates from precipitation runoff, the water quality will approach the chemical quality of precipitation. During dry periods when most streamflow originates from ground-water inflow, the water quality of streams will approach that of the ground water discharging into the stream. Consequently, the water quality of a stream during low-flow periods will be an indicator of the chemical quality of water from shallow aquifers cut into by the stream. Several streams that drain the study areas were sampled at sites of no known oil-field activity during periods of low streamflow. Generally, the water samples at these sites contained lower dissolved solids and chloride concentrations than in streams in areas of known oil-field activity. The results of analyses and site locations are given in tables and in the water-quality sections of each study area.

Typical stream-water quality in study areas 3 and 4, the eastern third of area 2, and the southern third of area 5 is represented by water quality at the hydrologic benchmark site (site whose drainage area has a minimum of human activity). The water in Cypress Creek near Janice, Miss., (Hydrologic Benchmark site 02479155) is generally soft (hardness as $CaCO_3$ averages 8.9 mg/L), slightly acidic (pH ranges from 4.4 to 7.8 units) and has a less than 50 mg/L dissolved-solids concentration.

Brine-Water Quality

In contrast to the low dissolved-solids concentrations of typical shallow ground water and streams in southern Mississippi, the dissolved-concentrations of brines produced during oil production are extremely high (table 3). Hawkins and others (1963, p. 10-18) and Carpenter and others (1974, p. 1195-1199) report dissolved-solids concentrations ranging from about 50,000 mg/L in the relatively shallow Wilcox Formation, to more than 300,000 mg/L in the deeper Lower Cotton Valley Formation. Selected water-quality analyses typical of brines that potentially enter and mix with waters of streams and shallow ground water in the five study areas are listed in table 3. Sodium and chloride are the predominant ions in all brines associated with oil and gas; however, the proportion of sodium and chloride varies between formations. The sodium to chloride ratio ranges from 0.60 in the comparatively shallow Wilcox brines to 0.32 in deeper Hosston Formation brines. Although some variation is evident, it is apparent that the sodium to chloride ratio of these brines generally decrease in proportion to an increase in calcium and dissolved-solids concentrations.

Several elements present in very small concentrations in shallow ground water are in comparatively large concentrations in brines. In Mississippi, strontium concentrations range from less than 50 mg/L in water from the Tuscaloosa Group to more than 2,000 mg/L from the Rodessa Formation. Bromide concentrations ranged from less than 100 mg/L in water from the Wilcox Formation to more than 2,000 mg/L from the Lower Cotton Valley Formation.

Geochemical Reactions

Concentrations of dissolved ions in brines entering shallow ground water will be chemically altered and diluted when mixed with freshwater in shallow zones. Dilution will occur in proportion to the degree of mixing. Mixing of different water types is dependent upon the residence time, density of the brine, ground-water gradient, and the rate of ground-water movement into and through surficial aquifers. In general, longer residence time and more rapid rates of ground-water movement provide a greater opportunity for mixing in freshwater zones. Because chloride and bromide are generally conservative elements in nature, they are less likely to be involved in chemical reactions in surficial aquifers than other chemical constituents, and their concentrations will not be altered significantly, except by dilution.

Table 3.--Selected chemical analyses of brines from oil fields in the study areas
(From Hawkins and others, 1963, P. 10-18.)
(Results in milligrams per liter)

Reference No.	Field	Formation	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Barium, Strontuim (Ba,Sr)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	*Bromide (Br)	Total Dis. Solids	Sodium/Chloride Ratio
						Adams County						
31	Carthage Point	Wilcox	1900	570	50700	399	339	0	85300	78	138809	0.59
41	Cranfield	Wilcox	2240	640	51500	155	158	0	85100	85	139638	.60
49	Deerfield	Wilcox	3200	650	55100	208	284	0	92400	86	151634	.60
65	Kingston	Wilcox	2700	1300	52200	171	366	0	88000	87	144566	.59
77	Lagrange	Wilcox	2000	700	54000	277	268	0	88600	87	145568	.61
120	Sibley	Wilcox	1700	400	43800	54	601	26	71400	78	117927	.61
29	Carthage Point	L. Tuscaloosa	13600	1400	38900	309	153	0	88500	409	142553	.44
46	Cranfield	L. Tuscaloosa	14000	1000	45900	75	125	1200	97500	495	159725	.47
						Clarke County						
220	Langsdale	Eutaw	3800	671	31500	5	128	0	57200	295	93299	.55
* 53	Quitman	Cotton Valley	32600	3700	65400	SR 1500	-	-	175400	1860	283700	.37
						Forrest County						
289	Pistol Ridge	Eutaw	7200	1070	51000	21	336	347	94000	495	153953	.54
294	Pistol Ridge	Tuscaloosa	13760	4000	41400	17	0	216	99800	756	159276	.41
						Franklin County						
140	Knoxville	Wilcox	2000	730	57300	144	95	-	94000	86	154125	.56
146	Richardson Cr	Wilcox	1100	650	32200	0	299	0	53400	70	87649	.60
148	Wells Cr	Wilcox	2900	830	56100	99	207	0	94000	84	154037	.60
						Jasper County						
211	Heidelburg	Eagle Ford	7000	1700	46100	0	91	0	88500	451	143391	.52
* 72	Soso	Rodessa	34700	2570	57700	SR 2060	-	-	156400	1160	255900	.37
* 76	Soso	Hosston	33000	2330	55600	SR 2150	-	-	156100	1210	251800	.36
* 4	Bay Springs	L. Cotton Valley	47300	2790	65000	SR 1780	-	143	197700	2300	323500	.33
						Jefferson County						
23	Sunnyside	Wilcox	2400	360	53600	171	238	0	87800	92	144398	.61

Table 3.--Selected chemical analyses of brines from oil fields in the study areas--Continued
(Results in milligrams per liter)

Reference No.	Field	Formation	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Barium, Strontuim (Ba,Sr)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	*Bromide (Br)	Total Dis. Solids	Sodium/Chloride Ratio
					Jones County							
230	Sandersville	Eagle Ford	7500	1600	44700	20	66	0	86900	424	140766	0.51
# 69	Reedy creek	Rodessa	51100	3510	58300	§2340	-	42	185900	1490	304800	.44
					Lamar County							
283	Baxterville	L. Tuscaloosa	18800	2200	56300	35	18	30	126400	882	203748	.44
					Lincoln County							
152	Brookhaven	Tuscaloosa	12100	1100	48700	1565	0	133	99600	579	161633	.49
160	Mallalieu	Tuscaloosa	14500	960	56300	9	0	169	115300	700	187229	.49
161	Sweetwater	Tuscaloosa	14200	910	51000	0	128	114	106200	630	172552	.48
					Madison County							
207	Pickens	Eutaw	7200	1400	43300	82	305	54	83300	544	135559	.52
					Wayne County							
261	Eucutta	Eagle ford	7500	1800	45500	43	49	0	88600	812	143449	.51
263	E. Yellow Creek	Eutaw	6300	1300	42800	30	155	0	82400	510	133955	.53
# 17	Cypress Creek	Smackover	32600	2720	69500	§1730	-	-	184200	1820	302400	.38
# 22	Diamond	Hosston	37200	2550	48800	§1060	-	-	150500	1290	242300	.32
					Yazoo County							
189	Tinsley	Austin	4000	900	44900	75	304	7	78700	387	128811	.57
193	Tinsley	Eagle ford	7000	700	46100	11	198	86	85300	454	139384	.54

* From Collins and others, 1966, p. 19-25.
# From Carpenter and others, 1974,P. 1195-1199.
§ Strontium only

Concentrations of some dissolved ions will be altered by cation-exchange reactions when contacting specific types of aquifer materials such as clays and sands. As the brines and freshwater-brine mixtures travel through the aquifer, sodium, calcium, and magnesium may take part in ion-exchange reactions. Normally, divalent ions (Ca^{+2}, Mg^{+2}) displace monovalent ions (Na^{+}) adsorbed on the clay-mineral surfaces contacted in the aquifer. However, this reaction will be reversed if monovalent ions are in greater abundance (Davis and DeWiest, 1966, p. 90-91) as is the case when brines enter shallow aquifers. The effect of ion exchange reversal would be to alter the proportion of sodium and calcium in solution. Thus, the resultant sodium to chloride ratio of contaminated freshwater aquifers may be less than in the brine. However, anion concentrations generally are not changed significantly by cation exchange reactions. Fryberger (1975, p. 157) found that strontium concentrations in water moving through the aquifer decreased faster than can be accounted for by dilution. He attributed this to the precipitation of strontium as a sulfate. (Fryberger (1975, p. 158) also found that the pH of ground water decreased near the source of brine contamination, then increased downgradient toward the fringe of contamination.

Geochemical reactions were considered for selection of sampling parameters in this study. However, full geochemical implications are beyond the scope of this report.

Definition of Contamination

The extent that freshwater is controlled by the chemical character of brines and the general behavior of selected dissolved ions when mixing in freshwater aquifers and streams are the criteria used for defining contamination. Definitions of terms for this study are as follows. Uncontaminated water: chloride concentration less than 20 mg/L. Water probably contaminated: chloride concentrations 20 to 50 mg/L. Contaminated water chloride concentration greater than 50 mg/L. Chloride concentrations are less than 20 mg/L in shallow ground waters (less than 300 feet depth) and streams in the study areas under natural conditions; therefore water with a chloride concentration greater than 20 mg/L is probably contaminated. Water with a chloride concentration ranging from 20 to 50 mg/L probably is contaminated, but not necessarily by an oil-field brine. Water with a chloride concentration greater than 50 mg/L is contaminated, probably by an oil-field brine. Supplementary characteristics of water that are used to indicate oil-field brine contamination are sodium to chloride ratios less than or equal to 0.60, and higher bromide and strontium concentrations than found in water from outside oil-producing areas.

STUDY AREA 1

Study area 1 encompasses 250 mi^2 in eastern Yazoo and northern Madison Counties (fig. 2). The data are discussed by two subareas, to more clearly illustrate contamination and show relationships between individual water samples. The Subarea A (Pickens) is located south of Pickens, Miss., in northern Madison County and northeastern Yazoo County. The second, the Subarea B (Tinsley), is located in and near the Tinsley oil field in south-central Yazoo County.

Subarea A (Pickens)

Significant differences are apparent in the water quality of Loves Creek near Pickens (07289503) and Doaks Creek near Canton (07289530) which drain outcrops of the Cockfield Formation in Madison County (fig. 3). The water in Loves Creek, which drains part of Pickens oil field was a sodium-chloride type during this study. In Loves Creek the chloride and sodium concentrations were 230 and 120 mg/L, respectively. The sodium to chloride ratio (0.52) is within the range of values for three brines from Pickens field reported by Hawkins and others (1963, p. 15). In Loves Creek, bromide and strontium concentrations were 3.2 and 0.5 mg/L, respectively. The water in Doaks Creek, a stream draining an area unaffected by oil production, is a calcium and sodium-bicarbonate type. Both the sodium and chloride concentrations were 10 mg/L in Doaks Creek. Differences in water quality in the outcrop of the Cockfield aquifer were apparent in a shallow dug well, D19, located within Pickens oil field, and a shallow dug well, A31, located outside the oil field. Chloride concentrations were 71 and 3.3 mg/L in water from wells D19 and A31, respectively. Concentrations of other major dissolved ions were also higher in water from well D19 than in well A31. The water quality of A31 is probably typical of the water at shallow depth in the outcrop of the Cockfield aquifer in the subarea.

Subarea B (Tinsley)

Field personnel were unable to locate wells screened at shallow depths in the Citronelle Formation in Tinsley oil field. Numerous land owners reported that shallow wells (approximately 100 ft deep or less) at one time produced water of good quality but subsequently produced salty water and were destroyed. Domestic water is now supplied by a rural water association or by wells tapping deeper aquifers. The quality of uncontaminated shallow ground water from the Citronelle Formation in the Tinsley area is probably similar to that of well R43, approximately 2.5 mi east of Oil City, Miss. Concentrations of calcium, magnesium, and sodium were greater than 10 mg/L in well R43. Chloride cencentrations of ground water and streams in the Tinsley area are shown in figure 4.

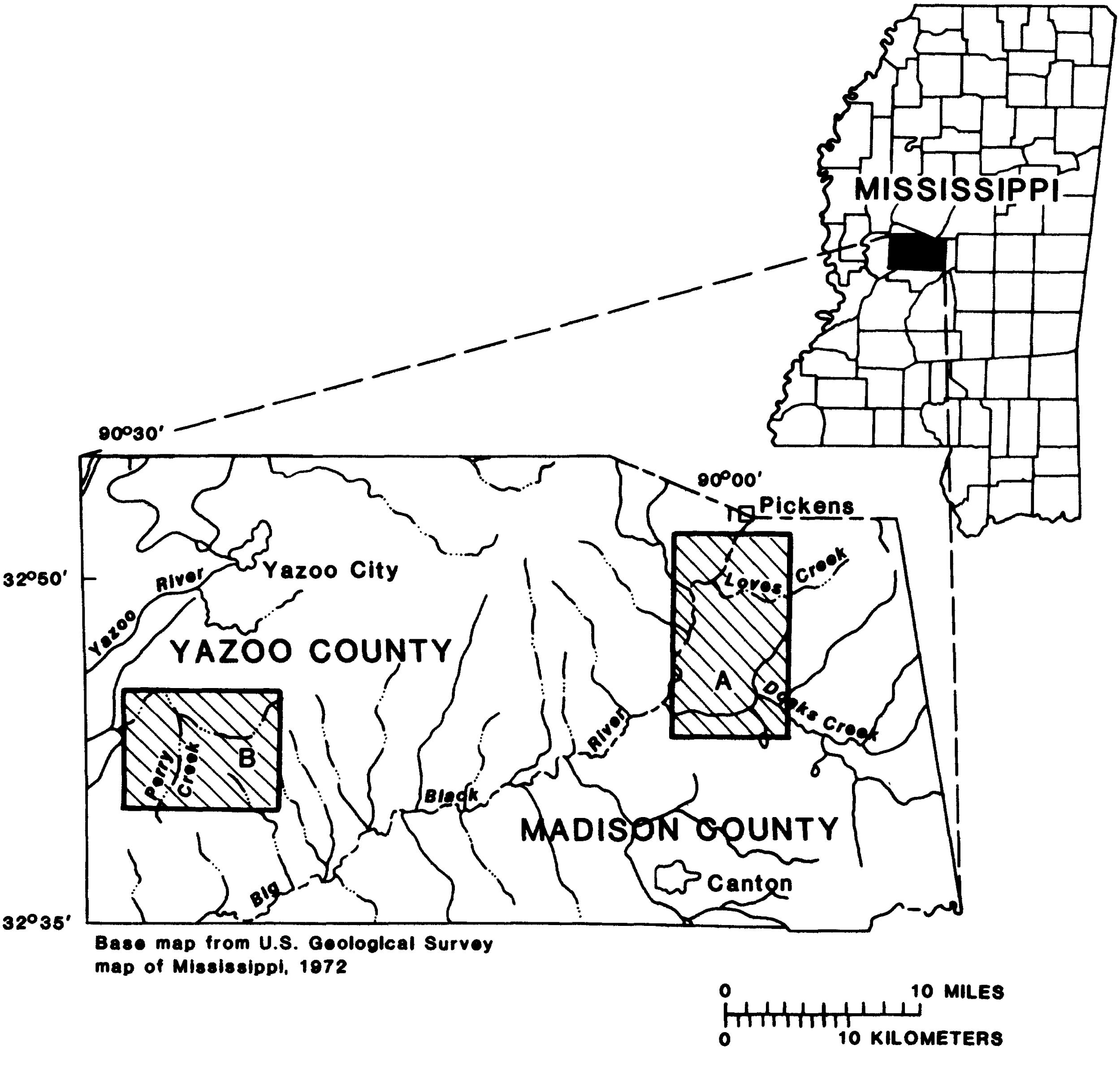


Figure 2.--Location of study area 1 showing subarea A (Pickens) and subarea B (Tinsley).

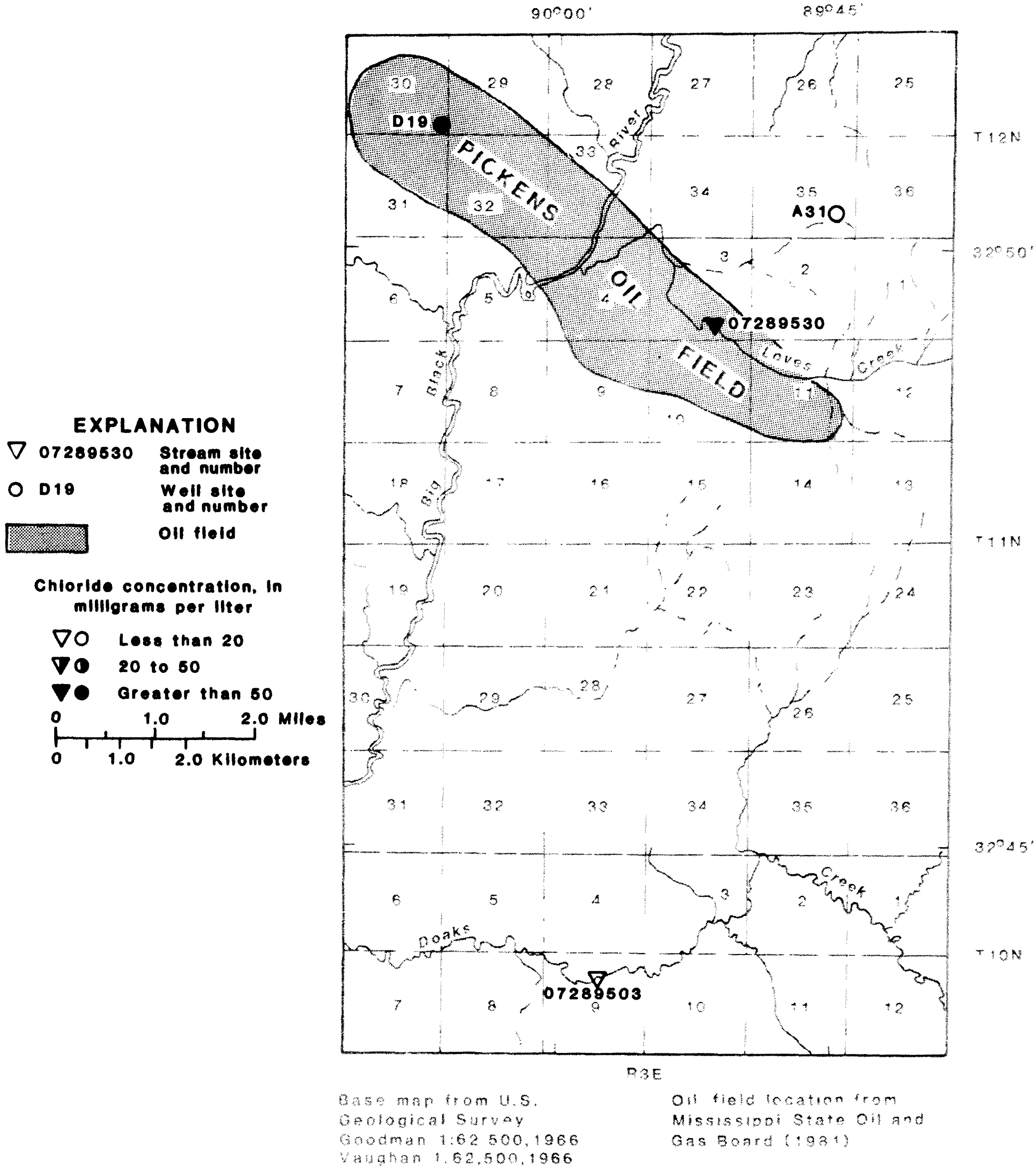
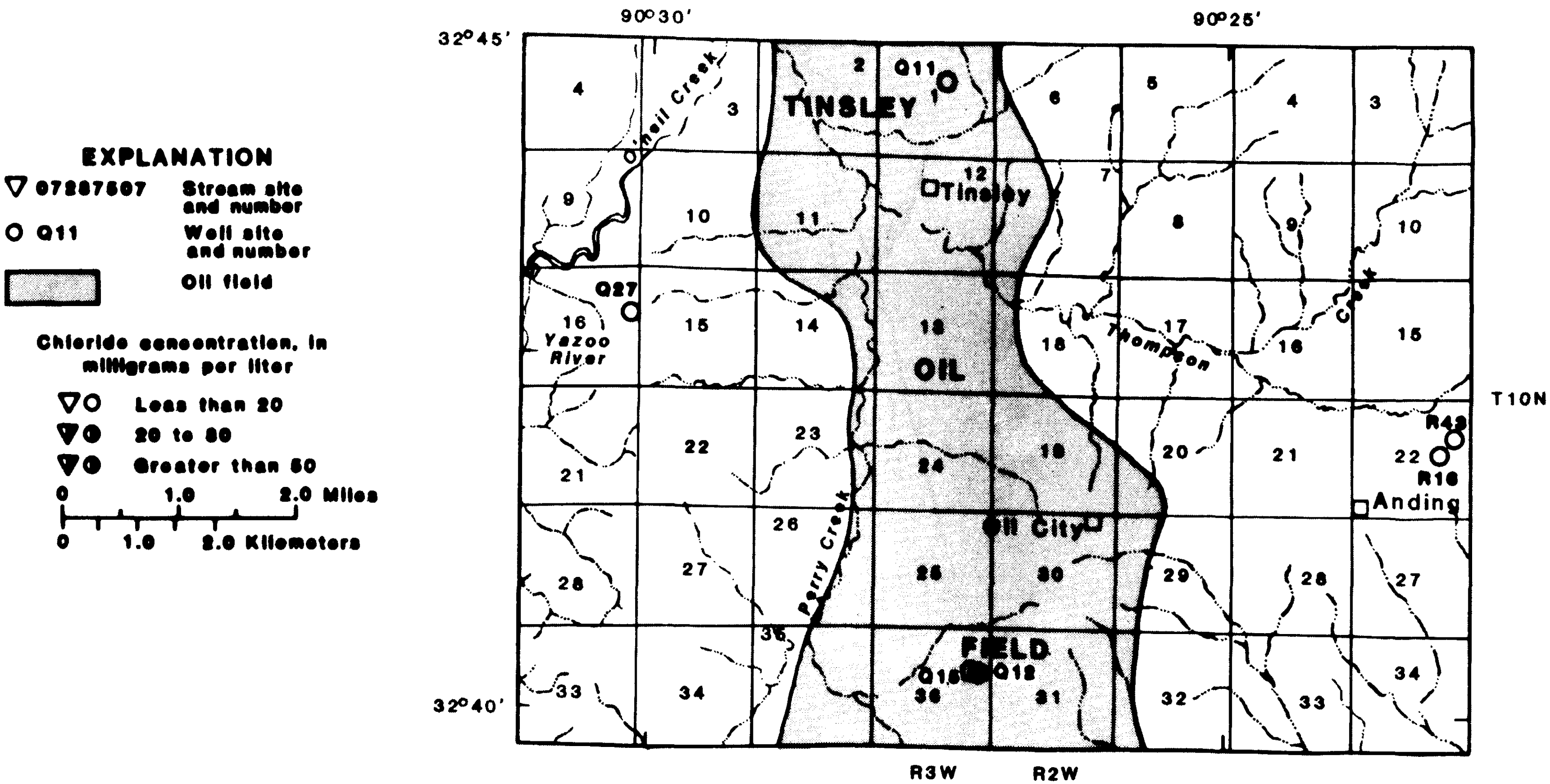


Figure 3.--Chloride concentrations at ground-water and surface-water sites in subarea A (Pickens), 1982.



Base map from U.S. Geological Survey
Flora 1:62,500, 1962
Mechanicsburg 1:62,500, 1966

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 4. — Chloride concentrations at ground-water and surface-water sites in subarea B (Tinsley), 1982.

Analyses of water from two wells screened in the Cockfield aquifer, one located in Tinsley oil field (Q11), and one located east of the oil field (R16), indicate water of similar quality. The water is a sodium bicarbonate type with sodium concentrations ranging from 63 to 94 mg/L. Chloride, calcium, magnesium, and sulfate concentrations were 10 mg/L or less.

Water quality in the upper part of the Sparta Sand is significantly different than in the lower part near Oil City. Water from well Q12, a 990-foot domestic well screened in the upper part of the Sparta Sand in Tinsley oil field, was reported by the owner to have become salty. Records of the Mississippi Bureau of Geology show that a water sample collected from well Q12 by that agency and analyzed by the Mississippi State Board of Health had a chloride concentration of 7,550 mg/L. The water from well Q15 in the lower part of the Sparta Sand at a depth of 1,183 ft is less mineralized than water in the upper part. The chloride concentration was 8.9 mg/L and the sodium concentration was 73 mg/L. Calcium, magnesium, and sulfate concentrations were 10 mg/L or less. Contamination of the upper Sparta Sand may indicate improper brine disposal in wells.

Chloride concentrations were 690, 2,100, and 2,300 mg/L; the sodium concentrations ranged from 350 to 1,200 mg/L; and sodium to chloride ratios ranged from 0.51 to 0.57 in three streams draining the Tinsley oil field near Tinsley.

Tables 4 and 5 give descriptions of surface-water and ground-water sites. Tables 6 and 7 give results of analyses of samples collected at surface-water and ground-water sites, respectively, in area 1.

Summary and Conclusions

Surface waters and shallow ground water are contaminated in the Pickens and Tinsley oil fields.

In the Pickens oil field, a chloride concentration of 230 mg/L and a sodium to chloride ratio similar to that of oil field brines indicate that water in Loves Creek is contaminated. Water samples were collected during a relatively dry period when discharge originates primarily from inflow of ground water; thus, inflow of contaminated ground water is the most probable source of contamination. However, the sparsity of wells preclude verifying the source of contamination in the Cockfield aquifer in the vicinity of Loves Creek, and the possibility of surface contamination cannot be eliminated. Although it was impossible to determine the water quality of the Cockfield aquifer in the vicinity of Loves Creek in Yazoo County, the chloride concentration in water from well D19 indicates that part of the Cockfield aquifer is contaminated in Pickens oil field.

Table 4.--Location and drainage area of surface-water sites in area 1

County	Site Number	Station Name	Location Lat	Location Long	Drainage Area (mi^2)
Madison	07289503	Loves Creek nr Pickens, MS	324924	0895829	11.7
Madison	07289530	Doaks Creek nr Canton, MS	324354	0895936	161
Yazoo	07287574	Unnamed Branch nr Oil City, MS	323956	0902758	--
Yazoo	07287580	Perry Creek at Tinsley, MS	324327	0902813	--
Yazoo	07287587	Thompson Creek at Tinsley, MS	324338	0902744	--

Table 5.--Records of wells in area 1

County	Well Number	Station Number	Owner	Location Sec.	T.	R.	Altitude (ft)	Well Depth (ft)	Water Bearing Unit
Madison	A031	325021089571501	C. Ford	SESE35	12N	03E	250	32	124CCKF
Yazoo	D019	325109090011401	L. Newell	SESE30	12N	03E	250	55	124CCKF
Yazoo	Q011	324446090272401	J. D. Twiner	NWNE11	13N	03W		500	124CCKF
Yazoo	Q012	323953090270301	Joe Brooks	SENE36	10N	03W	340	990	124SPRT
Yazoo	Q015	324019090270301	J. Brooks	SENE36	10N	03W	340	1183	124SPRT
Yazoo	Q027	324246090300601	C. S. Williams	NWSW16	10N	03W	207	640	124SPRT
Yazoo	R016	324158090232101	E. M. Creswell	NWSE22	10N	02W	300	840	124CCKF
Yazoo	R042	324508090230001	Cresswell Drlg	SENE22	10N	02W	320	80	122CTHL

122CTHL-Catahoula Sandstone
124CCKF-Cockfield Formation
124SPRT-Sparta Sand

Table 6.--Chemical analyses of surface water in area 1

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCo_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (So_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
							Madison County								
07289503	09/09/82	1030	0.33	954	6.6	23.5	149	33	16	120	54	230	3.24	<10	500
07289530	09/09/82	0900	12.0	113	6.7	22.0	30	7.0	3.1	10	13	10	--	--	--
							Yazoo County								
07287574	08/04/82	1350	0.59	8200	7.9	28.0	817	200	75	1200	25	2300	18.50	380	7900
07287580	07/01/82	1300	1.9	7300	8.0	32.5	669	160	63	1200	10	2100	7.13	300	9200
07287587	07/01/82	1550	2.1	2500	8.3	35.0	348	82	34	350	20	690	2.50	90	2400

Table 7.--Chemical analyses of ground water in area 1
(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit	Well depth (ft)	Date of collection	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCo_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (So_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
							Madison County								
A031	124CCKF	32	08/05/82	74	6.4	21.5	30	9.8	1.4	3.5	6.0	3.3	--	--	--
							Yazoo County								
D019	124CCKF	55	08/05/82	495	5.7	19.0	122	29	12	47	27	71	--	--	--
Q011	124CCKF	500	08/05/82	360	7.5	22.5	30	7.1	3.0	63	10	4.4	--	--	--
Q012	124SPRT	990	05/16/77	19200	7.4	--	392	--	--	--	--	7550	--	--	--
Q015	124SPRT	1183	08/04/82	318	8.6	24.0	5	1.6	0.4	73	10	8.9	--	--	--
Q027	124SPRT	640	08/04/82	445	7.8	23.0	14	3.1	1.4	100	17	8.7	--	--	--
R016	124CCKF	840	08/04/82	365	--	--	3	0.8	0.3	94	10	3.1	--	--	--
R043	122CTHL	80	08/04/82	584	6.9	19.5	262	57	29	21	3.0	8.5	--	--	--

122CTHL-Catahoula Sandstone
124CCKF-Cockfield Formation
124SPRT-Sparta Sand

* Analysis by Mississippi State Board of Health

In the Tinsley oil field, chloride concentrations range from 690 to 2,300 mg/L and sodium to chloride ratios within the range of brines produced in Tinsley field, indicate that three streams were contaminated. Channels of Perry and Thompson Creeks have cut through the loess into the underlying Citronelle strata in areas of Tinsley field. Inflow of water from the Citronelle aquifer may be the source of contaminated water in Perry and Thompson Creeks.

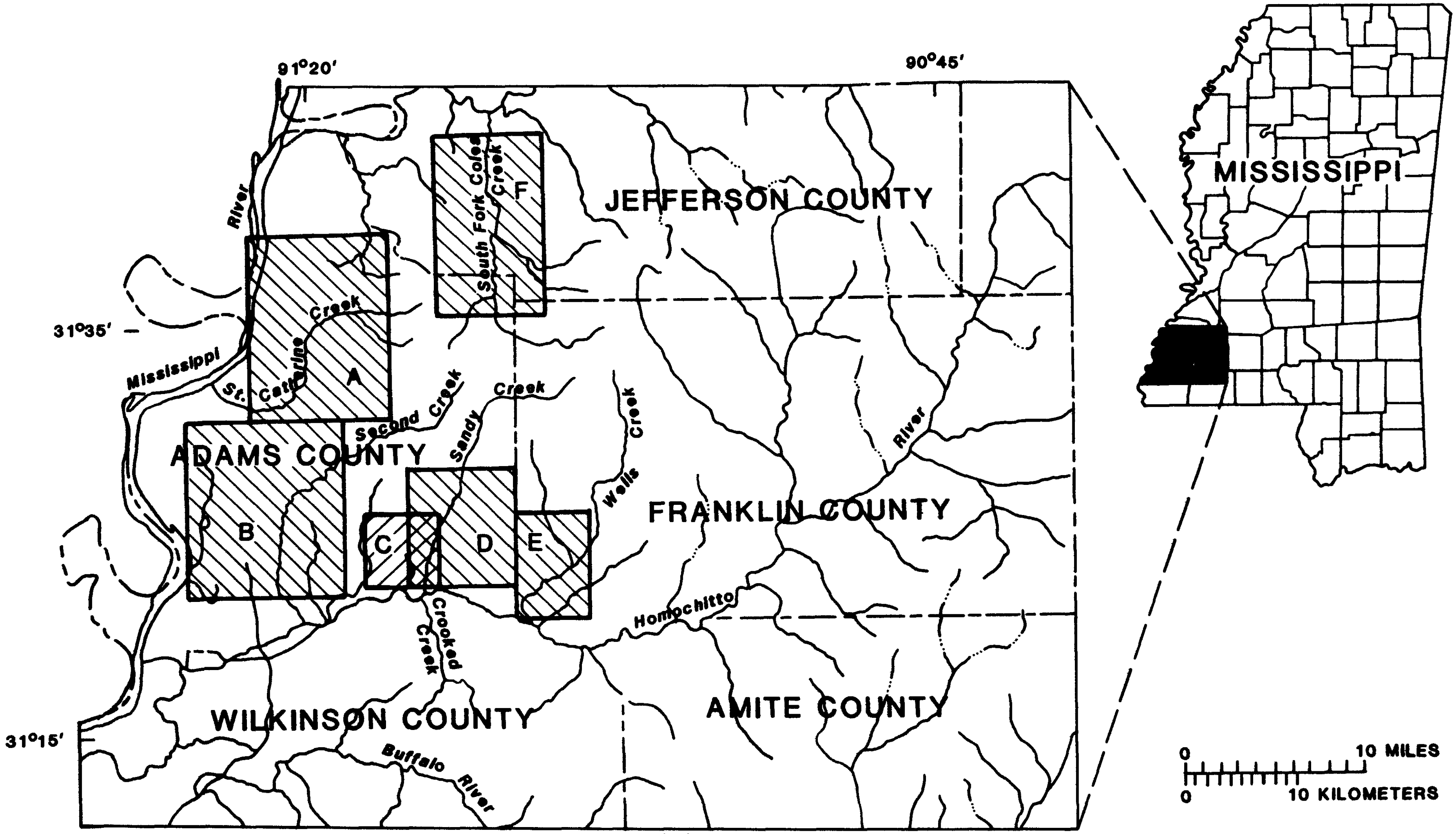
Oil-field brine contamination of the Sparta Sand in the Tinsley oil field is indicated by a sample from a 990-foot deep well having a chloride concentration of 7,550 mg/L. In contrast, a sample from a 1,183-foot deep well completed in the lower Sparta Sand in the same area had a chloride concentration of 8.9 mg/L.

STUDY AREA 2

Study area 2 in southwestern Mississippi includes all of Adams and Franklin, the northwestern corner of Amite, the southern half of Jefferson, and the northern half of Wilkinson Counties (fig. 5). This approximately 1,800 mi^2 area contains numerous oil fields. The Homochitto River, St. Catherine Creek, and South Fork Coles Creek are the largest streams draining the study area. Related data are discussed by six arbitrarily assigned subareas. Data from surface-water samples collected in the Homochitto drainage basin, are discussed as a group. Six subareas include a combination of related ground-water and surface-water data. Subarea A (Natchez), is located east and north of Natchez in Adams County. St. Catherine Creek and its tributaries drain the majority of this study area. Subarea B (Second Creek), is located in southwestern Adams County and is drained by Second Creek and its tributaries. Old St. Catherine Creek drains the western part of the subarea. Subarea C (Kingston), is near Kingston in south-central Adams County. Subarea D (southeastern Adams County), is located in east-central and southeastern Adams County. Adjacent subarea E (Knoxville), is centered near Knoxville in southwestern Franklin County. Subarea F (Cannonsburg), is located partially in northeastern Adams County and partially in southwestern Jefferson County.

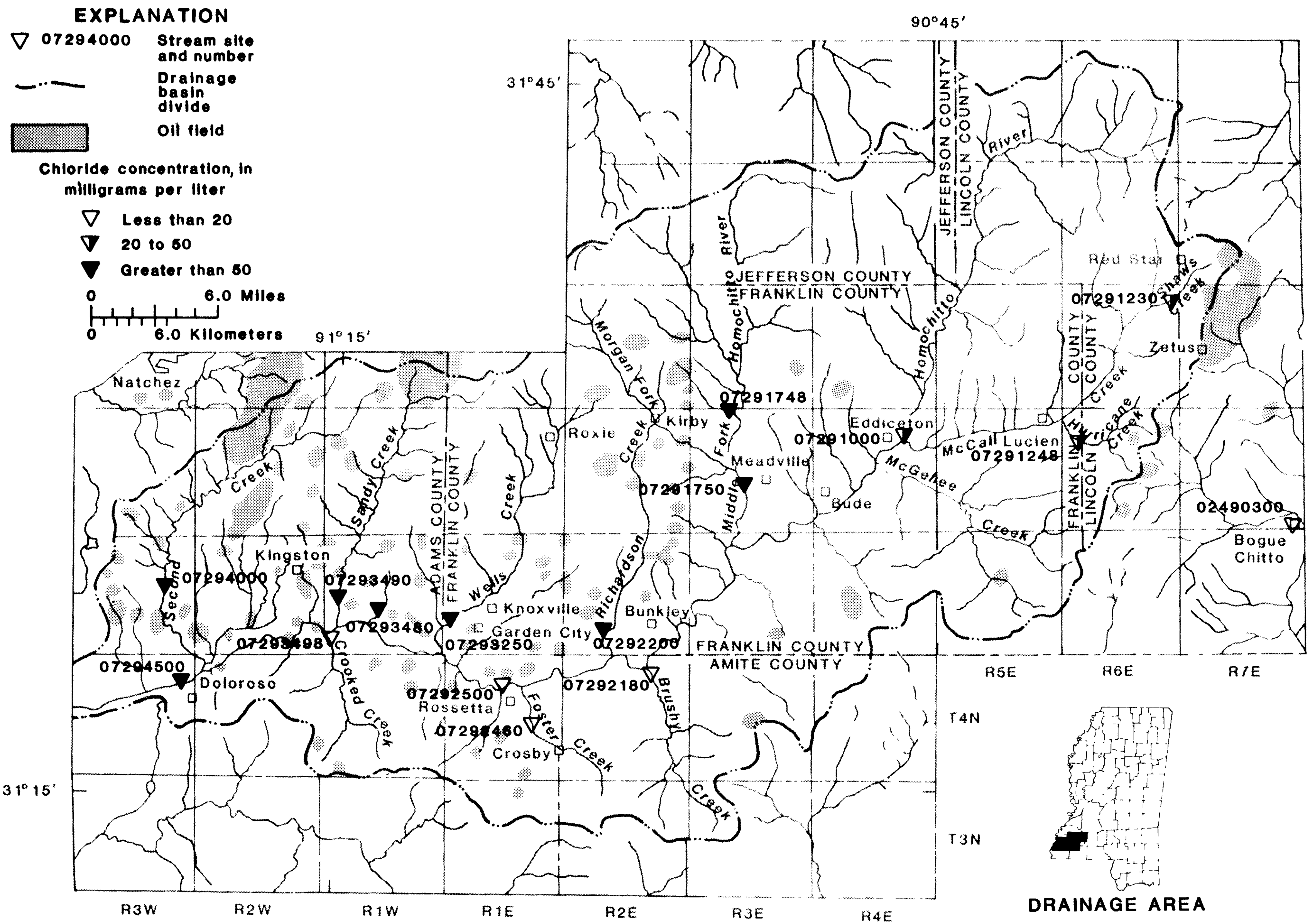
Homochitto Drainage Basin

Water-quality data for several years prior to the study are available for two sites on the Homochitto River at Rosetta (07292500) and near Doloroso (07294500) in study area 2 (fig. 6). Water-quality data were collected by the U.S. Geological Survey in 1982 and the Mississippi Bureau of Geology in 1975 at site 07293490 on Sandy Creek near Kingston and at site 07294000 on Second Creek at Sibley. During this study, water-quality data were collected from three sites on the Homochitto River and sites on most major tributaries (fig. 6).



Base map from U.S. Geological Survey map of Mississippi, 1972

Figure 5.--Location of study area 2 showing subareas A (Natchez), B (Second Creek), C (Kingston), D (southeastern Adams County), E (Knoxville), and F (Cannonsburg).



Base map from U.S. Geological Survey Natchez 1:250,000

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 6.--Chloride concentrations during low flow at surface-water sites in the Homochitto drainage basin, July and August, 1982.

The water at most sites upstream of the Homochitto River at Rosetta (07292500) was suitable for most uses. An exception was the water from Tom Branch near Meadville (07291748) where the chloride concentration was 690 mg/L. At the remaining sites sampled upstream of Rosetta in the Homochitto basin, chloride concentrations ranged from 6.0 to 63 mg/L.

The water quality of Brushy Creek near Bunkley (07292180) is of particular interest because there is no known oil production and little human activity in the drainage basin. Therefore, the water quality at this site should approximate the background water quality of streams draining outcrops of the Miocene aquifers in the area. Water in Brushy Creek has a hardness as $CaCO_3$ of 11 mg/L and is low in dissolved-minerals as indicated by a specific conductance of 48 µS/cm. Concentrations of all major dissolved ions are less than 10 mg/L and the strontium (26 µg/L) and bromide concentration (0.02 mg/L) are considered to be low.

Water-quality samples were collected from the Homochitto River at Rosetta (07292500) periodically from 1958 to 1971. Monthly sampling commenced in October 1974 and continued until September 1981. Bimonthly water samples were collected in the 1982 water year. The mean specific conductance of samples collected between 1958 and 1982 is 86 µS/cm indicating a low dissolved-solids concentration. Sodium and chloride are the predominant ions having a mean concentration of 11 and 14 mg/L, respectively (U.S. Geological Survey, 1965-82).

Statistical analysis of 100 water-quality samples from the Homochitto River at Rosetta indicates that a good correlation (correlation coefficient of 0.87) exists between specific conductance and chloride concentrations. A plot of the specific conductance versus chloride concentration is shown in figure 7. These points lie scattered around the regression line defined by the equation $y = 0.20(x) - 1.84$, where x is the specific conductance in microsiemens per centimeter and y is the chloride concentration in milligrams per liter.

Using the regression equation, chloride concentrations were calculated from specific conductance values determined from water samples collected once-daily from 1975 to 1981. The specific conductance value was substituted for x in the equation, and y, the chloride concentration, was calculated. A comparison of calculated daily chloride concentrations and mean-daily discharge is presented in figures 8 and 9.

Chloride concentrations of river water at Rosetta are generally highest during low-streamflow and generally remain less than 20 mg/L during high streamflow periods. However, chloride concentrations exceeded 20 mg/L several times each year, usually during or slightly after a relatively small increase in stream discharge. For example, on November 3, 1975, the chloride concentration was 18 mg/L and mean-daily discharge was 509 ft^3/s. Discharge increased the following 2 days to 791 ft^3/s on November 5, and the chloride concentration also increased and was 30 mg/L on November 5. Chloride concentrations usually decrease when streamflow is greater than 1,000 ft^3/s.

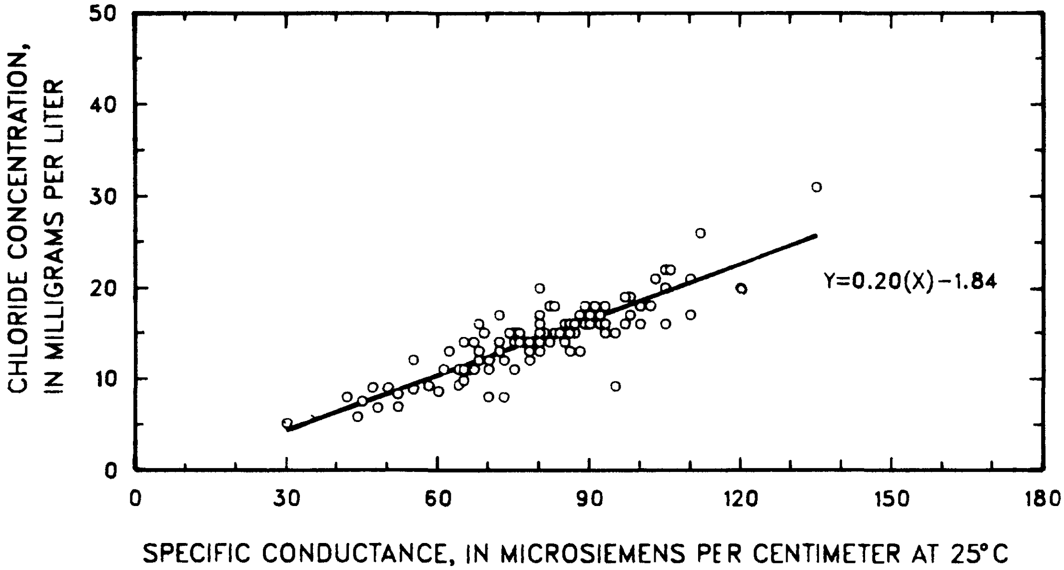


Figure 7.--Specific conductance versus chloride concentration in the Homochitto River at Rosetta (07292500), 1958-83.

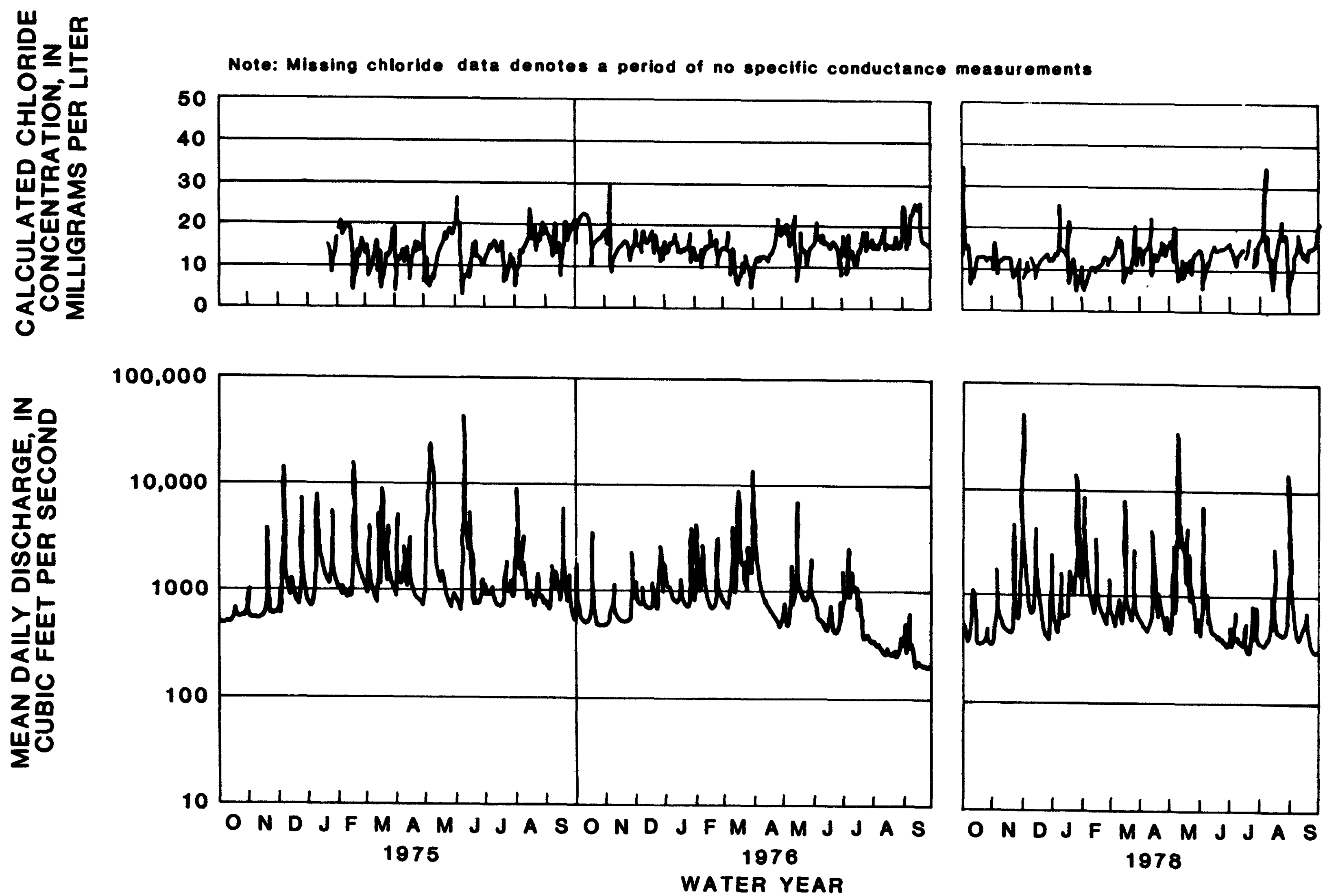


Figure 8.--Calculated chloride concentrations and mean-daily discharge in the Homochitto River at Rosetta (07292500), 1975, 1976, and 1978 water years.

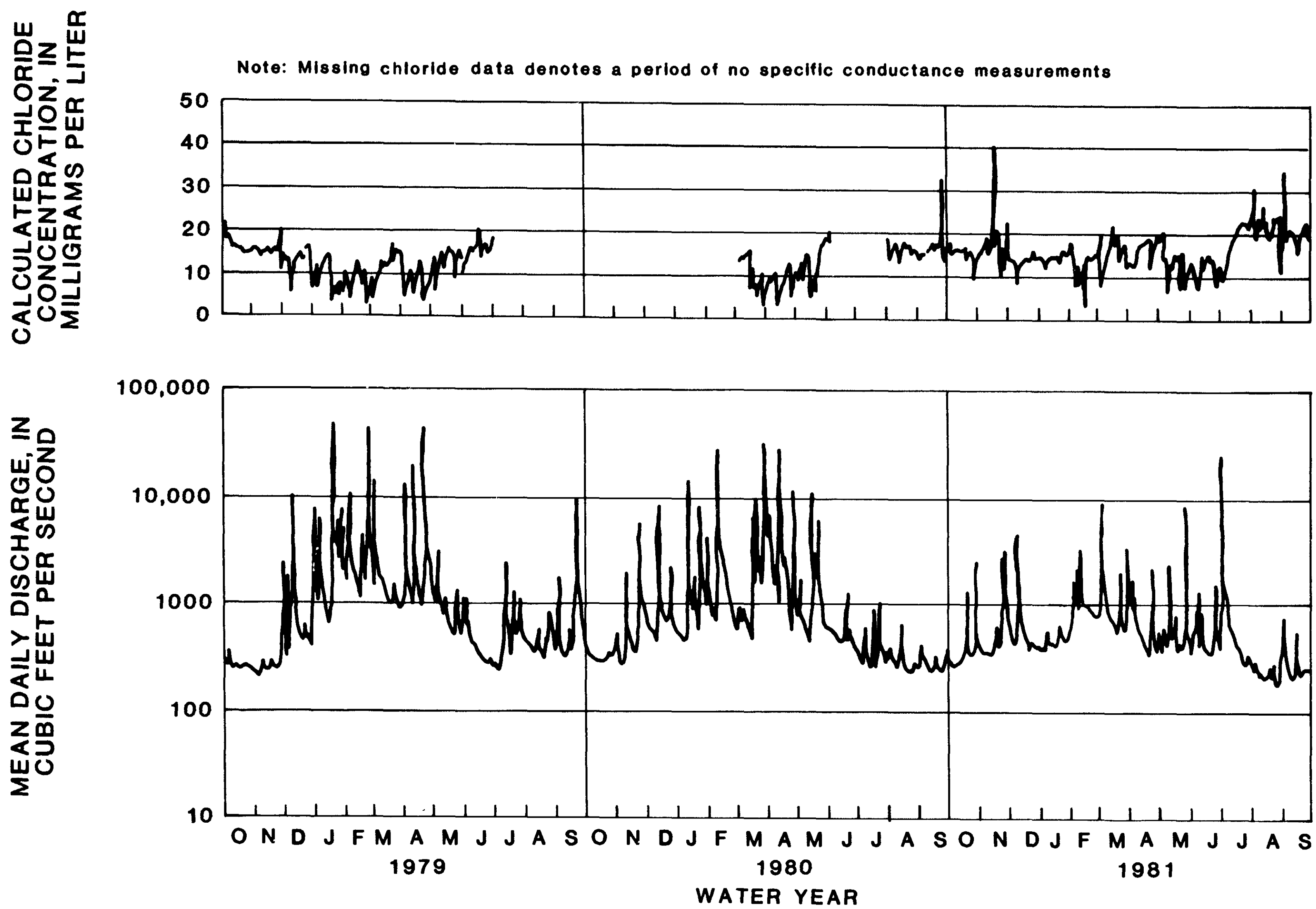


Figure 9.--Calculated chloride concentrations and mean-daily discharge in the Homochitto River at Rosetta (07292500), 1979-1981 water years.

The water at most sites on Homochitto River tributaries downstream of Rosetta is more mineralized than water at upstream sites (fig. 6) and may be unsuitable for some uses. Chloride concentrations in water at sites on Pretty Creek (07293480), Wells Creek (07293250), and Sandy Creek (07293490) were greater than 100 mg/L during the study. Sodium concentrations in water at these sites were correspondingly high, ranging from 94 mg/L in Wells Creek to 300 mg/L in Pretty Creek. Sodium to chloride ratios ranged from 0.48 to 0.59 at these sites.

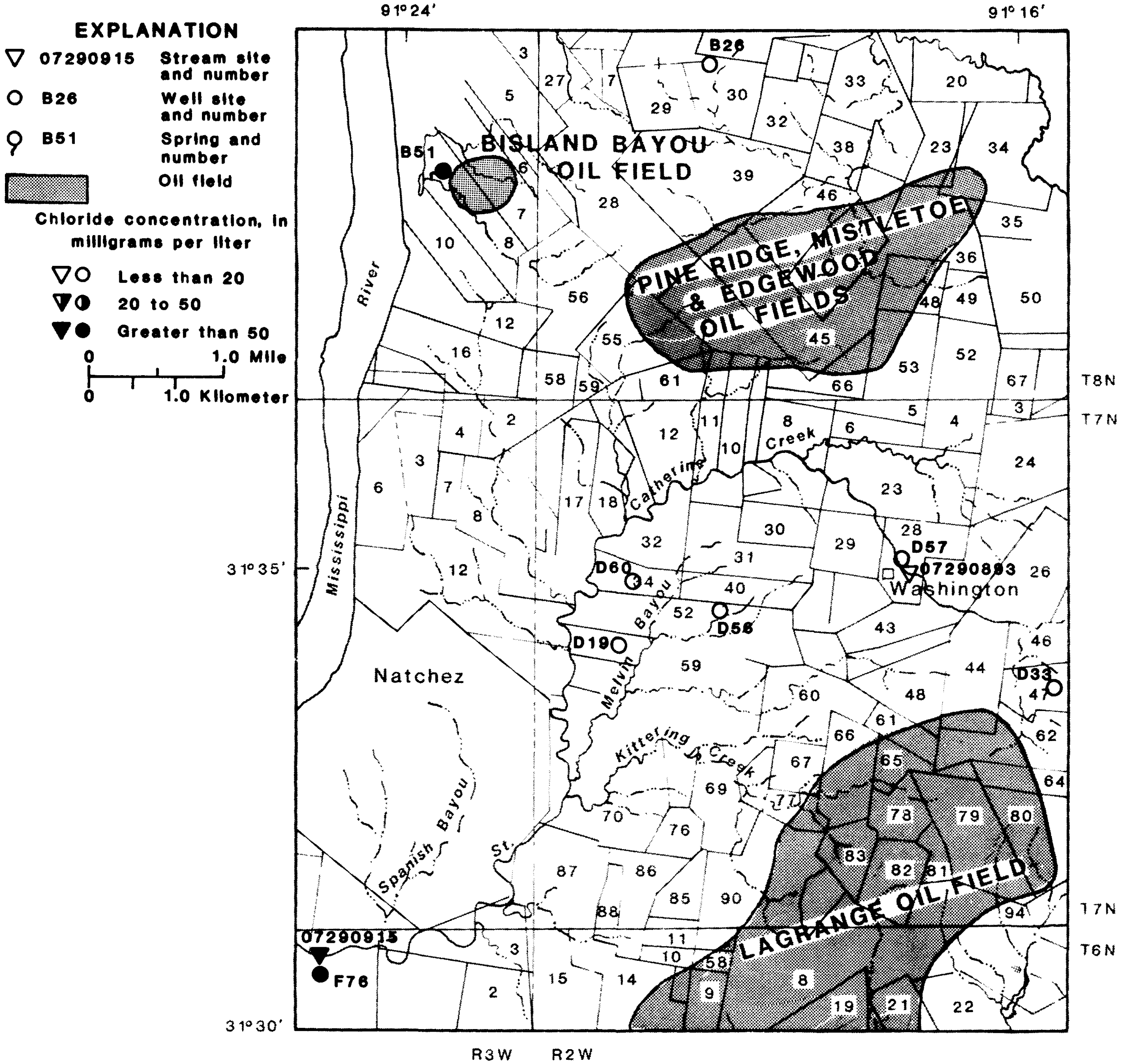
Analysis of low-flow samples collected in 1961 and 1962 by the U.S. Geological Survey indicate that the water in Sandy and Second Creeks have contained high sodium and chloride concentrations in the past. In four samples collected on Sandy Creek (07293490) chloride concentrations ranged from 62 to 71 mg/L and sodium concentrations ranged from 33 to 37 mg/L. Chloride concentrations on Second Creek (07294000) ranged from 21 to 408 mg/L in five samples of water collected during 1961-62.

In the fall of 1975, the Mississippi Bureau of Geology collected water samples containing chloride concentrations of 155 and 112 mg/L at Sandy Creek (07293490) and 53 and 55 mg/L at Second Creek (07294000) (Childress and others, 1976, p. 117-121). In 1961, chloride concentrations ranged from 67 to 200 mg/L and sodium concentrations ranged from 39 to 126 mg/L in five water samples collected by the U.S. Geological Survey from the Homochitto River at Doloroso (07294500).

Subarea A (Natchez)

Water-quality data are available for streams and the shallow Miocene aquifer in subarea A (Natchez). During the study, dissolved solids in St. Catherine Creek, as indicated by the specific conductance increased downstream (fig. 10). The specific conductance was 320 µS/cm in St. Catherine Creek at Washington (07290893) increasing to 1,350 µS/cm downstream (07290915). There was a corresponding increase in chloride concentration from 6.2 mg/L at the upstream site (07290893) to 320 mg/L at the downstream site (07290915). Concentrations of strontium quadrupled and bromide concentrations tripled in the water from the upstream to downstream site. The sodium to chloride ratio at the downstream site was 0.50.

Callahan and others (1964, p. 21) state that although part of the increased mineralization of water in St. Catherine Creek is from municipal and industrial sources, some sodium chloride in streams originate from oil fields. Reconnaissance sampling on March 15, 1963, indicated that the chloride concentration was 132 mg/L in Melvin Bayou and the chloride concentration was 1,360 mg/L in Kittering Creek. Data from Childress and others (1976, p. 118) show chloride concentrations exceeded 100 mg/L in 10 of 12 samples collected in July 1975 and January 1976 from surface-water sites in the Melvin Bayou and Kittering Creek drainage basins.



Base map from U.S. Geological Survey
Natchez 1:24,000, 1963
Pine Ridge 1:24,000, 1963
Spokane 1:24,000, 1976
Washington 1:24,000, 1976

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 10.--Chloride concentration at ground-water and surface-water sites in subarea A, 1981-82.

The specific conductance of ground water in St. Catherine Creek drainage basin ranged from 460 to 900 µS/cm. The lowest values were measured in samples from five wells completed in the Miocene aquifer system in T. 7 N., R. 2 W., (fig. 10). An analysis of the major ions in a sample from one well, D19, indicates that the water is a calcium, magnesium, bicarbonate type in this area. Chloride concentrations are less than 20 mg/L. Maximum specific conductance values were in samples from well F76 located in T. 6 N., R. 3 W. Well F76 is completed in the Mississippi River valley alluvial aquifer. Specific conductance values increased from 800 µS/cm in 1981 to 900 µS/cm in 1982. During this same period, chloride concentrations doubled (48 to 97 mg/L).

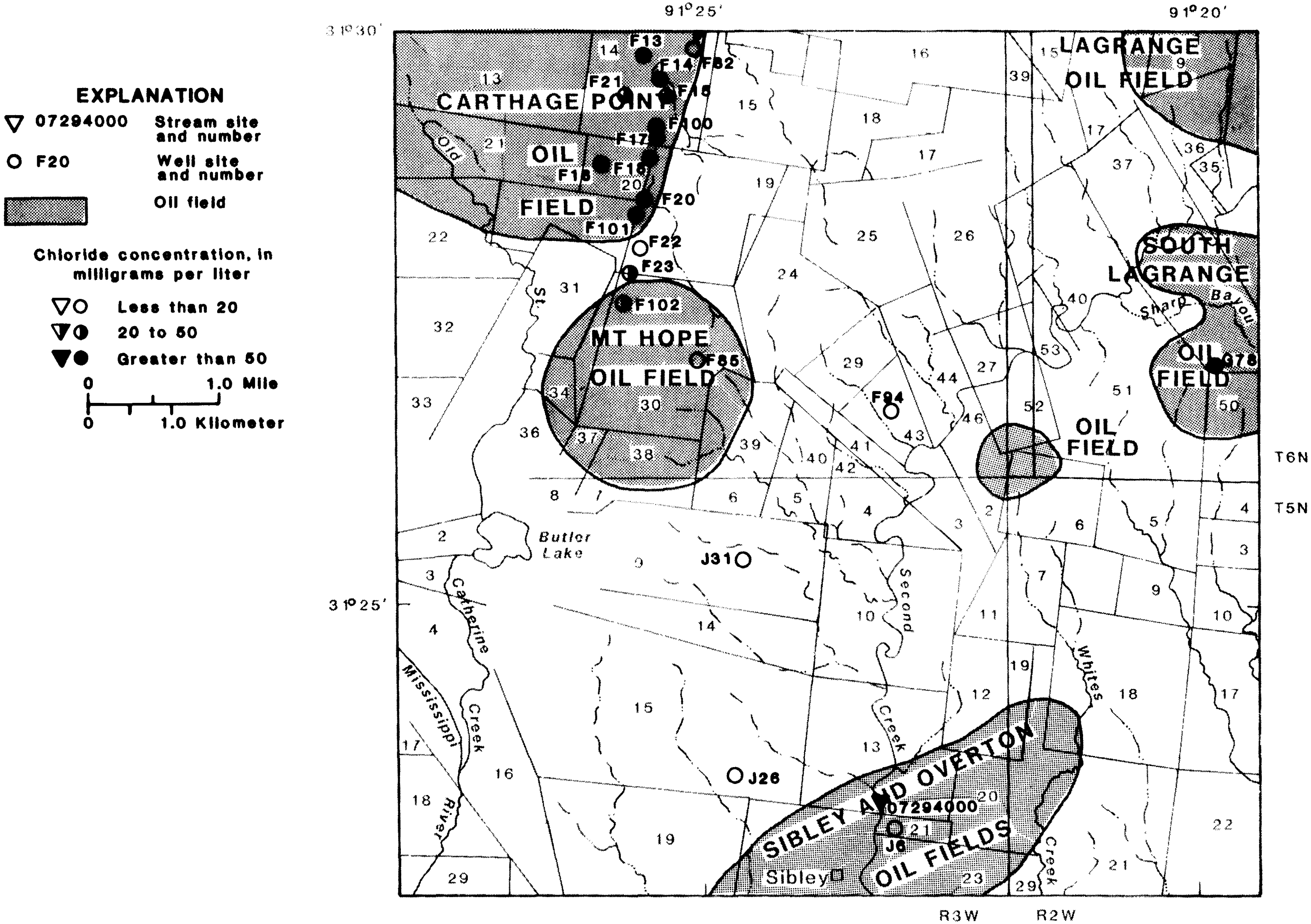
The specific conductance of ground water from the Miocene aquifer system in other parts of subarea A was variable. The conductance of a sample from well B26 was 760 µS/cm and had a chloride concentration of 5.5 mg/L. In contrast, the conductance of a sample from Spring BS01 near Bisland Bayou oil field was 4,590 µS/cm. The sodium concentration was 680 mg/L and the chloride concentration was 1,200 mg/L resulting in a sodium to chloride ratio of 0.57.

Subarea B (Second Creek)

Water in parts of the Mississippi River valley alluvial aquifer and Miocene aquifer system in the Carthage Point and Mt. Hope oil fields contained chloride concentrations greater than 20 mg/L in 1982 fig. 11). Chloride concentrations in water of 13 (F13-F18, F20-F23, F100-F102) industrial supply wells ranged from 9.0 to 170 mg/L. Samples from wells nearest the oil field generally contained the highest chloride concentrations. Water from nearby wells F82 and F85 in the Miocene aquifer had chloride concentrations less than 20 mg/L.

Water-quality deterioration has been observed in some shallow Miocene sands in the eastern part of the subarea (fig. 11). The chloride concentration of water in well G7 increased from 9 mg/L in 1969 to 470 mg/L in 1973. Water from well G8, located in the same area and about the same depth as G7, also became more mineralized and chloride concentrations increased from 32 mg/L in 1973 to 330 mg/L in 1974 (Childress and others, 1976, p. 136). A water sample collected from well G8 by the Geological Survey in 1974, had a chloride concentration of 1,200 mg/L. Chloride concentrations were also greater in the shallower sands during this period. The chloride concentration in water from well G19 (140 ft deep) was 3,600 mg/L (Childress and others, 1976, p. 136).

Chloride concentrations in samples from five other wells (F85, 94, J6, 26, 31) completed in Miocene sands were less than 20 mg/L. The chemical analysis of the sample from well J31 may be representative of typical Miocene aquifer water quality. The major ions are calcium, magnesium, and bicarbonate. The chloride concentration was less than 10 mg/L. The sodium to chloride ratio was 2.0.



Base map from U.S. Geological Survey Kingston 1:62,500, 1958

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 11.--Chloride concentrations at ground-water and surface-water sites in subarea B, 1981-82.

Subarea C (Kingston)

In subarea C (Kingston), the U.S. Geological Survey collected and analyzed water samples from shallow wells in the Miocene aquifer in 1963 (fig. 12). Chloride concentrations ranged from 10 mg/L to 2,850 mg/L. The highest chloride concentrations were in water from wells K4 (30 mg/L) and L4 (2,850 mg/L), each less than 100 feet deep. Chloride concentrations in water in three wells (K2, 5, L5) ranging from 380 to 480 ft in depth were 20 mg/L or less.

Subarea D (Southeastern Adams County)

Two wells (L19 and L20) were sampled in the southeastern Adams County subarea during the study (fig. 13). Water from well L19 (35 ft deep) located approximately 2.0 mi southeast of Kingston, contained a chloride concentration of 120 mg/L in 1981 and 88 mg/L in 1982. Water from well L20 (100 ft deep), located 3 miles east-southeast of Kingston, contained a chloride concentration of 2.6 mg/L in 1981.

Water from three springs 6 miles southeast of Kingston in Adams County contained chloride concentrations ranging from 95 to 990 mg/L. Specific conductance of the water from the springs ranged from 314 umhos at site LS01 to 3,190 at site LS02 (fig. 13). The sodium to chloride ratio ranged from 0.59 to 0.65.

Water from two wells in the shallow Miocene aquifer in eastern Adams County is more highly mineralized than water from two nearby wells (fig. 13) in 1982. In water samples collected from wells H16 and H17, the specific conductances were 730 and 925 umhos and chloride concentrations were 220 and 250 mg/L, respectively (fig.13). The chloride concentration in water of well H17 increased from 98 to 250 mg/L between September 1981 to April 1982. Water from well H20, located approximately 0.5 mi southwest of well H16, had a specific conductance of 78 umhos and a chloride concentration of 6.6 mg/L. Water from well H21, located 0.7 mi south of H17, had a specific conductance of 67 umhos and a chloride concentration of 4.5 mg/L.

Subarea E (Knoxville)

Water from a shallow well (L22) near Knoxville in Franklin County (fig. 14), located approximately 300 ft north of a site formerly used as an evaporation pit, was highly mineralized. The specific conductance was 11,800 µS/cm. Concentrations of all major ions except magnesium and sulfate were greater than 1,000 mg/L and concentrations of bromide and strontium were 3.74 mg/L and 5,600 µg/L. The sodium concentration was 1,200 mg/L and the chloride concentration was 3,900 mg/L, resulting in a sodium to chloride ratio of 0.31. Samples from two other wells (L15 and L21) also had chloride concentrations greater than 20 mg/L. Sodium to chloride ratios ranged from 0.41 to 0.51.

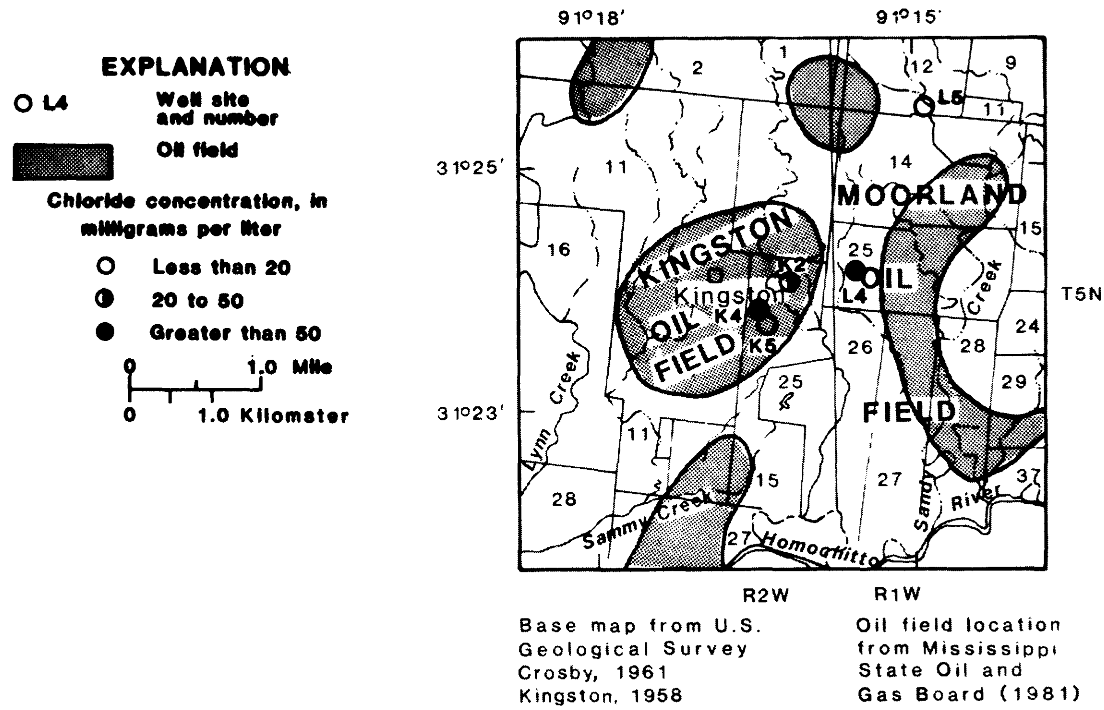


Figure 12.--Chloride concentrations at ground-water sites in subarea C, 1963.

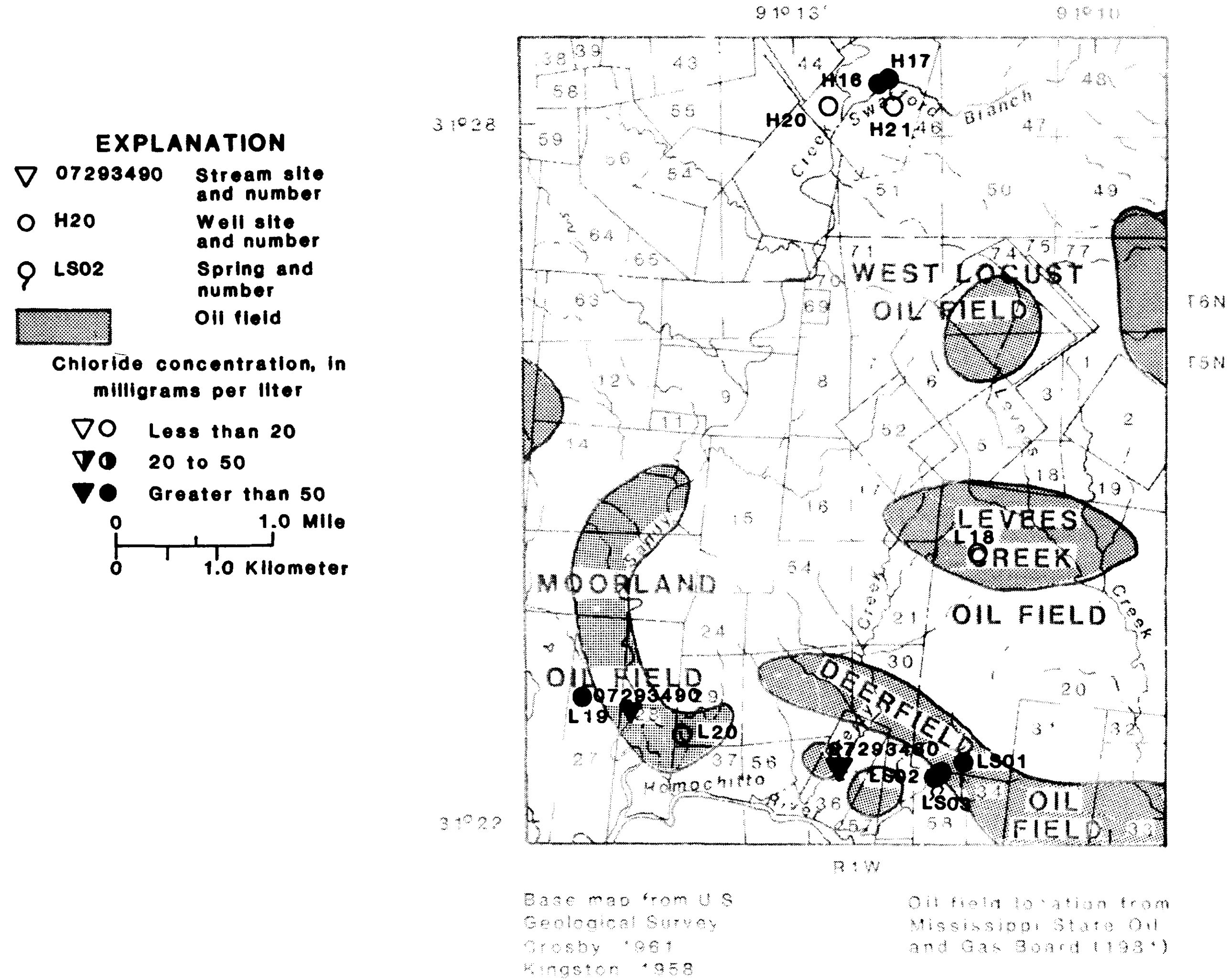


Figure 13.--Chloride concentrations at ground-water and surface-water sites in subarea D, 1981-82.

The chloride concentration in a stream draining several oil fields in the Knoxville area (Wells Creek at site 07293250) was 180 mg/L and the sodium concentration was 94 mg/L, resulting in a sodium to chloride ratio of 0.52.

Subarea F (Cannonsburg)

Several studies in the last 20 years have shown the mineral content of water in South Fork Coles Creek in the Cannonsburg area is considerably above the normal range for streams in the area. Callahan and others (1964, p. 21) state that between June 1961 and January 1963, the specific conductance of water in South Fork Coles Creek ranged from 754 to 4,150 uS/cm and the chloride concentration ranged from 210 to 1,320 mg/L. Callahan further states that during a specific conductance reconnaissance of South Fork Coles Creek, on October 5, 1961, from its mouth to the headwaters, values obtained ranged from 60 to 1,100 µS/cm with the greatest change occurring between Cannonsburg and the Adams-Franklin County line. Childress and others (1976, p. 118) also found that chloride concentrations exceeded 20 mg/L at sites in the South Fork Coles Creek drainage basin. During this study, chloride concentrations were 100 mg/L on Folkes Creek near Cannonsburg (07290850) and 65 mg/L on South Fork Coles Creek near Fayette (07290860) (fig. 15).

In 1962, the chloride concentrations changed in a relatively short period of time in two wells in the Sunnyside oil field in Jefferson County (Callahan and others, 1964, p. 5) near Cannonsburg. The chloride concentration in the water of well M3 decreased from 6,500 mg/L in July to 244 mg/L in August. The chloride concentration in well M4 increased from 57 mg/L in July to 66 mg/L in October. The chloride concentration of water in 10 other wells (ranging in depths from 25 to 400 ft) in the vicinity of well M3 was less than 10 mg/L.

Summary and Concusions

Oil-field brine contamination is apparent in both surface and ground water in study area 2. The water at sites on three major streams (the Homochitto River, St. Catherine Creek, and South Fork Coles Creek, and their tributaries) contained chloride concentrations that ranged from less than 20 to over 500 mg/L. Wells indicating contaminated ground water are present in the drainage basin of these streams.

Descriptions of ground- and surface-water sites are given in tables 8 and 9. Tables 10 and 11 give results of analysis of samples collected at ground- and surface-water sites in area 2.

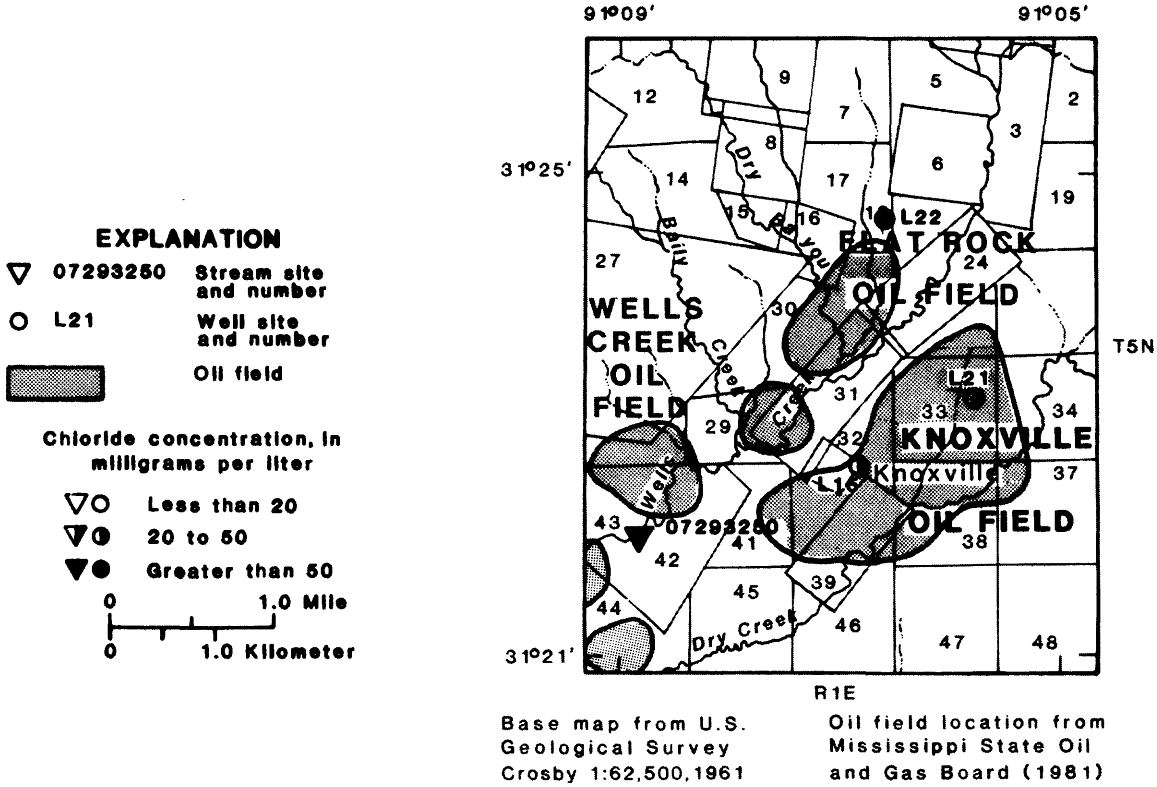
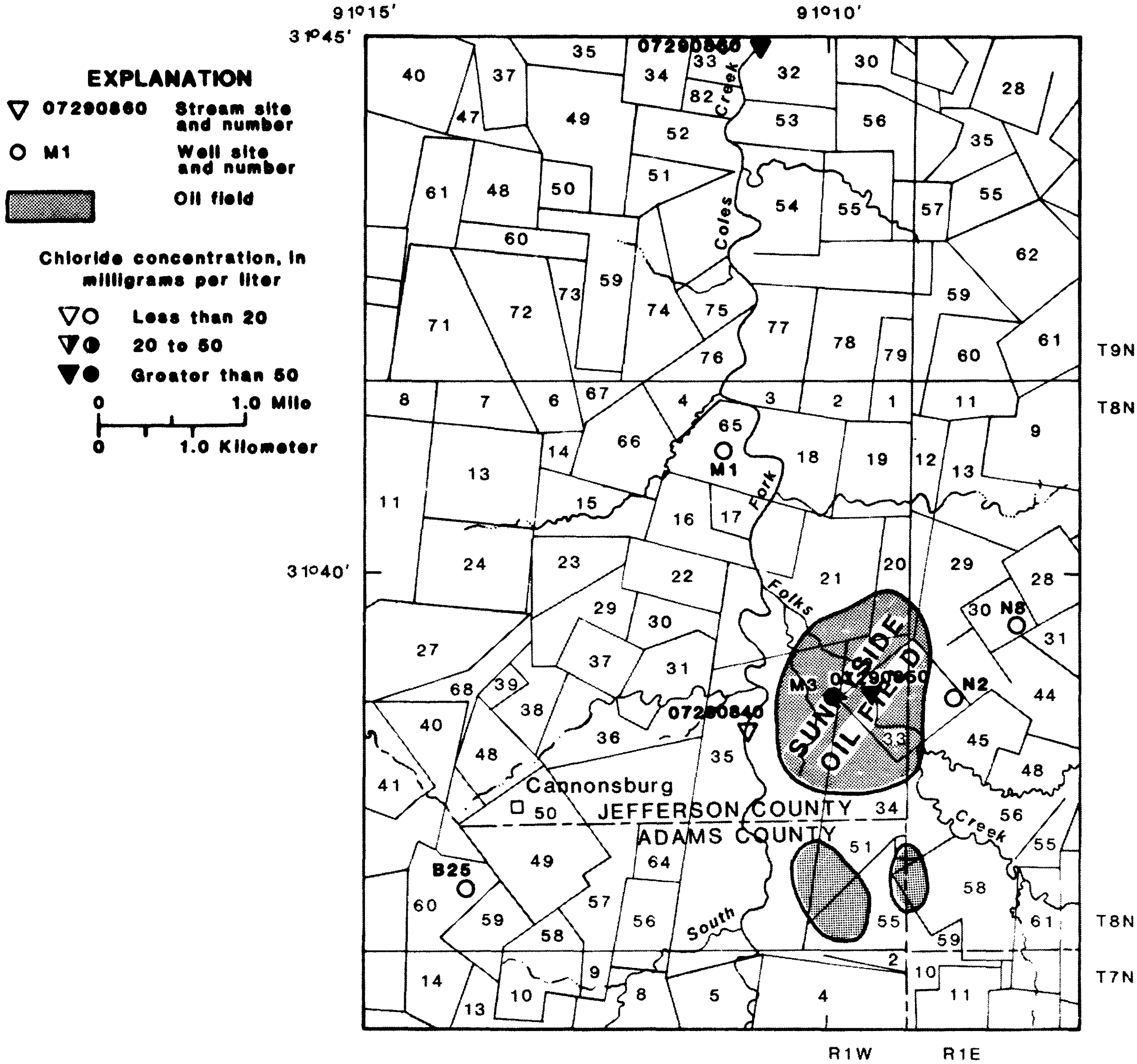


Figure 14.--Chloride concentrations at ground-water and surface-water sites in subarea E, 1981-82.



Base map from U.S. Geological Survey Fayette 1:62,500, 1962

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 15--Chloride concentrations at ground-water and surface-water sites in subarea F, 1981-82.

Although the water in the Homochitto River is suitable for most uses, it has been contaminated periodically. Contamination generally increases downstream of Rosetta (07292500). Data indicate that chloride concentrations at Rosetta increase to over 20 mg/L several times yearly. Higher chloride concentrations were observed during periods of increases in mean-daily discharge, which suggests that the probable source of chloride is from surface runoff. During periods of higher runoff, greater concentrations of chloride likely are entering the Homochitto River but are diluted to an extent that contamination is not noticable. The comparatively large increase in chloride concentrations at low streamflow suggests ground water is mixing with water of the Homochitto River and its tributaries and further suggests contamination of the shallow aquifer in the lower part of the drainage basin. Contaminated shallow Miocene aquifers were observed in several areas of the Homochitto drainage basin. Chloride concentrations ranging from 95 to 990 mg/L in water from three springs near Deerfield oil field indicate that brines are entering the shallow ground water in the area. Chloride concentrations of 220 and 250 mg/L indicate contaminated water in two wells in eastern Adams County. Chloride concentrations were significantly greater in these wells than in water from two nearby wells.

Ground-water sampling in 1963 showed two areas of contamination of the shallow Miocene aquifer near Kingston. Water from two wells less than 100 ft deep contained water having chloride concentrations greater than 20 mg/L. Several wells in shallow Miocene sands located near Second Creek northwest of Kingston were contaminated between 1973 and 1974. The chloride concentration in water from well G8 near Kingston increased from 32 mg/L in 1973 to 1,200 mg/L in 1974. A shallower sand (140 ft) in this area was also contaminated between 1973 and 1974.

The water in St. Catherine Creek in western Adams County near Natchez becomes increasingly contaminated downstream. During the study, chloride concentrations increased from 6.2 mg/L at site 07290893 near the headwaters to 320 mg/L at site 07290915 near the mouth. Some contamination originates from municipal and industrial wastes from Natchez and some originates from tributaries (Melvin Bayou and Kittering Creek) draining oil fields. In 1963, chloride concentrations exceeded 100 mg/L in Melvin Bayou and Kittering Creek, and in 1975 and 1976, chloride concentrations exceeded 100 mg/L in 10 of 12 samples collected at sites in Melvin Bayou and Kittering Creek drainage basins.

The Mississippi River valley alluvial aquifer is contaminated by oil-field brines near the mouth of St. Catherine Creek. Chloride concentrations were greater than 20 mg/L in the water of 13 of 14 industrial-supply wells.

Brine contamination is present in the Cannonsburg area of Jefferson and Adams Counties. Water samples collected by the U.S. Geological Survey from South Fork Coles Creek between June 1961 and January 1963 contained chloride concentrations ranging from 210 to 1,320 mg/L. The Mississippi Bureau of Geology also found that chloride concentrations exceeded 20 mg/L in the South Fork Coles Creek basin. The chloride concentration was 100 mg/L on Folkes Creek (07290850) and 65 mg/L on South Fork Coles Creek (07290860). In 1962, water in two domestic wells in Sunnyside oil field contained chloride concentrations greater than 50 mg/L. Chloride concentrations were less than 10 mg/L in water from 10 wells ranging in depth from 25 to 400 ft in the vicinity of Sunnyside oil field.

STUDY AREA 3

Study area 3, located in southwestern Mississippi, includes most of Lincoln, the northern half of Pike and a small corner of northeastern Amite Counties (fig. 16). This area of approximately 480 mi^2 includes McComb, Smithdale, Brookhaven, Little Creek, and Mallalieu oil fields. The Bogue Chitto and its tributaries drain a large part of study area 3 including the Brookhaven, Little Creek, and Mallalieu oil fields. Related surface-water data are grouped together and discussed under the topic of the Bogue Chitto drainage basin. Ground-water and surfacewater data collected in and near the major oil fields are discussed by arbitrarily assigned subareas. Subarea A (the Brookhaven area), is located in north-central Lincoln County near Brookhaven, Miss. Subarea B (McComb-Mars Hill) is located in northwestern Pike and northeastern Amite Counties. Subarea C (Little Creek), is in northeastern Pike County and a small part of south-central Lincoln County.

Bogue Chitto Drainage Basin

Natural surface water in the Bogue Chitto drainage basin (fig. 17) in study area 3 may be characterized by the quality of the water at Allbritton Creek near Bogue Chitto (02490350), which drains a rural area of no known oil production. The water is soft (hardness as $CaCO_3$, 6 mg/L), slightly acidic (pH of 5.9 units), and as indicated by the specific conductance (32 µS/cm), is very low in dissolved solids. The concentration of all major ions was less than 10 mg/L. Bromide (less than 0.1 mg/L) and strontium (11 µg/L), are present in very small concentrations.

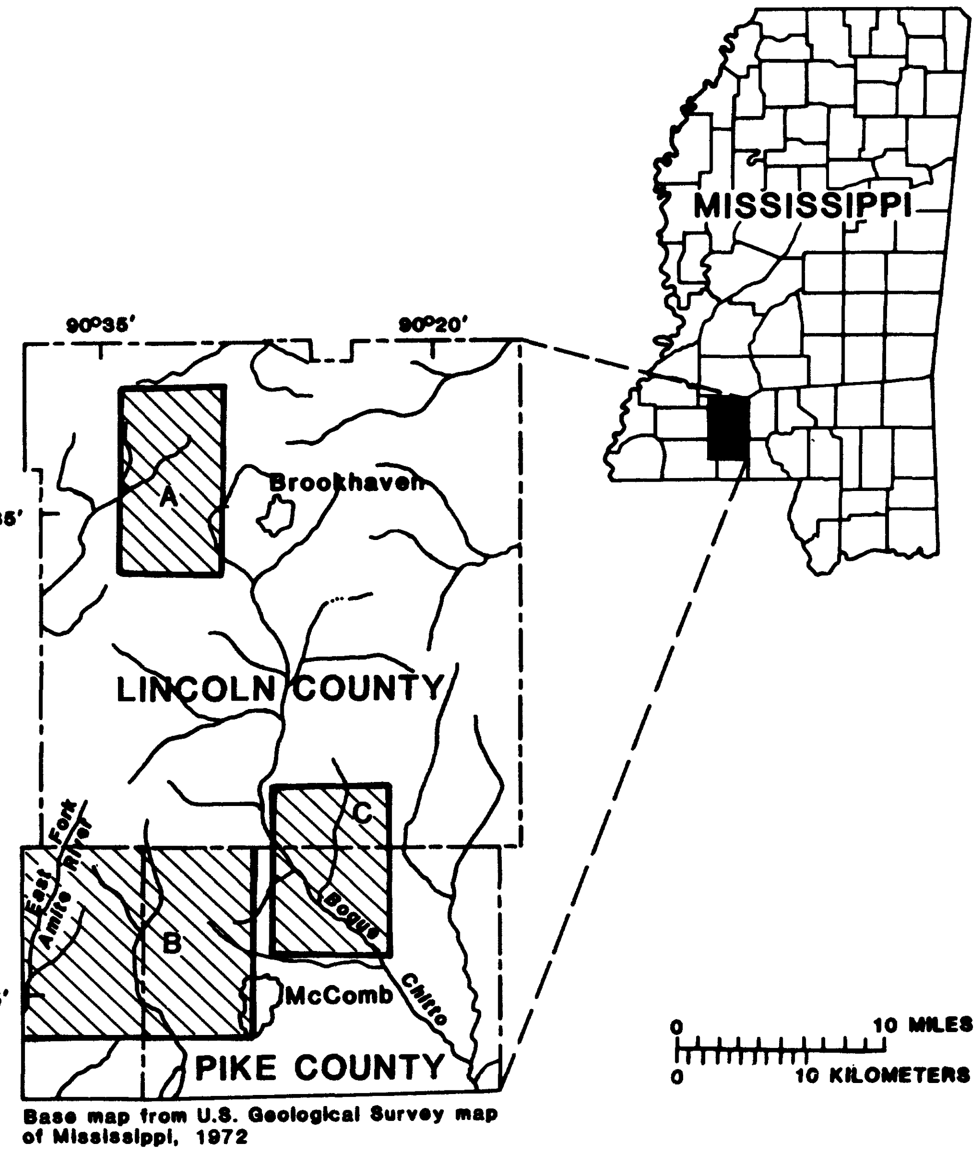


Figure 16.--Location of study area 3 showing subareas A (Brookhaven), B (McComb-Mars Hill), and C (Little Creek).

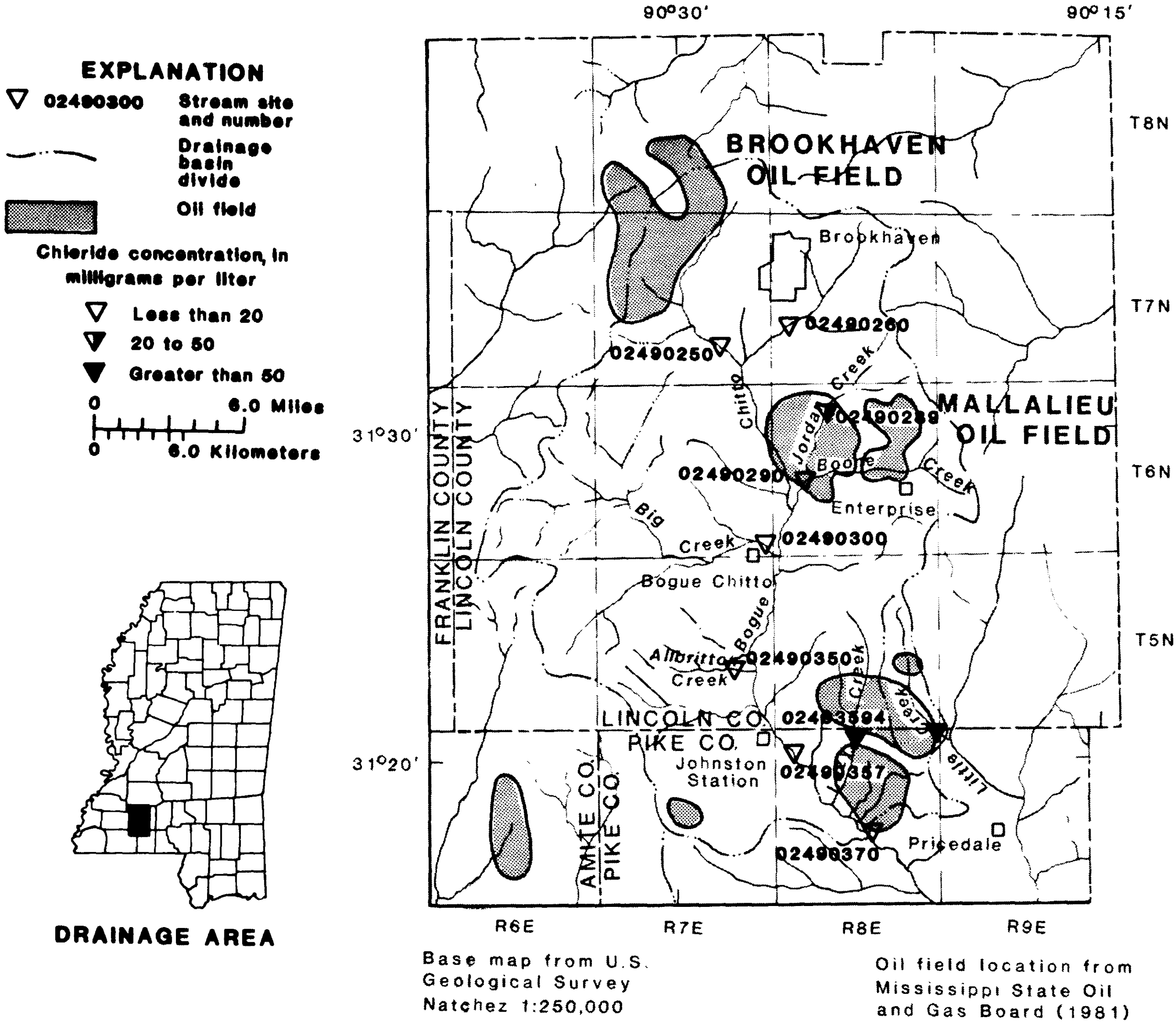


Figure 17.--Chloride concentrations during low flow at surface-water sites in the Bogue Chitto drainage basin, July 1982.

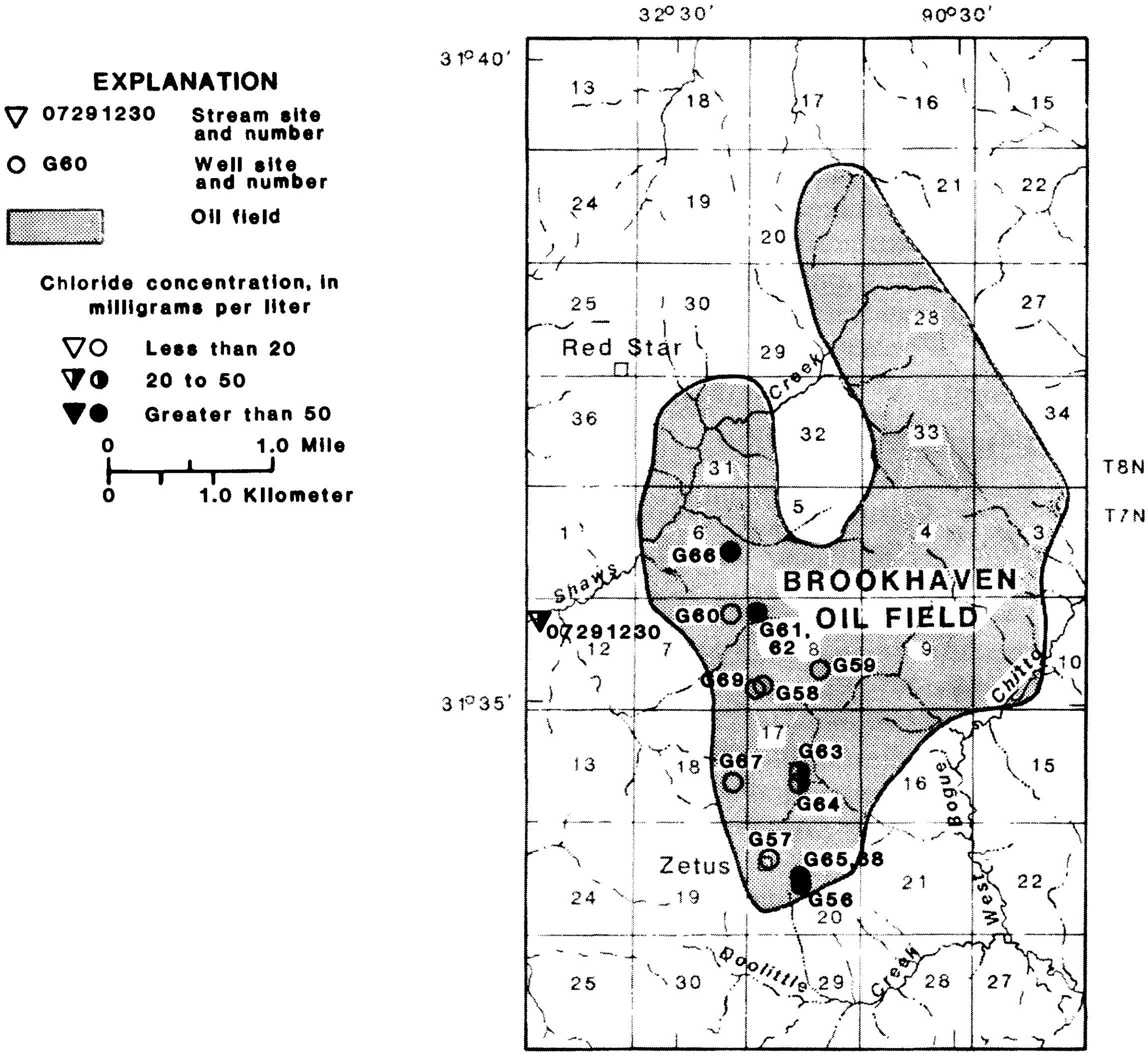
Water at three sites on tributaries of Bogue Chitto that drain oil fields were slightly more mineralized than in Allbritton Creek (02490350). The specific conductance in Jordan Creek near Enterprise (02490289) was 165 µS/cm. The sodium and chloride concentrations were 21 and 36 mg/L, respectively. The bromide concentration of water in Jordan Creek near Enterprise was similar to that in Allbritton Creek, but the strontium concentration (190 µg/L) although low, was significantly higher. Inflow of water from Jordan Creek contributed about 80 percent of the chloride load and about 30 percent of the discharge at site 02490290 on Boone Creek. The chloride concentration at this site on Boone Creek was 15 mg/L. Downstream on Lazy Creek near Johnstons Station (024903594), the specific conductance as 267 µS/cm, the sodium concentration was 38 mg/L, and the chloride concentration was 70 mg/L. In Little Creek near Ruth (02490415), the specific conductance was 400 µS/cm, the sodium concentration was 53 mg/L, and the chloride concentration was 110 mg/L. The sodium to chloride ratio at both sites (02493594 and 92490415) was 0.48. Bromide (0.54 mg/L) and strontium (230 µg/L) concentrations in Little Creek were significantly greater than in Allbritton Creek.

Tributary inflow of mineralized water through the study area increased the major ion concentration in downstream reaches of Bogue Chitto. In July 1982, sodium concentrations increased from less than 5.0 mg/L at the most upstream side near Brookhaven (02490250) to 8.7 mg/L at the most downstream site near Pricedale (02490370). Similarly, chloride concentrations increased from 7.1 mg/L near Brookhaven to 13 mg/L near Pricedale.

Subarea A (Brookhaven)

Normal shallow (less than 300 ft depth) ground-water quality in study area 3 can be characterized by the quality of water from Lincoln County well G57 (fig 18). The water is soft (hardness as $CaCO_3$ ranging from 4 to 6 mg/L), and as indicated by the specific conductance (22 to 38 µS/cm), is very low in dissolved solids. Major ion concentrations are less than 10 mg/L. The bromide (less than 0.10 mg/L) and strontium (5 µg/L) concentrations are low.

The water in the Citronelle aquifer and shallow Miocene aquifers in the Brookhaven oil field (fig. 18) is more mineralized than normal. The specific conductance of water in 11 of 14 wells is greater than 100 µS/cm, ranging from 38 to 3,290 µS/cm. Calcium, magnesium, and sulfate concentrations were less than 10 mg/L in all samples except a sample from well G65. In water from well G65, only the sulfate concentration is less than 10 mg/L, and sodium and chloride concentrations are greater than 10 mg/L. In samples collected from 8 of 14 wells, the chloride concentration exceeded 20 mg/L. The bromide concentration is significantly greater in wells G65, G61, and G62, than in well G57, ranging from 0.33 to 5.5 mg/L. The strontium concentration in the three wells ranged from 27 to 2,500 µg/L in well G57.



Base map from U S Geological Survey
Midway 1:24,000,1972
Zetus 1:24,000,1972

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 18.--Chloride concentrations at ground-water and surface-water sites in subarea A, 1981-82.

Water from a stream draining the Brookhaven Oil Field, Shaws Creek at Red Star (07291230), had a specific conductance of 108 µS/cm and a chloride concentration of 23 mg/L.

Subarea B (McComb-Mars Hill)

The results of analyses of samples indicate that water in the Citronelle aquifer in the Smithdale oil field is highly mineralized (fig. 19). Analyses of 13 samples collected in 1981 show that chloride concentrations ranged from 1.8 to 580 mg/L. Five of these wells (E82-E86) plus an additional well (E87) were sampled in 1982. Four of the five wells (E83-E86) resampled had greater chloride concentrations than in the previous sample. The chloride concentrations decreased slightly (270 to 260 mg/L) from samples collected from well E82. The higher chloride concentrations (greater than 20 mg/L) were clustered in sections 16 and 17 near Mars Hill.

Water from the East Fork Amite River at Mars Hill (07376640) a stream draining the Smithdale oil field, had a specific conductance of 110 µS/cm, a sodium concentration of 13 mg/L, and a chloride concentration of 24 mg/L. The resulting sodium to chloride ratio was 0.54.

Field personnel were able to locate only one shallow water well suitable for sampling in McComb oil field in Pike County (D190). Analysis of a sample from this well indicates that the Citronelle aquifer in this area is more mineralized than normal. The water from well D190, 100 feet deep, had a specific conductance of 359 uS/cm, a sodium concentration of 42 mg/L, and chloride concentration of 98 mg/L in 1982. Well D44, located approximately 1 mile north of D190 and screened in the Citronelle aquifer at a depth of 111 ft was sampled in 1966 and the chloride concentration was 970 mg/L.

Subarea C (Little Creek)

Water samples at six ground-water sites in the Little Creek and Sweetwater oil fields contained significantly greater concentrations of the major dissolved ions than in samples from Pike County well B119 located just outside of the oil field. The specific conductance of samples from these six sites (B96, BS01, B105, B118, B123, and Q44) ranged from 80 to 1,340 µS/cm. Concentrations of calcium, magnesium, and sulfate were less than 10 mg/L in samples from four sites. The calcium (33 mg/L), magnesium (12 mg/L), and sulfate (22 mg/L) concentrations in a sample from Pike County well B96 were greater than 10 mg/L and chloride concentrations were greater than 20 mg/L (fig. 20). The bromide concentrations in samples from well B105 (1.8 mg/L) and well B 123 (0.72 mg/L) were significantly greater than normal.

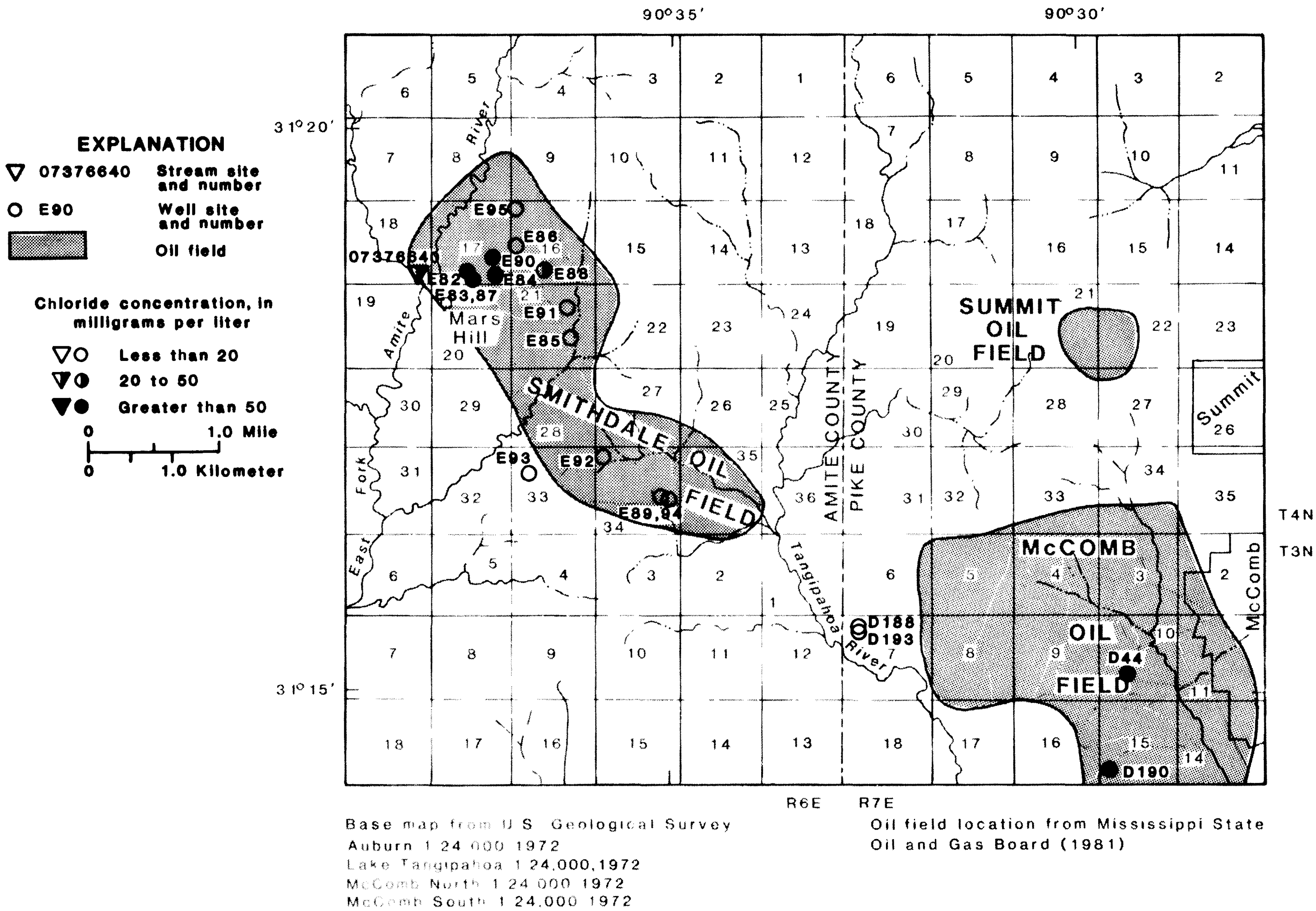
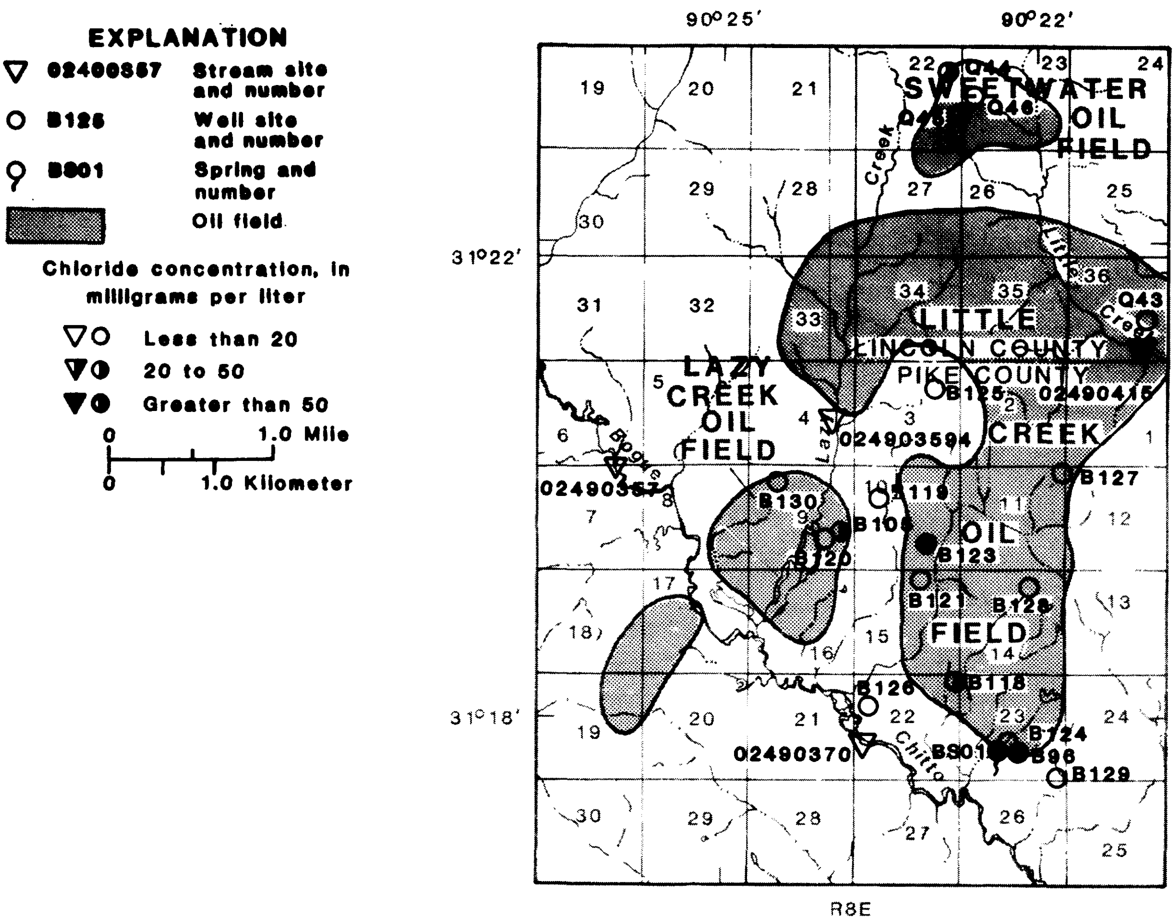


Figure 19.--Chloride concentrations at ground-water and surface-water sites in subarea B, 1981-1982.



Base map from U.S. Geological Survey McComb North 1:24,000, 1972 Pricedale 1:24,000, 1972

Oil field location from Mississippi State Oil and Gas Board (1981)

Figure 20.--Chloride concentrations at ground-water and surface-water sites in subarea C, 1981-82.

Summary and Conclusions

On the basis of increased mineralization, and in particular, increased chloride concentrations, it can be concluded that the shallow Citronelle and Miocene aquifers and some streams are contaminated by oil-field brines in the Brookhaven, Little Creek, Mars Hill, and McComb areas. The water quality of streams in these areas also is affected by inflow of oil-field brines.

Normally, concentrations of major dissolved ions are less than 10 mg/L in the Citronelle and shallow Miocene aquifers. Samples collected from 14 water wells in the Brookhaven oil field had chloride concentrations significantly greater than 10 mg/L, ranging from 20 to 980 mg/L.

Water from well G65, screened in the Citronelle aquifer, has a chloride concentration of 980 mg/L and is contaminated. A replacement well, G68, was drilled approximately 50 ft west to a depth of 308 ft and screened in a Miocene sand. The chloride concentration in this well is 20 mg/L. Although the water is of relatively good quality, the slightly increased chloride concentration suggests the potential for brine contamination in the Miocene aquifer. The chloride concentration from well G71 screened in the Miocene aquifer was 2.7 mg/L.

The slight increase in chloride concentration (23 mg/L) on Shaws Creek (07291230) during a period of low streamflow suggests that contaminated water from the Citronelle aquifer is entering Shaws Creek.

Descriptions of the ground- and surface-water sites in area 3 are given in tables 12 and 13, and the results of analysis of samples collected are given in tables 14 and 15.

STUDY AREA 4

Study area 4, located in south-central Mississippi, includes part of southern Marion, southern Lamar, southern Forrest, and northern Pearl River Counties (fig. 21). This area includes subarea A (Baxterville) and B (Pistol Ridge). The Baxterville subarea encompasses approximately 40 mi^2 including the Baxterville oil and gas field. The Pistol Ridge subarea includes approximately 30 mi^2 in a small corner of northeastern Pearl River and southwestern Forrest Counties.

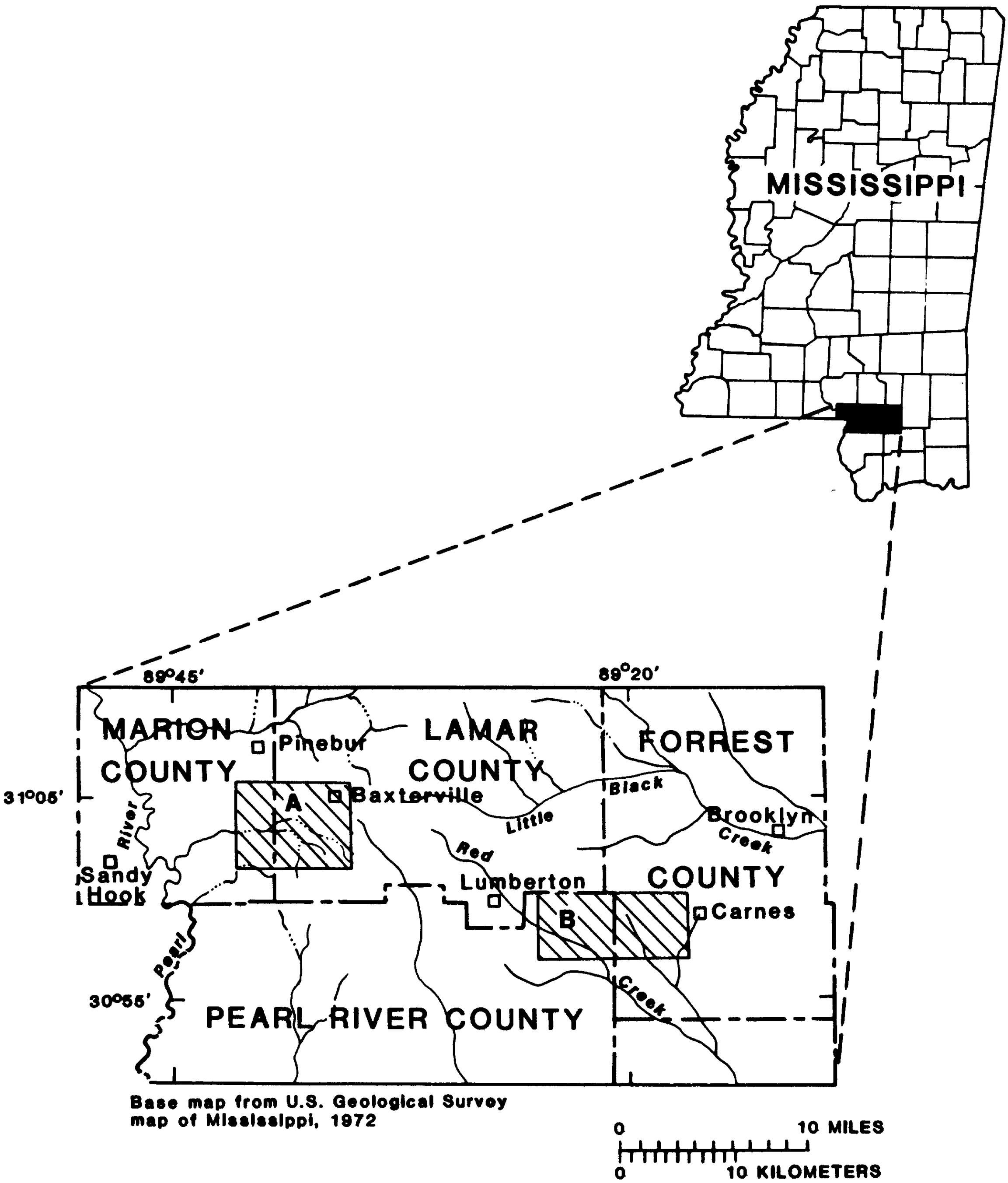


Figure 21.--Location of study area 4 showing subareas A (Baxterville) and B (Pistol Ridge).

Subarea A (Baxterville)

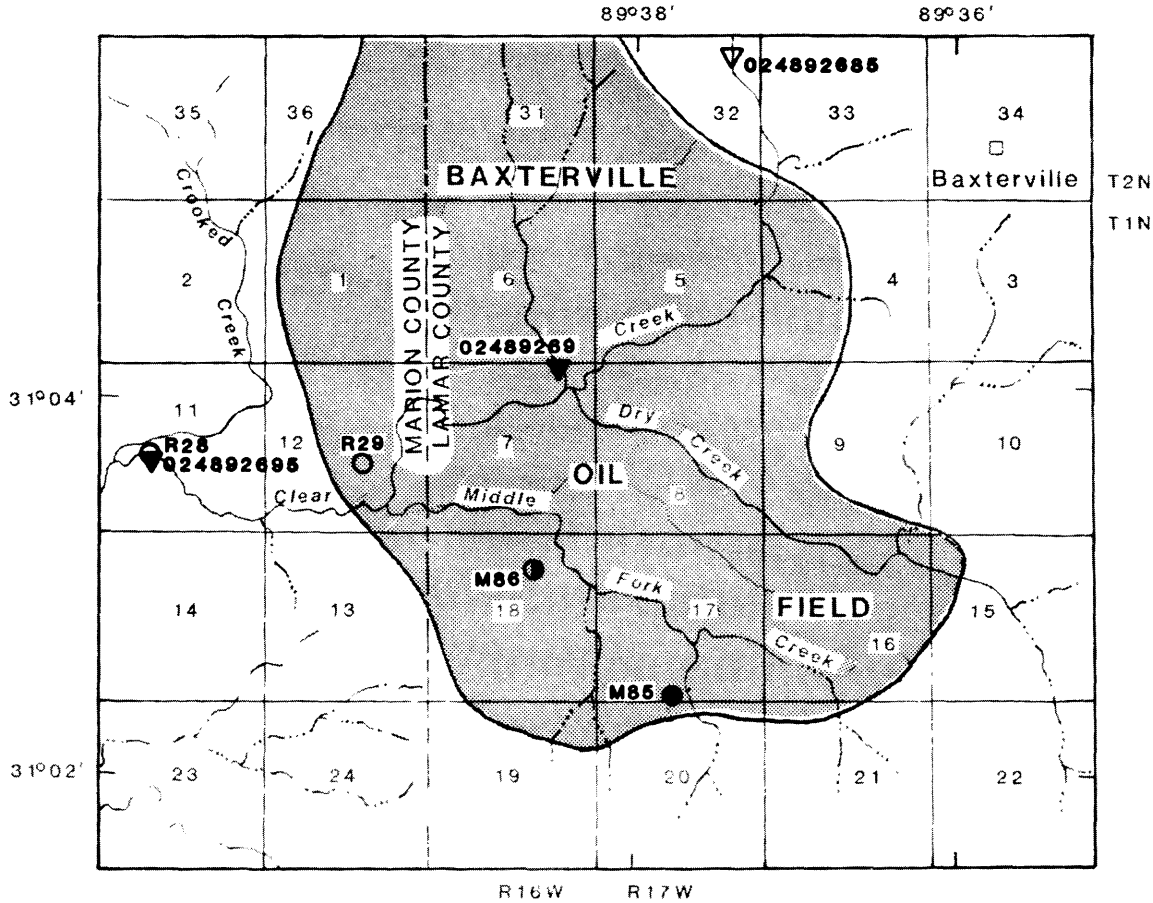
The water in Clear Creek became more mineralized as it flowed through study area 4 (fig. 22). Concentrations of all major dissolved ions except sulfate increased significantly. The water from Clear Creek near Baxterville (024892685), located upstream of the Baxterville oil field, was extremely low in dissolved solids; calcium and magnesium concentrations were less than 1.0 mg/L; sodium, chloride, and sulfate concentrations were less than 5.0 mg/L; and concentrations of bromide (0.07 mg/L) and strontium (8 µg/L) were low during the study. Downstream of Baxterville oil field, the water from Clear Creek near Pinebur (024892695) was more mineralized. Although sulfate concentrations increased, they were less than 5.0 mg/L. Calcium concentrations increased to 23 mg/L, sodium concentrations increased to 59 mg/L, and chloride concentrations increased to 150 mg/L. Concentrations of bromide (1.8 mg/L) and strontium (750 µg/L) also increased significantly.

Inflow of water from an unnamed tributary of Clear Creek (02489269) is one source of highly mineralized water. The water at this site had a specific conductance of 1,070 µS/cm, a calcium concentration of 40 mg/L, a sodium concentration of 150 mg/L, and a chloride concentration of 320 mg/L. The bromide concentration was 2.89 mg/L and the strontium concentration was 1,500 µg/L.

Only four shallow water wells were available for sampling in the Baxterville subarea. Water in several other shallow wells reportedly had become salty and the wells were destroyed. Water from Lamar County well M85 was high in dissolved solids, as indicated by the specific conductance of 1,450 µS/cm. Concentrations of the major ions were greater than 20 mg/L. The chloride concentration was 430 mg/L and bromide and strontium concentrations were 3.0 mg/L and 610 µg/L, respectively. A water sample from Lamar County well M86 had a lower dissolved-solids concentration. Concentrations of all major ions were less than 10 mg/L except chloride. The chloride concentration was 24 mg/L.

Subarea B (Pistol Ridge)

Results of the chemical analyses of samples collected from sites on four tributaries of Red Creek indicate that the water in streams draining Pistol Ridge oil field is generally soft (hardness as $CaCO_3$ ranges from 20 to 40 mg/L), slightly acidic (pH ranges from 4.9 to 5.9 units), and has a moderate concentration of dissolved solids as indicated by specific conductance that ranged from 150 to 309 µS/cm. The predominant ions in solution were sodium and chloride. The concentration of of sodium ranged from 13 to 34 mg/L and the concentration of chloride ranged from 38 to 77 mg/L (fig. 23), resulting in a sodium to chloride ratio that ranged from 0.34 to 0.47. Bromide concentrations ranged from 0.22 to 0.59 mg/L and strontium concentrations ranged from 48 to 370 µg/L.



Base map from U.S. Geological Survey
Baxterville 1:24,000, 1969
Baxterville SW 1:24,000, 1969

Oil field location from Mississippi
State Oil and Gas Board (1981)

EXPLANATION

▽ 024892685 Stream site and number

○ R28 Well site and number

Oil field

Chloride concentration, in milligrams per liter

▽○ Less than 20

20 to 50

Greater than 50

0 — 1.0 Mile

0 — 1.0 Kilometer

Figure 22.--Chloride concentrations at ground-water and surface-water sites in subarea A, 1981-82.

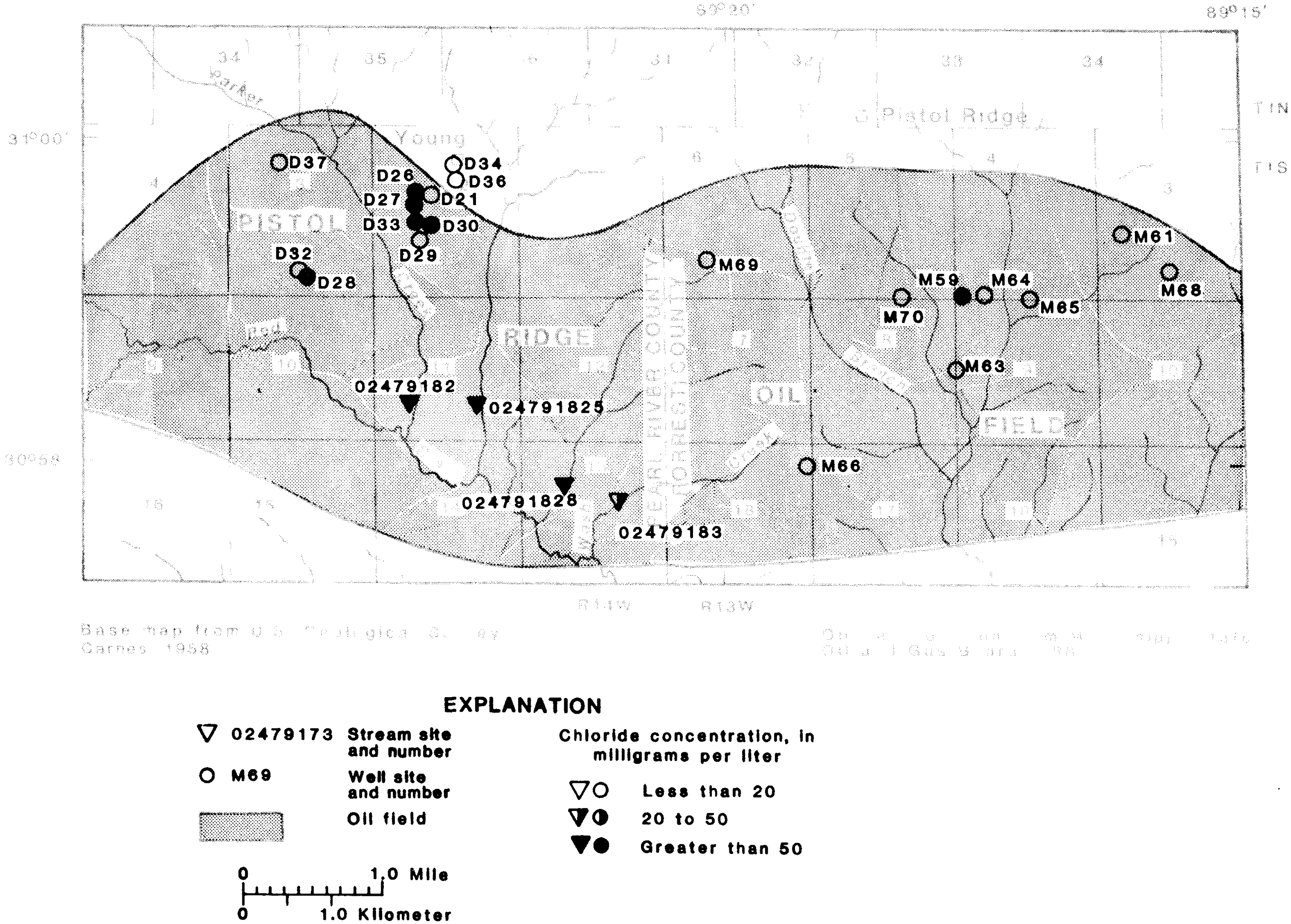


Figure 23.--Chloride concentrations at ground-water and surface-water sites in subarea B, 1981-82.

In two areas in the Pistol Ridge oil and gas field in Pearl River County, the Citronelle aquifer was more mineralized than normal (fig. 23). Water from wells D21, D29, D34, and D36 near Young had a low specific conductance (less than 100 µS/cm) and chloride concentrations less than 10 mg/L and is considered representative of the uncontaminated (normal) shallow water of the Citronelle aquifer in area 4. In contrast, water from wells D26, D27, D30, and D33 was more highly mineralized. The water from these four shallow wells was moderately-hard to very hard (hardness as $CaCO_3$ ranged from 82 to 540 mg/L), acidic (pH ranged from 3.6 to 4.5 units), and specific conductances ranged from 445 to 2,500 µS/cm. Sodium and chloride were the predominant ions and their ratios ranged from 0.28 to 0.43. However, calcium and magnesium concentrations also were significantly greater than in the uncontaminated wells. Bromide and strontium concentrations in well D27 were 5.38 mg/L and 1,600 µg/L, respectively. The second area of more highly mineralized Citronelle ground water is in section 3, immediately west of Parker Creek. The chloride concentration is 98 mg/L in a sample from well D28. A well located approximately 0.2 mi north of D28 was reportedly abandoned due to saltwater contamination. Two other wells, D32 and D37, in section 3, yielded water with chloride concentrations less than 20 mg/L.

The Citronelle aquifer in an area of the Pistol Ridge oil and gas field in Forrest County contained more highly mineralized water than water from the Citronelle in other areas of Forrest County. A sample from well M60 had a specific conductance of 2,240 µS/cm, a sodium concentration of 160 mg/L, and a chloride concentration of 690 mg/L. Minor ions, bromide (4.57 mg/L) and strontium (1,400 µg/L) were also present in large concentrations. Two shallow wells in the immediate area of well M60 were reported to produce "salty" water; however, one well had been destroyed and field personnel were unable to sample the other. Water samples from Citronelle wells in other areas of Forrest County had specific conductance values less than 100 µS/cm and chloride concentrations less than 20 mg/L (fig.23). Two wells M59 and M64 screened in the Miocene aquifer system in Forrest County yielded water that had specific conductance values greater than 100 µS/cm; however, the chloride concentrations were less than 5 mg/L.

Summary and Conclusions

Both ground and surface waters are contaminated in the Baxterville oil and gas field. Descriptions of the ground- and surface-water sites in area 4 are given in tables 16 and 17 and the results of analysis of samples collected at these sites are given in tables 18 and 19. One or more shallow aquifers (less than 300 ft in depth) in the study area are contaminated as indicated by chloride concentrations exceeding 20 mg/L in samples from two of four wells. Chloride concentrations in Clear Creek increased from less than 20 mg/L at site 024892685 upstream of the oil field to 150 mg/L at site 024892695 downstream of the oil field.

Chemical analyses of samples collected from four shallow wells screened in the Citronelle aquifer near Young in Pearl River County indicate brine contamination. Two streams, Parker Creek and an unnamed creek, are also being contaminated by inflow of the contaminated ground water as shown by the significant increase in chloride concentration through the oil field. Downstream, Dry and Wash Creeks also contained moderate concentrations of chloride, indicating that they also are draining areas where the Citronelle aquifer is contaminated.

The Citronelle aquifer is contaminated by oil-field brines in three areas in the Pistol Ridge oil and gas field in Forrest County. One well has a chloride concentration of 690 mg/L, and it was reported that several other wells in the immediate area were abandoned because they produced "salty" water. Shallow Citronelle wells and deeper wells screened in the Miocene aquifer within about 1.5 mi of the contaminated area are not contaminated. Consequently, it appears that brine contamination, at the present time, is confined to a relatively small area of the Citronelle aquifer in Forrest County, but contamination of several streams indicate that the shallow aquifer probably is contaminated in other areas. However, it appears that the contamination has not yet migrated to the deeper Miocene aquifer system.

STUDY AREA 5

Study area 5, located in southeastern Mississippi, includes Clark and Jasper Counties and the northern half of Jones and Wayne Counties (fig. 24). This area of approximately 2,000 mi^2 includes numerous oil fields. The study area is drained by the Chickasawhay River and tributaries and by tributaries of the Leaf River. Two smaller areas of ground-water contamination were identified within the Chickasawhay River drainage basin and are discussed as separate topics. The Subarea A (East Yellow Creek) is located in north-central Wayne County in the East Yellow Creek oil field. The Subarea B (Terrell Creek) is partially located in southeastern Jasper County and northeastern Jones County in the Bryan oil field.

Leaf River Drainage Basin

Several Leaf River tributaries entering the Bogue Homo, Tallahala, Tallahoma, and Big Creeks were more mineralized than other streams in the area (fig. 25).

Four streams were sampled in the Bogue Homo drainage basin; Prairie Creek near Heidelburg (02474569), Old Julie Branch near Sandersville (024745735), Reedy Creek at Sandersville (02474574), and Terrell Creek near Sandersville (024745785). Specific conductance of samples from all sites ranged from 184 to 750 µS/cm. The chloride concentrations ranged from 150 to 160 mg/L at all sites except Reedy Creek where the concentration was 35 mg/L. At sites where the chloride concentrations were 150 mg/L or greater, bromide concentrations ranged from 0.86 to 1.6 mg/L. The strontium concentrations were 790 and 1,100 µg/L on Prairie and Terrell Creeks, respectively.

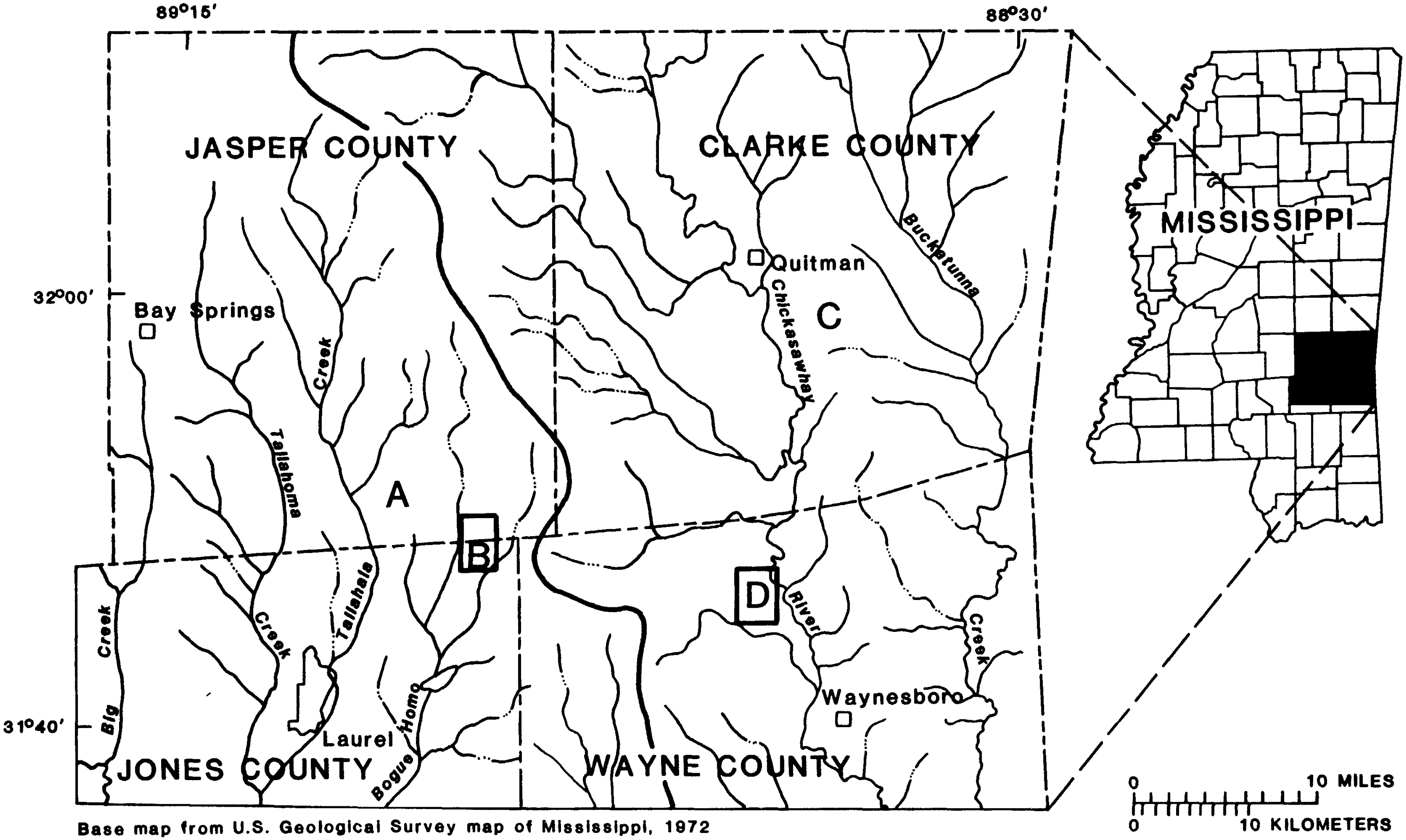


Figure 24.--Location of study area 5 showing subarea A (Leaf River drainage basin), B (Terrel Creek), C (Chickasawhay River drainage basin), and D (East Yellow Creek).

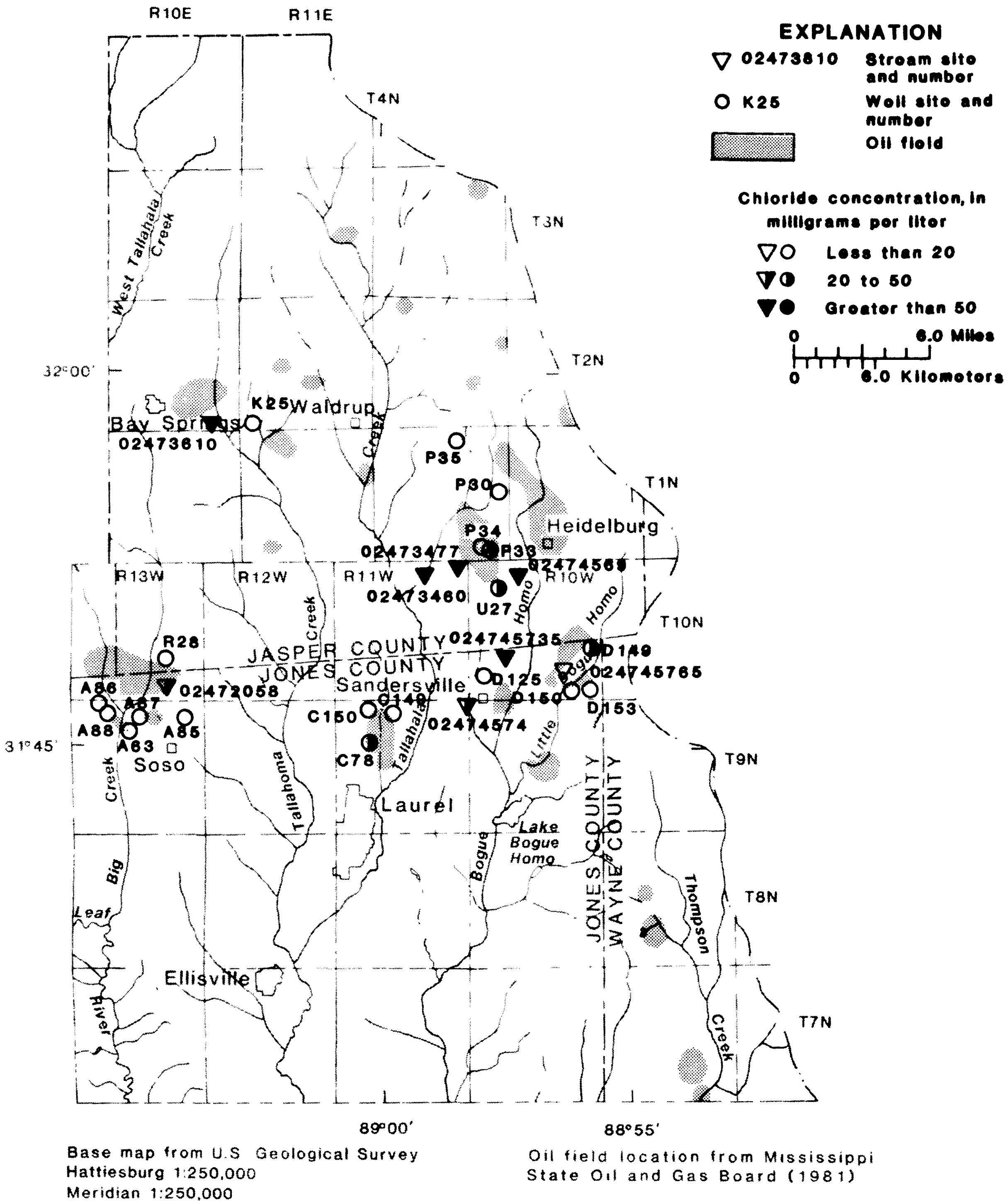


Figure 25.--Chloride concentrations at ground-water and surface-water sites in subarea A, 1981-82.

The U.S. Geological Survey measured water temperatures, specific conductance, and pH during the period 1965 to 1973 at Tallahatta Creek near Waldrup (02473480). The specific conductance was generally greater than 400 µS/cm and ranged from 50 to 4,300 µS/cm. During the current study, the specific conductance was 392 µS/cm, the chloride concentration was 87 mg/L, and the sodium to chloride ratio was 0.44. One source of highly-mineralized water in Tallahatta Creek is inflow from Horse Branch (02473477). A sample collected from this site had a specific conductance of 2,290 µS/cm, chloride concentration of 760 mg/L, bromide concentration of 3.62 mg/L, and strontium concentration of 4,100 µg/L.

An unnamed stream near Bay Springs (02473810) in the Tallahoma Creek drainage basin was sampled during the study. The specific conductance of the water was 310 µS/cm and the chloride concentration was 61 mg/L. Plant Branch near Soso (02472058) in the Big Creek drainage basin was also sampled. The specific conductance at this site was 117 µS/cm and the chloride concentration was 27 mg/L.

Chickasawhay River Drainage Basin

Water samples were collected at two sites on the Chickasawhay River (fig. 26) in August 1982. The site on Chickasawhay River at Enterprise (02477000) was located upstream of the study area in an area of no known oil production. The site on Chickasawhay River near Waynesboro (02477500) was located downstream of most oil-producing areas.

Results of the analyses of samples collected in 1982 in both areas indicate that dissolved-solids concentrations increased slightly downstream from the Chickasawhay River at Enterprise to the Chickasawhay River near Waynesboro (02477500). Specific conductance increased from 74 to 121 µS/cm. Concentrations of all major ions, except magnesium, increased downstream but were 10 mg/L or less. Strontium concentrations increased from 58 to 120 µg/L and bromide concentrations remained essentially unchanged, 0.03 and <0.04 µg/L, respectively.

Water-quality data collected by the Geological Survey at these sites prior to the study indicate that dissolved-solids concentrations generally were significantly greater downstream than upstream. The specific conductance ranged from 39 to 122 µS/cm from 1959 to 1975 at the upstream site and from 48 to 936 µS/cm, (1963-65), at the downstream site. Concentrations of the major ions ranged from less than 10 to 36 mg/L in the Chickasawhay River at Enterprise and from less than 10 to 280 mg/L in the Chickasawhay River near Waynesboro.

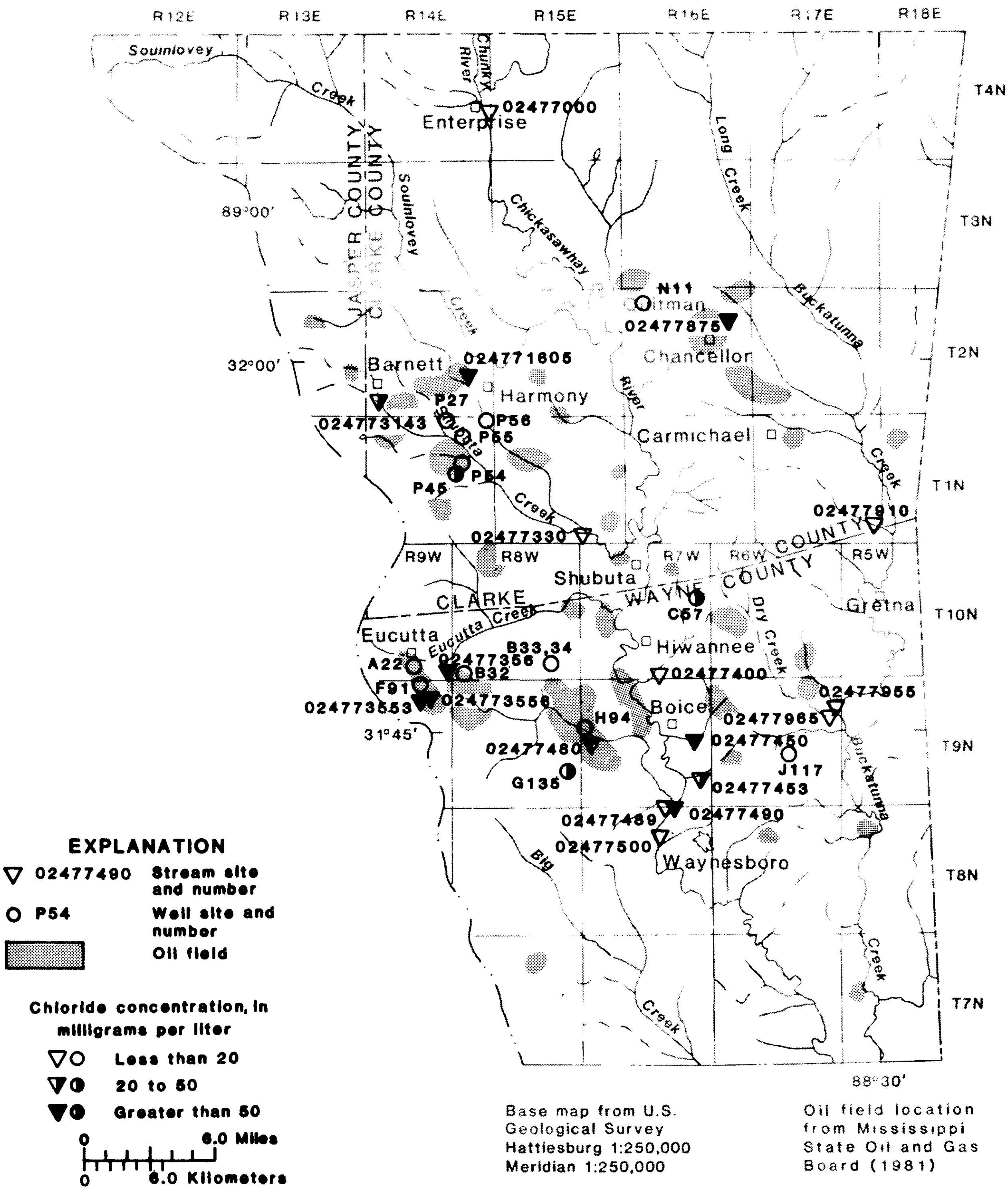


Figure 26.--Chloride concentrations at ground-water and surface-water sites in subarea C, 1982.

Regression equations can be used to estimate major ion concentrattions when only the specific conductance of a sample is known. Statistical analysis of water-quality data in the Chickasawhay River near Waynesboro indicates a good relationship (correlation coefficient of 0.99) between specific conductance and the chloride concentration (fig. 27). The equation of the line of best fit by least square regression analysis is:

$$\text{Chloride concentration} = 0.29 \text{ (specific conductance)} - 17$$

where: Chloride concentration is in milligrams per liter and specific conductance is in microsiemens per centimeter

When the specific conductance value is less than 100 µS/cm the linear relationship for chloride does not apply.

Using the above regression equation, daily chloride concentrations from October 1963 to September 1974 for the Chickasawhay River near Waynesboro (02477500) were calculated. A plot of the resultant chloride values (fig. 28) indicated that dissolved chloride concentrations generally varied inversely with gage height; that is, chloride concentrations decreased with increasing gage height and increased with decreasing gage height. Generally, chloride concentrations in the months of normally low streamflow, (October, November, and December), were greater than 100 mg/L. Higher chloride concentrations usually occurred during a period of a small rise in gage height. As there is a poor relationship between specific conductance and chloride concentration when the specific conductance of a sample is less than 100 µS/cm, chloride concentrations of 10 mg/L or less were omitted from the plot. Chloride concentrations were generally less than 100 mg/L from January to May and were less than 10 mg/L during periods of higher discharge (March, April, and May). Between April and September of 1964, chloride concentrations were greater than 100 mg/L, but were generally lower during periods of increased discharge.

Water-quality data collected during the study and data previously collected by the Mississippi Bureau of Geology indicate that the increased mineralization of the Chickasawhay River through the study area is caused, at least in part, by the inflow of highly mineralized water from tributaries draining oil fields (fig. 26). During the study period, the specific conductance of water ranged from 32 µS/cm on Sandy Creek near Waynesboro (02477489), a stream whose drainage area contains only one known oil well, to 1,050 µS/cm on Little Eucutta Creek near Eucutta (02477356), a stream draining an area of numerous oil wells.

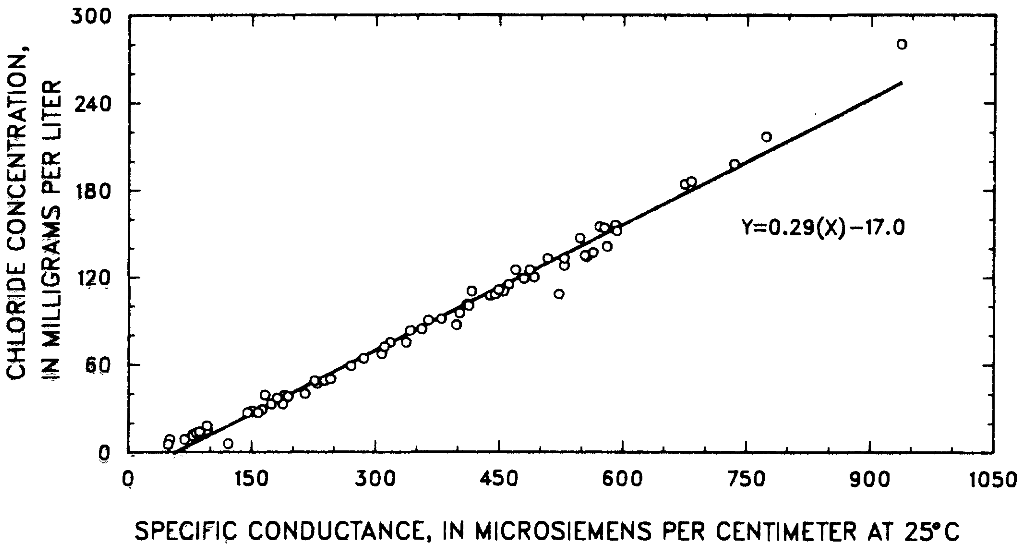


Figure 27.--Specific conductance versus chloride concentrations in the Chickasawhay River near Waynesboro (02477500), 1963-64.

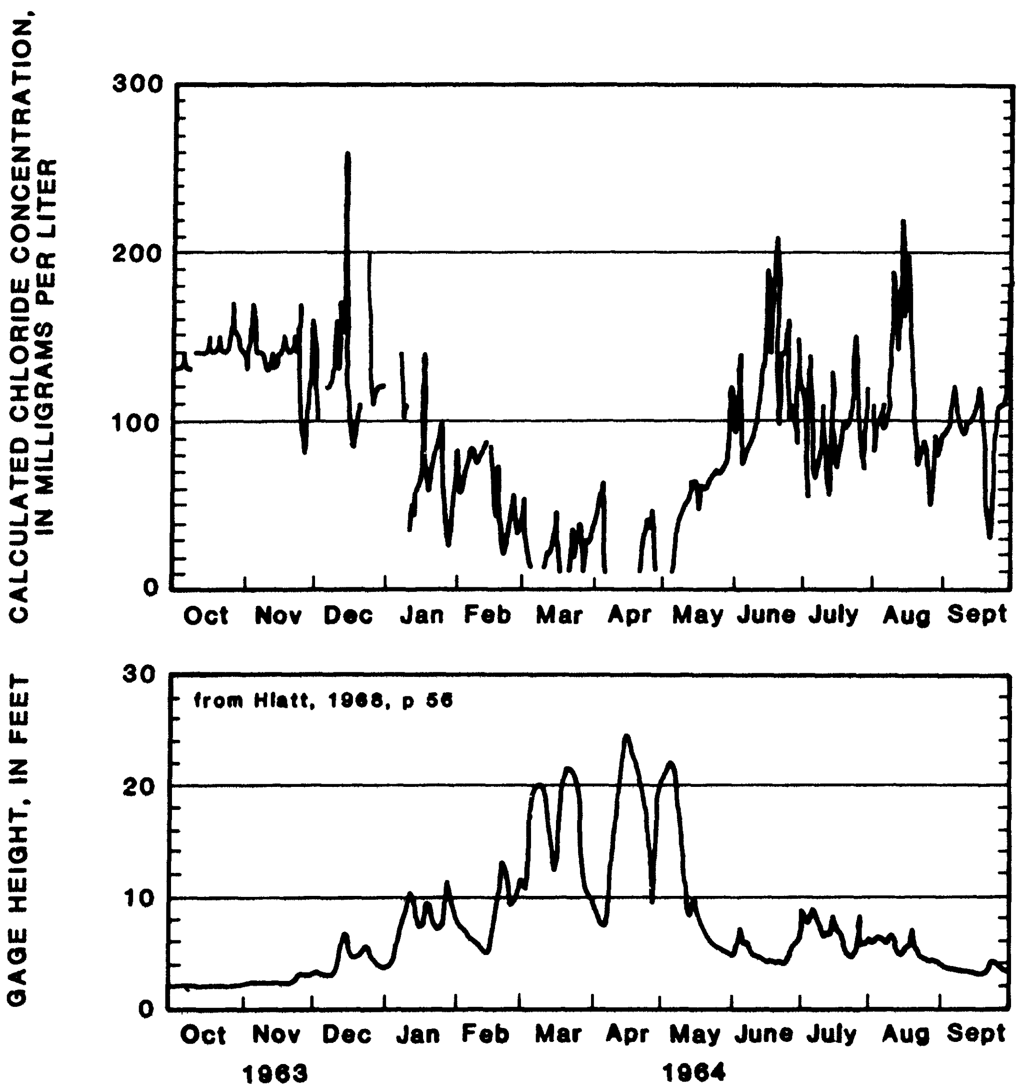


Figure 28.--Calculated chloride concentrations and gage height in the Chickasawhay River near Waynesboro (02477500), October 1963-64.

The quality of water the Sandy Creek is representative of the water in uncontaminated streams that drain outcrops of the Catahoula Sandstone. The water is soft (hardness as $CaCO_3$, 8 mg/L), slightly acidic (pH of 5.9), and has a low dissolved-solids concentration indicated by a specific conductance of 32 µS/cm. Concentrations of major dissolved ions is less than 10 mg/L and the sodium to chloride ratio is 0.68. Minor elements, bromide (0.05 mg/L) and strontium (16 µg/L) are present in small concentrations.

The water in tributaries that drain oil fields is generally more mineralized, as indicated by greater specific conductance, than water in Sandy Creek. Samples collected at two streams in Clarke County, an unnamed creek near Harmony (024771605) and Castaffa Creek at Barnet (024773143), were more mineralized, having specific conductances of 390 and 205 µS/cm, respectively. At the unnamed Creek near Harmony, the sodium concentration was 39 mg/L and the chloride concentration was 100 mg/L, resulting in a sodium to chloride ratio of 0.39. On Castaffa Creek at Barnet, the sodium and chloride concentrations were 18 and 48 mg/L, respectively. Although Shubuta Creek near Shubuta (02477330) drains several oil fields, the water had a specific conductance of 85 µS/cm and a chloride concentration less than 10 mg/L in 1982. The specific conductance of water on Shubuta Creek near Shubuta ranged from 44 to 65 µS/cm in 10 samples collected during low flow in 1967.

Water in streams draining the Yellow Creek and Eucutta oil fields in Wayne County were relatively high in dissolved minerals. The specific conductance of three samples collected at Tampa Creek near Eucutta (024773553), Wagon Branch near Eucutta (024773556), and Little Eucutta Creek near Eucutta (02477356) in the Eucutta oil field ranged from 395 to 1,050 µS/cm, the chloride concentrations ranged from 110 to 300 mg/L, and sodium to chloride ratios from 0.44 to 0.50, respectively. Bromide concentrations were 2.55 and 2.18 mg/L and strontium concentrations were 1,400 and 1,800 µg/L on Tampa Creek and Wagon Branch, respectively. During a low-flow period in 1973, the Mississippi Bureau of Geology found that the specific conductance ranged from 80 to 7,000 µS/cm and chloride concentrations ranged from 23 to 2,545 mg/L in six streams in the Eucutta oil field (Baughman, and McCarty, 1974, p. 280). The specific conductance of two water samples collected at Silver Creek near Boyce (02477480) and Yellow Creek at Waynesboro (02477490) on streams draining Yellow Creek oil fields was 735 and 346 µS/cm, respectively, and the chloride concentrations were 210 and 87 mg/L, respectively. The sodium to chloride ratios were 0.57 and 0.48, respectively, for the samples collected at the sites on Silver and Yellow Creeks. The Mississippi Bureau of Geology found, during a low-flow period in 1973, that the specific conductance ranged from 170 to 1,100 µS/cm and chloride concentrations ranged from 55 to 410 mg/L in six samples from streams flowing through Yellow Creek oil field (Baughman and McCarty, 1974, p. 280-281).

Two other Chickasawhay River tributaries that drain oil fields, Hortons Mill and Limestone Creeks, were more highly mineralized than Sandy Creek. The specific conductance was 510 µS/cm at Hortons Mill Creek near Waynesboro (02477450) and 275 µS/cm at Limestone Creek (02477453). The chloride concentration was 110 and 38 mg/L at these sites, respectively.

In August 1973, the specific conductance (2,500 µS/cm) and chloride concentrations (930 mg/L) were significantly greater in Hortons Mill Creek than during the current study (Baughman and McCarty, 1974 p. 281).

During the study, water-quality samples were collected at four sites on tributaries of Buckatunna Creek. The dissolved-solids concentration in Long Beach at Chancellor (02477875) was high. The specific conductance of the water was 1,750 µS/cm, chloride concentration was 480 mg/L, and the sodium concentration was 200 mg/L. The sodium to chloride ratio was 0.42. Concentrations of bromide (4.7 mg/L) and strontium (3,600 µg/L) were high. In the three other streams, Hanging Moss Creek near Carmichael (02477910), Cypress Creek near Gretna (02477955), and Dry Creek near Gretna (02477965), the specific conductance ranged from 100 to 276 µS/cm sodium concentrations ranged from 4.9 to 8.7 mg/L, and chloride concentrations were less than 20 mg/L.

The quality of shallow ground water in Chickasawhay Drainage basin is generally good. The dissolved-solids concentrations varied from aquifer to aquifer, ranging from extremely low concentrations (as indicated by a conductance of 60 µS/cm in Wayne County well F91) in the Catahoula aquifer of the Miocene aquifer system to moderately-high (as indicated by a conductance of 700 µS/cm in Clarke County well P55) in the Cockfield aquifer. Differences in chemical composition are readily apparent; sodium and bicarbonate are the predominant ions in both the Catahoula and Cockfield aquifers, whereas, calcium and bicarbonate ions predominate in the Vicksburg aquifer. Chloride concentrations generally were less than 20 mg/L (fig. 26).

The water from well F91 in Wayne County (fig. 26) is representative of the water quality of the Catahoula aquifer in the outcrop area. The water is soft (hardness as $CaCO_3$ was 11 mg/L), acidic (pH of 4.9 units) and is low in dissolved-solids concentrations (as indicated by a specific conductance of 60 µS/cm). Concentrations of all major dissolved ions are less than 10 mg/L. Specific conductance of samples from numerous other wells completed in the Catahoula aquifer were low (less than 100 µS/cm) and chloride concentrations were less than 10 mg/L. However, a sample from well G135 in Wayne County had a specific conductance slightly higher (122 µS/cm) than well F91. The chloride concentration in the sample was 29 mg/L and the sodium to chloride ratios was 0.45.

Subareas A (East Yellow Creek) and B (Terrell Creek)

Samples from shallow wells screened in the Vicksburg aquifer in two areas, in north-central Wayne County near East Yellow Creek oil field and extreme southeastern Jasper County in Bryan oil field, were more mineralized than water from Jasper County well U28 (fig. 29). The water from well U28 is probably representative of the water in the shallow Vicksburg aquifer in Jasper County. The water is hard (hardness as $CaCO_3$ is 122 mg/L), has a neutral pH (pH was 6.9 units) and has a moderate amount of dissolved soleds as indicated by a specific conductance of 274 µS/cm. Calcium (47 mg/L) and bicarbonate (calculated to be 145 mg/L) are the predominant ions in solution.

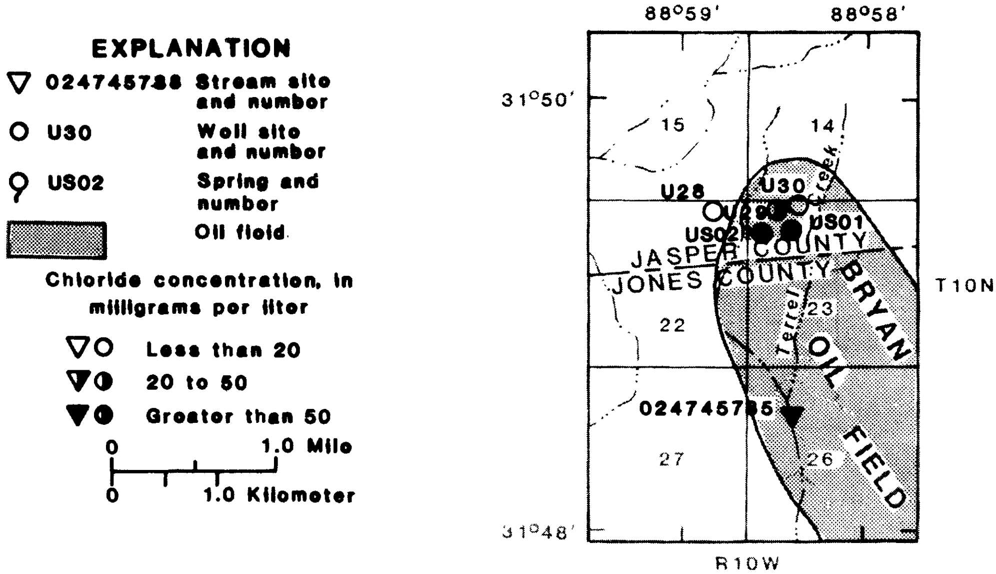
The chloride concentrations were greater than 20 mg/L in wells H46 and H196 in East Yellow Creek oil field in Wayne County (fig. 30). All major ions in well H196 exceeded 10 mg/L and two minor ions, bromide (13 mg/L) and strontium (10,000 µg/L) were present in large quantities. All major ions in samples from wells H46 and H196 (except magnesium in well H46) exceeded 10 mg/L. The bromide concentration was 1.07 mg/L in a sample from well H46. Chloride concentrations in well H11, located on the fringe of East Yellow Creek oil field, and from well H16, in the oil field, were less than 20 mg/L.

The chloride concentrations in samples from two springs in the Terrel Creek drainage (fig. 29) were 1,000 mg/L or greater, and was greater than 20 mg/L in one well in the northern part of Bryan oil field. In spring US01, the bromide concentration was 8.80 mg/L and the strontium concentration was 7,600 µg/L. The sample from spring US02 had a bromide concentration of 49 mg/L and a strontium concentration of 45,000 µg/L.

Summary and Conclusions

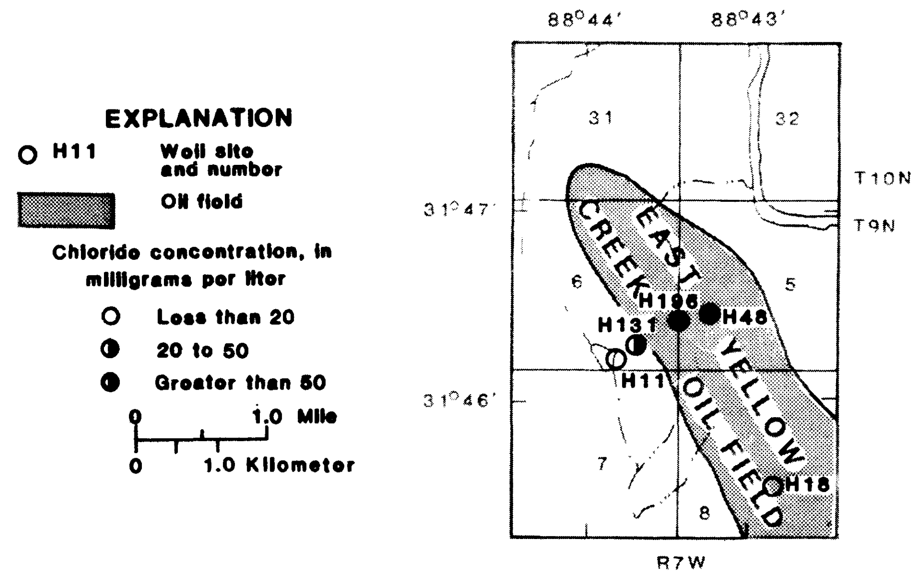
Generally, water in streams draining oil fields in study area 5 is more mineralized (chloride concentrations greater than 20 mg/L) than in streams draining areas of little or no oil production, indicating that many streams in area 5 are contaminated by oil-field brines. Numerous streams in the Chickasawhay drainage basin are contaminated as are streams draining into tributaries of the Leaf River. Inflow of contaminated shallow ground water is one source of contamination. Localized contamination of the Catahoula and Vicksburg aquifers was found in study area 5.

Descriptions of the ground- and surface-water sites in study area 5 are given in tables 20 and 21 and the results of analyses of samples collected at these sites are given in tables 22 and 23.



Base map from U.S. Geological Survey
Hiedelburg SW, 1:24,000, 1964
Oil field location from Mississippi State
Oil and Gas Board (1981)

Figure 29.--Chloride concentrations at ground-water and surface-water sites in subarea B, 1981-82



Base map from U.S. Geological Survey
Shubuta 1:24,000, 1964
Oil field location from Mississippi State
Oil and Gas Board (1981)

Figure 30.--Chloride concentrations at ground-water sites in subarea D, 1981-82.

Water-quality data from Chickasawhay River (02477000) upstream of most oil fields and Chickasawhay River (02477500) downstream of many oil fields in Wayne and Clarke Counties indicate that the river has been contaminated for several years in the study area. The dissolved solids concentration is consistently greater at the downstream site. Chloride concentrations generally were less than 10 mg/L at the upstream site and were generally greater than 20 mg/L at the downstream site. During the period October 1963 through September 1964, chloride concentrations at the upstream site ranged from less than 10 mg/L during periods of the greatest discharge to more than 100 mg/L during low-flow periods. It appears that brines were entering Chickasawhay River throughout the 1-year period, although chloride concentrations were low during periods of high streamflow when daily samples were collected. During the study period, the water quality at the upstream site was not significantly different than at the downstream site; therefore, the amount of brines now entering the Chickasawhay River may be less than in previous years.

Although the water quality is not significantly different at the upstream and downstream sites on the Chickasawhay River, several streams flowing into the Chickasawhay River below the upstream site were found to be contaminated during the study. Chloride concentrations greater than 20 mg/L and sodium to chloride ratios similar to those for brines indicate that water in an unnamed stream near Harmony, and Castaffa Creek in Clarke County; and Horse Branch, Tampa, Little Eucutta, Silver, Yellow, Hortons Mill, and Limestone Creeks in Wayne County are contaminated. Higher bromide and strontium concentrations than in Sandy Creek tend to confirm that brines enter Wagon Branch, Little Eucutta, Hortons Mill, and Silver Creeks.

Some contaminants in Silver Creek may originate from the inflow of contaminated shallow ground water. Well G135 located in the vicinity of Yellow Creek oil field yielded water that contained a greater than normal chloride concentration (29 mg/L). Thus, to some extent, the contaminated shallow ground water present in this area may be entering Silver Creek through seeps and springs.

Four streams in the Bogue Homa (a Leaf River tributary) drainage basin were found to be contaminated during the study. The chloride concentrations were greater than 20 mg/L in all streams. The presence of an industrial facility located immediately upstream of site Old Julie Branch (024745735) and a sodium to chloride ratio greater than 0.65 suggests that the increased mineralization of water at the site is probably not directly caused by oil-field brines. Increased mineralization of Terrell Creek is caused, at least in part, by inflow of highly-contaminated water issuing from a spring. Field personnel observed discharge from Jasper County spring US02 and water well U29 were also contaminated and chloride concentrations greater than 20 mg/L. Water from two nearby uncontaminated wells (chloride concentration less than 10 mg/L) indicate that contamination of shallow ground water is not widespread in the northern part of Bryan oil field.

Two streams in the Tallahala Creek drainage basin were contaminated. Tallahala Creek (02473480) and Horse Branch (02473477) contained chloride concentrations greater than 20 mg/L. The water samples from an unnamed stream (02473810) that flows through Bay Springs oil field and Plant Branch near Soso (02472058) had chloride concentrations of 61 and 27 mg/L, respectively.

SUGGESTIONS FOR ADDITIONAL STUDY

Water-quality data collected during and prior to the study show that areas of contaminated ground water are present in the oil and gas producing areas of Mississippi that were investigated. Contaminated ground water is a problem to well owners and it needs to be determined whether the area is large or small or whether it affects a few or many people; however, some contaminated areas are of immediate concern. Before remedial action can be taken, additional data may be needed to better define the geohydrology of an area, to delineate the full extent of brine contamination, and to establish the direction and rate of movement before individuals, municipalities, and industries can implement plans to protect aquifers for present and future water supplies.

The criteria used to assign priorities for more detailed studies of contaminated areas are:

(1) The population affected or potentially affected by brine contamination. This consideration is both a function of the size of the contaminated area and population density in the area.

(2) The proximity of the contaminated areas to nearby cities and communities that are dependent on ground-water supplies.

Listed below are the areas that meet the criteria for more detailed studies.

Tinsley oil field--Data indicate that the shallow Citronelle aquifer and the deeper Sparta aquifer are contaminated in large parts of the oil field. Individuals living in the area reported that shallow wells were abandoned and subsequently destroyed when the water became too salty to use. Contamination of two aquifers in this area limits the availability of freshwater; therefore, there is a need for a geohydrologic study to determine the extent, direction, and rate of movement of contamination.

Adams County--Although ground water in deep aquifers in Adams County was not found to be contaminated, there are numerous areas where shallow wells and streams are contaminated. Furthermore, contaminated water in streams during low flow suggests that additional areas not identified may be contaminated. Most domestic, municipal, and industrial water in Adams County is supplied by wells screened in the deeper (400-900 ft) Miocene aquifers; however, several community water systems obtain water from wells that are less than 300 ft deep. Contamination in the shallow aquifers poses a threat to deeper aquifers where aquifers are hydraulically connected. At present, oil-field brines are posing a problem to industries withdrawing water from the Mississippi River valley alluvial aquifer.

Brookhaven oil field--This field includes the largest area of contaminated ground water found during this study. The Citronelle aquifer is contaminated in at least a 10 mi^2 area in the Brookhaven subarea. The inhabitants in this area commonly obtain water from shallow wells screened in the Citronelle Formation. A hydrologic connection may exist between the Citronelle aquifer and underlying shallow Miocene aquifers. If so, contaminated water migrating to the relatively shallow Miocene aquifer can pose a threat to wells tapping this aquifer for water supply.

Baxterville oil field.--Parts of the Citronelle aquifer are contaminated in the vicinity of the oil field. Migration of brine in the Citronelle aquifer can endanger the water supply of this area.

Pistol Ridge oil field--Several generally small areas of the Citronelle aquifer in the oil field are contaminated. Higher than normal chloride concentrations in small streams suggests that other areas are also contaminated. Inhabitants in this area commonly depend upon the Citronelle aquifer for their water supplies. The geohydrology of the area needs to be studies to delineate the extent, direction, and rate of movement of the contamination.

Other subareas--In several other areas, shallow ground water was found to be contaminated. Ground-water contamination was found in the Little Creek area in Pike County, East Yellow Creek oil field in Wayne County, Mars Hill area in Amith County, Cannonsburg area in Jefferson County, and near Knoxville in Franklin County. Numerous streams draining oil fields were contaminated at low flow, indicating additional areas of potential contamination that may require further study in the future.

Additional geohydrologic data are needed to determine if a brine-contamination problem, or potential problem, exists in the McComb oil field. Two wells in the Citronelle aquifer near McComb were contaminated. If the Citronelle and Miocene aquifers are hydrologically connected, migration of contaminated water into the Miocene aquifer could pose a threat to water supplies depending on this aquifer.

In summary, either surface or ground water (or both) are contaminated, to some extent, in every oil field where data were collected. Water supplies in other oil fields outside the five study areas are likely contaminated to some extent. Water-quality studies are needed in oil-producing areas to define extent and degree of contamination by oil field brines in water to plan for future water supplies and as an early warning of possible ground-water degradation.

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HYDROLOGIC DATA

Table 8.--Location and drainage area of surface-water sites in area 2

County	Site Number	Station Name	Location Lat	Location Long	Drainage Area(mi^2)
Adams	07290893	St. Catherine Creek at Washington, MS	313452	0911736	--
Adams	07290915	St. Catherine Creek at Linwood, MS	313104	0912433	
Adams	07293480	Pretty Creek nr Kingston, MS	312227	0911240	--
Adams	07293490	Sandy Creek nr Kingston, MS	312235	0911441	--
Adams	07294000	Second Creek at Sibley, MS	312325	0912346	55.3
Adams	07294500	Homochitto River nr Doloroso, MS.	311953	0912137	1120
Amite	07292180	Brushy Creek nr Bunkley, MS	312004	0905904	40.4
Franklin	07291000	Homochitto River at Eddiceton, MS	313010	0904635	180
Franklin	07291750	Middle Fork Homochitto River at Meadville	312805	0905432	156
Franklin	07292200	Richardson Creek nr Bunkley, MS	312146	0910120	16.2
Franklin	07293250	Wells Creek nr Garden City, MS	312204	0910855	79.1
Franklin	07291748	Tom Branch nr Meadville, MS	313117	0905538	
Jefferson	07290840	South Fork Coles Creek nr Cannonsburg	313833	0911058	40.6
Jefferson	07290850	Folkes Creek nr Cannonsburg, MS	313849	0910933	31.0
Jefferson	07290860	South Fork Coles Creek nr Fayette, MS	314450	0911050	107
Wilkinson	07292500	Homochitto River at Rosetta, MS	311920	0910620	750
Wilkinson	07292460	Foster Creek nr Crosby, MS	311730	0910452	31.1
Wilkinson	07293498	Crooked Creek nr Doloroso, MS	312107	0911456	--

Table 9.--Records of well in area 2

County	Well No.	Station ID.	Owner	Location Sec.	T.	R.	Altitude (ft)	Well depth (ft)	Water bearing Unit
Adams	A005	314321091194701	Chester Hoover	13	09N	02W	85	265	122CTHL
Adams	BS01	313857091222665	Ansley Spring				100	--	
Adams	B005	314149091210901	Richard Junkin	09	08N	02W	85	45	112TRCS
Adams	B025	313711091135301	J.T. Marsh	60	08N	01W	360	262	122CTHL
Adams	B026	313958091200201	Lamar Felter	NWNW30	08N	02W	270	200	122CTHL
Adams	D019	313400091210003	Oakland Wtr Wks	57	07N	02W	160	135	122MOCN
Adams	D033	313348091163501	T.L. James	NWNW47	07N	02W	340	447	122MOCN
Adams	D055	313538091202001	R.L. Hensley	19	07N	02W	190	170	122CTHL
Adams	D056	313415091192001	Rayborn Drilling	51	07N	02W	215	165	122CTHL
Adams	D057	313502091174601	St. Catherine Gravel	28	07N	02W	195	90	122CTHL
Adams	D060	313449091204801	R. Wilson	34	07N	02W	205	150	122MOCN
Adams	F013	312946091253401	Int Paper #13	SENW14	06N	03W	73	213	112MRVA
Adams	F014	312934091252701	Int Paper #14	NWSE14	06N	03W	73	220	112MRVA
Adams	F015	312922091252301	Int Paper #15	SENW20	06N	03W	77	212	112MRVA
Adams	F016	312850091260001	Int Paper #16A	SENE14	06N	03W	78	180	112MRVA
Adams	F017	312903091252901	Int Paper #17	SESE14	06N	03W	85	220	112MRVA
Adams	F018	312853091253201	Int Paper #18	NESE20	06N	03W	76	235	112MRVA
Adams	F020	312833091253401	Int Paper #20	19	06N	03W	100	253	122MOCN
Adams	F021	312924091255201	Int Paper #21A	SWNE14	06N	03W	79	215	112MRVA
Adams	F022	312807091253801	Int Paper #22	SWSW19	06N	03W	86	262	122MOCN
Adams	F023	312754091254801	Int Paper #23	SWSW19	06N	03W	75	250	122MOCN
Adams	F076	313050091243801	St. Cath Rdy Mix	NWNW07	06N	03W	107	65	122MOCN
Adams	F082	313000091252301	Floyd McCalip				160	266	122MOCN
Adams	F085	312808091250601	Mead Hufford				270	170	122MOCN
Adams	F086	312621091243701	Hugh Pearson III				220	169	122CTHL
Adams	F094	312630091225901	Int Paper Research	43	06N	03W	170	260	122MOCN
Adams	F101	312825091253801	Int Paper #21	19	06N	03W	85	234	112MRVA
Adams	F102	312739091254901	Int Paper #24	30	06N	03W	90	259	112MRVA
Adams	G007	312730091200602	Adams Co. W A	41	06N	02W	220	267	122HBRG
Adams	G008	312730091200601	Adams Co W A	41	06N	02W	220	267	122HBRG
Adams	G019	312751091202601	Adams Co. W A	41	06N	02W	245	140	122MOCN
Adams	G021	312752091202201	Adams Co. W A	41	06N	02W	223	880	122MOCN
Adams	G028	313014091164201	Luther Davis	24	06N	02W	270	165	122MOCN
Adams	H016	312820091121101	J. Willard	45	06N	01W	195	75	122MOCN

Table 9.--Records of wells in area 2--Continued

County	Well No.	Station ID.	Owner	Location Sec.	T.	R.	Altitude (ft)	Well depth (ft)	Water bearing Unit
Adams	H017	312823091120801	J. M. Thomas	45	06N	01W	205	160	122MOCN
Adams	H020	312812091123601	T. Hazel	45	06N	01W	180	100	122MOCN
Adams	H021	312745091120001	J. Carter	45	06N	01W	215	120	122MOCN
Adams	J006	312248091231201	Jerome Arnold	NWNW23	05N	03W	140	125	122MOCN
Adams	J026	312323091244001	Johnie Brown	15	05N	03W	215	214	122MOCN
Adams	J031	312520091243701	Pierce-Butler	NWSE09	05N	03W	260	210	122MOCN
Adams	K002	312402091161401	E. L. Salmon	15	05N	02W	480	160	122MOCN
Adams	K004	312346091163401	F. E. Howard	15	05N	02W	82	160	122MOCN
Adams	K005	312340091162801	William Macilwain	15	05N	02W	450	160	122MOCN
Adams	LS01	312230091112465	Fox Spring	20	05N	01W	110	--	
Adams	LS02	312220091114965	Mill Pasture Spring	58	05N	01W	100	--	
Adams	LS03	312223091114365	Deerfield Spring	58	05N	01W	110	--	
Adams	L004	312410091152901	Jerry Walters	25	05N	01W	85	165	122MOCN
Adams	L005	312526091145701	Glen Stenson	12	05N	01W	380	200	122MOCN
Adams	L018	312418091111101	U.S. Forest Service	20	05N	01W	270	--	
Adams	L019	312303091151801	L. Green	27	05N	01W	100	35	122MOCN
Adams	L020	312250091141101	Clyde Williams	29	05N	01W	130	100	122MOCN
Franklin	L015	312215091063001	H. D. Shell	NENE40	05N	01W	160	151	122MOCN
Franklin	L021	312312091053901	J. Havard	SENE33	05N	01E	210	104	122MOCN
Franklin	L022	312440091063101	J. C. Graves	SWSE17	05N	01E	175	100	122MOCN
Jefferson	M001	314110091112001	Natchez Trace Park	65	08N	01W	140	444	122MOCN
Jefferson	M003	313833091094701	Mrs. L. Price	34	08N	01W	200	274	122MOCN
Jefferson	N002	313900091051901	Mrs. J. Logan Jr.	33	08N	01E	190	100	122MOCN
Jefferspm	N008	313933091080101	Willie Simon	26	01N	10E	290	167	122CTHL
Wilkinson	B002	311819091210901	McCarstle	25	04N	02W	--	110	122MOCN
Wilkinson	G020	311428091190401	Dave Carter	15	03N	02W	120	21	112TRCS

112MRVA-Mississippi River Alluvial Aquifer
112TRCS-Terrace Deposits
122CTHL-Catahoula Sandstone
122HBRG-Hattiesburg Formation
122MOCN-Miocene Series

Table 10.--Chemical analyses of surface-water sites in area 2

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Adams County															
07290893	09/07/61		--	28	7.7	--	148	36	14	7.4	11	5.5	--	--	--
07290893	10/25/61	0655	0.71	344	7.3	16.0	172	44	15	8.5	7.4	11	--	--	--
07290893	11/08/62	0710	0.98	328	8.2	13.5	161	38	16	7.4	8.0	6.6	--	--	--
07290893	07/16/82	0840	1.1	320	8.1	25.0	153	38	14	8.7	4.0	6.2	<0.10	<10	110
07290915	07/16/82	1100	2.9	1350	8.5	29.0	307	75	29	160	7.0	320	0.29	50	400
07293480	08/25/82	1130	2.6	2040	6.2	21.5	237	62	20	300	3.0	620	1.50	140	70
07293490	09/07/61	1220	--	274	6.6	30.0	43	12	3.2	33	1.6	66	--	--	--
07293490	10/24/61		--	257	6.6	--	35	10	2.5	34	0.4	64	--	--	--
07293490	08/30/62		--	266	5.9	--	36	11	2.1	34	0.4	62	--	--	--
07293490	11/07/62	1440	--	289	6.9	17.5	40	9	4.3	37	--	71	--	--	--
*07293490	10/08/75		--	500	7.1	27.0	--	--	--	--	--	155	--	--	--
*07293490	12/03/75		--	400	6.9	12.0	--	28	--	--	--	112	--	--	--
07293490	08/26/82	0745	11.0	1000	6.7	23.5	78	21	6.1	160	2.0	300	0.28	160	500
07294000	09/07/61	1145	--	462	7.3	30.5	91	24	7.5	59	2.2	95	--	--	--
07294000	10/24/61		--	272	7.2	--	102	25	9.7	14	0.4	21	--	--	--
07294000	08/30/62		--	760	7.2	--	116	32	8.8	106	2.4	171	--	--	--
07294000	09/12/62		--	1510	7.5	--	152	41	12	253	0.4	408	--	--	--
07294000	11/07/62		7.1	775	7.7	--	121	32	10	109	--	178	--	--	--
*07294000	10/07/75		--	320	7.6	24.0	--	--	--	--	--	55	--	--	--
*07294000	12/03/75		--	325	7.4	20.0	101	--	--	--	--	53	--	--	--
07294000	08/26/82	1045	12.0	490	7.7	26.5	154	37	15	40	4.0	80	0.27	30	170
07294500	06/03/61		--	271	6.5	--	22	6	1.7	40	2.2	68	--	--	--
07294500	08/14/61		--	272	6.3	--	29	8.4	2.0	39	0.6	67	--	--	--
07294500	09/07/61	1130	--	264	6.5	29.0	22	6.6	1.4	41	1.2	68	--	--	--
07294500	10/10/61		--	736	6.8	--	70	20	4.9	126	0.2	200	--	--	--
07294500	10/24/61		--	567	6.5	--	45	13	3.1	95	0.8	153	--	--	--
07294500	08/30/62		--	317	6.3	--	23	6.9	1.4	51	1.4	82	--	--	--

Table 10.--Chemical analyses of surface-water sites in area 2 --Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of col-lec-tion	Time (Hours)	Stream-flow (ft^3/s)	Spe-cific con-duct-ance (μS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard-ness as $CaCO_3$	Cal-cium (Ca)	Mag-nesi-um (Mg)	Sodium (Na)	Sul-fate (SO_4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (μg/L)	Stron-tium (Sr) (μg/L)
							Amite County								
07292180	07/15/82	1430	24.0	48	6.8	31.0	11	2.8	1.0	4.0	3.0	6.0	0.02	10	26
							Franklin County								
07291000	08/31/82	1400	53.0	95	7.4	31.0	14	3.8	1.1	12.0	2.0	21	0.23	20	88
07291748	07/15/82	1130	0.17	2450	6.4	25.5	230	59	20	350	20	690	0.47	<10	950
07291750	08/24/82	1145	44.0	258	6.7	28.5	21	5.4	1.8	38	4.0	63	--	--	--
07292200	08/24/82	1330	0.85	238	6.4	27.5	22	5.7	1.9	33	1.0	58	0.08	60	130
07293250	08/25/82	0915	7.60	596	6.2	26.5	61	16	5.0	94	2.0	180	0.19	150	250
							Jefferson County								
07290840	06/01/61		3.49	1370	7.0	--	138	36	12	200	8.0	362	--	--	--
07290840	09/07/61	1415	--	754	7.1	--	98	25	8.6	108	4.2	210	--	--	--
07290840	10/25/61		--	962	7.0	--	130	32	12	138	2.6	259	--	--	--
07290840	08/08/62		--	2440	7.0	--	133	37	9.9	432	1.8	699	--	--	--
07290840	09/12/62		--	4150	6.8	--	260	72	19	764	7.8	1320	--	--	--
07290840	10/24/62		--	2400	7.0	--	187	51	14	389	0.6	700	--	--	--
07290840	11/07/62	1300	--	2060	6.7	16.5	184	49	15	352	.	600	--	--	--
07290840	11/08/62		3.67	2820	7.7	--	221	59	18	515	6.8	882	--	--	--
07290840	01/02/63		--	1780	6.7	13.5	172	43	16	292	4.2	530	--	--	--
07290850	07/14/82	1330	1.50	521	7.5	29.0	89	21	8.8	67	3.0	100	<0.10	<10	190
07290860	06/02/61		10.6	1560	7.2	--	212	47	23	221	3.8	400	--	--	--
07290860	08/15/61		--	894	6.9	--	110	26	11	128	3.6	232	--	--	--
07290860	09/07/61	1500	--	837	6.9	30.0	84	23	6.5	125	3.8	231	--	--	--
07290860	10/11/61		--	1270	7.2	--	176	44	16	186	0.6	334	--	--	--
07290860	11/02/61		--	1510	7.1	--	192	52	15	236	3.2	412	--	--	--
07290860	08/29/62		--	2270	7.0	--	190	58	11	370	3.2	648	--	--	--
07290860	09/25/62		--	2270	7.5	--	226	56	21	354	5.8	630	--	--	--
07290860	11/08/62	0915	--	1890	7.3	14.0	199	50	18	281	1.4	520	--	--	--
07290860	07/14/82	1120	10.0	400	7.8	28.0	94	22	9.5	43	3.0	65	--	--	--
							Wilkinson County								
07292460	08/24/82	1530	8.30	70	7.1	28.0	14	3.6	1.3	7.2	3.0	9.1	--	--	--
07292500	08/24/82	1730	244	92	7.3	33.5	14	3.5	1.3	9.9	2.0	16	0.06	40	52
07293498	08/26/82	1500	0.59	131	6.8	35.5	36	9.3	3.1	10	4.0	15	--	--	--

* Sample collected by Mississippi Geological Survey and analyzed by the Mississippi State Board of Health

Table 11.--Chemical analyses of ground water in area 2

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit	Well depth (ft)	Date of col- lec- tion	Spe- cific con- duct- ance (µS/cm)	pH (Units)	Temper- ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi- um (Mg)	Sodium (Na)	Sul- fate (SO_4)	Chlo- ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron- tium (Sr) (µg/L)
							Adams County								
A005	122CTHL	265	09/15/81	660	--	--	--	--	--	--	--	8.0	--	--	--
A006	122CTHL	265	09/15/81	660	--	--	--	--	--	--	--	8.0	--	--	--
BS01		--	05/14/82	4590	--	--	456	110	44	680	29	1200	--	--	--
B005	112TRCS	45	09/15/81	700	--	--	--	--	--	--	--	3.5	--	--	--
B025	122CTHL	262	09/21/81	435	--	--	--	--	--	--	--	5.0	--	--	--
B026	122CTHL	200	09/15/81	760	--	--	--	--	--	--	--	5.5	--	--	--
D019	122MOCN	135	06/14/82	600	--	--	--	67	30	9.1	4.0	6.0	--	--	--
D033	122MOCN	447	09/16/81	460	--	--	--	--	--	--	--	2.0	--	--	--
D055	122CTHL	170	09/15/81	500	--	--	--	--	--	--	--	8.5	--	--	--
D056	122CTHL	165	09/15/81	550	--	--	--	--	--	--	--	5.7	--	--	--
D057	122CTHL	90	09/18/81	520	--	--	--	--	--	--	--	6.5	--	--	--
D060	122MOCN	150	05/18/82	660	6.9	20.0	340	78	35	12	8.0	17	--	--	--
F013	112MRVA	213	09/22/81	1750	--	--	--	--	--	--	--	24	--	--	--
F013	112MRVA	213	04/27/82	1510	6.8	19.5	488	113	50	75	12	170	0.44	30	320
F014	112MRVA	220	09/22/81	860	--	--	--	--	--	--	--	58	--	--	--
F014	112MRVA	220	04/27/82	910	6.8	19.5	386	87	41	49	11	81	--	--	--
F015	112MRVA	212	09/22/81	650	--	--	--	--	--	--	--	32	--	--	--
F015	112MRVA	212	04/27/82	620	6.9	19.5	293	68	30	17	10	35	--	--	--
F016	112MRVA	180	09/22/81	1020	--	--	--	--	--	--	--	100	--	--	--
F016	112MRVA	180	04/27/82	900	7.2	19.0	396	96	38	29	57	76	--	--	--
F017	112MRVA	220	09/22/81	850	--	--	--	--	--	--	--	80	--	--	--
F017	112MRVA	220	04/27/82	900	7.3	19.5	344	80	35	53	15	92	--	--	--
F018	112MRVA	235	09/22/81	1400	--	--	--	--	--	--	--	240	--	--	--
F018	112MRVA	235	04/27/82	1390	6.9	19.0	415	100	40	93	2.0	105	0.27	40	280
F020	122MOCN	253	09/22/81	980	--	--	--	--	--	--	--	85	--	--	--
F020	122MOCN	253	04/27/82	790	6.9	19.0	365	85	37	37	29	42	0.10	40	190
F021	112MRVA	215	09/22/81	650	--	--	--	--	--	--	--	29	--	--	--
F021	112MRVA	215	04/28/82	900	--	19.5	484	108	52	23	40	31	--	--	--
F022	122MOCN	262	09/22/81	620	--	--	--	--	--	--	--	16	--	--	--
F022	122MOCN	262	04/27/82	580	7.0	19.5	286	65	30	16	22	9.0	0.10	40	160
F023	122MOCN	250	09/22/81	676	--	--	--	--	--	--	--	24	--	--	--
F023	122MOCN	250	04/27/82	800	7.0	20.0	356	80	38	22	6.0	35	--	--	--
F076	122MOCN	65	09/14/81	800	--	--	--	--	--	--	--	48	--	--	--

Table 11.--Chemical analyses of ground water in area 2--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit	Well depth (ft)	Date of collection	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (ug/L)
Adams County (Continued)															
F076	122MOCN	65	04/27/82	900	6.8	21.0	321	74	33	61	11	97	--	--	--
F082	122MOCN	266	09/17/81	470	--	--	--	--	--	--	--	6.2	--	--	--
F085	122MOCN	170	09/17/81	450	--	--	--	--	--	--	--	2.2	--	--	--
F086	122CTHL	169	09/14/81	520	--	--	--	--	--	--	--	6.5	--	--	--
F094	122MOCN	260	09/17/81	490	--	--	--	--	--	--	--	5.1	--	--	--
F100	112MRVA	226	09/22/81	950	--	--	--	--	--	--	--	110	--	--	--
F100	112MRVA	226	04/27/82	950	7.1	19.5	394	95	38	43	58	110	0.21	20	220
F101	112MRVA	234	09/22/81	690	--	--	--	--	--	--	--	16	--	--	--
F101	112MRVA	234	04/27/82	655	7.0	19.0	330	81	31	14	130	69	--	--	--
F102	112MRVA	259	09/22/81	887	--	--	--	--	--	--	--	30	--	--	--
F102	112MRVA	259	04/28/82	900	--	20.0	431	105	41	19	2.0	24	--	--	--
*G007	122HBRG	267	10/13/69	--	6.3	--	73	17	7.1	8.6	7.1	9.0	--	--	--
*G007	122HBRG	267	07/20/73	--	5.9	--	--	100	141	--	--	470	--	--	--
*G008	122HBRG	267	07/20/73	--	5.9	--	130	24	17	--	--	32	--	--	--
*G008	122HBRG	267	02/19/74	--	--	--	--	--	--	--	--	330	--	--	--
G008	122HBRG	267	03/01/74	4110	6.3	20.5	680	190	70	500	4.4	1200	--	--	--
*G019	122MOCN	140	11/06/73	--	6.0	--	2600	608	264	--	--	3600	--	--	--
*G021	122MOCN	880	02/15/74	--	6.4	--	51	12	4.8	120	14	10	--	--	--
G028	122MOCN	165	09/17/81	430	--	--	--	--	--	--	--	3.3	--	--	--
H016	122MOCN	75	09/16/81	760	--	--	--	--	--	--	--	210	--	--	--
H016	122MOCN	75	04/26/82	730	6.2	20.0	74	19	6.5	120	3.0	220	--	--	--
H017	122MOCN	160	09/16/81	550	--	--	--	--	--	--	--	98	--	--	--
H017	122MOCN	160	04/26/82	925	--	--	--	--	--	--	--	250	--	--	--
H020	122MOCN	100	05/21/82	78	5.7	19.5	15	4.1	1.1	7.5	2.0	6.6	0.01	<10	23
H021	122MOCN	120	05/20/82	67	--	--	--	--	--	--	--	4.5	--	--	--
J006	122MOCN	125	09/23/81	310	--	--	--	--	--	--	--	4.1	--	--	--
J026	122MOCN	214	09/17/81	380	--	--	--	--	--	--	--	3.4	--	--	--
J031	122MOCN	210	05/14/82	475	7.8	--	240	56	25	12	3.0	6.0	--	--	--
K002	122MOCN	480	09/16/63	360	--	20.0	--	--	--	--	--	20	--	--	--
K004	122MOCN	82	09/16/63	100	--	22.0	--	--	--	--	--	30	--	--	--
K005	122MOCN	450	09/16/63	360	--	--	--	--	--	--	--	15	--	--	--
LS01		--	08/25/82	314	5.8	21.0	3	.9	.2	62	1.0	95	--	--	--
LS02		--	08/25/82	3190	5.0	22.5	92	25	6.7	610	6.0	990	0.96	280	1400

Table 11.--Chemical analyses of ground water in area 2--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit	Well depth (ft)	Date of col-lec-tion	Spe-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi-um (Mg)	Sodium (Na)	Sul-fate (SO_4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron-tium (Sr) (µg/L)
							Adams County (Continued)								
LS03		--	08/25/82	615	6.2	22.0	34	8.6	3.1	100	3.0	170	--	--	--
L004	122MOCN	85	09/16/63	5000	--	20.0	--	--	--	--	--	2850	--	--	
L005	122MOCN	380	09/16/63	320	--	--	--	--	--	--	--	10	--	--	
L018		--	09/16/81	230	--	--	--	--	--	--	--	6.5	--	--	--
L019	122MOCN	35	09/16/81	420	--	--	--	--	--	--	--	120	--	--	--
L019	122MOCN	35	08/26/82	414	5.4	23.0	102	26	8.9	32	1.0	88	0.15	110	210
L020	122MOCN	100	09/16/81	36	--	--	--	--	--	--	--	2.6	--	--	--
							Franklin County								
L015	122MOCN	151	05/18/82	105	--	--	31	8.6	2.4	9.9	8.0	24	--	--	--
L021	122MOCN	104	05/18/82	195	5.5	22.0	37	9.6	3.2	18	7.0	35	--	--	--
L022	122MOCN	100	05/18/82	11800	7.0	21.5	3245	1000	180	1200	70	3900	3.74	<10	5600
							Jefferson County								
M001	122MOCN	444	09/22/81	660	--	--	--	--	--	--	--	13	--	--	
M003	122MOCN	274	07/16/62	2630	6.7	--	--	44	21	446	14	707	--	80	
N002	122MOCN	100	10/24/62	190	6.9	19.0	73	18	6.8	7.6	0.2	5.8	--	--	
N008	122CTHL	167	09/21/81	260	--	--	--	--	--	--	--	6.5	--	--	--
							Wilkinson County								
B002	122MOCN	110	09/17/81	780	--	--	--	--	--	--	--	29	--	--	--
G020	112TRCS	21	09/17/81	145	--	--	--	--	--	--	--	8.2	--	--	--

112MRVA-Mississippi River Alluvial Aquifer
112TRCS-Terrace Deposits
122CTHL-Catahoula Sandstone
122HBRG-Hattiesburg Formation
122MOCN-Miocene Series
* Analysis by Mississippi State Board of Health

Table 12.--Location and drainage area of surface-water sampling sites in area 3

Site Number	Station Name	Location Lat	Location Long	Drainage Area (mi^2)
	Amite County			
07376640	East Fork Amite River at Mars Hill, MS	311825	0903803	39.1
	Franklin County			
07291248	Hurricane Creek nr Lucien, MS	313000	0903803	--
	Lincoln County			
02490250	Bogue Chitto nr Brookhaven, MS	313240	0902836	28.3
02490260	East Bogue Chitto nr Brookhaven, MS	313319	0902605	18.6
02490289	Jordan Creek nr Enterprise, MS	312934	0902515	11.6
02490290	Boone Creek nr Bogue Chitto, MS	312804	0902553	30.5
02490300	Big Creek at Bogue Chitto, MS	312646	0902724	55.1
02490350	Allbritton Creek nr Bogue Chitto, MS	312249	0902819	6.40
02490415	Little Creek nr Ruth, MS	312109	0902101	8.12
07291230	Shaws Creek nr Red Star, MS	313558	0903308	13.8
	Pike County			
02490357	Bogue Chitto nr Johnstons Station, MS	312011	0902603	212
024903594	Lazy Creek nr Johnstons Station, MS	312035	0902355	8.27
02490370	Bogue Chitto nr Pricedale, MS	311610	0902140	261

Table 13.--Records of wells in area 3

Well Number	Station Number	Owner	Location Sec.	T.	R.	Altitude (ft)	Well Depth (ft)	Water Bearing Unit *
		Amite County						
E082	311829090372601	L. Wilkinson	SWSE17	04N	06E	422	60	121CRNL
E083	311823090372201	G. Smith	SWSE17	04N	06E	430	133	121CRNL
E084	311825090371001	E. Clark	SESE17	04N	06E	428	100	121CRNL
E085	311747090350901	H. Cooper	NESE21	04N	06E	405	80	121CRNL
E086	311843090365501	MRS. J.D. Davis	NWSW16	04N	06E	440	85	121CRNL
E087	311823090372202	G. Smith	SWSE17	04N	06E	430	57	121CRNL
E088	311835090363001	Zack Allard	NESW16	04N	06E	445	85	121CRNL
E089	311608090350201	L.P. McCurley	NESE34	04N	06E	438	100	121CRNL
E090	311837090371001	Mrs. I. Young	NESE17	04N	06E	444	100	121CRNL
E091	311802090361201	Paul Dyke Sr.	SWNE21	04N	06E	415	80	121CRNL
E092	311623090355401	Myra Alford	NWNW34	04N	06E	415	85	121CRNL
E093	311616090364101	J.F. Edwards	SENW33	04N	06E	443	80	121CRNL
E094	311607090345601	Jewell McKnight	NESE34	04N	06E	442	55	121CRNL
E095	311912090365501	E.H. Mitchel	NWNW16	04N	06E	435	80	121CRNL
		Lincoln County						
G056	313344090312401	U. L. Day	SENW20	07N	07E	500	81	121CRNL
G057	313350090314201	S. McFadde	SWNW20	07N	07E	495	100	121CRNL
G058	313512090314701	H. Case	NWSW08	07N	07E	492	80	121CRNL
G059	313523090311601	Elvin Smith	NWSE08	07N	07E	495	80	121CRNL
G060	313540090320401	C. Case	NENE07	07N	07E	450	100	121CRNL
G061	313542090315301	J. Case Jr.	NWNW08	07N	07E	456	85	121CRNL
G062	313541090315301	J. Case Jr.	NWNW08	07N	07E	458	45	121CRNL
G063	313433090312801	C. A. Watts	SENW17	07N	07E	480	65	121CRNL
G065	313347090312101	Aaron Acord	SWSE20	07N	07E	492	187	121CRNL
G066	313618090321101	J. McCurle	SWNE06	07N	07E	460	50	121CRNL
G067	313433090315701	H. R. Owens	SENE18	07N	07E	475	150	121CRNL
G068	313347090312102	Aaron Acord	SWNE20	07N	07E	492	308	122MOCN
G069	313512090315201	D. Ballard	SWSW08	07N	07E	485	85	121CRNL
G071	313622090321201	Rayburn Bowman	SWNE06	07N	07E	440	256	122MOCN

Table 13.--Records of wells in area 3--Continued

Well Number	Station Number	Owner	Location Sec.	T.	R.	Alti-tude (ft)	Well Depth (ft)	Water Bearing Unit *
		Lincoln County (Continued)						
G099	313429090313001	Doug Warren	NESW17	07N	07E	472	48	121CRNL
Q043	312123090205501	Louie Jean Martin	NESE36	05N	08E	380	100	121CRNL
Q044	312320090225201	Clareman Hodges	SENE22	05N	08E	465	75	121CRNL
Q045	312305090224201	F. Moak	NWSW23	05N	08E	460	98	121CRNL
Q046	312318090222601	Mr. Tyler	SENW23	05N	08E	450	80	121CRNL
		Pike County						
BS01	311746090222265	Lofton Spring	NESW23	04N	08E	315	--	
B096	311748090221001	J Loftin	NWSE23	04N	08E	340	90	122MOCN
B105	311932090235201	P Fultz	NESE09	04N	08E	382	110	122MOCN
B118	311805090224501	J E Busby	NENE22	04N	08E	352	60	122MOCN
B119	311950090233001	D Ard	SWNE10	04N	08E	400	108	122MOCN
B120	311930090240001	R H Felter Jr	NESE09	04N	08E	370	90	122MOCN
B121	311914090231401	Joe C Brown	SWSE10	04N	08E	380	425	122MOCN
B123	311929090230801	Lonnie Pittman	NWSE10	04N	08E	390	--	121CRNL
B124	311751090221101	J.Lofton	NWSE23	04N	08E	335	200	122MOCN
B126	311808090230201	Mrs. A.M. Busby	SWNW22	04N	08E	318	70	122MOCN
B127	312006090214501	B.T. Gutter	NENE11	04N	08E	460	125	121CRNL
B128	311905090220301	Devone Guy	NWNE14	04N	08E	440	110	121CRNL
B129	311730090214601	E.H. Rollins	SESE23	04N	08E	330	60	
B130	311958090243701	Clem Wallace	NENW09	04N	08E	395	100	121CRNL
D044	311424090291901	Donnis Jefcoats	SWNE10	03N	07E		111	121CRNL
D188	311449090324201	J.E. Tate	NWNW07	03N	07E	407	100	121CRNL
D190	311312090294401	James Anding	SWSW15	03N	07E	430	100	121CRNL
D192	311415090321301	Elwin Hewitt	NWSE07	03N	07E	420	32	
D193	311442090324201	H.L. Tate	NWNW07	03N	07E	405	104	121CRNL

*
121CRNL-Citronelle Formation
122MOCN-Miocene Series

Table 14.--Chemical analyses of surface-water sites in area 3

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Amite County															
07376640	07/07/82	1130	9.30	110	6.2	22.5	19	4.4	1.9	13	1.0	24	--	--	--
Franklin County															
07291248	07/07/82	1330	3.40	110	6.5	28.0	20	4.7	1.9	11	3.0	22	0.10	10	84
Lincoln County															
02490250	07/08/82	1050	4.50	62	6.3	26.5	14	3.3	1.3	4.5	4.0	7.1	--	--	--
02490260	07/08/82	0900	3.00	54	5.9	23.0	11	2.6	1.2	4.8	3.0	5.3	--	--	--
02490289	07/08/82	1310	1.80	165	6.2	23.5	22	6.1	1.7	21	2.0	36	< .10	50	190
02490290	07/08/82	1525	5.40	96	6.2	24.5	4	3 .8	1.2	10	2.0	1 5	--	--	--
02490300	07/07/82	1600	4.80	46	6.4	25.5	8	1 .8	.8	4.1	1.0	5.2	--	--	--
02490350	07/08/82	1700	2.50	32	5.9	24.5	6	1.4	.6	3.7	1.0	6.4	< .10	<10	11
02490415	07/06/82	1745	2.60	400	6.1	23.0	50	12	4.9	53	4.0	110	.54	<10	230
07291230	07/06/82	1245	12.0	108	6.2	25.0	17	3.7	1.8	14	3.0	23	--	--	--
02490357	07/09/82	0950	69.0	58	6.5	24.5	10	2.5	1.0	4.6	2.0	6.0	--	--	--
024903594	07/06/82	1520	1.80	267	4.4	23.0	31	7.7	2.8	38	8.0	70	--	--	--
02490370	07/09/82	1300	99.0	84	6.7	26.5	14	3.3	1.5	8.7	2.0	13	--	--	--

Table 15.--Chemical analyses of ground water in area 3

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of col-lec-tion	Spec-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi-um (Mg)	Sodium (Na)	Sul-fate (SO_4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron-tium (Sr) (µg/L)
							Amite County								
E082	121CRNL	60	11/03/81	910	--	--	--	--	--	--	--	270	--	--	--
E082	121CRNL	60	05/27/82	895	--	19.5	114	27	11	110	8.0	260	1.36	10	690
E083	121CRNL	133	11/02/81	1800	--	--	--	--	--	--	--	580	--	--	--
E083	121CRNL	133	06/03/82	2110	4.8	19.5	403	95	40	250	23	660	2.70	10	610
E084	121CRNL	100	11/03/81	300	--	--	--	--	--	--	--	80	--	--	--
E084	121CRNL	100	06/02/82	331	5.0	20.0	75	18	7.4	22	3.0	89	--	--	--
E085	121CRNL	80	11/02/81	42	--	--	--	--	--	--	--	5.8	--	--	--
E085	121CRNL	80	06/02/82	36	--	20.0	6	1.3	0.6	4.7	2.0	6.8	--	--	--
E086	121CRNL	85	11/02/81	65	--	--	--	--	--	--	--	8.6	--	--	--
E086	121CRNL	85	06/03/82	60	--	--	8	2.0	.8	9.2	4.0	12	--	--	--
E087	121CRNL	57	06/03/82	2240	4.8	19.5	274	90	12	310	18	660	--	--	--
E088	121CRNL	85	11/02/81	205	--	--	--	--	--	--	--	50	--	--	--
E089	121CRNL	100	11/02/81	350	--	--	--	--	--	--	--	97	--	--	--
E090	121CRNL	100	11/03/81	1530	--	--	--	--	--	--	--	470	--	--	--
E091	121CRNL	80	11/02/81	53	--	--	--	--	--	--	--	8.2	--	--	--
E092	121CRNL	85	11/02/81	56	--	--	--	--	--	--	--	5.3	--	--	--
E093	121CRNL	80	11/02/81	32	--	--	--	--	--	--	--	4.6	--	--	--
E094	121CRNL	55	11/02/81	30	--	--	--	--	--	--	--	1.8	--	--	--
E095	121CRNL	80	11/02/81	39	--	--	--	--	--	--	--	3.6	--	--	--
							Lincoln County								
G056	121CRNL	81	05/26/82	860	4.8	20.0	114	30	9.6	120	4.0	260	--	--	--
G057	121CRNL	100	11/04/81	38	--	--	--	--	--	--	--	2.5	--	--	--
G057	121CRNL	100	05/26/82	38	--	20.0	4	1.2	0.4	3.9	1.0	4.4	>0.10	>10	5
G058	121CRNL	80	11/05/81	160	--	--	--	--	--	--	--	40	--	--	--
G058	121CRNL	80	05/26/82	175	4.8	19.5	19	4.8	1.8	18	2.0	42	--	--	--
G059	121CRNL	80	11/04/81	330	--	--	--	--	--	--	--	88	--	--	--
G059	121CRNL	80	05/26/82	355	4.8	20.0	41	9.3	4.3	55	1.0	97	--	--	--
G060	121CRNL	100	11/06/81	430	--	--	--	--	--	--	--	120	--	--	--
G060	121CRNL	100	05/25/82	455	5.2	20.5	20	4.9	1.9	64	4.0	120	--	--	--

Table 15.--Chemical analyses of ground water in area 3--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of collection	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Lincoln County (Continued)															
G061	121CRNL	85	11/06/81	133	--	--	--	--	--	--	--	30	--	--	--
G061	121CRNL	85	05/25/82	151	5.1	20.0	19	4.8	1.8	14	1.0	32	0.33	<10	27
G062	121CRNL	45	11/06/81	800	--	--	--	--	--	--	--	260	--	--	--
G062	121CRNL	45	05/25/82	895	4.6	20.5	23	2.9	3.7	170	2.0	270	.94	50	92
G063	121CRNL	65	11/04/81	176	--	--	--	--	--	--	--	48	--	--	--
G063	121CRNL	65	05/25/82	170	4.7	19.0	18	3.1	2.5	22.0	2.0	42	--	--	--
G065	121CRNL	187	06/01/82	3290	4.3	19.5	335	100	20	490	7.0	980	5.57	190	2500
G066	121CRNL	50	11/05/81	190	--	--	--	--	--	--	--	50	--	--	--
G066	121CRNL	50	06/02/82	238	4.4	21.0	16	5.2	0.8	30	5.0	66	--	--	--
G067	121CRNL	150	11/04/81	85	--	--	--	--	--	--	--	15	--	--	--
G067	121CRNL	150	06/02/82	49	--	20.5	12	2.9	1.2	5.0	1.0	6.5	--	--	--
G068	122MOCN	308	06/01/82	139	5.9	20.0	29	7.4	2.6	13	3.0	20	--	--	--
G069	121CRNL	85	05/26/82	107	--	--	--	--	--	--	--	21	--	--	--
G071	122MOCN	256	11/05/81	97	--	--	--	--	--	--	--	2.7	--	--	--
G099	121CRNL	48	11/04/81	209	--	--	--	--	--	--	--	56	--	--	--
G099	121CRNL	48	05/25/82	261	4.7	20.0	48	9.8	5.7	27	2.0	74	--	--	--
G099	121CRNL	48	08/04/83	408	5.4	--	--	--	--	36	--	110	--	--	--
KS01		--	05/26/82	82	5.6	21.0	12	2.4	1.4	8.6	1.0	14	--	--	--
Q043	121CRNL	100	11/04/81	63	--	--	--	--	--	--	--	3.8	--	--	--
Q044	121CRNL	75	11/04/81	110	--	--	--	--	--	--	--	28	--	--	--
Q045	121CRNL	98	11/04/81	32	--	--	--	--	--	--	--	3.0	--	--	--
Q046	121CRNL	80	11/04/81	32	--	--	--	--	--	--	--	4.0	--	--	--
Pike County															
BS01		--	06/03/82	355	5.2	23.0	68	15	7.5	47	1.0	120	--	--	--
B096	122MOCN	90	06/03/82	1340	5.4	19.5	133	33	12	150	22	400	1.82	190	600
B105	122MOCN	110	06/04/82	109	4.7	20.0	12	2.7	1.3	11	4.0	27	.25	10	18
B118	122MOCN	60	11/04/81	80	--	--	--	--	--	--	--	18	--	--	--
B118	122MOCN	60	06/03/82	89	4.5	19.5	11	1.8	1.5	11	5.0	24	--	--	--

Table 15.--Chemical analyses of ground water in area 3--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of collection	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Pike County (Continued)															
B119	122MOCN	108	06/04/82	22	--	19.5	5	1.1	0.5	3.1	3.0	4.0	--	--	--
B120	122MOCN	90	06/04/82	37	--	20.5	5	1.0	.6	4.7	3.0	6.7	--	--	--
B121	122MOCN	425	11/04/81	126	--	--	--	--	--	--	--	2.4	--	--	--
B121	122MOCN	425	06/04/82	114	--	--	--	--	--	--	--	3.2	--	--	--
B123	121CRNL	--	11/04/81	350	--	--	--	--	--	--	--	100	--	--	--
B123	121CRNL	--	08/31/82	371	4.8	21.5	49	11	5.3	45	2.0	110	0.72	20	84
B124	122MOCN	200	11/04/81	160	--	--	--	--	--	--	--	2.4	--	--	--
B126	122MOCN	70	11/05/81	59	--	--	--	--	--	--	--	8.7	--	--	--
B127	121CRNL	125	11/04/81	44	--	--	--	--	--	--	--	9.0	--	--	--
B128	121CRNL	110	11/04/81	32	--	--	--	--	--	--	--	4.0	--	--	--
B129		60	11/04/81	55	--	--	--	--	--	--	--	11	--	--	--
B130	121CRNL	100	11/04/81	34	--	--	--	--	--	--	--	1.1	--	--	--
D044	121CRNL	111	10/19/66	--	--	--	--	--	--	--	--	970	--	--	--
D188	121CRNL	100	11/03/81	36	--	--	--	--	--	--	--	4.9	--	--	--
D190	121CRNL	100	11/03/81	340	--	--	--	--	--	--	--	96	--	--	--
D190	121CRNL	100	06/02/82	359	4.8	20.5	41	9.3	4.4	42	3.0	98	--	--	--
D192		32	11/03/81	51	--	--	--	--	--	--	--	6.8	--	--	--
D193	121CRNL	104	11/03/81	34	--	--	--	--	--	--	--	2.2	--	--	--

*
121CRNL-Citronelle Formation
122MOCN-Miocene Series

Table 16.--Location and drainage area of surface-water sites in area 4

County	Site Number	Station Name	Location Lat	Location Long	Drainage Area(mi^2)
Lamar	024892685	Clear Creek nr Baxterville, MS	310547	0893717	2.99
Lamar	02489269	Unnamed Creek nr Baxterville, MS	310414	0893826	2.50
Marion	024892695	Clear Creek nr Pinebur, MS	310337	0894055	27.0
Pearl River	02479182	Parker Creek nr Young, MS	305822	0892210	11.2
Pearl River	024791825	Unnamed Creek nr Young, MS	305821	0892141	3.42
Pearl River	024791828	Dry Creek nr Young, MS	305749	0892108	1.95
Pearl River	02479183	Wash Creek nr Young, MS	305744	0892043	--

Table 17.--Records of wells in area 4

County	Well Number	Station Number	Owner	Location Sec.	T.	R.	Altitude (ft)	Well Depth (ft)	Water Bearing Unit*
Forrest	M059	305859089182001	W.C. Entrekin	SWSW04	01S	13W	275	350	122MOCN
Forrest	M060	305859089182002	W. C. Entrekin	SWSW04	01S	13W	275	--	121CRNL
Forrest	M061	305942089171601	Carl Archer	NWSW03	01S	13W	318	50	121CRNL
Forrest	M063	305838089182401	W. C. Entrekin	SWNW09	01S	13W	260	28	121CRNL
Forrest	M064	305900089180901	Zellena Entrekin	SESW04	01S	13W	240	350	122MOCN
Forrest	M065	305900089175201	Ottis Lee	SWSE04	01S	13W	280	82	121CRNL
Forrest	M066	305758089192901	P. A. McCardle	NENE18	01S	13W	273	68	121CRNL
Forrest	M068	305910089165601	Wesley Rawls	SESW03	01S	13W	295	41	121CRNL
Forrest	M069	305856089201001	Ophelia Walters	NENW07	01S	13W	290	50	121CRNL
Forrest	M070	305900089184601	K. L. Smith	SWSE05	01S	13W	285	89	121CRNL
Lamar	M085	310224089374701	O. Holston	SESW17	01N	16W	270	--	122MOCN
Lamar	M086	310402089382201	V. F. Davis	NESE07	01N	16W	240	235	122MOCN
Marion	R028	310342089405401	Douglas C. Alford	NESW11	01N	17W	165	130	122MOCN
Marion	R029	310339089393801	Virgis Schrader	NWSE12	01N	17W	200	148	122MOCN
Pearl River	D021	305935089220801	G. Merritt	SENW02	01S	14W	248	90	122MOCN
Pearl River	D026	305934089220901	A. W. Nall	SENW02	01S	14W	260	52	122MOCN
Pearl River	D027	305931089220901	J. B. Merritt	SENW02	01S	14W	265	97	122MOCN
Pearl River	D028	305902089225401	R. Boe	SWSE03	01S	14W	250	20	122MOCN
Pearl River	D029	305922089220601	J. O. Owens	NESW02	01S	14W	260	55	121CRNL
Pearl River	D030	305928089220201	J. Holston	NESW02	01S	14W	260	50	122MOCN
Pearl River	D032	305906089225801	R. Boe	SE03	01S	14W	250	50	122MOCN
Pearl River	D033	305928089220801	J. Holston	NESW02	01S	14W	250	50	122MOCN
Pearl River	D034	305948089215201	Tommy Brown	NWNE02	01S	14W	270	30	121CRNL
Pearl River	D036	305940089215201	P. Ladner	SWNE02	01S	14W	270	51	121CRNL
Pearl River	D037	305945089230901	Rocky McCadala	NENW03	01S	14W	280	73	121CRNL

121CRNL-Citronelle Formation
122MOCN-Miocene Series

Table 18.--Chemical analses of surface water in area 4

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
							Lamar County								
024892685	08/18/82	1645	*<0.50	20	4.8	23.0	3	0.7	0.4	1.8	2.0	3.2	0.07	20	8
02489269	09/01/82	1230	0.57	1070	5.7	27.0	126	40	5.9	150	2.0	320	2.89	130	1500
							Marion County								
024892695	08/18/82	1430	15.0	534	5.1	25.5	73	23	3.5	59	3.0	150	1.78	170	750
							Pearl River County								
02479182	08/19/82	0830	7.2	198	5.7	24.5	33	9.2	2.3	20	1.0	52	.37	70	210
024791825	08/19/82	1015	0.98	309	4.9	24.5	40	12	2.3	31	2.0	77	.55	90	370
024791828	08/19/82	1200	0.50	265	5.9	24.5	34	9.0	2.7	34	2.0	72	.59	90	340
02479183	08/19/82	1245	0.18	150	4.9	25.0	20	4.9	1.9	13	2.0	38	.22	50	48

* Estimated

Table 19.--Chemical analyses of ground water in area 4

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of collection	Specific conductance (μS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO4)	Chloride (Cl)	Bromide (Br)	Boron (B) (μg/L)	Strontium (Sr) (μg/L)
Forrest County															
M059	122MOCN	350	10/21/81	170	--	--	--	--	--	--	--	4.8	--	--	--
M060	121CRNL	--	06/08/82	2240	4.1	20.5	528	130	49	160	--	690	4.57	10	1400
M061	121CRNL	50	10/21/81	23	--	--	--	--	--	--	--	2.0	--	--	--
M063	121CRNL	28	10/21/81	59	--	--	--	--	--	--	--	10	--	--	--
M064	122MOCN	350	10/21/81	125	--	--	--	--	--	--	--	2.2	--	--	--
M065	121CRNL	82	10/21/81	39	--	--	--	--	--	--	--	1.9	--	--	--
M066	121CRNL	68	10/21/81	68	--	--	--	--	--	--	--	9.6	--	--	--
M068	121CRNL	41	10/21/81	22	--	--	--	--	--	--	--	2.7	--	--	--
M069	121CRNL	50	10/21/81	23	--	--	--	--	--	--	--	3.2	--	--	--
M070	121CRNL	89	10/21/81	23	--	--	--	--	--	--	--	1.3	--	--	--
Lamar County															
M085	122MOCN	--	10/19/81	1270	--	--	--	--	--	--	--	390	--	--	--
M085	122MOCN	--	06/07/82	1450	4.2	20.5	210	49	21	170	--	430	3.01	20	610
M086	122MOCN	235	10/19/81	99	--	--	--	--	--	--	--	22	--	--	--
M086	122MOCN	235	06/07/82	101	5.6	--	21	3.8	2.9	8.4	1.0	24	--	--	--
Marion County															
R028	122MOCN	130	10/19/81	57	--	--	--	--	--	--	--	11	--	--	--
R029	122MOCN	148	10/19/81	71	--	--	--	--	--	--	--	1.6	--	--	--

*
121CRNL-Citronelle Formation
122MOCN-Miocene Series

Table 19.--Chemical analyses of ground water in area 4--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of col-lec-tion	Spe-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi-um (Mg)	Sodium (Na)	Sul-fate (SO4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron-tium (Sr) (µg/L)
Pearl River County															
D021	122MOCN	90	10/20/81	32	--	--	--	--	--	--	--	2.0	--	--	--
D021	122MOCN	90	06/08/82	40	--	20.5	6	1.5	0.5	1.8	1.0	3.6	--	--	--
D026	122MOCN	52	10/20/81	410	--	--	--	--	--	--	--	110	--	--	--
D026	122MOCN	52	06/08/82	445	4.3	--	82	13	12	49	2.0	150	--	--	--
D027	122MOCN	97	10/20/81	2160	--	--	--	--	--	--	--	680	--	--	--
D027	122MOCN	97	06/08/82	2500	3.6	20.5	540	95	73	240	--	850	5.38	10	1600
D028	122MOCN	200	10/21/81	400	--	--	--	--	--	--	--	98	--	--	--
D028	122MOCN	200	06/08/82	410	--	--	--	--	--	--	--	98	--	--	--
D029	121CRNL	55	10/21/81	21	--	--	--	--	--	--	--	1.8	--	--	--
D029	121CRNL	55	06/08/82	51	5.0	22.0	4	0.6	0.6	2.6	1.0	3.1	--	--	--
D030	122MOCN	50	06/08/82	1180	4.3	21.0	174	25	27	160	2.0	350	--	--	--
D032	122MOCN	50	06/08/82	119	4.9	20.5	21	3.6	3.0	9.0	1.0	17	--	--	--
D033	122MOCN	50	06/08/82	619	4.5	21.0	104	22	12	77	2.0	180	--	--	--
D034	121CRNL	30	11/21/81	42	--	--	--	--	--	--	--	3.1	--	--	--
D036	121CRNL	51	10/21/81	32	--	--	--	--	--	--	--	3.8	--	--	--
D037	121CRNL	73	10/21/81	48	--	--	--	--	--	--	--	4.8	--	--	--

*
121CRNL-Citronelle Formation
122MOCN-Miocene Series

Table 20.--Location and drainage area of surface-water sites in area 5

County	Site Number	Station Name	Location Lat	Location Long	Drainage Area(mi^2)
Clarke	02477000	Chickasawhay River at Enterprise, MS	321032	0884910	918
Clarke	024771605	Unnamed Creek nr Harmony, MS	320016	0885020	--
Clarke	024773143	Castaffa Creek at Barnett, MS	315834	0885426	9.17
Clarke	02477330	Shubuta Creek nr Shubuta, MS	315304	0884420	75.5
Clarke	02477875	Long Branch at Chancellor, MS	320128	0883747	--
Clarke	02477910	Hanging Moss creek nr Carmichael, MS	315332	0883104	--
Jasper	02473477	Horse Branch nr Heidelberg, MS	315216	0890300	--
Jasper	02473480	Tallahattah Creek nr Waldrup, MS	315140	0890510	30.4
Jasper	02473810	Unnamed Creek nr Bay Springs, MS	315741	0891351	--
Jasper	02474569	Prairie Creek nr Heidelberg, MS	315202	0890042	--
Jones	02472058	Plant Branch nr Soso, MS	314754	0891644	2.44
Jones	024745735	Old Julie Branch nr Sandersville, MS	314910	0890017	--
Jones	02474574	Reedy Creek at Sandersville, MS	314717	0890248	8.15
Jones	024745785	Terrell Creek nr Sandersville, MS	314837	0885820	2.19
Wayne	024773553	Tampa Creek nr Eucutta, MS	314616	0885157	4.00
Wayne	024773556	Wagon Branch nr Eucutta, MS	314619	0885149	1.65
Wayne	02477356	Little Eucutta Creek nr Eucutta, MS	314732	0885039	--
Wayne	02477400	Carson Sand Creek at Hiwannee, MS	314730	0884057	13.8
Wayne	02477450	Hortons Mill Creek nr Waynesboro, MS	314438	0883912	7.43
Wayne	02477453	Limestone Creek nr Waynesboro, MS	314313	0883840	2.34
Wayne	02477480	Silver Creek nr Boyce, MS	314431	0884357	5.08
Wayne	02477489	Sandy Creek nr Waynesboro, MS	314158	0884056	--
Wayne	02477490	Yellow Creek at Waynesboro, MS	314148	0884014	54.7
Wayne	02477500	Chickasawhay River nr Waynesboro, MS	314046	0884100	1650
Wayne	02477955	Cypress Creek nr Gretna, MS	314628	0883246	6.24
Wayne	02477965	Dry Creek nr Gretna, MS	314530	0883240	25.4

Table 21.--Records of wells in area 5

County	Well Number	Station Number	Owner	Location Sec.	Location T.	Location R.	Altitude (ft)	Well Depth (ft)	Water Bearing Unit*
Clark	N011	320233088410701	T. R. Sykes	SWSE05	02N	16E	255	220	124SPRT
Clark	P027	315654088513001	W. C. Stallings	NWNW10	01N	14E	300	190	124CCKF
Clark	P045	315515088501001	J. Cooley	SWSE14	01N	14E	270	170	124CCKF
Clark	P054	315550088500101	Mrs. N. W. Mason	SWNE14	01N	14E	263	200	124CCKF
Clark	P055	315616088502401	E. McDaniel	SWSW11	01N	14E	255	90	124CCKF
Clark	P056	315846088485001	A. Dedwiler	NWNE01	01N	14E	285	285	124CCKF
Clark	S052	315648088340001	Herman Rolison				335	270	124SPRT
Jasper	K024	320056089100901	T. A. Bishop	SWNW16	02N	11E	398	40	123VKBG
Jasper	K025	315744089124401	W. N. Bolton	SESW31	02N	11E	348	20	123VKBG
Jasper	K026	320056089110101	Lexie Pugh	SENW16	02N	11E	400	55	123VKBG
Jasper	P003	315532089011801	R. Waldrup	SENW16	02N	11E	445	495	124CCKF
Jasper	P033	315240089020201	R. B. Thorton	SESE35	01N	12E	410	595	124CCKF
Jasper	P034	315305089021101	Marshall Beard	SENE35	01N	12E	390	63	123VKBG
Jasper	P035	315708089030501	Dan Jones	NESE03	01N	12E	475	40	123VKBG
Jasper	R028	314821089164801	Virgil Aansworth	SWNW26	10N	13W	350	35	122CTHL
Jasper	T019	315011089031301	Robert Patrick	SWNE13	10N	11W	350	25	122CTHL
Jasper	T020	315116089045101	W. T. Rowell	NENE10	10N	11W	360	118	122CTHL
Jasper	US01	314935088583665	Nixon Spring	NWNW23	10N	10W	--	--	
Jasper	US02	314934088583465	Carmichael Spring	NWNW23	10N	10W	--	--	
Jasper	U027	315140089012601	Arthur Pugh	NESW05	10N	10W	410	24	122CTHL
Jasper	U028	314938088585101	G. Young	NWNW23	10N	10W	340	21	122CTHL
Jasper	U029	314940088583001	M. Taylor	NENE22	10N	10W	365	40	122CTHL
Jasper	U030	314940088582101	Waneta Allen	SESW14	10N	10W	370	80	123VKBG

Table 21.--Records of wells in area 5--Continued

County	Well Number	Station Number	Owner	Location Sec.	T.	R.	Alti-tude (ft)	Well Depth (ft)	Water Bearing Unit*
Jones	A083	314555089182501	George Green Sr.	SWNE09	09N	13W	318	85	122CTHL
Jones	A084	314555089182502	George Green Sr.	SENE09	09N	13W	318	60	122CTHL
Jones	A085	314630089153601	Bernard Jefcoat	NESW01	09N	13W	370	62	122CTHL
Jones	A086	314658089193601	Claude Knight	NENW05	09N	13W	305	65	122CTHL
Jones	A087	314614089175601	O. L. Parker	SWSW03	09N	13W	300	30	122CTHL
Jones	A088	314632089192501	L. E. Welch	NWSE05	09N	13W	295	40	122CTHL
Jones	C078	314536089072801	R. L. Caves	SWNW08	09N	13W	270	148	122CTHL
Jones	C149	314642089063401	Damon Smith	SWNW04	09N	11W	340	68	122CTHL
Jones	C150	314650089072401	Martha Smith	SENW05	09N	11W	305	30	122CTHL
Jones	D125	314759089015101	Sandersville	SESE30	10N	10W	315	184	122CTHL
Jones	D149	314842088571501	C. McDonald	NENW25	10N	10W	330	518	124CCKF
Jones	D150	314702088580301	A. M. Black	SWSE35	10N	10W	320	125	122CTHL
Jones	D151	314436088574501	Elvan Hodge	SESE14	09N	10W	320	40	122CTHL
Jones	D152	314431088575101	Wright Hodge	SESE14	09N	10W	312	28	122CTHL
Jones	D153	314714088570801	Francis Yarber	SESW36	10N	10W	388	60	122CTHL
Jones	G016	314519091114401	Isabele Pinder	SENW27	08N	11W	140	150	122CTHL
Jones	J073	313502089175801	W. P. Gandy	NESE09	07N	13W	310	65	122CTHL
Wayne	B032	314710088500701	Mrs. M. Graham	SESW31	10N	08W	345	175	123VKBG
Wayne	B033	314750088460201	Troy Daniels	NENW35	10N	08W	360	32	122CTHL
Wayne	B034	314750088460202	Troy Daniels	NENW35	10N	08W	360	54	122CTHL
Wayne	C056	314957088440701	R. Davis	NESW18	10N	07W	242	320	124CCKF
Wayne	C057	315028088391701	Mrs. V. Jones	NWNW13	10N	07W	240	235	124CCKF
Wayne	F091	314623088520401	T. W. Waldron	NESW02	09N	09W	305	30	122CTHL
Wayne	G135	314330088450801	C. L. Brown Jr.	NENW25	09N	08W	280	100	122CTHL
Wayne	H011	314613088434601	Robert L. Graham	SWSE06	09N	08W	300	74	123VKBG
Wayne	H016	314524088425201	George Pugh	NWSE08	09N	07W	315	66	122CTHL
Wayne	H046	314627088431301	L. Graham	NWSW05	09N	07W	355	--	123VKBG

Table 21.--Records of wells in area 5--Continued

County	Well Number	Station Number	Owner	Location Sec.	T.	R.	Altitude (ft)	Well Depth (ft)	Water Bearing Unit*
Wayne	H094	314435088442701	Fred West	NWSW18	09N	07W	285	53	122CTHL
Wayne	H131	314616088433901	Karry Graham	SWSE06	09N	07W	345	135	123VKBG
Wayne	H192	314503088415801	W. C. Gavin	NENW16	09N	07W	215	30	123VKBG
Wayne	H196	314626088432301	G. Graham	NESE06	09N	07W	370	--	122CTHL
Wayne	J117	314411088341101	Eddie Blackledge	SENE22	09N	06W	315	62	122CTHL
Wayne	K035	314524088300501	Mr. Hudson	SESE08	09N	05W	300	250	123FRHL
Wayne	L055	313830088402101	Mr. Bond	NWSW20	08N	09W	255	--	122CTHL
Wayne	L056	313807088533101	Mr. Busby	NWNW27	08N	09W	245	254	122CTHL
Wayne	P011	314015088314701	W. E. Giles	SESW07	08N	05W	255	48	122CTHL
Wayne	P049	314046088313701	E. W. Huffman	NENW07	08N	05W	250	41	122CTHL
Wayne	P073	314122088312901	John Bishop	NWSE06	08N	05W	245	100	123VKBG

*
122CTHL-Catahoula Sandstone
123FRHL-Forest Hill Sand
123VKGB-Vicksburg Group
124CCKF-Cockfield Formation
124SPRT-Sparta Sand

Table 22.--Chemical analyses of surface water in area 5

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Clarke County															
02477000	11/24/59	0835	546	72	6.5	--	22	5.1	2.3	4.1	8.8	4.8	--	--	--
02477000	03/22/60	1020	1250	52	6.2	12.0	16	3.3	1.8	2.8	7.2	3.5	--	--	--
02477000	06/28/60	1800	115	87	6.8	--	23	6.1	2.0	6.2	8.2	5.5	--	--	--
02477000	01/23/64		270	99	6.2	10.0	28	6.8	2.7	6.7	16	7.8	--	--	--
02477000	05/26/64	1115	246	76	6.7	25.0	26	3.7	4.1	6.4	9.8	5.7	--	--	--
02477000	10/13/64	1530	213	83	6.0	18.0	28	7.2	2.4	5.5	9.6	10	--	--	--
02477000	03/08/65		1210	55	5.6	--	15	5.2	.5	3.2	7.2	4.1	--	--	--
02477000	06/21/65		146	92	5.7	--	26	7.5	1.8	6.2	10	6.5	--	--	--
02477000	08/24/65		298	82	5.5	--	19	5.4	1.4	4.4	11	3.8	--	--	--
02477000	10/18/66		135	118	5.9	19.4	26	6.8	2.3	9.0	10	13	--	--	--
02477000	11/30/66		168	91	6.2	9.4	24	5.9	2.3	6.2	8.4	6.6	--	--	--
02477000	01/04/67		260	63	6.1	8.9	18	4.5	1.6	4.0	9.8	5.0	--	--	--
02477000	02/09/67		372	55	5.5	6.1	15	4.2	1.1	3.5	8.2	5.1	--	--	--
02477000	03/03/67		238	67	5.9	9.4	18	5.9	.8	4.6	7.2	5.9	--	--	--
02477000	04/12/67		230	95	6.0	22.8	30	8.0	2.4	6.6	9.6	6.9	--	--	--
02477000	05/03/67		1610	76	6.1	--	16	4.9	.9	3.8	8.2	3.5	--	--	--
02477000	06/01/67		421	87	6.5	23.3	24	7.0	1.6	6.9	8.0	6.5	--	--	--
02477000	08/21/67		108	122	6.3	--	30	9.0	1.8	11	12	12	--	--	--
02477000	10/25/67		71.6	107	6.0	16.0	28	7.6	2.2	8.5	11	8.6	--	--	--
02477000	10/25/67	1050	71.6	107	6.0	16.0	28	7.6	2.2	8.5	11	8.6	--	--	--
02477000	06/11/69	0910	162	115	6.4	--	30	8.4	2.2	9.3	9.8	6.1	--	--	--
02477000	08/26/70	1515	946	75	5.8	26.0	103	20	13	--	8.4	35	--	--	--
02477000	11/15/71	1400	--	--	--	--	--	--	--	5.4	--	3.4	--	--	--
02477000	10/31/74	1200	246	105	6.5	20.0	22	5.8	1.9	--	15	6.5	--	--	--
02477000	01/16/75	1200	4160	54	6.2	8.0	35	12	1.3	--	6.6	3.4	--	--	--
02477000	04/16/75	1500	19100	39	6.0	15.0	18	5.0	1.3	--	6.2	3.3	--	--	--
02477000	08/20/82	1400	385	74	7.0	27.5	22	5.7	1.9	4.7	6.0	4.7	0.03	60	58
024771605	08/12/82	1245	.06	390	5.5	25.0	61	16	5.0	39	6.0	100	--	--	--
024773143	08/11/82	1245	5.3	205	6.5	25.0	43	14	1.9	18	5.0	48	--	--	--
02477330	10/18/66		9.5	43	6.0	15.0	18	6.2	.6	2.0	1.2	3.5	--	--	--
02477330	12/01/66		19	42	6.4	7.8	11	3.3	.6	2.0	1.8	2.2	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Clarke County (Continued)															
02477330	01/04/67		9.0	61	6.7	8.9	22	7.5	0.8	2.5	7.6	3.7	--	--	--
02477330	02/09/67		53	59	6.0	6.1	22	7.5	.8	2.4	7.8	3.5	--	--	--
02477330	03/03/67		12	65	6.5	11.7	26	8.6	1.1	2.6	6.2	4.6	--	--	--
02477330	04/12/67		8.0	64	6.2	--	26	8.9	1.0	2.3	1.6	3.5	--	--	--
02477330	05/03/67		37	59	6.5	--	21	7.0	.9	2.0	4.0	2.9	--	--	--
02477330	06/01/67		41	62	6.8	--	25	9.9	.1	2.5	1.8	2.8	--	--	--
02477330	08/21/67		7.0	57	6.4	25.0	22	7.9	.6	1.9	0.4	2.7	--	--	--
02477330	10/25/67		6.8	44	6.2	15.0	17	5.5	.8	2.0	1.4	3.0	--	--	--
02477330	10/25/67	0800	6.8	44	6.2	15.0	17	5.5	.8	2.0	1.4	3.0	--	--	--
02477330	11/18/71	1010	--	--	--	--	--	--	--	--	--	2.4	--	--	--
02477330	08/20/82	1145	32	85	7.2	26.5	28	9.7	1.0	3.9	3.0	8.9	--	--	--
02477875	08/11/82	1530	.28	1750	6.1	31.5	309	99	14	200	8.0	480	4.70	640	3600
02477910	08/11/82	1730	5.2	142	6.1	27.5	50	18	1.2	6.7	4.0	13	--	--	--
Jasper County															
02473477	07/26/82	1515	.78	2290	4.9	24.0	244	71	15	320	16	760	3.62	100	4100
02473480	05/11/65	1315	45.2	1750	--	22.0	--	--	--	--	--	--	--	--	--
02473480	08/23/65	1640	90.4	1100	--	27.0	--	--	--	--	--	--	--	--	--
02473480	10/07/65	1400	30.3	400	--	19.0	--	--	--	--	--	--	--	--	--
02473480	10/20/65	1730	10.2	3000	--	19.0	--	--	--	--	--	--	--	--	--
02473480	11/08/65	1600	12.0	3000	--	16.1	--	--	--	--	--	--	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Jasper County (Continued)															
02473480	12/13/65	1545	16.0	700	--	13.0	--	--	--	--	--	--	--	--	--
02473480	01/18/66	1220	25.0	800	--	72.0	--	--	--	--	--	--	--	--	--
02473480	04/19/66	1525	53.8	500	--	17.0	--	--	--	--	--	--	--	--	--
02473480	05/23/66	1730	42.8	40	--	22.0	--	--	--	--	--	--	--	--	--
02473480	07/05/66	1700	37.0	1300	--	25.0	--	--	--	--	--	--	--	--	--
02473480	08/15/66	1630	13.2	1400	--	26.0	--	--	--	--	--	--	--	--	--
02473480	09/27/66	1610	11.0	1850	--	21.0	--	--	--	--	--	--	--	--	--
02473480	12/01/66	1555	33.0	1500	--	8.0	--	--	--	--	--	--	--	--	--
02473480	01/18/67	0850	15.2	800	--	8.0	--	--	--	--	--	--	--	--	--
02473480	03/02/67	1215	18.6	700	--	9.0	--	--	--	--	--	--	--	--	--
02473480	04/12/67		36.8	1600	--	21.0	--	--	--	--	--	--	--	--	--
02473480	04/12/67	1325	36.8	1600	--	21.0	--	--	--	--	--	--	--	--	--
02473480	06/01/67	1215	97.8	1900	--	21.0	--	--	--	--	--	--	--	--	--
02473480	08/29/67		7.40	1550	--	22.0	--	--	--	--	--	--	--	--	--
02473480	10/12/67		.31	4300	--	10.0	--	--	--	--	--	--	--	--	--
02473480	11/14/67		1.40	3000	--	12.0	--	--	--	--	--	--	--	--	--
02473480	01/05/68		74.0	390	--	4.0	--	--	--	--	--	--	--	--	--
02473480	02/21/68		17.0	900	--	7.0	--	--	--	--	--	--	--	--	--
02473480	05/13/68		185	270	--	21.0	--	--	--	--	--	--	--	--	--
02473480	07/02/68		.53	3000	--	24.0	--	--	--	--	--	--	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Jasper County (Continued)															
02473480	08/12/68		0.56	3500	--	--	--	--	--	--	--	--	--	--	--
02473480	10/03/68		0.14	3300	--	23.0	--	--	--	--	--	--	--	--	--
02473480	10/24/68		0.21	3000	--	14.0	--	--	--	--	--	--	--	--	--
02473480	12/30/68		28.0	750	--	9.0	--	--	--	--	--	--	--	--	--
02473480	01/14/69		14.0	1200	--	5.0	--	--	--	--	--	--	--	--	--
02473480	02/27/69		21.0	800	--	11.0	--	--	--	--	--	--	--	--	--
02473480	04/09/69		32.0	210	--	18.0	--	--	--	--	--	--	--	--	--
02473480	05/28/69		6.00	2000	--	21.0	--	--	--	--	--	--	--	--	--
02473480	06/24/69		1.40	1100	--	31.0	--	--	--	--	--	--	--	--	--
02473480	09/15/69		0.21	3500	--	20.0	--	--	--	--	--	--	--	--	--
02473480	10/15/69		0.27	3000	--	16.0	--	--	--	--	--	--	--	--	--
02473480	11/12/69		0.45	3000	--	--	--	--	--	--	--	--	--	--	--
02473480	12/04/69		0.36	2800	--	11.0	--	--	--	--	--	--	--	--	--
02473480	12/04/69	1200	36.0	3000	7.1	7.0	--	--	--	--	--	--	--	--	--
02473480	01/06/70	1540	40.0	420	7.0	4.0	--	--	--	--	--	--	--	--	--
02473480	01/29/70		12.0	1100	--	11.0	--	--	--	--	--	--	--	--	--
02473480	02/17/70		57.0	520	--	10.0	--	--	--	--	--	--	--	--	--
02473480	02/18/70	1200	57.0	520	6.5	10.2	--	--	--	--	--	--	--	--	--
02473480	03/09/70		30.0	620	--	13.0	--	--	--	--	--	--	--	--	--
02473480	03/31/70		21.0	900	--	18.0	--	--	--	--	--	--	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
						Jasper County (Continued)									
02473480	03/31/70	1425	21.0	875	6.7	18.0	--	--	--	--	--	--	--	--	--
02473480	04/20/70		94.0	450	--	19.0	--	--	--	--	--	--	--	--	--
02473480	05/11/70		4.20	1350	--	23.0	--	--	--	--	--	--	--	--	--
02473480	05/11/70	1530	4.20	1350	6.4	23.0	--	--	--	--	--	--	--	--	--
02473480	06/01/70		8.60	1800	--	22.0	--	--	--	--	--	--	--	--	--
02473480	06/04/70	1830	4.00	2200	6.2	26.0	--	--	--	--	--	--	--	--	--
02473480	06/22/70		0.13	3500	--	31.0	--	--	--	--	--	--	--	--	--
02473480	08/10/70	1545	4.00	875	6.0	26.0	--	--	--	--	--	--	--	--	--
02473480	09/22/70	1645	0.60	3400	6.9	.	--	--	--	--	--	--	--	--	--
02473480	12/21/70	0940	15.0	700	7.0	15.1	--	--	--	--	--	--	--	--	--
02473480	02/09/71	1300	50.0	345	6.4	5.5	--	--	--	--	--	--	--	--	--
02473480	03/23/71	1025	60.0	350	6.7	14.1	--	--	--	--	--	--	--	--	--
02473480	05/04/71	0840	25.0	50	--	17.0	--	--	--	--	--	--	--	--	--
02473480	06/15/71	1100	7.50	800	7.0	2.6	--	--	--	--	--	--	--	--	--
02473480	08/04/71	1000	13.0	700	6.4	25.0	--	--	--	--	--	--	--	--	--
02473480	09/21/71	1220	.75	440	6.5	24.0	--	--	--	--	--	--	--	--	--
02473480	01/28/72	1000	--	500	7.0	12.0	--	--	--	--	--	--	--	--	--
02473480	03/15/72	1830	--	420	6.5	18.0	--	--	--	--	--	--	--	--	--
02473480	10/18/72	1530	--	800	7.1	23.0	--	--	--	--	--	--	--	--	--
02473480	11/30/72	1645	--	800	6.8	10.0	--	--	--	--	--	--	--	--	--
02473480	03/05/73	1200	59.2	290	6.3	15.5	--	--	--	--	--	--	--	--	--
02473480	04/26/73	1045	630	860	5.8	18.7	--	--	--	--	--	--	--	--	--
02473480	08/11/82	0930	12.0	392	6.7	25.0	72	24.0	2.7	38.0	5.0	87.0	0.51	50	470
02473810	07/27/82	0925	.6	310	6.5	25.5	81	27	3.4	21	15	61	--	--	--
02474569	07/26/82	1715	5.0	750	7.2	25.5	68	60	4.3	74	14	160	.86	20	790

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
						Jones County									
02472058	07/26/82	1230	0.96	117	6.4	22.0	0	5.0	1.7	12	3.0	27	0.11	20	180
024745735	07/27/82	1145	0.46	717	7.3	25.0	40	11	3.1	140	25	150	0.90	--	--
02474574	08/10/82	1030	0.94	184	6.5	25.5	27	7.5	2.0	19	4.0	35	--	--	--
024745785	07/27/82	1420	0.67	555	5.8	28.0	03	32	5.4	52	4.0	160	1.65	30	1100
						Wayne County									
024773553	08/13/82	1230	1.2	395	4.9	29.0	33	9.5	2.3	55	4.0	110	--	--	--
024773556	08/13/82	1030	0.76	717	5.1	25.0	94	29	4.9	89	2.0	200	2.55	280	1400
* 02477356	04/05/73			1350		13.5	--	--	--	--	--	750	--	--	--
* 02477356	08/13/73		--	7000	5.5	26.5	--	--	--	--	--	4200	--	--	--
02477356	08/12/82	1615	7.3	1050	5.1	28.5	04	31	5.9	140	3.0	300	2.18	140	1800
02477400	08/18/82	0815	9.5	205	6.8	24.0	79	28	2.3	8.4	14	14	--	--	--
* 02477450	04/03/73		--	1060	--	15.0	--	--	--	--	--	303	--	--	--
* 02477450	08/14/73		--	2500	8.2	21.5	--	--	--	--	--	930	--	--	--
02477450	08/17/82	1115	6.0	510	7.3	23.5	23	44	3.1	38	4.0	110	.92	160	690
02477453	08/17/82	1400	1.9	275	7.0	24.5	85	30	2.5	15	8.0	38	--	--	--
* 02477480	03/27/73			540	5.5	14.5	--	--	--	--	--	167	--	--	--
* 02477480	08/14/73			700	6.4	23.0	--	--	--	--	--	210	--	--	--
02477480	08/17/82	0830	10	735	5.5	23.0	58	16	4.1	120	1.0	210	1.40	180	1300
* 02477489	03/01/73		--	<50	6.6	12.0	--	--	--	--	--	7.6	--	--	--
* 02477489	08/14/73		--	<50	6.6	24.0	--	--	--	--	--	5.0	--	--	--
02477489	08/13/82	0830	6.2	32	5.9	25.5	8	2.2	0.6	2.1	1.0	3.1	.05	20	16
02477490	12/22/65	1200	84	1190	6.5	--	15	--	--	--	--	359	--	--	--
02477490	11/15/71	1445	--	--	--	--	--	--	--	--	--	278	--	--	--
* 02477490	04/11/73		--	60	6.5	12.0	--	--	--	--	--	61	--	--	--
* 02477490	08/13/73		--	260	6.3	25.5	--	--	--	--	--	152	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Wayne County (Continued)															
02477490	08/20/82	0915	39	346	6.9	24.0	45	14	2.4	42	3.0	87	0.48	160	560
02477500	10/01/63		--	521	6.9	22.0	88	28	4.4	52	8.0	108	--	--	--
02477500	10/11/63		--	553	7.0	22.0	92	27	6.0	73	8.0	135	--	--	--
02477500	10/21/63		--	580	6.8	22.0	90	28	4.9	78	12	141	--	--	--
02477500	11/01/63		--	563	6.9	23.0	00	27	7.9	69	9.0	137	--	--	--
02477500	11/11/63		--	555	6.7	23.0	86	28	3.9	71	10	134	--	--	--
02477500	11/21/63		--	592	7.2	23.0	95	32	3.7	81	11	152	--	--	--
02477500	11/25/63		--	397	7.0	23.0	68	20	4.4	46	13	87	--	--	--
02477500	11/29/63		--	528	7.5	23.0	84	23	6.4	71	14	133	--	--	--
02477500	12/02/63		--	479	6.6	23.0	80	23	5.5	55	12	119	--	--	--
02477500	12/10/63		--	590	7.0	23.0	95	28	6.1	76	12	156	--	--	--
02477500	12/14/63	0700	--	936	--	8.0	--	--	--	--	--	280	--	--	--
02477500	12/15/63		--	415	6.4	23.0	67	20	4.1	55	15	110	--	--	--
02477500	12/24/63		--	734	--	--	--	--	--	--	--	198	--	--	--
02477500	12/25/63		--	486	6.4	23.0	79	24	4.6	62	14	125	--	--	--
02477500	01/01/64		--	448	7.6	22.0	82	24	5.4	58	16	111	--	--	--
02477500	01/11/64		--	245	6.8	--	53	16	3.2	25	13	50	--	--	--
02477500	01/17/64		--	547	--	3.0	--	--	--	--	--	147	--	--	--
02477500	01/17/64	0700	--	547	--	3.0	--	--	--	--	--	147	--	--	--
02477500	01/18/64		--	336	6.5	--	65	21	3.1	37	13	75	--	--	--
02477500	01/26/64		--	193	7.2	22.0	43	12	3.2	20	11	38	--	--	--
02477500	02/01/64		--	310	6.9	--	57	16	4.1	39	14	72	--	--	--
02477500	02/11/64		--	317	7.6	26.0	58	18	3.2	42	13	75	--	--	--
02477500	02/14/64		--	682	--	--	--	--	--	--	--	186	--	--	--
02477500	02/14/64	0700	--	682	--	8.0	--	--	--	--	--	186	--	--	--
02477500	02/19/64		--	144	6.9	--	32	8.0	2.9	14	9.4	27	--	--	--

Table 22.--Chemical analyses of surface water in area 5--Continued

(Dissolved constituents and hardness in milligrams per liter, except as indicated)

Site Number	Date of collection	Time (Hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (Units)	Temperature (Deg°C)	Hardness as $CaCO_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO_4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Wayne County (Continued)															
02477500	05/01/64		--	68	7.1	25.0	19	4.1	2.1	5.1	2.4	8.7	--	--	--
02477500	05/05/64		--	162	7.2	--	42	12	2.9	15	7.0	29	--	--	--
02477500	05/08/64		--	229	7.1	25.0	53	16	3.2	24	8.2	47	--	--	--
02477500	05/13/64		--	270	7.1	25.0	58	17	3.8	29	7.4	59	--	--	--
02477500	05/23/64		--	307	7.2	25.0	62	17	4.8	33	8.6	67	--	--	--
02477500	05/30/64		--	444	7.0	--	72	23	3.5	54	7.8	108	--	--	--
02477500	06/04/64		--	355	6.9	--	69	23	2.8	41	8.4	84	--	--	--
02477500	06/12/64		--	492	7.2	--	85	28	3.7	58	8.2	120	--	--	--
02477500	06/15/64		--	674	7.0	--	104	34	4.6	89	9.6	184	--	--	--
02477500	06/20/64		--	528	7.3	--	97	30	5.4	59	8.2	128	--	--	--
02477500	06/25/64		--	454	6.8	--	74	23	4.0	52	9.2	110	--	--	--
02477500	07/01/64		--	469	7.0	--	78	24	4.4	58	7.2	125	--	--	--
02477500	07/03/64		--	285	7.0	--	49	17	1.6	33	7.2	64	--	--	--
02477500	07/11/64	0700	--	285	7.0	--	49	17	1.6	33	7.2	64	--	--	--
02477500	07/15/64		--	379	6.9	--	67	20	4.1	44	7.2	91	--	--	--
02477500	07/23/64		--	508	7.2	--	84	28	3.4	66	8.6	133	--	--	--
02477500	07/25/64	0700	--	577	--	29.0	--	--	--	--	--	154	--	--	--
02477500	07/27/64		--	412	6.8	--	64	20	3.4	52	13	100	--	--	--
02477500	08/08/64		--	571	7.0	--	88	29	3.8	77	9.0	155	--	--	--
02477500	08/14/64	0700	--	773	7.2	--	130	44	4.9	97	8.6	217	--	--	--
02477500	08/20/64		--	341	7.0	--	63	21	2.6	42	8.6	83	--	--	--
02477500	08/23/64	0700	--	363	--	28.0	--	--	--	--	--	90	--	--	--
02477500	09/01/64		--	410	7.4	--	79	24	4.6	50	7.4	101	--	--	--
02477500	09/11/64		--	438	7.1	--	80	27	3.1	53	9.4	107	--	--	--
02477500	09/19/64		--	214	7.2	--	40	14	1.2	23	8.2	40	--	--	--
02477500	09/24/64		--	461	7.2	--	78	26	3.2	55	7.4	115	--	--	--
02477500	10/21/64		--	401	6.5	--	74	24	3.4	46	9.8	95	--	--	--
02477500	11/15/71	1520	--	--	--	--	--	--	--	--	--	50	--	--	--
* 02477500	04/11/73		--	260	5.5	12.0	--	--	--	--	--	182	--	--	--
* 02477500	08/13/73		--	4800	5.5	28.0	--	--	--	--	--	2600	--	--	--
02477500	10/23/74	1700	448	165	6.6	17.0	43	14	1.9	--	6.8	39	--	--	--
02477500	01/22/75	1145	4450	95	6.4	10.0	30	9.5	1.5	--	6.9	15	--	--	--
02477500	04/02/75	1115	4480	50	6.1	15.0	26	8.3	1.3	--	6.0	8.7	--	--	--
02477500	08/20/82	0815	1050	121	7.1	27.0	33	10	1.8	8.7	7.0	5.8	<0.04	60	120
02477955	08/12/82	0945	.31	100	5.9	24.5	34	11	1.5	4.9	6.0	9.0	--	--	--
02477965	08/12/82	0815	5.3	276	6.7	25.0	106	39	2.0	8.7	12	16	--	--	--

* From Baughman, W. T., and McCarty, J. E., 1974

Table 23.--Chemical analyses of ground water in area 5

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of col-lec-tion	Spec-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hardness as $CaCo_3$	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sulfate (SO4)	Chloride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Strontium (Sr) (µg/L)
Clarke County															
N011	124SPRT	220	09/24/81	397	--	--	--	--	--	--	--	2.2	--	--	--
P027	124CCKF	190	10/07/81	740	--	--	--	--	--	--	--	20	--	--	--
P027	124CCKF	190	06/09/82	700	7 .7	21.5	44	11	.9	1 50	61	15	--	--	--
P045	124CCKF	170	10/07/81	750	--	--	--	--	--	--	--	22	--	--	--
P045	124CCKF	170	06/10/82	705	7 .4	20.5	108	27	.8	1 20	72	20	--	--	--
P054	124CCKF	200	10/07/81	740	--	--	--	--	--	--	--	20	--	--	--
P054	124CCKF	200	06/09/82	703	7 .4	20.5	81	20	.6	1 30	69	15	--	--	--
P055	124CCKF	90	10/07/81	700	--	--	--	--	--	--	--	22	--	--	--
P055	124CCKF	90	06/11/82	700	7 .3	20.0	126	36	.8	99	64	16	--	--	--
P056	124CCKF	285	10/15/81	500	--	--	--	--	--	--	--	1.7	--	--	--
S052	124SPRT	270	10/07/81	284	--	--	--	--	--	--	--	2.4	--	--	--
Jasper County															
K024	123VKBG	40	10/13/81	261	--	--	--	--	--	--	--	3.0	--	--	--
K025	123VKBG	20	10/13/81	49	--	--	--	--	--	--	--	4.4	--	--	--
K026	123VKBG	55	10/13/81	143	--	--	--	--	--	--	--	6.6	--	--	--
P003	124CCKF	49	10/15/81	645	--	--	--	--	--	--	--	33	--	--	--
P003	124CCKF	495	06/09/82	661	8 .1	--	20	5.1	.7	1 50	54	29	--	--	--
P033	124CCKF	595	10/15/81	810	--	--	--	--	--	--	--	27	--	--	--
P034	123VKBG	63	10/15/81	205	--	--	--	--	--	--	--	54	--	--	--
P035	123VKBG	40	10/14/81	309	--	--	--	--	--	--	--	6.6	--	--	--
R028	122CTHL	35	09/21/81	30	--	--	--	--	--	--	--	6.1	--	--	--
T019	122CTHL	25	10/14/81	71	--	--	--	--	--	--	--	9.3	--	--	--
T020	122CTHL	118	10/15/81	67	--	--	--	--	--	--	--	.0	--	--	--
US01		--	08/10/82	3160	4.0	23.5	607	200	4	340	16	1000	8.80	180	7600
US02		--	08/10/82	18000	3.5	34.5	3625	1200	40	2400	21	6300	49	2000	45000
U027	122CTHL	24	10/15/81	134	--	--	--	--	--	--	--	24.0	--	--	--
U027	122CTHL	24	06/09/82	133	5.2	23.0	26	5.5	3.1	14	3.0	27.0	--	--	--
U028	122CTHL	21	08/10/82	274	6.9	20.5	122	47	1.2	3.6	6.0	3.6	--	--	--

Table 23.--Chemical analyses of ground water in area 5--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of col-lec-tion	Spec-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi-um (Mg)	Sodium (Na)	Sul-fate (SO4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron-tium (Sr) (µg/L)
Jasper County (Continued)															
U029	122CTHL	40	08/10/82	230	6.4	20.0	--	--	--	--	--	31	--	--	--
U030	123VKBG	80	10/14/81	208	--	--	--	--	--	--	--	6.6	--	--	--
A083	122CTHL	85	10/09/81	46	--	--	--	--	--	--	--	6.4	--	--	--
A084	122CTHL	60	10/09/81	25	--	--	--	--	--	--	--	2.7	--	--	--
A085	122CTHL	62	10/08/81	59	--	--	--	--	--	--	--	9.1	--	--	--
A086	122CTHL	65	10/09/81	26	--	--	--	--	--	--	--	2.6	--	--	--
A087	122CTHL	30	09/21/81	78	--	--	--	--	--	--	--	2.9	--	--	--
A088	122CTHL	40	10/09/81	158	--	--	--	--	--	--	--	16	--	--	--
C078	122CTHL	148	10/08/81	205	--	--	--	--	--	--	--	31	--	--	--
C149	122CTHL	68	10/08/81	22	--	--	--	--	--	--	--	1.3	--	--	--
C150	122CTHL	30	10/08/81	148	--	--	--	--	--	--	--	4.6	--	--	--
D125	122CTHL	184	10/14/81	138	--	--	--	--	--	--	--	3.2	--	--	--
D149	124CCKF	518	10 /14/81	860	--	--	--	--	--	--	--	28	--	--	--
D149	124CCKF	518	06/09/82	853	8.7	23.0	8	2.1	0.8	240	32	27	.	.	.
D150	122CTHL	125	10/14/81	90	--	--	--	--	--	--	--	2.2	--	--	--
D151	122CTHL	40	10/14/81	41	--	--	--	--	--	--	--	1.1	--	--	--
D152	122CTHL	28	10/14/81	175	--	--	--	--	--	--	--	15	--	--	--
D153	122CTHL	60	10/14/81	63	--	--	--	--	--	--	--	8.3	--	--	--
G016	122CTHL	150	09/23/81	640	--	--	--	--	--	--	--	7.0	--	--	--
J073	122CTHL	65	10/09/81	88	--	--	--	--	--	--	--	4.4	--	--	--
Wayne County															
A028	123VKBG	150	09/24/81	280	--	--	--	--	--	--	--	2.1	--	--	--
B032	123VKBG	175	09/24/81	380	--	--	--	--	--	--	--	2.1	--	--	--
B033	122CTHL	32	09/23/81	16	--	--	--	--	--	--	--	2.2	--	--	--

Table 23.--Chemical analyses of ground water in area 5--Continued

(Dissolved constituents and hardness given in milligrams per liter, except as indicated)

Well Number	Water bearing unit*	Well depth (ft)	Date of col-lec-tion	Spec-cific con-duct-ance (µS/cm)	pH (Units)	Temper-ature (Deg°C)	Hard ness as $CaCO_3$	Cal cium (Ca)	Mag nesi-um (Mg)	Sodium (Na)	Sul-fate (SO4)	Chlo-ride (Cl)	Bromide (Br)	Boron (B) (µg/L)	Stron-tium (Sr) (µg/L)
							Wayne County (Continued)								
B034	122CTHL	54	09/23/81	52	--	--	--	--	--	--	--	2.0	--	--	--
C056	124CCKF	320	09/23/81	770	--	--	--	--	--	--	--	26	--	--	--
C057	124CCKF	235	09/22/81	980	--	--	--	--	--	--	--	38	--	--	--
C057	124CCKF	235	06/10/82	1000	--	--	--	--	--	--	--	39	--	--	--
F090	123VKBG	244	09/24/81	415	--	--	--	--	--	--	--	2.3	--	--	--
F091	122CTHL	30	09/24/81	57	--	--	--	--	--	--	--	6.1	--	--	--
F091	122CTHL	30	06/10/82	60	4.9	20.0	11	2.0	1.5	5.0	2.0	6.7	--	--	--
G135	122CTHL	100	09/24/81	120	--	--	--	--	--	--	--	27	--	--	--
G135	122CTHL	100	06/10/82	122	4.5	19.5	12	2.6	1.3	13	1.0	29	--	--	--
H011	123VKBG	74	09/23/81	310	--	--	--	--	--	--	--	16	--	--	--
H016	122CTHL	66	09/23/81	34	--	--	--	--	--	--	--	0.8	--	--	--
H046	123VKBG	--	09/23/81	870	--	--	--	--	--	--	--	180	--	--	--
H046	123VKBG	--	06/10/82	950	7.1	20.5	62	10	2.9	76	17	220	1.07	<10	220
H094	122CTHL	53	09/23/81	32	--	--	--	--	--	--	--	6.0	--	--	--
H131	123VKBG	135	09/23/81	136	--	--	--	--	--	--	--	36	--	--	--
H192	123VKBG	30	09/23/81	380	--	--	--	--	--	--	--	14	--	--	--
H196	122CTHL	--	06/10/82	7800	6.8	22.0	34	30	30	600	90	2500	12.8	400	10000
J117	122CTHL	62	09/22/81	20	--	--	--	--	--	--	--	1.9	--	--	--
K035	123FRHL	250	09/22/81	385	--	--	--	--	--	--	--	3.6	--	--	--
L055	122CTHL	--	09/24/81	95	--	--	--	--	--	--	--	1.0	--	--	--
L056	122CTHL	254	09/24/81	28	--	--	--	--	--	--	--	2.9	--	--	--
P011	122CTHL	48	09/22/81	34	--	--	--	--	--	--	--	4.4	--	--	--

*
122CTHL-Catahoula Formation
123FRHL-Forest Hill Sand
123VKBG-Vicksburg Group
124CCKF-Cockfield Formation
124SPRT-Sparta Sand