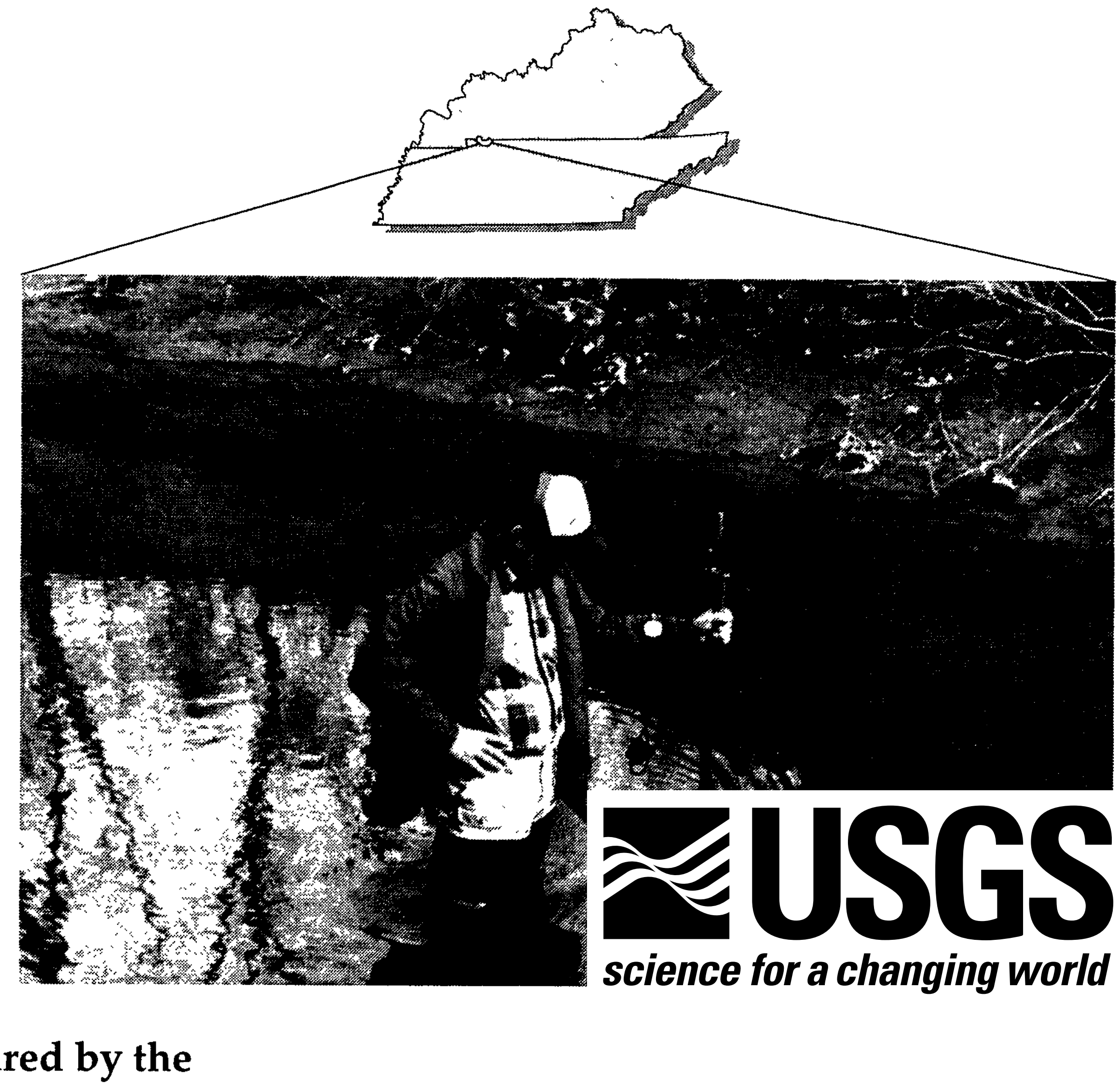
Open-File Report 96-343

Base-Flow Data for the Little West Fork Basin, Fort Campbell, Tennessee and Kentucky, 1993 and 1994



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U.S. Geological Survey

in cooperation with the
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By David E. Ladd

U.S. GEOLOGICAL SURVEY

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Prepared in cooperation with the

UNITED STATES DEPARTMENT OF THE ARMY, FORT CAMPBELL, DIRECTORATE OF PUBLIC WORKS, ENVIRONMENTAL DIVISION

Nashville, Tennessee

1996

U.S. DEPARTMENT OF THE INTERIOR
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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.59	square kilometer
cubic foot per second (ft^3/s)	0.02823	cubic meter per second
cubic foot per second per square mile ($ft^3/s/mi^2$)	0.01090	cubic meter per second per square kilometer
microSiemen per centimeter (µS/cm)	1	micromho per centimeter

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C), and temperature in °C to °F, as follows:

$$°F = 1.8°C + 32$$

$$°C = 5/9(°F - 32)$$

Base-Flow Data for the Little West Fork Basin, Fort Campbell, Tennessee and Kentucky, 1993 and 1994

By David E. Ladd

Abstract

Base-flow data were collected from selected sites within the Little West Fork basin during high and low base-flow conditions to support a study of the source and movement of ground water that supplies the Fort Campbell Military Reservation. Stream and spring discharge, water temperature, and specific-conductance data were collected during low base-flow conditions from 64 sites on September 1 and 13, 1993, and again on October 18 and 19, 1994. High base-flow data were collected from 63 sites on March 17 and 18, 1994. Discharge was greater during high base-flow conditions than during low base-flow conditions. Major tributaries on the south side of the study area consistently had lower flow than the tributaries on the north side.

Discharge data were used to categorize stream reaches and sub-basins. Stream reaches were categorized as gaining or losing, wet, dry, or unobserved for each base-flow measurement period. More gaining stream reaches occurred during the high base-flow period than either of the low base-flow periods. More dry stream reaches occurred during the two low base-flow periods than during the high base-flow period.

Sub-basin areas with surplus or deficient flow were also defined. Many areas of deficient flow occurred near the headwaters of the Little West Fork basin under all base-flow conditions. Fewer areas of deficient flow occurred near the mouth of the basin.

The flow per square mile for each major tributary basin in the study area was also calculated. The values of flow per square mile for the Noah Spring Branch and Dry Fork Creek basins in the northern part of the study area were greater than those for the Piney Fork and Fletchers Fork basins in the southern part of the study area under all base-flow conditions.

INTRODUCTION

In recent years, environmental managers at the Fort Campbell Military Reservation have become increasingly concerned with the need for protection and management of the Reservation's ground-water resources. In 1993, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army and Fort Campbell, began a study to better understand the occurrence and movement of ground water in the Fort Campbell area. As part of this study, a base-flow investigation of the drainage basin for the Little West Fork of the Red River was conducted. Base-flow data including stream and spring discharge, water temperature, and specific conductance were collected from selected sites within the basin during 1993 and 1994. Data were collected from 64 sites on September 1 and 13, 1993; from 63 sites on March 17 and 18, 1994; and from 64 sites on October 18 and 19, 1994. Discharge measurements help identify gains and losses of flow along stream channels (Riggs, 1972), and they aid in the comparison of low and high base-flow conditions. Specific-conductance and temperature measurements were used to help identify where ground-water discharged to the streams.

This report presents base-flow data collected during the course of the investigation. Gaining and losing reaches of the stream channels are delineated for low and high base-flow conditions. Sub-basins within the Little West Fork basin with surplus or deficient flow are also defined.

The Little West Fork basin is located in south-central Kentucky and north-central Tennessee. The study area consists of the surface-water drainage basin for the Little West Fork above site 50 (fig. 1). The Little West Fork basin above site 50 has a drainage area of 180 mi^2 which lies within parts of Trigg and Christian Counties, Kentucky, and parts of Stewart and Montgomery Counties, Tennessee (fig. 1). Most of the basin lies within the U.S. Army's Fort Campbell Military Reservation (fig. 1). The drainage areas for the most downstream sites along major tributaries to the Little West Fork include those for Noah Spring Branch (53.3 mi^2), Dry Fork Creek (18.7 mi^2), Piney Fork (50.2 mi^2), and Fletchers Fork (24.3 mi^2).

BASE-FLOW DATA

Base-flow data including discharge, temperature, and specific conductance were collected for the Little West Fork basin during low base-flow and high base-flow conditions. Data representing low base-flow conditions were collected on September 1 and 13, 1993, and October 18 and 19, 1994. Data representing high base-flow conditions were collected on March 17 and 18, 1994. Names and locations of base-flow measurement sites within the study area are shown in table 1. A hydrograph showing daily discharge measurements for the Little West Fork (site 40, fig. 1) and dates when base-flow data were collected is shown in figure 2.

Discharge Data

Discharge measurements were made at 64 of the 65 sites (60 stream sites and 4 springs) on September 1 and 13, 1993 (tables 2 and 3). The measurements were made during low base-flow conditions, and 45 of the measurement sites (70 percent) had zero flow. Most of the dry measurement sites lie in the head waters of Noah Spring Branch and Piney Fork Creek (fig. 1). Flows in the major streams in the basin were 4.38 ft^3/s for Noah Spring Branch (site 16a), 4.02 ft^3/s for Dry Fork Creek (site 16b), 0 ft^3/s for Piney Fork (site 39), 0 ft^3/s for Fletchers Fork (site 48), and 18.4 ft^3/s for Little West Fork (site 50). Discharge measurements at sites with flow ranged from 0.02 ft^3/s (site 22) to 18.4 ft^3/s (site 50, the most downstream site in the basin). Measurement sites with discharge values for September 1 and 13, 1993, and dry, gaining, and losing reaches are shown in figure 3.

Discharge measurements were made at 63 of the 65 sites (59 stream sites and 4 springs) on March 17 and 18, 1994 (tables 4 and 5). One other spring was visited, but discharge could not be measured (table 5). Measurements were made during high base-flow conditions, and only 8 of the measurement sites (13 percent) had zero flow. Flows in the major streams in the basin were 124 ft^3/s for Noah Spring Branch (site 16a), 66.3 ft^3/s for Dry Fork Creek (site 16b), 58.5 ft^3/s for Piney Fork (site 39), 28.7 ft^3/s for Fletchers Fork (site 48), and 419 ft^3/s for Little West Fork (site 50). Discharge measurements at sites with flow ranged from 0.01 ft^3/s (sites 1, 14, and 29) to 419 ft^3/s (site 50). Measurement sites with discharge values for March 17 and 18, 1994, and dry, gaining, and losing reaches are shown in figure 4.

Discharge measurements were made at 64 of the 65 sites (60 stream sites and 4 springs) on October 18 and 19, 1994 (tables 6 and 7). Measurements were again made during low base-flow conditions, and 44 of the measurement sites (69 percent) had zero flow. Most of the dry measurement sites lie in the head waters of Noah Spring Branch and Piney Fork Creek, as was observed in September 1993. Flows in the major streams in the basin were 4.69 ft^3/s for Noah Spring Branch (site 16a), 4.98 ft^3/s for Dry Fork Creek (site 16b), 0 ft^3/s for Piney Fork (site 39), 0 ft^3/s for Fletchers Fork (site 48), and 27.6 ft^3/s for Little West Fork (site 50). Discharge measurements at sites with flow ranged from 0.03 ft^3/s (sites 22 and 28) to 27.6 ft^3/s (site 50). Measurement sites with discharge values for October 18 and 19, 1994, and dry, gaining, and losing reaches are shown in figure 5.

Discharge leaving the Little West Fork basin was greater during high base-flow conditions than during low base-flow conditions. Site 50 on the Little West Fork is the farthest downstream measurement site within the basin (fig. 1) and had the greatest discharge of all sites during all three measurement periods. Low base-flow measurements made at site 50 on September 13, 1993, and October 18, 1994, were 18.4 ft^3/s (table 2) and 27.6 ft^3/s (table 6), respectively. On March 17, 1994, during high base flow, the discharge measurement at site 50 was 419 ft^3/s (table 4). Major tributaries on the south side of the study area (Piney Fork and Fletchers Fork) consistently had lower flow than the tributaries on the north side (Dry Fork Creek and Noah Spring Branch).

Discharge data were used to categorize stream reaches as gaining or losing, wet (little or no change in

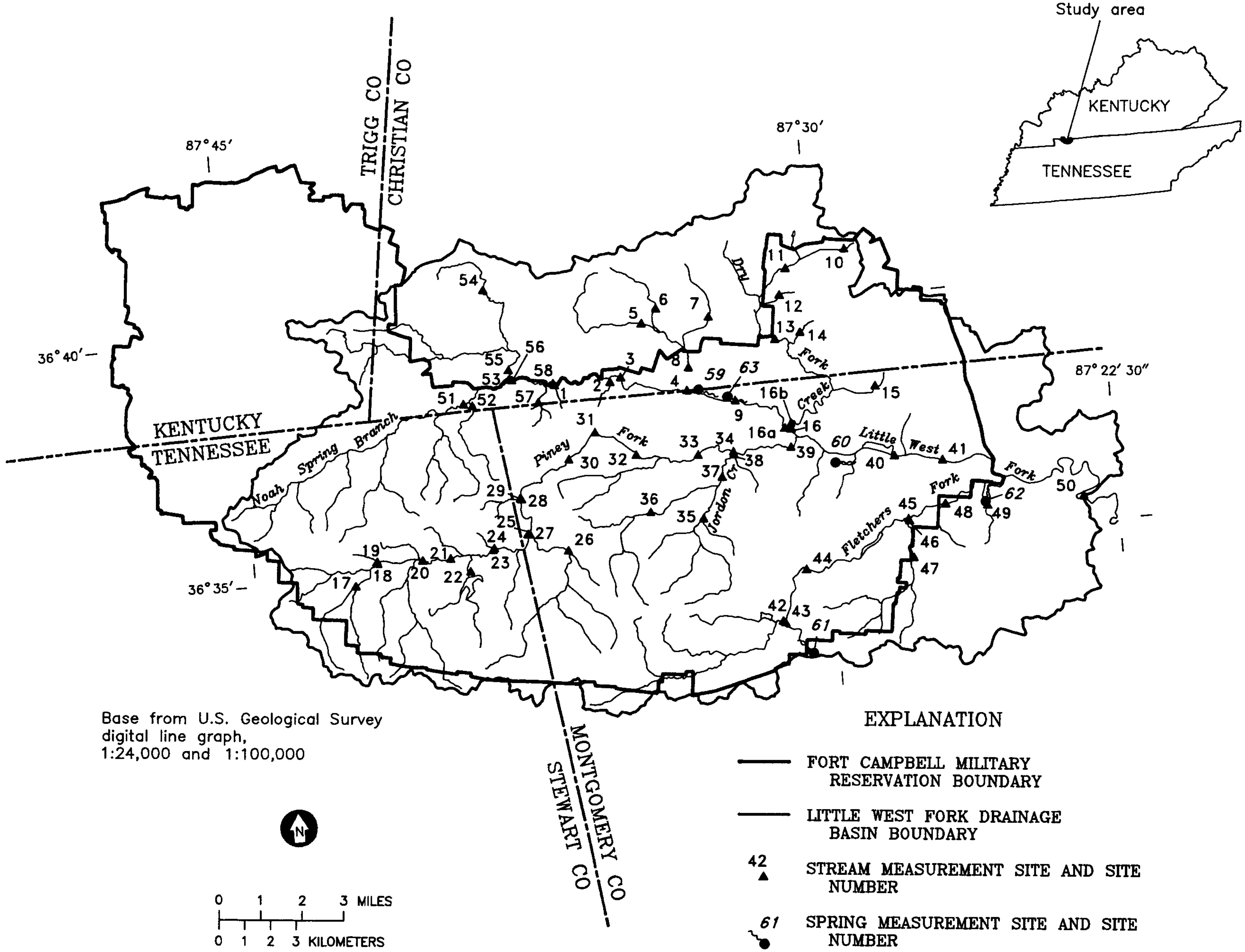


Figure 1. Study area and locations of stream and spring measurement sites.

Table 1. Site and station numbers, station names, and locations of stream and spring measurement sites in the Little West Fork basin, Fort Campbell

Site no.	Station no.	Station name	Location					
			Latitude			Longitude		
			°	'	"	°	'	"
1	03436370	Noah Spring Branch trib. near LaFayette, KY	36	38	39	87	36	51
2	03436372	Noah Spring Branch trib. on Angels Rd. near Garrettsburg, KY	36	38	37	87	35	24
3	03436373	Noah Spring Branch on Angels Rd. near Garrettsburg, KY	36	38	42	87	35	07
4	03436375	Noah Spring Branch trib. off Palmyra Rd. near Garrettsburg, KY	36	38	19	87	33	26
5	03436378	Unnamed trib. to Noah Cave at Lovelady Rd. near Garrettsburg, KY	36	39	46	87	34	28
6	03436379	Unnamed trib. to Noah Cave on Boodie Rd. near Garrettsburg, KY	36	40	03	87	34	04
7	03436382	Unnamed trib. to Noah Cave at Garrettsburg, KY	36	39	47	87	32	43
8	03436384	Noah Cave near Garrettsburg, KY	36	38	47	87	33	21
9	03436388	Noah Spring Branch at On the Line Rd. near Garrettsburg, KY	36	38	02	87	32	12
10	03436390	Dry Fork Creek trib. near Army Airfield at Fort Campbell	36	40	57	87	29	03
11	03436391	Dry Fork Creek trib. near Army Airfield at tower near Garrettsburg, KY	36	40	39	87	30	37
12	03436394	Dry Fork Creek trib. at water tank near Army Airfield near Garrettsburg, KY	36	40	07	87	30	50
13	03436396	Dry Fork Creek at Angels Rd. near Garrettsburg, KY	36	39	13	87	31	02
14	03436397	Dry Fork Creek trib. at Angels Rd. near Garrettsburg, KY	36	39	19	87	30	22
15	03436398	Dry Fork Creek trib. at Fort Campbell	36	38	06	87	28	33
16	03436400	Noah Spring Branch	36	37	22	87	30	47
16a	--	--	36	37	24	87	30	58
16b	--	--	36	37	29	87	30	48
17	03436401	Piney Fork at Destiny Trail near Legate, TN	36	34	51	87	42	24

Table 1. Site and station numbers, station names, and locations of stream and spring measurement sites in the Little West Fork basin, Fort Campbell—Continued

Site no.	Station no.	Station name	Location					
			Latitude			Longitude		
			°	'	"	°	'	"
18	034364015	Piney Fork at Normandy Loop Rd. near Legate, TN	36	35	17	87	41	48
19	03436402	Piney Fork trib. at Normandy Loop Rd. near Legate, TN	36	35	17	87	41	48
20	03436403	Piney Fork Creek near Legate, TN	36	35	16	87	40	37
21	03436404	Piney Fork Creek at Rendevous Rd. near Legate, TN	36	35	16	87	39	54
22	03436405	Lake Kyle outflow at Destiny Trail near Legate, TN	36	34	58	87	39	24
23	03436406	Piney Fork Creek at Indian Mound Rd. near Legate, TN	36	35	22	87	38	46
24	03436407	Piney Fork trib. below Indian Mound Rd. near Legate, TN	36	35	24	87	38	44
25	03436408	Piney Fork above Jordan Spring Rd. near LaFayette, KY	36	35	38	87	37	49
26	03463409	Elk Fork Creek near Oakwood, TN	36	35	14	87	36	50
27	03437410	Elk Fork Creek at mouth near LaFayette, KY	36	35	38	87	37	47
28	034364104	Piney Fork near LaFayette, KY	36	36	22	87	37	56
29	034364105	Piney Fork trib. near LaFayette, KY	36	36	23	87	37	58
30	03436411	Piney Fork Creek north of Rose Hill Rd. near LaFayette, KY	36	37	06	87	36	38
31	03436412	Piney Fork at Engineer Rd. near Garrettsburg, KY	36	37	37	87	35	54
32	03436413	Piney Fork at Palmyra Rd. near Oakwood, TN	36	37	03	87	34	53
33	03436414	Piney Fork near Oakwood, TN	36	36	59	87	33	17
34	03436415	Piney Fork at mouth of Jordan Creek near Oakwood, TN	36	36	59	87	32	21
35	03436416	Jordan Creek at Jordan Spring Rd. near Oakwood, TN	36	35	40	87	33	16
36	03436417	Moss Creek at Palmyra Rd. near Oakwood, TN	36	35	53	87	34	37
37	03436418	Jordan Creek at Ghost Corps Trail near Oakwood, TN	36	36	29	87	32	42
38	03436419	Jordan Creek at mouth near Oakwood, TN	36	36	56	87	32	21

Table 1. Site and station numbers, station names, and locations of stream and spring measurement sites in the Little West Fork basin, Fort Campbell—Continued

Site no.	Station no.	Station name	Location					
			Latitude			Longitude		
			°	'	"	°	'	"
39	03436420	Piney Fork	36	36	59	87	30	51
40	03436426	Little West Fork near Fort Campbell (East End Rd.)	36	36	38	87	28	11
41	03436430	Little West Fork Red River at Fort Campbell	36	36	28	87	26	57
42	03436433	Fletchers Fork near Woodlawn, TN	36	33	26	87	31	25
43	03436437	Fletchers Fork trib. near Woodlawn, TN	36	33	24	87	31	22
44	03436440	Fletchers Fork	36	34	27	87	30	42
45	03436441	Fletchers Fork on Woodlawn Rd. at walnut grove	36	35	19	87	27	57
46	03436442	Racoon Branch at walnut grove	36	35	17	87	27	56
47	03436443	Racoon Branch near walnut grove	36	34	31	87	27	57
48	03436444	Fletchers Fork near walnut grove	36	35	34	87	26	58
49	03436446	Fletchers Fork trib. on Even Rd. at Ringgold, TN	36	35	30	87	25	54
50	03436460	Little West Fork Red River near New Providence, TN	36	35	30	87	23	23
51	03436360	Noah Spring Branch on Angels Rd. near LaFayette, KY	36	38	24	87	39	15
52	03436361	Noah Spring Branch trib. on Angels Rd. near LaFayette, KY	36	38	21	87	39	01
53	03436362	Noah Spring Branch near LaFayette, KY	36	38	50	87	38	01
54	03436364	Noah Spring Branch trib. on HWY 107 near LaFayette, KY	36	40	42	87	38	30
55	03436365	Noah Spring Branch trib. at LaFayette Rd. near LaFayette, KY	36	39	02	87	38	00
56	03436366	Noah Spring Branch trib. near LaFayette, KY	36	38	50	87	38	00
57	03436368	Noah Spring Branch trib. on Angels Rd. near LaFayette, KY	36	38	19	87	37	18
58	03436369	Noah Spring Branch near LaFayette, KY	36	38	41	87	36	53
59	03436385	Noah Spring near Garrettsburg, KY	36	38	20	87	33	08

Table 1. Site and station numbers, station names, and locations of stream and spring measurement sites in the Little West Fork basin, Fort Campbell—Continued

Site no.	Station no.	Station name	Location					
			Latitude			Longitude		
			°	'	"	°	'	"
60	03436424	Dennis Spring to Little West Fork near Fort Campbell	36	36	36	87	29	44
61	03436435	Unnamed spring on Old Dover Rd. at Woodlawn, TN	36	32	44	87	30	42
62	03436445	Britton Spring at Ringgold, TN	36	35	35	87	25	56
63	--	On the Line Rd. Spring to Noah Spring Branch	36	38	02	87	32	13

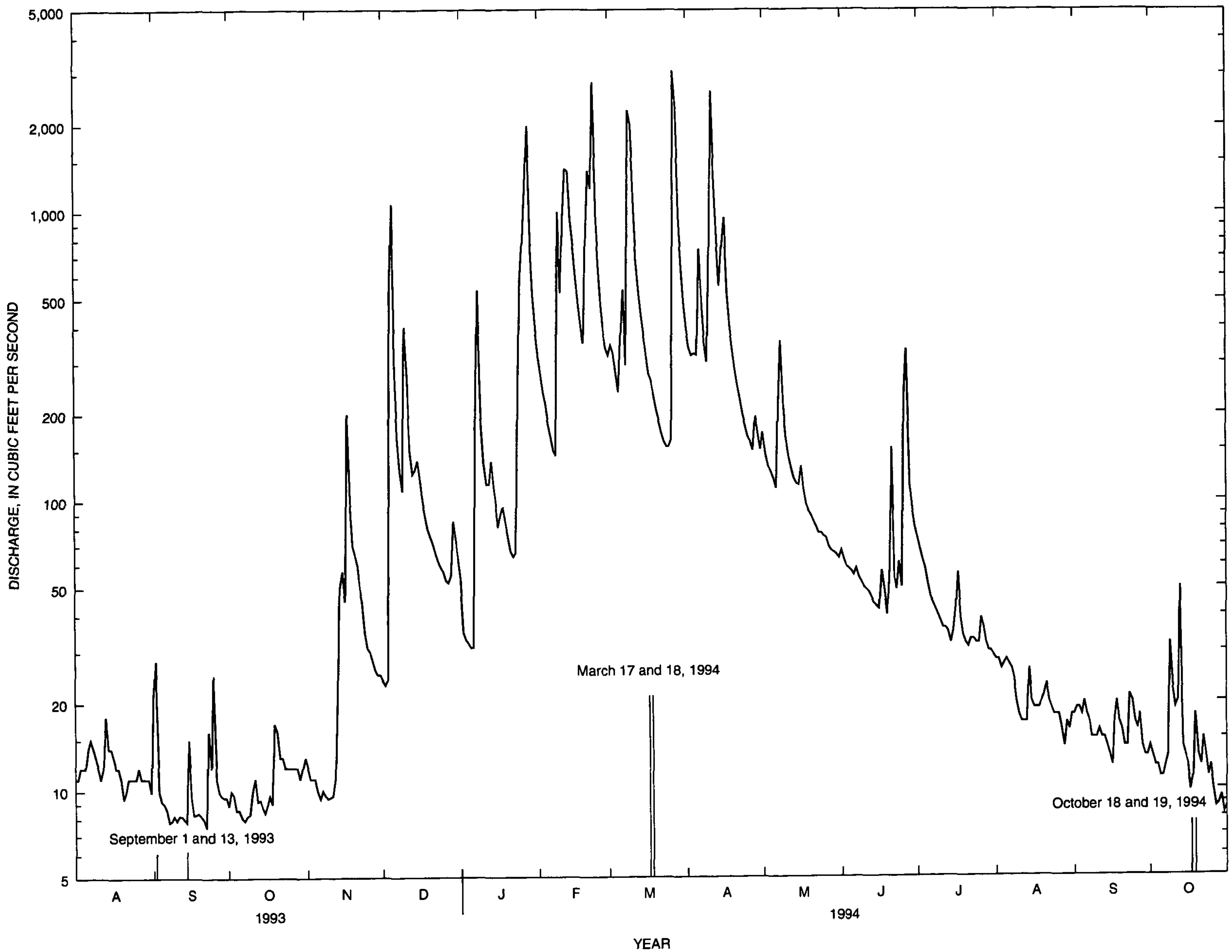


Figure 2. Mean daily discharge on the Little West Fork at site number 40 in Tennessee.

Table 2. Low base-flow data for streams in the Little West Fork basin, September 1 and 13, 1993

[ft³/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Stream discharge, instantaneous (ft³/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
1	03436370	0	--	--
2	03436372	0	--	--
3	03436373	0	--	--
4	03436375	0	--	--
5	03436378	0	--	--
6	03436379	0	--	--
7	03436382	0	--	--
8	03436384	0	--	--
9	03436388	3.62	16.0	385
10	03436390	0	--	--
11	03436391	0	--	--
12	03436394	0	--	--
13	03436396	3.50	17.1	375
14	03436397	0	--	--
15	03436398	0	--	--
[a]16	03436400	8.40	--	--
16a	--	4.38	18.2	382
16b	--	4.02	19.5	360
17	03436401	0	--	--
18	034364015	0	--	--
19	03436402	0	--	--
20	03436403	0	--	--
21	03436404	0	--	--
22	03436405	.02	25.3	184
23	03436406	0	--	--
24	03436407	0	--	--
25	03436408	0	--	--
26	03463409	0	--	--
27	03437410	0	--	--
28	034364104	.08	19.8	245
29	034364105	0	--	--
30	03436411	0	--	--
31	03436412	.13	21.2	128
32	03436413	.06	22.3	232
33	03436414	0	--	--
34	03436415	0	--	--
35	03436416	.39	20.3	371
36	03436417	0	--	--
37	03436418	.13	19.2	347
38	03436419	0	--	--
39	03436420	0	--	--
40	03436426	8.54	19.5	371
41	03436430	13.4	19.9	453
42	03436433	0	--	--
43	03436437	0	--	--

Table 2. Low base-flow data for streams in the Little West Fork basin, September 1 and 13, 1993—Continued

Site no.	Station no.	Stream discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
44	03436440	0.64	19.1	331
45	03436441	0	--	--
46	03436442	.08	17.6	407
47	03436443	0	--	--
48	03436444	0	--	--
49	03436446	0	--	--
50	03436460	18.4	19.4	660
51	03436360	0	--	--
52	03436361	0	--	--
53	03436362	0	--	--
54	03436364	0	--	--
55	03436365	0	--	--
56	03436366	0	--	--
57	03436368	0	--	--
58	03436369	0	--	--

[a] The streamflow measurement for this site was calculated by adding the measurements for sites 16a and 16b.

Table 3. Low base-flow data for springs in the Little West Fork basin, September 13, 1993

[ft^3/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Spring name	Discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
59	03436385	Noah Spring	0.31	14.8	418
60	03436424	Dennis Spring	1.16	13.6	425
61	03436435	Unnamed spring	0	--	--
62	03436445	Britton Spring	1.45	17.3	377

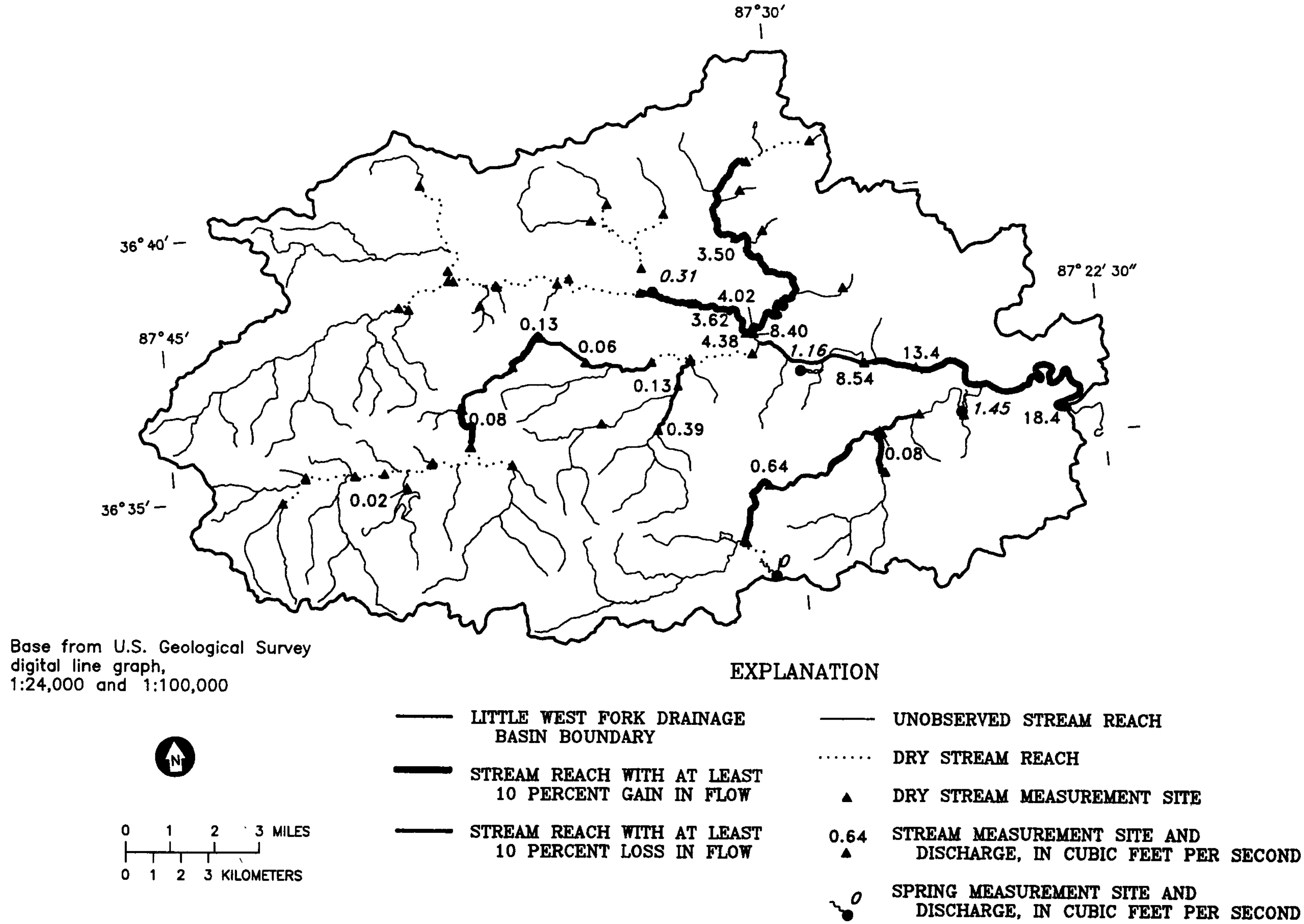


Figure 3. Little West Fork basin showing low base-flow stream and spring measurement sites and discharge measurements, September 1 and 13, 1993.

Table 4. High base-flow data for streams in the Little West Fork basin, March 17 and 18, 1994

[ft^3/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Stream discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
1	03436370	0.01	10.8	174
2	03436372	0	--	--
3	03436373	13.1	11.2	222
4	03436375	56.1	10.4	228
5	03436378	1.29	12.7	216
6	03436379	1.06	9.9	125
7	03436382	.10	9.5	317
8	03436384	15.9	12.5	270
9	03436388	116	10.8	232
10	03436390	.06	10.0	67
11	03436391	.43	9.3	113
12	03436394	0	--	--
13	03436396	45.2	12.8	280
14	03436397	.01	9.0	341
15	03436398	0	--	--
[a]16	03436400	190	10.0	252
16a	--	124	--	--
16b	--	66.3	--	--
17	03436401	.91	10.4	65
18	034364015	0	--	--
19	03436402	2.09	9.6	60
20	03436403	5.80	9.3	54
21	03436404	5.28	8.4	55
22	03436405	1.85	11.3	57
23	03436406	8.97	8.4	57
24	03436407	.12	7.0	85
25	03436408	10.9	7.6	59
26	03463409	4.35	8.8	65
27	03437410	5.14	6.6	63
28	034364104	18.3	7.4	77
29	034364105	.01	7.4	191
30	03436411	22.4	10.2	105
31	03436412	24.7	10.8	110
32	03436413	36.8	10.5	113
33	03436414	38.4	9.7	121
34	03436415	5.49	10.1	88
35	03436416	10.4	14.0	164
36	03436417	1.82	9.0	45
37	03436418	15.4	9.0	146
38	03436419	9.20	9.6	150
39	03436420	58.5	8.0	138
40	03436426	284	10.0	248
41	03436430	317	10.0	242
42	03436433	0	--	--
43	03436437	0	--	--
44	03436440	18.8	13.0	140

Table 4. High base-flow data for streams in the Little West Fork basin, March 17 and 18, 1994—Continued

Site no.	Station no.	Stream discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
45	03436441	31.9	8.0	165
46	03436442	6.09	--	180
47	03436443	2.14	7.0	75
48	03436444	28.7	12.0	170
49	03436446	0	--	--
50	03436460	419	11.2	250
51	03436360	5.34	8.9	112
52	03436361	.42	9.8	249
53	03436362	10.5	10.2	160
54	03436364	1.29	6.6	--
56	03436366	23.5	11.9	212
57	03436368	.32	8.4	66
58	03436369	38.2	11.5	202

[a] The streamflow measurement for this site was calculated by adding the measurements for sites 16a and 16b.

Table 5. High base-flow data for springs in the Little West Fork basin, March 17, 1994

[ft^3/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Spring name	Discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
59	03436385	Noah Spring	19.6	11.3	302
[a]60	03436424	Dennis Spring	--	--	--
61	03436435	Unnamed spring	0	--	--
62	03436445	Britton Spring	12.2	12.0	270
63	--	On the Line Rd. Spring	4.83	12.6	211

[a] A discharge measurement for this site was not possible during high base flow because the spring was submerged.

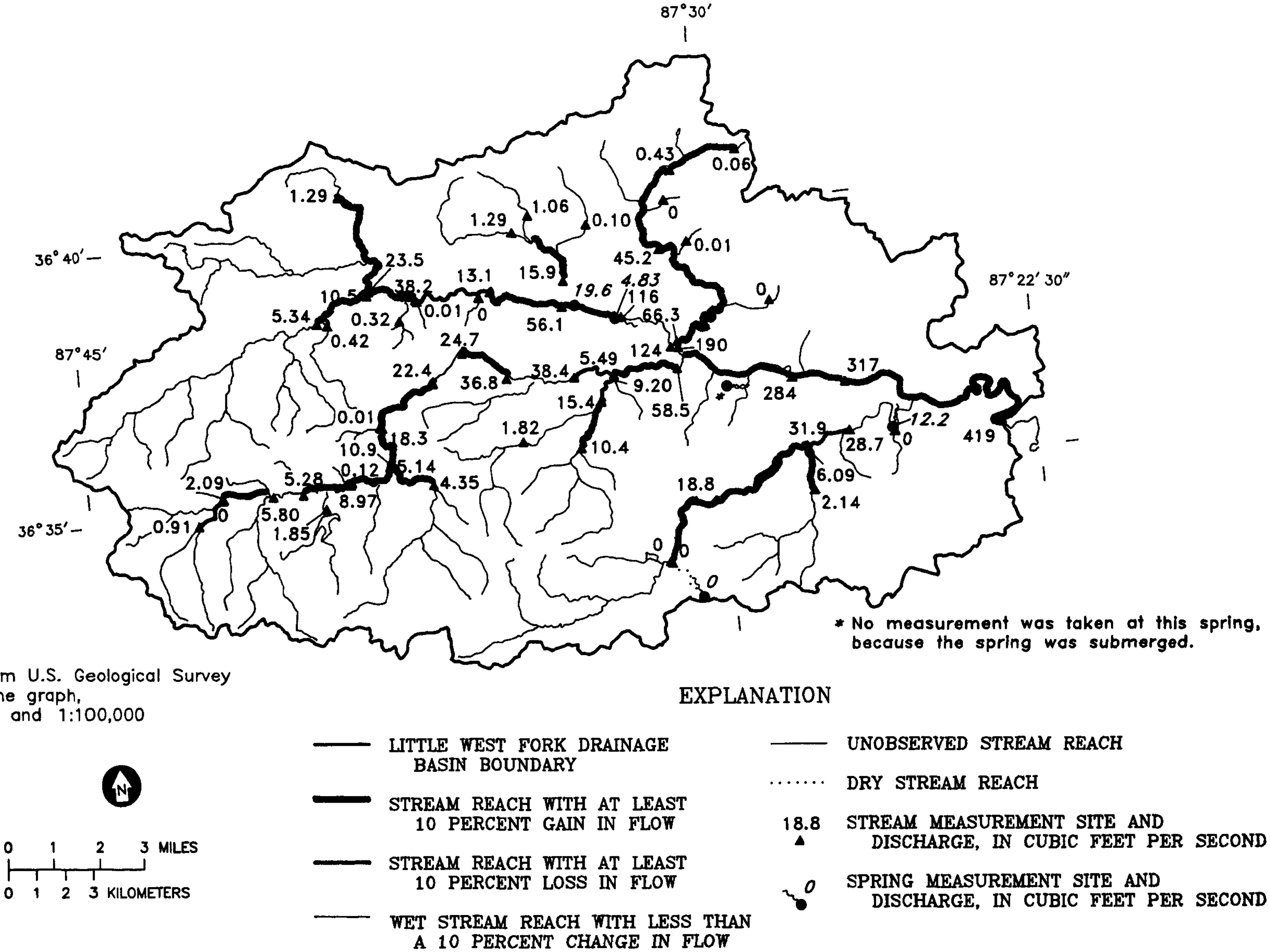


Figure 4. Little West Fork basin showing high base-flow stream and spring measurement sites and discharge measurements, March 17 and 18, 1994.

Table 6. Low base-flow data for streams in the Little West Fork basin, October 18 and 19, 1994

[ft^3/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Stream discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
1	03436370	0	--	--
2	03436372	0	--	--
3	03436373	0	--	--
4	03436375	0	--	--
5	03436378	0	--	--
6	03436379	0	--	--
7	03436382	0	--	--
8	03436384	0	--	--
9	03436388	2.10	13.9	415
10	03436390	0	--	--
11	03436391	0	--	--
12	03436394	0	--	--
13	03436396	3.91	14.4	380
14	03436397	0	--	--
15	03436398	0	--	--
[a]16	03436400	9.67	15.2	309
16a	--	4.69	--	--
16b	--	4.98	--	--
17	03436401	0	--	--
18	034364015	0	--	--
19	03436402	0	--	--
20	03436403	0	--	--
21	03436404	0	--	--
22	03436405	.03	17.1	176
23	03436406	0	--	--
24	03436407	0	--	--
25	03436408	0	--	--
26	03463409	0	--	--
27	03437410	0	--	--
28	034364104	.03	16.8	276
29	034364105	0	--	--
30	03436411	0	--	--
31	03436412	.21	15.0	261
32	03436413	.20	16.8	299
33	03436414	.16	15.9	333
34	03436415	0	--	--
35	03436416	.45	18.2	384
36	03436417	0	--	--
37	03436418	.31	15.0	357
38	03436419	0	--	--
39	03436420	0	--	--
40	03436426	10.5	15.9	376
41	03436430	17.2	16.8	440
42	03436433	0	--	--
43	03436437	0	--	--
44	03436440	.80	15.2	337

Table 6. Low base-flow data for streams in the Little West Fork basin, October 18 and 19, 1994—Continued

Site no.	Station no.	Stream discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
45	03436441	0	--	--
46	03436442	.40	15.4	389
47	03436443	0	--	--
48	03436444	0	--	--
49	03436446	0	--	--
50	03436460	27.6	16.3	393
51	03436360	0	--	--
52	03436361	0	--	--
53	03436362	0	--	--
54	03436364	0	--	--
55	03436365	0	--	--
56	03436366	0	--	--
57	03436368	0	--	--
58	03436369	0	--	--

[a] The streamflow measurement for this site was calculated by adding the measurements for sites 16a and 16b.

Table 7. Low base-flow data for springs in the Little West Fork basin, October 18, 1994

[ft^3/s, cubic foot per second; °C, degrees Celsius; µS/cm at 25 °C, microSiemen per centimeter at 25 degrees Celsius]

Site no.	Station no.	Spring name	Discharge, instantaneous (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm at 25 °C)
59	03436385	Noah Spring	0.04	14.1	413
60	03436424	Dennis Spring	.96	14.3	411
61	03436435	Unnamed spring	0	--	--
62	03436445	Britton Spring	3.41	16.0	364

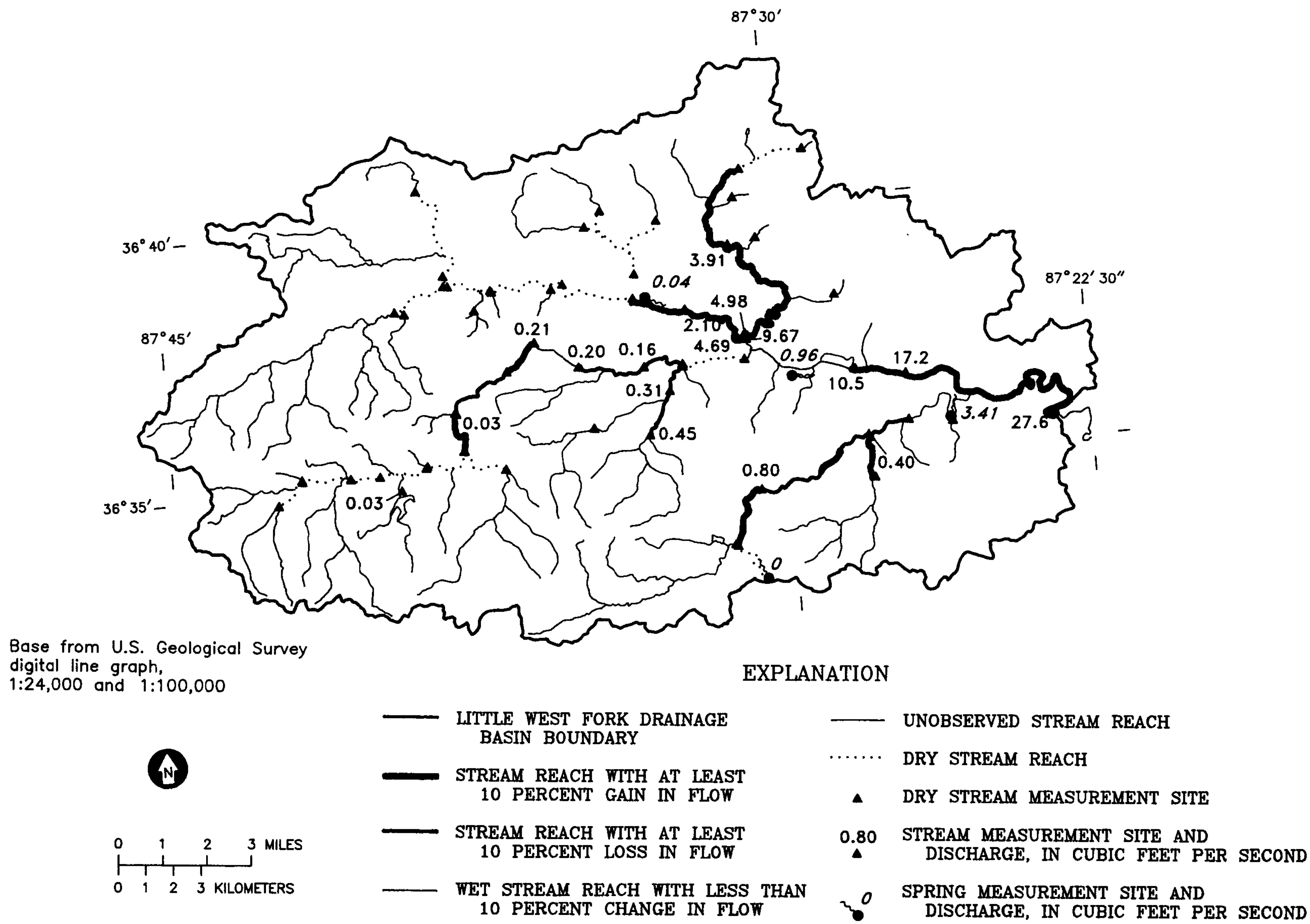


Figure 5. Little West Fork basin showing low base-flow stream and spring measurement sites and discharge measurements, October 18 and 19, 1994.

flow), dry, or unobserved. Gaining, losing, and dry stream reaches are bounded by one or more upstream and one downstream measurement sites. For this report, a gaining reach is defined as a reach in which flow has increased by at least 10 percent of its downstream discharge value. A losing reach is defined as a reach in which flow has decreased by at least 10 percent of its upstream discharge value. A wet reach is a reach in which the change in flow is less than 10 percent of its greater discharge value. A reach is categorized as dry if its upstream and downstream discharge measurements are 0 ft^3/s. A reach not bounded by both upstream and downstream measurement sites is categorized as unobserved. More gaining stream reaches occurred during the high base-flow period (fig. 4) than either low base-flow period (fig. 3 and 5). More dry stream reaches occurred during the two low base-flow periods (fig. 3 and 5) than during the high base-flow period (fig. 4).

Temperature Data

Water temperature data also were collected at most of the sites that had flow when discharge measurements were taken. On September 1 and 13, 1993, water temperature data collected at 18 of the 19 sites with flow ranged from 13.6 to 25.3 °C (tables 2 and 3). On March 17 and 18, 1994, water temperature at 52 of the 56 sites with flow ranged from 6.6 to 14.0 °C (tables 4 and 5). On October 18 and 19, 1994, water temperature at 18 of the 20 sites with flow ranged from 13.9 to 18.2 °C (tables 6 and 7).

Specific-Conductance Data

Specific conductance also was measured at most of the sites that had flow. On September 1 and 13, 1993, specific conductance at 18 of the 19 sites with flow ranged from 128 to 660 µS/cm (tables 2 and 3). On March 17 and 18, 1994, specific conductance at 52 of the 56 sites with flow ranged from 45 to 341 µS/cm (tables 4 and 5). On October 18 and 19, 1994, specific conductance at 18 of the 20 sites with flow ranged from 176 to 440 µS/cm (tables 6 and 7).

AREAS OF SURPLUS OR DEFICIENT FLOW

Areas of surplus or deficient flow can be determined by comparing the change in flow of each sub-basin with the flow of the entire basin. Such a comparison will reveal how much flow each sub-basin is contributing to the total flow of the basin. Areas of surplus or deficient flow were determined for low and high base-flow periods in the following manner:

- The drainage area for each sub-basin was measured from topographic maps.
- The change in flow for each sub-basin was calculated by subtracting the flow entering each sub-basin from the flow leaving each sub-basin. The change in flow was divided by the sub-basin drainage area. The change in flow per square mile for each sub-basin is shown in tables 8, 9, and 10.
- The flow per square mile of surface drainage for the entire study area was calculated by dividing the discharge at the most downstream site (50) (tables 2, 4, and 6) by the basin area at site 50 (180 mi^2). Values of flow per square mile were calculated using discharge data collected on September 1 and 13, 1993, March 17 and 18, 1994, and October 18 and 19, 1994.
- The change in flow per square mile for each sub-basin was compared to the flow per square mile for site 50. If the change in flow per square mile for a sub-basin was greater than 2 times or less than 1/2 of the flow per square mile for site 50, then it was defined as an area of surplus or deficient flow, respectively. Otherwise, the sub-basin was considered neither surplus nor deficient. Areas of surplus or deficient flow are shown in figures 6, 7, and 8.

Many areas of deficient flow occurred near the headwaters of the Little West Fork basin under all base-flow conditions. Fewer areas of deficient flow occurred near the mouth of the basin.

The flow per square mile for each major tributary basin in the study area was also calculated (table 11). The values of flow per square mile for the Noah Spring Branch and Dry Fork Creek basins in the northern part of the study area were greater than those for the Piney Fork and Fletchers Fork basins in the southern part of the study area under all base-flow conditions. The tributary basin areas in the southern part of the study area had deficient flow (0 $ft^3/s/mi^2$) for both low base-flow periods and neither surplus nor deficient flow for the high base-flow period. All

Table 8. Low base-flow data for drainage areas in the Little West Fork basin, September 1 and 13, 1993

[mi^2, square mile; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile; change in flow per square mile, positive numbers reflect gain and negative numbers reflect loss]

Site and sub-basin no. (figure 6)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
1	0.15	0	0	0
2	.46	0	0	0
3	2.39	0	0	0
4	1.76	0	0	0
5	4.77	0	0	0
6	1.99	0	0	0
7	2.36	0	0	0
8	5.17	0	0	0
9	1.64	0	3.62	2.21
10	.11	0	0	0
11	3.88	0	0	0
12	.23	0	0	0
13	5.45	0	3.50	.64
14	1.11	0	0	0
15	.95	0	0	0
16a	1.00	3.62	4.38	.76
16b	6.99	3.50	4.02	.07
17	2.60	0	0	0
18	2.88	0	0	0
19	.26	0	0	0
20	5.81	0	0	0
21	.93	0	0	0
22	2.07	0	.02	.01
23	1.63	.02	0	-.01
24	.47	0	0	0
25	2.23	0	0	0
26	7.01	0	0	0
27	.97	0	0	0
28	.90	0	.08	.09
29	.47	0	0	0
30	2.00	.08	0	-.04
31	.84	0	.13	.15
32	.96	.13	.06	-.07
33	4.50	.06	0	-.01
34	.72	0	0	0
35	4.50	0	.39	.09
36	3.12	0	0	0
37	2.33	.39	.13	-.11
38	1.21	.13	0	-.11
39	1.77	0	0	0
40	5.85	8.40	8.54	.02
41	2.65	8.54	13.4	1.83
42	9.73	0	0	0

Table 8. Low base-flow data for drainage areas in the Little West Fork basin, September 1 and 13, 1993—Continued

Site and sub-basin no. (figure 6)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
43	0.42	0	0	0
44	2.83	0	.64	.23
45	4.60	.64	0	-.14
46	1.27	0	.08	.06
47	3.94	0	0	0
48	1.50	.08	0	-.05
49	.88	0	0	0
50	23.7	13.4	18.4	.21
51	14.8	0	0	0
52	1.44	0	0	0
53	2.29	0	0	0
54	1.92	0	0	0
55	8.96	0	0	0
56	.10	0	0	0
57	1.03	0	0	0
58	1.16	0	0	0
Entire basin	180	0	18.4	.10 (Flow per square mile)

Table 9. High base-flow data for drainage areas in the Little West Fork basin, March 17 and 18, 1994

[mi^2, square mile; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile; change in flow per square mile, positive numbers reflect gain and negative numbers reflect loss]

Site and sub-basin no. (figure 7)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
1	0.15	0	0.01	0.07
2	.46	0	0	0
3	2.39	38.2	13.1	-10.5
4	1.76	13.1	56.1	24.4
5	4.77	0	1.29	.27
6	1.99	0	1.06	.53
7	2.36	0	.10	.04
8	5.17	2.45	15.9	2.60
9	1.64	56.1	116	36.5
10	.11	0	.06	.54
11	3.88	.06	.43	.10
12	.23	0	0	0
13	5.45	.43	45.2	8.22
14	1.11	0	.01	.01
15	.95	0	0	0
16a	1.00	116	124	8.00
16b	6.99	45.2	66.3	3.02
17	2.60	0	.91	.35
18	2.88	.91	0	-.32
19	.26	0	2.09	8.04
20	5.81	2.09	5.80	.64
21	.93	5.80	5.28	-.56
22	2.07	0	1.85	.89
23	1.63	7.13	8.97	1.13
24	.47	0	.12	.26
25	2.23	9.09	10.9	.81
26	7.01	0	4.35	.62
27	.97	4.35	5.14	.81
28	.90	16.0	18.3	2.51
29	.47	0	.01	.02
30	2.00	18.3	22.4	2.04
31	.84	22.4	24.7	2.74
32	.96	24.7	36.8	12.6
33	4.50	36.8	38.4	.36
34	.72	38.4	5.49	-45.7
35	4.50	0	10.4	2.31
36	3.12	0	1.82	.58
37	2.33	12.2	15.4	1.36
38	1.21	0	9.20	-5.12
39	1.77	14.7	58.5	24.7
40	5.85	248	284	6.07
41	2.65	284	317	12.4
42	9.73	0	0	0
43	.42	0	0	0

Table 9. High base-flow data for drainage areas in the Little West Fork basin, March 17 and 18, 1994—Continued

Site and sub-basin no. (figure 7)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
44	2.83	0	18.8	6.64
45	4.60	18.8	31.9	2.85
46	1.27	2.14	6.09	3.11
47	3.94	0	2.14	.54
48	1.50	38.0	28.7	-6.19
49	.88	0	0	0
50	23.7	346	419	3.09
51	14.8	0	5.34	.36
52	1.44	0	.42	.29
53	2.29	5.76	10.5	2.07
54	1.92	0	1.29	.67
56	9.06	1.29	23.5	2.45
57	1.03	0	.32	.31
58	1.16	34.3	38.2	3.34
Entire basin	180	0	419	2.33 (Flow per square mile)

Table 10. Low base-flow data for drainage areas in the Little West Fork basin, October 18 and 19, 1994

[mi^2, square mile; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile; change in flow per square mile, positive numbers reflect gain and negative numbers reflect loss]

Site and sub-basin no. (figure 8)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
1	0.15	0	0	0
2	.46	0	0	0
3	2.39	0	0	0
4	1.76	0	0	0
5	4.77	0	0	0
6	1.99	0	0	0
7	2.36	0	0	0
8	5.17	0	0	0
9	1.64	0	2.10	1.28
10	.11	0	0	0
11	3.88	0	0	0
12	.23	0	0	0
13	5.45	0	3.91	.72
14	1.11	0	0	0
15	.95	0	0	0
16a	1.00	2.10	4.69	2.59
16b	6.99	3.91	4.98	.15
17	2.60	0	0	0
18	2.88	0	0	0
19	.26	0	0	0
20	5.81	0	0	0
21	.93	0	0	0
22	2.07	0	.03	.01
23	1.63	.03	0	-.02
24	.47	0	0	0
25	2.23	0	0	0
26	7.01	0	0	0
27	.97	0	0	0
28	.90	0	.03	.03
29	.47	0	0	0
30	2.00	.03	0	-.02
31	.84	0	.21	.25
32	.96	.21	.20	-.01
33	4.50	.20	.16	-.01
34	.72	.16	0	-.22
35	4.50	0	.45	.10
36	3.12	0	0	0
37	2.33	.45	.31	-.06
38	1.21	.31	0	-.26
39	1.77	0	0	0
40	5.85	9.67	10.5	.14
41	2.65	10.5	17.2	2.53
42	9.73	0	0	0
43	.42	0	0	0

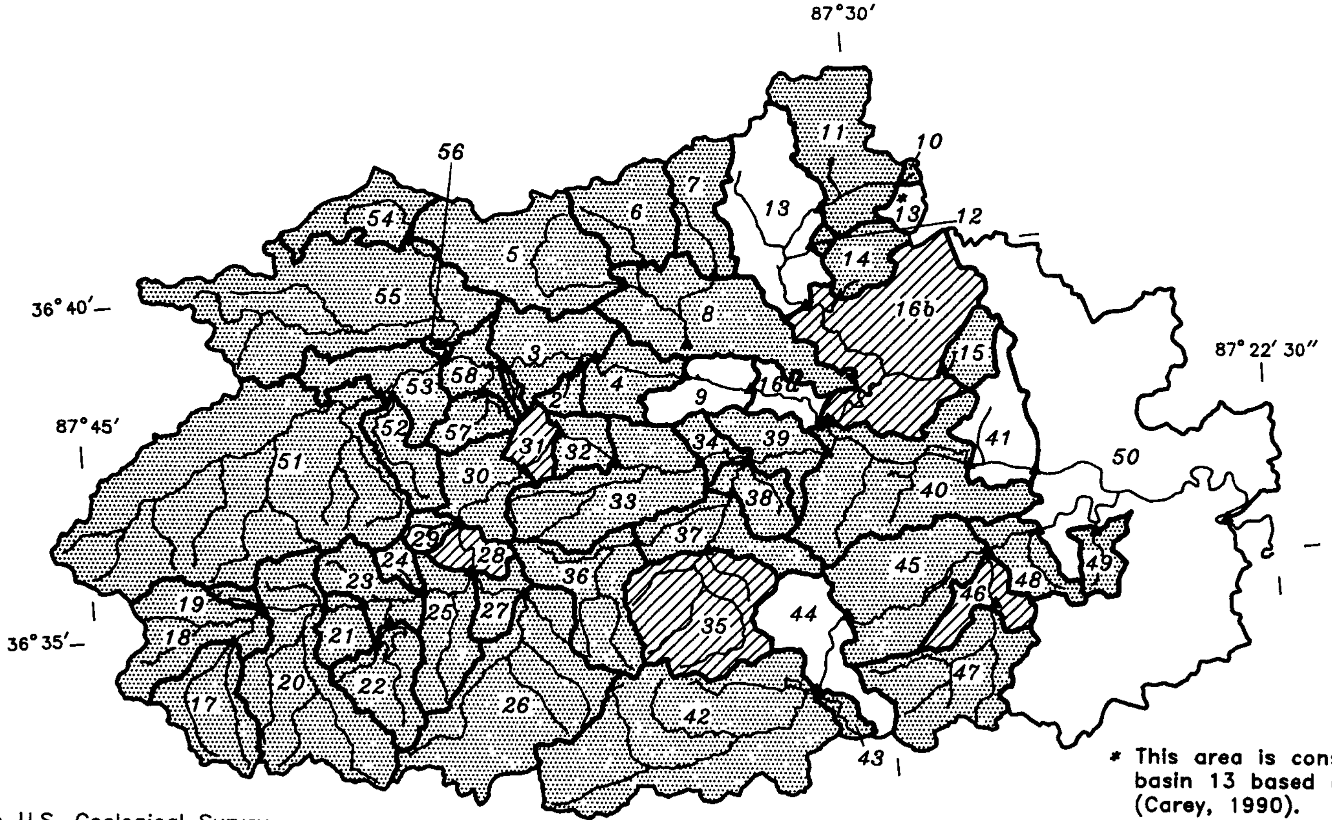
Table 10. Low base-flow data for drainage areas in the Little West Fork basin, October 18 and 19, 1994—Continued

Site and sub-basin no. (figure 8)	Sub-basin area (mi^2)	Discharge entering sub-basin (ft^3/s)	Discharge leaving sub-basin (ft^3/s)	Change in flow per square mile ($ft^3/s/mi^2$)
44	2.83	0	0.80	0.28
45	4.60	.80	0	-.17
46	1.27	0	.40	.32
47	3.94	0	0	0
48	1.50	.40	0	-.27
49	.88	0	0	0
50	23.7	17.2	27.6	.44
51	14.8	0	0	0
52	1.44	0	0	0
53	2.29	0	0	0
54	1.92	0	0	0
55	8.96	0	0	0
56	.10	0	0	0
57	1.03	0	0	0
58	1.16	0	0	0
Entire basin	180	0	27.6	.15 (Flow per square mile)

Table 11. Flow per square mile for major tributary basins in the Little West Fork basin

[mi^2, square mile; $ft^3/s/mi^2$, cubic foot per second per square mile]

Basin	Site no.	Basin area (mi^2)	Flow per square mile ($ft^3/s/mi^2$)		
			September 1993	March 1994	October 1994
Tributary					
Noah Spring Branch	16a	53.3	0.08	2.33	0.09
Dry Fork Creek	16b	18.7	.21	3.55	.27
Piney Fork	39	50.2	0	1.17	0
Fletchers Fork	48	24.3	0	1.18	0
Entire basin Little West Fork	50	180	.10	2.33	.15



* This area is considered part of sub-basin 13 based on dye-trace data (Carey, 1990).

Base from U.S. Geological Survey digital line graph, 1:24,000 and 1:100,000

0 1 2 3 MILES
0 1 2 3 KILOMETERS

EXPLANATION

LITTLE WEST FORK DRAINAGE BASIN BOUNDARY

26 — STREAM MEASUREMENT SITE AND SUB-BASIN WITH DEFICIENT FLOW, AND SITE AND SUB-BASIN NUMBER

35 — STREAM MEASUREMENT SITE AND SUB-BASIN WITH SURPLUS FLOW, AND SITE AND SUB-BASIN NUMBER

44 — STREAM MEASUREMENT SITE AND SUB-BASIN WITH NEITHER SURPLUS NOR DEFICIENT FLOW, AND SITE AND SUB-BASIN NUMBER

Figure 6. Little West Fork basin showing areas of surplus or deficient flow during low base flow, September 1 and 13, 1993.

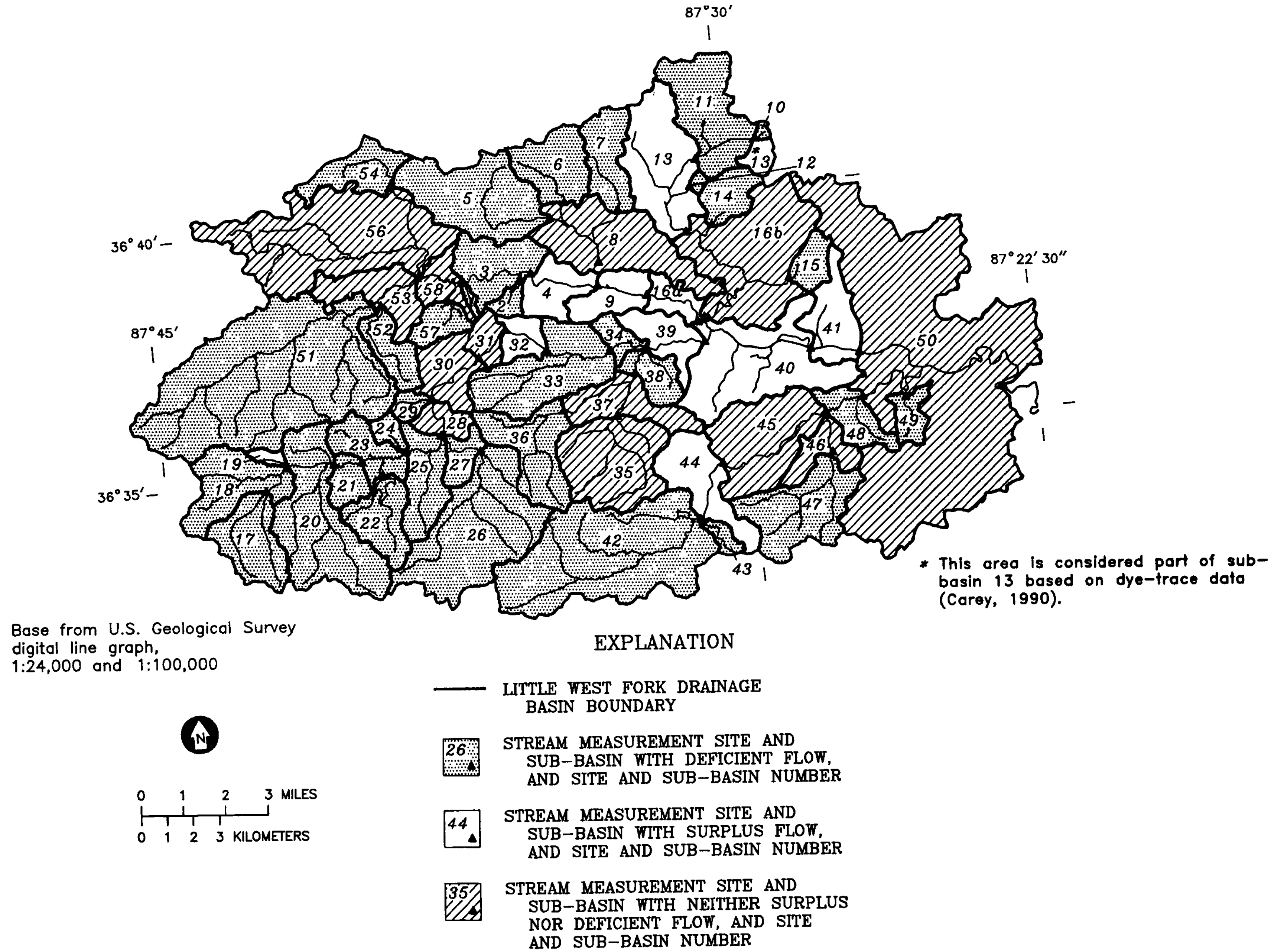
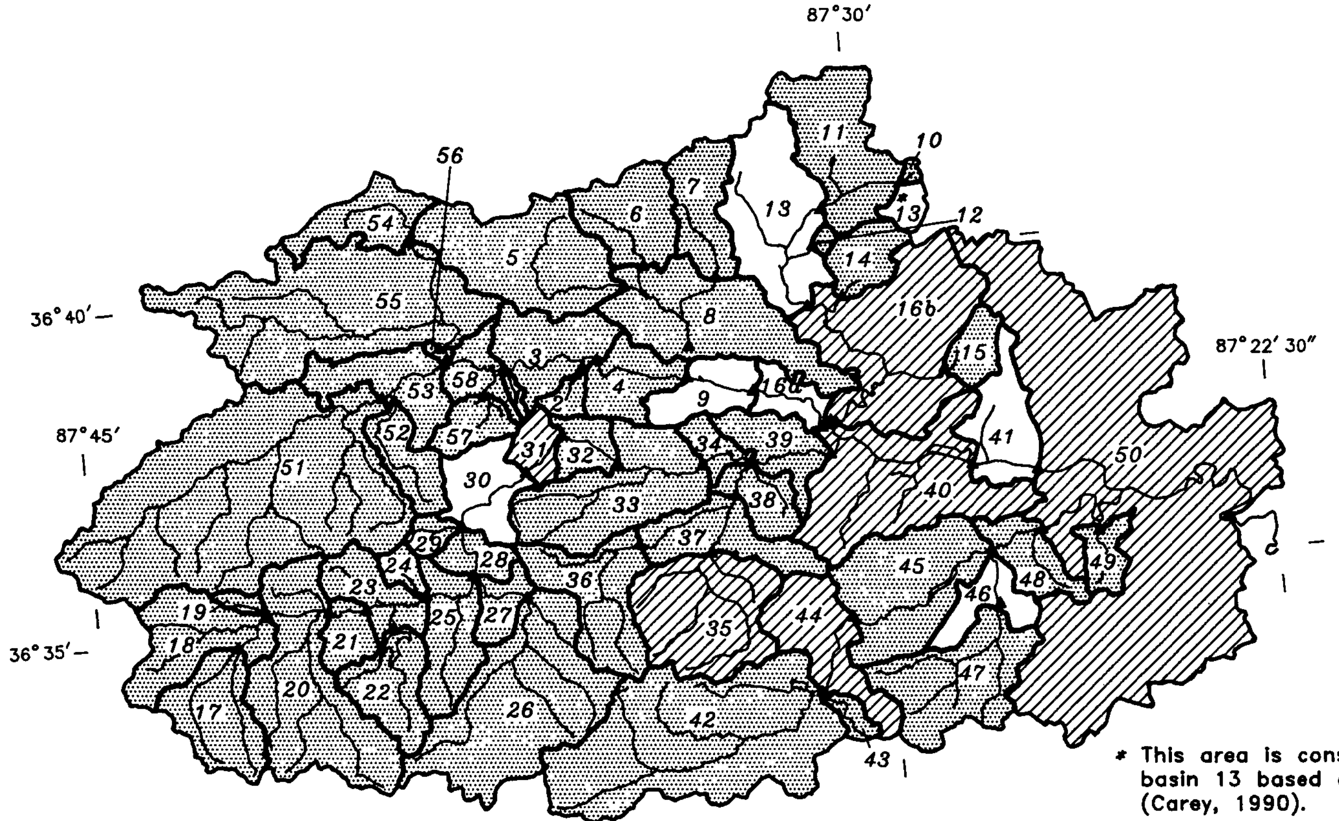
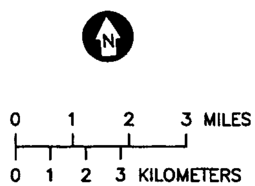


Figure 7. Little West Fork basin showing areas of surplus or deficient flow during high base flow, March 17 and 18, 1994.



* This area is considered part of sub-basin 13 based on dye-trace data (Carey, 1990).

Base from U.S. Geological Survey digital line graph, 1:24,000 and 1:100,000



EXPLANATION

LITTLE WEST FORK DRAINAGE BASIN BOUNDARY

26 STREAM MEASUREMENT SITE AND SUB-BASIN WITH DEFICIENT FLOW, AND SITE AND SUB-BASIN NUMBER

46 STREAM MEASUREMENT SITE AND SUB-BASIN WITH SURPLUS FLOW, AND SITE AND SUB-BASIN NUMBER

44 STREAM MEASUREMENT SITE AND SUB-BASIN WITH NEITHER SURPLUS NOR DEFICIENT FLOW, AND SITE AND SUB-BASIN NUMBER

Figure 8. Little West Fork basin showing areas of surplus or deficient flow during low base flow, October 18 and 19, 1994.

tributary basin areas in the northern part of the study area had neither surplus nor deficient flow for all base-flow periods, with the exception of the Dry Fork Creek basin, which had surplus flow of 0.21 $ft^3/s/mi^2$ for September 1993 (table 11).

SUMMARY

The Little West Fork drainage basin is located in south-central Kentucky and north-central Tennessee. Most of the basin lies within the Fort Campbell Military Reservation. Base-flow data including discharge, temperature, and specific conductance were collected from 65 sites within the basin. Low base-flow data were collected from 64 sites on September 1 and 13, 1993, and from 64 sites on October 18 and 19, 1994. On September 1 and 13, 1993, discharge at sites with flow ranged from 0.02 to 18.4 ft^3/s at the most downstream site in the basin. On October 18 and 19, 1994, discharge at sites with flow ranged from 0.03 to 27.6 ft^3/s at the most downstream site in the basin. High base-flow data were collected from 63 sites on March 17 and 18, 1994. Discharge at sites with flow ranged from 0.01 to 419 ft^3/s at the most downstream site in the basin. Discharge from the basin was greater during high base-flow conditions than during low base-flow conditions. Major tributaries on the south side of the study area (Piney Fork and Fletchers Fork) consistently had lower flow than the tributaries on the north side (Dry Fork Creek and Noah Spring Branch).

Discharge data were used to categorize stream reaches and sub-basins. Stream reaches were characterized as gaining or losing, wet, dry, or unobserved for each base-flow measurement period. More gaining stream reaches occurred during the high base-flow period than either low base-flow period. More dry stream reaches occurred during the two low base-flow periods than during the high base-flow period.

Sub-basin areas with surplus or deficient flow were defined within the basin. Drainage areas for each stream measurement site were delineated and measured from topographic maps. Change in flow per square mile for each sub-basin was calculated using data from each base-flow measurement period. The calculated values were used to define the areas of surplus or deficient flow for low and high base-flow conditions. Many areas of deficient flow occurred near the headwaters of the Little West Fork basin under all base-flow conditions. Fewer areas of deficient flow occurred near the mouth of the basin.

The flow per square mile for each major tributary basin in the study area was also calculated. The values of flow per square mile for the Noah Spring Branch and Dry Fork Creek basins in the northern part of the study area were greater than those for the Piney Fork and Fletchers Fork basins in the southern part of the study area under all base-flow conditions. The tributary basin areas in the southern part of the study area had deficient flow (0 $ft^3/s/mi^2$) for both low base-flow periods and neither surplus nor deficient flow for the high base-flow period. All tributary basin areas in the northern part of the study area had neither surplus nor deficient flow for all base-flow periods, with the exception of the Dry Fork Creek basin, which had surplus flow for September 1993.

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