SURFACE-WATER QUALITY OF COAL-MINE LANDS IN RACCOON CREEK BASIN, OHIO

By Karen S. Wilson

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 85-4060

Prepared in cooperation with the
OHIO DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF RECLAMATION

Columbus, Ohio

1985

UNITED STATES DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
Water Resources Division
U.S. Geological Survey
975 West Third Avenue
Columbus, Ohio 43212

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CONVERSION FACTORS

For the convenience of readers who prefer to use metric (International System) units, conversion factors for terms used in this report are listed below:

Multiply inch-pound units	By	To obtain metric units
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)
pound per day per square mile [$(lb/d)/mi^2$]	0.1751	kilogram per day per square kilometer [$(kg/d)/km^2$]

STANDARD ABBREVIATIONS USED IN STATION NAMES

AB	Above	F	Fork	NR	Near
B	Branch	G	Great	R	River
BK	Brook	L	Little	RN	Run
BL	Below	LK	Lake	S	South
C	Creek	M	Middle	TR	Tributary
E	East	N	North	W	West

OTHER SYMBOLS AND ABBREVIATIONS USED IN TABLES

ft^3/s	cubic feet per second
$(lb/d)/mi^2$	pounds per day per square mile
mg/L	milligrams per liter
mi^2	square miles
µg/L	micrograms per liter

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ABSTRACT

The Ohio Department of Natural Resources, Division of Reclamation, plans to reclaim abandoned surface mines in the Raccoon Creek watershed in southeastern Ohio. Historic water-quality data collected between 1975 and 1983 were compiled and analyzed in terms of eight selected mine-drainage characteristics to develop a data base for individual subbasin reclamation projects. Areas of mine drainage affecting Raccoon Creek were the East Branch Raccoon Creek basin, the Brushy Creek basin, the Sandy Run basin, the Hewett Fork basin, and the Little Raccoon Creek basin.

Surface-water-quality samples were collected from a 41-site network from November 1 through November 3, 1983. Results of the sampling reaffirmed that the major sources of mine drainage to Raccoon Creek are in the Little Raccoon Creek basin, the East Branch Raccoon Creek basin, the Brushy Creek basin, and the Hewett Fork basin. However, water quality at the mouth of Sandy Run indicated that it is not a source of mine drainage to Raccoon Creek.

Buffer Run, Goose Run, an unnamed tributary to Little Raccoon Creek, Mulga Run, and Sugar Run were the main sources of mine drainage sampled in the Little Raccoon Creek basin. All sites sampled in the East Branch Raccoon Creek basin were affected by mine drainage.

This information was used to prepare a work plan for additional data collection before, during, and after reclamation. The data will be used to define the effectiveness of reclamation efforts in the basin.

INTRODUCTION

The Raccoon Creek basin in southeastern Ohio has been classified by the Ohio Department of Natural Resources (ODNR) as a high-priority area for reclamation of abandoned surface mines (Ohio, 1974). Coal mining in the basin began in the 1850's, and continues on a small scale today. The long history of coal mining in the basin has resulted in a serious and widespread problem of water-quality degradation due to mine drainage. Stream water in the Raccoon Creek basin affected by abandoned mines generally has low pH, elevated specific conductance, and elevated concentrations of sulfates, metals, and sediment. Few aquatic organisms are supported. The water is generally too corrosive and (or) hard for industrial use, and too hard and (or) toxic for agricultural or municipal use.

Purpose and Scope

The purpose of this study was to develop a data base for individual subbasin reclamation projects within the Raccoon Creek basin. Historic water-quality data for the period January 1975 to January 1983 were compiled and analyzed, and a 41-site sampling network was designed for further data collection. Samples were collected from November 1 through November 3, 1983, during a hydrologically stable period. Results of the analyses of these samples were used to evaluate the extent of water-quality degradation in the Raccoon Creek basin.

A work plan was prepared for the collection and analysis of additional data before, during, and after reclamation. As these data become available, the effectiveness of the reclamation efforts can be assessed.

Basin Description

The Raccoon Creek basin drains approximately 684 square miles of southeastern Ohio. Although the basin is 78 miles long, the stream is 110 miles long. Raccoon Creek originates in Hocking County and flows through Vinton and Meigs Counties to the Ohio River in Gallia County (fig. 1). Among the many tributaries are Little Raccoon Creek (drainage area, 155 square miles), Elk Fork (drainage area, 59.8 square miles), Hewett Fork (drainage area, 40.5 square miles) and Brushy Creek (drainage area, 34 square miles). There are four lakes within the basin: Lake Hope, Lake Alma, Lake Rupert, and Tycoon Lake.

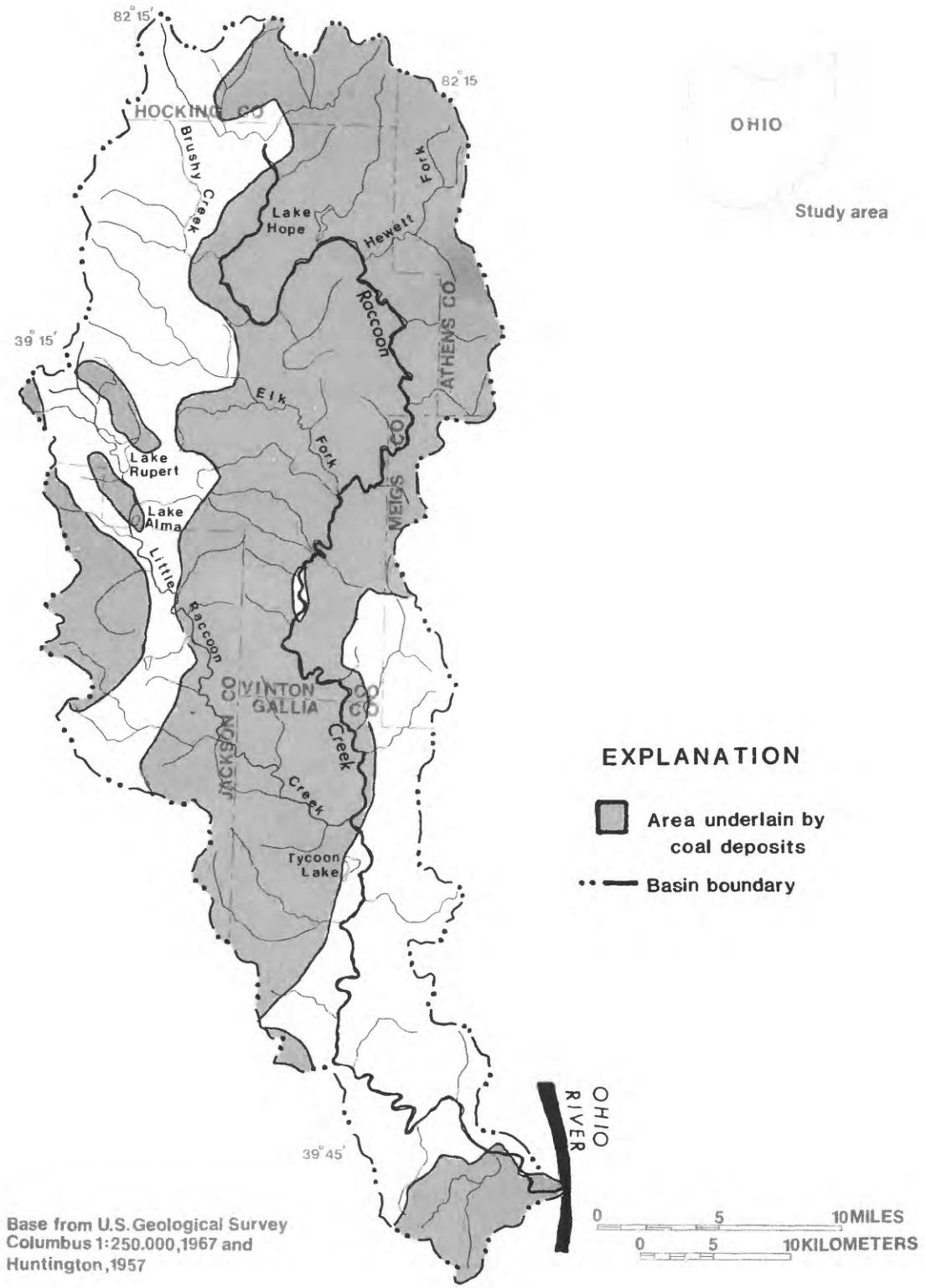

Figure 1.--Location of the Raccoon Creek basin and area underlain by coal deposits (United States Department of the Interior, 1967).

The basin is in the unglaciated part of the Appalachian Plateaus physiographic province (Fenneman, 1938). In general, the terrain is hilly. Bedrock consists of sandstone, shale, coal, and limestone of Pennsylvanian age. The predominant formations cropping out in the basin are the Conemaugh, the Pottsville, and the Allegheny. More than half of the basin is underlain by coal deposits (fig. 1).

HISTORIC WATER-QUALITY DATA

Compilation of Data

Concern about the effects of mine drainage on the water-quality of the Raccoon Creek basin has resulted in several studies during the past 30 years. Data from these studies were used to provide background for the development of a sampling network for further data collection.

Water-quality data were obtained from general studies of the hydrologic effects of coal mining on the streams of Ohio (Roth, D. K., and others, U.S. Geological Survey, written commun., 1983). A study of the relationship of inorganic and organic constituents to coal mining (Pfaff and others, 1981) also provided water-quality data, as did a study ranking streams according to the severity of water-quality conditions caused by drainage from abandoned surface mines (Childress, C. J. O., U.S. Geological Survey, written commun., 1983). A study on the efforts to seal abandoned drift mines near Lake Hope provided extensive water-quality data from the Sandy Run basin (Nichols, 1983). Water-quality data also have been collected routinely since 1967 at a U.S. Geological Survey gaging station, number 03202000, within the basin (Raccoon Creek at Adamsville; fig. 2, site H57).

Criteria were established for selecting historic water-quality data from earlier studies. To best reflect current water-quality conditions in Raccoon Creek basin, the historic data set was limited to data collected after 1974. In order to be included in the data base, the water-quality information had to be collected (1) concurrently with a measurement of discharge, (2) during low-flow conditions, and (3) after 1974. In addition, the data had to be accompanied by proper site identification, and had to include at least one of eight selected properties or constituents:

acidity	dissolved sulfate
alkalinity	dissolved iron
pH	dissolved manganese
specific conductance	dissolved aluminum

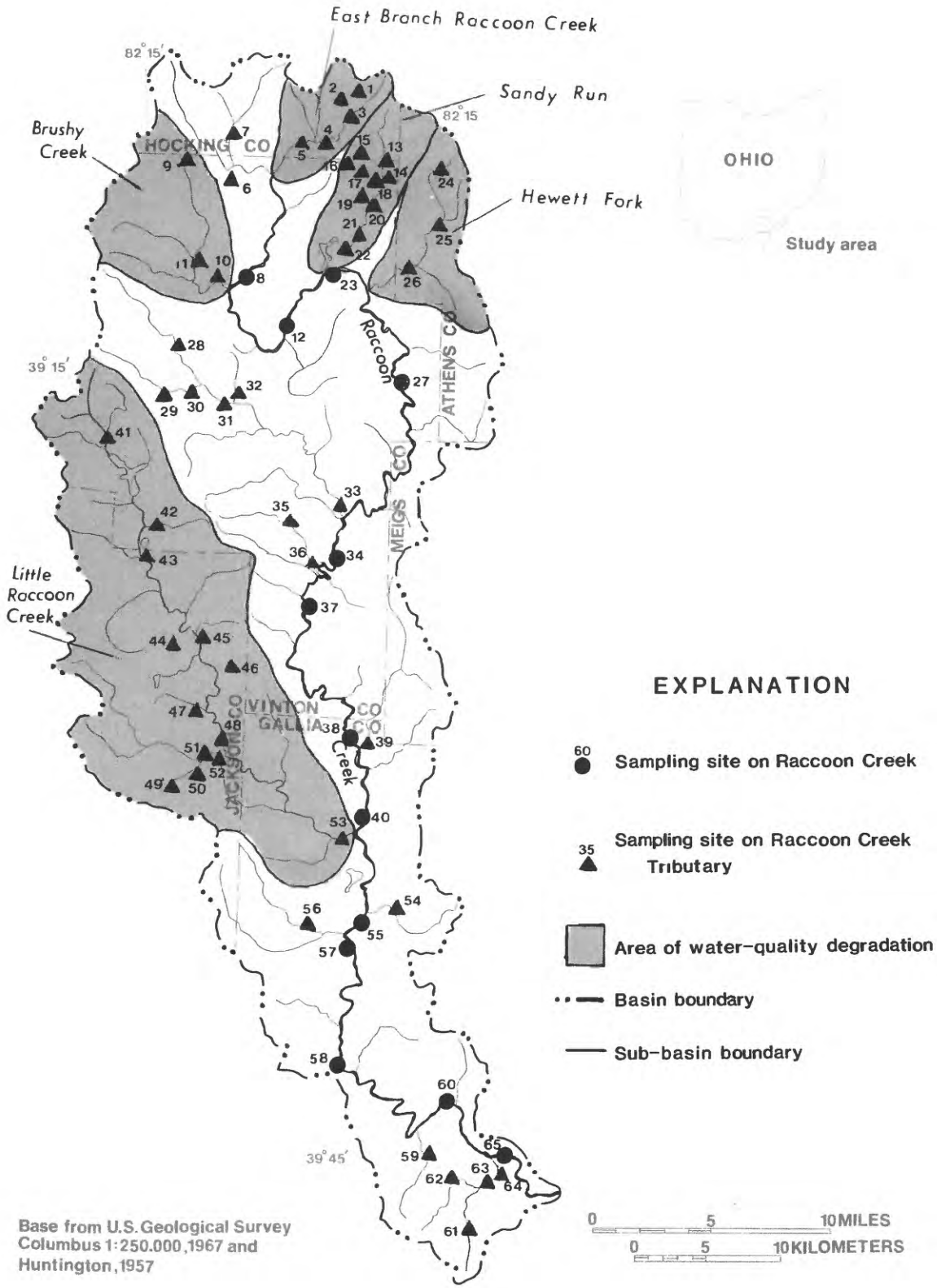

Figure 2.--Location of historic water-quality sites and areas of water-quality degradation. (Prefix H has been deleted from site numbers)

Analysis of Data

Analyses of 449 water samples collected at 65 different sites were compiled (appendix 1). Median values of pH, specific conductance, acidity, alkalinity, dissolved sulfate, dissolved iron, dissolved manganese, and dissolved aluminum were computed for each of the 65 sites sampled more than once (table 1). Basin-wide medians were computed for each of the eight selected properties and constituents by taking the median of the median values computed for each site. These basin-wide medians are:

acidity	32 milligrams per liter (mg/L) as $CaCO_3$
alkalinity	10 mg/L as $CaCO_3$
pH	6.0 units
specific conductance	494 microsiemens per centimeter (µS/cm)[1]
dissolved sulfate	182 mg/L as SO_4
dissolved iron	348 micrograms per liter (µg/L) as Fe
dissolved manganese	2,682 µg/L as Mn
dissolved aluminum	740 µg/L as Al

The basin-wide median values were compared to the median values computed for each of the 65 sites. Those sites with medians lower in pH and alkalinity and higher in specific conductance, acidity, and the dissolved constituents than the basin-wide medians were identified as points of degraded water-quality. On the basis of the historical data, five major subbasins were identified as areas of water-quality degradation (fig. 2): East Branch Raccoon Creek, Brushy Creek, Sandy Run, Hewett Fork, and Little Raccoon Creek.

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[1] At 25 degrees Celsius

Table 1.--Median values of historic water-quality data collected at sites in Raccoon Creek basin

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°Celsius]

Site number	Site name	U.S. Geological Survey identification number	Number of samples	pH (units)	Specific conductance (µS/cm)	Alkalinity (mg/l as $CaCO_3$)	Acidity (mg/l as $CaCO_3$)	Iron, dissolved (µg/l as Fe)	Aluminum, dissolved (µg/l as Al)	Manganese, dissolved (µg/l as Mn)	Sulfate, dissolved (mg/l as SO_4)
H1	Yost Rn nr Nelsonville OH	03201535	14	3.3	2,320	0	402	8,050	30,000	45,500	1,500
H2	Unnam Tr to EB Raccoon C nr Starr OH	392504082195100	2	3.4	1,560	0	300	1,700	23,500	21,000	910
H3	E B Raccoon C nr Starr OH	392427082200300	3	3.6	1,300	0	214	2,150	17,600	14,600	710
H4	E B Raccoon C at Starr OH	392349082214000	2	3.6	1,560	0	190	1,500	20,700	20,000	845
H5	E B Raccoon C nr New Plymouth OH	392348082220200	5	3.6	944	0	139	3,000	--	10,000	480
H6	Red Rn nr Orland OH	392257082253800	2	3.0	1,020	1	293	--	--	--	330
H7	Honey F nr New Plymouth OH	392350082255200	2	7.4	218	30	--	90	--	70	50
H8	RACCOON C NR ZALESKI OH	391913082250500	3	4.1	760	0	70	240	6,000	7,600	310
H9	Brushy F nr Mt Pleasant OH	392240082275000	5	5.6	258	4	5	100	205	2,060	92
H10	Brushy F nr Creola OH	391915082274600	3	3.6	480	0	79	2,600	--	3,100	180
H11	Brushy C nr Creola OH	391830082262300	3	3.5	1,100	1	65	1,000	4,700	3,650	160
H12	RACCOON C NR ZALESKI OH	391642082232700	3	4.6	720	2	50	5,260	4,160	314	275
H13	Sandy Rn ab Lk Hope OH	392155082183300	2	5.8	463	12	--	--	--	--	143
H14	Sandy Rn ab Big Four H C nr Lk Hope OH	03201600	62	3.4	752	0	129	11,000	--	1,700	310
H15	Big Four Hollow C ab EF nr Lk Hope OH	03201615	3	5.9	255	3	--	3,000	--	2,500	95
H16	E F Big Four Hollow C nr Lk Hope OH	03201630	13	6.6	220	18	--	200	--	130	77
H17	Big Four Hollow C bl EF nr Lk Hope OH	03201660	35	6.9	280	19	10	1,150	--	1,500	105
H18	Big Four Hollow C nr Lk Hope OH	03201700	72	3.8	590	1	89	4,800	--	4,300	250
H19	Hull Hollow C nr Lk Hope OH	03201720	45	6.9	140	16	7	10	--	20	45
H20	Sandy Run bl Hull Hollow nr Lk Hope OH	03201722	35	3.6	570	0	70	3,400	--	2,100	230
H21	Sandy Rn nr Lk Hope OH	03201800	7	4.1	480	1	25	440	--	3,250	200
H22	Sandy Rn ab Lk Hope nr Zaleski OH	391952082202500	2	4.5	447	--	--	--	--	--	--
H23	RACCOON C NR ZALESKI OH	391901082210400	3	4.9	620	3	31	150	2,760	6,000	245
H24	Hewett F nr Kimberly OH	392325082150300	3	4.5	550	0	31	308	1,710	2,600	230
H25	Hewett F nr Mineral OH	392216082160800	3	3.5	960	0	139	10,400	11,300	3,500	410
H26	Hewett F nr Albany OH	391903082164200	2	3.6	675	1	117	1,400	--	2,950	315
H27	RACCOON C NR MINERAL OH	391552082171900	3	5.3	495	3	42	160	1,180	4,100	185
H28	Elk F nr McArthur OH	391637082291400	3	6.4	200	26	10	460	75	514	30
H29	Puncheon F at McArthur OH	391430082284600	3	6.4	328	34	--	380	200	2,040	96
H30	Puncheon F at McArthur OH	391435082281800	3	6.8	320	34	15	150	--	1,500	100
H31	Elk F nr McArthur OH	391403082261600	3	7.2	500	43	0	1,160	159	2,760	172
H32	Unnam Tr to Elk F nr Prattsville OH	391416082255500	3	7.4	990	17	35	143	320	1,080	182
H33	Elk F nr Radcliff OH	390941082212200	2	6.8	365	44	--	348	75	--	120
H34	RACCOON C NR RADCLIFF OH	390748082213100	3	6.0	450	55	10	60	138	1,200	150
H35	Pierce Rn nr Radcliff OH	390940082243000	3	4.6	595	6	27	1,200	1,160	2,900	275
H36	Pierce Rn nr Radcliff OH	390828082224900	4	6.5	395	16	15	825	--	3,050	155
H37	RACCOON C NR WILKESVILLE OH	390622082230400	2	5.5	470	10	201	730	200	2,860	156
H38	RACCOON C AT EWINGTON OH	390052082210900	3	6.5	435	11	20	153	1,300	1,380	125
H39	Strongs Rn nr Ewington OH	390053082201000	2	6.9	172	44	15	205	--	350	28
H40	RACCOON C AT VINTON OH	385826082201800	1	6.8	520	20	30	160	320	2,700	190
H41	L Raccoon C ab Lk Rupert OH	391256082322700	2	7.5	208	--	--	--	--	--	--
H42	Sugar Rn nr Hamden OH	390924082303100	4	3.4	998	0	133	7,000	9,840	9,200	428

Table 1.--Median values of historic water-quality data collected at sites in Raccoon Creek basin--Continued

Site number	Site name	U.S. Geological Survey identification number	Number of samples	pH (units)	Specific conductance (µS/cm)	Alkalinity (mg/l as $CaCO_3$)	Acidity (mg/l as $CaCO_3$)	Iron, dissolved (µg/l as Fe)	Aluminum, dissolved (µg/l as Al)	Manganese, dissolved (µg/l as Mn)	Sulfate, dissolved (mg/l as SO_4)
H43	L Raccoon C nr Wellston OH	390801082302800	2	6.5	331	26	--	114	75	2,590	110
H44	Unnam Tr to L Raccoon C nr Roads OH	390452082292800	3	3.0	1,600	0	427	23,000	16,400	36,000	740
H45	L Raccoon C nr Roads OH	390509082281900	2	6.5	494	42	10	653	3	4,410	188
H46	Buffer Rn nr Roads OH	390341082270700	3	3.0	2,300	0	596	133,000	29,600	12,800	1,340
H47	Tarcamp Rn nr Roads OH	390224082282300	3	6.5	170	16	--	220	138	625	52
H48	L Raccoon C nr Ewington OH	390038082270800	3	3.7	730	.5	50	895	3,230	3,430	315
H49	Dixon Rn nr Winchester OH	385924082295300	3	6.0	780	10	25	529	202	3,620	400
H50	Dixon Rn nr Ewington OH	390012082283000	3	4.3	800	2	64	3,400	3,600	5,400	430
H51	Dickason Rn nr Thurman OH	390024082281200	3	6.2	360	13	15	960	--	3,000	160
H52	Dickason Rn nr Ewington OH	390031082271900	2	6.2	470	13	15	226	75	2,070	182
H53	L Raccoon C nr Vinton OH	385711082215600	3	5.0	620	2	30	180	1,900	3,220	270
H54	Barren C nr Harrisburg OH	385412082191300	3	7.2	332	100	--	205	--	270	42
H55	RACCOON C NR RIO GRANDE OH	385404082204200	3	6.2	450	7	17	208	138	2,280	175
H56	L Indian C nr Rio Grande OH	385334082225800	2	6.9	150	34	5	215	--	215	25
H57	RACCOON C AT ADAMSVILLE OH	03202000	14	6.0	420	6	10	130	--	2,200	140
H58	RACCOON C NR PATRIOT OH	384821082221900	3	6.5	475	13	15	94	206	2,050	169
H59	Claylick Rn nr Northup OH	384452082181400	3	7.6	650	110	--	30	--	40	190
H60	RACCOON C AT NORTHUP OH	384700082170300	1	6.5	400	21	--	--	--	--	140
H61	Bullskin C nr Mercerville OH	384206082161600	3	7.2	970	102	10	332	5,740	10,820	420
H62	L Bullskin C nr Mercerville OH	384347082164400	2	7.5	632	91	--	35	138	45	230
H63	Bullskin C nr Mercerville OH	384333082150500	3	7.3	870	75	--	65	202	592	350
H64	Bullskin C nr Gallipolis OH	384401082145000	2	7.2	875	70	--	30	--	610	375
H65	RACCOON C NR EUREKA OH	384412082144600	3	6.7	420	21	7	128	149	1,210	125

WATER-QUALITY DATA COLLECTED IN NOVEMBER 1983

Sampling Network

Using the historical water-quality data as a guide, a 41-site sampling network in the Raccoon Creek basin was designed to sample data-deficient areas and to identify areas of water-quality degradation (table 2).

Of the 41 sites selected, 10 sites were on the main stem of Raccoon Creek, 2 sites were on the East branch, and 2 sites were on the West branch. The remaining 27 sites were located on tributaries; 10 of these sites were within the basin of Little Raccoon Creek, the largest tributary to Raccoon Creek (fig. 3).

Methods of Study

Sampling was confined to a 3-day period so that base-flow conditions throughout the basin would be relatively constant.

Water samples were collected and discharge measurements made at each site. pH, specific conductance, water temperature, alkalinity, and acidity were measured at each site. Water samples were analyzed for dissolved aluminum, iron, manganese, and sulfate.

Suspended-sediment and benthic macroinvertebrate[1] samples were collected at each site. Macroinvertebrates were collected using the square-foot method (Needham and Needham, 1962) and the surber sampler. Samples were preserved in alcohol for laboratory identification.

Results of Analysis

Results of analyses of samples collected from November 1 through November 3, 1983, are given in table 3. These data were used to identify sources of water-quality degradation by comparing one site with another. To compensate for different-sized drainage areas, the following formula was used to compute instantaneous yields, in pounds per day per square mile [(lb/d)/mi^2] for acidity, alkalinity, dissolved sulfate, dissolved iron, dissolved aluminum, and dissolved manganese:

$$(\text{lb/d})/\text{mi}^2 = \frac{(\text{concentration in mg/L}) \times (\text{discharge in ft}^3/\text{s}) \times (5.4)}{(\text{drainage area in mi}^2)}$$

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[1] Benthic macroinvertebrates, which inhabit the substratum of streams, are organisms which are visible to the unaided eye and are retained on a sieve with a 0.595 mm opening.

Table 2.--Sites sampled on November 1-3, 1983

Site number	Site name	U.S. Geological Survey identification number	Drainage area (mi^2)	Latitude	Longitude
1	E B Raccoon C nr Starr OH----------	392500082192800	2.99	0392500	0821928
2	Unnam Tr to E B Raccoon C nr Starr OH	392504082195100	2.30	0392504	0821951
3	Unnam Tr to E B Raccoon C nr Starr OH	392420082193600	1.72	0392420	0821936
4	E B Raccoon C nr New Plymouth OH-----	392348082220200	14.46	0392348	0822202
5	W B Raccoon C nr Mt Pleasant OH------	392326082261900	7.43	0392326	0822619
6	Honey Fork nr New Plymouth OH--------	392318082251100	10.2	0392318	0822511
7	W B Raccoon C nr New Plymouth OH-----	392249082234500	22.7	0392249	0822345
8	Raccoon C nr New Plymouth OH---------	392208082232800	43.1	0392208	0822328
9	Two Mile Rn nr New Plymouth OH-------	392126082225000	5.12	0392126	0822250
10	Raccoon C nr Zaleski OH--------------	391913082250500	56.3	0391913	0822505
11	Brushy C nr Creola OH----------------	391915082274600	25.44	0391915	0822746
12	Brushy C nr Creola OH----------------	391830082262300	33.7	0391830	0822623
13	Wheelabout C nr Zaleski OH-----------	391535082224300	11.13	0391535	0822243
14	Sandy Rn bl Lk Hope OH---------------	391905082211900	9.94	0391905	0822119
15	Raccoon C nr Zaleski OH--------------	391901082210400	122	0391901	0822104
16	Hewett F nr Kimberly OH--------------	392325082150300	7.80	0392325	0821503
17	Carbondale C at Carbondale OH--------	392240082161100	1.97	0392240	0821611
18	Hewett F nr Albany OH----------------	391903082164200	27.79	0391903	0821642
19	Raccoon C nr Bolins Mills OH---------	391322082175300	205	0391322	0821753
20	Raccoon C nr Radcliff OH-------------	391017082200900	230	0391017	0822009
21	Elk F nr McArthur OH-----------------	391403082261600	26.4	0391403	0822616
22	Elk F nr Radcliff OH-----------------	390941082212200	59.5	0390941	0822122
23	Pierce Rn nr Oreton OH---------------	390730082253000	3.26	0390730	0822530
24	Raccoon C nr Wilkesville OH----------	390635082230400	303	0390635	0822304
25	Raccoon C nr Alice OH----------------	390002082223400	336	0390002	0822234
26	Raccoon C at Vinton OH---------------	385826082201800	382	0385826	0822018
27	L Raccoon C nr Hamden OH-------------	391020082310700	24.15	0391020	0823107
28	Sugar Rn nr Hamden OH----------------	390924082303100	5.00	0390924	0823031
29	Mulga Rn nr Wainwright OH------------	390557082285500	7.90	0390557	0822855
30	Unnam Tr to L Raccoon C nr Roads OH--	390431082291000	2.28	0390431	0822910
31	L Raccoon C nr Roads OH--------------	390509082281900	67.5	0390509	0822819
32	Buffer Rn nr Roads OH----------------	390341082270700	1.80	0390341	0822707
33	Goose Rn nr Ridgeland OH-------------	390142082282700	1.31	0390142	0822827
34	L Raccoon C nr Ewington OH-----------	390038082270800	99.7	0390038	0822708
35	Dickason Rn nr Ewington OH-----------	390031082271900	26.9	0390031	0822719
36	L Raccoon C nr Vinton OH-------------	385711082215600	154	0385711	0822156
37	Indian C nr Rio Grande OH------------	385320082225300	10.27	0385320	0822253
38	Raccoon C at Adamsville OH-----------	03202000	585	0385225	0822122
39	Raccoon C at Northup OH--------------	384700082170300	648	0384700	0821703
40	Bullskin C nr Mercerville OH---------	384206082161600	4.50	0384206	0821616
41	L Bullskin C nr Mercerville OH-------	384347082164400	3.30	0384347	0821644

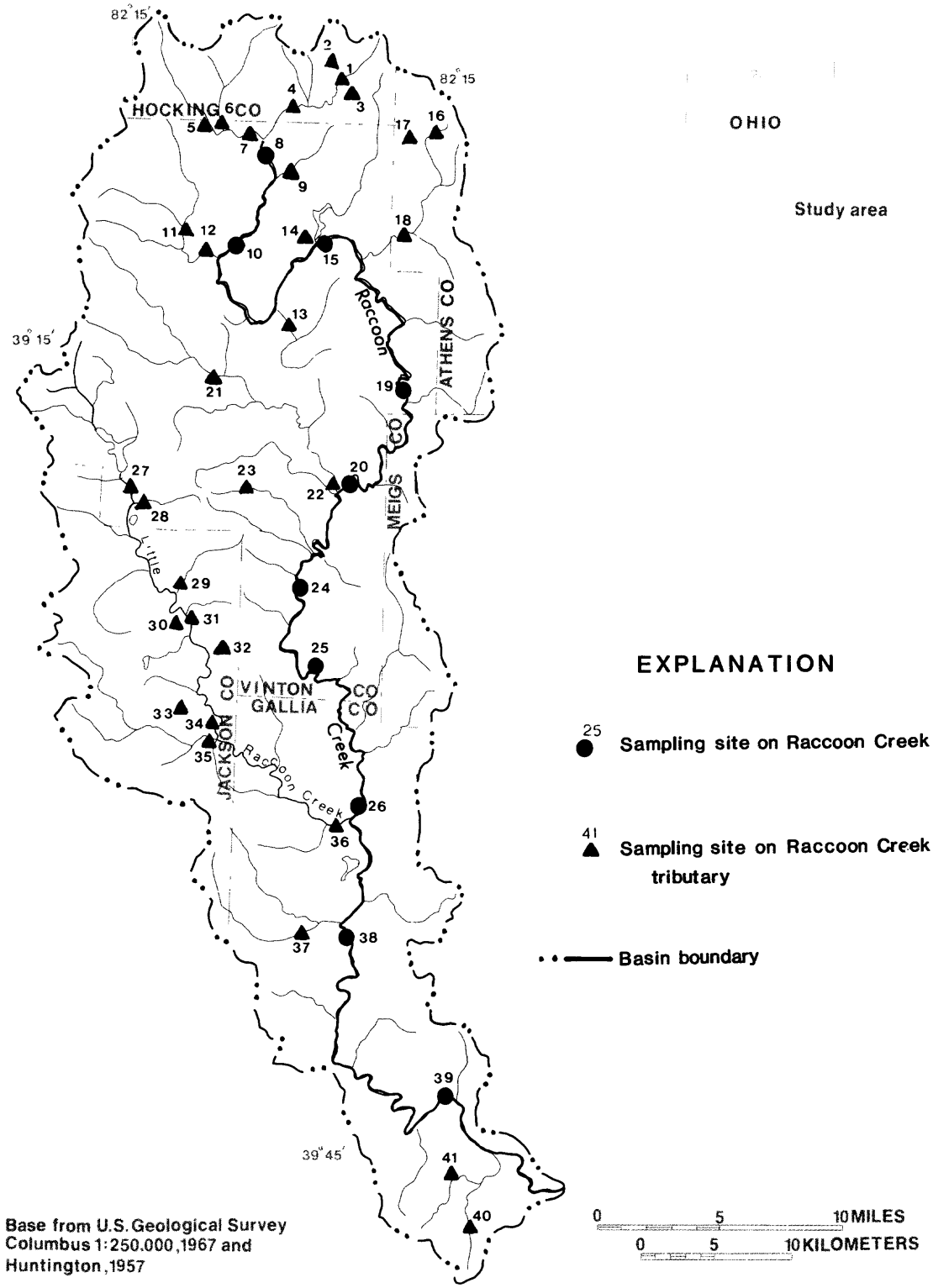


Figure 3.—Location of water-quality sites (November 1-3, 1983).

Table 3.--Water-quality data from the Raccoon Creek basin (November 1 - 3, 1983)

Date	Stream flow, instantaneous (ft^3/s)	Specific conductance ($\mu S/cm$)	pH	Alkalinity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Aluminum dissolved ($\mu g/L$ as Al)	Iron, dissolved ($\mu g/L$) as Fe)	Manganese, dissolved ($\mu g/L$ as Mn)	Sediment, suspended (mg/L)
SITE 1 E B RACCOON C NR STARR OH LAT 392500 LONG 0821928 DA 2.99										
11/02/83	0.57	1480	3.6	-	194	970	570	1700	21000	7
SITE 2 UNAM TR TO E B RACCOON C NR STARR OH LAT 392504 LONG 0821951 DA 2.30										
11/02/83	0.30	1650	3.5	-	313	1200	480	610	28000	4
SITE 3 UNAM TR TO E B RACCOON C NR STARR OH LAT 392420 LONG 0821936 DA 1.72										
11/02/83	0.29	1850	2.9	-	407	1200	33000	30000	8000	7
SITE 4 E B RACCOON C NR NEW PLYMOUTH OH LAT 392348 LONG 0822202 DA 14.46										
11/02/83	2.10	1350	3.6	-	218	890	26000	2300	17000	0
SITE 5 W B RACCOON C NR MT PLEASANT OH LAT 392326 LONG 0822619 DA 7.43										
11/01/83	0.53	700	4.5	-	40	280	5600	380	5900	4
SITE 6 HONEY F NR NEW PLYMOUTH OH LAT 392318 LONG 0822511 DA 10.20										
11/01/83	0.66	455	7.0	30	5	140	7000	120	310	6
SITE 7 W B RACCOON C NR NEW PLYMOUTH OH LAT 392249 LONG 0822345 DA 22.70										
11/01/83	1.90	725	6.1	29	20	260	2300	1300	6100	10
SITE 8 RACCOON C NR NEW PLYMOUTH OH LAT 392208 LONG 0822328 DA 43.10										
11/01/83	4.60	965	4.1	-	79	510	20000	1100	11000	0
SITE 9 TWO MILE RN NR NEW PLYMOUTH OH LAT 392126 LONG 0822250 DA 5.12										
11/02/83	0.53	545	4.8	2	15	260	170	440	3800	3
SITE 10 RACCOON C NR ZALESKI OH LAT 391913 LONG 0822505 DA 56.30										
11/02/83	6.60	845	4.2	-	60	390	26000	620	8500	8

Table 3.--Water-quality data from the Raccoon Creek basin (November 1 - 3, 1983)--Continued

Date	Stream flow, instantaneous (ft^3/s)	Specific conductance ($\mu S/cm$)	pH	Alkalinity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Aluminum dissolved ($\mu g/L$ as Al)	Iron, dissolved ($\mu g/L$) as Fe)	Manganese, dissolved ($\mu g/L$ as Mn)	Sediment, suspended (mg/L)
SITE 11 BRUSHY F NR CREOLA OH						LAT 391915 LONG 0822746			DA 25.44	
11/02/83	3.00	912	3.2	-	209	310	10000	14000	5900	42
SITE 12 BRUSHY C NR CREOLA OH						LAT 391830 LONG 0822623			DA 33.70	
11/02/83	3.50	825	3.4	-	129	420	18000	33000	7500	2
SITE 13 WHEELABOUT C NR ZALESKI OH						LAT 391535 LONG 0822243			DA 11.13	
11/02/83	0.98	300	7.0	22	5	110	14000	420	1500	7
SITE 14 SANDY RN BL LK HOPE NR ZALESKI OH						LAT 391905 LONG 0822119			DA 9.94	
11/01/83	0.66	150	7.0	12	5	59	20	270	670	6
SITE 15 RACCOON C NR ZALESKI OH						LAT 391901 LONG 0822104			DA 122.00	
11/01/83	16.00	640	4.8	1	40	280	380	320	6100	7
SITE 16 HEWETT F NR KIMBERLY OH						LAT 392325 LONG 0821503			DA 7.80	
11/02/83	1.20	675	3.8	-	40	330	3200	1200	3200	0
SITE 17 CARBONDALE C AT CARBONDALE OH						LAT 392240 LONG 0821611			DA 1.97	
11/02/83	0.30	1150	3.0	-	367	650	25000	40000	2900	2
SITE 18 HEWETT F NR ALBANY OH						LAT 391903 LONG 0821642			DA 27.79	
11/01/83	3.90	780	3.6	-	74	360	6200	2300	4100	1
SITE 19 RACCOON C NR BOLINS MILLS OH						LAT 391322 LONG 0821753			DA 204.59	
11/01/83	38.00	740	5.0	1	40	220	1400	400	4000	2
SITE 20 RACCOON C NR RADCLIFF OH						LAT 391017 LONG 0822009			DA 230.29	
11/02/83	35.00	630	6.4	24	45	200	600	140	3800	5

Table 3.--Water-quality data from the Raccoon Creek basin (November 1 - 3, 1983)--Continued

Date	Stream flow, instantaneous (ft^3/s)	Specific conductance ($\mu S/cm$)	pH	Alkalinity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Aluminum dissolved ($\mu g/L$ as Al)	Iron, dissolved ($\mu g/L$) as Fe)	Manganese, dissolved ($\mu g/L$ as Mn)	Sediment, suspended (mg/L)
SITE 21 ELK F NR MCARTHUR OH						LAT 391403 LONG 0822616			DA 26.40	
11/02/83	3.60	615	7.1	54	5	240	9000	370	2400	18
SITE 22 ELK F NR RADCLIFF OH						LAT 390941 LONG 0822122			DA 59.50	
11/03/83	9.10	565	6.7	44	35	190	250	140	2600	13
SITE 23 PIERCE RN NR ORETON OH						LAT 390730 LONG 0822530			DA 3.26	
11/02/83	0.53	750	5.0	4	40	440	1900	2800	6600	11
SITE 24 RACCOON C NR WILKESVILLE OH						LAT 390635 LONG 0822304			DA 303.00	
11/03/83	61.00	590	6.3	12	60	200	400	630	3500	9
SITE 25 RACCOON C NR ALICE OH						LAT 390002 LONG 0822234			DA 335.50	
11/03/83	66.00	590	5.0	3	55	210	400	370	3200	2
SITE 26 RACCOON C AT VINTON OH						LAT 385826 LONG 0822018			DA 381.50	
11/02/83	64.00	520	6.8	20	30	190	320	160	2700	7
SITE 27 L RACCOON C NR HAMDEN OH						LAT 391020 LONG 0823107			DA 24.15	
11/02/83	1.50	160	7.5	40	5	46	130	140	240	0
SITE 28 SUGAR RN AT HAMDEN OH						LAT 390924 LONG 0823031			DA 5.00	
11/02/83	0.74	1570	3.2	-	159	780	10000	6800	16000	11
SITE 29 MULGA RN NR WAINWRIGHT OH						LAT 390557 LONG 0822855			DA 7.90	
11/02/83	1.50	1120	3.2	-	243	910	18000	14000	11000	17
SITE 30 UNAM TR TO L RACCOON C NR ROADS OH						LAT 390431 LONG 0822910			DA 2.28	
11/02/83	0.43	1660	2.9	-	477	890	44000	22000	22000	0

Table 3.--Water-quality data from the Raccoon Creek basin (November 1 - 3, 1983)--Continued

Date	Stream flow, instantaneous (ft^3/s)	Specific conductance (µS/cm)	pH	Alkalinity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Aluminum dissolved (µg/L as Al)	Iron, dissolved (µg/L) as Fe)	Manganese, dissolved (µg/L as Mn)	Sediment, suspended (mg/L)
SITE 31 L RACCOON C NR ROADS OH						LAT 390509 LONG 0822819		DA 67.50		
11/02/83	12.00	705	5.9	14	30	320	50	610	5500	16
SITE 32 BUFFER RN NR ROADS OH						LAT 390341 LONG 0822707		DA 1.80		
11/02/83	0.35	2660	2.7	-	993	1900	60000	140000	17000	1
SITE 33 GOOSE RN NR RIDGELAND OH						LAT 390142 LONG 0822827		DA 1.31		
11/01/83	0.28	1840	2.8	-	745	1100	66000	94000	5400	7
SITE 34 L RACCOON C NR EWINGTON OH						LAT 390038 LONG 0822708		DA 99.70		
11/01/83	18.00	975	3.4	-	179	430	8400	6700	6200	19
SITE 35 DICKASON RN NR EWINGTON OH						LAT 390031 LONG 0822719		DA 26.90		
11/01/83	3.10	595	5.1	4	60	300	2000	960	5500	2
SITE 36 L RACCOON C NR VINTON OH						LAT 385711 LONG 0822156		DA 154.00		
11/02/83	28.00	870	3.5	-	124	350	40	2900	4700	3
SITE 37 INDIAN C NR RIO GRANDE OH						LAT 385320 LONG 0822253		DA 10.27		
11/01/83	1.20	320	6.4	64	15	63	700	210	250	12
SITE 38 RACCOON C AT ADAMSVILLE OH						LAT 385225 LONG 0822122		DA 585.00		
11/01/83	113.00	580	6.0	3	50	200	1300	430	3100	9
SITE 39 RACCOON C AT NORTHUP OH						LAT 384700 LONG 0821703		DA 648.50		
11/02/83	114.00	510	6.6	16	30	180	280	180	3000	10
SITE 40 BULLSKIN C NR MERCERVILLE OH						LAT 384206 LONG 0821616		DA 4.50		
11/02/83	0.86	1010	6.5	72	10	490	250	20	1700	11
SITE 41 L BULLSKIN C NR MERCERVILLE OH						LAT 384347 LONG 0821644		DA 3.30		
11/02/83	0.31	820	6.4	72	25	350	200	30	470	14

The constant 5.4 is a factor for converting concentrations and discharge to daily loads.

pH

The pH of water (table 4, fig. 4) ranged from 2.7 at Buffer Run (site 32) to 7.5 at Little Raccoon Creek near Hamden (site 27). Stream sites having a pH of 3.2 or less in the Little Raccoon Creek basin were Buffer Run (site 32), Goose Run (site 33), unnamed tributary to Little Raccoon Creek near Roads (site 30), Mulga Run (site 29), Sugar Run (site 28), Little Raccoon Creek near Ewington (site 34), and Little Raccoon Creek near Vinton (site 36). Carbondale Creek (site 17), unnamed tributaries to East Branch Raccoon Creek near Starr (sites 3 and 2), and Brushy Creek (sites 11 and 12) had a pH of 3.5 or less.

The pH of Little Raccoon Creek near Hamden (site 27) was 7.5. Elk Fork near McArthur (site 21) had a pH of 7.1; Sandy Run (site 14), Wheelabout Creek (site 13), and Honey Fork (site 6) had pH values of 7.0.

Specific Conductance

Specific conductance of water (table 5, fig. 5) ranged from 150 µS/cm at Sandy Run (site 14) to 2,660 µS/cm at Buffer Run (site 32). Stream sites having specific conductances greater than 1,000 µS/cm were in the Little Raccoon Creek and the East Branch Raccoon Creek basins. In the Little Raccoon Creek basin, these sites included Buffer Run (site 32), Goose Run (site 33), unnamed tributary to Little Raccoon Creek near Roads (site 30), Sugar Run (site 28), and Mulga Run (site 29). In the East Branch Raccoon Creek basin, all sites (1 through 4) had specific conductance values greater than 1,000 µS/cm. Other sites where specific conductances exceeded 1,000 µS/cm were Carbondale Creek (site 17) and Bullskin Creek (site 40).

Sites where specific conductance was less than 500 µS/cm were Sandy Run (site 14) and Little Raccoon Creek near Hamden (site 27). Wheelabout Creek (site 13), Indian Creek (site 37), and Honey Fork (site 6) also had a specific conductance that was less than 500 µS/cm.

Acidity and Alkalinity

The yield of acidity (table 6, fig. 6) ranged from 1.67 (lb/d)/mi^2 at Little Raccoon Creek near Hamden (site 27) to 1,042 (lb/d)/mi^2 at Buffer Run (site 32). There were yields of more than 100 (lb/d)/mi^2 at sites in the Little Raccoon Creek and the East Branch Raccoon Creek basins. In the Little Raccoon Creek basin, these sites include Buffer Run (site 32), Goose Run (site 33), unnamed tributary to Little Raccoon Creek near Roads (site 30), Mulga Run (site 29), Sugar Run (site 28), Little Raccoon Creek near Vinton (site 36), and Little Raccoon Creek near Ewington (site 34). In the East Branch Raccoon Creek basin, the yields at all sites (1 through 4) were greater than 170 (lb/d)/mi^2. Other sites where yields of acidity were greater than 100 (lb/d)/mi^2 were Carbondale Creek (site 17) and Brushy Fork near Creola (site 11). Sites at which yields were less than 2 (lb/d)/mi^2 were Little Raccoon Creek near Hamden (site 27), Sandy Run (site 14), and Honey Fork (site 6).

Alkalinity was measured when the pH of water at a site was greater than 4.5, which resulted in alkalinity determinations at only 22 of the 41 sites. The yield of alkalinity (table 7, fig. 7) ranged from 0.708 (lb/d)/mi^2 at Raccoon Creek near Zaleski (site 15) to 74.3 (lb/d)/mi^2 at Bullskin Creek (site 40). Alkalinity was measured at 8 of 10 sites on the Raccoon Creek main stem. The two main-stem sites (sites 8 and 10) located below the confluence of the East and West branches had pH values less than 4.5.

Dissolved Sulfate

The yield of dissolved sulfate (table 8, fig. 8) ranged from 15.4 (lb/d)/mi^2 at Little Raccoon Creek near Hamden (site 27) to 1,994 (lb/d)/mi^2 at Buffer Run (site 32). In the Little Raccoon Creek basin, Buffer Run (site 32), Goose Run (site 33), Mulga Run (site 29), unnamed tributary to Little Raccoon Creek near Roads (site 30), and Sugar Run (site 28) had sulfate yields ranging from 623 to 1,994 (lb/d)/mi^2. In the East Branch Raccoon Creek basin, unnamed tributary to East Branch Raccoon Creek near Starr (site 3) yielded 1,092 (lb/d)/mi^2; East Branch Raccoon Creek near Starr (site 1), unnamed tributary to East Branch Raccoon Creek near Starr (site 2), and East Branch Raccoon Creek near New Plymouth (site 4) had yields of dissolved sulfate ranging from 698 to 998 (lb/d)/mi^2. Other sites where the yields of dissolved sulfate were greater than 500 (lb/d)/mi^2 were Carbondale Creek (site 17) and Bullskin Creek (site 40).

Sites where the yields were less than 55 (lb/d)/mi^2 were Little Raccoon Creek near Hamden (site 27), Sandy Run (site 14), Wheelabout Creek (site 13), Honey Fork (site 6), and Indian Creek (site 37).

Table 4.--Site ranking based on pH values of water

[* indicates sites on main stem Raccoon Creek]

Site number	Site name	pH (units)
32	Buffer Rn nr Roads OH	2.7
33	Goose Rn nr Ridgeland OH	2.8
30	Unnam Tr to L Raccoon C nr Roads OH	2.9
3	Unnam Tr to E B Raccoon C nr Starr OH	2.9
17	Carbondale C at Carbondale OH	3.0
29	Mulga Rn nr Wainwright OH	3.2
28	Sugar Rn at Hamden OH	3.2
11	Brushy F nr Creola OH	3.2
34	L Raccoon C nr Ewington OH	3.4
12	Brushy C nr Creola OH	3.4
2	Unnam Tr to E B Raccoon C nr Starr OH	3.4
36	L Raccoon C nr Vinton OH	3.5
1	E B Raccoon C nr Starr OH	3.6
4	E B Raccoon C nr New Plymouth OH	3.6
18	Hewett F nr Albany OH	3.6
16	Hewett F nr Kimberly OH	3.8
8*	Raccoon C nr New Plymouth OH	4.1
10*	Racccoon C nr Zaleski OH	4.2
5	W B Raccoon C nr Mt Pleasant OH	4.5
9	Two Mile Rn nr New Plymouth OH	4.8
15*	Raccoon C nr Zaleski OH	4.8
19*	Raccoon C nr Bolins Mills OH	5.0
25*	Raccoon C nr Alice OH	5.0
23	Pierce Rn nr Oreton OH	5.0
35	Dickason Rn nr Ewington OH	5.1
31	L Raccoon C nr Roads OH	5.9
38*	Raccoon C at Adamsville OH	6.0
7	W B Raccoon C nr New Plymouth OH	6.1
24*	Raccoon C nr Wilkesville OH	6.3
20*	Raccoon C nr Radcliff OH	6.4
37	Indian C nr Rio Grande OH	6.4
41	L Bullskin C nr Mercerville OH	6.4
40	Bullskin C nr Mercerville OH	6.5
39*	Raccoon C at Northup OH	6.6
22	Elk F nr Radcliff OH	6.7
26*	Raccoon C at Vinton OH	6.8
6	Honey F nr New Plymouth OH	7.0
13	Wheelabout C nr Zaleski OH	7.0
14	Sandy Rn bl Lk Hope nr Zaleski OH	7.0
21	Elk F nr McArthur OH	7.1
27	L Raccoon C nr Hamden OH	7.5

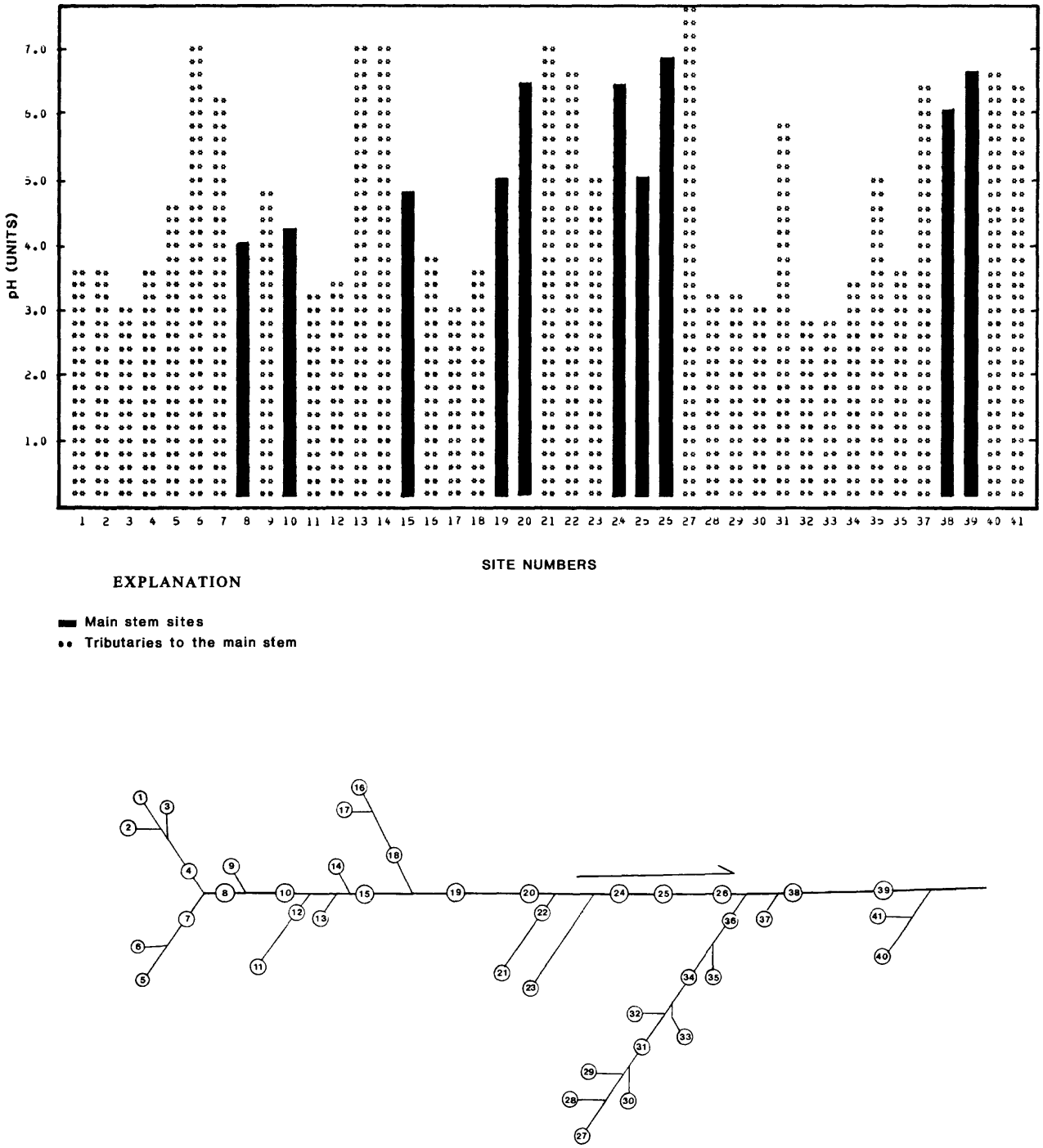


Figure 4.--Schematic diagram of site locations and bar graph of pH recorded at 41 sites.

Table 5.--Site ranking based on specific-conductance values of water

[µS/cm, microsiemens per centimeter at 25°Celsius. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Specific conductance (uS/cm)
32	Buffer Rn nr Roads OH----------	2660
3	Unnam Tr to E B Raccoon C nr Starr OH	1850
33	Goose Rn nr Ridgeland OH----------	1840
30	Unnam Tr to L Raccoon C nr Roads OH--	1660
2	Unnam Tr to E B Raccoon C nr Starr OH	1650
28	Sugar Rn nr Hamden OH----------	1570
1	E B Raccoon C nr Starr OH----------	1480
4	E B Raccoon C nr New Plymouth OH-----	1350
17	Carbondale C at Carbondale OH--------	1150
29	Mulga Rn nr Wainwright OH----------	1120
40	Bullskin C nr Mercerville OH---------	1010
34	L Raccoon C nr Ewington OH----------	975
8*	Raccoon C nr New Plymouth OH---------	965
11	Brushy F nr Creola OH----------	912
36	L Raccoon C nr Vinton OH----------	870
10*	Raccoon C nr Zaleski OH----------	845
12	Brushy C nr Creola OH----------	825
41	L Bullskin C nr Mercerville OH-------	820
18	Hewett F nr Albany OH----------	780
23	Pierce Rn nr Oreton OH----------	750
19*	Raccoon C nr Bolins Mills OH---------	740
7	W B Raccoon C nr New Plymouth OH-----	725
31	L Raccoon C nr Roads OH----------	705
5	W B Raccoon C nr Mt Pleasant OH------	700
16	Hewett F nr Kimberly OH----------	675
15*	Raccoon C nr Zaleski OH----------	640
20*	Raccoon C nr Radcliff OH----------	630
21	Elk F nr McArthur OH----------	615
35	Dickason Rn nr Ewington OH----------	595
24*	Raccoon C nr Wilkesville OH----------	590
25*	Raccoon C nr Alice OH----------	590
38*	Raccoon C at Adamsville OH----------	580
22	Elk F nr Radcliff OH----------	565
9	Two Mile Rn nr New Plymouth OH-------	545
26*	Raccoon C at Vinton OH----------	520
39*	Raccoon C at Northup OH----------	510
6	Honey F nr New Plymouth OH----------	455
37	Indian C nr Rio Grande OH----------	320
13	Wheelabout C nr Zaleski OH----------	300
27	L Raccoon C nr Hamden OH----------	160
14	Sandy Rn bl Lk Hope nr Zaleski OH----	150

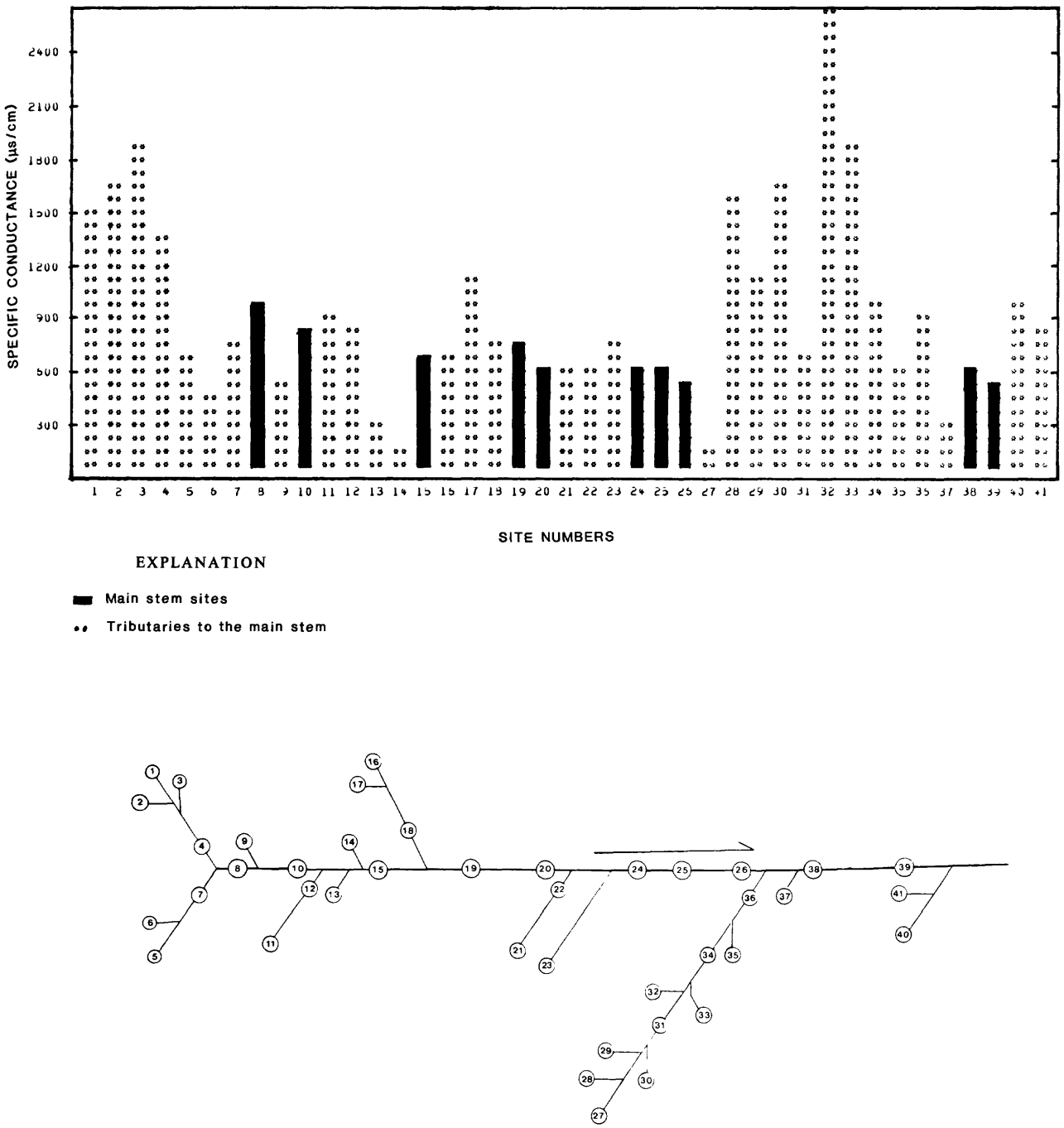
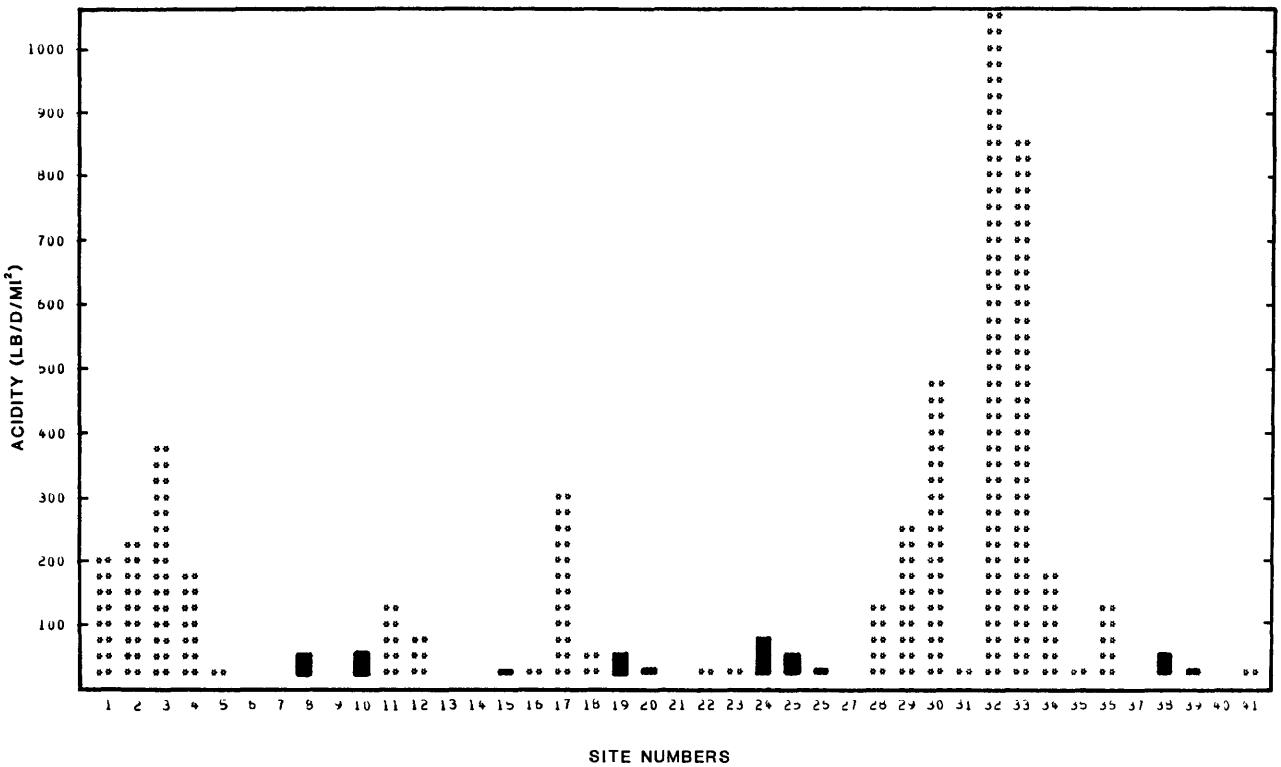


Figure 5.--Schematic diagram of site locations and bar graph of specific conductance recorded at 41 sites.

Table 6.--Site ranking based on yields of acidity

[(lb/d)/mi^2, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Acidity [(lb/d)/mi^2]
32	Buffer Rn nr Roads OH----------	1042
33	Goose Rn nr Ridgeland OH----------	859
30	Unnam Tr to L Raccoon C nr Roads OH--	485
3	Unnam Tr to E B Raccoon C nr Starr OH	370
17	Carbondale C at Carbondale OH--------	302
29	Mulga Rn nr Wainwright OH----------	249
2	Unnam Tr to E B Raccoon C nr Starr OH	220
1	E B Raccoon C nr Starr OH----------	199
34	L Raccoon C nr Ewington OH----------	174
4	E B Raccoon C nr New Plymouth OH-----	171
11	Brushy F nr Creola OH----------	133
28	Sugar Rn at Hamden OH----------	127
36	L Raccoon C nr Vinton OH----------	123
12	Brushy C nr Creola OH----------	72.4
24*	Raccoon C nr Wilkesville OH----------	64.8
25*	Raccoon C nr Alice OH----------	58.0
18	Hewett F nr Albany OH----------	56.4
38*	Raccoon C at Adamsville OH----------	51.8
8*	Raccoon C nr New Plymouth OH---------	45.8
19*	Raccoon C nr Bolins Mills OH---------	39.8
10*	Raccoon C nr Zaleski OH----------	37.7
35	Dickason Rn nr Ewington OH----------	37.1
20*	Raccoon C nr Radcliff OH----------	36.7
23	Pierce Rn nr Oreton OH----------	34.9
16	Hewett F nr Kimberly OH----------	33.0
22	Elk F nr Radcliff OH----------	28.7
31	L Raccoon C nr Roads OH----------	28.6
39*	Raccoon C at Northup OH----------	28.3
15*	Raccoon C nr Zaleski OH----------	28.1
26*	Raccoon C at Vinton OH----------	27.0
5	W B Raccoon C nr Mt Pleasant OH------	15.3
41	L Bullskin C nr Mercerville OH-------	12.6
40	Bullskin C nr Mercerville OH---------	10.2
37	Indian C nr Rio Grande OH----------	9.40
7	W B Raccoon C nr New Plymouth OH-----	8.98
9	Two Mile Rn nr New Plymouth OH-------	8.33
21	Elk F nr McArthur OH----------	3.66
13	Wheelabout C nr Zaleski OH----------	2.36
14	Sandy Rn bl Lk Hope nr Zaleski OH----	1.78
6	Honey F nr New Plymouth OH----------	1.73
27	L Raccoon C nr Hamden OH----------	1.67



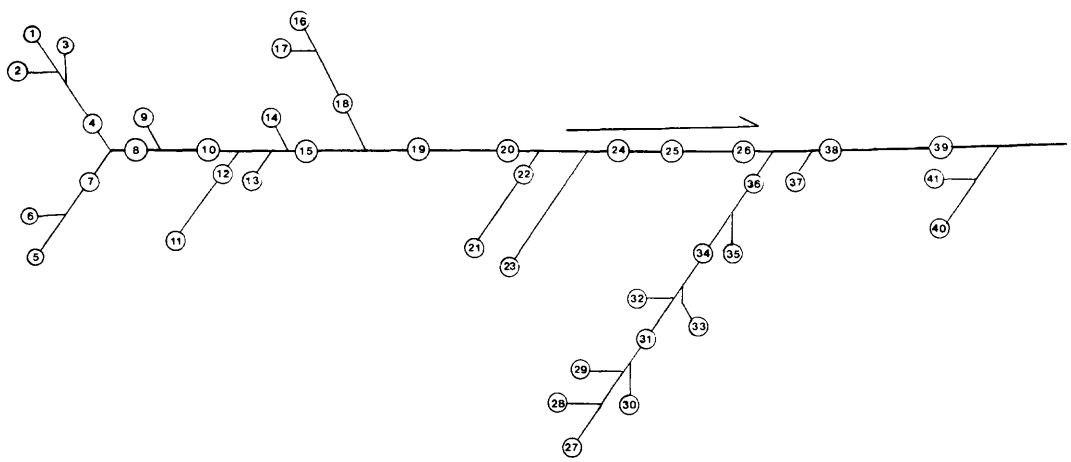
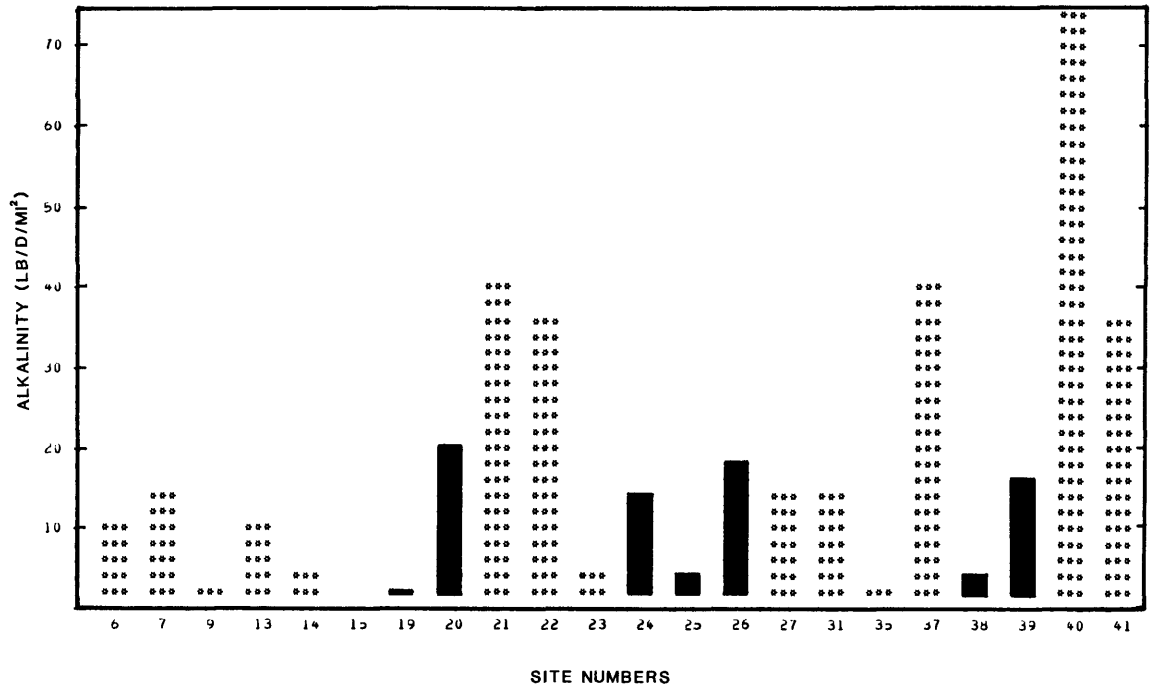


Figure 6.--Schematic diagram of site locations and bar graph of yields of acidity recorded at 41 sites.

Table 7.--Site ranking based on yields of alkalinity

[(lb/d)/mi^2, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Alkalinity [(lb/d)/mi^2]
15*	Raccoon C nr Zaleski OH	0.708
19*	Raccoon C nr Bolins Mills OH	1.00
9	Two Mile Rn nr New Plymouth OH	1.12
35	Dickason Rn nr Ewington OH	2.49
38*	Raccoon C at Adamsville OH	3.13
25*	Raccoon C nr Alice OH	3.19
23	Pierce Rn nr Oreton OH	3.51
14	Sandy Rn bl Lk Hope nr Zaleski OH	4.30
13	Wheelabout C nr Zaleski OH	10.5
6	Honey F nr New Plymouth OH	10.5
24*	Raccoon C nr Wilkesville OH	13.0
7	W B Raccoon C nr New Plymouth OH	13.1
27	L Raccoon C nr Hamden OH	13.4
31	L Raccoon C nr Roads OH	13.5
39*	Raccoon C at Northup OH	15.2
26*	Raccoon C at Vinton OH	18.1
20*	Raccoon C nr Radcliff OH	19.7
22	Elk F nr Radcliff OH	36.3
41	L Bullskin C nr Mercerville OH	36.5
21	Elk F nr McArthur OH	39.8
37	Indian C nr Rio Grande OH	40.4
40	Bullskin C nr Mercerville OH	74.3



EXPLANATION

▬ Main stem sites

••• Tributaries to the main stem

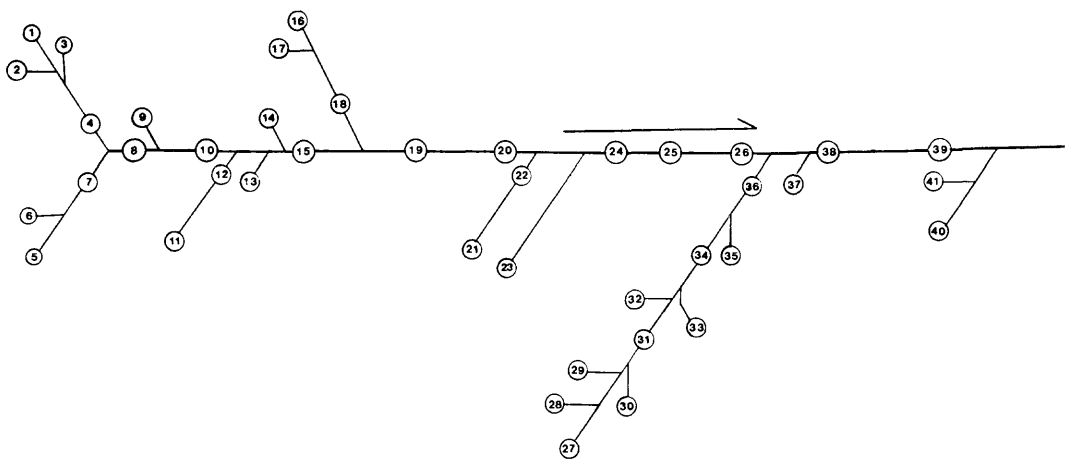


Figure 7.--Schematic diagram of site locations and bar graph of yields of alkalinity recorded at 41 sites.

Table 8.--Site ranking based on yields of dissolved sulfate

[(lb/d)/mi^2, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Sulfate, dissolved [(lb/d)/mi^2]
32	Buffer Rn nr Roads OH	1994
33	Goose Rn nr Ridgeland OH	1269
3	Unnam Tr to E B Raccoon C nr Starr OH	1092
1	E B Raccoon C nr Starr OH	998
29	Mulga Rn nr Wainwright OH	933
30	Unnam Tr to L Raccoon C nr Roads OH	906
2	Unnam Tr to E B Raccoon C nr Starr OH	845
4	E B Raccoon C nr New Plymouth OH	698
28	Sugar Rn at Hamden OH	623
17	Carbondale C at Carbondale OH	534
40	Bullskin C nr Mercerville OH	506
34	L Raccoon C nr Ewington OH	419
23	Pierce Rn nr Oreton OH	386
36	L Raccoon C nr Vinton OH	344
31	L Raccoon C nr Roads OH	307
8*	Raccoon C nr New Plymouth OH	294
16	Hewett F nr Kimberly OH	274
18	Hewett F nr Albany OH	273
10*	Raccoon C nr Zaleski OH	247
12	Brushy C nr Creola OH	236
25*	Raccoon C nr Alice OH	223
19*	Raccoon C nr Bolins Mills OH	221
24*	Raccoon C nr Wilkesville OH	217
38*	Raccoon C at Adamsville OH	209
15*	Raccoon C nr Zaleski OH	198
11	Brushy F nr Creola OH	197
35	Dickason Rn nr Ewington OH	187
41	L Bullskin C nr Mercerville OH	178
21	Elk F nr McArthur OH	176
26*	Raccoon C at Vinton OH	172
39*	Raccoon C at Northup OH	171
20*	Raccoon C nr Radcliff OH	164
22	Elk F nr Radcliff OH	157
9	Two Mile Rn nr New Plymouth OH	145
7	W B Raccoon C nr New Plymouth OH	118
5	W B Raccoon C nr Mt Pleasant OH	108
13	Wheelabout Creek nr Zaleski OH	52.3
6	Honey F nr New Plymouth OH	48.9
37	Indian C nr Rio Grande OH	39.8
14	Sandy Rn bl Lk Hope nr Zaleski OH	21.2
27	L Raccoon C nr Hamden OH	15.4

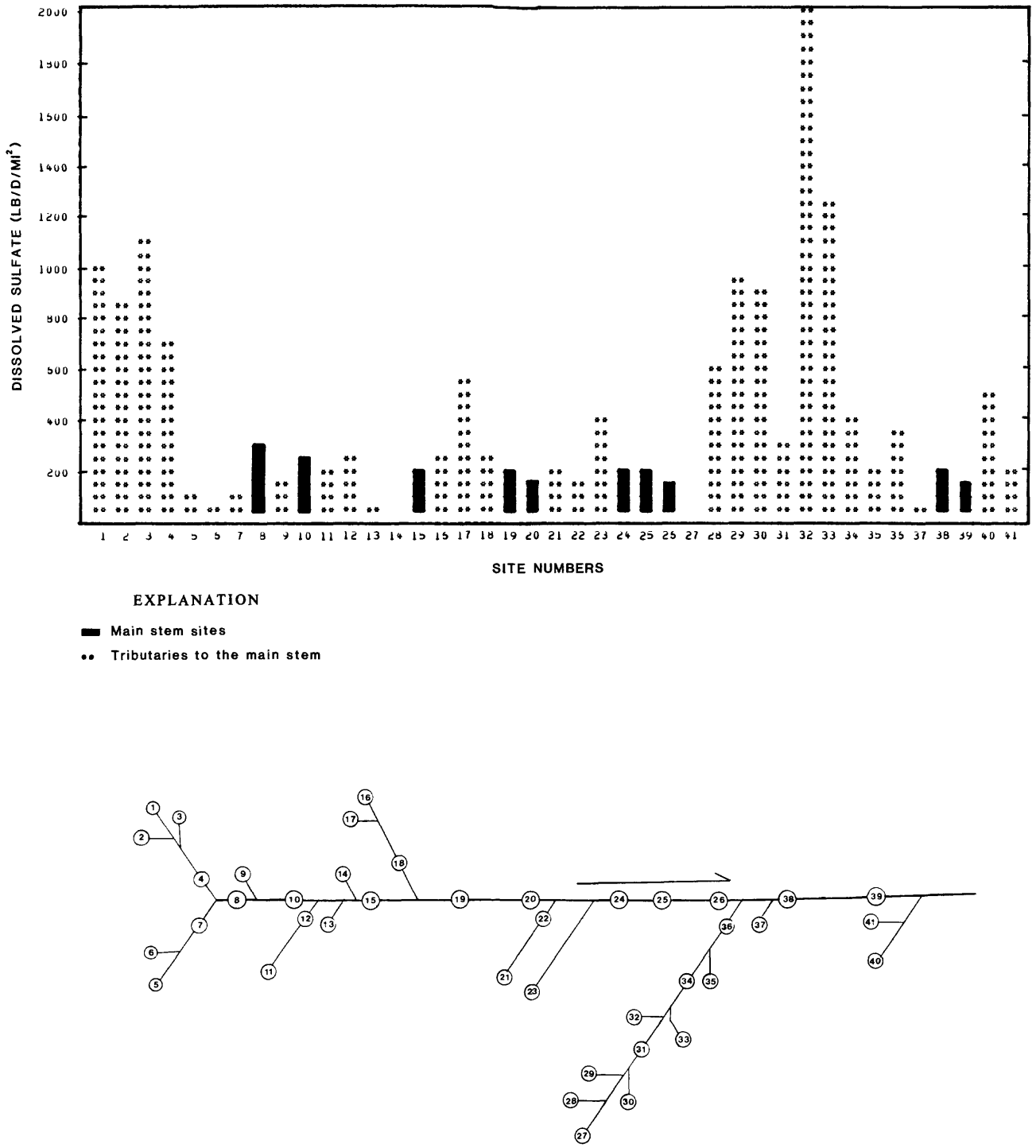


Figure 8.--Schematic diagram of site locations and bar graph of yields of dissolved sulfate recorded at 41 sites.

Dissolved Iron

The yield of dissolved iron (table 9, fig. 9) ranged from 0.015 $(lb/d)/mi^2$ at Little Bullskin Creek (site 41) to 147 $(lb/d)/mi^2$ at Buffer Run (site 32). In the Little Raccoon Creek basin, Buffer Run (site 32), Goose Run (site 33), unnamed tributary to Little Raccoon Creek near Roads (site 30), and Mulga Run (site 29) had yields ranging from 14.4 $(lb/d)/mi^2$ to 147 $(lb/d)/mi^2$. Carbondale Creek (site 17), unnamed tributary to East Branch Raccoon Creek (site 3), and Brushy Fork (site 11) and Brushy Creek (site 12) had yields of dissolved iron greater than 8 $(lb/d)/mi^2$.

At Little Bullskin Creek (site 41) the yield was 0.015 $(lb/d)/mi^2$; at Bullskin Creek (site 40), Sandy Run (site 14), Little Raccoon Creek near Hamden (site 27), and Honey Fork (site 6) the yields were less than 0.10 $(lb/d)/mi^2$.

Dissolved Manganese

The yield of dissolved manganese (table 10, fig. 10) ranged from 0.08 $(lb/d)/mi^2$ at Little Raccoon Creek near Hamden (site 27) to 22.4 $(lb/d)/mi^2$ at unnamed tributary to Little Raccoon Creek near Roads (site 30). Besides unnamed tributary to Little Raccoon Creek near Roads (site 30), Buffer Run (site 32), Sugar Run (site 28), and Mulga Run (site 29) had yields of dissolved manganese greater than 10.0 $(lb/d)/mi^2$ in the Little Raccoon Creek basin. In the East Branch Raccoon Creek basin, East Branch Raccoon Creek near Starr (site 1), unnamed tributaries to East Branch Raccoon Creek (sites 2 and 3), and East Branch Raccoon Creek near New Plymouth (site 4) had yields ranging from 7.28 $(lb/d)/mi^2$ to 21.6 $(lb/d)/mi^2$. Two sites on main-stem Raccoon Creek below the confluence of the East and West branches (sites 8 and 10), as well as Goose Run (site 33), Little Raccoon Creek near Ewington (site 34), Pierce Run (site 23), and Little Raccoon Creek near Roads (site 31), had yields greater than 5.0 $(lb/d)/mi^2$.

At Little Raccoon Creek near Hamden (site 27), the yield was 0.080 $(lb/d)/mi^2$, and Honey Fork (site 6), Indian Creek (site 37), Little Bullskin Creek (site 41), and Sandy Run (site 14) all had yields of dissolved manganese less than 1.0 $(lb/d)/mi^2$.

Dissolved Aluminum

The yield of dissolved aluminum (table 11, fig. 11) ranged from 0.007 (lb/d)/mi^2 at Sandy Run (site 14) to 76.1 (lb/d)/mi^2 at Goose Run (site 33). Within the Little Raccoon Creek basin, Goose Run (site 33), Buffer Run (site 32), unnamed tributary to Little Raccoon Creek near Roads (site 30), and Mulga Run (site 29) had yields of dissolved aluminum ranging from 76.1 (lb/d)/mi^2 to 18.4 (lb/d)/mi^2. Unnamed tributary to East Branch Raccoon Creek (site 3), Carbondale Creek (site 17), East Branch Raccoon Creek near New Plymouth (site 4), two main-stem Raccoon Creek sites (8 and 10), and Brushy Creek (site 12) had yields greater than 10.0 (lb/d)/mi^2.

Sandy Run (site 14), three main-stem Little Raccoon Creek sites (sites 31, 27, and 36), and Two Mile Run (site 9) had yields less than 0.10 (lb/d)/mi^2.

Suspended Sediment and Benthic Macroinvertebrates

Each of the 41 sites was sampled for suspended sediment and benthic macroinvertebrates. Suspended-sediment concentrations are given in table 3.

Benthic macroinvertebrates were found at 37 of the 41 sites. A total of 337 organisms from the 37 sites were collected and identified. Results are given in appendix 2.

Identification of Basins Affected By Mine Drainage

Data collected between November 1 and 3, 1983, indicate that the major sources of mine drainage are in the Little Raccoon Creek and the East Branch Raccoon Creek basins.[1] Within the Little Raccoon Creek basin, Buffer Run (site 32), Goose Run (site 33), unnamed tributary to Little Raccoon Creek near Roads (site 30), Mulga Run (site 29), and Sugar Run (site 28) have water quality indicative of mine drainage. In the East Branch Raccoon Creek basin, all four sites (sites 1-4) also have water quality indicative of mine drainage.

Although it has been determined that there are major sources of mine drainage in the East Branch Raccoon Creek basin, the West Branch Raccoon Creek basin (sites 5 and 7) does not have any major sources. West Branch Raccoon Creek's major tributary, Honey Fork (site 6), is, in fact, among the better water-quality sites sampled in the Raccoon Creek basin. Although the pH at Two Mile Run (site 9) is 4.5, other chemical constituents indicate that no major sources of mine drainage exist in the Two Mile Run basin.

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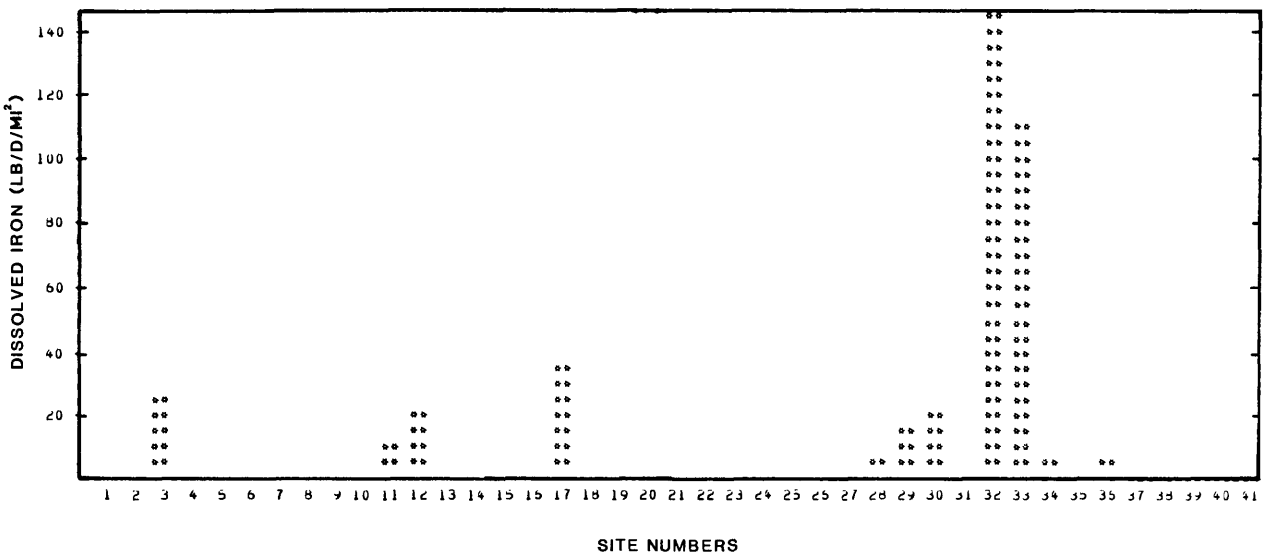
[1] The areas of water degradation are the same as indicated by the historical data except for the Sandy Run basin.

Table 9.--Site ranking based on yields of dissolved iron

[$(lb/d)/mi^2$, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Iron, dissolved $[(lb/d)/mi^2]$
32	Buffer Rn nr Roads OH	147
33	Goose Rn nr Ridgeland OH	108
17	Carbondale C at Carbondale OH	32.9
3	Unnam Tr to E B Raccoon C nr Starr OH	27.3
30	Unnam Tr to L Raccoon C nr Roads OH	22.4
12	Brushy C nr Creola OH	18.5
29	Mulga Rn nr Ewington OH	14.4
11	Brushy F nr Creola OH	8.92
34	L Raccoon C nr Ewington OH	6.53
28	Sugar Rn at Hamden OH	5.43
36	L Raccoon C nr Vinton OH	2.85
23	Pierce Rn nr Oreton OH	2.46
4	E B Raccoon C nr New Plymouth OH	1.80
1	E B Raccoon C nr Starr OH	1.75
18	Hewett F nr Albany OH	1.74
16	Hewett F nr Kimberly OH	0.997
24*	Raccoon C nr Wilkesville OH	.685
8*	Raccoon C nr New Plymouth OH	.634
35	Dickason Rn nr Ewington OH	.597
7	W B Raccoon C nr New Plymouth OH	.588
31	L Raccoon C nr Roads OH	.586
38*	Raccoon C at Adamsville OH	.449
2	Unnam Tr to E B Raccoon C nr Starr OH	.429
19*	Raccoon C nr Bolins Mills OH	.401
25*	Raccoon C nr Alice OH	.393
10*	Raccoon C nr Zaleski OH	.392
21	Elk F nr McArthur OH	.271
9	Two Mile Rn nr New Plymouth OH	.246
15*	Raccoon C nr Zaleski OH	.227
13	Wheelabout C nr Zaleski OH	.200
39*	Raccoon C at Northup OH	.171
5	W B Raccoon C nr Mt Pleasant OH	.146
26*	Raccoon C at Vinton OH	.145
37	Indian C nr Rio Grande OH	.132
22	Elk F nr Radcliff OH	.116
20*	Raccoon C nr Radcliff OH	.115
14	Sandy Rn bl Lk Hope nr Zaleski OH	.097
27	L Raccoon C nr Hamden OH	.047
6	Honey F nr New Plymouth OH	.042
40	Bullskin C nr Mercerville OH	.021
41	L Bullskin C nr Mercerville OH	.015



EXPLANATION

▬ Main stem sites

•• Tributaries to the main stem

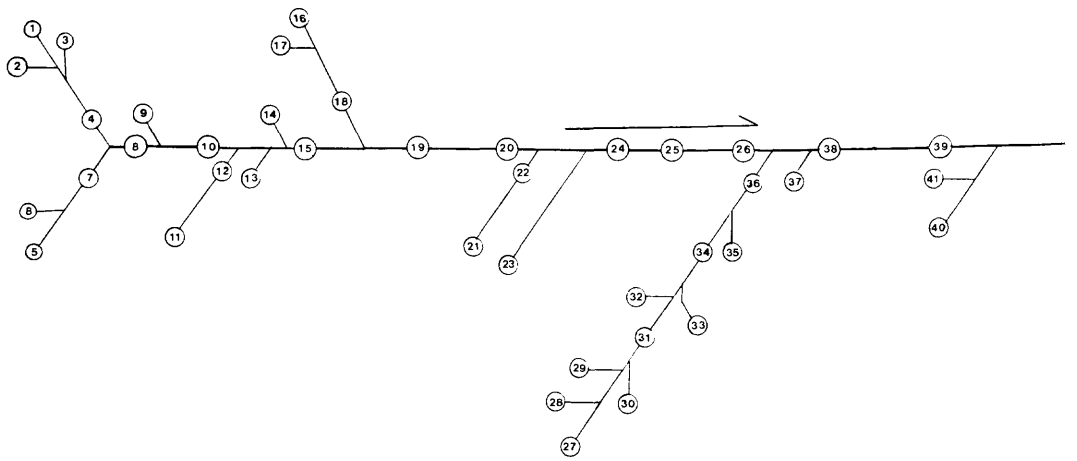


Figure 9.--Schematic diagram of site locations and bar graph of yields of dissolved iron recorded at 41 sites.

Table 10.--Site ranking based on yields of dissolved manganese

[(lb/d)/mi^2, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Manganese, dissolved [(lb/d)/mi^2]
30	Unnam Tr to L Raccoon C nr Roads OH----	22.4
1	E B Raccoon C nr Starr OH----------	21.6
2	Unnam Tr to E B Raccoon C nr Starr OH--	19.7
32	Buffer Rn nr Roads OH----------	17.8
4	E B Raccoon C nr New Plymouth OH-------	13.3
28	Sugar Rn at Hamden OH----------	12.8
29	Mulga Rn nr Wainwright OH----------	11.3
3	Unnam Tr to E B Raccoon C nr Starr OH--	7.28
8*	Raccoon C nr New Plymouth OH----------	6.34
33	Goose Rn nr Ridgeland OH----------	6.23
34	L Raccoon C nr Ewington OH----------	6.04
23	Pierce Rn nr Oreton OH----------	5.79
10*	Raccoon C nr Zaleski OH----------	5.38
31	L Raccoon C nr Roads OH----------	5.28
36	L Raccoon C nr Vinton OH----------	4.61
15*	Raccoon C nr Zaleski OH----------	4.32
12	Brushy C nr Creola OH----------	4.21
19*	Raccoon C nr Bolins Mills OH----------	4.02
24*	Raccoon C nr Wilkesville OH----------	3.80
11	Brushy F nr Creola OH----------	3.76
35	Dickason Rn nr Ewington OH----------	3.42
25*	Raccoon C nr Alice OH----------	3.40
38*	Raccoon C at Adamsville OH----------	3.23
20*	Raccoon C nr Radcliff OH----------	3.12
18	Hewett F nr Albany OH----------	3.11
39*	Raccoon C nr Northup OH----------	2.85
7	W B Raccoon C nr New Plymouth OH-------	2.76
16	Hewett F nr Kimberly OH----------	2.66
26*	Raccoon C at Vinton OH----------	2.45
17	Carbondale C at Carbondale OH----------	2.38
5	W B Raccoon C nr Mt Pleasant OH--------	2.27
22	Elk F nr Radcliff OH----------	2.15
9	Two Mile Rn nr New Plymouth OH---------	2.12
21	Elk F nr McArthur OH----------	1.77
40	Bullskin C nr Mercerville OH----------	1.75
13	Wheelabout C nr Zaleski OH----------	0.713
14	Sandy Rn bl Lk Hope nr Zaleski OH------	.240
41	L Bullskin C nr Mercerville OH---------	.238
37	Indian C nr Rio Grande OH----------	.158
6	Honey F nr New Plymouth OH----------	.108
27	L Raccoon C nr Hamden OH----------	.080

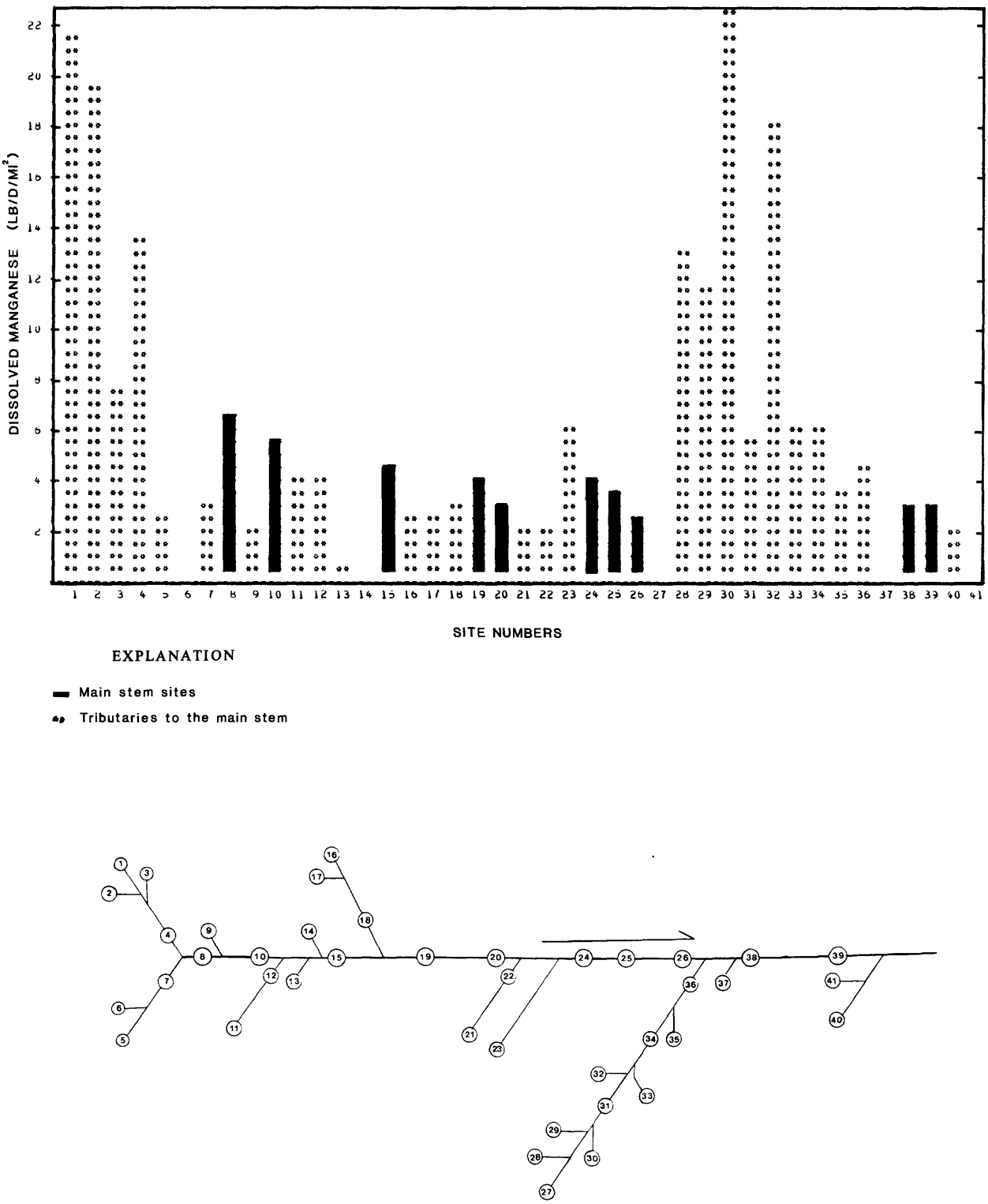


Figure 10.--Schematic diagram of site locations and bar graph of yields of dissolved manganese recorded at 41 sites.

Table 11.--Site ranking based on yields of dissolved aluminum

[(lb/d)/mi^2, pounds per day per square mile. An * indicates sites on main stem Raccoon Creek.]

Site number	Site name	Aluminum, dissolved [(lb/d)/mi^2]
33	Goose Rn nr Ridgeland OH----------	76.1
32	Buffer Rn nr Roads OH----------	63.0
30	Unnam Tr to L Raccoon C nr Roads OH----	44.8
3	Unnam Tr to E B Raccoon C nr Starr OH	30.0
17	Carbondale C at Carbondale OH----------	20.5
4	E B Raccoon C nr New Plymouth OH-------	20.4
29	Mulga Rn nr Wainwright OH----------	18.4
10*	Raccoon C nr Zaleski OH----------	16.5
8*	Raccoon C nr New Plymouth OH----------	11.5
12	Brushy C nr Creola OH----------	10.1
34	L Raccoon C nr Ewington OH----------	8.19
28	Sugar Rn at Hamden OH----------	7.99
13	Wheelabout C nr Zaleski OH----------	6.66
21	Elk F nr McArthur OH----------	6.63
11	Brushy F nr Creola OH----------	6.37
18	Hewett F nr Albany OH----------	4.70
16	Hewett F nr Kimberly OH----------	2.66
6	Honey F nr New Plymouth OH----------	2.44
5	W B Raccoon C nr Mt Pleasant OH--------	2.16
23	Pierce Rn nr Oreton OH----------	1.67
19*	Raccoon C nr Bolins Mills----------	1.40
38*	Raccoon C at Adamsville OH----------	1.36
35	Dickason Rn nr Ewington OH----------	1.24
7	W B Raccoon C nr New Plymouth OH-------	1.04
1	E B Raccoon C nr Starr OH----------	0.587
20*	Raccoon C nr Radcliff OH----------	.492
37	Indian C nr Rio Grande OH----------	.442
24*	Raccoon C nr Wilkesville OH----------	.425
25*	Raccoon C nr Alice OH----------	.425
2	Unnam Tr to E B Raccoon C nr Starr OH--	.338
26*	Raccoon C at Vinton OH----------	.290
15*	Raccoon C nr Zaleski OH----------	.269
39*	Raccoon C nr Northup OH----------	.266
40	Bullskin C nr Mercerville OH----------	.258
22	Elk F nr Radcliff OH----------	.206
41	L Bullskin C nr Mercerville OH---------	.101
9	Two Mile Rn nr New Plymouth OH---------	.095
31	L Raccoon C nr Roads OH----------	.048
27	L Raccoon C nr Hamden OH----------	.080
36	L Raccoon C nr Vinton OH----------	.039
14	Sandy Rn bl Lk Hope nr Zaleski OH------	.007

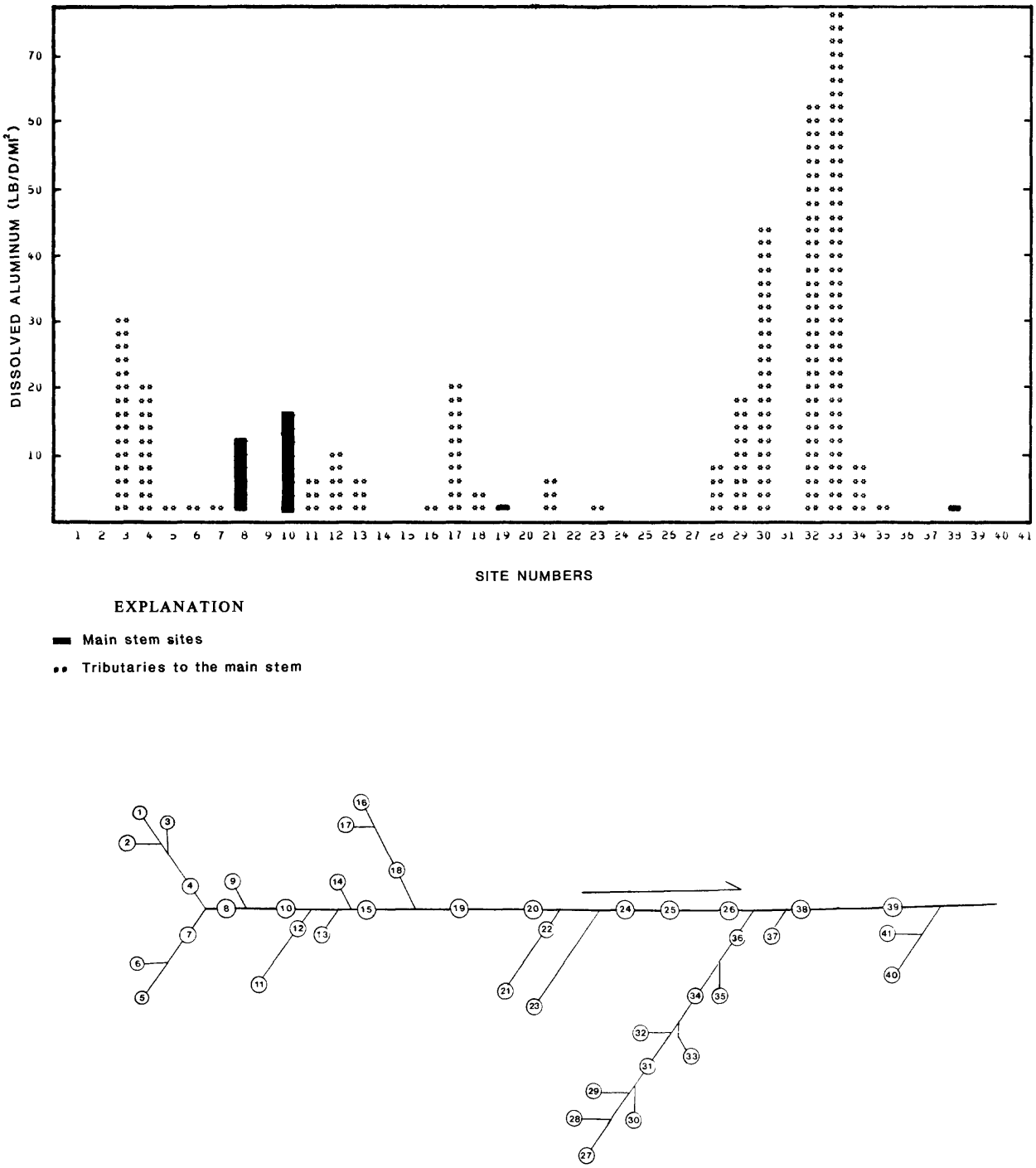


Figure 11.--Schematic diagram of site locations and bar graph of yields of dissolved aluminum recorded at 41 sites.

However, water quality at Brushy Creek (sites 11 and 12), indicates that there are major sources of mine drainage in this basin. Wheelabout Creek (site 13) is among the sites not severely affected by mine drainage.

Although historic data (table 1) indicate that the Sandy Run basin is severely affected by mine drainage, the stream did not contribute to the mine drainage of Raccoon Creek at the time of this survey. Water-quality data for November 1, 1983, at the mouth of Sandy Run (site 14) indicate that the stream is not contributing to the degradation of Raccoon Creek (table 3).

Carbondale Creek (site 17) is severely affected by mine drainage; it empties into Hewett Fork (sites 16 and 18), which also is affected by mine drainage.

The Elk Fork basin is relatively large and contains abandoned surface mines, but it does not contribute to degradation of Raccoon Creek during low-flow conditions. Water-quality data at the mouth of Elk Fork (site 22) and the middle part of the basin (site 21) indicate that mine drainage in times of low flow in the Elk Fork basin is not severe.

Dissolved sulfate and metals indicate that Pierce Run (site 23) is affected by mine drainage.

Indian Creek (site 37) is not affected by mine drainage. Although Little Bullskin Creek (site 41) and Bullskin Creek (site 40) have specific conductances and yields of dissolved sulfate that indicate mine drainage, water from these basins does not appear to be detrimental to Raccoon Creek.

SUGGESTIONS FOR FUTURE INVESTIGATIONS

The Ohio Department of Natural Resources, Division of Reclamation is planning to reclaim abandoned surface mines producing mine drainage in the Raccoon Creek basin. In order to assess the ultimate effectiveness of the methods used to reclaim abandoned surface mines in the Raccoon Creek basin, it would be necessary to document long-term, large-scale changes in water quality in Raccoon Creek and its tributaries during and after reclamation. The effects of reclamation on biological communities, water quality, sediment loading, and sediment deposition and scour in the stream channels could be quantified and could serve as the basis for such an assessment.

Increased sedimentation is one of the most detrimental effects of surface mining on surface water. In order to determine changes in sedimentation due to reclamation, sediment yields and long-term rates of deposition and scour in the basin could be documented and analyzed.

The adverse effects of sedimentation and mine drainage on macroinvertebrate communities are usually to decrease diversity and density. By using macroinvertebrate abundance and diversity at selected points and relating the data to the effects of mine drainage and reclamation, the usefulness of macroinvertebrates as indicators of reclamation effectiveness can be determined.

A study of the reclamation effects in Raccoon Creek basin by monitoring changes in water quality (chemical constituents, biology, and sediment) would last several years, from the installation of stations before reclamation begins until a few years after reclamation ends. The chemical constituents might include:

1. Laboratory analysis
   a) iron, total and dissolved
   b) manganese, total and dissolved
   c) aluminum, total and dissolved
   d) sulfate, dissolved

2. Field determinations
   a) pH
   b) specific conductance
   c) alkalinity
   d) acidity
   e) temperature
   f) dissolved oxygen

Macroinvertebrates could be analyzed for change in diversity and abundance. Suspended-sediment loads and deposition and (or) scour rates in the channel could be analyzed for change and relation to storm events.

Gaging stations could be established to provide information for the computation of trends in daily sediment discharge and water quality. The stations could be instrumented to record stream stage, and daily suspended-sediment samples could be collected. Sediment yields could be computed for comparison between stations. In order to determine deposition and scour rates, channel cross sections could be established near each site. Each cross section could be surveyed several times per year for the life of the station. The long-term stations could be sampled periodically throughout the year for chemical and biological data.

Two of the gaging stations could be located on Little Raccoon Creek, a major source of mine drainage to the Raccoon Creek basin. Three other stations could be located on Raccoon Creek, one below the confluence of the East and West Branches, one in mid-basin and one in the lower part of the basin (fig. 12).

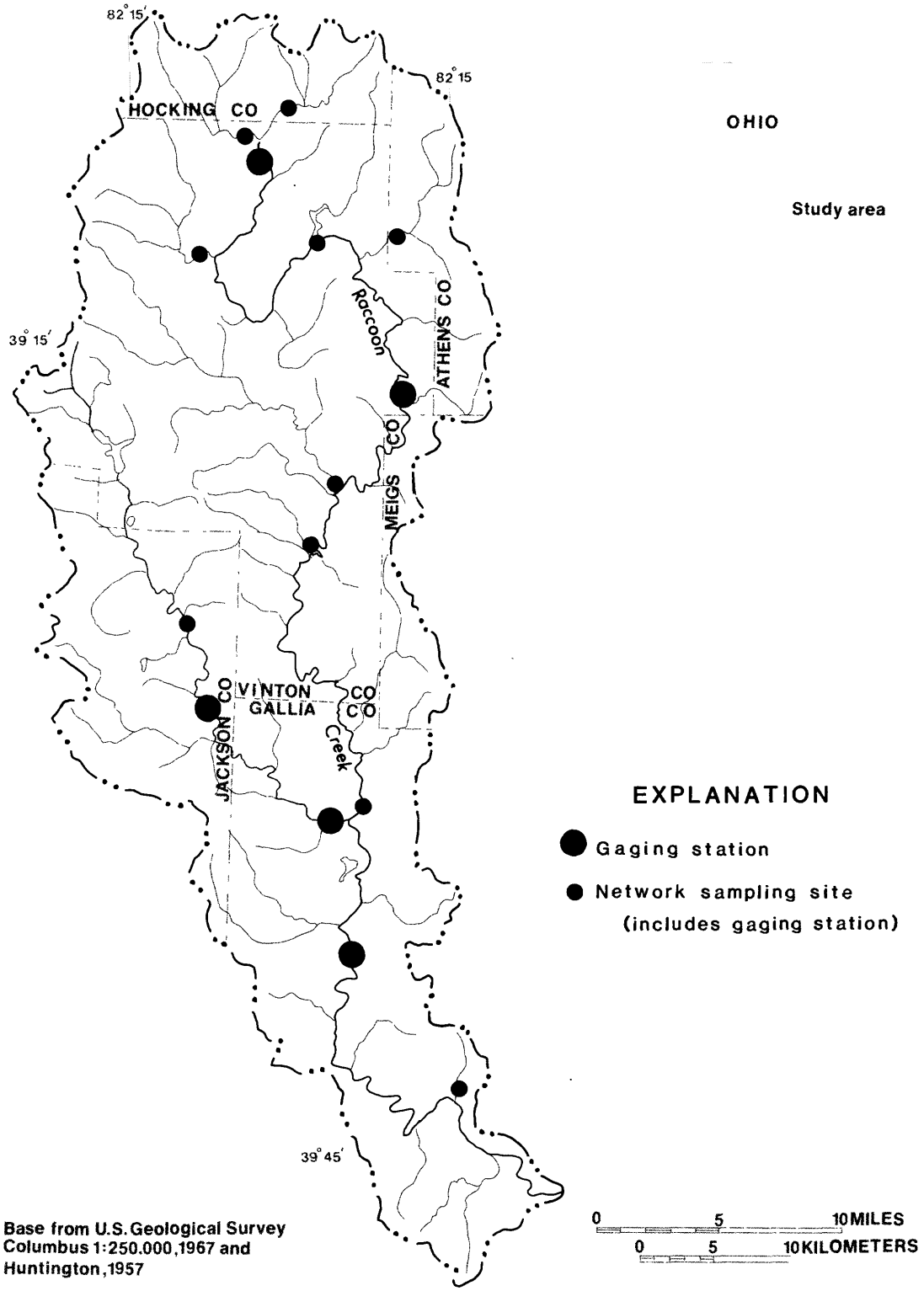


Figure 12.--Map showing location of suggested gaging stations and network sampling sites.

To determine the cumulative effects of reclamation by monitoring water-quality changes in Raccoon Creek basin, a network of approximately 15 water-quality and biological collection sites could be established (fig. 12). The network sites could be sampled twice a year (during base-flow conditions). Taxonomic identification and enumeration of macroinvertebrate samples could be made twice annually. The network could be sampled over a 2- to 3-day period when little change in base flow occurs in order to insure that hydrologic conditions remain relatively constant. Each time a water-quality sample is collected a discharge measurement should be made.

Chemical analyses could be used to compute instantaneous yields for comparison between collection periods at a single site as well as comparison between sites. Macroinvertebrate data could be used to define diversity and abundance, and to document any change.

Analysis of variance and a determination of trends could be used to indicate whether significant changes in water-quality and sediment discharge took place as a result of reclamation. Biometric analyses could be used to determine if significant changes took place in the abundance and diversity of macroinvertebrate species as a result of reclamation.

SUMMARY AND CONCLUSIONS

Historic data collected from January 1975 through January 1983 at 65 sites within the Raccoon Creek basin were analyzed. By comparing the basin-wide median values of pH, specific conductance, alkalinity, acidity, dissolved sulfate, dissolved aluminum, dissolved iron, and dissolved manganese to the individual median values for all 65 sites, East Branch Raccoon Creek, Brushy Creek, Sandy Run, Hewett Fork, and Little Raccoon Creek basins were determined to be major areas of water-quality degradation in the Raccoon Creek basin.

A 41-site sampling network was developed using the historic data. The sampling took place from November 1 through November 3, 1983, when flow conditions were relatively stable throughout the basin. By comparing the measurements and yields of eight mine-drainage characteristics from each site to the other sites during a hydrologically stable period, it was determined that the major sources of water-quality degradation to Raccoon Creek could be found in the Little Raccoon Creek, the East Branch Raccoon Creek, the Brushy Creek, and the Hewett Fork basins. The Sandy Run basin, although affected by mine drainage, is not considered detrimental to Raccoon Creek.

In the Little Raccoon Creek basin, the main sources of mine drainage sampled are in the basins of Buffer Run, Goose Run, an unnamed tributary to Little Raccoon Creek, Mulga Run, and Sugar Run. In the East Branch Raccoon Creek basin, all sites sampled were affected by mine drainage.

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Appendix 1.--Historic water-quality data from the Raccoon Creek basin

[Data collected from July 1975 through July 1983. Double dash indicates no data are available.]

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H1 YOST RN NR NELSONVILLE OH					LAT 392534 LONG 0821837			DA 0.53	
05/20/81	0.96	1530	3.4	0	233	890	20000	13000	18000
06/11/81	0.70	1600	3.5	0	288	970	320	9100	20
07/29/81	0.07	2400	3.1	0	407	1600	42000	11000	45000
09/01/81	0.25	2820	3.0	0	794	1600	10000	5200	57000
09/18/81	0.25	2500	3.2	0	452	1500	31000	11000	58000
09/29/81	0.25	2700	3.5	0	546	1800	43000	7000	58000
10/29/81	0.05	2330	3.2	0	546	1700	35000	17000	5700
12/02/81	0.05	2300	3.2	0	397	1800	33000	11000	57000
04/20/82	0.23	1300	3.8	0	392	930	8200	16000	21000
05/19/82	0.07	2200	3.4	0	596	1500	10000	1300	47000
07/14/82	0.19	2190	3.2	0	432	1300	29000	1400	41000
08/12/82	0.23	1930	3.4	0	253	1100	27000	4900	30000
09/07/82	0.10	2600	3.4	0	253	1400	31000	4300	46000
07/11/83	0.03	2600	3.2	--	362	1700	55000	6200	46000
SITE H2 UNAM TR TO E B RACCOON C NR STARR OH					LAT 392504 LONG 0821951			DA 2.30	
07/15/81	0.89	1500	3.6	--	328	930	28010	1506	19030
07/21/82	0.68	1610	3.3	0	273	890	19000	1900	23000
SITE H3 E B RACCOON C NR STARR OH					LAT 392427 LONG 0822003			DA 6.40	
09/05/80	7.60	1200	3.6	--	199	--	--	--	--
07/15/81	2.90	1300	3.8	--	214	780	21250	1492	16190
07/21/82	1.70	1400	3.4	0	214	640	14000	2800	13000
SITE H4 E B RACCOON C AT STARR OH					LAT 392349 LONG 0822140			DA 13.70	
08/26/81	0.08	1650	3.7	--	211	860	23450	1706	--
07/21/82	5.60	1470	3.4	0	169	830	18000	1300	20000
SITE H5 E B RACCOON C NR NEW PLYMOUTH OH					LAT 392348 LONG 0822202			DA 14.46	
04/26/79	11.00	1150	3.5	1	179	620	--	3000	13000
09/25/79	16.00	870	3.6	1	139	400	--	3300	1000
08/06/80	9.30	944	3.6	0	134	440	--	2100	10000
05/27/81	11.00	900	3.6	0	139	480	--	1800	10000
07/30/81	2.40	1670	3.6	0	308	950	--	9800	22000
SITE H6 RED RN NR ORLAND OH					LAT 392257 LONG 0822538			DA 0.49	
07/23/75	0.05	1650	2.8	1	497	530	--	--	--
10/20/75	0.43	390	3.3	1	89	130	--	--	--
SITE H7 HONEY F NR NEW PLYMOUTH OH					LAT 392350 LONG 0822552			DA 9.46	
04/26/79	4.60	210	7.3	21	--	56	--	90	100
09/13/79	1.60	225	7.5	39	--	45	--	90	40

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H8 RACCOON C NR ZALESKI OH					LAT 391913 LONG 0822505			DA 56.30	
09/18/80	14.80	760	4.3	--	70	310	6000	240	7600
08/26/81	0.14	1350	4.1	--	79	400	6069	510	7769
07/19/82	14.00	565	3.1	0	25	190	1500	140	4600
SITE H9 BRUSHY F NR MT PLEASANT OH					LAT 392241 LONG 0822752			DA 4.80	
07/23/75	0.20	401	4.7	1	--	120	--	--	--
10/20/75	1.70	235	5.0	2	--	83	--	--	--
09/25/80	0.27	275	6.5	5	--	99	205	100	2065
08/26/81	0.00	--	--	--	--	--	--	--	--
07/27/82	0.11	241	6.3	7	5	86	--	--	--
SITE H10 BRUSHY F NR CREOLA OH					LAT 391915 LONG 0822746			DA 25.44	
09/13/79	2.40	480	3.6	1	79	180	--	1800	4400
08/06/80	12.00	329	4.3	0	45	130	--	2600	3100
07/30/81	0.24	1240	3.3	0	258	510	--	20000	1500
SITE H11 BRUSHY C NR CREOLA OH					LAT 391830 LONG 0822623			DA 33.70	
09/18/80	5.90	1100	4.8	2	22	129	1590	1000	3650
08/26/81	0.13	1900	3.5	--	161	410	12070	2873	8231
07/19/82	6.30	690	3.5	0	65	160	4700	960	2800
SITE H12 RACCOON C NR ZALESKI OH					LAT 391642 LONG 0822327			DA 114.00	
09/25/80	15.00	720	4.6	--	50	275	4530	200	7000
07/16/81	16.00	6400	4.6	--	50	315	4156	314	5257
07/13/82	57.00	410	5.3	2	20	130	400	940	2700
SITE H13 SANDY RN AB LK HOPE OH					LAT 392155 LONG 0821833			DA 0.71	
07/23/75	0.05	616	5.3	2	--	200	--	--	--
10/21/75	0.64	310	6.2	21	--	86	--	--	--
SITE H14 SANDY RN AB BIG FOUR HOLLOW C NR LK HOPE					LAT 392145 LONG 0821847			DA 0.98	
07/23/75	0.05	616	5.3	2	--	200	--	--	--
10/15/75	0.09	1620	3.0	1	273	730	--	29000	4700
10/21/75	0.64	310	6.2	21	--	86	--	--	--
03/17/76	0.48	507	3.8	1	50	200	--	4500	1200
08/03/76	0.11	1000	3.2	1	134	440	--	7600	6700
06/15/77	0.08	1600	2.7	1	268	720	--	22000	4200
10/12/78	0.90	1800	2.7	1	372	910	--	44000	4900
10/24/78	0.70	1500	2.8	1	288	660	--	24000	4200
11/06/78	0.80	1400	2.7	1	273	640	--	30000	3600
11/22/78	0.20	1000	2.9	1	164	470	--	26000	2300
11/30/78	0.46	550	3.3	1	74	280	--	8200	1400

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H14 SANDY RN AB BIG FOUR HOLLOW C NR LK HOPE LAT 392145 LONG 0821847 DA 0.98									
02/01/79	0.59	450	3.5	1	50	180	--	4900	990
02/14/79	0.26	640	3.2	1	99	280	--	11000	1800
03/13/79	0.76	675	3.3	1	124	280	--	17000	1400
04/30/79	0.61	750	3.4	1	109	300	--	13000	1500
05/15/79	0.40	730	3.4	1	79	270	--	6200	1400
05/30/79	0.61	695	3.5	1	79	260	--	7300	1400
06/11/79	0.59	500	4.0	1	40	200	--	1300	1100
06/28/79	0.14	1300	3.0	1	199	560	--	22000	3100
07/10/79	0.25	900	3.4	1	124	390	--	12000	2100
07/26/79	0.20	1000	3.4	1	109	400	--	5800	2100
08/08/79	0.13	1100	2.9	1	164	480	--	16000	2900
09/05/79	0.24	950	3.1	1	164	430	--	16000	2300
09/17/79	0.19	790	3.5	1	99	320	--	7400	3400
10/23/79	0.31	870	3.2	0	129	330	--	13000	1900
11/20/79	0.40	625	3.6	0	89	250	--	6200	1300
12/06/79	0.68	560	3.7	0	79	230	--	7100	1200
12/20/79	0.65	408	4.2	0	50	170	--	1400	890
01/10/80	0.55	710	3.5	0	129	310	--	18000	1600
01/24/80	0.50	510	3.9	0	99	210	--	17000	1200
02/12/80	0.29	710	3.6	0	134	320	--	14000	1900
03/12/80	0.95	290	5.0	2	--	120	--	510	590
04/24/80	0.81	400	4.4	0	45	180	--	1400	880
05/09/80	0.28	680	3.6	0	124	300	--	7600	1400
06/12/80	0.26	650	3.7	0	129	260	--	3800	1500
06/24/80	0.15	1200	3.2	0	283	490	--	1800	2800
07/21/80	0.20	1100	3.2	0	189	500	--	13000	2700
08/06/80	0.15	1000	3.1	0	149	--	--	--	--
08/19/80	0.56	450	5.9	5	25	170	--	670	880
09/08/80	0.11	1050	3.4	0	179	460	--	14000	330
09/22/80	0.13	1100	3.3	0	199	520	--	12000	3000
10/07/80	0.10	1650	2.8	0	367	840	--	46000	4400
10/21/80	0.01	1250	3.2	0	243	540	--	24000	4000
11/05/80	0.01	1100	3.4	0	194	480	--	18000	3000
11/19/80	0.20	680	3.8	0	119	280	--	4500	1700
12/04/80	0.19	655	3.9	0	84	250	--	3900	1400
12/19/80	0.22	740	3.6	0	109	310	--	9800	1700
01/07/81	0.25	990	3.5	0	139	410	--	17000	2200
01/22/81	0.25	755	3.7	0	89	280	--	7000	1600
02/05/81	0.80	450	3.9	0	79	190	--	2300	910
03/11/81	0.90	565	3.7	0	79	210	--	6900	1000
03/24/81	0.55	525	3.8	0	70	210	--	3800	970
04/10/81	0.70	375	4.5	0	40	150	--	710	780
04/22/81	0.95	545	3.9	0	70	210	--	4300	1000
05/26/81	0.40	710	3.5	0	94	250	--	5000	1400
07/09/81	0.16	1010	3.1	0	174	430	--	12000	2500
07/21/81	0.13	1100	3.2	0	194	480	--	13000	2900
08/06/81	0.10	1200	3.2	0	278	540	--	2000	170
08/19/81	0.04	1900	3.0	0	1092	880	--	33000	5900
08/27/81	0.04	1900	3.1	0	497	920	--	31000	7500
09/09/81	0.05	1690	3.0	0	427	860	--	25000	6000
09/30/81	0.04	2000	2.8	0	407	830	--	30000	6700
SITE H15 BIG FOUR HOLLOW C AB E F NR LK HOPE OH LAT 392216 LONG 0821911 DA 0.44									
11/06/78	0.86	350	5.1	3	--	148	--	1100	6100
03/12/79	0.16	200	5.9	1	--	90	--	3000	1900
05/31/79	0.09	255	6.2	10	--	95	--	3300	2500

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H16 E F BIG FOUR HOLLOW C NR LK HOPE OH				LAT 392218 LONG 0821909				DA 0.46	
10/25/78	0.12	350	5.3	1	--	150	--	1600	810
11/06/78	0.10	350	5.6	5	--	140	--	1400	600
11/20/78	0.25	230	6.3	25	--	85	--	390	140
11/30/78	0.51	220	6.0	20	--	71	--	180	110
02/01/79	0.25	190	6.3	15	--	64	--	140	100
02/16/79	0.25	210	6.6	18	--	83	--	220	80
03/12/79	0.20	190	6.7	2	--	68	--	190	130
03/26/79	0.60	180	6.7	18	--	61	--	190	90
04/27/79	0.22	225	6.8	23	--	75	--	80	100
05/15/79	0.10	130	7.1	21	--	79	--	200	180
05/31/79	0.10	235	7.2	23	--	77	--	360	170
06/11/79	0.31	190	7.1	28	--	54	--	30	60
06/29/79	0.01	315	6.1	7	--	120	--	630	550
SITE H17 BIG FOUR HOLLOW C BL E F NR LK HOPE OH				LAT 392212 LONG 0821906				DA 0.73	
07/10/79	0.37	265	6.9	12	--	110	--	1200	1600
07/26/79	0.29	300	6.5	16	--	110	--	950	1500
08/08/79	0.25	300	6.5	10	--	110	--	1100	1800
08/23/79	0.62	245	6.8	26	--	75	--	480	800
09/05/79	0.17	258	6.6	16	--	97	--	950	1700
09/17/79	0.81	280	6.5	18	--	96	--	1300	1700
11/20/79	0.50	250	6.7	21	--	96	--	1500	1200
12/06/79	0.50	250	6.7	25	--	89	--	1600	1100
12/20/79	0.50	200	6.9	22	--	83	--	1700	940
01/10/80	0.40	240	7.6	23	--	110	--	3000	1600
01/24/80	0.40	240	7.0	27	--	95	--	3100	1400
02/12/80	0.40	270	7.1	19	--	110	--	3200	1700
02/28/80	0.80	230	7.0	30	--	88	--	1100	640
04/25/80	0.60	215	8.2	21	--	84	--	1100	1100
05/09/80	0.30	275	6.4	14	--	110	--	1100	1400
05/23/80	0.70	275	6.2	30	10	92	--	370	810
06/12/80	0.30	280	7.4	25	--	100	--	460	1200
06/24/80	0.10	315	7.8	20	--	130	--	890	1900
07/10/80	0.80	225	7.0	34	--	60	--	430	650
07/21/80	0.70	310	7.2	15	--	120	--	1000	1600
08/06/80	0.60	290	6.7	15	10	--	--	--	--
08/19/80	0.70	290	6.7	38	15	89	--	330	980
09/08/80	0.50	280	6.4	18	10	130	--	1200	1500
09/22/80	0.50	310	7.4	15	--	140	--	1200	2000
10/07/80	0.01	395	6.8	7	20	170	--	1700	2200
10/21/80	0.01	350	5.5	3	20	180	--	940	3100
11/05/80	0.01	390	7.1	6	--	160	--	1700	2800
11/19/80	0.10	350	7.7	20	--	130	--	2200	1900
12/04/80	0.10	330	7.7	20	--	120	--	2100	1600
12/18/80	0.10	310	7.5	18	--	100	--	1700	1300
02/17/81	0.70	170	7.3	15	--	53	--	280	290
03/11/81	0.56	225	6.5	18	10	86	--	870	720
03/24/81	0.56	260	6.5	19	10	93	--	960	800
07/09/81	0.42	320	7.0	33	--	130	--	1400	1700
07/22/81	0.56	340	6.0	10	15	140	--	1200	1800
SITE H17 BIG FOUR HOLLOW C NR LK HOPE OH				LAT 392148 LONG 0821851				DA 1.01	
10/15/75	0.11	900	3.4	1	124	390	--	15000	5700
03/17/76	0.44	580	3.7	1	89	250	--	15000	2000

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H18 BIG FOUR HOLLOW C NR LK HOPE OH					LAT 392148 LONG 0821851			DA 1.01	
08/04/76	0.07	480	4.2	1	25	220	--	1300	5600
06/15/77	0.04	660	3.5	1	55	290	--	210	3600
10/24/78	0.11	850	3.3	1	129	410	--	2700	6400
11/06/78	0.08	830	3.2	1	114	380	--	1800	5500
11/22/78	0.26	490	3.5	1	50	220	--	1300	2800
11/30/78	0.66	390	3.9	1	30	150	--	1500	2200
02/01/79	0.66	395	3.6	1	40	170	--	6600	1500
02/14/79	0.33	520	3.5	1	65	220	--	7000	2200
03/13/79	0.66	390	3.7	1	40	160	--	4600	1400
04/30/79	0.52	400	3.6	1	25	170	--	2000	1300
05/15/79	0.39	425	3.8	1	30	180	--	2100	1300
05/30/79	0.64	520	3.7	1	55	200	--	8300	1600
06/28/79	0.11	565	3.9	1	50	220	--	950	2000
07/10/79	0.20	500	3.8	1	40	220	--	570	2100
07/26/79	0.43	1200	3.5	1	228	550	--	66000	5700
08/08/79	0.16	1050	3.0	1	159	430	--	19000	6300
08/23/79	0.88	370	4.5	1	30	150	--	5400	1800
09/05/79	0.18	535	3.6	1	70	210	--	5900	3300
09/17/79	0.30	755	3.7	1	124	330	--	23000	4300
10/23/79	0.30	410	4.3	0	30	180	--	1700	2700
11/09/79	0.40	320	5.3	10	--	140	--	760	1900
11/20/79	0.42	310	5.6	3	--	140	--	850	1700
12/06/79	0.70	310	5.7	5	--	140	--	1400	1700
12/20/79	0.70	300	5.9	5	--	130	--	1100	1700
01/10/80	0.40	360	5.2	7	--	170	--	1500	2300
01/24/80	0.50	335	5.3	7	--	160	--	2000	2200
02/12/80	0.38	380	5.1	2	--	190	--	1700	2700
02/28/80	0.90	320	6.0	7	--	160	--	1300	1800
04/07/80	0.90	300	6.0	11	--	130	--	970	1700
04/24/80	0.60	310	6.1	10	--	130	--	710	1900
05/09/80	0.20	420	4.6	1	--	200	--	800	3000
05/23/80	0.95	370	7.1	15	--	150	--	1300	1900
06/12/80	0.20	470	4.8	2	60	210	--	1500	3800
06/24/80	0.10	800	3.9	0	129	380	--	1100	6900
07/10/80	0.10	300	7.1	25	--	110	--	690	1700
07/21/80	0.05	690	4.0	0	89	310	--	3600	7200
08/06/80	0.20	610	3.8	0	60	--	--	--	--
08/19/80	0.70	425	5.8	1	20	170	--	2100	3100
09/08/80	0.15	720	3.4	0	94	320	--	8100	7600
09/22/80	0.16	860	4.0	0	154	390	--	8600	10000
10/07/80	0.18	1100	3.4	0	159	580	--	17000	14000
10/21/80	0.03	1050	3.6	0	149	500	--	13000	15000
11/05/80	0.06	950	3.6	0	154	480	--	9600	12000
11/19/80	0.20	740	4.4	0	74	320	--	5100	7500
12/04/80	0.24	610	4.5	0	74	260	--	4500	5700
12/18/80	0.30	565	4.4	0	50	240	--	4800	5200
01/07/81	0.28	660	4.4	0	70	280	--	4500	6200
01/22/81	0.25	600	4.2	0	55	270	--	3300	4900
03/11/81	0.77	370	4.9	2	35	180	--	2600	2700
03/24/81	0.60	520	4.6	0	55	210	--	3700	3600
04/10/81	0.88	430	4.5	0	50	190	--	3900	3300
04/22/81	0.86	410	4.6	0	60	200	--	6700	3500
05/26/81	0.38	730	3.7	0	139	320	--	17000	6300
07/09/81	0.14	1400	3.0	0	323	690	--	40000	14000
07/21/81	0.14	1550	3.1	0	422	690	--	37000	11000
08/19/81	0.05	2700	2.9	0	1142	1800	--	140000	42000
08/27/81	0.04	3000	2.9	0	1192	2100	--	150000	52000
09/09/81	0.11	2600	2.9	0	993	1600	--	87000	38000
09/30/81	0.10	2850	3.2	0	894	1900	--	110000	40000
10/13/81	0.04	2700	3.0	0	844	1700	--	100000	37000

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H18 BIG FOUR HOLLOW C NR LK HOPE OH					LAT 392148 LONG 0821851			DA 1.01	
11/16/81	0.50	2000	2.9	0	794	1300	--	78000	24000
12/17/81	0.50	2020	2.9	0	596	1500	--	78000	23000
01/21/82	0.10	1500	2.8	0	487	840	--	35000	16000
02/24/82	0.66	600	3.8	0	139	260	--	12000	5000
04/20/82	0.46	715	3.7	0	169	340	--	17000	4600
05/19/82	0.10	1400	3.5	0	427	700	--	45000	11000
07/14/82	0.16	1200	3.5	0	318	500	--	33000	8900
08/12/82	0.20	1100	3.2	0	218	520	--	33000	8700
09/07/82	0.07	2200	3.2	0	477	910	--	63000	19000
01/25/83	0.76	540	3.9	0	65	190	--	10000	3600
SITE H19 HULL HOLLOW C NR LK HOPE OH					LAT 392132 LONG 0821905			DA 0.22	
11/06/78	0.15	190	5.9	15	--	57	--	130	110
11/21/78	0.23	130	5.9	11	--	45	--	10	20
11/30/78	0.32	150	5.8	1	--	51	--	210	30
12/22/78	0.11	130	6.0	11	--	42	--	80	30
01/04/79	0.44	110	6.2	11	--	38	--	70	30
01/17/79	0.44	130	6.6	11	--	38	--	90	30
02/01/79	0.22	100	6.1	8	--	42	--	10	20
02/15/79	0.22	120	6.1	10	--	44	--	10	30
03/13/79	0.70	95	6.3	1	--	40	--	20	20
05/15/79	0.58	135	6.3	11	--	44	--	10	30
05/31/79	0.49	140	7.1	14	--	45	--	10	30
06/11/79	0.70	120	7.3	18	--	41	--	10	20
06/28/79	0.27	150	7.0	14	--	51	--	30	10
07/09/79	0.44	185	6.8	15	--	48	--	20	30
07/26/79	0.37	130	6.6	15	--	46	--	10	10
08/08/79	0.44	150	6.7	11	--	48	--	20	20
08/23/79	0.53	129	7.1	20	--	44	--	10	30
09/05/79	0.30	160	7.1	16	--	39	--	40	30
09/17/79	0.37	125	6.9	16	--	47	--	10	30
10/02/79	0.60	130	7.1	20	--	39	--	20	30
10/23/79	0.60	130	6.4	16	--	46	--	10	20
11/20/79	0.60	140	7.0	15	--	45	--	10	20
12/06/79	0.50	140	7.9	16	--	46	--	10	20
12/20/79	0.50	120	7.0	18	--	45	--	10	30
01/10/80	0.40	135	7.5	14	--	52	--	10	30
01/24/80	0.40	120	7.5	14	--	45	--	10	20
02/12/80	0.15	140	7.6	16	--	49	--	10	30
02/28/80	0.30	140	6.7	17	--	51	--	0	10
03/12/80	0.30	130	7.3	16	--	44	--	10	20
03/25/80	0.30	125	7.8	30	--	42	--	10	20
04/08/80	0.20	133	6.8	18	--	45	--	20	20
04/24/80	0.20	135	7.4	16	--	47	--	20	20
05/09/80	0.03	140	7.3	16	--	51	--	20	10
05/23/80	0.10	160	8.0	14	--	55	--	10	20
06/24/80	0.01	150	8.0	34	--	50	--	10	10
07/10/80	0.80	160	6.3	29	30	42	--	20	20
08/19/80	0.06	170	6.9	28	10	45	--	40	20
10/21/80	0.01	170	7.9	21	--	51	--	30	10
11/19/80	0.30	170	7.9	21	--	52	--	10	20
12/18/80	0.10	153	6.5	13	5	46	--	0	10
01/22/81	0.11	200	6.0	11	5	64	--	10	10
03/24/81	0.04	160	6.5	15	10	51	--	50	10
04/22/81	0.09	150	8.0	20	--	45	--	20	10
05/26/81	0.03	140	7.4	17	--	45	--	10	20
06/22/81	0.39	135	6.7	20	5	40	--	30	20

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H20 SANDY RN BL HULL HOLLOW C NR LK HOPE OH LAT 392130 LONG 0821904 DA 2.24									
10/24/78	0.81	1100	3.1	1	179	540	--	5000	5600
11/06/78	1.03	1100	3.2	1	149	470	--	3500	10
11/21/78	0.89	720	3.1	1	74	260	--	4500	2400
11/30/78	1.44	470	3.3	1	50	200	--	2800	1900
02/01/79	1.47	430	3.5	1	40	170	--	3900	1300
02/15/79	0.81	620	3.4	1	89	270	--	7900	2000
03/13/79	2.12	450	3.5	1	65	190	--	7000	1300
05/15/79	1.37	540	3.6	1	45	200	--	2300	1400
05/30/79	1.79	570	3.6	1	50	220	--	4100	1400
06/28/79	0.52	780	3.3	1	124	350	--	4000	2700
07/09/79	0.89	500	4.1	1	25	190	--	330	1400
07/26/79	1.00	1100	3.4	1	184	510	--	24000	5500
08/08/79	0.73	1000	3.0	1	129	400	--	6100	4600
09/05/79	0.72	710	3.3	1	94	280	--	3700	2700
09/17/79	0.86	740	3.5	1	94	280	--	3400	1900
10/23/79	1.21	725	3.3	0	84	260	--	5400	2300
11/20/79	1.42	475	3.8	0	45	190	--	1800	1600
12/06/79	1.88	460	3.9	0	60	180	--	2800	1500
12/20/79	1.85	340	4.5	0	30	150	--	890	1300
01/10/80	1.35	460	4.0	0	60	210	--	2600	1700
01/24/80	1.40	385	4.2	0	40	180	--	1400	1700
02/12/80	0.82	540	3.7	0	70	230	--	3400	2100
04/24/80	1.61	330	4.7	0	25	150	--	550	1200
05/09/80	0.51	540	3.8	0	60	220	--	1600	2000
06/12/80	0.46	490	4.2	0	70	220	--	1000	2400
06/24/80	0.25	890	3.4	0	139	360	--	3500	4100
07/21/80	0.25	720	3.7	0	84	290	--	1000	3900
08/19/80	1.32	420	5.8	6	15	170	--	660	2000
10/21/80	0.05	1000	3.5	0	149	450	--	3100	7200
11/19/80	0.70	725	4.0	0	79	320	--	1900	4900
12/18/80	1.02	695	3.6	0	79	280	--	4500	3600
01/22/81	0.61	675	3.6	0	79	280	--	2200	3500
03/24/81	1.19	480	4.2	0	50	200	--	2300	2300
04/22/81	1.90	500	4.1	0	60	210	--	3500	2200
05/26/81	0.81	665	3.6	0	89	260	--	3500	3300
SITE H21 SANDY RN NR LK HOPE OH LAT 392001 LONG 0821956 DA 4.99									
07/24/75	0.07	480	4.1	1	25	210	--	450	2800
03/18/76	2.90	315	4.0	1	20	120	--	--	--
08/04/76	0.52	362	4.3	1	20	150	--	480	3700
06/15/77	0.27	480	4.1	1	25	200	--	420	2500
09/13/79	0.50	710	3.7	1	184	250	--	830	3800
08/06/80	1.20	309	5.1	3	15	120	--	300	1600
07/30/81	0.20	585	5.1	7	30	230	--	430	5700
SITE H22 SANDY RN AB LK HOPE NR ZALESKI OH LAT 391952 LONG 0822025 DA 6.46									
05/14/75	4.50	224	4.9	--	--	--	--	--	--
08/01/78	0.50	670	4.1	--	--	--	--	--	--
SITE H23 RACCOON C NR ZALESKI OH LAT 391901 LONG 0822104 DA 122.00									
09/18/80	28.00	620	4.9	3	31	245	2760	150	6000

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H23 RACCOON C NR ZALESKI OH					LAT 391901 LONG 0822104			DA 122.00	
09/02/81	3.20	830	5.2	10	79	300	4418	217	7278
07/20/82	23.00	515	4.8	0	20	150	1000	30	3600
SITE H24 HEWETT F NR KIMBERLY OH					LAT 392325 LONG 0821503			DA 7.80	
09/18/80	2.40	550	4.4	--	31	230	1710	400	2540
09/02/81	0.57	850	4.5	--	74	405	3994	308	2782
07/20/82	4.00	476	4.5	0	15	170	300	74	2600
SITE H25 HEWETT F NR MINERAL OH					LAT 392216 LONG 0821608			DA 11.80	
09/18/80	4.10	960	3.5	--	139	410	11300	10400	3500
09/02/81	1.40	1800	3.1	--	492	890	29560	19180	4480
07/20/82	7.60	734	3.5	0	70	310	4800	3900	3000
SITE H26 HEWETT F NR ALBANY OH					LAT 391903 LONG 0821642			DA 27.79	
04/26/79	18.00	570	3.7	1	60	260	--	1700	2100
09/13/79	4.80	780	3.5	1	174	370	--	1100	3800
SITE H27 RACCOON C NR MINERAL OH					LAT 391552 LONG 0821719			DA 194.00	
09/19/80	36.00	375	5.3	3	17	181	560	65	4100
07/15/81	87.00	495	5.3	3	42	185	1180	303	3212
09/07/82	2.00	680	4.4	0	45	300	6200	160	4400
SITE H28 ELK F NR MCARTHUR OH					LAT 391637 LONG 0822914			DA 8.60	
09/02/80	9.90	200	6.4	26	10	--	--	--	--
08/26/81	--	910	5.8	8	10	30	75	460	514
07/13/82	3.80	195	6.9	26	--	31	--	--	--
SITE H29 PUNCHEON F AT MCARTHUR OH					LAT 391430 LONG 0822846			DA 6.30	
09/18/80	1.00	330	6.1	26	--	107	200	380	2040
08/26/81	0.00	--	--	--	--	--	--	--	--
07/19/82	0.18	325	6.8	41	--	86	--	--	--
SITE H30 PUNCHEON F AT MCARTHUR OH					LAT 391435 LONG 0822818			DA 9.44	
04/23/79	5.10	320	6.6	15	10	100	--	330	1500
09/10/79	1.60	370	6.8	39	20	110	--	150	1900
08/29/80	3.70	290	7.2	34	--	81	--	60	1200

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H31 ELK F NR MCARTHUR OH					LAT 391403 LONG 0822616			DA 26.40	
09/18/80	5.70	500	7.2	38	--	172	200	320	2450
08/26/81	0.04	1100	7.2	44	--	345	118	1993	3077
07/19/82	2.40	468	6.9	43	--	140	--	--	--
SITE H32 UNAM TR TO ELK F NR PRATTSVILLE OH					LAT 391416 LONG 0822555			DA 2.40	
09/02/80	1.80	520	6.4	7	35	--	--	--	--
07/15/81	0.38	1275	7.4	184	--	215	320	143	1078
07/19/82	0.55	990	7.6	17	--	150	--	--	--
SITE H33 ELK F NR RADCLIFF OH					LAT 390941 LONG 0822122			DA 59.50	
07/27/81	3.30	410	6.8	46	--	160	75	348	--
07/20/82	6.30	320	6.9	41	--	81	--	--	--
SITE H34 RACCOON C NR RADCLIFF OH					LAT 390748 LONG 0822131			DA 296.00	
09/24/80	56.00	450	5.9	--	15	191	200	100	2140
09/02/81	0.00	590	7.8	66	--	150	75	20	270
07/20/82	57.00	389	6.0	44	5	100	--	--	--
SITE H35 PIERCE RN NR RADCLIFF OH					LAT 390940 LONG 0822430			DA 5.20	
09/17/80	1.80	550	4.6	--	30	250	1160	2450	2940
07/15/81	0.97	595	6.7	13	--	275	262	1176	2527
07/20/82	0.66	635	4.2	0	25	300	1400	1200	2900
SITE H36 PIERCE RN NR RADCLIFF OH					LAT 390828 LONG 0822249			DA 9.70	
04/24/79	5.50	340	5.7	4	15	140	--	2000	2300
09/11/79	1.90	450	6.2	12	15	170	--	1300	4000
08/25/80	7.90	310	6.8	23	15	120	--	350	1500
07/30/81	1.20	450	6.9	20	15	180	--	210	3800
SITE H37 RACCOON C NR WILKESVILLE OH					LAT 390622 LONG 0822304			DA 306.00	
09/25/80	56.00	445	5.9	10	30	142	200	960	2110
08/25/82	14.00	495	5.0	--	372	170	200	500	3600
SITE H38 RACCOON C AT EWINGTON OH					LAT 390052 LONG 0822109			DA 347.00	
09/25/80	76.00	440	6.0	11	20	139	200	50	1720
08/20/81	12.00	435	6.5	21	--	125	75	255	880
07/22/82	100.00	415	6.6	10	--	110	--	--	--

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H39 STRONGS RN NR EWINGTON OH					LAT 390053 LONG 0822010			DA 15.69	
04/26/79	8.10	160	7.1	30	--	35	--	130	200
09/11/79	1.50	185	6.7	57	15	21	--	280	500
SITE H40 RACCOON C AT VINTON OH					LAT 385834 LONG 0822017			DA 381.00	
11/13/75	146.00	350	6.5	15	--	120	--	--	--
SITE H41 L RACCOON C AB LK RUPERT NR HAMDEN OH					LAT 391256 LONG 0823227			DA 8.62	
06/15/79	3.00	195	7.3	--	--	--	--	--	--
09/04/79	5.00	220	7.7	--	--	--	--	--	--
SITE H42 SUGAR RN AT HAMDEN OH					LAT 390924 LONG 0823031			DA 5.00	
09/15/80	4.90	750	3.8	--	70	320	3470	4750	6300
05/06/81	6.30	895	3.3	--	102	430	5800	6900	6950
07/21/81	3.40	1100	3.4	--	164	425	13890	13390	11440
07/20/82	0.28	1900	2.8	0	228	900	19000	7100	21000
SITE H43 L RACCOON C NR WELLSTON OH					LAT 390801 LONG 0823028			DA 47.70	
07/27/81	1.70	360	6.3	28	--	135	75	114	2589
07/23/82	1.50	302	6.7	25	--	84	--	--	--
SITE H44 UNAM TR TO L RACCOON C NR ROADS OH					LAT 390452 LONG 0822928			DA 1.80	
09/15/80	0.63	1600	3.1	--	437	740	36000	27600	16400
07/21/81	0.92	1200	3.0	--	288	530	33110	12970	13140
07/12/82	0.38	1650	2.9	0	427	760	41000	23000	17000
SITE H45 L RACCOON C NR ROADS OH					LAT 390509 LONG 0822819			DA 67.50	
07/27/81	17.00	560	6.3	43	10	235	3	653	4413
07/12/82	19.00	428	6.6	40	--	140	--	--	--
SITE H46 BUFFER RN NR ROADS OH					LAT 390341 LONG 0822707			DA 1.80	
09/16/80	0.69	2300	3.1	--	596	1280	29600	133000	12800
08/19/81	0.30	2000	3.0	--	571	1340	28040	88390	11710
07/12/82	0.40	2550	2.5	0	695	1400	37000	160000	13000
SITE H47 TARCAMP RN NR ROADS OH					LAT 390224 LONG 0822823			DA 2.90	
09/16/80	0.78	170	6.2	18	--	56	200	260	830

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instantaneous (ft^3/s)	Specific conductance ($\mu S/cm$)	pH	Alkalinity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Aluminum, dissolved ($\mu g/L$ as Al)	Iron, dissolved ($\mu g/L$ as Fe)	Manganese, dissolved ($\mu g/L$ as Mn)
SITE H47 TARCAMP RN NR ROADS OH					LAT 390224 LONG 0822823			DA 2.90	
08/19/81	0.26	210	6.5	16	--	52	75	179	420
07/22/82	0.18	145	6.6	5	--	52	--	--	--
SITE H48 L RACCOON C NR EWINGTON OH					LAT 390038 LONG 0822709			DA 99.70	
11/13/75	57.00	700	3.7	1	94	290	--	--	--
08/19/81	14.00	730	4.2	--	50	315	2467	689	3269
07/22/82	15.00	745	3.7	0	50	320	4000	1100	3600
SITE H49 DIXON RN NR WINCHESTER OH					LAT 385924 LONG 0822953			DA 1.20	
09/24/80	0.18	890	7.0	11	--	460	330	330	4300
08/19/81	0.14	770	6.0	10	30	365	75	727	2950
08/25/82	0.16	780	5.9	7	20	400	--	--	--
SITE H50 DIXON RN NR EWINGTON OH					LAT 390012 LONG 0822830			DA 4.00	
09/24/80	0.84	770	5.1	3	35	410	720	3700	5400
08/19/81	0.31	800	4.3	--	65	430	3599	1578	5211
07/22/82	0.26	925	3.5	0	65	430	4900	3400	6000
SITE H51 DICKASON RN NR THURMAN OH					LAT 390024 LONG 0822812			DA 22.50	
09/13/79	3.20	360	6.2	13	15	160	--	960	3000
08/29/80	6.00	345	6.8	20	10	130	--	810	2500
09/03/81	2.50	765	4.4	0	84	190	--	1100	6500
SITE H52 DICKASON RN NR EWINGTON OH					LAT 390031 LONG 0822719			DA 26.90	
08/09/81	0.91	460	6.1	16	20	185	75	226	2070
07/22/82	0.98	480	6.2	10	10	180	--	--	--
SITE H53 L RACCOON C NR VINTON OH					LAT 385711 LONG 0822156			DA 154.00	
09/24/80	87.00	460	5.0	2	25	191	1450	180	3090
08/20/81	19.00	620	5.3	5	45	275	3076	192	3221
08/24/82	13.00	640	4.8	0	30	270	1900	84	3800
SITE H54 BARREN C NR HARRISBURG OH					LAT 385412 LONG 0821913			DA 7.21	
04/26/79	2.30	315	7.3	89	--	49	--	270	380
09/11/79	0.62	350	7.2	110	--	34	--	140	160

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H55 RACCOON C NR RIO GRANDE OH					LAT 385404 LONG 0822042			DA 560.00	
09/24/80	214.00	450	5.6	--	20	169	200	160	2230
08/20/81	38.00	390	6.2	7	15	175	75	255	2326
08/24/82	24.00	645	6.3	7	--	180	--	--	--
SITE H56 L INDIAN C NR RIO GRANDE OH					LAT 385334 LONG 0822258			DA 10.29	
04/26/79	6.00	125	7.0	24	--	29	--	110	90
09/11/79	1.10	175	6.8	43	5	21	--	320	340
SITE H57 RACCOON C AT ADAMSVILLE OH					LAT 385225 LONG 0822122			DA 585.00	
07/31/75	35.00	579	4.7	3	--	200	--	870	4100
03/09/76	345.00	333	5.5	2	--	120	--	1100	2200
08/10/76	226.00	357	5.0	2	--	150	--	80	5100
07/05/77	164.00	650	5.7	3	--	170	--	90	3600
05/21/79	245.00	370	5.2	1	0	130	--	550	2300
08/08/79	159.00	447	5.3	2	0	170	--	90	360
12/12/79	310.00	228	7.0	6	--	110	--	1000	2000
05/06/80	248.00	360	6.4	98	10	130	--	210	2000
06/03/80	403.00	394	7.7	100	--	70	--	130	410
07/01/80	162.00	522	5.0	7	20	200	--	120	3500
09/10/80	243.00	350	6.7	16	15	110	--	--	--
10/16/80	45.00	510	6.7	22	10	160	--	90	1700
11/05/80	89.00	446	6.2	8	10	180	--	270	3000
09/15/81	53.00	480	7.0	33	--	130	--	120	1600
SITE H58 RACCOON C NR PATRIOT OH					LAT 384821 LONG 0822219			DA 607.00	
09/25/80	176.00	475	5.9	10	15	169	320	30	2080
07/23/81	167.00	395	7.3	16	--	120	91	158	2021
08/24/82	30.00	640	6.5	13	--	190	--	--	--
SITE H59 CLAYLICK RN NR NORTHUP OH					LAT 384452 LONG 0821814			DA 4.75	
09/12/79	0.31	620	7.4	110	--	190	--	10	20
08/27/80	0.43	650	7.6	105	--	220	--	30	40
07/15/81	0.79	662	7.9	230	--	190	--	50	70
SITE H60 RACCOON C AT NORTHUP OH					LAT 384700 LONG 0821703			DA 648.50	
11/13/75	225.00	400	6.5	21	--	140	--	--	--
SITE H61 BULLSKIN C NR MERCERVILLE OH					LAT 384206 LONG 0821616			DA 4.50	
09/17/80	0.41	970	6.8	105	10	430	270	80	390
07/22/81	0.38	970	7.7	102	--	385	11220	584	21260
08/23/82	0.16	975	7.2	98	--	420	--	--	--

Appendix 1.--Historic water-quality data from the Raccoon Creek basin--Continued

Date	Stream-flow, instan-taneous (ft^3/s)	Spe-cific con-duc-tance ($\mu S/cm$)	pH	Alka-linity field (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Alu-minum, dis-solved ($\mu g/L$ as Al)	Iron, dis-solved ($\mu g/L$ as Fe)	Manga-nese, dis-solved ($\mu g/L$ as Mn)
SITE H62 L BULLSKIN C NR MERCERVILLE OH					LAT 384347 LONG 0821644			DA 3.30	
09/17/80	0.11	650	7.1	84	--	250	200	60	85
07/22/81	0.06	615	7.9	97	--	210	75	10	5
SITE H63 BULLSKIN C NR MERCERVILLE OH					LAT 384333 LONG 0821505			DA 13.10	
09/17/80	0.94	880	7.0	94	--	400	200	70	560
07/22/81	0.71	870	--	64	--	340	203	60	624
08/23/82	0.15	800	7.6	75	--	350	--	--	--
SITE H64 BULLSKIN C NR GALLIPOLIS OH					LAT 384401 LONG 0821450			DA 14.38	
09/12/79	3.30	910	7.2	63	--	390	--	40	570
08/26/80	2.70	840	7.3	77	--	360	--	20	650
SITE H65 RACCOON C NR EUREKA OH					LAT 384412 LONG 0821446			DA 661.00	
09/25/80	229.00	420	6.0	21	7	125	200	130	1210
07/22/81	215.00	400	7.3	25	--	118	98	126	1204
08/24/82	0.01	540	6.7	16	--	170	--	--	--

Appendix 2.--Benthic invertebrates from the Raccoon Creek Basin (November 1-3, 1983)

The following table contains the benthic invertebrate data collected during base-flow conditions in the Raccoon Creek basin from November 1 through November 3, 1983. For each site, the site number, station number, station name, date collected and invertebrates found are given. The invertebrates are reported by order, family and genera (if determined), the common name and the quantity collected.

Benthic invertebrate information is presented in the following format:

Site	Station number	Station name	Date
1.	392500082192800	E B Raccoon C nr Starr OH	11-2-83

Organism Name	Common Name	Quantity
DIPTERA (ORDER)		
Ceratopogondiae (Family)		
bezzia (genera)	Biting Midge	1

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

1. 392500082192800	E B Raccoon C nr Starr OH	11-2-83
DIPTERA		
Ceratopogonidae		
bezzia	Biting Midge	1
Chironomidae	Midge	1
Chironomidae		
pentaneura	Midge	1
Stratiomydae	Soldierfly	1
LEPIDOPTERA		
Noctuidae		1
2. 392504082195100	Unam Tr to E B Raccoon C nr Starr OH	11-2-83
DIPTERA		
Chironomidae	Midge	3
3. 392420082193600	Unam Tr to E B Raccoon C nr Starr OH	11-2-83
DIPTERA		
Chironomidae	Midge	4
MEGALOPTERA		
Sialidae		
sialis	Alderfly	1
4. 392348082220200	E B Raccoon C nr New Plymouth OH	11-2-83
DIPTERA		
Chironomidae	Midge	1
TRICHOPTERA		
Hydropsychidae	Caddisfly	1
5. 392326082261900	W B Raccoon C nr Mt Pleasant OH	11-1-83
	** none found **	
6. 392318082251100	Honey F nr New Plymouth OH	11-1-83
	** none found **	

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

7. 392249082234500	W B Raccoon C nr New Plymouth OH	11-1-83
DIPTERA		
Chironomidae	Midge	1
Chironomidae		
chironomus	Bloodworm	6
8. 392208082232800	Raccoon C nr New Plymouth OH	11-1-83
DIPTERA		
Ceratopogonidae		
bezzia	Biting Midge	4
Chironomidae		
chironomus	Bloodworm	3
9. 39212608222500	Two Mile Rn nr New Plymouth OH	11-2-83
DIPTERA		
Chironomidae	Midge	1
10. 391913082250500	Raccoon C nr Zaleski OH	11-2-83
DIPTERA		
Chironomidae	Midge	1
Chironomidae		
pentaneura	Midge	1
11. 391915082274600	Brushy C nr Creola OH	11-1-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	7
12. 391830082262300	Brushy C nr Creola OH	11-2-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	29
13. 391535082224300	Wheelabout Creek nr Zaleski OH	11-2-83
DIPTERA		
Chironomidae	Midge	2
COLEOPTERA		
Hydrophilidae	Water Scavenger	2

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

14. 391905082211900	Sandy Rn bl L Hope OH	11-1-83
DIPTERA		
Chironomidae	Midge	3
EPHEMEROPTERA		
Baetiscidae	Mayfly	1
Heptageniidae	Mayfly	1
TRICHOPTERA		
Hydropsychidae		
hydropsyche	Caddisfly	4
15. 391901082210400	Raccoon C nr Zaleski OH	11-1-83
DIPTERA		
Chironomidae	Midge	2
COLEOPTERA		
Elmidae	Riffle Beetle	1
16. 392325082150300	Hewett F nr Kimberly OH	11-2-83
DIPTERA		
Chironomidae	Midge	24
Ceratopogonidae		
bezzia	Biting Midge	2
Tipulidae		
tipula	Cranefly	1
MEGALOPTERA		
Sialidae		
sialis	Alderfly	1
TRICHOPTERA	Caddisfly	7
17. 392240082161100	Carbondale C at Carbondale OH	11-2-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	18
18. 391903082164200	Hewett F nr Albany OH	11-1-83
DIPTERA		
Ceratopogonidae		
bezzia	Biting Midge	9
Chironomidae	Midge	24
Chironomidae		
chironomus	Bloodworm	1
TRICHOPTERA		
Polycentropodidae		
polycentropus	Caddisfly	7

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

19. 391322082175300	Raccoon C nr Bolins Mills OH	11-1-83
DIPTERA		
Chironomidae	Midge	3
Tipulidae		
tipula	Cranefly	2
20. 391017082200900	Raccoon C nr Radcliff OH	11-2-83
	** none found **	
21. 391403082261600	Elk F nr McArthur OH	11-2-83
DIPTERA		
Chironomidae	Midge	24
COLEOPTERA		
Dytiscidae	Predaceous Diving Beetle	1
NAMATODA	Roundworm	3
22. 390941082212200	Elk F nr Radcliff OH	11-2-83
ODONATA		
Agriidae	Damselfly	2
EPHEMEROPTERA		
Baetidae	Mayfly	1
23. 39073008225300	Pierce Rn nr Oreton OH	11-2-83
ODONATA		
Agriidae	Damselfly	1
TRICHOPTERA		
Hydropsychidae	Caddisfly	2
MEGALOPTERA		
Sialidae	Alderfly	1
DIPTERA		
Tipulidae	Cranefly	1
24. 390635082230400	Raccoon C nr Wilkesville OH	11-3-83
DIPTERA		
Chironomidae	Bloodworm	2

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

25. 390002082223400	Raccoon C nr Alice OH	11-3-83
DIPTERA		
Ceratopogonidae		
bezzia	Biting Midge	1
Chironomidae		
chironomus	Bloodworm	1
EPHEMEROPTERA		
Baetidae	Mayfly	1
26. 385826082201800	Raccoon C at Vinton OH	11-2-83
DIPTERA		
Chironomidae	Midge	1
TRICHOPTERA		
Hydropsychidae	Caddisfly	4
ODONATA		
Libellulidae	Dragonfly	1
EPHEMEROPTERA		
Heptageniidae	Mayfly	2
Bactiscidae		
baetisca	Mayfly	1
Baetidae	Mayfly	1
27. 391020082310700	L Raccoon C nr Hamden OH	11-2-83
DIPTERA		
Chironomidae	Midge	1
Tipulidae	Cranefly	1
EPHEMEROPTERA		
Heptageniidae	Mayfly	1
TRICHOPTERA		
Hydropsychidae	Caddisfly	3
MEGALOPTERA		
Sialidae	Alderfly	1
28. 390924082303100	Sugar Rn nr Hamden OH	11-2-83
DIPTERA		
Ceratopogonidae	Biting Midge	3
29. 390557082285500	Mulga Rn nr Wainwright OH	11-2-83

** none found **

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

30. 39043108229100	Unam Tr to L Raccoon C nr Roads OH	11-2-83
DIPTERA		
Ceratopogonidae		
bezzia	Biting Midge	1
Chironomidae		
chironomus	Bloodworm	2
31. 39509082281900	L Raccoon C nr Roads OH	11-2-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	1
TRICHOPTERA		
Hydropsychidae	Caddisfly	1
32. 390341082270700	Buffer Rn nr Roads OH	11-2-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	4
33. 390142082282700	Goose Rn nr Ridgeland OH	11-1-83
DIPTERA		
Chironomidae		
chironomus	Bloodworm	6
34. 390038082270800	L Raccoon C nr Ewington OH	11-1-83
ODONATA		
Agriidae	Damselfly	1
TRICHOPTERA		
Polycentropodidae	Caddisfly	3
MEGALOPTERA		
Sialidae	Alderfly	2
35. 390031082271900	Dickason Rn nr Ewington OH	11-1-83
TRICHOPTERA		
Polycentropodidae	Caddisfly	1

Appendix 2.--Benthic invertebrates from the Raccoon Creek basin (November 1-3, 1983)--Continued

36. 385711082215600	L Raccoon C nr Vinton OH	11-2-83
TRICHOPTERA		
Hydropsychidae	Caddisfly	1
Polycentropodidae	Caddisfly	1
37. 385320082225300	Indian C nr Rio Grande OH	11-1-83
PLECOPTERA		
Chloroperlidae	Stonefly	1
38. 03202000	Raccoon C at Adamsville OH	11-1-83
TRICHOPTERA		
Hydropsychidae		
hydropsyche	Caddisfly	5
COLEOPTERA		
Hydrophilidae	Water Scavenger	1
MEGALOPTERA		
Cordalidae	Hellgrammite	1
39. 384700082170300	Raccoon C at Northup OH	11-2-83
EPHEMEROPTERA		
Baetidae	Mayfly	7
TRICHOPTERA		
Hydropsychidae		
hydropsyche	Caddisfly	4
Psychomyiidae		
polycentropus	Caddisfly	1
40. 384206082161600	Bullskin C nr Mercerville OH	11-2-83
EPHEMEROPTERA		
Baetidae	Mayfly	4
ODONATA		
Cordulegasteridae	Dragonfly	1
41. 384347082164400	L Bullskin C nr Mercerville OH	11-2-83
EPHEMEROPTERA		
Baetidae	Mayfly	53
DIPTERA		
Tipulidae	Cranefly	1

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