BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTH-CENTRAL MISSISSIPPI, AUGUST 1984

by

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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 foot 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 last two weeks of August 1984, hydrologic data were collected at 15 stream sites that drain potential lignite mining areas in Lafayette, Calhoun, and Yalobusha Counties.

Main channel widths ranged from approximately 60 feet at three streams (Coon Creek near Toccopula, Muckaloon Creek near Tula, and Hurricane Creek near Velma) to approximately 120 feet at two streams (Potlockney Creek near Tula, and Savannah Creek near Bruce). Maximum water depths ranged from less than 1.0 foot at most streams to over 5.0 feet at sites on Potlockney Creek near Tula and McGill Creek near Sarepta. Stream discharge ranged from 0.32 cubic feet per second in Persimmon Creek near Bruce to 18.5 cubic feet per second in Puskus Creek near Etta.

The specific conductance of stream water ranged from 25 to 160 microsiemens and dissolved solids concentrations ranged from 22 to 91 mg/L (milligrams per liter). Most major ion concentrations were less than 10 mg/L with the exception of calcium (11 mg/L), sodium (12 mg/L) and sulfate (18 mg/L) in the water of Persimmon Creek near Bruce. Dissolved oxygen concentrations were greater than 5.0 mg/L at all but one site. Turbidity values were generally less than 50 units. Nitrate plus nitrite concentrations were equal to or less than 0.10 mg/L in all streams except in Potlockney Creek near Tula where the concentration was 0.11 mg/L. Copper and selenium concentrations in the water at all sampling sites ranged from below the detection limits (1 ug/g) to 4 ug/g (micrograms per gram) and mercury concentrations in bottom material samples ranged from less than 0.01 ug/g to 0.15 ug/g.

INTRODUCTION

Lignite deposits occur in potentially commercial quantities in the outcrop areas 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 are more common. Within the Wilcox Group outcrop area, lignite beds more than 2.5 feet 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 favorable economic conditions. Surface mining of lignite, however, requires the removal of large quantities of overburden and may require 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 and dissolution of newly exposed overburden materials and large volumes of ground water that result from dewatering will impact the quality of water in streams that drain the mined area. To assess the impact of mining activities on 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 at 15 stream sites in north-central Mississippi that were selected jointly by the Mississippi Department of Natural Resources, Bureau of Geology, and the U.S. Geological Survey. During the last two weeks in August 1984, water samples and bottom material samples were collected and channel cross sections were defined at all 15 sites.

This report is the fifth in a series. Data collected during 1980, 1981, 1982, and 1983 were published in open-file reports for respective years by the U.S. Geological Survey (Arthur, 1981 and 1982, Kalkhoff, 1983 and 1984). The locations of the background hydrologic data studies completed to date are shown in figure 1.

OBJECTIVE AND SCOPE

The objective of the 6-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 future study of surface mining effects in Mississippi.

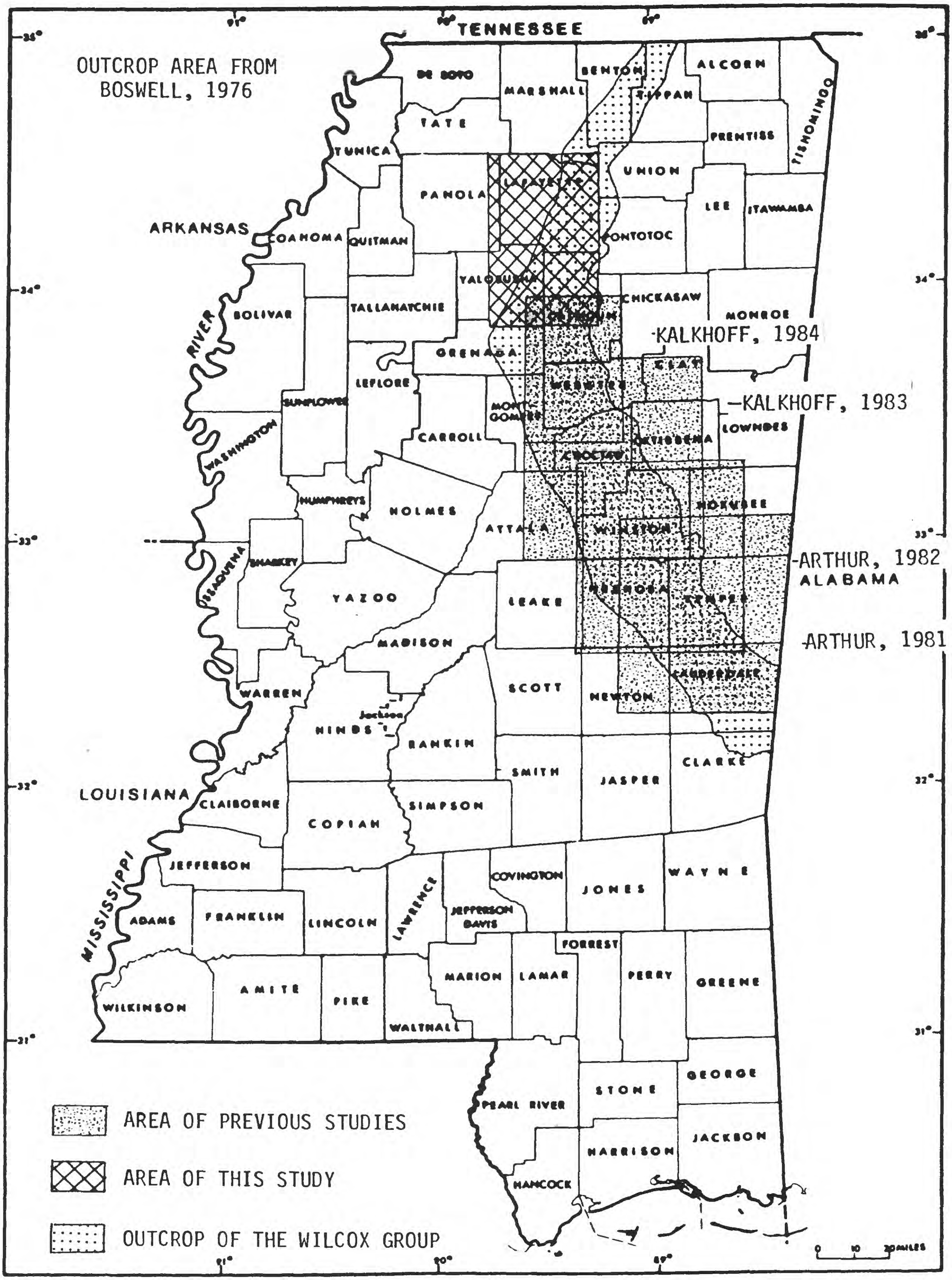

Figure 1.--Location of background hydrologic data studies in the outcrop area of the Wilcox Group.

Background data on streams draining potential lignite mining areas are being obtained by sampling 15 streams yearly for this and previous reports. Water samples were collected and analyzed for selected dissolved constituents, and bottom material samples were collected and analyzed for selected trace 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 1984 are located in three counties in northeastern Mississippi (fig. 2). Seven sites are located on streams in Lafayette County, four sites are in Calhoun County, and four sites are in Yalobusha County. All sites are in the Yazoo River basin.

The sites are all located on comparatively small streams draining less than 50 mi^2 (square miles). The drainage areas range from 5.99 mi^2 at site 4 on Muckaloon Creek to 41.9 mi^2 at site 14 on Turkey Creek (table 1).

Table 1.--Sampling sites and drainage areas in north-central Mississippi, August 1984

Site Number	Site ID	Station Name and Location	County	Latitude	Longitude	Drainage Area(mi^2)
1	07268500	CYPRESS CREEK NEAR ETTA, MS	LAFAYETTE	34 26 30	89 17 25	28.50
2	07268510	PUSKUS CREEK NEAR ETTA, MS	LAFAYETTE	34 26 42	89 19 57	19.28
3	07273660	COON CREEK NEAR TOCCOPOLA, MS	LAFAYETTE	34 12 32	89 15 46	7.89
4	07273690	MUCKALOON CREEK NEAR TULA, MS	LAFAYETTE	34 14 02	89 17 39	5.99
5	07273850	POTLOCKNEY CREEK NEAR TULA, MS	LAFAYETTE	34 13 16	89 23 41	20.44
6	07273950	PUMPKIN CREEK NEAR DENMARK, MS	LAFAYETTE	34 17 18	89 26 42	15.63
7	07274237	OTOUCALOFA CREEK AT PARIS, MS	LAFAYETTE	34 10 10	89 27 24	20.77
8	07282898	MCGILL CREEK NEAR SAREPTA, MS	CALHOUN	34 05 18	89 15 54	8.68
9	07282904	SAVANNAH CREEK NEAR BRUCE, MS	CALHOUN	34 02 50	89 16 22	7.02
10	07282980	COWPEN CREEK NEAR BRUCE, MS	CALHOUN	34 00 24	89 18 54	22.88
11	07283208	PERSIMMON CREEK NEAR BRUCE, MS	CALHOUN	34 02 02	89 26 04	18.48
12	07283465	UNNAMED CREEK NEAR BENWOOD, MS	YALOBUSHA	33 56 15	89 31 20	6.95
13	07283478	YORK CREEK NEAR COFFEEVILLE, MS	YALOBUSHA	33 55 35	89 35 48	12.42
14	07283720	TURKEY CREEK NEAR VELMA, MS	YALOBUSHA	34 00 49	89 36 28	41.93
15	07283725	HURRICANE CREEK NEAR VELMA, MS	YALOBUSHA	34 01 21	89 34 55	7.30

CHANNEL CROSS SECTIONS

Channel cross sections were delineated at 14 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 60 ft on three streams (Coon, Muckaloon, and Hurricane Creeks) to approximately 120 feet on two streams (Potlockney and Savannah Creeks). Stream depths were variable but generally less than 1 foot at most sites. The water

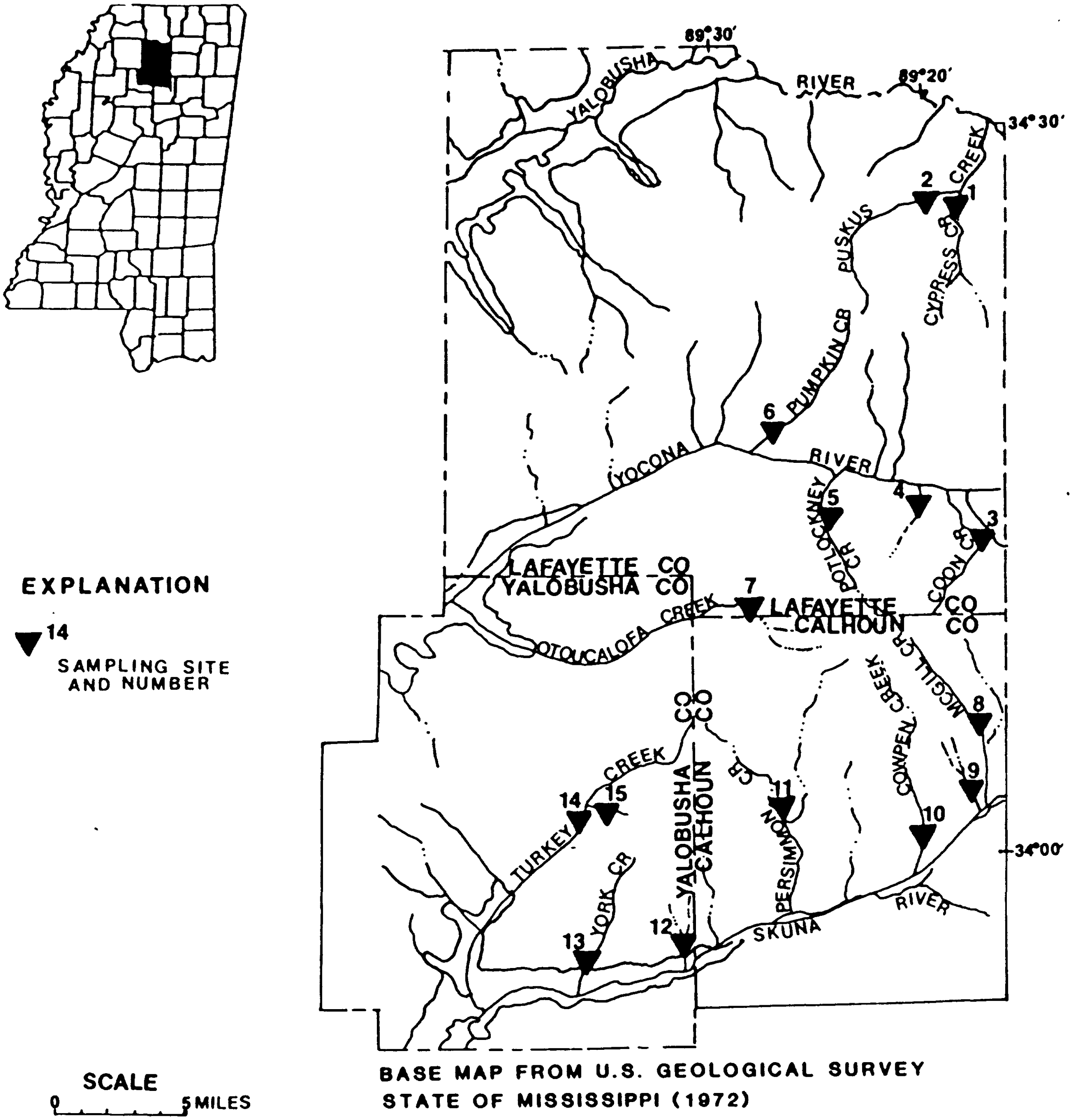

Figure 2.--Location of the study area and sampling sites in potential lignite mining areas.

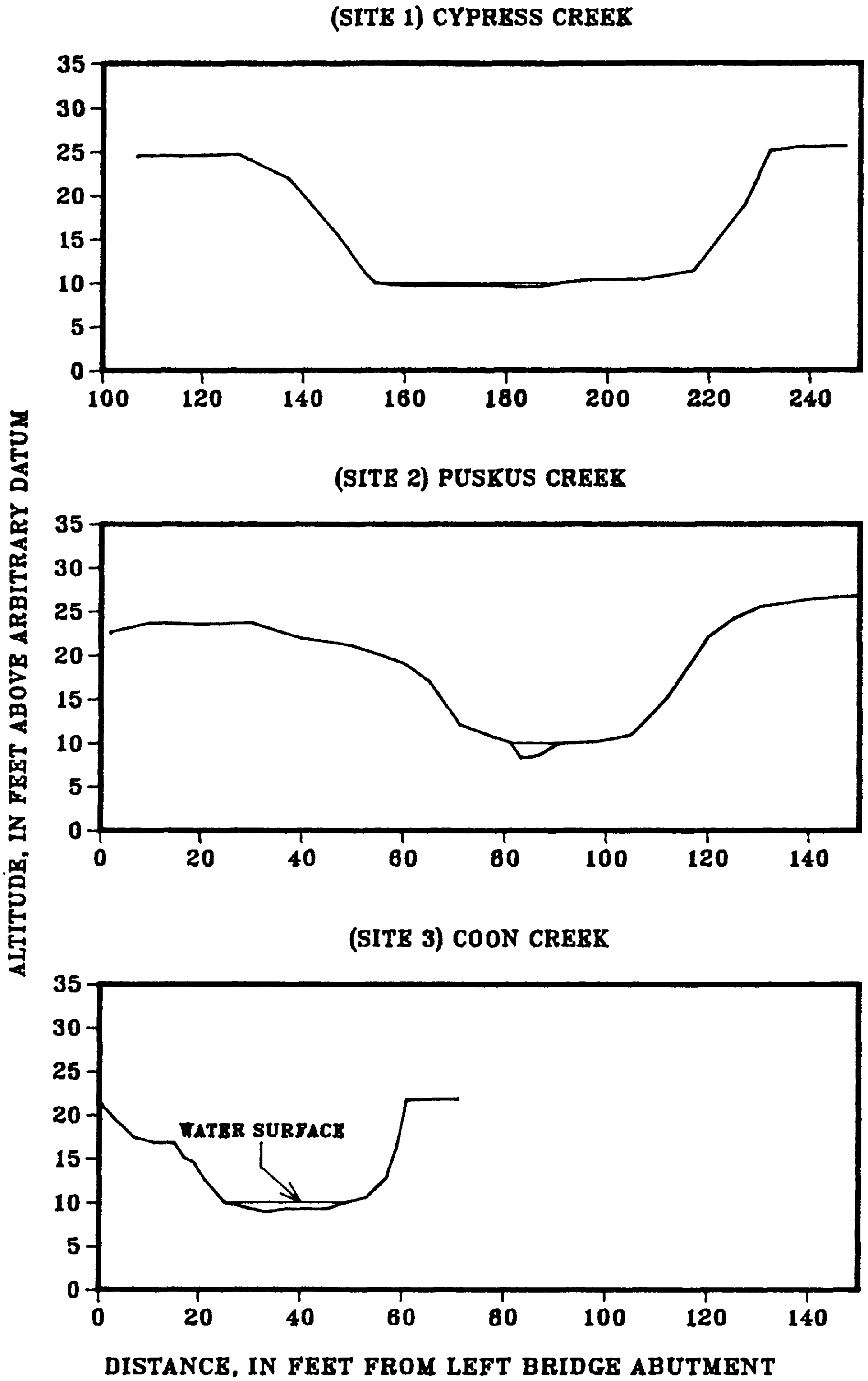

Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1984.

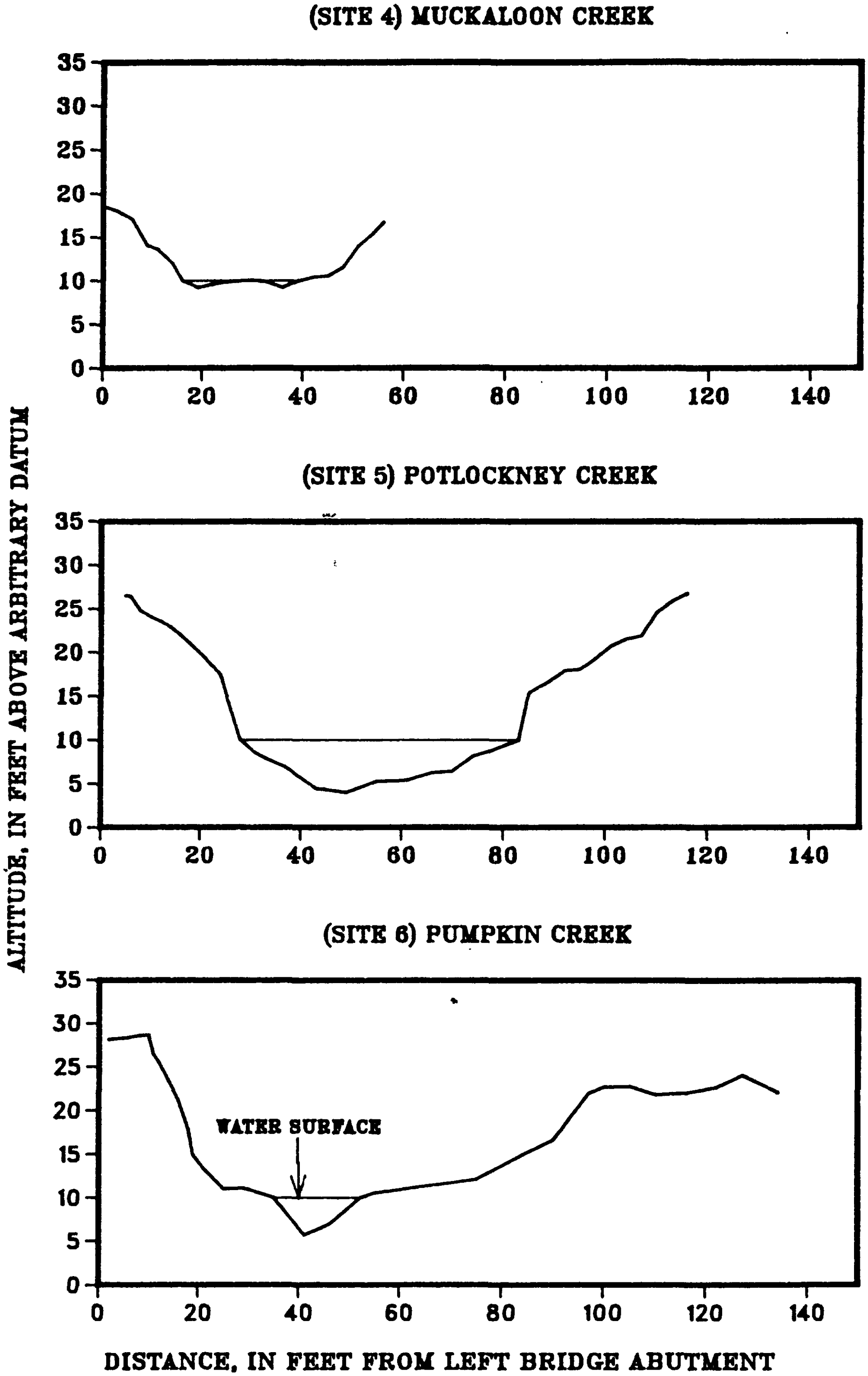

Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1984. --Continued

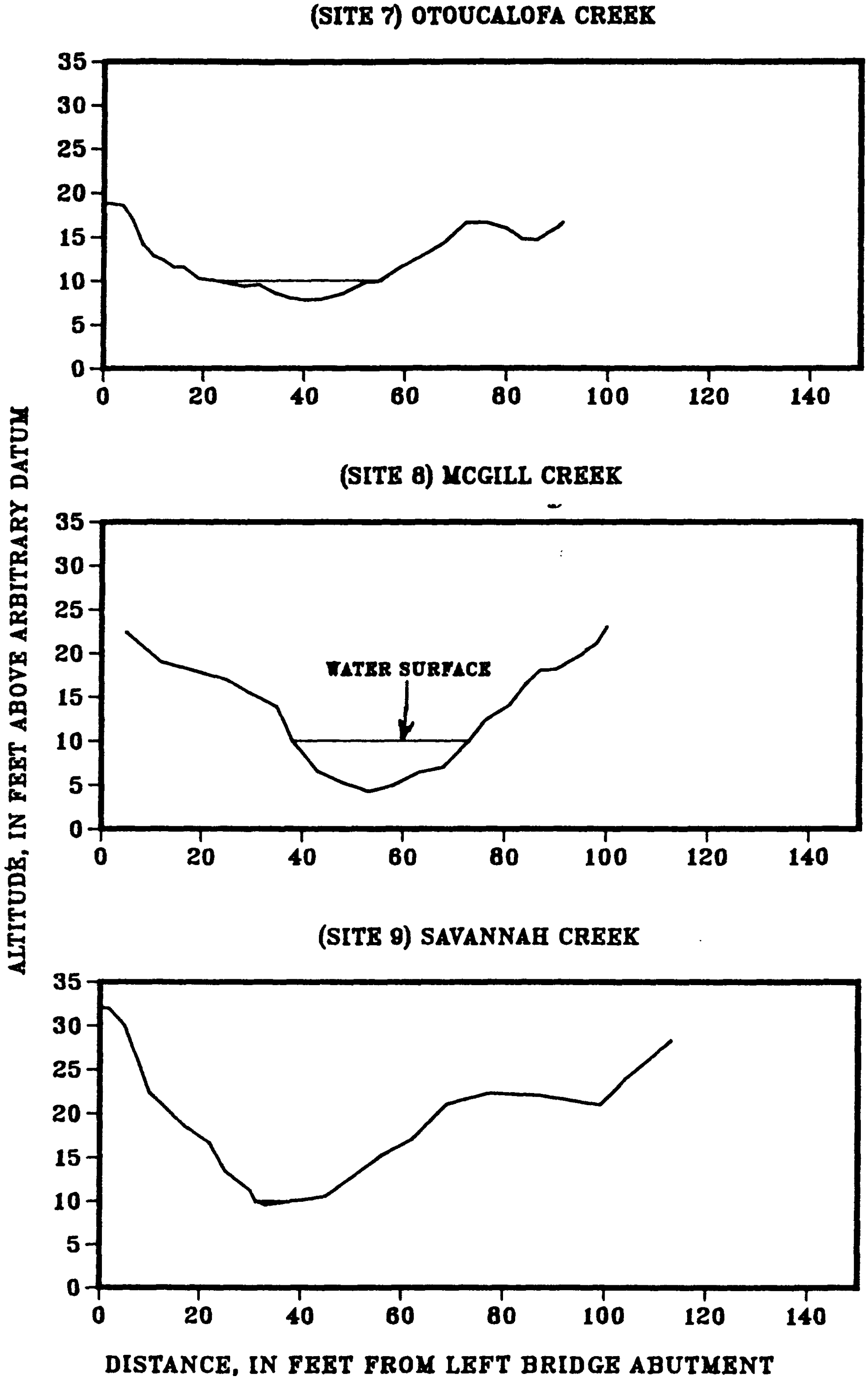

Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1984. --Continued

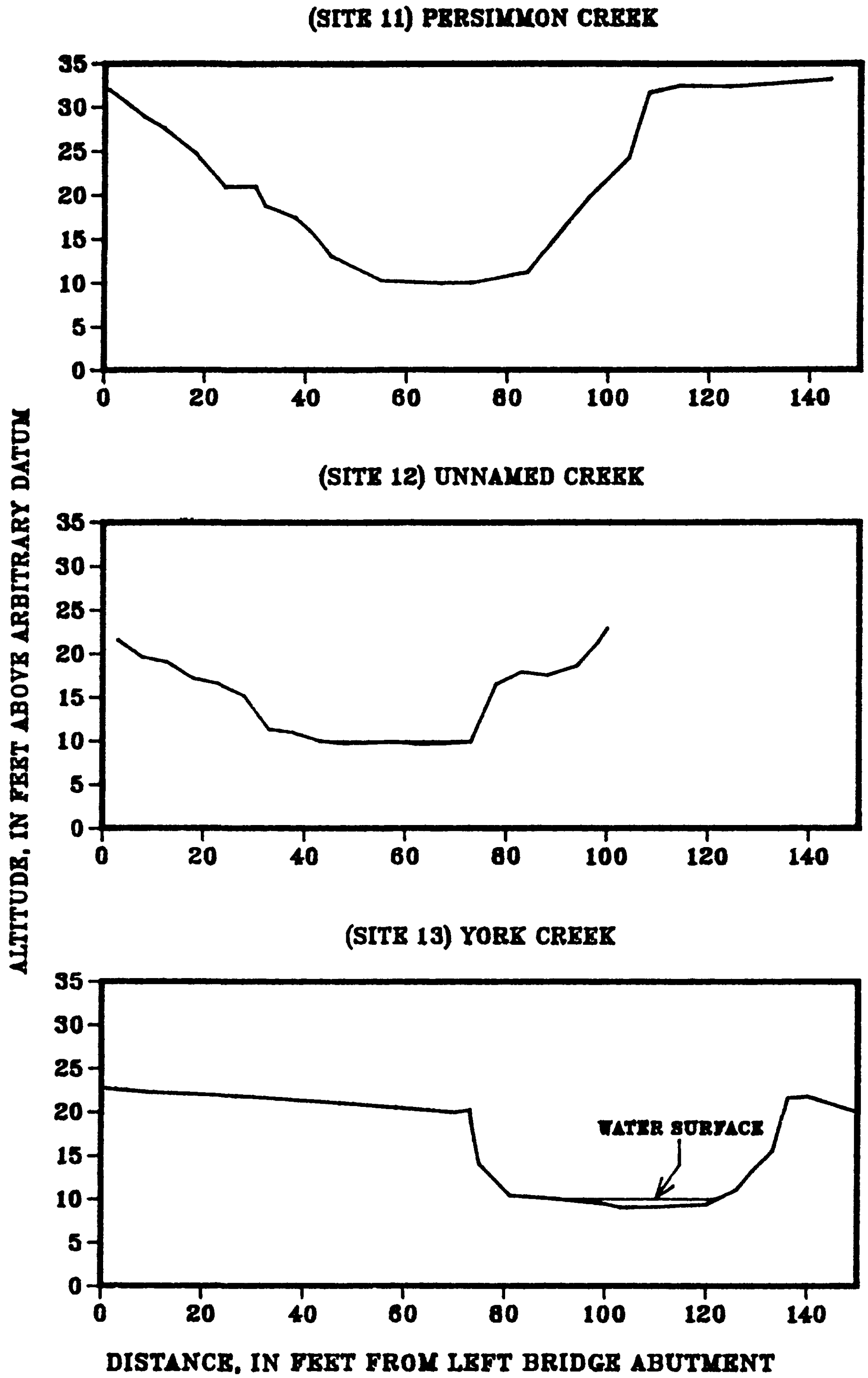

Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1984. --Continued

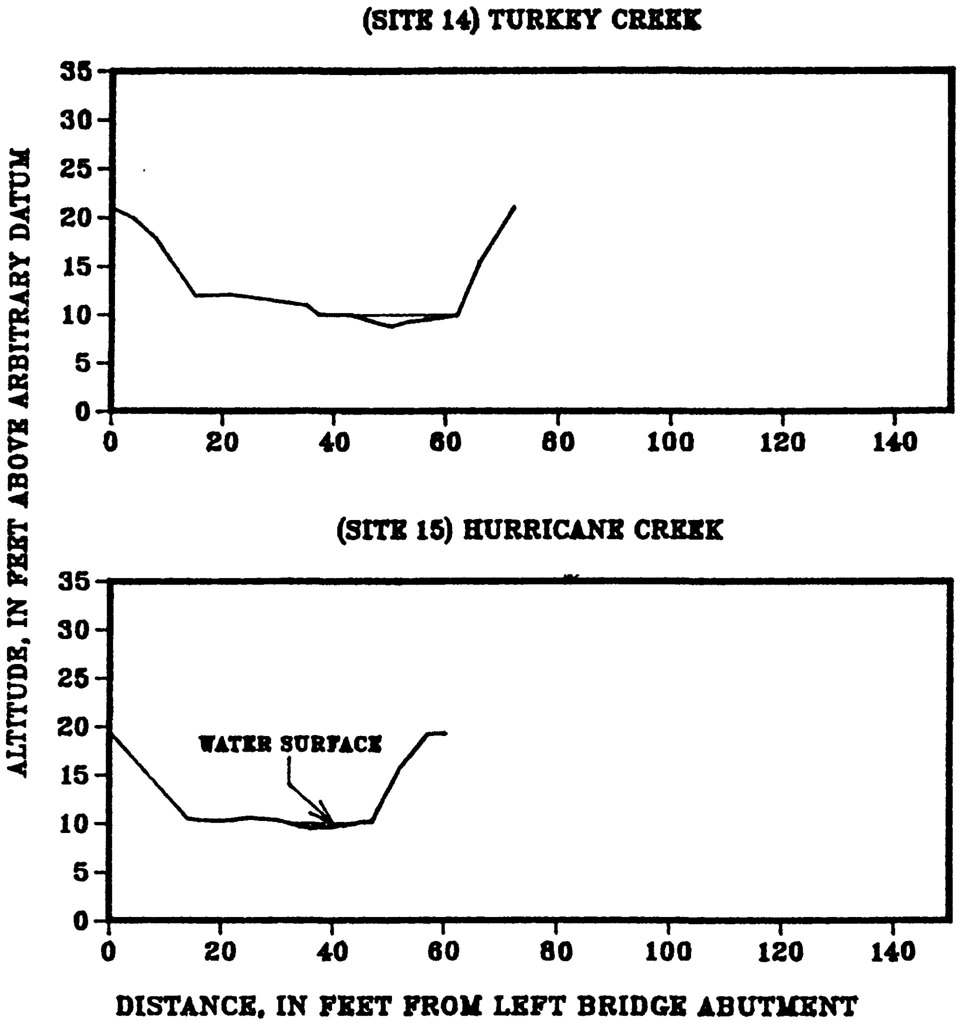

Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1984. --Continued

was ponded and greater than 5 feet deep at site 5 on Potlockney Creek and at site 8 on McGill Creek. Channel bottoms consisted mostly of sand and some gravel. Most channel banks were steep to vertical and were covered in varying degree, by trees and shrubs. Photographs that document the condition of the sites at time of sampling are available at the U.S. Geological Survey office in Jackson, Mississippi.

WATER QUALITY

Water temperature, specific conductance, dissolved oxygen concentrations, and streamflow were measured and water and bottom material samples were collected for laboratory analysis at each site. Discharge ranged from 0.32 ft^3/s (cubic feet per second) at site 11 on Persimmon Creek to 18.5 ft^3/s at site 2 on Puskus Creek. Discharge at other sites was less than 10 ft^3/s during the period of sample collection (table 2).

Water temperature ranged from 20.5 to 31.0°C (about 69° to 88°F) during the study. The lowest temperature was in Cypress Creek near Etta at 1100 hours on August 24. Maximum stream temperature was recorded in Cowpen Canal near Bruce at 1400 hours on August 14. Specific conductance values were generally less than 200 uS/cm (microsiemens per centimeter at 25°C). The specific conductance ranged from 25 uS/cm in Turkey Creek near Velma to 160 uS/cm in Persimmon Creek near Bruce. The specific conductance of samples collected during the study are tabulated in table 2 and illustrated in figure 4.

Dissolved oxygen concentrations were greater than 5.0 mg/L at all sites except one. The dissolved oxygen concentration in Potlockney Creek near Tula was 4.4 mg/L. The maximum concentration (10.4 mg/L) was measured in Cypress Creek near Etta.

Turbidity in all streams except one was less than 20 NTU (nephlometric turbidity units). The water in Turkey Creek near Velma had a turbidity value of 70 units. Suspended sediment concentrations were less than 50 mg/L at all sites except site 7 on Otoucalofa Creek (52 mg/L) and at site 14 on Turkey Creek (105 mg/L). Suspended sediment concentrations are shown in figure 5.

Table 2.--Field and laboratory measurements of water samples collected from streams in north-central Mississippi, August 1984

Site Number	Date of Collection	Time (Hours)	Streamflow (ft^3/s)	Specific Conductance (uS/cm)	Temperature (°C)	Color (Units)	Turbidity (NTU)	Oxygen Dissolved	Hardness (Mg/L as $CaCO_3$)
				Dissolved Constituents in Milligrams per Liter					
1	08/24/84	1100	7.33	53	20.5	1	12	10.4	15
2	08/24/84	0910	18.5	31	24.5	1	4.5	7.6	9
3	08/16/84	1430	2.58	49	25.0	2	10	7.0	15
4	08/16/84	1050	.40	75	23.0	3	17	8.4	23
5	08/17/84	0930	.95	93	24.0	2	10	4.4	40
6	08/13/84	1630	3.69	34	25.0	12	18	7.0	10
7	08/17/84	1340	2.34	49	25.0	17	18	7.2	15
8	08/15/84	1015	2.66	58	23.0	5	7.0	6.0	15
9	08/14/84	1650	.48	60	28.5	12	5.7	7.4	15
10	08/14/84	1400	3.13	100	31.0	11	17	9.4	27
11	08/14/84	1038	.32	160	26.0	3	4.5	8.0	50
12	08/15/84	1400	1.70	31	27.5	6	10	7.6	8
13	08/15/84	1715	4.94	31	29.0	5	--	7.5	8
14	08/23/84	1205	11.1	25	23.0	55	70	8.0	6
15	08/23/84	1515	4.06	36	25.5	6	13	6.5	9

Site Number	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sodium, Percent	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Solids, Residue at 180°C
				Dissolved Constituents in Milligrams per Liter				
1	3.1	1.8	4.3	36	0.9	2.2	2.8	48
2	2.0	1.0	2.0	30	.8	3.2	1.8	35
3	3.3	1.6	3.3	31	1.2	4.1	1.9	52
4	4.4	3.0	5.0	30	1.3	3.9	2.1	--
5	8.4	4.6	4.7	19	2.1	5.2	3.3	70
6	2.0	1.2	2.1	29	1.0	5.4	2.0	38
7	2.9	1.9	3.1	29	1.3	5.3	3.0	52
8	3.4	1.7	4.4	36	1.2	2.4	2.6	48
9	3.1	1.8	5.6	42	1.2	1.0	15	--
10	5.7	3.2	8.3	38	1.7	7.7	5.5	76
11	11	5.5	12	33	2.6	18	9.9	91
12	1.5	1.0	2.3	37	.8	3.4	2.1	36
13	1.7	1.0	2.1	33	.7	1.1	2.2	22
14	1.3	.7	2.3	41	.8	3.5	1.9	36
15	1.9	1.1	2.6	34	1.2	2.6	2.3	36

Table 2.--Field and laboratory measurements of water samples collected from streams in north-central Mississippi, August 1984--Continued

Site Number	Solids, Vol. on Ignition	Nitrite (N)	Nitrite Plus Nitrate (N)	Organic Carbon Total	Sediment Suspended	Aluminum (Al)	Iron Total (Fe)	Iron, Dissolved (Fe)	Manganese, Total (Mn)	Manganese, Dissolved (Mn)
	Milligrams per liter					Micrograms per liter				
1	12	<0.01	<0.10	1.0	22	<100	990	23	140	120
2	6	.01	<.10	2.7	32	<100	1300	410	170	130
3	18	--	<.10	3.2	33	<100	1400	47	200	150
4	16	--	<.10	3.5	26	100	1200	44	130	110
5	27	--	.11	3.7	26	100	2800	170	690	680
6	18	--	.10	3.2	33	<100	1900	32	160	130
7	14	--	<.10	2.7	52	100	2400	380	280	240
8	8	--	<.10	1.5	46	<100	1500	450	100	100
9	16	--	<.10	2.4	15	100	1700	370	230	210
10	13	--	<.10	2.3	22	<100	1600	210	100	41
11	17	--	<.10	3.2	22	<100	820	65	220	200
12	12	--	<.10	1.5	24	<100	1000	38	60	42
13	25	--	<.10	2.3	36	100	1700	150	100	71
14	11	<.01	<.10	3.4	105	<100	4500	310	110	38
15	11	.01	<.10	2.7	42	<100	2300	260	120	89

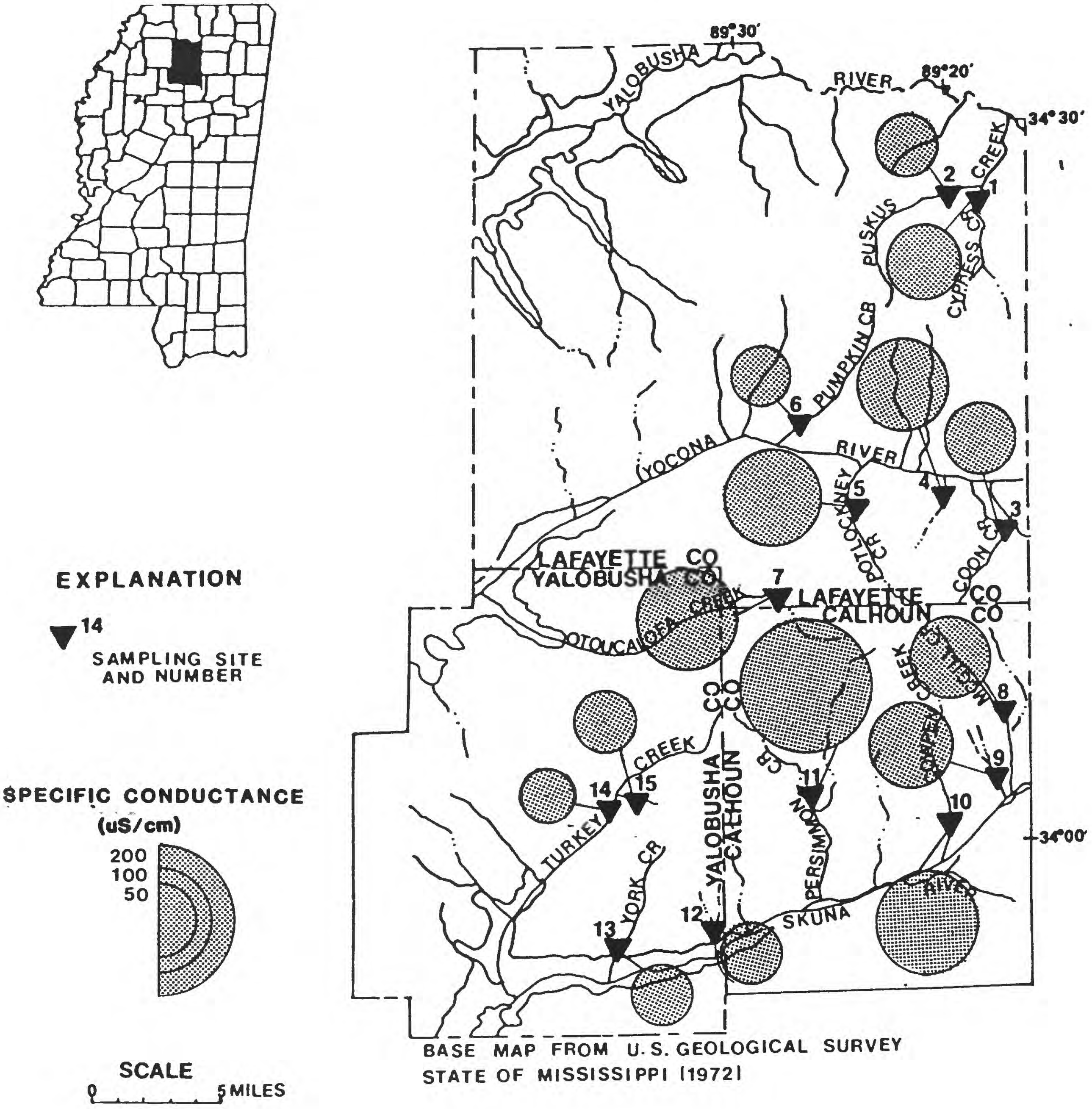

Figure 4.--Specific conductance of streams at sampling sites, August 1984.

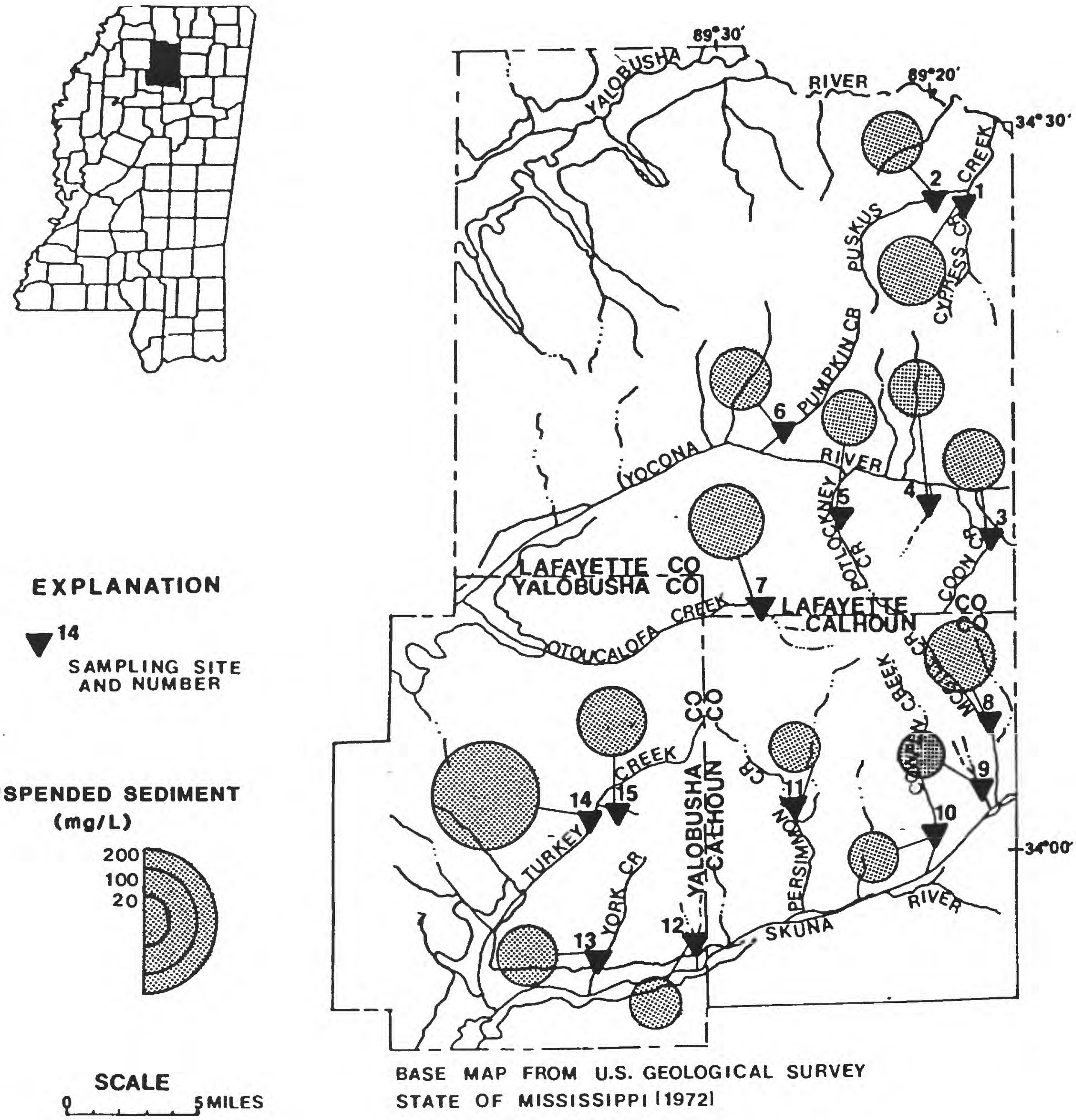

Figure 5.--Suspended sediment concentrations of streams at sampling sites, August 1984.

Dissolved constituents were similar in type and quantity at most sites. Dissolved solids concentrations were less than 100 mg/L in all streams. The highest value (91 mg/L) was found in Persimmon Creek and the lowest (22 mg/L) was in York Creek. Major ion concentrations were less than 10 mg/L in all streams except at site 11 in Persimmon Creek where the calcium (11.0 mg/L), sodium (12.0 mg/L), and sulfate (18.0 mg/L) concentrations exceeded 10 mg/L. The greatest chloride concentration was 15.0 mg/L at site 9 on Savannah Creek. Nitrate plus nitrite concentrations were less than or equal to 0.10 mg/L in all streams except Potlockney Creek at site 5. The nitrate plus nitrite concentration in Potlockney Creek was 0.11 mg/L. Dissolved aluminum concentrations were 100 ug/L (micrograms per liter) or less at all sites.

The results of laboratory analysis of bottom material samples indicate that concentrations of arsenic, cadmium, cobalt, and lead were at or below detectable limits at all sites (table 3). Chromium concentrations, at or below detectable limits (1 ug/g) at 12 sites, were 2 ug/g in Potlockney and Hurricane Creeks and 3 ug/g in Coon Creek. Copper concentrations were below detectable limits at nine sites and ranged from 2 to 4 ug/g at the remaining sites. Selenium concentrations ranged from less than 1 ug/g to 3 ug/g and zinc concentrations ranged from 2 to 7 ug/g. Mercury concentrations ranged from less than 0.01 ug/g (the lower detection limit) to 0.15 ug/g at site 1 on Cypress Creek. Iron concentrations exceeded 1000 ug/g at 7 sites and manganese concentrations ranged from 46 to 1,000 ug/g.

Table 3.--Laboratory analysis of bottom material samples collected from streams in north-central Mississippi, August 1984

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										
1	<1	<1	<1	<10	<1	970	<10	350	0.15	<1	3
2	<1	<1	1	<10	3	1500	<10	350	<.01	2	4
3	1	<1	3	<10	4	3400	<10	1000	<.01	3	7
4	<1	<1	1	<10	2	2500	<10	360	<.01	--	4
5	<1	<1	2	<10	4	4000	<10	510	<.01	1	6
6	<1	<1	1	<10	2	1900	<10	330	.03	1	5
7	<1	<1	<1	<10	<1	1600	<10	340	<.01	<1	5
8	<1	<1	1	<10	<1	460	<10	46	.02	<1	2
9	<1	<1	<1	<10	<1	790	<10	230	<.01	<1	2
10	<1	<1	<1	<10	<1	530	<10	100	<.01	<1	2
11	<1	<1	<1	<10	<1	590	<10	180	<.01	<1	2
12	<1	<1	<1	<10	<1	440	<10	190	<.01	<1	3
13	<1	<1	<1	<10	<1	390	<10	190	<.01	<1	2
14	<1	<1	<1	<10	<1	690	<10	340	<.01	<1	2
15	<1	<1	2	<10	2	1700	<10	310	<.01	<1	7

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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" constituents 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 ($CaCO^3$).

Micrograms per gram (ug/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 that comprises a stream's bottom material.

Micrograms 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 expressing the concentration 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 electric current and is expressed in microsiemens per centimeter at 25°C (uS/cm). The units were previously reported in micromhos per centimeter at 25°C (umhos). Microsiemens and umhos are equivalent units of measurements 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 solids (in mg/L) is 65 percent of the specific conductance value (in uS/cm). 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 suspended particulate matter. The unit of measure is the nephelometric turbidity unit (NTU) and is the measure of light scatter of a beam of light passed through a water sample.