UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTHEASTERN MISSISSIPPI, AUGUST 1983

by

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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
inch (in)	25.4	millimeter (mm)
foot (ft)	.3048	meter (m)
cubic feet per second (ft^3/s)	.0283	cubic meter per second (mi^3/s)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

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ABSTRACT

The U.S. Geological Survey, in cooperation with the Mississippi Department of Natural Resources, Bureau of Geology, is conducting a hydrologic data collection program in potential lignite-producing areas in Mississippi. During the period August 24-29, 1983, hydrologic data were collected at 15 stream sites draining potential lignite mining areas in northeastern Mississippi.

Main channel widths ranged from approximately 30 feet on Shutispear Creek northeast of Slate Springs to approximately 150 feet on Horse Pen Creek near Cadaretta. Maximum water depths at the stream sites ranged from less than 1 foot at numerous sites to approximately 6.5 feet in Wolf Creek at Sibleyton. Stream discharge ranged from 0.03 cubic feet per second in Salt Creek near Eupora and Huffman Creek near Calhoun City to 3.60 cubic feet per second in Wolf Creek at Sibleyton.

The specific conductance of water in streams ranged from 42 to 188 micromhos and total dissolved solids ranged from 25 to 149 mg/L (milligrams per liter). Most major ion concentrations were less than 10 mg/L with the exception of sulfate (38 mg/L) and sodium (21 mg/L) in Duncan Creek near Derma, and sulfate (20 mg/L) in Huffman Creek near Calhoun City. The pH ranged from 6.7 to 8.1 units and the dissolved oxygen was greater than 5.0 mg/L at 12 of 15 sites. The water in Little Black Creek at Eupora had a turbidity value of 120 units; all other streams had turbidity values less than 20 units and suspended sediment concentrations less than 30 mg/L. Nitrate plus nitrite concentrations were equal to or less than 0.10 mg/L in all streams except in Huffman Creek where the concentration was 0.80 mg/L. Dissolved aluminum concentrations ranged from less than 100 to 500 micrograms per liter. Chromium and zinc concentrations ranged from 1 to 10 ug/g (micrograms per gram) and mercury concentrations ranged from 0.01 to 0.04 ug/g in bottom material samples.

INTRODUCTION

Lignite deposits occur in potentially commercial quantities in the outcrop of the Wilcox Group. Williamson (1976,p. 1) states that lignites are present as tabular, discontinuous, irregularly shaped deposits overlain by unconsolidated sands, silts, and clays. Williamson also reports that lignite seams thicker than 10 feet are exceptional and that lignite seams 4 to 7 feet thick are more common. Within the Wilcox Group outcrop area, lignite beds 2.5 feet or more thick and less than 250 feet deep occur in every county, with the exception of Webster County (Meissner and others, 1982, plate 9).

Using modern mining technology, these thick, relatively shallow lignite deposits may be profitably strip mined under the proper economic conditions. However, surface mining of lignite may require the removal of large quantities of overburden and the disposal of large volumes of water. Overburden materials disturbed during the mining phase and sediment-laden water may enter streams, filling the stream channel and greatly increasing the sediment load. Overburden disposal in spoil banks may erode, producing a similar effect. Weathering of newly exposed overburden and large volumes of dewatered ground water will have an impact on the water quality of streams draining the mined area. To assess the impact of mining activities on the local streams, it is essential that background hydrologic data be collected prior to any mining activity.

To determine background data in potential lignite mining areas, hydrologic data were collected from 15 stream sites in northeast Mississippi during the period August 24-29, 1983. Water samples and bottom material samples were collected and channel cross sections were determined at all 15 sites. These hydrologic data sites were selected jointly by the Mississippi Department of Natural Resources, Bureau of Geology, and the U.S. Geological Survey. This report is the fourth in a series. Data collected during 1980, 1981, and 1982 were published in open-file reports for respective years by the U.S. Geological Survey (Arthur, 1981 and 1982, Kalkhoff, 1983). The locations of the background hydrologic data studies completed to date are shown in figure 1.

OBJECTIVE AND SCOPE

The objective of the 5-year study is to collect background data on water quality and channel characteristics in many small streams that drain potential lignite mining areas to document premining conditions in areas where little information is available. This information will be an invaluable data base for any future study of surface mining effects in Mississippi.

Background data on streams draining potential lignite mining areas are being obtained by sampling about 15 streams yearly. The water samples collected for this and previous reports were analyzed for selected dissolved constituents, and bottom material samples were analyzed for selected metals. Channel cross sections were delineated at each site at the time of sample collection.

AREA OF STUDY

The 15 data collection sites visited in 1983 are located in three counties in northeastern Mississippi (fig. 2). Seven sites are located on streams in both Webster and Calhoun Counties and one site is in Montgomery County (table 1). Five sites are in the Big Black River basin and 10 sites are in the Yazoo River basin.

All sites are locate on small streams draining less than 50 mi^2. The drainage areas ranged up to 41.28 mi on Wolf Creek and are listed in table 1.

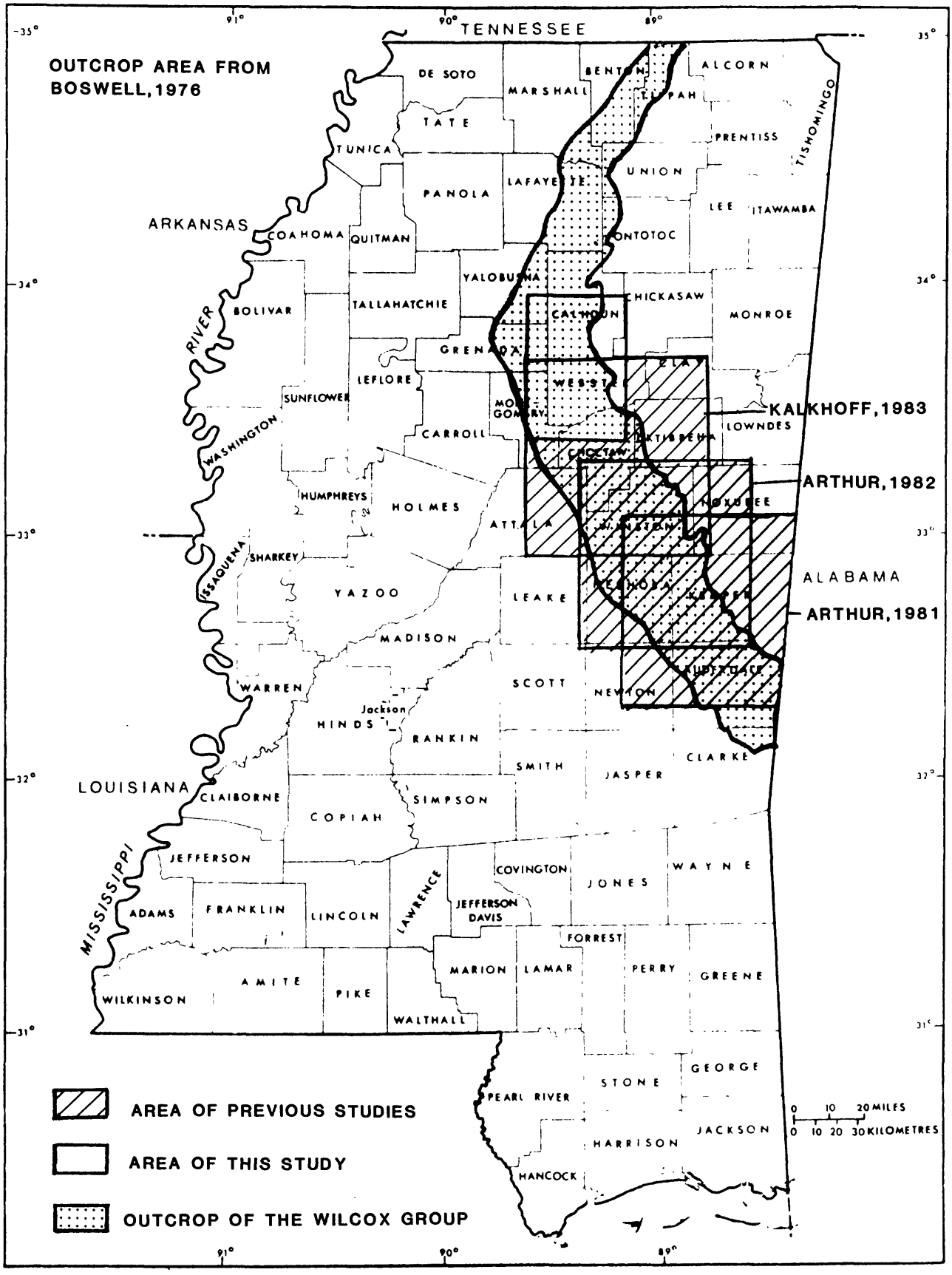
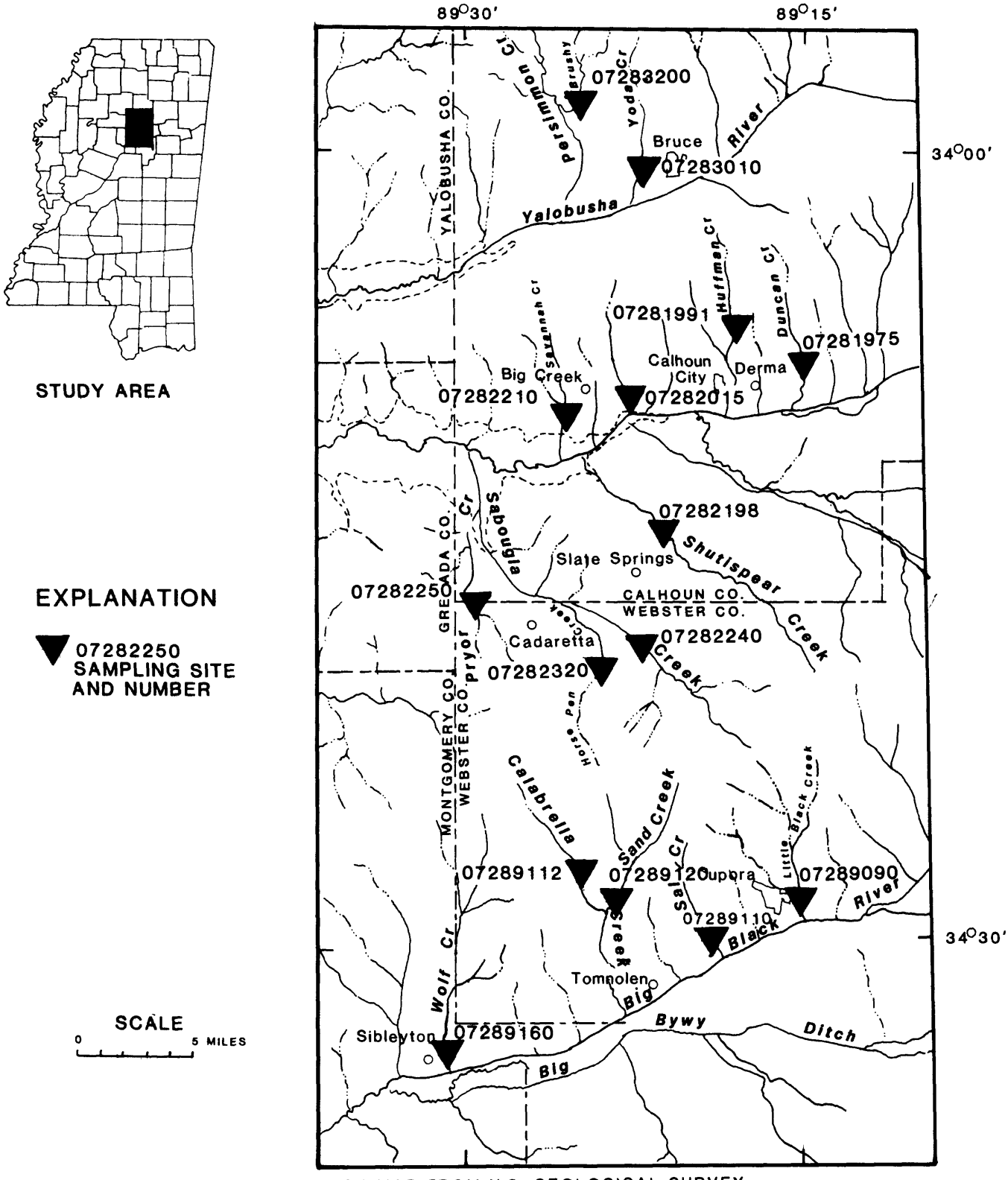


FIGURE 1.--LOCATION OF BACKGROUND HYDROLOGIC DATA STUDIES IN THE OUTCROP AREA OF THE WILCOX GROUP.



BASE MAP FROM U.S. GEOLOGICAL SURVEY
TUPELO 1:250,000
WEST POINT 1:250,000

FIGURE 2.--LOCATION OF STUDY AREA AND SAMPLING SITES IN A POTENTIAL LIGNITE MINING AREA IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983.

TABLE 1.--SAMPLING SITES AND DRAINAGE AREAS IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983

SITE NUMBER	STATION NAME AND LOCATION	COUNTY	LATITUDE	LONGITUDE	DRAINAGE AREA(MI^2)
07281975	DUNCAN CREEK NR DERMA, MS	CALHOUN	33° 51'40"	89° 15'08"	8.45
07281991	HUFFMAN CREEK NR CALHOUN CITY, MS	CALHOUN	33 53'10"	89° 18'06"	8.36
07282015	BIG CREEK NR BIG CREEK, MS	CALHOUN	33° 50'51"	89° 22'50"	15.56
07282198	SHUTISPEAR CREEK NE OF SLATE SPRINGS, MS	CALHOUN	33° 45'40"	89° 21'00"	6.52
07282210	SAVANNAH CREEK AT BIG CREEK, MS	CALHOUN	33° 50'05"	89° 25'50"	8.07
07282240	SABOUGLA CREEK NR SLATE SPRINGS, MS	WEBSTER	33° 41'20"	89° 21'49"	35.52
07282250	PRYOR CREEK NR CADARETTA, MS	WEBSTER	33° 40'42"	89° 23'53"	14.83
07282320	HORSE PEN CREEK NR CADARETTA, MS	WEBSTER	33° 43'20"	89° 29'52"	8.31
07283010	YODA CREEK AT BRUCE, MS	CALHOUN	33° 59'15"	89° 22'08"	11.00
07283200	BRUSHY CREEK NR BRUCE, MS	CALHOUN	34° 01'40"	89° 24'52"	20.28
07289090	LITTLE BLACK CREEK AT EUPORA, MS	WEBSTER	33° 32'25"	89° 15'05"	25.08
07289110	SALT CREEK NR EUPORA, MS	WEBSTER	33° 30'55"	89° 19'05"	6.90
07289112	CALABRELLA CREEK NR TOMNOLEN, MS	WEBSTER	33° 32'35"	89° 24'45"	15.01
07289120	SAND CREEK NR TOMNOLEN, MS	WEBSTER	33° 31'54"	89° 23'25"	13.30
07289160	WOLF CREEK AT SIBLEYTON, MS	MONTGOMERY	33° 26'16"	89° 30'43"	41.28

Most sites are located on streams in rural areas that drain farm and forest land. However, Little Black Creek at Eupora receives runoff from Eupora and Huffman Creek near Calhoun City receives runoff from Pittsboro.

CHANNEL CROSS SECTIONS

Channel cross sections were delineated at 15 sites at the time of water-quality sampling (fig. 3). The cross sections were determined by measuring down from a horizontal reference point on the bridge to the streambed. Stream channel widths ranged from approximately 30 feet on Shutispear Creek northeast of Slate Springs to approximately 150 feet on Horse Pen Creek near Cadaretta. Water depths ranged from less than 1 foot at numerous sites to approximately 6.5 feet in Wolf Creek at Sibleyton. Channel bottoms of most streams consisted of sand and some gravel. However, the streambed was a hard clay or marl in Horse Pen, Yoda, Little Black, and Wolf Creeks. Most channel banks were steep to vertical and were covered by variable amounts of shrubs and trees. Photographs documenting conditions at the sampling sites are available from the U.S. Geological Survey in Jackson, Mississippi.

WATER QUALITY

Water temperature, specific conductance, pH, and dissolved oxygen concentrations were measured at each site. Water and bottom material samples were collected for laboratory analysis. Major chemical constituents and suspended-sediment concentrations in water samples and selected metals in bottom material samples were determined (table 2). Stream discharge was also measured at each site. Discharge ranged from 0.03 ft^3/s in Salt Creek near Eupora and Huffman Creek near Calhoun City to 3.60 ft^3/s in Wolf Creek at Sibleyton. Discharge at most other sites was less than 1.0 ft^3/s.

Water temperature ranged from 24.5 to 35.5°C (about 76 to 96°F) during the study. The lowest temperature was in Pryor Creek near Cadaretta at 1400 hours on August 26 and in Horse Pen Creek near Cadaretta at 0920 hours on August 27. The maximum stream temperature was recorded in Big Creek at 1530 hours on August 27.

Specific conductance at all sites was less than 200 umhos (micromhos). The specific conductance ranged from 42 umhos in Sand Creek near Tomnolen to 188 umhos in Duncan Creek near Derma. The specific conductance of samples collected during the study are tabulated in table 2 and illustrated in figure 4.

The pH of the water in streams ranged from 6.7 to 8.1 units. Five streams had pH values less than 7.0 units with the lowest pH at site 07289120 on Sand Creek. The pH was 7.0 or greater in 10 streams; the highest was at site 07282015 on Big Creek.

Dissolved oxygen concentrations ranged from 3.6 to 9.2 mg/L and generally were greater than 5.0 mg/L. Two streams, Salt Creek near Eupora (4.9 mg/L) and Horse Pen Creek near Cadaretta (3.6 mg/l), had concentrations less than 5.0 mg/L (table 2).

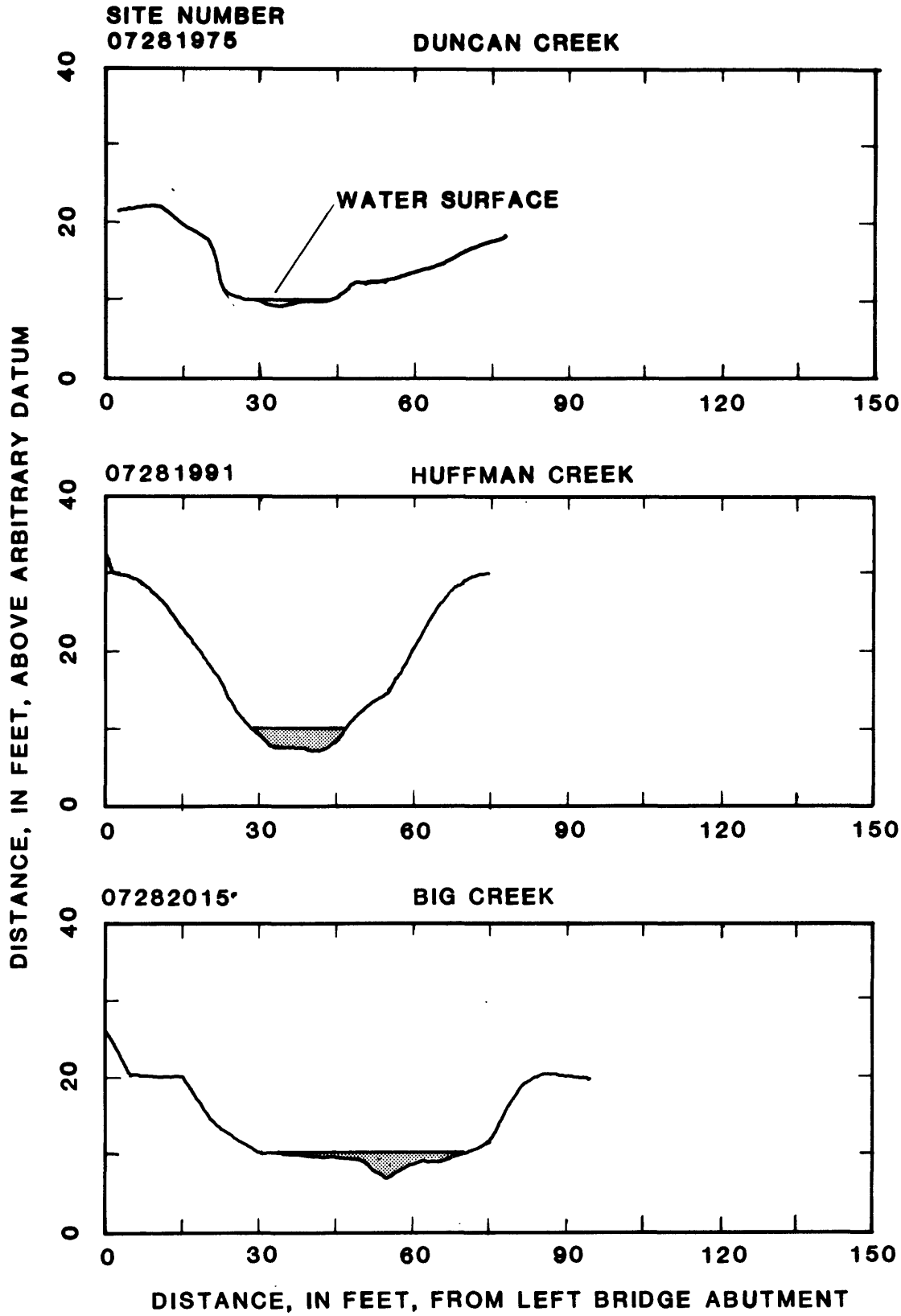


FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES NORTHEASTERN MISSISSIPPI AUGUST 24-29, 1983.

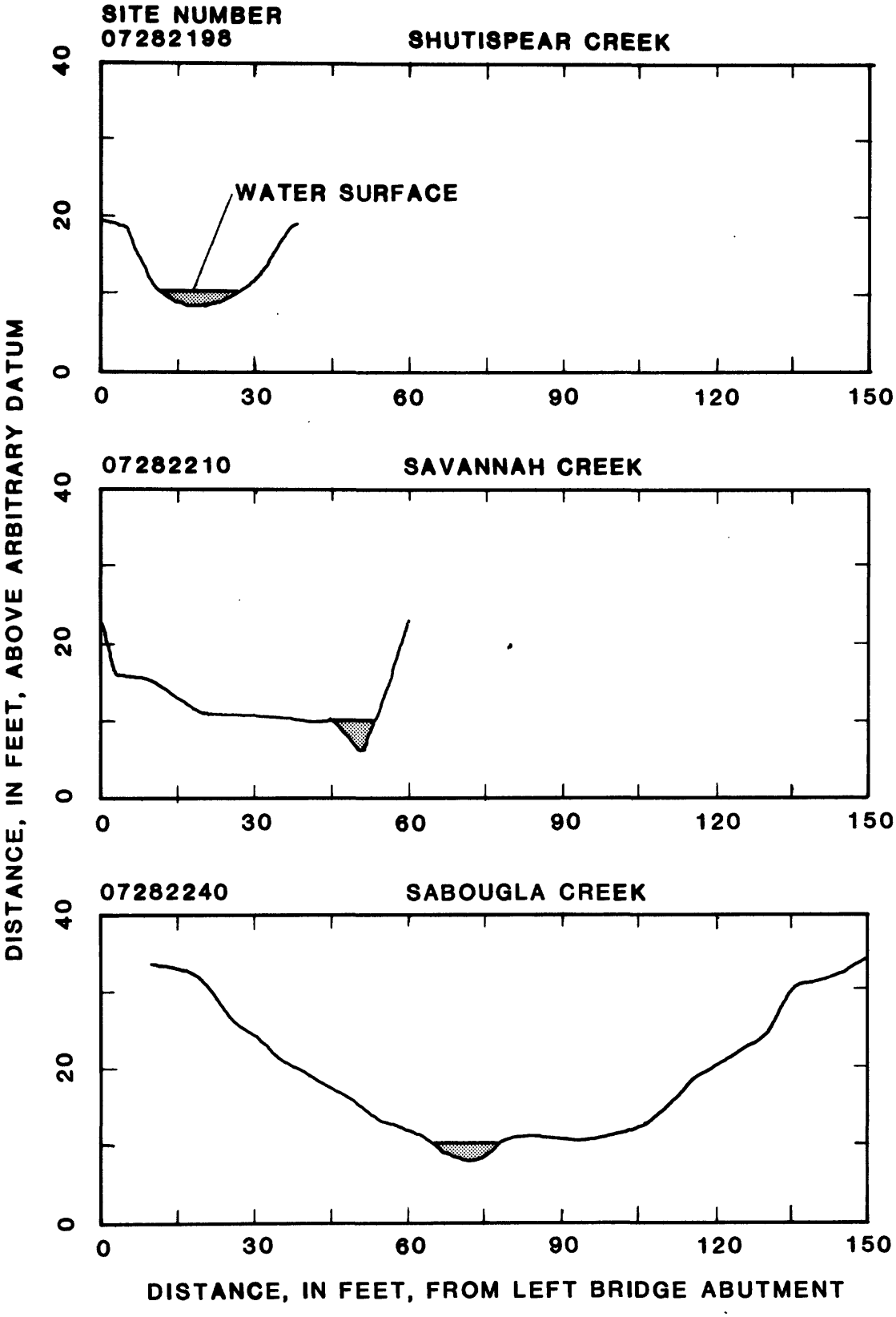


FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES NORTHEASTERN MISSISSIPPI AUGUST 24-29,1983 (CONTINUED).

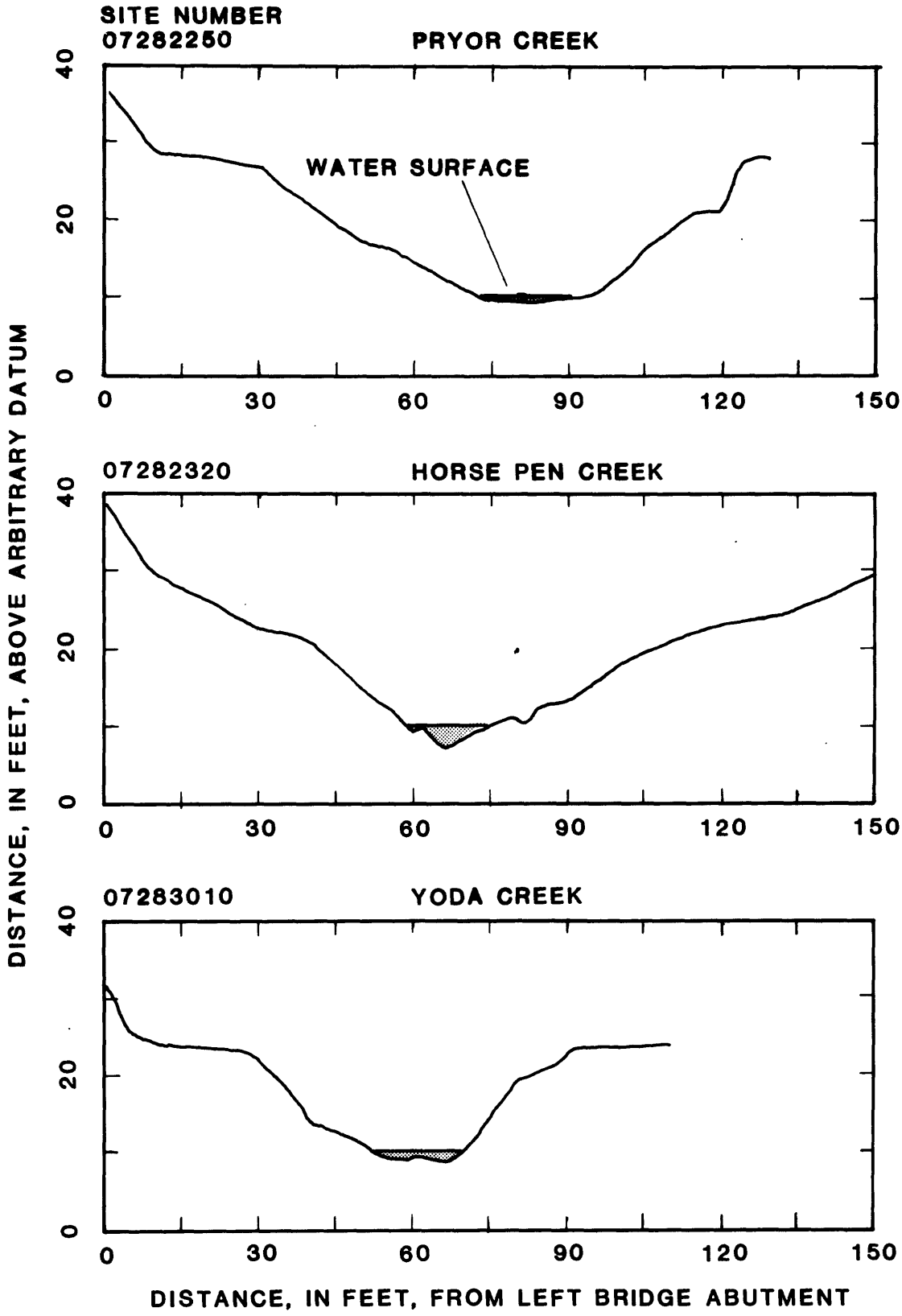


FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983 (CONTINUED).

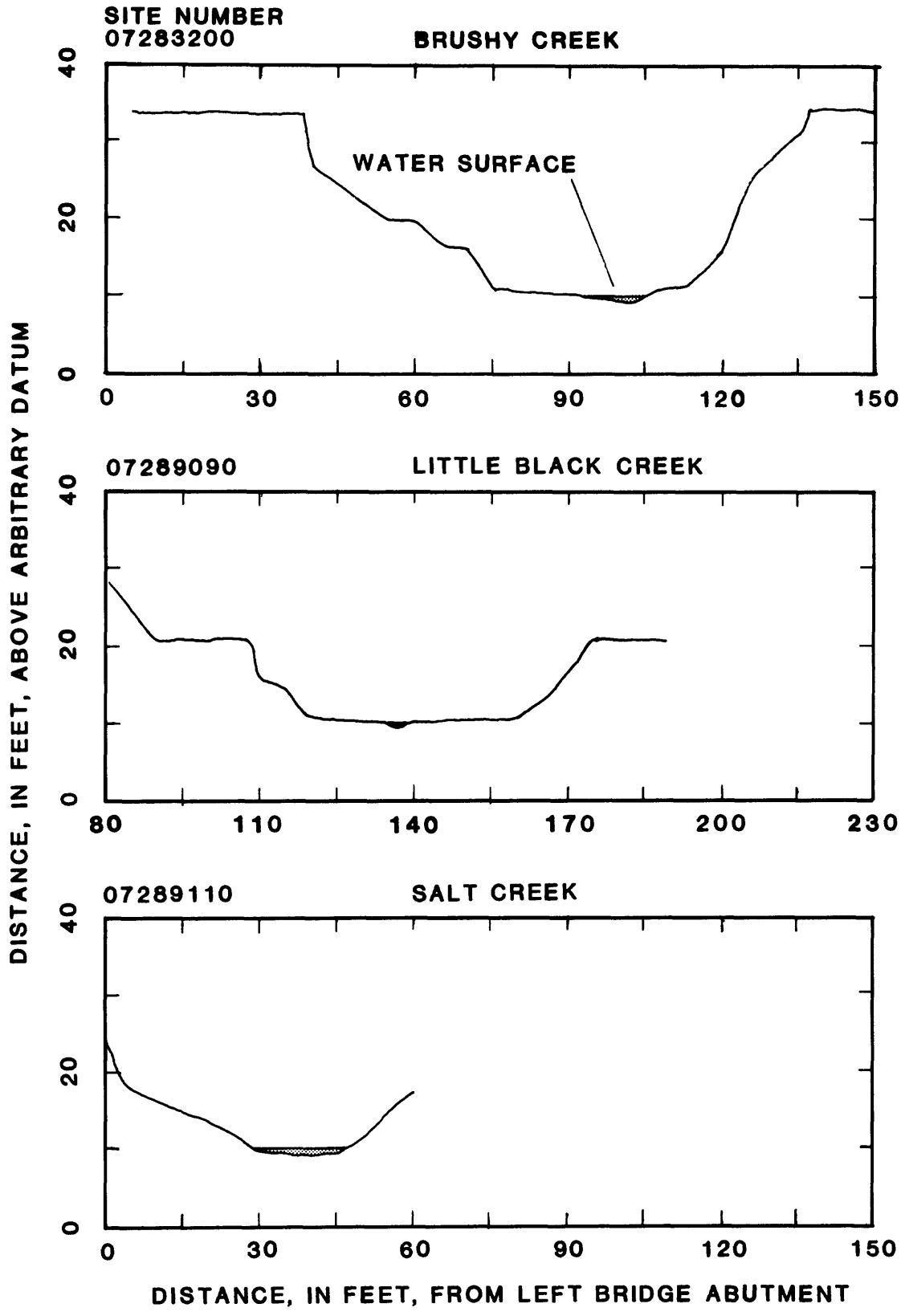


FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983 (CONTINUED).

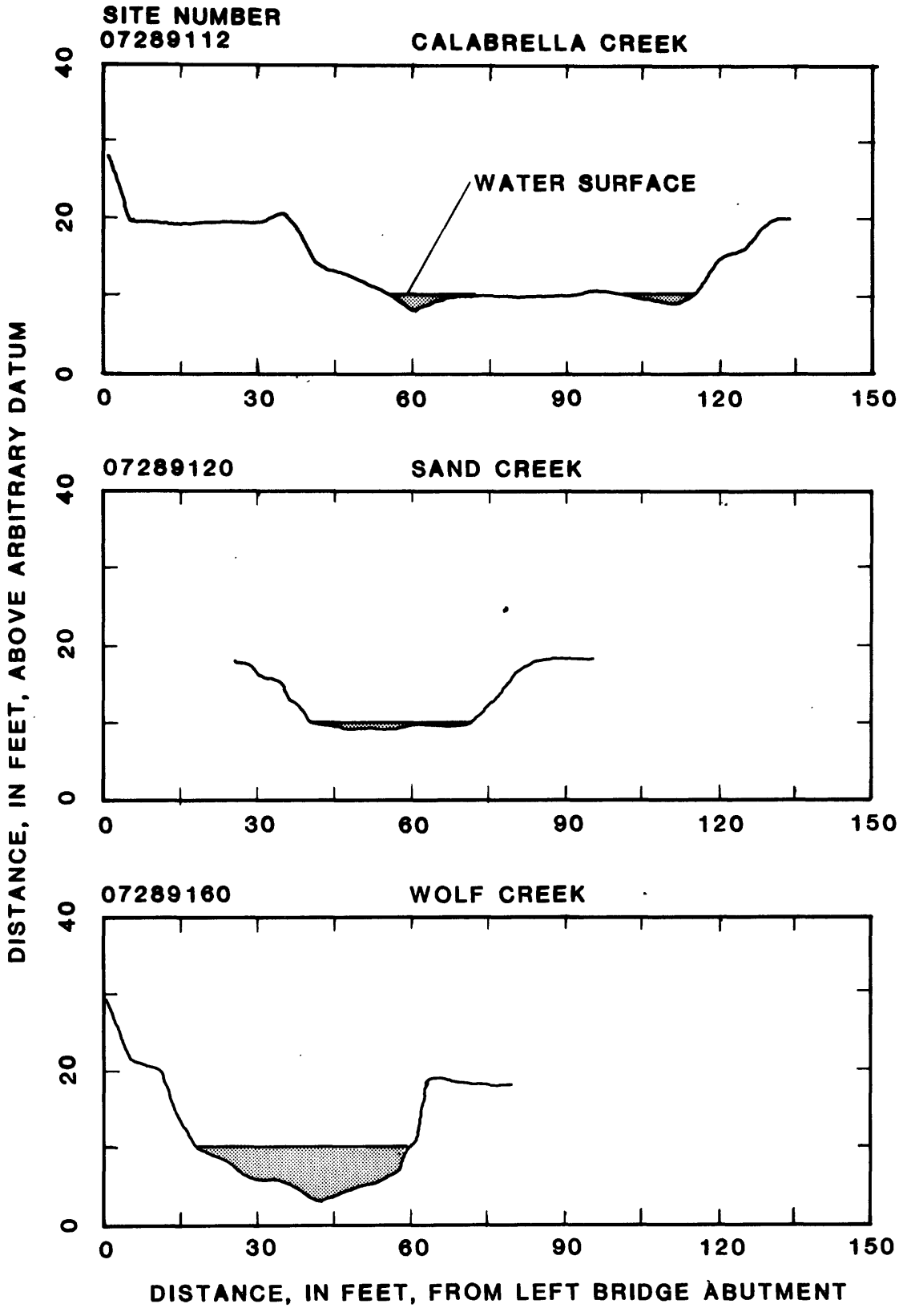


FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983 (CONTINUED).

TABLE 2.--FIELD AND LABORATORY MEASUREMENTS OF WATER SAMPLES COLLECTED FROM STREAMS IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983

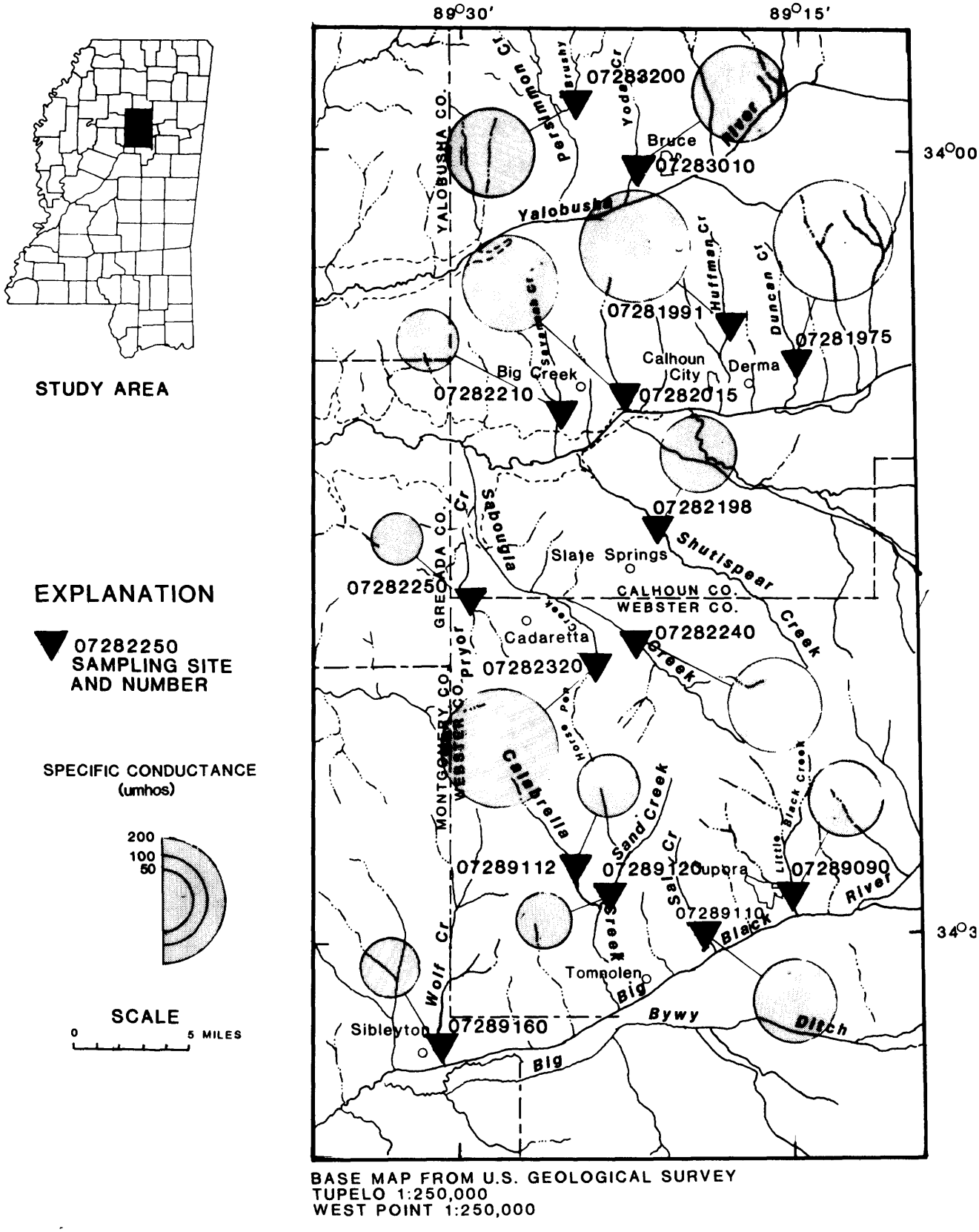
SITE NUMBER	DATE OF COL-LEC-TION	TIME (HOURS)	STREAM FLOW (CFS)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	COLOR (UNITS)	TUR-BID-ITY (NTU)	OXYGEN DIS-SOLVED (MG/L)	HARD-NESS (MG/L AS CaCO3)
07281975	08/28/1983	1010	0.41	188	7.3	25.5	3	11	8.1	42
07281991	08/28/1983	1220	0.03	156	7.2	31.0	2	3.0	6.8	32
07282015	08/27/1983	1530	0.30	115	8.1	35.5	9	1.0	9.1	31
07282198	08/27/1983	1215	3.25	77	6.9	25.5	2	15	5.6	24
07282210	08/28/1983	1400	0.63	45	7.3	31.5	2	12	8.3	.
07282240	08/26/1983	1145	2.67	121	7.5	27.5	6	3.0	8.0	42
07282250	08/26/1983	1400	3.38	34	7.5	24.5	3	6.0	8.3	9
07282320	08/27/1983	0920	0.21	179	6.8	24.5	2	5.0	3.6	66
07283010	08/29/1983	0915	1.37	118	7.3	27.0	13	7.0	6.5	35
07283200	08/29/1983	1145	2.85	105	7.8	31.0	7	1.5	8.8	33
07289090	08/26/1983	0810	0.76	76	7.0	27.5	13	120	5.2	21
07289110	08/25/1983	0830	0.03	92	6.9	25.5	2	4.0	4.9	29
07289112	08/25/1983	1540	0.96	51	7.0	29.5	10	9.0	.	15
07289120	08/25/1983	1200	2.78	42	6.7	25.5	2	6.0	9.2	10
07289160	08/24/1983	1745	3.60	44	6.8	27.5	23	18	5.8	11

TABLE 2.--FIELD AND LABORATORY MEASUREMENTS OF WATER SAMPLES COLLECTED FROM STREAMS IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983 (CONTINUED)

SITE NUMBER	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	PERCENT SODIUM	POTASSIUM (K)	SULFATE (SO4)	CHLORIDE (Cl)	SOLIDS, RESIDUE AT 180 DEG C
	DISSOLVED CONSTITUENTS IN MILLIGRAMS PER LITER							
07281975	9.1	4.6	21	51	1.7	38	13	149
07281991	7.4	3.3	19	54	2.2	20	15	128
07282015	6.8	3.5	11	41	2.1	8.0	8.0	79
07282198	5.4	2.6	5.3	30	2.2	3.0	4.2	55
07282210	.	.	.	.	.	1.0	4.0	30
07282240	9.5	4.4	9.9	33	1.7	3.0	6.8	88
07282250	2.0	1.0	3.1	40	0.8	2.0	2.1	23
07282320	15	6.9	11	26	2.1	7.0	7.1	127
07283010	7.6	3.9	11	38	2.7	5.0	6.0	83
07283200	7.3	3.7	8.5	34	1.9	3.0	3.7	72
07289090	4.6	2.4	7.3	40	1.6	2.0	5.3	61
07289110	6.0	3.5	6.5	31	1.9	2.0	7.0	52
07289112	3.2	1.7	3.9	34	1.1	4.0	3.7	40
07289120	2.3	1.1	3.3	37	1.7	2.0	4.5	25
07289160	2.5	1.2	3.6	38	1.1	2.0	3.8	32

TABLE 2.--FIELD AND LABORATORY MEASUREMENTS OF WATER SAMPLES COLLECTED FROM STREAMS IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983 (CONTINUED)

SITE NUMBER	SOLIDS, VOL. ON IGNITION	NITRATE (N)	NITRITE (N)	NITRITE PLUS NITRATE (N)	SEDIMENT, SUSPENDED	ALUMINUM (Al)	IRON TOTAL (Fe)	IRON DISSOLVED (Fe)	MANGANESE TOTAL (Mn)	MANGANESE DISSOLVED (Mn)
	MILLIGRAMS PER LITER					MICROGRAMS PER LITER				
07281975	41	.	0.01	<0.10	13	300	1700	350	420	310
07281991	39	0.77	0.03	0.80	11	500	840	170	190	120
07282015	29	.	<0.01	<0.10	8	<100	.	42	.	210
07282198	38	.	<0.01	0.10	29	300	1700	560	280	230
07282210	27	.	<0.01	<0.10	26	.	160	.	140	.
07282240	33	.	<0.01	<0.10	11	100	1400	440	30	230
07282250	19	.	<0.01	<0.10	13	300	680	140	90	65
07282320	39	.	<0.01	<0.10	.	<100	190	2300	2300	2300
07283010	40	0.09	0.01	0.10	19	400	1600	320	170	130
07283200	36	.	<0.01	<0.10	8	500	600	69	120	54
07289090	24	.	0.01	<0.10	18	100	1500	330	350	230
07289110	45	.	0.01	<0.10	18	500	1200	120	1200	1200
07289112	26	.	0.01	<0.10	11	100	2000	520	380	350
07289120	27	.	0.01	<0.10	10	100	1500	150	440	410
07289160	22	0.09	0.01	0.10	16	300	2400	640	310	270



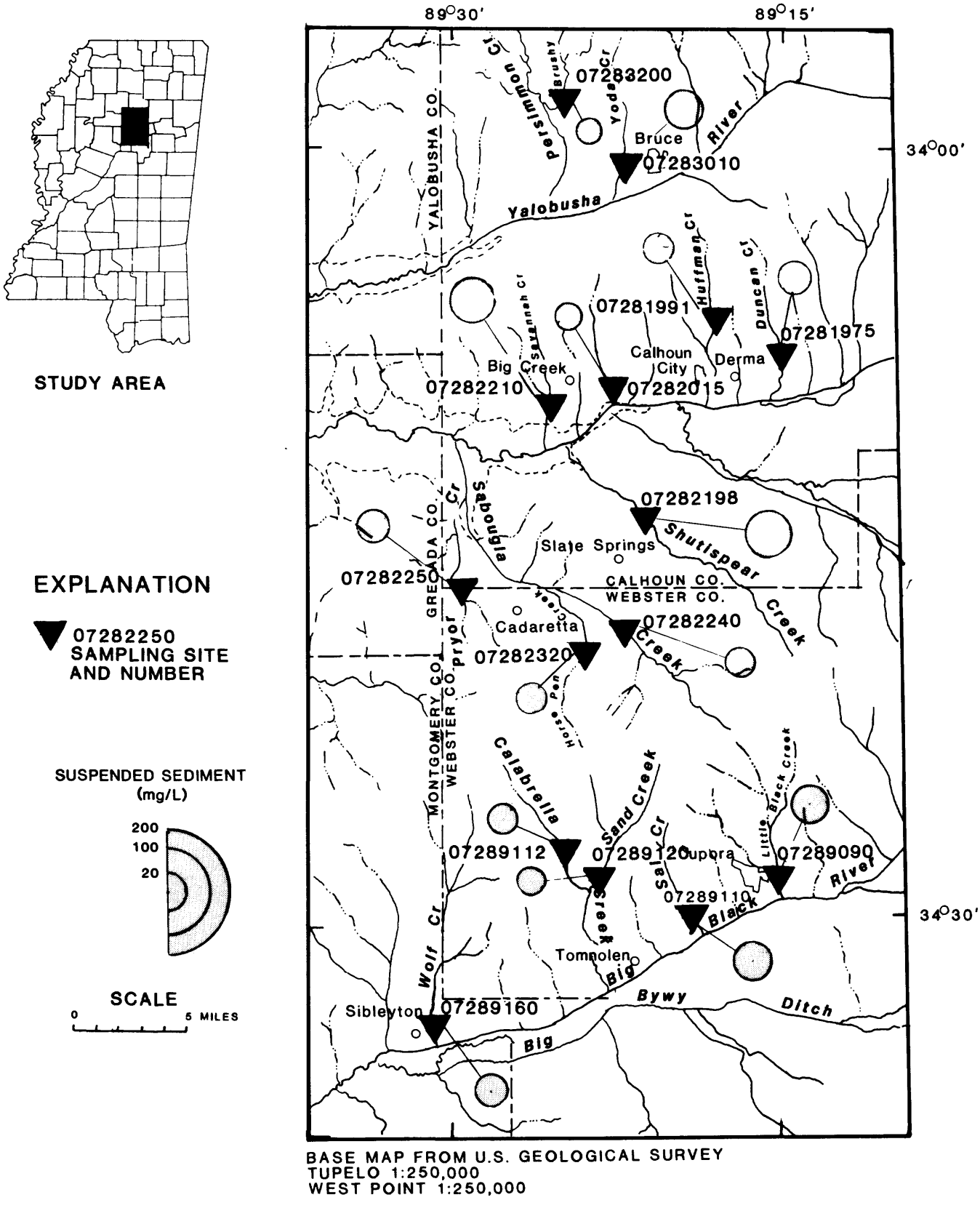
BASE MAP FROM U.S. GEOLOGICAL SURVEY
TUPELO 1:250,000
WEST POINT 1:250,000

FIGURE 4.--SPECIFIC CONDUCTANCE OF STREAMS AT SAMPLING SITES, AUGUST 24-29, 1983.

Turbidity of all streams except one was less than 20 NTU (nephlometric turbidity units). The water in Little Black Creek had a turbidity value of 120 units. Suspended sediment concentrations were less than 30 mg/L at all sites (fig. 5).

Dissolved constituents were similar in both types and quantity at most sites. Dissolved solids concentrations were less than 100 mg/L in all streams except Duncan and Huffman Creeks, which had sulfate concentrations of 38 and 20 mg/L, respectively, and in Horse Pen Creek Creek which had sodium and calcium concentrations of 11 and 15 mg/L, respectively. Major ion concentrations were generally less than 10 mg/L at the other sites. Nitrate plus nitrite concentrations were equal to or less than 0.10 mg/L in all streams except Huffman Creek. The nitrate plus nitrite concentration in Huffman Creek was 0.80 mg/L. Dissolved aluminum concentration ranged from less than 100 to 500 ug/L.

The results of laboratory analyses of bottom material samples indicate that concentrations of arsenic, cadmium, cobalt, lead, and selenium were below detectable limits at all sites (table 3). The copper concentrations, below detectable limits at 4 sites, ranged from 1 to 3 ug/g at the remaining sites. Chromium and zinc concentrations ranged from 1 to 10 ug/g and mercury concentrations ranged from 0.01 to 0.04 ug/g. Iron exceeded 1,000 ug/g at 11 sites. Manganese ranged from 78 to 620 ug/g.



BASE MAP FROM U.S. GEOLOGICAL SURVEY
TUPELO 1:250,000
WEST POINT 1:250,000

FIGURE 5.--SUSPENDED SEDIMENT CONCENTRATIONS OF STREAMS AT SAMPLING SITES, AUGUST 24-29, 1983.

TABLE 3.--LABORATORY ANALYSIS OF BOTTOM MATERIAL SAMPLES COLLECTED FROM STREAMS IN NORTHEASTERN MISSISSIPPI, AUGUST 24-29, 1983

SITE NUMBER	ARSENIC (As)	CADMIUM (Cd)	CHROMIUM (Cr)	COBALT (Co)	COPPER (Cu)	IRON (Fe)	LEAD (Pb)	MANGANESE (Mn)	MERCURY (Hg)	SELENIUM (Se)	ZINC (Zn)
	MICROGRAMS PER GRAM										
07281975	<1	<1	3	<10	<1	910	<10	390	0.02	<1	2
07281991	<1	<1	4	<10	1	4200	<10	260	0.02	<1	4
07282015	<1	<1	2	<10	1	2600	<10	310	0.01	<1	3
07282198	<1	<1	2	<10	1	1000	<10	88	0.02	<1	2
07282210	<1	<1	2	<10	<1	540	<10	78	0.01	<1	1
07282240	<1	<1	1	<10	<1	920	<10	290	0.04	<1	2
07282250	<1	<1	2	<10	1	1600	<10	370	0.01	<1	3
07282320	<1	<1	5	<10	2	3100	<10	200	0.02	<1	5
07283010	<1	<1	2	<10	1	2900	<10	260	0.04	<1	4
07283200	<1	<1	4	<10	3	4200	<10	620	0.03	<1	10
07289090	<1	<1	3	<10	2	2000	<10	130	0.02	<1	6
07289110	<1	<1	3	<10	1	2100	<10	330	0.02	<1	4
07289112	<1	<1	2	<10	1	3700	<10	370	0.04	<1	4
07289120	<1	<1	10	<10	<1	670	<10	530	0.02	<1	2
07289160	<1	<1	3	<10	1	2800	<10	300	0.04	<1	3

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GLOSSARY

Color is expressed in units of the platinum-cobalt scale. A color unit is produced by one milligram per liter of platinum in the form of the chloroplatinate ion.

Cubic feet per second (ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 449 gallons per minute.

Dissolved is that material in a representative water sample that passes through a 0.45 um membrane filter. Determinations of "dissolved" constutuents are made on subsamples of the filtrate.

Hardness of water is a physical-chemical characteristic that is commonly recognized by the increased quantity of soap required to produce lather. It is attributable to the presence of alkaline earths (principally calcium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO$).

Micrograms per gram (mg/g) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (gram) of sediment.

Microgram per liter (ug/L) is a unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Milligrams per liter (mg/L) is a unit for expressing the concentration of chem- of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water. Concentration of suspended sediment is also expressed in mg/L, and is based on the mass of sediment per liter of water-sediment mixture.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Specific conductance is a measure of the ability of water to conduct an elec- current and is expressed in micromhos (umhos) per centimeter at 25°C. Be- Because the specific conductance is related to the number and specific chemical types of ions in solution it can be used for approximating the dissolved-solids content in the water. Commonly, the amount of dissolved dissolved solids (in mg/L) is about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream and may vary in the same source with changes in the composition of the water.

Turbidity of water is the reduction of transparency due to the presence of sus
uspended particulate matter. The unit of measure is the nephelometric tur
bidity unit (NTU) and is a measure of light scatter of a beam of ligh
passed through a sample of water.